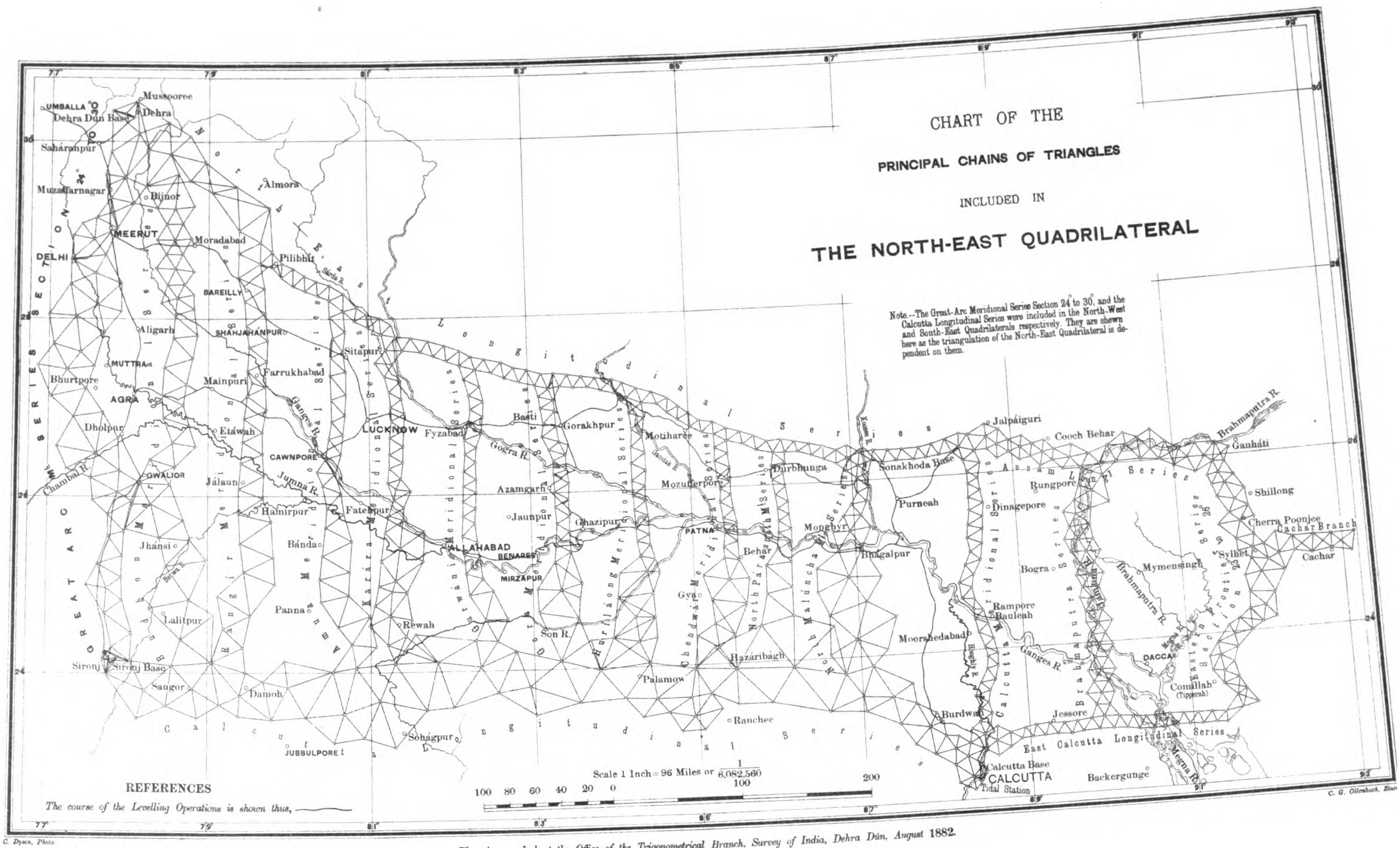

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ACCOUNT OF THE OPERATIONS OF

THE GREAT TRIGONOMETRICAL SURVEY OF INDIA

VOLUME VII.

UNIVERSITY OF MICHIGAN

GENERAL DESCRIPTION

OF THE

PRINCIPAL TRIANGULATION

OF THE

NORTH-EAST QUADRILATERAL

INCLUDING

THE SIMULTANEOUS REDUCTION,

AND THE DETAILS OF FIVE OF THE COMPONENT SERIES

THE NORTH-EAST LONGITUDINAL.

THE BUDHON MERIDIONAL	THE AMUA MERIDIONAL
THE RANGIR MERIDIONAL	THE KARARA MERIDIONAL

PREPARED UNDER THE DIRECTIONS OF

LIEUT.-GENERAL J. T. WALKER, C.B., R.E., F.R.S., &c., &c.,

SURVEYOR GENERAL OF INDIA, AND SUPERINTENDENT OF THE TRIGONOMETRICAL SURVEY.

Dehra Dun:

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B. V. HUGHES.

1882.

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PREFACE.

The present volume forms one of that series of publications known as the "*Accounts of the Operations of the Great Trigonometrical Survey of India*", of which the design is, as has already been stated in the second volume of the series, "to give full reports—historical and descriptive—of the nature and the general "procedure of the operations; to describe the instruments which were employed in executing the several "linear and angular measurements; to furnish complete details of the actual facts of observation and the "methods of reduction by which these facts have been combined together and duly harmonized; and, lastly "to give the results which have been determined after this final reduction of the operations."

The first volume of the series accordingly gives the details of the measurements of the several base-lines on which the triangulation of India rests, together with a discussion of the instruments on which the measurements depend, and the theoretical probable errors of the results. Volume II describes the principal triangulation, the theodolites with which it was executed, the procedure adopted in observing the angles, and all necessary details of the operations carried on in the field; it further describes the processes by which preliminary results were obtained from the observations, to satisfy immediate requirements, pending the completion of the several chains of triangles; also the method of final reduction, which was adopted after the chains were completed, and by which the errors at the junctions of the chains with each other and with the base-lines are eliminated, with the closest possible approach to mathematical rigour. It states briefly at page 28, and explains more fully at pages 162 to 170, the reasons why the method of final reduction could only be applied to limited portions of the triangulation at a time, thus necessitating the division of the triangulation into five great sections, to be reduced in succession, as indicated at page 32. It shows how the whole of the triangulation contained in the first of these sections—known as the North-West Quadrilateral—was reduced simultaneously; and, together with Volumes III and IV, it gives all the facts of angular observation appertaining to that Quadrilateral, full details of the preliminary and the final reductions of the angles and the several trigonometrical figures, and, finally, the resulting values of the lengths and azimuths of the sides of the triangles and the latitudes and longitudes of the stations.

Volume V deals with a subject of its own, the Indian Pendulum Operations, which is quite unconnected with the triangulation and therefore need not be here noticed.

Volume VI treats almost entirely of the triangulation appertaining to the South-East Quadrilateral, the second of the five great sections into which the principal triangulation of India has been divided for final reduction. It commences with a brief recapitulation of the formulæ employed in the calculations, in order

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to obviate the necessity for frequent reference to Volume II, and then gives first, a complete exposition of the Simultaneous Reduction of the six chains or series of triangles forming the South-East Quadrilateral; and afterwards, for each series,—an introductory account of the operations, a descriptive list of the stations, an abstract of the observations of each angle, full details of the preliminary reductions of the angles—made to satisfy the geometrical conditions of the trigonometrical figures—the final values of the angles after having been corrected to satisfy the conditions of the Quadrilateral, and, finally, the resulting values of the lengths and azimuths of the sides, and of the latitudes and longitudes of the stations, of the triangulation.

The present volume is the seventh of the series. It and the following volume are devoted to the North-East Quadrilateral, the third of the five great Sections into which the principal triangulation has been divided for reduction.

The several chains of triangles composing this Quadrilateral are shown in the frontispiece to the present volume; but the reader who may wish to obtain a clear conception of the triangulation as a whole, and the position of the Section now under consideration relatively to the other Sections, should refer to the Skeleton Chart of the Principal Triangulation of India which faces the present page. In this chart each line represents a chain of triangles. The chain which approximates to the meridian of 78° and extends from the extreme south of India to latitude 30°, where it terminates on the Dehra Dún Base-line at the foot of the Himalaya Mountains, forms the back-bone of the triangulation, and is well known as the Great Meridional Arc of India, which was commenced by Colonel Lambton in Southern India, and carried upwards to the Himalayas by Colonel Everest; Colonel Lambton's portion has been revised of late years, with all the refinement which the latest and best instruments and the most approved procedure rendered possible. Of the remaining chains, some were accomplished in the earlier days of the Survey, when the instrumental equipment was generally very inferior to what it became subsequently, and when the procedure, as regards portions of the operations—more particularly the construction of towers for the principal stations in the plains—was still imperfect; other chains were executed in more modern times, with the best instruments and with the utmost possible refinement in every particular. The chains last executed are generally on a par with the Great Arc itself, while some are superior to it in accuracy. It so happened that lines of demarcation could be drawn broadly between the several chains of triangles, in such a manner as to divide the superior and the inferior chains into separate groups, each group containing a large number of interdependent chains; this circumstance was therefore availed of in designing the great Sections into which the triangulation had to be divided for final reduction. The bounding chains of these Sections are represented in the Skeleton Chart by thick black lines, while the intermediate and all other chains are shown by thin lines. It will be seen that there are five Sections in all, of which four are quadrilateral figures, while the fifth—which lies to the south of the others—is a trigon. The four Quadrilaterals meet at the point—Kaliánpur, approximately in latitude 24° by longitude 78°—which was employed by Colonel Everest as the central or reference station of the triangulation; they are therefore distinguished by the corresponding cardinal points—North-East, South-East, South-West, and North-West—with reference to the central station.

It has already been shown, in Section 7 of Chapter I of Vol. II, that the most accurate of all the chains of triangles are those which enter the North-West and the South-East Quadrilaterals; the least accurate enter the North-East and the South-West Quadrilaterals. When therefore the method for the general treatment of the principal triangulation had been elaborated and was ready to be put into practice, the Simultaneous Reductions were taken in hand in the following order, *first* the North-West Quadrilateral,

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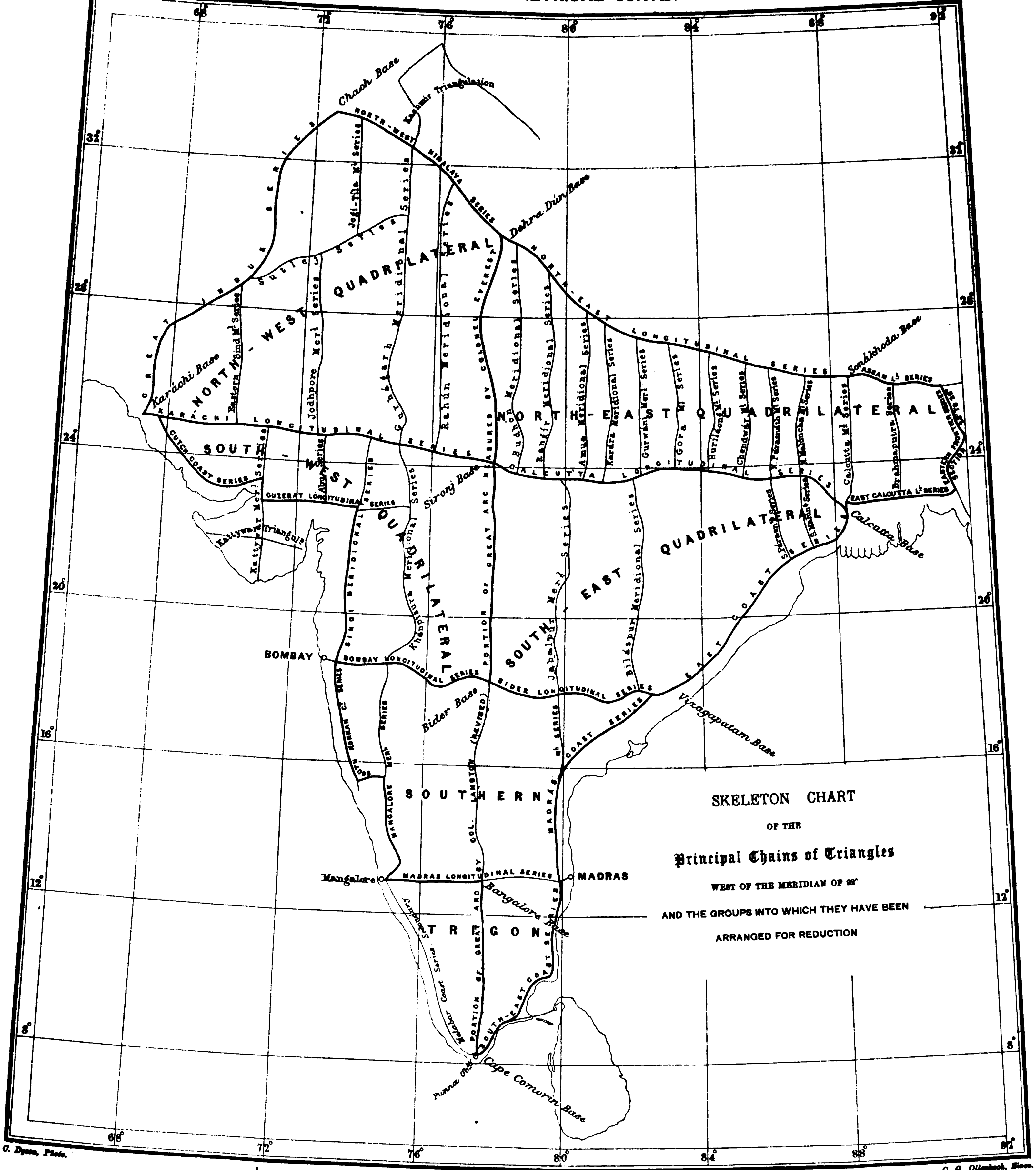
GREAT TRIGONOMETRICAL SURVEY



C. Dyson, Photo.

C. G. Ollenbach, Engr.

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secondly the South-East, and *thirdly* the North-East Quadrilateral. Volumes VII and VIII contain full details of the observations, reductions and final results of the whole of the triangulation which is contained within the limits of the third Quadrilateral.

Any description of the Triangulation of this Survey and the operations connected therewith, from the observations of the angles to the deduction of the most probable and therefore final results, is naturally subdivisible under six heads; *first*, the general principles in accordance with which the operations have been conducted; *second*, the practical execution of the measurement of the angles; *third*, the general principles followed in the combination and adjustment of the individual angular measures, with a view to satisfying all the geometrical conditions involved, as well as the primary linear elements which are fixed by the base-lines; *fourth*, the preliminary geometrical reduction of the individual triangles, polygons and net-works of which the chains are composed; *fifth*, the Simultaneous Reduction of either of the groups of chains, or Sections, into which the triangulation has been divided for convenience; and *sixth*, the presentation of the most probable values of the magnitudes of the angles, of the lengths and azimuths of the sides of the triangles, and of the latitudes and longitudes of the stations of the triangulation, which are the final results of the several reductions. The first and third of these branches of the subject are of general application, and they form the principal matter of Volume II, which was intended to be introductory to all subsequent volumes relating to the triangulation. The second, fourth and sixth branches have special reference to individual series or chains of triangles. The fifth has reference to either of the Sections or aggregations of chains grouped together for simultaneous reduction. In the present volume it has not been necessary to touch otherwise than lightly on the first and third divisions of the subject; but the remaining divisions, including the Simultaneous Reduction, are dwelt on at length, and full numerical details are given for five of the sixteen chains of triangles forming the Quadrilateral, the numerical details of the remaining eleven chains being given in Volume VIII.

The five chains of which the details are given in the present volume are

I. The North-East Longitudinal Series.
J. The Budhon Meridional Series.
K. The Rangír Meridional Series.
L. The Amua Meridional Series.
M. The Karára Meridional Series.

The eleven chains of which the details are given in Volume VIII are

N. The Gurwáni Meridional Series.
O. The Gora Meridional Series.
P. The Huríláong Meridional Series.
Q. The Chendwár Meridional Series.
R. The North Parasnáth Meridional Series.
S. The North Malúncha Meridional Series.
T. The Calcutta Meridional Series.
U. The East Calcutta Longitudinal Series.
V. The Brahmaputra Meridional Series.
W. The Eastern Frontier Series, Section 23° to 26°, with its pendant, the Cachar Branch Series.
X. The Assam Longitudinal Series.

For their linear and geodetic elements the whole of the above chains of triangles are mainly dependent on the final elements of the Great Arc, Section 24° to 30°, and of the West Calcutta Longitudinal Series, as derived respectively from the North-West and South-East Quadrilaterals; but they are also dependent on the base-line at Sonakhoda for a linear element.

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The present volume is divided into two parts. Part I is devoted to the Simultaneous Reduction of this Quadrilateral, and is followed by four Appendixes of which the two first dispose of the triangulation excluded from the Simultaneous Reduction, the third treats of the Theoretical Errors of triangulations, and the fourth treats of the dispersion of residual errors met with on the completion of Simultaneous Reductions. Part II is devoted to the details of the first five of the sixteen Series of triangles comprising the Quadrilateral.

Part I.

Chapter I gives a general account of the several chains of triangles, indicates the dependency of this Quadrilateral on the North-West and South-East Quadrilaterals for its fixed data, and describes the structure of the principal stations.

Chapter II describes the procedure followed in the measurement of the horizontal angles, and the methods adopted in determining the weights of the angles which were respectively measured with the primary and the modern theodolites; it quotes the mathematical formulæ employed in the reduction of the triangulation, from Volume II, where they are demonstrated; it indicates the final adjustment of the trigonometrical determinations of height by connection with the main lines of spirit levels; and finally it indicates the general principles of the Simultaneous Reduction of this Quadrilateral.

Chapter III gives full details of the Simultaneous Reduction as follows:—

First. A review of the general aspects and the magnitude of the undertaking, leading to the conclusion that the labour of reduction, which must in any case be very considerable, should be reduced as much as possible by intentional neglect of arithmetical nicety.

Second. A synopsis of the independent partial reductions antecedent to the Simultaneous Reduction.

Third. A description of the Reduction Chart which is given at the end of the volume, and a careful study of which is essential to a clear understanding of the several processes of calculation.

Fourth. A general out-line of the formation of the several Linear and Geodetic Equations of condition, 49 in number, which had to be satisfied, in order to produce the requisite consistency in the triangulation *per se*, and between it and the fixed elements on which it depended.

Fifth. The method of constructing the coefficients of the Unknown Quantities in the equations of condition, showing the general notation which was adopted for expressing the values of these coefficients, and specifying every exception to the general form.

Sixth. A synoptical exhibition of the several Equations of Condition, showing at a glance the triangles of which the angular errors enter as unknown quantities into each of the 49 equations of condition.

Seventh. The numerical values of the Fixed Data on which this Quadrilateral is based.

Eighth. The values of the Sides and Angles of the Circuit Triangles, as they stood before the Simultaneous Reduction.

Ninth. The Latitudes, Longitudes and Azimuths of the Stations on the right-hand flanks of the Circuit Triangles, as they stood before the Simultaneous Reduction.

Tenth. The numerical values of the Absolute Terms in the several linear and geodetic equations of condition.

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Eleventh. The numerical values of the μ s and ϕ s, the geodetic summations—exhibited in the table at page 55—which are required in forming the coefficients of the Unknown Quantities (the Angular Errors) in the geodetic equations of condition.

Twelfth. The numerical values of the coefficients, 𝔟 and 𝔠, of the Unknown Quantities in the several linear and geodetic equations of condition.

Thirteenth. The Weights of the Angles: the method of determining the value of the *modulus* which had to be applied in each instance, in order to convert the preliminary weights of angles measured with different instruments and under different circumstances into absolute weights, and thus to reduce them all to a common standard of accuracy before commencing the Simultaneous Reduction; the data for the calculation of the several *moduli,* with remarks on the results; and, finally, the values of the weights which were employed in the Simultaneous Reduction.

Fourteenth. The coefficients, 𝔅 and ℭ, of the Indeterminate Factors, in the equations in which the values of the Angular Errors are expressed in terms of those factors.

Fifteenth. The equations between the Indeterminate Factors, showing every significant coefficient and absolute term as it stood, first on the formation of the equations, and secondly after the successive eliminations of individual factors in the process of solution; finally, the numerical values of the Factors are given.

Sixteenth. The values of the Errors, x, y and z, of the angles of each triangle, resulting from the Simultaneous Reduction and the subsequent apportionments of residual error.

Seventeenth. The dispersion of the Residual Errors which were met with after the Simultaneous Reduction.

Eighteenth. General observations on the final results, and the numerical accuracy ultimately attained in the calculations. A table is given contrasting the original values of the linear and geodetic elements, at the sides and stations of the circuit junctions, with the values determined after the Simultaneous Reduction. A second table gives the apportionment of error among the several chains, showing the amounts of the corrections which have fallen on the linear and geodetic elements of each chain, or each separate section of a chain. A third table gives the average magnitudes of the angular corrections, as indicated by the number of errors of every successive magnitude in a scale ascending by tenths of seconds from zero upwards.

Nineteenth. Review of the General Reduction, with reference more particularly to the changes which had been introduced in previous methods of treatment, and to the results which had followed from aiming at a lower degree of arithmetical refinement.

The Appendixes to Part I.

No. 1 gives the details of the reduction of the Budhon Meridional Series, which was effected separately and not included in the Simultaneous Reduction of this Quadrilateral, for reasons which are set-forth at page 63 of the present volume.

No. 2 gives the reduction of the Non-Circuit Triangles,—*viz.*, the triangles excluded from the Simultaneous Reduction—which was needed for the final adjustments of their angles, to satisfy the geometrical conditions of the polygonal figures to which they appertain.

No. 3 is devoted to an investigation of the Theoretical Errors, generated respectively in Side, Azimuth Latitude and Longitude, in chains of triangles. These theoretical errors had been previously investigated, and

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form the subject of Section 9, Chapter XV of Volume II, and of the footnotes at pages 416 to 418 of that volume; but unfortunately some mistakes had occurred in the first investigation which were not detected until recently. This Appendix is therefore intended to supersede the original erroneous matter.

No. 4 indicates a simple method for the dispersion of the Residual Errors which may be met with on the completion of the Simultaneous Reduction of several chains of triangles, at sides and stations of junction.

PART II.

This portion of the present volume gives full details of five of the sixteen chains or series of triangles of which the Quadrilateral is composed. In arranging these details for publication it has been found convenient to give the whole for each Series—from the observations of the principal angles to the determination of the final results, angular, linear and geodetic—in groups by themselves. This has been done, *First*, because the printing of that part of this volume which is alloted to these details has extended over several years, proceeding *pari passû* with the progress of the calculations and the acquisition of data for publication; thus it was commenced with the Names and Descriptions of the Stations and the Details of the Observations of the Angles, and then continued with the results of calculation. *Secondly*, because by taking up each Series by itself, much of the matter which was set up in type for this volume could be made available for the Synoptical Volumes—as they are called—which are prepared to supply the data needed for the requirements of topographical surveyors operating in the districts passed over by the triangulation. The Synoptical Volumes contain full details of the several Secondary and Tertiary Triangulations which have been executed *pari passû* with the Principal Triangulation, for geographical and topographical purposes. The larger volumes—or the *Accounts of the Operations*, &c.,—are exclusively devoted to the details of the Principal Triangulation, excepting in so far that what has been done in the way of secondary and minor triangulation in each Series is described in the Introduction to the Series. It was obviously desirable that all matter which was required for both the Synoptical and the Principal Volumes should be set up in type and printed off, once for all, and therefore the arrangement of separate grouping was adopted. Thus in Part II of this volume and throughout Volume VIII, the numbering of the pages commences afresh for each Series, following the order of succession, which has already been indicated at page xiii; it is particularised for each Series by the addition, as a subscript to the number of the page, of the letter—I to M in the present volume and N to X in Volume VIII—which has been adopted as a symbol to indicate the Series.

It is now desirable to give first, a summary, and afterwards a general explanation, of the information and numerical data which the present volume furnishes for each chain of triangles. For the former purpose the fifth Series in order—the Karára Meridional—may be taken as typical.

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1. The Introduction gives a historical sketch of the progress of the whole of the operations in the field,—both principal and secondary—from year to year, mentions the Officers by whom they were conducted, and the theodolites with which the principal angles were measured, and indicates the work done by each of the Assistants.

2 and 3. It has been found convenient to indicate the Principal Stations by a system of numerals, as well as by their names. Consequently at the commencement of the details of each Series two lists are given, in the first of which the stations are arranged alphabetically with the numbers opposite the names, in the second numerically with the names opposite the numbers. Roman numerals have been adopted throughout for the nomenclature of the stations which is progressive in order from south to north in meridional chains, and from west to east in longitudinal chains, the first number for each Series being unity.

4 and 5. The Descriptions of Stations are based generally on those made originally by the observers and entered on the spot into the angle books, subject to such modifications as are occasionally required to take cognizance of any alterations which have been subsequently effected. They give the names of the district and the sub-division in which the station was situated at the time when its description was written; but as the boundaries of the districts and sub-divisions are not unfrequently altered, to suit the requirements of the Local Administration, the latest alterations are indicated in the Addendum to the Description of Stations, which also gives the latest information forthcoming regarding condition, &c. For information as to the general form and structure of the stations, reference should be made to Section 4 of Chapter I.

6. In the pages which are allotted to the Observations of the Angles, the name of the observer, the distinguishing number and the name of the maker of the theodolite, and the month and year in which the observations were taken, are specified at the head of the observations at each station.

In the details of the measures of the angles—called the Abstracts of the Angles—it is customary to give the reference number of the station on which the telescope was set at the commencement of each round of measures, and the reading to which the azimuthal circle was set, after each 'change of zero'; thus the graduations of the circle to which the readings were taken, at every measure of any angle, may be readily ascertained for an investigation of the law of the graduation error, such as will be found for Troughton and Simms' 18-inch Theodolite No. 1, in Appendix No. 4 of Volume II.

But the Abstracts of some of the older angles, measured before the year 1862, were printed before the practice of specifying the 'zero' or circle setting points was introduced; thus this information is wanting for Stations I to CXIX of the North-East Longitudinal Series. The modern Abstracts of Angles give the value of every measure of each angle, for each circle setting, the values being arranged in vertical columns at the foot of which the mean is given for the zero; but the older Abstracts give the zero means only, and merely state the number of measures from which each mean was derived.

For an explanation of the principles by which the changes of zero have been governed, reference should be made to Section 1 of Chapter II. During a short time two zero points of reference for the circle

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settings were adopted instead of a single point, the first half of the observations of each angle being measured from one point and the second half from the other; and as this occurred at Stations LXXXIV to CI of the North-East Longitudinal Series, and the Abstracts of the Angles do not specify the setting points, the information is given for those stations in the Errata and Addenda.

The right-hand column of the Abstract of Angles contains the following additional information;—for the angles measured prior to the year 1862, the probabilities of error and the general means; and for the angles measured afterwards, M, the mean of the several groups of measures on each setting, w and $\frac{1}{w}$, the weight, and its reciprocal, of the angle as deduced from differences between individual measures and between individual groups, and C, the concluded value of the angle as derived from the observations only. For fuller explanations reference must be made to Section 4, Chapter VII, Volume II, to the example at page 342 of the same volume, and to Section 2 of Chapter II of the present volume.

The modern Abstracts of Angles are followed by lists of the Sums of Squares of Apparent Errors of Single Observations and Single Zeros, which furnish data for the investigation of the average *e.m.s.* (theoretical error of mean square) of observation in a single measure of an angle, and the average *e.m.s.* of graduation *plus* observation in the mean of the measures on a single zero. The determinations are made in the first instance for groups of angles measured by the same observer, with the same instrument, and under similar conditions, and then for various combinations of these groups. With data thus obtained, from several series of triangles, for seven of the large theodolites which have been chiefly employed in the measurement of the principal angles, the investigation of the influences of Mixed Errors of Observation and Graduation was made which forms the subject of Section 3, Chapter VII, Volume II.

7. The Reductions of the several Polygonal Figures which are contained in any Series show how the angles of which each figure is composed were made consistent and harmonious *inter se*, so as to satisfy all geometrical conditions, with due regard to the respective weights of the angles. Full explanation of the principles and the procedure of these reductions, will be found in Chapter VIII of Volume II, and the formulæ are given in Section 3 of Chapter II of the present volume. The figures are numbered consecutively throughout the triangulation of the Quadrilateral, running generally through the several Series in the order of their alphabetical arrangement, but excluding the Budhon Series as it was not included in the Simultaneous Reduction. Diagrams of the figures are given in the plates appertaining to the Series. The small numerals within each of the observed angles correspond to the subscripts to the general symbol, $\mathbf{x}$, which is employed to indicate the error of any angle, the numerical subscript denoting the angle. Thus on referring to the diagram of Figure No. 10, and to the reduction of that figure; page $35_{\_M}$, $\mathbf{x}_3$ is the error of the angle 3, at Station II, between Stations I and III. The tabular statements of the reductions give, *first* the observed angles and reciprocals of their weights; *secondly* the equations by the solution of which the geometrical conditions of the figure are satisfied,—see equations (18), page 28; *thirdly* the equations between the 'indeterminate factors',—(19); *fourthly* the values of the indeterminate factors; *fifthly* the values of the angular errors,—(20); and *sixthly* the summation of the product of the square of each error by its weight—(21)—the value of which summation is made a minimum, in order that the values to be obtained for the several angular errors may be the most probable of each of the many values by which the geometrical conditions of the figure may be satisfied. In the group of equations between the indeterminate factors, the coefficient of the pth factor in the qth line is the same as that of the qth factor in the pth line; thus if a diagonal line be drawn from the coefficient of the first term in the first line to that of the

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last term in the last line, the coefficients which are symmetrically disposed on opposite sides of this line will be identical with each other. Consequently only the coefficients on and above the diagonal have been given; the absence of those below is indicated by asterisks.

8. Tabular statement of the Triangles. The two first columns of this table give the number adopted for each triangle to designate its place in the Quadrilateral; this number is entered in the first column if the triangle appertains to the chains of single triangles forming the several circuits whose closing errors are eliminated by the Simultaneous Reduction; it is entered in the second column for the non-circuit triangles exterior to the said chains. The triangles which enter the circuits are shown in the Reduction Chart (at the end of this volume) in firm lines, with their distinguishing numbers written in the centre; those which do not enter the circuits are shown in dotted lines, and their numbers are indicated by numerals of a smaller size than the former, commencing with 574, 573 being the number of the last of the circuit triangles.* The columns in the table which contain the corrections to the observed angles give, *first* the correction for the error of the angle, with reference merely to the triangle or polygonal figure to which it belongs, as obtained from the primary reductions; and *secondly* the further correction which has to be applied either for the apportionment of circuit error, should the angle appertain to one of the circuits, or for the restoration of consistency in the polygonal figure after the application of the circuit errors, should it appertain to a non-circuit triangle. Finally, the corrected plane angles and the lengths of the sides are given, as computed by the rules of Plane Trigonometry, in accordance with Legendre's theorem; see Section 4 of Chapter II.

9. The Table of the Latitudes and Longitudes of the Stations and the Azimuths and Lengths of the Sides. The principles on which the calculations of the Geodetic Co-ordinates and Azimuths have been made, and the method of computation, are fully explained in Sections 2 and 4 of Chapter IX of Volume II, and the formulæ are quoted in Section 5 of Chapter II of the present volume. All azimuths are referred to the south point and are measured right round the horizon, by the west.

10. The Determinations of the Differences of Height of the several stations have been deduced from the measurements of the vertical angles, as explained in Section 6 of Chapter II. It has not been considered necessary to give the individual measures of these angles, as has been done for the horizontal angles, because this portion of the operations is less exact and important. But the mean of the whole of the measures of each vertical angle, the calculated mean value of the amount of refraction in each angle and of the coefficient of refraction, the hour of observation, the heights of the signal and of the observer's telescope above the summits of the stations, the differences of height of the said summits and the absolute heights above the mean-sea level, are given. Several of the absolute determinations have been derived from the Spirit-leveling Operations of this Survey,—starting from the mean-sea level of the Harbour of Karáchi (Kurrachee)—of which full details will be found in the published *Tables of Heights in Sind, the Punjab, &c., the North-West Provinces, and Bengal, &c.* The errors generated trigonometrically between any two obligatory stations, fixed by the spirit-leveling, have been duly dispersed, sometimes by the method of minimum squares, but more generally by simple proportion over the intermediate trigonometrical values.

It may be here stated that all trigonometrically determined heights invariably refer to the upper surfaces of the central masonry pillars at the principal stations. Spirit-leveled values sometimes refer to the

* The triangles of the Budhon Series have a separate numbering of their own—1 to 44 for circuit, and 45 to 57 for non-circuit triangles—as they were excluded from the Simultaneous Reduction. See Chart facing page 1 of the Appendixes.

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upper surface and sometimes to the basement of the pillar, whichever the leveling-staff was set upon; a description of the exact point referred to is given in each instance.

11. Finally come the details and reductions of the Astronomical Observations which have been taken, at certain stations in each Series, for the determination of the Azimuth of one of the surrounding stations, or of a referring mark the angle between which and a contiguous station has been measured. The observations and the method of reducing them are fully described in Chapter XII of Volume II. For reasons which are explained in the first section of that chapter, the results have not been used in the general reduction of the Quadrilateral, further than to give a more exact mean value of the fundamental astronomical azimuth (at Kaliánpur) than the one obtained by the observations on the spot. At the end of the details of the determination of each azimuth, the difference between the observed value and the value obtained by calculation through the triangulation from the fundamental azimuth is given. These differences may be of much value in future investigations of the figure of the earth and of the influence of local attraction.

Full details regarding the Unit of the Linear Measures, the Base-lines, the Initial Elements of Latitude, Longitude and Azimuth, and the Elements of the Figure of the Earth which have been adopted in the calculations, will be met with in Volumes I and II. In this place it is only necessary to state that,—

(1). The Unit of Length is the Indian Standard 10-feet Bar **A**, the relations between which and the principal European Standards of Length are given at page 28 of Volume I.

(2). The adopted Elements of the Figure of the Earth—assumed to be spheroidal—are given at page 31 of this volume.

(3). The Longitudes depend on an astronomically determined value of the Longitude of the Madras Observatory, East of the Royal Observatory at Greenwich, which was deduced about the year 1815. The Longitude of the Madras Observatory has however been recently re-determined, by the Electro-Telegraphic method, by observations which were made at Greenwich, Mokattam (in Egypt), Suez, Aden, Bombay and certain stations of the triangulation in India, and with the following preliminary results;

	h	m	s		
Longitude of Mokattam ...	2	5	6·320	East of Greenwich	Supplied by Sir G. Airy, from observations taken in connection with Transit of Venus in 1874.
Increase for Suez ...	0	5	6·917	„	
„ Aden ...	0	49	42·656	„	By the operations of this Survey; see the Annual Report for 1876-77.
„ Bombay ...	1	51	19·983	„	
„ Madras ...	0	29	43·540	„	
Longitude of Madras ...	5	20	59·416	„	

This value of the Longitude of Madras is equivalent to 80° 14′ 51″; and as the originally adopted value, on which the longitudes of the whole of the stations of this Survey are based, is 80° 17′ 21″—see page 135 of Volume II—the following precept may be accepted with considerable confidence;—

All the Longitudes require a constant correction, probably of − 2′ 30″.

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As regards the Orthography of Indian names, it has not been possible to adopt a uniform system throughout the present volume. Many years ago Colonel Everest endeavoured to bring into general use in the Survey Department, Sir William Jones's method which is at once elegant and phonical, and is highly approved of by scientific men. But that method gives to all vowels their Italian sounds; and as the differences between the English and the Italian sounds are, in almost every instance, very considerable, and it is easier to lay down rules than to find followers for them, the surveyors gradually got into the way of using *ee* for the Italian *i* and *oo* for the Italian *u*, and of spelling generally in the manner that is natural to most Englishmen. In 1865, when the preparation of the final results was commenced, the spellings were corrected in accordance with Sir William Jones's system, excepting in the case of well-known names—such as Meerut, Calcutta, Cawnpore—which it would have been pedantic to alter, as they had become settled and familiar by long use. But in 1871 the Government of India made arrangements for the introduction of a uniform system of spelling throughout India, and circulated a "*Guide to the Orthography of Indian proper names, with a list showing the true spelling of Post-towns in India*", which was prepared by Dr. W. W. Hunter, L.L.D., Director General of Statistics to the Government of India; the guide was sent to the Survey Department with instructions that the directions it contained should be immediately complied with. Dr. Hunter's rules for spelling unfamiliar names, not given in his list of post-towns, are very similar to the rules which had been adopted in this Department, the chief difference being that the long *a*, *i* and *u* are required to be frequently unaccented, whereas by our rules they were invariably accented. In his list of post-towns however Dr. Hunter has not followed a uniform system of spelling, but has effected a compromise which—in his own words—"by sacrificing something in scientific precision, obtains a spelling more accurate than at present and yet recognisable as the same name." Thus the hill station at which the Head Quarters of the Trigonometrical Survey are located, during the summer months, is spelt ordinarily Mussoorie and scientifically Masúri, but according to Dr. Hunter it should be spelt Masauri. In September 1873 the Government of India issued amended rules for the spelling of all names not well known, which are practically identical with those originally followed in this Department. At the same time it was ordered that the orthography of the well-known names should be retained, and that a list of all note-worthy names should be prepared, in each Province, showing the orthography to be uniformly followed in future official correspondence and publications. When all these lists are published, uniformity of spelling will become possible; to what extent uniformity of system will be secured will depend on the latitude taken by the compilers of the lists in defining the number of names which are to be considered as well-known. This is a point on which there are considerable differences of opinion, some of the lists already published being much more conservative than others of the old fashioned Anglicised spellings.

Certain portions of the present volumes having been printed before, and others after, the issue of the several orders above quoted, the attempts to introduce a uniform system of orthography have occasionally led to considerable diversities of spelling, and in not a few instances to the adoption of one spelling, then of another and finally a return to the first; as in Dún, Doon, and finally, Dún,—or Cutch, Katch, Kach'h, and finally Cutch; or to successive divergencies from the first spelling, as Masúri, Masauri, Mussoorie and finally Mussooree. It is however believed that, notwithstanding such departures from a standard spelling, all the names will be readily recognizable. As a general rule the pronunciations of the vowels are as follow; *a* has a variable sound as in wom*a*n, rur*a*l, p*a*ltry; *á* as in t*a*rtan; *i* as in b*i*t; *í* as in rav*i*ne; *u* as in b*u*ll; *ú* as in r*u*ral; *o* as in n*o*te; *e* as *a* in s*a*y; *au* as *ou* in cl*ou*d; *ai* as *i* in r*i*de.

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It now only remains for me to express my acknowledgments to all who have mainly contributed towards the preparation of the present volume.

The primary reductions of the individual chains of triangles, and the general arrangement of Part II, for publication, were mostly effected under the supervision of Mr. J. B. N. Hennessey, M. A., F. R. S., (Deputy Superintendent 1st Grade) who succeeded to the charge of the Computing Office of the Trigonometrical Survey about the same time that I succeeded to the Superintendence of the Survey, in 1861, and with whom I have thus been intimately associated in all matters relating to the general reduction of the triangulation and other collateral operations, from the commencement of my administration of the Survey up to the present time. I have every reason to be much indebted to him for constant loyal co-operation and hearty assistance.

The important and intricate calculations which were required for the Simultaneous Reduction of the Triangulation as a whole, were executed under the supervision of Major J. Herschel, R. E., F. R. S., (Deputy Superintendent 2nd Grade) during the absence of Mr. Hennessey, Mr. Cole and myself in England. I had specially authorised Major Herschel to introduce into these calculations such modifications of the methods of procedure which had been previously followed—in the Simultaneous Reductions of the North-West and the South-East Quadrilaterals—as might be desirable for the purpose of reducing labour, and might be effected without materially impairing the accuracy of the final results. Circumstances unfortunately prevented him from remaining in India to draw up an account of his treatment of this important Section of the Principal Triangulation, for incorporation into the present volume; thus the preparation of the description of Major Herschel's methods has mainly devolved on myself. I had already given some description of them in Chapter XVIII of Volume II; and I have now entered more fully into the subject in Chapter III of the present volume, in which I discuss all the essential differences between the methods of procedure in the three successive reductions. I am indebted to Major Herschel for his searching examinations of previous methods, and for the pains he has uniformly taken to discover whatever alterations might be introduced with the object of improving the general procedure and facilitating the execution of the very complex and excessively laborious calculations.

The two first chapters of the present volume and the four appendixes are mainly due to Mr. W. H. Cole, M. A., (Assistant Superintendent 1st Grade) to whom I am also much indebted for very valuable help and hearty co-operation on all occasions, during the period of sixteen years which have elapsed since he joined the Survey.

The members of the Computing Office who have taken a leading share in the calculations generally, are Mr. C. Wood—who has also prepared the narrative Introductions for three out of the five Series included in Part II—Babu Gunga Pershad, and Babu Cally Mohun Ghose. The Simultaneous Reduction was principally effected, with the aid of Babus Madu Narain and Shiv Nath Saha, by Babu Cally Mohun Ghose, to whom also is due the credit of introducing sundry checks on the accuracy of the solution of the formidable equations between the Indeterminate Factors, and of suggesting the employment of tabular logarithmic differences in place of differentials. The entire printing of this volume has been performed as usual in the printing branch of the Trigonometrical Survey Office at Dehra. Mr. Peychers and Babu Gunga Pershad have rendered good service in the examination of the press proofs generally, and more particularly as regards the large amount of numerical matter, requiring very careful supervision and correction, which is contained in this volume.

MUSSOOREE,
August 1882.

J. T. WALKER, LIEUT.-GENERAL, R.E.,

Surveyor General of India, and

Superintendent of the Trigonometrical Survey.

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ERRATA ET ADDENDA.

PART I.

Page					
27	line 2 from bottom, of footnote	*for*	$a_1 x^1 - a_2 x_2$ &c.	*read*	$a_1 x_1 - a_2 x_2$ &c.
39	„ 11 from top, col. 5	*after*	from	*insert*	3 of
54	„ 4 „	*for*	${}_1^{n}[p]$	*read*	$1 + {}_1^{n}[p]$
„	„ 5 „	„	${}_2^{n}[p]$	„	$1 + {}_2^{n}[p]$
57	in expression (63)	„	$\left.\begin{array}{l} y = \iota\phi + \mu\beta \\ z = \iota\phi - \mu\gamma \end{array}\right\}$	„	$\left.\begin{array}{l} \text{for } y,\ \iota\phi + \mu\beta \\ \text{„ } z,\ \iota\phi - \mu\gamma \end{array}\right\}$
74	line 15 from top	„	to first ten circuits	„	to the first ten circuits
87	in equation (47)	„	$47k\Big\|_{518}^{573}$	„	$47k\Big\|_{518}^{572}$
„	„ (48)	„	$48k\Big\|_{518}^{573}$	„	$48k\Big\|_{518}^{572}$
144	line 1 of table, col. 13	„	+ 1·0003	„	+ 0·9997
168	„ 2, col. 4	„	*Equalizing Factor* = 1	„	*Equalizing Factor* = ·03
193	line 1 of table, cols. 9 and 10	„	·536 and ·913	„	± ·536 and ± ·913
„	„ 2 „ col. 11	„	1·045	„	± 1·045
198	to 203, cols. 7 and 14 in heading of tables	„	$\frac{u_c}{3}$	„	$\frac{u}{3}$
264	in heading of Section 18	after	*Simultaneous*	add	*and Subsequent*

PART II.

Page					
$17_{—I.}$	line 2 from bottom, *in some copies*	*for*	85° 32′	*read*	85° 38′
$18_{—I.}$	„ 1 from top „	„	85° 32′	„	85° 38′
$38_{—I.}$	col. 1 of 1st angle	„	VI & IX	„	VII & IX
„	9th zero-setting at station X, *in some copies*	„	21° 48′	„	28° 48′

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PAGE

$93_{I.}$ to $106_{I.}$ In the observations at stations LXXXIV to CI two zero points of reference for the circle settings were adopted instead of a single point as usual, half the observations being taken from one point, and half from the other. The respective zero-stations are shown in the following table:—

Station of Observation	Zero-station For 1st Set of Observations	Zero-station For 2nd Set of Observations	Station of Observation	Zero-station For 1st Set of Observations	Zero-station For 2nd Set of Observations
LXXXIV	LXXXV	LXXXVI	XCIII	XCII	XCIV
LXXXV	LXXXVII	LXXXVI	XCIV	XCIII	XCV
LXXXVI	LXXXIV	LXXXV	XCV	XCIV	XCVI
LXXXVII	LXXXVIII	LXXXVI	XCVI	XCV	XCVII
LXXXVIII	LXXXIX	LXXXVII	XCVII	XCVI	XCVIII
LXXXIX	LXXXVIII	XC	XCVIII	XCVII	XCIX
XC	LXXXIX	XCI	XCIX	XCVIII	C
XCI	XC	XCII	C	XCIX	CI
XCII	XCI	XCIII	CI	C	XCIX

$164_{I.}$	last line, col. 15	*for*	o	*read*	38·5
$5_{J.}$	line 25 from top	„	surmounted by	„	about 20 feet to the east of
$32_{J.}$	col. 1 of last angle	„	XLIII & LXVI	„	XLIII & XLVI
$64_{J.}$	line 7 from top	*after*	Mean Right Ascension	*add*	1842·0
„	„ 8 „	„	Mean North Polar Distance	„	1842·0
$8_{K.}$	„ 27 „	*for*	(1794)	*read*	(1774)
„	„ „ „	„	Naju	„	Háfiz Rahmat
$37_{L.}$	„ 8 „ col. 14	„	47·61	„	471·61
$\text{VII}_{M.}$	„ 3 from bottom, of footnote	„	Chapter II	„	Chapter IV

$11_{M.}$ to $19_{M.}$ The observations at the two initial and the following thirteen stations of the Karára Series, consisted simply of a single observation at each zero-setting, the instrument employed being Troughton and Simms' 18-inch Theodolite No. 1, which has an azimuthal circle with peculiar periodic errors of graduation, investigated in Appendix No. 4 to Volume II. Each of the means given in the abstracts of the angles observed at these stations, happens to be the mean of a pair of observations 'face right' and 'face left', with zero-settings exactly 180° apart, the observer having in these instances departed from the customary system of recording his observations; see page VII_{M}. The zero-settings given in the abstracts of these angles must therefore be understood to imply pairs of settings, the second of which differed by 180° from the one given.

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Page					
17—*M.*	last col. second angle	*for*	79° 36′ 44″·41	*read*	79° 36′ 44″·42
18—*M.*	at station XII	after	*Troughton and Simms*	add	*and with an* 18-*inch by Cary.*
21—*M.*	at stations XVIII and XIX	for	*a* 15-*inch Theodolite by Harris*	read	*an* 18-*inch Theodolite by Cary.*
22—*M.*	at station XIX	„	*a* 15-*inch Theodolite by Harris*	„	*an* 18-*inch Theodolite by Cary.*
48—*M.*	line 15 from top	„	Stn. XVI from Stn. XV	„	Stn. XVII from Stn. XVI

September, 1882.

J. B. N. HENNESSEY,
In charge of Computing Office.

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VOCABULARY OF CERTAIN NATIVE WORDS MADE USE OF IN THIS VOLUME.

Orthography employed.	Correct Orthography.	Meaning.
Báràdari	Bárádarí	A summer-house.
Barkandáz	Barkandáz	A watchman.
Chabútara	Chabútara	A platform.
Choki	Chaukí	A police-station.
Doáb	Duáb	Land between two rivers.
Duffadár	Dafadár	A native officer whose rank corresponds to that of a sergeant.
Gargaj	Gargaj	A tower.
Guru	Gurú	A spiritual guide.
Havildár	Hawáldár	A native officer whose rank corresponds to that of a sergeant.
Jagír	Jágír	Land given by Government as a reward for services.
Kacha	Kachchá	Built of clay only; or of stone or unburnt brick, and clay.
Kádar Khádar	Khádar	Low alluvial lands.
Kalán	Kalán	Great.
Khás	Khás	Proper.
Khurd	Khurd	Small.
Máoza	Mauza	A village.
Mastúl	Mastúl	A mast.
Minár Minára	Minár Minára	A steeple.
Nadi	Nadí	A river.
Náib	Náib	A deputy.
Nala	Nálá	A ravine, a rivulet.
Paka	Pakká	Built of stone, or brick, and mortar.
Pargana	Pargana	A sub-division of a district.
Pathán	Pathán	Name of a Muhammadan race.
Patti	Patti	A sub-division; portion.
Peshkár	Peshkár	An assistant revenue-collector.
Raja Rájá	Rájá	A king or ruler.
Sorái	Sorái	A spire.
Tahsíl Tehsíl	Tahsíl	Portion of a district subject to a revenue-collector.
Táluka	Taälluk	A sub-division of a district.
Tehsíldár	Tahsíldár	A revenue-collector.
Thána	Thánà	A police sub-division.
Zemindar	Zamíndár	A revenue-farmer, or holder of land immediately from Government.

September, 1882.

J. B. N. HENNESSEY,
In charge of Computing Office.

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PART 1.

INTRODUCTORY ACCOUNT

OF

THE TRIANGULATION EMBRACED

BY

THE NORTH-EAST QUADRILATERAL

WITH THE DETAILS OF ITS

SIMULTANEOUS REDUCTION.

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CHAPTER I.

ACCOUNT OF THE TRIANGULATION OF THE NORTH-EAST QUADRILATERAL.

1.

The Several Chains of Triangles which are contained in the North-East Quadrilateral.

The North-East Quadrilateral is the third in order of the five great sections into which the Principal Triangulation of India has been divided for final reduction, consecutively, for reasons which have already been set forth in Section 7 of Chapter I of Vol. II of the *Account of the Operations of the Great Trigonometrical Survey.* Abutting the North-West and South-East Quadrilaterals—of which full details, from the measurement of the angles to the determination of the final results, have already been published, for the former in Volumes II, III and IV, and for the latter in Volume VI—it depends on them for the whole of the data, both linear and angular, which were finally fixed by their reduction.

Originally it was intended to extend no further eastwards than the Calcutta Meridional Series, which was to form the east side of the Quadrilateral (see page 29 of Volume II). But when the final reductions came to be taken in hand, it was found—as will be explained subsequently—that the four meridional and longitudinal chains of triangles which fall between the meridians of $88\frac{1}{2}°$ (Calcutta) and $92°$, and the parallels of $23°$ and $26\frac{1}{2}°$, could be added to the Quadrilateral without inconvenience, and with the advantage of increasing the extent of triangulation which would be brought under Simultaneous Reduction. Its limits were therefore extended eastwards, so as to embrace those chains of triangles. Thus it eventually comprised the following Series:—

The North-East Longitudinal,	hereafter symbolised by	I
The Budhon Meridional,	,,	J
The Rangír Meridional,	,,	K
The Amúa Meridional,	,,	L
The Karára Meridional,	,,	M
The Gurwáni Meridional,	,,	N
The Gora Meridional,	,,	O
The Huríláong Meridional,	,,	P
The Chendwár Meridional,	,,	Q
The North Párasnáth Meridional,	,,	R
The North Malúncha Meridional,	,,	S

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The Calcutta Meridional, hereafter symbolised by		T
The East Calcutta Longitudinal,	,,	U
The Brahmaputra Meridional,	,,	V
The Eastern Frontier, Section 23° to 26°,	,,	W
The Assam Longitudinal,	,,	X

The triangulations contained in the above Series had to be brought into harmony with each other, with the Section of the Great Arc which lies between the parallels of 24° and 30°, and with the West Calcutta Longitudinal Series, the two last chains of triangles having already been fixed by the Simultaneous Reductions of the North-West and the South-East Quadrilaterals.

It is necessary to repeat in this place, what has already been set forth in Volume II, that the whole of the triangulation of the North-East Quadrilateral had been completed, up to the primarily assigned limits, before the final reductions of the contiguous Quadrilaterals were taken in hand, whereas three internal meridional chains were wanting in those Quadrilaterals. But the general character of the triangulation of the incomplete sections was so much superior to that of the one which was already completed, that there was no alternative but to commence the final reductions with those sections, in order that the earlier but less reliable and least accurate triangulations might be made to rest on the modern and more highly finished and exact triangulations. The propriety of the arrangement of the order of final reduction has been shewn by the small magnitudes of the final corrections for the angles of the North-West and South-East Quadrilaterals as compared with those for the North-East Quadrilateral; *vide* pages 395, 415 and 426 of Volume II.

2.

The Observers and Instruments employed on the Several Series of Triangles contained in the North-East Quadrilateral.

The series are here arranged in the chronological order of their commencement. The lengths recorded are of the chains as they now stand. When first executed some of the meridional series were considered to include triangles which now appertain to the West Calcutta and North-East Longitudinal Series.

The Budhon Meridional Series.

This series was commenced in 1833 from the side Budhon-Tinsmál of the old Calcutta Longitudinal Series, by Lieutenant R. Macdonald of the 69th Bengal Native Infantry, with Harris and Barrow's 15-inch theodolite* and by the end of field season 1833-34 it had been carried by him to the side Ráepur-Majhár. The next season was entirely occupied in selecting stations in advance. In September 1835 Lieutenant E. L. Ommanney of the Bengal Engineers received charge of the operations; but no final observations were made by him till 1836-37 when, using the same instrument, he carried them as far as the stations Gúrmi and Bhind.

* For descriptions of the instruments named in this Section see Appendix No. 2 of Volume II.

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On his resigning his appointment in 1837 the charge of the series devolved on Mr. Joseph Olliver, whose services being shortly after required on another triangulation, operations on the Budhon Series were suspended. They were resumed again at the end of 1839 under the general control of Lieutenant T. Renny; but final observations were not recommenced till the next field season, when Lieutenant Renny's services being required elsewhere, they were made by Mr. C. Murphy, who had been furnished with Troughton and Simms' 18-inch theodolite No. 2. He advanced the series this season as far as the side Sankráo-Sarsotha, except that the last named station was not observed at. During the next field season no final work was executed. In November 1842, as it was evident that the amount of work remaining to be completed was more than could be accomplished by the end of the season, the Surveyor General resolved to divide the unfinished portion into three parts to be executed simultaneously, the most northern by Mr. George Logan, who was provided with Cary's 15-inch, the southern portion by Lieutenant Renny assisted by Mr. Murphy with Troughton and Simms' 18-inch No. 2, and the intermediate portion by Mr. W. N. James with an instrument which cannot at present be identified. The series consists of 25 single triangles, 5 polygons and 1 quadrilateral, and has a direct length of 386 miles.

The Rangir Meridional Series.

The final observations on this series were commenced by Lieutenant A. S. Waugh of the Bengal Engineers in June 1834 from the side Tinsmál-Kusmár of the old Calcutta Longitudinal Series, with Cary's 18-inch theodolite L; and they were carried by him in that and the following month as far as the side Nágonáth-Phára. Here the hills, in which the series had previously lain, terminated, and a new organization of the party became necessary to adapt it for working in the plains. This having been effected, and the party placed under Mr. J. W. Armstrong, he was enabled to recommence final observations in December 1836, employing the same instrument. Operations were brought to a sudden termination on the 10th April by a fire accidentally breaking out at night in the tower of Birona, which destroyed the scaffolding and rendered the 18-inch quite unserviceable. The next season Mr. Armstrong was furnished with Cary's 18-inch M O; and, leaving some long rays to be observed later in the season when greater refraction might be expected, he carried the series northward. Returning in April to connect the work, he was prevented from accomplishing his object by unfavourable weather. Observations were continued in 1838-39, but none were taken during the following season; and it was not till 1840-41 that the hiatus which had been left in the chain was filled up and the series brought to a conclusion. Some of the angles, where the break had occurred, were observed with Harris and Barrow's 15-inch theodolite. Several years afterwards, 1864, when Mr. G. Shelverton was revising a portion of the Calcutta Longitudinal Series, prior to originating the Jabalpur Meridional Series, he found that Rangír Station had been destroyed: he therefore established a new station and measured the angles of the triangle Tinsmál-Rangír-Kusmár. The instrument he employed was Troughton and Simms' 36-inch theodolite. The series is now regarded as originating at the side Tinsmál-Rangír, and consists of a chain of 31 single triangles and 1 trigon, and has a direct distance of 318 miles.

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The Amua Meridional Series.

This series was commenced in 1834 from the side Amúa-Lakanpura of the old Calcutta Longitudinal Series by Lieutenant Renny assisted by Mr. C. Murphy. The observations during the first season were all made by Lieutenant Renny with Troughton and Simms' 18-inch theodolite No. 1. By June of that year the plain country was reached and new arrangements had to be made for continuing the series. These occupied the party until June 1837, scarcely any principal observations having been made during that interval. Towards the end of 1837 Lieutenant Renny's services were required at the measurement of the Sironj Base-line, and the charge of the series devolved on Mr. C. Murphy, who brought it to a conclusion in November 1838, all the observations, except a very few by Lieutenant Renny, having been made by himself. The instrument employed was the same throughout. The series consists of 34 single triangles, and has a direct length of 282 miles.

The Karara Meridional Series.

Operations were first commenced on this series by Lieutenant W. Jones of the Bengal Engineers in February 1838 from the side Karára-Marwás of the old Calcutta Longitudinal Series; but after the selection of a few stations, the commencement of the rains and sickness put a stop to work. Attempts were made in the two following seasons by the same officer to extend operations; but on each occasion the party, shortly after entering the field, was prostrated by jungle fever, and finally Lieutenant Jones had to proceed on leave on medical certificate, after which the party was broken up.

In June 1841 Captain R. Shortrede was nominated to the charge of the series, and was provided with Troughton and Simms' 18-inch theodolite No. 1. He did not reach his ground till February 1842, when the season was far advanced; but he completed observations at 10 stations before the party was driven from the field by sickness. During the next two seasons but slow progress was made. In 1844-45 Captain Shortrede, having found his instrument work very unsatisfactorily, had it replaced by Cary's 18-inch M O. During the same season Captain J. S. DuVernet commenced operations from the north, and with Saiyad Mir Mohsin's 18-inch theodolite brought the triangulation down to the side Sora-Janai, up to which side it was advanced from the south partly by Captain Shortrede with the instrument above mentioned and partly by Mr. J. W. Armstrong with Harris and Barrow's 15-inch theodolite. The southern section of the series consists of polygonal figures, which were originally of a very complicated form as designed by Captain Shortrede, but were subsequently modified by Colonel Waugh: the northern section which lies in the plains is formed of single triangles. The meridional length of the series is 246 miles.

The Chendwar Meridional Series.

Operations on this series were commenced by Mr. George Logan from the side Kasíátu-Chendwár of the old Calcutta Longitudinal Series, during the field season of 1843-44, with Troughton and Simms' 18-inch theodolite No 2. This instrument was, after the field season of

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1844-45, transferred to Captain Thorold Hill for employment on the South Malúncha Series, and its place was supplied by Barrow's 36-inch theodolite, with which Mr. Logan completed the series in the early part of 1846. During the revision of the Calcutta Longitudinal Series by Mr. Keelan the Chendwár Station was found to have been destroyed and a new one was established by him in 1869, when he re-observed the angles of the triangles Chendwár-Kasíátu-Sindraili and Chendwár-Sindraili-Paraia, using Colonel Waugh's 24-inch theodolite No 1. The series comprises 2 polygons, a quadrilateral and 17 single triangles, and its direct length is about 179 miles.

The North Maluncha Meridional Series.

This series is based on the side Durgapur-Malúncha of the old Calcutta Longitudinal Series. Operations were commenced by Mr. R. Clarkson in February 1844 with Cary's 15-inch theodolite. This instrument was replaced for a time by Troughton and Simms' 18-inch theodolite No. 2. During season 1844-45 Mr. Clarkson continued in charge of the party; but the next season he was transferred to the East Coast Series and Lieutenant R. Walker of the Bengal Engineers was placed in charge of the Malúncha Series and brought it to a conclusion during that season. He employed Cary's 15-inch. The series comprises 3 polygons and 6 single triangles, and extends over a distance of 151 miles.

The Gurwani Meridional Series.

The triangulation of the Gurwáni Meridional Series, which extends from the side Chapri-Pokra of the old Calcutta Longitudinal Series northwards along the meridian of Gurwáni Station of the last named series, was commenced by Captain DuVernet on the 21st December 1845 with Saiyad Mir Mohsin's 18-inch theodolite. In the second field season this instrument was set aside as of inferior quality and Colonel Waugh's 24-inch theodolite No. 1 was substituted in its place, with which Captain DuVernet completed the series in March 1847. The series consists of a chain of 32 single triangles, and is 213 miles in length.

The Gora Meridional Series.

The Gora Meridional Series is based on the side Gora-Sewádhi of the old Calcutta Longitudinal Series, and follows the meridian of the first named station. It was originally commenced by Mr. W. N. James; but he died before he had been able to effect any sensible amount of work, and Lieutenant Peter Garforth of the Bengal Engineers was put in charge of the party. No progress was made with the series during the first season, 1844-45, that Lieutenant Garforth was in charge, but the whole triangulation was executed by that officer between December 1845 and April 1847, including the revision of the few angles measured by Mr. James: the instrument he employed was Harris and Barrow's 15-inch theodolite. The series consists of a compound figure and 23 single triangles, and has a direct length of 208 miles.

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The Calcutta Meridional Series.

This series originally emanated from the Calcutta Base-line; but on the completion of the revision of the Calcutta Longitudinal Series the 4 triangles between the Base-line and the side Sátten-Chinsurah were included in the Base-line Figure, and the series now originates from the last named side. It was commenced by Mr. J. Peyton in May 1845 with Troughton and Simms' 18-inch theodolite No. 1; and with the exception of a few angles observed by Mr. J. Nicolson in April and May 1847, the whole series was completed by the former officer by May 1848. The series comprises 45 single triangles, and extends over a direct distance of 226 miles.

The North-East Longitudinal Series.

This chain of triangles lies partly on the Sub-Himalayan ranges, but mostly in the deadly forest tracts which form the southern boundary of the Himalayan mountains; it originates from the sides Mehesari-Chándípahár and Chándípahár-Ghandiál of the Great Arc Series, Section 24° to 30°, and terminates at the side Niwáni-Kanchábári of the Sonákhoda Base-line Figure. The object with which it was first commenced was to connect the northern limits of all the meridional chains emanating from the West Calcutta Longitudinal Series. Accordingly the Great Arc and Budhon, the Budhon and Rangír, the Rangír and Amúa and the Amúa and Karára Series were successively connected on their completion, during the years 1841-44. But the instruments employed—an 18-inch theodolite by Saiyad Mir Mohsin and a 15-inch by Harris—were very inferior to the instruments which were afterwards available; therefore this portion of the triangulation was revised subsequently as opportunity offered.

The history of the execution of the series as it at present stands is as follows:—In 1845-46, on the completion of the Chendwár Series, Mr. George Logan commenced a chain of triangles trending westwards from the northern terminus of that series, along the course of the British Frontier; he employed Barrow's 36-inch theodolite. By the end of season 1848-49 he had brought it to the side Tilakpur-Newáda, between the Karára and the Gurwáni Series; and the next season, being provided with Troughton and Simms' 24-inch No. 2, he extended his operations to the side Kaliánpur-Donau, at the head of the Rangír Series. While Mr. Logan was engaged in carrying on this triangulation, Lieutenant Reginald Walker was completing the North Malúncha Meridional Series with Cary's 15-inch theodolite; and in the course of his operations he triangulated the double polygon at the north end of that series. The next season, 1846-47, having been provided with Troughton and Simms' 36-inch theodolite, he commenced work at the side Menai-Ghiba and triangulated eastward as far as the Station Bandarjúla. Here he was attacked by jungle fever; and he died on his way to the Sanatarium of Darjeeling, where he hoped to have obtained medical aid. The next season Mr. Charles Lane resumed the triangulation with the same instrument, and extended it eastwards to include the Sonákhoda Base-line Figure, thereby completing this portion of the series. In 1848-49 Mr. Peyton with Barrow's 24-inch No. 1 executed the section

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of the triangulation between the northern extremity of the Chendwár Meridional Series and the double polygon at the north of the Malúncha Series. Finally in season 1850-51 Captain Renny Tailyour with Colonel Waugh's 24-inch No. 2 and Mr. Peyton with the sister instrument, No. 1, revised and added to the triangulation between the Great Arc and the side Kaliánpur-Donau, where Mr. Logan had closed work.

A few years later, 1855, there being some question as to the stability of one or more of the pillars of the Sonákhoda Base-line polygon, Mr. J. O. Nicolson revised this figure with Barrow's 24-inch No. 1: the discrepancies in the values of the angles were however not sufficient to shew that any deflection had occurred, and both sets of measures have been retained.

The Hurilaong Meridional Series.

The Huríláong Meridional Series originally emanated from the side Sewádhi-Huríláong of the old Calcutta Longitudinal Series, the station of Khaira Pándu, which was a secondary station of the latter series, being adopted as a principal station of the former. Afterwards, during the revision of the Calcutta Longitudinal Series, Khaira Pándu was one of the stations selected to form a polygon round Sewádhi and thus ceased to be reckoned as belonging to the Huríláong Series. The series was commenced by Mr. J. W. Armstrong in season 1848-49 with Troughton and Simms' 18-inch theodolite No. 1. This instrument was, during the following recess, transferred to Lieutenant H. Rivers for employment on the Gurhágarh Meridional Series, and its place was supplied by the sister instrument No. 2. This instrument was used by Mr. Armstrong during season 1849-50; after which it was changed for Barrow's 24-inch theodolite No. 2, with which Mr. Armstrong brought the series to a conclusion in June 1852. This triangulation comprises 1 compound figure, 1 simple polygon and 20 single triangles, and has a direct length of about 207 miles.

The North Parasnath Meridional Series.

This series originally emanated from the side Chendwár-Párasnáth of the old Calcutta Longitudinal Series; but, during the revision of the latter series, the stations of Bámani and Ghoranji were adopted to aid in forming a double polygon round the first named stations; thus the Párasnáth Series now emanates from them. It was executed by Mr. J. O. Nicolson in two seasons, having been commenced in December 1850 and brought to a close in June 1852. The instrument employed was Barrow's 24-inch theodolite No 1. The series comprises 20 single triangles, and has a direct distance of 130 miles.

The Assam Longitudinal Series.

This series which is double throughout is an extension to the eastward of the North East Longitudinal Series. It was commenced in 1853-54 by Mr. J. O. Nicolson with Colonel Waugh's 24-inch theodolite No 2. Towards the end of 1854 this instrument was replaced by Barrow's 24-inch No. 1 which had just undergone extensive alterations, and the remainder of the series was executed with the latter instrument partly by Mr. Nicolson, partly by

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Mr. Lane and partly by Mr. Rossenrode: it was completed early in 1860. When, 1855, Mr. Nicolson revised the Sonákhoda Base-line figure, he also revised some of the angles at the commencement of this series. The direct length of the series is 197 miles.

The Eastern Frontier Series—Section 23° to 26°.

This series, which consists wholly of polygons and quadrilaterals, was commenced in the year 1859-60 near the western extremity of the Assam Valley by Mr. W. C. Rossenrode, with Barrow's 24-inch theodolite No 1. It was continued by Mr. Lane and Mr. Rossenrode, and completed to the parallel of 23° together with the Cachar Branch—a Longitudinal Series which follows the parallel of 25°—by May 1864. The length of the series which is somewhat tortuous is about 220 miles and that of the Cachar Branch about 47 miles.

The East Calcutta Longitudinal Series.

The East Calcutta Longitudinal Series emanates from the side Chinsurah-Boga of the Calcutta Meridional Series. It was executed entirely by Lieutenant H. R. Thuillier, R. E., during the years 1863 to 1867, with Troughton and Simms' 24-inch theodolite No. 2. It was originally intended that the series should be formed of triangles arranged in polygonal figures, in order to afford mutual verification; but circumstances made it necessary to abandon this intention and to carry out the series as a chain of single triangles. Many plantations of cocoa-nut, betel-nut and other valuable trees, and an extensive amount of forest and jungle were met with, while the ground was a level plain, devoid of hills, undulations or even mounds of any kind. The triangulation of such a country involved either the building of lofty towers or the clearing away of all obstacles on the lines; but owing to the exceedingly high price of materials and labour, and to the heavy compensation demanded for trees cut down it became necessary after the completion of the first polygon to alter the design of the triangulation to a chain of single triangles involving a minimum amount of station building and line cutting. The series thus consisted of 1 polygon and 35 single triangles. Afterwards, when the Brahmaputra Series was originated in 1868, another polygon was formed. The direct extent of the chain is 199 miles.

The Brahmaputra Meridional Series.

This chain of triangles emanates from the East Calcutta Longitudinal Series and follows the meridian of 90°. After crossing the Ganges a little below its junction with the Jamoona branch of the Brahmaputra river, it advances along both banks of that branch. The series which is a chain of polygonal figures, was commenced by Lieutenant H. R. Thuillier, R.E., with Troughton and Simms' 24-inch No. 2 in season 1868-69 and was prosecuted by him till the end of the next field season, when the financial difficulties of the government and the consequent reductions of establishments led to its suspension. Final operations were resumed in 1872-73 by Captain T. T. Carter, R.E., who employed the same instrument as Lieutenant Thuillier, and the series was completed by him the following season. Its direct length is about 182 miles.

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3.

The Dependency of the North-East Quadrilateral on the North-West and South-East Quadrilaterals for its Fixed Data.

The North-East Quadrilateral rests on two chains of triangles which, having entered previous reductions, had been finally adjusted, *viz.*, the Great Arc Series, Section 24° to 30°, or Series A of the North-West Quadrilateral, and the Calcutta Longitudinal Series or Series B of the South-East Quadrilateral. These chains lie one to the west and the other to the south of the North-East Quadrilateral, and, with the exception of a linear element afforded by the Sonákhoda base-line, they furnish the whole of the fixed data on which this Quadrilateral depends. From the Calcutta Longitudinal Series eleven meridional series originated; one of these, the Budhon, closes on the Great Arc Series, and also touches it nearly midway, at Ráepur; the remaining series are tied together at their northern extremities by the North-East Longitudinal Series, the eastern extremity of which rests on the Sonákhoda Base Line. To the east of these chains of triangles there are four more chains which have been combined with the others for final reduction; *viz.*, the Assam Longitudinal, the East Calcutta Longitudinal, the Brahmaputra Meridional, and the Eastern Frontier Series. Various astronomical determinations of latitude and azimuth might also have been adopted as fixed data, but they have been excluded for the reasons given on page 27 of Volume II.

It will be seen on comparing this Quadrilateral with the two first—already described in Volumes II to IV, and Volume VI—that the fixed data are far more numerous and therefore exercise a greater influence on the results of the reduction. In both the former quadrilaterals, there were only four fixed lengths, one at each corner, and only one point of which the latitude and longitude were obligatory, and at which the azimuth of another point of the triangulation was fixed. In the present Quadrilateral there are no less than 13 sides fixed in length and azimuth, and as many points fixed in latitude and longitude, and one base-line, giving in all 53* fixed elements, with which the triangulation had to be brought into accord. Had the triangulation of the North-East Quadrilateral been on a par with that of the other two Quadrilaterals there might be reason to regret that it was fettered so much by them; but many causes have combined to render it of an inferior character. The instruments which were available at the time for the measurement of the principal angles were for the most part much inferior to those with which almost all the principal angles of the two contiguous Quadrilaterals were subsequently measured; moreover the best form of structure for the tower stations, which had to be built in large numbers on the extensive plains operated over, had not yet been devised, and it is certain that the operations were much impaired by the deflection of some of the tower stations during the interval between successive visits to the same station. This last is probably the chief cause of the comparative inferiority of the triangulation; and for this reason a full description of the several methods which were followed in the construction of the towers will be given in the following section.

* Including Ráepur—the point at which the Budhon touches the Great Arc—there would have been 14 points fixed in latitude and longitude, and 55 fixed elements in all; but this connection was not formed till after considerable progress had been made with the calculations of the North-East Quadrilateral. For further information on the subject, see the foot note to Section 1 of Chapter III.

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4.

The Construction of the Principal Stations.

The triangulation of the North-East Quadrilateral was commenced in 1826 with the Calcutta Longitudinal Series, at the Sironj Base-line which was then the northern extremity of the central meridional chain of triangles which is well known as the Great Arc of Colonels Lambton and Everest. Up to that time the principal triangulation had been carried over tracts of hills whose peaks furnished suitable points for the instruments to be set upon, so that at first it was deemed unnecessary to construct any stations of observation, and all that was done was to smooth the surface of the rock, and engrave the usual Indian Survey mark—a circle and central dot—on it as the point of reference. Subsequently circular masonry pillars were built on the rock, of sufficient diameter to carry the stand of the instrument, and surrounded by a platform to support the observatory tent and observer; these were raised a few feet above the surface of the ground on the summit of the hill, so as to furnish prominent objects which might be readily found whenever wanted, for the primary rock-marks were not always easy to find.

Almost the whole of the Calcutta Longitudinal Series, and the southern portions of nearly all the meridional chains of triangles which emanate from that series, lie in hill tracts, and at all the principal stations pillars and platforms were built such as have just been described. But in course of time the triangulation had to quit these hills and enter on the extensive plains which intervene between them and the Himalayan Ranges; and then it became necessary to abandon the simple pillar and platform at all places excepting where mounds or ruined forts were met with, and to construct towers of sufficient height to give the requisite command of view. The form of the tower appears to have been at first and for some time left to the judgment of the individuals who had to construct this new description of station, and thus a variety of forms were adopted in different portions of the triangulation. On the northern extension of the Great Arc, which was deemed the most important series of all, lofty masonry towers were constructed for Colonel Everest, at a considerable cost—over Rs. 2000 each—by Officers of the Department of Public Works. Elsewhere however the Trigonometrical Surveyors were rarely in a position to command either the services of those officers, or the requisite funds to defray the expense of constructing towers similar to those on the Great Arc; they were therefore obliged to economise their funds as much as possible and to dispense with skilled labour. This was generally done by using masonry only for the central pillar on which the instrument was intended to rest, by building the platform of sun-dried bricks or earth or rubble, or other cheap but perishable materials, and by employing such native artificers or common labourers as might be obtained on the spot in fabricating the whole structure. Special forms of tower were however occasionally introduced.

On the Calcutta Longitudinal Series it was found that some lofty semaphores, on the old telegraph line connecting Benares with Calcutta, were available and could be readily converted into principal stations; but they occurred only along one flank of the triangulation; along the other flank, survey towers had to be constructed. Those which were first

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built seem to have been of an experimental character; for when the series was undergoing revision forty years afterwards, one of them was found to consist of a column of masonry 7 feet square at base, 4 feet square at top, and 40 feet high; another of four masonry pillars, about 35 feet high, built at the corners of a rectangular platform supporting a stage for the instrument and observer. But the form of station which seems to have met with the greatest approval was a hollow square tower, somewhat similar to and probably not much less expensive than Colonel Everest's towers on the northern portion of the Great Arc.

On the Budhon Series solid earthen towers were erected, each with a hollow core of masonry in its centre, from 1 foot to 18 inches in diameter, to admit of plumbing over a mark at the ground level, to which access was obtained through a vaulted passage. After a time, for reasons not stated, the hollow core gave place to a solid core.

On the Rangír Series perforated pillars were built, around which temporary platforms were erected on posts at the time of observation; these pillars were found to oscillate with the wind; thus the arrangement was disapproved of and it does not seem to have been adopted on any other series. It was however again introduced several years afterwards in the modern triangulation of the Brahmaputra and the East Calcutta Longitudinal Series, but with the precaution of constructing walls of bamboos and matting round the posts supporting the platforms, in order to protect the pillars from the wind.

On the Amúa Series solid towers of mud* or of sun-dried bricks set in mud were built, with mark-stones inserted at intervals from basement to surface. The desirability of isolating the instrument from the platform on which the observer stood was apparently not considered of importance on this series, although it had already been done on the Great Arc and elsewhere.

When it became generally recognised that isolation of the instrument was necessary, earthen towers were built with central isolated pillars of solid masonry carrying mark-stones at top and bottom. These structures were employed on the Karára, Chendwár, North Malúncha, Gurwáni, Gora, North-East Longitudinal and North Párasnáth Series.

On the Calcutta Meridional Series hollow square towers were reverted to, built however in a much less expensive manner than those on the Great Arc. They were much lower and

* With reference to the structure of these stations the following remarks have been extracted from a note by Lieutenant Renny:—

"All the mud forts in India offer specimens of this species of work; and many of them, from the length of time they have endured, "even without repair, prove the tenacity of mud when properly worked and moulded. But although so many examples presented them-"selves, there arose a practical difficulty in their construction; for, owing to the length of time that has elapsed since the building of mud "forts, no experienced person could be found to give information on that head; and consequently much had to be left to the discretion "of the servant superintending the building, until occasional failures pointed out the necessary precautions and suggested the following "mode of procedure.

"The mud ought to be prepared at least one day before it is required for use, by mixing water with the most tenacious earth at hand "and working the mixture well with the feet, as in the preparation of mould for bricks. The building is carried on in distinct horizontal "layers each 18 inches high, as it is requisite that one layer be well dried before another is superadded; and in the construction of each layer "the outer edge is first raised with a breadth of 1½ or 2 feet, and after a lapse of 24 hours the interior is filled up. It generally requires "5 days to dry each layer properly; and during the second and third day of that period the outside, originally built rugged, is while yet "moist beat with wooden mallets into the required shape. * * * The ascent is usually perpendicular to the plan of the platform, and "by means of a flight of steps. * * * The whole is plastered over with a mixture of slime from the bed of jhíls, cow-dung and when "procurable the coarse husks of grain.

"A mark-stone is inserted within the centre and on a level with the base of the platform, and four marks are laid off outside and on "opposite radii of two lines passing through the centre mark, and serve to transfer the latter to the top of the platform. This might have "been more easily accomplished by leaving a well in the centre of the platform; but such a course complicated the work too much for the "simple understanding of the executives."

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it was thus possible to build them of burnt brick set in mud; mortar was used in plastering the outer crevices of the walls to prevent water soaking in; also at every two feet of height one layer of bricks was set in mortar. The beams were of wood instead of stone, and the total cost of each tower was usually under Rupees 300.

After completing the Calcutta Meridional Series, the Executive Officer, Mr. Peyton, in 1848-49 triangulated the section of the North-East Longitudinal Series between the North Malúncha and Chendwár Series, which was all that remained to complete the connection between the latter series and the Calcutta Meridional. When this was done, a much larger linear closing error was found than had been met with on any previous occasion. Investigation led to the discovery that the stations from which Mr. Peyton commenced operations, and at least one of those on which he had closed, had deflected considerably since they were built.

The deflections in these instances, and their influence on the lengths of the sides of the triangles, were calculated under the instructions of Sir Andrew Waugh the then Surveyor General and Superintendent of the Great Trigonometrical Survey—who caused the following record of them to be introduced into the Preliminary General Report of the North-East Longitudinal Series.

> At Bulákípur the upper surface of the pillar was found inclined to the horizon 0·84 inches in 4·192 feet (the diameter of the pillar) in azimuth 226° 36′. The height of the tower is 30 feet, whence 4·19 : 30::0·84 : 6·01 inches, the total quantity by which the pillar is inclined out of the vertical. The azimuth of Madanpur is 0° 52′; consequently the effect in augmenting this side may be equal to 4·2 inches.
>
> By following a similar process at Madanpur station, the side Bulákípur to Madanpur is found to have probably diminished by 1·3 inches, during the interval which occurred prior to Mr. Peyton's visit in 1849.
>
> Similarly too, the tower at Harpur indicates an augmentation in the side Barháta to Harpur of 1·7 inches; while the same side, from an examination of the tower at Barháta, was probably augmented by 9·1 inches. These changes occurred between May 1846 and May 1849.*

It may here be repeated that a considerable majority of the tower stations were erected on level plains, and that these plains are liable to be flooded with water during the Indian monsoons and rainy seasons. The water often lies on the ground for a long time, and it may do much damage to lofty buildings, by sinking into their foundations and causing irregular settlement of the superstructure. The central masonry pillar when surrounded by an earthen platform, as is generally the case, is liable to deflection not only from this cause, but because of the pressure to which it is subjected on one side, when the earthwork bears against it.

For many years this evil was not suspected, because—as already explained—most of the towers were constructed rudely and irregularly by common native artificers and village labourers, and there was always a doubt whether deviation from verticality was due to actual deflection or to the primary faults of construction. But eventually the magnitudes of the closing errors on base-lines of triangulations carried over these tower stations, as compared with triangulations carried over the hill stations, made it only too evident that deflections must have occurred at some of the towers.

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* Para 34 of Introduction to General Report—in manuscript—of the North-East Longitudinal Series, 1861.

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The influence of such deflections would obviously not be operative on the triangulations when the whole of the observations to and from any station were taken in immediate succession, as usually happened during the progress of the observations in each field season. But it might have operated very materially in the interval between the closing observations of one field season and the initial observations of the next, for they were separated by a rainy season; still more might it have acted during a suspension of the observations on any series of triangles for several years, or in any long interval between the connection of any two contiguous series.

Now on the North-East Longitudinal Series, by which the northern extremities of all the meridional series are tied together, there are two sides between pairs of stations at which three rainy seasons, one at which two, and five at which one rainy season intervened before the stations were revisited for the completion of the observations; and of course in each series there are one or more pairs of stations at and to which half the observations were taken before and the remainder after a rainy reason, as the completion of each series occupied rarely less than three years. In this circumstance therefore there is sufficient reason to attribute the magnitudes of the closing linear errors of the triangulation to the deflection of certain of the tower stations, as will be shown more fully in Section 1 of Chapter III.

It is impossible to trace the loci of the errors, and to determine the amount of deflection in each instance, with any degree of certainty. The preceding calculations have some probability; but they are based on the assumption that the surfaces of the pillars were made truly horizontal in the first instance, which very possibly may not have been the case. Sir Andrew Waugh says of them that though they "show that in these instances at least deflection did "take place, yet it is not possible to assign any but conjectural corrections on this account. "Corrections of such a nature are inadmissible, and hence a general dispersion of the error "throughout the series [for the preliminary reduction] has been preferred."

This tendency to deflection led to the introduction—about the year 1852—of towers with central masonry pillars perforated vertically, and having vaulted passages leading to the ground level mark-stone in the basement. Very few such towers and pillars exist in the North-East Quadrilateral, excepting on the Budhon Series—the oldest of all but instrumentally the least valuable, where a hollow core was adopted in the first instance, unfortunately to be set aside subsequently—and in the modern series which form the eastern extension of this Quadrilateral. On the other hand very few solid pillars, which are at all likely to have become deflected during the operations, are to be met with in the North-West and none in the South-East Quadrilateral. For these reasons, and also because of the general superiority of the instruments with which the principal angles of the two last mentioned Quadrilaterals were measured, the final reduction of the North-East Quadrilateral was set aside to be taken up after the completion of the final reduction of the two contiguous Quadrilaterals.

For further details of the constructions of the stations, and drawings of Colonel Everest's towers on the Great Arc and of the latest form of tower, see Section 4 of Chapter II, and Plates 1 and 2, of Volume II; see also the introductory remarks to the Descriptions of Stations for each Series, in this and the following volume.

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CHAPTER II.

THE MEASUREMENT OF THE ANGLES AND THE GENERAL PRINCIPLES FOLLOWED IN THE REDUCTION OF THE TRIANGULATION OF THE NORTH-EAST QUADRILATERAL.

1.

The Measurement of the Horizontal Angles and their Record.

In Chapter IV of Vol. II full particulars have been given of the methods of observing both the horizontal and the vertical angles which have been in practice since the year 1823. It will not be necessary therefore to do more here than briefly indicate what was done, in order that the reader may be enabled to understand the details of the observations.

The method of observing horizontal angles was that introduced by Colonel Everest, and had for its object the giving of readings at equal intervals round the azimuthal circle, with a view to the cancellation of periodic errors of graduation. When the instrument was set up for use, and had been properly centred over the station mark and levelled, either one of the surrounding stations, or a referring mark specially set up for the purpose, was adopted as what is called the *zero-station*, or the station for which the readings of the instrument are obligatory. The telescope being directed to this station, the index was made to read 0° 0′. The remaining stations were then observed to in succession, two or more rounds of observations being taken. When these were completed the telescope was turned over in altitude and brought round in azimuth to point to the *zero-station*: the index would then read 180° 0′. With this zero-reading another set of observations, similar to the last, was taken. A single measure on each of the two zero-settings constitute a pair of collimated observations, the face of the vertical circle being to the left of the observer at one setting and to his right at the other. The instrument was next shifted in azimuth, so as to bring the index to another arbitrary reading while the telescope pointed to the zero-station, and observations were again taken on F. L., face left, and F. R., face right; and so on. These arbitrary shifts were through arcs of 9° or 10° for theodolites with 3 microscopes and 7° 12′ for 5 microscope theodolites. In 1860, in order to secure a greater change of position of the axis in its socket, and so avoid the occurrence of certain constant errors which might be prejudicial in a long chain of triangles, Colonel Waugh decided that the arc between the microscopes should be added to each shift.

The systems of zero-settings for the triangulation of the North-East Quadrilateral varied a good deal; certain modifications also were introduced by Colonel Waugh to counteract special defects in some of the instruments which were of inferior construction, but which had to be employed, because the number of first class instruments then available was too few to meet

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the wants of the department. It had been found by experience that some of the theodolites gave the best results—as indicated by the triangular errors—when two zero-stations about 60° apart were employed and the number of settings on each zero-station was reduced by half, leaving the total number of observations the same as before. Colonel Waugh—see Appendix No. 5 of Vol. II—accordingly directed that when these instruments were employed, half the observations should be taken with settings on one station and half with settings on another giving readings about 60° from the former; or, if the situation of the surrounding stations did not admit of this, the first zero-station was to be again employed with zero-settings differing by exactly 60° from those previously adopted. One other modification was introduced by Captain Shortrede on the Karára Meridional Series, when observing with Troughton and Simms' 18-inch theodolite No. 1. Finding that it gave widely different* values of the angles on different faces, he doubled the number of zero-settings and took means of the readings on opposite faces; these means he recorded as single measures; moreover he only took one round of observations on each setting. The following table exhibits the zero-settings employed for each instrument on each series.

Instrument and	Season	Series	Zeros No.	Zeros Settings	No. of Microscopes	No. of Rounds
Troughton & Simms' 36-inch,	1846-47, 1847-48	N.E. Longitudinal	8	$\frac{0^\circ}{180^\circ}, \frac{9^\circ}{189^\circ}$, &c.	5	2
	1863-64	Rangír	10	$\frac{0^\circ}{180^\circ}, \frac{79^\circ 12'}{259^\circ 12'}$, &c.	„	3
Barrow's 36-inch,	1845-46	Chendwár	6	$\frac{0^\circ}{180^\circ}, \frac{12^\circ}{192^\circ}$, &c.	5	2
	„	„	8	$\frac{0^\circ}{180^\circ}, \frac{9^\circ}{189^\circ}$, &c.	„	„
	„	N.E. Longitudinal	6	$\frac{0^\circ}{180^\circ}, \frac{12^\circ}{192^\circ}$, &c.	„	„
	„	„	8	$\frac{0^\circ}{180^\circ}, \frac{9^\circ}{189^\circ}$, &c.	„	„
	1846-47	„	6	$\frac{0^\circ}{180^\circ}, \frac{12^\circ}{192^\circ}$, &c.	„	„
	„	„	8	$\frac{0^\circ}{180^\circ}, \frac{9^\circ}{189^\circ}$, &c.	„	„
	1848-49	„	„	„ „	„	„

* These large differences were subsequently traced to periodic errors of graduation which were eliminated by taking the mean of a pair of observations on opposite faces. See pages 98 to 109 of the Appendices to Volume II.

Instrument and	Season	Series	Zeros No.	Zeros Settings	No. of Microscopes	No. of Rounds
Troughton & Simms' 24-inch No. 2,	1849-50	N.E. Longitudinal	12	$\frac{0^\circ}{180^\circ}, \frac{10^\circ}{190^\circ}$, &c.	3	2
	1862-63 to 1866-67	E. Calcutta Longitudinal	10	$\frac{0^\circ}{180^\circ}, \frac{79^\circ\ 12'}{259^\circ\ 12'}$, &c.	5	3
	1868-69 to 1873-74	Brahmaputra	„	„ „	„	„
Barrow's 24-inch No. 1,	1848-49	N.E. Longitudinal	12*	$\frac{0^\circ}{180^\circ}, \frac{20^\circ}{200^\circ}$, &c.	3	2
	1850-51 & 1851-52	N. Párasnáth	„*	„ „	„	2
	1854-55 to 1859-60	Assam Longitudinal	10	$\frac{0^\circ}{180^\circ}, \frac{7^\circ\ 12'}{187^\circ\ 12'}$, &c.	5	3
	1859-60	E. Frontier, Section 23° to 26°	„	„ „	„	„
	1860-61 to 1863-64	„	„	$\frac{0^\circ}{180^\circ}, \frac{79^\circ\ 12'}{259^\circ\ 12'}$, &c.	„	„
Barrow's 24-inch No. 2,	1850-51 & 1851-52	Huríláong	12	$\frac{0^\circ}{180^\circ}, \frac{10^\circ}{190^\circ}$, &c.	3	2
Waugh's 24-inch No. 1,	1846-47	Gurwáni	8	$\frac{0^\circ}{180^\circ}, \frac{9^\circ}{189^\circ}$, &c.	5	2
	1850-51	N.E. Longitudinal	10	$\frac{0^\circ}{180^\circ}, \frac{7^\circ\ 12'}{187^\circ\ 12'}$, &c.	„	2
	1868-69	Chendwár	„	$\frac{0^\circ}{180^\circ}, \frac{79^\circ\ 12'}{259^\circ\ 12'}$, &c.	„	3
Waugh's 24-inch No. 2,	1850-51 & 1854-55	N.E. Longitudinal	10	$\frac{0^\circ}{180^\circ}, \frac{7^\circ\ 12'}{187^\circ\ 12'}$, &c.	5	2
	1853-54	Assam Longitudinal	„	„ „	„	3

* Two zero-stations were employed.

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Instrument	Season	Series	Zeros No.	Zeros Settings	No. of Microscopes	No. of Rounds
Troughton and Simms' 18-inch No. 1,	1833-34 to 1837-38	Amúa	12	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	3	2
	1842-43 & 1843-44	Karára	24	$\frac{0°}{180°}, \frac{5°}{185°}$, &c.	„	1
	1844-45 to 1847-48	Calcutta Meridional	12	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	„	2
	1848-49	Huríláong	„	„ „	„	„
Troughton & Simms' 18-inch No. 2,	1838-39	Amúa	12	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	3	2
	1840-41 & 1841-42	Budhon	„	„ „	„	„
	1843-44 & 1844-45	Chendwár	„	„ „	„	„
	1844-45	N. Malúncha	„	„ „	„	„
	1849-50	Huríláong	„	„ „	„	„
Saiyad Mir Mohsin's 18-inch,	1844-45	Karára	12	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	3	2
	1845-46	Gurwáni	24*	„ „	„	„
	„	„	12	„ „	„	„
	„	„	„*	$\frac{0°}{180°}, \frac{20°}{200°}$, &c.	„	„
	„	„	18†	„ „	„	„
Cary's 18-inch M O,	1837-38 & 1838-39	Rangír	12	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	3	2
	1844-45	Karára	„	„ „	„	„
Cary's 18-inch L,	1833-34 & 1836-37	Rangír	12	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	3	2

* Two zero-stations were employed. † Three zero-stations were employed.

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Instrument and Season		Series	Zeros No.	Zeros Settings	No. of Microscopes	No. of Rounds
Cary's 15-inch,	1842-43	Budhon	12	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	3	2
	1843-44 to 1845-46	N. Malúncha	,,	,, ,,	,,	,,
	1845-46	N.E. Longitudinal	,,	,, ,,	,,	,,
Harris and Barrow's 15-inch,	1832-33	Budhon	12	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	3	2
	,,	,,	24	$\frac{0°}{180°}, \frac{5°}{185°}$, &c.	,,	,,
	1832-33 & 1833-34	,,	24*	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	,,	2 & 1
	1833-34	,,	12	,, ,,	,,	1
	1836-37	,,	10	$\frac{0°}{180°}, \frac{12°}{192°}$, &c.	,,	2
	1839-40 & 1840-41	Rangír	12	$\frac{0°}{180°}, \frac{10°}{190°}$, &c.	,,	,,
	1844-45	Karára	,,	,, ,,	,,	,,
	1845-46 & 1846-47	Gora	,,	,, ,,	,,	,,

The minimum number of rounds of observation on each zero was two in the greater portion of the work and three in the rest, with the exception of Captain Shortrede's observations on the Karára Meridional Series with Troughton and Simms' 18-inch No. 1, and one season's work by Lieutenant MacDonald on the Budhon Series, where only one round of observations on each zero was taken. When larger differences shewed themselves in successive measures of an angle than it was considered the instrument ought to give, the observations were repeated. For full particulars of each instrument and any modifications it may have undergone, see Appendix No. 2 of Vol. II.

The manner in which the observations are usually recorded at the time of observation has been explained at page 66 of Volume II. Here we are only concerned with the Abstracts which are prepared from these observations, for publication as part of the necessary details

* Two zero-stations were employed.

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of the operations of this Survey. For many years it was the custom at the completion of each series to prepare a manuscript report, in triplicate, in which all details that were required to be kept on record were entered. In these reports, for five of the series—*viz.*, the Budhon, Rangír, Amúa, Karára and Gurwáni—only the means of the measures of each angle on each zero are given, with a number shewing of how many measures they are the means; for the other series, the several measures on each zero are exhibited, and against each measure is a letter in italics shewing whether the signal observed to was *l* a lamp, or *h* a heliotrope. Below the groups of measures on each zero are their means, and from these the general mean is obtained, and also its *probability of error*, as calculated by the formulæ which are given in the next section. When the publication of the details of the operations of this Survey was taken in hand, it was judged expedient to accept the original Abstracts—supplementing them where necessary with information as to the observer, date of observation and instrument—rather than incur the labour and expense of preparing new ones in the form which was afterwards adopted and is now always employed. In the modern form the several measures are entered and treated—as will be described in the next section—so as to give *C*, the *concluded angle*, together with *w* its weight relative to other angles measured with the same instrument, also $\frac{1}{w}$ —the reciprocal of the weight—which is most frequently used in the subsequent calculations.

The Abstracts of the Observed Angles of each Series in this Quadrilateral will be found respectively at pages 25—$_I$, 11—$_J$, 10—$_K$, 9—$_L$, 11—$_M$, 9—$_N$, 9—$_O$, 9—$_P$, 9—$_Q$, 7—$_R$, 7—$_S$, 11—$_T$, 11—$_U$, 11—$_V$, 11—$_W$ and 11—$_X$ of this and the following volume.

2.

The Deduction of an Angle from its several Measures. The Probabilities of Error and the Weights

In the last section it has been shewn that for the angles of some series the general mean only of the several measures on each zero has been given in the Abstracts, and for others an additional value called the *concluded angle* is added. The value of the angle is invariably accompanied by a theoretical measure of precision which, in the former case, is called the *probability of error*, and in the latter the *weight* of the angle.

Prior to the year 1862 the adopted values of the observed angles were the arithmetical means of the zero-means; their so-called *probabilities of error* were usually calculated by the formula

$$P = \sqrt{\frac{D_1^2 + D_2^2 + \ldots + D_z^2}{Z}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

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D_1, D_2, . . . being the differences between the several zero-means and the mean of all, or the general mean, and Z being the number of zeros on which the angle was measured. This formula, which was introduced by Colonel Everest, was in 1853 modified by Colonel Waugh who employed

$$P = \frac{D_1^2 + D_2^2 + \ldots + D_z^2}{\frac{1}{2} Z^2} \quad \ldots \ldots \ldots \ldots \quad (2)$$

but only for about three years, after which the original formula was reverted to*. The *probability of error* of old writers is not to be confounded with the more modern *probable error*, which—when deduced from the evidence of the differences between zeros only, neglecting the differences between the several observations on each zero—is

$$p.e. = \pm \cdot 6745 \sqrt{\frac{D_1^2 + D_2^2 + \ldots + D_z^2}{Z(Z-1)}} \quad \ldots \ldots \ldots \quad (3)$$

The value of the 'probable error' may be calculated with considerable precision by this formula when the same number of observations are taken on each zero—or equidistant part of the azimuthal circle—and all the observations are of equal weight, and when the graduation errors of the circle are accidental and not periodic. Periodic errors of graduation may exist which are not cancelled in the respective zero-means, but are cancelled in the mean of all the zeros; and when this happens, the differences, D, may be very considerable, and the value of the *p.e.* of the general mean which is computed on the basis of those differences, may be largely erroneous in excess, as has been shown at page 96 of Vol. II. But the graduation errors of almost all the great theodolites of this Survey are most probably accidental, and therefore the influence of periodicity may generally be disregarded. It then remains to take cognisance of the circumstance that not unfrequently more observations have been made on certain zeros than on others. Consequently in 1863, Colonel Walker introduced a formula for the calculation of the most probable value of an angle from the several zero-means, combined together with their respective *weights*, in which both the errors of observation and those of graduation—assumed to be non-periodic—are taken into consideration; the angle so obtained is called the *concluded angle*. This formula is as follows:—

Let d', d'', d''', &c., be the differences between the successive single measures and the mean of the measures on the zero to which they respectively belong, n_1, n_2, n_3, &c., the number of measures on each zero, the sum of which is equal to N, and D_1, D_2, D_3, &c., the algebraical excesses of the successive zero-means, Z in number, over the arithmetical mean, M, of all the zeros.

Now put

$$o^2 = \frac{d'^2 + d''^2 + d'''^2 + \ldots}{N-1} \quad \ldots \ldots \ldots \ldots \quad (4)$$

$$g^2 = \frac{D_1^2 + D_2^2 + D_3^2 + \ldots}{Z-1} \quad \ldots \ldots \ldots \ldots \quad (5)$$

* See page 85 of Volume II.

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and

$$\mathrm{w}_1 = \frac{1}{g^2 + \frac{o^2}{n_1}}, \quad \mathrm{w}_2 = \frac{1}{g^2 + \frac{o^2}{n_2}}, \quad \mathrm{w}_3 = \frac{1}{g^2 + \frac{o^2}{n_3}}, \quad \&c. \quad \ldots \ldots \quad (6)$$

then the *concluded angle*, *C*, is determined from the equation

$$C = M + \frac{\mathrm{w}_1 D_1 + \mathrm{w}_2 D_2 + \mathrm{w}_3 D_3 + \ldots}{\mathrm{w}_1 + \mathrm{w}_2 + \mathrm{w}_3 + \ldots} \quad \ldots \ldots \quad (7)$$

Here o* and g are taken as preliminary approximations to the theoretical *error of mean square* of observation and graduation, o being the *e.m.s.* of observation and g that of graduation in a single measure of an angle; these quantities being known, the *weights*, w_1, w_2, . . . of the successive zero-means are ascertained, whereby these means are readily combined to give the value of the Concluded Angle, as in the last equation. The weight, w, of the angle thus deduced is

$$w = \mathrm{w}_1 + \mathrm{w}_2 + \mathrm{w}_3 + \quad \ldots \ldots \quad (8)$$

and if the preliminary values of o and g, as obtained from the observations, are absolutely true, then w will be the reciprocal of the square of the *e.m.s.* of the concluded angle.

But it has already been shewn in Chapter VII of Vol. II that there is reason to doubt whether any values of the *e. m. s.* which may be obtained immediately from the observations, are true for angles measured with different instruments, or even for angles measured with the same instrument but under different circumstances. All values determined from the observations are therefore regarded as preliminary, applicable only in any combination of angles which have been measured with the same instrument and under similar circumstances, but requiring to be multiplied by factors of the nature of *moduli*, before they can be employed in a combination of angles which have been measured with different instruments and under different circumstances. The value of the *modulus* for each group of angles measured under common conditions has therefore to be determined subsequently, from investigations of the average value of the *e.m.s.* for the group, on the evidence which is furnished by the magnitudes either of the geometrical errors of single triangles, or of the most probable values of the errors of the angles of polygonal figures, which appertain to the group, or may be legitimately combined together for the purpose in question. This is done in the following manner:—

Let e_1, e_2 and e_3 be the average *e.m.s.* of a group of angles—observed with the same instrument and under similar circumstances—deduced as follows:—e_1 from the preliminary weights, e_2 from the triangular errors and e_3 from the most probable errors of the angles of polygonal figures; then

* Strictly speaking the denominator in the expression which gives the value of o would be $N-Z$; but a larger denominator, as N or $N-1$, is preferable in the present instance, because o is combined with g which, strictly speaking, would represent the total error and not that of graduation only, if each measure were absolutely independent of all the others, which it is not. Thus, though the denominator $N-1$ was originally employed by an oversight, as I may here frankly acknowledge, it has been retained as more appropriate than $N-Z$ under existing circumstances.

J. T. W.

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first, for the average *e.m.s.* of n angles of which the preliminary weights are w_1, w_2, . . . w_n

$$e_1^2 = \frac{n}{w_1 + w_2 + \ldots + w_n} \quad \ldots\ldots \quad (9)$$

secondly, for the average *e.m.s.* of n angles of $\frac{n}{3}$ triangles

$$e_2^2 = \frac{\text{Sum of squares of } \frac{n}{3} \text{ triangular errors}}{n} \quad \ldots\ldots \quad (10)$$

and *thirdly*, for the *e.m.s.* of a hypothetical angle, whose weight w is equal to the mean of the weights $w_1, w_2, w_3, \ldots$ of t angles of a polygonal figure in which there are m geometrical equations of condition

$$e_3^2 = \frac{w_1 x_1^2 + w_2 x_2^2 + \ldots + w_t x_t^2}{w\, m}$$

where $x_1, x_2, \ldots x_t$ are the most probable values of the errors of the observed angles. But since the polygonal figures which are commonly employed in the operations of this Survey, contain too few angles to give a satisfactory determination of the value of e_3 from the evidence of a single figure, the value is determined from several figures by the expression

$$e_3^2 = \frac{\text{Sum of } (U \div w)}{\text{Sum of } m} \quad \ldots\ldots \quad (11)$$

for all the figures available. In this expression

$$U = w_1 x_1^2 + w_2 x_2^2 + \ldots + w_t x_t^2$$

and is the quantity which is made a minimum in the reduction of each figure. Its numerical value may be readily computed; see Vol. II pages 106 and 198, also the end of the next section of this chapter.

Values of e_1, e_2 and e_3 having thus been found, corresponding values of the modulus ρ^2, taken either as

$$\rho = \frac{e_1}{e_2}, \text{ or } = \frac{e_1}{e_3},$$

as the case may be, are determined, the preference being given to the latter whenever e_3 is available.

Thus putting w_f for the final weight, and w for the average preliminary weight by e_1, we have

$$w_f = w\left(\frac{e_1^2}{e_2^2} \text{ or } \frac{e_1^2}{e_3^2}\right) = w\,\rho^2 \quad \ldots\ldots \quad (12)$$

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Now for a considerable number of the angles of the North-East Quadrilateral we have—for reasons already explained at the end of the preceding section—'probabilities of error' calculated by the first of the two formulæ already indicated, the second not having been made use of in this Quadrilateral. In the reductions of all the triangles and polygonal figures containing these angles, P^2, or the square of the 'probability', has been employed in place of $\frac{1}{w}$, the reciprocal of the preliminary weight, which has been employed in the reductions of the modern triangulation. Afterwards, when the Simultaneous Reduction of the whole Quadrilateral was taken in hand, it became necessary to form values of e_1 from the adopted 'probabilities of error' for the old angles, for which 'probabilities' had been given instead of preliminary weights, and then to proceed to determine the modulus ρ and the final or absolute weight from the evidence of e_2 or e_3, precisely in the same manner as they are determined for the modern angles. Thus the whole of the weights were brought to a common standard of precision before the Simultaneous Reduction was commenced.

The modulus ρ was determined for each group of angles immediately before the Simultaneous Reduction of the whole triangulation, as it was then first wanted.

For those series of which the observed angles have been treated by the formula of 1863 there will be found at the end of the abstracts of the measures of the angles, lists of the "Sums of Squares of Apparent Errors of Single Observations and of Apparent Errors of Single Zeros", which furnish the requisite data for the investigations, by which they are followed, of the average 'error of mean square' of observation only in a single measure, and that of graduation *plus* observation in the mean of several measures on a single zero; these are determined for certain groups of the angles in which all the measures have been made by the same observer with the same instrument and under the same conditions, and also for groups formed by various other combinations of the conditions. With the data thus obtained for each of the several series, investigations of the influence of "Mixed Errors of Observation and Graduation" similar to those which are given in Chapter VII of Vol. II may be made.

3.

Preliminary Reductions of the Groups of Angles contained in independent Trigonometrical Figures.

So long as chains of triangles are treated as independent of one another, the angles naturally separate themselves into as many groups as there are single triangles, and combinations of triangles into single polygonal figures and net-works. Every triangle is subject to the geometrical condition that the three angles are equal to 180° *plus* the spherical excess, and every group of triangles to additional geometrical conditions, such as that the angles at any

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central point should together equal 360°, and that the value of any side as calculated through any portion of the figure back to itself should be unaltered.

The formula which has been employed for calculating the spherical excess of the triangles in these volumes is

$$\epsilon = a\,b \sin C \times \frac{\text{cosec } 1''}{2r^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

in which ϵ is the spherical excess in seconds, a, b and C two sides of the triangle and the included angle, and r the radius of the sphere with the surface of which the spherical triangles may be considered most nearly to coincide. Up to the year 1851, the value which was adopted for r was ν, the normal to the meridian in latitude λ corresponding to the middle latitude of the triangle. From 1851 to 1868, r was taken as $\frac{1}{2}(\nu+\rho)$, ρ being the radius of curvature to the meridian in latitude λ. Since 1868, r has been taken equal to the radius of curvature at λ of an oblique section passing through the centre of the spheroid and having an azimuth of 45° or $r = \frac{2\rho\nu}{\rho+\nu}$. The last two values give practically the same results if the calculations have not to be carried beyond the 5th place of decimals of logarithms. The first was, however, used in obtaining the spherical excesses of the greater portion of the triangulation of this Quadrilateral, *viz.*, of all the triangles of the series I to T inclusive. Before undertaking the Simultaneous Reduction of the Quadrilateral it was necessary to change these spherical excesses to what they would be by the latest formula. To do this accurately it would have been necessary to multiply each by the factor $\frac{(\rho+\nu)^2}{4\rho^2}$ corresponding to the value of λ for which it had been calculated. But as this factor was 1·0056 for latitude 24° and only 1·0050 for latitude 30°, and the spherical excesses were only calculated to two places of decimals of seconds, the factor for 27°, *viz.*, 1·0053* was employed.

The geometrical conditions connecting groups of angles divide themselves under three heads, *triangular*, *central* and *side*. The first is, as before stated, that the three angles of a triangle must equal 180° + the spherical excess, the second that all the angles meeting at a point and completely surrounding it must equal 360°, or when an angle is measured as a whole and also in parts, the whole should equal the parts, and the third springs from the condition

---

* It has appeared from subsequent calculations that this method of treating the spherical excesses was not sufficiently accurate to produce results exactly re-entering; for when the usual check calculations for azimuth were carried separately along either flank of a chain of triangles, they exhibited differences at the end of the chain which could only be due to the spherical excesses employed being generally too small. The mean latitudes of two only of the Series are as much as 27°; those of the other Series range as low as 25°, and for them a larger factor should have been employed. The spherical excesses being generally too small, the azimuth by the right hand flank will be too small, because, at any station, in deducing every forward azimuth from the backward azimuth it is necessary to add the included spherical angles. In a similar manner the azimuth by the left hand flank will be too large because the included angles are subtracted. The results by the two flanks which should have been identical, exhibited discrepancies ranging from 0''·018 to 0''·131. The result by the right hand flank was maintained in each instance.

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that the value of any side carried through the triangulation back on itself should reproduce itself. The excesses or deficiencies which manifest themselves in these comparisons either form the right hand members of the equations amongst the angular errors furnished by the conditions, or they furnish the means for so doing.

The number of the equations for each independent trigonometrical figure is given by the formula

$$N - 2S + 4 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

in which N is the number of angles and S the number of stations.

In order to express the equations, denote the observed angles by $X_1, X_2, X_3, \ldots$ the corresponding angular errors by $x_1, x_2, x_3, \ldots$ and the absolute terms of the equations by e with subscripts denoting the equations to which they appertain. The triangular and central equations will then take the form

$$x_1 + x_2 + \ldots = e \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

Further, if $a_1 = \cot X_1$, $a_2 = \cot X_2$, &c., the side equations will be represented by

$$a_1 x_1 - a_2 x_2 + a_3 x_3 - a_4 x_4 + \ldots = \frac{\operatorname{cosec} 1''}{\mathrm{M}} \times \log \frac{\sin X_1 . \sin X_3 \ldots}{\sin X_2 . \sin X_4 \ldots} \text{*}$$

$$= e \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

M being the modulus of common logarithms.

These geometrical conditions have to be satisfied in such a manner, that the angles shall receive the most probable of the several systems of correction which present themselves. This is done by the so called method of solution by minimum squares, which is now so well known that nothing need be said regarding it, further than that it requires the following expression to be made a minimum,

$$U = \frac{x_1^2}{u_1} + \frac{x_2^2}{u_2} + \ldots + \frac{x_t^2}{u_t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (17)$$

---

* The form of the side equation has of late been slightly altered, and tabular differences of log.sines for a change of 1″ have been employed in place of cotangents, by which a saving of labour is obtained. This is no new form of equation, but it was not at first employed in the calculations of this Survey. It is derivable from the old form; for M cot X sin 1″ = tabular difference of log. sin X for 1″, hence if we write a for t.d. log. sin X for 1″ the equation becomes

$$a_1 x^1 - a_2 x_2 + a_3 x_3 - a_4 x_4 + \ldots = \log . \frac{\sin X_1 . \sin X_3 \ldots}{\sin X_2 . \sin X_4 \ldots}$$

$$= e$$

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in which $u_1, u_2, \ldots u_t$ are the reciprocals of the weights, $w_1, w_2, \ldots w_t$, of the observed angles.

The following equations—taken from Section 5, Chapter VIII, Vol. II—express first the geometrical conditions, secondly their relations with the indeterminate factors, $\lambda_a, \lambda_b, \ldots \lambda_n$, by the introduction of which U is made a minimum, and thirdly the most probable values of the angular errors in terms of the geometrical conditions and the indeterminate factors.

The geometrical equations of condition, n in number between t unknown quantities, are

$$\left.\begin{array}{l} a_1 x_1 + a_2 x_2 + \quad \ldots \quad + a_t x_t = e_a \\ b_1 x_1 + b_2 x_2 + \quad \ldots \quad + b_t x_t = e_b \\ \ldots\ldots\ldots\ldots\ldots \\ n_1 x_1 + n_2 x_2 + \quad \ldots \quad + n_t x_t = e_n \end{array}\right\} \quad \ldots\ldots \quad (18)$$

The equations between the indeterminate factors are

$$\left.\begin{array}{l} [aa.\,u]\,\lambda_a + [ab.\,u]\,\lambda_b + \quad \ldots \quad + [an.\,u]\,\lambda_n = e_a \\ [ab.\,u]\,\lambda_a + [bb.\,u]\,\lambda_b + \quad \ldots \quad + [bn.\,u]\,\lambda_n = e_b \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ [an.\,u]\,\lambda_a + [bn.\,u]\,\lambda_b + \quad \ldots \quad + [nn.\,u]\,\lambda_n = e_n \end{array}\right\} \quad \ldots\ldots \quad (19)$$

in which the brackets [ ] indicate summations, thus

$$[aa.\,u] = a_1 a_1.\,u_1 + a_2 a_2.\,u_2 + \quad \ldots \quad + a_t a_t.\,u_t.$$

The resulting values of the angular errors are

$$\left.\begin{array}{l} x_1 = u_1\,(a_1\,\lambda_a + b_1\,\lambda_b + \ \ldots \ + n_1\,\lambda_n) \\ x_2 = u_2\,(a_2\,\lambda_a + b_2\,\lambda_b + \ \ldots \ + n_2\,\lambda_n) \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ x_t = u_t\,(a_t\,\lambda_a + b_t\,\lambda_b + \ \ldots \ + n_t\,\lambda_n) \end{array}\right\} \quad \ldots\ldots \quad (20)$$

and the value of the minimum, U, is

$$\lambda_a e_a + \lambda_b e_b + \ldots + \lambda_n e_n \quad \ldots\ldots\ldots\ldots \quad (21)$$

In the case of a single triangle—one which does not enter with other triangles into

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the formation of a polygonal figure—there is only one geometrical equation of condition which is simply

$$x_1 + x_2 + x_3 = e \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (22)$$

and there is only one indeterminate factor, λ, which from (19) is

$$\lambda = \frac{e}{u_1 + u_2 + u_3} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (23)$$

and by (20)

$$x_1 = u_1 \lambda, \qquad x_2 = u_2 \lambda, \qquad x_3 = u_3 \lambda \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (24)$$

It should be noted that u stands for the reciprocal weight, $1 \div w$, of the angles of the North-East Quadrilateral for which the weights are given in the abstracts of the observed angles for each series, and for the square of the probability, P^2, of the angles for which the probabilities are given.

4.

Calculation of the Sides of the Triangles.

The values of the angular errors having thus been computed are applied to the observed angles with contrary signs; the angles of every triangle are then reduced to plane angles by the subtraction of one-third of the spherical excess of the triangle from each, and the sides of the triangles are obtained in the ordinary manner. The angular corrections furnished by the figural reductions, besides being the most probable, in so far as the conditions to which they have been subjected are concerned, render each figure or net of triangles consistent, so that the ratio of any one side to any other side is the same by whatever route it is calculated.

5.

Geodetic Elements of Stations and Sides.

The lengths of the sides of triangles and the dimensions of the Figure of the Earth being known, it will be evident that if the latitude of any one station and the azimuth of any side of the triangulation from it to a second station are given, the difference in latitude and longitude between it and the second station, and the back azimuth of the connecting side, may be computed.

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Now the origin of co-ordinates which has been adopted for the Indian triangulation is Kaliánpur, Station 1 of the North-West Quadrilateral, the initial elements at which are

Latitude North	24° 7′ 11″·26
Longitude E. of Greenwich	77 41 44·75
Azimuth of Station 29 (Súrentál)	190 27 5·10

as explained in Chapter XI of Vol. II.

But since the positions of all the stations of the North-West and South-East Quadrilaterals are regarded as having been finally fixed in the Simultaneous Reductions of those figures, the elements of any of them may be adopted in place of those of Kaliánpur, whenever it happens to be convenient to do so. Thus, as many of the series of the North-East Quadrilateral are based on sides of the Calcutta Longitudinal Series, one of the series of the South-East Quadrilateral, the elements of those sides have been adopted as the initial elements of the North-East Quadrilateral. Two of the series of the latter Quadrilateral also close on sides of the section of the Great Arc which appertains to the North-West Quadrilateral, and the elements of these sides might equally well have been considered initial elements.

The formulæ which have been employed on the successive calculations of latitude longitude and reverse azimuth are given below.

If A and B be two stations on the earth's surface, and the latitude and longitude of A, and the azimuth of B at A be λ, L and A respectively, the distance between A and B being c, and if

$\Delta\lambda$ denote the difference of latitude between A and B
ΔL „ „ longitude „
B „ azimuth of A at B
$\Delta A = B-(\pi+A)$
e „ the excentricity of the spheroid
ρ „ the radius of curvature to the meridian at λ
ν „ the normal to the meridian at λ terminated by the minor axis,

then

$$\Delta\lambda = \left\{\begin{array}{l} -\frac{c}{\rho}\cos A \operatorname{cosec} 1'' \\ -\frac{1}{1.2}\frac{c^2}{\rho.\nu}\sin^2 A \tan\lambda \operatorname{cosec} 1'' \\ -\frac{3}{4}\frac{c^2}{\rho.\nu}\frac{e^2}{1-e^2}\cos^2 A \sin 2\lambda \operatorname{cosec} 1'' \\ +\frac{1}{1.2.3}\frac{c^3}{\rho.\nu^2}\sin^2 A\cos A\,(1+3\tan^2\lambda) \operatorname{cosec} 1'' \end{array}\right\} \quad . . (25)$$

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$$\Delta L = \left\{ \begin{array}{l} -\frac{c}{\nu} \frac{\sin A}{\cos \lambda} \operatorname{cosec} 1'' \\ +\frac{1}{1.2} \frac{c^2}{\nu^2} \frac{\sin 2A \tan \lambda}{\cos \lambda} \operatorname{cosec} 1'' \\ -\frac{1}{1.2.3} \frac{c^3}{\nu^3} \frac{(1+3 \tan^2\lambda) \sin 2A \cos A}{\cos \lambda} \operatorname{cosec} 1'' \\ +\frac{1}{1.2.3} \frac{c^3}{\nu^3} \frac{2 \sin^3 A \tan^2 \lambda}{\cos \lambda} \operatorname{cosec} 1'' \end{array} \right\} \quad . \; . \; . \quad (26)$$

and

$$B = \pi + A + \left\{ \begin{array}{l} -\frac{c}{\nu} \sin A \tan \lambda \operatorname{cosec} 1'' \\ +\frac{1}{4} \frac{c^2}{\nu^2} \left\{ 1 + 2 \tan^2\lambda + \frac{e^2 \cos^2\lambda}{1-e^2} \right\} \sin 2A \operatorname{cosec} 1'' \\ -\frac{c^3}{\nu^3} \left(\frac{5}{6} + \tan^2 \lambda \right) \frac{\tan \lambda}{2} \sin 2A \cdot \cos A \operatorname{cosec} 1'' \\ +\frac{1}{2.3} \frac{c^3}{\nu^3} \sin^3 A \tan \lambda \,(1 + 2 \tan^2 \lambda) \operatorname{cosec} 1'' \end{array} \right\} \quad . \; . \quad (27)$$

For the derivation of these formulæ, and also for the manner in which they have been arranged for calculation, see Chapter IX of Volume II, and the *Auxiliary Tables to facilitate the calculations of the Survey Department of India.*

The values of the elements of the Figure of the Earth which have been employed in the calculations are those known as "Everest's Constants, 1st Set", and are :—

Semi-axis major,	$a = 20,922,932$ feet,	Log = 7·320 6225 4
Semi-axis minor,	$b = 20,853,375$ feet,	„ = 7·319 1763 4
Ellipticity,	$c = \frac{a-b}{a} = \frac{1}{300\cdot80}$	„ = $\bar{3}$·521 7196 8
	$e^2 = \frac{a^2-b^2}{a^2} = 0\cdot0066378$	„ = $\bar{3}$·822 0271 8
	$1 - e^2 = 0\cdot9933622$	„ = $\bar{1}$·997 1076 1

from which ρ and ν are found by the well known formulæ.

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6.

Reduction of the Vertical Angles for the determination of Differences of Height and Co-efficients of Refraction.

The relative heights of the principal stations of this Survey are determined in almost all instances by measuring the reciprocal vertical angles. The heights so obtained are controlled, wherever possible, by connecting the stations of the triangulation with those of lines of Spirit Levels, which are executed by this Survey, and occasionally with Tidal Stations on the coasts of the Peninsula, at which direct determinations of the mean sea level have been made. The formula that was employed for many years in the calculation of differences of height is due to Colonel Everest, and is as follows:—

If h be the difference of height of two stations A and B, D' the depression of B at A and D that of A at B, H the height of A above mean sea level, c the distance between A and B at that level, and r the radius of curvature corresponding to the mean latitude of A and B, then the angle subtended at the lower station by the excess of height of the higher, or the so-called *subtended angle*, is $\frac{1}{2}(D-D')$, and the height of B above or below A is given by the expression

$$h = c\left(1+\frac{H}{r}\right)\frac{\sin\frac{1}{2}(D-D')}{\cos D} \quad \ldots\ldots\ldots \quad (28)$$

according as the result is *plus* or *minus*. If either of the angles is an elevation instead of a depression its value must be employed with the opposite sign to that here given.

In order to use this formula it is first necessary to correct the observed angles for the heights of the observing instrument and observed signal. A much less laborious process is to employ the uncorrected vertical angles, and then reduce the result thus obtained to the levels of the stations by an algebraical combination of the heights of the instruments and signals. This procedure is as follows:—

If i_a, i_b be the heights in feet of the theodolites at A and B respectively
s_a, s_b " signals " "
D_a, D_b be the observed vertical angles, both assumed to be depressions,

and we put

$$\delta = s_a - s_b + i_a - i_b$$

then

$$h = c\left(1+\frac{H}{r}\right)\frac{\sin\frac{1}{2}(D_b - D_a)}{\cos D_b} + \frac{\delta}{2} \quad \ldots\ldots\ldots \quad (29)$$

This formula, though not absolutely rigorous, holds good for all cases that have hitherto occurred or are likely to occur in this Survey.

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For r, the radius of curvature, the same formulæ were at different times employed as in the calculation of spherical excess, see page 26, ρ and ν being taken for the mean latitude of the stations. The changes in the value of r have not, however, been sufficient to cause any appreciable change in the calculated differences of height.

In the preceding formulæ it is assumed that the reciprocal angles are equally affected by refraction, and in order that this may be as nearly the case as possible, the vertical angles in all the more modern operations are generally measured between the hours of 1 and 4 p. m., when the amount of refraction is usually a minimum. But in the earlier operations—especially those on the Budhon, Rangír and Amua Series, and even on the Great Arc—it was thought that the lengths of the sides of the triangles should always be considerable, even in the plains, in order that the number of triangles in each series might be as few as possible; thus the stations were occasionally chosen at such distances from one another as to be only mutually visible when the amount of refraction was very considerable. The custom then was to take the observations at any time when mutual visibility obtained, and frequently during the night when the refraction is usually greatest; reciprocal vertical angles at any two stations were generally measured at the same hour, as nearly as possible, of the day or night; and it was assumed that the refraction at both stations was then the same. In several instances in the earlier operations in this Quadrilateral, reciprocal observations were taken simultaneously by two observers.

The reciprocal angles are also employed to determine the co-efficient of refraction, to be used in reducing unreciprocated vertical angles; for, putting C for the arc between the stations **A** and **B**, or the *contained arc* as it is usually called, and ϕ_a, ϕ_b for the refraction at the respective stations, we have

$$C = D_a + \phi_a + D_b + \phi_b - \beta$$

in which expression

$$\beta = \frac{i_a - s_a + i_b - s_b}{c \sin 1''}.$$

Thus, the mean refraction, ϕ, is given by the expression

$$\phi = \tfrac{1}{2}\{C - (D_a + D_b) + \beta\} \quad \ldots\ldots\ldots\ldots \quad (30)$$

and $\frac{\phi}{C}$ gives the terrestrial refraction in decimals of contained arc—or in other words the *co-efficient of refraction*—for each pair of reciprocated observations. From the several values of the co-efficient thus determined, those which are deemed most suitable are selected for employment in the reduction of vertical angles to secondary points, at which reciprocal observations have not been taken.

The formula for calculating the *contained arc* is

$$C'' = \frac{c}{r} \operatorname{cosec} 1'' \quad \ldots\ldots\ldots\ldots\ldots \quad (31)$$

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7.

The Final Values of Height.

The final values of all the heights of the stations of this Quadrilateral have been obtained by comparing the values derived from the reciprocal vertical angles with determinations by Spirit Leveling operations wherever available, or with heights already finally fixed, and then dispersing the differences which exhibited themselves in the intermediate sections.

Two of the lines of spirit levels executed by the Great Trigonometrical Survey, traverse the Quadrilateral longitudinally, and have been connected with principal stations in all the meridional series west of 89° and in the North-East Longitudinal Series; they have also been connected with other leveling operations, notably those of the Revenue Survey, by which again the heights of other principal stations have been determined. Furthermore, the heights of all the stations of the Calcutta Longitudinal Series had been fixed in the course of the reduction of the South-East Quadrilateral, and of the Great Arc Series, Section 24° to 30°, in that of the North-West Quadrilateral. Thus a large amount of data existed for the final reduction of the heights of the stations. A list of the stations of which the heights were determined by Spirit Leveling is given below.

Spirit Leveled Points in the North-East Quadrilateral.

Series	By Great Trigonometrical Survey	By Revenue Survey
N. E. Longitudinal	XI or Atária	XXIV or Rámnagar
	XIII „ Kaliánpur	XXVIII „ Kutia
	XV „ Umra	XXXI „ Lákún
	LV „ Púrena	XXXII „ Chelua
	LVII „ Bharmi	XXXV „ Mási
	LVIII „ Gharbaria	XXXIX „ Tilakpur
	LXIX „ Bakwa	XLIII „ Saibara
	LXXIX „ Rúpdi	
	CII „ Diwánganj	
	CIII „ Latona	
	CVII „ Rámnagar	
	CIX „ Ghiba	
	CXXI „ Sonákhoda	
	CXXII „ Rámganj	
Budhon Meridional	XXII „ Firozabad	XXIV „ Pondri
	XXIII „ Baragaon	XXXIV „ Mehtra
	XL „ Sirsa	XXXV „ Bánsgopál
	XLII „ Bhatauli	XXXVII „ Barauli
		XXXIX „ Atora
Rangír Meridional	XIX „ Kalsán	VII „ Manang
	XX „ Bisungarh	
	XXXI „ Fatehganj	

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Spirit Leveled Points in the North-East Quadrilateral—(Continued).

Series	By Great Trigonometrical Survey			By Revenue Survey		
Amua Meridional	XVIII	or	Jájmau	XI	or	Paprendi
	XXVIII	„	Daráwal	XIII	„	Kánákhera
	XXIX	„	Sirwaia	XX	„	Rau
	XXX	„	Parser			
Karára Meridional	XVI	„	Karra	XIX	„	Horesa
	XVII	„	Majilgaon	XX	„	Salon
	XXX	„	Pesar	XXIII	„	Munai
	XXXI	„	Turkani	XXVI	„	Tauli
	XXXII	„	Utiámau	XXVIII	„	Parewa
Gurwáni Meridional	VII	„	Barípur	XIX	„	Kapradi
	VIII	„	Ganeshpur	XXIII	„	Bisaul
	XXII	„	Ráhet			
	XXIV	„	Orejhár			
	XXV	„	Kumeria			
Gora Meridional	VIII	„	Barháni			
	IX	„	Hirdepur			
	X	„	Barhanpur			
	XII	„	Kanaun			
	XIV	„	Chit Bisrám			
	XV	„	Samenda			
	XVII	„	Balariáganj			
	XVIII	„	Baniápár			
	XX	„	Rájgarh			
	XXII	„	Katwar			
	XXIV	„	Saraia			
	XXVI	„	Rájabári			
Huríláong Meridional	XV	„	Nuáon			
	XXVIII	„	Patjirwa			
Chendwár Meridional	XIV	„	Phulwaria			
	XXI	„	Paládpur			
	XXII	„	Harpur			
	XXIII	„	Sáwajpur			
North Párasnáth Meridional	XV	„	Basantpur			
	XVII	„	Chotaipati			
	XVIII	„	Harpur			
North Malúncha Meridional	XII	„	Barári			
	XX	„	Dighi			
Calcutta Meridional	LXXXI	„	Chinsurah			
	II	„	Niál			

The usual method of dispersing discrepancies between spirit leveled and trigonometrical heights, is to divide them in proportion to the number of intermediate stations and to

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correct each height according to its number of removes from the point determined by spirit leveling. For a time, the method of minimum squares* was applied; but this is generally held to be too refined and laborious a process to be suitable for the purpose, and it was soon abandoned for the more rough and ready one, which may be considered to give values quite as near the truth.

The heights resulting from the vertical observations of the North-East Quadrilateral have been divided, for final adjustment, into groups as shewn in the table which follows. In this table the errors dispersed in each group, except when the adjustment had been made by minimum squares, are exhibited; and where necessary a few explanatory remarks are added.

Group	Commencing at Stations	Ending at Stations	Errors in feet	Method of Dispersion, and Remarks.
	North-East Longitudinal Series.			
1	Mahesari, Chándípahár and Ghandiál	Atária	+ 8·5	Simple proportion. Besides the points of origin and the terminal point, the height of Sísgarh stood fixed by a former simultaneous adjustment of Groups 1, 2 and 3 by minimum squares.
2	Atária, Baheri and Birond	Umra		This group fixes the heights of only two points, Donau and Káimkhera. Their values are the arithmetical means of the measures from the surrounding stations.
3	Umra and Káimkhera	Kokra and Rámnagar	+ 9·2 & +11·1	Simple proportion. The height of Kokra was fixed in Group 3 of the Amua Series.
4	Kokra and Rámnagar	Kutia		Minimum squares. The heights of this Group were determined in connection with Group 3 of the Amua Series.
5	Saidara and Kutia	Lákún and Chelua	+ 5·2 & + 3·7	Simple proportion.
6	Lákún and Chelua	Khánpur and Mási	− 3·8 & − 4·4	Khánpur was fixed by the Karára Series. This Group only fixes the height of Bela.

* This method may be illustrated as follows:—Let A, B and C be stations at the vertices of a triangle, and let the differences of height obtained by vertical angular observations be $A - B = c$ feet, $B - C = a$ feet, $C - A = b$ feet, then $a + b + c$ should equal o; but in practice this is seldom or never the case: hence for each triangle in which the differences of height of the stations have been observed we shall have an equation

$$a + b + c = e$$

When a group of triangles connect two spirit leveled points, there is also an equation formed by equating the differences of height, along any route connecting the stations, to the difference as shewn by spirit leveling. The solution of those equations by minimum squares is performed in the usual manner and needs no illustration.

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Group	Commencing at Stations	Ending at Stations	Errors in feet	Method of Dispersion, and Remarks
	North-East Longitudinal Series—(Continued).			
7	Bela and Mási	Tilakpur	− 2·1	Simple proportion.
8	Dadaura and Tilakpur	Saibara	− 5·1	„
9	Mánichauk, Saibara and Bansídíla	Gharbaria, Púrena and Bharmi	− 9·1 − 9·7 & −10·7	„ Bansídíla had its height fixed by Group 4 of the Gurwáni Series.
10	Púrena, Bharmi, and Gharbaria	Bakwa	+11·8	Simple proportion.
11	Bájra, Bakwa and Naunangarhi	Rúpdi	− 0·9	„ The height of Naunangarhi was fixed by Group 3 of the Huríláong Series.
12	Rúpdi and Batwaia	Amua	− 3·3	Simple proportion. The height of Amua was obtained as explained in Group 3 of the Chendwár Series.
13	Sinaria, Amua and Madanpur	Chandarsanpur	+ 0·6	Simple proportion. The heights of Madanpur and Chandarsanpur as well as that of Bheria Bisanpur were obtained as explained in Group 3 of the Chendwár Series.
14	Jirol, Chandarsanpur and Bheria Bisanpur	Dewánganj and Latona	− 0·5 & − 1·6	Simple proportion.
15	Diwánganj and Latona	Ghiba		„ Chúni and Manúla were first fixed and then Baisi and Minai.
16	Minai and Ghiba	Sonákhoda and Rámganj	+ 3·0 & + 5·6	Simple proportion.
17	... ...	... ...	... ...	The heights of Chotáki and Newáni were fixed in the adjustment of the Calcutta Meridional Series, and those of Dúmdángi and Kanchábári were determined from the observed angles and received no correction.
	Budhon Meridional Series.			
1	Budhon and Tinsmál	Firozabad and Baragaon	+ 11·3 & + 12·0	Simple proportion.
2	Baragaon and Pondri	Mehtra and Bánsgopál	− 16·7 & − 17·3	„

Group	Commencing at Stations	Ending at Stations	Errors in feet	Method of Dispersion, and Remarks.
		Budhon Meridional Series—(Continued).		
3	Rajauli and Bánsgopál	Sirsa, Bhatauli and Milik	... ...	The adjustment of this group was somewhat complex, because of the number of fixed heights in it. They comprise Rajauli and Milik fixed in Groups 2 and 4, and Bánsgopál, Barauli, Atora, Sirsa and Bhatauli fixed by Spirit Leveling. The adjustment was made thus:—A preliminary value of Kandarki was obtained from the mean of those furnished by Bánsgopál, Atora and Sirsa, and employing this value and the heights of Bánsgopál and Rajauli, a mean value of height of Chandanpur was obtained and adopted as final. Again, employing a preliminary value of height of Chandanpur, as determined from Rajauli and Bánsgopál, and the heights of Bánsgopál, Atora and Sirsa a mean value of height of Kandarki was obtained and accepted as final. Lastly the height of Lút was determined by taking the mean as derived from Kandarki, Sirsa and Milik.
4	Sirsa and Bhatauli	Sheopuri and Mahesari		Minimum squares.
		Rangír Meridional Series.		
1	Tinsmál and Rangír	Manang	+ 3·8	Simple proportion.
2	Datiára and Manang	Kalsán	− 31·3	"
3	Kalsán and Bisungarh	Fatehganj	− 25·0	"
		Amua Meridional Series.		
1	Amua and Lakanpura	Jájmau		Minimum squares*.
2	Máwa and Jájmau	Daráwal and Sirwaia		Minimum squares.

* After this reduction was made the heights of Paprendi and Kánákhera were determined by the Revenue Survey Leveling Operations that of the former station differed only by 2 feet from the value determined by minimum squares, but that of Kánákhera differed by 10 feet. The spirit leveled values of both heights were adopted, as also the values of all the stations obtained by computation south of Kánákhera. The error which shewed itself to the north of that station was dispersed by proportion between it and Jájmau.

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Group	Commencing at Stations	Ending at Stations	Errors in feet	Method of Dispersion, and Remarks.
		***Amua Meridional Series*—(Continued).**		
3	Sirwaia and Parser	... ...	... ...	The remaining heights of this series were determined by minimum squares in connection with some appertaining to the North-East Longitudinal Series. See remarks to Group 4 of that Series.
		Karára Meridional Series.		
1	Karára and Marwás	Majilgaon and Karra	.	Minimum squares.
2	Majilgaon and Karra	Horesa and Salon		The height of only one station, Pariáon, is obtained in this Group, its value being the mean of the determinations from the 4 surrounding stations.
3	Horesa and Salon	Munai	− 1·0	Simple proportion.
4	Khára and Munai	Tauli	− 1·8	„
5	Janai and Tauli	Pesar and Turkani		This Group fixes the heights of Tikiri and Basantpur only. The adjustment was performed in a similar manner to that of Group 3 of the Budhon Series.
6	Turkani and Utiámau	Mási	− 2·3	Simple proportion.
		Gurwáni Meridional Series.		
1	Chapri and Pokra	Barípur and Ganeshpur	− 10·2 & − 6·4	Simple proportion.
2	Barípur and Ganeshpur	Kapradi	− 2·3	„
3	Sirwára and Kapradi	Ráhet and Bisaul		Minimum squares. The only two points of this Group not fixed by Spirit Leveling are Rarauli and Nansa.
4	Orejhár and Kumeria	Saibara		Minimum squares.

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Group	Commencing at Stations	Ending at Stations	Errors in feet	Method of Dispersion, and Remarks
		Gora Meridional Series.		
1	Gora and Sewádhi	Barháni and Hirdepur	− 5·7 & − 6·2	Simple proportion.
2	Hirdepur and Barhanpur	Chit Bisrám and Samenda		This Group contains only 2 points, Gaura and Kharakpur, which are not fixed by Spirit Leveling. A preliminary value of Kharakpur was obtained from Kanaun, Chit Bisrám and Samenda, and the final value of Gaura was then given by the mean of those obtained from Hirdepur, Barhanpur, Kanaun and Kharakpur. Similarly with a preliminary value of Gaura, derived from Hirdepur, Barhanpur and Kanaun, and with the Spirit Leveled values of Kanaun, Chit Bisrám and Samenda the final value of Kharakpur was obtained.
3	Chit Bisrám and Samenda	Balariáganj and Baniápár		This Group contains only one point, Bhadir, not fixed by Spirit Leveling, and its final height is the mean derived from the four neighbouring stations.
4	Balariáganj and Baniápár	Gharbaria and Dharamsingua		All the stations on the right flank of the chain of triangles included between these limits have had their heights determined by Spirit Leveling. The height of Dharamsingua was fixed by Group 9 of the North-East Longitudinal Series. The remaining heights were obtained on a similar principle to that adopted in Group 2 of this Series.
		Huríláong Meridional Series.		
1	Khaira Pándu and Huríláong	Nuáon	− 0·7	Simple proportion.
2	Hetampur and Nuáon	Patjirwa	+ 8·6	Ditto.
3	Daunáha and Patjirwa	Naunangarhi and Bakwa		The height of Naunangarhi was first determined; it is the mean of the value from Patjirwa and that from a dispersion by removes between Bakwa and Rúpdi of the North-East Longitudinal Series. The height of Binharwa was obtained from all the other stations of the group, a mean value being accepted as final.

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Group	Commencing at Stations	Ending at Stations	Errors in feet	Method of Dispersion, and Remarks
		Chendwár Meridional Series.		
1	Kasíátu and Chendwár	Phulwaria	− 0·5	Simple proportion.
2	Barra and Phulwaria	Paládpur and Harpur	− 5·0 & − 3·4	Ditto.
3	Harpur and Sáwajpur	Madanpur and Amua	− 0·3 & + 2·4	The height of Madanpur is the mean of four values, two of which are obtained from the Chendwár and two from the North-East Longitudinal Series. The latter are brought up from the stations Chandarsanpur and Narhar, for which provisional values of height were deduced by simple proportion between the Spirit Leveled heights of Chotaipati and Harpur of the North Párasnáth Series and the stations of the Chúni-Di-wánganj polygon on the North-East Longitudinal Series, which themselves rest on Spirit Leveled determinations at 4 of the stations in that polygon. The height of Amua is the mean of four values two of which are derived from the Chendwár Series and two from the North-East Longitudinal Series.
		North Párasnáth Meridional Series.		
1	Bámani and Ghoranji	Basantpur	− 5·3	Simple proportion.
2	Sajanpura and Basantpur	Chotaipati and Harpur		The height of Achalpur is the mean value obtained from the three Spirit Leveled heights of Basantpur, Chotaipati and Harpur and from the height of Sajanpura fixed by Group 1.
		North Malúncha Meridional Series.		
1	Durgapur and Malúncha	Barári	− 4·2	Simple proportion.
2	Pírdauri and Barári	Dighi	+ 6·0	Ditto.
3	Barára and Dighi	Rámnagar and Manula		The height of Manula is derived from Group 15 of the North-East Longitudinal Series, and the height of Mohania is the mean derived from the four neighbouring stations.

Group	Commencing at Stations	Ending at Stations	Errors in feet	Method of Dispersion, and Remarks
	Calcutta Meridional Series.			
	Sátten, Chinsurah and Niál	Sonákhoda and Rámganj of the N.E. Longitudinal Series.	+11·7 & +10·5	Simple proportion.

East Calcutta Longitudinal Series, Brahmaputra Series, Eastern Frontier Series—Section 23° to 26°, and Assam Longitudinal Series.

No Spirit Leveled values of height occur in any of these series, and the heights of the stations were adjusted by simple proportion as follows:—A circuit was formed of which the right-hand branch commenced from Chinsurah and Boga of the Calcutta Meridional Series, and passing *viá* the East Calcutta Longitudinal and the Brahmaputra Series, closed on the stations Alangjáni and Sámding of the Assam Longitudinal Series, and the left-hand branch commenced from Kanchábári and Newáni of the North-East Longitudinal Series, and following the Assam Longitudinal Series, closed on the same stations. This gave closing errors of −2·3 and +0·2 feet, which being dispersed, the heights of Orfi, Hatiára and Pákdiha of the East Calcutta Longitudinal Series became available as fixed data for originating the right-hand branch of a second circuit, and those of Partábganj, Dhubri and Sámding of the Assam Longitudinal Series for the left-hand branch: these two branches closed on the stations Sogaria and Gojalia, where the East Calcutta Longitudinal Series unites with the Eastern Frontier Series. The second circuit exhibited errors of + 13·3 and + 12·7 feet. In both circuits the mean of the errors at the closing stations were the quantities dispersed.

Abstracts of the calculations of the trigonometrical differences of height for the several series embraced in the North-East Quadrilateral, and which also contain the final values of the heights adopted for the stations, will be found on pages 163—I, 55—J, 38—K, 34—L, 48—M, 34—N, 53—O, 50—P, 48—Q, 32—R, 43—S, 58—T, 65—U, 81—V, 93—W, and 76—X.

In these abstracts there are given for each station, the astronomical date and mean time of observation whenever forthcoming, the mean of the observed angles preceded by a letter shewing whether it is *D*, a depression, or *E*, an elevation, and the number of observations of which it is the mean. Then follow in succession the heights in feet of the signal and instrument employed, the contained arc between each pair of stations and the amount of refraction expressed both in seconds and as a factor of the contained arc. Next is recorded the trigonometrical difference of height of each pair of stations as deduced from the observations. These differences are followed by the several values of height of the deduced station above sea level as brought up by the triangulation, and the means of these values for each station. And lastly are recorded the final values, obtained as has been explained in this section, together with the heights of the pillars or towers from which the observations were made.

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It has occasionally happened that after observations have been taken by one observer at a tower station, a second observer, coming to connect the station with new stations, has found it necessary to increase the height of the tower. In such cases the final height of the tower is that to which the results given in the numerical abstracts relate, the previous observations having been reduced to it, by referring the heights of the signal and instrument to the surface of the raised tower. When the height added to the tower exceeds either or both of these heights, the corrections for signal and instrument require the opposite sign to that which they usually take. In such cases a note is always inserted in the numerical abstracts, drawing attention to the fact.

8.

The Determination of Azimuths by Astronomical Observations.

It has been the practice in this Survey to determine azimuths at certain stations in the course of the execution of each chain of triangles. It used to be customary to select stations for this purpose in meridional series at about 1° apart, and in longitudinal series at shorter intervals. Of late the choice of stations has also been governed by the nature of the surrounding country, those localities only being accepted where there was reason to expect that the results would be least influenced by local attraction.

When the meridional series of this Quadrilateral which emanate from the Calcutta Longitudinal Series were executed, azimuths were observed at one of the base stations of each series; and the direction of the meridian so obtained was employed in the calculations of the series in preference to that brought up by triangulation. This procedure was due to the then inferior character of the triangulation on the Calcutta Longitudinal Series. Since the revision of this series, which was completed in 1869, the azimuths obtained by star observations have been discarded in favour of those furnished by the triangulation; they were employed when the fundamental azimuth at Kaliánpur was determined from a combination of the observed azimuths at several of the surrounding stations—see pages 137 to 141 of Vol. II—they have not however been made use of in direct connection with the triangulation, but are reserved for future investigations of the Figure of the Earth and of local attraction. The observations having been made *pari passû* with those of the angles of the triangles, and reduced *pari passû* with the preliminary reductions of the triangulation which precede the Simultaneous Reduction of each Quadrilateral, they and their reduction have been given in the volumes which treat of the triangulation.

The observations for azimuth consist of measures of the angle, at any station, between a circumpolar star, when near either elongation, and some other station—either directly or through the medium of a referring mark—which are made in accordance with the system followed in observing the horizontal angles as regards the changes of zero, but with a large number of repetitions on each zero, as the observations are individually liable to greater error.

The time of each intersection of the star being carefully noted, the difference of the momentary azimuth, δA, from the value at elongation is subsequently calculated and applied

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to the observed angle between the star and the referring mark. Thus a series of determinations of the angle between the referring mark and the star's position at elongation is obtained, from each of which and the known value of the azimuth of the star at elongation, a determination of the azimuth of the referring mark may be deduced.

The formula for calculating δA is

$$\delta A^* = \frac{(2 \sin^2 \tfrac{1}{2} \delta P \operatorname{cosec} 1'') \tan A \cos^2 a}{1 - (2 \sin^2 a . \sin^2 \tfrac{1}{2} \delta P) \pm (\cot P . \sin \delta P)} \quad . \; . \; . \; . \; . \; . \quad (32)$$

in which A is the azimuth of the star at elongation, P the corresponding hour angle, a the North Polar Distance of the star and δA the difference in azimuth for the time δP before and after elongation. The last term of the denominator is positive when the star is below and negative when above the position of maximum elongation.

At each station where the azimuth of a referring mark is observed, the angle between the referring mark and one of the contiguous stations of the triangulation is measured, just as any other angle; the several measures will generally be found in the Abstract of the Observed Angles at the observing station, and if not there then after the abstract of the azimuthal observations.

The Abstracts of the Azimuthal Observations which were made on each series will be found respectively on pages 181—I, 64—J, 44—K, 39—L, 56—M, 40—N, 59—O, 56—P, 54—Q, 36—R, 48—S, 65—T, 71—U, 89—V, 103—W, 84—X, in which are given, besides all necessary information regarding the observations themselves, such details of the calculations as will enable them to be followed up to the final result, *viz.*, the differences between the Astronomical and the Geodetical Azimuths. Sometimes the whole of the observations on a pair of zeros could not be completed in one night; in such cases the remainder were taken on a subsequent night, and the change of star's place was duly allowed for in the reductions.

9.

The Final Reduction of the Triangulation. Preliminary Sketch.

The different processes employed in the reductions which have as yet been described, are applied to the single triangles, polygonal figures and net-works by which the chains are built up. It has been the custom to make each field season's work, whenever possible, close with a complete figure; so that, during the succeeding recess, the preliminary reduction of the whole might be effected, and the resulting data rendered available for any immediate pur-

* The values of the portions of the formula enclosed in brackets, within the limits $\delta P = 30^m$ and $a = 10°$, have been calculated, and are given in the *Auxiliary Tables*; thus, as $\tan A \cos^2 a$ may be treated as a constant for each elongation, the calculation of δA is easily performed.

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poses for which they might be required. The portions of the triangulation so treated fulfil all existing conditions until a chain closes on a base-line, or two or more chains combine together to form a circuit. Further conditions then present themselves which the triangulation has to satisfy as a whole, namely:—

First, in the case of a chain closing on a measured base-line, the length of the base-line obtained from the triangulation should agree with the measured length.

Secondly, when two or more chains combine together to form a circuit, the values of the length and azimuth of the side of origin, and of the latitude and longitude of the station of origin, which are obtained by processes of calculation through the triangulation and back to the origin, should agree with their initial values.

Before proceeding to indicate the forms of equations which result from the foregoing conditions, it may be as well to anticipate a possible objection in their application. As all errors are to be dispersed by the method of minimum squares, which assumes the independency of all the quantities under investigation, it might be imagined that we must now again revert to the observed angles, as the angles which have been corrected for figural conditions cannot be considered independent. It has however been shewn in Appendix No. 8 of Vol. II, that the observed angles may be corrected in accordance with a part only of the conditions which govern them; and that when new conditions present themselves the corrected angles may be employed for finding other corrections, so that final corrections can be obtained by employing the angles after they have received any number of partial corrections, provided that the conditions which have already been satisfied are maintained when the further corrections, required to satisfy additional conditions, are calculated.

It appears therefore that all the preliminary calculations stand good, and consequently that the equations due to the new conditions may be obtained by employing the corrected, instead of reverting to the observed, values of the angles. But when we are seeking for final corrections, we must treat the corrected angles in such a manner as to preserve all the conditions already satisfied. These are however so numerous and entangled as to make an exact solution of the problem impossible. Consequently all the central and side conditions of the different polygonal figures and net-works composing the chains are excluded, by omitting from the Simultaneous Reduction all angles appertaining to polygonal figures and net-works over and above what are needed to form continuous chains of single triangles, and increasing the weights of the angles of the retained triangles. By this means the entanglement is greatly diminished, and the number of figural equations is reduced to one for each triangle, of the simple form

$$x + y + z = 0$$

which permits of the elimination of one of the unknown quantities in each triangle, and thus enables all the triangular equations to be dispensed with. Thus the number of equations to be solved is eventually reduced to the number of new conditions to be satisfied, or in other words to the number of what are here called Circuit Equations, the term having reference to all the closing errors of the chains of triangles, whether occurring internally at the ends of the circuits, or externally on the base-lines.

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After the completion of the Simultaneous Reduction, the angles appertaining to the portions of the polygonal figures and net-works, which had been excluded, are corrected in such a manner as to restore the consistency of each figure, without altering the values of the angles which have already been fixed.

10.

The Final Reduction of the Triangulation. Formation of the Circuit Equations.

It will now be understood that the several chains of triangles which are presented for simultaneous reduction consist only of single triangles. These are numbered consecutively in such order as may be most convenient. The angle opposite the flank side of each triangle is known as X, that opposite the side of continuation as Y and that opposite the base as Z, each being further distinguished by a subscript, which is the number of the triangle: x, y and z with corresponding subscripts are the symbols employed to represent the errors of the angles, or, in other words, the unknown fallible quantities of which the most probable values that will satisfy the equations have to be found. These equations are respectively termed *Linear* and *Geodetic*, the former taking cognizance of the errors in the ratios of the sides of triangles which are met with at the base-lines and junctions of chains, the latter expressing the errors in latitude, longitude and azimuth which exhibit themselves at the junctions of chains. In the reduction of the present Quadrilateral these equations were formed in the following manner:—

I. *Linear Equations.*

If a be the length of the side of origin of a chain and b the length of the closing side as obtained by triangulation, and the triangles are numbered from 1 to m consecutively, we express the value of b logarithmically as follows:—

$$\left.\begin{aligned}\log b = \log a + \log\sin Y_1 - \log\sin Z_1 + \log\sin Y_2 - \log\sin Z_2 \\ + \ldots + \log\sin Y_m - \log\sin Z_m\end{aligned}\right\} \quad . \quad . \quad (33)$$

When this equation is differentiated, if we write y for dY and z for dZ, we shall have an expression for $d\log b$, the error in $\log b$, in terms of the angular errors y and z. Now

$$d\log\sin Y = \{\text{tabular difference (t.d.) } \log\sin Y \text{ for a change of } 1''\} \times dY$$

$$d\log\sin Z = \{\ \ldots\ldots\ldots \log\sin Z \ldots\ldots\ldots\ \} \times dZ$$

Thus if for brevity we denote t.d. log sin Y by β and t.d. log sin Z by γ, we have

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$$d \log b = \beta_1 y_1 - \gamma_1 z_1 + \beta_2 y_2 - \gamma_2 z_2 + \ldots + \beta_m y_m - \gamma_m z_m \quad . \quad . \quad . \quad (34)$$

As in this equation $d \log b$ as well as β and γ represent quantities in the 7th place of decimals, it is convenient to treat it as if both sides were multiplied by 10^7, by which means $d \log b$, β and γ become respectively the number of units in the 7th place of decimals. If we put E to represent the actual closing error in $\log b$, and employ brackets to denote summation, the last equation may be written

$$E = \overset{m}{\underset{1}{}}[\beta y - \gamma z] \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (35)$$

The value of E is derived by comparing the logarithms of the measured and computed values of a base-line, or those of the two computed values of the side of junction of any two chains. Thus at base-lines we have

$$[\beta y - \gamma z] = \log b \text{ } computed - \log b \text{ } measured \quad . \quad . \quad . \quad . \quad . \quad . \quad (36)$$

and at junctions of chains we have

$$[\beta y - \gamma z]_r - [\beta y - \gamma z]_l = \log b_r - \log b_l \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (37)$$

the subscripts r and l referring to the right and left-hand chains of the circuit.

The coefficients β and γ are taken by inspection from any book of logarithms which gives the logarithmic sines of angles for every second of arc.*

The form of linear equation here given is the same as that employed for the South-East Quadrilateral, but differs from that employed in the reduction of the North-West Quadrilateral, in that β there stands for $\cot Y$ and γ for $\cot Z$, and E is the error in $\log b$ multiplied by $\frac{\text{cosec } 1''}{\text{Modulus}}$.

II. *Geodetic Equations.*

The formulæ which have been employed for calculating differences of latitude and longitude and azimuth, have already been quoted at pages 30 and 31. In now dealing with these we confine our attention to the first terms only. Differentiating them with respect to c and A, treating ρ, ν and λ as constants, we have the following expressions for the errors in latitude, longitude and reverse azimuth at any station;—

---

* To save time this is done in course of the preliminary calculation of the triangles, the tabular differences being then noted on the triangle sheets, from which they are afterwards taken when wanted. Provision is also made in the triangle sheets for again employing the same tabular differences as factors of the final corrections of the angles in calculating the corresponding corrections to the logarithms of the sides of the triangles.

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$$d\Delta\lambda = \Delta\lambda\left\{\frac{dc}{c} - dA \tan A \sin 1''\right\} \quad \dots\dots\dots \quad (38)$$

$$d\Delta L = \Delta L\left\{\frac{dc}{c} + dA \cot A \sin 1''\right\} \quad \dots\dots\dots \quad (39)$$

$$dB = dA + \Delta A\left\{\frac{dc}{c} + dA \cot A \sin 1''\right\} \quad \dots\dots\dots \quad (40)$$

In these formulæ dc and dA represent the total errors in the length and azimuth of any side of a triangle, which have been generated between it and the side of origin of the chain of triangles. These errors have to be expressed eventually as functions of the generating angular errors; consequently it is necessary to express them, in the first instance, in terms of the errors generated between the stations of which the geodetic co-ordinates have been computed consecutively from the origin. Let Station 1 be assumed to be the origin of co-ordinates, and 2, 3, . . . to be the subsequent stations; suppose the origin of co-ordinates to be situated at either extremity of the initial side of the chain, and let the given data on which the calculations are based be the length of the initial side c, the latitude and longitude of 1, and the azimuth of c at 1: also make the general symbols of the differential equations special by the addition of numerical subscripts, in the following order

for the side 1 to 2; $\Delta\lambda_1$, ΔL_1, ΔA_1, c_1, A_1 and B_1

. . . .

„ n to $n+1$; $\Delta\lambda_n$, ΔL_n, ΔA_n, c_n, A_n and B_n

where $n+1$ is the last flank station.

Now if δc_1 be the linear error generated between c and c_1

. . . .

δc_n . . . . c_{n-1} and c_n

and if

δA_1 be the azimuthal error generated between c and c_1

. . . .

δA_n . . . . c_{n-1} and c_n

then for the successive values of $\frac{dc}{c}$ in the differential equations we have

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$$\left.\begin{aligned} \frac{dc_1}{c_1} &= \frac{\delta c_1}{c_1} \\ \frac{dc_2}{c_2} &= \frac{\delta c_1}{c_1} + \frac{\delta c_2}{c_2} \\ &\cdots\cdots \\ \frac{dc_n}{c_n} &= \frac{\delta c_1}{c_1} + \frac{\delta c_2}{c_2} + \ldots + \frac{\delta c_n}{c_n} \end{aligned}\right\} \quad \ldots\ldots\ldots \quad (41)$$

and for successive values of dA

$$\left.\begin{aligned} dA_1 &= \delta A_1 \\ dA_2 &= dB_1 + \delta A_2 \\ &\cdots\cdots \\ dA_n &= dB_{n-1} + \delta A_n \end{aligned}\right\} \quad \ldots\ldots\ldots \quad (42)$$

Returning now to the expressions for $d\Delta\lambda$, $d\Delta L$ and dB, but treating the last first because it is required for the formation of the others, and omitting all terms in which higher powers of sin 1″ than the first occur, or are latent as in products of sin 1″ by $\frac{dc}{c}$, we obtain the following general expression for dB_n, the error in the azimuth of the n^{th} at the $(n+1)^{\text{th}}$ station

$$\left.\begin{aligned} dB_n = {}& {}_1^n\!\left[\Delta A\right]\frac{\delta c_1}{c_1} + {}_2^n\!\left[\Delta A\right]\frac{\delta c_2}{c_2} + \ldots + \Delta A_n \frac{\delta c_n}{c_n} \\ & + \left\{1 + {}_1^n\!\left[\Delta A \cot A\right]\sin 1''\right\}\delta A_1 + \left\{1 + {}_2^n\!\left[\Delta A \cot A\right]\sin 1''\right\}\delta A_2 \\ & + \ldots + \left\{1 + \Delta A_n \cot A_n \sin 1''\right\}\delta A_n \end{aligned}\right\} \quad \ldots \quad (43)$$

The errors in latitude and longitude at the same station, the $(n+1)^{\text{th}}$, are the sums of the respective errors generated between the successive stations of the traverse, that is to say

$$d\lambda_{n+1} = {}_1^n\!\left[d\Delta\lambda\right]; \qquad dL_{n+1} = {}_1^n\!\left[d\Delta L\right].$$

Expressing the $d\Delta\lambda$ and $d\Delta L$ for each station in terms of δc and δA, and making the successive summations for the right-hand members of the last equations, we have

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$$\left.\begin{aligned} d\lambda_{n+1} = {}_1^n\left[\Delta\lambda\right]\frac{\delta c_1}{c_1} + {}_2^n\left[\Delta\lambda\right]\frac{\delta c_2}{c_2} + \ldots + \Delta\lambda_n\frac{\delta c_n}{c_n} \\ -\left\{{}_1^n\left[\Delta\lambda\tan A\right]\delta A_1 + {}_2^n\left[\Delta\lambda\tan A\right]\delta A_2\right. \\ \left. + \ldots + \Delta\lambda_n\tan A_n\,\delta A_n\right\}\sin 1'' \end{aligned}\right\} \quad \ldots\ldots \quad (44)$$

and

$$\left.\begin{aligned} dL_{n+1} = {}_1^n\left[\Delta L\right]\frac{\delta c_1}{c_1} + {}_2^n\left[\Delta L\right]\frac{\delta c_2}{c_2} + \ldots + \Delta L_n\frac{\delta c_n}{c_n} \\ +\left\{{}_1^n\left[\Delta L\cot A\right]\delta A_1 + {}_2^n\left[\Delta L\cot A\right]\delta A_2\right. \\ \left. + \ldots + \Delta L_n\cot A_n\,\delta A_n\right\}\sin 1'' \end{aligned}\right\} \quad \ldots\ldots \quad (45)$$

These formulæ are given in Volume II and were employed in the reduction of the North-West Quadrilateral. Major Herschel made the following changes in their mode of expression with a view to obtaining the numerical coefficients of the unknown quantities in a more expeditious manner :—

$$\Delta\lambda\frac{\delta c}{c} = \frac{1}{\mathrm{M}}\Delta\lambda\frac{1}{10^7}\times\frac{\mathrm{M}}{c}\delta c\times 10^7$$

and $\frac{\mathrm{M}}{c}\times 10^7$ = the number of units in the tabular difference of $\log c$ in the 7th place of decimals; if we call this t.d. log c, and put

$${}_\lambda m = \frac{1}{\mathrm{M}}\Delta\lambda\frac{1}{10^7} \quad \ldots\ldots\ldots\ldots \quad (46)$$

then

$$[\Delta\lambda]\frac{\delta c}{c} = [{}_\lambda m]\,\text{t.d.}\log c.\delta c \quad \ldots\ldots\ldots\ldots \quad (47)$$

Similarly if we put

$$\left.\begin{aligned} {}_L m = \frac{1}{\mathrm{M}}\Delta L\frac{1}{10^7} \\ {}_A m = \frac{1}{\mathrm{M}}\Delta A\frac{1}{10^7} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots \quad (48)$$

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we shall have

$$\left.\begin{array}{l}[\Delta L]\dfrac{\delta c}{c} = [{}_L m]\,\text{t.d.}\log c.\delta c \\ [\Delta A]\dfrac{\delta c}{c} = [{}_A m]\,\text{t.d.}\log c.\delta c\end{array}\right\} \quad \ldots \ldots \ldots \quad (49)$$

Again putting

$$\left.\begin{array}{l}{}_\lambda g = \dfrac{\nu}{\rho}\cos\lambda \sin 1'' \; 10^6 \\ {}_L g = \dfrac{\rho}{\nu}\sec\lambda \sin 1'' \; 10^6 \\ {}_A g = \dfrac{\rho}{\nu}\tan\lambda \sin 1'' \; 10^6\end{array}\right\} \quad \ldots \ldots \ldots \quad (50)$$

it follows that

$$\left.\begin{array}{l} -\left[\Delta\lambda \tan A\right]\sin 1'' = -\left[{}_\lambda g\,\Delta L \frac{1}{10^6}\right] = \left[{}_\lambda p\right] \text{ suppose} \\ +\left[\Delta L \cot A\right]\sin 1'' = +\left[{}_L g\,\Delta\lambda\, \frac{1}{10^6}\right] = \left[{}_L p\right] \quad \text{,,} \\ +\left[\Delta A \cot A\right]\sin 1'' = +\left[{}_A g\,\Delta\lambda\, \frac{1}{10^6}\right] = \left[{}_A p\right] \quad \text{,,} \end{array}\right\} \quad \ldots \quad (51)$$

For calculating these expressions ${}_\lambda g$, ${}_L g$ and ${}_A g$ can be tabulated for every degree of latitude involved, and special values may be obtained by interpolation.

The formulæ for errors in latitude, longitude and azimuth may now be expressed as follows:—

$$\left.\begin{array}{l} d\lambda_{n+1} = {}_1^n\left[{}_\lambda m\right]\text{t.d.}\log c_1.\delta c_1 + {}_2^n\left[{}_\lambda m\right]\text{t.d.}\log c_2.\delta c_2 + \ldots + {}_\lambda m_n\,\text{t.d.}\log c_n.\delta c_n \\ \quad + {}_1^n\left[{}_\lambda p\right]\delta A_1 + {}_2^n\left[{}_\lambda p\right]\delta A_2 + \ldots + {}_\lambda p_n\,\delta A_n \end{array}\right\} \quad . \; . \; (52)$$

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$$\left.\begin{aligned} dL_{n+1} = {}_1^n\left[{}_L m\right]\text{t.d.}\log c_1.\delta c_1 + {}_2^n\left[{}_L m\right]\text{t.d.}\log c_2.\delta c_2 + \ldots + {}_L m_n\,\text{t.d.}\log c_n.\delta c_n \\ + {}_1^n\left[{}_L p\right]\delta A_1 + {}_2^n\left[{}_L p\right]\delta A_2 + \ldots + {}_L p_n\,\delta A_n \end{aligned}\right\} \quad . \quad (53)$$

and

$$\left.\begin{aligned} dB_n = {}_1^n\left[{}_A m\right]\text{t.d.}\log c_1.\delta c_1 + {}_2^n\left[{}_A m\right]\text{t.d.}\log c_2.\delta c_2 + \ldots + {}_A m_n\,\text{t.d.}\log c_n.\delta c_n \\ + \left\{1 + {}_1^n\left[{}_A p\right]\right\}\delta A_1 + \left\{1 + {}_2^n\left[{}_A p\right]\right\}\delta A_2 + \ldots + \left\{1 + {}_A p_n\right\}\delta A_n \end{aligned}\right\} \quad . \quad (54)$$

We have finally to express the values of the errors $\delta c_1, \delta c_2, \delta c_3, \ldots$ and $\delta A_1, \delta A_2, \delta A_3, \ldots$ in side and azimuth, which were successively generated between the stations whose geodetic elements have been computed, in terms of the generating angular errors. In doing this there are two courses open to us. One is to carry the geodetic calculations from station to station along either flank of each chain of triangles, the right flank being preferred because every value of A is then always obtained by adding the included angles of the traverse to the previous B; another is to carry them from flank to flank in a zig-zag manner across the chain, when the included angles of the traverse have to be alternately added and subtracted to obtain a following A from a preceding B. These methods are illustrated in both the accompanying figures, the dotted lines representing the traverse along one flank of the triangles, and the broken lines the zig-zag traverse from flank to flank. Of the two methods the first has been employed for the whole of the triangulation comprised within the North-West and South-East Quadrilaterals and the first ten Circuits of the present Quadrilateral. But for the remaining triangulation, which falls to the east of the Calcutta Meridional Series, Major Herschel adopted the second method. The sets of equations which result from either method will now be shewn.

Fig. 1.

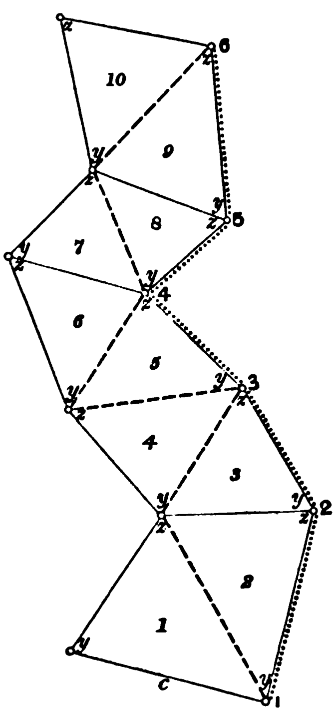
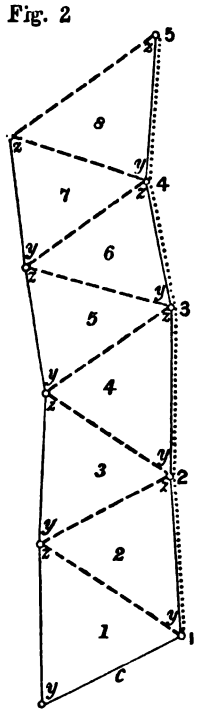


Fig. 2



But first it must be stated, in explanation of the two figures in the margin, that in both of them the block numerals **1, 2, . . .** indicate the numbering of the stations on the direct line of traverse. When the traverse is carried along a flank of the chain of triangles, the traverse stations are much less numerous than the triangles, and they therefore

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require a separate numbering; but when it is carried in a zig-zag, from flank to flank, every traverse station is the vertex of a triangle and may take the number of the triangle, and consequently in this case the traverse stations do not require a special numbering. Thus different notations are needed in the two cases, as will now be exemplified with reference, in both cases, to the chain indicated by Figure 1, because it is less direct, and thus leads to more complex expressions of error, than the chain indicated by Figure 2.

1.—*The Direct Line of Traverse.*

Following Fig. 1, and employing old face numerals as the subscripts for the traverse stations and ordinary numerals as subscripts for the triangles, it will be seen that δc_1 and δA_1 are the linear and azimuthal errors generated between the initial side c and the traverse side **1-2**, δc_2 and δA_2 are the linear and azimuthal errors generated between the traverse sides **1-2** and **2-3**, and so on. Hence

$$\left.\begin{aligned} \delta A_1 &= x_1 + y_2 \\ \delta A_2 &= z_2 + y_3 \\ \delta A_3 &= z_3 + x_4 + y_5 \\ &\ldots\ldots \end{aligned}\right\} \quad \ldots\ldots\ldots \quad (55)$$

also writing

$$\begin{aligned} &\alpha \ \text{ for t.d.} \log \sin X \\ &\beta \ \ ,, \ \text{t.d.} \log \sin Y \\ &\gamma \ \ ,, \ \text{t.d.} \log \sin Z \end{aligned}$$

it can be easily demonstrated that

$$\left.\begin{aligned} \text{t.d.} \log c_1.\delta c_1 &= \beta_1 y_1 - \gamma_1 z_1 + \alpha_2 x_2 - \gamma_2 z_2 \\ \text{t.d.} \log c_2.\delta c_2 &= \beta_2 y_2 - \alpha_2 x_2 + \alpha_3 x_3 - \gamma_3 z_3 \\ \text{t.d.} \log c_3.\delta c_3 &= \beta_3 y_3 - \alpha_3 x_3 + \beta_4 y_4 - \gamma_4 z_4 + \alpha_5 x_5 - \gamma_5 z_5 \\ &\ldots\ldots\ldots\ldots\ldots\ldots \end{aligned}\right\} \quad (56)$$

Eliminating x from these expressions by help of the triangular equation $x + y + z = 0$, substituting the values of δA and δc in the expressions for $d\lambda_{n+1}$, dL_{n+1} and dB_n, and introducing the following symbols, *viz.*,

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E for the left-hand member of either equation

μ_1 for the coefficient of t.d. log $c_1.\delta c_1$, or $\overset{''}{_1}\left[m\right]$

μ_2 ,, ,, t.d. log $c_2.\delta c_2$, ,, $\overset{''}{_2}\left[m\right]$

. . . .

ϕ_1 ,, ,, δA_1, or $\overset{''}{_1}\left[p\right]$

ϕ_2 ,, ,, δA_2, ,, $\overset{''}{_2}\left[p\right]$

. . . .

we shall have the following general expression for an error either in latitude, longitude or azimuth, in which when two consecutive μs occur as forming a factor of a, thus $(\mu_{l+1} - \mu_l)$, they may be replaced by $-m_l$:—

$$\left.\begin{aligned} E = &+ (\mu_1\beta_1 - \phi_1)y_1 && + (-\mu_1\gamma_1 - \phi_1)z_1 \\ &+ (-m_1 a_2 + \mu_2\beta_2 + \phi_1)y_2 && + (-m_1 a_2 - \mu_1\gamma_2 + \phi_2)z_2 \\ &+ (-m_2 a_3 + \mu_3\beta_3 + \phi_2)y_3 && + (-m_2 a_3 - \mu_2\gamma_3 + \phi_3)z_3 \\ &+ (\mu_3\beta_4 - \phi_3)y_4 && + (-\mu_3\gamma_4 - \phi_3)z_4 \\ &+ \ldots \end{aligned}\right\} \quad \ldots \quad (57)$$

The general forms for the coefficients of y and z are:—

First.—If the pth triangle have no side in the line of traverse, but only an angle at the station l,

$$(\mu_l\beta_p - \phi_l)y_p + (-\mu_l\gamma_p - \phi_l)z_p \quad \ldots\ldots\ldots \quad (58)$$

Secondly.—If the qth triangle have a side in the traverse between the stations l and $l+1$,

$$\{-m_l a_q + \mu_{l+1}\beta_q + \phi_l\}y_q + \{-m_l a_q - \mu_l\gamma_q + \phi_{l+1}\}z_q \quad \ldots\ldots \quad (59)$$

Exceptions may present themselves at the commencement and end of chains, owing to the non-existence of some of the coefficients. In all instances, however it will be found that ϕ_l enters the coefficients of all the errors of the angles at station l; also that μ_l enters the coefficients of the errors of the other angles of the same triangles, with a *plus* sign if looking from station l the angle is the left-hand one of the triangle and a *minus* sign if the right-hand.

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The substitutions for μ and ϕ to render the general equation applicable to either latitude, longitude or azimuth are now as follows :—

Table of Substitutions for μ and ϕ.

	Latitude	Longitude	Azimuth
For E	$d\lambda_{n+1}$	dL_{n+1}.	dB_n
" μ	${}_\lambda\mu$	${}_L\mu$	${}_A\mu$
" ϕ	${}_\lambda\phi$	${}_L\phi$	${}_A\phi$
" μ_1	$+\overset{n}{\underset{1}{}}[{}_\lambda m]$	$+\overset{n}{\underset{1}{}}[{}_L m]$	$+\overset{n}{\underset{1}{}}[{}_A m]$
" μ_2	$+\overset{n}{\underset{2}{}}[{}_\lambda m]$	$+\overset{n}{\underset{2}{}}[{}_L m]$	$+\overset{n}{\underset{2}{}}[{}_A m]$
. . .	. . .	. . .	. . .
" μ_n	$+{}_\lambda m_n$	$+{}_L m_n$	$+{}_A m_n$
" ϕ_1	$+\overset{n}{\underset{1}{}}[{}_\lambda p]$	$+\overset{n}{\underset{1}{}}[{}_L p]$	$1+\overset{n}{\underset{1}{}}[{}_A p]$
" ϕ_2	$+\overset{n}{\underset{2}{}}[{}_\lambda p]$	$+\overset{n}{\underset{2}{}}[{}_L p]$	$1+\overset{n}{\underset{2}{}}[{}_A p]$
. . .	. . .	. . .	. . .
" ϕ_n	$+{}_\lambda p_n$	$+{}_L p_n$	$1+{}_A p_n$

2.—*The Zig-zag Line of Traverse.*

The Zig-zag Line of Traverse follows a course such as is indicated by the broken lines - - - - in Figures 1 and 2; every two consecutive sides of the traverse include only those angles of the triangles which are known as flank angles and are symbolized by X, in contradistinction to the 'angles of continuation' which are symbolized by Y and Z; in the direct line of traverse all three angles occur indifferently. There is of necessity, therefore, a greater uniformity in the coefficients of y and z in the resulting geodetic equations, and further we may dispense with traverse numbers and employ the triangle numbers only in indicating the component factors of the coefficients which are respectively due to the traverse and the

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triangle. This can be easily done in the case of a chain originally consisting of single triangles, such as is represented by Fig. 2; because the number of triangles and the number of sides in the traverse are the same. But when the triangles are taken from a chain which was originally double, as in Fig. 1— where however, the non-circuit triangles are not shewn— we must adopt numerical subscripts which will recognize the crossing of the line of traverse from the vertex of one triangle to that—not of the next but—of the next but one, as frequently happens in such cases. Thus the symbols for Fig. 1 will be as follows :—

For the side of continuation of triangle 1, $\Delta\lambda_1$, ΔL_1, ΔA_1, c_1, A_1, and B_1,

" triangle 3, $\Delta\lambda_{2,3}$, $\Delta L_{2,3}$, $\Delta A_{2,3}$, $c_{2,3}$, $A_{2,3}$, and $B_{2,3}$,

" triangle 4, $\Delta\lambda_4$, ΔL_4, ΔA_4, c_4, A_4, and B_4,

and so on, shewing by the subscripts the specific numbers of the triangles which are made use of in the successive deductions. δc_1 and δA_1 are now the linear and geodetic errors generated between the initial side c and the first side of the traverse, or the side of continuation of triangle 1. $\delta c_{2,3}$ and $\delta A_{2,3}$ are the linear and geodetic errors generated between the first and second sides of the traverse, or between the sides of continuation of the triangles 1 and 3; and so on. But it must be carefully borne in mind that whereas in the direct line of traverse the forward azimuth A at any station is deduced by the *addition* of the included angles to the back azimuth B, in the zig-zag line of traverse the included angles are *additive* only when they are to the left of the line of traverse and are *subtractive* when they are to the right; hence δA carries a *plus* sign in the former case and a *minus* sign in the latter.

If we now substitute for δc and δA in terms of x, y and z, we may dispense with different symbols to distinguish between the traverse and the triangle numbers, and shall have

$$\left.\begin{aligned} \delta A_1 &= + x_1 &&= - y_1 - z_1 \\ \delta A_{2,3} &= - x_2 - x_3 &&= + y_2 + z_2 + y_3 + z_3 \\ \delta A_4 &= + x_4 &&= - y_4 - z_4 \\ &\cdots\cdots\cdots \end{aligned}\right\} \quad \ldots\ldots \quad (60)$$

and

$$\left.\begin{aligned} \text{t.d.}\log c_1.\delta c_1 &= \beta_1 y_1 - \gamma_1 z_1 \\ \text{t.d.}\log c_{2,3}.\delta c_{2,3} &= \beta_2 y_2 - \gamma_2 z_2 + \beta_3 y_3 - \gamma_3 z_3 \\ \text{t.d.}\log c_4.\delta c_4 &= \beta_4 y_4 - \gamma_4 z_4 \\ &\cdots\cdots\cdots \end{aligned}\right\} \quad \ldots \quad (61)$$

We are now again in a position to substitute the generating angular errors for the

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errors in side and azimuth in the expressions for $d\lambda_{n+1}$, dL_{n+1} and dB_n given by equations (52) to (54). But before so doing we must make further changes in the notation. n is now no longer the number of sides in the traverse but the number of triangles in the chain, and the right-hand subscripts of the expressions will be (1), (2,3), (4), (5), (6,7), &c., double numbers occurring wherever two triangles are included between successive sides of the traverse. The same double numbers will have to be employed to symbolize summations, thus $\overset{*}{\underset{2,3}{}}\left[m\right]$ or $\overset{*}{\underset{2,3}{}}\left[p\right]$, and also for the μs and ϕs, thus $\mu_{2,3}$, $\phi_{2,3}$. These double numbers, although they somewhat confuse the analytical expressions for the errors in latitude, longitude and azimuth, cause no trouble in practice, when the calculations are made with the aid of a reduction chart, as is usually necessary.

The general expression for an error in latitude, longitude or azimuth now becomes

$$\left.\begin{aligned} E = &+ (-\phi_1 + \mu_1\beta_1)y_1 + (-\phi_1 - \mu_1\gamma_1)z_1 \\ &+ (\phi_{2,3} + \mu_{2,3}\beta_2)y_2 + (\phi_{2,3} - \mu_{2,3}\gamma_2)z_2 \\ &+ (\phi_{2,3} + \mu_{2,3}\beta_3)y_3 + (\phi_{2,3} - \mu_{2,3}\gamma_3)z_3 \\ &+ (-\phi_4 + \mu_4\beta_4)y_4 + (-\phi_4 - \mu_4\gamma_4)z_4 \\ &+ \ldots \end{aligned}\right\} \quad \ldots \quad (62)$$

On reference to Fig. 1 it will be at once evident how easily this expression can be written down for any chain of triangles, with the aid of the figure.

The general expressions for the coefficients of y and z in the preceding equation are

$$\left.\begin{aligned} y &= \iota\phi + \mu\beta \\ z &= \iota\phi - \mu\gamma \end{aligned}\right\} \quad \ldots \quad (63)$$

where ι stands for + or −, the former if the triangle lies to the right of the traverse and the latter if to the left*.

* If the traverse stations are numbered in succession, the 'Table of Substitutions' will furnish the formula for any μ or ϕ; but it was preferred to calculate these triangle by triangle in the same form in which the coefficients of the angular errors, $\iota\phi + \mu\beta$ and $\iota\phi - \mu\gamma$, were calculated. Besides the dispensing with separate subscripts for the μs and ϕs, this form has the advantage that the longer expressions for the coefficients of the angular errors of triangles with one side in the traverse are absent, while if the series to which it is applied are double the number of μs and ϕs which have to be computed may be much the same. On the other hand, when the chains of triangles are single, see Fig. 2, the number of μs and ϕs is nearly doubled; some slight liability to error is also occasioned by the change of sign of ϕ. This liability to error is absent from the old form, and the double formulæ for the coefficients of the angular errors are not so troublesome as might be supposed at first sight, as they can be easily written down with the aid of the Reduction Chart, by help of the rules given on page 54.

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3.—*Calculation of the Absolute Terms of the Geodetic Equations.*

It has now been demonstrated how the geodetic errors met with at the close of any circuit of triangles, or at the junctions of separate chains of triangles, may be readily expressed in terms of the symbolic errors of the included angles. The absolute terms of the equations will be the differences of the values in latitude, longitude and azimuth, which are calculated from the origin of the circuit through the two branches up to this junction. The calculation of the absolute term E for the geodetic equations is performed thus. The circuit is divided into two branches—right-hand and left-hand—and the values of latitude, longitude and azimuth are calculated from a common station and side of origin to a closing station and side by either branch; and, if the subscripts r and l denote the values obtained by the right and left-hand branches,

$$\left.\begin{aligned} {}_{\lambda}E &= \lambda_r - \lambda_l \\ {}_{L}E &= L_r - L_l \\ {}_{A}E &= B_r - B_l \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots \quad (64)$$

4.—*Calculation of the Geodetic Factors in the Coefficients.*

In calculating the factors μ and ϕ the following approximations were made:—

$$\left.\begin{aligned} \text{For } {}_{\lambda}m &= \frac{1}{\mathrm{M}}\Delta\lambda\frac{1}{10^7} \quad \text{was put} \quad \cdot 23\,\Delta\lambda\,\frac{1}{10^6} \\ \text{,, } {}_{L}m &= \frac{1}{\mathrm{M}}\Delta L\frac{1}{10^7} \qquad \text{,,} \qquad \cdot 23\,\Delta L\frac{1}{10^6} \\ \text{,, } {}_{A}m &= \frac{1}{\mathrm{M}}\Delta A\frac{1}{10^7} \qquad \text{,,} \qquad \cdot 23\,\Delta A\frac{1}{10^6} \end{aligned}\right\} \quad \ldots\ldots \quad (65)$$

and $\Delta\lambda$, ΔL and ΔA were retained to the nearest second only. ${}_{\lambda}g$, ${}_{L}g$ and ${}_{A}g$ were tabulated for every degree of latitude required to two decimal places and were employed by interpolation to one decimal place. The table will be found at the commencement of Section 11 of Chapter III. The values of the μs and ϕs obtained in this manner are somewhat less rigorous than those of the South-East Quadrilateral; but with the aid of Crelle's Tables of Products the labour of calculating them is greatly reduced.

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5.—*Application of Equalizing Factors to the Linear and Geodetic Equations.*

When the linear and geodetic equations have been obtained in the manner here described, it will be found that the numerical values of the coefficients are much larger in the former than those in latter, and that those in the latitude and longitude equations are least of all. Although this can not produce any effect on the final results, it leads to an amount of labour in the calculations, which may be materially diminished if the coefficients can be equalized roughly without much trouble, by multiplying each by a special factor. Such factors were employed for the North-East Quadrilateral; their values were

for azimuth equations	1
„ latitude and longitude equations	15
„ linear equations	0·03

11.

The Final Reduction of the Triangulation. Solution of the Equations between the Indeterminate Factors.

If we assume that the number of triangles entering the reduction is t and that they furnish n circuit equations, the latter may now be written in order

$$\left.\begin{array}{l} {}_1\mathfrak{b}_1 y_1 + {}_1\mathfrak{c}_1 z_1 + \cdot\ \cdot\ \cdot + {}_1\mathfrak{b}_t y_t + {}_1\mathfrak{c}_t z_t = {}_1E \\ {}_2\mathfrak{b}_1 y_1 + {}_2\mathfrak{c}_1 z_1 + \cdot\ \cdot\ \cdot + {}_2\mathfrak{b}_t y_t + {}_2\mathfrak{c}_t z_t = {}_2E \\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot \\ {}_n\mathfrak{b}_1 y_1 + {}_n\mathfrak{c}_1 z_1 + \cdot\ \cdot\ \cdot + {}_n\mathfrak{b}_t y_t + {}_n\mathfrak{c}_t z_t = {}_nE \end{array}\right\} \quad \cdot\ \cdot\ \cdot\ \cdot \quad (66)$$

in which equations the left-hand subscript in 'old face' type corresponds to the number of the equation and the right-hand subscript in ordinary type gives the number of the triangle.

Now for reasons which have been stated in Section 2 of Chapter XIV, Vol. II, the angles appertaining to any single trigonometrical figure are taken as of equal weight in

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the simultaneous reductions. Thus the minimum which governs the solution of the foregoing equations will, when x has been eliminated from it, become

$$U = \frac{(y_1 + z_1)^2 + y^2_1 + z^2_1}{u_1} + \ . \ . \ . + \frac{(y_t + z_t)^2 + y^2_t + z^2_t}{u_t} \quad . \ . \ . \quad (67)$$

The symbols employed for the 'indeterminate factors' are ${}_1\Lambda$, ${}_2\Lambda$, ${}_3\Lambda$, &c., and the equations between them are* †

$$\left.\begin{array}{l}
{}_1^t\Big[{}_1\mathfrak{b}\,{}_1\mathfrak{B} + {}_1\mathfrak{c}\,{}_1\mathfrak{C}\Big]{}_1\Lambda + {}_1^t\Big[{}_1\mathfrak{b}\,{}_2\mathfrak{B} + {}_1\mathfrak{c}\,{}_2\mathfrak{C}\Big]{}_2\Lambda + \ . \ . \ . + {}_1^t\Big[{}_1\mathfrak{b}\,{}_n\mathfrak{B} + {}_1\mathfrak{c}\,{}_n\mathfrak{C}\Big]{}_n\Lambda = {}_1E \\
{}_1^t\Big[{}_2\mathfrak{b}\,{}_1\mathfrak{B} + {}_2\mathfrak{c}\,{}_1\mathfrak{C}\Big]{}_1\Lambda + {}_1^t\Big[{}_2\mathfrak{b}\,{}_2\mathfrak{B} + {}_2\mathfrak{c}\,{}_2\mathfrak{C}\Big]{}_2\Lambda + \ . \ . \ . + {}_1^t\Big[{}_2\mathfrak{b}\,{}_n\mathfrak{B} + {}_2\mathfrak{c}\,{}_n\mathfrak{C}\Big]{}_n\Lambda = {}_2E \\
\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \\
{}_1^t\Big[{}_n\mathfrak{b}\,{}_1\mathfrak{B} + {}_n\mathfrak{c}\,{}_1\mathfrak{C}\Big]{}_1\Lambda + {}_1^t\Big[{}_n\mathfrak{b}\,{}_2\mathfrak{B} + {}_n\mathfrak{c}\,{}_2\mathfrak{C}\Big]{}_2\Lambda + \ . \ . \ . + {}_1^t\Big[{}_n\mathfrak{b}\,{}_n\mathfrak{B} + {}_n\mathfrak{c}\,{}_n\mathfrak{C}\Big]{}_n\Lambda = {}_nE
\end{array}\right\} \quad (68)$$

* In these equations, although the corresponding coefficients on opposite sides of the diagonal appear to differ, their values are in reality identical in each term of the summation. Both forms were made use of as a check on the calculations in the North-West and South-East Quadrilaterals; and the diagonal coefficients were obtained also by the formula

$$\frac{2}{3}\,{}_1^t\Big[u\,(\mathfrak{b}^2 - \mathfrak{bc} + \mathfrak{c}^2)\Big].$$

These checks were superseded in the North-East Quadrilateral by equating the sum of the coefficients of the Λs in any, the q^{th}, equation to

$$\sum_{m=1}^{m=t}\Big[{}_q\mathfrak{b}_m\,{}_1^n\Big[\mathfrak{B}_m\Big] + {}_q\mathfrak{c}_m\,{}_1^n\Big[\mathfrak{C}_m\Big]\Big]$$

† The analytical expressions for the coefficients of the indeterminate factors in equations (68) have been obtained by eliminating from the circuit equations one of the angular errors of each triangle, by help of the triangular equation $x + y + z = 0$. The same form may be arrived at by retaining the unknown quantities, but eliminating the factors appertaining to the triangular equations from the equations between the indeterminate factors, prior to their solution. This has already been pointed out, see note on page 404 of Vol. II.

If ${}_pa_m$, ${}_pb_m$, ${}_pc_m$ be the coefficients of x_m, y_m, z_m in any the pth equation and their sum be put equal 3_ps_m, the coefficient of ${}_p\Lambda$ in the qth equation will first take the form

$$\sum_{m=1}^{m=t}\Big[\frac{1}{w}\Big\{{}_pa_m\,{}_qa_m + {}_pb_m\,{}_qb_m + {}_pc_m\,{}_qc_m - 3\,{}_ps_m\,{}_qs_m\Big\}\Big]$$

which is remarkable for its symmetry.

If now we write $\mathfrak{b}$ for $b-a$ and $\mathfrak{c}$ for $c-a$ the coefficient becomes

$$\sum_{m=1}^{m=t}\Big[{}_q\mathfrak{b}_m\,{}_p\mathfrak{B}_m + {}_q\mathfrak{c}_m\,{}_p\mathfrak{C}_m\Big]$$

which is the same as in the text; and the expressions for the errors y *and* z take the same form as in (69).

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in which

$$\mathfrak{B} = \frac{u}{3}(2\mathfrak{b} - \mathfrak{c}), \text{ and } \mathfrak{C} = \frac{u}{3}(2\mathfrak{c} - \mathfrak{b})$$

These equations having been solved, the values of the angular errors are given by the formulæ

$$\left.\begin{array}{c} y_p = {}_1\mathfrak{B}_p\,{}_1\Lambda + {}_2\mathfrak{B}_p\,{}_2\Lambda + \ . \ \ . \ \ . \ + {}_n\mathfrak{B}_p\,{}_n\Lambda \\ z_p = {}_1\mathfrak{C}_p\,{}_1\Lambda + {}_2\mathfrak{C}_p\,{}_2\Lambda + \ . \ \ . \ \ . \ + {}_n\mathfrak{C}_p\,{}_n\Lambda \\ x_p = -(y_p + z_p) \end{array}\right\} \quad \ldots \ldots \quad (69)$$

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CHAPTER III.

THE DETAILS OF THE SIMULTANEOUS REDUCTION.

1.

On the General Aspects and the Magnitude of the Undertaking.

It has been stated, in the first chapter of this volume, that the eastern limit of the triangulation appertaining to the North-East Quadrilateral was originally intended to be the Calcutta Meridional Series. The Quadrilateral would thus have embraced eleven meridional series, starting from the already fixed Calcutta Longitudinal Series to the south and running parallel to the already fixed section of the Great Arc to the west; it would also have embraced a longitudinal series to the north, and one obligatory measured length, *viz*, the Sonákhoda base-line, at its north-east corner. Its reduction would have involved the formation and simultaneous solution of 45* equations between indeterminate factors, of the form given in the last section of the preceding chapter. Now the North-West Quadrilateral had only presented 23 and the South-East 15 such equations; and in both the labour entailed, first in the formation of these equations, and afterwards in solving them by the method of minimum squares—so as to obtain the most probable results—was very great, involving many precautionary calculations, to guard against the occurrence of any error, without detection, throughout a mass of calculations occupying several computers for many months. Thus it was not unnatural that an undertaking which, at first sight, appeared to be so much more extensive than the two great reductions which had preceded it, should have been contemplated with some anxiety lest it might prove to be impracticable.

* In reality there might have been 47 equations, for the Budhon Meridional Series has a station, at Ráepur, near its middle latitude, which is only a few feet distant from a station of the Great Arc, the intervening space being occupied by a temple; and while the final reductions were in hand the distance and mutual bearings of the two points were measured by an Officer specially deputed for the purpose; afterwards the Budhon elements were adjusted to the fixed elements of the Great Arc at Ráepur, by the introduction of 2 additional equations, one in latitude the other in longitude.

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Now some of the interior meridional chains of triangles had been executed by inexperienced observers and with instruments of an inferior order to those subsequently employed on the other chains, so that these portions of the triangulation had been accomplished under less favourable conditions than the other portions. Thus a material simplification of the undertaking might have been effected by excluding the inferior chains from the general reduction, and fitting them into their final places subsequently; for the exclusion of any internal chain would diminish the number of equations for simultaneous treatment by four, and consequently leave four equations for subsequent independent solution by themselves. It had been found necessary in the reduction of the South-East Quadrilateral to exclude the two meridional chains known as the South Malúncha and the South Párasnáth Series, because of their marked inferiority to the surrounding chains. This method of simplification was at first seriously contemplated; but on closer examination it was found not to be desirable; for the theoretical errors of the angles in the worst portion of the triangulation were not so much greater than those of the angles in the better portions, but that a judicious combination of the whole triangulation might be made on the basis of the existing evidence regarding the relative weights of the several angles.

One series only—the Budhon Meridional—was eventually excluded; this was done not so much because of its inferior character, as because its connection with any other portion of the triangulation than the Calcutta Longitudinal, was so slight that its influence on the general reduction would have been barely if at all perceptible. Starting from the southern longitudinal series, the Budhon chain closes on the upper extremity of the Great Arc, and not on the northern longitudinal as do all the other series; it is connected with the northern longitudinal series, but only by a single triangle, the one which is now numbered 57—see the Reduction Chart for that series. By excluding this triangle from the Simultaneous Reduction, and treating it as one of the redundant triangles of the polygonal figure to which it appertains, the Budhon Series could be, and was, completely severed from the North-East Quadrilateral, and made to rest entirely on the two fundamental series at its extremities. Its separate reduction will be found in an appendix to Part I of this volume.

The exclusion of the Budhon Meridional Series diminished the number of equations, 45, originally presented for simultaneous treatment by four, and by six the number, 47, which would have been required to take cognisance also of the connection with the Great Arc at Ráepur, indicated in the foot note to the preceding page.

A further elimination of eight equations, by the rejection of the Rangír and the Karára Series, was at first contemplated. For on comparing the closing errors of the several circuits it was found that the largest of all occurred in the circuits into which these series entered, and that the circuits which would be formed by omitting these series presented much smaller closing errors. And as the angles had been mostly measured with indifferent instruments—those of the former with Cary's two 18-inch theodolites and Harris and Barrow's 15-inch, and of the latter with Troughton and Simms' 18-inch No. 1, a Cary's 18-inch, Harris and Barrow's 15-inch and Saiyad Mir Mohsin's 18-inch—it was at first thought that the angular measurements were in fault. But when the relative weights of the whole of the angles came to be

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investigated, with a view to assigning to each angle its proper weight in the final combination, it was found that the angles of these series were not so inferior in weight to the angles of the other series as to justify their exclusion from the Simultaneous Reduction.

This will be at once seen from the following table of the average values of the 'errors of mean square'—*e.m.s.*—of the *observed* angles in each of the several series of triangles, which has been deduced from the data—given in a subsequent section of this chapter—for the investigation of the Weights of the Angles.

Average Errors of Mean Square of the Observed Angles, in each Series of Triangles.*

Rangír	± 1″·70	Huríláong	± 1″·36	The old meridional chains, appertaining to the North-East Quadrilateral.
Amua	1 ·64	Chendwár	1 ·09	
Karára	1 ·27	North Párasnáth	0 ·90	
Gurwáni	1 ·11	North Malúncha	1 ·27	
Gora	1 ·00	Calcutta Meridional	1 ·40	
		North-East Longitudinal Series	0 ·42	
Assam Longitudinal	± 0″·63	Brahmaputra	0 ·50	The modern meridional and longitudinal series appertaining to the Extension.
East Calcutta Longitudinal	0 ·34	Eastern Frontier	0 ·52	
		West Calcutta Longitudinal Series	0 ·29.†	

It will be seen that the value of the angular *e.m.s.* is largest for the Rangír Series which might have been eliminated; but this value is not very much larger than that for the Calcutta Meridional Series, the retention of which was obligatory; the value for the Karára Series is less than that for either the Amua, the Huríláong, or the Calcutta Meridional Series, and is the same as for the North Malúncha. Thus the rejection of either the Rangír or the Karára Series, on the grounds of the general inferiority of the angular measurements, was evidently not admissible. This became all the more obvious when an investigation of the relative magnitudes of the linear and geodetic errors at the close of the 'circuits' pointed to

* These values of the *e.m.s.* are the average values of the adopted denominators of ρ—or, in other words, of either the e_2 or the e_3, or the mean of both, as was deemed most appropriate in each instance—which are given for each group of triangles in each series, in the tabular *Synopsis of the Values of ρ^2 and the Evidence for their Determination* in the section of this chapter on the Weights of the Angles.

† On reference to Section 12 of Chapter II of Vol. VI, data will be found for the calculation of the average *e.m.s.*, not merely of the observed but also of the figurally corrected angles of this series; the angles are comprised in Figures 9 to 12 of Group III, Figures 13 to 20 of Group IV, and Figure 21 which forms Group XIV; the final weights, w_c, of these angles are the Absolute Weights in the table at the end of the section. The square root of the reciprocal of w_c may be accepted as giving a very fairly approximate value of the average *e.m.s.* of the figurally corrected angles of each figure; these values have been combined with weights proportional to the number of angles in each figure. The value of the *e.m.s.* thus deduced for the whole series is ± 0·21, while that for the series as it stands after final correction, by the reduction of the South-East Quadrilateral, must be somewhat less; see Section 18 of Chapter XVII, Volume II.

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a preponderance in the magnitudes of the linear and the azimuthal errors, as compared with those in latitude and longitude, which is inexplicable, excepting on the assumption that the lengths and azimuths of the sides of some of the triangles had not remained constant throughout the operations, but had in some instances become altered, because of deflections occurring insensibly at the (solid) tower stations in the plains during the progress of the operations. Such deflections might take place when a newly built tower was used before it had become settled; but they would most probably occur during the interval which elapsed between the closing observations of one field season and the initial observations of the next, and which sometimes comprised more than one monsoon season with its concomitant heavy rainfalls.

It has already been stated, at page 14, that deflections were met with at the towers at the extremities of the side Harpur to Barháta of the North-East Longitudinal Series by which the length of that side may have been augmented by 10·8 inches, more or less, the exact amount not being ascertainable without pulling down the pillars—which were solid throughout—to refer to the markstones at their basements. But since that page was passed through the press, some information has been obtained, from the old records of the Rangír Series, which renders certain what had previously been only conjectural, and furnishes positive evidence of the magnitude of the possible deflections. The pillars at all the stations of that series in the plains were made hollow from top to bottom, to enable plumb-lines suspended from the summit to reach the basement. Thus deflections were easily measureable. The cores of the pillars were about 12 inches in diameter at top and 18 inches at base; therefore whenever any deflection not exceeding 9 inches took place, a plummet suspended from the centre of the orifice above would alight freely on the basement; this however was not found to be sufficient to give all the play that was desired; consequently in several instances a 'capital' was constructed on the top of the pillar, exceeding the diameter of the shaft by about 12 inches, to enable the theodolite to be set up excentrically, and thus admit of a further deflection of 6 inches. This shows that experience indicated the necessity of being prepared to deal with actual deflections of as much as 15 inches. But in some instances the deflections were even greater, for the upper half of the pillar had to be pulled down and rebuilt, to permit of reference being made from the summit to the ground level by plummet; and in one instance, when there was not time to rebuild, four markstones, forming a quadrilateral figure with the diagonals intersecting in the normal of the point over which the theodolite was set up, had to be constructed round the station, in order to recover the point in case of any subsequent deflection of the pillar. Now it so happened that permanent platforms were not built round these hollow pillars, but a temporary stage was erected at each, whenever required. Subsequently the form of tower station was altered, and the solitary hollow pillar gave place to a solid pillar surrounded by a platform of earthwork; and then it appears to have been expected that the platform would serve as a protection to the pillar and prevent it from deflecting; but experience has shown that the platform is itself more liable than the pillar to become deflected during the rainy season, and that by pressing against the pillar on one side it not unfrequently aggravates the evil it was expected to obviate. Thus the introduction of the solid pillar was the eventual cause of grave evil, though at the time it was attended with much advantage, in facilitating the construction and cheapening the cost of the tower stations.

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We may assume the *probable error* due to the deflection of a station on the summit of a solid pillar, during the cessation of operations in the rainy seasons, to be fully ± 6 inches. Then the *e.m.s.* of deflection on the side between two deflected stations will be equal to $\pm \sqrt{2} \times 1\cdot48 \times 6 =$ say 12 inches.

Hence, as the average length of the sides of cessation on the North-East Longitudinal Series is 10·8 miles, we may assume that

$$\text{the average } e.m.s. \text{ of deflection is} = \begin{cases} \pm \cdot000{,}0077 \text{ in logarithmic length,} \\ \pm\ 3''\cdot6 \text{ in azimuth} \end{cases}$$

on any side affected, while the corresponding *e.m.s.* of deflection on the latitude and longitude of either of the tower stations at the extremity of that side would be only ± 0″·007.

The normal relations between the magnitudes of the theoretical errors in length and azimuth of the side and in latitude and longitude of the stations at the extremity of a chain of sensibly equilateral triangles are given by the following equations, for a proof of which reference must be made to the Appendix to Part I of the present volume "On the Theoretical "Errors generated respectively in Side, Azimuth, Latitude and Longitude in a Chain of Tri-"angles". Assuming that the triangles are sensibly equilateral, that the three angles of every triangle have been measured and corrected for geometrical error, that the angles are all of equal weight, and that *no errors exist other than those of the fallible measures of the angles,*— and putting ϵ for the *e.m.s.* of any angle, R for the ratio of the last to the first side of the chain, n for the number of triangles, and l for the length of any side expressed in seconds of a great circle, 100 feet being taken as = 1″, then we have

$$e.m.s. \text{ of } \log R = \text{Modulus} \sqrt{\frac{2n}{3}}.\,\epsilon \sin 1''$$

$$e.m.s. \text{ of Azimuth} = \sqrt{\frac{2n}{3}}.\,\epsilon \quad \text{very approximately}$$

$$e.m.s. \text{ of Latitude or Longitude} = l\,\frac{\sqrt{2n^3+3n^2+10n}}{6}.\,\epsilon \sin 1''.$$

On applying these formulæ to the North-East Longitudinal Series—which may be regarded as a chain of 117 fairly equilateral triangles with an average side length of 730″, and with angles of which the average *e.m.s.* = ± 0″·42—we find that the theoretical errors accumulated between the origin and terminus are approximately as follows;—

$$e.m.s. \text{ of } \log R = \pm \cdot000{,}0078^*$$

$$e.m.s. \text{ of Azimuth} = \pm\ 3''\cdot7$$

$$e.m.s. \text{ of Latitude or Longitude} = \pm\ 0''\cdot45.$$

Thus then we see that the theoretical errors in length and azimuth, which the deflection of the tower stations have rendered only too probable, at any *single* side of cessation, are practically identical with the theoretical errors accumulated throughout the entire length of this chain of 117 triangles by reason of the fallibility of the measurements of the angles.

* If instead of assuming the triangulation to be sensibly equilateral, we take it as it stands, and employ the values of the actual angles in the calculations of theoretical error—using the logarithmic tabular differences of the sines of the angles which are the coefficients of the errors of those angles in the linear equations of condition, as given in Section 12 of the present Chapter—we obtain ± ·000,0081 as the value of this *e.m.s.*, which is very slightly in excess of the approximate value.

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And when we test this Series by reference to the measured base-lines which are situated at its extremities—one in Dehra Dún, the other at Sonákhoda—and compare the trigonometrical with the measured ratios of these base-lines, we find discrepancies which clearly indicate the presence of other sources of error than those due to the angular measurements. The ratio which is given by the base-line measurements may be assumed to be exact, as has been shown in Section 4 of Chapter XVII, Volume II; then the (logarithmically expressed) error of the trigonometrical ratio becomes ·000,0343, which is four times greater than the preceding investigation would lead us to expect. But there are no less than eight sides of cessation on this Series at which tower-deflections may very possibly have taken place; we may therefore consider that, on the whole Series,

$$\text{the } e.m.s. \text{ of deflection is} = \pm\sqrt{8}\times \cdot 000{,}0077 = \pm \cdot 000{,}0218$$

or more than twice and-a-half the *e.m.s.* due to the angular measurements. Thus the magnitude of the actual error of the triangulation, which is inexplicable if account is taken of the angular errors only, becomes sufficiently probable when the influence of tower-deflections is also taken into account.

The instances in which material deflections might have occurred insensibly, during a suspension in the observations of the angles, were much more numerous in the North-East Longitudinal Series than in any of the ten meridional chains which it ties together, and for the completion of which it had necessarily to wait; thus though this Series is superior to all the others as regards the precision of the angular measurements, it is inferior to them all in the matter of deflection. Its retention was obviously necessary to permit of the final reduction being undertaken. Clearly therefore the omission of any of the meridional chains in the final reduction would not have been justifiable.

For these reasons it became necessary to undertake the very formidable task of first constructing, and then solving simultaneously 41 geodetic and linear equations of condition, involving no less than 1269 unknown quantities. As this appeared, at first sight, to be a much more arduous undertaking than had been accomplished in the Simultaneous Reductions of the North-West and the South-East Quadrilaterals, it was considered necessary to simplify the calculations as much as possible, by aiming at less arithmetical nicety and precision in the results than had been previously attained, when every equation of condition had been solved with almost perfect accuracy; *vide* Section 17 of Chapter XVII and Appendix No. 12 of Volume II, and also Section 16, Chapter II, of Volume VI. But that accuracy had been obtained not so much by the very perfect system of checks against accidental error which was established, as by carrying all the calculations to such a number of decimal places as would prevent any accumulation of arithmetical error to an extent which would become sensible at the close of a very lengthy series of computations; and this last had been found a most laborious matter. In the present instance it was therefore determined, from the outset, not to add to the labour of the undertaking by paying much regard to possible arithmetical accumulations of error; before the calculations were commenced, Colonel Walker intimated to Major Herschel—to whom they were entrusted—that he was prepared to accept residual errors at the junctions of the several chains of triangles with each other and with the base-lines, 'of, say, 0″·5 in azimuth, 0″·05 in latitude and longitude, and 5 in the 7th place of decimals of the logarithm

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of a side'. Thus while the material portion of each closing error would be dispersed systematically over the whole of the triangulation, small residual errors might remain, not exceeding what would ordinarily be generated in a few triangles; and these—it was expected—might be subsequently dispersed over a few of the triangles nearest the junctions, by calculations of a comparatively simple nature.

It soon dawned on Major Herschel that the North-East Quadrilateral, though containing several more chains of triangles than either of its predecessors, was actually much less entangled; for each chain abutted in succession on triangulation which had been finally adjusted; and of the linear equations connecting base-lines, which usually introduce more or less entanglement and cause a very considerable amount of additional labour, there was no need to employ more than one. And he noticed that by arranging the primary equations of condition in the order of the circuits—grouping together the linear and the three geodetic equations for the first circuit, and then those for the second, and so on up to the last—the subsequent equations between the indeterminate factors would be presented in a far more simple form for solution, than if the primaries had been arranged in any other way— as, for instance, by grouping the linear, latitude, longitude and azimuth equations separately; or by forming the whole of the linear equations into one group, and the geodetic equations into another arranged in the order of the circuits, as was done in the reduction of the two first Quadrilaterals. He further noticed that the single primary equation between base-lines might be so introduced as only to entangle with three other equations which appertained to a single circuit; whereas in the previous reductions there were several equations between base-lines, and they caused an unavoidable entanglement with the whole of the circuit equations*.

* When a choice of equations exists it is generally preferable to select that which involves the fewer unknown quantities; because, in most cases, it will entail fewer calculations. These calculations are:— (1). The formation of terms $(\mathfrak{b}\mathfrak{B} + \mathfrak{c}\mathfrak{C})$ of which the sums constitute the significant coefficients of the indeterminate factors (Λ); (2). The solution of the equations between the indeterminate factors; and, (3). The deduction of the errors by the formulæ

$$y = [\mathfrak{B}\Lambda], \quad z = [\mathfrak{C}\Lambda].$$

(1). The number of terms $(\mathfrak{b}\mathfrak{B} + \mathfrak{c}\mathfrak{C})$ which any geometrical equation will furnish, may be ascertained by counting the number of triangles involved in it, and the number of those same triangles which are involved in any of the other geometrical equations. In each case the sum will give the number of terms in the coefficient of the corresponding indeterminate factor in the resulting equation between the factors. Suppose for example the equation to be selected is the pth geometrical equation; then the number of triangles involved will give the number of terms $(\mathfrak{b}\mathfrak{B} + \mathfrak{c}\mathfrak{C})$ which go to form the coefficient of ${}_p\Lambda$ in the pth equation between the factors; and the number of common triangles involved in the pth and qth equations will give the number of terms forming the coefficient of ${}_q\Lambda$ in the pth equation between the factors: the total number of terms $(\mathfrak{b}\mathfrak{B} + \mathfrak{c}\mathfrak{C})$ due to any geometrical equation may be thus easily ascertained. (2). One equation, however, will in all probability give more significant coefficients of Λs than another; and if the excess is great the additional labour in solving the equations will also be great; if on the other hand the excess is small, while the saving in terms $(\mathfrak{b}\mathfrak{B} + \mathfrak{c}\mathfrak{C})$ is large, the choice should be governed by the latter. (3). The calculation of

$$y = [\mathfrak{B}\Lambda], \quad z = [\mathfrak{C}\Lambda]$$

is of course a minimum when the unknown quantities, generally, enter a minimum number of equations; a condition which is often better fulfilled by selecting a short equation rather than a long one, although the fewer unknown quantities appertaining to it may enter the larger number of equations.

In illustration of this, in the North-West Quadrilateral a choice lay between a linear equation between base-lines derived from a chain of 39 triangles, but entailing 19 significant coefficients of indeterminate factors, and a circuit equation derived from 249 triangles but entailing only 18 significant coefficients of factors. In this case there could be no question as to which to select; but had an examination been necessary it would have shewn that the shorter equation required the calculation of only 178 terms $(\mathfrak{b}\mathfrak{B} + \mathfrak{c}\mathfrak{C})$ while the longer would have involved 1606 such terms. Further, although certain of the 78 unknown quantities y and z of the shorter equation entered 18 other equations, a very much larger proportion of the 498 unknown quantities entered the 17 other equations. In the

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The arrangement of the equations between the indeterminate factors has obviously no significance on the final results; but it may have much significance on the amount of labour which has to be gone through in order to obtain those results. The object which should be aimed at in the arrangement is, to group together all equations which contain a large number of the unknown quantities in common, in such a manner that each group shall contain as many as possible of the unknown quantities included in the two groups immediately preceding and following it; in other words, when the coefficients of the unknown quantities are arranged in order vertically, the number of blank values *between* significant values should be a minimum, and the number of blank values *exterior* to significant values a maximum. When this is the case, the equations are presented in the simplest form, for treatment in successive groups, each group containing one unknown quantity less than the group preceding it. Blank values entering (vertically) between significant values of the coefficients of any unknown quantity, lead to the introduction of significant coefficients in every subsequent stage of the calculations, until the unknown quantity itself becomes eliminated; obviously therefore that arrangement is the best which causes no unnecessary calculations of this nature.

In the present instance the most appropriate arrangement was readily secured by grouping together all the four equations appertaining to each circuit, and then marshalling the several groups in the order of sequence of the chains of triangles from west to east; finally the linear equation, which was wanted to introduce the single base-line into the triangulation, was formed on a meridional series, entering into the four equations of a single circuit—the last—whereas in both the previous reductions the base-line equations had necessarily been formed on the longitudinal series which enter the whole of the circuits. Thus there was much less of entanglement than had been previously encountered; and when the equations between the indeterminate factors came to be formed, there were no blank values of coefficients between, while there were very many exterior to, the significant coefficients.

Moreover it became obvious that additional groups of equations might be introduced for the purpose of bringing certain external chains of triangles lying to the east of the Calcutta Meridional Series—under treatment simultaneously with the chains first selected for reduction, without causing any entanglement of the unknown quantities, but merely increasing the labour of the solution in proportion to their number; whereas when every term in the equations between the indeterminate factors is significant, an increase in the number, say k, of equations causes an increase in the number of terms in the proportion of $\frac{1}{2}(k^2 + k)$ to k, as has been shown at page 107 of Volume II. Major Herschel thereupon extended the Simultaneous Reduction to embrace the four chains of triangles lying immediately to the east of the Calcutta Meridional Series. Thus two circuits, involving eight equations, were added to the investigation. Consequently the total number of equations became 49, of which the first 40 are the circuit equations appertaining to the North-East Quadrilateral as originally designed, the 41st is the linear equation introducing the Sonákhoda Base-line, and the last 8 are the circuit equations appertaining to the Extension.

South-East Quadrilateral an exactly similar choice existed; but the equation between the base-lines now entailed three extra significant coefficients of indeterminate factors, but only 240 terms ($\mathfrak{b}\,\mathfrak{B} + \mathfrak{c}\,\mathfrak{C}$) against 891 and 480 products $\mathfrak{B}\,\Lambda$ and $\mathfrak{C}\,\Lambda$ against 1782. Here again the small extra labour entailed by the extra coefficients of factors was quite counterbalanced by the great saving in the other calculations.

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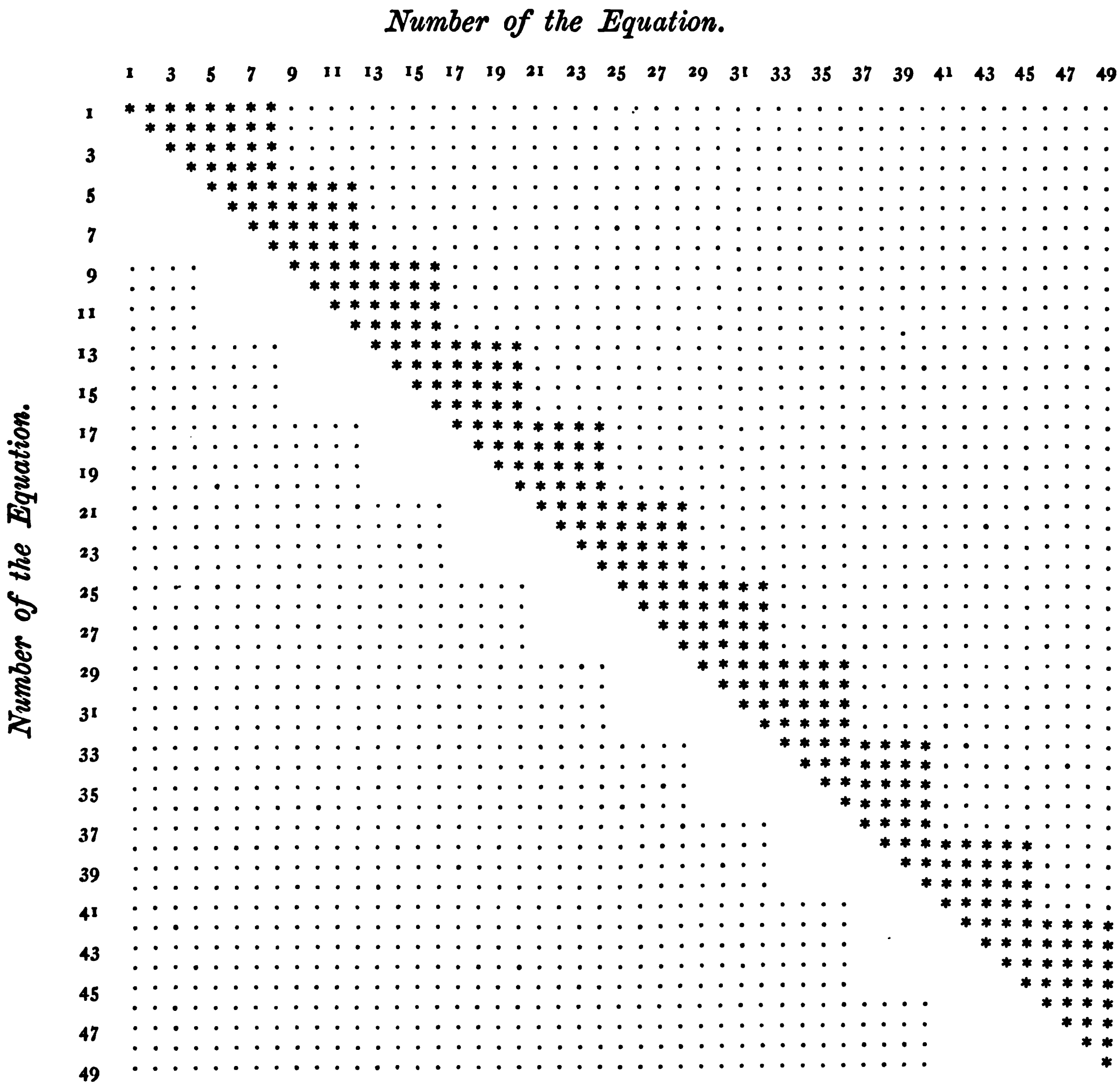
The following diagram indicates the significant terms *on and above the diagonal* on the left-hand sides of Major Herschel's equations between the indeterminate factors, and is interesting as an illustration of the symmetrical arrangement which the conditions of the problem rendered possible. The absolute terms, of which there is of course one to each equation, are omitted.



It may be here observed that in the North-West and the South-East Quadrilaterals the presence of base-lines or fixed lengths at the four corners, and the necessary linear equations connecting them, tied together the chains of triangles to such an extent that the application of the foregoing method of arrangement would not have led to a very material saving of labour. The number of blank values entering vertically between significant values of the coefficients would have been diminished by 57 in the first and by 16 in the second; but this would

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not have materially affected the calculations, as a considerable majority of the coefficients were significant in both cases, whereas here a considerable majority of the coefficients were = o. On the other hand if, through any inadvertence, the primary equations of condition of this Quadrilateral had been grouped for solution in the same way as in the two previous instances, the labour of solving them would have been enormously increased, and the introduction of the four additional chains of triangles appertaining to the Extension would have been impracticable.

2.

Synopsis of Independent Figural Reductions antecedent to the Final Simultaneous Reduction.

The North-East Quadrilateral is made up of the following single triangles, quadrilaterals, polygons of one or more centres, and compound figures; and the angular errors have been obtained by the method of Least Squares.

Series		Single Triangles	Quadri-laterals	Polygons of 1 to 4 Centres				Compound Figures	No. of Angles in each Series
				1	2	3	4		
North-East Longitudinal	...	96	2	4	1	...	...	...	403
Rangír Meridional	...	31	...	1	...	...	...	...	102
Amua "	...	34	...	...	...	...	...	...	102
Karára "	...	21	1	1	...	...	1	...	137
Gurwáni "	...	32	...	...	...	...	...	...	96
Gora "	...	23	...	...	...	...	...	1	92
Huriláong "	...	20	...	1	...	...	...	1	109
Chendwár "	...	17	1	2	...	...	...	...	92
North Párasnáth Meridional	...	20	...	...	...	...	...	...	60
North Malúncha "	...	6	...	3	...	...	...	...	78
Calcutta Meridional	...	45	...	...	...	...	...	...	135
East Calcutta Longitudinal	...	32	...	2	...	...	...	...	132
Assam Longitudinal	...	...	2	6	2	...	...	...	169
Eastern Frontier, Section 23° to 26° and Cachar Branch	...	...	6	3	1	1	1	...	216
Brahmaputra	...	...	...	7	1	...	...	1	180
		377	12	30	5	1	2	3	2103

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The figural conditions and reductions—excluding those of the single triangles, which are of so simple a form as not to require special exhibition, but will be found in the general data of the triangles—are given for each series, immediately after the abstracts of the observed angles: a diagram of each figure is also given in the plates for each series. These together afford the means of readily following the calculations appertaining to each figure*.

Summing up the geometrical equations of condition, *triangular*, *central* and *side*, furnished by the whole of the figures, they amount collectively to 706 triangular, 58 central and 73 side equations, or 837 equations in all.

The weights employed in the figural reductions in the Series I and K to T were the reciprocals of the squares of the 'probabilities of error'—see page 21—with the following exceptions:—(1) Triangle No. 1 of the Rangír Series; the angles were measured by Mr. Shelverton, when revising the western portion of the West Calcutta Longitudinal Series, and their weights were calculated by the modern formula. (2) Fig. No. 7 or the Sonákhoda Base-line Figure; the angles of this figure were measured twice, first by Mr. Lane with Troughton and Simms' 36-inch theodolite, and afterwards by Mr. Nicolson with Barrow's 24-inch No. 1—see pages 8 and 9; both sets of measures were retained, and values of the observed angles were deduced by combining the separate measures of each angle with their respective weights, but without the introduction of any equalizing modulus; the reciprocal weights employed in the figural reduction are those of the sums of the individual weights of the angles obtained by each measurement. (3) Fig. No. 15. The original station of Chendwár having been destroyed prior to the revision of the West Calcutta Longitudinal Series, and a fresh one having been established, it became necessary to connect this with the triangulation of the Chendwár Series; consequently Mr. Keelan, when carrying out the revision, measured the angles of two of the triangles—see page 7; the weights of these angles and those of the other three triangles composing the figure, were reduced to a common standard of accuracy prior to the commencement of the figural reduction†. For the remaining Series, U to X, weights calculated in the modern manner—as described at pages 22 and 23—were employed.

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* The side equations in the figural reductions are expressed in different forms in different portions of the triangulation. In the form first adopted the coefficients of the unknown quantities are the cotangents of the angles, in the other they are the tabular differences of the logarithmic sines of the angles. The latter have been made use of for figures Nos. 7, 21, 23 to 41 and 46 to 53.

† Fig. No. 15 consists of five triangles, two measured by Mr. Keelan with Colonel Waugh's 24-inch No. 1 and three by Mr. Logan with Troughton and Simms' 18-inch No. 2. Computing e_1 and e_2 for each we have

For triangles by Mr. Keelan $e_1 = 0{\cdot}33$, $e_2 = 0{\cdot}34$

" Mr. Logan $e_1 = 0{\cdot}73$, $e_2 = 1{\cdot}34$

It appeared however that 87 angles measured with Troughton and Simms' 18-inch No. 2 on the Chendwár Series, give the average following values of e_1 and e_2;

$$e_1 = 0{\cdot}98, \quad e_2 = 0{\cdot}87$$

Thus the calculations for this instrument from the figure itself give e_1 somewhat too small and e_2 somewhat too large; consequently the mean of e_1 and e_2 was taken and its square employed for $\frac{1}{w}$ for Mr. Logan's angles. Thus, with sufficient approximation, we have for Mr. Keelan's angles $\frac{1}{w} = 0{\cdot}12$ and for Mr. Logan's angles $\frac{1}{w} = 1{\cdot}00$.

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3.

Description of the Reduction Chart.

The Reduction Chart at the end of this volume exhibits the whole of the Principal Triangulation of the North-East Quadrilateral, as it was originally executed, including the Budhon Series, though, as has already been explained, that series was reduced after the simultaneous reduction of the whole of the others. Part of the triangulation consists of polygonal figures or net-works, of which some of the angles are not introduced into the final reduction, and part of single triangles, of which all the angles are introduced. The fixed data for the final reduction are the length of the Sonákhoda Base-line, the Great Arc Series—Section 24° to 30°—of the North-West Quadrilateral, and the West Calcutta Longitudinal Series of the South-East Quadrilateral. The two fundamental series are fully exhibited, and are distinguished by the sides of the triangles being shewn by thicker lines than those of all the other triangles; the sides on which the several series of the North-East Quadrilateral abut, and of which the elements enter the calculations as fixed quantities, are defined by double lines terminated by black circles with white centres.

The positions of Base-lines are indicated by thick black lines; of these fixed linear elements, the Sironj, Dehra Dún and Calcutta Bases, situated at the extremities of the fundamental series, fall outside the limits of this Quadrilateral, and the Sonákhoda Base alone enters in the simultaneous reduction of the Quadrilateral. Of the several series which enter the reduction, the *circuit* triangles—the errors of whose angles are the unknown quantities in the reduction, and are all investigated simultaneously—are indicated by continuous lines. The *non-circuit* triangles are the portions of the original polygonal figures and net-works which are excluded from the simultaneous reduction, and their sides are indicated by broken lines.

The fifteen chains I to X, J being excluded, form twelve circuits, into which each of the meridional chains enter wholly; the longitudinal chains, I, U and X are divided into sections which are denoted thus:—

I by I_1, I_2, I_3, . . . and I_{10},

U „ U_1, and U_2,

X „ X_1, and X_2,

the sections being numbered from west to east.

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Thus the circuits are composed of the following chains:—

Circuit	*I*	of	K and I_1,
,,	*II*	,,	L, I_2, and K
,,	*III*	,,	M, I_3, ,, L
,,	*IV*	,,	N, I_4, ,, M
,,	*V*	,,	O, I_5, ,, N
,,	*VI*	,,	P, I_6, ,, O
,,	*VII*	,,	Q, I_7, ,, P
,,	*VIII*	,,	R, I_8, ,, Q
,,	*IX*	,,	S, I_9, ,, R
,,	*X*	,,	T, I_{10}, ,, S
,,	*XI*	,,	U_1, V, T and X_1
,,	*XII*	,,	U_2, W, V ,, X_2

Along the flank, on the right-hand side, looking north or west, of every chain of triangles but T which appertains to first ten circuits, a dotted line runs parallel to the sides of the triangles; this is the *line of the traverse.* In the chains which enter Circuits *XI* and *XII* this line zig-zags backwards and forwards across the chain*†.

The line of traverse for each circuit is usually divided into two parts, known as the right-hand and left-hand branches; but Circuit *I* has no left-hand branch, because the right-hand branch both orginates from and closes on sides already fixed in length and position. Where the station of origin of any circuit is not a point of which the position has been already fixed by previous reductions, it is denoted by two concentric circles; with a similar exception, the closing point is denoted by three concentric circles. The sides which form the origins of the right and left-hand branches of the circuits and on which they close are shewn by double lines.

The principal stations are indicated on the Chart by small circles, with their names and the serial numbers by which it has been found convenient to distinguish them for reference in the course of the reductions. These numbers, which are in Roman character, are progressive in order from south to north in meridional series and from west to east in longitudinal series, except in the Eastern Frontier Series, where the usual order of numbering is reversed, as the series extends many degrees to the south of the limits of this Quadrilateral.

* Both the direct and the zig-zag line of traverse were employed for chain T, the former in Circuit *X* and the latter in Circuit *XI*. In order to avoid confusion the zig-zag line alone is shewn on the Chart, the direct line being sufficiently indicated by the sequence of the numbers in block type.

† The course of the zig-zag line of traverse in the neighbourhood of triangle 461 needs explanation, since all three sides of that triangle are accompanied by a dotted line. This is because the traverse for the right-hand branch of Circuit *XI* passes *viâ* Bábupur, Daulatpur, Hatiára, Maheshpur, &c., that for the left-hand branch of Circuit *XII* commences from Orfi and passes *viâ* Daulatpur, Hatiára, Maheshpur, &c.; and that for the right-hand branch of the same circuit also commences from Orfi and passes *viâ* Hatiára, Baniári, &c. Triangle 501 is similarly circumstanced.

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The principal stations on the right-hand flank of all the chains of circuit triangles, in the order in which the circuits are formed, have each an additional number in block type assigned to them. These numbers indicate the stations of which the geodetic elements have been calculated in ascertaining the circuit errors; and, for the first ten circuits in which the direct traverse has been employed, they are also the traverse numbers: they commence from the initial station of Circuit *I*, *viz.*, Rangír of the Rangír Series, which is numbered **1**, and terminate at Umter, **292**, near the northern extremity of the Eastern Frontier Series.

The circuit triangles are numbered from 1 to 573; commencing from the initial side of Circuit *I*, Rangír-Tinsmál of the Rangír Series, they follow the same course as the traverse, and terminate at the northern extremity of the Eastern Frontier Series. In each of these triangles one of the angles is marked y and another z; y and z are the symbols for the errors of the 'angles of continuation' which have been adopted throughout the Simultaneous Reduction; x is the symbol for the errors of the flank angles; but as x has been eliminated throughout by the substitution for it of $-(y+z)$, it is not indicated on the Chart. The addition of the number of any triangle as a subscript to either of these symbols, particularizes the angle in each instance. The numbering of the '*non*-circuit triangles' is carried on in continuation of that of the circuit triangles, and enters the chains in the same order as the numbering of the circuit triangles; here smaller numerals are used on the Chart for distinction.

Polygonal figures and net-works occur in all the series except L, N, R and T, and are distinguished by numbers, carried consecutively through the several series I, K, &c., to U, taken in alphabetical order, which increase in the directions south to north and west to east. After chain U the numbering has been somewhat irregular, having been carried first through X, then down W from north to south, and lastly up V from south to north. These numerals have also been retained as the Figure-numbers in the diagrams and the reductions of the figures which are given for each series.

It is to be remarked that the term 'figure' is only applied in the Chart to groups of triangles forming a polygon or other net-work, and is not applied to single triangles. A single triangle has, however, as much claim to be called a figure: hence the term 'figural errors', when made use of elsewhere in this volume, is generally applied to errors of single triangles as well as of net-works.

The course of the lines of Spirit Levels of this Survey which traverse the North-East Quadrilateral, and the connections which have been effected with many of the principal stations, are also shewn on the Chart. The Spirit Leveling Operations orginate at the mean-sea level of Kurrachee (Karáchi) Harbour; they approach the Quadrilateral from the neighbourhood of Umballa, latitude 30° 21′, longitude 76° 52′, and after connecting with the Dehra Dún Base-line, they pass down the Great Arc Series to Sironj: two main lines have been carried respectively east and south-east from the neighbourhood of Meerut and Agra, and they close on the Sonákhoda and Calcutta Base-lines.

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4.

General Outline of the Formation of the Linear and Geodetic Equations of Condition, and a Statement of the Entire Number of Equations presented by the Triangulation.

The triangulation having been first made consistent so far as all figural conditions were concerned, the linear calculations were commenced successively at the sides Tinsmál-Rangír, Amua-Lakanpura, Karára-Marwás, &c., where series K to T abut on the Calcutta Longitudinal Series, and they were carried up those series and then westwards through the intervening sections of the North-East Longitudinal Series, to close successively on the sides Chándípahár-Ghandiál, Atária-Beheri, Dahlelnagar-Rámnagar, &c. They were then recommenced from the side Rámganj-Newáni of the Sonákhoda Base-line Figure (Fig. 7), and carried eastwards along X_1 as far as the head of Series V where they stopped. They were taken up again at the side Chinsurah-Boga at the southern extremity of Series T, and carried through U_1, V and X_2, closing on the side Harogaon-Tepkilabama; and lastly they were recommenced at the side Orfi-Hatiára of U_1 and carried through U_2 and W, closing again on the side Harogaon-Tepkilabama.

The calculations of the geodetic latitudes, longitudes and azimuths were carried in all cases along the right flanks of the chains of circuit triangles, commencing and terminating with the linear calculations.

The order in which the calculations have been made for the simultaneous reduction, will be readily understood on reference to the Reduction Chart, for the linear calculations by tracing the sequence of the numbering of the circuit triangles, and for the geodetic calculations by noting the sequence of the numbers in block type.

The errors of the circuits are the differences between the two sets of linear and geodetic values at the stations and sides of junction, as exhibited by the calculations through the right and left-hand chains of each circuit.

The error at the junction of the chain of triangles with the base-line, has been simply taken as the difference between the measured length of the base-line and the computed length brought up through the Calcutta Meridional Series. The base-line measurement was assumed to be errorless for similar reasons to those given in Section 4 of Chapter XVII, Vol. II.

We may employ formula (14) on page 27 to ascertain the number of equations of condition, here called circuit equations, to which the triangulation should still be subjected to make it consistent. The figural equations make each group of angles of a figure or net-work consistent *inter se*; but they take no cognisance of the connection of chains into circuits, and the conditions required for such connection. The formula is however equally applicable to both simple figures and to larger sections of triangulation forming circuits.

Now this Quadrilateral is so closely connected with the Great Arc and the West Calcutta Longitudinal Series, that portions of some of the figures or net-works belonging to it are situated in the fundamental series, and have been therefore already reduced, thereby furnishing fixed data to which the other portions have to conform; it will therefore simplify the application of the formula to include those series. The data will then be as follows:—

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The Great Arc—Section 24° to 30°, has 247 angles connecting 67 stations, and has been subjected to 117 figural equations of condition (see Vol. IV).

The Calcutta Longitudinal Series has 324 angles connecting 87 stations, excluding the 2 stations of the Great Arc on the positions of which it is based, and has been subjected to 150 figural equations of condition (see Vol. VI).

The North-East Quadrilateral has 2103 angles connecting 609 stations, excluding those appertaining to the foregoing series, and has been subjected to 837 figural equations of condition.

Thus we have for the combined triangulation:—N (the number of angles) = 2674, S (the number of stations) = 763, or

$$N - 2S + 4 = 1152$$

Now of these 1152 equations it has been shewn that 1104 have already been employed; therefore there remain 48 equations of condition to which the triangulation has not been subjected; the Sonákhoda Base-line gives an additional equation. Thus there are in all 49 equations for treatment.

Let the symbols I, K, L, . . . X, which have been hitherto employed in lieu of the names of the several series, be now employed, with the addition of certain subscripts, to indicate the sum of the terms on the right-hand side of the linear equations—(35) or (36) page 47, as the case may be—and of the geodetic equations—(57) or (62) pages 54 and 57, which express the errors of the several angles. Let the subscripts be c and A for the linear and azimuthal errors, λ and L for the errors in latitude and longitude, placed on the left-hand side of the governing symbol. Also let E with a numerical subscript on the left-hand side, corresponding to the number of the equation, be employed to represent the absolute terms, as in equations (66) page 59.

The several equations will now be briefly expressed in the order in which they enter the circuits as follows:—

Circuit I.

$${}_c\mathrm{K} + {}_c\mathrm{I}_1 \; . \; . \; . \; . \; . \; . \; . = {}_1E.$$
$${}_\lambda\mathrm{K} + {}_\lambda\mathrm{I}_1 \; . \; . \; . \; . \; . \; . \; . = {}_2E.$$
$${}_L\mathrm{K} + {}_L\mathrm{I}_1 \; . \; . \; . \; . \; . \; . \; . = {}_3E.$$
$${}_A\mathrm{K} + {}_A\mathrm{I}_1 \; . \; . \; . \; . \; . \; . \; . = {}_4E.$$

Circuit II.

$${}_c\mathrm{L} + {}_c\mathrm{I}_2 - {}_c\mathrm{K} \; . \; . \; . \; . = {}_5E.$$
$${}_\lambda\mathrm{L} + {}_\lambda\mathrm{I}_2 - {}_\lambda\mathrm{K} \; . \; . \; . \; . = {}_6E.$$
$${}_L\mathrm{L} + {}_L\mathrm{I}_2 - {}_L\mathrm{K} \; . \; . \; . \; . = {}_7E.$$
$${}_A\mathrm{L} + {}_A\mathrm{I}_2 - {}_A\mathrm{K} \; . \; . \; . \; . = {}_8E.$$

Circuit III.

$${}_c\mathrm{M} + {}_c\mathrm{I}_3 - {}_c\mathrm{L} \; . \; . \; . \; . = {}_9E.$$
$${}_\lambda\mathrm{M} + {}_\lambda\mathrm{I}_3 - {}_\lambda\mathrm{L} \; . \; . \; . \; . = {}_{10}E.$$
$${}_L\mathrm{M} + {}_L\mathrm{I}_3 - {}_L\mathrm{L} \; . \; . \; . \; . = {}_{11}E.$$
$${}_A\mathrm{M} + {}_A\mathrm{I}_3 - {}_A\mathrm{L} \; . \; . \; . \; . = {}_{12}E.$$

Circuit IV.

$${}_c\mathrm{N} + {}_c\mathrm{I}_4 - {}_c\mathrm{M} \; . \; . \; . \; . = {}_{13}E.$$
$${}_\lambda\mathrm{N} + {}_\lambda\mathrm{I}_4 - {}_\lambda\mathrm{M} \; . \; . \; . \; . = {}_{14}E.$$
$${}_L\mathrm{N} + {}_L\mathrm{I}_4 - {}_L\mathrm{M} \; . \; . \; . \; . = {}_{15}E.$$
$${}_A\mathrm{N} + {}_A\mathrm{I}_4 - {}_A\mathrm{M} \; . \; . \; . \; . = {}_{16}E.$$

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Circuit V.

$$
\begin{aligned}
{}_{c}O + {}_{c}I_5 - {}_{c}N \dots\dots &= {}_{17}E. \\
{}_{\lambda}O + {}_{\lambda}I_5 - {}_{\lambda}N \dots\dots &= {}_{18}E. \\
{}_{L}O + {}_{L}I_5 - {}_{L}N \dots\dots &= {}_{19}E. \\
{}_{\Delta}O + {}_{\Delta}I_5 - {}_{\Delta}N \dots\dots &= {}_{20}E.
\end{aligned}
$$

Circuit VI.

$$
\begin{aligned}
{}_{c}P + {}_{c}I_6 - {}_{c}O \dots\dots &= {}_{21}E. \\
{}_{\lambda}P + {}_{\lambda}I_6 - {}_{\lambda}O \dots\dots &= {}_{22}E. \\
{}_{L}P + {}_{L}I_6 - {}_{L}O \dots\dots &= {}_{23}E. \\
{}_{\Delta}P + {}_{\Delta}I_6 - {}_{\Delta}O \dots\dots &= {}_{24}E.
\end{aligned}
$$

Circuit VII.

$$
\begin{aligned}
{}_{c}Q + {}_{c}I_7 - {}_{c}P \dots\dots &= {}_{25}E. \\
{}_{\lambda}Q + {}_{\lambda}I_7 - {}_{\lambda}P \dots\dots &= {}_{26}E. \\
{}_{L}Q + {}_{L}I_7 - {}_{L}P \dots\dots &= {}_{27}E. \\
{}_{\Delta}Q + {}_{\Delta}I_7 - {}_{\Delta}P \dots\dots &= {}_{28}E.
\end{aligned}
$$

Circuit VIII.

$$
\begin{aligned}
{}_{c}R + {}_{c}I_8 - {}_{c}Q \dots\dots &= {}_{29}E. \\
{}_{\lambda}R + {}_{\lambda}I_8 - {}_{\lambda}Q \dots\dots &= {}_{30}E. \\
{}_{L}R + {}_{L}I_8 - {}_{L}Q \dots\dots &= {}_{31}E. \\
{}_{\Delta}R + {}_{\Delta}I_8 - {}_{\Delta}Q \dots\dots &= {}_{32}E.
\end{aligned}
$$

Circuit IX.

$$
\begin{aligned}
{}_{c}S + {}_{c}I_9 - {}_{c}R \dots\dots &= {}_{33}E. \\
{}_{\lambda}S + {}_{\lambda}I_9 - {}_{\lambda}R \dots\dots &= {}_{34}E. \\
{}_{L}S + {}_{L}I_9 - {}_{L}R \dots\dots &= {}_{35}E. \\
{}_{\Delta}S + {}_{\Delta}I_9 - {}_{\Delta}R \dots\dots &= {}_{36}E.
\end{aligned}
$$

Circuit X.

$$
\begin{aligned}
{}_{c}I_{10} - {}_{c}S \dots\dots &= {}_{37}E. \\
{}_{\lambda}T + {}_{\lambda}I_{10} - {}_{\lambda}S \dots\dots &= {}_{38}E. \\
{}_{L}T + {}_{L}I_{10} - {}_{L}S \dots\dots &= {}_{39}E. \\
{}_{\Delta}T + {}_{\Delta}I_{10} - {}_{\Delta}S \dots\dots &= {}_{40}E.
\end{aligned}
$$

Base-line Equation.

$$ {}_{c}T \dots\dots\dots = {}_{41}E. $$

Circuit XI.

$$
\begin{aligned}
{}_{c}U_1 + {}_{c}V - {}_{c}X_1 \dots &= {}_{42}E. \\
{}_{\lambda}U_1 + {}_{\lambda}V - ({}_{\lambda}T + {}_{\lambda}X_1) &= {}_{43}E. \\
{}_{L}U_1 + {}_{L}V - ({}_{L}T + {}_{L}X_1) &= {}_{44}E. \\
{}_{\Delta}U_1 + {}_{\Delta}V - ({}_{\Delta}T + {}_{\Delta}X_1) &= {}_{45}E.
\end{aligned}
$$

Circuit XII.

$$
\begin{aligned}
{}_{c}U_2 + {}_{c}W - ({}_{c}V + {}_{c}X_2) &= {}_{46}E. \\
{}_{\lambda}U_2 + {}_{\lambda}W - ({}_{\lambda}V + {}_{\lambda}X_2) &= {}_{47}E. \\
{}_{L}U_2 + {}_{L}W - ({}_{L}V + {}_{L}X_2) &= {}_{48}E. \\
{}_{\Delta}U_2 + {}_{\Delta}W - ({}_{\Delta}V + {}_{\Delta}X_2) &= {}_{49}E.
\end{aligned}
$$

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5.

Formation of the Coefficients of the Unknown Quantities.

On page 59 the Equations of Condition are represented by a form of which the following may be taken as a general illustration

$$ {}_m\mathfrak{b}_1\, y_1 + {}_m\mathfrak{c}_1\, z_1 + {}_m\mathfrak{b}_2\, y_2 + {}_m\mathfrak{c}_2\, z_2 + \ldots = {}_mE_1 \quad \ldots\ldots \quad (70) $$

the left-hand subscript denoting the equation number and the right-hand subscript the number of the triangle to which the errors appertain, and $\mathfrak{b}$ and $\mathfrak{c}$ being the coefficients of y and z respectively.

For the *Linear* Equations we shall have generally, see equation (34) page 47,

$$ \left. \begin{aligned} \mathfrak{b}_p &= \pm\, \beta_p = \pm \text{ t.d. log sin } Y \text{ for } 1''; \\ \mathfrak{c}_p &= \mp\, \gamma_p = \mp \text{ t.d. log sin } Z \quad ,, \end{aligned} \right\} \quad \ldots\ldots \quad (71) $$

For the *Geodetic* Equations we shall have

First, where the *direct* traverse has been employed, see expressions (58) and (59) on page 54,

$$ \left. \begin{aligned} \mathfrak{b}_p &= \pm\, (\mu_l\, \beta_p - \phi_l); \\ \mathfrak{c}_p &= \mp\, (\mu_l\, \gamma_p + \phi_l); \end{aligned} \right\} \quad \ldots\ldots \quad (72) $$

or

$$ \left. \begin{aligned} \mathfrak{b}_p &= \pm\, \{- m_l\, a_p + \mu_{l+1}\, \beta_p + \phi_l\}; \\ \mathfrak{c}_p &= \pm\, \{- m_l\, a_p - \mu_l\, \gamma_p + \phi_{l+1}\}; \end{aligned} \right\} \quad \ldots\ldots \quad (73) $$

(72) being applicable to any, the p^{th}, triangle when it has only the angle X in the traverse at station l, and (73) when it has the side opposite X in the traverse and lying between the stations l and $l+1$;

Secondly, where the *zig-zag* traverse has been employed, as appears from (63), page 57,

$$ \left. \begin{aligned} \mathfrak{b} &= \pm\, (\iota\phi + \mu\beta); \\ \mathfrak{c} &= \pm\, (\iota\phi - \mu\gamma); \end{aligned} \right\} \quad \ldots\ldots \quad (74) $$

in which the symbol ι stands for + when the triangle lies to the right of the traverse, and for − when it lies to the left.

In all the above expressions the double sign is necessary to make them applicable to both branches of the circuit, the lower signs being required when the triangle forms part of the left-hand branch of a circuit and the upper when it forms part of the right-hand branch.

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Exceptions to the General Expressions for $\mathfrak{b}$ *and* $\mathfrak{c}$.

The exceptions to the formulæ for $\mathfrak{b}$ and $\mathfrak{c}$ are as follows:—

(1) *The Direct Traverse.*

Circuit I. Equations 1 to 4.

Equation 1 has no exceptional coefficients; but in Equations 2, 3 and 4

$$\mathfrak{b}_{43} = -\mu_{22}\, a_{43} + \phi_{22}; \qquad \mathfrak{c}_{43} = -\mu_{22}\,(a_{43} + \gamma_{43});$$

with the exception of $\mathfrak{c}_{43}$ in Equation 4 which needs the addition of unity; because otherwise the left-hand member of the equation would only express the error in azimuth at the closing station Ghandiál of Station **22**; thus

$$_4\mathfrak{c}_{43} = 1 - {}_4\mu_{22}\,(a_{43} + \gamma_{43}).$$

The same equation also has additional terms to those of 2 and 3 furnished by triangle 44; these are

$$-\,y_{44} \text{ and } -\,z_{44}.$$

Circuit II. Equations 5 to 8.

In Equation 5

$$\mathfrak{b}_{34} = +\,a_{34}; \qquad \mathfrak{c}_{34} = +\,(a_{34} + \gamma_{34}).$$

In Equations 6, 7 and 8

$$\mathfrak{b}_{34} = +\,\mu_{17}\, a_{34} - \phi_{17}; \qquad \mathfrak{c}_{34} = +\,\mu_{17}\,(a_{34} + \gamma_{34});$$

$$\mathfrak{b}_{92} = -\,\mu_{46}\, a_{92} + \phi_{46}; \qquad \mathfrak{c}_{92} = -\,\mu_{46}\,(a_{92} + \gamma_{92});$$

with the exception of $\mathfrak{c}_{92}$ in Equation 8, in Azimuth, which needs the addition of unity to make the equation applicable to the azimuth at **18** of **17**; thus

$$_8\mathfrak{c}_{92} = 1 - {}_8\mu_{46}\,(a_{92} + \gamma_{92}).$$

Circuit III. Equations 9 to 12.

In Equation 9

$$\mathfrak{b}_{79} = +\,a_{79}; \qquad \mathfrak{c}_{79} = +\,(a_{79} + \gamma_{79}).$$

In Equations 10, 11 and 12

$$\mathfrak{b}_{79} = +\,\mu_{39}\, a_{79} - \phi_{39}; \qquad \mathfrak{c}_{79} = +\,\mu_{39}\,(a_{79} + \gamma_{79});$$

$$\mathfrak{b}_{138} = -\,\mu_{69}\, a_{138} + \phi_{69}; \qquad \mathfrak{c}_{138} = -\,\mu_{69}\,(a_{138} + \gamma_{138});$$

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Exceptions to the General Expressions for $\mathfrak{b}$ *and* $\mathfrak{c}$—(Continued).

with the exception of $\mathfrak{c}_{138}$ in Equation 12, in Azimuth, which like ${}_8\mathfrak{c}_{92}$ needs the addition of unity; thus

$${}_{12}\mathfrak{c}_{138} = 1 - {}_{12}\mu_{69}\,(\alpha_{138} + \gamma_{138}).$$

Circuit IV. Equations 13 to 16.

In Equation 13

$$\mathfrak{b}_{129} = +\,\alpha_{129}; \qquad \mathfrak{c}_{129} = +\,(\alpha_{129} + \gamma_{129}).$$

In Equations 14, 15 and 16

$$\mathfrak{b}_{129} = +\,\mu_{64}\,\alpha_{129} - \phi_{64}; \qquad \mathfrak{c}_{129} = +\,\mu_{64}\,(\alpha_{129} + \gamma_{129});$$

$$\mathfrak{b}_{180} = -\,\mu_{91}\,\alpha_{180} + \phi_{91}; \qquad \mathfrak{c}_{180} = -\,\mu_{91}\,(\alpha_{180} + \gamma_{180});$$

with the exception of $\mathfrak{c}_{180}$ in Equation 16, in Azimuth, which needs the addition of unity; thus

$${}_{16}\mathfrak{c}_{180} = 1 - {}_{16}\mu_{91}\,(\alpha_{180} + \gamma_{180}).$$

Circuit V. Equations 17 to 20.

In Equation 17

$$\mathfrak{b}_{171} = +\,\alpha_{171}; \qquad \mathfrak{c}_{171} = +\,(\alpha_{171} + \gamma_{171}).$$

In Equations 18, 19 and 20

$$\mathfrak{b}_{171} = +\,\mu_{86}\;\alpha_{171} - \phi_{86}; \qquad \mathfrak{c}_{171} = +\,\mu_{86}\;(\alpha_{171} + \gamma_{171});$$

$$\mathfrak{b}_{220} = -\,\mu_{112}\,\alpha_{220} + \phi_{112}; \qquad \mathfrak{c}_{220} = -\,\mu_{112}\,(\alpha_{220} + \gamma_{220});$$

with the exception of $\mathfrak{c}_{220}$ in Equation 20, in Azimuth, which needs the addition of unity; thus

$${}_{20}\mathfrak{c}_{220} = 1 - {}_{20}\mu_{112}\,(\alpha_{220} + \gamma_{220}).$$

Circuit VI. Equations 21 to 24.

In Equation 21

$$\mathfrak{b}_{211} = +\,\alpha_{211}; \qquad \mathfrak{c}_{211} = +\,(\alpha_{211} + \gamma_{211}).$$

In Equations 22, 23 and 24

$$\mathfrak{b}_{211} = +\,\mu_{107}\,\alpha_{211} - \phi_{107}; \qquad \mathfrak{c}_{211} = +\,\mu_{107}\,(\alpha_{211} + \gamma_{211});$$

$$\mathfrak{b}_{262} = -\,\mu_{135}\,\alpha_{262} + \phi_{135}; \qquad \mathfrak{c}_{262} = -\,\mu_{135}\,(\alpha_{262} + \gamma_{262});$$

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Exceptions to the General Expressions for $\mathfrak{b}$ *and* $\mathfrak{c}$—(Continued).

with the exception of $\mathfrak{c}_{262}$ in Equation 24, in Azimuth, which needs the addition of unity; thus

$${}_{24}\mathfrak{c}_{262} = 1 - {}_{24}\mu_{135} \left(a_{262} + \gamma_{262}\right).$$

Circuit VII. Equations 25 to 28.

In Equation 25

$$\mathfrak{b}_{249} = + a_{249}; \qquad \mathfrak{c}_{249} = + \left(a_{249} + \gamma_{249}\right).$$

In Equations 26, 27 and 28

$$\mathfrak{b}_{249} = + \mu_{128}\, a_{249} - \phi_{128}; \qquad \mathfrak{c}_{249} = + \mu_{128} \left(a_{249} + \gamma_{249}\right);$$

$$\mathfrak{b}_{302} = - \mu_{155}\, a_{302} + \phi_{155}; \qquad \mathfrak{c}_{302} = - \mu_{155} \left(a_{302} + \gamma_{302}\right);$$

with the exception of $\mathfrak{c}_{302}$ in Equation 28, in Azimuth, which needs the addition of unity; thus

$${}_{28}\mathfrak{c}_{302} = 1 - {}_{28}\mu_{155} \left(a_{302} + \gamma_{302}\right).$$

Circuit VIII. Equations 29 to 32.

In Equation 29

$$\mathfrak{b}_{289} = + a_{289}; \qquad \mathfrak{c}_{289} = + \left(a_{289} + \gamma_{289}\right).$$

In Equations 30, 31 and 32

$$\mathfrak{b}_{289} = + \mu_{148}\, a_{289} - \phi_{148}; \qquad \mathfrak{c}_{289} = + \mu_{148} \left(a_{289} + \gamma_{289}\right);$$

$$\mathfrak{b}_{330} = - \mu_{170}\, a_{330} + \phi_{170}; \qquad \mathfrak{c}_{330} = - \mu_{170} \left(a_{330} + \gamma_{330}\right);$$

with the exception of $\mathfrak{c}_{330}$ in Equation 32, in Azimuth, which needs the addition of unity; thus

$${}_{32}\mathfrak{c}_{330} = 1 - {}_{32}\mu_{170} \left(a_{330} + \gamma_{330}\right).$$

Circuit IX. Equations 33 to 36.

In Equation 33

$$\mathfrak{b}_{323} = + a_{323}; \qquad \mathfrak{c}_{323} = + \left(a_{323} + \gamma_{323}\right).$$

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Exceptions to the General Expressions for $\mathfrak{b}$ *and* $\mathfrak{c}$—(Continued).

In Equations 34, 35 and 36

$$\mathfrak{b}_{323} = + \mu_{166}\, a_{323} - \phi_{166}; \qquad \mathfrak{c}_{323} = + \mu_{166}\, (a_{323} + \gamma_{323});$$

$$\mathfrak{b}_{361} = - \mu_{186}\, a_{361} + \phi_{186}; \qquad \mathfrak{c}_{361} = - \mu_{186}\, (a_{361} + \gamma_{361});$$

with the exception of $\mathfrak{c}_{361}$ in Equation 36, in Azimuth, which needs the addition of unity; thus

$$_{36}\mathfrak{c}_{361} = 1 - {_{36}\mu_{186}}\, (a_{361} + \gamma_{361}).$$

Circuit X. Equations 37 to 40.

In Equation 37

$$\mathfrak{b}_{351} = + a_{351}; \qquad \mathfrak{c}_{351} = + (a_{351} + \gamma_{351}).$$

In Equations 38, 39 and 40

$$\mathfrak{b}_{351} = + \mu_{181}\, a_{351} - \phi_{181}; \qquad \mathfrak{c}_{351} = + \mu_{181}\, (a_{351} + \gamma_{351});$$

$$\mathfrak{b}_{423} = - \mu_{218}\, a_{423} + \phi_{218}; \qquad \mathfrak{c}_{423} = - \mu_{218}\, (a_{423} + \gamma_{423});$$

with the exception of $\mathfrak{c}_{423}$ in Equation 40, in Azimuth, which needs the addition of unity; thus

$$_{40}\mathfrak{c}_{423} = 1 - {_{40}\mu_{218}}\, (a_{423} + \gamma_{423}).$$

The Base-line Equation 41 has no exceptional coefficients.

(2) *The Zig-zag Traverse.*

Circuit XI. Equations 42 to 45.

In Equation 42

$$\mathfrak{b}_{362} = - a_{362}; \qquad \mathfrak{c}_{362} = - (a_{362} + \gamma_{362});$$

$$\mathfrak{b}_{407} = + (a_{407} + \beta_{407}); \qquad \mathfrak{c}_{407} = + a_{407};$$

$$\mathfrak{b}_{408} = + \beta_{408}; \qquad \mathfrak{c}_{408} = - \gamma_{408};$$

$$\mathfrak{b}_{501} = - a_{501}; \qquad \mathfrak{c}_{501} = - (a_{501} + \gamma_{501}).$$

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Exceptions to the General Expressions for $\mathfrak{b}$ *and* $\mathfrak{c}$—(Continued).

In equations 43, 44 and 45 Triangle 362 occurs in both branches of the circuit; in the left-hand branch there is nothing exceptional regarding it; but in the right-hand branch the coefficients of y and z are respectively

$$+ \phi_{362.444} - \mu_{362.444}\, a_{362} \text{ and } - \mu_{362.444}\, (a_{362} + \gamma_{362}).$$

When the coefficients furnished by both branches are combined

$$\mathfrak{b}_{362} = - \phi_{362} - \mu_{362}\, \beta_{362} + \phi_{362.444} - \mu_{362.444}\, a_{362};$$

$$\mathfrak{c}_{362} = - \phi_{362} + \mu_{362}\, \gamma_{362} - \mu_{362.444}\, (a_{362} + \gamma_{362}).$$

Again

$$\mathfrak{b}_{407} = - \phi_{407.424.425} + \mu_{407.424.425}\, a_{407}; \qquad \mathfrak{c} = + \mu_{407.424.425}\, (a_{407} + \gamma_{407});$$

$$\mathfrak{b}_{501} = - \phi_{501} - \mu_{501}\, a_{501}; \qquad \mathfrak{c} = - \mu_{501}\, (a_{501} + \gamma_{501}).$$

Circuit XII. Equations 46 to 49.

Triangle 461 occurs in both branches of the circuit: in the left-hand branch there is nothing exceptional regarding it; but in the right-hand branch in Equation 46 the coefficients of y and z are respectively

$$- a_{461} \text{ and } - (a_{461} + \gamma_{461}).$$

When combined

$$\mathfrak{b}_{461} = - a_{461} - \beta_{461}; \qquad \mathfrak{c}_{461} = - a_{461}.$$

In equations 47, 48 and 49, right-hand branch, the coefficients of y and z are respectively

$$+ \phi_{461} - \mu_{461}\, a_{461} \text{ and } - \mu_{461}\, (a_{461} + \gamma_{461});$$

hence

$$\mathfrak{b}_{461} = - {}_l\phi_{461} - {}_l\mu_{461}\, \beta_{461} + {}_r\phi_{461} - {}_r\mu_{461}\, a_{461};$$

$$\mathfrak{c}_{461} = - {}_l\phi_{461} + {}_l\mu_{461}\, \gamma_{461} - {}_r\mu_{461}\, (a_{461} + \gamma_{461}).$$

The subscripts l and r being employed to distinguish between the different values of ϕ_{461} and μ_{461} in the left and right-hand branches of the circuit.

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6.

Synoptical Exhibition of the several Equations of Condition.

For the sake of brevity let us put ${}_m\mathrm{k}_p$ for ${}_m\mathfrak{b}_p\, y_p + {}_m\mathfrak{c}_p\, z_p$, or in other words for the sum of the errors y and z of the angles Y and Z in any, the pth, triangle, respectively multiplied by their coefficients $\mathfrak{b}$ and $\mathfrak{c}$ in any, the mth, equation of condition. Then in forming the equations it will be necessary to substitute for m the number of the equation, and for p the number of the triangle. It will now be convenient to arrange the ks in numerical order between the initial and the terminal sides or stations of the chains to which they respectively appertain, so far at least as this can be done without any break of continuity in the numeration of the triangles. We may here put ${}_m\mathrm{k}\Big|_p^q$ to represent the sum of the terms ${}_m\mathrm{k}$ for a series of triangles of which the first term is ${}_m\mathrm{k}_p$ and the last term ${}_m\mathrm{k}_q$: when the triangles enter as usual in a numerically increasing order p will be $< q$; when they enter in a numerically decreasing order, as sometimes though very rarely happens, p will be $> q$.

The equations will then be expressed as follows:—

Circuit I.

(1). *Linear.* $${}_1\mathrm{k}\Big|_1^{44} \;.\;.\; = {}_1E.$$

(2). *Latitude.* $${}_2\mathrm{k}\Big|_1^{43} \;.\;.\; = {}_2E.$$

(3). *Longitude.* $${}_3\mathrm{k}\Big|_1^{43} \;.\;.\; = {}_3E.$$

(4). *Azimuth.* $${}_4\mathrm{k}\Big|_1^{44} \;.\;.\; = {}_4E.$$

Circuit II.

(5). *Linear.* $${}_5\mathrm{k}\Big|_1^{34} + {}_5\mathrm{k}\Big|_{45}^{92} = {}_5E.$$

(6). *Latitude.* $${}_6\mathrm{k}\Big|_1^{34} + {}_6\mathrm{k}\Big|_{45}^{92} = {}_6E.$$

(7). *Longitude.* $${}_7\mathrm{k}\Big|_1^{34} + {}_7\mathrm{k}\Big|_{45}^{92} = {}_7E.$$

(8). *Azimuth.* $${}_8\mathrm{k}\Big|_1^{34} + {}_8\mathrm{k}\Big|_{45}^{92} = {}_8E.$$

Circuit III.

(9). *Linear.* $${}_9\mathrm{k}\Big|_{45}^{79} + {}_9\mathrm{k}\Big|_{93}^{138} = {}_9E.$$

(10). *Latitude.* $${}_{10}\mathrm{k}\Big|_{45}^{79} + {}_{10}\mathrm{k}\Big|_{93}^{138} = {}_{10}E.$$

(11). *Longitude.* $${}_{11}\mathrm{k}\Big|_{45}^{79} + {}_{11}\mathrm{k}\Big|_{93}^{138} = {}_{11}E.$$

(12). *Azimuth.* $${}_{12}\mathrm{k}\Big|_{45}^{79} + {}_{12}\mathrm{k}\Big|_{93}^{138} = {}_{12}E.$$

Circuit IV.

(13). *Linear.* $${}_{13}\mathrm{k}\Big|_{93}^{129} + {}_{13}\mathrm{k}\Big|_{139}^{180} = {}_{13}E.$$

(14). *Latitude.* $${}_{14}\mathrm{k}\Big|_{93}^{129} + {}_{14}\mathrm{k}\Big|_{139}^{180} = {}_{14}E.$$

(15). *Longitude.* $${}_{15}\mathrm{k}\Big|_{93}^{129} + {}_{15}\mathrm{k}\Big|_{139}^{180} = {}_{15}E.$$

(16). *Azimuth.* $${}_{16}\mathrm{k}\Big|_{93}^{129} + {}_{16}\mathrm{k}\Big|_{139}^{180} = {}_{16}E.$$

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Circuit V.

(17). *Linear.* $ {}_{17}k\Big|_{139}^{171} + {}_{17}k\Big|_{181}^{220} = {}_{17}E.$

(18). *Latitude.* $ {}_{18}k\Big|_{139}^{171} + {}_{18}k\Big|_{181}^{220} = {}_{18}E.$

(19). *Longitude.* $ {}_{19}k\Big|_{139}^{171} + {}_{19}k\Big|_{181}^{220} = {}_{19}E.$

(20). *Azimuth.* $ {}_{20}k\Big|_{139}^{171} + {}_{20}k\Big|_{181}^{220} = {}_{20}E.$

Circuit VI.

(21). *Linear.* $ {}_{21}k\Big|_{181}^{211} + {}_{21}k\Big|_{221}^{262} = {}_{21}E.$

(22). *Latitude.* $ {}_{22}k\Big|_{181}^{211} + {}_{22}k\Big|_{221}^{262} = {}_{22}E.$

(23). *Longitude.* $ {}_{23}k\Big|_{181}^{211} + {}_{23}k\Big|_{221}^{262} = {}_{23}E.$

(24). *Azimuth.* $ {}_{24}k\Big|_{181}^{211} + {}_{24}k\Big|_{221}^{262} = {}_{24}E.$

Circuit VII.

(25). *Linear.* $ {}_{25}k\Big|_{221}^{240} + {}_{25}k\Big|_{263}^{302} = {}_{25}E.$

(26). *Latitude.* $ {}_{26}k\Big|_{221}^{240} + {}_{26}k\Big|_{263}^{302} = {}_{26}E.$

(27). *Longitude.* $ {}_{27}k\Big|_{221}^{240} + {}_{27}k\Big|_{263}^{302} = {}_{27}E.$

(28). *Azimuth.* $ {}_{28}k\Big|_{221}^{240} + {}_{28}k\Big|_{263}^{302} = {}_{28}E.$

Circuit VIII.

(29). *Linear.* $ {}_{29}k\Big|_{263}^{289} + {}_{29}k\Big|_{303}^{330} = {}_{29}E.$

(30). *Latitude.* $ {}_{30}k\Big|_{263}^{289} + {}_{30}k\Big|_{303}^{330} = {}_{30}E.$

(31). *Longitude.* $ {}_{31}k\Big|_{263}^{289} + {}_{31}k\Big|_{303}^{330} = {}_{31}E.$

(32). *Azimuth.* $ {}_{32}k\Big|_{263}^{289} + {}_{32}k\Big|_{303}^{330} = {}_{32}E.$

Circuit IX.

(33). *Linear.* $ {}_{33}k\Big|_{303}^{323} + {}_{33}k\Big|_{331}^{361} = {}_{33}E.$

(34). *Latitude.* $ {}_{34}k\Big|_{303}^{323} + {}_{34}k\Big|_{331}^{361} = {}_{34}E.$

(35). *Longitude.* $ {}_{35}k\Big|_{303}^{323} + {}_{35}k\Big|_{331}^{361} = {}_{35}E.$

(36). *Azimuth.* $ {}_{36}k\Big|_{303}^{323} + {}_{36}k\Big|_{331}^{361} = {}_{36}E.$

Circuit X.

(37). *Linear.* $ {}_{37}k\Big|_{331}^{351} + {}_{37}k\Big|_{409}^{423} = {}_{37}E.$

(38). *Latitude.* $ {}_{38}k\Big|_{331}^{351} + {}_{38}k\Big|_{362}^{423} = {}_{38}E.$

(39). *Longitude.* $ {}_{39}k\Big|_{331}^{351} + {}_{39}k\Big|_{362}^{423} = {}_{39}E.$

(40). *Azimuth.* $ {}_{40}k\Big|_{331}^{351} + {}_{40}k\Big|_{362}^{423} = {}_{40}E.$

Base-line Equation.

(41). *Linear.* $ {}_{41}k\Big|_{362}^{408} \quad . \quad . \quad . \quad . \quad . \quad = {}_{41}E.$

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Circuit XI.

(42). *Linear.* $${}_{42}k\Big|_{408}^{407} + {}_{42}k\Big|_{424}^{443} + {}_{42}k_{362} + {}_{42}k\Big|_{444}^{501} = {}_{42}E.$$

(43). *Latitude.* $${}_{43}k\Big|_{362}^{407} + {}_{43}k\Big|_{424}^{443} + {}_{43}k\Big|_{444}^{501} \quad . \; . \; . = {}_{43}E.$$

(44). *Longitude.* $${}_{44}k\Big|_{362}^{407} + {}_{44}k\Big|_{424}^{443} + {}_{44}k\Big|_{444}^{501} \quad . \; . \; . = {}_{44}E.$$

(45). *Azimuth.* $${}_{45}k\Big|_{362}^{407} + {}_{45}k\Big|_{424}^{443} + {}_{45}k\Big|_{444}^{501} \quad . \; . \; . = {}_{45}E.$$

Circuit XII.

(46). *Linear.* $${}_{46}k\Big|_{461}^{517} + {}_{46}k\Big|_{518}^{573} \quad . \; . \; . = {}_{46}E.$$

(47). *Latitude.* $${}_{47}k\Big|_{461}^{517} + {}_{47}k\Big|_{518}^{573} \quad . \; . \; . = {}_{47}E.$$

(48). *Longitude.* $${}_{48}k\Big|_{461}^{517} + {}_{48}k\Big|_{518}^{573} \quad . \; . \; . = {}_{48}E.$$

(49). *Azimuth.* $${}_{49}k\Big|_{461}^{517} + {}_{49}k\Big|_{518}^{573} \quad . \; . \; . = {}_{49}E.$$

7.

The Numerical Values of the Fixed Data on which the Simultaneous Reduction of the North-East Quadrilateral is based.

It has been stated in Section 3 of Chapter I, that the North-East Quadrilateral rests on two chains of triangles, which, having been already finally adjusted, furnish, with one exception, the whole of the data on which the Quadrilateral is based, the exception being the measured length of the Sonákhoda Base-line. The two series are the Great Arc—Section 24° to 30°, or Series A of the North-West Quadrilateral, and the Calcutta Longitudinal, or Series B of the South-East Quadrilateral. The fixed data furnished by these series are given in Volumes IV and VI respectively; but for the geodetic elements a third place of decimals of seconds has been obtained by reference to the calculations of the North-West and South-East Quadrilaterals. The data are as follows:—

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Volume IV page $29_{—a}$:—

North-East Longitudinal Series.

Western terminus, Chándípahár or LIV to Ghandiál or LVI, Ghandiál being the closing station of Circuit *I.*

At Ghandiál

Latitude North	30°	13′	25″·321,
Longitude East of Greenwich	78	27	54 ·613,
Azimuth of Chándípahár	34	47	42 ·606,
Distance „	Log Feet 5·1212764,1.		

Volume VI pages $156_{—B}$ to $161_{—B}$:—

Rangir Meridional Series.

Station of origin Rangír or X; side of origin Tinsmál or VII to Rangír or X.

At Rangír

Latitude North	24°	0′	20″·365,
Longitude East of Greenwich	79	28	26 ·429,
Azimuth of Tinsmál	106	1	22 ·390,
Distance „	Log Feet 5·1809675,5.		

Amua Meridional Series.

Station of origin Lakanpura or XIX; side of origin Amua or XVII to Lakanpura or XIX.

At Lakanpura

Latitude North	24°	2′	49″·918,
Longitude East of Greenwich	80	49	51 ·667,
Azimuth of Amua	80	11	43 ·057,
Distance „	Log Feet 5·0098779,4.		

Karara Meridional Series.

Station of origin Marwás or XXVI; side of origin Karára or XXIII to Marwás or XXVI.

At Marwás

Latitude North	24°	4′	59″·330,
Longitude East of Greenwich	81	49	2 ·460,
Azimuth of Karára	89	31	10 ·757,
Distance „	Log Feet 5·2336163,3.		

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Gurwani Meridional Series.

Station of origin Pokra or XXXI; side of origin Chapri or XXIX to Pokra or XXXI.

At Pokra

Latitude North	...	...	...	24°	18′	47″·974,
Longitude East of Greenwich		...	...	82	31	5 ·683,
Azimuth of Chapri	...	...	...	89	57	44 ·812,
Distance „	...	...	Log Feet 4·9166608,4.			

Gora Meridional Series.

Station of origin Sewádhi or XXXVIII; side of origin Gora or XXXV to Sewádhi or XXXVIII.

At Sewádhi

Latitude North	...	...	...	23°	58′	24″·165,
Longitude East of Greenwich		...	...	83	47	40 ·015,
Azimuth of Gora	...	...	...	103	1	7 ·308,
Distance „	...	...	Log Feet 5·2475620,4.			

Hurilaong Meridional Series.

Station of origin Huríláong or XLII; side of origin Khaira Pándu or XL to Huríláong or XLII.

At Huríláong

Latitude North	...	...	...	24°	2′	5″·987,
Longitude East of Greenwich		...	...	84	24	17 ·757,
Azimuth of Khaira Pándu		...	...	128	18	27 ·061,
Distance „ „		...	Log Feet 5·2576726,9.			

Chendwar Meridional Series.

Station of origin Chendwár or LIII; side of origin Kasíátu or XLIV to Chendwár or LIII.

At Chendwár

Latitude North	...	...	...	23°	57′	13″·750,
Longitude East of Greenwich		...	...	85	28	36 ·468,
Azimuth of Kasíátu	...	...	...	92	35	7 ·003,
Distance „	...	...	Log Feet 5·2486588,2.			

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North Parasnath Meridional Series.

Station of origin Ghoranji or LIX; side of origin Bámani or LVI to Ghoranji or LIX.

At Ghoranji

Latitude North	24°	33′	34″·536,
Longitude East of Greenwich	86	10	46 ·965,
Azimuth of Bámani	71	4	51 ·796,
Distance „	Log Feet 5·1150652,5.		

North Maluncha Meridional Series.

Station of origin Malúncha or LXIV; side of origin Durgapur or LXII to Malúncha or LXIV.

At Malúncha

Latitude North	23°	54′	29″·021,
Longitude East of Greenwich	87	8	9 ·038,
Azimuth of Durgapur	74	46	40 ·026,
Distance „	Log Feet 5·0425046,7.		

Calcutta Meridional Series.

Station of origin Chinsurah or LXXXI; side of origin Sátten or LXXVIII to Chinsurah or LXXXI.

At Chinsurah

Latitude North	22°	52′	55″·874,
Longitude East of Greenwich	88	26	38 ·512,
Azimuth of Sátten	122	3	47 ·437,
Distance „	Log Feet 4·8097497,2.		

The value of the Sonákhoda Base-line* has been taken from Vol. I, Section V, where full details of its measurement are given. Its length expressed in feet of the Indian Standard 10-foot Bar **A**, at a temperature of 62° Fahrenheit, and reduced to mean sea level, is

Feet **36685·7946,** Log = **4·5644979,30**

* This base-line was reduced before the Spirit Leveling operations had approached its neighbourhood. The values of Height employed were obtained from the triangulation of the Calcutta Meridional Series and were :—for the South-West End 222·5 feet above mean sea level, and for the North-East End 246·9 feet. These are in excess of the Spirit Leveled heights, which were afterwards obtained, by 14·3 and 15·4 feet respectively; thus the length of the base-line is more correctly 36685·8216 feet, the logarithm of which is 4·5644982,50, and these values should have been adopted in place of those given in the text.

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8.

The Sides and Angles of the Circuit Triangles.

The values of the Figurally Corrected Angles, and the logarithms of the Side-lengths, computed (in feet) with these angles in terms of the fixed sides of origin furnished by the West Calcutta Longitudinal Series, are exhibited in the following table. The given angles are the corrected plane angles, obtained by deducting the sum of the spherical excess and the figural error from the observed angles. Should it be desired to trace the formation of any corrected plane angle, reference must be made to the Abstract of the Observed Angles and to the final data of the Sides and Angles of the Triangles, which are given for each Series in this and the following volume. The final data will be found to contain three columns of angular corrections, which are respectively headed by the words 'Figure', 'Circuit' and 'Non-circuit',—'figure' being here taken to include single triangles as well as polygons and net-works; the corrections in the first column are what have been applied, with the spherical excess, to the observed angles, in order to obtain the figurally corrected plane angles; those in the second column are what have been derived from the Simultaneous Reduction; and those in the third column are what have been computed to satisfy the geometrical conditions of figures containing non-circuit triangles, which have to be adjusted to the fixed circuit triangles; the application of the correction in the second or the third column, as the case may be, to the figurally corrected plane angle gives the finally corrected plane angle.

In order that it may be readily ascertained—without reference to the Reduction Chart—whether any angle is a 'flank angle' or an 'angle of continuation', a column is inserted in the table which gives the symbolic error of the angle, either x, y, or z, but without the numerical subscript, as that may be inferred from the number of the triangle in the contiguous column. And since the stations on the right-hand flank of each chain are those at which the angles are the data for the formation of the values of the forward azimuth, and the side-lengths are the distances which were employed in the calculations of latitude, longitude and back azimuth—see the next section; these stations are indicated by numbers in block type—shewing by their sequence the order in which the geodetic calculations were performed—as well as by their Serial-numbers. The latter are distinguished in respect to the Series to which they appertain by their Serial-letters, as K for the Rangír Meridional Series, &c.

The logarithm of the side* opposite any angle is given in the same horizontal line as the angle.

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* In calculating these values 7-place Logarithm Tables were employed, the 8th place here shewn being obtained by interpolation.

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
1	y	B* X	1	54 24 15·70	·90	5·0914028,0
	x	VII		37 36 19·34	·90	4·9667207,7
	z	K I	2	87 59 24·96	·90	5·1809675,5
2	„	B VII		44 20 35·70	·89	4·9830852,2
		K I	2	71 53 49·46	·90	5·1165878,0
		II		63 45 34·84	·89	5·0914028,0
3	„	I	2	55 51 14·28	·86	5·0621006,3
		II		80 31 14·99	·87	5·1383042,1
		III	3	43 37 30·73	·86	4·9830852,2
4	„	II		73 16 38·15	1·28	5·1995234,3
		III	3	62 27 42·31	1·28	5·1660679,8
		IV		44 15 39·54	1·27	5·0621006,3
5	„	IV		74 12 3·92	1·73	5·2614478,5
		III	3	49 15 0·20	1·72	5·1575922,6
		V		56 32 55·88	1·73	5·1995234,3
6	„	III	3	45 37 4·65	1·67	5·1302833,5
		V		59 12 49·90	1·67	5·2101999,6
		VI	4	75 10 5·45	1·67	5·2614478,5
7	„	VI	4	62 30 39·18	1·12	5·1222269,7
		V		52 50 21·24	1·12	5·0756827,5
		VII	5	64 38 59·58	1·13	5·1302833,5
8	„	V		64 59 46·84	1·19	5·1413682,1
		VII	5	54 52 5·73	1·18	5·0967690,5
		VIII		60 8 7·43	1·18	5·1222269,7
9	„	VII	5	59 42 21·18	1·36	5·1483022,4
		VIII		62 6 26·51	1·36	5·1584330,7
		IX	6	58 11 12·31	1·35	5·1413682,1
10	„	VIII		60 8 12·15	1·10	5·1134368,9
		IX	6	49 51 38·94	1·10	5·0586761,1
		X		70 0 8·91	1·11	5·1483022,4
11	„	IX	6	57 38 9·29	·92	5·0640170,6
		X		51 11 49·84	·92	5·0290419,1
		XI	7	71 10 0·87	·93	5·1134368,9
12	„	X		53 8 37·18	·82	5·0090646,3
		XI	7	61 36 58·71	·82	5·0502735,4
		XII		65 14 24·11	·82	5·0640170,6
13	„	XI	7	72 58 45·20	·74	5·0721680,1
		XII		51 14 26·84	·74	4·9835941,2
		XIII	8	55 46 47·96	·74	5·0090646,3
14	„	XII		53 40 13·23	·80	5·0095165,4
		XIII	8	57 47 40·35	·80	5·0308288,3
		XIV		68 32 6·42	·81	5·0721680,1
15	y	K XIII	8	62 33 50·85	·65	5·0028930,1
	x	XIV		53 7 26·48	·65	4·9577667,9
	z	XV	9	64 18 42·67	·65	5·0095165,4
16	„	XIV		57 49 39·44	·56	4·9550790,5
		XV	9	51 16 11·09	·56	4·9196281,3
		XVI		70 54 9·47	·56	5·0028930,1
17	„	XV	9	61 21 24·44	·53	4·9506268,9
		XVI		56 11 9·98	·52	4·9268418,8
		XVII	10	62 27 25·58	·53	4·9550790,5
18	„	XVI		58 5 48·95	·57	4·9537225,5
		XVII	10	64 27 14·35	·57	4·9801655,6
		XVIII		57 26 56·70	·57	4·9506268,9
19	„	XVII	10	65 16 18·15	·59	4·9891272,8
		XVIII		57 53 0·41	·59	4·9587643,0
		XIX	11	56 50 41·44	·58	4·9537225,5
20	„	XVIII		58 33 56·39	·62	4·9737337,5
		XIX	11	59 18 9·76	·62	4·9770993,5
		XX		62 7 53·85	·63	4·9891272,8
21	„	XIX	11	54 11 22·37	·59	4·9456367,2
		XX		65 54 35·39	·60	4·9970640,5
		XXI	12	59 54 2·24	·60	4·9737337,5
22	„	XX		57 15 4·60	·42	4·8929185,0
		XXI	12	51 1 0·83	·42	4·8587024,3
		XXII		71 43 54·57	·43	4·9456367,2
23	„	XXII		119 54 1·26	·16	4·9846722,1
		XXI	12	15 31 41·56	·16	4·4743754,8
		XXIII		44 34 17·18	·16	4·8929185,0
24	„	XXI	12	56 33 48·48	·63	4·9699343,5
		XXIII		63 44 49·95	·64	5·0012300,8
		XXIV	13	59 41 21·57	·64	4·9846722,1
25	„	XXIII		59 36 30·66	·65	4·9876509,6
		XXIV	13	64 29 11·59	·65	5·0072866,9
		XXV		55 54 17·75	·64	4·9699343,5
26	„	XXIV	13	53 37 20·40	·55	4·9284756,5
		XXV		59 3 37·88	·56	4·9559532,5
		XXVI	14	67 19 1·72	·56	4·9876509,6
27	„	XXV		74 42 22·45	·59	5·0288895,6
		XXVI	14	55 20 42·37	·59	4·9597329,9
		XXVII		49 56 55·18	·58	4·9284756,5
28	„	XXVI	14	51 57 55·47	·74	4·9816434,8
		XXVII		66 36 48·59	·74	5·0480871,6
		XXVIII	15	61 25 15·94	·74	5·0288895,6

* B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	K XXVII		59 5 50·06	·62	4·9765318,4		y	I II	22	71 54 2·10	·87	5·1013045,2
29	x	XXVIII	15	60 39 9·92	·63	4·9833740,6	43	x	I		54 22 20·92	·87	5·0333387,2
	z	XXIX		60 15 0·02	·62	4·9816434,8		z	A* LVI		53 43 36·98	·86	5·0297900,2
		XXVIII	15	57 34 5·11	·63	4·9753741,4			I I		73 55 28·21	·84	5·1213051,2
30	,,	XXIX		64 37 20·40	·64	5·0049459,0	44	,,	A LVI		39 29 26·66	·83	4·9420533,4
		XXX	16	57 48 34·49	·64	4·9765318,4			LIV		66 35 5·13	·84	5·1013045,2
		XXIX		70 35 32·73	·74	5·0630826,3							
31	,,	XXX	16	58 59 26·73	·74	5·0215121,0							
		XXXI		50 25 0·54	·73	4·9753741,4							
		XXX	16	57 55 51·65	·85	5·0411051,9			B XVII		42 12 35·04	·71	4·9453593,4
32	,,	XXXI		59 1 11·20	·86	5·0461675,2	45	,,	XIX	23	86 34 47·91	·71	5·1173152,3
		I XI	17	63 2 57·15	·86	5·0630826,3			L I		51 12 37·05	·71	5·0098779,4
		K XXXI		53 17 53·50	·68	4·9723723,2			B XIX	23	67 44 52·96	·94	5·1427175,3
33	,,	I XI	17	56 46 40·35	·68	4·9908230,6	46	,,	L I		76 16 11·74	·94	5·1637373,4
		X		69 55 26·15	·68	5·0411051,9			II	24	35 58 55·30	·93	4·9453593,4
		XI	17	71 26 51·03	·59	5·0159798,4			II	24	61 58 14·19	1·36	5·1580298,3
34	,,	X		49 31 10·22	·58	4·9203283,9	47	,,	I		59 35 8·42	1·36	5·1479156,7
		IX	18	59 1 58·75	·58	4·9723723,2			III	25	58 26 37·39	1·36	5·1427175,3
		X		58 59 9·06	·65	4·9881777,7			I		72 14 24·87	·96	5·1590222,0
35	,,	IX	18	54 59 32·90	·65	4·9685011,5	48	,,	III	25	35 55 24·07	·96	4·9486462,9
		VII		66 1 18·04	·66	5·0159798,4			IV		71 50 11·06	·96	5·1580298,3
		IX	18	78 39 45·62	1·11	5·2017297,1			III	25	67 18 35·19	1·25	5·1685985,5
36	,,	VII		64 29 35·84	1·10	5·1657519,0	49	,,	IV		48 12 13·89	1·25	5·0760430,7
		VIII	19	36 50 38·54	1·10	4·9881777,7			V	26	64 29 10·92	1·25	5·1590222,0
		VIII	19	74 15 28 64	1·89	5·2796149,0			IV		50 0 18·49	1·12	5·0685573,3
37	,,	VII		52 10 56·97	1·89	5·1938266,7	50	,,	V	26	55 17 41·92	1·12	5·0991922,8
		VI	20	53 33 34·39	1·89	5·2017297,1			VI		74 41 59·59	1·12	5·1685985,5
		VII		31 53 27·15	1·56	5·0292853,5			VI		77 31 3·44	·87	5·1282376,5
38	,,	VI	20	78 1 36·02	1·57	5·2968494,5	51	,,	V	26	44 9 41·41	·86	4·9816618,9
		V		70 4 56·83	1·57	5·2796149,0			VII		58 19 15·15	·86	5·0685573,3
		VI	20	48 50 56·09	·99	5·0704790,9			V	26	63 6 19·76	·91	5·0971331,8
39	,,	V		87 55 41·55	1·00	5·1934134,2	52	,,	VII		43 32 50·91	·91	4·9850369,2
		IV	21	43 13 22·36	·99	5·0292853,5			VIII	27	73 20 49·33	·91	5·1282376,5
		V		56 8 20·24	·77	5·0151445,8			VII		69 48 26·72	·94	5·1171566,3
40	,,	IV	21	53 15 35·55	·77	4·9996877,2	53	,,	VIII	27	46 31 24·07	·93	5·0054349,9
		III		70 36 4·21	·77	5·0704790,9			IX		63 40 9·21	·94	5·0971331,8
		III		75 35 12·30	1·13	5·1866178,5			VIII	27	64 32 41·79	1·15	5·1331966,5
41	,,	IV	21	63 40 34·95	1·13	5·1529618,5	54	,,	IX		54 58 30·57	1·15	5·0907786,6
		I		40 44 12·75	1·12	5·0151445,8			X	28	60 28 47·64	1·15	5·1171566,3
		IV	21	43 22 55·64	1·08	5·0297900,2			IX		58 51 54·90	1·09	5·1008496,2
42	,,	I		56 21 22·25	1·08	5·1133043,6	55	,,	X	28	53 53 37·10	1·09	5·0757701,0
		II	22	80 15 42·11	1·09	5·1866178,5			XI		67 14 28·00	1·10	5·1331966,5

* A is the Serial letter for the Great Arc Series which appertains to the North-West Quadrilateral.

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	L X	28	44 37 48·81	·84	4·9732275,0		y	L XXIV		70 9 33·30	·51	5·0001777,3
56	x	XI		64 53 32·16	·85	5·0834574,6	70	x	XXV	35	70 2 24·08	·51	4·9998506,5
	z	XII	29	70 28 39·03	·85	5·1008496,2		z	XXVI		39 48 2·62	·50	4·8330155,4
		XI		50 18 40·17	·47	4·8804935,0			XXV	35	37 59 26·74	·46	4·8040256,7
57	,,	XII	29	57 22 53·82	·48	4·9197276,4	71	,,	XXVI		66 46 50·32	·47	4·9780899,6
		XIII		72 18 26·01	·48	4·9732275,0			XXVII	36	75 13 42·94	·47	5·0001777,3
		XII	29	57 42 48·81	·44	4·8990329,0			XXVI		75 18 17·75	·37	4·9322592,6
58	,,	XIII		68 11 4·97	·44	4·9397055,5	72	,,	XXVII	36	58 38 30·82	·37	4·8781257,8
		XIV	30	54 6 6·22	·44	4·8804935,0			XXVIII		46 3 11·43	·37	4·8040256,7
		XIII		56 50 23·81	·48	4·9131495,7			XXVII	36	39 34 3·70	·36	4·7589932,5
59	,,	XIV	30	69 1 39·90	·48	4·9605808,6	73	,,	XXVIII		68 45 26·22	·36	4·9243020,8
		XV		54 7 56·29	·48	4·8990329,0			XXIX	37	71 40 30·08	·37	4·9322592,6
		XIV	30	52 37 50·85	·49	4·9006189,1			XXVIII		59 40 13·28	·30	4·8391199,9
60	,,	XV		72 29 0·87	·49	4·9797735,6	74	,,	XXIX	37	74 27 48·77	·30	4·8868753,1
		XVI	31	54 53 8·28	·49	4·9131495,7			XXX		45 51 57·95	·30	4·7589932,5
		XV		59 0 28·66	·34	4·8547661,6			XXIX	37	47 55 31·64	·33	4·7963060,9
61	,,	XVI	31	48 41 7·49	·34	4·7973597,8	75	,,	XXX		77 4 19·28	·34	4·9145917,1
		XVII		72 18 23·85	·34	4·9006189,1			XXXI	38	55 0 9·08	·33	4·8391199,9
		XVII		59 2 13·77	·34	4·8436749,3			XXX		68 2 30·23	·37	4·9209886,3
62	,,	XVI	31	59 21 31·54	·34	4·8451282,3	76	,,	XXXI	38	67 51 3·92	·37	4·9204032.5
		XVIII		61 36 14·69	·34	4·8547661,6			XXXII		44 6 25·85	·37	4·7963060,9
		XVI	31	51 36 32·89	·34	4·8134847,5			XXXI	38	44 55 35·26	·38	4·7950611,2
63	,,	XVIII		71 13 40·27	·34	4·8955445,3	77	,,	XXXII		64 23 0·09	·38	4·9011996,7
		XIX	32	57 9 46·84	·34	4·8436749,3			I XXV	39	70 41 24·65	·39	4·9209886,3
		XVIII		67 44 40·79	·38	4·9091766,2			L XXXII		65 10 32·98	·33	4·8693212,1
64	,,	XIX	32	64 18 42·82	·38	4·8976030,3	78	,,	I XXV	39	64 55 16·97	·33	4·8684239,0
		XX		47 56 36·39	·37	4·8134847,5			XXIII		49 54 10·05	·33	4·7950611,2
		XIX	32	44 33 21·19	·37	4·7913836,1			XXV	39	51 47 57·96	·34	4·8129295,7
65	,,	XX		68 29 16·00	·37	4·9139325,9	79	,,	XXIII		64 42 58·61	·35	4·8738558,5
		XXI	33	66 57 22·81	·37	4·9091766,2			XXIV	40	63 29 3·43	·34	4·8693212,1
		XX		63 41 23·17	·33	4·8629312,6			XXIV	40	55 38 39·45	·27	4·7854982,7
66	,,	XXI	33	66 49 25·65	·33	4·8738825,8	80	,,	XXIII		62 47 18·65	·28	4·8178152,4
		XXII		49 29 11·18	·33	4·7913836,1			XXII	41	61 34 1·90	·28	4·8129295,7
		XXI	33	46 7 20·54	·32	4·7704565,3			XXIII		68 6 36·33	·26	4·8198723,7
67	,,	XXII		70 46 5·45	·33	4·8876897,1	81	,,	XXII	41	52 52 34·37	·25	4·7540103,0
		XXIII	34	63 6 34·01	·32	4·8629312,6			XXI		59 0 49·30	·25	4·7854982,7
		XXII		71 59 31·80	·37	4·9344014,1			XXII	41	53 23 5·37	·23	4·7445383,0
68	,,	XXIII	34	67 18 57·17	·37	4·9212490,0	82	,,	XXI		53 55 39·03	·23	4·7475647,6
		XXIV		40 41 31·03	·37	4·7704565,3			XX	42	72 41 15·60	·24	4·8198723,7
		XXIII	34	46 56 50·90	·42	4·8330155,4			XXI		63 3 58·05	·18	4·7353034,1
69	,,	XXIV		65 42 10·23	·42	4·9289800,4	83	,,	XX	42	51 19 58·51	·18	4·6777014,3
		XXV	35	67 20 58·87	·43	4·9344014,1			XIX		65 36 3·44	·19	4·7445383,0

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle ° ′ ″	Spherical Excess ″	Logarithm of side-length in Feet
	y	I XX	42	63 39 35·88	·18	4·7326134,0
84	x	XIX		51 57 6·03	·18	4·6764655,7
	z	XVIII	43	64 23 18·09	·18	4·7353034,1
		XIX		68 41 37·51	·20	4·7725455,5
85	,,	XVIII	43	53 6 55·21	·20	4·7062980,8
		XVII		58 11 27·28	·20	4·7326134,0
		XVIII	43	65 49 56·41	·25	4·8012164,0
86	,,	XVII		55 30 39·62	·24	4·7571053,2
		XVI	44	58 39 23·97	·24	4·7725455,5
		XVII		52 16 9·77	·23	4·7367807,2
87	,,	XVI	44	61 10 57·89	·24	4·7812451,7
		XV		66 32 52·34	·24	4·8012164,0
		XVI	44	59 35 45·22	·19	4·7254227,3
88	,,	XV		58 6 42·46	·19	4·7186237,7
		XIV	45	62 17 32·32	·20	4·7367807,2
		XV		48 58 57·63	·18	4·6699745,2
89	,,	XIV	45	72 0 24·25	·19	4·7705317,7
		XIII		59 0 38·12	·19	4·7254227,3
		XIV	45	65 8 18·93	·20	4·7617047,4
90	,,	XIII		67 35 25·54	·20	4·7698393,4
		XII	46	47 16 15·53	·19	4·6699745,2
		XIII		75 34 17·39	·24	4·8321643,9
91	,,	XII	46	48 59 59·31	·23	4·7238615,8
		XI	17	55 25 43·30	·23	4·7617047,4
		XII	46	75 33 34·39	·36	4·9203276,6
92	,,	XI	17	52 12 33·78	·35	4·8320370,1
		IX	18	52 13 51·83	·35	4·8321643,9
		B* XXVI	47	40 57 8·61	1·44	5·0686258,3
93	,,	XXIII		65 38 41·46	1·44	5·2116199,8
		M II	48	73 24 9·93	1·44	5·2336163,3
		B XXIII		49 8 29·54	·58	4·9483798,9
94	,,	M II	48	44 49 45·89	·58	4·9178578,8
		I		86 1 44·57	·58	5·0686258,3
		I		60 27 41·94	·71	5·0281612,4
95	,,	II	48	73 9 3·32	·72	5·0695734,0
		III		46 23 14·74	·71	4·9483798,9
		II	48	59 23 8·28	·51	4·9694495,0
96	,,	III		40 29 13·96	·51	4·8470718,4
		V	49	80 7 37·76	·51	5·0281612,4

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle ° ′ ″	Spherical Excess ″	Logarithm of side-length in Feet
	y	M V	49	65 26 37·37	·83	5·0792515,8
97	x	III		69 37 0·32	·83	5·0923408,1
	z	VIII	50	44 56 22·31	·82	4·9694495,0
		III		34 29 58·34	·57	4·8357783,5
98	,,	VIII	50	62 39 52·40	·58	5·0312313,4
		VII		82 50 9·26	·58	5·0792515,8
		VII		63 21 37·26	·23	4·8034428,2
99	,,	VIII	50	42 17 16·37	·23	4·6801031,8
		X		74 21 6·37	·23	4·8357783,5
		VIII	50	72 57 4·37	·70	5·1509113,0
100	,,	X		81 36 35·02	·71	5·1657549,5
		XII	51	25 26 20·61	·70	4·8034428,2
		X		46 21 48·03	1·01	5·0263647,9
101	,,	XII	51	59 2 6·19	1·02	5·1000130,8
		XIII		74 36 5·78	1·02	5·1509113,0
		XII	51	70 46 50·94	1·01	5·1342040,8
102	,,	XIII		61 46 23·60	1·01	5·1041261,8
		XV	52	47 26 45·46	1·00	5·0263647,9
		XV	52	62 26 0·93	·95	5·1011939,6
103	,,	XIII		44 31 54·17	·95	4·9994337,1
		XVI	53	73 2 4·90	·96	5·1342040,8
		XIII		41 43 53·20	·63	4·9244562,2
104	,,	XVI	53	48 51 18·76	·63	4·9780401,3
		XIV		89 24 48·04	·63	5·1011939,6
		XIV		49 48 44·56	·34	4·8158073,0
105	,,	XVI	53	51 20 59·91	·34	4·8253880,1
		XVII		78 50 15·53	·34	4·9244562,2
		XVI	53	72 37 7·19	·24	4·8400203,7
106	,,	XVII		42 52 52·05	·24	4·6931332,8
		XVIII	54	64 30 0·76	·24	4·8158073,0
		XVII		45 17 14·91	·25	4·7148893,3
107	,,	XVIII	54	63 16 49·30	·25	4·8141933,5
		XIX		71 25 55·79	·25	4·8400203,7
		XVIII	54	72 58 35·68	·30	4·8934104,7
108	,,	XIX		67 41 5·87	·29	4·8790618,6
		XX	55	39 20 18·45	·29	4·7148893,3
		XIX		47 45 56·45	·21	4·7652368,0
109	,,	XX	55	36 16 6·40	·21	4·6677747,0
		XXI		95 57 57·15	·21	4·8934104,7
		XX	55	49 54 22·43	·23	4·7235658,2
110	,,	XXI		72 44 19·18	·23	4·8198949,8
		XXIII	56	57 21 18·39	·23	4·7652368,0

* B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Triangle Number	Symbolic Error	Station Numbers		Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers		Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
		Serial	Traverse						Serial	Traverse			
				° ′ ″	″						° ′ ″	″	
	y	M XXI		72 35 36·72	·18	4·7611766,0		y	M XXXV	62	55 37 48·22	·33	4·8258291,0
111	x	XXIII	56	46 21 21·17	·17	4·6410571,4	125	x	XXXVI		62 58 29·86	·34	4·8589436,4
	z	XXII		61 3 2·11	·17	4·7235658,2		z	XXXVII	63	61 23 41·92	·34	4·8526248,0
		XXII		61 32 16·70	·24	4·7767699,4			XXXVI		62 10 56·75	·33	4·8473018,3
112	”	XXIII	56	60 27 12·28	·24	4·7722120,8	126	”	XXXVII	63	60 29 23·39	·32	4·8402876,7
		XXIV		58 0 31·02	·23	4·7611766,0			XXXVIII		57 19 39·86	·32	4·8258291,0
		XXIII	56	53 0 32·28	·25	4·7612992,1			XXXVIII		59 31 34·30	·34	4·8470805,4
113	”	XXIV		71 7 41·88	·26	4·8349030,8	127	”	XXXVII	63	60 53 52·66	·35	4·8530329,1
		XXV	57	55 51 45·84	·26	4·7767699,4			I XXXIV		59 34 33·04	·34	4·8473018,3
		XXIV		57 2 59·15	·23	4·7525199,0			M XXXVII	63	60 51 46·89	·37	4·8709573,2
114	”	XXV	57	64 2 55·99	·23	4·7825244,8	128	”	I XXXIV		63 22 20·52	·37	4·8810226,2
		XXVI		58 54 4·86	·23	4·7612992,1			XXXV	64	55 45 52·59	·37	4·8470805,4
		XXV	57	61 16 49·78	·25	4·7927245,4			XXXV	64	60 17 6·02	·31	4·8369382,6
115	”	XXVI		65 38 33·96	·25	4·8092480,4	129	”	XXXIV		49 47 9·29	·30	4·7810546,6
		XXVII	58	53 4 36·26	·25	4·7525199,0			XXXIII	65	69 55 44·69	·31	4·8709573,2
		XXVI		61 33 8·43	·28	4·8143996,6			XXXIV		56 26 48·78	·28	4·7920620,1
116	”	XXVII	58	61 40 50·96	·28	4·8149258,5	130	”	XXXIII	65	56 1 15·67	·27	4·7899038,6
		XXVIII		56 46 0·61	·28	4·7927245,4			XXXI		67 31 55·55	·28	4·8369382,6
		XXVII	58	59 44 28·26	·28	4·8124440,9			XXXIII	65	61 56 15·52	·23	4·7787808,7
117	”	XXVIII		60 4 17·09	·29	4·8138946,9	131	”	XXXI		52 34 45·47	·23	4·7330248,0
		XXIX	59	60 11 14·65	·29	4·8143996,6			XXXII	66	65 28 59·01	·24	4·7920620,1
		XXVIII		59 1 28·56	·28	4·8062799,1			XXXII	66	70 19 24·81	·25	4·8263718,9
118	”	XXIX	59	60 33 28·98	·29	4·8130478,2	132	”	XXXI		52 7 28·31	·25	4·7497692,4
		XXX		60 25 2·46	·28	4·8124440,9			XXX	67	57 33 6·88	·25	4·7787808,7
		XXIX	59	61 27 3·25	·30	4·8324377,7			XXXI		57 48 43·43	·28	4·7964439,1
119	”	XXX		62 45 3·31	·31	4·8376552,3	133	”	XXX	67	57 8 13·73	·27	4·7931815,7
		XXXI	60	55 47 53·44	·30	4·8062799,1			XXIX		65 3 2·84	·28	4·8263718,9
		XXX		57 44 58·50	·30	4·8160136,2			XXX	67	56 30 39·13	·23	4·7492938,2
120	”	XXXI	60	60 48 36·17	·30	4·8298029,7	134	”	XXIX		55 6 41·66	·22	4·7420882,3
		XXXII		61 26 25·33	·31	4·8324377,7			XXVIII	68	68 22 39·21	·23	4·7964439,1
		XXXI	60	54 22 25·04	·27	4·7798223,3			XXIX		57 25 9·90	·22	4·7431637,5
121	”	XXXII		63 33 44·64	·28	4·8218478,7	135	”	XXVIII	68	63 51 48·85	·22	4·7706185,4
		XXXIII	61	62 3 50·32	·28	4·8160136,2			XXVII		58 43 1·25	·22	4·7492938,2
		XXXII		58 20 43·27	·24	4·7743084,4			XXVIII	68	69 19 51·01	·23	4·7986462,5
122	”	XXXIII	61	62 6 4·03	·25	4·7906048,2	136	”	XXVII		55 14 24·48	·22	4·7421735,6
		XXXIV		59 33 12·70	·25	4·7798223,3			XXVI	69	55 25 44·51	·22	4·7431637,5
		XXXIII	61	60 4 53·82	·30	4·8290273,3			XXVII		54 2 33·38	·23	4·7387702,2
123	”	XXXIV		70 5 18·85	·30	4·8643697,3	137	”	XXVI	69	57 39 38·06	·23	4·7573803,3
		XXXV	62	49 49 47·33	·29	4·7743084,4			XXV	39	68 17 48·56	·23	4·7986462,5
		XXXIV		67 49 20·77	·30	4·8526248,0			XXVI	69	74 34 50·27	·28	4·8739040,8
124	”	XXXV	62	50 53 22·44	·29	4·7758286,3	138	”	XXV	39	60 29 25·54	·28	4·8294802,7
		XXXVI		61 17 16·79	·29	4·8290273,3			XXIV	40	44 55 44·19	·28	4·7387702,2

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	B* XXIX		67 28 56·63	·64	5·0248730,0		y	N XIII	77	67 25 10·75	·26	4·8263344,5
139	x	XXXI	70	66 27 39·65	·63	5·0215821,2	153	x	XIV		64 41 23·86	·26	4·8171439,4
	z	N I		46 3 23·72	·63	4·9166608,4		z	XV	78	47 53 25·39	·25	4·7312958,1
		B XXXI	70	48 31 52·71	·64	4·9350064,1			XIV		51 8 2·37	·27	4·7619004,2
140	,,	N I		64 18 38·44	·65	5·0151412,7	154	,,	XV	78	64 17 29·41	·27	4·8253082,4
		II	71	67 9 28·85	·65	5·0248730,0			XVI		64 34 28·22	·28	4·8263344,5
		II	71	63 53 41·77	·78	5·0770043,5			XV	78	62 54 39·48	·24	4·7824967,5
141	,,	I		75 44 52·70	·79	5·1101568,3	155	,,	XVI		58 58 44·83	·24	4·7659309,0
		III	72	40 21 25·53	·78	4·9350064,1			XVII	79	58 6 35·69	·23	4·7619004,2
		I		49 3 9·75	·82	4·9891077,1			XVI		57 44 40·33	·26	4·7855924,9
142	,,	III	72	63 19 0·76	·82	5·0620772,2	156	,,	XVII	79	65 9 0·58	·27	4·8161927,1
		IV		67 37 49·49	·82	5·0770043,5			XVIII		57 6 19·09	·26	4·7824967,5
		III	72	66 12 53·93	·52	4·9814873,5			XVII	79	53 5 11·20	·25	4·7596808,6
143	,,	IV		45 9 8·82	·52	4·8706728.3	157	,,	XVIII		68 50 35·53	·26	4·8265328,6
		V	73	68 37 57·25	·53	4·9891077,1			XIX	80	58 4 13·27	·26	4·7855924,9
		IV		43 18 33·63	·52	4·8598473,4			XVIII		51 39 4·41	·22	4·7254102,9
144	,,	V	73	71 30 23·01	·52	5·0005359,0	158	,,	XIX	80	70 17 4·38	·23	4·8047213.9
		VI		65 11 3·36	·52	4·9814873,5			XX		58 3 51·21	·23	4·7596808,6
		V	73	65 38 51·65	·41	4·9103956,7			XIX	80	60 33 2·03	·22	4·7623999,6
145	,,	VI		60 9 55·78	·40	4·8891168,2	159	,,	XX		66 20 54·81	·22	4·7843833,6
		VII	74	54 11 12·57	·40	4·8598473,4			XXI	81	53 6 3·16	·22	4·7254102,9
		VI		49 28 31·76	·38	4·8253703.3			XX		58 33 4·75	·24	4·7662553,2
146	,,	VII	74	62 55 47·12	·38	4·8940926,9	160	,,	XXI	81	63 42 57·01	·24	4·7878544,3
		VIII		67 35 41·12	·39	4·9103956,7			XXII		57 43 58·24	·23	4·7623999,6
		VII	74	64 40 41·07	·33	4·8556102,9			XXI	81	76 17 29·49	·26	4·8527153,9
147	,,	VIII		57 51 3·00	·32	4·8271927,2	161	,,	XXII		50 56 43·75	·25	4·7554339.8
		IX	75	57 28 15·93	·32	4·8253703,3			XXIII	82	52 45 46·76	·25	4·7662553,2
		VIII		58 16 47·33	·33	4·8353484,8			XXII		53 42 17·90	·28	4·7863597,4
148	,,	IX	75	58 41 21·18	·33	4·8372512.8	162	,,	XXIII	82	56 24 20·35	·28	4·8006680,8
		X		63 1 51·49	·34	4·8556102,9			XXIV		69 53 21·75	·29	4·8527153,9
		IX	75	63 52 20·07	·41	4·9112472,5			XXIII	82	58 28 47·50	·28	4·8003175,3
149	,,	X		67 12 8·43	·41	4·9227345,7	163	,,	XXIV		65 52 53·13	·28	4·8299742,0
		XI	76	48 55 31·50	·40	4·8353484,8			XXV	83	55 38 19·37	·27	4·7863597,4
		X		37 7 27·19	·32	4·7181712,3			XXIV		53 35 55·60	·25	4·7603515,2
150	,,	XI	76	72 35 0·62	·33	4·9170800,7	164	,,	XXV	83	64 27 35·97	·26	4·8099632,3
		XII		70 17 32·19	·32	4·9112472,5			XXVI		61 56 28·43	·26	4·8003175,3
		XI	76	70 30 12·86	·22	4·7915658,0			XXV	83	56 10 23·12	·26	4·7769174,9
151	,,	XII		56 44 17·56	·21	4·7395059,8	165	,,	XXVI		70 43 54·88	·26	4·8324262,4
		XIII	77	52 45 29·58	·21	4·7181712,3			XXVII	84	53 5 42·00	·25	4·7603515,2
		XII		53 0 45·71	·22	4·7312958,1			XXVI		62 53 18·45	·25	4·7909707,0
152	,,	XIII	77	60 23 53·16	·23	4·7681335,6	166	,,	XXVII	84	57 35 40·64	·24	4·7680069,0
		XIV		66 35 21·13	·23	4·7915658,0			XXVIII		59 31 0·91	·24	4·7769174,9

* B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-legth in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	N XXVII	84	49 30 48·91	·24	4·7286101,4		y	B* XXXVIII	92	54 40 18·74	2·56	5·2780661,7
167	x	XXVIII		69 5 4·18	·25	4·8178737,4	181	x	XXXV		75 49 6·38	2·57	5·3530125,5
	z	XXIX	85	61 24 6·91	·24	4·7909707,0		z	O I	93	49 30 34·88	2·56	5·2475620,4
		XXVIII		63 57 24·06	·26	4·8146540,1			B XXXV		48 13 57·37	2·39	5·2220856,8
168	„	XXIX	85	68 34 6·54	·26	4·8300361,7	182	„	O I	93	73 43 19·42	2·40	5·3316631,7
		XXX		47 28 29·40	·25	4·7286101,4			II		58 2 43·21	2·39	5·2780661,7
		XXIX	85	52 38 53·76	·27	4·7684646,0			II		55 49 7·54	1·40	5·1531955,3
169	„	XXX		65 12 25·49	·28	4·8261420,7	183	„	I	93	48 22 31·27	1·39	5·1091694,8
		I XLV	86	62 8 40·75	·27	4·8146540,1			III		75 48 21·19	1·40	5·2220856,8
		N XXX		65 10 35·56	·25	4·8031215,6			I	93	35 36 45·50	·57	4·9409119,1
170	„	I XLV	86	57 53 40·91	·25	4·7731450,4	184	„	III		36 4 33·24	·58	4·9457728,1
		XLIII		56 55 43·53	·24	4·7684646,0			V	94	108 18 41·26	·58	5·1531955,3
		XLV	86	63 46 33·84	·26	4·8064525,3			V	94	74 15 16·10	·39	4·9585619,2
171	„	XLIII		53 19 23·01	·25	4·7578074,3	185	„	III		38 12 20·73	·38	4·7665027,3
		XLIV	87	62 54 3·15	·26	4·8031215,6			VI	95	67 32 23·17	·39	4·9409119,1
		XLIV	87	58 19 52·67	·25	4·7749249,3			III		85 3 40·22	·84	5·1523229,1
172	„	XLIII		55 26 13·92	·24	4·7606115,4	186	„	VI	95	55 19 3·08	·84	5·0689781,9
		XLII	88	66 13 53·41	·25	4·8064525,3			VII		39 37 16·70	·83	4·9585619,2
		XLIII		73 48 55·03	·22	4·8186925,7			VI	95	31 34 47·81	·78	4·8772964,5
173	„	XLII	88	45 55 22·65	·22	4·6926242,5	187	„	VII		67 50 37·92	·78	5·1249098,3
		XLI		60 15 42·32	·22	4·7749249,3			VIII	96	80 34 34·27	·78	5·1523229,1
		XLII	88	64 55 54·63	·29	4·8339063,2			VII		56 6 54·48	·37	4·8501818,0
174	„	XLI		54 4 4·14	·28	4·7852025,1	188	„	VIII	96	61 48 0·14	·37	4·8761458,8
		XL	89	61 0 1·23	·29	4·8186925,7			IX		62 5 5·38	·38	4·8772964,5
		XLI		53 27 13·14	·25	4·7642423,5			VIII	96	52 38 5·63	·39	4·8528365,5
175	„	XL	89	55 57 29·62	·26	4·7776843,0	189	„	IX		75 11 6·45	·39	4·9379045,7
		XXXIX		70 35 17·24	·26	4·8339063,2			X	97	52 10 47·92	·38	4·8501818,0
		XL	89	62 57 11·85	·27	4·8125807,3			IX		47 29 3·83	·34	4·7973191,4
176	„	XXXIX		64 13 8·05	·27	4·8173459,4	190	„	X	97	75 37 38·68	·35	4·9159868,7
		XXXVIII	90	52 49 40·10	·26	4·7642423,5			XI		56 53 17·49	·34	4·8528365,5
		XXXIX		51 2 57·13	·23	4·7268156,7			X	97	54 35 45·85	·26	4·7727391,4
177	„	XXXVIII	90	57 36 10·04	·23	4·7625359,1	191	„	XI		65 47 59·08	·27	4·8215857,3
		XXXVII		71 20 52·83	·23	4·8125807,3			XII	98	59 36 15·07	·27	4·7973191,4
		XXXVIII	90	65 19 9·94	·27	4·8370282,1			XI		62 22 33·60	·30	4·8452220,0
178	„	XXXVII		69 51 6·11	·27	4·8512066,6	192	„	XII	98	69 2 57·98	·31	4·8680790,2
		XXXVI	91	44 49 43·95	·27	4·7268156,7			XIII		48 34 28·42	·30	4·7727391,4
		XXXVII		48 57 11·57	·30	4·7717712,5			XII	98	52 9 49·22	·29	4·7790495,1
179	„	XXXVI	91	69 49 46·08	·30	4·8668130,8	193	„	XIII		60 56 46·96	·29	4·8231447,1
		XXXV	64	61 13 2·35	·30	4·8370282,1			XIV	99	66 53 23·82	·29	4·8452220,0
		XXXVI	91	58 22 27·77	·26	4·7809905,6			XIII		68 6 55·02	·28	4·8355945,6
180	„	XXXV	64	65 9 16·24	·26	4·8086296,0	194	„	XIV	99	57 19 53·80	·27	4·7932900,6
		XXXIII	65	56 28 15·99	·25	4·7717712,5			XV		54 33 11·18	·27	4·7790495,1

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	O XIV	99	56 19 47·65	·30	4·8101727,0
195	x	XV		61 44 6·65	·31	4·8347839,7
	z	XVI	100	61 56 5·70	·31	4·8355945,6
		XV		60 32 10·71	·31	4·8337587,2
196	,,	XVI	100	63 54 40·70	·31	4·8472380,4
		XVII		55 33 8·59	·31	4·8101727,0
		XVI	100	48 39 29·41	·24	4·7260772,8
197	,,	XVII		57 10 41·55	·24	4·7750290,2
		XVIII	101	74 9 49·04	·24	4·8337587,2
		XVII		71 56 50·19	·22	4·8021174,9
198	,,	XVIII	101	55 6 26·61	·22	4·7379746,1
		XIX		52 56 43·20	·21	4·7260772,8
		XVIII	101	55 57 26·93	·25	4·7673391,7
199	,,	XIX		60 11 2·85	·25	4·7873158,9
		XX	102	63 51 30·22	·26	4·8021174,9
		XIX		85 23 48·34	·24	4·8741129,7
200	,,	XX	102	43 23 14·21	·23	4·7124261,6
		XXI		51 12 57·45	·24	4·7673391,7
		XX	102	44 38 25·99	·24	4·7237536,2
201	,,	XXI		51 58 13·38	·24	4·7733669,9
		XXII	103	83 23 20·63	·25	4·8741129,7
		XXI		77 27 20·60	·24	4·8440215,7
202	,,	XXII	103	54 48 42·48	·24	4·7668766,9
		XXIII		47 43 56·92	·23	4·7237536,2
		XXII	103	62 29 48·88	·30	4·8389192,5
203	,,	XXIII		53 40 33·03	·30	4·7971643,3
		XXIV	104	63 49 38·09	·31	4·8440215,7
		XXIII		51 28 19·15	·22	4·7385115,6
204	,,	XXIV	104	48 11 58·48	·22	4·7175670,1
		XXV		80 19 42·37	·22	4·8389192,5
		XXIV	104	70 5 28·99	·25	4·8201489,3
205	,,	XXV		58 43 45·35	·24	4·7787376,0
		XXVI	105	51 10 45·66	·24	4·7385115,6
		XXV		57 32 45·14	·27	4·7935772,9
206	,,	XXVI	105	58 40 46·82	·28	4·7989242,6
		XXVII		63 46 28·04	·28	4·8201489,3
		XXVI	105	72 18 26·25	·25	4·8364984,3
207	,,	XXVII		48 1 55·66	·25	4·7288347,7
		I LVIII	106	59 39 38·09	·25	4·7935772,9
		O XXVII		59 18 50·20	·23	4·7837886,7
208	,,	I LVIII	106	44 31 49·96	·23	4·6951994,2
		LVI		76 9 19·84	·23	4·8364984,3

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	I LVIII	106	54 26 52·99	·21	4·7253442,2
209	x	LVI		56 59 39·97	·21	4·7385033,9
	z	LV	107	68 33 27·04	·22	4·7837886,7
		LVI		63 2 31·53	·20	4·7418256,2
210	,,	LV	107	57 50 55·33	·19	4·7194841,0
		LIII		59 6 33·14	·19	4·7253442,2
		LV	107	52 32 29·00	·23	4·7403527,4
211	,,	LIII		74 39 44·76	·23	4·8248956,0
		LIV	108	52 47 46·24	·23	4·7418256,2
		LIV	108	78 53 21·94	·24	4·8435479,2
212	,,	LIII		50 25 15·00	·23	4·7386758,4
		LII	109	50 41 23·06	·23	4·7403527,4
		LIII		52 36 35·73	·27	4·7702126,9
213	,,	LII	109	57 13 28·89	·27	4·7948005,8
		LI		70 9 55·38	·27	4·8435479,2
		LII	109	71 4 43·02	·27	4·8430100,1
214	,,	LI		55 47 36·55	·27	4·7846494,7
		L	110	53 7 40·43	·26	4·7702126,9
		LI		51 16 0·64	·25	4·7507345,6
215	,,	L	110	53 59 40·12	·25	4·7665290,6
		XLIX		74 44 19·24	·25	4·8430100,1
		L	110	71 32 32·53	·21	4·7928794,7
216	,,	XLIX		49 2 50·58	·20	4·6939074,4
		XLVIII	111	59 24 36·89	·21	4·7507345,6
		XLIX		55 50 58·40	·23	4·7532161,2
217	,,	XLVIII	111	59 5 47·37	·24	4·7689175,0
		XLVII		65 3 14·23	·24	4·7928794,7
		XLVIII	111	63 38 10·73	·25	4·7945582,5
218	,,	XLVII		61 48 44·89	·24	4·7874296,2
		XLVI	112	54 33 4·38	·24	4·7532161,2
		XLVII		56 1 27·09	·27	4·7904475,1
219	,,	XLVI	112	67 8 3·72	·28	4·8362066,6
		XLV	86	56 50 29·19	·28	4·7945582,5
		XLVI	112	57 23 17·09	·23	4·7578243,7
220	,,	XLV	86	57 22 27·75	·23	4·7577578,3
		XLIV	87	65 14 15·16	·24	4·7904475,1
		B XLII	113	25 34 4·49	·61	5·0027539,2
221	,,	XL		25 20 49·88	·61	4·9992395,3
		P I	114	129 5 5·63	·62	5·2576726,9

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
222	y	P I	114	66 55 9·40	·80	5·0642131,6	236	y	P XVII		56 30 36·12	·25	4·7697393,0
	x	B* XL		60 5 17·09	·80	5·0383627,1		x	XVIII	122	63 13 5·12	·26	4·7993015,7
	z	P III	115	52 59 33·51	·79	5·0027539,2		z	XIX		60 16 18·76	·25	4·7872962,5
223	,,	B XL		33 46 42·28	·82	4·9633098,5	237	,,	XVIII	122	67 49 40·09	·28	4·8356448,2
		P III	115	101 40 56·38	·82	5·2091580,0			XIX		59 27 14·38	·27	4·8041233,4
		V		44 32 21·34	·82	5·0642131,6			XX	123	52 43 5·53	·27	4·7697393,0
224	,,	III	115	80 29 28·17	·90	5·1561304,2	238	,,	XIX		54 10 58·72	·26	4·7743926,3
		V		60 15 43·71	·90	5·1008107,0			XX	123	56 47 43·98	·27	4·7880117,5
		VI	116	39 14 48·12	·90	4·9633098,5			XXI		69 1 17·30	·27	4·8356448,2
225	,,	V		37 22 57·77	1·11	4·9964353,7	239	,,	XX	123	69 14 9·91	·28	4·8477578,1
		VI	116	81 20 21·02	1·11	5·2081686,0			XXI		58 36 18·81	·28	4·8081769,3
		VII		61 16 41·21	1·11	5·1561304,2			XXII	124	52 9 31·28	·28	4·7743926,3
226	,,	VI	116	31 39 6·58	·38	4·7218189,8	240	,,	XXI		54 28 19·67	·32	4·8130923,8
		VII		67 23 11·01	·38	4·9671190,6			XXII	124	63 42 33·66	·33	4·8551358,3
		IX	117	80 57 42·41	·39	4·9964353,7			XXIII		61 49 6·67	·33	4·8477578,1
227	,,	IX	117	61 41 7·38	·21	4·7487140,9	241	,,	XXII	124	63 51 7·69	·33	4·8592974,7
		VII		62 28 21·83	·21	4·7518768,0			XXIII		62 20 16·93	·33	4·8534733,3
		XI	118	55 50 30·79	·20	4·7218189,8			XXIV	125	53 48 35·38	·33	4·8130923,8
228	,,	VII		59 32 37·31	·23	4·7690118,2	242	,,	XXIII		54 45 50·75	·31	4·8085790,5
		XI	118	65 6 17·57	·24	4·7911420,9			XXIV	125	58 36 20·73	·31	4·8277281,5
		X		55 21 5·12	·23	4·7487140,9			XXV		66 37 48·52	·31	4·8592974,7
229	,,	XI	118	58 47 38·90	·23	4·7604893,9	243	,,	XXIV	125	55 57 23·39	·27	4·7822295,2
		X		60 29 0·10	·23	4·7679906,4			XXV		62 20 51·63	·27	4·8112037,6
		XII	119	60 43 21·00	·23	4·7690118,2			XXVI	126	61 41 44·98	·27	4·8085790,5
230	,,	X		55 4 9·84	·25	4·7624796,4	244	,,	XXV		48 6 39·92	·26	4·7454535,2
		XII	119	70 14 4·42	·25	4·8223761,2			XXVI	126	77 46 15·25	·26	4·8636550,0
		XIII		54 41 45·74	·24	4·7604893,9			XXVII		54 7 4·83	·26	4·7822295,2
231	,,	XII	119	66 24 17·23	·21	4·7732595,3	245	,,	XXVI	126	59 21 56·31	·28	4·8190103,9
		XIII		50 13 26·12	·20	4·6968487,4			XXVII		74 3 3·06	·28	4·8672434,6
		XIV	120	63 22 16·65	·21	4·7624796,4			XXVIII	127	46 35 0·63	·27	4·7454535,2
232	,,	XIII		61 47 55·73	·24	4·7774121,6	246	,,	XXVII		61 11 28·74	·29	4·8217051,0
		XIV	120	57 24 10·56	·23	4·7578510,6			XXVIII	127	58 15 19·26	·29	4·8087091,3
		XV		60 47 53·71	·23	4·7732595,3			XXIX		60 33 12·00	·29	4·8190103,9
233	,,	XIV	120	64 37 14·29	·34	4·8837699,9	247	,,	XXVIII	127	69 43 21·13	·32	4·8728688,8
		XV		70 22 7·54	·35	4·9018397,8			XXIX		53 47 18·86	·31	4·8074430,7
		XVI	121	45 0 38·17	·34	4·7774121,6			I LXXI	128	56 29 20·01	·31	4·8217051,0
234	,,	XV		48 41 58·35	·33	4·7927453,5	248	,,	P XXIX		62 36 17·98	·31	4·8522061,6
		XVI	121	63 24 53·80	·34	4·8684249,0			I LXXI	128	48 47 6·52	·31	4·7802226,7
		XVII		67 53 7·85	·34	4·8837699,9			LXIX		68 36 35·50	·32	4·8728688,8
235	,,	XVI	121	59 35 54·57	·26	4·7872962,5	249	,,	LXXI	128	51 23 21·90	·28	4·7708189,4
		XVII		59 32 47·28	·25	4·7870646,3			LXIX		58 8 29·32	·28	4·8070313,3
		XVIII	122	60 51 18·15	·26	4·7927453,5			LXX	129	70 28 8·78	·28	4·8522061,6

* B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Triangle Number	Symbolic Error	Station Numbers Serial	Station Numbers Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers Serial	Station Numbers Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	I LXX	129	59 48 13·18	·24	4·7779223,4		y	B XLIV		39 51 54·731	1·189	5·0557003,5
250	x	LXIX		61 57 13·11	·25	4·7870022,4	263	x	LIII	136	48 25 10·270	1·189	5·1227691,1
	z	LXVIII	130	58 14 33·71	·24	4·7708189,4		z	Q I		91 42 54·999	1·190	5·2486588,2
		LXIX		63 48 12·99	·23	4·7841496,9			B LIII	136	38 11 55·550	·763	4·9309304,4
251	”	LXVIII	130	54 0 17·61	·23	4·7392032,8	264	”	Q I		86 17 37·025	·764	5·1387576,5
		LXVII		62 11 29·40	·23	4·7779223,4			III	137	55 30 27·425	·763	5·0557003,5
		LXVIII	130	62 38 40·41	·20	4·7578197,9			I		61 47 41·757	·595	4·9833046,7
252	”	LXVII		46 40 31·37	·20	4·6711420,8	265	”	III	137	66 50 22·948	·596	5·0017081,9
		LXVI	131	70 40 48·22	·20	4·7841496,9			IV		51 21 55·295	·595	4·9309304,4
		LXVII		65 28 29·59	·24	4·7914949,1			III	137	80 33 10·62	1·07	5·1983680,4
253	”	LXVI	131	57 11 1·36	·23	4·7570513,2	266	”	IV		62 29 32·71	1·06	5·1521973,7
		LXV		57 20 29·05	·23	4·7578197,9			VI	138	36 57 16·67	1·06	4·9833046,7
		LXVI	131	48 56 43·86	·24	4·7298121,6			IV		62 30 49·64	1·08	5·1530328,8
254	”	LXV		70 41 32·99	·25	4·8272521,2	267	”	VI	138	37 30 39·16	1·07	4·9896041,3
		LXIV	132	60 21 43·15	·25	4·7914949,1			V		79 58 31·20	1·08	5·1983680,4
		LXV		58 42 36·85	·20	4·7272012,4			V		54 42 22·79	1·00	5·0762077,8
255	”	LXIV	132	62 0 22·82	·20	4·7414234,3	268	”	VI	138	48 21 5·44	1·00	5·0378681,3
		LXIII		59 17 0·33	·20	4·7298121,6			VII		76 56 31·77	1·00	5·1530328,8
		LXIV	132	57 34 55·34	·19	4·7175310,2			VI	138	41 11 0 73	·67	4·9080679,6
256	”	LXIII		62 44 37·94	·20	4·7399925,1	269	”	VII		62 56 8·13	·68	5·0391615,5
		LXII	133	59 40 26·72	·19	4·7272012,4			IX	139	75 52 51·14	·68	5·0762077,8
		LXIII		65 9 49·48	·21	4·7672820,8			IX	139	71 14 39·46	·53	4·9903102,0
257	”	LXII	133	60 48 36·63	·21	4·7504483,6	270	”	VII		57 10 11·61	·52	4·9384319,3
		LXI		54 1 33·89	·21	4·7175310,2			XI	140	51 35 8·93	·52	4·9080679,6
		LXII	133	50 33 5·11	·22	4·7112630,5			VII		38 54 1·59	·45	4·8061565,8
258	”	LXI		67 59 8·05	·22	4·7906576,1	271	”	XI	140	67 26 26·50	·46	4·9736472,0
		LX	134	61 27 46·84	·22	4·7672820,8			X		73 39 31·91	·46	4·9903102,0
		LXI		59 57 19·79	·19	4·7221652,8			X		82 34 0·16	·26	4·8882023,9
259	”	LX	134	62 27 38·29	·19	4·7326030,4	272	”	XI	140	42 15 30·68	·26	4·7195449,0
		LIX		57 35 1·92	·19	4·7112630,5			XII		55 10 29·16	·26	4·8061565,8
		LX	134	63 45 58·17	·23	4·7963029,4			XI	140	45 1 48·54	·34	4·7768422,6
260	”	LIX		67 6 3·37	·23	4·8078617,8	273	”	XII		68 52 4·28	·34	4·8968947,5
		LVII	135	49 7 58·46	·23	4·7221652,8			XIII	141	66 6 7·18	·34	4·8882023,9
		LIX		60 30 28·68	·24	4·7788523,4			XII		60 26 27·14	·22	4·7632119,3
261	”	LVII	135	54 31 7·20	·24	4·7499083,2	274	”	XIII	141	55 43 2·46	·22	4·7408904,5
		LV	107	64 58 24·12	·24	4·7963029,4			XIV		63 50 30·40	·23	4·7768422,6
		LVII	135	72 32 28·91	·24	4·8249038,1			XIII	141	58 59 22·10	·25	4·7796837,3
262	”	LV	107	48 22 13·42	·23	4·7189705,7	275	”	XIV		65 24 15·59	·25	4·8053577,9
		LIV	108	59 5 17·67	·24	4·7788523,4			XV	142	55 36 22·31	·25	4·7632119,3
									XIV		61 54 36·07	·25	4·7908260,2
							276	”	XV	142	58 47 19·55	·25	4·7773539,6
									XVI		59 18 4·38	·25	4·7796837,3

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	Q XV	142	54 15 16·16	·24	4·7504593,5
277	x	XVI		62 47 14·29	·24	4·7901623,3
	z	XVII	143	62 57 29·55	·25	4·7908260,2
		XVI		57 8 4·57	·21	4·7329389,6
278	"	XVII	143	61 52 35·35	·21	4·7541224,8
		XVIII		60 59 20·08	·21	4·7504593,5
		XVII	143	61 1 15·29	·21	4·7418569,0
279	"	XVIII		59 59 45·11	·20	4·7374623,1
		XIX	144	58 58 59·60	·20	4·7329389,6
		XVIII		55 32 8·95	·20	4·7229367,7
280	"	XIX	144	65 0 48·25	·21	4·7640795,9
		XX		59 27 2·80	·21	4·7418569,0
		XIX	144	59 46 56·16	·20	4·7381658,0
281	"	XX		63 40 12·94	·21	4·7540244,5
		XXI	145	56 32 50·90	·20	4·7229367,7
		XX		61 37 24·65	·21	4·7448819,5
282	"	XXI	145	58 20 24·68	·20	4·7304976,1
		XXII		60 2 10·67	·20	4·7381658,0
		XXI	145	66 23 5·31	·23	4·7852962,2
283	"	XXII		57 0 57·97	·22	4·7469498,0
		XXIII	146	56 35 56·72	·22	4·7448819,5
		XXII		61 17 48·73	·24	4·7804120,8
284	"	XXIII	146	56 11 58·34	·24	4·7569436,8
		XXIV		62 30 12·93	·24	4·7852962,2
		XXIII	146	62 22 54·12	·23	4·7784412,9
285	"	XXIV		54 44 3·50	·23	4·7429277,1
		XXV	147	62 53 2·38	·24	4·7804120,8
		XXIV		60 40 46·60	·24	4·7765462,2
286	"	XXV	147	58 11 29·49	·24	4·7654062,4
		XXVI		61 7 43·91	·24	4·7784412,9
		XXV	147	63 54 1·68	·21	4·7715943,8
287	"	XXVI		50 49 26·70	·21	4·7077223,9
		I LXXXV	148	65 16 31·62	·22	4·7765462,2
		Q XXVI		63 55 59·71	·22	4·7747784,0
288	"	I LXXXV	148	52 58 35·13	·22	4·7235792,3
		LXXXIII		63 5 25·16	·22	4·7715943,8
		LXXXV	148	62 32 56·29	·25	4·7913365,6
289	"	LXXXIII		58 46 43·16	·25	4·7752677,3
		LXXXIV	149	58 40 20·55	·24	4·7747784,0
		LXXXIV	149	54 40 56·28	·25	4·7595774,7
290	"	LXXXIII		63 55 54·80	·25	4·8013171,5
		LXXXII	150	61 23 8·92	·25	4·7913365,6
	y	I LXXXIII		75 44 31·73	·21	4·8129919,9
291	x	LXXXII	150	45 16 22·00	·20	4·6781226,5
	z	LXXXI		58 59 6·27	·21	4·7595774,7
		LXXXII	150	49 2 39·24	·21	4·7079373,7
292	"	LXXXI		56 49 28·17	·22	4·7525907,8
		LXXX	151	74 7 52·59	·22	4·8129919,9
		LXXXI		56 49 48·03	·21	4·7344572,5
293	"	LXXX	151	71 13 14·23	·21	4·7879475,7
		LXXIX		51 56 57·74	·20	4·7079373,7
		LXXX	151	65 8 0·64	·23	4·7742877,3
294	"	LXXIX		58 59 41·93	·22	4·7495842,7
		LXXVIII	152	55 52 17·43	·22	4·7344572,5
		LXXIX		51 28 4·75	·23	4·7256496,1
295	"	LXXVIII	152	67 29 29·33	·23	4·7978869,3
		LXXVII		61 2 25·92	·23	4·7742877,3
		LXXVIII	152	67 46 53·59	·22	4·7836178,1
296	"	LXXVII		58 6 54·79	·22	4·7460896,1
		LXXVI	153	54 6 11·62	·21	4·7256496,1
		LXXVII		56 18 9·48	·22	4·7408969,7
297	"	LXXVI	153	57 3 53·06	·22	4·7446939,8
		LXXV		66 37 57·46	·22	4·7836178,1
		LXXVI	153	66 47 23·23	·22	4·7852290,7
298	"	LXXV		57 7 26·48	·22	4·7460832,3
		LXXIV	154	56 5 10·29	·22	4·7408969,7
		LXXV		54 51 36·06	·22	4·7324829,0
299	"	LXXIV	154	57 43 9·54	·22	4·7469471,1
		LXXIII		67 25 14·40	·22	4·7852290,7
		LXXIV	154	52 14 28·01	·21	4·7135202,8
300	"	LXXIII		72 4 52·23	·21	4·7939722,2
		LXXII	155	55 40 39·76	·21	4·7324829,0
		LXXIII		69 25 4·95	·18	4·7459319,1
301	"	LXXII	155	50 15 25·36	·17	4·6604584,6
		LXXI	128	60 19 29·69	·17	4·7135202,8
		LXXII	155	65 49 5·77	·25	4·8070180,4
302	"	LXXI	128	61 45 25·27	·25	4·7918543,9
		LXX	129	52 25 28·96	·24	4·7459319,1
		B* LVI		63 13 0·90	1·23	5·1408669,0
303	"	LIX	156	59 30 47·52	1·23	5·1255315,2
		R I		57 16 11·58	1·22	5·1150652,5

* B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	B LIX	156	50 45 13·29	·94	5·0407902,3		y	R XIV	163	61 5 49·51	·19	4·7314660,1
304	x	R I		52 3 8·39	·94	5·0486479,0	318	x	XV		52 3 14·44	·19	4·6860913,5
	z	II	157	77 11 38·32	·95	5.1408669,0		z	XVI	164	66 50 56·05	·19	4·7527778,0
		I		73 59 38·45	1·01	5·1432954,1			XV		67 53 6·02	·23	4·7990811,5
305	,,	II	157	56 37 2·28	1·01	5·0821605,3	319	,,	XVI	164	59 39 40·37	·23	4·7683063,1
		III		49 23 19·27	1·00	5·0407902,3			XVII		52 27 13·61	·23	4·7314660,1
		II	157	42 40 5·41	·80	4·9751017,0			XVI	164	53 31 47·26	·18	4·7096663,6
306	,,	III		50 39 59·09	·80	5·0324741,2	320	,,	XVII		45 21 8·38	·18	4·6564599,0
		IV	158	86 39 55·50	·80	5·1432954,1			XVIII	165	81 7 4·36	·18	4·7990811,5
		III		48 1 7·01	·41	4·8511742,1			XVII		80 20 48·21	·21	4·8235001,0
307	,,	IV	158	50 32 51·63	·41	4·8676774,6	321	,,	XVIII	165	50 19 6·49	·21	4·7159615,5
		V		81 26 1·36	·41	4·9751017,0			I XCI		49 20 5·30	·20	4·7096663,6
		IV	158	51 11 29·18	·32	4·7998557,2			R XVIII	165	53 24 11·47	·19	4·7301537,5
308	,,	V		67 31 40·07	·33	4·8738846,7	322	,,	I XCI		42 7 1·85	·18	4·6520143,6
		VI	159	61 16 50·75	·33	4·8511742,1			XCIII	166	84 28 46·68	·19	4·8235001,0
		V		57 26 3·24	·24	4·7703504,8			XCIII	166	77 13 11·34	·23	4·8359009,6
309	,,	VI	159	58 8 26·91	·25	4·7737248,5	323	,,	XCI		52 55 14·51	·23	4·7486907,1
		VII		64 25 29·85	·25	4·7998557,2			XCII	167	49 51 34·15	·23	4·7301537,5
		VI	159	54 22 45·02	·19	4·7063504,0			XCII	167	49 47 31·18	·24	4·7337914,7
310	,,	VII		55 14 16·25	·19	4·7109404,2	324	,,	XCI		55 9 45·80	·24	4·7650909,5
		VIII	160	70 22 58·73	·20	4·7703504,8			XC	168	75 2 43·02	·24	4·8359009,6
		VII		62 57 33·25	·18	4·7235096,3			XCI		58 0 51·94	·23	4·7639322,6
311	,,	VIII	160	58 9 2·33	·18	4·7029182,8	325	,,	XC	168	69 40 38·04	·23	4·8075309,7
		IX		58 53 24·42	·18	4·7063504,0			LXXXIX		52 18 30·02	·23	4·7337914,7
		VIII	160	50 45 42·05	·18	4·6680891,1			XC	168	61 47 52·34	·21	4·7577001,6
312	,,	IX		67 36 10·58	·18	4·7449932,4	326	,,	LXXXIX		54 49 7·92	·21	4·7249832,4
		X	161	61 38 7·37	·18	4·7235096,3			LXXXVIII	169	63 22 59·74	·22	4·7639322,6
		IX		57 6 33·73	·16	4·6800321,6			LXXXIX		57 12 49·61	·22	4·7469984,7
313	,,	X	161	68 6 42·65	·17	4·7234109,6	327	,,	LXXXVIII	169	63 16 53·67	·23	4·7733207,9
		XI		54 46 43·62	·16	4·6680891,1			LXXXVII		59 30 16·72	·22	4·7577001,6
		X	161	52 54 57·87	·18	4·6864815,6			LXXXVIII	169	52 43 31·46	·21	4·7199172,7
314	,,	XI		75 16 16·49	·18	4·7701025,6	328	,,	LXXXVII		69 23 38·44	·22	4·7904313,4
		XII	162	51 48 45·64	·17	4·6800321,6			LXXXVI	170	57 52 50·10	·22	4·7469984,7
		XI		60 54 41·85	·19	4·7274131,8			LXXXVII		68 16 58·53	·25	4·8166816,7
315	,,	XII	162	66 24 26·76	·19	4·7480579,2	329	,,	LXXXVI	170	63 41 22·09	·24	4·8011597,8
		XIII		52 40 51·39	·18	4·6864815,6			LXXXV	148	48 1 39·38	·24	4·7199172,7
		XII	162	53 51 16·97	·22	4·7304495,6			LXXXVI	170	58 40 50·97	·24	4·7752874,0
316	,,	XIII		72 50 0·85	·22	4·8035027,2	330	,,	LXXXV	148	51 18 54·37	·24	4·7361104,7
		XIV	163	53 18 42·18	·21	4·7274131,8			LXXXIV	149	70 0 14·66	·24	4·8166816,7
		XIII		56 56 5·14	·22	4·7527778,0							
317	,,	XIV	163	70 18 37·71	·23	4·8033430,9							
		XV		52 45 17·15	·22	4·7304495,6							

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	B* LXIV	171	80 1 29·20	1·15	5·1978856,4
331	x	LXII		56 27 4·50	1·14	5·1253628,8
	z	S I	172	43 31 26·30	1·14	5·0425046,7
		B LXII		57 36 6·90	1·07	5·1281964,9
332	„	S I	172	39 57 25·37	1·07	5·0093553,5
		II		82 26 27·73	1·08	5·1978856,4
		II		56 27 29·68	1·49	5·1659909,8
333	„	I	172	73 43 20·01	1·49	5·2273264,4
		IV		49 49 10·31	1·49	5·1281964,9
		I	172	61 43 58·94	1·57	5·1891866,4
334	„	IV		61 39 25·08	1·57	5·1888761,0
		V	173	56 36 35·98	1·57	5·1659909,8
		IV		43 6 19·37	1·52	5·1041849,9
335	„	V	173	80 41 7·23	1·53	5·2637821,5
		VII		56 12 33·40	1·53	5·1891866,4
		V	173	64 45 2·77	1·16	5·1338149,4
336	„	VII		57 35 50·93	1·15	5·1039241,8
		IX	174	57 39 6·30	1·15	5·1041849,9
		IX	174	52 27 28·75	1·22	5·0921114,8
337	„	VII		66 45 13·65	1·22	5·1561185,7
		XII	175	60 47 17·60	1·22	5·1338149,4
		VII		46 33 38·07	·77	4·9683353,7
338	„	XII	175	58 31 22·83	·77	5·0382105,1
		XI		74 54 59·10	·78	5·0921114,8
		XI		52 46 52·54	·52	4·9108009,2
339	„	XII	175	61 49 57·23	·53	4·9549644,1
		XIII		65 23 10·23	·53	4·9683353,7
		XII	175	62 23 33·33	·48	4·9313242,8
340	„	XIII		59 54 34·52	·48	4·9209543,4
		XV	176	57 41 52·15	·47	4·9108009,2
		XV	176	58 25 9·11	·37	4·8777062,7
341	„	XIII		47 2 3·97	·37	4·8116871,7
		XVII	177	74 32 46·92	·38	4·9313242,8
		XIII		56 33 43·65	·30	4·8181503,0
342	„	XVII	177	50 16 26·81	·30	4·7827213,5
		XVI		73 9 49·54	·30	4·8777062,7
		XVI		52 55 22·91	·23	4·7405196,1
343	„	XVII	177	54 31 36·73	·23	4·7494424,5
		XVIII		72 33 0·36	·23	4·8181503,0
		XVII	177	60 7 53·54	·21	4·7501751,5
344	„	XVIII		61 51 44·61	·22	4·7574491,3
		XIX	178	58 0 21·85	·21	4·7405196,1

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	S XVIII		59 22 5·52	·21	4·7382747,9
345	x	XIX	178	58 27 30·72	·20	4·7341174,5
	z	XX		62 10 23·76	·21	4·7501751·5
		XIX	178	50 56 35·98	·19	4·6923097,4
346	„	XX		69 22 37·47	·20	4·7733934,5
		XXI	179	59 40 46·55	·20	4·7382747,9
		XX		63 13 37·27	·21	4·7669456,4
347	„	XXI	179	68 1 26·95	·21	4·7834320,0
		I CVII		48 44 55·78	·21	4·6923097,4
		S XXI	179	51 49 44·28	·22	4·7226167,4
348	„	I CVII		67 38 11·18	·23	4·7931428,5
		CVIII	180	60 32 4·54	·22	4·7669456,4
		CVIII	180	58 49 41·22	·20	4·7365304,9
349	„	CVII		65 12 45·04	·21	4·7622736,4
		CVI	181	55 57 33·74	·20	4·7226167,4
		CVII		62 16 6·77	·21	4·7544768,9
350	„	CVI	181	59 35 42·27	·21	4·7432097,9
		CIII		58 8 10·96	·21	4·7365304,9
		CVI	181	59 59 15·04	·22	4·7595490,1
351	„	CIII		61 9 26·55	·23	4·7645514,2
		CII	182	58 51 18·41	·22	4·7544768,9
		CIII		55 54 8·87	·20	4·7218503,6
352	„	CII	182	59 31 6·86	·20	4·7391790,6
		CI		64 34 44·27	·21	4·7595490,1
		CII	182	63 14 48·16	·20	4·7500041,5
353	„	CI		59 56 19·79	·20	4·7364381,2
		C	183	56 48 52·05	·20	4·7218503,6
		CI		75 36 22·35	·21	4·8069127,1
354	„	C	183	46 13 12·33	·20	4·6793026,9
		XCIX		58 10 25·32	·20	4·7500041,5
		C	183	60 53 5·45	·24	4·7834747,6
355	„	XCIX		51 52 54·94	·24	4·7379718,6
		XCVIII	184	67 13 59·61	·24	4·8069127,1
		XCIX		67 50 24·01	·24	4·8033188,2
356	„	XCVIII	184	49 56 12·85	·23	4·7204971,4
		XCVII		62 13 23·14	·23	4·7834747,6
		XCVIII	184	56 3 36·80	·24	4·7626543,1
357	„	XCVII		58 17 15·87	·25	4·7735483,2
		XCVI	185	65 39 7·33	·25	4·8033188,2
		XCVII		65 18 45·31	·22	4·7793987,4
358	„	XCVI	185	53 43 58·16	·22	4·7275050,7
		XCV		60 57 16·53	·22	4·7626543,1

* B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	I XCVI	185	61 11 50·83	·24	4·7772000,5
359	x	XCV		57 4 18·00	·23	4·7584982,5
	z	XCIV	186	61 43 51·17	·24	4·7793987,4
		XCV		68 47 2·31	·25	4·8177886,7
360	,,	XCIV	186	53 6 28·82	·24	4·7512333,3
		XCIII	166	58 6 28·87	·25	4·7772000,5
		XCIV	186	53 44 12·68	·23	4·7486622,5
361	,,	XCIII	166	55 16 45·45	·24	4·7569999,4
		XCII	167	70 59 1·87	·24	4·8177886,7
		B LXXXI	187	59 46 2·92	·28	4·8070143,6
362	,,	LXXVIII		59 50 16·61	·28	4·8073251,9
		T I	188	60 23 40·47	·28	4·8097497,2
		B LXXVIII		56 31 27·95	·23	4·7531425,5
363	,,	T I	188	52 41 32·28	·22	4·7324946,7
		II		70 46 59·77	·23	4·8070143,6
		II		66 18 37·91	·19	4·7535653,9
364	,,	I	188	47 30 20·51	·18	4·6594653,4
		III		66 11 1·58	·19	4·7531425,5
		I	188	53 56 11·86	·18	4·6898034,8
365	,,	III		56 38 23·78	·18	4·7040019,9
		IV	189	69 25 24·36	·19	4·7535653,9
		IV	189	77 47 41·65	·18	4·7763317,9
366	,,	III		48 59 42·87	·17	4·6640092,3
		V	190	53 12 35·48	·17	4·6898034,8
		III		49 47 37·89	·19	4·6831118,1
367	,,	V	190	59 1 5·55	·19	4·7333223,2
		VI		71 11 16·56	·20	4·7763317,9
		V	190	48 59 34·28	·14	4·6079419,1
368	,,	VI		67 12 40·02	·14	4·6949109,3
		VII	191	63 47 45·70	·14	4·6831118,1
		VI		69 34 17·77	·17	4·7526998,1
369	,,	VII	191	68 14 49·56	·17	4·7488275,7
		VIII		42 10 52·67	·16	4·6079419,1
		VII	191	70 21 26·83	·21	4·7879413,4
370	,,	VIII		49 22 8·63	·20	4·6941748,9
		IX	192	60 16 24·54	·21	4·7526998,1
		VIII		45 4 55·31	·20	4·6697734,4
371	,,	IX	192	66 33 10·30	·21	4·7822393,6
		X		68 21 54·39	·21	4·7879413,4
	y	T IX	192	78 39 26·18	·18	4·7846466,2
372	x	X		52 31 37·93	·18	4·6928378,4
	z	XI	193	48 48 55·89	·17	4·6697734,4
		X		54 55 19·44	·24	4·7501392,9
373	,,	XI	193	62 41 49·48	·24	4·7858923,6
		XII		62 22 51·08	·24	4·7846466,2
		XI	193	49 31 40·21	·20	4·6939428,2
374	,,	XII		70 29 49·00	·21	4·7870554,4
		XIII	194	59 58 30·79	·21	4·7501392,9
		XII		67 22 30·18	·19	4·7471340,0
375	,,	XIII	194	57 52 30·37	·18	4·7097396,2
		XIV		54 44 59·45	·18	4·6939428,2
		XIII	194	47 44 37·96	·17	4·6415738,9
376	,,	XIV		61 33 25·85	·17	4·7163899,1
		XV	195	70 41 56·19	·17	4·7471340,0
		XIV		77 5 25·21	·15	4·7421714,1
377	,,	XV	195	52 16 7·74	·15	4·6514063,8
		XVI		50 38 27·05	·15	4·6415738,9
		XV	195	49 24 37·80	·22	4·7185347,6
378	,,	XVI		77 16 50·97	·22	4·8272794,3
		XVII	196	53 18 31·23	·22	4·7421714,1
		XVI		69 53 23·00	·23	4·8101433,0
379	,,	XVII	196	60 36 22·19	·23	4·7776136,3
		XVIII		49 30 14·81	·23	4·7185347,6
		XVII	196	52 20 47·08	·23	4·7371253,5
380	,,	XVIII		58 9 11·43	·23	4·7676983,7
		XIX	197	69 30 1·49	·24	4·8101433,0
		XVIII		61 49 55·48	·22	4·7582710,3
381	,,	XIX	197	61 3 44·41	·21	4·7550961,5
		XX		57 6 20·11	·21	4·7371253,5
		XIX	197	58 24 32·23	·24	4·7670955,3
382	,,	XX		65 0 32·41	·24	4·7940609,4
		XXI	198	56 34 55·36	·24	4·7582710,3
		XX		53 17 59·74	·17	4·6857507,3
383	,,	XXI	198	51 28 30·10	·17	4·6750920,1
		XXII		75 13 30·16	·18	4·7670955,3
		XXI	198	53 13 43·02	·17	4·6716607,0
384	,,	XXII		70 56 3·22	·17	4·7435097,5
		XXIII	199	55 50 13·76	·17	4·6857507,3
		XXII		58 37 54·89	·19	4·7370916,4
385	,,	XXIII	199	74 6 34·70	·20	4·7887938,0
		XXIV		47 15 30·41	·19	4·6716607,0

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	T XXIII	199	67 52 8·25	·19	4·7550532,0		y	T XXXVII	206	58 52 31·99	·23	4·7608389,6
386	x	XXIV		49 24 31·69	·18	4·6687441,1	400	x	XXXVIII		55 23 34·66	·23	4·7437765,6
	z	XXV	200	62 43 20·06	·18	4·7370916,4		z	XXXIX	207	65 43 53·35	·23	4·7881598,2
		XXIV		59 17 14·51	·23	4·7654937,3			XXXVIII		58 52 31·17	·21	4·7381712,4
387	,,	XXV	200	63 38 40·16	·24	4·7834622,5	401	,,	XXXIX	207	56 42 50·91	·20	4·7278514,1
		XXVI		57 4 5·33	·23	4·7550532,0			XL		64 24 37·92	·21	4·7608389,6
		XXV	200	80 11 24·25	·24	4·8529589,1			XXXIX	207	65 9 28·98	·22	4·7691700,8
388	,,	XXVI		46 8 18·24	·23	4·7173005,9	402	,,	XL		57 10 29·45	·21	4·7357869,3
		XXVII	201	53 40 17·51	·23	4·7654937,3			XLI	208	57 40 1·57	·21	4·7381712,4
		XXVI		44 50 14·17	·30	4·7557340,1			XL		59 8 20·99	·21	4·7468548,0
389	,,	XXVII	201	73 16 37·50	·31	4·8887188,5	403	,,	XLI	208	56 12 54·84	·21	4·7328272,9
		XXVIII		61 53 8·33	·31	4·8529589,1			XLII		64 38 44·17	·22	4·7691700,8
		XXVII	201	66 58 12·97	·28	4·8368846,0			XLI	208	66 44 3·47	·23	4·7888421,8
390	,,	XXVIII		63 15 38·04	·27	4·8238357,7	404	,,	XLII		56 45 5·04	·23	4·7480383,7
		XXIX	202	49 46 8·99	·27	4·7557340,1			XLIII	209	56 30 51·49	·22	4·7468548,0
		XXVIII		45 47 16·77	·22	4·7001390,2			XLII		67 14 10·07	·23	4·7994170,7
391	,,	XXIX	202	55 5 32·19	·22	4·7586159,7	405	,,	XLIII	209	48 36 56·14	·22	4·7098653,8
		XXX		79 7 11·04	·22	4·8368846,0			I CXXV		64 8 53·79	·23	4·7888421,8
		XXIX	202	52 34 0·53	·20	4·7171073,3			T XLIII	209	60 39 42·96	·22	4·7693896,9
392	,,	XXX		77 38 50·56	·20	4·8070802,6	406	,,	I CXXV		50 14 48·88	·22	4·7148182,4
		XXXI	203	49 47 8·91	·20	4·7001390,2			CXXVI	210	69 5 28·16	·23	4·7994170,7
		XXX		66 41 30·03	·22	4·7842447,1			CXXVI	210	49 48 47·72	·23	4·7249543,2
393	,,	XXXI	203	61 25 0·00	·22	4·7647729,8	407	,,	CXXV		72 22 51·07	·24	4·8210257,6
		XXXII		51 53 29·97	·22	4·7171073,3			CXXII	211	57 48 21·21	·23	4·7693896,9
		XXXI	203	74 17 53·09	·29	4·8705941,8			CXXV		40 11 10·90	·14	4·5645016,0
394	,,	XXXII		53 36 0·57	·29	4·7928504,9	408	,,	CXXII	211	70 47 51·64	·15	4·7298951,0
		XXXIII	204	52 6 6·34	·28	4·7842447,1			CXXI		69 0 57·46	·15	4·7249543,2
		XXXII		54 27 59·27	·25	4·7872250,7			CXXII	211	70 52 34·85	·18	4·8006368,3
395	,,	XXXIII	204	45 8 4·67	·25	4·7272235,7	409	,,	CXXI		75 51 23·44	·18	4·8119221,5
		XXXIV		80 23 56·06	·26	4·8705941,8			CXX	212	33 16 1·71	·17	4·5645016,0
		XXXIII	204	77 54 22·51	·23	4·8454871,1			CXXI		76 0 35·74	·27	4·8634171,5
396	,,	XXXIV		43 19 43·17	·23	4·6916738,4	410	,,	CXX	212	46 52 40·30	·26	4·7397565,8
		XXXV	205	58 45 54·32	·23	4·7872250,7			CXIX		57 6 43·96	·27	4·8006368,3
		XXXIV		55 11 46·46	·27	4·7882533,8			CXX	212	46 33 10·35	·23	4·7272160,8
397	,,	XXXV	205	55 17 12·02	·28	4·7887290,2	411	,,	CXIX		50 0 41·82	·23	4·7506017,6
		XXXVI		69 31 1·52	·28	4·8454871,1			CXVIII	213	83 26 7·83	·24	4·8634171,5
		XXXV	205	65 16 15·86	·24	4·7991631,4			CXIX		71 37 52·91	·19	4·7735028,8
398	,,	XXXVI		52 22 59·50	·24	4·7397210,3	412	,,	CXVIII	213	49 49 4·14	·19	4·6793058,9
		XXXVII	206	62 20 44·64	·24	4·7882533,8			CXVII		58 33 2·95	·19	4·7272160,8
		XXXVI		64 38 47·94	·22	4·7881598,2			CXVIII	213	62 58 0·78	·22	4·7706039,8
399	,,	XXXVII	206	47 24 3·24	·22	4·6990844,4	413	,,	CXVII		53 18 15·33	·22	4·7249280,3
		XXXVIII		67 57 8·82	·23	4·7991631,4			CXVI	214	63 43 43·89	·22	4·7735028,8

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
414	y	I CXVII		62 10 5·73	·25	4·7860486,8
	x	CXVI	214	59 14 43·59	·24	4·7736160,1
	z	CXV		58 35 10·68	·24	4·7706039,8
415	„	CXVI	214	56 49 19·22	·25	4·7698082,4
		CXV		62 51 3·17	·25	4·7963990,4
		CXIV	215	60 19 37·61	·25	4·7860486,8
416	„	CXV		56 4 12·64	·22	4·7368312,9
		CXIV	215	60 23 54·61	·22	4·7571594,2
		CXIII		63 31 52·75	·22	4·7698082,4
417	„	CXIV	215	61 37 15·94	·23	4·7703689,9
		CXIII		63 50 49·51	·23	4·7790663,2
		CXII	216	54 31 54·55	·22	4·7368312,9
418	„	CXIII		59 57 38·50	·24	4·7731766,2
		CXII	216	60 42 39·83	·24	4·7764161,3
		CXI		59 19 41·67	·24	4·7703689,9
419	„	CXII	216	70 17 12·83	·25	4·8269676,5
		CXI		53 26 12·08	·25	4·7580197,1
		CX	217	56 16 35·09	·25	4·7731766,2
420	„	CXI		49 20 53·83	·20	4·7115115,0
		CX	217	48 52 12·71	·20	4·7083734,6
		CIX		81 46 53·46	·21	4·8269676,5
421	„	CX	217	61 6 29·36	·22	4·7703660,3
		CIX		69 1 22·60	·23	4·7983118,1
		CV	218	49 52 8·04	·22	4·7115115,0
422	„	CIX		60 35 35·66	·21	4·7545775,7
		CV	218	54 47 48·99	·21	4·7267643,7
		CVI	181	64 36 35·35	·22	4·7703660,3
423	„	CV	218	61 40 48·98	·23	4·7645741,8
		CVI	181	58 58 17·12	·22	4·7528718,6
		CII	182	59 20 53·90	·22	4·7545775,7
424	„	I CXXII	211	66 31 16·48	·33	4·8705538,7
		CXXVI	210	58 33 31·31	·33	4·8391242,4
		CXXIV		54 55 12·21	·33	4·8210257,6
425	„	CXXIV		56 55 31·526	·354	4·8443371,7
		CXXVI	210	60 11 17·948	·355	4·8594650,3
		X I		62 53 10·526	·355	4·8705538,7
426	„	I CXXVI	210	51 51 11·493	·213	4·7425462,1
		X I		44 20 52·500	·213	4·6913713,7
		II	219	83 47 56·007	·213	4·8443371,7

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
427	y	X I		47 8 54·546	·174	4·6425288,3
	x	II	219	65 29 9·618	·174	4·7363291,0
	z	IV		67 21 55·836	·174	4·7425462,1
428	„	II	219	67 38 11·933	·177	4·7479748,7
		IV		65 51 30·717	·177	4·7421830,8
		VI	220	46 30 17·350	·176	4·6425288,3
429	„	VI	220	63 22 54·850	·211	4·7598395,6
		IV		56 10 7·743	·211	4·7279303,6
		VII	221	60 26 57·407	·211	4·7479748,7
430	„	IV		53 48 32·082	·188	4·6953257,4
		VII	221	56 45 6·249	·188	4·7107876,7
		VIII		69 26 21·669	·188	4·7598395,6
431	„	VIII		55 7 42·667	·192	4·7107551,8
		VII	221	72 31 2·731	·192	4·7761712,9
		IX		52 21 14·602	·191	4·6953257,4
432	„	VII	221	57 50 19·352	·198	4·7244807,2
		IX		67 3 17·278	·198	4·7610287,1
		X	222	55 6 23·370	·197	4·7107551,8
433	„	X	222	71 47 51·163	·194	4·7760891,3
		IX		50 41 18·768	·193	4·6869646,3
		XII	223	57 30 50·069	·193	4·7244807,2
434	„	IX		59 19 31·171	·209	4·7443259,1
		XII	223	52 57 18·352	·208	4·7118800,6
		XIII		67 43 10·477	·209	4·7760891,3
435	„	XIII		52 1 25·517	·197	4·6942305,7
		XII	223	65 46 7·010	·198	4·7575028,0
		XIV		62 12 27·473	·197	4·7443259,1
436	„	XII	223	58 43 29·037	·194	4·7271826,1
		XIV		68 52 50·076	·194	4·7651807,2
		XV	224	52 23 40·887	·194	4·6942305,7
437	„	XV	224	65 44 21·237	·207	4·7645657,7
		XIV		57 29 21·471	·206	4·7306985,4
		XVII	225	56 46 17·292	·206	4·7271826,1
438	„	XIV		52 14 1·914	·190	4·6902134,4
		XVII	225	58 1 33·847	·191	4·7208460,8
		XVIII		69 44 24·239	·191	4·7645657,7
439	„	XVIII		62 8 46·849	·217	4·7737869,4
		XVII	225	71 1 11·386	·217	4·8029857,8
		XIX		46 50 1·765	·217	4·6902134,4
440	„	XVII	225	58 25 49·107	·227	4·7542937,9
		XIX		58 33 20·630	·227	4·7548765,1
		XX	226	63 0 50·263	·227	4·7737869,4

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	X XX	226	66 5 49·953	·232	4·7916651,2
441	x	XIX		56 53 0·738	·232	4·7536244,9
	z	XXII	227	57 1 9·309	·232	4·7542937,9
		XIX		60 12 19·060	·337	4·8607684,3
442	„	XXII	227	72 3 0·647	·337	4·9006728,1
		XXIII		47 44 40·293	·337	4·7916651,2
		XXIII	227	71 5 3·519	·333	4·8945794,4
443	„	XXII		47 51 14·026	·333	4·7887636,3
		XXIV	228	61 3 42·455	·333	4·8607684,3
		T I	188	54 42 10·963	·246	4·7561828,8
444	„	B* LXXXI	187	58 38 14·201	·247	4·7758048,8
		U I		66 39 34·836	·247	4·8073251,9
		B LXXXI	187	60 21 43·310	·247	4·7826270,7
445	„	U I		64 46 13·846	·247	4·7999839,5
		II	229	54 52 2·844	·246	4·7561828,8
		II	229	65 6 17·034	·250	4·8039447,4
446	„	I		55 10 7·380	·250	4·7605568,8
		IV	230	59 43 35·586	·250	4·7826270,7
		I		59 17 42·358	·272	4·7974079,6
447	„	IV	230	59 54 49·017	·273	4·8001581,1
		V		60 47 28·625	·273	4·8039447,4
		IV	230	52 56 5·507	·226	4·7301854,8
448	„	V		58 23 23·878	·226	4·7584629,1
		VI	231	68 40 30·615	·227	4·7974079,6
		V		46 34 38·193	·188	4·6629305,5
449	„	VI	231	75 25 58·482	·189	4·7876230,0
		VII		57 59 23·325	·189	4·7301854,8
		VI	231	65 11 12·827	·157	4·7024476,3
450	„	VII		58 50 38·210	·157	4·6768667,7
		VIII	232	55 58 8·963	·156	4·6629305,5
		VII		59 53 7·290	·166	4·6923052,7
451	„	VIII	232	57 48 22·203	·165	4·6827764,8
		IX		62 18 30·507	·166	4·7024476,3
		VIII	232	68 6 21·582	·179	4·7432411,6
452	„	IX		56 17 10·667	·179	4·6957816,4
		X	233	55 36 27·751	·179	4·6923052,7
		IX		58 25 21·172	·205	4·7317422,9
453	„	X	233	60 33 25·833	·205	4·7412784,7
		XI		61 1 12·995	·205	4·7432411,6

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	U X	233	65 38 1·078	·204	4·7610749,0
454	x	XI		55 59 54·561	·203	4·7201583,1
	z	XII	234	58 22 4·361	·203	4·7317422,9
		XI		55 12 39·460	·228	4·7414715,3
455	„	XII	234	65 33 52·650	·229	4·7862375,3
		XIII		59 13 27·890	·228	4·7610749,0
		XII	234	60 31 38·915	·226	4·7635942,0
456	„	XIII		63 38 40·390	·226	4·7761154,2
		XIV	235	55 49 40·695	·226	4·7414715,3
		XIII		58 24 36·395	·200	4·7297788,7
457	„	XIV	235	54 32 50·446	·200	4·7103731,3
		XV		67 2 33·159	·200	4·7635942,0
		XIV	235	61 47 43·812	·176	4·7165331,2
458	„	XV		52 53 51·254	·175	4·6731884,4
		XVI	236	65 18 24·934	·176	4·7297788,7
		XV		62 15 44·049	·228	4·7782031,6
459	„	XVI	236	67 34 13·112	·228	4·7970529,1
		XVII		50 10 2·839	·227	4·7165331,2
		XVI	236	51 36 54·387	·235	4·7311972,7
460	„	XVII		67 31 18·110	·236	4·8026437,1
		XVIII	237	60 51 47·503	·236	4·7782031,6
		XVIII	237	56 58 48·693	·201	4·7213268,9
461	„	XVII		63 57 14·933	·201	4·7513235,5
		XIX	238	59 3 56·374	·201	4·7311972,7
		XVII		62 14 57·354	·210	4·7549726,6
462	„	XIX	238	62 45 54·166	·210	4·7570072,5
		XX		54 59 8·480	·210	4·7213268,9
		XIX	238	63 0 32·534	·210	4·7576509,9
463	„	XX		54 39 55·955	·209	4·7193135,3
		XXI	239	62 19 31·511	·210	4·7549726,6
		XXI	239	53 50 8·805	·205	4·7110627,8
464	„	XX		62 10 12·077	·205	4·7506299,5
		V I	240	63 59 39·118	·206	4·7576509,9
		U XX		66 51 54·410	·217	4·7827452,4
465	„	V I	240	61 54 17·822	·217	4·7647056,7
		III		51 13 47·768	·217	4·7110627,8
		III		57 43 10·235	·239	4·7625600,4
466	„	I	240	59 56 48·925	·240	4·7727734,4
		V		62 20 0·840	·240	4·7827452,4
		I	240	59 30 3·830	·224	4·7559743,3
467	„	V		59 28 37·705	·224	4·7558674,8
		IV	241	61 1 18·465	·225	4·7625600,4

* B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	V IV	241	62 55 26·135	·232	4·7777925,4		y	V XXIV		72 30 46·191	·211	4·8007806,8
468	x	V		59 12 48·219	·232	4·7622393,7	482	x	XXI	248	47 27 59·111	·211	4·6887280,6
	z	VI	242	57 51 45·646	·231	4·7559743,3		z	XXVII		60 1 14·698	·211	4·7589519,9
		V		59 50 59·921	·219	4·755283,11			XXI	248	67 29 52·071	·254	4·8202576,3
469	„	VI	242	54 32 45·443	·219	4·7293452,6	483	„	XXVII		50 27 12·169	·254	4·7417636,7
		VIII		65 36 14·636	·220	4·7777925,4			XXV	249	62 2 55·760	·254	4·8007806,8
		VIII		51 11 59·962	·217	4·7135362,1			XXV	249	53 36 44·689	·256	4·7595809,4
470	„	VI	242	69 42 37·701	·218	4·7939912,3	484	„	XXVII		58 36 31·655	·256	4·7850430,6
		X		59 5 22·337	·218	4·7552831,1			XXVIII	250	67 46 43·656	·256	4·8202576,3
		VI	242	52 54 52·256	·178	4·6772401,4			XXVII		61 1 54·685	·225	4·7628925,4
471	„	X		66 56 32·091	·179	4·7392205,1	485	„	XXVIII	250	58 42 46·838	·224	4·7526906,1
		IX	243	60 8 35·653	·178	4·7135362,1			XXX		60 15 18·477	·224	4·7595809,4
		IX	243	55 45 45·048	·184	4·7082519,2			XXX		65 9 45·766	·225	4·7817792,3
472	„	X		73 54 25·721	·184	4·7735365,8	486	„	XXVIII	250	54 30 28·902	·225	4·7346599,9
		XI	244	50 19 49·231	·184	4·6772401,4			XXXII		60 19 45·332	·225	4·7628925,4
		X		60 53 17·676	·217	4·7616024,3			XXVIII	250	58 51 3·836	·227	4·7575087,6
473	„	XI	244	68 31 0·618	·217	4·7889819,8	487	„	XXXII		56 19 25·105	·227	4·7453423,2
		XIII		50 35 41·706	·216	4·7082519,2			XXXI	251	64 49 31·059	·228	4·7817792,3
		XIII		47 55 30·429	·209	4·6884787,2			XXXI	251	57 9 39·185	·210	4·7321060,3
474	„	XI	244	70 37 35·723	·210	4·7926021,8	488	„	XXXII		59 51 51·391	·211	4·7446601,6
		XV		61 26 53·848	·210	4·7616024,3			XXXIII	252	62 58 29·424	·211	4·7575087,6
		XI	244	56 24 19·790	·175	4·6917810,4			XXXII		64 57 9·043	·232	4·7886562,5
475	„	XV		67 50 12·790	·176	4·7378137,4	489	„	XXXIII	252	62 21 33·509	·232	4·7789207,7
		XIV	245	55 45 27·420	·175	4·6884787,2			XXXV		52 41 17·448	·231	4·7321060,3
		XIV	245	61 58 22·074	·194	4·7396214,3			XXXV		56 25 38·545	·247	4·7637762,4
476	„	XV		65 46 50·868	·195	4·7537827,3	490	„	XXXIII	252	61 39 0·732	·248	4·7875491,9
		XVI	246	52 14 47·058	·194	4·6917810,4			XXXVII		61 55 20·723	·248	4·7886562,5
		XV		54 14 39·347	·206	4·7150258,4			XXXIII	252	58 49 11·569	·229	4·7578848,6
477	„	XVI	246	66 34 24·730	·207	4·7683687,8	491	„	XXXVII		61 2 30·918	·230	4·7676377,3
		XVIII		59 10 55·923	·206	4·7396214,3			XXXVI	253	60 8 17·513	·229	4·7637762,4
		XVIII		84 46 56·661	·201	4·8339187,9			XXXVI	253	81 27 24·499	·304	4·9141495,6
478	„	XVI	246	45 59 7·297	·200	4·6925489,5	492	„	XXXVII		54 54 28·818	·303	4·8318707,9
		XX		49 13 56·042	·201	4·7150258,4			XXXIX	254	43 38 6·683	·303	4·7578848,6
		XVI	246	68 5 18·051	·268	4·8407350,2			XXXVII		70 56 54·772	·394	4·9354216,1
479	„	XX		45 56 39·831	·268	4·7298258,4	493	„	XXXIX	254	44 53 15·636	·393	4·8085180,1
		XIX	247	65 58 2·118	·268	4·8339187,9			XL		64 9 49·592	·394	4·9141495,6
		XIX	247	57 56 24·170	·265	4·7937973,4			XL		52 33 9·066	·304	4·8359265,8
480	„	XX		51 17 12·832	·265	4·7579157,3	494	„	XXXIX	254	40 46 32·578	·304	4·7511342,6
		XXI	248	70 46 22·998	·266	4·8407350,2			XLI		86 40 18·356	·305	4·9354216,1
		XX		58 2 46·685	·231	4·7589519,9			XXXIX	254	64 41 58·402	·307	4·8475921,1
481	„	XXI	248	55 7 16·379	·231	4·7443188,3	495	„	XLI		53 38 37·786	·306	4·7973689,7
		XXIV		66 49 56·936	·231	4·7937973,4			XLIII	255	61 39 23·812	·306	4·8359265,8

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
496	y	V XLI		70 12 30·360	·328	4·8855859,3
	x	XLIII	255	50 14 13·205	·328	4·7977833,9
	z	XLIV		59 33 16·435	·328	4·8475921,1
497	,,	XLIV		56 23 46·270	·430	4·8859109,6
		XLIII	255	67 16 19·483	·430	4·9302219,1
		XLV		56 19 54·247	·429	4·8855859,3
498	,,	XLIII	255	68 4 24·362	·455	4·9463526,6
		XLV		58 6 33·021	·455	4·9078987,6
		XLVI	256	53 49 2·617	·455	4·8859109,6
499	,,	XLVI	256	37 22 25·397	·478	4·8369673,6
		XLV		91 17 7·504	·479	5·0536611,9
		X XXV	257	51 20 27·099	·479	4·9463526,6
500	,,	V XLV		65 3 55·147	·521	4·9962118,6
		X XXV	257	75 59 59·219	·521	5·0256093,2
		XXII	227	38 56 5·634	·521	4·8369673,6
501	,,	XXII	227	31 43 43·676	·322	4·7198524,5
		XXV	257	51 50 38·851	·322	4·8945564,0
		XXIV	228	96 25 37·473	·323	4·9962118,6
502	,,	XXV	257	67 12 8·775	·300	4·8791018,8
		XXIV	228	73 5 18·998	·300	4·8952287,8
		XXVI	258	39 42 32·227	·299	4·7198524,5
503	,,	XXIV	228	62 21 44·125	·436	4·9144081,1
		XXVI	258	62 52 44·867	·437	4·9164371,2
		XXVII		54 45 31·008	·436	4·8791018,8
504	,,	XXVII		60 15 34·415	·439	4·9056461,7
		XXVI	258	57 22 6·366	·438	4·8923778,5
		XXVIII		62 22 19·219	·439	4·9144081,1
505	,,	XXVI	258	55 47 20·347	·525	4·9354738,0
		XXVIII		73 40 11·230	·525	5·0000988,5
		XXX	259	50 32 28·423	·525	4·9056461,7
506	,,	XXVIII		80 55 21·289	·391	4·9827155,5
		XXX	259	36 44 24·314	·390	4·7650251,7
		XXXI		62 20 14·397	·391	4·9354738,0
507	,,	XXXI		38 50 42·976	·349	4·7802370,2
		XXX	259	49 54 45·732	·350	4·8665155,0
		XXXII		91 14 31·292	·350	4·9827155,5
508	,,	XXX	259	46 45 57·422	·248	4·7272519,3
		XXXII		77 50 16·627	·248	4·8549271,0
		XXXIV	260	55 23 45·951	·248	4·7802370,2
509	,,	XXXII		82 16 20·612	·295	4·9173832,2
		XXXIV	260	57 57 56·893	·295	4·8496036,0
		XXXV		39 45 42·495	·295	4·7272519,3

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
510	y	X XXXV		81 45 52·168	·399	4·9816075,2
	x	XXXIV	260	39 37 33·206	·398	4·7907748,9
	z	XXXVII		58 36 34·626	·399	4·9173832,2
511	,,	XXXIV	260	49 51 26·055	·421	4·8698526,4
		XXXVII		48 44 4·726	·421	4·8625321,6
		XXXVI	261	81 24 29·219	·421	4·9816075,2
512	,,	XXXVI	261	45 36 8·991	·270	4·7362725,6
		XXXVII		58 1 57·682	·270	4·8108435,7
		XXXVIII	262	76 21 53·327	·270	4·8698526,4
513	,,	XXXVII		64 44 34·821	·289	4·8511788,0
		XXXVIII	262	71 17 49·777	·289	4·8712559,2
		XL		43 57 35·402	·289	4·7362725,6
514	,,	XXXVIII	262	56 42 30·400	·316	4·8187484,0
		XL		59 2 30·243	·316	4·8298556,6
		XLI	263	64 14 59·357	·317	4·8511788,0
515	,,	XL		59 41 47·134	·368	4·8750474,4
		XLI	263	70 58 50·686	·369	4·9144732,6
		XLIII		49 19 22·180	·368	4·8187484,0
516	,,	XLI	263	90 40 2·068	·261	4·9416885,5
		XLIII		30 16 29·105	·260	4·6442752,4
		XLII	264	59 3 28·827	·261	4·8750474,4
517	,,	XLIII		30 49 10·187	·320	4·6757146,6
		XLII	264	78 14 5·386	·320	4·9569394,6
		XLIV	265	70 56 44·427	·320	4·9416885,5
518	,,	U XVIII	237	64 20 34·716	·239	4·7908502,5
		XIX	238	60 16 20·340	·239	4·7746475,4
		XXII	266	55 23 4·944	·238	4·7513235,5
519	,,	XIX	238	56 56 19·487	·246	4·7652830,3
		XXII	266	60 19 29·736	·247	4·7809367,8
		XXIII		62 44 10·777	·247	4·7908502,5
520	,,	XXII	266	65 20 4·509	·221	4·7793709,2
		XXIII		53 3 9·644	·221	4·7235708,4
		XXIV	267	61 36 45·847	·221	4·7652830,3
521	,,	XXIII		56 2 7·337	·223	4·7400294,5
		XXIV	267	58 43 52·289	·223	4·7531092,6
		XXV		65 14 0·374	·223	4·7793709,2
522	,,	XXIV	267	67 22 8·800	·214	4·7784657,0
		XXV		54 58 39·669	·213	4·7265087,0
		XXVI	268	57 39 11·531	·213	4·7400294,5

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	U XXV		61 39 32·655	·222	4·7659545,8
523	x	XXVI	268	53 24 4·608	·222	4·7260275,7
	z	XXVII		64 56 22·737	·222	4·7784657,0
		XXVI	268	59 6 3·719	·224	4·7537355,6
524	,,	XXVII		58 56 46·782	·223	4·7530316,5
		XXVIII	269	61 57 9·499	·224	4·7659545,8
		XXVII		67 58 33·890	·191	4·7642527,8
525	,,	XXVIII	269	47 13 16·230	·191	4·6628449,4
		XXIX		64 48 9·880	·191	4·7537355,6
		XXVIII	269	68 40 11·569	·216	4·7897025,9
526	,,	XXIX		49 52 12·929	·216	4·7039465,0
		XXX	270	61 27 35·502	·216	4·7642527,8
		XXIX		59 9 21·884	·234	4·7658652,9
527	,,	XXX	270	55 44 55·280	·234	4·7493742,6
		XXXI		65 5 42·836	·235	4·7897025,9
		XXX	270	60 54 42·075	·209	4·7492758,9
528	,,	XXXI		53 52 18·834	·208	4·7150789,3
		XXXII	271	65 12 59·091	·209	4·7658652,9
		XXXI		60 11 7·070	·210	4·7448497,3
529	,,	XXXII	271	58 35 19·144	·210	4·7376881,4
		XXXIII		61 13 33·786	·210	4·7492758,9
		XXXII	271	59 49 13·562	·200	4·7332121,4
530	,,	XXXIII		57 33 54·291	·200	4·7228132,5
		XXXIV	272	62 36 52·147	·201	4·7448497,3
		XXXIII		61 24 44·566	·224	4·7664268,7
531	,,	XXXIV	272	64 9 17·171	·225	4·7771200,2
		XXXV		54 25 58·263	·224	4·7332121,4
		XXXIV	272	55 9 27·855	·221	4·7330452,4
532	,,	XXXV		62 25 49·048	·221	4·7664994,1
		XXXVI	273	62 24 43·097	·221	4·7664268,7
		XXXV		61 47 6·154	·217	4·7594384,3
533	,,	XXXVI	273	62 11 45·357	·217	4·7610950,9
		XXXVII		56 1 8·489	·217	4·7330452,4
		XXXVI	273	55 2 21·461	·180	4·6951947,5
534	,,	XXXVII		53 7 5·581	·179	4·6846442,9
		XXXVIII	274	71 50 32·958	·180	4·7594384,3
		XXXVII		66 43 18·737	·212	4·7795526,6
535	,,	XXXVIII	274	64 7 40·344	·212	4·7705590,8
		XXXIX		49 9 0·919	·211	4·6951947,5
		XXXVIII	274	46 42 25·440	·171	4·6490003,3
536	,,	XXXIX		53 50 27·190	·171	4·6940328,5
		XL	275	79 27 7·370	·171	4·7795526,6
	y	U XL	275	53 54 27·595	·229	4·8146649,4
537	x	XXXIX		92 36 5·661	·230	4·9067687,8
	z	W XLIX	276	33 29 26·744	·229	4·6490003,3
		U XXXIX		42 20 41·280	·279	4·7366225,1
538	,,	W XLIX	276	83 55 46·808	·280	4·9057844,3
		XLVII		53 43 31·912	·279	4·8146649,4
		XLIX	276	34 58 58·169	·204	4·6927341,2
539	,,	XLVII		105 38 57·112	·205	4·9179241,4
		XLVIII	277	39 22 4·719	·204	4·7366225,1
		XLVIII	277	88 18 23·051	·208	4·8551990,9
540	,,	XLVII		48 15 7·205	·208	4·7281746,7
		XLVI	278	43 26 29·744	·208	4·6927341,2
		XLVII		59 40 8·128	·360	4·8596023,6
541	,,	XLVI	278	61 38 9·335	·360	4·8679866,6
		XLV		58 41 42·537	·360	4·8551990,9
		XLV		62 55 17·630	·286	4·8359244,9
542	,,	XLVI	278	46 58 49·804	·286	4·7503366,7
		XLIV		70 5 52·566	·286	4·8596023,6
		XLVI	278	45 24 42·323	·265	4·7246396,8
543	,,	XLIV		67 38 13·719	·266	4·8381004,1
		XLII	279	66 57 3·958	·265	4·8359244,9
		XLIV		62 41 1·012	·239	4·7904931,2
544	,,	XLII	279	67 32 40·227	·239	4·8075974,1
		XL		49 46 18·761	·238	4·7246396,8
		XLII	279	81 55 8·851	·292	4·9035897,0
545	,,	XL		48 20 40·106	·291	4·7813338,4
		XXXIX	280	49 44 11·043	·291	4·7904931,2
		XL		77 18 26·903	·342	4·9385080,4
546	,,	XXXIX	280	38 30 31·185	·341	4·7434846,9
		XXXVIII		64 11 1·912	·341	4·9035897,0
		XXXVIII		36 40 48·232	·298	4·7156250,5
547	,,	XXXIX	280	56 59 19·359	·298	4·8629348,0
		XXXVI		86 19 52·409	·299	4·9385080,4
		XXXIX	280	58 44 18·510	·322	4·8956949,9
548	,,	XXXVI		86 52 54·516	·322	4·9631831,8
		XXXV	281	34 22 46·974	·322	4·7156250,5
		XXXVI		56 3 14·988	·374	4·8531412,3
549	,,	XXXV	281	57 44 42·077	·374	4·8614971,5
		XXXIV		66 12 2·935	·374	4·8956949,9
		XXXIV		84 52 51·156	·319	4·9403170,1
550	,,	XXXV	281	40 32 40·486	·318	4·7549924,1
		XXXII		54 34 28·358	·319	4·8531412,3

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Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	W XXXV	281	62 23 35·902	·341	4·8964623,6
551	x	XXXII		38 59 47·737	·341	4·7477952,9
	z	XXXIII	282	78 36 36·361	·341	4·9403170,1
		XXXIII	282	52 28 16·577	·336	4·8173854,3
552	"	XXXII		55 27 34·270	·336	4·8338686,3
		XXX	283	72 4 9·153	·337	4·8964623,6
		XXXII		74 40 32·430	·358	4·9213039,7
553	"	XXX	283	55 55 48·583	·358	4·8552430,7
		XXIV		49 23 38·987	·358	4·8173854,3
		XXX	283	82 43 52·431	·452	5·0061480,4
554	"	XXIV		42 35 22·464	·451	4·8400754,8
		XXV	284	54 40 45·105	·452	4·9213039,7
		XXIV		63 52 10·181	·675	5·0151567,5
555	"	XXV	284	54 33 54·100	·675	4·9730176,0
		XXI		61 33 55·719	·675	5·0061480,4
		XXV	284	57 55 57·808	·713	5·0004121,9
556	"	XXI		60 49 17·998	·714	5·0133779,4
		XXIII	285	61 14 44·194	·714	5·0151567,5
		XXIII	285	35 57 6·237	·391	4·7698830,9
557	"	XXI		57 25 42·303	·392	4·9268514,2
		XX	286	86 37 11·460	·392	5·0004121,9
		XXI		65 16 13·920	·295	4·8450474,4
558	"	XX	286	64 54 58·706	·294	4·8438007,3
		XIX		49 48 47·374	·294	4·7698830,9
		XIX		80 51 52·175	·246	4·8866324,5
559	"	XX	286	35 20 52·769	·246	4·6545106,1
		XVI		63 47 15·056	·246	4·8450474,4
		XX	286	35 34 45·075	·224	4·6514969,7
560	"	XVI		55 27 3·636	·224	4·8024409,0
		XVIII	287	88 58 11·289	·225	4·8866324,5
		XVIII	287	60 33 58·316	·171	4·7111278,8
561	"	XVI		70 2 28·090	·171	4·7442467,7
		XV	288	49 23 33·594	·171	4·6514969,7
		XVI		67 47 36·640	·289	4·8736528,7
562	"	XV	288	72 39 9·505	·290	4·8869052,6
		XIV		39 33 13·855	·289	4·7111278,8

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	W XIV		64 48 18·447	·422	4·9166742,5
563	x	XV	288	60 9 27·175	·422	4·8983083,1
	z	XI		55 2 14·378	·422	4·8736528,7
		XV	288	44 6 43·418	·353	4·7811871,6
564	"	XI		63 54 58·990	·353	4·8918885,3
		XIII	289	71 58 17·592	·354	4·9166742,5
		XIII	289	76 40 9·202	·222	4·8318207,8
565	"	XI		43 20 12·813	·222	4·6801889,5
		X	290	59 59 37·985	·222	4·7811871,6
		XI		87 23 17·739	·290	4·9288702,5
566	"	X	290	39 35 7·322	·289	4·7336158,9
		IX		53 1 34·939	·290	4·8318207,8
		IX		47 31 30·262	·317	4·7993916,1
567	"	X	290	48 52 35·557	·318	4·8085512,1
		VIII		83 35 54·181	·318	4·9288702,5
		X	290	49 52 11·007	·274	4·7602927,7
568	"	VIII		73 20 47·674	·274	4·8582601,6
		VI	291	56 47 1·319	·274	4·7993916,1
		VIII		72 36 33·714	·339	4·9142938,3
569	"	VI	291	65 22 14·400	·339	4·8931886,3
		V		42 1 11·886	·339	4·7602927,7
		VI	291	32 31 46·842	·261	4·6488346,3
570	"	V		65 12 24·883	·262	4·8762687,3
		III	292	82 15 48·275	·262	4·9142938,3
		V		80 44 8·484	·176	4·7918199,3
571	"	III	292	54 1 19·854	·176	4·7056018,1
		I		45 14 31·662	·176	4·6488346,3
		III	292	47 22 30·488	·240	4·7159329,9
572	"	I		71 25 35·954	·241	4·8259414,3
		X XLIV	265	61 11 53·558	·241	4·7918199,3
		W I		55 50 31·583	·166	4·6757248,6
573	"	X XLIV	265	58 57 35·372	·166	4·6908428,2
		XLII	264	65 11 53·045	·167	4·7159329,9

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9.

Preliminary Latitudes, Longitudes and Azimuths of the Stations on the Right-hand Flanks of the Circuit Triangles.

The following table gives the Geodetic Latitudes, Longitudes and Azimuths which have been obtained for all the stations and sides on the right-hand flank of the chains of circuit triangles, by applying the values of the difference of latitude, longitude and azimuth—computed by the formulæ (25), (26) and (27) of Section 5 of the preceding chapter—first to the fixed elements of the several stations of origin of the chains K to T, as given in Section 7 of this chapter, and then to the deduced elements of every subsequent station: the order of succession is indicated by the numbers in block type. Each station is thus regarded, first as the 'Deduced Station B' and afterwards as the 'Fixed Station A'.

In order to ascertain the differential values given by the geodetic calculations on which the tabulated elements are built up, we have for any, the ath, side on the flank of the chain

$$\Delta\lambda_a = (\lambda_{a+1} - \lambda_a); \qquad \Delta L_a = (L_{a+1} - L_a);$$

$$\Delta A_a = B_a - (\pi + A_a);$$

where A_a stands for the forward azimuth at 'fixed station' A_a of 'deduced station' B_a and B_a for the back azimuth of A_a at B_a.

The three differential values depend on the length c_a and forward azimuth A_a of the side a, and also on the latitude λ_a. The logarithmic length is given in the preceding Section, on the same horizontal line as the angle at the Serial station which enters, in the table, between the stations numbered in block type a and $(a+1)$. The forward azimuth of the side a may be deduced by adding all the spherical angles at a, as given in the table, to the back azimuth B_{a-1}. Thus the logarithmic length of flank-side 11 is 4·9970640,5, which occurs in triangle 21, on the same line as the angle for the serial station K XX, entering between the flank stations 11 and 12; and the forward azimuth of this side is equal to the back azimuth of 10 at 11 + the sum of the spherical angles at 11, which occur in triangles 19, 20 and 21, the respective values of which are 10° 49′ 43″·215 and 170° 20′ 15″·360, together amounting to 181° 9′ 58″·575.

In the following table, breaks of continuity in the numbering of the stations necessarily occur at the origins and closing points of all the Circuits. The two values of each of the geodetic co-ordinates and of the azimuth of the side of junction at these closing points, furnish the data for the determination of the absolute terms of the geodetic equations of condition in the Simultaneous Reduction.

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Fixed Station A		Deduced Station B				Fixed Station A		Deduced Station B			
No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A	No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A
	° ′ ″		° ′ ″	° ′ ″	° ′ ″		° ′ ″		° ′ ″	° ′ ″	° ′ ″
1	160 25 38·990	2	24 14 44·921	79 22 51·134	340 23 21·941	33	186 21 51·159	34	26 54 17·892	80 42 5·314	6 22 33·790
2	196 7 53·301	3	24 36 33·385	79 29 45·141	16 10 44·511	34	183 44 56·980	35	27 8 17·061	80 43 6·780	3 45 24·806
3	217 8 7·931	4	24 57 53·803	79 47 29·692	37 15 34·245	35	179 8 15·896	36	27 23 58·576	80 42 50·903	359 8 8·622
4	174 56 21·665	5	25 17 28·421	79 45 35·273	354 55 33·077	36	172 34 27·282	37	27 37 43·489	80 40 50·184	352 33 31·514
5	174 9 3·237	6	25 41 7·650	79 42 54·816	354 7 54·187	37	186 37 23·004	38	27 51 11·533	80 42 35·750	6 38 12·142
6	159 48 58·097	7	25 57 41·507	79 36 10·589	339 46 2·015	38	174 25 1·482	39	28 4 16·541	80 41 9·236	354 24 20·916
7	185 31 49·285	8	26 13 30·846	79 37 52·506	5 32 34·112	39	181 49 1·556	40	28 16 36·772	80 41 35·764	1 49 14·081
8	181 40 55·462	9	26 28 29·147	79 38 21·819	1 41 8·473	40	120 56 57·571	41	28 22 11·128	80 31 4·581	300 51 58·108
9	178 37 28·413	10	26 42 25·798	79 37 59·451	358 37 18·401	41	108 41 40·508	42	28 25 8·246	80 21 11·287	288 36 58·375
10	190 48 18·171	11	26 57 10·490	79 41 7·874	10 49 43·215	42	116 17 48·965	43	28 28 36·274	80 13 14·306	296 14 1·751
11	181 9 58·575	12	27 13 33·983	79 41 30·272	1 10 8·775	43	119 34 12·091	44	28 33 15·268	80 3 56·736	299 29 45·909
12	184 10 43·695	13	27 30 4·477	79 42 51·432	4 11 20·999	44	118 55 53·659	45	28 37 25·587	79 55 22·912	298 51 47·782
13	181 59 16·399	14	27 44 58·721	79 43 26·321	1 59 32·577	45	138 18 3·872	46	28 44 40·555	79 48 2·981	318 14 32·713
14	176 37 14·027	15	28 3 22·994	79 42 12·814	356 36 39·627	46	130 4 22·723	18	28 51 53·169	79 38 18·317	309 59 41·017
15	176 15 12·597	16	28 20 2·403	79 40 58·847	356 14 37·649	18	2 13 33·197	17			
16	170 58 32·749	17	28 38 9·964	79 37 43·057	350 56 59·370						
17	182 13 30·030	18	28 51 53·521	79 38 19·407	2 13 47·514	47	130 28 20·807	48	24 22 24·552	81 26 42·966	310 19 11·111
18	194 55 7·124	19	29 15 14·645	79 45 25·151	14 58 33·916	48	201 5 21·781	49	24 33 14·487	81 31 17·047	21 7 15·283
19	126 4 44·086	20	29 30 23·528	79 21 35·821	305 53 2·847	49	166 41 31·753	50	24 53 6·897	81 26 7·819	346 39 22·440
20	126 19 13·797	21	29 45 36·763	78 57 48·679	306 7 28·145	50	209 30 0·220	51	25 14 9·225	81 39 13·407	29 35 32·979
21	149 40 0·615	22	30 4 5·317	78 45 22·530	329 33 48·507	51	184 50 53·449	52	25 35 3·704	81 41 10·738	4 51 43·795
22	121 43 34·677	LVI*	30 13 26·260	78 27 55·547	301 34 48·874	52	114 44 32·135	53	25 41 56·820	81 24 39·036	294 37 22·982
LVI*	34 47 54·204	LIV*				53	180 28 55·912	54	25 50 5·467	81 24 43·581	0 28 57·888
						54	201 14 24·418	55	26 1 44·221	81 29 44·240	21 16 35·897
23	234 31 25·577	24	24 16 46·740	81 11 14·972	54 40 10·888	55	146 47 23·907	56	26 10 51·470	81 23 7·068	326 44 29·145
24	152 37 22·668	25	24 37 23·041	80 59 34·357	332 32 32·667	56	183 54 54·155	57	26 22 7·139	81 23 58·403	3 55 16·880
25	134 13 12·887	26	24 51 5·387	80 44 7·299	314 6 44·951	57	185 6 49·230	58	26 32 42·981	81 25 1·670	5 7 17·417
26	181 9 43·101	27	25 7 2·296	80 44 28·618	1 9 52·106	58	179 37 13·707	59	26 43 28·205	81 24 56·910	359 37 11·573
27	185 34 50·286	28	25 27 17·405	80 46 39·396	5 35 46·147	59	181 48 59·333	60	26 54 49·367	81 25 21·008	1 49 10·206
28	164 36 2·777	29	25 46 34·639	80 40 47·320	344 33 30·563	60	172 48 5·726	61	27 5 41·308	81 23 49·004	352 47 23·951
29	170 7 53·993	30	26 0 43·993	80 38 3·794	350 6 42·579	61	177 2 12·951	62	27 17 45·042	81 23 7·070	357 1 53·786
30	165 52 20·959	31	26 16 0·764	80 33 47·842	345 50 28·197	62	153 22 52·686	63	27 28 24·744	81 17 7·542	333 20 7·316
31	200 22 49·907	32	26 28 10·656	80 38 49·177	20 25 3·742	63	216 58 53·556	64	27 38 25·999	81 25 36·192	37 2 48·874
32	186 26 55·682	33	26 41 37·889	80 40 30·761	6 27 41·139	64	153 5 48·164	65	27 47 19·324	81 20 31·847	333 3 26·623

* These stations appertain to the Great Arc Meridional Series—Section 24° to 30°—of the North-West Quadrilateral.

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Fixed Station A		Deduced Station B			
No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A
	° ′ ″		° ′ ″	° ′ ″	° ′ ″
65	160 56 43·313	66	27 55 45·462	81 17 14·998	340 55 11·326
66	116 43 35·636	67	27 59 55·449	81 7 54·925	296 39 13·008
67	107 51 13·498	68	28 2 42·744	80 58 8·268	287 46 37·879
68	129 20 57·629	69	28 8 29·275	80 50 11·138	309 17 12·944
69*	136 57 26·514	40	28 16 37·697	80 41 35·581	316 53 22·813
40	1 49 7·283	39			
70	204 57 18·442	71	24 34 17·869	82 38 58·983	25 0 34·284
71	156 3 46·334	72	24 53 44·479	82 29 31·047	335 59 48·708
72	145 53 11·048	73	25 3 53·247	82 21 58·144	325 49 59·784
73	171 37 13·154	74	25 16 32·453	82 19 55·141	351 36 20·840
74	173 24 2·710	75	25 27 33·454	82 18 30·904	353 23 26·621
75	173 25 24·861	76	25 41 17·119	82 16 46·101	353 24 39·620
76	185 25 25·550	77	25 50 18·412	82 17 42·896	5 25 50·236
77	186 0 24·426	78	26 1 4·984	82 18 58·197	6 0 57·351
78	181 6 32·391	79	26 10 42·690	82 19 10·592	1 6 37·844
79	177 27 26·064	80	26 21 46·359	82 18 37·874	357 27 11·583
80	186 21 31·973	81	26 31 45·510	82 19 52·105	6 22 5·032
81	199 28 35·412	82	26 40 37·172	82 23 21·428	19 30 9·149
82	187 9 4·569	83	26 51 41·518	82 24 54·367	7 9 46·429
83	183 26 5·679	84	27 2 53·643	82 25 39·425	3 26 26·103
84	163 38 38·383	85	27 13 18·382	82 22 14·312	343 37 4·833
85	166 14 12·813	86	27 24 2·927	82 19 17·412	346 12 51·647
86	170 1 47·927	87	27 33 21·350	82 17 27·265	350 0 57·104
87	111 14 53·434	88	27 36 47·806	82 7 30·163	291 10 16·941
88	108 15 28·391	89	27 39 56·590	81 56 46·012	288 10 29·565
89	108 5 13·085	90	27 43 17·995	81 45 11·343	287 59 50·241
90	103 44 51·081	91	27 46 4·470	81 32 23·615	283 38 53·677
91	96 40 52·307	65	27 47 18·115	81 20 31·787	276 35 20·560
65	333 3 36·800	64			
92	157 41 28·608	93	24 32 49·670	83 32 13·139	337 35 7·766
93	184 48 25·756	94	24 47 20·996	83 33 33·410	4 48 59·258
94	187 22 57·588	95	24 56 54·865	83 34 34·970	7 23 31·888

Fixed Station A		Deduced Station B			
No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A
	° ′ ″		° ′ ″	° ′ ″	° ′ ″
95	161 49 47·958	96	25 17 49·577	83 27 21·909	341 46 35·605
96	176 47 17·185	97	25 32 6·849	83 26 28·883	356 46 54·427
97	179 11 7·867	98	25 43 3·640	83 26 18·575	359 11 3·409
98	180 0 6·549	99	25 54 2·844	83 26 18·598	0 0 6·559
99	180 33 12·689	100	26 5 19·904	83 26 25·842	0 33 15·864
100	175 3 32·534	101	26 15 7·749	83 25 29·481	355 3 7·676
101	180 16 50·966	102	26 25 14·701	83 25 32·785	0 16 52·432
102	152 10 3·582	103	26 33 54·378	83 20 27·612	332 7 47·448
103	172 49 40·228	104	26 44 10·366	83 19 1·280	352 49 1·504
104	174 56 7·844	105	26 54 3·087	83 18 2·689	354 55 41·410
105	177 5 40·910	106	27 2 52·848	83 17 32·661	357 5 27·289
106	155 43 49·019	107	27 11 7·226	83 13 23·363	335 41 55·388
107	154 38 47·398	108	27 21 5·123	83 8 6·020	334 36 22·005
108	106 17 30·655	109	27 23 36·992	82 58 22·539	286 13 2·386
109	105 12 38·126	110	27 26 14·816	82 47 30·185	285 7 37·756
110	103 47 31·556	111	27 28 11·211	82 38 37·281	283 43 25·871
111	105 52 1·561	112	27 30 56·746	82 27 42·363	285 46 59·226
112	104 51 25·166	87	27 33 21·733	82 17 27·502	284 46 40·913
87	350 0 56·313	86			
113	153 52 32·161	114	24 16 53·774	84 16 22·648	333 49 17·718
114	169 49 34·168	115	24 34 38·943	84 12 53·604	349 48 7·713
115	224 58 8·283	116	24 49 22·116	84 29 1·232	45 4 52·627
116	197 19 10·737	117	25 3 58·816	84 34 1·427	17 21 17·342
117	160 0 7·732	118	25 12 44·529	84 30 31·096	339 58 38·379
118	159 43 6·309	119	25 21 49·110	84 26 49·573	339 41 31·681
119	177 3 15·021	120	25 30 1·343	84 26 21·661	357 3 3·034
120	182 26 45·314	121	25 43 10·802	84 26 58·889	2 27 1·405
121	170 28 28·885	122	25 53 9·078	84 25 7·904	350 27 40·576
122	182 21 44·736	123	26 3 39·481	84 25 36·700	2 21 57·347
123	181 6 57·587	124	26 14 16·202	84 25 50·454	1 7 3·649
124	180 50 17·219	125	26 26 2·959	84 26 1·939	0 50 22·314
125	169 12 42·724	126	26 36 32·871	84 23 48·405	349 11 43·096
126	188 1 40·446	127	26 48 35·274	84 25 41·958	8 2 31·484

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Fixed Station A		Deduced Station B				Fixed Station A		Deduced Station B			
No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A	No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A
	° ′ ″		° ′ ″	° ′ ″	° ′ ″		° ′ ″		° ′ ″	° ′ ″	° ′ ″
127	182 36 13·384	128	26 59 10·317	84 26 14·194	2 36 27·968	157	177 49 55·497	158	25 9 49·150	86 10 31·176	357 49 36·733
128	159 16 17·298	129	27 9 4·227	84 22 2·908	339 14 22·948	158	186 13 54·573	159	25 22 5·719	86 11 59·707	6 14 32·360
129	109 30 45·428	130	27 12 26·385	84 11 23·557	289 25 53·388	159	180 2 35·810	160	25 30 34·859	86 12 0·131	0 2 35·992
130	104 19 25·788	131	27 14 21·038	84 3 0·085	284 15 35·470	160	179 20 19·662	161	25 39 45·479	86 11 53·119	359 20 16·634
131	101 4 9·580	132	27 16 28·250	83 50 49·313	280 58 34·901	161	182 0 5·054	162	25 49 28·543	86 12 15·633	2 0 14·833
132	100 55 36·851	133	27 18 11·056	83 40 51·118	280 51 2·593	162	174 4 44·783	163	25 59 55·222	86 11 3·712	354 4 13·355
133	91 53 11·673	134	27 18 30·724	83 29 26·828	271 47 57·762	163	178 47 23·385	164	26 7 55·900	86 10 52·463	358 47 18·442
134	99 29 21·702	135	27 20 15·133	83 17 44·065	279 23 59·129	164	178 49 42·722	165	26 15 24·874	86 10 42·281	358 49 38·227
135	95 35 34·409	108	27 21 5·334	83 8 6·124	275 31 8·938	165	183 40 1·127	166	26 22 48·450	86 11 13·844	3 40 15·121
108	334 36 26·848	107				166	165 22 13·561	167	26 31 45·722	86 8 37·923	345 21 4·100
						167	85 0 9·900	168	26 30 55·093	85 57 59·338	264 55 24·742
136	179 12 14·775	137	24 19 57·350	85 28 15·794	359 12 6·319	168	111 26 38·822	169	26 34 7·031	85 48 55·073	291 22 35·615
137	202 6 9·741	138	24 41 40·203	85 37 55·082	22 10 10·094	169	110 46 1·145	170	26 37 43·386	85 38 19·059	290 41 16·377
138	186 10 15·894	139	24 59 38·064	85 40 2·963	6 11 9·624	170	110 56 20·237	149	26 40 55·856	85 28 58·203	290 52 8·623
139	153 18 41·434	140	25 12 26·007	85 32 58·526	333 15 41·384	149	0 52 23·523	148			
140	179 34 37·614	141	25 25 27·251	85 32 52·176	359 34 34·899						
141	180 23 7·449	142	25 36 0·013	85 32 56·870	0 23 9·471	171	154 48 10·376	172	24 14 25·183	86 57 55·073	334 43 59·927
142	169 2 8·231	143	25 45 59·848	85 30 48·524	349 1 12·606	172	193 40 15·817	173	24 39 12·167	87 4 30·880	13 42 59·622
143	174 52 33·466	144	25 54 58·855	85 29 55·076	354 52 10·169	173	215 45 49·862	174	24 56 12·765	87 17 57·585	35 51 28·175
144	178 38 54·789	145	26 4 20·895	85 29 40·394	358 38 48·354	174	145 58 5·595	175	25 15 48·160	87 3 24·140	325 51 55·076
145	179 55 9·874	146	26 13 33·995	85 29 39·531	359 55 9·494	175	209 24 9·066	176	25 27 47·370	87 10 50·719	29 27 20·361
146	175 5 59·364	147	26 22 39·980	85 28 47·561	355 5 36·336	176	145 34 22·461	177	25 36 36·822	87 4 10·356	325 31 29·869
147	180 4 10·576	148	26 31 5·291	85 28 48·243	0 4 10·880	177	205 0 14·989	178	25 45 10·317	87 8 34·856	25 2 9·615
148	180 52 14·610	149	26 40 55·553	85 28 58·230	0 52 19·082	178	192 26 38·765	179	25 54 44·338	87 10 54·930	12 27 39·801
149	114 13 36·402	150	26 45 12·368	85 18 21·493	294 8 50·127	179	191 59 38·211	180	26 4 46·075	87 13 16·497	12 0 40·261
150	89 51 0·947	151	26 45 10·522	85 7 57·371	269 46 19·999	180	131 22 26·441	181	26 11 4·571	87 5 19·935	311 18 56·543
151	120 15 28·119	152	26 49 50·615	84 59 1·627	300 11 26·632	181	126 51 28·223	182	26 16 49·805	86 56 48·709	306 47 42·253
152	131 20 7·652	153	26 55 54·950	84 51 19·236	311 16 38·585	182	128 24 56·303	183	26 22 25·040	86 48 59·095	308 21 28·032
153	129 14 7·145	154	27 1 43·828	84 43 21·849	309 10 30·561	183	112 16 38·502	184	26 25 50·117	86 39 42·235	292 12 30·884
154	115 13 19·051	155	27 6 6·054	84 32 58·867	295 8 35·591	184	105 26 20·854	185	26 28 26·268	86 29 12·420	285 21 40·301
155	106 53 47·111	129	27 9 3·870	84 22 2·878	286 48 48·009	185	105 56 37·331	186	26 31 1·929	86 19 5·333	285 52 6·492
129	339 14 17·209	128				186	94 26 39·872	167	26 31 45·408	86 8 37·959	274 21 59·711
						167	345 21 1·821	166			
156	181 20 54·776	157	24 52 2·348	86 11 15·551	1 21 6·727						

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Fixed Station A		Deduced Station B				Fixed Station A		Deduced Station B			
No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A	No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A
	° ′ ″		° ′ ″	° ′ ″	° ′ ″		° ′ ″		° ′ ″	° ′ ″	° ′ ″
187	181 49 50·637	188	23 3 31·409	88 27 0·465	1 49 59·204	210	276 4 32·694	219	26 15 8·855	88 40 35·706	96 8 30·147
188	216 21 45·184	189	23 10 14·943	88 32 21·893	36 23 51·368	219	313 3 48·269	220	26 8 55·129	88 47 58·575	133 7 3·802
189	183 36 57·748	190	23 17 51·153	88 32 53·107	3 37 10·062	220	243 0 16·389	221	26 12 55·170	88 56 41·560	63 4 7·143
190	164 50 25·872	191	23 25 44·880	88 30 34·004	344 49 30·709	221	310 37 33·671	222	26 6 42·948	89 4 41·884	130 41 5·463
191	187 13 33·319	192	23 33 50·969	88 31 40·866	7 13 59·977	222	257 35 20·387	223	26 8 26·225	89 13 23·174	77 39 9·938
192	212 43 1·597	193	23 40 41·870	88 36 27·540	32 44 56·464	223	312 36 55·199	224	26 1 55·464	89 21 13·060	132 40 21·820
193	193 47 22·654	194	23 50 31·162	88 39 4·790	13 48 26·011	224	250 48 24·345	225	26 4 50·324	89 30 30·276	70 52 29·105
194	179 24 5·691	195	23 59 6·807	88 38 58·928	359 24 3·315	225	315 7 21·578	226	25 58 10·974	89 37 50·003	135 10 34·516
195	171 46 45·585	196	24 10 5·620	88 37 15·182	351 46 3·261	226	264 17 15·191	227	25 59 6·514	89 48 8·408	84 21 46·063
196	158 1 44·441	197	24 19 3·738	88 33 18·243	338 0 7·152	227	261 17 10·947	228	26 1 3·538	90 2 18·504	81 23 23·624
197	166 58 25·972	198	24 29 4·470	88 30 46·369	346 57 23·229						
198	148 14 32·289	199	24 36 51·060	88 25 30·366	328 12 20·997	187	300 49 48·642	229	22 47 35·163	88 36 17·565	120 53 33·385
199	166 1 18·267	200	24 44 19·409	88 23 28·154	346 0 27·244	229	240 51 53·759	230	22 52 12·891	88 45 15·772	60 55 22·597
200	192 33 52·374	201	24 52 43·715	88 25 31·374	12 34 44·076	230	233 29 53·456	231	22 57 50·672	88 53 29·029	53 33 5·530
201	206 29 52·876	202	25 2 34·579	88 30 54·784	26 32 9·355	231	262 50 48·027	232	22 58 49·084	89 1 53·651	82 54 4·973
202	183 57 51·755	203	25 13 8·380	88 31 43·071	3 58 12·262	232	264 46 58·221	233	22 59 33·562	89 10 42·719	84 50 24·830
203	189 28 14·972	204	25 23 14·818	88 33 34·444	9 29 2·574	233	266 38 20·080	234	23 0 3·786	89 20 3·729	86 41 59·256
204	184 37 36·854	205	25 31 20·274	88 34 17·745	4 37 55·465	234	271 9 35·840	235	22 59 51·448	89 30 42·839	91 13 45·553
205	183 57 18·415	206	25 40 22·989	88 34 59·153	3 57 36·305	235	263 24 1·108	236	23 0 44·889	89 39 3·908	83 27 16·932
206	172 34 56·865	207	25 49 27·493	88 33 40·824	352 34 22·837	236	267 56 50·004	237	23 1 7·016	89 50 23·082	88 1 15·548
207	180 10 36·727	208	25 58 26·574	88 33 42·665	0 10 37·531	237	205 51 52·181	238	23 9 29·891	89 54 46·787	25 53 35·593
208	180 47 38·061	209	26 7 41·017	88 33 51·176	0 47 41·799	238	210 43 59·288	239	23 16 56·102	89 59 34·020	30 45 52·535
209	166 35 13·049	210	26 16 0·642	88 31 39·016	346 34 14·705	239	146 55 33·266	240	23 24 43·602	89 54 4·038	326 53 22·494
210	105 28 31·045	211	26 18 55·189	88 19 57·527	285 23 20·333	240	212 14 13·076	241	23 32 41·222	89 59 30·822	32 16 23·268
211	124 52 8·593	212	26 25 2·084	88 10 12·207	304 47 48·647	241	156 13 8·325	242	23 41 25·617	89 55 19·860	336 11 27·782
212	71 29 41·667	213	26 22 4·725	88 0 25·022	251 25 20·652	242	211 13 29·674	243	23 49 10·316	90 0 26·137	31 15 33·051
213	87 38 34·052	214	26 21 42·772	87 50 41·890	267 34 15·090	243	147 9 54·114	244	23 57 24·431	89 54 39·079	327 7 33·572
214	87 22 2·500	215	26 21 13·846	87 39 14·636	267 16 57·376	244	213 0 19·720	245	24 4 58·652	90 0 0·518	33 2 30·563
215	89 37 46·236	216	26 21 9·571	87 28 13·593	269 32 52·796	245	150 46 20·426	246	24 13 9·040	89 55 1·274	330 44 17·992
216	95 4 40·716	217	26 21 59·408	87 17 46·206	275 0 2·154	246	203 37 55·997	247	24 21 16·238	89 58 54·006	23 39 31·721
217	81 15 19·984	218	26 20 24·315	87 6 23·302	261 10 16·839	247	147 33 58·542	248	24 29 15·009	89 53 21·476	327 31 41·061
218	67 31 3·509	182	26 16 49·591	86 56 48·596	247 26 48·781	248	208 23 12·582	249	24 37 15·857	89 58 5·785	28 25 10·728
182	306 47 42·901	181				249	144 4 51·687	250	24 45 24·805	89 51 37·783	324 2 9·621
						250	203 53 13·785	251	24 53 48·696	89 55 42·484	23 54 56·530

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Fixed Station A		Deduced Station B				Fixed Station A		Deduced Station B			
No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A	No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A
	° ′ ″		° ′ ″	° ′ ″	° ′ ″		° ′ ″		° ′ ″	° ′ ″	° ′ ″
251	145 54 7·212	252	25 1 24·266	89 50 3·895	325 51 44·332	271	269 5 13·990	272	23 0 47·873	90 57 35·541	89 8 55·021
252	211 40 0·486	253	25 9 37·952	89 55 38·563	31 42 22·410	272	271 4 32·841	273	23 0 36·663	91 8 0·731	91 8 37·240
253	173 18 4·955	254	25 20 45·986	89 54 12·218	353 17 28·118	273	270 47 27·773	274	23 0 29·810	91 16 38·559	90 50 50·182
254	187 17 22·724	255	25 31 2·207	89 55 39·092	7 18 0·031	274	273 31 29·487	275	22 59 59·448	91 25 26·720	93 34 55·891
255	254 32 22·412	256	25 34 35·122	90 9 50·651	74 38 29·646	275	226 56 31·256	276	23 9 4·923	91 35 58·445	47 0 38·858
256	165 49 58·593	257	25 52 41·779	90 4 47·401	345 47 46·955	276	199 24 51·292	277	23 21 58·454	91 40 53·781	19 26 47·916
257	164 58 53·446	228	26 1 3·667	90 2 18·361	344 57 48·233	277	147 7 16·098	278	23 29 23·380	91 35 41·886	327 5 12·090
228	81 23 26·029	227				278	164 33 24·415	279	23 40 21·204	91 32 24·559	344 32 5·474
257	232 11 2·521	258	26 0 38·476	90 16 7·781	52 16 0·188	279	200 56 59·306	280	23 49 40·429	91 36 17·330	20 58 33·055
258	268 0 45·694	259	26 1 11·680	90 34 23·695	88 8 46·375	280	224 56 54·404	281	24 0 24·220	91 47 57·387	45 1 38·220
259	272 6 23·779	260	26 0 45·018	90 47 28·108	92 12 7·843	281	240 5 25·014	282	24 5 0·382	91 56 40·788	60 8 58·277
260	295 2 51·310	261	25 55 38·940	90 59 31·275	115 8 7·985	282	191 13 51·892	283	24 16 3·252	91 59 4·376	11 14 50·696
261	242 8 46·886	262	26 0 37·945	91 9 58·279	62 13 21·442	283	221 58 42·010	284	24 24 32·655	92 7 25·129	42 2 8·383
262	266 35 35·821	263	26 1 17·201	91 22 17·939	86 41 0·252	284	209 12 47·236	285	24 39 24·139	92 16 30·788	29 16 33·803
263	312 34 53·310	264	25 56 21·621	91 28 13·555	132 37 29·093	285	126 28 25·339	286	24 47 41·267	92 4 13·345	306 23 16·884
264	269 55 3·887	265	25 56 22·036	91 36 52·782	89 58 51·007	286	168 51 6·050	287	24 57 57·983	92 2 0·013	348 50 9·954
						287	138 22 19·955	288	25 4 48·760	91 55 19·003	318 19 30·334
238	325 37 15·014	266	23 1 4·523	90 1 0·257	145 39 41·469	288	184 38 25·262	289	25 17 38·549	91 56 27·734	4 38 54·512
266	271 19 16·182	267	23 0 52·152	90 10 26·572	91 22 57·606	289	153 17 21·882	290	25 24 42·220	91 52 32·969	333 15 41·357
267	279 5 45·200	268	22 59 28·421	90 19 49·614	99 9 25·224	290	171 35 14·331	291	25 36 29·264	91 50 37·638	351 34 24·662
268	269 18 45·741	269	22 59 34·830	90 29 55·700	89 22 42·481	291	146 15 28·097	292	25 46 48·558	91 43 0·571	326 12 9·928
269	267 13 20·410	270	22 59 58·860	90 38 56·444	87 16 51·664	292	149 51 49·223	265	25 56 22·209	91 36 52·155	329 49 8·530
270	265 24 5·180	271	23 0 39·815	90 48 10·139	85 27 41·574	265	89 58 37·867	264			

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10.

Numerical Values of the Absolute Terms in the Primary Equations of Condition, and of their Products by the Equalizing Factors.

The Lengths and Azimuths of the Sides of the triangles, and the Latitudes and Longitudes of the Stations on the right-hand flank of the chains having been computed—as set forth in the two preceding Sections—the values of the several Absolute Terms in the Primary Equations of Condition are indicated by the discrepancies between the two sets of computed values which are presented at the close of the right and left-hand branches of the several Linear and Geodetic Circuits, and between the computed and absolute linear value at the junction with the Base-line. In all cases the closing linear discrepancies are first expressed logarithmically, as the differences between the logarithms of the two values which are given in each instance, and the 7th place of decimals is then treated as unity. Finally the Absolute Terms thus obtained, are multiplied by the Equalizing Factors—see page 59—which were employed for the purpose of obviating the inconveniences arising in treating a number of Simultaneous Equations, when the coefficients of the unknown quantities in some of the equations are generally much larger than those in others.

The Absolute Terms will now be particularized.

Circuit I. Equations 1 to 4.

Equation 1, *Linear*. Between the sides Tinsmál-Rangír and Ghandiál-Chándípahár.

Log. computed length Ghandiál-Chándípahár by Triangle No. 44		5·121,3051,2
Log. final value from Great Arc Series—Section 24° to 30°—see page 88 . .		5·121,2764,1
$_1E = + 287·1$	Logarithmic Error	+ ·000,0287,1

Equations 2 to 4, *Geodetic*. Terminal Station, Ghandiál. Terminal Side, Ghandiál-Chándípahár.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	30 13 26·260	78 27 55·547	34 47 54·204
Final values from Great Arc Series—Section 24° to 30°,—see page 88,	30 13 25·321	78 27 54·613	34 47 42·606
Errors	$_2E = + 0·939$	$_3E = + 0·934$	$_4E = + 11·598$

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Circuit II. Equations 5 to 8.

Equation 5, *Linear*. Junction, Baheri-Atária.

Log. computed length Baheri-Atária by Triangle No. 92	. . . .	4·920,3276,6
" " " No. 34	. . . .	4·920,3283,9
${}_5E = -7{\cdot}3$	Logarithmic Error	− ·000,0007,3

Equations 6 to 8, *Geodetic*. Terminal Station, Baheri, 18. Terminal Side, Baheri-Atária, 16-17.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	28 51 53·169	79 38 18·317	2 13 33·197
Left-hand	28 51 53·521	79 38 19·407	2 13 47·514
Errors $(R - L)$	${}_6E = -0{\cdot}352$	${}_7E = -1{\cdot}090$	${}_8E = -14{\cdot}317$

Circuit III. Equations 9 to 12.

Equation 9, *Linear*. Junction, Rámnagar-Dahlelnagar.

Log. computed length Rámnagar-Dahlelnagar by Triangle No. 138	. . .	4·873,9040,8
" " " No. 79	. . .	4·873,8558,5
${}_9E = +482{\cdot}3$	Logarithmic Error	+ ·000,0482,3

Equations 10 to 12, *Geodetic*. Terminal Station, Rámnagar, 40. Terminal Side, Rámnagar-Dahlelnagar, 40-39.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	28 16 37·697	80 41 35·581	1 49 7·283
Left-hand	28 16 36·772	80 41 35·764	1 49 14·081
Errors $(R - L)$	${}_{10}E = +0{\cdot}925$	${}_{11}E = -0{\cdot}183$	${}_{12}E = -6{\cdot}798$

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Circuit IV. Equations 13 to 16.

Equation 13, *Linear.* Junction, Bela-Mási.

Log. computed length Bela-Mási by Triangle No. 180	. . . .	4·780,9905,6
„ „ „ No. 129	. . . .	4·781,0546,6
$_{13}E = -641·0$	Logarithmic Error −	·000,0641,0

Equations 14 to 16, *Geodetic.* Terminal Station, Bela, 65. Terminal Side, Bela-Mási, 65-64.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	27 47 18·115	81 20 31·787	333 3 36·800
Left-hand	27 47 19·324	81 20 31·847	333 3 26·623
Errors $(R - L)$	$_{14}E = -1·209$	$_{15}E = -0·060$	$_{16}E = +10·177$

Circuit V. Equations 17 to 20.

Equation 17, *Linear.* Junction, Lohápánia-Bansídíla.

Log. computed length Lohápánia-Bansídíla by Triangle No. 220	. . . .	4·757,8243,7
„ „ „ No. 171	. . . .	4·757,8074,3
$_{17}E = +169·4$	Logarithmic Error +	·000,0169,4

Equations 18 to 20, *Geodetic.* Terminal Station, Lohápánia, 87. Terminal Side, Lohápánia-Bansídíla, 87-86.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	27 33 21·733	82 17 27·502	350 0 56·313
Left-hand	27 33 21·350	82 17 27·265	350 0 57·104
Errors $(R - L)$	$_{18}E = +0·383$	$_{19}E = +0·237$	$_{20}E = -0·791$

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Circuit VI. Equations 21 to 24.

Equation 21, *Linear*. Junction, Ghaus-Púrena.

Log. computed length Ghaus-Púrena by Triangle No. 262	. . . .	4·824,9038,1
" " " No. 211	. . . .	4·824,8956,0
$_{21}E = + 82·1$	Logarithmic Error	+ ·000,0082,1

Equations 22 to 24, *Geodetic*. Terminal Station, Ghaus, 108. Terminal Side, Ghaus-Púrena, 108-107.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	27 21 5·334	83 8 6·124	334 36 26·848
Left-hand	27 21 5·123	83 8 6·020	334 36 22·005
Errors $(R - L)$	$_{22}E = + 0·211$	$_{23}E = +0·104$	$_{24}E = +4·843$

Circuit VII. Equations 25 to 28.

Equation 25, *Linear*. Junction, Rámnagar-Naunangarhi.

Log. computed length Rámnagar-Naunangarhi by Triangle No. 302	. . .	4·807,0180,4
" " " No. 249	. . .	4·807,0313,3
$_{25}E = - 132·9$	Logarithmic Error	− 000,0132,9

Equations 26 to 28, *Geodetic*. Terminal Station, Rámnagar, 129. Terminal Side, Rámnagar-Naunangarhi, 129-128.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	27 9 3·870	84 22 2·878	339 14 17·209
Left-hand	27 9 4·227	84 22 2·908	339 14 22·948
Errors $(R - L)$	$_{26}E = -0·357$	$_{27}E = -0·030$	$_{28}E = -5·739$

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Circuit VIII. Equations 29 to 32.

Equation 29, *Linear.* Junction, Bulákípur-Madanpur.

Log. computed length Bulákípur-Madanpur by Triangle No. 330	. . . .	4·775,2874,0
" " " No. 289	. . . .	4·775,2677,3
$_{29}E = + 196·7$	Logarithmic Error	+ 000,0196,7

Equations 30 to 32, *Geodetic.* Terminal Station, Bulákípur, 149. Terminal Side, Bulákípur-Madanpur, 149-148.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	26 40 55·856	85 28 58·203	0 52 23·523
Left-hand	26 40 55·553	85 28 58·230	0 52 19·082
Errors $(R - L)$	$_{30}E = + 0·303$	$_{31}E = - 0·027$	$_{32}E = + 4·441$

Circuit IX. Equations 33 to 36.

Equation 33, *Linear.* Junction, Narhar-Bheria Bisanpur.

Log. computed length Narhar-Bheria Bisanpur by Triangle No. 361	. . .	4·748,6622,5
" " " No. 323	. . .	4·748,6907,1
$_{33}E = - 284·6$	Logarithmic Error	— ·000,0284,6

Equations 34 to 36, *Geodetic.* Terminal Station, Narhar, 167. Terminal Side, Narhar-Bheria Bisanpur, 167-166.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	26 31 45·408	86 8 37·959	345 21 1·821
Left-hand	26 31 45·722	86 8 37·923	345 21 4·100
Errors $(R - L)$	$_{34}E = - 0·314$	$_{35}E = + 0·036$	$_{36}E = - 2·279$

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Circuit X. Equations 37 to 40.

Equation 37, *Linear.* Junction, Diwánganj-Chúni.

Log. measured length Sonákhoda Base-line, see page 90			4·564,4979,3
„ computed length „	by Triangle No. 408	4·564,5016,0	
„ „ Diwánganj-Chúni	by „ No. 423	4·764,5741,8	·200,0725,8
„ „ „	in terms of Sonákhoda Base-line .		4·764,5705,1
„ „ „	by Triangle No. 351		4·764,5514,2
$_{37}E = + 190·9$	Logarithmic Error	+	·000,0190,9

Equations 38 to 40, *Geodetic.* Terminal Station, Diwánganj, 182. Terminal Side, Diwánganj-Chúni, 182-181.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	26 16 49·591	86 56 48·596	306 47 42·901
Left-hand	26 16 49·805	86 56 48·709	306 47 42·253
Errors $(R - L)$	$_{38}E = -0·214$	$_{39}E = -0·113$	$_{40}E = +0·648$

Base-line Equation.

Equation 41, *Linear.* Side Sátten-Chinsurah and Sonákhoda Base-line.

Log. computed length Sonákhoda Base-line by Triangle No. 408		4·564,5016,0
„ measured length „ as in Equation 37		4·564,4979,3
$_{41}E = + 36·7$	Logarithmic Error +	·000,0036,7

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Circuit XI. Equations 42 to 45.

Equation 42, *Linear.* Junction, Dhubri-Alangjáni.

Log. computed length Dhubri-Alangjáni by Triangle No. 501		4·894,5564,0
„ measured length Sonákhoda Base-line as in Equation 37		4·564,4979,3
„ computed length „ „ by Triangle No. 408	4·564,5016,0	
„ „ „ Dhubri-Alangjáni „ No. 443	4·894,5794,4	·330,0778,4
„ „ „ „ in terms of Sonákhoda Base-line		4·894,5757,7
$_{42}E = -193·7$* Logarithmic Error		— ·000,0193,7

Equations 43 to 45, *Geodetic.* Terminal Station, Dhubri, 228. Terminal Side, Dhubri-Alangjáni, 228-227.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	26 1 3·667	90 2 18·361	81 23 26·029
Left-hand	26 1 3·538	90 2 18·504	81 23 23·624
Errors $(R - L)$	$_{43}E = +$ 0·129	$_{44}E = -$ 0·143	$_{45}E = +$ 2·405†

* This numerical value is the absolute term of the equation

$$_{c}U_1 + {_{c}V} - {_{c}X_1} = {_{42}E}$$

which was employed in the reduction; see page 78. Through an unfortunate mistake the absolute term was taken as 230·4, the value which appertains to the linear equation

$$_{c}U_1 + {_{c}V} - ({_{c}T} + {_{c}X_1}) = E$$

—not employed in the reduction—and is deduced as follows:—

Log. computed length Dhubri-Alangjáni by Triangle No. 501		4·894,5564,0
„ „ „ No. 443		4·894,5794,4
$E = -$ 230·4	Logarithmic Error	— ·000,0230,4

The mistake was not discovered until the values of the unknown quantities had been obtained and tested. In order to correct it the equations between the Indeterminate Factors were reverted to and a portion of the solution was re-calculated, giving new values to several of the factors. With the differences between the old and the new factors corrections were found to the previously determined values of the unknown quantities of Circuits *XI* and *XII*, as will be explained hereafter. The unknown quantities appertaining to the other Circuits were allowed to stand uncorrected.

† The error in Azimuth at Alangjáni, + 2″·424, was by an oversight adopted in place of the error at Dhubri, + 2″·405. This mistake was not detected until the Simultaneous Reduction had been completed. It was then arbitrarily adjusted.

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Circuit XII. Equations 46 to 49.

Equation 46, *Linear*. Junction, Tepkilabama-Harogaon.

Log. computed length Tepkilabama-Harogaon by Triangle No. 573	. . .	4·675,7248,6
„ „ „ No. 517	. . .	4·675,7146,6
$_{46}E = + 102·0$ Logarithmic Error	+	·000,0102,0

Equations 47 to 49, *Geodetic*. Terminal Station, Tepkilabama, 265. Terminal Side, Tepkilabama-Harogaon, 265-264.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	25 56 22·209	91 36 52·155	89 58 37·867
Left-hand	25 56 22·036	91 36 52·782	89 58 51·007
Errors $(R - L)$	$_{47}E = + 0·173$	$_{48}E = - 0·627$	$_{49}E = - 13·140$

The products of the Absolute Terms by the Equalizing Factors are shewn in the following Table.

Equation.	Absolute Term.	Equalizing Factor.	Product.
1. *Linear*	$_1E = + 287.1$	·03	+ 8·613
2. *Latitude*	$_2E = + 0·939$	15	+ 14·085
3. *Longitude*	$_3E = + 0·934$	15	+ 14·010
4. *Azimuth*	$_4E = + 11·598$	1	+ 11·598
5. *Linear*	$_5E = - 7·3$	·03	− 0·219
6. *Latitude*	$_6E = - 0·352$	15	− 5·280
7. *Longitude*	$_7E = - 1·090$	15	− 16·350
8. *Azimuth*	$_8E = - 14·317$	1	− 14·317

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Equation.	Absolute Term.	Equalizing Factor.	Product.
9. *Linear*	$_{9}E = + 482{\cdot}3$	·03	+ 14·469
10. *Latitude*	$_{10}E = + 0.925$	15	+ 13·875
11. *Longitude*	$_{11}E = - 0{\cdot}183$	15	− 2·745
12. *Azimuth*	$_{12}E = - 6{\cdot}798$	1	− 6·798
13. *Linear*	$_{13}E = - 641{\cdot}0$	·03	− 19·230
14. *Latitude*	$_{14}E = - 1{\cdot}209$	15	− 18·135
15. *Longitude*	$_{15}E = - 0{\cdot}060$	15	− 0·900
16. *Azimuth*	$_{16}E = + 10{\cdot}177$	1	+ 10·177
17. *Linear*	$_{17}E = + 169{\cdot}4$	·03	+ 5·082
18. *Latitude*	$_{18}E = + 0{\cdot}383$	15	+ 5·745
19. *Longitude*	$_{19}E = + 0{\cdot}237$	15	+ 3·555
20. *Azimuth*	$_{20}E = - 0{\cdot}791$	1	− 0·791
21. *Linear*	$_{21}E = + 82{\cdot}1$	·03	+ 2·463
22. *Latitude*	$_{22}E = + 0{\cdot}211$	15	+ 3·165
23. *Longitude*	$_{23}E = + 0{\cdot}104$	15	+ 1·560
24. *Azimuth*	$_{24}E = + 4{\cdot}843$	1	+ 4·843
25. *Linear*	$_{25}E = - 132{\cdot}9$	·03	− 3·987
26. *Latitude*	$_{26}E = - 0{\cdot}357$	15	− 5·355
27. *Longitude*	$_{27}E = - 0{\cdot}030$	15	− 0·450
28. *Azimuth*	$_{28}E = - 5.739$	1	− 5·739
29. *Linear*	$_{29}E = + 196.7$	·03	+ 5·901
30. *Latitude*	$_{30}E = + 0{\cdot}303$	15	+ 4·545

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Equation.		Absolute Term.	Equalizing Factor.	Product.
31.	*Longitude*	${}_{31}E = -$ 0·027	15	− 0·405
32.	*Azimuth*	${}_{32}E = +$ 4·441	1	+ 4·441
33.	*Linear*	${}_{33}E = -$ 284·6	·03	− 8·538
34.	*Latitude*	${}_{34}E = -$ 0·314	15	− 4·710
35.	*Longitude*	${}_{35}E = +$ 0·036	15	+ 0·540
36.	*Azimuth*	${}_{36}E = -$ 2·279	1	− 2·279
37.	*Linear*	${}_{37}E = +$ 190·9	·03	+ 5·727
38.	*Latitude*	${}_{38}E = -$ 0·214	15	− 3·210
39.	*Longitude*	${}_{39}E = -$ 0·113	15	− 1·695
40.	*Azimuth*	${}_{40}E = +$ 0·648	1	+ 0·648
41.	*Linear*	${}_{41}E = +$ 36·7	·03	+ 1·101
42.	*Linear*	${}_{42}E^{*} = -\begin{cases}230·4\\193·7\end{cases}$	·03	$-\begin{cases}6·912\\5·811\end{cases}$
43.	*Latitude*	${}_{43}E = +$ 0·129	15	+ 1·935
44.	*Longitude*	${}_{44}E = -$ 0·143	15	− 2·145
45.	*Azimuth*	${}_{45}E^{*} = +$ 2·424	1	+ 2·424
46.	*Linear*	${}_{46}E = +$ 102·0	·03	+ 3·060
47.	*Latitude*	${}_{47}E = +$ 0·173	15	+ 2·595
48.	*Longitude*	${}_{48}E = -$ 0·627	15	− 9·405
49.	*Azimuth*	${}_{49}E = -$ 13·140	1	− 13·140

* See the note referring to this absolute term on page 126.

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11.

Numerical Values of the μs and ϕs.

The Table of Substitutions at page 55 together with the formulæ

$$ {}_{\lambda}m = \cdot 23\,\Delta\lambda\,\frac{1}{10^6}\,; \qquad {}_{L}m = \cdot 23\,\Delta L\,\frac{1}{10^6}\,; \qquad {}_{A}m = \cdot 23\,\Delta A\,\frac{1}{10^6}\,; $$

and

$$ {}_{\lambda}p = {}_{\lambda}g\,\Delta L\,\frac{1}{10^6}\,; \qquad {}_{L}p = {}_{L}g\,\Delta\lambda\,\frac{1}{10^6}\,; \qquad {}_{A}p = {}_{A}g\,\Delta\lambda\,\frac{1}{10^6}\,; $$

which are derived from pages 58 and 51 respectively, shew the general form of the factors μ and ϕ. The numerical values are tabulated in this section: they were constructed in the opposite order to that in which they are now recorded, commencing in each instance at the closing side of the circuit-branch to which they appertain.

In the above formulæ, in place of the total differences $\Delta\lambda$, ΔL and ΔA, the values of the first terms of the expressions (25), (26) and (27), pages 30 and 31, taken from the geodetic calculations, were made use of. For the North-West Quadrilateral the total values were employed; and as these were easily obtainable from the geodetic elements of the traverse stations already given, it was unnecessary to record them. In the case of the South-East Quadrilateral, although, as in the present instance, the first terms only were used, they did not differ so materially from the totals as to make it desirable to alter the form of the tables previously adopted. Here, however, the geodetic calculations, of which the results are given in Section 9, do not follow the course of the *zig-zag* traverse; hence, where that obtains, there are no data for furnishing the geodetic differences, even approximately, and it has been found necessary to record them; the opportunity has been taken of giving them for the *direct* traverse also.

To facilitate the calculation of the ϕs the following table of the factors ${}_{\lambda}g$, ${}_{L}g$ and ${}_{A}g$—the analytical expressions for which are given in equations (50) page 51—was constructed, and the necessary values, corresponding to the latitude of each traverse station, were obtained

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from it by interpolation and employed to one place of decimals only.

λ	${}_{\lambda}g$	${}_{L}g$	${}_{\Delta}g$
23°	2·49	5·24	2·04
24	·45	·28	·15
25	·42	·32	·25
26	·38	·36	·35
27	·34	·41	·46
28	·30	·46	·56
29	·26	·51	·67
30	·22	·57	·78
31	·18	·63	·90

Two forms of calculation were made use of, one for the *direct* traverse, in which every traverse station has its traverse number, the other for the *zig-zag* traverse where no traverse station is numbered, but each is defined by the triangle or triangles connecting it with the two preceding stations; the process is, however, the same in both, as will be seen from the examples given below.

Examples.

(1). To find the μs and ϕs in latitude for the Right-hand Branch of Circuit *I*. For this Circuit the Direct Traverse was employed and the right-hand subscripts in the following expressions are therefore the traverse numbers.

$${}_{\lambda}\mu_{22} = {}_{\lambda}m_{22} = \cdot 23 \Delta\lambda_{22} \frac{1}{10^6}$$

$${}_{\lambda}\mu_{21} = {}_{\lambda}\mu_{22} + {}_{\lambda}m_{21} = {}_{\lambda}\mu_{22} + \cdot 23 \Delta\lambda_{21} \frac{1}{10^6}$$

$${}_{\lambda}\mu_{20} = {}_{\lambda}\mu_{21} + {}_{\lambda}m_{20} = {}_{\lambda}\mu_{21} + \cdot 23 \Delta\lambda_{20} \frac{1}{10^6}$$

. . . .

$${}_{\lambda}\phi_{22} = {}_{\lambda}p_{22} = - {}_{\lambda}g \Delta L_{22} \frac{1}{10^6}$$

$${}_{\lambda}\phi_{21} = {}_{\lambda}\phi_{22} + {}_{\lambda}p_{21} = {}_{\lambda}\phi_{22} - {}_{\lambda}g \Delta L_{21} \frac{1}{10^6}$$

$${}_{\lambda}\phi_{20} = {}_{\lambda}\phi_{21} + {}_{\lambda}p_{20} = {}_{\lambda}\phi_{21} - {}_{\lambda}g \Delta L_{20} \frac{1}{10^6}$$

. . . .

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(2). To find the μs and ϕs in latitude for the Left-hand Branch of Circuit *XI*. For this Circuit the Zig-zag Traverse was employed and the right-hand subscripts in the following expressions are consequently the triangle numbers.

$$_{\lambda}\mu_{442\text{-}443} = {}_{\lambda}m_{442\text{-}443} = \cdot 23 \Delta \lambda_{442\text{-}443} \frac{1}{10^6}$$

$$_{\lambda}\mu_{440\text{-}441} = {}_{\lambda}\mu_{442\text{-}443} + {}_{\lambda}m_{440\text{-}441} = {}_{\lambda}\mu_{442\text{-}443} + \cdot 23 \Delta \lambda_{440\text{-}441} \frac{1}{10^6}$$

$$_{\lambda}\mu_{438\text{-}439} = {}_{\lambda}\mu_{440\text{-}441} + {}_{\lambda}m_{438\text{-}439} = {}_{\lambda}\mu_{440\text{-}441} + \cdot 23 \Delta \lambda_{438\text{-}439} \frac{1}{10^6}$$

. . . .

$$_{\lambda}\phi_{442\text{-}443} = {}_{\lambda}p_{442\text{-}443} = -{}_{\lambda}g \, \Delta L_{442\text{-}443} \frac{1}{10^6}$$

$$_{\lambda}\phi_{440\text{-}441} = {}_{\lambda}\phi_{442\text{-}443} + {}_{\lambda}p_{440\text{-}441} = {}_{\lambda}\phi_{442\text{-}443} - {}_{\lambda}g \Delta L_{440\text{-}441} \frac{1}{10^6}$$

$$_{\lambda}\phi_{438\text{-}439} = {}_{\lambda}\phi_{440\text{-}441} + {}_{\lambda}p_{438\text{-}439} = {}_{\lambda}\phi_{440\text{-}441} - {}_{\lambda}g \, \Delta L_{438\text{-}439} \frac{1}{10^6}$$

. . . .

The necessary data for calculating the numerical values of the expressions in both these examples as also the values themselves will be found in the following Table. With regard to this table, it is to be observed, that although the μs are recorded to 5 places of decimals and the ϕs to 4, as they were obtained, the full number of places of decimals was only availed of in the calculations appertaining to the zig-zag traverse. For the direct traverse μ was taken to 4 places and ϕ to 3.

Where the *direct* traverse has been adopted the numerical values of the ms are required in the calculation of those coefficients of the unknown quantities which take the form (73) on page 79; but they are not tabulated because they are simply the differences between the successive μs: thus $m_i = \mu_i - \mu_{i+1}$.

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The Direct Traverse.

CIRCUIT *I.* Right-hand Branch.

No. of Station in Traverse	Latitude $\Delta\lambda$	λ^g	λ^μ	λ^ϕ	Longitude ΔL	L^g	L^μ	L^ϕ	Azimuth ΔA	A^g	A^μ	A^ϕ	No. of Station in Traverse
1	+ 865	4·4	+·00516	+·0151	− 335	5·3	−·00085	+·1211	− 136	2·2	−·00043	+1·0553	1
2	1309		496	136	+ 413		077	·1165	+ 170		40	1·0534	2
3	1281		466	154	1062		086	·1096	442		44	1·0505	3
4	1175		437	201	− 114		110	·1028	− 48		54	1·0477	4
5	1419		410	196	160		107	·0966	68	2·3	53	1·0451	5
6	994		377	189	403	5·4	103	891	175		51	1·0418	6
7	949		354	171	+ 102		094	837	+ 45		47	1·0395	7
8	898		332	175	29		096	786	13	2·4	48	1·0373	8
9	837		311	176	− 22		097	738	− 10		48	1·0351	9
10	885		292	175	+ 188		096	693	+ 85		48	1·0331	10
11	984	4·3	272	183	22		100	645	10	2·5	50	1·0310	11
12	991		249	184	81		101	592	37		50	1·0285	12
13	894		226	187	35		103	538	16		51	1·0260	13
14	1104		205	189	− 73		104	490	− 34		51	1·0238	14
15	999		180	186	74	5·5	102	430	35	2·6	50	1·0210	15
16	1088		157	183	195		100	375	93		49	1·0184	16
17	824		132	175	+ 36		096	315	+ 17		47	1·0156	17
18	1401		113	177	424		097	270	205	2·7	47	1·0135	18
19	911	4·2	081	195	− 1426		107	193	− 697		52	1·0097	19
20	915		060	135	1424		074	143	701		36	1·0072	20
21	1109		039	075	744	5·6	041	093	369	2·8	20	1·0047	21
22	562		013	044	1045		024	031	524		12	1·0016	22

CIRCUIT *II.* Left-hand Branch.

No. of Station in Traverse	Latitude $\Delta\lambda$	λ^g	λ^μ	λ^ϕ	Longitude ΔL	L^g	L^μ	L^ϕ	Azimuth ΔA	A^g	A^μ	A^ϕ	No. of Station in Traverse
1	+ 865	4·4	+·00403	−·0026	− 335	5·3	+·00012	+·0941	− 136	2·2	+·00004	+1·0418	1
2	1309		383	41	+ 413		20	895	+ 170		07	1·0399	2
3	1281		353	23	1062		11	826	442		03	1·0370	3
4	1175		324	+ 24	− 114		− 13	758	− 48		− 07	1·0342	4
5	1419		297	19	160		10	696	68	2·3	06	1·0316	5
6	994		264	12	403	5·4	06	621	175		04	1·0283	6
7	949		241	− 06	+ 102		+ 03	567	+ 45		00	1·0260	7
8	898		219	02	29		01	516	13	2·4	01	1·0238	8

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
	CIRCUIT *II.* Left-hand Branch—(*Continued*).												
9	+ 837	4·4	+·00198	−·0001	− 22	5·4	·00000	+·0468	− 10	2·4	−·00001	+1·0216	9
10	885		179	02	+ 188		+ 01	423	+ 85		01	1·0196	10
11	984	4·3	159	+ 06	22		− 03	375	10	2·5	03	1·0175	11
12	991		136	07	81		04	322	37		03	1·0150	12
13	894		113	10	35		06	268	16		04	1·0125	13
14	1104		092	12	− 73		07	220	− 34		04	1·0103	14
15	999		067	09	74	5·5	05	160	35	2·6	03	1·0075	15
16	1088		044	06	195		03	105	93		02	1·0049	16
17	824		019	− 02	+ 36		+ 01	045	+ 17		00	1·0021	17
	CIRCUIT *II.* Right-hand Branch.												
23	+ 838	4·4	+·00400	+·0185	+ 1281	5·3	−·00101	+·0935	+ 522	2·2	−·00047	+1·0416	23
24	1237		381	241	− 699		130	891	− 287		59	1·0398	24
25	823		353	210	925		114	825	386		52	1·0371	25
26	957		334	169	+ 21		093	781	+ 9		43	1·0353	26
27	1215		312	170	130		093	730	55	2·3	43	1·0332	27
28	1157		284	176	− 351		096	666	− 151		44	1·0304	28
29	849		257	161	163	5·4	088	605	71		41	1·0277	29
30	917		237	154	255		084	559	112	2·4	39	1·0257	30
31	730		216	143	+ 301		078	509	+ 133		36	1·0235	31
32	807		199	156	101		085	470	45		39	1·0217	32
33	760		180	160	94		087	426	42		40	1·0198	33
34	839	4·3	163	164	61		089	385	28	2·5	41	1·0180	34
35	942		144	167	− 16		090	340	− 7		42	1·0159	35
36	825		122	166	120		090	289	55		42	1·0135	36
37	808		103	161	+ 105		087	244	+ 49		41	1·0114	37
38	785		084	166	− 86	5·5	089	200	− 40		42	1·0094	38
39	740		066	162	+ 26		087	157	+ 12	2·6	41	1·0074	39
40	335		049	163	− 631		088	116	− 299		41	1·0055	40
41	177		041	136	593		073	098	282		34	1·0046	41
42	208		037	111	477		059	088	227		28	1·0041	42
43	279		032	090	557		048	077	266		23	1·0036	43

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
	Circuit *II*. Right-hand Branch—(*Continued*).												
44	+ 251	4·3	+·00026	+·0066	− 513	5·5	−·00035	+·0062	− 245	2·6	−·00017	+1·0029	44
45	435		20	44	439		23	48	211		11	1·0022	45
46	433		10	25	584		13	24	281		06	1·0011	46
	Circuit *III*. Left-hand Branch.												
23	+ 838	4·4	+·00351	+·0022	+ 1281	5·3	−·00013	+·0819	+ 522	2·2	−·00006	+1·0361	23
24	1237		332	78	− 699		42	775	− 287		18	1·0343	24
25	823		304	47	925		26	709	386		11	1·0316	25
26	957		285	06	+ 21		05	665	+ 9		02	1·0298	26
27	1215		263	07	130		05	614	55	2·3	02	1·0277	27
28	1157		235	13	− 351		08	550	− 151		03	1·0249	28
29	849		208	− 02	163	5·4	00	489	71		00	1·0222	29
30	917		188	09	255		+ 04	443	112	2·4	+ 02	1·0202	30
31	730		167	20	+ 301		10	393	+ 133		05	1·0180	31
32	807		150	07	101		03	354	45		02	1·0162	32
33	760		131	03	94		01	310	42		01	1·0143	33
34	839	4·3	114	+ 01	61		− 01	269	28	2·5	00	1·0125	34
35	942		095	04	− 16		02	224	− 7		− 01	1·0104	35
36	825		073	03	120		02	173	55		01	1·0080	36
37	808		054	− 02	+ 105		+ 01	128	+ 49		00	1·0059	37
38	785		035	+ 03	− 86	5·5	− 01	084	− 40		01	1·0039	38
39	740		017	− 01	+ 26		+ 01	041	+ 12	2·6	00	1·0019	39
	Circuit *III*. Right-hand Branch.												
47	+ 1047	4·4	+·00350	+·0176	− 1336	5·3	−·00093	+·0813	− 545	2·2	−·00041	+1·0356	47
48	650		326	117	+ 274		62	758	+ 113		28	1·0333	48
49	1193		311	129	− 308		68	724	− 128		31	1·0319	49
50	1263		284	115	+ 783		61	661	+ 330		28	1·0293	50
51	1255		255	149	117		79	594	50	2·3	36	1·0265	51
52	414		226	154	− 991		82	527	− 428		37	1·0236	52
53	489		216	110	+ 5	5·4	59	505	+ 2		27	1·0226	53

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
	CIRCUIT *III*. Right-hand Branch—(*Continued*).												
54	+ 699	4·4	+ ·00205	+ ·0110	+ 300	5·4	− ·00059	+ ·0479	+ 131	2·3	− ·00027	+ 1·0215	54
55	547		189	123	− 397		66	441	− 174	2·4	30	1·0199	55
56	676		176	106	+ 51		57	411	+ 23		26	1·0186	56
57	636		160	108	63		58	374	28		27	1·0170	57
58	645		145	111	− 5		59	340	− 2		28	1·0155	58
59	681		130	111	+ 24		59	305	+ 11		28	1·0140	59
60	652	4·3	114	112	− 92		60	268	− 42	2·5	28	1·0124	60
61	724		099	108	42		58	233	19		27	1·0108	61
62	640		082	106	359		57	194	165		27	1·0090	62
63	602		067	091	+ 508		49	159	+ 234		23	1·0074	63
64	533		053	113	− 304		61	126	− 141		28	1·0059	64
65	506		041	100	197	5·5	54	097	92		25	1·0046	65
66	250		029	092	560		49	069	262	2·6	23	1·0033	66
67	168		023	068	586		36	055	275		17	1·0026	67
68	347		019	043	477		23	046	224		11	1·0022	68
69	489		011	022	515		12	027	243		06	1·0013	69
	CIRCUIT *IV*. Left-hand Branch.												
47	+ 1047	4·4	+ ·00309	+ ·0076	− 1336	5·3	− ·00039	+ ·0716	− 545	2·2	− ·00016	+ 1·0310	47
48	650		285	17	+ 274		08	661	+ 113		03	1·0287	48
49	1193		270	29	− 308		14	627	− 128		06	1·0273	49
50	1263		243	15	+ 783		07	564	+ 330		03	1·0247	50
51	1255		214	49	117		25	497	50	2·3	11	1·0219	51
52	414		185	54	− 991		28	430	− 428		12	1·0190	52
53	489		175	10	+ 5	5·4	05	408	+ 2		02	1·0180	53
54	699		164	10	300		05	382	131		02	1·0169	54
55	547		148	23	− 397		12	344	− 174	2·4	05	1·0153	55
56	676		135	06	+ 51		03	314	+ 23		01	1·0140	56
57	636		119	08	63		04	277	28		02	1·0124	57
58	645		104	11	− 5		05	243	− 2		03	1·0109	58
59	681		089	11	+ 24		05	208	+ 11		03	1·0094	59
60	652	4·3	073	12	− 92		06	171	− 42	2·5	03	1·0078	60

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
	CIRCUIT *IV*. Left-hand Branch—(*Continued*).												
61	+ 724	4·3	+ ·00058	+ ·0008	− 42	5·4	− ·00004	+ ·0136	− 19	2·5	− ·00002	+ 1·0062	61
62	640		41	06	359		03	097	165		02	1·0044	62
63	602		26	− 09	+ 508		+ 05	062	+ 234		+ 02	1·0028	63
64	533		12	+ 13	− 304		− 07	029	− 141		− 03	1·0013	64
	CIRCUIT *IV*. Right-hand Branch.												
70	+ 930	4·4	+ ·00286	+ ·0184	+ 472	5·3	− ·00098	+ ·0670	+ 194	2·2	− ·00043	+ 1·0293	70
71	1167		265	205	− 566		109	621	− 236		47	1·0273	71
72	609		238	180	452		096	559	190		42	1·0247	72
73	759		224	160	123		086	527	52	2·3	38	1·0234	73
74	661		207	155	84		083	487	36		37	1·0217	74
75	824		192	151	105		081	452	45		36	1·0202	75
76	541		173	146	+ 57	5·4	079	408	+ 25		35	1·0183	76
77	647		161	149	75		080	379	33		36	1·0171	77
78	578		146	152	12		082	344	5	2·4	37	1·0156	78
79	664		133	153	− 33		082	313	− 14		37	1·0142	79
80	599		118	152	+ 74		081	277	+ 33		37	1·0126	80
81	532		104	155	209		083	245	93		38	1·0112	81
82	664		092	164	93		088	216	42		40	1·0099	82
83	672	4·3	077	168	45		090	180	20		00	1·0083	83
84	625		062	170	− 205		091	144	− 93	2·5	41	1·0067	84
85	645		048	161	177		086	110	81		39	1·0051	85
86	558		033	153	110		082	075	51		37	1·0035	86
87	207		020	148	597		079	045	276		36	1·0021	87
88	189		015	122	644		065	034	298		30	1·0016	88
89	202		011	094	694		050	024	322		23	1·0011	89
90	167		006	064	767		034	013	357		16	1·0006	90
91	74		002	031	712		016	004	332		08	1·0002	91
	CIRCUIT *V*. Left-hand Branch.												
70	+ 930	4·4	+ ·00266	+ ·0036	+ 472	5·3	− ·00019	+ ·0625	+ 194	2·2	− ·00007	+ 1·0272	70
71	1167		245	57	− 566		030	576	− 236		11	1·0252	71

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	$_{\lambda}g$	$_{\lambda}\mu$	$_{\lambda}\phi$	ΔL	$_{L}g$	$_{L}\mu$	$_{L}\phi$	ΔA	$_{A}g$	$_{A}\mu$	$_{A}\phi$	
	Circuit V. Left-hand Branch—(*Continued*).												
72	+ 609	4·4	+ ·00218	+ ·0032	− 452	5·3	− ·00017	+ ·0514	− 190	2·2	− ·00006	+ 1·0226	72
73	759		204	12	123		07	482	52	2·3	02	1·0213	73
74	661		187	07	84		04	442	36		01	1·0196	74
75	824		172	03	105		02	407	45		00	1·0181	75
76	541		153	− 02	+ 57	5·4	00	363	+ 25		+ 01	1·0162	76
77	647		141	+ 01	75		01	334	33		00	1·0150	77
78	578		126	04	12		03	299	5	2·4	− 01	1·0135	78
79	664		113	05	− 33		03	268	− 14		01	1·0121	79
80	599		098	04	+ 74		02	232	+ 33		01	1·0105	80
81	532		084	07	209		04	200	93		02	1·0091	81
82	664		072	16	93		09	171	42		04	1·0078	82
83	672	4·3	057	20	45		11	135	20		05	1·0062	83
84	625		042	22	− 205		12	099	− 93	2·5	05	1·0046	84
85	645		028	13	177		07	065	81		03	1·0030	85
86	558		013	05	110		03	030	51		01	1·0014	86
	Circuit V. Right-hand Branch.												
92	+ 2066	4·5	+ ·00298	+ ·0233	− 923	5·3	− ·00122	+ ·0691	− 375	2·1	− ·00057	+ 1·0298	92
93	871	4·4	250	192	+ 80		101	582	+ 33	2·2	48	1·0255	93
94	574		230	196	81		103	536	34		49	1·0236	94
95	1255		217	200	− 452		105	506	− 191		50	1·0223	95
96	857		188	180	53		095	439	23	2·3	46	1·0195	96
97	657		168	178	10		094	394	4		45	1·0175	97
98	659		153	178	0	5·4	094	359	0		45	1·0160	98
99	677		138	178	+ 7		094	323	+ 3		45	1·0145	99
100	588		122	178	− 56		094	286	− 25	2·4	45	1·0129	100
101	607		108	176	+ 3		093	254	+ 1		44	1·0115	101
102	520		094	176	− 305		093	221	− 136		44	1·0100	102
103	616		082	163	86		086	193	39		41	1·0088	103
104	593		068	159	59		084	160	26		40	1·0073	104
105	530	4·3	054	156	30		083	128	14		39	1·0059	105
106	494		042	155	249		082	099	113	2·5	39	1·0046	106
107	598		031	144	317		076	072	145		36	1·0034	107

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude $\Delta\lambda$	λ^g	λ^μ	λ^ϕ	Longitude ΔL	L^g	L^μ	L^ϕ	Azimuth ΔA	A^g	A^μ	A^ϕ	No. of Station in Traverse
	Circuit *V*. Right-hand Branch—(*Continued*).												
108	+ 152	4·3	+·00017	+·0130	− 583	5·4	−·00069	+·0040	− 268	2·5	−·00033	+1·0019	108
109	158		14	105	652		56	32	300		27	1·0015	109
110	117		10	077	533		41	23	245		20	1·0011	110
111	166		07	054	655		29	17	302		14	1·0008	111
112	145		03	026	615		14	08	284		07	1·0004	112
	Circuit *VI*. Left-hand Branch.												
92	+ 2066	4·5	+·00281	+·0103	− 923	5·3	−·00053	+·0651	− 375	2·1	−·00024	+1·0279	92
93	871	4·4	233	062	+ 80		32	542	+ 33	2·2	15	1·0236	93
94	574		213	066	81		34	496	34		16	1·0217	94
95	1255		200	070	− 452		36	466	− 191		17	1·0204	95
96	857		171	050	53		26	399	23	2·3	13	1·0176	96
97	657		151	048	10		25	354	4		12	1·0156	97
98	659		136	048	0	5·4	25	319	0		12	1·0141	98
99	677		121	048	+ 7		25	283	+ 3		12	1·0126	99
100	588		105	048	− 56		25	246	− 25	2·4	12	1·0110	100
101	607		091	046	+ 3		24	214	+ 1		11	1·0096	101
102	520		077	046	− 305		24	181	− 136		11	1·0081	102
103	616		065	033	86		17	153	39		08	1·0069	103
104	593		051	029	59		15	120	26		07	1·0054	104
105	530	4·3	037	026	30		14	088	14		06	1·0040	105
106	494		025	025	249		13	059	113	2·5	06	1·0027	106
107	598		014	014	317		07	032	145		03	1·0015	107
	Circuit *VI*. Right-hand Branch.												
113	+ 888	4·4	+·00273	+·0196	− 474	5·3	−·00107	+·0638	− 193	2·2	−·00048	+1·0276	113
114	1065		253	175	209		096	591	86		44	1·0256	114
115	884		229	166	+ 966		091	535	+ 402		42	1·0233	115
116	877		209	209	300		113	488	126		51	1·0214	116
117	526		189	222	− 210		120	442	− 89	2·3	54	1·0195	117
118	545		177	213	221		115	414	94		52	1·0183	118

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
	CIRCUIT *VI*. Right-hand Branch—(*Continued*).												
119	+ 492	4·4	+ ·00164	+ ·0203	− 28	5·3	− ·00110	+ ·0385	− 12	2·3	− ·00050	+ 1·0170	119
120	789		153	202	+ 37		109	359	+ 16		50	1·0159	120
121	598		135	204	− 111	5·4	110	317	− 48		50	1·0141	121
122	630		121	199	+ 29		107	285	+ 13		49	1·0127	122
123	637		107	200	14		108	251	6	2·4	49	1·0113	123
124	707		092	201	11		108	217	5		49	1·0098	124
125	630		076	201	− 133		108	179	− 59		49	1·0081	125
126	722		062	195	+ 113		105	145	+ 51		48	1·0066	126
127	635	4·3	045	200	32		108	106	15		49	1·0049	127
128	594		030	201	− 251		109	072	− 114	2·5	49	1·0034	128
129	203		016	190	639		103	040	292		46	1·0019	129
130	115		011	163	503		088	029	230		39	1·0014	130
131	128		008	141	731		076	023	334		34	1·0011	131
132	103		005	110	598		059	016	274		26	1·0008	132
133	20		003	084	684		045	010	314		20	1·0005	133
134	105		003	055	703		029	009	322		13	1·0004	134
135	51		001	025	578		013	003	265		06	1·0001	135
	CIRCUIT *VII*. Left-hand Branch.												
113	+ 888	4·4	+ ·00257	+ ·0006	− 474	5·3	− ·00004	+ ·0598	− 193	2·2	− ·00002	+ 1·0257	113
114	1065		237	− 15	209		+ 07	551	86		+ 02	1·0237	114
115	884		213	24	+ 966		12	495	+ 402		04	1·0214	115
116	877		193	+ 19	300		− 10	448	126		− 05	1·0195	116
117	526		173	32	− 210		17	402	− 89	2·3	08	1·0176	117
118	545		161	23	221		12	374	94		06	1·0164	118
119	492		148	13	28		07	345	12		04	1·0151	119
120	789		137	12	+ 37		06	319	+ 16		04	1·0140	120
121	598		119	14	− 111	5·4	07	277	− 48		04	1·0122	121
122	630		105	09	+ 29		04	245	+ 13		03	1·0108	122
123	637		091	10	14		05	211	6	2·4	03	1·0094	123
124	707		076	11	11		05	177	5		03	1·0079	124
125	630		060	11	− 133		05	139	− 59		03	1·0062	125

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
	CIRCUIT *VII*. Left-hand Branch—(*Continued*).												
126	+ 722	4·4	+·00046	+·0005	+ 113	5·4	−·00002	+·0105	+ 51	2·4	−·00002	+1·0047	126
127	635	4·3	29	10	32		05	66	15		03	1·0030	127
128	594		14	11	− 251		06	32	− 114	2·5	03	1·0015	128
	CIRCUIT *VII*. Right-hand Branch.												
136	+ 1364	4·5	+·00266	+·0174	− 21	5·3	−·00091	+·0615	− 8	2·1	−·00044	+1·0266	136
137	1303	4·4	235	173	+ 578		091	543	+ 238	2·2	44	1·0237	137
138	1078		205	198	128		104	474	53		49	1·0208	138
139	768		180	204	− 424		107	417	− 179	2·3	50	1·0184	139
140	781		162	185	6		097	376	3		46	1·0166	140
141	633		144	185	+ 5		097	335	+ 2		46	1·0148	141
142	600		129	185	− 128	5·4	097	301	− 55		46	1·0133	142
143	539		115	179	53		094	269	23		45	1·0119	143
144	562		103	177	15		093	240	6		44	1·0107	144
145	553		090	176	1		093	210	0	2·4	44	1·0094	145
146	546		077	176	52		093	180	23		44	1·0081	146
147	505		064	174	+ 1		092	151	0		43	1·0068	147
148	590		052	174	10		092	124	+ 4		43	1·0056	148
149	257		038	174	− 636		092	092	− 286		43	1·0042	149
150	− 1		032	146	624		077	078	281		36	1·0036	150
151	+ 280	4·3	032	119	535		063	078	241		30	1·0036	151
152	365		026	096	462		051	063	209		24	1·0029	152
153	349		018	076	477		040	043	216	2·5	19	1·0020	153
154	263		010	055	623		029	024	283		14	1·0011	154
155	178		004	028	656		015	010	299		07	1·0004	155
	CIRCUIT *VIII*. Left-hand Branch.												
136	+ 1364	4·5	+·00228	·0000	− 21	5·3	+·00001	+·0523	− 8	2·1	−·00001	+1·0224	136
137	1303	4·4	197	− 01	+ 578		01	451	+ 238	2·2	01	1·0195	137
138	1078		167	+ 24	128		− 12	382	53		06	1·0166	138
139	768		142	30	− 424		15	325	− 179	2·3	07	1·0142	139
140	781		124	11	6		05	284	3		03	1·0124	140

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
	CIRCUIT *VIII*. Left-hand Branch—(*Continued*).												
141	+ 633	4·4	+·00106	+·0011	+ 5	5·3	−·00005	+·0243	+ 2	2·3	−·00003	+1·0106	141
142	600		091	11	− 128	5·4	05	209	− 55		03	1·0091	142
143	539		077	05	53		02	177	23		02	1·0077	143
144	562		065	03	15		01	148	6		01	1·0065	144
145	553		052	02	1		01	118	0	2·4	01	1·0052	145
146	546		039	02	52		01	088	23		01	1·0039	146
147	505		026	00	+ 1		00	059	0		00	1·0026	147
148	590		014	00	10		00	032	+ 4		00	1·0014	148
	CIRCUIT *VIII*. Right-hand Branch.												
156	+ 1108	4·4	+·00174	+·0110	+ 29	5·3	−·00058	+·0408	+ 12	2·2	−·00028	+1·0177	156
157	1067		149	111	− 44		59	349	− 19		28	1·0153	157
158	737		124	109	+ 88		58	292	+ 38	2·3	28	1·0130	158
159	509		107	113	0		60	253	0		29	1·0113	159
160	551		095	113	− 7		60	226	− 3		29	1·0101	160
161	583		082	113	+ 22	5·4	60	197	+ 10		29	1·0088	161
162	627		069	114	− 72		61	166	− 31		29	1·0075	162
163	481		055	111	11		59	132	5	2·4	28	1·0061	163
164	449		044	111	10		59	106	4		28	1·0049	164
165	444		034	111	+ 32		59	082	+ 14		28	1·0038	165
166	537		024	112	− 156		60	058	− 69		28	1·0027	166
167	− 50		012	105	639		56	029	285		26	1·0014	167
168	+ 192		013	077	544		41	032	243		19	1·0015	168
169	217		009	053	636		28	022	284		13	1·0010	169
170	193		004	025	561		13	010	251		06	1·0005	170
	CIRCUIT *IX*. Left-hand Branch.												
156	+ 1108	4·4	+·00162	+·0005	+ 29	5·3	−·00002	+·0379	+ 12	2·2	−·00002	+1·0163	156
157	1067		137	06	− 44		03	320	− 19		02	1·0139	157
158	737		112	04	+ 88		02	263	+ 38	2·3	02	1·0116	158
159	509		095	08	0		04	224	0		03	1·0099	159
160	551		083	08	− 7		04	197	− 3		03	1·0087	160

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	${}_{\lambda}g$	${}_{\lambda}\mu$	${}_{\lambda}\phi$	ΔL	${}_{L}g$	${}_{L}\mu$	${}_{L}\phi$	ΔA	${}_{A}g$	${}_{A}\mu$	${}_{A}\phi$	
	Circuit *IX*. Left-hand Branch—(*Continued*).												
161	+ 583	4·4	+·00070	+·0008	+ 22	5·4	−·00004	+·0168	+ 10	2·3	−·00003	+1·0074	161
162	627		57	09	− 72		05	137	− 31		03	1·0061	162
163	481		43	06	11		03	103	5	2·4	02	1·0047	163
164	449		32	06	10		03	077	4		02	1·0035	164
165	444		22	06	+ 32		03	053	+ 14		02	1·0024	165
166	537		12	07	− 156		04	029	− 69		02	1·0013	166
	Circuit *IX*. Right-hand Branch.												
171	+ 1197	4·5	+·00219	+·0160	− 612	5·3	−·00082	+·0502	− 248	2·1	−·00036	+1·0213	171
172	1487	4·4	191	132	+ 395		68	439	+ 162	2·2	30	1·0188	172
173	1021		157	149	805		77	360	336		34	1·0155	173
174	1176		134	184	− 871		96	306	− 367		42	1·0133	174
175	719		107	146	+ 446		76	244	+ 190	2·3	34	1·0107	175
176	530		090	166	− 400		86	206	− 172		38	1·0090	176
177	514		078	148	+ 264	5·4	77	178	+ 114		34	1·0078	177
178	574		066	160	140		83	150	61		37	1·0066	178
179	602		053	166	141		86	119	62		38	1·0053	179
180	379		039	172	− 476		89	086	− 209	2·4	39	1·0039	180
181	345		030	151	511		78	066	225		34	1·0030	181
182	335		022	129	469		66	047	208		29	1·0022	182
183	205		014	108	557		55	029	247		24	1·0014	183
184	157		009	083	630		42	018	280		18	1·0009	184
185	156		005	055	607		28	010	271		12	1·0005	185
186	44		001	028	627		14	002	280		06	1·0001	186
	Circuit *X*. Left-hand Branch.												
171	+ 1197	4·5	+·00197	+·0031	− 612	5·3	−·00016	+·0455	− 248	2·1	−·00007	+1·0191	171
172	1487	4·4	169	03	+ 395		02	392	+ 162	2·2	01	1·0166	172
173	1021		135	20	805		11	313	336		05	1·0133	173
174	1176		112	55	− 871		30	259	− 367		13	1·0111	174
175	719		085	17	+ 446		10	197	+ 190	2·3	05	1·0085	175

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude				Longitude				Azimuth				No. of Station in Traverse
	$\Delta\lambda$	$_\lambda g$	$_\lambda\mu$	$_\lambda\phi$	ΔL	$_L g$	$_L\mu$	$_L\phi$	ΔA	$_A g$	$_A\mu$	$_A\phi$	
	CIRCUIT X. Left-hand Branch—(*Continued*).												
176	+ 530	4·4	+·00068	+·0037	− 400	5·3	−·00020	+·0159	− 172	2·3	−·00009	+1·0068	176
177	514		56	19	+ 264	5·4	11	131	+ 114		05	1·0056	177
178	574		44	31	140		17	103	61		08	1·0044	178
179	602		31	37	141		20	072	62		09	1·0031	179
180	379		17	43	− 476		23	039	− 209	2·4	10	1·0017	180
181	345		08	22	511		12	019	225		05	1·0008	181
	CIRCUIT X. Right-hand Branch.												
187	+ 636	4·5	+·00281	+·0238	+ 22	5·2	−·00120	+·0650	+ 9	2·0	−·00056	+1·0269	187
188	404		266	239	321		121	617	126	2·1	56	1·0256	188
189	456		257	253	31		128	596	12		59	1·0248	189
190	474		247	254	− 139	5·3	129	572	− 55		59	1·0238	190
191	486		236	248	+ 67		126	547	+ 27		58	1·0228	191
192	411		225	251	286		128	521	115		59	1·0218	192
193	589		216	264	157		135	499	63		62	1·0209	193
194	516		202	271	− 6		139	468	− 2		63	1·0197	194
195	659		190	271	104		139	441	42	2·2	63	1·0186	195
196	538	4·4	175	266	237		137	406	97		62	1·0172	196
197	601		163	256	152		132	377	62		60	1·0160	197
198	467		149	249	316		129	345	131		59	1·0147	198
199	448		138	235	122		122	320	51		56	1·0137	199
200	504		128	230	+ 123		119	296	+ 52		55	1·0127	200
201	591		116	235	323		122	269	136		56	1·0116	201
202	634		102	249	48		129	238	20	2·3	59	1·0103	202
203	606		087	251	111		130	204	47		59	1·0088	203
204	485		073	256	43		133	172	19		60	1·0074	204
205	543		062	258	41		134	146	18		60	1·0063	205
206	545		050	260	− 78	5·4	135	117	− 34		60	1·0051	206
207	539		037	257	+ 2		133	088	+ 1		59	1·0038	207
208	554		025	257	9		133	059	4		59	1·0026	208
209	500		012	257	− 132		133	029	− 58	2·4	59	1·0013	209
210	175		000	251	701		130	002	310		58	1·0001	210

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The Direct Traverse—(Continued).

No. of Station in Traverse	Latitude $\Delta\lambda$	$_{\lambda}g$	$_{\lambda}\mu$	$_{\lambda}\phi$	Longitude ΔL	$_{L}g$	$_{L}\mu$	$_{L}\phi$	Azimuth ΔA	$_{A}g$	$_{A}\mu$	$_{A}\phi$	No. of Station in Traverse
	CIRCUIT X. Right-hand Branch—(*Continued*).												
211	+ 367	4·4	−·00004	+·0220	− 585	5·4	−·00114	−·0007	− 259	2·4	−·00051	+1·0003	211
212	− 177		012	194	587		101	27	261		45	0·9988	212
213	22		008	168	583		087	17	259		39	0·9992	213
214	28		007	142	687		074	16	305		33	0·9993	214
215	4		006	112	661		058	14	293		26	0·9994	215
216	+ 50		006	083	627		043	14	278		19	0·9994	216
217	− 95		007	055	683		029	17	303		13	0·9993	217
218	214		005	025	575		013	12	255		06	0·9995	218

The Zig-zag Traverse.

No. of Circuit Triangle	Latitude $\Delta\lambda$	$_{\lambda}g$	$_{\lambda}\mu$	$_{\lambda}\phi$	Longitude ΔL	$_{L}g$	$_{L}\mu$	$_{L}\phi$	Azimuth ΔA	$_{A}g$	$_{A}\mu$	$_{A}\phi$	No. of Circuit Triangle
	CIRCUIT XI. Left-hand Branch.												
362	+ 296	4·5	+·00251	−·0277	+ 607	5·2	+·00149	+·0577	+ 237	2·0	+·00059	+1·0241	362
363, 364	536		244	250	− 184		155	562	− 72	2·1	54	1·0235	363, 364
365, 366	324		232	258	+ 536		139	534	+ 212		56	1·0224	365, 366
367	208		225	234	− 466	5·3	127	517	− 184		51	1·0217	367
368	266		220	255	+ 327		138	506	+ 130		55	1·0213	368
369	253		214	240	− 542		130	492	− 216		52	1·0207	369
370	233		208	264	+ 609		142	479	+ 243		57	1·0202	370
371	322		203	237	− 361		128	467	− 145		51	1·0197	371
372	89		196	253	+ 648		136	450	+ 260		54	1·0190	372
373	452		194	224	− 354		121	445	− 142		48	1·0188	373
374	137		184	240	+ 511		129	421	+ 206		51	1·0179	374
375	368		181	217	− 450		117	414	− 182		46	1·0176	375
376	148		173	237	+ 444		127	394	+ 180		50	1 0168	376

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The Zig-zag Traverse—(Continued).

No. of Circuit Triangle	Latitude				Longitude				Azimuth				No. of Circuit Triangle
	$\Delta\lambda$	$_\lambda g$	$_\lambda\mu$	$_\lambda\phi$	ΔL	$_L g$	$_L\mu$	$_L\phi$	ΔA	$_A g$	$_A\mu$	$_A\phi$	
	Circuit *XI*. Left-hand Branch—(*Continued*).												
377	+ 293	4·5	+·00170	−·0217	− 503	5·3	+·00117	+·0386	− 205	2·1	+·00046	+1·0165	377
378	366	4·4	163	240	+ 400		129	371	+ 164	2·2	51	1·0159	378
379	172		155	222	− 672		120	352	− 275		47	1·0151	379
380	366		151	252	+ 435		135	343	+ 179		53	1·0147	380
381	180		143	233	− 588		125	324	− 242		49	1·0139	381
382	420		139	259	+ 436		139	314	+ 180		55	1·0135	382
383	42		129	240	− 523		129	292	− 217		51	1·0126	383
384	425		128	263	+ 207		141	290	+ 86		56	1·0125	384
385	76		118	254	− 586		136	267	− 244		54	1·0116	385
386	372		116	280	+ 463		149	263	+ 194		60	1·0114	386
387	220		107	260	− 585		138	243	− 245		56	1·0106	387
388	285		102	286	+ 708		151	231	+ 297		62	1·0101	388
389	429		095	255	− 402		135	216	− 170		55	1·0095	389
390	162		085	273	+ 725		144	193	+ 307		59	1·0086	390
391	328		081	241	− 409		127	184	− 174	2·3	52	1·0082	391
392	306		073	259	+ 457		136	167	+ 195		56	1·0074	392
393	258		066	239	− 600		125	151	− 256		52	1·0067	393
394	350		060	265	+ 711		139	137	+ 304		58	1·0061	394
395	174		052	234	− 640		123	118	− 275		51	1·0053	395
396	311		048	262	+ 683		138	109	+ 294		57	1·0049	396
397	292		041	232	− 589		122	093	− 254		50	1·0042	397
398	251		034	258	+ 630		136	078	+ 273		56	1·0035	398
399	244		028	230	− 615	5·4	122	065	− 267		50	1·0029	399
400	300		022	257	+ 537		136	052	+ 233		56	1·0023	400
401	229		015	233	− 543		124	036	− 237		51	1·0016	401
402	310		010	257	+ 545		136	024	+ 238		56	1·0011	402
403	225		003	233	− 559		123	007	− 245		51	1·0004	403
404	329		− 002	258	+ 567		136	− 005	+ 249	2·4	57	0·9999	404
405	171		010	233	− 665		123	023	− 293		51	0·9991	405
406	329		014	262	+ 533		138	032	+ 236		58	0·9987	406
407, 424, 425	496		022	239	535		126	050	237		53	0·9979	407, 424, 425

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The Zig-zag Traverse—(Continued).

No. of Circuit Triangle	Latitude $\Delta\lambda$	${}_{\lambda}^{g}$	${}_{\lambda}^{\mu}$	${}_{\lambda}^{\phi}$	Longitude ΔL	${}_{L}^{g}$	${}_{L}^{\mu}$	${}_{L}^{\phi}$	Azimuth ΔA	${}_{A}^{g}$	${}_{A}^{\mu}$	${}_{A}^{\phi}$	No. of Circuit Triangle
	CIRCUIT *XI.* Left-hand Branch—(*Continued*).												
426	− 547	4·4	−·00033	−·0215	+ 1	5·4	+·00114	−·0077	+ 0	2·4	+·00048	+0·9967	426
427	+ 181		20	215	439		114	47	194		48	0·9980	427
428, 429	− 314		24	196	527		104	57	234		44	0·9976	428, 429
430, 431	+ 151		17	173	539		092	40	238		39	0·9984	430, 431
432, 433	− 419		20	149	463		080	48	205		34	0·9980	432, 433
434, 435	+ 136		10	129	521		069	25	239		29	0·9990	434, 435
436, 437	− 351		13	106	506		057	32	223		24	0·9987	436, 437
438, 439	+ 135		5	084	634		045	13	279		19	0·9995	438, 439
440, 441	− 479		8	056	424		030	20	187		13	0·9992	440, 441
442, 443	+ 118		+ 3	037	850		020	+ 6	372		9	1·0003	442, 443
	CIRCUIT *XI.* Right-hand Branch.												
362, 444	+ 279	4·5	+·00257	−·0255	+ 531	5·2	+·00131	+·0598	+ 206	2·0	+·00051	+1·0245	362, 444
445, 446	− 321		251	231	587		119	583	229		46	1·0239	445, 446
447	+ 621		258	205	7		105	600	3		41	1·0245	447
448	− 283		244	205	487		105	568	191	2·1	41	1·0233	448
449	+ 435		251	183	149		094	583	58	2·0	37	1·0239	449
450	− 376		241	176	355		091	560	139	2·1	36	1·0230	450
451	+ 467		250	160	151		083	580	59	2·0	33	1·0238	451
452	− 423		239	153	378		080	556	148	2·1	32	1·0229	452
453	+ 499		249	136	207		071	578	81	2·0	29	1·0238	453
454	− 468		238	127	354		066	552	139	2·1	27	1·0228	454

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The Zig-zag Traverse – (Continued).

No. of Circuit Triangle	Latitude				Longitude				Azimuth				No. of Circuit Triangle
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
	Circuit *XI*. Right-hand Branch—(*Continued*).												
455	+ 470	4·5	+·00249	−·0111	+ 301	5·2	+·00058	+·0576	+ 118	2·0	+·00024	+1·0238	455
456	− 482		238	097	338		51	552	133	2·1	21	1·0229	456
457	+ 495		249	082	212		43	577	83	2·0	18	1·0239	457
458	− 441		238	072	290		38	551	114	2·1	16	1·0229	458
459	+ 479		248	059	381		31	574	149	2·0	13	1·0238	459
460 461	46		237	042	562		22	549	221	2·1	10	1·0228	460 461
462	477		236	017	− 326		09	547	− 128		05	1·0227	462
463 464	437		225	032	+ 283		16	522	+ 112		08	1·0217	463 464
465 466	510		215	019	− 285	5·3	09	499	− 113		05	1·0208	465 466
467 468	492		203	032	+ 360		16	472	+ 144		08	1·0197	467 468
469 470	476		192	016	− 206		08	446	− 83		05	1·0187	469 470
471 472	483		181	025	+ 165		13	421	+ 67		07	1·0177	471 472
473 474	444		170	018	− 209		09	395	− 85		05	1·0167	473 474
475 476	501		160	027	+ 231		14	371	+ 94	2·2	07	1·0158	475 476
477 478	482	4·4	148	017	− 516		09	344	− 212		05	1·0147	477 478
479 480	484		137	040	+ 416		21	318	+ 172		10	1·0136	479 480
481 482	486		126	022	− 432		11	292	− 179		06	1·0125	481 482
483 484	484		115	041	+ 328		21	266	+ 137		10	1·0114	483 484
485 486	491		104	027	− 376		13	240	− 158		07	1·0103	485 486
487	468		093	044	+ 282		22	214	+ 119		11	1·0092	487

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The Zig-zag Traverse—(Continued).

No. of Circuit Triangle	Latitude				Longitude				Azimuth				No. of Circuit Triangle
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
Circuit *XI*. Right-hand Branch—(*Continued*).													
488	+ 468	4·4	+ ·00093	− ·0044	+ 282	5·3	+ ·00022	+ ·0214	+ 119	2·2	+ ·00011	+ 1·0092	488
489 490	512		82	32	− 288		16	189	− 122		8	1·0082	489 490
491 492	650		70	45	+ 536		23	162	+ 228	2·3	11	1·0070	491 492
493 494	366		55	21	− 630		11	128	− 269		6	1·0055	493 494
495	251		47	49	+ 716		25	109	+ 308		12	1·0047	495
496 497	757		41	17	94		9	096	41		5	1·0041	496 497
498 499	543		24	13	453	5·4	7	056	197		4	1·0024	498 499
500	386		12	7	− 998		− 3	027	− 436		− 1	1·0012	500
501	118		3	37	+ 850		+ 20	6	+ 372	2·4	+ 9	1·0003	501
Circuit *XII*. Left-hand Branch.													
461	+ 46	4·5	+ ·00231	− ·0292	+ 562	5·2	+ ·00153	+ ·0533	+ 221	2·1	+ ·00068	+ 1·0221	461
462	477		230	267	− 326		140	531	− 128		63	1·0220	462
463 464	437		219	282	+ 283		147	506	+ 112		66	1·0210	463 464
465 466	510		209	269	− 285	5·3	140	483	− 113		63	1·0201	465 466
467 468	492		197	282	+ 360		147	456	+ 144		66	1·0190	467 468
469 470	476		186	266	− 206		139	430	− 83		63	1·0180	469 470
471 472	483		175	275	+ 165		144	405	+ 67		65	1·0170	471 472
473 474	444		164	268	− 209		140	379	− 85		63	1·0160	473 474
475 476	501		154	277	+ 231		145	355	+ 94	2·2	65	1·0151	475 476
477	482	4·4	142	267	− 516		140	328	− 212		63	1·0140	477

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The Zig-zag Traverse—(Continued).

No. of Circuit Triangle	Latitude				Longitude				Azimuth				No. of Circuit Triangle
	$\Delta\lambda$	λ^g	λ^μ	λ^ϕ	ΔL	L^g	L^μ	L^ϕ	ΔA	A^g	A^μ	A^ϕ	
	CIRCUIT *XII.* Left-hand Branch—(*Continued*).												
478	+ 482	4·4	+·00142	−·0267	− 516	5·3	+·00140	+·0328	− 212	2·2	+·00063	+1·0140	478
479 480	484		131	290	+ 416		152	302	+ 172		68	1·0129	479 480
481 482	486		120	272	− 432		142	276	− 179		64	1·0118	481 482
483 484	484		109	291	+ 328		152	250	+ 137		68	1·0107	483 484
485 486	491		098	277	− 376		144	224	− 158		65	1·0096	485 486
487 488	468		087	294	+ 282		153	198	+ 119		69	1·0085	487 488
489 490	512		076	282	− 288		147	173	− 122	2·3	66	1·0075	489 490
491 492	650		064	295	+ 536		154	146	+ 228		69	1·0063	491 492
493 494	366		049	271	− 630		142	112	− 269		64	1·0048	493 494
495	251		041	299	+ 716		156	093	+ 308		70	1·0040	495
496 497	757		035	267	94		140	080	41		63	1·0034	496 497
498 499	543		018	263	453	5·4	138	040	197		62	1·0017	498 499
500 501	502		006	243	− 149		128	011	− 65		57	1·0005	500 501
502	− 24		− 006	250	+ 830		131	− 016	+ 364	2·4	58	0·9993	502
503 504	+ 674		005	213	470		112	015	206		50	0·9994	503 504
505	− 641		021	192	626		101	051	276		45	0·9978	505
506 507	+ 420		006	164	470		087	016	206		39	0·9993	506 507
508	− 446		016	143	314		076	039	138		34	0·9983	508
509 510	+ 398		006	129	954		069	015	418		31	0·9994	509 510
511	− 404		015	087	396		047	036	174		21	0·9984	511

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The Zig-zag Traverse—(Continued).

No. of Circuit Triangle	Latitude Δλ	Latitude $_\lambda g$	Latitude $_\lambda\mu$	Latitude $_\lambda\phi$	Longitude ΔL	Longitude $_Lg$	Longitude $_L\mu$	Longitude $_L\phi$	Azimuth ΔA	Azimuth $_Ag$	Azimuth $_A\mu$	Azimuth $_A\phi$	No. of Circuit Triangle
	Circuit *XII.* Left-hand Branch—(*Continued*).												
512	− 404	4·4	−·00015	−·0087	+ 396	5·4	+·00047	−·0036	+ 174	2·4	+·00021	+0·9984	512
513	+ 610		06	70	388		38	14	170		17	0·9994	513
514	− 570		20	53	352		29	47	155		13	0·9979	514
515	+ 553		07	38	549		21	16	241		09	0·9993	515
516	− 848		20	14	− 195		08	46	− 86		03	0·9980	516
517	+ 1		00	23	+ 519		12	00	+ 227	2·3	05	1·0000	517
	Circuit *XII.* Right-hand Branch.												
461	+ 503	4·5	+·00245	−·0287	+ 263	5·2	+·00148	+·0556	+ 103	2·0	+·00056	+1·0227	461
518	− 505		233	275	374		142	530	147	2·1	54	1·0217	518
519	+ 519		245	258	273		133	556	107	2·0	51	1·0228	519
520	− 531		233	246	293		127	529	115	2·1	49	1·0218	520
521	+ 463		245	233	309		120	557	121	2·0	46	1·0229	521
522	− 547		234	219	254		113	533	100	2·1	43	1·0220	522
523	+ 500		247	208	314		107	561	123	2·0	41	1·0231	523
524	− 493		235	194	292		100	535	115	2·1	38	1·0221	524
525	+ 546		246	181	198		093	561	77	2·0	35	1·0231	525
526	− 522		233	172	343		088	533	135	2·1	33	1·0220	526
527	+ 526		245	157	259		080	560	101	2·0	30	1·0231	527
528	− 485		233	145	295		074	533	116	2·1	28	1·0220	528
529	+ 480		244	132	291		067	558	114	2·0	25	1·0230	529
530	− 472		233	119	275		060	533	108	2·1	22	1·0220	530
531	+ 469		244	107	367		054	558	143	2·0	20	1·0230	531
532	− 480		233	090	258		046	534	102	2·1	17	1·0221	532
533	+ 462		244	078	359		040	559	141	2·0	15	1·0231	533
534	− 469		233	062	158		032	535	62	2·1	12	1·0222	534
535	+ 408		244	055	470		028	559	184	2·0	11	1·0232	535
536 537	108		235	034	689		017	538	271	2·1	07	1·0224	536 537
538	520		233	003	− 157		001	532	− 62		01	1·0222	538
539 540	698		221	010	+ 141		005	505	+ 56		02	1·0211	539 540
541	330		205	004	− 644	5·3	002	469	− 258		01	1·0196	541

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The Zig-zag Traverse—(Continued).

No. of Circuit Triangle	Latitude $\Delta\lambda$	$_\lambda g$	$_\lambda\mu$	$_\lambda\phi$	Longitude ΔL	$_L g$	$_L\mu$	$_L\phi$	Azimuth ΔA	$_A g$	$_A\mu$	$_A\phi$	No. of Circuit Triangle
					Circuit *XII*. Right-hand Branch—(*Continued*).								
542	+ 330	4·5	+ ·00205	− ·0004	− 644	5·3	+ ·00002	+ ·0469	− 258	2·1	+ ·00001	+ 1·0196	542
543	327		197	33	+ 447		17	452	+ 179		07	1·0189	543
544	296		189	13	− 581		07	435	− 234		03	1·0182	544
545	262		182	39	+ 814		20	419	+ 329		08	1·0176	545
546 547	500		176	02	− 134		01	405	− 54		00	1·0170	546 547
548	143		164	08	+ 834		04	378	+ 339		01	1·0159	548
549 550	863		161	+ 30	− 38		− 15	370	− 16.		− 07	1·0156	549 550
551 552	76	4·4	141	28	+ 705		14	324	+ 290	2·2	07	1·0138	551 552
553	626		139	59	− 590		30	320	− 244		14	1·0136	553
554	− 118		125	33	+ 1090		16	287	+ 450		08	1·0122	554
555	+ 899		128	81	− 541		41	293	− 226		18	1·0125	555
556 557	489		107	57	+ 348		29	245	+ 146		13	1·0105	556 557
558 559	522		096	72	− 610		37	219	− 257		16	1·0094	558 559
560 561	505		084	45	+ 75		23	191	+ 32		10	1·0083	560 561
562 563	631		072	48	− 572		25	164	− 244	2·3	11	1·0072	562 563
564 565	562		057	23	+ 406		12	131	+ 174		05	1·0057	564 565
566 567	327		044	41	− 586		21	101	− 252		09	1·0044	566 567
568	379		036	15	+ 470		08	084	+ 203		03	1·0036	568
569	326		027	36	− 822		19	064	− 357		08	1·0027	569
570	293		020	00	+ 365	5·4	00	047	+ 159		00	1·0020	570
571	132		013	16	− 662		08	031	− 288		04	1·0013	571
572	441		010	− 13	+ 294		+ 07	024	+ 128		+ 03	1·0010	572
573												1·0000	573

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12.

Numerical Values of the Coefficients $\mathfrak{b}$ *and* $\mathfrak{c}$ *of the Unknown Quantities* y *and* z.

The following table gives the numerical values of the coefficients $\mathfrak{b}$ and $\mathfrak{c}$ of the unknown quantities y and z in every equation of condition. Should it be desired to reproduce any one of these coefficients, as the value of $\mathfrak{b}_p$ in the qth equation, it is first necessary to ascertain, by reference to pages 80-84, whether the coefficient is one of those of an exceptional form for which symbolical expressions are there given. When not found in this list it will be understood to take one of the general forms on page 79; if it occurs in a *linear* equation the form is (71), if in a *geodetic* equation, appertaining to any one of the Circuits *I* to *X* inclusive, it takes one of the forms (72) or (73); but if the geodetic equation occurs in Circuits *XI* or *XII* the form will be given by (74).

Examples.

(1). To find the values of $\mathfrak{b}_{34}$ and $\mathfrak{c}_{34}$ in equation (5).

This is a linear equation, and the forms of the coefficients are exceptional, see page 80, being

$$ {}_5\mathfrak{b}_{34} = + a_{34} = + \text{t.d. log sin } 49^\circ\ 31'\ 10'' = + 17 $$

$$ {}_5\mathfrak{c}_{34} = + (a_{34} + \gamma_{34}) = + \text{t.d. log sin } 49^\circ\ 31'\ 10'' + \text{t.d. log sin } 59^\circ\ 1'\ 58'' $$

$$ = + 17 + 12 = + 29 $$

The values of the angles are given in the data for Triangle 34, page 93, in the same horizontal lines as the symbolical errors x and z.

(2). To find the values of $\mathfrak{b}_{482}$ and $\mathfrak{c}_{482}$ in equation (46).

This is a linear equation and the forms of the coefficients are normal, but the angles appertain to a triangle on the left-hand branch of a circuit.

$$ {}_{46}\mathfrak{b}_{482} = - \beta_{482} = - \text{t.d. log sin } 72^\circ\ 30'\ 46'' = - 7 $$

$$ {}_{46}\mathfrak{c}_{482} = + \gamma_{482} = + \text{t.d. log sin } 60\quad 1\ \ 14 = + 12 $$

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(3). To find the values of $\mathfrak{d}_{138}$ and $\mathfrak{c}_{138}$ in equation (12).

The equation is azimuthal, appertaining to Circuit *III*, and the forms of the coefficients are exceptional, see pages 80 and 81, being

$$_{12}\mathfrak{d}_{138} = -\ {}_{12}\mu_{69}\ a_{138} + {}_{12}\phi_{69} = +\ {\cdot}0001 \times 12 + 1{\cdot}001 = +\ 1{\cdot}002$$

$$_{12}\mathfrak{c}_{138} = 1 -\ {}_{12}\mu_{69}\ (a_{138} + \gamma_{138}) = 1 +\ {\cdot}0001\ (12 + 21) = +\ 1{\cdot}003$$

(4). To find the values of $\mathfrak{d}_{54}$, $\mathfrak{c}_{54}$, $\mathfrak{d}_{55}$ and $\mathfrak{c}_{55}$ in equation (7).

The equation is longitudinal, appertaining to Circuit *II*, and the forms of the coefficients are normal. Triangles 54 and 55 are both situated in the right-hand branch of the circuit; the former has a side in the traverse between the stations 27 and 28; the latter has no side in the traverse, but it has an angle at station 28. Thus

$$_{7}\mathfrak{d}_{54} = +\ \{-\ {}_{L}m_{27}\ a_{54} + {}_{L}\mu_{28}\ \beta_{54} + {}_{L}\phi_{27}\}$$

$$= +\ \{-\ {\cdot}0000 \times 14 -\ {\cdot}0010 \times 10 +\ {\cdot}073\} = +\ {\cdot}063$$

$$_{7}\mathfrak{c}_{54} = +\ \{-\ {}_{L}m_{27}\ a_{54} -\ {}_{L}\mu_{27}\ \gamma_{54} + {}_{L}\phi_{28}\}$$

$$= +\ \{-\ {\cdot}0000 \times 14 +\ {\cdot}0009 \times 12 +\ {\cdot}067\} = +\ {\cdot}078$$

$$_{7}\mathfrak{d}_{55} = +\ \{{}_{L}\mu_{28}\ \beta_{55} -\ {}_{L}\phi_{28}\}$$

$$= +\ \{-\ {\cdot}0010 \times 13 -\ {\cdot}067\} = -\ {\cdot}080$$

$$_{7}\mathfrak{c}_{55} = -\ \{{}_{L}\mu_{28}\ \gamma_{55} + {}_{L}\phi_{28}\}$$

$$= -\ \{-\ {\cdot}0010 \times 9 +\ {\cdot}067\} = -\ {\cdot}058$$

(5). To find the values of $\mathfrak{d}_{484}$ and $\mathfrak{c}_{484}$ in equation (47).

The equation is in latitude, appertaining to Circuit *XII*, for which the zig-zag traverse has been employed, and the forms of the coefficients are normal, while they occur in the left-hand branch of the circuit.

$$_{47}\mathfrak{d}_{484} = -\ \{\iota\ {}_{\lambda}\phi_{483,484} + {}_{\lambda}\mu_{483,484}\ \beta_{484}\} = -\ {}_{\lambda}\phi_{483,484} -\ {}_{\lambda}\mu_{483,484}\ \beta_{484} = +\ {\cdot}0291 -\ {\cdot}00109 \times 15$$
$$= +\ {\cdot}013$$

$$_{47}\mathfrak{c}_{484} = -\ \{\iota\ {}_{\lambda}\phi_{483,484} -\ {}_{\lambda}\mu_{483,484}\ \gamma_{484}\} = -\ {}_{\lambda}\phi_{483,484} + {}_{\lambda}\mu_{483,484}\ \gamma_{484} = +\ {\cdot}0291 +\ {\cdot}00109 \times 8$$
$$= +\ {\cdot}038$$

In these coefficients ι stands for +, because Triangle 484 falls to the right of the line of traverse.

The numerical coefficients $\mathfrak{d}$ and $\mathfrak{c}$ which follow, before being manipulated for finding the coefficients of the Indeterminate Factors, were multiplied by equalizing factors—see page 59—which may be symbolized by $_{1}f$, $_{2}f$, &c., the subscripts 1, 2, . . . corresponding to the equation-numbers. The products $f\ \mathfrak{d}$ and $f\ \mathfrak{c}$, were retained to two decimal places only. For the sake of convenience the value of the equalizing factor for each equation is placed at the commencement of the statement of the coefficients and at the head of every succeeding column, in the following table.

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1st Equation Linear.
Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
1	+ 15	− 1
2	22	11
3	15	22
4	6	22
5	6	14
6	21	6
7	11	10
8	9	12
9	13	13
10	12	8
11	13	7
12	15	9
13	6	15
14	16	8
15	11	10
16	13	7
17	11	11
18	13	14
19	10	14
20	13	11
21	15	12
22	13	7
23	− 12	21
24	+ 13	12
25	13	14
26	16	9
27	5	18
28	16	11
29	13	12
30	13	13
31	7	17
32	14	10

1st Equation—(Continued).
Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
33	+ 15	− 8
34	7	12
35	12	10
36	4	28
37	6	15
38	34	8
39	19	23
40	14	7
41	5	25
42	22	4
43	7	15
44	6	10

2nd Equation. Latitude.
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
1	+ ·085	+ ·004
2	·096	− ·069
3	·084	·096
4	·013	·118
5	·013	·081
6	·103	·012
7	·060	·029
8	·017	·069
9	·066	·037
10	·027	·049
11	·062	·013
12	·036	·049
13	·034	·038
14	·035	·044
15	·049	·018
16	·022	·040
17	·047	·019

2nd Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
18	+ ·020	− ·059
19	·042	·026
20	·017	·048
21	·054	·016
22	·015	·036
23	− ·048	·071
24	+ ·046	·013
25	·011	·051
26	·050	·005
27	− ·008	·057
28	+ ·045	·007
29	·004	·041
30	·038	·007
31	− ·007	·045
32	+ ·032	·002
33	·002	·028
34	·023	·001
35	− ·005	·029
36	+ ·018	·014
37	·021	·001
38	·006	·019
39	·022	·006
40	− ·002	·011
41	·006	·018
42	+ ·006	·002
43	·002	·004

3rd Equation. Longitude.
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
1	+ ·112	+ ·121
2	− ·135	− ·108
3	+ ·103	+ ·128

3rd Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
4	− ·115	− ·090
5	·115	·097
6	+ ·085	+ ·106
7	·091	.108
8	− ·107	− ·084
9	+ ·084	+ ·103
10	− ·101	− ·081
11	+ ·079	+ ·093
12	− ·098	− ·076
13	+ ·078	+ ·093
14	− ·095	− ·071
15	+ ·068	+ ·084
16	− ·087	− ·067
17	+ ·063	+ ·080
18	− ·082	− ·055
19	+ ·059	+ ·079
20	− ·078	− ·054
21	+ ·050	+ ·071
22	− ·072	− ·052
23	·047	·038
24	+ ·046	+ ·066
25	− ·067	− ·040
26	+ ·038	+ ·058
27	− ·054	− ·031
28	+ ·033	+ ·054
29	− ·056	− ·031
30	+ ·030	+ ·051
31	− ·045	− ·021
32	+ ·024	+ ·042
33	− ·047	− ·024
34	+ ·025	+ ·039
35	− ·039	− ·017

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No. of Circuit Triangle	Coefficients of y and z	
	$\mathfrak{b}$	$\mathfrak{c}$

3rd Equation—(Continued).

Equalizing Factor = 15.

36	+ ·022	+ ·046
37	·020	·036
38	− ·038	− ·008
39	+ ·006	+ ·025
40	− ·015	− ·006
41	·011	+ ·001
42	+ ·008	·008
43	·006	·006

4th Equation. Azimuth.

Equalizing Factor = 1.

1	+ 1·049	+ 1·053
2	− 1·062	− 1·049
3	+ 1·047	+ 1·060
4	− 1·053	− 1·042
5	1·053	1·045
6	+ 1·039	+ 1·049
7	1·042	1·050
8	− 1·050	− 1·039
9	+ 1·038	+ 1·049
10	− 1·048	− 1·038
11	+ 1·035	+ 1·044
12	− 1·048	− 1·035
13	+ 1·037	+ 1·045
14	− 1·045	− 1·033
15	+ 1·031	+ 1·040
16	− 1·042	− 1·031
17	+ 1·029	+ 1·039
18	− 1·040	− 1·026
19	+ 1·028	+ 1·038
20	− 1·038	− 1·025
21	+ 1·023	+ 1·035

4th Equation—(Continued).

Equalizing Factor = 1.

22	− 1·036	− 1·025
23	1·023	1·018
24	+ 1·022	+ 1·032
25	− 1·033	− 1·019
26	+ 1·018	+ 1·029
27	− 1·027	− 1·015
28	+ 1·016	+ 1·027
29	− 1·028	− 1·015
30	+ 1·014	+ 1·025
31	− 1·022	− 1·009
32	+ 1·011	+ 1·021
33	− 1·024	− 1·012
34	+ 1·012	+ 1·020
35	− 1·020	− 1·009
36	+ 1·011	+ 1·023
37	1·011	1·018
38	− 1·021	− 1·004
39	+ 1·003	+ 1·014
40	− 1·008	− 1·004
41	1·006	1·000
42	+ 1·004	+ 1·004
43	1·004	1·004
44	− 1·000	− 1·000

5th Equation Linear.

Equalizing Factor = ·03.

Left-hand Branch

1	− 15	+ 1
2	22	11
3	15	22
4	6	22
5	6	14

5th Equation—(Continued).

Equalizing Factor = ·03.

6	− 21	+ 6
7	11	10
8	9	12
9	13	13
10	12	8
11	13	7
12	15	9
13	6	15
14	16	8
15	11	10
16	13	7
17	11	11
18	13	14
19	10	14
20	13	11
21	15	12
22	13	7
23	+ 12	21
24	− 13	12
25	13	14
26	16	9
27	5	18
28	16	11
29	13	12
30	13	13
31	7	17
32	14	10
33	15	8
34	+ 17	29

Right-hand Branch

45	+ 23	− 17
46	9	29

5th Equation—(Continued).

Equalizing Factor = ·03.

47	+ 11	− 13
48	7	7
49	9	10
50	17	6
51	5	13
52	10	7
53	8	11
54	10	12
55	13	9
56	21	8
57	18	6
58	14	15
59	14	16
60	16	15
61	13	6
62	13	12
63	17	13
64	9	19
65	22	9
66	10	18
67	20	10
68	7	25
69	19	9
70	8	25
71	27	6
72	6	20
73	25	7
74	12	21
75	19	15
76	9	22
77	21	7
78	10	18

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5th Equation—(Continued).

Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	c
79	+ 17	− 11
80	15	12
81	8	12
82	16	6
83	10	10
84	10	10
85	8	13
86	10	13
87	16	9
88	12	11
89	18	12
90	10	19
91	5	15
92	5	16

6th Equation. Latitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
1	− ·049	+ ·013
2	·088	·038
3	·048	·087
4	·023	·075
5	·023	·047
6	·061	·023
7	·030	·035
8	·025	·038
9	·033	·041
10	·030	·022
11	·029	·022
12	·037	·021
13	·009	·039
14	·035	·018

6th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
15	− ·019	+ ·025
16	·026	·014
17	·017	·025
18	·023	·025
19	·013	·027
20	·020	·019
21	·020	·020
22	·017	·011
23	+ ·018	·030
24	− ·013	·018
25	·013	·016
26	·012	·012
27	·004	·017
28	·009	·012
29	·008	·009
30	·004	·010
31	·002	·008
32	·000	·008
33	·003	·002
34	+ ·003	·005

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
45	+ ·073	− ·087
46	·052	·093
47	·059	·032
48	·004	·046
49	·047	·022
50	·039	·037
51	·000	·060
52	·044	·010
53	·008	·051
54	·041	·023
55	·018	·043

6th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
56	+ ·070	− ·009
57	·031	·032
58	·048	·026
59	·019	·053
60	·049	·023
61	·015	·027
62	·015	·040
63	·047	·014
64	·002	·054
65	·054	·004
66	·002	·048
67	·046	·004
68	− ·005	·056
69	+ ·041	+ ·001
70	− ·006	− ·052
71	+ ·047	+ ·007
72	− ·010	− ·041
73	+ ·040	+ ·006
74	− ·004	− ·037
75	+ ·030	+ ·001
76	− ·010	− ·035
77	+ ·030	+ ·008
78	− ·009	− ·029
79	+ ·023	+ ·006
80	·021	·007
81	− ·011	− ·019
82	+ ·020	+ ·009
83	− ·007	− ·015
84	+ ·012	+ ·003
85	− ·007	− ·013
86	+ ·010	+ ·001
87	− ·002	− ·010

6th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
88	+ ·008	− ·000
89	·000	·006
90	·004	·002
91	− ·002	·005
92	+ ·001	·004

7th Equation. Longitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
1	− ·100	− ·093
2	+ ·086	+ ·092
3	− ·092	− ·079
4	+ ·082	+ ·085
5	·082	·084
6	− ·079	− ·073
7	·075	·071
8	+ ·071	+ ·069
9	− ·069	− ·063
10	+ ·063	+ ·061
11	− ·064	− ·060
12	+ ·057	+ ·057
13	− ·057	− ·052
14	+ ·052	+ ·052
15	− ·052	− ·047
16	+ ·047	+ ·047
17	− ·047	− ·042
18	+ ·042	+ ·042
19	− ·042	− ·038
20	+ ·038	+ ·038
21	− ·038	− ·032
22	+ ·032	+ ·032
23	·032	·032

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No. of Circuit Triangle	Coefficients of y and z	
	b	c
7th Equation—(Continued). *Equalizing Factor* = 15.		
24	− ·031	− ·027
25	+ ·028	+ ·026
26	− ·025	− ·023
27	+ ·023	+ ·020
28	− ·020	− ·017
29	+ ·017	+ ·015
30	− ·016	− ·012
31	+ ·011	+ ·011
32	− ·011	− ·005
33	+ ·005	+ ·005
34	− ·005	·000
Right-hand Branch		
45	− ·117	− ·077
46	+ ·080	+ ·116
47	·080	·103
48	− ·091	− ·075
49	+ ·079	+ ·093
50	− ·093	− ·073
51	− ·083	− ·066
52	+ ·069	+ ·079
53	− ·080	− ·063
54	+ ·063	+ ·078
55	− ·080	− ·058
56	+ ·049	+ ·070
57	− ·077	− ·056
58	+ ·050	+ ·070
59	− ·067	− ·043
60	+ ·044	+ ·064
61	− ·061	− ·046
62	·061	·041
63	+ ·035	+ ·056
64	− ·055	− ·030

No. of Circuit Triangle	Coefficients of y and z	
	b	c
7th Equation—(Continued). *Equalizing Factor* = 15.		
65	+ ·027	+ ·051
66	− ·052	− ·027
67	+ ·025	+ ·048
68	− ·045	− ·016
69	+ ·022	+ ·042
70	− ·041	− ·011
71	+ ·010	+ ·034
72	− ·034	− ·011
73	+ ·006	+ ·030
74	− ·035	− ·005
75	+ ·007	+ ·034
76	− ·028	·000
77	+ ·001	+ ·022
78	− ·025	·000
79	+ ·001	+ ·022
80	·003	·023
81	− ·016	− ·002
82	+ ·002	+ ·015
83	− ·015	− ·003
84	+ ·006	+ ·016
85	− ·012	− ·001
86	+ ·006	+ ·015
87	− ·012	− ·002
88	+ ·005	+ ·010
89	− ·009	− ·003
90	+ ·005	+ ·007
91	− ·003	·000
92	+ ·004	+ ·004
8th Equation. Azimuth. *Equalizing Factor* = 1.		
Left-hand Branch		
1	− 1·044	− 1·040

No. of Circuit Triangle	Coefficients of y and z	
	b	c
8th Equation—(Continued). *Equalizing Factor* = 1.		
2	+ 1·038	+ 1·041
3	− 1·040	− 1·035
4	+ 1·037	+ 1·037
5	1·037	1·037
6	− 1·034	− 1·033
7	1·033	1·033
8	+ 1·033	+ 1·031
9	− 1·032	− 1·029
10	+ 1·028	+ 1·028
11	− 1·028	− 1·026
12	+ 1·026	+ 1·026
13	− 1·026	− 1·024
14	+ 1·024	+ 1.024
15	− 1·024	− 1·022
16	+ 1·022	+ 1·022
17	− 1·022	− 1·020
18	+ 1·020	+ 1·020
19	− 1·020	− 1·018
20	+ 1·018	+ 1·018
21	− 1·018	− 1·015
22	+ 1·015	+ 1·015
23	+ 1·015	+ 1·015
24	− 1·015	− 1·013
25	+ 1·013	+ 1·013
26	− 1·013	− 1·010
27	+ 1·010	+ 1·010
28	− 1·010	− 1·008
29	+ 1·008	+ 1·008
30	− 1·008	− 1·005
31	+ 1·005	+ 1·005
32	− 1·005	− 1·002
33	+ 1·002	+ 1·002

No. of Circuit Triangle	Coefficients of y and z	
	b	c
8th Equation—(Continued). *Equalizing Factor* = 1.		
34	− 1·002	0·000
Right-hand Branch		
45	− 1·054	− 1·033
46	+ 1·036	+ 1·054
47	1·035	1·046
48	− 1·041	− 1·033
49	+ 1·035	+ 1·042
50	− 1·042	− 1·033
51	1·037	1·030
52	+ 1·031	+ 1·036
53	− 1·036	− 1·029
54	+ 1·029	+ 1·035
55	− 1·035	− 1·026
56	+ 1·022	+ 1·031
57	− 1·035	− 1·026
58	+ 1·022	+ 1·032
59	− 1·032	− 1·020
60	+ 1·020	+ 1·030
61	− 1·029	− 1·022
62	1·029	1·019
63	+ 1·017	+ 1·027
64	− 1·026	− 1·014
65	+ 1·013	+ 1·024
66	− 1·024	− 1·013
67	+ 1·012	+ 1·022
68	− 1·021	− 1·008
69	+ 1·010	+ 1·020
70	− 1·019	− 1·006
71	+ 1·005	+ 1·016
72	− 1·016	− 1·006
73	+ 1·004	+ 1·014
74	− 1·016	− 1·003

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No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
8th Equation—(Continued). *Equalizing Factor* = 1.		
75	+ 1·003	+ 1·015
76	− 1·013	− 1·000
77	+ 1·001	+ 1·010
78	− 1·011	− 1·000
79	+ 1·000	+ 1·010
80	1·002	1·011
81	− 1·007	− 1·001
82	+ 1·002	+ 1·008
83	− 1·007	− 1·001
84	+ 1·004	+ 1·009
85	− 1·006	− 1·001
86	+ 1·004	+ 1·008
87	− 1·006	− 1·001
88	+ 1·003	+ 1·005
89	− 1·004	− 1·001
90	+ 1·002	+ 1·004
91	− 1·002	− 0·999
92	+ 1·003	+ 1·004
9th Equation. Linear. *Equalizing Factor* = ·03. Left-hand Branch		
45	− 23	+ 17
46	9	29
47	11	13
48	7	7
49	9	10
50	17	6
51	5	13
52	10	7
53	8	11
54	10	12

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
9th Equation—(Continued). *Equalizing Factor* = ·03.		
55	− 13	+ 9
56	21	8
57	18	6
58	14	15
59	14	16
60	16	15
61	13	6
62	13	12
63	17	13
64	9	19
65	22	9
66	10	18
67	20	10
68	7	25
69	19	9
70	8	25
71	27	6
72	6	20
73	25	7
74	12	21
75	19	15
76	9	22
77	21	7
78	10	18
79	+ 10	21
Right-hand Branch		
93	+ 24	− 6
94	18	2
95	12	20
96	13	4
97	9	21
98	31	3

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
9th Equation—(Continued). *Equalizing Factor* = ·03.		
99	+ 11	− 6
100	7	44
101	20	6
102	7	19
103	11	6
104	23	1
105	17	5
106	6	11
107	21	7
108	6	26
109	19	+ 2
110	18	− 14
111	7	11
112	11	13
113	16	14
114	14	13
115	11	16
116	11	14
117	12	12
118	12	12
119	11	14
120	13	12
121	15	11
122	13	12
123	12	18
124	8	12
125	14	11
126	11	14
127	12	12
128	12	15
129	12	7
130	14	8

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
9th Equation—(Continued). *Equalizing Factor* = ·03.		
131	+ 11	− 9
132	8	14
133	13	10
134	14	8
135	14	13
136	8	14
137	15	9
138	6	21
10th Equation. Latitude. *Equalizing Factor* = 15. Left-hand Branch		
45	− ·079	+ ·062
46	·031	·095
47	·037	·042
48	·016	·026
49	·027	·033
50	·048	·018
51	·014	·039
52	·023	·023
53	·020	·030
54	·021	·034
55	·030	·023
56	·042	·022
57	·038	·013
58	·025	·035
59	·028	·029
60	·025	·032
61	·024	·008
62	·024	·018
63	·023	·024
64	·015	·028

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10th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
65	− ·026	+ ·016
66	·013	·023
67	·020	·015
68	·008	·028
69	·017	·012
70	·008	·025
71	·017	·008
72	·004	·014
73	·011	·007
74	·006	·011
75	·007	·009
76	·004	·009
77	·002	·005
78	·002	·004
79	+ ·002	·004
	Right-hand Branch	
93	+ ·095	− ·011
94	·047	·019
95	·028	·078
96	·047	·005
97	·036	·055
98	·075	·020
99	·019	·029
100	·029	·109
101	·037	·031
102	·028	·037
103	·037	·005
104	·040	·013
105	·026	·022
106	·022	·015
107	·033	·026
108	·020	·045

10th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
109	+ ·024	− ·008
110	·043	·017
111	·002	·031
112	·009	·034
113	·036	·015
114	·011	·032
115	·026	·017
116	·006	·032
117	·025	·009
118	·005	·027
119	·021	·009
120	·003	·024
121	·024	·003
122	·002	·023
123	·019	·009
124	− ·005	·021
125	+ ·019	·002
126	− ·001	·019
127	·001	·017
128	+ ·014	·001
129	·014	+ ·004
130	− ·004	− ·013
131	+ ·011	+ ·003
132	·009	·001
133	− ·004	− ·009
134	+ ·010	+ ·002
135	− ·001	− ·007
136	+ ·003	·003
137	·000	·003
138	·001	·003

11th Equation. Longitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
45	+ ·084	+ ·080
46	− ·076	− ·079
47	·078	·079
48	+ ·073	+ ·069
49	− ·074	− ·074
50	+ ·069	+ ·066
51	·068	·066
52	− ·066	− ·062
53	+ ·062	+ ·060
54	− ·060	− ·056
55	+ ·056	+ ·054
56	− ·056	− ·051
57	+ ·049	+ ·049
58	− ·049	− ·044
59	+ ·044	+ ·044
60	− ·047	− ·040
61	+ ·038	+ ·040
62	·038	·040
63	− ·038	− ·033
64	+ ·035	+ ·035
65	− ·035	− ·031
66	+ ·031	+ ·031
67	− ·031	− ·027
68	+ ·027	+ ·027
69	− ·027	− ·022
70	+ ·022	+ ·022
71	− ·022	− ·017
72	+ ·017	+ ·017
73	− ·017	− ·013
74	+ ·013	+ ·013
75	− ·013	− ·008

11th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
76	+ ·008	+ ·008
77	− ·008	− ·004
78	+ ·004	+ ·004
79	− ·004	·000
	Right-hand Branch	
93	+ ·070	+ ·084
94	− ·087	− ·075
95	·083	·064
96	+ ·064	+ ·071
97	·068	·082
98	− ·085	− ·064
99	·073	·062
100	+ ·059	+ ·084
101	− ·075	− ·054
102	+ ·053	+ ·068
103	·050	·060
104	− ·065	− ·050
105	·061	·048
106	+ ·047	+ ·055
107	− ·061	− ·044
108	+ ·043	+ ·059
109	− ·057	− ·045
110	+ ·034	+ ·052
111	− ·045	− ·034
112	·048	·033
113	+ ·031	+ ·045
114	− ·045	− ·029
115	+ ·030	+ ·044
116	− ·041	− ·026
117	+ ·027	+ ·038
118	− ·038	− ·024
119	+ ·024	+ ·035

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11th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
120	− ·035	− ·020
121	+ ·018	+ ·030
122	− ·031	− ·016
123	+ ·016	+ ·030
124	− ·024	− ·012
125	+ ·013	+ ·024
126	− ·022	− ·009
127	·022	·010
128	+ ·008	+ ·020
129	·009	·016
130	− ·017	− ·006
131	+ ·006	+ ·014
132	·006	·015
133	− ·011	− ·002
134	+ ·005	+ ·010
135	− ·008	− ·002
136	+ ·006	+ ·008
137	− ·005	− ·002
138	+ ·004	+ ·003

12th Equation. Azimuth.

Equalizing Factor = 1.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
45	+ 1·038	+ 1·034
46	− 1·033	− 1·036
47	1·034	1·036
48	+ 1·033	+ 1·031
49	− 1·034	− 1·033
50	+ 1·030	+ 1·030
51	1·030	1·030
52	− 1·030	− 1·028
53	+ 1·028	+ 1·028

12th Equation—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	c
54	− 1·028	− 1·025
55	+ 1·025	+ 1·025
56	− 1·025	− 1·022
57	+ 1·022	+ 1·022
58	− 1·022	− 1·020
59	+ 1·020	+ 1·020
60	− 1·022	− 1·018
61	+ 1·017	+ 1·019
62	1·017	1·019
63	− 1·018	− 1·015
64	+ 1·016	+ 1·016
65	− 1·016	− 1·014
66	+ 1·014	+ 1·014
67	− 1·014	− 1·013
68	+ 1·013	+ 1·013
69	− 1·013	− 1·010
70	+ 1·010	+ 1·010
71	− 1·010	− 1·008
72	+ 1·008	+ 1·008
73	− 1·008	− 1·006
74	+ 1·006	+ 1·006
75	− 1·006	− 1·004
76	+ 1·004	+ 1·004
77	− 1·004	− 1·002
78	+ 1·002	+ 1·002
79	− 1·002	·000

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
93	+ 1·030	+ 1·036
94	− 1·038	− 1·032
95	1·037	1·027
96	+ 1·029	+ 1·033
97	1·029	1·035

12th Equation —(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	c
98	− 1·038	− 1·028
99	1·032	1·027
100	+ 1·026	+ 1·040
101	− 1·035	− 1·025
102	+ 1·024	+ 1·032
103	1·023	1·027
104	− 1·030	− 1·023
105	1·028	1·021
106	+ 1·021	+ 1·025
107	− 1·028	− 1·020
108	+ 1·020	+ 1·028
109	− 1·026	− 1·021
110	+ 1·015	+ 1·023
111	− 1·021	− 1·016
112	1·022	1·015
113	+ 1·014	+ 1·021
114	− 1·021	− 1·013
115	+ 1·014	+ 1·021
116	− 1·019	− 1·012
117	+ 1·012	+ 1·018
118	− 1·018	− 1·010
119	+ 1·011	+ 1·016
120	− 1·016	− 1·008
121	+ 1·007	+ 1·014
122	− 1·015	− 1·007
123	+ 1·007	+ 1·014
124	− 1·011	− 1·005
125	+ 1·006	+ 1·010
126	− 1·009	− 1·004
127	1·009	1·005
128	+ 1·002	+ 1·008
129	1·002	1·007

12th Equation—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	c
130	− 1·009	− 1·003
131	+ 1·003	+ 1·006
132	1·003	1·008
133	− 1·006	− 1·001
134	+ 1·004	+ 1·006
135	− 1·003	− 1·001
136	+ 1·003	+ 1·004
137	− 1·003	− 1·000
138	+ 1·002	+ 1·003

13th Equation. Linear.

Equalizing Factor = ·03.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
93	− 24	+ 6
94	18	2
95	12	20
96	13	4
97	9	21
98	31	3
99	11	6
100	7	44
101	20	6
102	7	19
103	11	6
104	23	1
105	17	5
106	6	11
107	21	7
108	6	26
109	19	− 2
110	18	+ 14
111	7	11

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No. of Circuit Triangle	Coefficients of y and z	
	b	c
***13th Equation*—(Continued).**		
***Equalizing Factor* = ·03.**		
112	− 11	+ 13
113	16	14
114	14	13
115	11	16
116	11	14
117	12	12
118	12	12
119	11	14
120	13	12
121	15	11
122	13	12
123	12	18
124	8	12
125	14	11
126	11	14
127	12	12
128	12	15
129	+ 18	25
Right-hand Branch		
139	+ 9	− 21
140	18	9
141	10	25
142	18	8
143	9	8
144	23	10
145	9	15
146	18	9
147	10	13
148	13	11
149	10	18
150	28	8
151	7	16

No. of Circuit Triangle	Coefficients of y and z	
	b	c
***13th Equation*—(Continued).**		
***Equalizing Factor* = ·03.**		
152	+ 16	− 10
153	9	19
154	16	10
155	11	13
156	14	13
157	16	13
158	17	13
159	11	16
160	12	14
161	6	16
162	15	8
163	13	15
164	16	11
165	14	16
166	11	12
167	18	11
168	11	20
169	16	11
170	9	14
171	11	10
172	13	9
173	6	12
174	10	12
175	16	8
176	11	16
177	17	7
178	10	21
179	18	11
180	13	14

No. of Circuit Triangle	Coefficients of y and z	
	b	c
14th Equation. Latitude.		
***Equalizing Factor* = 15.**		
Left-hand Branch		
93	− ·076	+ ·019
94	·050	·008
95	·033	·060
96	·032	·014
97	·023	·057
98	·072	·009
99	·024	·016
100	·016	·102
101	·037	·018
102	·015	·038
103	·023	·012
104	·040	·003
105	·030	·010
106	·009	·021
107	·033	·012
108	008	·042
109	·027	− ·001
110	·026	+ ·021
111	·009	·016
112	·014	·019
113	·019	·020
114	·016	·017
115	·010	.020
116	·010	·015
117	·010	·013
118	·010	·012
119	·007	·014
120	·008	·009
121	·008	·009
122	·007	·008
123	·004	·012

No. of Circuit Triangle	Coefficients of y and z	
	b	c
***14th Equation*—(Continued).**		
***Equalizing Factor* = 15.**		
124	− ·002	+ ·006
125	·003	·007
126	·004	·003
127	·005	·003
128	+ ·001	·005
129	·001	·003
Right-hand Branch		
139	+ ·008	− ·079
140	·065	·007
141	·043	·052
142	·025	·037
143	·036	·005
144	·035	·038
145	·033	·019
146	·022	·035
147	·032	·015
148	·010	·036
149	·030	·021
150	·033	·029
151	·025	·013
152	·011	·031
153	·027	·017
154	·009	·030
155	·028	·006
156	·003	·032
157	·032	·004
158	·005	·031
159	·025	·004
160	− ·004	·030
161	+ ·019	·002
162	− ·002	·023
163	+ ·024	+ ·001

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14th Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z	
	b	c
164	− ·004	− ·026
165	+ ·024	+ ·003
166	− ·010	− ·024
167	+ ·025	+ ·008
168	− ·010	− ·026
169	+ ·019	+ ·007
170	− ·012	− ·019
171	+ ·015	+ ·010
172	·016	·008
173	− ·011	− ·014
174	+ ·013	+ ·007
175	− ·007	− ·010
176	+ ·009	+ ·003
177	− ·004	− ·007
178	+ ·006	+ ·001
179	− ·003	− ·003
180	+ ·003	·000

15th Equation. Longitude.
Equalizing Factor = 15.
Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z	
	b	c
93	− ·073	− ·071
94	+ ·068	+ ·066
95	·067	·064
96	− ·062	− ·060
97	·063	·059
98	+ ·059	+ ·056
99	·057	·055
100	− ·053	− ·053
101	+ ·056	+ ·048
102	− ·048	− ·049
103	·046	·047

15th Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z	
	b	c
104	+ ·043	+ ·041
105	·043	·040
106	− ·040	− ·039
107	+ ·040	+ ·037
108	− ·036	− ·036
109	+ ·036	+ ·034
110	− ·035	− ·033
111	+ ·031	+ ·031
112	·031	·031
113	− ·031	− ·028
114	+ ·028	+ ·028
115	− ·027	− ·024
116	+ ·025	+ ·023
117	− ·023	− ·022
118	+ ·022	+ ·020
119	− ·020	− ·018
120	+ ·018	+ ·016
121	− ·017	− ·015
122	+ ·014	+ ·014
123	− ·014	− ·010
124	+ ·010	+ ·010
125	− ·012	− ·007
126	+ ·005	+ ·007
127	·005	·007
128	− ·004	·000
129	·005	− 003

Right-hand Branch

No. of Circuit Triangle	b	c
139	− ·076	− ·046
140	+ ·046	+ ·070
141	·053	·085
142	− ·074	− ·048
143	+ ·050	+ ·063

15th Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z	
	b	c
144	− ·074	− ·044
145	+ ·046	+ ·063
146	− ·063	− ·042
147	+ ·041	+ ·055
148	− ·055	− ·036
149	+ ·037	+ ·055
150	− ·063	− ·035
151	+ ·035	+ ·051
152	− ·051	− ·030
153	+ ·031	+ ·049
154	− ·047	− ·026
155	+ ·025	+ ·041
156	− ·042	− ·021
157	+ ·018	+ ·038
158	− ·042	− ·018
159	+ ·019	+ ·038
160	− ·035	− ·014
161	+ ·018	+ ·033
162	− ·036	− ·015
163	+ ·010	+ ·032
164	− ·032	− ·008
165	+ ·005	+ ·028
166	− ·024	− ·003
167	·001	+ ·022
168	·021	·007
169	·002	·018
170	·015	·003
171	·001	·013
172	·002	·012
173	·007	·005
174	+ ·001	·013
175	− ·010	·002

15th Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z	
	b	c
176	+ ·001	+ ·011
177	− ·006	·001
178	+ ·001	·008
179	− ·004	·002
180	+ ·002	·003

16th Equation. Azimuth.
Equalizing Factor = 1.
Left-hand Branch

No. of Circuit Triangle	b	c
93	− 1·032	− 1·031
94	+ 1·029	+ 1·029
95	1·029	1·029
96	− 1·028	− 1·027
97	1·027	1·027
98	+ 1·025	+ 1·025
99	1·025	1·025
100	− 1·024	− 1·022
101	+ 1·024	+ 1·021
102	− 1·021	− 1·021
103	1·021	1·021
104	+ 1·018	+ 1·018
105	1·018	1·018
106	− 1·018	− 1·017
107	+ 1·017	+ 1·017
108	− 1·016	− 1·015
109	+ 1·017	+ 1·015
110	− 1·015	− 1·015
111	+ 1·014	+ 1·014
112	1·014	1·014
113	− 1·014	− 1·012
114	+ 1·012	+ 1·012
115	− 1·012	− 1·011

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16*th Equation*—(Continued).
Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	c
116	+ 1·011	+ 1·011
117	− 1·011	− 1·009
118	+ 1·009	+ 1·009
119	− 1·009	− 1·008
120	+ 1·008	+ 1·008
121	− 1·008	− 1·006
122	+ 1·006	+ 1·006
123	− 1·006	− 1·004
124	+ 1·004	+ 1·004
125	− 1·004	− 1·003
126	+ 1·003	+ 1·003
127	1·003	1·003
128	− 1·002	− 1·000
129	1·001	·000

Right-hand Branch

No. of Circuit Triangle	b	c
139	− 1·033	− 1·021
140	+ 1·020	+ 1·031
141	1·024	1·039
142	− 1·032	− 1·022
143	+ 1·021	+ 1·026
144	− 1·032	− 1·019
145	+ 1·019	+ 1·028
146	− 1·029	− 1·018
147	+ 1·018	+ 1·025
148	− 1·025	− 1·016
149	+ 1·016	+ 1·025
150	− 1·029	− 1·015
151	+ 1·015	+ 1·023
152	− 1·023	− 1·013
153	+ 1·013	+ 1·024
154	− 1·022	− 1·012
155	+ 1·012	+ 1·019

16*th Equation*—(Continued).
Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	c
156	− 1·020	− 1·009
157	+ 1·008	+ 1·018
158	− 1·020	− 1.008
159	+ 1·009	+ 1·017
160	− 1·016	− 1·005
161	+ 1·009	+ 1·016
162	− 1·016	− 1·007
163	+ 1·005	+ 1·014
164	− 1·014	− 1·004
165	+ 1·002	+ 1·013
166	− 1·011	− 1·002
167	+ 1·000	+ 1·009
168	− 1·009	− 0·997
169	+ 0·999	+ 1·008
170	− 1·008	− 0·998
171	+ 1·000	+ 1·006
172	1·000	1·008
173	− 1·004	− 0·998
174	+ 1·002	+ 1·007
175	− 1·004	− 0·999
176	+ 1·000	+ 1·005
177	− 1·004	− 1·000
178	+ 1·001	+ 1·005
179	− 1·002	− 0·999
180	+ 1·001	+ 1·002

17*th Equation. Linear.*
Equalizing Factor = ·03.
Left-hand Branch

No. of Circuit Triangle	b	c
139	− 9	+ 21
140	18	9
141	10	25

17*th Equation*—(Continued).
Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	c
142	− 18	+ 8
143	9	8
144	23	10
145	9	15
146	18	9
147	10	13
148	13	11
149	10	18
150	28	8
151	7	16
152	16	10
153	9	19
154	16	10
155	11	13
156	14	13
157	16	13
158	17	13
159	11	16
160	12	14
161	6	16
162	15	8
163	13	15
164	16	11
165	14	16
166	11	12
167	18	11
168	11	20
169	16	11
170	9	14
171	+ 15	25

Right-hand Branch

No. of Circuit Triangle	b	c
181	+ 15	− 18

17*th Equation*—(Continued).
Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	c
182	+ 19	− 14
183	14	6
184	30	+ 7
185	6	− 9
186	2	25
187	34	4
188	14	11
189	16	17
190	19	14
191	15	12
192	11	19
193	16	9
194	8	15
195	14	11
196	12	14
197	19	6
198	7	16
199	15	10
200	2	17
201	21	2
202	5	19
203	11	10
204	17	4
205	7	17
206	14	11
207	6	12
208	13	5
209	15	9
210	11	13
211	16	16
212	4	17
213	16	8

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17th Equation—(Continued).

Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
214	+ 7	− 16
215	17	6
216	7	13
217	14	9
218	11	15
219	14	14
220	13	10

18th Equation. Latitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	b	c
139	− ·020	+ ·061
140	·047	·020
141	·026	·062
142	·037	·021
143	·019	·019
144	·045	·021
145	·016	·031
146	·033	·018
147	·015	·028
148	·022	·019
149	·013	·033
150	·042	·012
151	·009	·025
152	·022	·014
153	·010	·029
154	·021	·013
155	·011	·017
156	·014	·015
157	·015	·016
158	·017	·013
159	·008	·016

18th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	b	c
160	− ·009	+ ·012
161	·003	·013
162	·009	·008
163	·008	·011
164	·008	·009
165	·007	·009
166	·002	·007
167	·006	·004
168	·002	·007
169	·001	·004
170	·000	·002
171	+ ·001	·003

Right-hand Branch

No. of Circuit Triangle	b	c
181	+ ·058	− ·038
182	·029	·054
183	·016	·034
184	·082	+ ·032
185	·030	− ·004
186	− ·016	·075
187	+ ·082	+ ·006
188	·009	− ·039
189	·044	·015
190	·014	·042
191	·039	·004
192	− ·001	·047
193	+ ·038	+ ·002
194	− ·007	− ·039
195	+ ·033	+ ·001
196	− ·004	− ·035
197	+ ·038	+ ·010
198	− ·010	− ·036
199	+ ·031	+ ·006

18th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	b	c
200	− ·016	− ·033
201	+ ·033	+ ·012
202	− ·012	− ·031
203	+ ·022	+ ·006
204	− ·004	− ·019
205	+ ·019	+ ·003
206	− ·009	− ·022
207	+ ·016	+ ·008
208	− ·011	− ·018
209	+ ·020	+ ·009
210	− ·011	− ·018
211	+ ·016	+ ·007
212	·013	·008
213	− ·009	− ·012
214	+ ·012	+ ·006
215	− ·006	− ·009
216	+ ·009	+ ·004
217	− ·004	− ·006
218	+ ·005	+ ·001
219	− ·003	− ·003
220	+ ·003	·000

19th Equation. Longitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	b	c
139	+ ·065	+ ·059
140	− ·057	− ·059
141	·057	·060
142	+ ·055	+ ·049
143	− ·052	− ·052
144	+ ·050	+ ·047
145	− ·048	− ·046

19th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	b	c
146	+ ·044	+ ·044
147	− ·044	− ·041
148	+ ·041	+ ·041
149	− ·041	− ·036
150	+ ·036	+ ·036
151	− ·036	− ·033
152	+ ·033	+ ·033
153	− ·033	− ·030
154	+ ·030	+ ·030
155	− ·030	− ·027
156	+ ·027	+ ·027
157	− ·027	− ·023
158	+ ·023	+ ·023
159	− ·023	− ·020
160	+ ·020	+ ·020
161	− ·017	− ·015
162	+ ·019	+ ·016
163	− ·016	− ·016
164	+ ·016	+ ·013
165	− ·013	− ·012
166	+ ·011	+ ·009
167	− ·009	− ·009
168	+ ·008	+ ·005
169	− ·007	− ·004
170	+ ·003	+ ·003
171	− ·003	·000

Right-hand Branch

No. of Circuit Triangle	b	c
181	+ ·055	+ ·081
182	− ·077	− ·044
183	·072	·052
184	+ ·028	+ ·047
185	·047	·060

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19*th Equation*—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
186	− ·053	− ·023
187	+ ·018	+ ·049
188	− ·058	− ·033
189	+ ·030	+ ·056
190	− ·056	− ·026
191	+ ·025	+ ·047
192	− ·046	− ·019
193	+ ·022	+ ·040
194	− ·039	− ·018
195	+ ·019	+ ·039
196	− ·040	− ·016
197	+ ·012	+ ·030
198	− ·031	− ·011
199	+ ·011	+ ·031
200	− ·024	− ·007
201	+ ·005	+ ·023
202	− ·014	− ·002
203	+ ·010	+ ·025
204	− ·030	− ·013
205	+ ·010	+ ·027
206	− ·024	− ·004
207	+ ·008	+ ·020
208	− ·020	− ·006
209	·001	+ ·015
210	·016	·003
211	·003	·018
212	+ ·004	·017
213	− ·013	·002
214	+ ·003	·015
215	− ·009	·000
216	+ ·002	·009
217	− ·006	·001

19*th Equation*—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
218	+ ·003	+ ·008
219	− ·002	·000
220	+ ·002	·002

20*th Equation. Azimuth.*

Equalizing Factor = 1.

Left-hand Branch

No. of Circuit Triangle	b	c
139	+ 1·028	+ 1·025
140	− 1·025	− 1·026
141	1·025	1·027
142	+ 1·025	+ 1·022
143	− 1·023	− 1·022
144	+ 1·021	+ 1·021
145	− 1·021	− 1·020
146	+ 1·020	+ 1·020
147	− 1·020	− 1·018
148	+ 1·018	+ 1·018
149	− 1·018	− 1·016
150	+ 1·016	+ 1·016
151	− 1·016	− 1·015
152	+ 1·015	+ 1·015
153	− 1·015	− 1·014
154	+ 1·014	+ 1·014
155	− 1·014	− 1·012
156	+ 1·012	+ 1·012
157	− 1·012	− 1·011
158	+ 1·011	+ 1·011
159	− 1·011	− 1·009
160	+ 1·009	+ 1·009
161	− 1·009	− 1·008
162	+ 1·008	+ 1·008
163	− 1·007	− 1·006

20*th Equation*—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
164	+ 1·008	+ 1·005
165	− 1·005	− 1·007
166	+ 1·006	+ 1·004
167	− 1·005	− 1·004
168	+ 1·003	+ 1·003
169	− 1·003	− 1·001
170	+ 1·001	+ 1·001
171	− 1·001	0·000

Right-hand Branch

No. of Circuit Triangle	b	c
181	+ 1·023	+ 1·038
182	− 1·036	− 1·019
183	1·033	1·023
184	+ 1·011	+ 1·020
185	1·021	1·027
186	− 1·023	− 1·009
187	+ 1·005	+ 1·022
188	− 1·027	− 1·014
189	+ 1·012	+ 1·027
190	− 1·028	− 1·011
191	+ 1·010	+ 1·022
192	− 1·022	− 1·006
193	+ 1·008	+ 1·020
194	− 1·019	− 1·007
195	+ 1·008	+ 1·019
196	− 1·019	− 1·006
197	+ 1·005	+ 1·015
198	− 1·015	− 1·006
199	+ 1·006	+ 1·014
200	− 1·011	− 1·003
201	+ 1·002	+ 1·010
202	− 1·011	− 1·001
203	+ 1·005	+ 1·011

20*th Equation*—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
204	− 1·014	− 1·005
205	+ 1·004	+ 1·013
206	− 1·012	− 1·002
207	+ 1·004	+ 1·010
208	− 1·010	− 1·003
209	+ 0·999	+ 1·007
210	− 1·007	− 0·998
211	+ 0·998	+ 1·008
212	1·003	1·009
213	− 1·007	− 1·000
214	+ 1·002	+ 1·007
215	− 1·004	− 1·000
216	+ 1·002	+ 1·006
217	− 1·002	− 1·000
218	+ 1·001	+ 1·003
219	− 1·001	− 0·999
220	+ 1·001	+ 1·002

21*st Equation. Linear.*

Equalizing Factor = ·03.

Left-hand Branch

No. of Circuit Triangle	b	c
181	− 15	+ 18
182	19	14
183	14	6
184	30	− 7
185	6	+ 9
186	2	25
187	34	4
188	14	11
189	16	17
190	19	14
191	15	12

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Coefficients of y and z

21st Equation—(Continued). Equalizing Factor = ·03.

No. of Circuit Triangle	b	c
192	− 11	+ 19
193	16	9
194	8	15
195	14	11
196	12	14
197	19	6
198	7	16
199	15	10
200	2	17
201	21	2
202	5	19
203	11	10
204	17	4
205	7	17
206	14	11
207	6	12
208	13	5
209	15	9
210	11	13
211	+ 6	22
Right-hand Branch		
221	+ 44	+ 17
222	9	− 16
223	32	21
224	4	25
225	27	11
226	35	3
227	11	14
228	13	14
229	13	12
230	15	15
231	9	11

21st Equation—(Continued). Equalizing Factor = ·03.

No. of Circuit Triangle	b	c
232	+ 12	− 12
233	10	21
234	18	9
235	12	12
236	13	12
237	8	16
238	16	8
239	8	16
240	15	11
241	11	15
242	14	9
243	14	12
244	19	15
245	12	19
246	11	12
247	7	14
248	11	8
249	17	7
250	12	13
251	11	11
252	11	7
253	10	14
254	19	12
255	13	13
256	13	12
257	10	16
258	17	11
259	13	13
260	11	18
261	12	10
262	7	13

22nd Equation. Latitude. Equalizing Factor = 15.

No. of Circuit Triangle	b	c
Left-hand Branch		
181	− ·042	+ ·047
182	·038	·038
183	·026	·020
184	·063	− ·017
185	·016	+ ·015
186	+ ·003	·057
187	− ·062	·006
188	·019	·024
189	·028	·025
190	·024	·026
191	·024	·015
192	·010	·032
193	·022	·010
194	·005	·023
195	·018	·010
196	·008	·020
197	·021	·003
198	·001	·019
199	·016	·005
200	+ ·003	·019
201	− ·018	·001
202	·001	·016
203	·007	·006
204	·006	·005
205	·005	·007
206	·003	·007
207	·003	·004
208	·001	·005
209	·004	·003
210	·000	·002
211	·000	·003

22nd Equation—(Continued). Equalizing Factor = 15.

No. of Circuit Triangle	b	c
Right-hand Branch		
221	+ ·121	+ ·055
222	·037	− ·025
223	·057	·065
224	·023	·039
225	·036	·044
226	·086	+ ·014
227	·041	− ·007
228	·002	·046
229	·041	·003
230	·004	·044
231	·032	·000
232	− ·002	·038
233	+ ·033	·013
234	·005	·033
235	·033	+ ·002
236	− ·004	− ·034
237	+ ·028	·000
238	− ·002	·029
239	+ ·024	·001
240	− ·006	·030
241	+ ·027	+ ·004
242	− ·009	− ·027
243	+ ·027	+ ·009
244	− ·009	− ·029
245	+ ·025	+ ·008
246	− ·014	− ·026
247	+ ·019	+ ·010
248	− ·017	− ·022
249	+ ·022	+ ·016
250	·019	·012
251	− ·015	− ·017

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22nd Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*	
	b	c
252	+ ·017	+ ·013
253	− ·013	− ·015
254	+ ·016	+ ·010
255	− ·010	− ·012
256	+ ·011	+ ·007
257	− ·008	− ·008
258	+ ·008	+ ·006
259	− ·006	− ·006
260	+ ·006	+ ·003
261	− ·003	− ·003
262	+ ·003	·000

23rd Equation. Longitude.
Equalizing Factor = 15.
Left-hand Branch

No. of Circuit Triangle	b	c
181	− ·061	− ·064
182	+ ·060	+ ·050
183	·058	·052
184	− ·045	− ·048
185	·048	·050
186	+ ·048	+ ·037
187	− ·038	− ·043
188	+ ·044	+ ·037
189	− ·035	− ·040
190	+ ·041	+ ·031
191	− ·030	− ·036
192	+ ·035	+ ·026
193	− ·027	− ·031
194	+ ·030	+ ·023
195	− ·024	− ·028
196	+ ·029	+ ·021
197	− ·021	− ·023

23rd Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	b	c
198	+ ·022	+ ·018
199	− ·018	− ·020
200	+ ·018	+ ·015
201	− ·016	− ·017
202	+ ·016	+ ·011
203	− ·013	− ·014
204	+ ·015	+ ·011
205	− ·011	− ·012
206	+ ·010	+ ·008
207	− ·008	− ·007
208	+ ·007	+ ·005
209	− ·005	− ·005
210	+ ·004	+ ·002
211	− ·004	− ·003

Right-hand Branch

No. of Circuit Triangle	b	c
221	+ ·024	+ ·044
222	·052	·071
223	− ·083	− ·035
224	+ ·048	+ ·070
225	− ·079	− ·037
226	+ ·006	+ ·046
227	·032	·059
228	− ·057	− ·024
229	+ ·028	+ ·054
230	− ·056	− ·022
231	+ ·029	+ ·048
232	− ·049	− ·023
233	+ ·025	+ ·055
234	− ·052	− ·022
235	+ ·019	+ ·042
236	− ·043	− ·016
237	+ ·020	+ .043

23rd Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	b	c
238	− ·043	− ·016
239	+ ·016	+ ·040
240	− ·039	− ·010
241	+ ·010	+ ·035
242	− ·033	− ·008
243	+ ·003	+ ·028
244	− ·036	·002
245	+ ·002	·032
246	− ·023	·002
247	+ ·003	·022
248	− ·019	·002
249	·009	·013
250	·005	.018
251	·013	·007
252	·004	·010
253	·010	·009
254	·008	·013
255	·010	·006
256	·004	·009
257	·006	·007
258	·002	.009
259	·005	·003
260	+ ·002	·007
261	− ·001	·001
262	+ ·002	·003

24th Equation. Azimuth.
Equalizing Factor = 1.
Left-hand Branch

No. of Circuit Triangle	b	c
181	− 1·026	− 1·029
182	+ 1·028	+ 1·021
183	1·027	1·023

24th Equation—(Continued).
Equalizing Factor = 1.

No. of Circuit Triangle	b	c
184	− 1·018	− 1·021
185	1·021	1·022
186	+ 1·020	+ 1·015
187	− 1·017	− 1·019
188	+ 1·019	+ 1·017
189	− 1·016	− 1·018
190	+ 1·018	+ 1·015
191	− 1·014	− 1·015
192	+ 1·015	+ 1·012
193	− 1·012	− 1·014
194	+ 1·014	+ 1·011
195	− 1·012	− 1·012
196	+ 1·012	+ 1·010
197	− 1·009	− 1·011
198	+ 1·011	+ 1·008
199	− 1·008	− 1·009
200	+ 1·008	+ 1·006
201	− 1·006	− 1·007
202	+ 1·008	+ 1·005
203	− 1·006	− 1·006
204	+ 1·007	+ 1·005
205	− 1·004	− 1·006
206	+ 1·005	+ 1·003
207	− 1·003	− 1·004
208	+ 1·004	+ 1·002
209	− 1·003	− 1·003
210	+ 1·002	+ 1·002
211	− 1·002	0·000

Right-hand Branch

No. of Circuit Triangle	b	c
221	+ 1·010	+ 1·017
222	1·022	1·029
223	− 1·036	− 1·015

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24th Equation—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z — b	Coefficients of y and z — c
224	+ 1·020	+ 1·030
225	− 1·035	− 1·015
226	+ 1·003	+ 1·022
227	1·014	1·025
228	− 1·025	− 1·011
229	+ 1·011	+ 1·023
230	− 1·025	− 1·009
231	+ 1·012	+ 1·022
232	− 1·022	− 1·010
233	+ 1·011	+ 1·025
234	− 1·023	− 1·009
235	+ 1·008	+ 1·019
236	− 1·020	− 1·007
237	+ 1·009	+ 1·019
238	− 1·019	− 1·007
239	+ 1·007	+ 1·018
240	− 1·018	− 1·004
241	+ 1·004	+ 1·016
242	− 1·015	− 1·003
243	+ 1·001	+ 1·013
244	− 1·017	− 0·999
245	+ 1·001	+ 1·015
246	− 1·011	− 0·999
247	+ 1·001	+ 1·010
248	− 1·009	− 0·999
249	+ 0·994	+ 1·006
250	0·998	1·009
251	− 1·005	− 0·997
252	+ 1·000	+ 1·006
253	− 1·004	− 0·997
254	+ 0·996	+ 1·006
255	− 1·005	− 0·997

24th Equation—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z — b	Coefficients of y and z — c
256	+ 0·999	+ 1·006
257	− 1·003	− 0·998
258	+ 1·000	+ 1·003
259	− 1·001	− 0·999
260	+ 1·000	+ 1·003
261	− 1·001	− 0·999
262	+ 1·002	+ 1·003

25th Equation. Linear.

Equalizing Factor = ·03.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z — b	Coefficients of y and z — c
221	− 44	− 17
222	9	+ 16
223	32	21
224	4	25
225	27	11
226	35	3
227	11	14
228	13	14
229	13	12
230	15	15
231	9	11
232	12	12
233	10	21
234	18	9
235	12	12
236	13	12
237	8	16
238	16	8
239	8	16
240	15	11
241	11	15

25th Equation—(Continued).

Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z — b	Coefficients of y and z — c
242	− 14	+ 9
243	14	12
244	19	15
245	12	19
246	11	12
247	7	14
248	11	8
249	+ 13	20

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z — b	Coefficients of y and z — c
263	+ 25	0
264	27	− 14
265	11	17
266	4	28
267	11	3
268	15	5
269	24	5
270	7	17
271	26	6
272	3	15
273	21	9
274	12	10
275	13	14
276	11	13
277	15	11
278	14	11
279	11	13
280	15	12
281	12	14
282	11	13
283	9	14
284	12	11
285	11	11

25th Equation—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z — b	Coefficients of y and z — c
286	+ 12	− 12
287	10	10
288	11	10
289	11	12
290	15	11
291	6	12
292	18	6
293	13	17
294	9	14
295	17	12
296	9	15
297	14	9
298	9	14
299	15	9
300	17	15
301	8	12
302	10	16

26th Equation. Latitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z — b	Coefficients of y and z — c
221	− ·098	− ·033
222	·015	+ ·042
223	·069	·042
224	·004	·053
225	·049	·023
226	·060	·005
227	·020	·023
228	·019	·024
229	·021	·019
230	·022	·024
231	·012	·018

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26th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
232	− ·016	+ ·018
233	·012	·029
234	·021	·012
235	·013	·014
236	·013	·014
237	·007	·018
238	·013	·008
239	·004	·016
240	·011	·010
241	·006	·013
242	·007	·006
243	·007	·007
244	·009	·009
245	·004	·010
246	·002	·005
247	+ ·001	·006
248	·000	·002
249	·000	·002

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
263	+ ·051	− ·017
264	·082	·021
265	·009	·058
266	·022	·050
267	·003	·026
268	·012	·031
269	·060	+ ·006
270	·028	− ·015
271	·023	·029
272	− ·014	·043
273	+ ·046	+ ·003
274	− ·002	− ·033
275	+ ·034	·003

26th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
276	− ·005	− ·036
277	+ ·036	+ ·003
278	− ·001	− ·031
279	+ ·028	+ ·001
280	− ·003	− ·030
281	+ ·028	+ ·003
282	− ·008	− ·030
283	+ ·024	+ ·004
284	− ·008	− ·027
285	+ ·023	+ ·006
286	− ·010	− ·024
287	+ ·020	+ ·009
288	− ·011	− ·022
289	+ ·020	+ ·010
290	·021	·010
291	− ·013	− ·019
292	+ ·020	+ ·010
293	− ·008	− ·017
294	+ ·014	+ ·005
295	− ·005	− ·014
296	+ ·011	+ ·002
297	− ·005	− ·010
298	+ ·008	+ ·002
299	− ·004	− ·007
300	+ ·005	·000
301	− ·003	·003
302	+ ·003	·000

27th Equation. Longitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
221	− ·068	− ·059

27th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
222	− ·057	− ·049
223	+ ·047	+ ·052
224	− ·048	− ·040
225	+ ·048	+ ·044
226	− ·037	− ·039
227	·040	·041
228	+ ·038	+ ·036
229	− ·037	− ·037
230	+ ·037	+ ·033
231	− ·034	− ·033
232	+ ·033	+ ·031
233	− ·031	− ·030
234	+ ·030	+ ·027
235	− ·028	− ·026
236	+ ·025	+ ·025
237	− ·024	− ·021
238	+ ·023	+ ·020
239	− ·020	− ·020
240	+ ·020	+ ·017
241	− ·017	− ·016
242	+ ·015	+ ·013
243	− ·014	− ·012
244	+ ·011	+ ·011
245	− ·010	− ·007
246	+ ·008	+ ·006
247	− ·006	− ·004
248	+ ·004	+ ·002
249	− ·004	− ·002

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
263	− ·085	− ·062
264	+ ·038	+ ·067
265	− ·064	− ·039

27th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
266	+ ·049	+ ·071
267	− ·058	− ·044
268	·062	·042
269	+ ·021	+ ·047
270	·036	·058
271	− ·064	− ·032
272	·041	·023
273	+ ·017	+ ·043
274	− ·046	− ·024
275	+ ·021	+ ·044
276	− ·041	− ·017
277	+ ·016	+ ·038
278	− ·040	− ·017
279	+ ·017	+ ·036
280	− ·038	− ·013
281	+ ·013	+ ·034
282	− ·031	− ·009
283	+ ·013	+ ·031
284	− ·029	− ·008
285	+ ·008	+ ·025
286	− ·026	− ·004
287	+ ·006	+ ·021
288	− ·022	− ·003
289	+ ·002	+ ·020
290	− ·001	·020
291	·013	·002
292	·002	·014
293	·016	·002
294	+ ·004	·015
295	− ·015	·000
296	+ ·003	·013
297	− ·010	·000

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No. of Circuit Triangle	Coefficients of y and z: b	c
27th Equation—(Continued).		
Equalizing Factor = 15.		
298	+ ·002	+ ·009
299	− ·007	·001
300	·000	·007
301	·003	·001
302	+ ·003	·005
28th Equation. Azimuth.		
Equalizing Factor = 1.		
Left-hand Branch		
221	− 1·026	− 1·024
222	1.024	1·021
223	+ 1·021	+ 1·021
224	− 1·020	− 1·019
225	+ 1·023	+ 1·019
226	− 1·016	− 1·018
227	1·017	1·017
228	+ 1·017	+ 1·015
229	− 1·016	− 1·016
230	+ 1·015	+ 1·015
231	− 1·015	− 1·014
232	+ 1·014	+ 1·014
233	− 1·014	− 1·012
234	+ 1·012	+ 1·012
235	− 1·012	− 1·011
236	+ 1·011	+ 1·011
237	− 1·011	− 1·009
238	+ 1·009	+ 1·009
239	− 1·009	− 1·008
240	+ 1·008	+ 1·008
241	− 1·008	− 1·006
242	+ 1·006	+ 1·006
243	− 1·006	− 1·005

No. of Circuit Triangle	Coefficients of y and z: b	c
28th Equation—(Continued).		
Equalizing Factor = 1.		
244	+ 1·005	+ 1·005
245	− 1·005	− 1·003
246	+ 1·003	+ 1·003
247	− 1·003	− 1·002
248	+ 1·002	+ 1·002
249	− 1·002	0·000
Right-hand Branch		
263	− 1·037	− 1·027
264	+ 1·016	+ 1·030
265	− 1·028	− 1·017
266	+ 1·021	+ 1·031
267	− 1·027	− 1·019
268	1·029	1·018
269	+ 1·009	+ 1·021
270	1·014	1·026
271	− 1·030	− 1·014
272	1·019	1·009
273	+ 1·006	+ 1·020
274	− 1·021	− 1·010
275	+ 1·008	+ 1·020
276	− 1·019	− 1·006
277	+ 1·005	+ 1·018
278	− 1·019	− 1·006
279	+ 1·008	+ 1·018
280	− 1·017	− 1·006
281	+ 1·006	+ 1·015
282	− 1·013	− 1·004
283	+ 1·005	+ 1·014
284	− 1·013	− 1·004
285	+ 1·004	+ 1·011
286	− 1·012	− 1·002
287	+ 1·003	+ 1·010

No. of Circuit Triangle	Coefficients of y and z: b	c
28th Equation—(Continued).		
Equalizing Factor = 1.		
288	− 1·010	− 1·002
289	+ 1·002	+ 1·009
290	0·999	1·009
291	− 1·006	− 0·999
292	+ 1·000	+ 1·007
293	− 1·008	− 0·999
294	+ 1·003	+ 1·008
295	− 1·006	− 1·001
296	+ 1·002	+ 1·006
297	− 1·005	− 1·000
298	+ 1·002	+ 1·005
299	− 1·003	− 1·000
300	+ 1·000	+ 1.003
301	− 1·001	− 0·999
302	+ 1·001	+ 1·003
29th Equation. Linear.		
Equalizing Factor = ·03.		
Left-hand Branch		
263	− 25	0
264	27	+ 14
265	11	17
266	4	28
267	11	3
268	15	5
269	24	5
270	7	17
271	26	6
272	3	15
273	21	9
274	12	10
275	13	14

No. of Circuit Triangle	Coefficients of y and z: b	c
29th Equation—(Continued).		
Equalizing Factor = ·03.		
276	− 11	+ 13
277	15	11
278	14	11
279	11	13
280	15	12
281	12	14
282	11	13
283	9	14
284	12	11
285	11	11
286	12	12
287	10	10
288	11	10
289	+ 12	24
Right-hand Branch		
303	+ 10	− 13
304	17	5
305	6	18
306	23	1
307	19	3
308	17	12
309	13	10
310	15	7
311	11	13
312	17	11
313	14	14
314	16	17
315	11	16
316	16	15
317	13	16
318	11	9
319	8	16

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No. of Circuit Triangle	Coefficients of y and z	
	b	c
29th Equation—(Continued).		
Equalizing Factor = ·03.		
320	+ 16	− 3
321	4	18
322	16	3
323	5	17
324	18	6
325	13	16
326	12	11
327	14	13
328	16	14
329	9	18
330	13	8
30th Equation. Latitude.		
Equalizing Factor = 15.		
Left-hand Branch		
263	− ·058	·000
264	·054	+ ·032
265	·022	·034
266	·004	·057
267	·017	·007
268	·024	·011
269	·033	·009
270	·008	·026
271	·030	·008
272	·003	·019
273	·022	·012
274	·012	·012
275	·011	·016
276	·009	·013
277	·012	·010
278	·010	·010
279	·008	·011

No. of Circuit Triangle	Coefficients of y and z	
	b	c
30th Equation—(Continued).		
Equalizing Factor = 15.		
280	− ·011	+ ·008
281	·005	·011
282	·006	·007
283	·003	·008
284	·005	·004
285	·001	·006
286	·004	·004
287	+ ·001	·005
288	− ·001	·001
289	+ ·001	·002
Right-hand Branch		
303	+ ·006	− ·033
304	·032	·003
305	− ·002	·038
306	+ ·034	+ ·004
307	·012	− ·015
308	·028	·005
309	·003	·022
310	·025	+ ·002
311	·000	− ·024
312	·024	·001
313	·000	·022
314	·021	·004
315	− ·003	·022
316	+ ·020	·001
317	− ·003	·021
318	+ ·013	+ ·004
319	− ·008	− ·017
320	+ ·014	+ ·008
321	− ·010	− ·016
322	+ ·012	+ ·008
323	·010	·006

No. of Circuit Triangle	Coefficients of y and z	
	b	c
30th Equation—(Continued).		
Equalizing Factor = 15.		
324	+ ·013	+ ·007
325	− ·007	− ·010
326	+ ·009	+ ·004
327	− ·004	− ·006
328	+ ·004	+ ·001
329	− ·003	− ·003
330	+ ·003	·000
31st Equation. Longitude.		
Equalizing Factor = 15.		
Left-hand Branch		
263	+ ·052	+ ·052
264	− ·052	− ·045
265	+ ·045	+ ·045
266	− ·044	− ·037
267	+ ·039	+ ·038
268	·040	·037
269	− ·033	− ·034
270	·033	·032
271	+ ·031	+ ·027
272	·028	·026
273	− ·026	− ·025
274	+ ·025	+ ·023
275	− ·023	− ·022
276	+ ·022	+ ·020
277	− ·021	− ·019
278	+ ·018	+ ·018
279	− ·018	− ·015
280	+ ·015	+ ·015
281	− ·015	− ·012
282	+ ·012	+ ·012
283	− ·012	− ·009

No. of Circuit Triangle	Coefficients of y and z	
	b	c
31st Equation—(Continued).		
Equalizing Factor = 15.		
284	+ ·009	+ ·009
285	− ·009	− ·006
286	+ ·006	+ ·006
287	− ·006	− ·003
288	+ ·003	+ ·003
289	− ·003	·000
Right-hand Branch		
303	− ·047	− ·033
304	+ ·031	+ ·038
305	− ·039	− ·024
306	+ ·021	+ ·030
307	− ·040	− ·027
308	+ ·019	+ ·032
309	− ·033	− ·019
310	+ ·016	+ ·027
311	− ·030	− ·015
312	+ ·013	+ ·027
313	− ·028	− ·012
314	+ ·010	+ ·027
315	− ·024	− ·007
316	+ ·007	+ ·022
317	− ·021	− ·003
318	+ ·006	+ ·016
319	− ·016	− ·001
320	+ ·001	+ ·010
321	− ·010	·003
322	·002	·008
323	+ ·003	·013
324	− ·001	·010
325	·008	·003
326	·000	·007
327	·006	·002

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31st Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
328	+ ·001	+ ·006
329	− ·002	·001
330	+ ·003	·003

32nd Equation. Azimuth.

Equalizing Factor = 1.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
263	+ 1.022	+ 1·022
264	− 1·022	− 1·020
265	+ 1·020	+ 1·020
266	− 1·019	− 1·016
267	+ 1·018	+ 1·017
268	1·019	1·016
269	− 1·015	− 1·015
270	1·014	1·014
271	+ 1·012	+ 1·012
272	1·012	1·012
273	− 1·012	− 1·011
274	+ 1·011	+ 1·011
275	− 1·011	− 1·009
276	+ 1·009	+ 1·009
277	− 1·009	− 1·008
278	+ 1·008	+ 1·008
279	− 1·008	− 1·007
280	+ 1·007	+ 1·007
281	− 1·007	− 1·005
282	+ 1·005	+ 1·005
283	− 1·005	− 1·004
284	+ 1·004	+ 1·004
285	− 1·004	− 1·003
286	+ 1·003	+ 1·003
287	− 1·003	− 1·001

32nd Equation—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	c
288	+ 1·001	+ 1·001
289	− 1·001	0·000

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
303	− 1·021	− 1·014
304	+ 1·013	+ 1·017
305	− 1.017	− 1·010
306	+ 1·008	+ 1·013
307	− 1·019	− 1·012
308	+ 1·008	+ 1·015
309	− 1·015	− 1·008
310	+ 1·006	+ 1·012
311	− 1·013	− 1·006
312	+ 1·005	+ 1·012
313	− 1·013	− 1·005
314	+ 1·004	+ 1·013
315	− 1·011	− 1·003
316	+ 1.003	+ 1·011
317	− 1·010	− 1·001
318	+ 1·003	+ 1·008
319	− 1·007	− 1·000
320	+ 1·000	+ 1·005
321	− 1·005	− 0·999
322	+ 0·999	+ 1·004
323	1·001	1·006
324	0.999	1·006
325	− 1·005	− 0·999
326	+ 1·002	+ 1·004
327	− 1·002	− 1·000
328	+ 1·000	+ 1·003
329	− 1·002	− 0·999
330	+ 1·003	+ 1·003

33rd Equation. Linear.

Equalizing Factor = ·03.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
303	− 10	+ 13
304	17	5
305	6	18
306	23	1
307	19	3
308	17	12
309	13	10
310	15	7
311	11	13
312	17	11
313	14	14
314	16	17
315	11	16
316	16	15
317	13	16
318	11	9
319	8	16
320	16	3
321	4	18
322	16	3
323	+ 16	33

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
331	+ 3	− 23
332	13	3
333	14	18
334	11	14
335	22	14
336	10	14
337	16	11
338	20	5
339	16	9

33rd Equation—(Continued).

Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	c
340	+ 11	− 13
341	13	6
342	14	7
343	16	7
344	12	13
345	13	11
346	17	13
347	11	18
348	16	12
349	13	14
350	11	13
351	12	13
352	14	10
353	10	14
354	5	13
355	11	9
356	9	11
357	14	10
358	10	11
359	12	11
360	8	13
361	16	7

34th Equation. Latitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
303	− ·015	+ ·022
304	·020	·012
305	·007	·026
306	·021	·006
307	·021	·003
308	·015	·014

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34th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
309	− ·012	+ ·011
310	·012	·007
311	·008	·011
312	·012	·009
313	·009	·011
314	·010	·012
315	·006	·011
316	·006	·009
317	·004	·007
318	·002	·005
319	·001	·006
320	·002	·002
321	·000	·005
322	·001	·002
323	+ ·001	·004

Right-hand Branch

No. of Circuit Triangle	b	c
331	+ ·018	− ·042
332	·012	·019
333	·014	·047
334	·028	·015
335	·020	·037
336	·025	·007
337	·033	·002
338	·007	·021
339	·003	·025
340	·023	+ ·001
341	·025	·008
342	− ·004	− ·021
343	·002	·021
344	+ ·022	+ ·005
345	− ·007	− ·024
346	+ ·024	+ ·007

34th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
347	− ·011	− ·026
348	+ ·022	+ ·010
349	·020	·008
350	− ·012	− ·019
351	+ ·016	+ ·008
352	− ·010	− ·015
353	+ ·013	+ ·007
354	− ·010	− ·012
355	+ ·010	+ ·005
356	− ·007	− ·009
357	+ ·009	+ ·005
358	− ·005	− ·007
359	+ ·006	+ ·002
360	− ·003	− ·003
361	+ ·003	·000

35th Equation. Longitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	b	c
303	+ ·038	+ ·038
304	− ·038	− ·032
305	+ ·032	+ ·032
306	− ·032	− ·026
307	+ ·026	+ ·026
308	− ·026	− ·022
309	+ ·022	+ ·022
310	− ·022	− ·020
311	+ ·020	+ ·020
312	− ·020	− ·017
313	+ ·017	+ ·017
314	− ·015	− ·014
315	+ ·015	+ ·012

35th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
316	− ·014	− ·012
317	+ ·010	+ ·010
318	− ·010	− ·008
319	+ ·008	+ ·008
320	− ·008	− ·005
321	+ ·005	+ ·005
322	− ·005	− ·003
323	·003	·000

Right-hand Branch

No. of Circuit Triangle	b	c
331	+ ·049	+ ·063
332	− ·053	− ·042
333	·054	·031
334	+ ·034	+ ·045
335	− ·054	− ·025
336	+ ·023	+ ·039
337	·020	·037
338	− ·040	− ·020
339	·037	·017
340	+ ·013	+ ·030
341	·013	·025
342	− ·029	− ·012
343	·031	·012
344	+ ·007	+ ·024
345	− ·025	− ·006
346	·000	+ ·022
347	·022	·004
348	·002	·020
349	·000	·021
350	·016	·003
351	·000	·016
352	·015	·002
353	·000	·014

35th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
354	− ·006	+ ·005
355	+ ·001	·009
356	− ·006	·002
357	·001	·006
358	·004	·002
359	+ ·001	·004
360	− ·001	·001
361	+ ·002	·003

36th Equation. Azimuth.

Equalizing Factor = 1.

Left-hand Branch

No. of Circuit Triangle	b	c
303	+ 1·016	+ 1·016
304	− 1·016	− 1·014
305	+ 1·014	+ 1·014
306	− 1·014	− 1·012
307	+ 1·012	+ 1·012
308	− 1·012	− 1·010
309	+ 1·010	+ 1·010
310	− 1·010	− 1·009
311	+ 1·009	+ 1·009
312	− 1·009	− 1·007
313	+ 1·007	+ 1·007
314	− 1·007	− 1·006
315	+ 1·006	+ 1·006
316	− 1·006	− 1·005
317	+ 1·005	+ 1·005
318	− 1·005	− 1·004
319	+ 1·004	+ 1·004
320	− 1·004	− 1·002
321	+ 1·002	+ 1·002
322	− 1·002	− 1·001

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36th Equation—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	Coefficients of *y* and *z*: c
323	− 1·001	0·000

Right-hand Branch

No. of Circuit Triangle	b	c
331	+ 1·021	+ 1·029
332	− 1·023	− 1·018
333	1·023	1·014
334	+ 1·016	+ 1·020
335	− 1·023	− 1·012
336	+ 1·011	+ 1·016
337	1·009	1·016
338	− 1·017	− 1·009
339	1·016	1·008
340	+ 1·007	+ 1·013
341	1·005	1·010
342	− 1·012	− 1·006
343	1·013	1·006
344	+ 1·003	+ 1·011
345	− 1·012	− 1·003
346	+ 1·000	+ 1·010
347	− 1·009	− 0·998
348	+ 0·999	+ 1·009
349	1·001	1·010
350	− 1·006	− 0·999
351	+ 1·000	+ 1·007
352	− 1·006	− 0·999
353	+ 1·001	+ 1·006
354	− 1·002	− 0·998
355	+ 1·001	+ 1·005
356	− 1·003	− 0·999
357	+ 1·001	+ 1·004
358	− 1·002	− 1·000
359	+ 1·001	+ 1·002
360	− 1·001	− 0·999

36th Equation—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	b	c
361	+ 1·002	+ 1·003

37th Equation. Linear.

Equalizing Factor = ·03.

Left-hand Branch

No. of Circuit Triangle	b	c
331	− 3	+ 23
332	13	3
333	14	18
334	11	14
335	22	14
336	10	14
337	16	11
338	20	5
339	16	9
340	11	13
341	13	6
342	14	7
343	16	7
344	12	13
345	13	11
346	17	13
347	11	18
348	16	12
349	13	14
350	11	13
351	+ 12	25

Right-hand Branch

No. of Circuit Triangle	b	c
409	+ 7	− 32
410	5	13
411	20	2
412	7	13
413	10	11

37th Equation—(Continued).

Equalizing Factor = ·03.

No. of Circuit Triangle	b	c
414	+ 12	− 13
415	13	12
416	14	10
417	12	15
418	12	13
419	8	14
420	18	3
421	11	18
422	12	10
423	12	13

38th Equation. Latitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	b	c
331	− ·004	+ ·050
332	·022	·005
333	·024	·031
334	·012	·025
335	·029	·022
336	·010	·017
337	·017	·013
338	·016	·007
339	·012	·010
340	·008	·010
341	·010	·004
342	·006	·006
343	·008	·006
344	·006	·006
345	·002	·007
346	·007	·002
347	+ ·001	·009
348	− ·006	·001

38th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	b	c
349	− ·004	+ ·002
350	+ ·001	·003
351	− ·001	·002

Right-hand Branch

No. of Circuit Triangle	b	c
362	+ ·054	− ·012
363	·014	·043
364	·000	·051
365	·065	+ ·002
366	·036	− ·016
367	·018	·043
368	·067	·001
369	− ·008	·080
370	+ ·039	·006
371	·023	·046
372	·032	·020
373	·007	·050
374	·061	·000
375	− ·009	·057
376	+ ·062	+ ·012
377	− ·017	− ·061
378	+ ·060	·004
379	− ·014	·059
380	+ ·053	+ ·011
381	− ·008	− ·048
382	+ ·045	+ ·002
383	− ·001	− ·033
384	+ ·046	+ ·002
385	− ·006	− ·052
386	+ ·034	+ ·006
387	− ·006	− ·040
388	+ ·026	+ ·001
389	·001	− ·037

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38*th Equation*—(Continued).

***Equalizing Factor* = 15.**

No. of Circuit Triangle	Coefficients of y and z: b		c	
390	+	·032	+	·002
391	−	·005	−	·029
392	+	·038	+	·006
393	−	·017	−	·039
394	+	·027	+	·009
395	−	·015	−	·029
396	+	·027	+	·015
397	−	·017	−	·031
398	+	·029	+	·017
399	−	·021	−	·030
400	+	·029	+	·019
401	−	·021	−	·030
402	+	·028	+	·020
403	−	·022	−	·029
404	+	·026	+	·021
405	−	·025	−	·027
406	+	·024	+	·022
407		·025		·022
408	−	·022	−	·022
409	+	·020	+	·018
410	−	·020	−	·018
411	+	·017	+	·017
412	−	·018	−	·016
413	+	·016	+	·015
414	−	·015	−	·013
415	+	·013	+	·012
416	−	·012	−	·010
417	+	·010	+	·010
418	−	·009	−	·007
419	+	·007	+	·007
420	−	·008	−	·006
421	+	·005	+	·005

38*th Equation*—(Continued).

***Equalizing Factor* = 15.**

No. of Circuit Triangle	Coefficients of y and z: b		c	
422	−	·004	−	·002
423	+	·004	+	·002

39*th Equation. Longitude.*

***Equalizing Factor* = 15.**

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b		c	
331	−	·047	−	·045
332	+	·039	+	·039
333		·039		·039
334	−	·037	−	·030
335	+	·033	+	·030
336	−	·025	−	·024
337		·026		·025
338	+	·022	+	·019
339		·022		·019
340	−	·017	−	·016
341		·017		·016
342	+	·014	+	·012
343		·015		·012
344	−	·010	−	·010
345	+	·013	+	·008
346	−	·007	−	·010
347	+	·009	+	·003
348	−	·004	−	·006
349		·004		·006
350	+	·003	+	·001
351	−	·003	−	·002

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b		c	
362	+	·051	+	·076
363	−	·079	−	·054
364		·073		·050
365	+	·040	+	·069

39*th Equation*—(Continued).

***Equalizing Factor* = 15.**

No. of Circuit Triangle	Coefficients of y and z: b		c	
366	+	·053	+	·077
367	−	·079	−	·048
368	+	·034	+	·068
369	−	·064	−	·025
370	+	·046	+	·068
371	−	·079	−	·040
372	+	·044	+	·073
373	−	·071	−	·035
374	+	·025	+	·064
375	−	·060	−	·026
376	+	·020	+	·054
377	−	·051	−	·019
378	+	·017	+	·063
379	−	·051	−	·016
380	+	·020	+	·050
381	−	·052	−	·020
382	+	·021	+	·053
383	−	·056	−	·028
384	+	·017	+	·051
385	−	·048	−	·008
386	+	·021	+	·043
387	−	·046	−	·014
388	+	·025	+	·046
389	−	·052	−	·014
390	+	·014	+	·045
391	−	·050	−	·019
392	+	·003	+	·043
393	−	·032		·001
394	+	·012		·039
395	−	·037	−	·012
396	+	·010	+	·032
397	−	·035	−	·005

39*th Equation*—(Continued).

***Equalizing Factor* = 15.**

No. of Circuit Triangle	Coefficients of y and z: b		c	
398	+	·001	+	·026
399	−	·026	−	·001
400		·004	+	·023
401		·025		·004
402		·004		·023
403		·023		·007
404		·007		·021
405		·015		·011
406		·013		·010
407		·019		·017
408		·027		·010
409		·007		·033
410		·002		·016
411		·019		·002
412		·004		·014
413		·007		·010
414		·006		·011
415		·008		·009
416		·007		·007
417		·004		·010
418		·004		·006
419		·001		·006
420		·003		·003
421		·001		·006
422		·000		·002
423		·000		·002

40*th Equation. Azimuth.*

***Equalizing Factor* = 1.**

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b		c	
331	−	1·020	−	1·020
332	+	1·017	+	1·017

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No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
40th Equation—(Continued). Equalizing Factor = 1.		
333	+ 1·017	+ 1·017
334	− 1·016	− 1·013
335	+ 1·015	+ 1·012
336	− 1·011	− 1·011
337	1·010	1·011
338	+ 1·011	+ 1·008
339	1·011	1·008
340	− 1·008	− 1·008
341	1·006	1·007
342	+ 1·007	+ 1·005
343	1·008	1·005
344	− 1·005	− 1·005
345	+ 1·005	+ 1·003
346	− 1·002	− 1·004
347	+ 1·004	+ 1·001
348	− 1·001	− 1·003
349	1·002	1·003
350	+ 1·002	+ 1·000
351	− 1·002	− 0·002
Right-hand Branch		
362	+ 1·020	+ 1·033
363	− 1·034	− 1·022
364	1·031	1·020
365	+ 1·016	+ 1·030
366	1·022	1·033
367	− 1·034	− 1·020
368	+ 1·013	+ 1·029
369	− 1·027	− 1·009
370	+ 1·019	+ 1·029
371	− 1·035	− 1·017
372	+ 1·020	+ 1·032
373	− 1·030	− 1·014

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
40th Equation—(Continued). Equalizing Factor = 1.		
374	+ 1·010	+ 1·027
375	− 1·025	− 1·011
376	+ 1·009	+ 1·023
377	− 1·022	− 1·008
378	+ 1·008	+ 1·027
379	− 1·021	− 1·006
380	+ 1·007	+ 1·021
381	− 1·023	− 1·008
382	+ 1·008	+ 1·023
383	− 1·025	− 1·012
384	+ 1·005	+ 1·022
385	− 1·022	− 1·002
386	+ 1·009	+ 1·020
387	− 1·021	− 1·005
388	+ 1·011	+ 1·022
389	− 1·025	− 1·005
390	+ 1·007	+ 1·021
391	− 1·022	− 1·008
392	+ 1·000	+ 1·020
393	− 1·014	− 0·999
394	+ 1.005	+ 1·017
395	− 1·016	− 1·005
396	+ 1·004	+ 1·014
397	− 1·015	− 1·001
398	+ 1·000	+ 1·012
399	− 1·011	− 1·000
400	+ 0·998	+ 1·010
401	− 1·011	− 0·998
402	+ 0·998	+ 1·011
403	− 1·011	− 0·997
404	+ 0·997	+ 1·009
405	− 1·006	− 0·994

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
40th Equation—(Continued). Equalizing Factor = 1.		
406	+ 0·994	+ 1·005
407	0·992	1·009
408	− 1·013	− 0·996
409	+ 0·997	+ 1·016
410	− 1·002	− 0·992
411	+ 0·993	+ 1·002
412	− 1·002	− 0·994
413	+ 0·998	+ 1·005
414	− 1·003	− 0·995
415	+ 0·996	+ 1·004
416	− 1·003	− 0·996
417	+ 0·998	+ 1·005
418	− 1·001	− 0·996
419	+ 1·000	+ 1·004
420	− 1·001	− 0·999
421	+ 0·999	+ 1·002
422	− 1·000	− 0·998
423	+ 1·000	+ 1·002
41st Equation. Linear. Equalizing Factor = ·03.		
362	+ 12	− 12
363	14	7
364	9	10
365	16	8
366	5	15
367	17	7
368	18	10
369	7	23
370	7	12
371	21	9
372	4	19

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
41st Equation—(Continued). Equalizing Factor = ·03.		
373	+ 15	− 11
374	18	12
375	9	15
376	19	7
377	5	18
378	19	16
379	7	18
380	17	8
381	11	14
382	13	14
383	16	5
384	16	14
385	13	20
386	9	11
387	13	13
388	4	16
389	21	11
390	9	18
391	20	4
392	16	18
393	9	16
394	6	17
395	15	4
396	5	13
397	15	8
398	10	11
399	10	8
400	12	10
401	12	10
402	10	13
403	13	10
404	10	14

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41st Equation—(Continued). Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	c
405	+ 9	− 11
406	12	8
407	18	13
408	25	8

42nd Equation. Linear. Equalizing Factor = ·03.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
407	+ 24	+ 6
408	25	− 8
424	− 9	+ 15
425	13	11
426	17	3
427	20	8
428	9	20
429	11	11
430	15	8
431	15	16
432	13	14
433	7	14
434	12	9
435	17	11
436	13	17
437	10	13
438	16	8
439	11	20
440	13	11
441	9	14
442	12	19
443	7	12

42nd Equation—(Continued). Equalizing Factor = ·03.

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
362	− 12	− 24
444	+ 15	9
445	12	14
446	10	13
447	13	12
448	16	8
449	20	13
450	10	14
451	12	12
452	9	15
453	13	11
454	10	13
455	15	13
456	11	15
457	13	9
458	11	9
459	11	18
460	17	11
461	14	12
462	11	15
463	11	11
464	15	10
465	9	17
466	13	12
467	12	11
468	10	13
469	12	10
470	17	13
471	16	12
472	14	17
473	12	17

42nd Equation—(Continued). Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	c
474	+ 19	− 11
475	14	14
476	11	16
477	15	12
478	2	19
479	8	9
480	13	7
481	13	9
482	7	12
483	8	12
484	15	8
485	12	13
486	9	12
487	13	10
488	13	11
489	10	16
490	14	12
491	13	12
492	4	22
493	7	10
494	16	1
495	10	12
496	8	13
497	14	14
498	9	15
499	27	17
500	10	26
501	− 17	15

43rd Equation. Latitude. Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
362	− ·058	− ·004
363	·059	·008
364	·047	·001
365	·011	+ ·044
366	+ ·014	·061
367	− ·062	− ·008
368	·014	+ ·048
369	·039	·025
370	+ ·012	·051
371	− ·066	− ·005
372	+ ·018	+ ·063
373	− ·052	− ·001
374	·009	+ ·046
375	·038	·006
376	·009	·036
377	·030	·009
378	·007	·050
379	·033	·006
380	·001	·037
381	·039	− ·003
382	+ ·008	+ ·045
383	− ·045	− ·018
384	+ ·006	+ ·044
385	− ·041	− ·002
386	+ ·018	+ ·041
387	− ·040	− ·012
388	+ ·025	+ ·045
389	− ·046	− ·015
390	+ ·020	+ ·043
391	− ·040	− ·021
392	+ ·014	+ ·039

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43rd Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
393	− ·030	− ·013
394	+ ·023	+ ·037
395	− ·031	− ·021
396	+ ·024	+ ·032
397	− ·029	− ·020
398	+ ·022	+ ·030
399	− ·026	− ·021
400	+ ·023	+ ·028
401	− ·025	− ·022
402	+ ·025	+ ·027
403	− ·024	− ·023
404	+ ·026	+ ·026
405	− ·022	− ·024
406	+ ·028	+ ·025
407	·023	− ·004
424	− ·022	·027
425	·021	·026
426	+ ·027	+ ·021
427	− ·018	− ·023
428	+ ·022	+ ·015
429	·022	·017
430	− ·015	− ·019
431	·015	·020
432	+ ·018	+ ·012
433	·016	·012
434	− ·012	− ·014
435	·011	·014
436	+ ·012	+ ·008
437	·012	·009
438	− ·008	− ·009
439	·008	·009
440	+ ·007	+ ·005

43rd Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
441	+ ·006	+ ·005
442	− ·004	− ·003
443	·004	·003
Right-hand Branch		
444	+ ·064	+ ·002
445	·007	− ·058
446	·002	·056
447	·054	·011
448	·019	·040
449	·069	·014
450	·007	·051
451	·046	·014
452	·006	·051
453	·046	·014
454	·011	·044
455	·049	·021
456	·017	·045
457	·041	·014
458	·019	·029
459	·033	·039
460	·036	·030
461	·029	·033
462	·028	·034
463	·022	·028
464	·031	·026
465	·021	·035
466	·030	·024
467	·021	·026
468	·017	·030
469	·025	·018
470	·034	·023
471	·027	·024

43rd Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
472	+ ·023	− ·033
473	·022	·027
474	·034	·017
475	·020	·025
476	·015	·028
477	·024	·016
478	·005	·026
479	·007	·016
480	·014	·014
481	·019	·009
482	·011	·013
483	·005	·018
484	·013	·013
485	·015	·011
486	·012	·010
487	·008	·014
488	·008	·015
489	·011	·010
490	·015	·007
491	·005	·013
492	− ·002	·020
493	+ ·006	·003
494	·011	+ ·002
495	·000	− ·011
496	·005	·004
497	·007	·004
498	·001	·005
499	·005	·005
500	·001	·004
501	·003	·000

44th Equation. Longitude.
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
Left-hand Branch		
362	− ·032	− ·071
363	+ ·037	+ ·066
364	·044	·070
365	− ·076	− ·042
366	·060	·033
367	+ ·030	+ ·061
368	− ·075	− ·037
369	+ ·040	+ ·079
370	− ·058	− ·031
371	+ ·020	+ ·058
372	− ·050	− ·019
373	+ ·026	+ ·058
374	− ·065	− ·027
375	+ ·031	+ ·059
376	− ·064	− ·031
377	+ ·033	+ ·060
378	− ·062	− ·017
379	+ ·027	+ ·057
380	− ·057	− ·024
381	+ ·019	+ ·050
382	− ·050	− ·012
383	+ ·009	+ ·036
384	− ·052	− ·009
385	+ ·009	+ ·054
386	− ·040	− ·010
387	+ ·006	+ ·042
388	− ·029	·001
389	·007	·037
390	·032	·007
391	·007	·024
392	·039	·008

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44th Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*			
	b		c	
393	+	·004	+	·035
394	−	·022		·010
395		·007		·017
396		·018		·007
397		·009		·019
398		·021		·007
399		·006		·016
400		·022		·008
401		·011		·016
402		·016		·015
403		·015		·013
404		·013		·020
405		·013		·011
406		·013		·014
407	+	·013		·024
424	−	·016		·014
425		·021		·009
426		·012		·011
427		·028		·004
428		·004		·027
429		·006		·017
430		·018		·003
431		·018		·011
432		·006		·016
433		·001		·016
434		·011		·004
435		·014		·005
436		·004		·013
437		·003		·011
438		·009		·002
439		·006		·008
440		·002		·005

44th Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*			
	b		c	
441	−	·001	+	·006
442		·002		·004
443		·001		·003
Right-hand Branch				
444	−	·040	−	·072
445	+	·073	+	·042
446		·070		·043
447	−	·046	−	·073
448	+	·074	+	·048
449	−	·040	−	·071
450	+	·065	+	·043
451	−	·048	−	·068
452	+	·063	+	·044
453	−	·049	−	·066
454	+	·062	+	·047
455	−	·049	−	·065
456	+	·061	+	·048
457	−	·052	−	·062
458	+	·059	+	·052
459	−	·054	−	·063
460	+	·059	+	·053
461		·058		·052
462	−	·054	−	·056
463	+	·054	+	·050
464		·055		·051
465	−	·049	−	·051
466		·049		·051
467	+	·049	+	·045
468		·049		·045
469	−	·044	−	·045
470		·043		·046
471	+	·044	+	·041

44th Equation—(Continued).
Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*			
	b		c	
472	+	·044	+	·040
473	−	·038	−	·041
474		·038		·041
475	+	·039	+	·035
476		·039		·035
477	−	·033	−	·036
478		·034		·036
479	+	·034	+	·030
480		·035		·030
481	−	·028	−	·030
482		·028		·031
483	+	·028	+	·024
484		·030		·025
485	−	·022	−	·026
486		·023		·026
487	+	·024	+	·019
488		·024		·019
489	−	·017	−	·022
490		·017		·021
491	+	·019	+	·013
492		·017		·011
493	−	·012	−	·014
494		·011		·013
495	+	·013	+	·008
496	−	·009	−	·011
497		·008		·011
498	+	·006	+	·005
499		·008		·004
500	−	·003	−	·002
501		·004		·003

45th Equation. Azimuth.
Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of *y* and *z*			
	b		c	
Left-hand Branch				
362	−	0·013	−	1·029
363	+	1·016	+	1·027
364		1·019		1·029
365	−	1·031	−	1·018
366		1·025		1·014
367	+	1·013	+	1·025
368	−	1·031	−	1·016
369	+	1·017	+	1·033
370	−	1·024	−	1·013
371	+	1·009	+	1·024
372	−	1·021	−	1·009
373	+	1·012	+	1·024
374	−	1·027	−	1·012
375	+	1·014	+	1·025
376	−	1·026	−	1·013
377	+	1·014	+	1·025
378	−	1·026	−	1·008
379	+	1·012	+	1·024
380	−	1·024	−	1·011
381	+	1·009	+	1·021
382	−	1·021	−	1·006
383	+	1·004	+	1·015
384	−	1·022	−	1·005
385	+	1·005	+	1·022
386	−	1·017	−	1·005
387	+	1·003	+	1·018
388	−	1·013	−	1·000
389	+	0·998	+	1·016
390	−	1·014	−	0·998
391	+	0·998	+	1·010
392	−	1·016	−	0·997

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45th Equation—(Continued). Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
393	+ 1·002	+ 1·015
394	− 1·010	− 0·996
395	+ 0·998	+ 1·007
396	− 1·008	− 0·998
397	+ 0·997	+ 1·008
398	− 1·009	− 0·997
399	+ 0·998	+ 1·007
400	− 1·009	− 0·997
401	+ 0·996	+ 1·007
402	− 1·007	− 0·994
403	+ 0·994	+ 1·006
404	− 1·006	− 0·992
405	+ 0·995	+ 1·005
406	− 1·006	− 0·994
407	0·995	+ 0·010
424	+ 0·993	1·006
425	0·991	1·004
426	− 1·005	− 0·995
427	+ 0·998	+ 1·002
428	− 1·002	− 0·989
429	1·002	0·993
430	+ 0·993	+ 1·002
431	0·993	1·005
432	− 1·002	− 0·993
433	1·000	0·993
434	+ 0·996	+ 1·002
435	0·994	1·002
436	− 1·002	− 0·995
437	1·001	0·996
438	+ 0·997	+ 1·001
439	0·997	1·003
440	− 1·001	− 0·998

45th Equation—(Continued). Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
441	− 1·000	− 0·997
442	+ 0·999	+ 1·002
443	1·000	1·001
Right-hand Branch		
444	− 1·017	− 1·029
445	+ 1·029	+ 1·018
446	1·029	1·018
447	− 1·019	− 1·029
448	+ 1·030	+ 1·020
449	− 1·017	− 1·029
450	+ 1·027	+ 1·018
451	− 1·020	− 1·028
452	+ 1·026	+ 1·018
453	− 1·020	− 1·027
454	+ 1·026	+ 1·019
455	− 1·020	− 1·027
456	+ 1·025	+ 1·020
457	− 1·022	− 1·026
458	+ 1·025	+ 1·022
459	− 1·022	− 1·026
460	+ 1·025	+ 1·022
461	1·024	1·022
462	− 1·022	− 1·024
463	+ 1·023	+ 1·021
464	1·023	1·021
465	− 1·020	− 1·022
466	1·020	1·021
467	+ 1·021	+ 1·019
468	1·021	1·019
469	− 1·018	− 1·019
470	1·018	1·019
471	+ 1.019	+ 1·017

45th Equation—(Continued). Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
472	+ 1·019	+ 1·017
473	− 1·016	− 1·018
474	1·016	1·017
475	+ 1·017	+ 1·015
476	1·017	1·015
477	− 1·014	− 1·015
478	1·015	1·016
479	+ 1·014	+ 1·013
480	1·015	1·013
481	− 1·012	− 1·013
482	1·012	1·013
483	+ 1·012	+ 1·010
484	1·013	1·011
485	− 1·010	− 1·011
486	1·010	1·011
487	+ 1·011	+ 1·008
488	1·011	1·008
489	− 1·007	− 1·010
490	1·007	1·009
491	+ 1·008	+ 1·006
492	1·007	1·005
493	− 1·005	− 1·006
494	1·005	1·006
495	+ 1·006	+ 1·003
496	− 1·004	− 1·005
497	1·003	1·005
498	+ 1·003	+ 1·002
499	1·004	1·002
500	− 1·001	− 1·001
501	1·002	0·001

46th Equation. Linear. Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
Left-hand Branch		
461	− 25	− 11
462	11	+ 15
463	11	11
464	15	10
465	9	17
466	13	12
467	12	11
468	10	13
469	12	10
470	17	13
471	16	12
472	14	17
473	12	17
474	19	11
475	14	14
476	11	16
477	15	12
478	2	19
479	8	9
480	13	7
481	13	9
482	7	12
483	8	12
484	15	8
485	12	13
486	9	12
487	13	10
488	13	11
489	10	16
490	14	12
491	13	12

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46th Equation—(Continued).

Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
492	− 4	+ 22
493	7	10
494	16	1
495	10	12
496	8	13
497	14	14
498	9	15
499	27	17
500	10	26
501	34	− 2
502	9	+ 25
503	11	15
504	12	11
505	14	18
506	3	11
507	26	− 1
508	20	+ 15
509	3	26
510	3	12
511	17	3
512	21	5
513	10	22
514	14	10
515	12	18
516	+ 1	13
517	− 35	8

Right-hand Branch

No. of Circuit Triangle	b	c
518	+ 10	− 15
519	13	11
520	10	12
521	14	9
522	8	13

46th Equation—(Continued).

Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
523	+ 11	− 10
524	13	11
525	9	10
526	8	11
527	13	9
528	12	10
529	12	12
530	12	11
531	11	15
532	15	11
533	11	14
534	15	7
535	9	18
536	20	3
537	15	32
538	23	15
539	30	25
540	1	22
541	13	13
542	10	7
543	20	9
544	11	18
545	3	18
546	5	10
547	28	1
548	13	31
549	14	9
550	1	15
551	11	4
552	17	7
553	5	18
554	3	15

46th Equation—(Continued).

Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
555	+ 11	− 11
556	13	11
557	29	2
558	10	18
559	4	10
560	29	0
561	12	18
562	8	26
563	10	15
564	22	7
565	5	12
566	1	16
567	19	2
568	18	14
569	7	23
570	33	3
571	4	21
572	19	12
573	14	10

47th Equation. Latitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	b	c
461	− ·059	+ ·001
462	·052	·008
463	+ ·004	·052
464	− ·005	·050
465	·046	·009
466	·054	− ·002
467	+ ·005	+ ·050
468	·009	·054
469	− ·049	− ·008

47th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	Coefficients of y and z: c
470	− ·058	− ·002
471	·001	+ ·049
472	+ ·003	·057
473	− ·047	·001
474	·058	− ·009
475	+ ·006	+ ·049
476	·011	·052
477	− ·048	− ·010
478	·030	·000
479	+ ·019	+ ·041
480	·012	·038
481	− ·043	− ·016
482	·036	·013
483	+ ·020	+ ·042
484	·013	·038
485	− ·040	− ·015
486	·037	·016
487	+ ·018	+ ·038
488	·018	·039
489	− ·036	− ·016
490	·039	·019
491	+ ·021	+ ·037
492	·027	·044
493	− ·031	− ·022
494	·035	·027
495	+ ·026	+ ·035
496	− ·030	− ·022
497	·032	·022
498	+ ·025	+ ·029
499	·021	·029
500	− ·025	− ·023
501	·026	·024

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47th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
502	+ ·026	+ ·024
503	− ·021	− ·022
504	·021	·022
505	+ ·022	+ ·015
506	− ·016	− ·017
507	·015	·016
508	+ ·018	+ ·012
509	− ·013	− ·015
510	·013	·014
511	+ ·011	+ ·008
512	·012	·008
513	− ·006	− ·008
514	+ ·008	+ ·003
515	− ·003	− ·005
516	+ ·001	·001
517	− ·002	·002

Right-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
518	− ·004	− ·063
519	+ ·058	·001
520	− ·001	·053
521	+ ·058	+ ·001
522	− ·003	− ·052
523	+ ·048	·004
524	·011	·045
525	·040	·007
526	·001	·043
527	·048	·006
528	·014	·038
529	·043	·016
530	·016	·038
531	·038	·026
532	·026	·035

47th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
533	+ ·035	− ·026
534	·029	·023
535	·028	·038
536	·044	·011
537	·032	·079
538	·054	·035
539	·065	·056
540	·001	·050
541	·027	·026
542	·021	·014
543	·036	·021
544	·022	·033
545	·002	·037
546	·009	·017
547	·050	·002
548	·021	·052
549	·020	·018
550	− ·001	·027
551	+ ·018	·003
552	·027	·007
553	·001	·031
554	·007	·016
555	·006	·022
556	·020	·006
557	·037	+ ·004
558	·002	− ·025
559	− ·003	·017
560	+ ·029	+ ·005
561	·015	− ·011
562	·001	·024
563	·002	·016
564	·015	·002

47th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
565	+ ·005	− ·005
566	− ·004	·011
567	+ ·004	·005
568	·008	·004
569	− ·002	·010
570	+ ·007	·001
571	− ·001	·004
572	+ ·001	·003

48th Equation. Longitude.

Equalizing Factor = 15.

Left-hand Branch

No. of Circuit Triangle	Coefficients of y and z: b	c
461	− ·036	− ·069
462	+ ·038	+ ·074
463	− ·067	− ·034
464	·073	·036
465	+ ·036	+ ·072
466	·030	·065
467	− ·063	− ·029
468	·060	·027
469	+ ·026	+ ·057
470	·019	·061
471	− ·064	− ·023
472	·061	·016
473	+ ·021	+ ·062
474	·011	·053
475	− ·056	− ·015
476	·052	·012
477	+ ·012	+ ·050
478	·030	·059
479	− ·042	− ·017
480	·050	·020

48th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
481	+ ·009	+ ·040
482	·018	·045
483	− ·037	− ·007
484	·048	·013
485	+ ·005	+ ·041
486	·009	·040
487	− ·040	− ·005
488	·040	·003
489	+ ·003	+ ·041
490	− ·003	·035
491	·035	·004
492	·021	·019
493	+ ·001	·025
494	− ·012	·013
495	·025	·009
496	·003	·026
497	·012	·028
498	·016	·017
499	·041	·020
500	·012	·034
501	·042	− ·002
502	·010	+ ·034
503	·014	·015
504	·015	·011
505	·009	·023
506	·004	·008
507	·024	− ·003
508	·011	+ ·015
509	·004	·016
510	·004	·007
511	·004	·005
512	·006	·006

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48th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
513	− ·005	+ ·007
514	+ ·001	·008
515	− ·004	·002
516	+ ·005	·006
517	− ·004	·001

Right-hand Branch

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
518	+ ·067	+ ·032
519	− ·038	− ·070
520	+ ·066	+ ·038
521	− ·039	− ·067
522	+ ·062	+ ·039
523	− ·044	− ·067
524	+ ·067	+ ·043
525	− ·048	− ·065
526	+ ·060	+ ·044
527	− ·046	− ·063
528	+ ·062	+ ·046
529	− ·048	− ·064
530	+ ·061	+ ·047
531	− ·050	− ·064
532	+ ·060	+ ·048
533	− ·052	− ·062
534	+ ·058	+ ·051
535	− ·053	− ·061
536	+ ·057	+ ·053
537	·056	·048
538	− ·053	− ·053
539	+ ·052	+ ·049
540	·051	·049
541	− ·047	− ·047
542	·047	·047
543	+ ·049	+ ·044

48th Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
544	− ·043	− ·045
545	+ ·043	+ ·038
546	− ·040	− ·041
547	·040	·041
548	+ ·038	+ ·037
549	− ·039	− ·036
550	·037	·035
551	+ ·031	+ ·033
552	·030	·033
553	− ·034	− ·027
554	+ ·028	+ ·031
555	− ·034	− ·025
556	+ ·021	+ ·028
557	·016	·025
558	− ·026	− ·015
559	·023	·018
560	+ ·012	+ ·019
561	·016	·023
562	− ·018	− ·010
563	·019	·013
564	+ ·011	+ ·014
565	·013	·015
566	− ·010	− ·007
567	·014	·010
568	+ ·007	+ ·010
569	− ·008	− ·002
570	+ ·005	+ ·005
571	− ·003	− ·001
572	+ ·004	+ ·002

49th Equation. Azimuth.

Equalizing Factor = 1.

Left-hand Branch

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
461	− 0·015	− 1·027
462	+ 1·015	+ 1·032
463	− 1·028	− 1·014
464	1·031	1·014
465	+ 1·014	+ 1·031
466	1·012	1·028
467	− 1·027	− 1·012
468	1·026	1·010
469	+ 1·010	+ 1·024
470	1·007	1·026
471	− 1·027	− 1·009
472	1·026	1·006
473	+ 1·008	+ 1.027
474	1·004	1·023
475	− 1·024	− 1·006
476	1·022	1·005
477	+ 1·005	+ 1·022
478	1·013	1·026
479	− 1·018	− 1·007
480	1·022	1·008
481	+ 1·004	+ 1·018
482	1·007	1·020
483	− 1·016	− 1·003
484	1·021	1·005
485	+ 1·002	+ 1·018
486	1·004	1·017
487	− 1·018	− 1·002
488	1·018	1·001
489	+ 1·001	+ 1·018
490	0·998	1·015
491	− 1·015	− 0·998

49th Equation—(Continued).

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
492	− 1·009	− 0·991
493	+ 1·000	+ 1·011
494	0·995	1·005
495	− 1·011	− 0·996
496	+ 0·998	+ 1·012
497	0·995	1·012
498	− 1·007	− 0·992
499	1·018	0·991
500	+ 0·995	+ 1·015
501	0·981	0·999
502	− 1·005	− 0·985
503	+ 0·994	+ 1·007
504	0·993	1·005
505	− 1·004	− 0·990
506	+ 0·998	+ 1·004
507	0·989	0·999
508	− 1·005	− 0·993
509	+ 0·999	+ 1·008
510	0·999	1·003
511	− 1·002	− 0·998
512	1·003	0·997
513	+ 0·998	+ 1·003
514	− 1·000	− 0·997
515	+ 0·998	+ 1·001
516	− 0·998	− 0·998
517	+ 0·998	+ 1·000

Right-hand Branch

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
518	+ 1·027	+ 1·014
519	− 1·016	− 1·028
520	+ 1·027	+ 1·016
521	− 1·017	− 1·027
522	+ 1·025	+ 1·016

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No. of Circuit Triangle	Coefficients of y and z		No. of Circuit Triangle	Coefficients of y and z		No. of Circuit Triangle	Coefficients of y and z		No. of Circuit Triangle	Coefficients of y and z	
	b	c		b	c		b	c		b	c
49th Equation—(Continued). *Equalizing Factor* = 1.			*49th Equation*—(Continued). *Equalizing Factor* = 1.			*49th Equation*—(Continued). *Equalizing Factor* = 1.			*49th Equation*—(Continued). *Equalizing Factor* = 1.		
523	− 1·019	− 1·027	536	+ 1.024	+ 1·022	549	− 1·017	− 1·015	562	− 1·008	− 1·004
524	+ 1·027	+ 1·018	537	1·024	1·020	550	1·016	1·015	563	1·008	1·006
525	− 1.020	− 1·027	538	− 1·022	− 1·022	551	+ 1·013	+ 1·014	564	+ 1·005	+ 1·006
526	+ 1·025	+ 1·018	539	+ 1·022	+ 1·021	552	1·013	1·014	565	1·005	1·006
527	− 1·019	− 1·026	540	1·021	1·021	553	− 1·014	− 1·011	566	− 1·005	− 1·003
528	+ 1·025	+ 1·019	541	− 1·020	− 1·020	554	+ 1·012	+ 1·013	567	1·006	1·004
529	− 1·020	− 1·026	542	1·020	1·020	555	− 1·015	− 1·011	568	+ 1·003	+ 1·004
530	+ 1·025	+ 1·020	543	+ 1·020	+ 1·018	556	+ 1·009	+ 1·012	569	− 1·003	− 1·001
531	− 1·021	− 1·026	544	− 1·018	− 1·019	557	1·007	1·011	570	+ 1·002	+ 1·002
532	+ 1·025	+ 1·020	545	+ 1·018	+ 1·016	558	− 1·011	− 1·007	571	− 1·002	− 1·001
533	− 1·021	− 1·025	546	− 1·017	− 1·017	559	1·010	1·008	572	+ 1·002	+ 1·001
534	+ 1·024	+ 1·021	547	1·017	1·017	560	+ 1·005	+ 1·008	573	− 1·000	− 1·000
535	− 1·022	− 1·025	548	+ 1·016	+ 1·016	561	1·007	1·010			

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13.

The Weights of the Angles.

The last Section has furnished us with the coefficients of the unknown quantities, 1146 in number, which enter the 49 circuit equations; the absolute terms of the same equations are shewn in Section 10. The next step, therefore, in order to obtain the most probable system of values of the unknown quantities which satisfies these equations, is to ascertain the weights of the angles, for employment in the expression for the minimum—see equation (67) page 60—which is to govern the solution of the equations. This is done—for reasons which have been set forth at length in Section 5 of Chapter VII, Volume II—by multiplying the preliminary weights,—*viz.*, those obtained from the evidence afforded by the actual measures of each angle—by certain factors or *moduli* which are required to reduce them all to a common and absolute unit of accuracy. Each group of angles, measured with the same instrument and under similar circumstances, has a constant value of the modulus, ρ, obtained as shewn in Section 2 of the preceding chapter.

Disparity of circumstance necessarily occurs whenever there are very marked variations in the general elevation of the observing and signal stations above the level of the ground; for on this condition freedom from grazing rays—and their concomitant lateral refractions—greatly depends. Disparity also occurs when the system of operation is varied, even without a change of instrument; for although there is a standing rule, to which no exception has ever been permitted, that the measurement of every angle must rest on readings taken at equidistant points of the azimuthal circle; yet the number of points read has varied with the number of microscopes attached to the theodolite, and with the number of changes of zero which were effected in each instance: again the number of standard measures on each zero has been sometimes 2, sometimes 3. Moreover certain of the theodolites, after having been employed for some years with three azimuthal microscopes, have had two more added—all five being placed at equal distances apart—which has led to a corresponding change in the arcs between the circle readings before and after the alteration. Now it has been found that the value of ρ^2 is frequently more influenced by changes of circumstance than by change of instrument; and consequently considerable circumspection is necessary before applying a value of this factor to any observations other than those of the group for which it was determined, even when made with the same instrument; for though this factor is partly dependent on the instrument, it is also dependent, and probably—in the case of all the best instruments, *viz.*, the 36-inch and 24-inch theodolites—to a greater extent, on various extraneous influences; and of these there can be little doubt that the most important is lateral refraction, which is liable to be greater in the plains than in the hills, and much greater in tracts of country which are covered with dense forest and jungle, than in tracts which are open and cultivated.

It has already been stated, at page 24, that the trigonometrical figures which are ordi-

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narily employed in the operations of this Survey have too few angles and geometrical conditions to permit of a reliable value of the modulus being usually determinable from the evidence of a single figure. In order therefore to obtain a fairly exact value, it was necessary to group together the several figures of which the angles have been measured with the same instrument and as nearly as possible under similar circumstances, to determine an average value of the Absolute Weights of all the observed angles from the geometrical errors exhibited in the several figures, and then to find the ratio of that average to the average of the Preliminary Weights of the same angles. This ratio gives the value of the modulus ρ^2. The several figures appertaining to the North-East Quadrilateral have been collected into 33 groups, for each of which a separate value of ρ^2 has been determined. The values of the weights of the angles which are obtained by multiplying the preliminary weights by ρ^2 are considered to be absolute and final; thus, with these values, independent measures of the same angles, made with different instruments, may be legitimately combined together; moreover the several angles of portions of the triangulation, which have been measured with different instruments, or under different circumstances, may also be combined together in the final reduction, with due regard to the relative accuracy of each angle.

The details on which the determinations of ρ^2 have been based will now be given. The symbols e_1, e_2 and e_3 will be here employed, as in Section 2 of the preceding chapter, to indicate the several values of the *e. m. s.*, which are respectively deduced from the preliminary weights, the triangular errors, and the geometrical errors of the angles of the polygonal figures. The values of e_1, e_2 and e_3 will be given for each group for comparison, and because e_1 is always the numerator of ρ, while either e_2, e_3, or a combined value of them, has been taken as the denominator of ρ.

Putting w for the preliminary weight of any angle, w_o for the average preliminary weight—or the unit of weight—of the whole of the angles, t in number, which are contained in any figure, and n for the number of geometrical equations of condition presented by the figure, we have

$$e_1^2 = \frac{1}{w_o}\,; \qquad e_3^2 = \frac{[wx^2]}{w_o n}\,;$$

$$e_2^2 = \frac{\text{sum of squares of triangular errors}}{\text{number of triangles} \times 3}\,.$$

Then, when we accept e_3 as the most probable value of the *e. m. s.*, we have

$$\rho^2 = \begin{cases} \dfrac{n}{[wx^2]} & \text{for a single polygonal figure,} \\[2ex] \dfrac{[n]}{\left[[wx^2]\right]} & \text{for a group of figures.} \end{cases}$$

The value of the quantity $[w\,x^2]$ for each polygonal figure is given at the end of the reduction of the figure, among the numerical details of the series to which it appertains.

The Data for the Calculation of ρ.

The following table gives the data from which the values of e_1, e_2 and e_3 were determined for each group of figures; also the approximate values of e_3 which are given by each figure.

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Data for the Calculation of ρ—(Continued).

Group	Series and Figure or Triangle	Hills or Plains	Data for e_1: Number of Angles t	Data for e_1: Sum of Preliminary Weights $[w]$	Data for e_2: Number of Triangles	Data for e_2: Sum of Squares of Triangular Errors	Data for e_3: Number of Geometrical Equations n	Data for e_3: Average of Preliminary Weights w_o	Data for e_3: $[wx^2]$	Data for e_3: $\frac{[wx^2]}{w_o}$	Approximate Single Values of e_3
I	I Fig. 1	H	18	247·95	6	4·79	10	13·78	32·17	2·33	± ·48
	„ 2	„	8	102·43	3	4·19	4	12·80	12·06	0·94	·49
	„ 3	„	8	65·05	3	4·15	4	8·13	7·78	0·96	·49
	„ 4	P	15	74·32	5	10·59	7	4·95	10·79	2·18	·56
	Tri. 91	„	3	20·18	1	0·77					
	Totals		52	509·93	18	24·49	25			6·41	
II	I Triangles 79—90	P	36	321·37	12	1·38					
	129—138	„	30	453·32	10	0·24					
	177—180	„	12	95·31	4	2·55					
	Totals		78	870·00	26	4·17					
III	I Fig. 5	P	18	296·38	6	2·31	8	16·47	66·27	4·02	± ·71
	Triangles 171—176	„	18	303·07	6	0·51					
	212—220	„	27	710·30	9	0·81					
	249—260	„	36	1077·47	12	5·13					
	289—302	„	42	1175·09	14	2·39					
	Totals		141	3562·31	47	11·15	8			4·02	
IV	I Triangles 323—330	P	24	94·49	8	11·70					
	354—361	„	24	95·19	8	9·78					
	Totals		48	189·68	16	21·48					
V	I Fig. 6	P	30	30·99	10	10·29	14	1·03	6·41	6·22	± ·67
VI	I Triangles 410—421	P	36	271·80	12	9·99					

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Data for the Calculation of ρ—(Continued).

Group	Series and Figure or Triangle	Hills or Plains	Data for e_1		Data for e_2		Data for e_3				Approximate Single Values of e_3
			Number of Angles t	Sum of Preliminary Weights $[w]$	Number of Triangles	Sum of Squares of Triangular Errors	Number of Geometrical Equations n	Average of Preliminary Weights w_o	$[wx^2]$	$\frac{[wx^2]}{w_o}$	
VII	I Fig. 7	P	18	222·60	6	4·11	8	12·37	16·31	1·32	± ·41
VIII	K Triangles 1—19	H & P	57	87·17	19	175·09					
IX	K Tri. 20	P	3	5·11	1	5·06					
X	K Triangles 21	P	3	3·74	1	0·21					
	24—33	„	30	33·43	10	94·68					
		Totals	33	37·17	11	94·89					
XI	K Fig. 8	P	9	14·01	3	0·25	5	1·56	0·18	0·12	± ·15
XII	L Triangles 45—71	H & P	81	36·87	27	258·46					
XIII	L Triangles 72—78	P	21	26·91	7	18·31					
XIV	M Fig. 9	H	8	16·15	3	55·23	4	2·02	33·62	16·64	± 2·04
	„ 10	„	54	85·49	18	148·37	26	1·58	81·78	51·76	1·41
		Totals	62	101·64	21	203·60	30			68·40	
XV	M Triangles 105—108	P	12	23·22	4	21·09					
	Fig. 11	„	12	16·95	4	11·82	6	1·41	4·61	3·27	± ·74
	Triangles 112—113	„	6	6·45	2	11·00					
		Totals	30	46·62	10	43·91	6			3·27	

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Data for the Calculation of ρ—(Continued).

Group	Series and Figure or Triangle	Hills or Plains	Data for e_1		Data for e_2		Data for e_3				Approximate Single Values of e_3
			Number of Angles t	Sum of Preliminary Weights $[w]$	Number of Triangles	Sum of Squares of Triangular Errors	Number of Geometrical Equations n	Average of Preliminary Weights w_0	$[wx^2]$	$\frac{[wx^2]}{w_0}$	
XVI	M Triangles 114—128	P	45	31·13	15	70·77					
XVII	N Triangles 139—149	H & P	33	22·45	11	77·78					
XVIII	N Triangles 150—170	P	63	219·68	21	52·58					
XIX	O Triangles 181—182	H	6	8·58	2	5·37					
	Fig. 12	"	23	27·56	8	15·75	11	1·20	14·41	12·01	± 1·04
	Triangles 188—208	P	63	76·40	21	67·01					
		Totals	92	112·54	31	88·13	11			12·01	
XX	P Fig. 13	H	31	6·07	11	15·28	19	0·20	1·78	8·88	± ·68
XXI	P Fig. 14	P & H	18	36·24	6	21·37	8	2·01	19·17	9·54	± 1·09
	Triangles 229—232	P	12	36·23	4	8·79					
		Totals	30	72·47	10	30·16	8			9·54	
XXII	P Triangles 233—248	P	48	158·50	16	201·86					
XXIII	Q Fig. 15	H	15	58·98	5	16·87	7	3·93	8·37	2·13	± ·55
	" 16	"	8	9·21	3	4·13	4	1·15	33·31	28·97	2·69
	" 17	"	18	22·68	6	22·48	8	1·26	12·96	10·29	1·13
	Triangles 272—283	P	36	60·50	12	19·90					
		Totals	77	151·37	26	63·38	19			41·39	

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Data for the Calculation of ρ—(Continued).

Group	Series and Figure or Triangle	Hills or Plains	Data for e_1		Data for e_2		Data for e_3				Approximate Single Values of e_3
			Number of Angles t	Sum of Preliminary Weights $[w]$	Number of Triangles	Sum of Squares of Triangular Errors	Number of Geometrical Equations n	Average of Preliminary Weights w_0	$[wx^2]$	$\frac{[wx^2]}{w_0}$	
XXIV	Q Triangles 284–288	P	15	342·55	5	3·06					
XXV	R Triangles 303–322	H & P	60	234·33	20	48·11					
XXVI	S Fig. 18	H	21	14·51	7	22·46	9	0·69	10·15	14·70	± 1·28
	,, 20	P	18	12·49	6	59·22	8	0·69	11·33	16·43	1·43
	Triangles 343–348	,,	18	14·21	6	16·56					
	Totals		57	41·21	19	98·24	17			31·13	
XXVII	S Fig. 19	H	21	24·76	7	26·71	9	1·18	15·94	13·51	± 1·23
XXVIII	T Triangles 362–406	P	135	15·94	45	185·80					
XXIX	U Fig. 21	P	18	264·92	6	2·09	8	14·72	9·99	0·68	± ·29
	Triangles 448–460	,,	39	497·82	13	2·95					
	Fig. 22	,,	18	281·33	6	0·81	8	15·63	4·94	0·32	·20
	Triangles 520–538	H & P	57	815·11	19	13·11					
	Totals		132	1859·18	44	18·96	16			1·00	
XXX	X Fig. 23	P	30	102·57	10	18·45	14	3·42	28·88	8·44	± ·78
	,, 24	,,	18	77·37	6	3·23	8	4·30	19·52	4·54	·75
	Totals		48	179·94	16	21·68	22			12·98	

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Data for the Calculation of ρ—(Continued).

Group	Series and Figure or Triangle	Hills or Plains	Data for e_1: Number of Angles t	Data for e_1: Sum of Preliminary Weights $[w]$	Data for e_2: Number of Triangles	Data for e_2: Sum of Squares of Triangular Errors	Data for e_3: Number of Geometrical Equations n	Data for e_3: Average of Preliminary Weights w_0	Data for e_3: $[wx^2]$	Data for e_3: $\frac{[wx^2]}{w_0}$	Approximate Single Values of e_3
XXXI	X F 25	P	18	83·75	6	4·31	8	4·65	12·10	2·60	± ·57
	„ 26	„	18	80·42	6	9·56	8	4·47	19·66	4·40	·74
	„ 27	H & P	15	71·37	5	7·30	7	4·76	9·41	1·98	·53
	„ 28	H	15	46·84	5	6·17	7	3·12	15·48	4·96	·84
	„ 29	„	15	67·43	5	1·60	7	4·50	2·27	0·51	·27
	„ 30	„	8	28·84	3	1·16	4	3·61	3·53	0·98	·49
	„ 31	„	24	104·73	8	4·06	12	4·36	10·36	2·38	·44
	„ 32	„	8	30·61	3	2·25	4	3·83	2·14	0·56	·37
		Totals	121	513·99	41	36·41	57			18·37	
XXXII	W F 33	H	39	141·43	13	6·08	19	3·63	9·74	2·68	± ·38
	„ 34	„	18	76·97	6	2·70	8	4·28	7·34	1·72	·46
	„ 35	„	54	159·00	18	11·24	26	2·94	44·35	15·08	·76
	„ 36	„	15	75·69	5	0·63	7	5·05	3·74	0·74	·33
	„ 37	„	8	32·92	3	1·79	4	4·12	1·70	0·41	·32
	„ 38	„	15	78·11	5	2·12	7	5·21	4·47	0·86	·35
	„ 39	„	27	164·17	9	4·02	13	6·08	14·71	2·42	·43
	„ 40	„	8	51·38	3	0·22	4	6·42	0·33	0·05	·11
	„ 41	„	8	45·28	3	2·98	4	5·66	4·47	0·79	·44
		Totals	192	824·95	65	31·78	92			24·75	
XXXIII	V F 42	P	18	228·81	6	5·67	8	12·71	24·88	1·96	± ·49
	„ 43	„	18	199·10	6	2·77	8	11·06	10·20	0·92	·34
	„ 44	„	18	264·25	6	2·75	8	14·68	14·95	1·02	·36
	„ 45	„	18	351·97	6	1·70	8	19·55	13·88	0·71	·30
	„ 46	„	27	355·87	9	14·59	13	13·18	54·13	4·11	·56
	„ 47	„	18	91·86	6	3·04	8	5·10	4·90	0·96	·35
	„ 48	„	30	232·41	10	11·54	14	7·75	38·85	5·01	·60
	„ 49	H, P	15	125·86	5	9·85	7	8·39	33·45	3·99	·75
	„ 50	„	18	180·97	6	4·20	8	10·05	17·14	1·71	·46
		Totals	180	2031·10	60	56·11	82			20·39	

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Synopsis of the Values of ρ^2, and the evidence for their determination.

Series	Group	Hills or Plains	Number of Angles	Instrument	Arc between Circle readings	Number of measures on each Zero	Minimum number of measures	e_1	e_2	e_3	Adopted denominator of ρ	ρ^2
					° ′						‡	
I	I	H,P	52	Col. Waugh's 24-inch No. 1	7 12	2	20	± ·319	± ·673	± ·506	0·51	·39
I	II	P	78	Troughton and Simms' 24-inch No. 2	10 0	2	24	·299	·232		0·23	1·70
I	III	„	141	Barrow's 36-inch	*9 0	2	16	·199	·281	·709	0·33	·37
					12 0	2	12					
I	IV	„	48	Barrow's 24-inch No. 1	10 0	2	24	·503	·669		0·67	·56
I	V	„	30	Cary's 15-inch	10 0	2	24	·984	·586	·666	0·67	2·14
I	VI	„	36	Troughton and Simms' 36-inch	9 0	2	16	·364	·527		0·53	·46
I	VII	„	18	Troughton and Simms' 36-inch	9 0	2	16	·284	·478	·406	0·41	·47
				Col. Waugh's 24-inch No. 2	7 12	2	20					
K	VIII	H,P	57	Cary's 18-inch L	10 0	2	24	·809	1·753		1·7	·23
K	IX	P	3	Cary's 18-inch M. O. / Harris and Barrow's 15-inch	10 0	2	24	·766	1·299			·21
K	X	„	33	Cary's 18-inch M. O.	10 0	2	24	·942	1·696			·31
K	XI	„	9	Harris and Barrow's 15-inch	10 0	2	24	·801	·165	·153		·22
L	XII	H,P	81	Troughton and Simms' 18-inch No. 1	10 0	2	24	1·482	1·786		1·8	·68
L	XIII	P	21	Troughton and Simms' 18-inch No. 2	10 0	2	24	·883	·934		1·0	·77
M	XIV	H	62	Troughton and Simms' 18-inch No. 1	10 0	2	24	·781	1·798	1·510	1·5	·27
M	XV	P	30	Harris and Barrow's 15-inch	10 0	2	24	·802	1·210	·738	0·9	·79
M	XVI	„	45	Saiyad Mir Mohsin's 18-inch	10 0	2	24	1·202	1·254		1·2	1·00
N	XVII	H,P	33	„ „ „	†10 0	2	24	1·212	1·535		1·5	·65
					6 40	2	36					
					5 0	2	48					

* The angles were measured on two sets of zeros. † The angles were measured on three sets of zeros.

‡ The values of the *Adopted Denominator of ρ*, are those which were employed in deducing the *Average Errors of Mean Square of the Observed Angles in each Series of Triangles*, which are given at page 64.

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Synopsis of the Values of ρ^2, *and the evidence for their determination*—(Continued).

Series	Group	Hills or Plains	Number of Angles	Instrument	Arc between Circle readings ° ′	Number of measures on each Zero	Minimum number of measures	e_1	e_2	e_3	Adopted denominator of ρ ‡	ρ^2
N	XVIII	P	63	Col. Waugh's 24-inch No. 1	9 0	2	16	·536	·913		0·9	·36
O	XIX	H,P	92	Harris and Barrow's 15-inch	10 0	2	24	·904	·974	1·045	1·0	·81
P	XX	H	31	Troughton and Simms' 18-inch No. 1	10 0	2	24	2·260	·680	·683	0·7	10·42
P	XXI	H,P	30	Troughton and Simms' 18-inch No. 2	10 0	2	24	·643	1·003	1·092	1·0	·41
P	XXII	P	48	Barrow's 24-inch No. 2.	10 0	2	24	·550	2·051		2·0	.08
Q	XXIII	H,P	77	Troughton and Simms' 18-inch No. 2	10 0	2	24	·713	·901	1·476	1·2	·35
Q	XXIV	P	15	Barrow's 36-inch	{*9 0 12 0}	2 2	{16 12}	·209	·452		0·5	·18
R	XXV	H,P	60	Barrow's 24-inch No. 1	10 0	2	24	·506	·895		0·9	·32
S	XXVI	,,	57	Cary's 15-inch	10 0	2	24	1·176	1·313	1·353	1·3	·82
S	XXVII	H	21	Troughton and Simms' 18-inch No. 2	10 0	2	24	·921	1·128	1·225	1·2	·59
T	XXVIII	P	147	Troughton and Simms' 18-inch No. 1	10 0	2	24	3·100	1·170		1·4	4·32
U	XXIX	H,P	132	Troughton and Simms' 24-inch No. 2	7 12	3	30	·266	·379	·249	0·34	·61
X	XXX	P	48	{Barrow's 24-inch No. 1 Col. Waugh's 24-inch No. 2}	7 12	3	30	·516	·672	·768	0·77	·45
X	XXXI	H,P	121	Barrow's 24-inch No. 1	7 12	3	30	·485	·544	·567	0·57	·72
W	XXXII	H	192	,, ,,	7 12	3	30	·482	·404	·519	0·52	·86
V	XXXIII	H,P	180	Troughton and Simms' 24-inch No. 2	7 12	3	30	·298	·558	·499	0·50	·36

* The angles were measured on two sets of zeros.

‡ The values of the *Adopted Denominator of* ρ, are those which were employed in deducing the ***Average Errors of Mean Square of the Observed Angles in each Series of Triangles***, which are given at page 64.

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A few remarks in explanation of the details given in the preceding table are here necessary.

In forming the several combinations of angles, angles observed at hill stations have been combined with those observed at stations in the plains, wherever the magnitudes of the triangular or polygonal errors shewed that either instrumental defects, or want of skill on the part of the observer, had influenced the observations in a greater degree than they were influenced by variations in the atmospheric conditions of the localities of operation. Thus, as the instruments employed were frequently of an inferior character, hill and plain observations have been combined together far more frequently than in the reductions of the North-West and South-East Quadrilaterals.

The value of ρ had in previous reductions been taken as $= e_1 \div e_3$ wherever possible, otherwise as $= e_1 \div e_2$. In the present reduction the denominator of ρ has sometimes been assigned a value intermediate between e_2 and e_3, as in groups which are composed both of single triangles and of polygonal figures; for this reason a column has been added giving the adopted value of the said denominators for each group. It is from the quantities in this column that the average values of the *e.m. s*'s of the observed angles in each series of triangles, which are given in Section 1 of the present chapter, were determined, as has already been explained in a foot note to page 64.

Group III comprises 41 single triangles and one polygonal figure composed of 6 triangles: all the angles were measured with Barrow's 36-inch theodolite, and the denominator of ρ for the whole group was taken as

$$\frac{41\, e_2 + 6\, e_3}{47}$$

Groups VIII, IX, X and XI. These groups make up the Rangír Meridional Series. The first three were almost entirely executed with Cary's two 18-inch theodolites and the last with Harris and Barrow's 15-inch. As Group IX only contained one triangle and Group XI only three, the data afforded by each for the calculation of ρ was insufficient, and a value of the denominator of ρ for all four groups was obtained by taking the mean of e_2 for Groups VIII and X.

Group XII. There is some doubt as to the instrument employed in measuring the angles of this group. It was one of the two 18-inch theodolites by Troughton and Simms, but the present distinguishing numbers of these instruments were not assigned to them originally, nor until some years after they had both been extensively employed; thus it is only possible to arrive at any conclusions as to which of the two instruments had previously been employed in any particular instance by an examination of the observations. The zero means by the instrument now known as No. 1 have of late years exhibited far larger discrepancies than those by No. 2; and these discrepancies have formed the subject of the special investigations which are mentioned at page 96 of Vol. II, and are given in detail in Appendix No. 4 of the same volume, where they are shown to be due to periodic errors of graduation, entering the zero means but eliminated in the general mean of the zeros. Thus for all the later obser-

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vations with this instrument, e_1 is always much larger than e_2 or e_3, as previously pointed out and here shewn in Groups XX and XXVIII. But in Group XII e_1 is materially less than e_2, and is much smaller than usual, while e_2 is much greater than usual. An interval of about four years elapsed between the measurement of the angles of this group and that of the angles of the next group, XIV—taken, it is believed, with the same instrument—in which the value of e_1 is only half as great, while that of e_2 is the same as in Group XII. This may arise from the circumstance that the observer of XIV is known to have discovered that the large differences between the results obtained at successive zero-settings with his instrument, were due to systematic graduation error which might be eliminated to a great extent by taking the means of pairs of zero means, on face left and face right, for circle readings 180° apart from each other; he operated accordingly, and recorded the results without giving any details of the circle readings; thus his angles give much smaller values of e_1 than those of other observers who recorded the whole of their observations in the usual way; on the other hand his e_2 is as large as that of Group XII. The angles of that group were measured in 1833-38, those of XIV in 1841-44, those of XXVIII in 1845-47, and of XX in 1848-49. All the old instruments that were employed in the principal triangulation are known to have been occasionally modified as well as repaired in the Mathematical Instrument Department at Calcutta. Thus it is very possible that No. 1, which had been unfavorably reported of and removed from the Karára Series and sent to that Department for repair in August 1844, was modified before being again employed a few months afterwards, in April 1845, on the Calcutta Meridional Series; if so, it appears that the alterations, while improving the general efficiency of the instrument and rendering it capable of giving much more accurate results, must in some way have increased the magnitude of the periodic but eliminable errors of its azimuthal circle. On this subject however no information is now forthcoming.

Group XIII comprises 7 triangles of which the angles were measured with Troughton and Simms' 18-inch theodolite No. 2, and as the same theodolite was employed for measuring the angles of Group XXI, which comprises 4 triangles and 1 polygonal figure, a mean value of e_2 from both groups was taken as the denominator of ρ for each.

Group XV comprises 6 triangles and 1 polygonal figure, and the value of the denominator of ρ has been taken intermediately between e_2 and e_3.

Group XXI.—See remarks on Group XIII.

Group XXIII comprises 12 triangles and 3 polygonal figures, and the mean of e_2 and e_3 has been taken as the denominator of ρ.

Group XXIX comprises 32 single triangles, and 2 polygonal figures embracing 12 triangles. The angles were all measured with Troughton and Simms' 24-inch theodolite No. 2, and the denominator of ρ was obtained as in Group III.

It is to be noted that the values of e_1 for angles observed with the old and less accurate instruments were computed with the old "probability" formula—page 21—and are

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therefore not comparable with those for the modern angles and better instruments which were computed with the modern "weight" formula—page 23. When both formulæ are applied to the same observations, the modern one gives the largest value of e_1; but the difference between the two results is usually insignificant when the graduation errors of the azimuthal circles are larger than errors of observation, as generally happened in the case of the old instruments. The value of e_1 is not required to be known absolutely, as it merely furnishes a determination of relative weight, which is eliminated in the calculation of the final and absolute weight to be employed in the simultaneous reduction of the triangulation as a whole.

The Weights employed in the Simultaneous Reduction of the North-East Quadrilateral.

On multiplying the several Preliminary Weights of the angles in each group by the corresponding value of the Factor ρ^2, as now set forth, we acquire the most exact values of the Final or Absolute Weights of the observed angles which appear to be obtainable. And had it been desirable, in the Simultaneous Reduction, to introduce the circuit errors of the whole of the angles of the polygonal figures and net-works, we should have wanted nothing more; for then the weights to be employed would have been the absolute weights of the *observed* angles. But this would have caused so large a number of equations to be presented for simultaneous treatment, that the solution would not have been manageable. Thus such portions only of the polygonal figures and net-works have been introduced into the Simultaneous Reduction as are necessary to complete the chains of single triangles, and the remaining were reserved for subsequent treatment, figure by figure.

This departure from rigorous accuracy in the treatment of the facts of observation, has necessitated a transition from the weights of the observed angles to those of the corrected angles, for reasons which have been fully set forth at page 168 of Volume II. The transition is performed with all desirable exactitude, by multiplying the average absolute weight of all the angles appertaining to any single triangle, polygonal figure, or net-work, by the factor $t \div (t - n)$ —in which t is the number of observed angles and n the number of geometrical conditions for the figure—as is demonstrated in Section 5 of Chapter XV, Volume II, for figures in which all the observed angles are of equal weight. Illustrations of the differences of this value of the factor and the value which obtains when the variations of weight are recognised, will be found at pages 220 and 241 of the same volume.

If we now put w_o for the average value of the Preliminary Weights of the Observed Angles of a single triangle, or those of a polygonal figure, as formerly; also w_c for the average value of the Absolute Weights of the Corrected Angles of the same triangle or figure, we have

$$w_c = w_o \times \rho^2 \times \frac{t}{t - n}.$$

It will be evident that w_c corresponds to the $\frac{1}{u}$ of the formulæ for the normal equa-

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tions from which the values of the Indeterminate Factors are determined for the Simultaneous Reduction; see Section 11 of Chapter II.

In the formation and calculation of the Normal Equations between the Indeterminate Factors it was considered that if the adopted value of any weight does not differ by more than a tenth part from its computed value, it is sufficiently accurate, arithmetical nicety being here out of place. A table was therefore employed, which is given below, for determining the working values of $\frac{u}{3}$ from the values of w_c in the formation of the equations between the Indeterminate Factors and those in which the most probable values of the angular errors are expressed in terms of those factors; see again Section 11 of Chapter II.

w_c	$\frac{u}{3}$	w_c	$\frac{u}{3}$	w_c	$\frac{u}{3}$	w_c	$\frac{u}{3}$	w_c	$\frac{u}{3}$
60·6		21·5		4·4		1·48		·35	
	·006		·016		·08		·25		1·0
51·2		18·5		3·9		1·21		·31	
	·007		·02		·09		·3		1·1
44·4		14·8		3·5		1·02		·28	
	·008		·025		·10		·35		1·2
39·2		12·1		3·1		·88		·26	
	·009		·03		·11		·4		1·3
35·0		10·2		2·8		·78		·24	
	·010		·035		·12		·45		1·4
31·7		8·8		2·6		·70		·22	
	·011		·04		·13		·5		1·5
28·9		7·8		2·4		·60		·21	
	·012		·045		·14		·6		1·6
26·6		7·0		2·2		·51		·18	
	·013		·05		·15		·7		2·0
24·6		6·0		2·1		·44		·14	
	·014		·06		·16		·8		2·5
22·9		5·1		1·85		·39		·12	
	·015		·07		·2		·9		
21·5		4·4		1.48		·35			

The following table gives the average values of w_c for the angles of every circuit triangle and also the corresponding value of $\frac{u}{3}$ employed in the calculations.

The Absolute Weights of the Figurally Corrected Angles with the data for their determination.

All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$	All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$
1		10·4	ρ^2_8, 0·23	3 ÷ 2, 1·5	3·64	0·09	50		0·5	ρ^2_{12}, 0·68	3 ÷ 2, 1·5	0·51	0·7
2		0·6	"	3 2, 1·5	0·21	1·6	51		0·3	"	3 2, 1·5	0·31	1·1
3		0·6	"	3 2, 1·5	0·21	1·6	52		0·3	"	3 2, 1·5	0·31	1·1
4		0·9	"	3 2, 1·5	0·32	1·0	53		0·3	"	3 2, 1·5	0·31	1·1
5		0·5	"	3 2, 1·5	0·18	2·0	54		0·7	"	3 2, 1·5	0·71	0·45
6		2·2	"	3 2, 1·5	0·77	0·4	55		0·4	"	3 2, 1·5	0·41	0·8
7		2·4	"	3 2, 1·5	0·84	0·4	56		0·3	"	3 2, 1·5	0·31	1·1
8		1·6	"	3 2, 1·5	0·56	0·6	57		0·5	"	3 2, 1·5	0·51	0·7
9		1·6	"	3 2, 1·5	0·56	0·6	58		0·5	"	3 2, 1·5	0·51	0·7
10		0·6	"	3 2, 1·5	0·21	1·6	59		0·4	"	3 2, 1·5	0·41	0·8
11		0·7	"	3 2, 1·5	0·25	1·3	60		0·3	"	3 2, 1·5	0·31	1·1
12		0·7	"	3 2, 1·5	0·25	1·3	61		0·6	"	3 2, 1·5	0·61	0·5
13		0·5	"	3 2, 1·5	0·18	2·0	62		0·4	"	3 2, 1·5	0·41	0·8
14		0·6	"	3 2, 1·5	0·21	1·6	63		0·4	"	3 2, 1·5	0·41	0·8
15		0·4	"	3 2, 1·5	0·14	2·5	64		0·4	"	3 2, 1·5	0·41	0·8
16		0·7	"	3 2, 1·5	0·25	1·3	65		0·4	"	3 2, 1·5	0·41	0·8
17		0·7	"	3 2, 1·5	0·25	1·3	66		0·4	"	3 2, 1·5	0·41	0·8
18		1·9	"	3 2, 1·5	0·67	0·5	67		0·3	"	3 2, 1·5	0·31	1·1
19		1·6	"	3 2, 1·5	0·56	0·6	68		0·3	"	3 2, 1·5	0·31	1·1
20		1·7	ρ^2_9, 0·21	3 2, 1·5	0·54	0·6	69		0·3	"	3 2, 1·5	0·31	1·1
21		1·2	ρ^2_{10}, 0·31	3 2, 1·5	0·56	0·6	70		0·4	"	3 2, 1·5	0·41	0·8
22,23	8	1·6	ρ^2_{11}, 0·22	9 4, 2·3	0·82	0·4	71		0·7	"	3 2, 1·5	0·71	0·45
24		1·0	ρ^2_{10}, 0·31	3 2, 1·5	0·47	0·7	72		1·0	ρ^2_{13}, 0·77	3 2, 1·5	1·16	0·3
25		1·1	"	3 2, 1·5	0·52	0·6	73		1·0	"	3 2, 1·5	1·16	0·3
26		0·8	"	3 2, 1·5	0·38	0·9	74		2·0	"	3 2, 1·5	2·32	0·14
27		1·1	"	3 2, 1·5	0·52	0·6	75		1·7	"	3 2, 1·5	1·97	0·16
28		0·8	"	3 2, 1·5	0·38	0·9	76		0·9	"	3 2, 1·5	1·04	0·3
29		1·0	"	3 2, 1·5	0·47	0·7	77		1·4	"	3 2, 1·5	1·62	0·2
30		1·8	"	3 2, 1·5	0·85	0·4	78		1·1	"	3 2, 1·5	1·28	0·25
31		1·0	"	3 2, 1·5	0·47	0·7	79		7·6	ρ^2_2, 1·70	3 2, 1·5	19·38	0·016
32		1·5	"	3 2, 1·5	0·71	0·45	80		4·7	"	3 2, 1·5	11·99	0·03
33		1·0	"	3 2, 1·5	0·47	0·7	81		6·7	"	3 2, 1·5	17·09	0·02
34—36	4	5·0	ρ^2_1, 0·39	15 8, 1·9	3·70	0·09	82		8·1	"	3 2, 1·5	20·66	0·016
37,38	3	8·1	"	8 4, 2·0	6·32	0·05	83		15·2	"	3 2, 1·5	38·76	0·009
39,40	2	12·8	"	8 4, 2·0	9·98	0·035	84		8·0	"	3 2, 1·5	20·40	0·016
41—44	1	13·8	"	18 8, 2·3	12·42	0·025	85		10·6	"	3 2, 1·5	27·03	0·012
45		0·8	ρ^2_{12}, 0·68	3 2, 1·5	0·82	0·4	86		8·9	"	3 2, 1·5	22·70	0·015
46		0·6	"	3 2, 1·5	0·61	0·5	87		9·8	"	3 2, 1·5	24·99	0·013
47		0·5	"	3 2, 1·5	0·51	0·7	88		6·2	"	3 2, 1·5	15·81	0·02
48		0·7	"	3 2, 1·5	0·71	0·45	89		10·3	"	3 2, 1·5	26·27	0·013
49		0·5	"	3 2, 1·5	0·51	0·7	90		11·2	"	3 2, 1·5	28·56	0·012

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The Absolute Weights of the Figurally Corrected Angles with the data for their determination—(Continued).

All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$	All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$
91		6·7	ρ^2_1, 0·39	3 ÷ 2, 1·5	3·95	0·08	144		0·9	ρ^2_{17}, 0·65	3 ÷ 2, 1·5	0·88	0·4
92	4	5·0	"	15 8, 1·9	3·70	0·09	145		0·8	"	3 2, 1·5	0·78	0·45
93,94	9	2·0	ρ^2_{14}, 0·27	8 4, 2·0	1·08	0·3	146		0·2	"	3 2, 1·5	0·20	1·6
95—104	10	1·6	"	54 28, 1·9	0·82	0·4	147		0·4	"	3 2, 1·5	0·39	0·9
105		2·5	ρ^2_{15}, 0·79	3 2, 1·5	2·98	0·11	148		0·5	"	3 2, 1·5	0·49	0·7
106		1·7	"	3 2, 1·5	2·02	0·16	149		0·6	"	3 2, 1·5	0·59	0·6
107		1·5	"	3 2, 1·5	1·79	0·2	150		2·9	ρ^2_{18}, 0·36	3 2, 1·5	1·57	0·2
108		2·1	"	3 2, 1·5	2·50	0·13	151		4·0	"	3 2, 1·5	2·16	0·15
109—111	11	1·4	"	12 6, 2·0	2·21	0·15	152		4·4	"	3 2, 1·5	2·38	0·14
112		1·3	"	3 2, 1·5	1·55	0·2	153		2·4	"	3 2, 1·5	1·30	0·25
113		0·8	"	3 2, 1·5	0·95	0·35	154		1·5	"	3 2, 1·5	0·81	0·4
114		0·7	ρ^2_{16}, 1·00	3 2, 1·5	1·05	0·3	155		3·4	"	3 2, 1·5	1·84	0·2
115		0·6	"	3 2, 1·5	0·90	0·35	156		1·2	"	3 2, 1·5	0·65	0·5
116		1·0	"	3 2, 1·5	1·50	0·2	157		5·2	"	3 2, 1·5	2·81	0·12
117		0·6	"	3 2, 1·5	0·90	0·35	158		2·4	"	3 2, 1·5	1·30	0·25
118		1·1	"	3 2, 1·5	1·65	0·2	159		5·1	"	3 2, 1·5	2·75	0·12
119		0·7	"	3 2, 1·5	1·05	0·3	160		4·1	"	3 2, 1·5	2·21	0·15
120		0·5	"	3 2, 1·5	0·75	0·45	161		2·9	"	3 2, 1·5	1·57	0·2
121		0·4	"	3 2, 1·5	0·60	0·6	162		7·1	"	3 2, 1·5	3·83	0·09
122		0·6	"	3 2, 1·5	0·90	0·35	163		3·9	"	3 2, 1·5	2·11	0·16
123		0·6	"	3 2, 1·5	0·90	0·35	164		5·3	"	3 2, 1·5	2·86	0·12
124		0·6	"	3 2, 1·5	0·90	0·35	165		7·0	"	3 2, 1·5	3·78	0·09
125		0·6	"	3 2, 1·5	0·90	0·35	166		3·8	"	3 2, 1·5	2·05	0·16
126		0·6	"	3 2, 1·5	0·90	0·35	167		1·7	"	3 2, 1·5	0·92	0·35
127		1·1	"	3 2, 1·5	1·65	0·2	168		1·4	"	3 2, 1·5	0·76	0·45
128		0·7	"	3 2, 1·5	1·05	0·3	169		1·1	"	3 2, 1·5	0·59	0·6
129		15·5	ρ^2_2, 1·70	3 2, 1·5	39·53	0·008	170		2·7	"	3 2, 1·5	1·46	0·25
130		10·8	"	3 2, 1·5	27·54	0·012	171		14·8	ρ^2_3, 0·37	3 2, 1·5	8·29	0·04
131		15·3	"	3 2, 1·5	39·02	0·009	172		21·6	"	3 2, 1·5	12·10	0·03
132		11·8	"	3 2, 1·5	30·09	0·011	173		19·2	"	3 2, 1·5	10·75	0·03
133		23·6	"	3 2, 1·5	60·18	0·006	174		14·7	"	3 2, 1·5	8·23	0·04
134		11·1	"	3 2, 1·5	28·31	0·012	175		20·6	"	3 2, 1·5	11·54	0·03
135		22·5	"	3 2, 1·5	57·38	0·006	176		10·2	"	3 2, 1·5	5·71	0·06
136		18·3	"	3 2, 1·5	46·67	0·007	177		10·4	ρ^2_2, 1·70	3 2, 1·5	26·52	0·013
137		14·0	"	3 2, 1·5	35·70	0·009	178		6·1	"	3 2, 1·5	15·56	0·02
138		8·1	"	3 2, 1·5	20·66	0·016	179		6·6	"	3 2, 1·5	16·83	0·02
139		1·0	ρ^2_{17}, 0·65	3 2, 1·5	0·98	0·35	180		8·6	"	3 2, 1·5	21·93	0·015
140		1·1	"	3 2, 1·5	1·08	0·3	181		0·8	ρ^2_{19}, 0·81	3 2, 1·5	0·98	0·35
141		1·0	"	3 2, 1·5	0·98	0·35	182		2·0	"	3 2, 1·5	2·44	0·14
142		0·5	"	3 2, 1·5	0·49	0·7	183—187	12	1·2	"	23 12, 1·9	1·85	0·2
143		0·6	"	3 2, 1·5	0·59	0·6	188		1·3	"	3 2, 1·5	1·59	0·2

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The Absolute Weights of the Figurally Corrected Angles with the data for their determination—(Continued).

All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$	All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$
189		1·0	ρ^2_{19}, 0·81	3 ÷ 2, 1·5	1·22	0·25	238		3·4	ρ^2_{22}, 0·08	3 ÷ 2, 1·5	0·41	0·8
190		1·2	,,	3 2, 1·5	1·46	0·25	239		3·6	,,	3 2, 1·5	0·43	0·8
191		1·3	,,	3 2, 1·5	1·59	0·2	240		3·9	,,	3 2, 1·5	0·47	0·7
192		1·1	,,	3 2, 1·5	1·34	0·25	241		3·4	,,	3 2, 1·5	0·41	0·8
193		1·5	,,	3 2, 1·5	1·83	0·2	242		1·9	,,	3 2, 1·5	0·23	1·4
194		1·3	,,	3 2, 1·5	1·59	0·2	243		2·3	,,	3 2, 1·5	0·28	1·2
195		1·3	,,	3 2, 1·5	1·59	0·2	244		3·2	,,	3 2, 1·5	0·38	0·9
196		0·9	,,	3 2, 1·5	1·10	0·3	245		2·9	,,	3 2, 1·5	0·35	1·0
197		1·0	,,	3 2, 1·5	1·22	0·25	246		3·6	,,	3 2, 1·5	0·43	0·8
198		1·4	,,	3 2, 1·5	1·71	0·2	247		3·4	,,	3 2, 1·5	0·41	0·8
199		0·9	,,	3 2, 1·5	1·10	0·3	248		2·8	,,	3 2, 1·5	0·34	1·0
200		1·2	,,	3 2, 1·5	1·46	0·25	249		26·4	ρ^2_{3}, 0·37	3 2, 1·5	14·78	0·025
201		1·1	,,	3 2, 1·5	1·34	0·25	250		52·8	,,	3 2. 1·5	29·57	0·011
202		1·3	,,	3 2, 1·5	1·59	0·2	251		66·7	,,	3 2, 1·5	37·35	0·009
203		1·0	,,	3 2, 1·5	1·22	0·25	252		14·3	,,	3 2, 1·5	8·01	0·04
204		0·7	,,	3 2, 1·5	0·85	0·4	253		66·7	,,	3 2, 1·5	37·35	0·009
205		1·3	,,	3 2, 1·5	1·59	0·2	254		30·6	,,	3 2, 1·5	17·14	0·02
206		0·9	,,	3 2, 1·5	1·10	0·3	255		26·4	,,	3 2, 1·5	14·78	0·025
207		2·5	,,	3 2, 1·5	3·05	0·11	256		7·4	,,	3 2, 1·5	4·14	0·08
208		1·3	,,	3 2, 1·5	1·59	0·2	257		15·3	,,	3 2, 1·5	8·57	0·04
209—211	5	16·5	ρ^2_{3}, 0·37	18 10, 1·8	11·06	0·03	258		7·4	,,	3 2, 1·5	4·14	0·08
212		16·2	,,	3 2, 1·5	9·07	0·035	259		7·7	,,	3 2, 1·5	4·31	0·08
213		13·7	,,	3 2, 1·5	7·67	0·045	260		37·7	,,	3 2, 1·5	21·11	0·016
214		8·8	,,	3 2, 1·5	4·93	0·07	261,262	5	16·5	,,	18 10, 1·8	11·06	0·03
215		18·8	,,	3 2, 1·5	10·53	0·03	263—265	15	3·9	ρ^2_{23}, 0·35	15 8, 1·9	2·61	0·13
216		19·2	,,	3 2, 1·5	10·75	0·03	266,267	16	1·2	,,	8 4, 2·0	0·84	0·4
217		115·9	,,	3 2, 1·5	64·90	0·005	268—271	17	1·3	,,	18 10, 1·8	0·82	0·4
218		17·3	,,	3 2, 1·5	9·69	0·035	272		1·3	,,	3 2, 1·5	0·69	0·5
219		15·7	,,	3 2, 1·5	8·79	0·04	273		1·1	,,	3 2, 1·5	0·58	0·6
220		11·2	,,	3 2, 1·5	6·27	0·05	274		1·6	,,	3 2, 1·5	0·85	0·4
221—224	13	0·2	ρ^2_{20}, 10·42	31 12, 2·6	5·42	0·06	275		1·2	,,	3 2, 1·5	0·64	0·5
225—228	14	2·0	ρ^2_{21}, 0·41	18 10, 1·8	1·48	0·25	276		1·7	,,	3 2, 1·5	0·90	0·35
229		2·8	,,	3 2, 1·5	1·74	0·2	277		3·1	,,	3 2, 1·5	1·64	0·2
230		2·0	,,	3 2, 1·5	1·24	0·25	278		1·6	,,	3 2, 1·5	0·85	0·4
231		2·5	,,	3 2, 1·5	1·55	0·2	279		1·5	,,	3 2, 1·5	0·80	0·4
232		4·8	,,	3 2, 1·5	2·98	0·11	280		1·3	,,	3 2, 1·5	0·69	0·5
233		4·9	ρ^2_{22}, 0·08	3 2, 1·5	0·59	0·6	281		1·6	,,	3 2, 1·5	0·85	0·4
234		3·0	,,	3 2, 1·5	0·36	0·9	282		1·3	,,	3 2, 1·5	0·69	0·5
235		3·2	,,	3 2, 1·5	0·38	0·9	283		2·7	,,	3 2, 1·5	1·43	0·25
236		2·0	,,	3 2, 1·5	0·24	1·4	284		14·2	ρ^2_{24}, 0·18	3 2, 1·5	3·83	0·09
237		5·3	,,	3 2, 1·5	0·64	0·5	285		55·6	,,	3 2, 1·5	15·01	0·02

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The Absolute Weights of the Figurally Corrected Angles with the data for their determination—(Continued).

All Angles in Triangles	Figure	w_0	ρ^2	$\frac{t}{t-n}$	$w_c = w_0 \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$	All Angles in Triangles	Figure	w_0	ρ^2	$\frac{t}{t-n}$	$w_c = w_0 \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$
286		11·1	ρ^2_{24}, 0·18	3 ÷ 2, 1·5	3·00	0·11	327		2·9	ρ^2_4, 0·56	3 ÷ 2, 1·5	2·44	0·14
287		19·4	„	3 2, 1·5	5·24	0·06	328		3·6	„	3 2, 1·5	3·02	0·11
288		13·9	„	3 2, 1·5	3·75	0·09	329		4·1	„	3 2, 1·5	3·44	0·10
289		21·4	ρ^2_3, 0·37	3 2, 1·5	11·98	0·03	330		3·8	„	3 2, 1·5	3·19	0·10
290		19·7	„	3 2, 1·5	11·03	0·03	331—334	18	0·7	ρ^2_{26}, 0·82	21 12, 1·8	1·04	0·3
291		16·3	„	3 2, 1·5	9·13	0·035	335—338	19	1·2	ρ^2_{27}, 0·59	21 12, 1·8	1·27	0·25
292		14·2	„	3 2, 1·5	7·95	0·04	339—342	20	0·7	ρ^2_{26}, 0·82	18 10, 1·8	1·04	0·3
293		12·8	„	3 2, 1·5	7·17	0·045	343		1·0	„	3 2, 1·5	1·23	0·25
294		20·3	„	3 2, 1·5	11·37	0·03	344		0·9	„	3 2, 1·5	1·11	0·3
295		25·9	„	3 2, 1·5	14·50	0·025	345		0·9	„	3 2, 1·5	1·11	0·3
296		11·6	„	3 2, 1·5	6·50	0·05	346		0·5	„	3 2, 1·5	0·62	0·6
297		51·1	„	3 2, 1·5	28·62	0·012	347		0·5	„	3 2, 1·5	0·62	0·6
298		54·8	„	3 2, 1·5	30·69	0·011	348		0·8	„	3 2, 1·5	0·98	0·35
299		44·4	„	3 2, 1·5	24·86	0·013	349—353	6	1·0	ρ^2_5, 2·14	30 16, 1·9	4·07	0·08
300		17·6	„	3 2, 1·5	9·86	0·035	354		5·2	ρ^2_4, 0·56	3 2, 1·5	4·37	0·08
301		58·3	„	3 2, 1·5	32·65	0·01	355		4·0	„	3 2, 1·5	3·36	0·10
302		23·3	„	3 2, 1·5	13·05	0·025	356		4·8	„	3 2, 1·5	4·03	0·08
303		6·7	ρ^2_{25}, 0·32	3 2, 1·5	3·22	0·10	357		4·7	„	3 2, 1·5	3·95	0·08
304		4·8	„	3 2, 1·5	2·30	0·14	358		3·3	„	3 2, 1·5	2·77	0·12
305		3·9	„	3 2, 1·5	1·87	0·16	359		3·7	„	3 2, 1·5	3·11	0·11
306		3·3	„	3 2, 1·5	1·58	0·2	360		3·7	„	3 2, 1·5	3·11	0·11
307		5·2	„	3 2, 1·5	2·50	0·13	361		2·3	„	3 2, 1·5	1·93	0·16
308		5·1	„	3 2, 1·5	2·45	0·14	362		0·13	ρ^2_{28}, 4·32	3 2, 1·5	0·84	0·4
309		2·2	„	3 2, 1·5	1·06	0·3	363		0·13	„	3 2, 1·5	0·84	0·4
310		2·1	„	3 2, 1·5	1·01	0·35	364		0·17	„	3 2, 1·5	1·10	0·3
311		2·5	„	3 2, 1·5	1·20	0·3	365		0·13	„	3 2, 1·5	0·84	0·4
312		2·5	„	3 2, 1·5	1·20	0·3	366		0·13	„	3 2, 1·5	0·84	0·4
313		5·1	„	3 2, 1·5	2·45	0·14	367		0·1	„	3 2, 1·5	0·65	0·5
314		9·0	„	3 2, 1·5	4·32	0·08	368		0·1	„	3 2, 1·5	0·65	0·5
315		3·9	„	3 2, 1·5	1·87	0·16	369		0·13	„	3 2, 1·5	0·84	0·4
316		5·1	„	3 2, 1·5	2·45	0·14	370		0·1	„	3 2, 1·5	0·65	0·5
317		3·4	„	3 2, 1·5	1·63	0·2	371		0·1	„	3 2, 1·5	0·65	0·5
318		3·0	„	3 2, 1·5	1·44	0·25	372		0·13	„	3 2, 1·5	0·84	0·4
319		2·8	„	3 2, 1·5	1·34	0·25	373		0·1	„	3 2, 1·5	0·65	0·5
320		2·3	„	3 2, 1·5	1·10	0·3	374		0·13	„	3 2, 1·5	0·84	0·4
321		3·3	„	3 2, 1·5	1·58	0·2	375		0·13	„	3 2, 1·5	0·84	0·4
322		2·0	„	3 2, 1·5	0·96	0·35	376		0·1	„	3 2, 1·5	0·65	0·5
323		2·8	ρ^2_4, 0·56	3 2, 1·5	2·35	0·14	377		0·13	„	3 2, 1·5	0·84	0·4
324		4·8	„	3 2, 1·5	4·03	0·08	378		0·1	„	3 2, 1·5	0·65	0·5
325		4·9	„	3 2, 1·5	4·12	0·08	379		0·1	„	3 2, 1·5	0·65	0·5
326		4·7	„	3 2, 1·5	3·95	0·08	380		0·1	„	3 2, 1·5	0·65	0·5

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The Absolute Weights of the Figurally Corrected Angles with the data for their determination—(Continued).

All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$	All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$
381		0·1	ρ^2_{28}, 4·32	3÷ 2, 1·5	0·65	0·5	425—430	23	3·4	ρ^2_{30}, 0·45	30÷ 16, 1·9	2·92	0·11
382		0·1	„	3 2, 1·5	0·65	0·5	431—434	24	4·3	„	18 10, 1·8	3·48	0·10
383		0·13	„	3 2, 1·5	0·84	0·4	435—438	25	4·7	ρ^2_{31}, 0·72	18 10, 1·8	6·11	0·05
384		0·13	„	3 2, 1·5	0·84	0·4	439—442	26	4·5	„	18 10, 1·8	5·85	0·06
385		0·1	„	3 2, 1·5	0·65	0·5	443	27	4·8	„	15 8, 1·9	6·58	0·05
386		0·1	„	3 2, 1·5	0·65	0·5	444—447	21	14·7	ρ^2_{29}, 0·61	18 10, 1·8	16·17	0·02
387		0·1	„	3 2, 1·5	0·65	0·5	448		7·6	„	3 2, 1·5	6·99	0·05
388		0·13	„	3 2, 1·5	0·84	0·4	449		9·8	„	3 2, 1·5	9·02	0·035
389		0·13	„	3 2, 1·5	0·84	0·4	450		9·3	„	3 2, 1·5	8·56	0·04
390		0·13	„	3 2, 1·5	0·84	0·4	451		9·3	„	3 2, 1·5	8·56	0·04
391		0·13	„	3 2, 1·5	0·84	0·4	452		13·7	„	3 2, 1·5	12·60	0·025
392		0·13	„	3 2, 1·5	0·84	0·4	453		14·8	„	3 2, 1·5	13·62	0·025
393		0·1	„	3 2, 1·5	0·65	0·5	454		23·5	„	3 2, 1·5	21·62	0·015
394		0·13	„	3 2, 1·5	0·84	0·4	455		12·2	„	3 2, 1·5	11·22	0·03
395		0·13	„	3 2, 1·5	0·84	0·4	456		17·9	„	3 2, 1·5	16·47	0·02
396		0·13	„	3 2, 1·5	0·84	0·4	457		12·3	„	3 2, 1·5	11·32	0·03
397		0·13	„	3 2, 1·5	0·84	0·4	458		13·2	„	3 2, 1·5	12·14	0·025
398		0·1	„	3 2, 1·5	0·65	0·5	459		10·1	„	3 2, 1·5	9·29	0·035
399		0·1	„	3 2, 1·5	0·65	0·5	460		12·4	„	3 2, 1·5	11·41	0·03
400		0·13	„	3 2, 1·5	0·84	0·4	461—463	22	15·6	„	18 10, 1·8	17·16	0·02
401		0·1	„	3 2, 1·5	0·65	0.5	464—467	42	12·7	ρ^2_{33}, 0·36	18 10, 1·8	8·26	0·04
402		0·13	„	3 2, 1·5	0·84	0·4	468—471	43	11·1	„	18 10, 1·8	7·22	0·045
403		0·1	„	3 2, 1·5	0·65	0·5	472—475	44	14·7	„	18 10, 1·8	9·56	0·035
404		0·1	„	3 2, 1·5	0·65	0·5	476—479	45	19·6	„	18 10, 1·8	12·74	0·025
405		0·1	„	3 2, 1·5	0·65	0·5	480—483	46	13·2	„	27 14, 1·9	8·98	0·035
406		0·13	„	3 2, 1·5	0·84	0·4	484—487	47	5·1	„	18 10, 1·8	3·32	0·10
407—409	7	12·4	ρ^2_{7}, 0·47	18 10, 1·8	10·54	0·03	488—493	48	7·8	„	30 16, 1·9	5·30	0·06
410		5·4	ρ^2_{6}, 0·46	3 2, 1·5	3·73	0·09	494—496	49	8·4	„	15 8, 1·9	5·71	0·06
411		6·3	„	3 2, 1·5	4·35	0·08	497—500	50	10·1	„	18 10, 1·8	6·57	0·05
412		6·2	„	3 2, 1·5	4·28	0·08	501—503	27	4·8	ρ^2_{31}, 0·72	15 8, 1·9	6·58	0·05
413		7·7	„	3 2, 1·5	5·31	0·06	504—506	28	3·1	„	15 8, 1·9	4·25	0·08
414		8·0	„	3 2, 1·5	5·52	0·06	507—509	29	4·5	„	15 8, 1·9	6·17	0·05
415		5·4	„	3 2, 1·5	3·73	0·09	510,511	30	3·6	„	8 4, 2·0	5·18	0·06
416		14·6	„	3 2, 1·5	10·07	0·035	512—516	31	4·4	„	24 12, 2·0	6·34	0·05
417		11·4	„	3 2, 1·5	7·87	0·04	517	32	3·8	„	8 4, 2·0	5·47	0·06
418		8·3	„	3 2, 1·5	5·73	0·06	518,519	22	15·6	ρ^2_{29}, 0·61	18 10, 1·8	17·16	0·02
419		6·3	„	3 2, 1·5	4·35	0·08	520		13·3	„	3 2, 1·5	12·24	0·025
420		4·2	„	3 2, 1·5	2·90	0·11	521		12·4	„	3 2, 1·5	11·41	0·03
421		6·9	„	3 2, 1·5	4·76	0·07	522		13·8	„	3 2, 1·5	12·70	0·025
422,423	6	1·0	ρ^2_{5}, 2·14	30 16, 1·9	4·07	0·08	523		32·1	„	3 2, 1·5	29·53	0·011
424	7	12·4	ρ^2_{7}, 0·47	18 10, 1·8	10·54	0·03	524		13·0	„	3 2, 1·5	11·96	0·03

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The Absolute Weights of the Figurally Corrected Angles with the data for their determination—(Continued).

All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$	All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	$\frac{u_c}{3}$
525		10·9	ρ^2_{29}, 0·61	3 ÷ 2, 1·5	10·03	0·035	537		30·2	ρ^2_{29}, 0·61	3 ÷ 2, 1·5	27·78	0·012
526		7·4	"	3 2, 1·5	6·81	0·05	538		25·6	"	3 2, 1·5	23·55	0·014
527		7·0	"	3 2, 1·5	6·44	0·05	539	41	5·7	ρ^2_{32}, 0·86	8 4, 2·0	9·80	0·035
528		6·5	"	3 2, 1·5	5·98	0·06	540,541	40	6·4	"	8 4, 2·0	11·01	0·03
529		5·9	"	3 2, 1·5	5·43	0·06	542—546	39	6·1	"	27 14, 1·9	9·94	0·035
530		2·2	"	3 2, 1·5	2·02	0·16	547—549	38	5·2	"	15 8, 1·9	8·48	0·04
531		8·0	"	3 2, 1·5	7·36	0·045	550,551	37	4·1	"	8 4, 2·0	7·05	0·045
532		10·2	"	3 2, 1·5	9·38	0·035	552—554	36	5·1	"	15 8, 1·9	8·31	0·04
533		13·8	"	3 2, 1·5	12·70	0·025	555—562	35	2·9	"	54 28, 1·9	4·73	0·07
534		15·6	"	3 2, 1·5	14·35	0·025	563—566	34	4·3	"	18 10, 1·8	6·67	0·05
535		22·0	"	3 2, 1·5	20·24	0·016	567—573	33	3·6	"	39 20, 2·0	6·19	0·05
536		21·9	"	3 2, 1·5	20·15	0·016							

14.

The Coefficients of the Indeterminate Factors in the Values of the Unknown Quantities.

On reference to equations (20) on page 28 it will be seen that the general expression for the error x_p of any angle X_p appertaining to a trigonometrical figure, is

$$x_p = u_p\,(a_p\,\lambda_a + b_p\,\lambda_b + \quad . \quad . \quad . \quad + n_p\,\lambda_n)$$

so that the coefficients of λ_a, λ_b, . . . λ_n, the indeterminate factors, are products of the reciprocal weight of the angle by the coefficients of the x_p in the several absolute geometrical equations to which the indeterminate factors are respectively related. But one of the three unknown quantities appertaining to every triangle having been eliminated, as a preliminary to the Simultaneous Reduction of the North-East Quadrilateral, the coefficients

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of the indeterminate factors take a more complex form, which is given by equations (69) on page 61. The expressions are

$$y_p = {}_1\mathfrak{B}_p\, {}_1\Lambda + {}_2\mathfrak{B}_p\, {}_2\Lambda + \quad . \quad . \quad . \quad + {}_n\mathfrak{B}_p\, {}_n\Lambda.$$
$$z_p = {}_1\mathfrak{C}_p\, {}_1\Lambda + {}_2\mathfrak{C}_p\, {}_2\Lambda + \quad . \quad . \quad . \quad + {}_n\mathfrak{C}_p\, {}_n\Lambda.$$

where

$${}_1\mathfrak{B}_p = \frac{u_p}{3}\,(2\ {}_1\mathfrak{b}_p - {}_1\mathfrak{c}_p)\,; \qquad {}_2\mathfrak{B}_p = \frac{u_p}{3}\,(2\ {}_2\mathfrak{b}_p - {}_2\mathfrak{c}_p)\,; \quad . \quad . \quad .$$
$${}_1\mathfrak{C}_p = \frac{u_p}{3}\,(2\ {}_1\mathfrak{c}_p - {}_1\mathfrak{b}_p)\,; \qquad {}_2\mathfrak{C}_p = \frac{u_p}{3}\,(2\ {}_2\mathfrak{c}_p - {}_2\mathfrak{b}_p)\,; \quad . \quad . \quad .$$

the left-hand subscripts indicating the number of any one of the equations into which the errors y and z of any, the pth, triangle happen to enter.

In the present instance, however, the coefficients $\mathfrak{b}$ and $\mathfrak{c}$ and the absolute term E of each primary equation of condition have been multiplied by an equalizing factor—see pages 59 and 153—before the subsequent calculations were proceeded with.

It is evident that this is a mere computer's artifice for facilitating the solution of the problem, which does not alter the application of any of the formulæ or the results arrived at, although it changes the numerical values of certain of the symbolical coefficients. For instance, instead of $\mathfrak{b}$, $\mathfrak{c}$ and E we now have to deal with $\mathfrak{b}'$, $\mathfrak{c}'$ and E', where

$${}_q\mathfrak{b}' = {}_qf\ {}_q\mathfrak{b}, \quad {}_q\mathfrak{c}' = {}_qf\ {}_q\mathfrak{c} \quad \text{and}\ {}_qE' = {}_qf\ {}_qE,$$

${}_qf$ denoting the equalizing factor employed for the qth equation. Corresponding to these values we have

$${}_q\mathfrak{B}' = {}_qf\ {}_q\mathfrak{B}, \quad {}_q\mathfrak{C}' = {}_qf\ {}_q\mathfrak{C}$$

and

$${}_q\Lambda' = \frac{{}_q\Lambda}{{}_qf}.\text{*}$$

The coefficients $\mathfrak{b}_p$ and $\mathfrak{c}_p$ of y_p and z_p, in each equation into which these unknown quantities enter, and the corresponding equalizing factors are given in the table in Section 12; the value of $\frac{u}{3}$ for every triangle will be found in the table on pages 198 to 203. From these data $\mathfrak{B}'_p$ and $\mathfrak{C}'_p$ were obtained and entered in the following table. As the continued use of the accents is now no longer necessary they have not been introduced in the headings to the table.

Examples.

$$\begin{aligned} {}_5\mathfrak{B}_{55} &= \frac{u_{55}}{3}\,(2 \times {}_5f \times {}_5\mathfrak{b}_{55} - {}_5f \times {}_5\mathfrak{c}_{55}) \\ &= \cdot 8\ (2 \times \cdot 03 \times 13 - \cdot 03 \times -9) = +\cdot 840 \\ {}_{23}\mathfrak{C}_{245} &= \frac{u_{245}}{3}(2 \times {}_{23}f \times {}_{23}\mathfrak{c}_{245} - {}_{23}f \times {}_{23}\mathfrak{b}_{245}) \\ &= 1{\cdot}0\,(2 \times 15 \times \cdot 032 - 15 \times \cdot 002) = +\cdot 930 \end{aligned}$$

* The introduction of equalizing factors, is in fact the same thing as employing indeterminate factors with numerical coefficients, thus ${}_1f\ {}_1\Lambda'$, ${}_2f\ {}_2\Lambda'$, &c., in place of ${}_1\Lambda$, ${}_2\Lambda$, &c., which is perfectly legitimate.

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1st Equation. Linear.

No. of Circuit Triangle	𝔅	ℭ
1	+ 0·084	− 0·046
2	2·640	2·112
3	2·496	2·832
4	1·020	1·500
5	1·560	2·040
6	0·576	0·396
7	0·384	0·372
8	0·540	0·594
9	0·702	0·702
10	1·536	1·344
11	1·287	1·053
12	1·521	1·287
13	1·620	2·160
14	1·920	1·536
15	2·400	2·325
16	1·287	1·053
17	1·287	1·287
18	0·600	0·615
19	0·612	0·684
20	0·666	0·630
21	0·756	0·702
22	0·396	0·324
23	− 0·036	0·360
24	+ 0·798	0·777
25	0·720	0·738
26	1·107	0·918
27	0·504	0·738
28	1·161	1·026
29	0·798	0·777
30	0·468	0·468
31	0·651	0·861
32	0·513	0·459

1st Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
33	+ 0·798	− 0·651
34	0·070	0·084
35	0·092	0·086
36	0·097	0·162
37	0·041	0·054
38	0·114	0·075
39	0·064	0·068
40	0·037	0·029
41	0·026	0·041
42	0·036	0·023
43	0·022	0·028
44	0·017	0·020

2nd Equation. Latitude.

No. of Circuit Triangle	𝔅	ℭ
1	+ 0·225	− 0·104
2	6·272	5·632
3	6·336	6·624
4	2·170	3·740
5	3·240	5·280
6	1·312	0·764
7	0·896	0·712
8	0·936	1·404
9	1·524	1·266
10	2·496	3·024
11	2·678	1·729
12	2·366	2·626
13	3·180	3·300
14	2·752	2·960
15	4·375	3·200
16	1·638	1·989
17	2·223	1·677
18	0·745	1·040

2nd Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
19	+ 0·990	− 0·846
20	0·744	1·020
21	1·116	0·774
22	0·400	0·524
23	− 0·148	0·568
24	+ 1·106	0·763
25	0·666	1·026
26	1·422	0·819
27	0·372	0·960
28	1·323	0·810
29	0·518	0·910
30	0·500	0·316
31	0·322	0·875
32	0·446	0·243
33	0·336	0·609
34	0·065	0·035
35	0·025	0·072
36	0·068	0·062
37	0·033	0·018
38	0·024	0·034
39	0·026	0·018
40	0·004	0·011
41	0·002	0·011
42	0·005	0·004
43	0·003	0·004

3rd Equation. Longitude.

No. of Circuit Triangle	𝔅	ℭ
1	+ 0·139	+ 0·176
2	− 3·904	− 1·936
3	+ 1·888	+ 3·664
4	− 2·110	− 0·970
5	4·000	2·380

3rd Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
6	+ 0·388	+ 0·760
7	0·448	0·748
8	− 1·176	− 0·546
9	+ 0·582	+ 1·104
10	− 2·912	− 1·472
11	+ 1·274	+ 2·093
12	− 2·340	− 1·053
13	+ 1·880	+ 3·260
14	− 2·864	− 1·136
15	+ 1·950	+ 3·750
16	− 2·093	− 0·923
17	+ 0·910	+ 1·885
18	− 0·815	− 0·215
19	+ 0·354	+ 0·894
20	− 0·918	− 0·270
21	+ 0·258	+ 0·834
22	− 0·552	− 0·192
23	0·340	0·172
24	+ 0·273	+ 0·903
25	− 0·852	− 0·114
26	+ 0·243	+ 1·053
27	− 0·690	− 0·078
28	+ 0·171	+ 1·008
29	− 0·847	− 0·070
30	+ 0·052	+ 0·436
31	− 0·728	0·028
32	+ 0·041	0·405
33	− 0·742	− 0·007
34	+ 0·015	+ 0·072
35	− 0·083	0·006
36	0·003	0·095
37	+ 0·003	0·039

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No. of Circuit Triangle	B	C
3rd Equation—(Continued).		
38	− 0·051	+ 0·017
39	0·007	0·023
40	0·013	0·002
41	0·009	0·005
42	+ 0·003	0·003
43	0·002	0·002
4th Equation. Azimuth.		
1	+ 0·095	+ 0·095
2	− 1·712	− 1·664
3	+ 1·664	+ 1·712
4	− 1·060	− 1·030
5	2·100	2·100
6	+ 0·412	+ 0·424
7	0·412	0·424
8	− 0·636	− 0·618
9	+ 0·618	+ 0·636
10	− 1·696	− 1·648
11	+ 1·352	+ 1·352
12	− 1·378	− 1·339
13	+ 2·060	+ 2·120
14	− 1·712	− 1·616
15	+ 2·550	+ 2·625
16	− 1·365	− 1·326
17	+ 1·326	+ 1·365
18	− 0·525	− 0·510
19	+ 0·612	+ 0·630
20	− 0·630	− 0·612
21	+ 0·600	+ 0·636
22	− 0·420	− 0·408
23	0·408	0·408
24	+ 0·707	+ 0·728

No. of Circuit Triangle	B	C
4th Equation—(Continued).		
25	− 0·624	− 0·606
26	+ 0·909	+ 0·936
27	− 0·624	− 0·606
28	+ 0·909	+ 0·936
29	− 0·728	− 0·707
30	+ 0·396	+ 0·420
31	− 0·721	− 0·700
32	+ 0·450	+ 0·464
33	− 0·721	− 0·700
34	+ 0·090	+ 0·093
35	− 0·093	− 0·090
36	+ 0·090	+ 0·093
37	0·050	0·052
38	− 0·052	− 0·049
39	+ 0·035	+ 0·036
40	− 0·036	− 0·035
41	0·026	0·025
42	+ 0·025	+ 0·025
43	0·025	0·025
44	− 0·025	− 0·025
5th Equation. Linear. Left-hand Branch		
1	− 0·084	+ 0·046
2	2·640	2·112
3	2·496	2·832
4	1·020	1·500
5	1·560	2·040
6	0·576	0·396
7	0·384	0·372
8	0·540	0·594
9	0·702	0·702

No. of Circuit Triangle	B	C
5th Equation—(Continued).		
10	− 1·536	+ 1·344
11	1·287	1·053
12	1·521	1·287
13	1·620	2·160
14	1·920	1·536
15	2·400	2·325
16	1·287	1·053
17	1·287	1·287
18	0·600	0·615
19	0·612	0·684
20	0·666	0·630
21	0·756	0·702
22	0·396	0·324
23	+ 0·036	0·360
24	− 0·798	0·777
25	0·720	0·738
26	1·107	0·918
27	0·504	0·738
28	1·161	1·026
29	0·798	0·777
30	0·468	0·468
31	0·651	0·861
32	0·513	0·459
33	0·798	0·651
34	+ 0·014	0·111
Right-hand Branch		
45	+ 0·756	− 0·684
46	0·705	1·005
47	0·735	0·777
48	0·284	0·284
49	0·588	0·609
50	0·840	0·609

No. of Circuit Triangle	B	C
5th Equation—(Continued).		
51	+ 0·759	− 1·023
52	0·891	0·792
53	0·891	0·990
54	0·432	0·459
55	0·840	0·744
56	1·650	1·221
57	0·882	0·630
58	0·903	0·924
59	1·056	1·104
60	1·551	1·518
61	0·480	0·375
62	0·912	0·888
63	1·128	1·032
64	0·888	1·128
65	1·272	0·960
66	0·912	1·104
67	1·650	1·320
68	1·287	1·881
69	1·551	1·221
70	0·984	1·392
71	0·810	0·527
72	0·288	0·414
73	0·513	0·351
74	0·189	0·227
75	0·254	0·235
76	0·360	0·477
77	0·294	0·210
78	0·285	0·345
79	0·022	0·019
80	0·038	0·035
81	0·017	0·019
82	0·018	0·013

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5th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
83	+ 0·008	− 0·008
84	0·014	0·014
85	0·010	0·012
86	0·015	0·016
87	0·016	0·013
88	0·021	0·020
89	0·019	0·016
90	0·014	0·017
91	0·060	0·084
92	0·070	0·100

6th Equation. Latitude.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
1	− 0·151	+ 0·103
2	5·136	3·936
3	4·400	5·344
4	1·830	2·610
5	2·820	3·540
6	0·876	0·648
7	0·572	0·604
8	0·798	0·912
9	0·972	1·044
10	1·968	1·776
11	1·573	1·430
12	1·872	1·560
13	1·740	2·640
14	2·128	1·712
15	2·400	2·625
16	1·287	1·053
17	1·170	1·326
18	0·540	0·555
19	0·486	0·612

6th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
20	− 0·534	+ 0·528
21	0·540	0·540
22	0·276	0·240
23	+ 0·036	0·252
24	− 0·469	0·518
25	0·384	0·408
26	0·486	0·486
27	0·228	0·348
28	0·414	0·450
29	0·266	0·280
30	0·108	0·144
31	0·126	0·189
32	0·054	0·108
33	0·091	0·077
34	+ 0·002	0·010

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
45	+ 1.404	− 1·488
46	1·480	1·790
47	1·582	1·295
48	0·365	0·648
49	1·225	0·959
50	1·218	1·197
51	0·990	1·980
52	1·617	1·056
53	1·111	1·826
54	0·716	0·594
55	0·952	1·256
56	2·464	1·463
57	0·994	1·001
58	1·281	1·050
59	1·104	1·512
60	2·013	1·584

6th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
61	+ 0·435	− 0·525
62	0·848	1·144
63	1·304	0·904
64	0·696	1·320
65	1·344	0·744
66	0·624	1·176
67	1·584	0·891
68	0·748	1·760
69	1·342	0·638
70	0·480	1·176
71	0·590	0·221
72	0·096	0·327
73	0·333	0·126
74	0·062	0·148
75	0·141	0·066
76	0·069	0·273
77	0·156	0·042
78	0·040	0·185
79	0·010	0·003
80	0·016	0·003
81	− 0·001	0·008
82	+ 0·007	0·000
83	0·000	0·003
84	0·005	0·001
85	0·000	0·003
86	0·004	0·002
87	0·001	0·004
88	0·005	0·002
89	0·001	0·002
90	0·002	0·001
91	0·002	0·010
92	0·009	0·013

7th Equation. Longitude.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
1	− 0·144	− 0·117
2	+ 1·920	+ 2·352
3	− 2·512	− 1·600
4	+ 1·180	+ 1·330
5	2·400	2·580
6	− 0·512	− 0·404
7	0·476	0·404
8	+ 0·660	+ 0·606
9	− 0·678	− 0·516
10	+ 1·568	+ 1·424
11	− 1·326	− 1·092
12	+ 1·118	+ 1·118
13	− 1·880	− 1·400
14	+ 1·248	+ 1·248
15	− 2·125	− 1·600
16	+ 0·923	+ 0·923
17	− 1·027	− 0·715
18	+ 0·315	+ 0·315
19	− 0·414	− 0·306
20	+ 0·342	+ 0·342
21	− 0·396	− 0·234
22	+ 0·192	+ 0·192
23	0·192	0·192
24	− 0·371	− 0·245
25	+ 0·270	+ 0·216
26	− 0·369	− 0·288
27	+ 0·240	+ 0·150
28	− 0·306	− 0·198
29	+ 0·203	+ 0·140
30	− 0·120	− 0·048
31	+ 0·119	+ 0·119

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7th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
32	− 0·117	+ 0·005
33	+ 0·056	0·056
34	− 0·014	0·007
Right-hand Branch		
45	− 0·944	− 0·224
46	+ 0·330	+ 1·140
47	0·595	1·330
48	− 0·725	− 0·401
49	+ 0·686	+ 1·127
50	− 1·190	− 0·560
51	1·661	0·803
52	+ 0·979	+ 1·474
53	− 1·595	− 0·770
54	+ 0·329	+ 0·626
55	− 1·224	− 0·432
56	+ 0·473	+ 1·496
57	− 1·036	− 0·364
58	+ 0·315	+ 0·945
59	− 1·096	− 0·232
60	+ 0·396	+ 1·386
61	− 0·575	− 0·230
62	0·976	0·256
63	+ 0·176	+ 0·920
64	− 0·968	− 0·056
65	+ 0·040	+ 0·904
66	− 0·920	− 0·032
67	+ 0·044	+ 1·166
68	− 1·232	0·220
69	+ 0·033	1·023
70	− 0·856	0·224
71	0·095	0·392
72	0·255	0·051

7th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
73	− 0·081	+ 0·243
74	0·137	0·052
75	0·046	0·146
76	0·252	0·126
77	0·058	0·128
78	0·190	0·095
79	0·005	0·010
80	0·008	0·020
81	0·009	0·004
82	0·003	0·007
83	0·004	0·001
84	0·001	0·006
85	0·004	0·002
86	0·001	0·006
87	0·004	0·002
88	0·000	0·004
89	0·003	0·001
90	+ 0·001	0·002
91	− 0·008	0·004
92	+ 0·005	0·005

8th Equation. Azimuth.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
1	− 0·094	− 0·094
2	+ 1·664	+ 1·664
3	− 1·664	− 1·664
4	+ 1·040	+ 1·040
5	2·080	2·080
6	− 0·412	− 0·412
7	0·412	0·412
8	+ 0·618	+ 0·618
9	− 0·618	− 0·618

8th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
10	+ 1·648	+ 1·648
11	− 1·339	− 1·339
12	+ 1·339	+ 1·339
13	− 2·080	− 2·020
14	+ 1·632	+ 1·632
15	− 2·550	− 2·550
16	+ 1·326	+ 1·326
17	− 1·326	− 1·326
18	+ 0·510	+ 0·510
19	− 0·612	− 0·612
20	+ 0·612	+ 0·612
21	− 0·612	− 0·612
22	+ 0·408	+ 0·408
23	0·408	0·408
24	− 0·721	− 0·700
25	+ 0·606	+ 0·606
26	− 0·909	− 0·909
27	+ 0·606	+ 0·606
28	− 0·909	− 0·909
29	+ 0·707	+ 0·707
30	− 0·404	− 0·404
31	+ 0·707	+ 0·707
32	− 0·459	− 0·446
33	+ 0·700	+ 0·700
34	− 0·180	0·090
Right-hand Branch		
45	− 0·428	− 0·404
46	+ 0·515	+ 0·530
47	0·721	0·742
48	− 0·473	− 0·459
49	+ 0·728	+ 0·728
50	− 0·735	− 0·714

8th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
51	− 1·155	− 1·122
52	+ 1·122	+ 1·155
53	− 1·155	− 1·122
54	+ 0·459	+ 0·473
55	− 0·840	− 0·816
56	+ 1·111	+ 1·144
57	− 0·735	− 0·714
58	+ 0·707	+ 0·728
59	− 0·832	− 0·808
60	+ 1·111	+ 1·144
61	− 0·520	− 0·505
62	0·832	0·808
63	+ 0·808	+ 0·832
64	− 0·840	− 0·792
65	+ 0·800	+ 0·824
66	− 0·824	− 0·800
67	+ 1·100	+ 1·133
68	− 1·133	− 1·100
69	+ 1·100	+ 1·133
70	− 0·824	− 0·800
71	+ 0·450	+ 0·464
72	− 0·309	− 0·300
73	+ 0·297	+ 0·306
74	− 0·146	− 0·137
75	+ 0·157	+ 0·166
76	− 0·306	− 0·297
77	+ 0·198	+ 0·204
78	− 0·255	− 0·248
79	+ 0·016	+ 0·016
80	0·030	0·031
81	− 0·020	− 0·020
82	+ 0·016	+ 0·016

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No. of Circuit Triangle	B	C	No. of Circuit Triangle	B	C	No. of Circuit Triangle	B	C	No. of Circuit Triangle	B	C
8th Equation—(Continued).			*9th Equation*—(Continued).			*9th Equation*—(Continued).			*10th Equation. Latitude.* Left-hand Branch		
83	− 0·009	− 0·009	64	− 0·888	+ 1·128	108	+ 0·148	− 0·226	45	− 1·324	+ 1·220
84	+ 0·016	+ 0·016	65	1·272	0·960	109	0·162	0·068	46	1·185	1·665
85	− 0·012	− 0·012	66	0·912	1·104	110	0·225	0·207	47	1·225	1·274
86	+ 0·015	+ 0·015	67	1·650	1·320	111	0·113	0·131	48	0·392	0·459
87	− 0·013	− 0·013	68	1·287	1·881	112	0·210	0·222	49	0·924	0·987
88	+ 0·020	+ 0·020	69	1·551	1·221	113	0·483	0·462	50	1·197	0·882
89	− 0·013	− 0·013	70	0·984	1·392	114	0·369	0·360	51	1·111	1·529
90	+ 0·012	+ 0·012	71	0·810	0·527	115	0·399	0·452	52	1·155	1·155
91	− 0·080	− 0·080	72	0·288	0·414	116	0·216	0·234	53	1·155	1·320
92	+ 0·090	+ 0·090	73	0·513	0·351	117	0·378	0·378	54	0·518	0·603
			74	0·189	0·227	118	0·216	0·216	55	1·000	0·920
9th Equation. Linear.			75	0·254	0·235	119	0·324	0·351	56	1·749	1·419
Left-hand Branch			76	0·360	0·477	120	0·513	0·500	57	0·938	0·679
45	− 0·756	+ 0·684	77	0·294	0·210	121	0·738	0·666	58	0·903	1·008
46	0·705	1·005	78	0·285	0·345	122	0·399	0·389	59	1·024	1·040
47	0·735	0·777	79	0·000	0·015	123	0·441	0·504	60	1·364	1·474
48	0·284	0·284	Right-hand Branch			124	0·294	0·336	61	0·420	0·300
49	0·588	0·609	93	+ 0·486	− 0·324	125	0·410	0·378	62	0·792	0·720
50	0·840	0·609	94	0·342	0·198	126	0·378	0·410	63	0·848	0·856
51	0·759	1·023	95	0·528	0·624	127	0·216	0·216	64	0·704	0·856
52	0·891	0·792	96	0·360	0·252	128	0·351	0·378	65	0·816	0·696
53	0·891	0·990	97	0·468	0·612	129	0·007	0·006	66	0·600	0·720
54	0·432	0·459	98	0·780	0·444	130	0·013	0·011	67	0·913	0·836
55	0·840	0·744	99	0·336	0·276	131	0·008	0·008	68	0·726	1·056
56	1·650	1·221	100	0·696	1·140	132	0·010	0·012	69	0·770	0·682
57	0·882	0·630	101	0·552	0·384	133	0·006	0·006	70	0·496	0·704
58	0·903	0·924	102	0·396	0·540	134	0·013	0·011	71	0·288	0·225
59	1·056	1·104	103	0·336	0·276	135	0·007	0·007	72	0·099	0·144
60	1·551	1·518	104	0·564	0·300	136	0·006	0·008	73	0·135	0·117
61	0·480	0·375	105	0·129	0·089	137	0·011	0·009	74	0·049	0·060
62	0·912	0·888	106	0·110	0·134	138	0·016	0·023	75	0·058	0·062
63	1·128	1·032	107	0·294	0·210				76	0·078	0·102

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10th Equation—(Continued).

No. of Circuit Triangle	B	C
77	− 0·028	+ 0·038
78	0·030	0·038
79	0·000	0·001
Right-hand Branch		
93	+ 0·909	− 0·531
94	0·513	0·387
95	0·804	1·104
96	0·600	0·348
97	0·764	0·880
98	1·024	0·692
99	0·408	0·468
100	1·008	1·488
101	0·636	0·600
102	0·560	0·616
103	0·480	0·288
104	0·560	0·400
105	0·122	0·116
106	0·142	0·126
107	0·278	0·256
108	0·166	0·216
109	0·126	0·090
110	0·234	0·176
111	0·080	0·146
112	0·158	0·232
113	0·459	0·350
114	0·246	0·339
115	0·364	0·319
116	0·132	0·210
117	0·315	0·231
118	0·114	0·180
119	0·234	0·180
120	0·207	0·347

10th Equation—(Continued).

No. of Circuit Triangle	B	C
121	+ 0·462	− 0·276
122	0·144	0·256
123	0·252	0·200
124	0·056	0·196
125	0·214	0·123
126	0·088	0·196
127	0·044	0·100
128	0·132	0·075
129	0·003	0·001
130	0·001	0·004
131	0·003	0·001
132	0·003	0·001
133	0·000	0·001
134	0·003	0·001
135	0·000	0·001
136	0·001	0·001
137	0·000	0·001
138	0·001	0·002
11th Equation. Longitude.		
Left-hand Branch		
45	+ 0·528	+ 0·456
46	− 0·545	− 0·620
47	0·805	0·847
48	+ 0·522	+ 0·441
49	− 0·777	− 0·777
50	+ 0·763	+ 0·658
51	1·155	1·056
52	− 1·155	− 0·957
53	+ 1·056	+ 0·957
54	− 0·432	− 0·351
55	+ 0·696	+ 0·624

11th Equation—(Continued).

No. of Circuit Triangle	B	C
56	− 1·001	− 0·770
57	+ 0·518	+ 0·518
58	− 0·574	− 0·406
59	+ 0·528	+ 0·528
60	− 0·902	− 0·539
61	+ 0·270	+ 0·315
62	0·432	0·504
63	− 0·512	− 0·344
64	+ 0·424	+ 0·424
65	− 0·472	− 0·328
66	+ 0·376	+ 0·376
67	− 0·583	− 0·385
68	+ 0·451	+ 0·451
69	− 0·539	− 0·275
70	+ 0·264	+ 0·264
71	− 0·180	− 0·086
72	+ 0·078	+ 0·078
73	− 0·096	− 0·042
74	+ 0·028	+ 0·028
75	− 0·045	− 0·006
76	+ 0·036	+ 0·036
77	− 0·036	0·000
78	+ 0·015	0·015
79	− 0·002	0·001
Right-hand Branch		
93	+ 0·252	+ 0·441
94	− 0·447	− 0·285
95	0·616	0·268
96	+ 0·340	+ 0·472
97	0·324	0·576
98	− 0·640	− 0·256
99	0·508	0·304

11th Equation—(Continued).

No. of Circuit Triangle	B	C
100	+ 0·208	+ 0·652
101	− 0·580	− 0·196
102	+ 0·232	+ 0·496
103	0·240	0·420
104	− 0·484	− 0·208
105	0·123	0·057
106	+ 0·094	+ 0·152
107	− 0·236	− 0·080
108	+ 0·053	+ 0·147
109	− 0·156	− 0·075
110	+ 0·036	+ 0·158
111	− 0·128	− 0·051
112	0·188	0·056
113	+ 0·091	+ 0·312
114	− 0·276	− 0·060
115	+ 0·084	+ 0·305
116	− 0·170	− 0·032
117	+ 0·088	+ 0·256
118	− 0·156	− 0·030
119	+ 0·057	+ 0·210
120	− 0·342	− 0·032
121	+ 0·054	+ 0·378
122	− 0·245	− 0·004
123	+ 0·011	+ 0·231
124	− 0·189	0·000
125	+ 0·014	0·182
126	− 0·182	0·018
127	0·102	0·006
128	0·018	0·144
129	0·000	0·003
130	0·005	0·001
131	0·000	0·003

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11th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
132	− 0·001	+ 0·004
133	0·002	0·001
134	0·000	0·003
135	0·001	0·000
136	0·000	0·001
137	0·001	0·000
138	+ 0·001	0·001

12th Equation. Azimuth.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
45	+ 0·420	+ 0·408
46	− 0·510	− 0·525
47	0·714	0·735
48	+ 0·464	+ 0·464
49	− 0·721	− 0·721
50	+ 0·721	+ 0·721
51	1·133	1·133
52	− 1·133	− 1·133
53	+ 1·133	+ 1·133
54	− 0·464	− 0·464
55	+ 0·824	+ 0·824
56	− 1·144	− 1·111
57	+ 0·714	+ 0·714
58	− 0·714	− 0·714
59	+ 0·816	+ 0·816
60	− 1·122	− 1·122
61	+ 0·510	+ 0·510
62	0·816	0·816
63	− 0·816	− 0·816
64	+ 0·816	+ 0·816
65	− 0·824	− 0·800
66	+ 0·808	+ 0·808

12th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
67	− 1·111	− 1·111
68	+ 1·111	+ 1·111
69	− 1·111	− 1·111
70	+ 0·808	+ 0·808
71	− 0·455	− 0·455
72	+ 0·303	+ 0·303
73	− 0·303	− 0·303
74	+ 0·141	+ 0·141
75	− 0·163	− 0·158
76	+ 0·300	+ 0·300
77	− 0·200	− 0·200
78	+ 0·250	+ 0·250
79	− 0·032	0·016

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
93	+ 0·306	+ 0·315
94	− 0·315	− 0·306
95	0·420	0·408
96	+ 0·412	+ 0·412
97	0·408	0·420
98	− 0·420	− 0·408
99	0·412	0·412
100	+ 0·408	+ 0·420
101	− 0·420	− 0·408
102	+ 0·404	+ 0·416
103	0·404	0·416
104	− 0·416	− 0·404
105	0·114	0·111
106	+ 0·162	+ 0·166
107	− 0·208	− 0·202
108	+ 0·131	+ 0·135
109	− 0·156	− 0·152
110	+ 0·153	+ 0·153

12th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
111	− 0·153	− 0·153
112	0·204	0·204
113	+ 0·350	+ 0·361
114	− 0·309	− 0·300
115	+ 0·350	+ 0·361
116	− 0·206	− 0·200
117	+ 0·350	+ 0·361
118	− 0·206	− 0·200
119	+ 0·300	+ 0·309
120	− 0·464	− 0·450
121	+ 0·606	+ 0·606
122	− 0·361	− 0·350
123	+ 0·354	+ 0·354
124	− 0·354	− 0·354
125	+ 0·354	+ 0·354
126	− 0·357	− 0·347
127	0·202	0·202
128	+ 0·297	+ 0·306
129	0·008	0·008
130	− 0·012	− 0·012
131	+ 0·009	+ 0·009
132	0·011	0·011
133	− 0·006	− 0·006
134	+ 0·012	+ 0·012
135	− 0·006	− 0·006
136	+ 0·007	+ 0·007
137	− 0·009	− 0·009
138	+ 0·016	+ 0·016

13th Equation. Linear.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
93	− 0·486	+ 0·324

13th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
94	− 0·342	+ 0·198
95	0·528	0·624
96	0·360	0·252
97	0·468	0·612
98	0·780	0·444
99	0·336	0·276
100	0·696	1·140
101	0·552	0·384
102	0·396	0·540
103	0·336	0·276
104	0·564	0·300
105	0·129	0·089
106	0·110	0·134
107	0·294	0·210
108	0·148	0·226
109	0·162	0·068
110	0·225	0·207
111	0·113	0·131
112	0·210	0·222
113	0·483	0·462
114	0·369	0·360
115	0·399	0·452
116	0·216	0·234
117	0·378	0·378
118	0·216	0·216
119	0·324	0·351
120	0·513	0·500
121	0·738	0·666
122	0·399	0·389
123	0·441	0·504
124	0·294	0·336
125	0·410	0·378

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No. of Circuit Triangle	B	C
13th Equation—(Continued).		
126	− 0·378	+ 0·410
127	0·216	0·216
128	0·351	0·378
129	+ 0·003	0·008
Right-hand Branch		
139	+ 0·410	− 0·536
140	0·405	0·324
141	0·473	0·630
142	0·924	0·714
143	0·468	0·450
144	0·672	0·516
145	0·446	0·527
146	2·160	1·728
147	0·891	0·972
148	0·777	0·735
149	0·684	0·828
150	0·384	0·264
151	0·135	0·176
152	0·176	0·151
153	0·278	0·353
154	0·504	0·432
155	0·210	0·222
156	0·615	0·600
157	0·162	0·151
158	0·353	0·323
159	0·137	0·155
160	0·171	0·180
161	0·168	0·228
162	0·103	0·084
163	0·197	0·206
164	0·155	0·137
165	0·119	0·124

No. of Circuit Triangle	B	C
13th Equation—(Continued).		
166	+ 0·163	− 0·168
167	0·494	0·420
168	0·567	0·689
169	0·774	0·684
170	0·240	0·278
171	0·038	0·037
172	0·032	0·028
173	0·022	0·027
174	0·038	0·041
175	0·036	0·029
176	0·068	0·077
177	0·016	0·012
178	0·025	0·031
179	0·028	0·024
180	0·018	0·018
14th Equation. Latitude.		
Left-hand Branch		
93	− 0·771	+ 0·516
94	0·486	0·297
95	0·760	0·920
96	0·468	0·360
97	0·624	0·828
98	0·920	0·544
99	0·384	0·336
100	0·804	1·320
101	0·556	0·440
102	0·412	0·548
103	0·352	0·284
104	0·500	0·280
105	0·116	0·083
106	0·096	0·125

No. of Circuit Triangle	B	C
14th Equation—(Continued).		
107	− 0·236	+ 0·172
108	0·113	0·179
109	0·120	0·056
110	0·165	0·155
111	0·078	0·093
112	0·142	0·158
113	0·308	0·312
114	0·222	0·228
115	0·210	0·263
116	0·106	0·122
117	0·175	0·193
118	0·096	0·102
119	0·129	0·159
120	0·171	0·180
121	0·228	0·240
122	0·119	0·123
123	0·105	0·147
124	0·053	0·074
125	0·074	0·095
126	0·060	0·056
127	0·042	0·036
128	0·012	0·042
129	0·000	0·001
Right-hand Branch		
139	+ 0·501	− 0·875
140	0·621	0·360
141	0·728	0·774
142	0·924	1·050
143	0·696	0·420
144	0·652	0·668
145	0·581	0·486
146	1·904	2·224

No. of Circuit Triangle	B	C
14th Equation—(Continued).		
147	+ 1·071	− 0·846
148	0·588	0·861
149	0·732	0·654
150	0·288	0·276
151	0·144	0·117
152	0·113	0·155
153	0·270	0·233
154	0·292	0·416
155	0·186	0·120
156	0·290	0·505
157	0·122	0·072
158	0·158	0·255
159	0·098	0·060
160	0·050	0·126
161	0·122	0·070
162	0·026	0·060
163	0·112	0·051
164	0·032	0·086
165	0·060	0·023
166	0·010	0·091
167	0·224	0·049
168	0·041	0·284
169	0·282	0·042
170	− 0·018	0·100
171	+ 0·012	+ 0·003
172	0·011	0·000
173	− 0·004	− 0·008
174	+ 0·012	+ 0·001
175	− 0·002	− 0·006
176	+ 0·014	0·002
177	0·000	0·002
178	0·003	0·001

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No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ
14th Equation—(Continued).			*15th Equation*—(Continued).			*15th Equation*—(Continued).			*16th Equation*—(Continued).		
179	− 0·001	− 0·001	120	+ 0·135	+ 0·095	160	− 0·128	+ 0·017	101	+ 0·408	+ 0·408
180	+ 0·002	0·001	121	− 0·174	− 0·120	161	+ 0·008	0·146	102	− 0·408	− 0·408
			122	+ 0·074	+ 0·074	162	− 0·077	0·007	103	0·408	0·408
15*th Equation. Longitude.*			123	− 0·095	− 0·032	163	0·029	0·130	104	+ 0·408	+ 0·408
Left-hand Branch			124	+ 0·053	+ 0·053	164	0·101	0·029	105	0·112	0·112
93	− 0·339	− 0·312	125	− 0·088	− 0·014	165	0·023	0·068	106	− 0·163	− 0·163
94	+ 0·315	+ 0·288	126	+ 0·018	+ 0·049	166	0·107	0·042	107	+ 0·204	+ 0·204
95	0·424	0·364	127	0·010	0·028	167	0·130	0·238	108	− 0·133	− 0·133
96	− 0·384	− 0·348	128	− 0·036	0·018	168	0·338	0·243	109	+ 0·153	+ 0·153
97	0·404	0·332	129	0·001	0·000	169	0·198	0·342	110	− 0·153	− 0·153
98	+ 0·376	+ 0·316	Right-hand Branch			170	0·128	0·083	111	+ 0·152	+ 0·152
99	0·356	0·320	139	− 0·557	− 0·084	171	0·010	0·017	112	0·202	0·202
100	− 0·320	− 0·320	140	+ 0·099	+ 0·423	172	0·007	0·012	113	− 0·354	− 0·354
101	+ 0·384	+ 0·240	141	0·112	0·616	173	0·009	0·008	114	+ 0·303	+ 0·303
102	− 0·280	− 0·304	142	− 1·050	− 0·231	174	0·006	0·015	115	− 0·354	− 0·354
103	0·268	0·292	143	+ 0·330	+ 0·690	175	0·010	0·006	116	+ 0·202	+ 0·202
104	+ 0·272	+ 0·236	144	− 0·624	− 0·084	176	0·008	0·019	117	− 0·354	− 0·354
105	0·077	0·061	145	+ 0·194	+ 0·545	177	0·003	0·002	118	+ 0·202	+ 0·202
106	− 0·098	− 0·093	146	− 2·032	− 0·496	178	0·002	0·004	119	− 0·303	− 0·303
107	+ 0·128	+ 0·104	147	+ 0·369	+ 0·936	179	0·003	0·002	120	+ 0·455	+ 0·455
108	− 0·070	− 0·070	148	− 0·784	− 0·175	180	0·000	0·001	121	− 0·606	− 0·606
109	+ 0·086	+ 0·072	149	+ 0·174	+ 0·660				122	+ 0·354	+ 0·354
110	− 0·084	− 0·071	150	− 0·274	− 0·022	16*th Equation. Azimuth.*			123	− 0·357	− 0·347
111	+ 0·071	+ 0·071	151	+ 0·044	+ 0·152	Left-hand Branch			124	+ 0·350	+ 0·350
112	0·094	0·094	152	− 0·153	− 0·018	93	− 0·309	− 0·309	125	− 0·350	− 0·350
113	− 0·182	− 0·130	153	+ 0·050	+ 0·253	94	+ 0·309	+ 0·309	126	+ 0·350	+ 0·350
114	+ 0·126	+ 0·126	154	− 0·412	− 0·028	95	0·412	0·412	127	0·200	0·200
115	− 0·161	− 0·109	155	+ 0·028	+ 0·172	96	− 0·412	− 0·412	128	− 0·300	− 0·300
116	+ 0·082	+ 0·064	156	− 0·470	− 0·005	97	0·412	0·412	129	0·016	+ 0·008
117	− 0·130	− 0·109	157	0·004	+ 0·104	98	+ 0·412	+ 0·412	Right-hand Branch		
118	+ 0·072	+ 0·054	158	0·248	0·023	99	0·412	0·412	139	− 0·364	− 0·354
119	− 0·099	− 0·072	159	+ 0·001	0·102	100	− 0·408	− 0·408	140	+ 0·303	+ 0·312

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16th *Equation*—(Continued).

No. of Circuit Triangle	B	C
141	+ 0·350	+ 0·371
142	− 0·728	− 0·707
143	+ 0·606	+ 0·624
144	− 0·416	− 0·404
145	+ 0·455	+ 0·468
146	− 1·664	− 1·616
147	+ 0·909	+ 0·936
148	− 0·728	− 0·707
149	+ 0·606	+ 0·624
150	− 0·208	− 0·202
151	+ 0·153	+ 0·153
152	− 0·144	− 0·140
153	+ 0·250	+ 0·258
154	− 0·412	− 0·400
155	+ 0·200	+ 0·206
156	− 0·515	− 0·500
157	+ 0·120	+ 0·124
158	− 0·258	− 0·250
159	+ 0·120	+ 0·124
160	− 0·155	− 0·150
161	+ 0·200	+ 0·206
162	− 0·093	− 0·090
163	+ 0·162	+ 0·162
164	− 0·122	− 0·119
165	+ 0·089	+ 0·092
166	− 0·163	− 0·158
167	+ 0·347	+ 0·357
168	− 0·459	− 0·446
169	+ 0·594	+ 0·612
170	− 0·255	− 0·248
171	+ 0·040	+ 0·041
172	0·030	0·031

16th *Equation*—(Continued).

No. of Circuit Triangle	B	C
173	− 0·030	− 0·030
174	+ 0·040	+ 0·041
175	− 0·030	− 0·030
176	+ 0·059	+ 0·061
177	− 0·013	− 0·013
178	+ 0·020	+ 0·020
179	− 0·020	− 0·020
180	+ 0·015	+ 0·015

17th *Equation. Linear.*

Left-hand Branch

No. of Circuit Triangle	B	C
139	− 0·410	+ 0·536
140	0·405	0·324
141	0·473	0·630
142	0·924	0·714
143	0·468	0·450
144	0·672	0·516
145	0·446	0·527
146	2·160	1·728
147	0·891	0·972
148	0·777	0·735
149	0·684	0·828
150	0·384	0·264
151	0·135	0·176
152	0·176	0·151
153	0·278	0·353
154	0·504	0·432
155	0·210	0·222
156	0·615	0·600
157	0·162	0·151
158	0·353	0·323
159	0·137	0·155

17th *Equation*—(Continued).

No. of Circuit Triangle	B	C
160	− 0·171	+ 0·180
161	0·168	0·228
162	0·103	0·084
163	0·197	0·206
164	0·155	0·137
165	0·119	0·124
166	0·163	0·168
167	0·494	0·420
168	0·567	0·689
169	0·774	0·684
170	0·240	0·278
171	+ 0·006	0·042

Right-hand Branch

No. of Circuit Triangle	B	C
181	+ 0·504	− 0·536
182	0·218	0·197
183	0·204	0·156
184	0·318	0·096
185	0·126	0·144
186	0·174	0·312
187	0·432	0·252
188	0·234	0·216
189	0·368	0·375
190	0·390	0·353
191	0·252	0·234
192	0·308	0·368
193	0.246	0·204
194	0·186	0·228
195	0·234	0·216
196	0·342	0·360
197	0·330	0·233
198	0·180	0·234
199	0·360	0·315

17th *Equation*—(Continued).

No. of Circuit Triangle	B	C
200	+ 0·158	− 0·270
201	0·330	0·188
202	0·174	0·258
203	0·240	0·233
204	0·456	0·300
205	0·186	0·246
206	0·351	0·324
207	0·079	0·099
208	0·186	0·138
209	0·035	0·030
210	0·032	0·033
211	0·043	0·043
212	0·026	0·040
213	0·054	0·043
214	0·063	0·082
215	0·036	0·026
216	0·024	0·030
217	0·006	0·005
218	0·039	0·043
219	0·050	0·050
220	0·054	0·050

18th *Equation. Latitude.*

Left-hand Branch

No. of Circuit Triangle	B	C
139	− 0·532	+ 0·749
140	0·516	0·393
141	0·599	0·788
142	1·008	0·840
143	0·522	0·522
144	0·672	0·528
145	0·428	0·531
146	2·032	1·664

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No. of Circuit Triangle	B	C
18th Equation—(Continued).		
147	− 0·792	+ 0·963
148	0·665	0·637
149	0·540	0·720
150	0·288	0·198
151	0·099	0·135
152	0·122	0·105
153	0·185	0·258
154	0·336	0·288
155	0·120	0·138
156	0·325	0·335
157	0·084	0·085
158	0·180	0·165
159	0·058	0·072
160	0·069	0·075
161	0·060	0·090
162	0·036	0·034
163	0·066	0·074
164	0·046	0·048
165	0·032	0·035
166	0·027	0·040
167	0·084	0·074
168	0·077	0·113
169	0·060	0·084
170	0·008	0·015
171	0·000	0·003
Right-hand Branch		
181	+ 0·809	− 0·704
182	0·237	0·288
183	0·198	0·252
184	0·396	0·054
185	0·192	0·114
186	0·130	0·404

No. of Circuit Triangle	B	C
18th Equation—(Continued).		
187	+ 0·474	− 0·210
188	0·174	0·264
189	0·388	0·280
190	0·263	0·368
191	0·248	0·142
192	0·168	0·350
193	0·222	0·102
194	0·074	0·214
195	0·196	0·092
196	0·123	0·300
197	0·248	0·068
198	0·048	0·186
199	0·255	0·087
200	0·005	0·190
201	0·205	0·035
202	0·022	0·152
203	0·143	0·038
204	0·068	0·208
205	0·106	0·038
206	0·015	0·156
207	0·040	0·000
208	− 0·014	0·074
209	+ 0·014	0·001
210	− 0·002	0·011
211	+ 0·011	0·001
212	0·010	+ 0·001
213	− 0·005	− 0·010
214	+ 0·019	0·000
215	− 0·001	0·006
216	+ 0·007	0·001
217	0·000	0·001
218	0·005	0·001

No. of Circuit Triangle	B	C
18th Equation—(Continued).		
219	− 0·002	− 0·002
220	+ 0·005	0·003
19th Equation. Longitude. Left-hand Branch		
139	+ 0·375	+ 0·280
140	− 0·249	− 0·276
141	0·287	0·329
142	+ 0·644	+ 0·455
143	− 0·468	− 0·468
144	+ 0·316	+ 0·268
145	− 0·338	− 0·297
146	+ 1·056	+ 1·056
147	− 0·630	− 0·522
148	+ 0·434	+ 0·434
149	− 0·420	− 0·276
150	+ 0·108	+ 0·108
151	− 0·087	− 0·069
152	+ 0·070	+ 0·070
153	− 0·138	− 0·100
154	+ 0·180	+ 0·180
155	− 0·098	− 0·074
156	+ 0·205	+ 0·205
157	− 0·056	− 0·035
158	+ 0·088	+ 0·088
159	− 0·048	− 0·030
160	+ 0·045	+ 0·045
161	− 0·058	− 0·040
162	+ 0·031	+ 0·017
163	− 0·038	− 0·038
164	+ 0·034	+ 0·019
165	− 0·020	− 0·014

No. of Circuit Triangle	B	C
19th Equation—(Continued).		
166	+ 0·032	+ 0·018
167	− 0·049	− 0·049
168	+ 0·072	+ 0·018
169	− 0·096	− 0·006
170	+ 0·013	+ 0·013
171	− 0·004	0·002
Right-hand Branch		
181	+ 0·154	+ 0·564
182	− 0·232	− 0·022
183	0·276	0·096
184	+ 0·026	+ 0·200
185	0·104	0·218
186	− 0·250	0·020
187	0·040	0·242
188	0·248	− 0·026
189	+ 0·015	+ 0·308
190	− 0·323	0·015
191	+ 0·010	0·208
192	− 0·273	0·028
193	+ 0·012	0·174
194	− 0·182	0·010
195	0·002	0·178
196	0·288	0·036
197	0·023	0·180
198	0·154	0·026
199	0·039	0·231
200	0·153	0·035
201	0·048	0·155
202	0·138	0·060
203	0·020	0·153
204	0·280	0·020
205	0·022	0·134

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No. of Circuit Triangle	B	C
	***19th Equation*—(Continued).**	
206	− 0·198	+ 0·072
207	0·007	0·053
208	0·102	0·024
209	0·008	0·014
210	0·016	0·010
211	0·011	0·018
212	0·005	0·016
213	0·019	0·012
214	0·009	0·029
215	0·008	0·004
216	0·002	0·008
217	0·001	0·001
218	0·001	0·007
219	0·002	0·001
220	+ 0·002	0·002
	***20th Equation. Azimuth.* Left-hand Branch**	
139	+ 0·361	+ 0·361
140	− 0·309	− 0·309
141	0·361	0·361
142	+ 0·728	+ 0·707
143	− 0·612	− 0·612
144	+ 0·408	+ 0·408
145	− 0·459	− 0·459
146	+ 1·632	+ 1·632
147	− 0·918	− 0·918
148	+ 0·714	+ 0·714
149	− 0·612	− 0·612
150	+ 0·204	+ 0·204
151	− 0·153	− 0·153
152	+ 0·143	+ 0·143

No. of Circuit Triangle	B	C
	***20th Equation*—(Continued).**	
153	− 0·258	− 0·250
154	+ 0·404	+ 0·404
155	− 0·202	− 0·202
156	+ 0·505	+ 0·505
157	− 0·121	− 0·121
158	+ 0·253	+ 0·253
159	− 0·121	− 0·121
160	+ 0·152	+ 0·152
161	− 0·202	− 0·202
162	+ 0·091	+ 0·091
163	− 0·162	− 0·162
164	+ 0·121	+ 0·121
165	− 0·091	− 0·091
166	+ 0·163	+ 0·158
167	− 0·357	− 0·347
168	+ 0·450	+ 0·450
169	− 0·600	− 0·600
170	+ 0·250	+ 0·250
171	− 0·080	0·040
	Right-hand Branch	
181	+ 0·350	+ 0·371
182	− 0·148	− 0·140
183	0·208	0·202
184	+ 0·200	+ 0·206
185	0·202	0·208
186	− 0·206	− 0·200
187	+ 0·200	+ 0·206
188	− 0·210	− 0·198
189	+ 0·248	+ 0·263
190	− 0·263	− 0·248
191	+ 0·200	+ 0·206
192	− 0·258	− 0·250

No. of Circuit Triangle	B	C
	***20th Equation*—(Continued).**	
193	+ 0·200	+ 0·206
194	− 0·206	− 0·200
195	+ 0·200	+ 0·206
196	− 0·309	− 0·300
197	+ 0·250	+ 0·258
198	− 0·206	− 0·200
199	+ 0·303	+ 0·303
200	− 0·255	− 0·248
201	+ 0·248	+ 0·255
202	− 0·204	− 0·198
203	+ 0·253	+ 0·253
204	− 0·404	− 0·404
205	+ 0·198	+ 0·204
206	− 0·306	− 0·297
207	+ 0·109	+ 0·112
208	− 0·204	− 0·198
209	+ 0·030	+ 0·031
210	− 0·031	− 0·030
211	+ 0·030	+ 0·031
212	0·035	0·036
213	− 0·046	− 0·045
214	+ 0·069	+ 0·071
215	− 0·030	− 0·030
216	+ 0·030	+ 0·031
217	− 0·005	− 0·005
218	+ 0·035	+ 0·035
219	− 0·040	− 0·040
220	+ 0·050	+ 0·050
	***21st Equation. Linear.* Left-hand Branch**	
181	− 0·504	+ 0·536

No. of Circuit Triangle	B	C
	***21st Equation*—(Continued).**	
182	− 0·218	+ 0·197
183	0·204	0·156
184	0·318	0·096
185	0·126	0·144
186	0·174	0·312
187	0·432	0·252
188	0·234	0·216
189	0·368	0·375
190	0·390	0·353
191	0·252	0·234
192	0·308	0·368
193	0·246	0·204
194	0·186	0·228
195	0·234	0·216
196	0·342	0·360
197	0·330	0·233
198	0·180	0·234
199	0·360	0·315
200	0·158	0·270
201	0·330	0·188
202	0·174	0·258
203	0·240	0·233
204	0·456	0·300
205	0·186	0·246
206	0·351	0·324
207	0·079	0·099
208	0·186	0·138
209	0·035	0·030
210	0·032	0·033
211	0·009	0·034
	Right-hand Branch	
221	+ 0·128	− 0·018

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21st Equation—(Continued).

No. of Circuit Triangle	B	C
222	+ 0·061	− 0·074
223	0·153	0·133
224	0·059	0·097
225	0·488	0·368
226	0·548	0·308
227	0·270	0·293
228	0·300	0·308
229	0·228	0·222
230	0·338	0·338
231	0·174	0·186
232	0·119	0·119
233	0·738	0·936
234	1·215	0·972
235	0·972	0·972
236	1·596	1·554
237	0·480	0·600
238	0·960	0·768
239	0·768	0·960
240	0·861	0·777
241	0·888	0·984
242	1·554	1·344
243	1·440	1·368
244	1·431	1·323
245	1·290	1·500
246	0·816	0·840
247	0·672	0·840
248	0·900	0·810
249	0·031	0·023
250	0·012	0·013
251	0·009	0·009
252	0·035	0·030
253	0·009	0·010

21st Equation—(Continued).

No. of Circuit Triangle	B	C
254	+ 0·030	− 0·026
255	0·029	0·029
256	0·091	0·089
257	0·043	0·050
258	0·108	0·094
259	0·094	0·094
260	0·019	0·023
261	0·031	0·029
262	0·024	0·030

22nd Equation. Latitude.

Left-hand Branch

No. of Circuit Triangle	B	C
181	− 0·690	+ 0·718
182	0·239	0·239
183	0·216	0·198
184	0·328	0·086
185	0·142	0·140
186	0·152	0·334
187	0·390	0·222
188	0·188	0·202
189	0·305	0·295
190	0·278	0·285
191	0·190	0·164
192	0·195	0·278
193	0·162	0·126
194	0·102	0·156
195	0·138	0·114
196	0·162	0·216
197	0·173	0·105
198	0·066	0·120
199	0·168	0·120
200	0·048	0·133

22nd Equation—(Continued).

No. of Circuit Triangle	B	C
201	− 0·140	+ 0·078
202	0·056	0·100
203	0·078	0·073
204	0·104	0·100
205	0·054	0·060
206	0·063	0·081
207	0·018	0·019
208	0·024	0·036
209	0·005	0·005
210	0·001	0·002
211	0·002	0·003

Right-hand Branch

No. of Circuit Triangle	B	C
221	+ 0·169	− 0·010
222	0·090	0·079
223	0·162	0·169
224	0·077	0·092
225	0·435	0·465
226	0·593	0·218
227	0·338	0·210
228	0·188	0·353
229	0·258	0·144
230	0·195	0·345
231	0·192	0·096
232	0·056	0·122
233	0·720	0·540
234	0·594	0·972
235	0·873	0·396
236	0·546	1·344
237	0·420	0·210
238	0·304	0·680
239	0·592	0·320
240	0·189	0·567

22nd Equation—(Continued).

No. of Circuit Triangle	B	C
241	+ 0·608	− 0·232
242	0·182	0·952
243	0·816	0·156
244	0·144	0·666
245	0·640	0·140
246	− 0·024	0·456
247	+ 0·344	+ 0·008
248	− 0·190	− 0·400
249	+ 0·011	+ 0·004
250	0·004	0·001
251	− 0·002	− 0·003
252	+ 0·013	+ 0·006
253	− 0·002	− 0·002
254	+ 0·007	+ 0·001
255	− 0·003	− 0·005
256	+ 0·018	+ 0·004
257	− 0·005	− 0·005
258	+ 0·012	+ 0·005
259	− 0·007	− 0·007
260	+ 0·002	0·000
261	− 0·002	0·002
262	+ 0·003	0·002

23rd Equation. Longitude.

Left-hand Branch

No. of Circuit Triangle	B	C
181	− 0·308	− 0·350
182	+ 0·147	+ 0·084
183	0·192	0·138
184	− 0·128	− 0·152
185	0·138	0·156
186	+ 0·176	+ 0·080
187	− 0·098	− 0·146

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23rd Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
188	+ 0·152	+ 0·092
189	− 0·115	− 0·168
190	+ 0·193	+ 0·080
191	− 0·072	− 0·126
192	+ 0·168	+ 0·063
193	− 0·070	− 0·106
194	+ 0·110	+ 0·050
195	− 0·060	− 0·096
196	+ 0·168	+ 0·060
197	− 0·073	− 0·095
198	+ 0·078	+ 0·042
199	− 0·072	− 0·099
200	+ 0·078	+ 0·048
201	− 0·055	− 0·070
202	+ 0·062	+ 0·020
203	− 0·048	− 0·055
204	+ 0·116	+ 0·044
205	− 0·032	− 0·038
206	+ 0·054	+ 0·027
207	− 0·014	− 0·011
208	+ 0·028	+ 0·010
209	− 0·002	− 0·002
210	+ 0·003	0·000
211	− 0·002	0·001

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
221	+ 0·004	+ 0·058
222	0·029	0·082
223	− 0·118	0·011
224	+ 0·023	0·083
225	− 0·455	0·018
226	0·128	0·323
227	+ 0·018	0·325

23rd Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
228	− 0·340	+ 0·035
229	+ 0·006	0·240
230	− 0·338	0·045
231	+ 0·032	0·200
232	− 0·124	0·004
233	0·042	0·768
234	1·107	0·108
235	0·045	0·873
236	1·484	0·238
237	0·025	0·500
238	0·848	0·136
239	0·096	0·768
240	0·721	0·203
241	0·184	0·728
242	1·232	0·364
243	0·384	0·948
244	0·999	0·540
245	0·420	0·930
246	0·584	0·328
247	0·184	0·488
248	0·610	0·350
249	0.012	0·014
250	0·005	0·007
251	0·005	0·004
252	0·011	0·014
253	0·004	0·004
254	0·009	0·010
255	0·010	0·008
256	0·021	0·027
257	0·012	0·012
258	0·016	0·025
259	0·017	0·014

23rd Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
260	− 0·001	+ 0·003
261	0·002	0·002
262	0·000	0·002

24th Equation. Azimuth.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
181	− 0·361	− 0·361
182	+ 0·146	+ 0·141
183	0·208	0·202
184	− 0·204	− 0·204
185	0·204	0·204
186	+ 0·204	+ 0·204
187	− 0·204	− 0·204
188	+ 0·204	+ 0·204
189	− 0·255	− 0·255
190	+ 0·255	+ 0·255
191	− 0·200	− 0·206
192	+ 0·258	+ 0·250
193	− 0·202	− 0·202
194	+ 0·202	+ 0·202
195	− 0·202	− 0·202
196	+ 0·303	+ 0·303
197	− 0·253	− 0·253
198	+ 0·202	+ 0·202
199	− 0·303	− 0·303
200	+ 0·253	+ 0·253
201	− 0·253	− 0·253
202	+ 0·202	+ 0·202
203	− 0·253	− 0·253
204	+ 0·404	+ 0·404
205	− 0·198	− 0·204
206	+ 0·306	+ 0·297

24th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
207	− 0·110	− 0·110
208	+ 0·200	+ 0·200
209	− 0·030	− 0·030
210	+ 0·030	+ 0·030
211	− 0·060	0·030

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
221	+ 0·060	+ 0·062
222	0·061	0·062
223	− 0·064	− 0·060
224	+ 0·061	+ 0·062
225	− 0·265	− 0·250
226	+ 0·245	+ 0·260
227	0·248	0·263
228	− 0·263	− 0·248
229	+ 0·200	+ 0·206
230	− 0·263	− 0·248
231	+ 0·200	+ 0·206
232	− 0·113	− 0·110
233	+ 0·594	+ 0·630
234	− 0·927	− 0·900
235	+ 0·900	+ 0·927
236	− 1·442	− 1·400
237	+ 0·500	+ 0·515
238	− 0·824	− 0·800
239	+ 0·800	+ 0·824
240	− 0·728	− 0·686
241	+ 0·784	+ 0·832
242	− 1·456	− 1·372
243	+ 1·188	+ 1·224
244	− 0·936	− 0·882
245	+ 0·980	+ 1·040
246	− 0·816	− 0·792

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24th *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
247	+ 0·792	+ 0·816
248	− 1·020	− 0·990
249	+ 0·024	+ 0·026
250	0·011	0·011
251	− 0·009	− 0·009
252	+ 0·040	+ 0·041
253	− 0·009	− 0·009
254	+ 0·020	+ 0·020
255	− 0·026	− 0·025
256	+ 0·079	+ 0·082
257	− 0·040	− 0·040
258	+ 0·080	+ 0·080
259	− 0·080	− 0·080
260	+ 0·016	+ 0·016
261	− 0·030	− 0·030
262	+ 0·030	+ 0·030

25th *Equation. Linear.*

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
221	− 0·128	+ 0·018
222	0·061	0·074
223	0·153	0·133
224	0·059	0·097
225	0·488	0·368
226	0·548	0·308
227	0·270	0·293
228	0·300	0·308
229	0·228	0·222
230	0·338	0·338
231	0·174	0·186
232	0·119	0·119
233	0·738	0·936

25th *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
234	− 1·215	+ 0·972
235	0·972	0·972
236	1·596	1·554
237	0·480	0·600
238	0·960	0·768
239	0·768	0·960
240	0·861	0·777
241	0·888	0·984
242	1·554	1·344
243	1·440	1·368
244	1·431	1·323
245	1·290	1·500
246	0·816	0·840
247	0·672	0·840
248	0·900	0·810
249	+ 0·005	0·020

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
263	+ 0·195	− 0·098
264	0·265	0·215
265	0·152	0·176
266	0·432	0·720
267	0·300	0·204
268	0·420	0·300
269	0·636	0·408
270	0·372	0·492
271	0·696	0·456
272	0·315	0·495
273	0·918	0·702
274	0·408	0·384
275	0·600	0·615
276	0·368	0·389
277	0·246	0·222

25th *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
278	+ 0·468	− 0·432
279	0·420	0·444
280	0·630	0·585
281	0·456	0·480
282	0·525	0·555
283	0·240	0·278
284	0·095	0·092
285	0·020	0·020
286	0·119	0·119
287	0·054	0·054
288	0·086	0·084
289	0·031	0·032
290	0·037	0·033
291	0·025	0·032
292	0·050	0·036
293	0·058	0·063
294	0·029	0·033
295	0·035	0·031
296	0·050	0·059
297	0·013	0·012
298	0·011	0·012
299	0·015	0·013
300	0·051	0·049
301	0·008	0·010
302	0·027	0·032

26th *Equation. Latitude.*

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
221	− 0·146	+ 0·028
222	0·065	0·089
223	0·163	0·138
224	0·055	0·100

26th *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
225	− 0·458	+ 0·360
226	0·470	0·265
227	0·238	0·250
228	0·235	0·253
229	0·186	0·180
230	0·255	0·263
231	0·126	0·144
232	0·083	0·086
233	0·480	0·636
234	0·738	0·612
235	0·549	0·558
236	0·854	0·868
237	0·245	0·325
238	0·416	0·352
239	0·288	0·432
240	0·343	0·329
241	0·304	0·392
242	0·434	0·406
243	0·396	0·396
244	0·378	0·378
245	0·270	0·360
246	0·112	0·152
247	0·040	0·128
248	0·030	0·060
249	0·001	0·002

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
263	+ 0·234	− 0·168
264	0·361	0·243
265	0·150	0·244
266	0·564	0·732
267	0·196	0·332
268	0·332	0·448

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26th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
269	+ 0·684	− 0·288
270	0·428	0·352
271	0·456	0·492
272	0·115	0·545
273	0·798	0·354
274	0·176	0·388
275	0·535	0·305
276	0·133	0·350
277	0·206	0·088
278	0·172	0·368
279	0·328	0·152
280	0·175	0·425
281	0·316	0·128
282	0·105	0·390
283	0·165	0·060
284	0·015	0·063
285	0·012	0·003
286	0·007	0·063
287	0·028	0·001
288	− 0·001	0·044
289	+ 0·014	0·000
290	0·015	0·001
291	− 0·004	0·013
292	+ 0·018	0·000
293	0·001	0·018
294	0·010	0·002
295	0·001	0·009
296	0·016	0·006
297	0·000	0·003
298	0·002	0·001
299	0·000	0·002
300	0·006	0·003

26th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
301	− 0·001	− 0·001
302	+ 0·003	0·001

27th Equation. Longitude.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
221	− 0·069	− 0·046
222	0·059	0·037
223	+ 0·038	+ 0·051
224	− 0·050	− 0·029
225	+ 0·195	+ 0·150
226	− 0·133	− 0·155
227	0·145	0·160
228	+ 0·150	+ 0·128
229	− 0·112	− 0·112
230	+ 0·155	+ 0·110
231	− 0·104	− 0·098
232	+ 0·058	+ 0·048
233	− 0·294	− 0·258
234	+ 0·441	+ 0·333
235	− 0·405	− 0·324
236	+ 0·532	+ 0·532
237	− 0·200	− 0·140
238	+ 0·320	+ 0·200
239	− 0·240	− 0·240
240	+ 0·238	+ 0·154
241	− 0·224	− 0·176
242	+ 0·364	+ 0·238
243	− 0·288	− 0·180
244	+ 0·153	+ 0·153
245	− 0·190	− 0·070
246	+ 0·120	+ 0·048
247	− 0·096	− 0·024

27th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
248	+ 0·090	0·000
249	− 0·002	0·000

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
263	− 0·212	− 0·075
264	+ 0·017	+ 0·189
265	− 0·173	− 0·029
266	+ 0·164	+ 0·560
267	− 0·432	− 0·180
268	0·492	0·132
269	0·028	+ 0·440
270	+ 0·084	0·480
271	− 0·576	0·000
272	0·445	− 0·040
273	0·078	+ 0·624
274	0·408	− 0·012
275	0·010	+ 0·500
276	0·343	0·035
277	0·018	0·180
278	0·376	0·032
279	0·008	0·328
280	0·470	0·085
281	0·044	0·328
282	0·400	0·095
283	0·018	0·185
284	0·068	0·018
285	0·003	0·013
286	0·079	0·030
287	0·008	0·033
288	0·055	0·021
289	0·007	0·017
290	0·010	0·019
291	0·015	0·009

27th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
292	− 0·011	+ 0·018
293	0·023	0·014
294	0·003	0·012
295	0·012	0·006
296	0·005	0·018
297	0·004	0·002
298	0·001	0·003
299	0·003	0·002
300	0·004	0·008
301	0·001	0·001
302	+ 0·001	0·003

28th Equation. Azimuth.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
221	− 0·062	− 0·061
222	0·061	0·061
223	+ 0·061	+ 0·061
224	− 0·061	− 0·061
225	+ 0·255	+ 0·255
226	− 0·255	− 0·255
227	0·255	0·255
228	+ 0·255	+ 0·255
229	− 0·204	− 0·204
230	+ 0·255	+ 0·255
231	− 0·206	− 0·200
232	+ 0·111	+ 0·111
233	− 0·606	− 0·606
234	+ 0·909	+ 0·909
235	− 0·909	− 0·909
236	+ 1.414	+ 1·414
237	− 0·505	− 0·505
238	+ 0·808	+ 0·808

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28th *Equation*—(Continued).

No. of Circuit Triangle	B	C
239	− 0·808	− 0.808
240	+ 0·707	+ 0·707
241	− 0·808	− 0·808
242	+ 1·414	+ 1·414
243	− 1·212	− 1·212
244	+ 0·909	+ 0·909
245	− 1·020	− 0·990
246	+ 0·800	+ 0·800
247	− 0·800	− 0·800
248	+ 1·000	+ 1·000
249	− 0·050	0·025

Right-hand Branch

No. of Circuit Triangle	B	C
263	− 0·137	− 0·133
264	+ 0·131	+ 0·135
265	− 0·135	− 0·131
266	+ 0·404	+ 0·416
267	− 0·416	− 0·404
268	0·416	0·404
269	+ 0·400	+ 0·412
270	0·396	0·420
271	− 0·420	− 0·396
272	0·515	0·500
273	+ 0·600	+ 0·618
274	− 0·412	− 0·400
275	+ 0·500	+ 0·515
276	− 0·361	− 0·350
277	+ 0·200	+ 0·206
278	− 0·412	− 0·400
279	+ 0·400	+ 0·412
280	− 0·515	− 0·500
281	+ 0·400	+ 0·412
282	− 0·510	− 0·495

28th *Equation*—(Continued).

No. of Circuit Triangle	B	C
283	+ 0·253	+ 0·253
284	− 0·092	− 0·089
285	+ 0·020	+ 0·020
286	− 0·112	− 0·109
287	+ 0·059	+ 0·061
288	− 0·092	− 0·089
289	+ 0·030	+ 0·031
290	0·030	0·031
291	− 0·036	− 0·035
292	+ 0·040	+ 0·041
293	− 0·046	− 0·045
294	+ 0·030	+ 0·031
295	− 0·026	− 0·025
296	+ 0·050	+ 0·051
297	− 0·012	− 0·012
298	+ 0·011	+ 0·011
299	− 0·013	− 0·013
300	+ 0·035	+ 0·035
301	− 0·010	− 0·010
302	+ 0·025	+ 0·025

29th *Equation. Linear.*

Left-hand Branch

No. of Circuit Triangle	B	C
263	− 0·195	+ 0·098
264	0·265	0·215
265	0·152	0·176
266	0·432	0·720
267	0·300	0·204
268	0·420	0·300
269	0·636	0·408
270	0·372	0·492
271	0·696	0·456

29th *Equation*—(Continued).

No. of Circuit Triangle	B	C
272	− 0·315	+ 0·495
273	0·918	0·702
274	0·408	0·384
275	0·600	0·615
276	0·368	0·389
277	0·246	0·222
278	0·468	0·432
279	0·420	0·444
280	0·630	0·585
281	0·456	0·480
282	0·525	0·555
283	0·240	0·278
284	0·095	0·092
285	0·020	0·020
286	0·119	0·119
287	0·054	0·054
288	0·086	0·084
289	0·000	0·032

Right-hand Branch

No. of Circuit Triangle	B	C
303	+ 0·099	− 0·108
304	0·164	0·113
305	0·144	0·202
306	0·282	0·150
307	0·160	0·098
308	0·193	0·172
309	0·324	0·297
310	0·389	0·305
311	0·315	0·333
312	0·405	0·351
313	0·176	0·176
314	0·118	0·120
315	0·182	0·206

29th *Equation*—(Continued).

No. of Circuit Triangle	B	C
316	+ 0·197	− 0·193
317	0·252	0·270
318	0·233	0·218
319	0·240	0·300
320	0·315	0·198
321	0·156	0·240
322	0·368	0·231
323	0·113	0·164
324	0·101	0·072
325	0·101	0·108
326	0·084	0·082
327	0·172	0·168
328	0·152	0·145
329	0·108	0·135
330	0·102	0·087

30th *Equation. Latitude.*

Left-hand Branch

No. of Circuit Triangle	B	C
263	− 0·226	+ 0·113
264	0·273	0·230
265	0·152	0·176
266	0·392	0·712
267	0·252	0·192
268	0·356	0·280
269	0·456	0·312
270	0·252	0·360
271	0·408	0·276
272	0·195	0·315
273	0·504	0·414
274	0·216	0·216
275	0·290	0·325
276	0·168	0·189

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No. of Circuit Triangle	B	C	No. of Circuit Triangle	B	C	No. of Circuit Triangle	B	C	No. of Circuit Triangle	B	C
30*th Equation*—(Continued).			30*th Equation*—(Continued).			31*st Equation*—(Continued).			31*st Equation*—(Continued).		
277	− 0·102	+ 0·096	321	− 0·012	− 0·066	282	+ 0·090	+ 0·090	326	− 0·009	+ 0·018
278	0·180	0·180	322	+ 0·084	+ 0·021	283	− 0·055	− 0·025	327	0·029	0·021
279	0·164	0·184	323	0·029	0·004	284	+ 0·013	+ 0·013	328	0·006	0·018
280	0·230	0·205	324	0·023	0·002	285	− 0·004	− 0·001	329	0·008	0·007
281	0·132	0·168	325	− 0·006	− 0·015	286	+ 0·010	+ 0·010	330	+ 0·005	0·005
282	0·145	0·155	326	+ 0·018	0·002	287	− 0·008	− 0·001			
283	0·055	0·073	327	− 0·004	0·017	288	+ 0·005	+ 0·005	32*nd Equation. Azimuth.*		
284	0·020	0·018	328	+ 0·011	0·002	289	− 0·003	0·002	Left-hand Branch		
285	0·003	0·004	329	− 0·005	0·005	Right-hand Branch			263	+ 0·133	+ 0·133
286	0·020	0·020	330	+ 0·010	0·005	303	− 0·092	− 0·029	264	− 0·133	− 0·133
287	0·002	0·008				304	+ 0·052	+ 0·094	265	+ 0·133	+ 0·133
288	0·005	0·005	31*st Equation. Longitude.*			305	− 0·131	− 0·021	266	− 0·408	− 0·408
289	0·000	0·001	Left-hand Branch			306	+ 0·038	+ 0·116	267	+ 0·408	+ 0·408
Right-hand Branch			263	+ 0·101	+ 0·101	307	− 0·103	− 0·029	268	0·408	0·408
303	+ 0·068	− 0·109	264	− 0·114	− 0·075	308	+ 0·014	+ 0·094	269	− 0·408	− 0·408
304	0·141	0·081	265	+ 0·088	+ 0·088	309	− 0·213	− 0·024	270	0·404	0·404
305	0·082	0·178	266	− 0·304	− 0·184	310	+ 0·025	+ 0·203	271	+ 0·404	+ 0·404
306	0·192	0·078	267	+ 0·244	+ 0·220	311	− 0·201	− 0·003	272	0·505	0·505
307	0·077	0·083	268	0·256	0·208	312	0·003	+ 0·186	273	− 0·606	− 0·606
308	0·129	0·081	269	− 0·196	− 0·208	313	0·092	0·008	274	+ 0·404	+ 0·404
309	0·129	0·213	270	0·208	0·184	314	0·009	0·054	275	− 0·505	− 0·505
310	0·256	0·112	271	+ 0·212	+ 0·140	315	0·098	0·022	276	+ 0·354	+ 0·354
311	0·108	0·216	272	0·225	0·180	316	0·015	0·077	277	− 0·202	− 0·202
312	0·222	0·120	273	− 0·240	− 0·222	317	0·118	0·044	278	+ 0·404	+ 0·404
313	0·046	0·092	274	+ 0·164	+ 0·128	318	0·015	0·098	279	− 0·404	− 0·404
314	0·056	0·035	275	− 0·185	− 0·155	319	0·115	0·050	280	+ 0·505	+ 0·505
315	0·037	0·098	276	+ 0·126	+ 0·095	320	0·033	0·084	281	− 0·404	− 0·404
316	0·087	0·048	277	− 0·070	− 0·052	321	0·070	0·050	282	+ 0·505	+ 0·505
317	0·044	0·118	278	+ 0·108	+ 0·108	322	0·063	0·095	283	− 0·255	− 0·248
318	0·085	0·020	279	− 0·124	− 0·076	323	0·014	0·049	284	+ 0·090	+ 0·090
319	0·005	0·100	280	+ 0·115	+ 0·115	324	0·015	0·026	285	− 0·020	− 0·020
320	0·090	+ 0·009	281	− 0·112	− 0·052	325	0·023	0·018	286	+ 0·110	+ 0·110

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No. of Circuit Triangle	𝔅	ℭ
***32nd Equation*—(Continued).**		
287	− 0·060	− 0·060
288	+ 0·090	+ 0·090
289	− 0·060	0·030
Right-hand Branch		
303	− 0·103	− 0·100
304	+ 0·140	+ 0·144
305	− 0·165	− 0·160
306	+ 0·202	+ 0·202
307	− 0·134	− 0·130
308	+ 0·140	+ 0·144
309	− 0·309	− 0·300
310	+ 0·354	+ 0·354
311	− 0·303	− 0·303
312	+ 0·303	+ 0·303
313	− 0·141	− 0·141
314	+ 0·079	+ 0·082
315	− 0·163	− 0·158
316	+ 0·139	+ 0·143
317	− 0·204	− 0·198
318	+ 0·248	+ 0·255
319	− 0·255	− 0·248
320	+ 0·297	+ 0·306
321	− 0·204	− 0·198
322	+ 0·350	+ 0·350
323	0·139	0·143
324	0·079	0·082
325	− 0·082	− 0·079
326	+ 0·080	+ 0·080
327	− 0·140	− 0·140
328	+ 0·110	+ 0·110
329	− 0·100	− 0·100
330	+ 0·100	+ 0·100

No. of Circuit Triangle	𝔅	ℭ
***33rd Equation. Linear.* Left-hand Branch**		
303	− 0·099	+ 0·108
304	0·164	0·113
305	0·144	0·202
306	0·282	0·150
307	0·160	0·098
308	0·193	0·172
309	0·324	0·297
310	0·389	0·305
311	0·315	0·333
312	0·405	0·351
313	0·176	0·176
314	0·118	0·120
315	0·182	0·206
316	0·197	0·193
317	0·252	0·270
318	0·233	0·218
319	0·240	0·300
320	0·315	0·198
321	0·156	0·240
322	0·368	0·231
323	0·004	0·210
Right-hand Branch		
331	+ 0·261	− 0·441
332	0·261	0·171
333	0·414	0·450
334	0·324	0·351
335	0·435	0·375
336	0·255	0·285
337	0·323	0·285
338	0·338	0·225
339	0·369	0·306
340	0·315	0·333

No. of Circuit Triangle	𝔅	ℭ
***33rd Equation*—(Continued).**		
341	+ 0·288	− 0·225
342	0·315	0·252
343	0·293	0·225
344	0·333	0·342
345	0·333	0·315
346	0·846	0·774
347	0·720	0·846
348	0·462	0·420
349	0·096	0·098
350	0·084	0·089
351	0·089	0·091
352	0·091	0·082
353	0·082	0·091
354	0·055	0·074
355	0·093	0·087
356	0·070	0·074
357	0·091	0·082
358	0·112	0·115
359	0·116	0·112
360	0·096	0·112
361	0·187	0·144
***34th Equation. Latitude.* Left-hand Branch**		
303	− 0·079	+ 0·089
304	0·109	0·092
305	0·098	0·142
306	0·146	0·100
307	0·090	0·055
308	0·094	0·091
309	0·159	0·156
310	0·165	0·140

No. of Circuit Triangle	𝔅	ℭ
***34th Equation*—(Continued).**		
311	− 0·123	+ 0·138
312	0·150	0·138
313	0·063	0·067
314	0·038	0·041
315	0·056	0·069
316	0·045	0·052
317	0·046	0·056
318	0·035	0·048
319	0·033	0·050
320	0·027	0·027
321	0·016	0·032
322	0·025	0·028
323	0·003	0·014
Right-hand Branch		
331	+ 0·351	− 0·459
332	0·195	0·228
333	0·339	0·489
334	0·321	0·264
335	0·290	0·355
336	0·218	0·150
337	0·258	0·140
338	0·135	0·188
339	0·144	0·243
340	0·204	0·093
341	0·192	0·042
342	0·060	0·174
343	0·065	0·153
344	0·174	0·051
345	0·042	0·183
346	0·366	0·084
347	0·030	0·366
348	0·179	0·011

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No. of Circuit Triangle	B	C
***34th Equation*—(Continued).**		
349	+ 0·038	− 0·005
350	− 0·006	0·032
351	+ 0·029	0·000
352	− 0·006	0·025
353	+ 0·023	+ 0·002
354	− 0·010	− 0·017
355	+ 0·022	+ 0·001
356	− 0·006	− 0·014
357	+ 0·016	+ 0·002
358	− 0·006	− 0·017
359	+ 0·017	0·003
360	− 0·006	0·006
361	+ 0·016	0·008
35th Equation. Longitude.		
Left-hand Branch		
303	+ 0·057	+ 0·057
304	− 0·092	− 0·055
305	+ 0·077	+ 0·077
306	− 0·114	− 0·060
307	+ 0·051	+ 0·051
308	− 0·063	− 0·038
309	+ 0·099	+ 0·099
310	− 0·126	− 0·095
311	+ 0·090	+ 0·090
312	− 0·102	− 0·066
313	+ 0·036	+ 0·036
314	− 0·020	− 0·015
315	+ 0·045	+ 0·021
316	− 0·034	− 0·021
317	+ 0·030	+ 0·030
318	− 0·045	− 0·023

No. of Circuit Triangle	B	C
***35th Equation*—(Continued).**		
319	+ 0·030	+ 0·030
320	− 0·048	− 0·012
321	+ 0·016	+ 0·016
322	− 0·039	− 0·007
323	0·014	+ 0·007
Right-hand Branch		
331	+ 0·159	+ 0·348
332	− 0·291	− 0·138
333	0·345	0·039
334	+ 0·102	+ 0·255
335	− 0·310	0·013
336	+ 0·028	0·208
337	0·010	0·205
338	− 0·225	0·000
339	0·258	0·012
340	0·015	0·210
341	+ 0·006	0·168
342	− 0·210	0·024
343	0·190	0·028
344	0·042	0·183
345	0·201	0·060
346	0·198	0·396
347	0·432	0·270
348	0·126	0·221
349	0·026	0·051
350	0·042	0·027
351	0·019	0·038
352	0·039	0·023
353	0·017	0·034
354	0·021	0·020
355	0·010	0·026
356	0·017	0·012

No. of Circuit Triangle	B	C
***35th Equation*—(Continued).**		
357	− 0·010	+ 0·016
358	0·018	0·014
359	0·002	0·011
360	0·007	0·007
361	+ 0·002	0·011
36th Equation. Azimuth.		
Left-hand Branch		
303	+ 0·102	+ 0·102
304	− 0·144	− 0·140
305	+ 0·162	+ 0·162
306	− 0·202	− 0·202
307	+ 0·131	+ 0·131
308	− 0·141	− 0·141
309	+ 0·303	+ 0·303
310	− 0·354	− 0·354
311	+ 0·303	+ 0·303
312	− 0·303	− 0·303
313	+ 0·141	+ 0·141
314	− 0·081	− 0·081
315	+ 0·162	+ 0·162
316	− 0·141	− 0·141
317	+ 0·202	+ 0·202
318	− 0·255	− 0·248
319	+ 0·250	+ 0·250
320	− 0·300	− 0·300
321	+ 0·200	+ 0·200
322	− 0·350	− 0·350
323	0·280	+ 0·140
Right-hand Branch		
331	+ 0·303	+ 0·312
332	− 0·306	− 0·306

No. of Circuit Triangle	B	C
***36th Equation*—(Continued).**		
333	− 0·309	− 0·300
334	+ 0·306	+ 0·306
335	− 0·258	− 0·250
336	+ 0·250	+ 0·258
337	0·250	0·258
338	− 0·258	− 0·250
339	0·309	0·300
340	+ 0·303	+ 0·303
341	0·303	0·303
342	− 0·303	− 0·303
343	0·253	0·253
344	+ 0·297	+ 0·306
345	− 0·306	− 0·297
346	+ 0·594	+ 0·612
347	− 0·612	− 0·594
348	+ 0·347	+ 0·357
349	0·079	0·082
350	− 0·082	− 0·079
351	+ 0·079	+ 0·082
352	− 0·082	− 0·079
353	+ 0·079	+ 0·082
354	− 0·080	− 0·080
355	+ 0·099	+ 0·102
356	− 0·080	− 0·080
357	+ 0·080	+ 0·080
358	− 0·120	− 0·120
359	+ 0·110	+ 0·110
360	− 0·110	− 0·110
361	+ 0·160	+ 0·160

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37th Equation. Linear.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
331	− 0·261	+ 0·441
332	0·261	0·171
333	0·414	0·450
334	0·324	0·351
335	0·435	0·375
336	0·255	0·285
337	0·323	0·285
338	0·338	0·225
339	0·369	0·306
340	0·315	0·333
341	0·288	0·225
342	0·315	0·252
343	0·293	0·225
344	0·333	0·342
345	0·333	0·315
346	0·846	0·774
347	0·720	0·846
348	0·462	0·420
349	0·096	0·098
350	0·084	0·089
351	0·002	0·091

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
409	+ 0·041	− 0·064
410	0·062	0·084
411	0·101	0·058
412	0·065	0·079
413	0·056	0·058
414	0·067	0·068
415	0·103	0·100
416	0·040	0·036
417	0·047	0·050
418	0·067	0·068

37th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
419	+ 0·072	− 0·086
420	0·129	0·079
421	0·084	0·099
422	0·082	0·077
423	0·089	0·091

38th Equation. Latitude.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
331	− 0·261	+ 0·468
332	0·222	0·147
333	0·357	0·390
334	0·222	0·282
335	0·303	0·275
336	0·140	0·168
337	0·180	0·165
338	0·148	0·115
339	0·153	0·144
340	0·117	0·126
341	0·108	0·081
342	0·081	0·081
343	0·083	0·075
344	0·081	0·081
345	0·051	0·075
346	0·150	0·102
347	0·060	0·156
348	0·070	0·046
349	0·012	0·010
350	0·001	0·006
351	0·006	0·006

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
362	+ 0·720	− 0·468
363	0·428	0·604

38th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
364	+ 0·231	− 0·462
365	0·772	0·368
366	0·528	0·408
367	0·595	0·785
368	1·020	0·525
369	0·384	0·912
370	0·635	0·385
371	0·695	0·865
372	0·504	0·432
373	0·485	0·805
374	0·736	0·368
375	0·232	0·632
376	0·840	0·285
377	0·160	0·632
378	0·930	0·510
379	0·235	0·785
380	0·715	0·230
381	0·240	0·660
382	0·665	0·310
383	0·184	0·392
384	0·540	0·252
385	0·300	0·735
386	0·465	0·165
387	0·210	0·555
388	0·304	0·140
389	0·240	0·456
390	0·372	0·168
391	0·112	0·320
392	0·420	0·156
393	0·035	0·460
394	0·272	0·052
395	− 0·008	0·260

38th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
396	+ 0·236	+ 0·020
397	− 0·020	− 0·272
398	+ 0·310	+ 0·040
399	− 0·095	− 0·290
400	+ 0·236	+ 0·056
401	− 0·095	− 0·290
402	+ 0·216	+ 0·072
403	− 0·110	− 0·275
404	+ 0·230	+ 0·125
405	− 0·175	− 0·220
406	+ 0·156	+ 0·120
407	0·013	0·008
408	− 0·010	− 0·010
409	+ 0·010	+ 0·007
410	− 0·030	− 0·022
411	+ 0·021	+ 0·021
412	− 0·024	− 0·017
413	+ 0·015	+ 0·013
414	− 0·016	− 0·010
415	+ 0·020	+ 0·014
416	− 0·007	− 0·004
417	+ 0·006	+ 0·006
418	− 0·010	− 0·005
419	+ 0·009	+ 0·009
420	− 0·017	− 0·007
421	+ 0·006	+ 0·006
422	− 0·007	0·000
423	+ 0·007	0·000

39th Equation. Longitude.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
331	− 0·222	− 0·195

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No. of Circuit Triangle	𝔅	ℭ
39th Equation—(Continued).		
332	+ 0·177	+ 0·177
333	0·177	0·177
334	− 0·201	− 0·102
335	+ 0·138	+ 0·100
336	− 0·100	− 0·085
337	0·100	0·093
338	+ 0·093	+ 0·063
339	0·111	0·075
340	− 0·084	− 0·066
341	0·084	0·066
342	+ 0·072	+ 0·045
343	0·070	0·033
344	− 0·045	− 0·045
345	+ 0·084	+ 0·012
346	− 0·042	− 0·114
347	+ 0·138	0·024
348	− 0·011	0·042
349	0·002	0·010
350	+ 0·006	0·001
351	− 0·006	0·001
Right-hand Branch		
362	+ 0·160	+ 0·604
363	− 0·628	− 0·172
364	0·435	0·120
365	+ 0·064	+ 0·592
366	0·176	0·608
367	− 0·830	− 0·125
368	0·000	+ 0·765
369	0·616	0·080
370	+ 0·180	0·675
371	− 0·890	− 0·005
372	+ 0·088	+ 0·616

No. of Circuit Triangle	𝔅	ℭ
39th Equation—(Continued).		
373	− 0·805	+ 0·005
374	0·080	0·616
375	0·564	0·048
376	0·105	0·660
377	0·500	0·076
378	0·215	0·820
379	0·650	0·145
380	0·075	0·600
381	0·630	0·090
382	0·080	0·640
383	0·504	0·000
384	0·100	0·512
385	0·660	0·240
386	0·005	0·490
387	0·585	0·135
388	+ 0·028	0·400
389	− 0·540	0·144
390	0·104	0·460
391	0·484	0·068
392	0·220	0·500
393	0·490	0·260
394	0·092	0·400
395	0·376	0·080
396	0·072	0·324
397	0·392	0·148
398	0·175	0·380
399	0·380	0·175
400	0·188	0·304
401	0·410	0·250
402	0·188	0·304
403	0·405	0·285
404	0·270	0·375

No. of Circuit Triangle	𝔅	ℭ
39th Equation—(Continued).		
405	− 0·315	+ 0·285
406	0·220	0·200
407	0·025	0·024
408	0·029	0·021
409	0·022	0·033
410	0·027	0·046
411	0·049	0·028
412	0·026	0·038
413	0·022	0·025
414	0·021	0·026
415	0·034	0·036
416	0·012	0·012
417	0·011	0·014
418	0·013	0·014
419	0·010	0·016
420	0·017	0·017
421	0·009	0·014
422	0·002	0·005
423	0·002	0·005
40th Equation. Azimuth.		
Left-hand Branch		
331	− 0·306	− 0·306
332	+ 0·306	+ 0·306
333	0·306	0·306
334	− 0·309	− 0·300
335	+ 0·258	+ 0·250
336	− 0·253	− 0·253
337	0·253	0·253
338	+ 0·253	+ 0·253
339	0·303	0·303
340	− 0·303	− 0·303

No. of Circuit Triangle	𝔅	ℭ
40th Equation—(Continued).		
341	− 0·303	− 0·303
342	+ 0·303	+ 0·303
343	0·253	0·253
344	− 0·303	− 0·303
345	+ 0·306	+ 0·297
346	− 0·600	− 0·600
347	+ 0·600	+ 0·600
348	− 0·350	− 0·350
349	0·080	0·080
350	+ 0·080	+ 0·080
351	− 0·160	0·080
Right-hand Branch		
362	+ 0·404	+ 0·416
363	− 0·416	− 0·404
364	0·312	0·303
365	+ 0·404	+ 0·416
366	0·404	0·416
367	− 0·520	− 0·505
368	+ 0·495	+ 0·525
369	− 0·420	− 0·396
370	+ 0·505	+ 0·520
371	− 0·530	− 0·500
372	+ 0·404	+ 0·416
373	− 0·525	− 0·495
374	+ 0·396	+ 0·420
375	− 0·420	− 0·396
376	+ 0·500	+ 0·515
377	− 0·412	− 0·400
378	+ 0·495	+ 0·525
379	− 0·515	− 0·500
380	+ 0·500	+ 0·515
381	− 0·515	− 0·500

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40th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
382	+ 0·500	+ 0·515
383	− 0·420	− 0·396
384	+ 0·400	+ 0·412
385	− 0·520	− 0·490
386	+ 0·500	+ 0·515
387	− 0·515	− 0·500
388	+ 0·400	+ 0·412
389	− 0·420	− 0·396
390	+ 0·400	+ 0·412
391	− 0·412	− 0·400
392	+ 0·392	+ 0·416
393	− 0·510	− 0·495
394	+ 0·400	+ 0·412
395	− 0·412	− 0·400
396	+ 0·396	+ 0·408
397	− 0·416	− 0·392
398	+ 0·495	+ 0·510
399	− 0·510	− 0·495
400	+ 0·396	+ 0·408
401	− 0·510	− 0·495
402	+ 0·396	+ 0·408
403	− 0·510	− 0·495
404	+ 0·495	+ 0·510
405	− 0·515	− 0·485
406	+ 0·388	+ 0·412
407	0·029	0·031
408	− 0·031	− 0·030
409	+ 0·029	+ 0·031
410	− 0·091	− 0·088
411	+ 0·078	+ 0·081
412	− 0·081	− 0·078
413	+ 0·059	+ 0·061

40th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
414	− 0·060	− 0·060
415	+ 0·090	+ 0·090
416	− 0·035	− 0·035
417	+ 0·040	+ 0·041
418	− 0·060	− 0·060
419	+ 0·080	+ 0·080
420	− 0·110	− 0·110
421	+ 0·070	+ 0·070
422	− 0·080	− 0·080
423	+ 0·080	+ 0·080

41st Equation. Linear.

No. of Circuit Triangle	𝔅	ℭ
362	+ 0·432	− 0·432
363	0·420	0·336
364	0·252	0·261
365	0·480	0·384
366	0·300	0·420
367	0·615	0·465
368	0·690	0·570
369	0·444	0·636
370	0·390	0·465
371	0·765	0·585
372	0·324	0·504
373	0·615	0·555
374	0·576	0·504
375	0·396	0·468
376	0·675	0·495
377	0·336	0·492
378	0·810	0·765
379	0·480	0·645
380	0·630	0·495
381	0·540	0·585

41st Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
382	+ 0·600	− 0·615
383	0·444	0·312
384	0·552	0·528
385	0·690	0·795
386	0·435	0·465
387	0·585	0·585
388	0·288	0·432
389	0·636	0·516
390	0·432	0·540
391	0·528	0·336
392	0·600	0·624
393	0·510	0·615
394	0·348	0·480
395	0·408	0·276
396	0·276	0·372
397	0·456	0·372
398	0·465	0·480
399	0·420	0·390
400	0·408	0·384
401	0·510	0·480
402	0·396	0·432
403	0·540	0·495
404	0·510	0·570
405	0·435	0·465
406	0·384	0·336
407	0·044	0·040
408	0·052	0·037

42nd Equation. Linear.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
407	+ 0·038	− 0·011
408	0·052	0·037

42nd Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
424	− 0·030	+ 0·035
425	0·122	0·116
426	0·122	0·076
427	0·158	0·119
428	0·125	0·162
429	0·109	0·109
430	0·125	0·102
431	0·138	0·141
432	0·120	0·123
433	0·084	0·105
434	0·099	0·090
435	0·068	0·059
436	0·065	0·071
437	0·050	0·054
438	0·060	0·048
439	0·076	0·092
440	0·067	0·063
441	0·058	0·067
442	0·077	0·090
443	0·039	0·047

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
362	0·000	− 0·432
444	+ 0·023	0·020
445	0·023	0·024
446	0·020	0·022
447	0·023	0·022
448	0·060	0·048
449	0·056	0·048
450	0·041	0·046
451	0·043	0·043
452	0·025	0·029
453	0·028	0·026

42nd Equation—(Continued).

No. of Circuit Triangle	B	C
454	+ 0·015	− 0·016
455	0·039	0·037
456	0·022	0·025
457	0·032	0·028
458	0·023	0·022
459	0·042	0·049
460	0·041	0·035
461	0·024	0·023
462	0·022	0·025
463	0·020	0·020
464	0·048	0·042
465	0·042	0·052
466	0·046	0·044
467	0·042	0·041
468	0·045	0·049
469	0·046	0·043
470	0·063	0·058
471	0·059	0·054
472	0·047	0·050
473	0·043	0·048
474	0·051	0·043
475	0·044	0·044
476	0·029	0·032
477	0·032	0·029
478	0·017	0·030
479	0·019	0·020
480	0·035	0·028
481	0·037	0·033
482	0·027	0·033
483	0·029	0·034
484	0·114	0·093
485	0·111	0·114

42nd Equation—(Continued).

No. of Circuit Triangle	B	C
486	+ 0·090	− 0·099
487	0·108	0·099
488	0·067	0·063
489	0·065	0·076
490	0·072	0·068
491	0·068	0·067
492	0·054	0·086
493	0·043	0·049
494	0·059	0·032
495	0·058	0·061
496	0·052	0·061
497	0·063	0·063
498	0·050	0·059
499	0·107	0·092
500	0·069	0·093
501	− 0·029	0·020

43rd Equation. Latitude.

Left-hand Branch

No. of Circuit Triangle	B	C
362	− 0·672	+ 0·300
363	0·664	0·260
364	0·420	0·201
365	0·400	0·596
366	0·200	0·652
367	0·870	0·345
368	0·570	0·825
369	0·624	0·540
370	0·205	0·680
371	0·950	0·415
372	0·164	0·652
373	0·770	0·370
374	0·388	0·608

43rd Equation—(Continued).

No. of Circuit Triangle	B	C
375	− 0·492	+ 0·300
376	0·410	0·610
377	0·416	0·292
378	0·485	0·805
379	0·545	0·340
380	0·300	0·570
381	0·565	0·245
382	0·220	0·620
383	0·436	0·056
384	0·192	0·492
385	0·605	0·280
386	0·040	0·485
387	0·510	0·120
388	+ 0·032	0·392
389	− 0·460	0·092
390	0·020	0·400
391	0·352	− 0·016
392	0·068	+ 0·388
393	0·350	0·025
394	+ 0·056	0·308
395	− 0·248	− 0·068
396	+ 0·096	+ 0·240
397	− 0·232	− 0·064
398	+ 0·105	+ 0·285
399	− 0·230	− 0·125
400	+ 0·112	+ 0·196
401	− 0·215	− 0·140
402	+ 0·140	+ 0·176
403	− 0·185	− 0·170
404	+ 0·195	+ 0·195
405	− 0·150	− 0·195
406	+ 0·184	+ 0·136

43rd Equation—(Continued).

No. of Circuit Triangle	B	C
407	+ 0·023	− 0·014
424	− 0·008	0·015
425	0·028	0·051
426	+ 0·055	+ 0·025
427	− 0·021	− 0·047
428	+ 0·047	+ 0·014
429	0·044	0·021
430	− 0·019	− 0·039
431	0·016	0·037
432	+ 0·036	+ 0·009
433	0·030	0·012
434	− 0·015	− 0·024
435	0·007	0·013
436	+ 0·012	+ 0·003
437	0·011	0·005
438	− 0·005	− 0·008
439	0·006	0·010
440	+ 0·008	+ 0·003
441	0·006	0·004
442	− 0·004	− 0·002
443	0·004	0·002

Right-hand Branch

No. of Circuit Triangle	B	C
444	+ 0·038	− 0·018
445	0·022	0·037
446	0·018	0·034
447	0·036	0·023
448	0·059	0·075
449	0·080	0·051
450	0·040	0·066
451	0·064	0·044
452	0·024	0·041
453	0·040	0·028

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No. of Circuit Triangle	𝔅	ℭ
43rd Equation—(Continued).		
454	+ 0·015	− 0·022
455	0·054	0·041
456	0·024	0·032
457	0·044	0·031
458	0·026	0·029
459	0·056	0·059
460	0·046	0·043
461	0·028	0·029
462	0·027	0·029
463	0·022	0·023
464	0·053	0·050
465	0·047	0·055
466	0·050	0·047
467	0·041	0·044
468	0·044	0·052
469	0·046	0·041
470	0·062	0·054
471	0·053	0·051
472	0·042	0·047
473	0·037	0·040
474	0·045	0·036
475	0·034	0·037
476	0·022	0·027
477	0·024	0·021
478	0·014	0·022
479	0·012	0·015
480	0·022	0·022
481	0·025	0·020
482	0·019	0·020
483	0·015	0·022
484	0·060	0·060
485	0·063	0·057

No. of Circuit Triangle	𝔅	ℭ
43rd Equation—(Continued).		
486	+ 0·051	− 0·048
487	0·045	0·054
488	0·028	e·035
489	0·029	0·028
490	0·034	0·027
491	0·022	0·029
492	0·014	0·034
493	0·014	0·011
494	0·019	0·007
495	0·010	0·020
496	0·013	0·012
497	0·014	0·012
498	0·006	0·009
499	0·012	0·012
500	0·005	0·007
501	0·005	0·003
44th Equation. Longitude.		
Left-hand Branch		
362	+ 0·044	− 0·664
363	0·052	+ 0·568
364	0·081	0·432
365	− 0·660	− 0·048
366	0·520	0·040
367	0·010	+ 0·695
368	0·850	0·005
369	+ 0·004	0·712
370	− 0·635	− 0·035
371	0·135	+ 0·720
372	0·484	0·068
373	0·045	0·675
374	0·620	0·064

No. of Circuit Triangle	𝔅	ℭ
44th Equation—(Continued).		
375	+ 0·020	+ 0·524
376	− 0·725	0·010
377	+ 0·040	0·520
378	− 0·800	0·205
379	0·020	0·655
380	0·680	0·070
381	0·085	0·605
382	0·660	0·195
383	0·104	0·376
384	0·568	0·200
385	0·265	0·740
386	0·525	0·150
387	0·225	0·585
388	0·360	0·192
389	0·312	0·492
390	0·428	0·280
391	0·232	0·332
392	0·520	0·332
393	0·205	0·500
394	0·324	0·252
395	0·192	0·252
396	0·260	0·196
397	0·228	0·288
398	0·375	0·270
399	0·210	0·285
400	0·312	0·228
401	0·290	0·325
402	0·284	0·280
403	0·330	0·315
404	0·350	0·400
405	0·285	0·270
406	0·244	0·248

No. of Circuit Triangle	𝔅	ℭ
44th Equation—(Continued).		
407	+ 0·001	+ 0·016
424	− 0·021	0·020
425	0·086	0·066
426	0·058	0·057
427	0·099	0·059
428	0·058	0·097
429	0·048	0·067
430	0·065	0·041
431	0·071	0·061
432	0·042	0·057
433	0·028	0·050
434	0·040	0·029
435	0·025	0·019
436	0·016	0·023
437	0·014	0·020
438	0·016	0·010
439	0·018	0·020
440	0·008	0·011
441	0·008	0·012
442	0·007	0·009
443	0·005	0·006
Right-hand Branch		
444	− 0·002	− 0·031
445	+ 0·031	+ 0·003
446	0·029	0·005
447	− 0·006	− 0·030
448	+ 0·075	+ 0·017
449	− 0·005	− 0·054
450	+ 0·052	+ 0·013
451	− 0·017	− 0·053
452	+ 0·031	+ 0·009
453	− 0·012	− 0·031

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44th Equation—(Continued).

No. of Circuit Triangle	B	C
454	+ 0·017	+ 0·007
455	− 0·015	− 0·037
456	+ 0·022	+ 0·010
457	− 0·019	− 0·032
458	+ 0·025	+ 0·017
459	− 0·023	− 0·038
460	+ 0·029	+ 0·021
461	0·019	0·014
462	− 0·016	− 0·017
463	+ 0·017	+ 0·014
464	0·036	0·028
465	− 0·028	− 0·032
466	0·028	0·032
467	+ 0·032	+ 0·025
468	0·036	0·028
469	− 0·029	− 0·032
470	0·027	0·033
471	+ 0·032	+ 0·026
472	0·025	0·019
473	− 0·018	− 0·023
474	0·018	0·023
475	+ 0·023	+ 0·016
476	0·016	0·012
477	− 0·012	− 0·015
478	0·012	0·014
479	+ 0·014	+ 0·010
480	0·021	0·013
481	− 0·014	− 0·017
482	0·013	0·018
483	+ 0·017	+ 0·011
484	0·052	0·031
485	− 0·027	− 0·045

44th Equation—(Continued).

No. of Circuit Triangle	B	C
486	− 0·031	− 0·043
487	+ 0·043	+ 0·022
488	0·026	0·013
489	− 0·011	− 0·024
490	0·012	0·023
491	+ 0·023	+ 0·007
492	0·021	0·005
493	− 0·009	− 0·014
494	0·008	0·014
495	+ 0·017	+ 0·002
496	− 0·007	− 0·012
497	0·004	0·011
498	+ 0·005	+ 0·004
499	0·009	0·000
500	− 0·004	− 0·001
501	0·004	0·002

45th Equation. Azimuth.

Left-hand Branch

No. of Circuit Triangle	B	C
362	+ 0·404	− 0·820
363	0·404	+ 0·416
364	0·303	0·312
365	− 0·416	− 0·404
366	0·420	0·396
367	+ 0·495	+ 0·525
368	− 0·520	− 0·505
369	+ 0·404	+ 0·416
370	− 0·515	− 0·500
371	+ 0·500	+ 0·515
372	− 0·412	− 0·400
373	+ 0·500	+ 0·515
374	− 0·420	− 0·396

45th Equation—(Continued).

No. of Circuit Triangle	B	C
375	+ 0·396	+ 0·420
376	− 0·525	− 0·495
377	+ 0·396	+ 0·420
378	− 0·525	− 0·495
379	+ 0·500	+ 0·515
380	− 0·515	− 0·500
381	+ 0·500	+ 0·515
382	− 0·515	− 0·500
383	+ 0·392	+ 0·416
384	− 0·412	− 0·400
385	+ 0·500	+ 0·515
386	− 0·515	− 0·500
387	+ 0·490	+ 0·520
388	− 0·408	− 0·396
389	+ 0·392	+ 0·416
390	− 0·408	− 0·396
391	+ 0·396	+ 0·408
392	− 0·416	− 0·392
393	+ 0·490	+ 0·520
394	− 0·408	− 0·396
395	+ 0·396	+ 0·408
396	− 0·408	− 0·396
397	+ 0·396	+ 0·408
398	− 0·510	− 0·495
399	+ 0·495	+ 0·510
400	− 0·408	− 0·396
401	+ 0·495	+ 0·510
402	− 0·412	− 0·388
403	+ 0·485	+ 0·515
404	− 0·515	− 0·485
405	+ 0·495	+ 0·510
406	− 0·412	− 0·388

45th Equation—(Continued).

No. of Circuit Triangle	B	C
407	− 0·060	+ 0·031
424	+ 0·029	0·031
425	0·108	0·111
426	− 0·112	− 0·109
427	+ 0·108	+ 0·111
428	− 0·111	− 0·108
429	0·111	0·108
430	+ 0·108	+ 0·111
431	0·097	0·103
432	− 0·101	− 0·098
433	0·101	·0·098
434	+ 0·100	+ 0·100
435	0·049	0·051
436	− 0·050	− 0·050
437	0·050	0·050
438	+ 0·050	+ 0·050
439	0·060	0·060
440	− 0·060	− 0·060
441	0·060	0·060
442	+ 0·060	+ 0·060
443	0·050	0·050

Right-hand Branch

No. of Circuit Triangle	B	C
444	− 0·020	− 0·021
445	+ 0·021	+ 0·020
446	0·021	0·020
447	− 0·020	− 0·021
448	+ 0·052	+ 0·051
449	− 0·035	− 0·036
450	+ 0·042	+ 0·040
451	− 0·040	− 0·042
452	+ 0·026	+ 0·025
453	− 0·025	− 0·026

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45th *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
454	+ 0·016	+ 0·015
455	− 0·030	− 0·031
456	+ 0·021	+ 0·020
457	− 0·030	− 0·031
458	+ 0·026	+ 0·025
459	− 0·035	− 0·036
460	+ 0·031	+ 0·030
461	0·020	0·020
462	− 0·020	− 0·020
463	+ 0·020	+ 0·020
464	0·041	0·041
465	− 0·041	− 0·041
466	0·041	0·041
467	+ 0·041	+ 0·041
468	0·046	0·046
469	− 0·046	− 0·046
470	0·046	0·046
471	+ 0·046	+ 0·046
472	0·036	0·036
473	− 0·036	− 0·036
474	0·036	0·036
475	+ 0·036	+ 0·036
476	0·026	0·026
477	− 0·025	− 0·026
478	0·026	0·026
479	+ 0·025	+ 0·025
480	0·036	0·035
481	− 0·035	− 0·035
482	0·035	0·035
483	+ 0·035	+ 0·035
484	0·101	0·101
485	− 0·101	− 0·101

45th *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
486	− 0·101	− 0·101
487	+ 0·101	+ 0·101
488	0·061	0·061
489	− 0·061	− 0·061
490	0·061	0·061
491	+ 0·061	+ 0·061
492	0·061	0·061
493	− 0·061	− 0·061
494	0·061	0·061
495	+ 0·061	+ 0·059
496	− 0·059	− 0·061
497	0·050	0·051
498	+ 0·050	+ 0·050
499	0·050	0·050
500	− 0·050	− 0·050
501	0·100	+ 0·050

46th *Equation. Linear.*

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
461	− 0·023	+ 0·002
462	0·022	0·025
463	0·020	0·020
464	0·048	0·042
465	0·042	0·052
466	0·046	0·044
467	0·042	0·041
468	0·045	0·049
469	0·046	0·043
470	0·063	0·058
471	0·059	0·054
472	0·047	0·050
473	0·043	0·048

46th *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
474	− 0·051	+ 0·043
475	0·044	0·044
476	0·029	0·032
477	0·032	0·029
478	0·017	0·030
479	0·019	0·020
480	0·035	0·028
481	0·037	0·033
482	0·027	0·033
483	0·029	0·034
484	0·114	0·093
485	0·111	0·114
486	0·090	0·099
487	0·108	0·099
488	0·067	0·063
489	0·065	0·076
490	0·072	0·068
491	0·068	0·067
492	0·054	0·086
493	0·043	0·049
494	0·059	0·032
495	0·058	0·061
496	0·052	0·061
497	0·063	0·063
498	0·050	0·059
499	0·107	0·092
500	0·069	0·093
501	0·099	0·045
502	0·065	0·089
503	0·056	0·062
504	0·084	0·082
505	0·110	0·120

46th *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
506	− 0·041	+ 0·060
507	0·077	0·036
508	0·083	0·075
509	0·048	0·083
510	0·032	0·049
511	0·067	0·041
512	0·071	0·047
513	0·063	0·081
514	0·057	0·051
515	0·063	0·072
516	0·017	0·038
517	0·140	0·092

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
518	+ 0·021	− 0·024
519	0·022	0·021
520	0·024	0·026
521	0·033	0·029
522	0·022	0·026
523	0·011	0·010
524	0·033	0·032
525	0·029	0·030
526	0·041	0·045
527	0·053	0·047
528	0·061	0·058
529	0·065	0·065
530	0·168	0·163
531	0·050	0·055
532	0·043	0·039
533	0·027	0·029
534	0·028	0·022
535	0·017	0·022
536	0·021	0·012

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46th Equation—(Continued).

No. of Circuit Triangle	B	C
537	+ 0·022	− 0·028
538	0·026	0·022
539	0·089	0·084
540	0·022	0·041
541	0·035	0·035
542	0·028	0·025
543	0·051	0·040
544	0·042	0·049
545	0·025	0·041
546	0·021	0·026
547	0·068	0·036
548	0·068	0·090
549	0·044	0·038
550	0·023	0·042
551	0·035	0·026
552	0·049	0·037
553	0·034	0·049
554	0·025	0·040
555	0·069	0·069
556	0·078	0·074
557	0·126	0·069
558	0·080	0·097
559	0·038	0·050
560	0·122	0·061
561	0·088	0·101
562	0·088	0·126
563	0·053	0·060
564	0·077	0·054
565	0·033	0·044
566	0·027	0·050
567	0·060	0·035
568	0·075	0·069

46th Equation—(Continued).

No. of Circuit Triangle	B	C
569	+ 0·056	− 0·080
570	0·104	0·059
571	0·044	0·069
572	0·075	0·065
573	0·057	0·051

47th Equation. Latitude.

Left-hand Branch

No. of Circuit Triangle	B	C
461	− 0·036	+ 0·019
462	0·034	0·020
463	0·013	0·030
464	0·036	0·063
465	0·061	0·039
466	0·064	0·030
467	0·024	0·057
468	0·024	0·067
469	0·061	0·023
470	0·077	0·036
471	0·035	0·068
472	0·027	0·058
473	0·050	0·026
474	0·056	0·021
475	0·020	0·049
476	0·011	0·035
477	0·032	0·011
478	0·023	0·011
479	0·001	0·024
480	0·007	0·034
481	0·037	0·006
482	0·031	0·005
483	0·001	0·034
484	0·017	0·094

47th Equation—(Continued).

No. of Circuit Triangle	B	C
485	− 0·097	+ 0·014
486	0·088	0·008
487	0·003	0·087
488	0·003	0·055
489	0·050	0·004
490	0·053	0·001
491	+ 0·005	0·048
492	0·010	0·055
493	− 0·037	− 0·011
494	0·039	0·017
495	+ 0·015	+ 0·040
496	− 0·034	− 0·013
497	0·032	0·009
498	+ 0·016	+ 0·025
499	0·010	0·028
500	− 0·021	− 0·016
501	0·021	0·017
502	+ 0·021	+ 0·017
503	− 0·016	− 0·017
504	0·025	0·027
505	+ 0·034	+ 0·010
506	− 0·018	− 0·022
507	0·011	0·013
508	+ 0·018	+ 0·005
509	− 0·009	− 0·013
510	0·011	0·013
511	+ 0·013	+ 0·004
512	0·012	0·003
513	− 0·003	− 0·008
514	+ 0·010	0·001
515	− 0·001	0·006
516	+ 0·003	0·003

47th Equation—(Continued).

No. of Circuit Triangle	B	C
517	− 0·002	− 0·002

Right-hand Branch

No. of Circuit Triangle	B	C
518	+ 0·017	− 0·037
519	0·035	0·018
520	0·019	0·040
521	0·052	0·025
522	0·017	0·038
523	0·017	0·009
524	0·031	0·046
525	0·046	0·029
526	0·035	0·066
527	0·077	0·045
528	0·059	0·081
529	0·092	0·068
530	0·168	0·221
531	0·069	0·061
532	0·046	0·051
533	0·036	0·033
534	0·031	0·029
535	0·023	0·025
536	0·024	0·016
537	0·026	0·034
538	0·030	0·026
539	0·098	0·093
540	0·024	0·046
541	0·036	0·036
542	0·030	0·026
543	0·049	0·041
544	0·041	0·047
545	0·022	0·040
546	0·019	0·023
547	0·061	0·032

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47th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
548	+ 0·057	− 0·075
549	0·035	0·034
550	0·017	0·036
551	0·027	0·017
552	0·037	0·025
553	0·020	0·038
554	0·018	0·024
555	0·036	0·053
556	0·048	0·034
557	0·074	0·031
558	0·031	0·055
559	0·011	0·033
560	0·056	0·020
561	0·044	0·040
562	0·028	0·052
563	0·015	0·026
564	0·025	0·015
565	0·012	0·012
566	0·003	0·014
567	0·010	0·011
568	0·015	0·012
569	0·005	0·014
570	0·012	0·008
571	0·001	0·005
572	0·005	0·006

48th Equation. Longitude.

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
461	− 0·001	− 0·031
462	+ 0·001	+ 0·033
463	− 0·030	0·000
464	0·066	0·001

48th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
465	0·000	+ 0·065
466	− 0·003	0·060
467	0·058	0·003
468	0·063	0·004
469	0·004	0·060
470	0·015	0·070
471	0·071	0·012
472	0·056	0·015
473	0·010	0·054
474	0·016	0·050
475	0·051	0·013
476	0·035	0·011
477	0·010	0·033
478	0·000	0·033
479	0·025	0·003
480	0·042	0·005
481	0·011	0·037
482	0·005	0·038
483	0·035	0·012
484	0·124	0·032
485	0·046	0·116
486	0·032	0·106
487	0·112	0·044
488	0·069	0·030
489	0·031	0·071
490	0·038	0·067
491	0·067	0·039
492	0·056	0·054
493	0·020	0·044
494	0·034	0·035
495	0·054	0·040
496	0·029	0·050

48th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
497	− 0·039	+ 0·051
498	0·037	0·038
499	0·077	0·061
500	0·044	0·060
501	0·062	0·029
502	0·041	0·059
503	0·033	0·034
504	0·050	0·046
505	0·050	0·067
506	0·019	0·024
507	0·034	0·013
508	0·029	0·032
509	0·018	0·027
510	0·014	0·017
511	0·012	0·013
512	0·014	0·014
513	0·014	0·015
514	0·004	0·011
515	0·008	0·006
516	+ 0·004	0·005
517	− 0·008	0·006

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
518	+ 0·031	− 0·001
519	− 0·002	0·031
520	+ 0·035	+ 0·004
521	− 0·005	− 0·043
522	+ 0.032	+ 0·006
523	− 0·003	− 0·015
524	+ 0·041	+ 0·009
525	− 0·016	− 0·043
526	+ 0·057	+ 0·021
527	− 0·022	− 0·061

48th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
528	+ 0·070	+ 0·027
529	− 0·029	− 0·072
530	+ 0·181	+ 0·080
531	− 0·024	− 0·053
532	+ 0·038	+ 0·019
533	− 0·016	− 0·027
534	+ 0·024	+ 0·017
535	− 0·011	− 0·017
536	+ 0·015	+ 0·012
537	0·012	0·007
538	− 0·011	− 0·011
539	+ 0·029	+ 0·025
540	0·024	0·021
541	− 0·021	− 0·021
542	0·025	0·025
543	+ 0·029	+ 0·020
544	− 0·022	− 0·025
545	+ 0·026	+ 0·017
546	− 0·020	− 0·022
547	0·023	0·026
548	+ 0·023	+ 0·022
549	− 0·026	− 0·020
550	0·027	0·023
551	+ 0·020	+ 0·024
552	0·016	0·022
553	− 0·024	− 0·012
554	+ 0·015	+ 0·021
555	− 0·045	− 0·018
556	+ 0·015	+ 0·036
557	0·007	0·036
558	− 0·039	− 0·005
559	0·030	0·013

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No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ
48th Equation—(Continued).			*49th Equation*—(Continued).			*49th Equation*—(Continued).			*49th Equation*—(Continued).		
560	+ 0·005	+ 0·028	478	+ 0·025	+ 0·026	511	− 0·060	− 0·060	543	+ 0·036	+ 0·036
561	0·009	0·032	479	− 0·026	− 0·025	512	0·050	0·050	544	− 0·036	− 0·036
562	− 0·027	− 0·002	480	0·036	0·035	513	+ 0·050	+ 0·050	545	+ 0·036	+ 0·036
563	0·019	0·006	481	+ 0·034	+ 0·036	514	− 0·050	− 0·050	546	− 0·036	− 0·036
564	+ 0·007	+ 0·013	482	0·035	0·036	515	+ 0·050	+ 0·050	547	0·041	0·041
565	0·009	0·013	483	− 0·036	− 0·034	516	− 0·050	− 0·050	548	+ 0·041	+ 0·041
566	− 0·010	− 0·004	484	0·103	0·100	517	+ 0·060	+ 0·060	549	− 0·041	− 0·041
567	0·014	0·005	485	+ 0·098	+ 0·104	Right-hand Branch			550	0·046	0·046
568	+ 0·004	+ 0·010	486	0·098	0·104	518	+ 0·021	+ 0·020	551	+ 0·045	+ 0·045
569	− 0·011	0·003	487	− 0·104	− 0·098	519	− 0·020	− 0·021	552	0·040	0·040
570	+ 0·004	0·004	488	0·062	0·059	520	+ 0·026	+ 0·025	553	− 0·040	− 0·040
571	− 0·004	0·001	489	+ 0·059	+ 0·062	521	− 0·030	− 0·031	554	+ 0·040	+ 0·040
572	+ 0·005	0·000	490	0·059	0·062	522	+ 0·026	+ 0·025	555	− 0·072	− 0·070
			491	− 0·062	− 0·059	523	− 0·011	− 0·011	556	+ 0·071	+ 0·071
49th Equation. Azimuth.			492	0·062	0·058	524	+ 0·031	+ 0·030	557	0·071	0·071
Left-hand Branch			493	+ 0·059	+ 0·061	525	− 0·035	− 0·036	558	− 0·071	− 0·071
461	+ 0·020	− 0·041	494	0·059	0·061	526	+ 0·052	+ 0·051	559	0·071	0·071
462	0·020	+ 0·021	495	− 0·061	− 0·059	527	− 0·051	− 0·052	560	+ 0·071	+ 0·071
463	− 0·021	− 0·020	496	+ 0·059	+ 0·061	528	+ 0·062	+ 0·061	561	0·071	0·071
464	0·042	0·040	497	0·050	0·051	529	− 0·061	− 0·062	562	− 0·071	− 0·069
465	+ 0·040	+ 0·042	498	− 0·052	− 0·049	530	+ 0·166	+ 0·162	563	0·051	0·051
466	0·040	0·042	499	0·053	0·048	531	− 0·045	− 0·047	564	+ 0·051	+ 0·051
467	− 0·042	− 0·040	500	+ 0·049	+ 0·052	532	+ 0·036	+ 0·035	565	0·051	0·051
468	0·047	0·045	501	0·048	0·051	533	− 0·025	− 0·026	566	− 0·051	− 0·050
469	+ 0·045	+ 0·046	502	− 0·052	− 0·049	534	+ 0·026	+ 0·026	567	0·051	0·050
470	0·045	0·047	503	+ 0·049	+ 0·052	535	− 0·016	− 0·017	568	+ 0·050	+ 0·050
471	− 0·047	− 0·045	504	0·078	0·082	536	+ 0·016	+ 0·016	569	− 0·050	− 0·050
472	0·037	0·035	505	− 0·081	− 0·078	537	0·012	0·012	570	+ 0·050	+ 0·050
473	+ 0·035	+ 0·037	506	+ 0·080	+ 0·080	538	− 0·014	− 0·014	571	− 0·050	− 0·050
474	0·034	0·036	507	0·049	0·051	539	+ 0·036	+ 0·036	572	+ 0·050	+ 0·050
475	− 0·036	− 0·035	508	− 0·052	− 0·049	540	0·031	0·031	573	− 0·050	− 0·050
476	0·026	0·025	509	+ 0·050	+ 0·051	541	− 0·031	− 0·031			
477	+ 0·025	+ 0·026	510	0·060	0·060	542	0·036	0·036			

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15.

The Equations between the Indeterminate Factors, and their Solution.

In the equations between the Indeterminate Factors, the coefficients of the factors are summations of terms of the form $(\mathfrak{b}\mathfrak{B} + \mathfrak{c}\mathfrak{C})$, such as are exhibited in equations (68) on page 60. But as in the present reduction equalizing factors have been applied to the primary equations, the numerical values of the coefficients will correspond to $(\mathfrak{b}'\mathfrak{B}' + \mathfrak{c}'\mathfrak{C}')$, $\mathfrak{b}'$ being $= f\mathfrak{b}$, and $\mathfrak{B}' = f\mathfrak{B}$, . . . and f being the equalizing factor. The values of $\mathfrak{B}'$ and $\mathfrak{C}'$ are given in the tables in the last section; those of $\mathfrak{b}$ and $\mathfrak{c}$ are given in the table in Section 12, with the values of the equalizing factors shewn at the head of each column. This much being premised we may again drop the accents, as in Section 14.*

The following table gives the numerical values of the coefficients of the Indeterminate Factors and the values of the Absolute Terms, in each of the 49 Equations which were presented for simultaneous solution; the Absolute Terms are the products of those of the primary equations of condition by their respective equalizing factors, as shown in the table at the end of Section 10. The solution of the equations was effected with the aid of the 5-place Logarithm Tables—comprised in three 'openings'—in the *Auxiliary Tables to facilitate the Calculations of the Survey Department of India.*

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* It appears desirable to point out here that equalizing factors may be introduced into the equations between the Indeterminate Factors, without going through the labour of actually multiplying the coefficients of the unknown quantities in each of the primary equations of condition by an equalizing factor, as has been done in the present instance. If we multiply equations (18) page 28 in succession by the equalizing factors f_a, f_b . . . . f_n and put λ'_a, λ'_b . . . . λ'_n for the Indeterminate Factors corresponding to the equalized equations, we eventually obtain the following groups of equations between the Indeterminate Factors :—

$$f_a f_a [aa.u] \lambda'_a + f_a f_b [ab.u] \lambda'_b + \ . \ . \ . \ + f_a f_n [an.u] \lambda'_n = f_a e_a$$

$$f_a f_b [ab.u] \lambda'_a + f_b f_b [bb.u] \lambda'_b + \ . \ . \ . \ + f_b f_n [bn.u] \lambda'_n = f_b e_b$$

$$. \ .$$

$$f_a f_n [an.u] \lambda'_a + f_b f_n [bn.u] \lambda'_b + \ . \ . \ . \ + f_n f_n [nn.u] \lambda'_n = f_n e_n$$

It will be seen that in these equations the identity of the coefficients that are symmetrically situated on opposite sides of the *diagonal*, which is so valuable an aid in solving the equations, is preserved.

Now it may be readily found that

$$\lambda'_a = \frac{\lambda_a}{f_a}, \ . \ . \ . \ \lambda'_n = \frac{\lambda_n}{f_n}.$$

Now whatever advantages may be derived from the employment of equalizing factors are restricted, almost solely, to the solution of the equations between the Indeterminate Factors, and those advantages may obviously be obtained by introducing the equalizing factors, as above, into the equations between the Indeterminate Factors; after solving the equations we may proceed to find the values of the Indeterminate Factors which correspond to the primary equations of condition, and then employ those values in the subsequent calculations, corresponding to equations (20).

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The Equations between the Indeterminate

No. of Equation	THE COEFFICIENTS OF THE INDETERMINATE FACTORS BEFORE THE SOLUTION.												THE ABSOLUTE TERMS
	${}_1\Delta$	${}_2\Delta$	${}_3\Delta$	${}_4\Delta$	${}_5\Delta$	${}_6\Delta$	${}_7\Delta$	${}_8\Delta$	${}_9\Delta$	${}_{10}\Delta$	${}_{11}\Delta$	${}_{12}\Delta$	
1	+ 26·44	+ 45·32	− 11·44	− 0·40	− 25·87	− 30·22	− 1·37	− 0·18					+ 8·613
2	+ 45·32	+ 90·20	− 2·87	+ 14·15	− 45·10	− 60·22	− 13·61	− 14·51					+ 14·085
3	− 11·44	− 2·87	+ 99·58	+ 76·77	+ 11·27	+ 15·91	− 64·25	− 75·21					+ 14·010
4	− 0·40	+ 14·15	+ 76·77	+ 67·79	+ 0·40	+ 2·98	− 50·23	− 65·87					+ 11·598
5	− 25·87	− 45·10	+ 11·27	+ 0·40	+ 50·31	+ 57·94	− 7·03	+ 3·02	− 24·12	− 21·23	− 1·67	− 3·23	− 0·219
6	− 30·22	− 60·22	+ 15·91	+ 2·98	+ 57·94	+ 81·39	− 1·76	+ 9·94	− 27·67	− 28·39	− 8·09	− 12·68	− 5·280
7	− 1·37	− 13·61	− 64·25	− 50·23	− 7·03	− 1·76	+ 85·75	+ 88·89	+ 8·35	+ 9·07	− 29·97	− 38·90	− 16·350
8	− 0·18	− 14·51	− 75·21	− 65·87	+ 3·02	+ 9·94	+ 88·89	+ 114·40	− 2·90	− 0·11	− 32·18	− 48·36	− 14·317

COEFFICIENTS &c.—(*Continued*).

No. of Equation	${}_5\Delta$	${}_6\Delta$	${}_7\Delta$	${}_8\Delta$	${}_9\Delta$	${}_{10}\Delta$	${}_{11}\Delta$	${}_{12}\Delta$	${}_{13}\Delta$	${}_{14}\Delta$	${}_{15}\Delta$	${}_{16}\Delta$	${}_{17}\Delta$	${}_{18}\Delta$	${}_{19}\Delta$	${}_{20}\Delta$	The Absolute Terms
9	− 24·12	− 27·67	+ 8·35	− 2·90	+ 35·89	+ 33·07	− 2·85	+ 1·51	− 11·69	− 9·63	+ 1·10	+ 1·56					+ 14·469
10	− 21·23	− 28·39	+ 9·07	− 0·11	+ 33·07	+ 37·88	− 2·51	+ 1·73	− 11·83	− 11·92	− 0·39	− 1·47					+ 13·875
11	− 1·67	− 8·09	− 29·97	− 32·18	− 2·85	− 2·51	+ 38·92	+ 47·91	+ 4·50	+ 3·93	− 10·28	− 15·74					− 2·745
12	− 3·23	− 12·68	− 38·90	− 48·36	+ 1·51	+ 1·73	+ 47·91	+ 71·71	+ 1·69	+ 1·72	− 12·10	− 23·25					− 6·798
13					− 11·69	− 11·83	+ 4·50	+ 1·69	+ 23·80	+ 19·56	− 6·92	− 3·02	− 11·87	− 9·01	+ 0·91	+ 1·25	− 19·230
14					− 9·63	− 11·92	+ 3·93	+ 1·72	+ 19·56	+ 21·06	− 2·98	+ 2·26	− 9·91	− 9·06	− 1·88	− 3·93	− 18·135
15					+ 1·10	− 0·39	− 10·28	− 12·10	− 6·92	− 2·98	+ 21·10	+ 27·26	+ 5·77	+ 4·56	− 9·46	− 15·07	− 0·900
16					+ 1·56	− 1·47	− 15·74	− 23·25	− 3·02	+ 2·26	+ 27·26	+ 48·48	+ 1·48	+ 1·45	− 12·97	− 24·70	+ 10·177

COEFFICIENTS &c.—(*Continued*).

No. of Equation	${}_{13}\Delta$	${}_{14}\Delta$	${}_{15}\Delta$	${}_{16}\Delta$	${}_{17}\Delta$	${}_{18}\Delta$	${}_{19}\Delta$	${}_{20}\Delta$	${}_{21}\Delta$	${}_{22}\Delta$	${}_{23}\Delta$	${}_{24}\Delta$	${}_{25}\Delta$	${}_{26}\Delta$	${}_{27}\Delta$	${}_{28}\Delta$	The Absolute Terms
17	− 11·87	− 9·91	+ 5·77	+ 1·48	+ 18·46	+ 14·08	− 3·15	− 0·62	− 6·28	− 4·40	+ 0·12	− 0·84					+ 5·081
18	− 9·01	− 9·06	+ 4·56	+ 1·45	+ 14·08	+ 14·13	− 1·05	+ 2·61	− 5·05	− 4·44	− 1·29	− 3·93					+ 5·745
19	+ 0·91	− 1·88	− 9·46	− 12·97	− 3·15	− 1·05	+ 12·83	+ 19·17	+ 2·18	+ 1·20	− 3·49	− 6·13					+ 3·555
20	+ 1·25	− 3·93	− 15·07	− 24·70	− 0·62	+ 2·61	+ 19·17	+ 38·81	− 0·70	− 1·20	− 5·63	− 13·42					− 0·791
21					− 6·28	− 5·05	+ 2·18	− 0·70	+ 22·56	+ 12·51	− 9·00	− 1·20	− 15·85	− 7·40	+ 0·46	+ 1·68	+ 2·463
22					− 4·40	− 4·44	+ 1·20	− 1·20	+ 12·51	+ 11·79	− 0·95	+ 9·95	− 8·09	− 4·86	− 2·52	− 8·71	+ 3·165
23					+ 0·12	− 1·29	− 3·49	− 5·63	− 9·00	− 0·95	+ 13·00	+ 18·48	+ 8·79	+ 4·06	− 4·56	− 12·61	+ 1·560
24					− 0·84	− 3·93	− 6·13	− 13·42	− 1·20	+ 9·95	+ 18·48	+ 48·24	+ 2·05	+ 0·81	− 9·80	− 33·72	+ 4·843

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Factors expressed in Natural Numbers.

No. of Equation	Coefficients &c.—(*Continued*).																The Absolute Terms
	$_{21}A$	$_{22}A$	$_{23}A$	$_{24}A$	$_{25}A$	$_{26}A$	$_{27}A$	$_{28}A$	$_{29}A$	$_{30}A$	$_{31}A$	$_{32}A$	$_{33}A$	$_{34}A$	$_{35}A$	$_{36}A$	
25	−15·85	−8·09	+8·79	+2·05	+23·85	+13·22	−4·20	−2·23	−7·65	−4·49	+0·17	+0·37					−3·987
26	−7·40	−4·86	+4·06	+0·81	+13·22	+10·39	−0·89	+3·21	−5·75	−3·82	−1·35	−3·83					−5·355
27	+0·46	−2·52	−4·56	−9·80	−4·20	−0·89	+10·33	+18·65	+3·67	+2·32	−3·68	−8·70					−0·450
28	+1·68	−8·71	−12·61	−33·72	−2·23	+3·21	+18·65	+51·31	+0·55	+0·57	−6·23	−16·82					−5·739
29					−7·65	−5·75	+3·67	+0·55	+11·88	+6·10	−1·00	+0·39	−3·58	−1·24	−0·28	−0·91	+5·901
30					−4·49	−3·82	+2·32	+0·57	+6·10	+4·13	−0·19	+1·12	−1·55	−0·67	−0·44	−1·53	+4·545
31					+0·17	−1·35	−3·68	−6·23	−1·00	−0·19	+3·81	+8·58	+0·76	+0·26	−0·72	−2·26	−0·405
32					+0·37	−3·83	−8·70	−16·82	+0·39	+1·12	+8·58	+26·97	−0·57	−0·15	−2·14	−8·65	+4·441

No. of Equation	Coefficients &c.—(*Continued*).																	The Absolute Terms
	$_{29}A$	$_{30}A$	$_{31}A$	$_{32}A$	$_{33}A$	$_{34}A$	$_{35}A$	$_{36}A$	$_{37}A$	$_{38}A$	$_{39}A$	$_{40}A$	$_{41}A$	$_{42}A$	$_{43}A$	$_{44}A$	$_{45}A$	
33	−3·58	−1·55	+0·76	−0·57	+10·09	+4·28	−2·22	+0·47	−5·73	−2·43	+0·39	+0·28						−8·538
34	−1·24	−0·67	+0·26	−0·15	+4·28	+3·08	−0·35	+2·51	−2·96	−1·75	−0·42	−2·16						−4·710
35	−0·28	−0·44	−0·72	−2·14	−2·22	−0·35	+3·66	+6·73	+2·39	+1·06	−1·80	−4·43						+0·540
36	−0·91	−1·53	−2·26	−8·65	+0·47	+2·51	+6·73	+23·15	+0·51	+0·21	−3·49	−12·25						−2·279
37					−5·73	−2·96	+2·39	+0·51	+6·59	+2·43	−0·63	−0·41						+5·727
38					−2·43	−1·75	+1·06	+0·21	+2·43	+19·20	−1·05	+14·62	+12·81	+0·08	−5·57	−13·82	−14·12	−3·210
39					+0·39	−0·42	−1·80	−3·49	−0·63	−1·05	+21·45	+24·39	−10·93	−0·53	+13·91	−4·37	−20·30	−1·695
40					+0·28	−2·16	−4·43	−12·25	−0·41	+14·62	+24·39	+55·70	−0·98	−0·43	+14·80	−16·28	−40·71	+0·648

No. of Equation	Coefficients &c.—(*Continued*).												The Absolute Terms
	$_{38}A$	$_{39}A$	$_{40}A$	$_{41}A$	$_{42}A$	$_{43}A$	$_{44}A$	$_{45}A$	$_{46}A$	$_{47}A$	$_{48}A$	$_{49}A$	
41	+12·81	−10·93	−0·98	+17·26	+0·23	−11·31	−10·83	+0·74					+1·101
42	+0·08	−0·53	−0·43	+0·23	+3·92	+1·45	+1·34	+0·41	−1·64	−0·85	−1·19	−0·11	− {6·912 5·811}
43	−5·57	+13·91	+14·80	−11·31	+1·45	+16·86	+1·32	−16·15	−0·95	−0·75	−0·62	+0·15	+1·935
44	−13·82	−4·37	−16·28	−10·83	+1·34	+1·32	+19·23	+18·91	−0·15	+0·55	−0·86	−1·56	−2·145
45	−14·12	−20·30	−40·71	+0·74	+0·41	−16·15	+18·91	+49·27	+0·02	+1·59	−1·46	−3·97	+2·424
46					−1·64	−0·95	−0·15	+0·02	+5·23	+2·58	+1·76	+0·35	+3·060
47					−0·85	−0·75	+0·55	+1·59	+2·58	+3·13	+0·04	−2·09	+2·595
48					−1·19	−0·62	−0·86	−1·46	+1·76	+0·04	+3·52	+3·95	−9·405
49					−0·11	+0·15	−1·56	−3·97	+0·35	−2·09	+3·95	+10·99	−13·140

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The Equations between the Indeterminate

THE COEFFICIENTS OF THE INDETERMINATE FACTORS, AFTER THE SUCCESSIVE ELIMINATIONS.

No. of Equation	$_1A$	$_2A$	$_3A$	$_4A$	$_5A$	$_6A$	$_7A$	$_8A$	$_9A$	$_{10}A$	$_{11}A$	$_{12}A$	THE ABSOLUTE TERMS
1	+ 26·44	+ 45·32	− 11·44	− 0·40	− 25·87	− 30·22	− 1·37	− 0·18					+ 8·613
2		+ 12·52	+ 16·74	+ 14·84	− 0·76	− 8·42	− 11·26	− 14·20					− 0·678
3			+ 72·25	+ 56·76	+ 1·10	+ 14·09	− 49·78	− 56·30					+ 18·644
4				+ 5·60	+ 0·05	+ 1·43	+ 2·21	− 4·81					− 2·115
5					+ 24·93	+ 27·64	− 8·31	+ 2·88	− 24·12	− 21·23	− 1·67	− 3·23	+ 7·902
6						+ 7·42	+ 7·46	+ 9·20	− 0·93	− 4·85	− 6·24	− 9·10	− 7·749
7							+ 30·11	+ 30·93	+ 1·25	+ 6·87	− 24·26	− 30·83	+ 7·591
8								+ 6·78	− 0·24	+ 1·29	+ 0·67	− 5·04	− 1·419

THE COEFFICIENTS &c.—(*Continued*).

No. of Equation	$_9A$	$_{10}A$	$_{11}A$	$_{12}A$	$_{13}A$	$_{14}A$	$_{15}A$	$_{16}A$	$_{17}A$	$_{18}A$	$_{19}A$	$_{20}A$	THE ABSOLUTE TERMS
9	+ 12·37	+ 11·68	− 4·22	− 1·66	− 11·69	− 9·63	+ 1·10	+ 1·56					+ 20·778
10		+ 3·78	+ 1·38	+ 2·59	− 0·79	− 2·83	− 1·43	− 2·94					− 5·542
11			+ 12·00	+ 14·18	+ 0·80	+ 1·67	− 9·38	− 14·14					+ 6·635
12				+ 6·06	− 0·29	+ 0·40	+ 0·11	− 4·32					− 9·815
13					+ 12·52	+ 9·78	− 5·54	− 1·43	− 11·87	− 9·01	+ 0·91	+ 1·25	− 1·664
14						+ 3·54	+ 2·44	+ 4·65	− 0·64	− 2·02	− 2·59	− 4·91	− 5·083
15							+ 9·00	+ 11·20	+ 0·96	+ 1·96	− 7·27	− 11·14	+ 3·287
16								+ 6·04	− 0·23	+ 0·63	− 0·42	− 4·25	+ 6·463

THE COEFFICIENTS &c.—(*Continued*).

No. of Equation	$_{17}A$	$_{18}A$	$_{19}A$	$_{20}A$	$_{21}A$	$_{22}A$	$_{23}A$	$_{24}A$	$_{25}A$	$_{26}A$	$_{27}A$	$_{28}A$	THE ABSOLUTE TERMS
17	+ 6·98	+ 4·98	− 2·00	+ 0·71	− 6·28	− 4·40	+ 0·12	− 0·84					+ 2·480
18		+ 2·45	+ 1·17	+ 3·07	− 0·57	− 1·30	− 1·38	− 3·33					− 1·511
19			+ 3·84	+ 4·92	+ 0·65	+ 0·56	− 2·80	− 4·78					+ 4·494
20				+ 4·88	− 0·18	+ 0·16	− 0·32	− 3·04					− 3·175
21					+ 16·66	+ 8·17	− 8·75	− 2·03	− 15·85	− 7·40	+ 0·46	+ 1·68	+ 3·464
22						+ 4·23	+ 3·11	+ 9·45	− 0·32	− 1·23	− 2·75	− 9·53	+ 1·676
23							+ 3·27	+ 4·90	+ 0·71	+ 1·07	− 2·30	− 4·72	+ 4·322
24								+ 7·07	− 0·23	+ 1·06	− 0·15	− 5·16	− 3·095

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Factors expressed in Natural Numbers.

The Coefficients &c.—(*Continued*).

No. of Equation	$_{25}\Lambda$	$_{26}\Lambda$	$_{27}\Lambda$	$_{28}\Lambda$	$_{29}\Lambda$	$_{30}\Lambda$	$_{31}\Lambda$	$_{32}\Lambda$	$_{33}\Lambda$	$_{34}\Lambda$	$_{35}\Lambda$	$_{36}\Lambda$	The Absolute Terms
25	+ 8·59	+ 5·89	− 3·47	− 0·50	− 7·65	− 4·49	+ 0·17	+ 0·37					− 1·603
26		+ 2·19	+ 1·66	+ 3·84	− 0·50	− 0·74	− 1·47	− 4·08					− 3·180
27			+ 4·25	+ 5·86	+ 0·96	+ 1·07	− 2·50	− 5·46					+ 5·280
28				+ 4·25	− 0·34	+ 0·13	− 0·19	− 2·12					− 0·130
29					+ 4·71	+ 1·70	− 0·65	+ 0·85	− 3·58	− 1·24	− 0·28	− 0·91	+ 2·544
30						+ 0·65	+ 0·27	+ 1·05	− 0·26	− 0·22	− 0·34	− 1·20	+ 0·389
31							+ 1·14	+ 2·21	+ 0·38	+ 0·18	− 0·62	− 1·89	+ 0·781
32								+ 5·15	− 0·24	+ 0·08	− 0·34	− 2·89	+ 2·703

The Coefficients &c.—(*Continued*).

No. of Equation	$_{33}\Lambda$	$_{34}\Lambda$	$_{35}\Lambda$	$_{36}\Lambda$	$_{37}\Lambda$	$_{38}\Lambda$	$_{39}\Lambda$	$_{40}\Lambda$	$_{41}\Lambda$	$_{42}\Lambda$	$_{43}\Lambda$	$_{44}\Lambda$	$_{45}\Lambda$	The Absolute Terms
33	+ 7·13	+ 3·19	− 2·38	− 0·20	− 5·73	− 2·43	+ 0·39	+ 0·28						− 6·582
34		+ 1·22	+ 0·63	+ 2·29	− 0·40	− 0·66	− 0·59	− 2·29						− 1·128
35			+ 1·98	+ 3·58	+ 0·69	+ 0·59	− 1·37	− 3·16						− 0·118
36				+ 5·22	− 0·15	+ 0·31	+ 0·11	− 2·23						+ 3·888
37					+ 1·62	+ 0·06	− 0·03	+ 0·11						+ 0·220
38						+ 17·81	− 0·84	+ 14·55	+ 12·81	+ 0·08	− 5·57	− 13·82	− 14·12	− 6·267
39							+ 20·15	+ 21·81	− 10·33	− 0·53	+ 13·65	− 5·02	− 20·97	− 2·337
40								+ 9·89	− 0·27	+ 0·07	+ 4·58	+ 0·44	− 6·47	+ 7·897
41									+ 2·74	− 0·10	− 0·17	− 3·45	− 0·03	+ 4·627

The Coefficients &c.—(*Continued*).

No. of Equation	$_{42}\Lambda$	$_{43}\Lambda$	$_{44}\Lambda$	$_{45}\Lambda$	$_{46}\Lambda$	$_{47}\Lambda$	$_{48}\Lambda$	$_{49}\Lambda$	The Absolute Terms
42	+ 3·91	+ 1·80	+ 1·14	− 0·03	− 1·64	− 0·85	− 1·19	− 0·11	{ *− 6·826* − 5·725
43		+ 2·91	− 0·53	− 3·35	− 0·20	− 0·36	− 0·07	+ 0·20	{ *+ 1·330* + 0·824
44			+ 2·47	+ 2·38	+ 0·29	+ 0·73	− 0·52	− 1·49	{ *+ 0·117* − 0·296
45				+ 5·88	− 0·50	+ 0·47	− 1·05	− 2·30	{ *+ 1·606* + 1·430
46					+ 4·46	+ 2·15	+ 1·23	+ 0·28	{ *+ 0·405* + 0·867
47						+ 1·61	− 0·59	− 1·60	{ *+ 0·918* + 1·007
48							+ 2·30	+ 2·53	{ *− 10·914* − 10·804
49								+ 4·79	{ *+ 0·168* − 0·147

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The manner of the formation of the coefficients of the Indeterminate Factors has already been indicated in Section 11 of Chapter II. Here it is only necessary to repeat that the coefficient of the mth Λ in the lth equation is equal to that of the lth Λ in the mth equation in each term of the summation, and these coefficients may be expressed either as

$$\sum_1^t \left[{}_m\mathfrak{b}_p\, {}_l\mathfrak{B}_p + {}_m\mathfrak{c}_p\, {}_l\mathfrak{C}_p\right], \quad \text{or as} \quad \sum_1^t \left[{}_l\mathfrak{b}_p\, {}_m\mathfrak{B}_p + {}_l\mathfrak{c}_p\, {}_m\mathfrak{C}_p\right]$$

in which expressions the summations are for all values of p from 1 to t, corresponding to the numbers of the triangles whose angular errors enter into the mth and the lth equation. The identity of the coefficients was taken advantage of in the former reductions as a means of checking their accuracy. In the present instance the coefficients were only computed once, and a check was obtained by equating the sum of all the coefficients of any, the mth, equation to

$$\sum_1^t \left[{}_m\mathfrak{b}_p \sum_1^n [{}_q\mathfrak{B}_p] + {}_m\mathfrak{c}_p \sum_1^n [{}_q\mathfrak{C}_p]\right]$$

between the limits $p = 1$ and $p = t$, the numbers of the triangles involved, and $q = 1$ and $q = n$ the numbers of those Λs of which the coefficients enter the equation.

When the solution was first undertaken an erroneous value had been assigned to the absolute term of Equation 42, as already stated in the note to page 125. This was not discovered until the equations had been solved and values of the unknown quantities, x, y and z, had been obtained and applied to the calculations, when a large closing linear error in Circuit *XI* made it manifest. The true absolute term was then introduced, and the solution of the equations between the indeterminate factors was corrected onwards from the point where Equation 42 first became operative; then the values of the factors were re-computed backwards as far as ${}_{29}\Lambda$. This last was done not so much with any definite purpose of employing the corrected values of the earlier factors, as to ascertain how far back the effect of the error had extended. It was then decided to employ only the corrected factors ${}_{38}\Lambda$ to ${}_{49}\Lambda$, disregarding the re-computed factors back to ${}_{29}\Lambda$, and not attempting to ascertain the errors of the anterior factors.

The differences $\delta\Lambda$, between the true and the erroneous values of the factors ${}_{38}\Lambda \ldots {}_{49}\Lambda$, were employed in the computation of differential corrections δx, δy, δz to the values of the error x, y, z of the angles in Circuits *XI* and *XII* and in the Base-line equation, No. 41, which had been obtained with the erroneous factors; these angles appertain to triangles 362 onwards to the end, excluding triangles 409 to 423.

No further corrections were applied, as it was evident that they would not be large, and probable that the employment of the values of the errors of the angles in the first ten circuits as already determined, would not lead to the occurrence of larger closing errors than those of which the limits had been primarily assigned—see page 67.

Recently, by General Walker's direction, the second or revisionary solution was completed and the values of all the factors were found. The whole of these with the corresponding values of $\delta\Lambda$ are hereafter shewn, those quantities which were not made use of being in different type.

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The table following the Equations between the Indeterminate Factors, gives the first of each group of equations between certain of the Indeterminate Factors which remained after the other factors had been eliminated. These are the equations which were used in obtaining the numerical values of the factors by successive substitution backwards from the last to the first.

The double solution of the equations between the Indeterminate Factors has necessitated double numbers in the column of Absolute Terms. Where these occur, the first numbers are those which belong to the first solution and the second to the second solution.

The following table gives the values of the Indeterminate Factors to 3 places of decimals, as deduced from the solution of the equations. Those quantities shewn in large type were employed in the calculations; those in small type were subsequently obtained as previously stated.

The Values of the Indeterminate Factors.

Factor	Numerical value by		$\delta\Lambda$	Factor	Numerical value by		$\delta\Lambda$	Factor	Numerical value by		$\delta\Lambda$
	1st Solution	2nd Solution			1st Solution	2nd Solution			1st Solution	2nd Solution	
$_{1}\Lambda$	+9·290	+9·286	−0·004	$_{17}\Lambda$	+3·405	+3·414	+0·009	$_{33}\Lambda$	−0·582	−0·590	−0·008
$_{2}\Lambda$	+0·054	+0·081	+ ·027	$_{18}\Lambda$	+0·373	+0·400	+ ·027	$_{34}\Lambda$	−2·925	−3·002	− ·077
$_{3}\Lambda$	+3·538	+3·549	+ ·011	$_{19}\Lambda$	+4·022	+4·047	+ ·025	$_{35}\Lambda$	−1·061	−1·039	+ ·022
$_{4}\Lambda$	−2·048	−2·065	− ·017	$_{20}\Lambda$	+0·006	+0·013	+ ·007	$_{36}\Lambda$	+1·212	+1·258	+ ·046
$_{5}\Lambda$	+8·005	+8·012	+ ·007	$_{21}\Lambda$	+3·036	+3·044	+ ·008	$_{37}\Lambda$	+0·157	+0·155	− ·002
$_{6}\Lambda$	−0·379	−0·352	+ ·027	$_{22}\Lambda$	−0·883	−0·860	+ ·023	$_{38}\Lambda$	−2·325	−2·476	−0·151
$_{7}\Lambda$	+3·111	+3·122	+ ·011	$_{23}\Lambda$	+3·702	+3·741	+ ·039	$_{39}\Lambda$	−0·858	−0·962	− ·104
$_{8}\Lambda$	−0·545	−0·551	− ·006	$_{24}\Lambda$	+0·438	+0·446	+ ·008	$_{40}\Lambda$	+0·718	+0·800	+ ·082
$_{9}\Lambda$	+6·492	+6·500	+ ·008	$_{25}\Lambda$	+1·630	+1·621	− ·009	$_{41}\Lambda$	+0·920	+0·712	− ·208
$_{10}\Lambda$	−0·356	−0·328	+ ·028	$_{26}\Lambda$	−2·306	−2·286	+ ·020	$_{42}\Lambda$	−2·420	−1·919	+ ·501
$_{11}\Lambda$	+3·568	+3·580	+ ·012	$_{27}\Lambda$	+2·560	+2·607	+ ·047	$_{43}\Lambda$	−0·120	−0·346	− ·226
$_{12}\Lambda$	−0·378	−0·377	+ ·001	$_{28}\Lambda$	+0·579	+0·594	+ ·015	$_{44}\Lambda$	−0·532	−0·700	− ·168
$_{13}\Lambda$	+4·241	+4·252	+ ·011	$_{29}\Lambda$	−0·264	−0·279	− ·015	$_{45}\Lambda$	−0·309	−0·341	− ·032
$_{14}\Lambda$	−0·505	−0·477	+ ·028	$_{30}\Lambda$	−1·028	−1·026	+ ·002	$_{46}\Lambda$	+1·961	+2·020	+ ·059
$_{15}\Lambda$	+1·379	+1·396	+ ·017	$_{31}\Lambda$	+0·538	+0·587	+ ·049	$_{47}\Lambda$	−1·148	−1·114	+ ·034
$_{16}\Lambda$	+1·445	+1·449	+ ·004	$_{32}\Lambda$	+1·153	+1·181	+ ·028	$_{48}\Lambda$	−4·784	−4·664	+ ·120
								$_{49}\Lambda$	+0·035	−0·031	− ·066

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16.

The Final Values of the Angular Errors x, y and z.

The values of the Λs having been obtained, the next step was the deduction of the errors x, y and z. The formulæ which have usually been employed for this purpose are the following, as indicated in Section 11 of Chapter II.

$$y_p = {}_1\mathfrak{B}_p\,{}_1\Lambda + {}_2\mathfrak{B}_p\,{}_2\Lambda + \;.\;\;.\;\;.\;\;. + {}_n\mathfrak{B}_p\,{}_n\Lambda,$$

$$z_p = {}_1\mathfrak{C}_p\,{}_1\Lambda + {}_2\mathfrak{C}_p\,{}_2\Lambda + \;.\;\;.\;\;.\;\;. + {}_n\mathfrak{C}_p\,{}_n\Lambda,$$

$$x_p = -\{y_p + z_p\}.$$

In the present instance equalizing factors were applied to the primary equations of condition. Thus the numerical values of the coefficients $\mathfrak{B}$ and $\mathfrak{C}$, and of the Indeterminate Factors Λ for the two first of the above equations, which are given in Sections 14 and 15, are the values obtained after the said equalization; and these values would have been employed if the angular errors y and z had been calculated by those equations.

But the course which was actually adopted in the present instance, was to revert to the primary equations and employ the factorially equalized coefficients in combination with the corresponding Indeterminate Factors. The values of the angular errors may then be obtained from the following equations in which ${}_1f$, ${}_2f$, . . . are the equalizing factors for the primary equations, ${}_1\Lambda$, ${}_2\Lambda$, . . . the corresponding Indeterminate Factors of which the numerical values are given in Section 15, while $\mathfrak{b}$ and $\mathfrak{c}$ are the coefficients in the primary equations of which the numerical values are given in Section 12.

$$y_p = +\frac{u_p}{3}\left\{(2\,{}_1f\,{}_1\mathfrak{b}_p - {}_1f\,{}_1\mathfrak{c}_p)\,{}_1\Lambda + (2\,{}_2f\,{}_2\mathfrak{b}_p - {}_2f\,{}_2\mathfrak{c}_p)\,{}_2\Lambda + \;.\;\;.\;\;. + (2\,{}_nf\,{}_n\mathfrak{b}_p - {}_nf\,{}_n\mathfrak{c}_p)\,{}_n\Lambda\right\}$$

$$z_p = +\frac{u_p}{3}\left\{(2\,{}_1f\,{}_1\mathfrak{c}_p - {}_1f\,{}_1\mathfrak{b}_p)\,{}_1\Lambda + (2\,{}_2f\,{}_2\mathfrak{c}_p - {}_2f\,{}_2\mathfrak{b}_p)\,{}_2\Lambda + \;.\;\;.\;\;. + (2\,{}_nf\,{}_n\mathfrak{c}_p - {}_nf\,{}_n\mathfrak{b}_p)\,{}_n\Lambda\right\}$$

$$x_p = -\frac{u_p}{3}\left\{(\,{}_1f\,{}_1\mathfrak{b}_p + {}_1f\,{}_1\mathfrak{c}_p)\,{}_1\Lambda + (\,{}_2f\,{}_2\mathfrak{b}_p + {}_2f\,{}_2\mathfrak{c}_p)\,{}_2\Lambda + \;.\;\;.\;\;. + (\,{}_nf\,{}_n\mathfrak{b}_p + {}_nf\,{}_n\mathfrak{c}_p)\,{}_n\Lambda\right\}$$

These equations may be put in the following form, in which they were actually employed in computing the values of the angular errors;—

$$y_p = +\frac{u_p}{3}\left\{2\,{}_1^n\big[f\mathfrak{b}_p\Lambda\big] - {}_1^n\big[f\mathfrak{c}_p\Lambda\big]\right\}$$

$$z_p = +\frac{u_p}{3}\left\{2\,{}_1^n\big[f\mathfrak{c}_p\Lambda\big] - {}_1^n\big[f\mathfrak{b}_p\Lambda\big]\right\}$$

$$x_p = -\frac{u_p}{3}\left\{{}_1^n\big[f\mathfrak{b}_p\Lambda\big] + {}_1^n\big[f\mathfrak{c}_p\Lambda\big]\right\}$$

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The following is an example of the calculation of the angular errors of a single triangle, the 25th.

Example.

Equation	Triangle No. 25. $\frac{u}{3}=0\cdot6$				
	$f\mathfrak{b}$	Λ	$f\mathfrak{c}$	$f\mathfrak{b}\Lambda$	$f\mathfrak{c}\Lambda$
1	+0·39	+9·290	−0·42	+3·623	−3·902
2	+0·17	+0·054	−0·77	+0·009	−0·042
3	−1·01	+3·538	−0·60	−3·573	−2·123
4	−1·03	−2·048	−1·02	+2·109	+2·089
5	−0·39	+8·005	+0·42	−3·122	+3·362
6	−0·20	−0·379	+0·24	+0·076	−0·091
7	+0·42	+3·111	+0·39	+1·307	+1·213
8	+1·01	−0·545	+1·01	−0·550	−0·550
			Sums	−0·121	−0·044

$$y = +0\cdot6\{2(-0\cdot121) - (-0\cdot044)\} = -0''\cdot119$$
$$z = +0\cdot6\{2(-0\cdot044) - (-0\cdot121)\} = +0\cdot020$$
$$x = -0\cdot6\{(-0\cdot121) + (-0\cdot044)\} = +0\cdot099$$

The numerical values of the angular errors were computed to 3 places of decimals. They were contracted to 2 places for the angles appertaining to the first ten circuits, with the exception of those of Fig. 15 of the Chendwár Series, for which the 3 places were retained; 3 places were also retained in the remaining angles of Circuit *XI* and all the angles of Circuit *XII*.

The Lengths and Azimuths of the sides, and the Latitudes and Longitudes of the stations, were recomputed with the values of the corrected angles. The arithmetical error in the absolute term of Equation 42 then became apparent. It was disposed of in the first instance by recomputing the values of such of the Indeterminate Factors as were believed to be principally affected, leaving the others unaltered, as has already been described in the last section.

The next step taken was to apply corrections to those values of angular error which would be affected by the corrected Indeterminate Factors. The same formulæ which had been employed for finding x, y and z were now used for deducing corrections to these values for all angles entering Equations 41 to 49, by substituting δx, δy and δz in place of x, y and z, and $\delta\Lambda$ for Λ.

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Corresponding corrections having been next made to the linear and geodetic calculations, the discrepancies which are exhibited in the following table of residual errors were met with at the close of the several circuits.

Residual Errors of Corrected Circuits				
Circuit	Linear	Latitude	Longitude	Azimuth
	7th place of logs.	"	"	"
I	0·0	+ 0·014	− 0·031	+ 0·080
II	−6·5	− ·008	+ ·021	+ ·272
III	−0·8	+ ·020	− ·021	− ·182
IV	+2·0	− ·024	+ ·009	− ·040
V	−2·0	− ·007	− ·001	+ ·023
VI	−0·2	− ·001	− ·005	− ·065
VII	+2·4	− ·003	+ ·002	− ·012
VIII	−1·1	+ ·003	− ·004	− ·053
IX	+0·4	− ·006	+ ·001	− ·002
X	{ 0·0 −2·4	− ·011	·000	+ ·286
XI	−1·4	− ·001	·000	+ ·016
XII	−0·2	+ ·003	+ ·004	− ·086

Here it may be remarked that, with a single exception, the residual errors are well within the limits which had been previously prescribed, as stated on page 67.

These errors were to have been dispersed, circuit by circuit, over the angles appertaining to the triangles nearest the junctions of the circuits, selecting for that purpose triangles of the North-East Longitudinal Series which only enter single circuits. It had been expected that the requisite degree of harmony might be produced without either violating the integrity of the angles subjected to treatment by applying corrections of unduly large magnitude, or extending the calculations to triangles entering some other circuit, which would disturb the consistency of that circuit. But it was found that the first condition could not always be maintained without violating the second; for unfortunately all the triangles near the closing points of the circuits were situated in the plains, and they had such short sides that small changes in the closing linear and geodetic elements largely affected the angles. Consequently the adjustment was extended beyond one circuit into the next,

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and in three cases was wholly thrown on portions of the meridional chains. The correction of the triangles common to two circuits for the adjustment of the circuit first treated, necessarily disturbed the consistency of the second. Thus the residual errors of many circuits became changed.

The actual errors for dispersion are shewn in the following table, which also indicates the triangles subjected to adjustment, and the maximum and average changes of their angles*.

Residual Errors for Dispersion

Circuit	Linear	Latitude	Longitude	Azimuth	Triangles involved and the number		Computed Corrections Maximum	Computed Corrections Average
	7th place of logs.	"	"	"			"	"
I	0·0	+0·014	−0·031	+0·080	31 to 44	14	0·8	0·1
II	+12·6	− ·001	+ ·012	− ·582	79 „ 92	14	·9	·1
III	− 3·4	+ ·020	− ·022	− ·323	117 „ 126	10	1·1	·4
IV	− 1·4	·000	− ·014	− ·371	163 „ 170	8	·9	·3
V	− 3·4	·000	− ·017	− ·386	199 „ 206	8	·8	·3
VI	− 3·5	+ ·003	− ·020	− ·424	243 „ 262	20	·7	·1
VII	+17·9	+ ·008	− ·008	− ·407	295 „ 302	8	·4	·2
VIII	− 1·1	+ ·003	− ·004	− ·053	330	1	·07	·05
IX	+ 0·4	− ·006	+ ·001	− ·002	352, 353, 360 & 361	4	·3	·2
X	{ 0·0 { − 2·4	− ·011	− ·003	+ ·286	409 to 411, 420 to 423	7	·3	·2
XI	+ 0·8	− ·001	·000	+ ·016	443	1	·037	·025
XII	− 0·2	+ ·003	+ ·004	− ·086	517	1	·086	·057

The errors in latitude and longitude of Circuits *VIII*, *XI* and *XII* being already small, no attempt was made to reduce them, and the linear and azimuthal errors were disposed of by inspection in a terminal triangle in each instance.

After the necessary calculations had been made, sundry slight discrepancies remained which were adjusted arbitrarily by inspection.

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* With regard to the magnitude of the angular errors admissible, General Walker, on being applied to, prior to their calculation, to assign the limits, while refraining from laying down any hard and fast rule, expressed it as his opinion that the residual errors should be dispersed over a sufficient number of triangles to give residual angular corrections not exceeding half the *probable errors* of the angles.

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Thus the finally determined values of the angular errors rest

1. On the original calculations.
2. On the calculations for correcting the effect of the error of the absolute term of the 42nd equation on the original calculations.
3. On the calculations for dispersing the residual errors at the close of the circuits.
4. On the arbitrary corrections for dispersing the ultimate small residual errors at the close of the circuits.

The principal details of the calculations for determining the corrections to the angles corresponding to the residual errors of the circuits, will be given in Section 17.

The whole of the components of the finally adopted values of the angular errors are given in the following table. In a large majority of instances the primary value could be adopted without alteration of any kind, and these values are printed in ordinary type without remark. In the instances in which the final value is derived from more than one component, the several components are entered in small type, with a distinguishing number attached, either (1), (2), (3) or (4), corresponding to the preceding numeration of the order of their determination; their sum is entered below in the larger type.

The Angular Errors.

No. of Triangle	x	y	z
	"	"	"
1	− ·09	+ ·08	+ ·01
2	+1·10	+ ·44	−1·54
3	− ·95	+1·59	− ·64
4	+ ·94	− ·07	− ·87
5	+1·75	− ·27	−1·48
6	− ·30	+ ·31	− ·01
7	− ·24	+ ·24	·00
8	+ ·40	− ·10	− ·30
9	− ·34	+ ·37	− ·03
10	+ ·86	·00	− ·86
11	− ·72	+ ·74	− ·02
12	+ ·54	+ ·08	− ·62
13	− ·61	+ ·63	− ·02

No. of Triangle	x	y	z
	"	"	"
14	+ ·71	− ·21	− ·50
15	− ·84	+ ·69	+ ·15
16	+ ·49	− ·23	− ·26
17	− ·38	+ ·25	+ ·13
18	+ ·16	− ·09	− ·07
19	− ·17	+ ·07	+ ·10
20	+ ·17	− ·13	− ·04
21	− ·13	+ ·02	+ ·11
22	+ ·09	− ·08	− ·01
23	+ ·05	− ·06	+ ·01
24	− ·11	+ ·02	+ ·09
25	+ ·10	− ·12	+ ·02
26	− ·03	+ ·03	·00

No. of Triangle	x	y	z
	"	"	"
27	+ ·02	+ ·01	− ·03
28	− ·01	+ ·01	·00
29	+ ·01	− ·11	+ ·10
30	+ ·03	− ·11	+ ·08
(1)	− ·08	− ·21	+ ·29
(3)	− ·50	+ ·81	− ·31
31	− ·58	+ ·60	− ·02
(1)	+ ·09	− ·19	+ ·10
(3)	+ ·27	− ·16	− ·11
32	+ ·36	− ·35	− ·01
(1)	− ·02	− ·28	+ ·30
(3)	− ·08	+ ·46	− ·38
33	− ·10	+ ·18	− ·08
(1)	− ·83	+ ·69	+ ·14
(3)	− ·02	·00	+ ·02
34	− ·85	+ ·69	+ ·16
(1)	− ·15	+ ·75	− ·60
(3)	+ ·07	·00	− ·07
35	− ·08	+ ·75	− ·67

No. of Triangle	x	y	z
	"	"	"
(1)	+ ·65	+ ·71	− 1·36
(3)	− ·12	+ ·02	+ ·10
36	+ ·53	+ ·73	−1·26
(1)	+ ·18	+ ·29	− ·47
(3)	− ·06	+ ·02	+ ·04
37	+ ·12	+ ·31	− ·43
(1)	− ·45	+ ·99	− ·54
(3)	+ ·17	− ·15	− ·02
38	− ·28	+ ·84	− ·56
(1)	+ ·13	+ ·50	− ·63
(3)	− ·09	− ·05	+ ·14
39	+ ·04	+ ·45	− ·49
(1)	− ·17	+ ·37	− ·20
(3)	+ ·14	− ·12	− ·02
40	− ·03	+ ·25	− ·22
(1)	+ ·06	+ ·26	− ·32
(3)	+ ·06	− ·09	+ ·03
41	+ ·12	+ ·17	− ·29
(1)	− ·04	+ ·29	− ·25
(3)	− ·03	− ·07	+ ·10
42	− ·07	+ ·22	− ·15

NOTE.—(1) Original Error; (3) Residual Error.

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No. of Triangle	x	y	z
	"	"	"
(1)	+ ·14	+ ·16	− ·30
(3)	− ·10	− ·02	+ ·12
43	+ ·04	+ ·14	− ·18
(1)	− ·07	+ ·20	− ·13
(3)	+ ·10	− ·11	+ ·01
(4)	− ·01	·00	+ ·01
44	+ ·02	+ ·09	− ·11
45	− ·20	+ ·11	+ ·09
46	+ ·27	− ·08	− ·19
47	+ ·35	− ·20	− ·15
48	− ·18	+ ·12	+ ·06
49	+ ·31	− ·01	− ·30
50	− ·33	+ ·39	− ·06
51	− ·44	+ ·33	+ ·11
52	+ ·35	− ·11	− ·24
53	− ·27	+ ·35	− ·08
54	+ ·10	− ·03	− ·07
55	− ·13	+ ·09	+ ·04
56	+ ·18	− ·09	− ·09
57	− ·07	+ ·05	+ ·02
58	− ·03	+ ·02	+ ·01
59	+ ·01	+ ·16	− ·17
60	+ ·13	− ·10	− ·03
61	·00	− ·02	+ ·02
62	+ ·04	− ·01	− ·03
63	− ·07	+ ·10	− ·03
64	+ ·07	− ·02	− ·05
65	− ·10	+ ·02	+ ·08
66	+ ·13	− ·02	− ·11
67	− ·20	+ ·10	+ ·10
68	+ ·19	− ·10	− ·09
69	− ·28	+ ·12	+ ·16
70	+ ·23	− ·09	− ·14
71	− ·14	+ ·10	+ ·04
72	+ ·10	− ·03	− ·07
73	− ·09	+ ·06	+ ·03

No. of Triangle	x	y	z
	"	"	"
74	+ ·05	− ·02	− ·03
75	− ·07	+ ·02	+ ·05
76	+ ·15	− ·06	− ·09
77	− ·10	+ ·05	+ ·05
78	+ ·15	− ·07	− ·08
(1)	− ·12	+ ·15	− ·03
(3)	− ·05	− ·14	+ ·19
79	− ·17	+ ·01	+ ·16
(1)	− ·02	+ ·26	− ·24
(3)	− ·17	− ·21	+ ·38
80	− ·19	+ ·05	+ ·14
(1)	+ ·01	+ ·12	− ·13
(3)	·00	− ·12	+ ·12
81	+ ·01	·00	− ·01
(1)	− ·03	+ ·13	− ·10
(3)	− ·03	− ·07	+ ·10
82	− ·06	+ ·06	·00
(1)	·00	+ ·06	− ·06
(3)	+ ·02	− ·05	+ ·03
83	+ ·02	+ ·01	− ·03
(1)	·00	+ ·10	− ·10
(3)	− ·05	− ·01	+ ·06
84	− ·05	+ ·09	− ·04
(1)	+ ·01	+ ·08	− ·09
(3)	− ·02	− ·02	+ ·04
85	− ·01	+ ·06	− ·05
(1)	+ ·01	+ ·11	− ·12
(3)	− ·05	·00	+ ·05
86	− ·04	+ ·11	− ·07
(1)	− ·03	+ ·12	− ·09
(3)	− ·07	+ ·03	+ ·04
87	− ·10	+ ·15	− ·05
(1)	·00	+ ·16	− ·16
(3)	+ ·01	+ ·07	− ·08
88	+ ·01	+ ·23	− ·24
(1)	− ·03	+ ·15	− ·12
(3)	− ·05	+ ·09	− ·04
89	− ·08	+ ·24	− ·16
(1)	+ ·03	+ ·11	− ·14
(3)	+ ·01	+ ·10	− ·11
90	+ ·04	+ ·21	− ·25
(1)	+ ·11	+ ·50	− ·61
(3)	− ·31	+ ·50	− ·19
(4)	+ ·02	·00	− ·02
91	− ·18	+ 1·00	− ·82
(1)	+ ·30	+ ·53	− ·83
(3)	+ ·54	+ ·39	− ·93
(4)	− ·03	+ ·06	− ·03
92	+ ·81	+ ·98	− 1·79
93	− ·81	+ 1·03	− ·22
94	+ ·28	+ ·24	− ·52

No. of Triangle	x	y	z
	"	"	"
95	+ ·75	+ ·43	− 1·18
96	− ·60	+ ·77	− ·17
97	− ·31	+ ·95	− ·64
98	− ·09	+ ·85	− ·76
99	+ ·29	+ ·23	− ·52
100	+ ·40	+ 1·17	− 1·57
101	− ·01	+ ·51	− ·50
102	+ ·07	+ ·60	− ·67
103	− ·20	+ ·51	− ·31
104	− ·37	+ ·72	− ·35
105	− ·06	+ ·18	− ·12
106	+ ·06	+ ·15	− ·21
107	− ·15	+ ·39	− ·24
108	+ ·16	+ ·18	− ·34
109	− ·18	+ ·22	− ·04
110	+ ·06	+ ·24	− ·30
111	− ·08	+ ·18	− ·10
112	− ·12	+ ·32	− ·20
113	+ ·28	+ ·51	− ·79
114	− ·31	+ ·60	− ·29
115	+ ·44	+ ·31	− ·75
116	− ·20	+ ·37	− ·17
(1)	+ ·43	+ ·32	− ·75
(3)	+ ·69	+ ·46	− 1·15
117	+ 1·12	+ ·78	− 1·90
(1)	− ·27	+ ·41	− ·14
(3)	− ·12	+ ·50	− ·38
118	− ·39	+ ·91	− ·52
(1)	+ ·48	+ ·23	− ·71
(3)	+ ·43	+ ·08	− ·51
119	+ ·91	+ ·31	− 1·22
(1)	− ·72	+ ·97	− ·25
(3)	− ·02	+ ·30	− ·28
120	− ·74	+ 1·27	− ·53
(1)	+ ·98	+ ·46	− 1·44
(3)	+ ·31	− ·23	− ·08
121	+ 1·29	+ ·23	− 1·52
(1)	− ·67	+ ·78	− ·11
(3)	+ ·27	− ·09	− ·18
122	− ·40	+ ·69	− ·29

No. of Triangle	x	y	z
	"	"	"
(1)	+ ·78	+ ·21	− ·99
(3)	− ·01	− ·30	+ ·31
123	+ ·77	− ·09	− ·68
(1)	− ·70	+ ·71	− ·01
(3)	+ ·55	− ·64	+ ·09
124	− ·15	+ ·07	+ ·08
(1)	+ ·70	+ ·17	− ·87
(3)	− ·02	− ·52	+ ·54
(4)	·00	− ·03	+ ·03
125	+ ·68	− ·38	− ·30
(1)	− ·76	+ ·87	− ·11
(3)	+ ·40	− ·95	+ ·55
(4)	·00	− ·03	+ ·03
126	− ·36	− ·11	+ ·47
127	− ·47	+ ·51	− ·04
128	+ ·77	+ ·09	− ·86
129	− ·04	+ ·03	+ ·01
130	− ·01	+ ·07	− ·06
131	− ·01	+ ·05	− ·04
132	+ ·01	+ ·06	− ·07
133	− ·01	+ ·04	− ·03
134	− ·01	+ ·08	− ·07
135	− ·01	+ ·05	− ·04
136	+ ·01	+ ·04	− ·05
137	− ·02	+ ·07	− ·05
138	+ ·05	+ ·10	− ·15
139	− ·89	+ ·11	+ ·78
140	+ ·62	− ·60	− ·02
141	+ ·47	− ·69	+ ·22
142	− ·76	+ ·02	+ ·74
143	+ ·71	− ·71	·00
144	− ·27	− ·21	+ ·48
145	+ ·29	− ·52	+ ·23
146	− ·67	− ·87	+ 1·54
147	+ ·30	− ·81	+ ·51
148	− ·27	− ·28	+ ·55
149	− ·03	− ·58	+ ·61
150	+ ·07	− ·18	+ ·11
151	− ·04	− ·07	+ ·11

Note.—(1) Original Error; (3) Residual Error; and (4) Arbitrary apportionment of Error.

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No. of Triangle	x	y	z
	″	″	″
152	+ ·04	− ·09	+ ·05
153	− ·14	− ·10	+ ·24
154	+ ·22	− ·29	+ ·07
155	− ·13	− ·03	+ ·16
156	+ ·34	− ·32	− ·02
157	− ·10	− ·02	+ ·12
158	+ ·27	− ·21	− ·06
159	− ·15	+ ·02	+ ·13
160	+ ·20	− ·13	− ·07
161	− ·34	+ ·12	+ ·22
162	+ ·14	− ·06	− ·08
(1)	− ·26	+ ·12	+ ·14
(3)	+ ·67	− ·14	− ·53
163	+ ·41	− ·02	− ·39
(1)	+ ·19	− ·08	− ·11
(3)	− ·26	+ ·38	− ·12
164	− ·07	+ ·30	− ·23
(1)	− ·16	+ ·07	+ ·09
(3)	+ ·17	− ·08	− ·09
165	+ ·01	− ·01	·00
(1)	+ ·31	− ·13	− ·18
(3)	− ·05	+ ·16	− ·11
166	+ ·26	+ ·03	− ·29
(1)	− ·74	+ ·39	+ ·35
(3)	+ ·16	− ·07	− ·09
167	− ·58	+ ·32	+ ·26
(1)	+1·04	− ·41	− ·63
(3)	+ ·40	+ ·14	− ·54
168	+1·44	− ·27	−1·17
(1)	−1·49	+ ·68	+ ·81
(3)	− ·08	− ·86	+ ·94
(4)	·00	+ ·02	− ·02
169	−1·57	− ·16	+1·73
(1)	+ ·66	− ·29	− ·37
(3)	+ ·44	− ·56	+ ·12
(4)	− ·01	+ ·03	− ·02
170	+1·09	− ·82	− ·27
171	− ·28	+ ·20	+ ·08
172	− ·10	+ ·16	− ·06
173	+ ·10	+ ·04	− ·14
174	− ·12	+ ·21	− ·09
175	+ ·05	+ ·10	− ·15
176	− ·15	+ ·36	− ·21
177	+ ·02	+ ·05	− ·07

No. of Triangle	x	y	z
	″	″	″
178	− ·03	+ ·13	− ·10
179	+ ·04	+ ·09	− ·13
(1)	− ·04	+ ·10	− ·06
(4)	− ·04	+ ·02	+ ·02
180	− ·08	+ ·12	− ·04
181	− ·14	+ ·42	− ·28
182	+ ·06	+ ·05	− ·11
183	+ ·08	+ ·03	− ·11
184	− ·12	+ ·10	+ ·02
185	− ·05	+ ·06	− ·01
186	+ ·12	− ·02	− ·10
187	− ·05	+ ·07	− ·02
188	+ ·06	− ·03	− ·03
189	− ·07	+ ·07	·00
190	+ ·04	+ ·01	− ·05
191	− ·04	+ ·04	·00
192	+ ·08	− ·02	− ·06
193	− ·02	+ ·02	·00
194	+ ·04	− ·05	+ ·01
195	− ·02	− ·04	+ ·06
196	+ ·03	− ·09	+ ·06
197	+ ·04	− ·10	+ ·06
198	+ ·01	− ·10	+ ·09
(1)	·00	− ·18	+ ·18
(3)	+ ·67	+ ·12	− ·79
199	+ ·67	− ·06	− ·61
(1)	− ·02	− ·12	+ ·14
(3)	− ·20	+ ·40	− ·20
200	− ·22	+ ·28	− ·06
(1)	+ ·08	− ·18	+ ·10
(3)	+ ·48	− ·04	− ·44
201	+ ·56	− ·22	− ·34
(1)	− ·04	− ·12	+ ·16
(3)	− ·04	+ ·27	− ·23
202	− ·08	+ ·15	− ·07
(1)	+ ·02	− ·16	+ ·14
(3)	+ ·21	− ·20	− ·01
203	+ ·23	− ·36	+ ·13
(1)	+ ·10	− ·24	+ ·14
(3)	+ ·30	− ·19	− ·11
204	+ ·40	− ·43	+ ·03

No. of Triangle	x	y	z
	″	″	″
(1)	− ·01	− ·14	+ ·15
(3)	− ·22	− ·10	+ ·32
205	− ·23	− ·24	+ ·47
(1)	·00	− ·27	+ ·27
(3)	+ ·73	− ·77	+ ·04
(4)	·00	− ·02	+ ·02
206	+ ·73	−1·06	+ ·33
207	·00	− ·07	+ ·07
208	+ ·03	− ·14	+ ·11
209	+ ·01	− ·03	+ ·02
210	− ·01	− ·03	+ ·04
211	− ·08	+ ·05	+ ·03
212	·00	+ ·07	− ·07
213	·00	+ ·10	− ·10
214	− ·03	+ ·19	− ·16
215	− ·02	+ ·09	− ·07
216	− ·01	+ ·08	− ·07
217	− ·01	+ ·02	− ·01
218	− ·01	+ ·13	− ·12
219	+ ·01	+ ·16	− ·17
(1)	− ·03	+ ·19	− ·16
(4)	+ ·02	− ·01	− ·01
220	− ·01	+ ·18	− ·17
221	− ·21	+ ·20	+ ·01
222	− ·07	+ ·11	− ·04
223	+ ·05	+ ·12	− ·17
224	− ·03	+ ·09	− ·06
225	+ ·25	+ ·20	− ·45
226	− ·39	+ ·48	− ·09
227	− ·24	+ ·28	− ·04
228	+ ·25	− ·04	− ·21
229	− ·20	+ ·23	− ·03
230	+ ·22	+ ·07	− ·29
231	− ·14	+ ·19	− ·05
232	+ ·09	+ ·01	− ·10
233	− ·31	+ ·51	− ·20
234	+ ·50	+ ·03	− ·53
235	− ·50	+ ·52	− ·02

No. of Triangle	x	y	z
	″	″	″
236	+ ·76	− ·21	− ·55
237	− ·21	+ ·19	+ ·02
238	+ ·33	− ·17	− ·16
239	− ·19	+ ·13	+ ·06
240	+ ·24	− ·14	− ·10
241	− ·09	+ ·03	+ ·06
242	+ ·23	− ·42	+ ·19
(1)	− ·06	− ·12	+ ·18
(3)	+ ·66	− ·10	− ·56
243	+ ·60	− ·22	− ·38
(1)	+ ·04	− ·43	+ ·39
(3)	− ·17	+ ·48	− ·31
244	− ·13	+ ·05	+ ·08
(1)	·00	− ·33	+ ·33
(3)	+ ·21	− ·09	− ·12
245	+ ·21	− ·42	+ ·21
(1)	− ·01	− ·32	+ ·33
(3)	+ ·09	+ ·10	− ·19
246	+ ·08	− ·22	+ ·14
(1)	+ ·15	− ·31	+ ·16
(3)	− ·02	− ·19	+ ·21
247	+ ·13	− ·50	+ ·37
(1)	− ·13	− ·39	+ ·52
(3)	+ ·55	− ·42	− ·13
248	+ ·42	− ·81	+ ·39
(1)	− ·06	+ ·03	+ ·03
(3)	·00	− ·01	+ ·01
249	− ·06	+ ·02	+ ·04
(1)	− ·01	+ ·02	− ·01
(3)	− ·01	·00	+ ·01
250	− ·02	+ ·02	·00
(1)	+ ·01	+ ·01	− ·02
(3)	+ ·01	− ·01	·00
251	+ ·02	·00	− ·02
(1)	− ·04	+ ·07	− ·03
(3)	− ·01	− ·02	+ ·03
252	− ·05	+ ·05	·00
(1)	+ ·01	+ ·01	− ·02
(3)	·00	− ·01	+ ·01
253	+ ·01	·00	− ·01
(1)	− ·03	+ ·06	− ·03
(3)	·00	− ·03	+ ·03
254	− ·03	+ ·03	·00
(1)	+ ·02	+ ·04	− ·06
(3)	+ ·01	− ·04	+ ·03
255	+ ·03	·00	− ·03
(1)	− ·08	+ ·22	− ·14
(3)	·00	− ·11	+ ·11
256	− ·08	+ ·11	− ·03

Note.—(1) Original Error; (3) Residual Error; and (4) Arbitrary apportionment of Error.

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No. of Triangle	x	y	z
	"	"	"
(1)	+ ·04	+ ·08	− ·12
(3)	·00	− ·07	+ ·07
257	+ ·04	+ ·01	− ·05
(1)	− ·13	+ ·29	− ·16
(3)	+ ·05	− ·18	+ ·13
258	− ·08	+ ·11	− ·03
(1)	+ ·07	+ ·19	− ·26
(3)	− ·01	− ·16	+ ·17
259	+ ·06	+ ·03	− ·09
(1)	− ·01	+ ·06	− ·05
(3)	·00	− ·04	+ ·04
260	− ·01	+ ·02	− ·01
(1)	+ ·02	+ ·07	− ·09
(3)	·00	− ·06	+ ·06
261	+ ·02	+ ·01	− ·03
(1)	− ·02	+ ·09	− ·07
(3)	·00	− ·05	+ ·05
(4)	+ ·01	+ ·07	− ·08
262	− ·01	+ ·11	− ·10
263	+ ·328	− ·352	+ ·024
264	− ·140	− ·145	+ ·285
265	+ ·119	− ·221	+ ·102
266	− ·64	− ·06	+ ·70
267	+ ·29	− ·37	+ ·08
268	+ ·31	− ·50	+ ·19
269	− ·03	− ·32	+ ·35
270	− ·26	− ·16	+ ·42
271	+ ·15	− ·45	+ ·30
272	− ·08	− ·20	+ ·28
273	+ ·07	− ·27	+ ·20
274	− ·08	− ·14	+ ·22
275	+ ·10	− ·22	+ ·12
276	− ·17	− ·05	+ ·22
277	+ ·11	− ·11	·00
278	− ·22	·00	+ ·22
279	+ ·22	− ·11	− ·11
280	− ·40	+ ·17	+ ·23
281	+ ·34	− ·14	− ·20
282	− ·49	+ ·21	+ ·28
283	+ ·23	− ·09	− ·14
284	− ·11	+ ·05	+ ·06

No. of Triangle	x	y	z
	"	"	"
285	+ ·02	− ·01	− ·01
286	− ·14	+ ·10	+ ·04
287	+ ·08	− ·02	− ·06
288	− ·13	+ ·08	+ ·05
289	+ ·01	− ·05	+ ·04
290	− ·03	+ ·02	+ ·01
291	+ ·03	− ·01	− ·02
292	− ·05	+ ·04	+ ·01
293	+ ·04	+ ·01	− ·05
294	− ·03	+ ·03	·00
(1)	+ ·02	+ ·01	− ·03
(3)	+ ·32	+ ·06	− ·38
295	+ ·34	+ ·07	− ·41
(1)	− ·05	+ ·06	− ·01
(3)	·00	+ ·22	− ·22
296	− ·05	+ ·28	− ·23
(1)	+ ·01	+ ·01	− ·02
(3)	+ ·20	·00	− ·20
297	+ ·21	+ ·01	− ·22
(1)	− ·01	+ ·02	− ·01
(3)	+ ·09	+ ·07	− ·16
298	+ ·08	+ ·09	− ·17
(1)	+ ·01	+ ·01	− ·02
(3)	+ ·07	+ ·02	− ·09
299	+ ·08	+ ·03	− ·11
(1)	− ·05	+ ·08	− ·03
(3)	+ ·33	− ·10	− ·23
300	+ ·28	− ·02	− ·26
(1)	+ ·01	+ ·01	− ·02
(3)	− ·19	+ ·05	+ ·14
301	− ·18	+ ·06	+ ·12
(1)	− ·02	+ ·05	− ·03
(3)	+ ·39	− ·20	− ·19
302	+ ·37	− ·15	− ·22
303	+ ·16	+ ·09	− ·25
304	− ·22	+ ·34	− ·12
305	+ ·28	+ ·10	− ·38
306	− ·30	+ ·45	− ·15
307	+ ·04	+ ·13	− ·17
308	− ·12	+ ·27	− ·15
309	+ ·20	+ ·23	− ·43
310	− ·27	+ ·47	− ·20
311	+ ·21	+ ·16	− ·37

No. of Triangle	x	y	z
	"	"	"
312	− ·19	+ ·43	− ·24
313	+ ·07	+ ·11	− ·18
314	− ·02	+ ·10	− ·08
315	+ ·07	+ ·09	− ·16
316	− ·01	+ ·12	− ·11
317	+ ·04	+ ·08	− ·12
318	+ ·01	+ ·11	− ·12
319	+ ·05	+ ·08	− ·13
320	·00	+ ·10	− ·10
321	+ ·02	+ ·06	− ·08
322	+ ·05	+ ·09	− ·14
323	− ·01	− ·22	+ ·23
324	− ·16	+ ·03	+ ·13
325	+ ·17	− ·13	− ·04
326	− ·18	+ ·05	+ ·13
327	+ ·31	− ·22	− ·09
328	− ·25	+ ·07	+ ·18
329	+ ·21	− ·14	− ·07
(1)	− ·23	+ ·08	+ ·15
(4)	+ ·05	− ·07	+ ·02
330	− ·18	+ ·01	+ ·17
331	− ·10	− ·44	+ ·54
332	− ·05	− ·24	+ ·29
333	− ·19	− ·41	+ ·60
334	+ ·10	− ·45	+ ·35
335	− ·07	− ·38	+ ·45
336	+ ·08	− ·32	+ ·24
337	+ ·15	− ·38	+ ·23
338	·00	− ·27	+ ·27
339	− ·06	− ·32	+ ·38
340	+ ·11	− ·32	+ ·21
341	+ ·18	− ·31	+ ·13
342	− ·08	− ·21	+ ·29
343	− ·06	− ·20	+ ·26
344	+ ·13	− ·34	+ ·21

No. of Triangle	x	y	z
	"	"	"
345	− ·11	− ·26	+ ·37
346	+ ·24	− ·81	+ ·57
347	− ·33	− ·45	+ ·78
348	+ ·17	− ·39	+ ·22
349	+ ·03	− ·09	+ ·06
350	− ·03	− ·05	+ ·08
351	− ·05	− ·12	+ ·17
(1)	+ ·09	− ·09	·00
(3)	− ·34	+ ·06	+ ·28
352	− ·25	− ·03	+ ·28
(1)	− ·11	·00	+ ·11
(3)	+ ·16	− ·17	+ ·01
353	+ ·05	− ·17	+ ·12
354	+ ·11	− ·08	− ·03
355	− ·15	+ ·01	+ ·14
356	+ ·13	− ·10	− ·03
357	− ·13	+ ·01	+ ·12
358	+ ·22	− ·17	− ·05
359	− ·22	+ ·02	+ ·20
(1)	+ ·23	− ·17	− ·06
(3)	+ ·24	− ·07	− ·17
360	+ ·47	− ·24	− ·23
(1)	− ·33	+ ·04	+ ·29
(3)	− ·26	+ ·19	+ ·07
361	− ·59	+ ·23	+ ·36
(1)	− ·90	− 1·19	+ 2·09
(2)	+ ·07	− ·05	− ·02
362	− ·83	− 1·24	+ 2·07
(1)	− ·05	− ·44	+ ·49
(2)	+ ·01	+ ·01	− ·02
363	− ·04	− ·43	+ ·47
(1)	− ·13	− ·24	+ ·37
(2)	+ ·02	·00	− ·02
364	− ·11	− ·24	+ ·35
(1)	+ ·22	− ·59	+ ·37
(2)	− ·02	+ ·03	− ·01
365	+ ·20	− ·56	+ ·36
(1)	− ·03	− ·38	+ ·41
(2)	− ·01	+ ·02	− ·01
366	− ·04	− ·36	+ ·40
(1)	− ·05	− ·52	+ ·57
(2)	+ ·02	+ ·01	− ·03
367	− ·03	− ·51	+ ·54
(1)	+ ·23	− ·70	+ ·47
(2)	− ·02	+ ·03	− ·01
368	+ ·21	− ·67	+ ·46

Note.—(1) Original Error; (2) Error by change of Absolute term of 42nd Equation; (3) Residual Error; and (4) Arbitrary apportionment of Error.

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No. of Triangle	x	y	z
	"	"	"
(1)	− ·30	− ·31	+ ·61
(2)	+ ·02	+ ·01	− ·03
369	− ·28	− ·30	+ ·58
(1)	+ ·03	− ·39	+ ·36
(2)	− ·01	+ ·02	− ·01
370	+ ·02	− ·37	+ ·35
(1)	− ·03	− ·50	+ ·53
(2)	+ ·01	+ ·01	− ·02
371	− ·02	− ·49	+ ·51
(1)	− ·06	− ·26	+ ·32
(2)	·00	+ ·01	− ·01
372	− ·06	− ·25	+ ·31
(1)	− ·15	− ·29	+ ·44
(2)	+ ·02	·00	− ·02
373	− ·13	− ·29	+ ·42
(1)	+ ·14	− ·32	+ ·18
(2)	− ·01	+ ·02	− ·01
374	+ ·13	− ·30	+ ·17
(1)	− ·20	− ·07	+ ·27
(2)	+ ·01	·00	− ·01
375	− ·19	− ·07	+ ·26
(1)	+ ·21	− ·29	+ ·08
(2)	− ·02	+ ·02	·00
376	+ ·19	− ·27	+ ·08
(1)	− ·20	− ·02	+ ·22
(2)	+ ·01	·00	− ·01
377	− ·19	− ·02	+ ·21
(1)	+ ·13	− ·23	+ ·10
(2)	− ·01	+ ·02	− ·01
378	+ ·12	− ·21	+ ·09
(1)	− ·21	+ ·01	+ ·20
(2)	+ ·01	·00	− ·01
379	− ·20	+ ·01	+ ·19
(1)	+ ·12	− ·10	− ·02
(2)	·00	+ ·01	− ·01
380	+ ·12	− ·09	− ·03
(1)	− ·12	+ ·07	+ ·05
(2)	·00	·00	·00
381	− ·12	+ ·07	+ ·05
(1)	+ ·08	− ·03	− ·05
(2)	+ ·01	·00	− ·01
382	+ ·09	− ·03	− ·06
(1)	− ·10	+ ·10	·00
(2)	·00	·00	·00
383	− ·10	+ ·10	·00
(1)	+ ·01	+ ·08	− ·09
(2)	·00	·00	·00
384	+ ·01	+ ·08	− ·09
(1)	− ·02	+ ·19	− ·17
(2)	− ·01	·00	+ ·01
385	− ·03	+ ·19	− ·16
(1)	− ·05	+ ·13	− ·08
(2)	+ ·01	·00	− ·01
386	− ·04	+ ·13	− ·09

No. of Triangle	x	y	z
	"	"	"
(1)	·00	+ ·21	− ·21
(2)	− ·01	·00	+ ·01
387	− ·01	+ ·21	− ·20
(1)	+ ·01	+ ·14	− ·15
(2)	+ ·01	− ·01	·00
388	+ ·02	+ ·13	− ·15
(1)	− ·07	+ ·29	− ·22
(2)	− ·01	·00	+ ·01
389	− ·08	+ ·29	− ·21
(1)	+ ·01	+ ·27	− ·28
(2)	+ ·01	− ·01	·00
390	+ ·02	+ ·26	− ·28
(1)	− ·18	+ ·39	− ·21
(2)	·00	− ·01	+ ·01
391	− ·18	+ ·38	− ·20
(1)	− ·01	+ ·46	− ·45
(2)	+ ·02	− ·02	·00
392	+ ·01	+ ·44	− ·45
(1)	+ ·07	+ ·44	− ·51
(2)	− ·02	·00	+ ·02
393	+ ·05	+ ·44	− ·49
(1)	+ ·07	+ ·35	− ·42
(2)	+ ·02	− ·02	·00
394	+ ·09	+ ·33	− ·42
(1)	− ·17	+ ·43	− ·26
(2)	− ·02	·00	+ ·02
395	− ·19	+ ·43	− ·24
(1)	+ ·08	+ ·31	− ·39
(2)	+ ·02	− ·02	·00
396	+ ·10	+ ·29	− ·39
(1)	− ·14	+ ·53	− ·39
(2)	− ·01	− ·01	+ ·02
397	− ·15	+ ·52	− ·37
(1)	− ·04	+ ·56	− ·52
(2)	+ ·03	− ·03	·00
398	− ·01	+ ·53	− ·52
(1)	− ·07	+ ·56	− ·49
(2)	− ·03	·00	+ ·03
399	− ·10	+ ·56	− ·46
(1)	− ·08	+ ·55	− ·47
(2)	+ ·03	− ·03	·00
400	− ·05	+ ·52	− ·47
(1)	− ·05	+ ·70	− ·65
(2)	− ·03	− ·01	+ ·04
401	− ·08	+ ·69	− ·61
(1)	+ ·01	+ ·57	− ·58
(2)	+ ·02	− ·03	+ ·01
402	+ ·03	+ ·54	− ·57
(1)	− ·06	+ ·78	− ·72
(2)	− ·03	− ·01	+ ·04
403	− ·09	+ ·77	− ·68
(1)	+ ·02	+ ·84	− ·86
(2)	+ ·03	− ·04	+ ·01
404	+ ·05	+ ·80	− ·85

No. of Triangle	x	y	z
	"	"	"
(1)	+ ·06	+ ·73	− ·79
(2)	− ·03	− ·01	+ ·04
405	+ ·03	+ ·72	− ·75
(1)	− ·20	+ ·69	− ·49
(2)	+ ·03	− ·04	+ ·01
406	− ·17	+ ·65	− ·48
(1)	+ ·07	− ·02	− ·05
(2)	− ·01	+ ·01	·00
407	+ ·06	− ·01	− ·05
(1)	+ ·01	− ·05	+ ·04
(2)	− ·01	+ ·02	− ·01
(4)	·00	− ·07	+ ·07
408	·00	− ·10	+ ·10
(1)	+ ·01	+ ·02	− ·03
(3)	+ ·34	− ·15	− ·19
409	+ ·35	− ·13	− ·22
(1)	+ ·03	+ ·04	− ·07
(3)	− ·23	+ ·16	+ ·07
410	− ·20	+ ·20	·00
(1)	− ·05	+ ·07	− ·02
(3)	+ ·18	− ·07	− ·11
411	+ ·13	·00	− ·13
412	+ ·03	+ ·03	− ·06
413	− ·02	+ ·04	− ·02
414	+ ·03	+ ·02	− ·05
415	− ·04	+ ·06	− ·02
416	+ ·02	+ ·01	− ·03
417	− ·02	+ ·03	− ·01
418	+ ·06	·00	− ·06
419	− ·07	+ ·06	+ ·01
(1)	+ ·10	− ·01	− ·09
(3)	+ ·26	− ·13	− ·13
420	+ ·36	− ·14	− ·22
(1)	− ·07	+ ·06	+ ·01
(3)	− ·25	+ ·12	+ ·13
421	− ·32	+ ·18	+ ·14
(1)	+ ·10	− ·03	− ·07
(3)	+ ·26	− ·13	− ·13
422	+ ·36	− ·16	− ·20
(1)	− ·10	+ ·06	+ ·04
(3)	− ·25	+ ·12	+ ·13
(4)	− ·02	+ ·01	+ ·01
423	− ·37	+ ·19	+ ·18
(1)	+ ·02	+ ·08	− ·10
(2)	− ·01	− ·01	+ ·02
424	+ ·01	+ ·07	− ·08
(1)	+ ·032	+ ·311	− ·343
(2)	− ·010	− ·044	+ ·054
425	+ ·022	+ ·267	− ·289

No. of Triangle	x	y	z
	"	"	"
(1)	− ·172	+ ·355	− ·183
(2)	+ ·035	− ·061	+ ·026
426	− ·137	+ ·294	− ·157
(1)	− ·057	+ ·405	− ·348
(2)	+ ·004	− ·061	+ ·057
427	− ·053	+ ·344	− ·291
(1)	+ ·048	+ ·363	− ·411
(2)	− ·005	− ·060	+ ·065
428	+ ·043	+ ·303	− ·346
(1)	− ·050	+ ·318	− ·268
(2)	+ ·011	− ·053	+ ·042
429	− ·039	+ ·265	− ·226
(1)	− ·008	+ ·307	− ·299
(2)	+ ·001	− ·051	+ ·050
430	− ·007	+ ·256	− ·249
(1)	+ ·057	+ ·344	− ·401
(2)	− ·008	− ·057	+ ·065
431	+ ·049	+ ·287	− ·336
(1)	− ·041	+ ·340	− ·299
(2)	+ ·005	− ·058	+ ·053
432	− ·036	+ ·282	− ·246
(1)	+ ·006	+ ·246	− ·252
(2)	− ·004	− ·041	+ ·045
433	+ ·002	+ ·205	− ·207
(1)	+ ·029	+ ·232	− ·261
(2)	·000	− ·042	+ ·042
434	+ ·029	+ ·190	− ·219
(1)	+ ·004	+ ·162	− ·166
(2)	+ ·003	− ·030	+ ·027
435	+ ·007	+ ·132	− ·139
(1)	− ·011	+ ·179	− ·168
(2)	− ·001	− ·031	+ ·032
436	− ·012	+ ·148	− ·136
(1)	− ·015	+ ·141	− ·126
(2)	− ·001	− ·023	+ ·024
437	− ·016	+ ·118	− ·102
(1)	− ·003	+ ·139	− ·136
(2)	+ ·005	− ·028	+ ·023
438	+ ·002	+ ·111	− ·113
(1)	+ ·075	+ ·175	− ·250
(2)	− ·008	− ·035	+ ·043
439	+ ·067	+ ·140	− ·207
(1)	− ·042	+ ·183	− ·141
(2)	+ ·001	− ·032	+ ·031
440	− ·041	+ ·151	− ·110
(1)	− ·011	+ ·161	− ·150
(2)	− ·005	− ·027	+ ·032
441	− ·016	+ ·134	− ·118
(1)	+ ·068	+ ·173	− ·241
(2)	− ·004	− ·038	+ ·042
442	+ ·064	+ ·135	− ·199
(1)	+ ·049	+ ·082	− ·131
(2)	− ·001	− ·020	+ ·021
(4)	− ·016	− ·021	+ ·037
443	+ ·032	+ ·041	− ·073

Note.—(1) Original Error; (2) Error by change of Absolute term of 42nd Equation; (3) Residual Error; and (4) Arbitrary apportionment of Error.

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No. of Triangle	x	y	z	No. of Triangle	x	y	z	No. of Triangle	x	y	z	No. of Triangle	x	y	z
	"	"	"		"	"	"		"	"	"		"	"	"
(1)	− ·019	− ·054	+ ·073	(1)	+ ·103	− ·049	− ·054	(1)	− ·075	+ ·031	+ ·044	(1)	+ ·051	− ·079	+ ·028
(2)	− ·004	+ ·004	·000	(2)	− ·008	+ ·005	+ ·003	(2)	+ ·004	+ ·003	− ·007	(2)	− ·001	+ ·018	− ·017
444	− ·023	− ·050	+ ·073	462	+ ·095	− ·044	− ·051	480	− ·071	+ ·034	+ ·037	498	+ ·050	− ·061	+ ·011
(1)	+ ·026	− ·081	+ ·055	(1)	− ·096	+ ·054	+ ·042	(1)	+ ·067	− ·049	− ·018	(1)	+ ·072	− ·133	+ ·061
(2)	+ ·004	+ ·001	− ·005	(2)	+ ·006	− ·002	− ·004	(2)	− ·005	+ ·009	− ·004	(2)	− ·008	+ ·036	− ·028
445	+ ·030	− ·080	+ ·050	463	− ·090	+ ·052	+ ·038	481	+ ·062	− ·040	− ·022	499	+ ·064	− ·097	+ ·033
(1)	+ ·024	− ·072	+ ·048	(1)	− ·194	+ ·110	+ ·084	(1)	+ ·065	− ·044	− ·021	(1)	− ·105	− ·052	+ ·157
(2)	+ ·005	·000	− ·005	(2)	+ ·013	− ·005	− ·008	(2)	− ·004	+ ·007	− ·003	(2)	+ ·013	+ ·022	− ·035
446	+ ·029	− ·072	+ ·043	464	− ·181	+ ·105	+ ·076	482	+ ·061	− ·037	− ·024	500	− ·092	− ·030	+ ·122
(1)	− ·029	− ·050	+ ·079	(1)	+ ·182	− ·091	− ·091	(1)	− ·056	+ ·019	+ ·037	(1)	− ·233	+ ·227	+ ·006
(2)	− ·005	+ ·005	·000	(2)	− ·012	+ ·009	+ ·003	(2)	+ ·004	+ ·004	− ·008	(2)	+ ·037	− ·029	− ·008
447	− ·034	− ·045	+ ·079	465	+ ·170	− ·082	− ·088	483	− ·052	+ ·023	+ ·029	501	− ·196	+ ·198	− ·002
(1)	+ ·107	− ·208	+ ·101	(1)	+ ·180	− ·088	− ·092	(1)	− ·146	+ ·043	+ ·103	(1)	+ ·086	+ ·041	− ·127
(2)	+ ·010	+ ·002	− ·012	(2)	− ·013	+ ·010	+ ·003	(2)	+ ·006	+ ·016	− ·022	(2)	− ·011	− ·005	+ ·016
448	+ ·117	− ·206	+ ·089	466	+ ·167	− ·078	− ·089	484	− ·140	+ ·059	+ ·081	502	+ ·075	+ ·036	− ·111
(1)	− ·032	− ·131	+ ·163	(1)	− ·164	+ ·086	+ ·078	(1)	+ ·119	− ·113	− ·006	(1)	− ·048	+ ·066	− ·018
(2)	− ·010	+ ·012	− ·002	(2)	+ ·011	− ·002	− ·009	(2)	− ·008	+ ·027	− ·019	(2)	+ ·007	− ·011	+ ·004
449	− ·042	− ·119	+ ·161	467	− ·153	+ ·084	+ ·069	485	+ ·111	− ·086	− ·025	503	− ·041	+ ·055	− ·014
(1)	+ ·045	− ·144	+ ·099	(1)	− ·186	+ ·091	+ ·095	(1)	+ ·114	− ·095	− ·019	(1)	− ·084	+ ·108	− ·024
(2)	+ ·010	+ ·001	− ·011	(2)	+ ·013	− ·003	− ·010	(2)	− ·007	+ ·023	− ·016	(2)	+ ·013	− ·017	+ ·004
450	+ ·055	− ·143	+ ·088	468	− ·173	+ ·088	+ ·085	486	+ ·107	− ·072	− ·035	504	− ·071	+ ·091	− ·020
(1)	− ·060	− ·091	+ ·151	(1)	+ ·173	− ·088	− ·085	(1)	− ·087	+ ·003	+ ·084	(1)	+ ·119	− ·018	− ·101
(2)	− ·010	+ ·011	− ·001	(2)	− ·013	+ ·011	+ ·002	(2)	+ ·003	+ ·021	− ·024	(2)	− ·015	− ·006	+ ·021
451	− ·070	− ·080	+ ·150	469	+ ·160	− ·077	− ·083	487	− ·084	+ ·024	+ ·060	505	+ ·104	− ·024	− ·080
(1)	+ ·024	− ·087	+ ·063	(1)	+ ·174	− ·093	− ·081	(1)	− ·050	+ ·004	+ ·046	(1)	− ·066	+ ·035	+ ·031
(2)	+ ·007	+ ·001	− ·008	(2)	− ·013	+ ·013	·000	(2)	+ ·002	+ ·013	− ·015	(2)	+ ·010	− ·010	·000
452	+ ·031	− ·086	+ ·055	470	+ ·161	− ·080	− ·081	488	− ·048	+ ·017	+ ·031	506	− ·056	+ ·025	+ ·031
(1)	− ·033	− ·058	+ ·091	(1)	− ·158	+ ·079	+ ·079	(1)	+ ·030	− ·053	+ ·023	(1)	− ·050	+ ·025	+ ·025
(2)	− ·007	+ ·008	− ·001	(2)	+ ·011	+ ·001	− ·012	(2)	·000	+ ·017	− ·017	(2)	+ ·012	− ·012	·000
453	− ·040	− ·050	+ ·090	471	− ·147	+ ·080	+ ·067	489	+ ·030	− ·036	+ ·006	507	− ·038	+ ·013	+ ·025
(1)	+ ·019	− ·052	+ ·033	(1)	− ·124	+ ·061	+ ·063	(1)	+ ·033	− ·050	+ ·017	(1)	+ ·059	− ·048	− ·011
(2)	+ ·004	+ ·001	− ·005	(2)	+ ·009	+ ·001	− ·010	(2)	− ·004	+ ·018	− ·014	(2)	− ·008	− ·004	+ ·012
454	+ ·023	− ·051	+ ·028	472	− ·115	+ ·062	+ ·053	490	+ ·029	− ·032	+ ·003	508	+ ·051	− ·052	+ ·001
(1)	− ·040	− ·083	+ ·123	(1)	+ ·112	− ·065	− ·047	(1)	− ·010	− ·019	+ ·029	(1)	− ·053	+ ·004	+ ·049
(2)	− ·009	+ ·011	− ·002	(2)	− ·007	+ ·009	− ·002	(2)	·000	+ ·016	− ·016	(2)	+ ·005	− ·009	+ ·004
455	− ·049	− ·072	+ ·121	473	+ ·105	− ·056	− ·049	491	− ·010	− ·003	+ ·013	509	− ·048	− ·005	+ ·053
(1)	+ ·023	− ·075	+ ·052	(1)	+ ·113	− ·068	− ·045	(1)	− ·024	− ·014	+ ·038	(1)	− ·050	+ ·018	+ ·032
(2)	+ ·006	+ ·001	− ·007	(2)	− ·010	+ ·011	− ·001	(2)	+ ·008	+ ·013	− ·021	(2)	+ ·008	− ·008	·000
456	+ ·029	− ·074	+ ·045	474	+ ·103	− ·057	− ·046	492	− ·016	− ·001	+ ·017	510	− ·042	+ ·010	+ ·032
(1)	− ·036	− ·062	+ ·098	(1)	− ·101	+ ·044	+ ·057	(1)	− ·017	− ·026	+ ·043	(1)	+ ·079	− ·090	+ ·011
(2)	− ·009	+ ·010	− ·001	(2)	+ ·007	+ ·002	− ·009	(2)	+ ·002	+ ·012	− ·014	(2)	− ·007	− ·001	+ ·008
457	− ·045	− ·052	+ ·097	475	− ·094	+ ·046	+ ·048	493	− ·015	− ·014	+ ·029	511	+ ·072	− ·091	+ ·019
(1)	+ ·042	− ·081	+ ·039	(1)	− ·072	+ ·033	+ ·039	(1)	+ ·008	− ·032	+ ·024	(1)	+ ·068	− ·089	+ ·021
(2)	+ ·007	+ ·001	− ·008	(2)	+ ·006	+ ·001	− ·007	(2)	− ·007	+ ·016	− ·009	(2)	− ·006	− ·002	+ ·008
458	+ ·049	− ·080	+ ·031	476	− ·066	+ ·034	+ ·032	494	+ ·001	− ·016	+ ·015	512	+ ·062	− ·091	+ ·029
(1)	− ·073	− ·085	+ ·158	(1)	+ ·065	− ·042	− ·023	(1)	+ ·029	− ·042	+ ·013	(1)	− ·043	− ·054	+ ·097
(2)	− ·010	+ ·014	− ·004	(2)	− ·005	+ ·007	− ·002	(2)	− ·001	+ ·016	− ·015	(2)	+ ·006	− ·009	+ ·003
459	− ·083	− ·071	+ ·154	477	+ ·060	− ·035	− ·025	495	+ ·028	− ·026	− ·002	513	− ·037	− ·063	+ ·100
(1)	+ ·060	− ·129	+ ·069	(1)	+ ·060	− ·038	− ·022	(1)	− ·046	− ·027	+ ·073	(1)	+ ·058	− ·105	+ ·047
(2)	+ ·008	+ ·004	− ·012	(2)	− ·002	+ ·005	− ·003	(2)	+ ·004	+ ·015	− ·019	(2)	− ·008	·000	+ ·008
460	+ ·068	− ·125	+ ·057	478	+ ·058	− ·033	− ·025	496	− ·042	− ·012	+ ·054	514	+ ·050	− ·105	+ ·055
(1)	− ·095	− ·078	+ ·173	(1)	− ·054	+ ·021	+ ·033	(1)	− ·031	− ·036	+ ·067	(1)	− ·036	− ·085	+ ·121
(2)	+ ·010	− ·002	− ·008	(2)	+ ·004	+ ·001	− ·005	(2)	+ ·001	+ ·018	− ·019	(2)	+ ·006	− ·008	+ ·001
461	− ·085	− ·080	+ ·165	479	− ·050	+ ·022	+ ·028	497	− ·030	− ·018	+ ·048	515	− ·030	− ·093	+ ·123

NOTE.—(1) Original Error; and (2) Error by change of Absolute term of 42nd Equation.

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No. of Triangle		x	y	z
		″	″	″
	(1)	+ ·003	− ·054	+ ·051
	(2)	− ·009	+ ·003	+ ·006
516		− ·006	− ·051	+ ·057
	(1)	+ ·076	− ·231	+ ·155
	(2)	+ ·011	− ·013	+ ·002
	(4)	+ ·086	− ·016	− ·070
517		+ ·173	− ·260	+ ·087
	(1)	+ ·124	− ·125	+ ·001
	(2)	·000	+ ·004	− ·004
518		+ ·124	− ·121	− ·003
	(1)	− ·136	+ ·011	+ ·125
	(2)	·000	+ ·004	− ·004
519		− ·136	+ ·015	+ ·121
	(1)	+ ·164	− ·142	− ·022
	(2)	− ·001	+ ·005	− ·004
520		+ ·163	− ·137	− ·026
	(1)	− ·205	+ ·029	+ ·176
	(2)	+ ·001	+ ·005	− ·006
521		− ·204	+ ·034	+ ·170
	(1)	+ ·164	− ·128	− ·036
	(2)	·000	+ ·004	− ·004
522		+ ·164	− ·124	− ·040
	(1)	− ·080	+ ·018	+ ·062
	(2)	+ ·001	+ ·001	− ·002
523		− ·079	+ ·019	+ ·060
	(1)	+ ·215	− ·165	− ·050
	(2)	− ·002	+ ·006	− ·004
524		+ ·213	− ·159	− ·054
	(1)	− ·261	+ ·081	+ ·180
	(2)	+ ·002	+ ·004	− ·006
525		− ·259	+ ·085	+ ·174
	(1)	+ ·342	− ·231	− ·111
	(2)	− ·001	+ ·007	− ·006
526		+ ·341	− ·224	− ·117
	(1)	− ·364	+ ·116	+ ·248
	(2)	+ ·002	+ ·006	− ·008
527		− ·362	+ ·122	+ ·240
	(1)	+ ·429	− ·282	− ·147
	(2)	− ·003	+ ·010	− ·007
528		+ ·426	− ·272	− ·154
	(1)	− ·450	+ ·157	+ ·293
	(2)	+ ·003	+ ·007	− ·010
529		− ·447	+ ·164	+ ·283
	(1)	+ 1·167	− ·723	− ·444
	(2)	− ·008	+ ·026	− ·018
530		+ 1·159	− ·697	− ·462

No. of Triangle		x	y	z
		″	″	″
	(1)	− ·346	+ ·134	+ ·212
	(2)	+ ·004	+ ·005	− ·009
531		− ·342	+ ·139	+ ·203
	(1)	+ ·255	− ·148	− ·107
	(2)	− ·002	+ ·006	− ·004
532		+ ·253	− ·142	− ·111
	(1)	− ·194	+ ·086	+ ·108
	(2)	+ ·001	+ ·003	− ·004
533		− ·193	+ ·089	+ ·104
	(1)	+ ·185	− ·096	− ·089
	(2)	− ·002	+ ·004	− ·002
534		+ ·183	− ·092	− ·091
	(1)	− ·124	+ ·059	+ ·065
	(2)	+ ·001	+ ·002	− ·003
535		− ·123	+ ·061	+ ·062
	(1)	+ ·119	− ·057	− ·062
	(2)	− ·002	+ ·003	− ·001
536		+ ·117	− ·054	− ·063
	(1)	+ ·091	− ·041	− ·050
	(2)	·000	+ ·003	− ·003
537		+ ·091	− ·038	− ·053
	(1)	− ·108	+ ·069	+ ·039
	(2)	+ ·001	+ ·002	− ·003
538		− ·107	+ ·071	+ ·036
	(1)	+ ·248	− ·074	− ·174
	(2)	− ·002	+ ·010	− ·008
539		+ ·246	− ·064	− ·182
	(1)	+ ·227	− ·099	− ·128
	(2)	·000	+ ·003	− ·003
540		+ ·227	− ·096	− ·131
	(1)	− ·201	+ ·128	+ ·073
	(2)	+ ·001	+ ·003	− ·004
541		− ·200	+ ·131	+ ·069
	(1)	− ·237	+ ·139	+ ·098
	(2)	+ ·001	+ ·002	− ·003
542		− ·236	+ ·141	+ ·095
	(1)	+ ·218	− ·091	− ·127
	(2)	− ·002	+ ·006	− ·004
543		+ ·216	− ·085	− ·131
	(1)	− ·212	+ ·138	+ ·074
	(2)	+ ·001	+ ·004	− ·005
544		− ·211	+ ·142	+ ·069
	(1)	+ ·211	− ·096	− ·115
	(2)	+ ·001	+ ·003	− ·004
545		+ ·212	− ·093	− ·119

No. of Triangle		x	y	z
		″	″	″
	(1)	− ·196	+ ·115	+ ·081
	(2)	+ ·001	+ ·002	− ·003
546		− ·195	+ ·117	+ ·078
	(1)	− ·261	+ ·173	+ ·088
	(2)	− ·002	+ ·006	− ·004
547		− ·263	+ ·179	+ ·084
	(1)	+ ·235	− ·041	− ·194
	(2)	+ ·002	+ ·006	− ·008
548		+ ·237	− ·035	− ·202
	(1)	− ·224	+ ·168	+ ·056
	(2)	·000	+ ·003	− ·003
549		− ·224	+ ·171	+ ·053
	(1)	− ·216	+ ·151	+ ·065
	(2)	+ ·001	+ ·002	− ·003
550		− ·215	+ ·153	+ ·062
	(1)	+ ·199	− ·055	− ·144
	(2)	·000	+ ·002	− ·002
551		+ ·199	− ·053	− ·146
	(1)	+ ·169	− ·021	− ·148
	(2)	·000	+ ·003	− ·003
552		+ ·169	− ·018	− ·151
	(1)	− ·164	+ ·158	+ ·006
	(2)	+ ·001	+ ·002	− ·003
553		− ·163	+ ·160	+ ·003
	(1)	+ ·190	− ·041	− ·149
	(2)	+ ·002	+ ·001	− ·003
554		+ ·192	− ·040	− ·152
	(1)	− ·313	+ ·307	+ ·006
	(2)	− ·002	+ ·005	− ·003
555		− ·315	+ ·312	+ ·003
	(1)	+ ·251	+ ·026	− ·277
	(2)	+ ·003	+ ·003	− ·006
556		+ ·254	+ ·029	− ·283
	(1)	+ ·141	+ ·131	− ·272
	(2)	− ·001	+ ·006	− ·005
557		+ ·140	+ ·137	− ·277
	(1)	− ·198	+ ·303	− ·105
	(2)	− ·002	+ ·006	− ·004
558		− ·200	+ ·309	− ·109
	(1)	− ·203	+ ·203	·000
	(2)	− ·003	+ ·004	− ·001
559		− ·206	+ ·207	− ·001
	(1)	+ ·074	+ ·154	− ·228
	(2)	+ ·001	+ ·005	− ·006
560		+ ·075	+ ·159	− ·234

No. of Triangle		x	y	z
		″	″	″
	(1)	+ ·222	+ ·081	− ·303
	(2)	+ ·005	+ ·003	− ·008
561		+ ·227	+ ·084	− ·311
	(1)	− ·089	+ ·269	− ·180
	(2)	− ·003	+ ·008	− ·005
562		− ·092	+ ·277	− ·185
	(1)	− ·111	+ ·175	− ·064
	(2)	− ·003	+ ·005	− ·002
563		− ·114	+ ·180	− ·066
	(1)	+ ·054	+ ·093	− ·147
	(2)	+ ·003	+ ·003	− ·006
564		+ ·057	+ ·096	− ·153
	(1)	+ ·120	+ ·012	− ·132
	(2)	+ ·005	·000	− ·005
565		+ ·125	+ ·012	− ·137
	(1)	− ·028	+ ·094	− ·066
	(2)	− ·003	+ ·004	− ·001
566		− ·031	+ ·098	− ·067
	(1)	− ·134	+ ·169	− ·035
	(2)	− ·006	+ ·006	·000
567		− ·140	+ ·175	− ·035
	(1)	+ ·050	+ ·115	− ·165
	(2)	+ ·005	+ ·002	− ·007
568		+ ·055	+ ·117	− ·172
	(1)	+ ·004	+ ·152	− ·156
	(2)	− ·004	+ ·006	− ·002
569		·000	+ ·158	− ·158
	(1)	− ·049	+ ·172	− ·123
	(2)	+ ·003	+ ·004	− ·007
570		− ·046	+ ·176	− ·130
	(1)	+ ·033	+ ·101	− ·134
	(2)	− ·004	+ ·005	− ·001
571		+ ·029	+ ·106	− ·135
	(1)	− ·004	+ ·122	− ·118
	(2)	+ ·005	+ ·002	− ·007
572		+ ·001	+ ·124	− ·125
	(1)	− ·008	+ ·110	− ·102
	(2)	− ·007	+ ·007	·000
573		− ·015	+ ·117	− ·102

Note.—(1) Original Error; (2) Error by change of Absolute term of 42nd Equation; and (4) Arbitrary apportionment of Error.

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17

The Dispersion of the Residual Errors remaining after the Simultaneous Reduction.

The residual errors that remained after the completion of the Simultaneous Reduction have already been exhibited on page 244. The method adopted for their dispersion has now to be described. Certain triangles having been chosen in which the residual errors were to be dispersed, new equations, both linear and geodetic, had to be constructed in a similar manner to the original equations, but restricted to contain only those of the angles of continuation over which the discrepancies were to be dispersed. This was readily done by taking the original equations furnished by each circuit in *side*, *latitude*, *longitude* and *azimuth*, substituting the residual errors for the absolute terms, and equating to zero all the angular errors, except those of the selected triangles. As the coefficients already employed stood multiplied by the equalizing factors given on page 59, the absolute terms had also to be multiplied by the same factors.

The equations being thus given, their solution was effected in two different ways. First, in Circuits *I* to *VI*, the previous calculations up to the products $f\,\mathfrak{b}\,\mathfrak{B}$, $f\,\mathfrak{c}\,\mathfrak{C}$, were made use of, the coefficients of the Indeterminate Factors being the sums of these quantities which appertained to the triangles retained; thus the real calculation began with the solution of the Equations between the Indeterminate Factors. The factors being found, the errors y and z of the angles of continuation were obtained by the usual formulæ. This method necessarily employed the same weights that were used in the original calculations.

In the second method, which was applied to Circuits *VII*, *IX* and *X*, the angles were all assumed to be of equal weight (= 1) and the triangular equation

$$x + y + z = 0$$

was neglected. Thus the circuit equations which are represented by equations (66), page 59, had to be solved subject to the minimum

$$U = [y^2 + z^2].$$

The coefficients of the Λs therefore took the form

$$[{}_mf\,{}_m\mathfrak{b}\;{}_lf\,{}_l\mathfrak{b} + {}_mf\,{}_m\mathfrak{c}\;{}_lf\,{}_l\mathfrak{c}]$$

in place of those given in equations (68), page 60; and this involved fresh calculations.

The values of the angular errors were then given by the formulæ

$$y = [f\mathfrak{b}\Lambda], \quad z = [f\mathfrak{c}\Lambda].$$

After they were obtained

$$x \text{ was put } = -(y + z).$$

In dispersing the residual errors of one circuit those of the next in several instances became changed. The actual errors dispersed in each case are given on page 245.

Very considerable trouble was occasioned in selecting a sufficient number of triangles to make the residual angular errors small enough to be admissible; in some cases several trials had to be made before the resulting angular errors were deemed acceptable; in other cases modifications were introduced which need not be described here as they are exhibited in the details of the calculations on the following pages.

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CIRCUIT *I.*

Triangles employed Nos. 31 to 44.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 1 to 4; Absolute Terms from Residuals page 245).

				Factors
Page 154,	*Side.*	${}_1\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{31}^{44}$	$= {}_1E_E = 0\cdot0 \times \cdot03 = 0\cdot000,$	${}_1\Lambda_E$
„ „	*Latitude.*	${}_2\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{31}^{43}$	$= {}_2E_E = +0\cdot014 \times 15 = +0\cdot210,$	${}_2\Lambda_E$
„ 154 & 155,	*Longitude.*	${}_3\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{31}^{43}$	$= {}_3E_E = -0\cdot031 \times 15 = -0\cdot465,$	${}_3\Lambda_E$
„ 155,	*Azimuth.*	${}_4\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{31}^{44}$	$= {}_4E_E = +0\cdot080 \times 1 = +0\cdot080,$	${}_4\Lambda_E$

Equations between Factors

(Formed with the aid of the previously computed values of $\mathfrak{b}\mathfrak{B}$ and $\mathfrak{c}\mathfrak{C}$)

No. of E_E	Values of E_E	Coefficients of ${}_1\Lambda_E$	${}_2\Lambda_E$	${}_3\Lambda_E$	${}_4\Lambda_E$	Values of the Factors
1	·000	+2·06	+1·28	−0·84	−0·03	${}_1\Lambda_E = -\ 3\cdot042$
2	+·210		+1·17	+0·02	+1·16	${}_2\Lambda_E = +\ 1\cdot438$
3	−·465		*	+1·51	+2·31	${}_3\Lambda_E = -\ 5\cdot347$
4	+·080				+4·92	${}_4\Lambda_E = +\ 2\cdot174$

Residual Angular Errors.

Triangle	*x*	*y*	*z*	Triangle	*x*	*y*	*z*	Triangle	*x*	*y*	*z*
31	−·498	+·809	−·311	36	−·113	+·015	+·098	41	+·057	−·085	+·028
32	+·271	−·161	−·110	37	−·057	+·015	+·042	42	−·037	−·065	+·102
33	−·074	+·455	−·381	38	+·171	−·152	−·019	43	−·102	−·020	+·122
34	−·019	−·004	+·023	39	−·091	−·045	+·136	44	+·099	−·106	+·007
35	+·072	−·002	−·070	40	+·130	−·115	−·015				

* In the tables of the equations between the factors the coefficients of the terms below the diagonal are omitted for convenience, the coefficient of the *p*th term in the *q*th line being always the same as the coefficient of the *q*th term in the *p*th line.

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CIRCUIT *II.*

Triangles employed Nos. 79 to 92.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 5 to 8; Absolute Terms from Residuals page 245).

						Factors
Pages 155 & 156, *Side.*	$_5\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{79}^{92}$	$= {}_5E_B$	$= +12\cdot6$	$\times\cdot03$	$= +0\cdot378,$	$_5\Lambda_B$
" 156, *Latitude.*	$_6\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{79}^{92}$	$= {}_6E_B$	$= -0\cdot001$	$\times 15$	$= -0\cdot015,$	$_6\Lambda_B$
" 156 & 157, *Longitude.*	$_7\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{79}^{92}$	$= {}_7E_B$	$= +0\cdot012$	$\times 15$	$= +0\cdot180,$	$_7\Lambda_B$
" 157 & 158, *Azimuth.*	$_8\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{79}^{92}$	$= {}_8E_B$	$= -0\cdot582$	$\times 1$	$= -0\cdot582,$	$_8\Lambda_B$

Equations between Factors

(Formed with the aid of the previously computed values of $\mathfrak{b}\,\mathfrak{B}$ and $\mathfrak{c}\,\mathfrak{C}$)

No. of E_B	Values of E_B	Coefficients of $_5\Lambda_B$	$_6\Lambda_B$	$_7\Lambda_B$	$_8\Lambda_B$	Values of the Factors
5	$+\cdot378$	$+0\cdot262$	$+0\cdot046$	$-0\cdot040$	$+0\cdot002$	$_5\Lambda_B = +8\cdot628$
6	$-\cdot015$		$+\cdot021$	$-\cdot001$	$+\cdot059$	$_6\Lambda_B = -6\cdot662$
7	$+\cdot180$		*	$+\cdot020$	$+\cdot067$	$_7\Lambda_B = +39\cdot209$
8	$-\cdot582$				$+\cdot725$	$_8\Lambda_B = -3\cdot899$

Residual Angular Errors.

Triangle	*x*	*y*	*z*	Triangle	*x*	*y*	*z*	Triangle	*x*	*y*	*z*
79	−·051	−·135	+·186	84	−·046	−·013	+·059	89	−·055	+·090	−·035
80	−·171	−·210	+·381	85	−·017	−·024	+·041	90	+·009	+·100	−·109
81	−·003	−·121	+·124	86	−·055	+·004	+·051	91	−·314	+·503	−·189
82	−·028	−·072	+·100	87	−·069	+·025	+·044	92	+·542	+·389	−·931
83	+·028	−·053	+·025	88	+·011	+·070	−·081				

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Circuit *III.*

Triangles employed Nos. 117 to 126.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 9 to 12; Absolute Terms from Residuals page 245).

				Factors
Page 158,	*Side.*	${}_{9}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{117}^{126} = {}_{9}E_{R}$	$= -3{\cdot}4 \times {\cdot}03 = -0{\cdot}102,$	${}_{9}\Lambda_{R}$
„ 158 & 159,	*Latitude.*	${}_{10}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{117}^{126} = {}_{10}E_{R}$	$= +0{\cdot}020 \times 15 = +0{\cdot}300,$	${}_{10}\Lambda_{R}$
„ 159 & 160,	*Longitude.*	${}_{11}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{117}^{126} = {}_{11}E_{R}$	$= -0{\cdot}022 \times 15 = -0{\cdot}330,$	${}_{11}\Lambda_{R}$
„ 160,	*Azimuth.*	${}_{12}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{117}^{126} = {}_{12}E_{R}$	$= -0{\cdot}323 \times 1 = -0{\cdot}323,$	${}_{12}\Lambda_{R}$

Equations between Factors

(Formed with the aid of the previously computed values of $\mathfrak{b}\mathfrak{B}$ and $\mathfrak{c}\mathfrak{C}$)

No. of E_R	Values of E_R	Coefficients of ${}_{9}\Lambda_R$	${}_{10}\Lambda_R$	${}_{11}\Lambda_R$	${}_{12}\Lambda_R$	Values of the Factors
9	−·102	+3·127	+1·633	−0·779	+0·040	${}_{9}\Lambda_R = -\ 7{\cdot}571$
10	+·300		+1·025	− ·041	+1·034	${}_{10}\Lambda_R = +11{\cdot}630$
11	−·330		*	+1·207	+2·683	${}_{11}\Lambda_R = -\ 5{\cdot}854$
12	−·323				+7·482	${}_{12}\Lambda_R = +\ 0{\cdot}489$

Residual Angular Errors.

Triangle	*x*	*y*	*z*	Triangle	*x*	*y*	*z*
117	+·689	+·458	−1·147	122	+·269	−·089	−·180
118	−·123	+·503	− ·380	123	−·013	−·298	+·311
119	+·432	+·082	− ·514	124	+·550	−·642	+·092
120	−·014	+·298	− ·284	125	−·015	−·524	+·539
121	+·317	−·234	− ·083	126	+·398	−·948	+·550

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CIRCUIT *IV.*

Triangles employed Nos. 163 to 170.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 13 to 16; Absolute Terms from Residuals, page 245).

				Factors
Pages 160 & 161, *Side.*	${}_{13}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{163}^{170}$	$= {}_{13}E_R$	$= -1{\cdot}4 \times {\cdot}03 = -0{\cdot}042,$	${}_{13}\Lambda_R$
„ 161 & 162, *Latitude.*	${}_{14}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{163}^{170}$	$= {}_{14}E_R$	$= 0{\cdot}000 \times 15 = 0{\cdot}000,$	${}_{14}\Lambda_R$
„ 162, *Longitude.*	${}_{15}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{163}^{170}$	$= {}_{15}E_R$	$= -0{\cdot}014 \times 15 = -0{\cdot}210,$	${}_{15}\Lambda_R$
„ 162 & 163, *Azimuth.*	${}_{16}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{163}^{170}$	$= {}_{16}E_R$	$= -0{\cdot}371 \times 1 = -0{\cdot}371,$	${}_{16}\Lambda_R$

Equations between Factors

(Formed with the aid of the previously computed values of $\mathfrak{b}\mathfrak{B}$ and $\mathfrak{c}\mathfrak{C}$)

No. of E_R	Values of E_R	Coefficients of ${}_{13}\Lambda_R$	${}_{14}\Lambda_R$	${}_{15}\Lambda_R$	${}_{16}\Lambda_R$	Values of the Factors
13	−·042	+2·299	+0·689	−0·906	+0·270	${}_{13}\Lambda_R = -\ 9{\cdot}102$
14	·000		+ ·416	− ·100	+1·007	${}_{14}\Lambda_R = +\ 9{\cdot}982$
15	−·210		*	+ ·515	+0·691	${}_{15}\Lambda_R = -15{\cdot}282$
16	−·371				+4·411	${}_{16}\Lambda_R = +\ 0{\cdot}588$

Residual Angular Errors.

Triangle	*x*	*y*	*z*	Triangle	*x*	*y*	*z*
163	+″·662	−″·137	−″·525	167	+″·163	−″·069	−″·094
164	−·255	+·379	−·124	168	+·395	+·144	−·539
165	+·168	−·081	−·087	169	−·084	−·855	+·939
166	−·042	+·156	−·114	170	+·440	−·558	+·118

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CIRCUIT *V*.

Triangles employed Nos. 199 to 206.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 17 to 20; Absolute Terms from Residuals, page 245).

			Factors
Pages 163 & 164, *Side.*	${}_{17}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{199}^{206}$	$= {}_{17}E_R = -3{\cdot}4 \times {\cdot}03 = -0{\cdot}102,$	${}_{17}\Lambda_R$
„ 164, *Latitude.*	${}_{18}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{199}^{206}$	$= {}_{18}E_R = 0{\cdot}000 \times 15 = 0{\cdot}000,$	${}_{18}\Lambda_R$
„ 164 & 165, *Longitude.*	${}_{19}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{199}^{206}$	$= {}_{19}E_R = -0{\cdot}017 \times 15 = -0{\cdot}255,$	${}_{19}\Lambda_R$
„ 165, *Azimuth.*	${}_{20}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{199}^{206}$	$= {}_{20}E_R = -0{\cdot}386 \times 1 = -0.386,$	${}_{20}\Lambda_R$

Equations between Factors

(Formed with the aid of the previously computed values of $\mathfrak{b}$ $\mathfrak{B}$ and $\mathfrak{c}$ $\mathfrak{C}$)

No. of E_R	Values of E_R	Coefficients of ${}_{17}\Lambda_R$	${}_{18}\Lambda_R$	${}_{19}\Lambda_R$	${}_{20}\Lambda_R$	Values of the Factors
17	$-{\cdot}102$	$+1{\cdot}632$	$+0{\cdot}675$	$-0{\cdot}586$	$+0{\cdot}135$	${}_{17}\Lambda_R = -\ 9{\cdot}677$
18	${\cdot}000$		$+\ {\cdot}548$	$+\ {\cdot}046$	$+1{\cdot}109$	${}_{18}\Lambda_R = +\ 9{\cdot}969$
19	$-{\cdot}255$		*	$+\ {\cdot}547$	$+1{\cdot}140$	${}_{19}\Lambda_R = -14{\cdot}93$
20	$-{\cdot}386$				$+4{\cdot}366$	${}_{20}\Lambda_R = +\ 1{\cdot}577$

Residual Angular Errors.

Triangle	*x*	*y*	*z*	Triangle	*x*	*y*	*z*
199	$+''{\cdot}672$	$+''{\cdot}118$	$-''{\cdot}790$	203	$+''{\cdot}207$	$-''{\cdot}198$	$-''{\cdot}009$
200	$-{\cdot}208$	$+{\cdot}403$	$-{\cdot}195$	204	$+{\cdot}299$	$-{\cdot}192$	$-{\cdot}107$
201	$+{\cdot}483$	$-{\cdot}041$	$-{\cdot}442$	205	$-{\cdot}220$	$-{\cdot}103$	$+{\cdot}323$
202	$-{\cdot}047$	$+{\cdot}273$	$-{\cdot}226$	206	$+{\cdot}737$	$-{\cdot}774$	$+{\cdot}037$

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CIRCUIT *VI.*

Triangles employed Nos. 243 to 262.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 21 to 24; Absolute Terms from Residuals, page 245).

			Factors
Pages 165 & 166, *Side.*	${}_{21}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{243}^{262} = {}_{21}E_R$	$= -3.5 \times .03 = -0.105,$	${}_{21}\Lambda_R$
" 166 & 167, *Latitude.*	${}_{22}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{243}^{262} = {}_{22}E_R$	$= +0.003 \times 15 = +0.045,$	${}_{22}\Lambda_R$
" 167, *Longitude.*	${}_{23}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{243}^{262} = {}_{23}E_R$	$= -0.020 \times 15 = -0.300,$	${}_{23}\Lambda_R$
" 167 & 168, *Azimuth.*	${}_{24}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{243}^{262} = {}_{24}E_R$	$= -0.424 \times 1 = -0.424,$	${}_{24}\Lambda_R$

Equations between Factors

(Formed with the aid of the previously computed values of $\mathfrak{b}\mathfrak{B}$ and $\mathfrak{c}\mathfrak{C}$)

No. of E_R	Values of E_R	Coefficients of ${}_{21}\Lambda_R$	${}_{22}\Lambda_R$	${}_{23}\Lambda_R$	${}_{24}\Lambda_R$	Values of the Factors
21	−·105	+5·811	+1·376	−2·939	− 0·552	${}_{21}\Lambda_R = -2.252$
22	+·045		+1·299	−0·112	+ 3·231	${}_{22}\Lambda_R = +2.699$
23	−·300		*	+1·953	+ 2·452	${}_{23}\Lambda_R = -3.113$
24	−·424				+12·548	${}_{24}\Lambda_R = -0.220$

Residual Angular Errors.

Triangle	x	y	z	Triangle	x	y	z	Triangle	x	y	z
243	+″·664	−″·104	−″·560	250	−″·006	−″·002	+″·008	257	−″·006	−″·065	+″·071
244	−·176	+·482	−·306	251	+·005	−·007	+·002	258	+·049	−·179	+·130
245	+·209	−·085	−·124	252	−·012	−·019	+·031	259	−·007	−·160	+·167
246	+·092	+·095	−·187	253	+·003	−·011	+·008	260	·000	−·039	+·039
247	−·029	−·185	+·214	254	−·002	−·025	+·027	261	+·001	−·062	+·061
248	+·545	−·417	−·128	255	+·004	−·036	+·032	262	+·003	−·053	+·050
249	−·005	−·008	+·013	256	−·001	−·108	+·109				

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Circuit *VII.*

Triangles employed Nos. 295 to 302.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 25 to 28; Absolute Terms from Residuals, page 245).

					Factors
Page 168,	*Side.*	${}_{25}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{295}^{302}$	$= {}_{25}E_R = +17{\cdot}9 \times {\cdot}03 = +0{\cdot}537,$		${}_{25}\Lambda_R$
„ 168 & 169,	*Latitude.*	${}_{26}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{295}^{302}$	$= {}_{26}E_R = +\ 0{\cdot}008 \times 15 = +0{\cdot}120,$		${}_{26}\Lambda_R$
„ 169 & 170,	*Longitude.*	${}_{27}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{295}^{302}$	$= {}_{27}E_R = -\ 0{\cdot}008 \times 15 = -0{\cdot}120,$		${}_{27}\Lambda_R$
„ 170,	*Azimuth.*	${}_{28}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{295}^{302}$	$= {}_{28}E_R = -\ 0{\cdot}407 \times 1 = -0{\cdot}407,$		${}_{28}\Lambda_R$

Equations between Factors

(Formed with the aid of values of $\mathfrak{bb}$ and $\mathfrak{cc}$)

No. of E_R	Values of E_R	Coefficients of ${}_{25}\Lambda_R$	${}_{26}\Lambda_R$	${}_{27}\Lambda_R$	${}_{28}\Lambda_R$	Values of the Factors
25	+·537	+2.409	+0·158	−0·455	− 0·81	${}_{25}\Lambda_R = -0{\cdot}275$
26	+·120		+ ·154	+ ·061	+ 1·27	${}_{26}\Lambda_R = +3{\cdot}406$
27	−·120		*	+ ·175	+ 1·16	${}_{27}\Lambda_R = -1{\cdot}036$
28	−·407				+16	${}_{28}\Lambda_R = -0{\cdot}235$

Residual Angular Errors.

Triangle	*x*	*y*	*z*	Triangle	*x*	*y*	*z*
295	+″·318	+″·062	−″·380	299	+″·065	+″·021	−″·086
296	·000	+·217	−·217	300	+·328	−·103	−·225
297	+·198	+·003	−·201	301	−·194	+·051	+·143
298	+·095	+·068	−·163	302	+·386	−·200	−·186

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CIRCUIT *IX.*

Triangles employed Nos. 352, 353 & 361.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 33 to 36; Absolute Terms from Residuals, page 245).

Factors

Page 172, *Side.* $_{33}\left[f\mathfrak{b}y+f\mathfrak{c}z\right]_{352}^{353}+{}_{33}\left(f\mathfrak{b}y+f\mathfrak{c}z\right)_{361}={}_{33}E_R=+0{\cdot}4\ \times{\cdot}03=+0{\cdot}012,$ $_{33}\Lambda_R$

" 172 & 173, *Latitude.* $_{34}\left[f\mathfrak{b}y+f\mathfrak{c}z\right]_{352}^{353}+{}_{34}\left(f\mathfrak{b}y+f\mathfrak{c}z\right)_{361}={}_{34}E_R=-0{\cdot}006\times15=-0{\cdot}090,$ $_{34}\Lambda_R$

" 173, *Longitude.* $_{35}\left[f\mathfrak{b}y+f\mathfrak{c}z\right]_{352}^{353}+{}_{35}\left(f\mathfrak{b}y+f\mathfrak{c}z\right)_{361}={}_{35}E_R=+0{\cdot}001\times15=+0{\cdot}015,$ $_{35}\Lambda_R$

" 173 & 174, *Azimuth.* $_{36}\left[f\mathfrak{b}y+f\mathfrak{c}z\right]_{352}^{353}+{}_{36}\left(f\mathfrak{b}y+f\mathfrak{c}z\right)_{361}={}_{36}E_R=-0{\cdot}002\times\ 1=-0{\cdot}002,$ $_{36}\Lambda_R$

Equations between Factors (Formed with the aid of values of $\mathfrak{bb}$ and $\mathfrak{cc}$)						Values of the Factors
No. of E_R	Values of E_R	Coefficients of $_{33}\Lambda_R$	$_{34}\Lambda_R$	$_{35}\Lambda_R$	$_{36}\Lambda_R$	
33	+·012	+0·807	+0·044	−0·190	+0·03	$_{33}\Lambda_R$ = +0·47
34	−·090		+0·130	+0·052	+0·74	$_{34}\Lambda_R$ = −2·51
35	+·015		*	+0·101	+0·49	$_{35}\Lambda_R$ = +1·38
36	−·002				+6	$_{36}\Lambda_R$ = +0·194

Residual Angular Errors.

Triangle	x	y	z	Triangle	x	y	z
352	− ″·346	+ ″·063	+ ″·283	361	− ″·499	+ ″·335	+ ″·164
353	+ ·156	− ·167	+ ·011				

The Angular Errors of triangle 361 being large were arbitrarily divided between triangles 360 and 361 as below

Triangle	x	y	z
360	+ ″·239	− ″·066	− ″·173
361	− ·259	+ ·188	+ ·071

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CIRCUIT X.

1st Solution. Triangles employed Nos. 409 to 411, 422 and 423.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 37 to 40; Absolute Terms from Residuals, page 245).

			Factors
Page 174,	*Side.*	${}_{37}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{409}^{411} + {}_{37}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{422}^{423} = {}_{37}E_R = 0\cdot0 \times \cdot03 = 0\cdot000,$	${}_{37}\Lambda_R$
„ 174 & 175,	*Latitude.*	${}_{38}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{409}^{411} + {}_{38}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{422}^{423} = {}_{38}E_R = -0\cdot011 \times 15 = -0\cdot165,$	${}_{38}\Lambda_R$
„ 175,	*Longitude.*	${}_{39}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{409}^{411} + {}_{39}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{422}^{423} = {}_{39}E_R = -0\cdot003 \times 15 = -0\cdot045,$	${}_{39}\Lambda_R$
„ 175 & 176,	*Azimuth.*	${}_{40}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{409}^{411} + {}_{40}\Big[f\mathfrak{b}y + f\mathfrak{c}z\Big]_{422}^{423} = {}_{40}E_R = +0\cdot286 \times 1 = +0\cdot286,$	${}_{40}\Lambda_R$

Equations between Factors (Formed with the aid of values of $\mathfrak{b}\mathfrak{b}$ and $\mathfrak{c}\mathfrak{c}$)						Values of the Factors
No. of E_R	Values of E_R	Coefficients of ${}_{37}\Lambda_R$	${}_{38}\Lambda_R$	${}_{39}\Lambda_R$	${}_{40}\Lambda_R$	
37	·000	+2·005	+0·002	−0·798	− 0·06	${}_{37}\Lambda_R = -0\cdot188$
38	−·165		+ ·470	− ·021	+ 1·84	${}_{38}\Lambda_R = -1\cdot66$
39	−·045		*	+ ·407	− 0·08	${}_{39}\Lambda_R = -0\cdot501$
40	+·286				+10	${}_{40}\Lambda_R = +0\cdot329$

Residual Angular Errors.

Triangle	x	y	z
409	+″·343	−″·153	−″·190
410	−·228	+·156	+·072
411	+·178	−·071	−·107
422	+·535	−·297	−·238
423	−·498	+·161	+·337

The Angular Errors of triangles 422 and 423 were too large to be admissible; they were accordingly rejected and after correcting triangles 409 to 411 fresh residuals were obtained, which were dispersed by a second solution as shewn on the next page.

CIRCUIT *X*.

2nd Solution. Triangles employed Nos. 420 to 423.

As these triangles were situated at the extremity of the right-hand branch of Circuit *X*, any small angular changes could have no perceptible effect on the latitude and longitude of the station of junction; hence the equations in these elements were omitted.

Equations to be satisfied.

(Left-hand Members taken from Circuit Equations 37 and 40) Factors

$$_{37}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{420}^{423} = {}_{37}E'_R = 3\cdot 6 \times \cdot 03 = -0\cdot 108, \qquad {}_{37}\Lambda'_R$$

$$_{40}\left[f\mathfrak{b}y + f\mathfrak{c}z\right]_{420}^{423} = {}_{40}E'_R = 1\cdot 033 \times 1 = +1\cdot 033, \qquad {}_{40}\Lambda'_R$$

Equations between Factors (Formed with the aid of values of $\mathfrak{bb}$ and $\mathfrak{cc}$)				Values of the Factors
No. of E'_R	Values of E'_R	Coefficients of $_{37}\Lambda'_R$	Coefficients of $_{40}\Lambda'_R$	
37	−0·108	+1·202	−0·75	$_{37}\Lambda'_R = -\ 0\cdot 011$
40	+1·033	*	+8	$_{40}\Lambda'_R = +\ 0\cdot 128$

Residual Angular Errors.

Triangle	*x*	*y*	*z*
420	+″·261	−″·134	−″·127
421	−·258	+·124	+·134
422	+·257	−·132	−·125
423	−·256	+·124	+·132

18.

The Final Results of the Simultaneous Reduction.

After the total values of the angular errors, tabulated in Section 16, had been applied with changed sign to the linear and geodetic calculations, trifling residual errors still remained in the 8th place of decimals of log.side and the 3rd place of decimals of seconds in latitude, longitude and azimuth, which are shewn in the following table. These errors are of no greater magnitude than those which remained at the close of the reductions of the North-West and South-East Quadrilaterals, and, as in those cases, no attempt was made to disperse them; for the Logarithm Tables employed in the calculations gave only 7 places of decimals, an 8th place being obtained by interpolation, while the first terms of the expressions for $\Delta\lambda$, ΔL and ΔA given on pages 30 and 31 often contained 4 integral figures, making their determination with accuracy to the 3rd place of decimals doubtful: thus such small inconsistencies were almost unavoidable and quite immaterial, especially as it was not intended to give the final geodetic results to more than two places of decimals of seconds in the details of each series.

Final Residual Errors				
Circuit	Linear	Latitude	Longitude	Azimuth
	7th place of logs.	"	"	"
I	− 0·2	+ 0·002	− 0·001	− 0·006
II	0·0	− ·002	+ ·002	+ ·004
III	0·0	+ ·001	+ ·002	+ ·008
IV	+ 0·1	− ·001	+ ·002	− ·002
V	− 0·1	+ ·001	− ·002	− ·007
VI	+ 0·1	− ·002	·000	− ·004
VII	− 0·3	+ ·001	·000	+ ·007
VIII	0·0	+ ·003	− ·004	− ·003
IX	+ 0·2	+ ·001	+ ·001	− ·002
X	{ − 0·1 − 0·2	− ·001	·000	− ·004
XI	+ 0·2	− ·001	·000	·000
XII	− 0·2	+ ·003	+ ·004	·000

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Contrasting the primary values given at the ends of the several branches of the uncorrected circuits, with those now furnished by the corrected circuits we have the following results, from which it will be seen that in 25 instances the final value is intermediate between, and in 19 it is outside of both, the two primary values given by the respective branches of the circuits.

Linear and Geodetic Values at the Sides and Stations of the Circuit-Junctions.

	Logarithmic Length.	*Azimuth.*	*Latitude.*	*Longitude.*
CIRCUIT *I.*	*Side* Ghandiál-Chándípahár.		*Station* Ghandiál.	
		° ′ ″	° ′ ″	° ′ ″
Final values from Great Arc Series—Section 24° to 30°,—see page 88,	5·121,2764,1	34 47 42·606	30 13 25·321	78 27 54·613
Right branch	3051,2	54·204	26·260	55·547
Final	2764,1	42·61	25·32	54·61
CIRCUIT *II.*	*Side* Baheri-Atária.		*Station* Baheri.	
Left branch	4·920,3283,9	2 13 47·514	28 51 53·521	79 38 19·407
Right "	276,6	33·197	53·169	18·317
Final	155,7	35·20	53·07	18·56
CIRCUIT *III.*	*Side* Rámnagar-Dahlelnagar.		*Station* Rámnagar.	
Left branch	4·873,8558,5	1 49 14·081	28 16 36·772	80 41 35·764
Right "	9040,8	7·283	37·697	35·581
Final	8518,3	15·36	36·69	35·94
CIRCUIT *IV.*	*Side* Bela-Mási.		*Station* Bela.	
Left branch	4·781,0546,6	333 3 26·623	27 47 19·324	81 20 31·847
Right "	0,9905,6	36·800	18·115	31·787
Final	1,0038,8	34·45	18·45	31·86
CIRCUIT *V.*	*Side* Loháp´ania-Bansídíla.		*Station* Lohápánia.	
Left branch	4·757,8074,3	350 0 57·104	27 33 21·350	82 17 27·265
Right "	243,7	56·313	21·733	27·502
Final	241,6	55·58	21·68	27·47
CIRCUIT *VI.*	*Side* Ghaus-Púrena.		*Station* Ghaus.	
Left branch	4·824,8956,0	334 36 22·005	27 21 5·123	83 8 6·020
Right "	9038,1	26·848	5·334	6·124
Final	8978,6	21·34	5·08	5·99

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Linear and Geodetic Values at the Sides and Stations of the Circuit-Junctions.—(Continued).

	Logarithmic Length.	*Azimuth.*	*Latitude.*	*Longitude.*
CIRCUIT *VII.*	*Side* Rámnagar-Naunangarhi.		*Station* Rámnagar.	
		° ′ ″	° ′ ″	° ′ ″
Left branch	4·807,0313,3	339 14 22·948	27 9 4·227	84 22 2·908
Right „	180,4	17·209	3·870	2·878
Final	266,3	17·93	4·09	2·74
CIRCUIT *VIII.*	*Side* Bulákípur-Madanpur.		*Station* Bulákípur.	
Left branch	4·775,2677,3	0 52 19·082	26 40 55·553	85 28 58·230
Right „	874,0	23·523	55·856	58·203
Final	788,4	19·84	55·73	58·19
CIRCUIT *IX.*	*Side* Narhar-Bheria Bisanpur.		*Station* Narhar.	
Left branch	4·748,6907,1	345 21 4·100	26 31 45·722	86 8 37·923
Right „	622,5	1·821	45·408	37·959
Final	814,0	2·08	45·64	37·86
CIRCUIT *X.*	*Side* Diwánganj-Chúni.		*Station* Diwánganj.	
Left branch	4·764,5514,2	306 47 42·253	26 16 49·805	86 56 48·709
Right „	705,1	42·901	49·591	48·596
Final	694,8	42·46	49·97	48·73
CIRCUIT *XI.*	*Side* Dhubri-Alangjáni.		*Station* Dhubri.	
Left branch	4·894,5757,7	81 23 23·624	26 1 3·538	90 2 18·504
Right „	564,0	26·029	3·667	18·361
Final	653,1	25·58	3·82	18·44
CIRCUIT *XII.*	*Side* Tepkilabama-Harogaon.		*Station* Tepkilabama.	
Left branch	4·675,7146,6	89 58 51·007	25 56 22·036	91 36 52·782
Right „	248,6	37·867	22·209	52·155
Final	244,6	51·20	22·18	52·96

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The amount of error which has devolved on each entire chain, or on each part of a chain, that enters into the several circuits (see page 74) is shewn in the following table, in which the number of triangles between the extreme sides is given for each *linear* and each *azimuthal* apportionment of error. The arc-length of each chain, in latitude and longitude, as measured between the adopted terminal and junction stations, is also given.

Apportionments of Error.

Chain of Triangles	Linear		Azimuthal		Arc-length in		Errors in	
	No. of included Triangles	Errors in millionth parts of side-length	No. of Circuit Triangles	Error	Latitude	Longitude	Latitude	Longitude
				″	° ′ ″	° ′ ″	″	″
I_1	11	+ 36·6	11	− 0·716	1 21 32·26	1 10 23·94	+ 0·484	+ 0·082
I_2	14	+ 18·6	14	− 0·728	0 35 16·38	1 3 17·39	+ 0·021	− 0·062
I_3	10	+ 3·4	10	− 0·255	0 29 18·24	0 38 55·92	+ 0·130	− 0·351
I_4	10	+ 7·9	10	+ 0·828	0 13 56·76	0 56 55·61	+ 0·003	+ 0·127
I_5	10	+ 5·7	10	+ 0·076	0 12 16·60	0 50 38·53	+ 0·009	+ 0·011
I_6	14	+ 2·9	14	+ 0·485	0 12 1·00	1 13 56·75	+ 0·112	− 0·033
I_7	14	+ 5·8	14	+ 0·030	0 28 8·36	1 6 55·44	− 0·044	+ 0·089
I_8	8	− 1·7	8	+ 1·673	0 9 10·09	0 39 39·68	+ 0·040	− 0·037
I_9	11	− 2·5	11	+ 1·943	0 14 55·67	0 48 10·87	− 0·063	+ 0·118
I_{10}	15	+ 2·4	18	+ 0·934	0 0 49·02	1 34 50·36	− 0·066	− 0·058
K	34	+ 29·5	34	+ 12·314	4 51 32·70	0 9 52·13	+ 0·455	+ 0·852
L	35	+ 9·3	35	− 1·279	4 13 46·77	0 8 15·73	+ 0·084	− 0·178
M	37	+ 117·0	37	− 7·830	3 42 19·12	0 28 30·60	+ 0·878	− 0·012
N	33	− 38·5	33	+ 1·521	3 14 33·71	0 13 38·22	− 0·333	− 0·201
O	31	− 5·2	31	+ 0·661	3 22 40·92	0 39 34·02	+ 0·040	+ 0·027
P	29	+ 10·8	29	+ 5·023	3 6 58·10	0 2 15·01	+ 0·141	+ 0·164
Q	22	− 25·6	27	− 0·753	2 43 41·98	0 0 21·72	− 0·173	+ 0·045
R	21	+ 21·5	21	+ 2·018	1 58 11·10	0 2 9·10	+ 0·087	+ 0·059
S	21	− 41·6	21	− 2·202	2 22 20·95	0 11 20·31	− 0·165	− 0·024
T	47	+ 8·5	47	− 2·484	3 23 5·08	0 5 0·58	− 0·312	− 0·079
U_1	19	− 17·2	19	− 2·168	0 16 33·99	1 28 8·35	+ 0·027	− 0·074
U_2	22	− 3·5	21	− 5·536	0 0 25·10	1 41 11·79	+ 0·134	− 0·127
V	41	− 3·4	41	+ 2·616	2 51 33·96	0 7 31·58	− 0·180	− 0·007
W	35	+ 21·6	35	− 5·630	2 47 17·42	0 0 54·32	− 0·138	− 0·611
X_1	22	+ 24·1	19	+ 0·527	0 14 57·13	1 30 39·35	+ 0·029	+ 0·141
X_2	17	− 2·1	17	− 0·642	0 4 41·64	1 34 34·52	+ 0·006	− 0·100

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The following table gives the number of determinations of the several angular corrections, ranged in order of magnitude, and classed in the order in which they were determined, namely—

(1). Corrections, as primarily computed, simultaneously;

(2). Corrections for the error of the absolute term of one of the primary equations;

(3). Corrections for residual errors within authorised limits, arising from contraction of the number of figures employed in the calculations;

(4). Arbitrary corrections for ultimate petty residual errors;

as already set forth at page 246. The last line of the table gives the number of the aggregate corrections—the algebraical sum of the respective partial corrections—ranged in order of magnitude.

Table of the Number and Magnitudes of the Several Corrections.

Corrections		Magnitudes in Seconds																			Total No. computed
		0 to .1	.1 to .2	.2 to .3	.3 to .4	.4 to .5	.5 to .6	.6 to .7	.7 to .8	.8 to .9	.9 to 1.0	1.0 to 1.1	1.1 to 1.2	1.2 to 1.3	1.3 to 1.4	1.4 to 1.5	1.5 to 1.6	1.7 to 1.8	1.9 to 2.0	2.0 to 2.1	
		Number																			
Partial	(1)	791	412	207	106	54	40	29	37	18	8	2	5	...	1	3	4	1	...	1	1719
„	(2)	591	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	591
„	(3)	119	72	29	20	11	14	5	3	2	3	...	1	...	...	...	...	...	...	...	279
„	(4)	48	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	48
Total		1549	484	236	126	65	54	34	40	20	11	2	6	...	1	3	4	1	...	1	2637
Aggregate		780	390	229	106	58	43	32	27	20	6	4	6	5	...	2	6	3	1	1	1719

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19.

Review of the General Reduction.

It has been shown in Section 1 of the present chapter that when the question of the general treatment of the mass of triangulation which is contained within the North-East Quadrilateral was under consideration, the Simultaneous Reduction of the whole appeared at first sight to be so much more formidable than either of the two corresponding Simultaneous Reductions previously completed—*viz.*, those of the Sections of the great triangulation known as the North-West and the South-East Quadrilaterals, both which had been found to be excessively laborious—that the propriety of omitting certain of the interior chains of triangles, with a view to diminishing the labour of the reduction, was discussed, but was eventually abandoned as unjustifiable. Thus the Computing Office was confronted by the task of first constructing 41 geometrical equations of condition involving 1269 unknown quantities, and then solving the equations; and this appeared to be a very formidable undertaking, as in each of the two preceding reductions the number of equations of condition was materially less and yet the labour involved had been very great.

The office was then under the charge of Major Herschel, as a temporary measure during the absence in Europe of Messrs. Hennessey and Cole. The two previous Simultaneous Reductions had been effected under their supervision, and with remarkable precision, every condition of the triangulation having been fulfilled with almost perfect accuracy. But in order to secure this degree of accuracy, the calculations had been carried to a large number of decimal places, sufficient to prevent any sensible accumulations of arithmetical error at the close of the very lengthy computations (see page 67); and this had been found very laborious. Thus when the third section of the triangulation—which appeared to be very much more arduous and difficult to treat than either of its predecessors, because of the larger number of geometrical conditions it presented for simultaneous satisfaction—came to be taken in hand, the measure of arithmetical accuracy to be aimed at was purposely lowered, by contracting the number of decimal places employed in different stages of the calculations, as a set off against the additional labour involved by the increased number of geometrical conditions to be satisfied.

For these reasons the present reduction is not so strictly simultaneous as either of its predecessors; for though the simultaneous calculations still form by far the greater portion of the reduction, and satisfy broadly all the geometrical conditions involved, they had to be supplemented by further calculations, in order to disperse the 'residual errors' which were caused by the intentional neglect of arithmetical nicety.

In supervising the reduction of this great mass of triangulation, Major Herschel availed himself of the opportunity afforded him to re-investigate *de novo* all the formulæ which had been elaborated for the two first reductions, and to examine the methods of their practical application. He made whatever changes he believed to be improvements. Thus in reviewing the present Reduction it is necessary first to notice these changes, and then to indicate the results which followed from aiming at a lower degree of arithmetical refinement.

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Changes in Previous Methods of Treatment.

Of these the most important are:—(1). The arrangement of the geometrical or primary equations of condition in the most appropriate order for the formation of the equations between the Indeterminate Factors. (2). The introduction of the 'zig-zag' instead of the 'direct' line of traverse, in forming the several geodetic equations of condition. (3). The introduction of a table of constants to assist in the construction of the coefficients in the geodetic equations of condition. (4). The introduction of 'equalizing factors', for application to the primary equations, with a view to facilitate the solution of the equations of condition. (5). An alteration of the usual procedure in solving the equations between the Indeterminate Factors.

(1). In the reduction of the two first sections of the triangulation, the arrangement of the primary equations of condition had been as follows:—the whole of the linear (or side-length) equations—whether formed between the base-lines of verification or round the circuits of triangles—were collected together in a group by themselves, which was followed by the several geodetic equations in groups of three—for latitude, longitude and azimuth—one group for each circuit in succession. In the present reduction, the linear and the three geodetic equations for each circuit are grouped together, and the single base-line equation is introduced in such a manner as to avoid any general entanglement of the equations. This arrangement is the most advantageous for the formation of equations between the Indeterminate Factors of which the solution will entail the minimum amount of labour, as has already been shown at pages 68 and 69; thus it is also the most suitable arrangement for the primary equations, because in such very complicated and laborious calculations as these, any changes in the grouping of the unknown quantities under determination are liable to cause serious mistakes and are therefore to be greatly deprecated; thus the primary equations must of necessity be arranged and numbered from the very outset in the order which is best suited for the solution of the equations between the Indeterminate Factors.

In the present instance the conditions to be fulfilled were happily such that the system adopted for the arrangement of the equations permitted of the introduction of four additional chains of triangles, in extension of the triangulation as originally limited, for treatment simultaneously with the chains which had at first been selected for disposal, without causing a disproportionate increase of labour. Usually additional equations cause more or less entanglement among the first equations, and then the labour of calculation may be very greatly increased; but in the present instance all entanglement could be and was avoided. Consequently a much larger extent of triangulation has been treated simultaneously than was at first contemplated; it comprises 1719 angles connected by 49 equations, instead of 1269 angles connected by 41 equations, as had originally been intended. The additional calculations entailed little more labour than would have been required for the separate treatment of the four chains of triangles forming the 'Extension'. Thus the arrangement has been most advantageous and is to be much commended.

The diagram at page 70 indicates the significant terms in the equations between the Indeterminate Factors, and is interesting as an illustration of the simplest possible arrange-

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ment of the primary equations of condition of any triangulation. Of course such an arrangement is only possible in exceptional instances as the present; but the more closely the principle underlying it is followed, the greater will be the saving of labour in the calculations. Even in the present instance a re-arrangement of the equations on a different principle, separating, instead of grouping together, the equations containing the same unknown quantities—as for instance adopting the symmetrical order 1, 9, 17, 25 . . . , 2, 10, 18, 26 . . . , and so on—would have increased the labour of calculation enormously and prevented any extension of the area of triangulation embraced in the first programme of operation.

(2). The methods of procedure entailed by the adoption of the two lines of traverse known respectively as the 'direct' and the 'zig-zag', one or other of which has to be followed in forming the geodetic equations of condition, are described at pages 52 to 57. The relative merits of these two methods are a matter of opinion, as their respective advantages and disadvantages appear to be pretty fairly balanced. The zig-zag system has not commended itself to the Computing Office, which continues to employ the direct method, as applied in the reduction of the South-East Quadrilateral.

(3). The introduction of a table of constants,—formed as at page 130, on the analytical expressions in page 51—in constructing the coefficients in the geodetic equations of condition, has not commended itself to the Computing Office, which continues as formerly to employ the data furnished in the primary calculations of latitude, longitude and azimuth.

(4). The introduction of 'equalizing factors' to facilitate the solution of the equations between the Indeterminate Factors is a matter of which no one will question the propriety when the factors are powers of 10, the application of which merely necessitates a general shifting of decimal places. But when other factors than these are employed, opinions may well differ as to their propriety. And there can be no doubt that the application of any such factors—whether powers of 10, or other numbers—to the primary equations of condition, as has been done in the present instance, causes a very needless amount of labour; for by the method of treatment which is exemplified in the footnote to page 235, and is due to Mr. Cole, the equalizing factors may be applied to the equations between the Indeterminate Factors, without disturbing the desirable identity in each pair of coefficients symmetrically situated on opposite sides of the *diagonal*, which is of such value in diminishing the labour of the solution.

(5). The usual procedure in solving the equations between the Indeterminate Factors is, first to eliminate one unknown quantity from the whole of the given equations, say, n in number, leaving $(n-1)$ equations between as many unknown quantities for treatment, and then to continue the process until a single equation containing a single unknown quantity is arrived at. The adopted procedure was as follows:—

Given equations

1
2 Combine **1** and **2** to eliminate λ_1 and call the combination $\mathbf{2}_2$.
3 Combine **1**, $\mathbf{2}_2$ and **3** to elimnate λ_1 and λ_2 simultaneously, and call the combination $\mathbf{3}_3$.
4 Combine **1**, $\mathbf{2}_2$, $\mathbf{3}_3$ and **4** to eliminate λ_1 to λ_3 simultaneously, and call the combination $\mathbf{4}_4$.
5 and so on.

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The number of products to be performed is the same by both processes; but the number of coefficients to be written down is less in the proportion of $(n+7)$ to $2(n+1)$ when all the coefficients are significant; the saving of labour has been roughly estimated to be about one-sixth.

In very elaborate and complicated calculations, such as those which are needed for the reduction of the great Sections of the Triangulation of India, any modifications of the governing formulæ which may be introduced from time to time with a view to reducing the

Table of Equivalents.

Symbol	Adopted Equivalent of Symbol in Reductions		
	N. W. Quadrilateral	S. E. Quadrilateral	N. E. Quadrilateral
α	cot X	t.d. log sin X	10^7 t.d. log sin X *
β	cot Y	t.d. log sin Y	10^7 t.d. log sin Y *
γ	cot Z	t.d. log sin Z	10^7 t.d. log sin Z *
${}_\lambda\mu$	$[\Delta\lambda''] \sin 1''$	$\left[\frac{1}{\text{t.d. log } \Delta\lambda''}\right]$	$\left[\frac{1}{M}\Delta\lambda''\frac{1}{10^7}\right]$ †
${}_\lambda\phi$	$-[\Delta\lambda'' \tan A] \sin 1''$	$\left[\frac{\text{t.d. log cos } A}{\text{t.d. log } \Delta\lambda''}\right]$	$-\left[{}_\lambda g\,\Delta L''\frac{1}{10^6}\right]$ †
${}_L\mu$	$[\Delta L''] \sin 1''$	$\left[\frac{1}{\text{t.d. log } \Delta L''}\right]$	$\left[\frac{1}{M}\Delta L''\frac{1}{10^7}\right]$ †
${}_L\phi$	$[\Delta L'' \cot A] \sin 1''$	$\left[\frac{\text{t.d. log sin } A}{\text{t.d. log } \Delta L''}\right]$	$\left[{}_L g\,\Delta\lambda''\frac{1}{10^6}\right]$ †
${}_A\mu$	$[\Delta A''] \sin 1''$	$\left[\frac{1}{\text{t.d. log } \Delta A''}\right]$	$\left[\frac{1}{M}\Delta A''\frac{1}{10^7}\right]$
${}_A\phi$	$1+[\Delta A'' \cot A] \sin 1''$	$1+\left[\frac{\text{t.d. log sin } A}{\text{t.d. log } \Delta A''}\right]$	$1+\left[{}_A g\,\Delta\lambda''\frac{1}{10^6}\right]$
${}_\lambda g$			$\frac{\nu}{\rho}\cos\lambda \sin 1''\cdot 10^6$ †
${}_L g$			$\frac{\nu}{\rho}\sec\lambda \sin 1''\cdot 10^6$ †
${}_A g$			$\frac{\nu}{\rho}\tan\lambda \sin 1''\cdot 10^6$

* These quantities were all multiplied by the equalizing factor 0·03 in constructing the linear equations. † The coefficients in the latitude and longitude equations, formed by combinations of these quantities, were all multiplied by the equalizing factor 15.

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labour of calculation, without impairing the accuracy of the results or tending to increase the risk of error, are obviously not only legitimate, but highly desirable. Thus various forms of procedure were introduced from time to time; these are given in the table on the preceding page, those in the last column being due to Major Herschel.

It will be seen from the table that important modifications in the forms of the coefficients of the unknown quantities in the geometrical equations of condition were introduced when the second section was about to be reduced; the tabular differences of the logarithms of the sines were substituted for the cotangents of the angles in the linear (or side) equations, and this well-known system of substituting tabular logarithmic differences for numbers was extended to the far more complex coefficients in the geodetic equations, by an ingenious re-arrangement of previous formulæ which was devised by Babu Cally Mohun Ghose of the Computing Office, with a view to more fully utilizing the data to hand in the primary calculations of the latitudes, longitudes and azimuths.

Results of Aiming at a Lower Degree of Arithmetical Refinement.

The following table shows the maximum number of significant figures retained at each stage of the numerical calculations in the course of the reductions of the North-West, the South-East, and the North-East Quadrilaterals.

Maximum Number of Significant Numerals.

Quantities.	N. W. Q.	S. E. Q.	N. E. Q.
μ in latitude, longitude and Azimuth ...	5	5	3
ϕ „ „ „ ...	6	6	4
𝔟 and 𝔠 in side	6	3	2
„ in latitude and longitude ...	5	5	3
„ in azimuth	6	6	4
𝔅 and ℭ in side	7	4	4
„ in latitude and longitude ...	6	6	4
„ in azimuth	7	7	4
Coefficients of Indeterminate Factors ...	8	7	4
Indeterminate Factors	8	7	4
Angular Errors, x, y, and z seconds of ...	5 decimals	5 decimals	3 decimals

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We may assume that the average number of significant figures in each column is a fair indication of the relative amount of labour of computation, provided that the conditions to be fulfilled had been otherwise alike in the three instances; on this assumption the amount of labour involved would be as 7 for the N. W. Quadrilateral is to 6 for the S. E. Quadrilateral and to 4 for the N. E. Quadrilateral. In reality however there was much dissimilarity of circumstance, as has already been abundantly indicated; every change that ingenuity could devise was made in the course of the 3rd reduction; moreover while the 1st was effected with the aid of tables of common logarithms and sum-and-difference logarithms, both to 7 places, the 2nd was effected with the aid of arithmometers, and the 3rd with common logarithms to 5 places and Crelle's multiplication tables. Thus the hypothetical labour-ratios indicate rather the possible savings of labour which might have been obtained by the contraction of significant figures in the calculations, all other things remaining constant, than the savings which actually were obtained. In the 3rd reduction the saving happened eventually to be much less than had originally been anticipated.

It has already been shown by the table at page 244 that, with a single exception, the residual errors are well within the limits of "0″·5 in azimuth, 0″·05 in latitude and longitude, and 5 in the 7th place of decimals of the logarithm of a side" which had originally been prescribed. And this happens notwithstanding that other errors occurred in the calculations, the influence of which may possibly exceed that of the errors arising from the neglect of arithmetical refinement. The mistake in the absolute term of the 42nd equation was purposely rectified to a limited extent only, in calculating the finally adopted values of the Indeterminate Factors; 12 of the Factors were corrected while 37 were left uncorrected, and it will be seen on reference to page 241 that several of the latter contain errors exceeding 2 *per cent* of their magnitudes. Assuming then the limits for the residuals to have been correctly fixed, it appears that even a lower degree of arithmetical refinement would have sufficed to satisfy the required conditions.

But the application of final corrections for the dispersion of the residual errors was found to be a much more laborious matter than had originally been contemplated, necessitating the extension of the dispersion over larger groups of triangles than those primarily treated—with of course corresponding recomputations of those groups—in order to diminish the magnitudes of the corrections to be finally applied to the angles. And even then it occasionally became necessary to apply larger angular corrections than, strictly speaking, are permissible. It happened unfortunately that all the triangles in the vicinity of the points which had been adopted for the circuit closings were small triangles, lying in the plains on the north flank of the Quadrilateral; thus the dispersion of residual errors in latitude and longitude which were materially less than the prescribed limit of 0″·05, required angular corrections which were occasionally of a magnitude exceeding the mean *probable errors* of the angles; they were much larger than would have been needed had the circuits been arranged to close at the large triangles in the hills on the south flank, which however was undesirable for other reasons. Full details of the final dispersions are given in Sec. 17 of this Chapter. The number and magnitudes of the angular corrections are given in the 3rd line of the table at page 268; it will be seen that in all 279 angles out of 1719 were

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adjusted for the dispersion, and that in 28 instances the alterations exceeded $0''\cdot5$.

Thus for a time it seemed that the limits assigned to the residual errors had been too large, and that the degree of arithmetical refinement aimed at had been too low. But subsequent examination by Mr. Cole showed that this was merely the result of the procedure which had been adopted in dispersing the residual errors, and that the required consistency in the final results might have been obtained with very much less labour and by the application of far smaller corrections. If the numerical values of the coefficients of the angular errors in the geometrical equations of condition—*viz.*, the $\mathfrak{b}$s and $\mathfrak{c}$s of Section 12 of this chapter—are examined with a view to ascertaining whether their magnitudes are influenced by the place, in the general reduction, of the triangle to which they appertain—as shown in the Reduction Chart—it will be found that the coefficients in the latitude and longitude equations are materially greater for the triangles at the commencement than for those at the close of each chain; on the other hand the magnitudes of the coefficients are not at all influenced in the linear equations, and only very slightly in the azimuth equations, by the position of the triangle. Thus when residual errors in latitude and longitude have to be dispersed arbitrarily, it is obviously desirable to apply the requisite corrections to the angles of triangles situated near the commencement of a chain, because minute corrections applied there may be made to produce as much influence as large corrections applied to the angles of triangles situated near the end of the chain.

In the present instance this simple method of final adjustment was overlooked, and the whole of the final corrections were applied to the angles nearest the sides of circuit junction, and therefore near the ends of the several chains. By so doing there was less of seeming arbitrariness in the dispersion; for the values of the corrections were determined in each instance by applications of the rigorous theoretical method, the coefficients in the equations expressing the second series of angular errors were the same as those which had already been employed in evaluating the first series, and much of the numerical work was common to both calculations, as has already been set forth in page 253. But, strictly speaking, it is quite as arbitrary to adjust the angles at the end as those at the commencement, or in any other part, of a chain of triangles; and as it is imperatively necessary to apply the smallest corrections which will produce the required result, in order that the values of the angles may not be unduly disturbed, the selection of the angles for treatment should obviously be made with this object in view.

In Appendix No. 4 to the present volume Mr. Cole has shown how residual terminal errors may be dispersed with the smallest possible expenditure of labour and disturbance of the values of the angles, far less than was actually incurred in the present instance.

Thus it appears that the magnitudes of the limits of residual error which were prescribed before the reduction of the North-East Quadrilateral was commenced were not too large, and that the degree of arithmetical refinement aimed at was not too low. If the labour of calculation had actually been reduced in the proportion of 6 : 4—that of the number of significant figures employed in the preceding and in this Simultaneous Reduction—and the residual errors had been dispersed by Mr. Cole's method, the gain would have far outweighed

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any practical loss arising from the relaxation of numerical accuracy. As matters stand the final adjustments have occasionally been of objectionable magnitude; but this happens to be of no practical importance, as the triangulation is mostly of a second rate order of accuracy, and its value is moreover much impaired by the deflections of the tower stations of the North-East Longitudinal Series, as has been fully set forth in Section 1 of the present chapter.

It may be here repeated of this Section of the Principal Triangulation—most of which was completed before the chains of triangles in the two adjoining Sections had been commenced—that its general inferiority, as compared with those Sections, was the reason why its reduction was postponed until their reductions were completed; see pages 32 and 426 of Vol. II, and page 4 of the present volume.

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APPENDICES.

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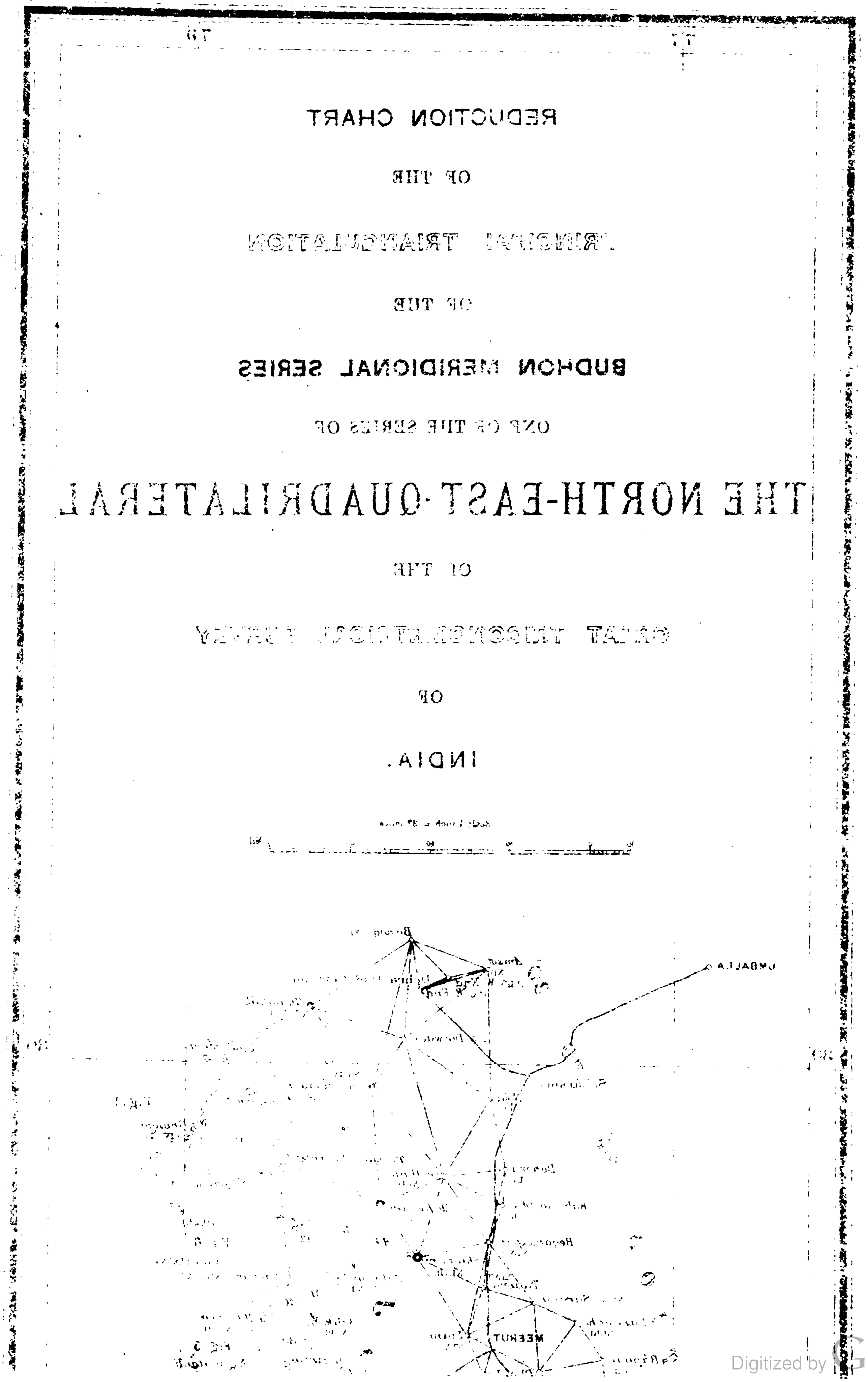

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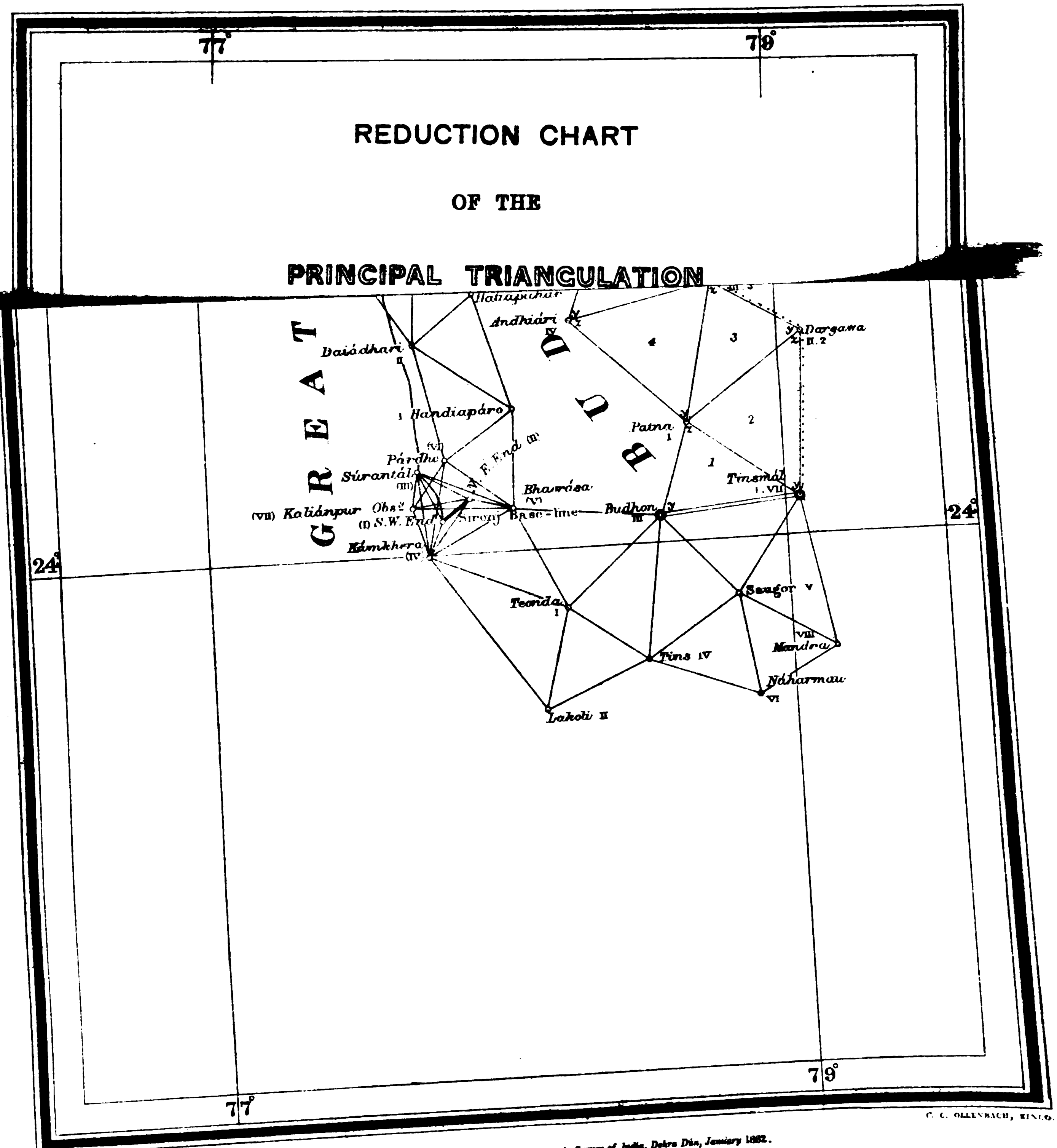

C. C. Ollenbach, Zinco.

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, January 1882.

APPENDIX.

No. 1.

THE DETAILS OF THE SEPARATE REDUCTION OF THE BUDHON MERIDIONAL SERIES, OR SERIES J OF THE NORTH-EAST QUADRILATERAL.

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1. *Introductory Remarks.*

The Budhon Series, which is the westernmost meridional chain of the North-East Quadrilateral, was omitted from the Simultaneous Reduction of that Quadrilateral for reasons which have already been stated on page 63. Its severance was effected by treating the triangle, now numbered 57, as a *non*-circuit triangle, and the Series was thus made to close, as it had originated, at a side which had been fixed in length and position by former reductions. Its adjustment then involved the solution of a group of four Circuit Equations, *viz.*, one each in *side, latitude, longitude* and *azimuth,* and it was commenced accordingly; but when nearly complete the position of Ráepur Station was brought under further control by special measurements connecting it with the station of the same name of the Great Arc Meridional Series, situated only a few feet distant from it but on the other side of a temple*. This connection necessitated the introduction of two supplemental equations, one in latitude, and the other in longitude, whereby additional calculations, practically constituting a Second Reduction, had to be made at many stages of the reduction as originally effected; this will be shewn hereafter in Section 4.

2. *Preliminary Calculations preceding the Simultaneous Reduction of the Series.*

The Budhon Series embraces 171 angles, which are grouped in the following figures:—1 quadrilateral, 5 simple polygons and 25 single triangles. Three of the single triangles connect the two sides Sheopuri-Mahesari and Mahesari-Mabegarh, and form a portion of what was once a large compound figure uniting the extremities of the Great Arc, North-East Longitudinal and Budhon Series. Partly for convenience, and partly owing to the different character of the triangulation, the portions of this figure which appertained to the several series were reduced separately, each portion in succession furnishing fixed data which had to be maintained in the next. The order of reduction was:—first the portion appertaining to the Great Arc, next that falling within the North-East Longitudinal Series, and lastly the three triangles in question. It thus happened that the figural errors of these triangles had to be obtained simultaneously, subject to the conditions that the ratio between two sides, which had already resulted from the previous calculations, should be maintained, and that the angle contained by these sides should not alter.

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* See the details of the Budhon Meridional Series pages $73_{\_J}$ and $74_{\_J}$ in Part II of this Volume.

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The figural errors were in all cases deduced by the method of Least Squares, as usually applied in this Survey, with the aid of the formulæ given in Section 3 of Chapter II, the weights employed being the reciprocals of the squares of the 'probabilities of error' obtained by the formula given on page 21. The conditions and reductions—excluding those of the single triangles—are given, as usual, in the details of the Series immediately after the Abstracts of the Observed Angles; a diagram of each figure will also be found in the plate at the end of the Series.

3. *The Reduction Chart.*

The whole of the principal triangulation of the Budhon Meridional Series is exhibited on the Reduction Chart at the commencement of this Appendix. This Chart also includes the Great Arc Series—Section 24° to 30°—and sufficient portions of the Calcutta Longitudinal and North-East Longitudinal Series, to shew the connection with the Budhon Series. The description given of the Reduction Chart of the North-East Quadrilateral in Section 3 of Chapter III is generally applicable to this Chart.

Prior to the special determination of the position of Ráepur, the Budhon Series formed but one circuit, of which only the right-hand branch was susceptible of correction. But afterwards it formed two circuits which were so arranged that while each originated from the side Budhon-Tinsmál of the Calcutta Longitudinal Series, one closed on the side Sheopuri-Mahesari of the Great Arc for its linear and azimuthal elements, and on the station Mahesari for its elements in latitude and longitude, while the other closed on the station Ráepur. As J is the serial letter for the chain, the section to the south of Ráepur is denoted by J_1 and to the north of that station by J_2. The Circuits are symbolically indicated for the First Simultaneous Reduction thus:—

Circuit *I* by $J_1 + J_2$

and for the Second Simultaneous Reduction due to the determination of Ráepur thus:—

Circuit *I* by $J_1 + J_2$

Circuit *II* by J_1

The Direct Traverse, see page 53, was employed for this Series; it is indicated on the Chart as usual by a dotted line parallel to the sides of the triangles in the right flank of the chain, looking north; all the stations in this line have traverse as well as serial numbers. The traverse numbers commence from Tinsmál, one of the initial stations of the Series, which is numbered 1, and end at Harpálsid, 23.

The Circuit Triangles are numbered from 1 to 44, commencing from the initial side Budhon-Tinsmál and ending at the closing side Sheopuri-Mahesari. The errors of the 'angles of continuation' are, as usual, denoted by the symbols y and z, the flank angle, of which the symbolical error is x, being left blank. The triangle numbers are employed as subscripts to distinguish the errors. The numbering of the '*Non*-circuit Triangles' commences with 45 and terminates with 57, smaller numerals being used on the Chart in order to distinguish these triangles from the Circuit Triangles.

The Polygonal Figures are numbered from 1 to 7, and these numbers are also employed in the Diagrams and Figural Reductions.

4. *The Equations of Condition.*

First Simultaneous Reduction.

The several polygonal figures having been made consistent, linear calculations were commenced at the

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side Budhon-Tinsmál and carried through the selected circuit triangles to the side Sheopuri-Mahesari. The calculations of latitude, longitude and azimuth were then made from Tinsmál along the course of the traverse to Mahesari. These calculations furnished the errors of Circuit *I*, $J_1 + J_2$, which are the differences between the final linear and geodetic values at the side and station of junction, as given by the Great Arc Series and the values as obtained by calculation through the Budhon Series.

Employing now the symbols J_1 and J_2 with the addition of the customary distinguishing subscripts, to indicate the sums of the terms on the right-hand side of the linear Equation (35) page 47, and of the geodetic Equations (57) page 54, we have the following circuit equations

Circuit I.

$$ {}_{c}J_1 + {}_{c}J_2 = {}_{1}E \quad . \; . \; . \quad 1 $$

$$ {}_{\lambda}J_1 + {}_{\lambda}J_2 = {}_{2}E \quad . \; . \; . \quad 2 $$

$$ {}_{L}J_1 + {}_{L}J_2 = {}_{3}E \quad . \; . \; . \quad 3 $$

$$ {}_{A}J_1 + {}_{A}J_2 = {}_{4}E \quad . \; . \; . \quad 4 $$

The solution of these equations was the problem first presented to be solved. After this had been done, and the resulting angular errors had been applied to the calculations, the connection at Ráepur was effected, furnishing the two new equations, in latitude and longitude, which have been already referred to and thus necessitating further calculations.

Second Simultaneous Reduction.

The First Simultaneons Reduction being so far complete, was allowed to stand; but in order to maintain its effect while solving the new equations, it was necessary to include the former equations in the subsequent calculations with new absolute terms, see Section 8 of Appendix No. 8, Vol. II. Had the former equations been completely satisfied, these absolute terms would each have been $=0$; but as a matter of fact small residual errors remained after the First Reduction; they were denoted respectively by $\delta_1 E$, $\delta_2 E$, $\delta_3 E$ and $\delta_4 E$. Thus for the Second Reduction the following equations, in which the left-hand members of the first four stood unaltered from what they were in the First Reduction, were presented for solution:—

Circuit I.

$$ {}_{c}J_1 + {}_{c}J_2 = \delta_1 E \quad . \; . \; . \quad 1 $$

$$ {}_{\lambda}J_1 + {}_{\lambda}J_2 = \delta_2 E \quad . \; . \; . \quad 2 $$

$$ {}_{L}J_1 + {}_{L}J_2 = \delta_3 E \quad . \; . \; . \quad 3 $$

$$ {}_{A}J_1 + {}_{A}J_2 = \delta_4 E \quad . \; . \; . \quad 4 $$

Circuit II.

$$ {}_{\lambda}J_1 = {}_{5}E \quad . \; . \; . \quad 5 $$

$$ {}_{L}J_1 = {}_{6}E \quad . \; . \; . \quad 6 $$

It is to be observed that ${}_{\lambda}J_1$ and ${}_{L}J_1$ in equations 5 and 6 do not represent the same coefficients as the same symbols in equations 2 and 3 although they include the same angular errors.

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5. *Formation of the Coefficients of the Unknown Quantities in the Primary Equations of Condition.*

These coefficients are given by the formulæ (71), (72) and (73) on page 79, with the following exceptions.

In Equations 2 and 3

$$\mathfrak{b}_{43} = -\mu_{23}\, a_{43} + \phi_{23}, \qquad \mathfrak{c}_{43} = -\mu_{23}\,(a_{43} + \gamma_{43}),$$

$$\mathfrak{b}_{44} = 0, \qquad \mathfrak{c}_{44} = 0.$$

In Equation 4

$$\mathfrak{b}_{43} = -\mu_{23}\, a_{43} + \phi_{23}, \qquad \mathfrak{c}_{43} = 1 - \mu_{23}\,(a_{43} + \gamma_{43}),$$

$$\mathfrak{b}_{44} = -1, \qquad \mathfrak{c}_{44} = -1.$$

In Equations 5 and 6

$$\mathfrak{b}_{12} = \mu_7\,\beta_{12} - \phi_7,$$

$$\mathfrak{c}_{12} = -\mu_7\,\gamma_{12} - \phi_7.$$

6. *Synoptical Exhibition of the Several Equations of Condition.*

Making use of the symbols in Section 6 of Chapter III, the Equations are as follows :—

First Simultaneous Reduction.

Circuit I.

1. *Linear.* $\;{}_1\mathrm{k}\Big|_{1}^{44} = {}_1E.$ 3. *Longitude.* $\;{}_3\mathrm{k}\Big|_{1}^{43} = {}_3E.$

2. *Latitude.* $\;{}_2\mathrm{k}\Big|_{1}^{43} = {}_2E.$ 4. *Azimuth.* $\;{}_4\mathrm{k}\Big|_{1}^{44} = {}_4E.$

Second Simultaneous Reduction.

Circuit I.

1. *Linear.* $\;{}_1\mathrm{k}\Big|_{1}^{44} = \delta_1 E.$ 3. *Longitude.* $\;{}_3\mathrm{k}\Big|_{1}^{43} = \delta_3 E.$

2. *Latitude.* $\;{}_2\mathrm{k}\Big|_{1}^{43} = \delta_2 E.$ 4. *Azimuth.* $\;{}_4\mathrm{k}\Big|_{1}^{44} = \delta_4 E.$

Circuit II.

5. *Latitude.* $\;{}_5\mathrm{k}\Big|_{1}^{12} = {}_5E.$ 6. *Longitude.* $\;{}_6\mathrm{k}\Big|_{1}^{12} = {}_6E.$

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7. *The Numerical Values of the Fixed Data on which the Simultaneous Reduction of the Budhon Meridional Series is based.*

The fixed data are the length and position of the side Budhon-Tinsmál of the Calcutta Longitudinal Series—the side of origin of the Budhon Series—and the length and position of the side Sheopuri-Mahesari of the Great Arc Series—the closing side of the Budhon Series. These data will be found in Volumes VI and IV respectively; but for the geodetic elements a third place of decimals of seconds has been obtained by reference to the manuscript calculations of the North-West and South-East Quadrilaterals. Further we have the position of Ráepur Station fixed.

The numerical values of the data are as follows :—

Vol. VI, page 156—$_B$

Station of origin Tinsmál or VII; side of origin Tinsmál or VII to Budhon or III.

At Tinsmál

Latitude North	24° 7′ 12″·965
Longitude East of Greenwich	79 2 12 ·451
Azimuth of Budhon	85 34 7 ·811
Distance „ Log. feet	5·2020309,0

Vol. IV, page 29—$_a$

Closing station Mahesari or LII; closing side Sheopuri or XLVIII to Mahesari or LII.

At Mahesari

Latitude North	29° 30′ 18″·206
Longitude East of Greenwich	78 11 18 ·883
Azimuth of Sheopuri	35 52 46 ·318
Distance „ Log. feet	4·9274737,0

Page 74—$_J$ of the Details of the Budhon Series given in Part II of this Volume.

At Ráepur or XIII

Latitude North	26° 8′ 14″·29
Longitude East of Greenwich	78 7 16 ·15

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8. *The Sides and Angles of the Circuit Triangles.*

The following table gives the Figurally Corrected Plane Angles and the logarithms of the Side-lengths in feet of all the Circuit Triangles of the Series. It has been prepared on the same principle as that given in Section 8 of Chapter III.

Sides and Angles of the Circuit Triangles for the First Simultaneous Reduction.

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Number: Serial	Station Number: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	B* III		65 18 10·20	1·10	5·1693282,0		y	J X		76 21 32·21	·83	5·1103887,0
1	x	VII	1	36 17 41·56	1·10	4·9832680,2	12	x	XIV	7	49 31 1·81	·83	5·0039719,5
	z	J I		78 24 8·24	1·10	5·2020309,0		z	XIII		54 7 25·98	·83	5·0314536,6
		B* VII	1	61 1 28·67	1·85	5·2302982,3			XIV	7	100 21 44·04	·80	5·2125415,1
2	„	J I		69 29 22·96	1·86	5·2599340,0	13	„	XIII		28 36 16·86	·79	4·8998042,8
		II	2	49 29 8·37	1·85	5·1693282,0			XVI	8	51 1 59·10	·79	5·1103887,0
		II	2	69 43 34·25	1·49	5·2308020,7			XIII		40 42 28·45	·86	5·0350287,9
3	„	I		40 43 36·18	1·48	5·0731257,2	14	„	XVI	8	38 15 27·06	·86	5·0124748,7
		III	3	69 32 49·57	1·49	5·2302982,3			XV		101 2 4·49	·87	5·2125415,1
		I		56 48 44·99	2·03	5·2243285,5			XV		53 2 59·36	·84	5·0180797,7
4	„	III	3	65 2 7·54	2·04	5·2590643,0	15	„	XVI	8	70 45 8·38	·84	5·0904659,3
		IV		58 9 7·47	2·04	5·2308020,7			XVII		56 11 52·26	·84	5·0350287,9
		IV		56 13 32·61	2·08	5·2284044,7			XVI	8	47 50 57·32	·74	4·9712756,6
5	„	III	3	68 20 26·37	2·08	5·2768813,2	16	„	XVII		76 29 11·88	·75	5·0890408,9
		V		55 26 1·02	2·07	5·2243285,5			XVIII	9	55 39 50·80	·75	5·0180797,7
		III	3	60 23 40·86	2·08	5·2443695,0			XVIII	9	62 47 5·76	·61	4·9851633,3
6	„	V		62 40 7·28	2·08	5·2537174,8	17	„	XVII		57 45 4·43	·60	4·9633533,9
		VI	4	56 56 11·86	2·08	5·2284044,7			XIX	10	59 27 49·81	·60	4·9712756,6
		VI	4	57 0 34·11	1·27	5·1699859,3			XVII		65 42 21·88	·77	5·0522330,5
7	„	V		38 27 18·81	1·27	5·0400704,7	18	„	XIX	10	62 56 23·79	·76	5·0421503,4
		VII	5	84 32 7·08	1·28	5·2443695,0			XX		51 21 14·33	·76	4·9851633,3
		V		54 35 51·63	1·13	5·0974735,7			XIX	10	61 29 7·58	·62	5·0099209,7
8	„	VII	5	50 59 24·35	1·13	5·0767022,2	19	„	XX		42 54 27·05	·62	4·8991127,5
		VIII		74 24 44·02	1·14	5·1699859,3			XXI	11	75 36 25·37	·62	5·0522330,5
		VII	5	65 3 16·23	·82	5·0784897,5			XX		58 26 41·38	·67	4·9884499,7
9	„	VIII		43 38 35·98	·81	4·9599757,8	20	„	XXI	11	58 0 18·36	·66	4·9863854,5
		IX	6	71 18 7·79	·82	5·0974735,7			XXII		63 33 0·26	·67	5·0099209,7
		VIII		66 16 16·70	1·31	5·1781898,8			XXI	11	71 28 6·05	·65	5·0369555,8
10	„	IX	6	67 2 11·50	1·31	5·1806935,0	21	„	XXII		50 32 31·85	·64	4·9477487,7
		X		46 41 31·80	1·31	5·0784897,5			XXIII	12	57 59 22·10	·65	4·9884499,7
		IX	6	40 58 5·19	1·21	5·0314536,6			XXII		66 30 21·87	·92	5·0930491,0
11	„	X		72 13 31·06	1·22	5·1935464,4	22	„	XXIII	12	59 47 20·09	·92	5·0672342,3
		XIV	7	66 48 23·75	1·22	5·1781898,8			XXIV		53 42 18·04	·91	5·0369555,8

* B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Sides and Angles of the Circuit Triangles for the First Simultaneous Reduction—(Continued).

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	J XXIII	12	62 54 58·01	·98	5·0922444,7		y	J XXXVI		63 27 2·38	·34	4·8642497,8
23	x	XXIV		53 57 33·32	·97	5·0504212,4	34	x	XXXV	18	54 44 9·01	·34	4·8246008,8
	z	XXV	13	63 7 28·67	·98	5·0930491,0		z	XXXVIII		61 48 48·61	·34	4·8578255,9
		XXIV		57 55 48·42	·98	5·0697525,0			XXXV	18	59 27 32·75	·31	4·8322526,8
24	,,	XXV	13	58 53 16·38	·98	5·0742173,1	35	,,	XXXVIII		52 33 3·88	·31	4·7968785,8
		XXVI		63 10 55·20	·99	5·0922444,7			XXXIX	19	67 59 23·37	·31	4·8642497,8
		XXV	13	54 56 14·72	·70	4·9964016,0			XXXVIII		63 45 26·41	·38	4·8896223,4
25	,,	XXVI		[illegible] 20 8·14	·69	4·9633476,7	36	,,	XXXIX	19	64 26 6·36	·38	4·8921173,5
		XXVII	14	75 43 [illegible]·14	·70	5·0697525,0			XL		51 48 27·23	·37	4·8322526,8
		XXVI		80 27 37·62	·75	5·1015702,5			XXXIX	19	46 52 27·00	·34	4·7868669,4
26	,,	XXVII	14	48 49 5·44	·74	4·9841957,9	37	,,	XL		65 30 20·44	·34	4·8826733,8
		XXVIII		50 43 16·94	·74	4·9964016,0			XLII	20	67 37 12·56	·35	4·8896223,4
		XXVII	14	35 36 24·50	[illegible]3	4·8687711,5			XLII	20	63 44 48·73	·31	4·8499681,9
27	,,	XXVIII		60 2 30·98	·64	5·0413983,3	38	,,	XL		65 23 48·81	·31	4·8559149,7
		XXIX	15	84 21 4·52	·64	5·1015702,5			XLIV	21	50 51 22·46	·31	4·7868669,4
		XXVIII		67 27 52·43	·36	4·8901761,0			XL		58 19 37·45	·33	4·8376374,2
28	,,	XXIX	15	50 59 11·99	·35	4·8150927,9	39	,,	XLIV	21	60 33 37·77	·34	4·8476334,8
		XXX		61 32 55·58	·35	4·8687711,5			XLIII		61 6 44·78	·34	4·8499681,9
		XXIX	15	57 42 23·30	·28	4·8266505,7			XLIV	21	65 1 6·59	·36	4·8829749,9
29	,,	XXX		44 12 14·89	·28	4·7429961,5	40	,,	XLIII		60 14 12·20	·36	4·8641955,4
		XXXII	16	78 5 21·81	·29	4·8901761,0			XLV	22	54 44 41·21	·36	4·8376374,2
		XXXII	16	59 50 44·43	·25	4·7915814,7			XLIII		62 57 43·99	·47	4·9367195,4
30	,,	XXX		50 32 9·12	·25	4·7423583,1	41	,,	XLV	22	65 7 44·81	·48	4·9447153,6
		XXXIV	17	69 37 6·45	·25	4·8266505,7			XLVI		51 54 31·20	·47	4·8829749,9
		XXX		67 2 52·70	·32	4·8670559,6			XLV	22	88 23 43·93	1·00	5·2241196,3
31	,,	XXXIV	17	62 14 35·69	·32	4·8497859,9	42	,,	XLVI		60 33 27·47	1·00	5·1642336,0
		XXXIII		50 42 31·61	·32	4·7915814,7			XLVIII	23	31 2 48·60	·99	4·9367195,4
		XXXIV	17	59 54 4·04	·39	4·8805762,2			XLVIII	23	32 54 28·48	1·02	4·9592004,3
32	,,	XXXIII		63 6 6·66	·40	4·8937525,3	43	,,	XLVI		57 57 4·72	1·02	5·1523580,9
		XXXV	18	56 59 49·30	·39	4·8670559,6			A* LII		89 8 26·80	1·02	5·2241196,3
		XXXIII		55 37 36·85	·39	4·8578255,9			J XLVI		56 0 35·00	·53	4·9275039,6
33	,,	XXXV	18	63 56 28·64	·39	4·8946151,5	44	,,	A* LII		60 52 34·33	·53	4·9501778,6
		XXXVI		60 25 54·51	·39	4·8805762,2			XLVIII		63 6 50·67	·53	4·9592004,3

* A is the Serial letter for the Great Arc Series—Section 24° to 30°—which appertains to the North-West Quadrilateral.

After the completion of the First Reduction the angles obtained corrections which, having been applied, gave the following values of the sides and angles for the Second Reduction

Sides and Angles of the Circuit Triangles for the Second Simultaneous Reduction.

Triangle Number	Symbolic Error	Station Numbers		Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers		Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
		Serial	Traverse						Serial	Traverse			
				° ′ ″	″						° ′ ″	″	
	y	B* III		65 18 10·00	1·10	5·1693278,8		y	J X		76 21 32·01	·83	5·1103693,5
1	x	VII	1	36 17 41·44	1·10	4·9832675,6	12	x	XIV	7	49 31 1·50	·83	5·0039521,4
	z	J I		78 24 8·56	1·10	5·2020309,0		z	XIII		54 7 26·49	·83	5·0314351,8
		B* VII	1	61 1 27·10	1·85	5·2302935,9			XIV	7	100 21 43·94	·80	5·2125219,1
2	,,	J I		69 29 23·17	1·86	5·2599314,1	13	,,	XIII		28 36 16·79	·79	4·8997843,7
		II	2	49 29 9·73	1·85	5·1693278,8			XVI	8	51 1 59·27	·79	5·1103693,5
		II	2	69 43 33·83	1·49	5·2307968,9			XIII		40 42 28·22	·86	5·0350087,0
3	,,	I		40 43 36·35	1·48	5·0731213,1	14	,,	XVI	8	38 15 27·12	·86	5·0124554,8
		III	3	69 32 49·82	1·49	5·2302935,9			XV		101 2 4·66	·87	5·2125219,1
		I		56 48 44·30	2·03	5·2243211,5			XV		53 2 58·80	·84	5·0180576,5
4	,,	III	3	65 2 7·25	2·04	5·2590575,1	15	,,	XVI	8	70 45 8·11	·84	5·0904444,6
		IV		58 9 8·45	2·04	5·2307968,9			XVII		56 11 53·09	·84	5·0350087,0
		IV		56 13 31·87	2·08	5·2283944,7			XVI	8	47 50 56·73	·74	4·9712519,0
5	,,	III	3	68 20 26·06	2·08	5·2768721,0	16	,,	XVII		76 29 12·11	·75	5·0890183,7
		V		55 26 2·07	2·07	5·2243211,5			XVIII	9	55 39 51·16	·75	5·0180576,5
		III	3	60 23 40·03	2·08	5·2443576,9			XVIII	9	62 47 5·40	·61	4·9851389,1
6	,,	V		62 40 7·49	2·08	5·2537068,9	17	,,	XVII		57 45 4·58	·60	4·9633295,8
		VI	4	56 56 12·48	2·08	5·2283944,7			XIX	10	59 27 50·02	·60	4·9712519,0
		VI	4	57 0 33·56	1·27	5·1699733,2			XVII		65 42 21·67	·77	5·0522075,5
7	,,	V		38 27 19·18	1·27	5·0400596,1	18	,,	XIX	10	62 56 23·49	·76	5·0421247,2
		VII	5	84 32 7·26	1·28	5·2443576,9			XX		51 21 14·84	·76	4·9851389,1
		V		54 35 51·34	1·13	5·0974603,4			XIX	10	61 29 7·24	·62	5·0098950,2
8	,,	VII	5	50 59 24·28	1·13	5·0766893,1	19	,,	XX		42 54 27·27	·62	4·8990876,8
		VIII		74 24 44·38	1·14	5·1699733,2			XXI	11	75 36 25·49	·62	5·0522075,5
		VII	5	65 3 15·41	·82	5·0784753,9			XX		58 26 41·20	·67	4·9884233,9
9	,,	VIII		43 38 36·36	·81	4·9599630,7	20	,,	XXI	11	58 0 18·17	·66	4·9863588,5
		IX	6	71 18 8·23	·82	5·0974603,4			XXII		63 33 0·63	·67	5·0098950,2
		VIII		66 16 16·31	1·31	5·1781736,7			XXI	11	71 28 5·88	·65	5·0369287,5
10	,,	IX	6	67 2 11·14	1·31	5·1806773,2	21	,,	XXII		50 32 31·92	·64	4·9477221,9
		X		46 41 32·55	1·31	5·0784753,9			XXIII	12	57 59 22·20	·65	4·9884233,9
		IX	6	40 58 4·41	1·21	5·0314351,8			XXII		66 30 21·72	·92	5·0930213,8
11	,,	X		72 13 31·40	1·22	5·1935300,8	22	,,	XXIII	12	59 47 19·77	·92	5·0672062,5
		XIV	7	66 48 24·19	1·22	5·1781736,7			XXIV		53 42 18·51	·91	5·0369287,5

* B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Sides and Angles of the Circuit Triangles for the Second Simultaneous Reduction—(Continued).

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet	Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″						° ′ ″	″	
	y	J XXIII	12	62 54 57·66	·98	5·0922162,2		y	J XXXVI		63 27 2·41	·34	4·8642187,3
23	x	XXIV		53 57 33·53	·97	5·0503936,9	34	x	XXXV	18	54 44 8·87	·34	4·8245695,9
	z	XXV	13	63 7 28·81	·98	5·0930213,8		z	XXXVIII		61 48 48·72	·34	4·8577946,4
		XXIV		57 55 48·30	·98	5·0697236,7			XXXV	18	59 27 32·67	·31	4·8322215,7
24	,,	XXV	13	58 53 16·12	·98	5·0741883,2	35	,,	XXXVIII		52 33 4·00	·31	4·7968477,7
		XXVI		63 10 55·58	·99	5·0922162,2			XXXIX	19	67 59 23·33	·31	4·8642187,3
		XXV	13	54 56 14·53	·70	4·9963724,7			XXXVIII		63 45 26·47	·38	4·8895910,4
25	,,	XXVI		49 20 8·30	·69	4·9633191,1	36	,,	XXXIX	19	64 26 6·15	·38	4·8920857,7
		XXVII	14	75 43 37·17	·70	5·0697236,7			XL		51 48 27·38	·37	4·8322215,7
		XXVI		80 27 37·62	·75	5·1015407,3			XXXIX	19	46 52 26·90	·34	4·7868355,2
26	,,	XXVII	14	48 49 5·22	·74	4·9841658,8	37	,,	XL		65 30 20·63	·34	4·8826423,5
		XXVIII		50 43 17·16	·74	4·9963724,7			XLII	20	67 37 12·47	·35	4·8895910,4
		XXVII	14	35 36 24·24	·63	4·8687408,4			XLII	20	63 44 48·63	·31	4·8499368,2
27	,,	XXVIII		60 2 31·21	·64	5·0413690,7	38	,,	XL		65 23 49·00	·31	4·8558838,9
		XXIX	15	84 21 4·55	·64	5·1015407,3			XLIV	21	50 51 22·37	·31	4·7868355,2
		XXVIII		67 27 52·43	·36	4·8901457,0			XL		58 19 37·58	·33	4·8376061,2
28	,,	XXIX	15	50 59 11·91	·35	4·8150622,6	39	,,	XLIV	21	60 33 37·56	·34	4·8476017,9
		XXX		61 32 55·66	·35	4·8687408,4			XLIII		61 6 44·86	·34	4·8499368,2
		XXIX	15	57 42 23·23	·28	4·8266200,8			XLIV	21	65 1 6·53	·36	4·8829437,8
29	,,	XXX		44 12 14·97	·28	4·7429659,2	40	,,	XLIII		60 14 12·36	·36	4·8641645,8
		XXXII	16	78 5 21·80	·29	4·8901457,0			XLV	22	54 44 41·11	·36	4·8376061,2
		XXXII	16	59 50 44·36	·25	4·7915508,9			XLIII		62 57 44·12	·47	4·9366884,1
30	,,	XXX		50 32 9·19	·25	4·7423279,4	41	,,	XLV	22	65 7 44·65	·48	4·9446839,4
		XXXIV	17	69 37 6·45	·25	4·8266200,8			XLVI		51 54 31·23	·47	4·8829437,8
		XXX		67 2 52·71	·32	4·8670252,7			XLV	22	88 23 43·91	1·00	5·2240890,6
31	,,	XXXIV	17	62 14 35·61	·32	4·8497552,0	42	,,	XLVI		60 33 27·65	1·00	5·1642032,5
		XXXIII		50 42 31·68	·32	4·7915508,9			XLVIII	23	31 2 48·44	·99	4·9366884,1
		XXXIV	17	59 54 3·92	·39	4·8805453,7			XLVIII	23	32 54 28·50	1·02	4·9591699,4
32	,,	XXXIII		63 6 6·77	·40	4·8937219,4	43	,,	XLVI		57 57 4·81	1·02	5·1523276,4
		XXXV	18	56 59 49·31	·39	4·8670252,7			A* LII		89 8 26·69	1·02	5·2240890,6
		XXXIII		55 37 36·87	·39	4·8577946,4			J XLVI		56 0 35·14	·53	4·9274736,9
33	,,	XXXV	18	63 56 28·51	·39	4·8945840,4	44	,,	A* LII		60 52 34·21	·53	4·9501472,4
		XXXVI		60 25 54·62	·39	4·8805453,7			XLVIII		63 6 50·65	·53	4·9591699,4

* A is the Serial letter for the Great Arc Series—Section 24° to 30°—which appertains to the North-West Quadrilateral.

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9. *Preliminary Latitudes, Longitudes and Azimuths of the Stations on the Line of Traverse.*

The Geodetic Latitudes, Longitudes and Azimuths given in the next table have been calculated from the elements at Tinsmál on page 7 by employing the side lengths and spherical angles obtained from the triangles recorded in the first table of Section 8. For further explanation see the preamble to Section 8 of Chapter III.

Geodetic Elements of the Flank Stations employed in the First Simultaneous Reduction.

Fixed Station A		Deduced Station B			
No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A
	° ′ ″		° ′ ″	° ′ ″	° ′ ″
1	182 53 20·991	2	24 37 13·235	79 3 51·841	2 54 2·003
2	122 6 47·963	3	24 47 35·369	78 45 44·030	301 59 13·285
3	205 18 25·315	4	25 14 21·002	78 59 39·118	25 24 18·455
4	139 21 7·775	5	25 28 4·678	78 46 39·549	319 15 33·960
5	159 50 24·850	6	25 42 12·588	78 40 55·895	339 47 56·439
6	159 6 24·259	7	26 6 17·263	78 30 44·939	339 1 57·351
7	195 43 9·801	8	26 18 54·218	78 34 41·360	15 44 54·219
8	223 38 29·309	9	26 33 33·248	78 50 14·456	43 45 24·740
9	162 12 22·660	10	26 47 59·891	78 45 4·463	342 10 3·473
10	166 3 26·633	11	27 0 41·810	78 41 33·256	346 1 51·057
11	191 6 42·767	12	27 15 3·412	78 44 42·613	11 8 9·120
12	191 49 51·870	13	27 33 11·962	78 48 58·475	11 51 49·627
13	188 48 52·057	14	27 48 11·330	78 51 35·319	8 50 4·912
14	168 59 14·062	15	28 6 0·502	78 47 40·656	348 57 24·069
15	182 0 5·149	16	28 15 8·099	78 48 2·268	2 0 15·354
16	139 56 22·134	17	28 22 6·682	78 41 24·151	319 53 13·328
17	151 39 0·468	18	28 33 28·811	78 34 27·161	331 35 41·732
18	206 43 42·862	19	28 42 42·700	78 39 43·615	26 46 14·515
19	206 4 12·275	20	28 54 1·389	78 46 1·040	26 7 14·137
20	157 29 16·087	21	29 4 57·693	78 40 51·321	337 26 45·972
21	153 52 53·802	22	29 15 47·811	78 34 47·722	333 49 56·566
22	182 6 8·356	23	29 39 51·880	78 35 48·419	2 6 38·212
23	66 3 57·302	LII*	29 30 19·208	78 11 19·190	245 51 51·922
LII*	35 52 54·602	XLVIII*			

* These stations appertain to the Great Arc Meridional Series—Section 24° to 30°—of the North-West Quadrilateral.

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After the completion of the First Reduction of the Series, and the application of the Angular Errors therein determined to the linear and geodetic calculations, the value of the sides and angles given in the second table of Section 8 were obtained, and the values of Latitude, Longitude and Azimuth in the line of traverse were corrected. The corrected values are now given as they were employed in the Second Reduction.

Geodetic Elements of the Flank Stations as employed in the Second Simultaneous Reduction.

Fixed Station A		Deduced Station B			
No. in Traverse	Azimuth of B	No. in Traverse	Latitude North	Longitude East of Greenwich	Azimuth of A
	° ′ ″		° ′ ″	° ′ ″	° ′ ″
1	182 53 19·301	2	24 37 13·225	79 3 51·824	2 54 0·306
2	122 6 47·206	3	24 47 35·349	78 45 44·021	301 59 12·531
3	205 18 23·381	4	25 14 20·950	78 59 39·072	25 24 16·506
4	139 21 5·896	5	25 28 4·599	78 46 39·515	319 15 32·086
5	159 50 22·266	6	25 42 12·480	78 40 55·860	339 47 53·854
6	159 6 20·974	7	26 6 17·092	78 30 44·901	339 1 54·065
7	......	XIII	26 8 14·39	78 7 16·13	......
7	195 43 6·545	8	26 18 54·016	78 34 41·298	15 44 50·953
8	223 38 25·413	9	26 33 33·016	78 50 14·328	43 45 20·814
9	162 12 18·734	10	26 47 59·606	78 45 4·334	342 9 59·546
10	166 3 22·276	11	27 0 41·477	78 41 33·122	346 1 46·697
11	191 6 38·167	12	27 15 3·030	78 44 42·446	11 8 4·505
12	191 49 46·685	13	27 33 11·517	78 48 58·261	11 51 44·420
13	188 48 46·540	14	27 48 10·830	78 51 35·068	8 49 59·378
14	168 59 8·078	15	28 5 59·925	78 47 40·386	348 57 18·076
15	181 59 59·036	16	28 15 7·484	78 48 1·978	2 0 9·232
16	139 56 15·932	17	28 22 6·027	78 41 23·875	319 53 7·132
17	151 38 54·072	18	28 33 28·096	78 34 26·890	331 35 35·339
18	206 43 36·129	19	28 42 41·954	78 39 43·301	26 46 7·762
19	206 4 5·172	20	28 54 0·606	78 46 0·673	26 7 7·008
20	157 29 8·768	21	29 4 56·853	78 40 50·950	337 26 38·651
21	153 52 46·121	22	29 15 46·913	78 34 47·349	333 49 48·884
22	182 6 0·394	23	29 39 50·883	78 35 47·978	2 6 30·216
23	66 3 49·166	LII*	29 30 18·200	78 11 18·878	245 51 43·850
LII*	35 52 46·300	XLVIII*			

* These stations appertain to the Great Arc Meridional Series—Section 24° to 30°—of the North-West Quadrilateral.

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10. *Numerical Values of the Absolute Terms in the Equations of Condition, and of their Products by the Equalizing Factors.*

The numerical values of the Absolute Terms were obtained as described in Section 10 of Chapter III: after which they were multiplied by the Equalizing Factors—see page 59.

For the First Reduction we have

Circuit I. Equations 1 to 4.

Equation 1, *Linear.* Between the sides Tinsmál-Budhon and Mahesari-Sheopuri.

Log computed length Mahesari-Sheopuri by Triangle No. 44	4·927,5039,6
Log final value from Great Arc Series—Section 24° to 30°—see page 7	4·927,4737,0
$_1E = + 302,6$ . . . . Logarithmic Error	+ ·000,0302,6

Equations 2 to 4, *Geodetic.* Terminal Station, Mahesari; Terminal side, Mahesari-Sheopuri.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	29 30 19·208	78 11 19·190	35 52 54·602
Final values from Great Arc Series—Section 24° to 30°—see page 7	29 30 18·206	78 11 18·883	35 52 46·318
Errors	$_2E = + 1·002$	$_3E = + 0·307$	$_4E = + 8·284$

After the completion of the First Reduction the Absolute Terms became as follows for the Second Reduction, due to the previous fixing of Ráepur by the Great Arc:—

Circuit I. Equations 1 to 4.

Equation 1, *Linear.* Between the sides Tinsmál-Budhon and Mahesari-Sheopuri.

Log computed length Mahesari-Sheopuri by Triangle No. 44	4·927,4736,9
Log final value from Great Arc Series—Section 24° to 30°—as above	4·927,4737,0
$\delta_1 E = - 0·1$ . . . . Logarithmic Error	− ·000,0000,1

Equations 2 to 4, *Geodetic.* Terminal Station, Mahesari; Terminal Side, Mahesari-Sheopuri.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	29 30 18·200	78 11 18·878	35 52 46·300
Final values from Great Arc Series—Section 24° to 30°—as above	29 30 18·206	78 11 18·883	35 52 46·318
Errors	$\delta_2 E = - 0·006$	$\delta_3 E = - 0·005$	$\delta_4 E = - 0·018$

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Circuit II. Equations 5 and 6.

Terminal Station, Ráepur.

Branch of Circuit.	*Latitude.*	*Longitude.*
	° ′ ″	° ′ ″
Right-hand	26 8 14·39	78 7 16·13
Final values from Budhon Meridional Series—page 7	26 8 14·29	78 7 16·15
Errors	$_5E = +0·10$	$_6E = -0·02$

The products of the Absolute Terms by the Equalizing Factors are as follows:—

For the First Simultaneous Reduction.

Equation	Absolute Term	Equalizing Factor	Product
1. *Linear*	$_1E = +302·6$	·03	+ 9·078
2. *Latitude*	$_2E = +\ \ 1·002$	15	+15·030
3. *Longitude*	$_3E = +\ \ 0·307$	15	+ 4·605
4. *Azimuth*	$_4E = +\ \ 8·284$	1	+ 8·284

For the Second Simultaneous Reduction.

Equation	Absolute Term	Equalizing Factor	Product
1. *Linear*	$\delta_1E = -0·1$	·03	− 0·003
2. *Latitude*	$\delta_2E = -0·006$	15	− 0·090
3. *Longitude*	$\delta_3E = -0·005$	15	− 0·075
4. *Azimuth*	$\delta_4E = -0·018$	1	− 0·018
5. *Latitude*	$_5E = +0·10$	15	+ 1·50
6. *Longitude*	$_6E = -0·02$	15	− 0·30

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11. *Numerical Values of the μs and ϕs.*

The values of the μs and ϕs were obtained in the form employed in the reduction of the South-East Quadrilateral, and described in Section 13 of Chapter I, Volume VI; from which section the following table of substitutions for μ and ϕ in Equation (57), page 54 of this volume, has been extracted.

Table of Substitutions for μ and ϕ.

	Latitude	Longitude	Azimuth
For E	$d\lambda_{n+1}$	dL_{n+1}	dB_n
" μ	${}_{\lambda}\mu$	${}_{L}\mu$	${}_{A}\mu$
" ϕ	${}_{\lambda}\phi$	${}_{L}\phi$	${}_{A}\phi$
" μ_1	$+{}_1^n\left[\frac{1}{\text{t.d.log}\,\Delta\lambda}\right]$	$+{}_1^n\left[\frac{1}{\text{t.d.log}\,\Delta L}\right]$	$+{}_1^n\left[\frac{1}{\text{t.d.log}\,\Delta A}\right]$
" μ_2	$+{}_2^n\left[\frac{1}{\text{t.d.log}\,\Delta\lambda}\right]$	$+{}_2^n\left[\frac{1}{\text{t.d.log}\,\Delta L}\right]$	$+{}_2^n\left[\frac{1}{\text{t.d.log}\,\Delta A}\right]$
. . .	. . . .	. . . .	. . . .
" μ_n	$+\frac{1}{\text{t.d.log}\,\Delta\lambda_n}$	$+\frac{1}{\text{t.d.log}\,\Delta L_n}$	$+\frac{1}{\text{t.d.log}\,\Delta A_n}$
" ϕ_1	$+{}_1^n\left[\frac{\text{t.d.log}\cos A}{\text{t.d.log}\,\Delta\lambda}\right]$	$+{}_1^n\left[\frac{\text{t.d.log}\sin A}{\text{t.d.log}\,\Delta L}\right]$	$1+{}_1^n\left[\frac{\text{t.d.log}\sin A}{\text{t.d.log}\,\Delta A}\right]$
" ϕ_2	$+{}_2^n\left[\frac{\text{t.d.log}\cos A}{\text{t.d.log}\,\Delta\lambda}\right]$	$+{}_2^n\left[\frac{\text{t.d.log}\sin A}{\text{t.d.log}\,\Delta L}\right]$	$1+{}_2^n\left[\frac{\text{t.d.log}\sin A}{\text{t.d.log}\,\Delta A}\right]$
. . .	. . . .	. . . .	. . . .
" ϕ_n	$+\frac{\text{t.d.log}\cos A_n}{\text{t.d.log}\,\Delta\lambda_n}$	$+\frac{\text{t.d.log}\sin A_n}{\text{t.d.log}\,\Delta L_n}$	$1+\frac{\text{t.d.log}\sin A_n}{\text{t.d.log}\,\Delta A_n}$

In applying these formulæ the tabular log differences of the first terms of $\Delta\lambda$, ΔL and ΔA in the expression (25), (26) and (27), pages 30 and 31, were employed for t.d. log $\Delta\lambda$, t.d. log ΔL and t.d. log ΔA.

The values of m are not recorded for the reason already assigned on page 131, *viz.* that $m_t = \mu_t - \mu_{t+1}$ and can therefore be obtained by inspection.

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In the following table will be found the μs and ϕs for both circuits. It is obvious that those for Circuit *I* will be the same in the Second Reduction as in the First.

Numerical Values of the μs and ϕs.

No. of Station in Traverse	Latitude		Longitude		Azimuth	
	${}_\lambda\mu$	${}_\lambda\phi$	${}_L\mu$	${}_L\phi$	${}_A\mu$	${}_A\phi$
			CIRCUIT *I*.			
1	+ 44661	+ ·01314	− 7038	+ ·10448	− 3264	+1·04687
2	40512	1355	7265	9500	3357	1·04301
3	39063	863	4765	9175	2315	1·04165
4	35359	1233	6688	8310	3121	1·03802
5	33472	893	4902	7881	2358	1·03619
6	31511	736	4115	7432	2019	1·03426
7	28189	471	2726	6668	1413	1·03093
8	26435	576	3269	6261	1652	1·02913
9	24435	976	5397	5793	2604	1·02704
10	22435	836	4683	5328	2286	1·02497
11	20681	731	4198	4921	2069	1·02314
12	18681	811	4633	4455	2265	1·02104
13	16175	936	5221	3867	2535	1·01835
14	14092	1019	5581	3382	2702	1·01610
15	11629	921	5040	2798	2451	1·01338
16	10379	933	5090	2498	2474	1·01197
17	9417	760	4173	2278	2041	1·01093
18	7854	588	3211	1893	1586	1·00912
19	6588	727	3936	1596	1933	1·00769
20	5025	884	4798	1225	2350	1·00590
21	3510	763	4089	856	2006	1·00411
22	2017	598	3249	503	1599	1·00241
23	− 1316	632	3390	− 305	1667	0·99850

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Numerical Values of the μs and φs—(Continued).

No. of Station in Traverse	Latitude		Longitude	
	$_\lambda\mu$	$_\lambda\phi$	$_L\mu$	$_L\phi$
		CIRCUIT *II.*		
1	+ 16743	+ ·01449	− 7559	+ ·03844
2	12594	1491	7786	2897
3	11145	998	5286	2572
4	7441	1368	7209	1706
5	5554	1029	5423	1278
6	3593	872	4636	829
7	271	606	3247	65

12. *Numerical Values of the Coefficients* 𝔟 *and* 𝔠 *of the Unknown Quantities, y and z, in the Primary Equations.*

The next table contains the numerical values of the coefficients 𝔟 and 𝔠 for both circuits; those for Circuit *I* necessarily remain the same both for the First and for the Second Reduction. The following example will illustrate the deduction of values appertaining to the geodetic equations: those for the linear equation have already been illustrated in Section 12 of Chapter III.

Example.

To find the values of $\mathfrak{b}_{30}$ and $\mathfrak{c}_{30}$ in Equation 3.

The equation is in longitude, and the forms of the coefficients are normal.

$$_3\mathfrak{b}_{30} = - {}_Lm_{16}\,a_{30} + {}_L\mu_{17}\,\beta_{30} + {}_L\phi_{16}$$

$$= - 917 \text{ t.d. log sin } 50^\circ\ 32'\ 9'' - 4173 \text{ t.d. log sin } 59^\circ\ 50'\ 44'' + \cdot 02498 = + \cdot 02112$$

$$_3\mathfrak{c}_{30} = - {}_Lm_{16}\,a_{30} - {}_L\mu_{16}\,\gamma_{30} + {}_L\phi_{17}$$

$$- 917 \text{ t.d. log sin } 50^\circ\ 32'\ 9'' - 5090 \text{ t.d. log sin } 69^\circ\ 37'\ 6'' + \cdot 02278 = + \cdot 02841$$

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Numerical Values of the Coefficients.

1st Equation. Linear.

Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of *y* and *z* — b	Coefficients of *y* and *z* — c
1	+ 9·5	− 4·5
2	12	18
3	8	8
4	13·5	13
5	14	14·5
6	12	13·5
7	14	2
8	15	5·5
9	10	7
10	9	20
11	24	9
12	5	15·5
13	− 4	17
14	+ 24	+ 4
15	15	− 14
16	19	14·5
17	11	12·5
18	9·5	17
19	11	6
20	13	11
21	7	13
22	9	15·5
23	11	11
24	13	10·5
25	15	5·5
26	4	17·5

1st Equation—(Continued).

Equalizing Factor = ·03.

No. of Circuit Triangle	Coefficients of *y* and *z* — b	Coefficients of *y* and *z* — c
27	+ 30	− 2
28	9	11
29	13	4·5
30	13	8
31	9	17
32	12	13
33	14·5	12
34	11	12
35	12	8
36	11	17
37	19·5	9
38	10	17
39	13	11·5
40	10	15
41	10·5	16·5
42	1	35
43	33	0·5
44	14	10

2nd Equation. Latitude.

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z* — b	Coefficients of *y* and *z* — c
1	+ 0·029	− 0·033
2	·058	·070
3	·041	·027
4	·044	·059
5	·046	·065

2nd Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of *y* and *z* — b	Coefficients of *y* and *z* — c
6	+ 0·047	− 0·044
7	·054	·003
8	·041	·027
9	·036	·020
10	·021	·070
11	·073	·026
12	·009	·048
13	− ·013	·049
14	+ ·058	+ ·005
15	·034	− ·043
16	·051	·030
17	·032	·025
18	·013	·047
19	·027	·010
20	·020	·030
21	·017	·022
22	·009	·037
23	·022	·015
24	·012	·026
25	·027	·002
26	− ·005	·035
27	+ .042	+ ·003
28	·001	− ·022
29	·020	+ ·001
30	·020	− ·002
31	·001	·024

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Numerical Values of the Coefficients.—(Continued).

2nd Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
32	+ 0·015	− 0·008
33	·006	·015
34	·003	·015
35	·012	·001
36	·000	·018
37	·016	+ ·001
38	·011	− ·002
39	− ·003	·012
40	+ ·008	·001
41	− ·004	·009
42	+ ·002	·005
43	·008	+ ·002

3rd Equation. Longitude.

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
1	− 0·111	− 0·101
2	+ ·096	+ ·107
3	·097	·104
4	− ·098	− ·086
5	·098	·085
6	+ ·082	+ ·087
7	·081	·085
8	− ·086	− ·076
9	+ ·076	+ ·079
10	− ·078	− ·066
11	+ ·069	+ ·071

3rd Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
12	− 0·068	− 0·062
13	+ ·066	+ ·065
14	− ·070	− ·064
15	·068	·058
16	+ ·051	+ ·062
17	·054	·061
18	− ·058	− ·045
19	+ ·050	+ ·053
20	− ·055	− ·045
21	+ ·045	+ ·049
22	− ·049	− ·037
23	+ ·038	+ ·043
24	− ·045	− ·033
25	+ ·030	+ ·036
26	− ·036	− ·024
27	+ ·019	+ ·030
28	− ·033	− ·022
29	+ ·021	+ ·027
30	·021	·028
31	− ·027	− ·016
32	+ ·020	+ ·025
33	− ·024	− ·015
34	− ·022	− ·015
35	+ ·013	+ ·017
36	− ·020	− ·009
37	+ ·006	+ ·015

3rd Equation—(Continued).

Equalizing Factor = 15.

No. of Circuit Triangle	Coefficients of y and z: b	c
38	+ 0·009	+ 0·017
39	− ·014	− ·004
40	+ ·006	+ ·012
41	− ·008	·000
42	+ ·005	·008
43	·001	·005

4th Equation. Azimuth.

Equalizing Factor = 1.

No. of Circuit Triangle	Coefficients of y and z: b	c
1	− 1·050	− 1·045
2	+ 1·043	+ 1·049
3	1·044	1·047
4	− 1·045	− 1·039
5	1·045	1·038
6	+ 1·037	+ 1·040
7	1·037	1·039
8	− 1·040	− 1·035
9	+ 1·035	+ 1·037
10	− 1·036	− 1·030
11	+ 1·031	+ 1·033
12	− 1·032	− 1·029
13	+ 1·031	+ 1·031
14	− 1·033	− 1·030
15	1·032	1·027
16	+ 1·024	+ 1·029
17	1·025	1·029

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Numerical Values of the Coefficients—(Continued).

No. of Circuit Triangle	Coefficients of y and z		No. of Circuit Triangle	Coefficients of y and z		No. of Circuit Triangle	Coefficients of y and z	
	b	c		b	c		b	c
4th Equation—(Continued).			*4th Equation*—(Continued).			*5th Equation*—(Continued).		
Equalizing Factor = 1.			*Equalizing Factor* = 1.			*Equalizing Factor* = 15.		
18	− 1·027	− 1·021	37	+ 1·003	+ 1·007	9	+ 0·010	+ 0·001
19	+ 1·023	+ 1·025	38	1·004	1·008	10	− ·005	− ·016
20	− 1·026	− 1·021	39	− 1·007	− 1·002	11	+ ·007	+ ·001
21	+ 1·021	+ 1·023	40	+ 1·003	+ 1·006	12	− ·006	− ·006
22	− 1·023	− 1·018	41	− 1·004	− 1·000			
23	+ 1·018	+ 1·020	42	+ 1·002	+ 1·004	*6th Equation. Longitude.*		
24	− 1·022	− 1·016	43	1·001	1·002	*Equalizing Factor* = 15.		
25	+ 1·014	+ 1·017	44	− 1·000	− 1·000	1	− 0·046	− 0·035
26	− 1·017	− 1·011				2	+ ·029	+ ·042
27	+ 1·009	+ 1·014	*5th Equation. Latitude.*			3	·031	·038
28	− 1·016	− 1·011	*Equalizing Factor* = 15.			4	− ·033	− ·019
29	+ 1·010	+ 1·013	1	+ 0·001	− 0·022	5	·033	·018
30	1·010	1·014	2	·026	·019	6	+ ·015	+ ·022
31	− 1·013	− 1·007	3	·020	·004	7	·014	·019
32	+ 1·009	+ 1·012	4	·005	·024	8	− ·021	− ·010
33	− 1·011	− 1·007	5	·006	·026	9	+ ·010	+ ·014
34	1·011	1·007	6	·015	·005	10	− ·012	·001
35	+ 1·006	+ 1·008	7	·016	+ ·004	11	+ ·001	·006
36	− 1·010	− 1·004	8	− ·002	− ·013	12	− ·002	·004

13. *The Weights of the Angles.*

The principles on which the weights of the unknown quantities have been calculated, are the same as have been already described in Section 2 of Chapter II and Section 13 of Chapter III, and no further explanation is here required.

The first table on the following page gives the data from which the values of e_1, e_2 and e_3 were determined for each group of figures; also the approximate values of e_3 which are given by each figure. The second table gives a synopsis of the values of ρ^2, with the evidence for their determination; the data adopted for their calculation are indicated in continuation, at the commencement of page 23.

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Data for the Calculation of ρ.

Group	Figure or Triangle	Hills or Plains	Data for e_1: Number of Angles t	Data for e_1: Sum of Preliminary Weights $[w]$	Data for e_2: Number of Triangles	Data for e_2: Sum of Squares of Triangular Errors	Data for e_3: Number of Geometrical Equations n	Data for e_3: Average of Preliminary Weights w_0	Data for e_3: $[wx^2]$	Data for e_3: $\frac{[wx^2]}{w_0}$	Approximate Single Values of e_3
I	Triangles 1 to 9	H	27	28·69	9	257·25					
	Fig. 1	,,	18	15·89	6	79·36	8	0·88	17·53	19·92	±1·58
	,, 2	,,	8	10·18	3	3·44	4	1·27	3·18	2·50	·79
	Triangles 15 to 17	P	9	8·95	3	16·40					
	Totals		62	63·71	21	356·45	12			22·42	
II	Triangles 18 to 27	P	30	35·52	10	49·50					
	Fig. 3	,,	18	44·52	6	57·77	8	2.47	41·32	16·73	±1·45
	Totals		48	80·04	16	107·27	8			16·73	
III	Fig. 4	P	18	19·14	6	184·94	8	1·06	41·38	39·04	±2·21
	,, 5	,,	18	13·09	6	175·79	8	0.73	35·97	49·28	2·48
	,, 6	,,	15	11·23	5	22·78	7	0·75	9·68	12.90	1·36
	,, 7	,,	9	5·37	3	12·59	5	0·60	3·76	6·27	1·12
	Totals		60	48·83	20	396·10	28			107·49	

Synopsis of the Values of ρ^2, and the Evidence for their Determination.

Group	Hills or Plains	Number of Angles	Instrument	Arc between Circle Readings	Number of Measures on each Zero	Minimum number of Measures	e_1	e_2	e_3	ρ^2
				° ′						
				*10 0	1	10				
				10 0	1	12				
I	H,P	62	Harris and Barrow's 15-inch	12 0	2	20	±0·987	±2·379	±1·367	·25
				10 0	2	24				
				5 0	2	48				
II	P	48	Troughton and Simms' 18-inch No. 2	10 0	2	24	0·774	1·495	1·446	·26
III	,,	60	Cary's 15-inch	10 0	2	24	1·108	2·569	1·959	·31

* Only one angle was so measured, and one pair of zeros was omitted thus giving 10 measures instead of 12.

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The triangulation was executed with Harris and Barrow's 15-inch, Troughton and Simms' 18-inch No. 2, and Cary's 15-inch theodolites.

For Groups I and III, which were executed with the two 15-inch theodolites, the mean values of e_2 and e_3 from both groups was employed for the denominator of ρ.

For Group II a mean value of e_2 and e_3 for the group was used.

The Absolute Weights of the Figurally Corrected Angles with the Data for their Determination.

All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$	All Angles in Triangles	Figure	w_o	ρ^2	$\frac{t}{t-n}$	$w_c = w_o \cdot \frac{\rho^2 t}{t-n}$
1		1·9	ρ^2_1, 0·25	3 ÷ 2, 1·5	0·72	19		1·0	ρ^2_2, 0·26	3 ÷ 2, 1·5	0·39
2		0·6	„	3 2, 1·5	0·23	20		1·1	„	3 2, 1·5	0·43
3		1·4	„	3 2, 1·5	0·53	21		1·8	„	3 2, 1·5	0·70
4		0·9	„	3 2, 1·5	0·34	22		0·9	„	3 2, 1·5	0·35
5		0·9	„	3 2, 1·5	0·34	23		0·9	„	3 2, 1·5	0·35
6		0·9	„	3 2, 1·5	0·34	24		0·9	„	3 2, 1·5	0·35
7		1·1	„	3 2, 1·5	0·42	25		1·4	„	3 2, 1·5	0·55
8		1·4	„	3 2, 1·5	0·53	26		1·6	„	3 2, 1·5	0·62
9		0·6	„	3 2, 1·5	0·23	27		1·3	„	3 2, 1·5	0·51
10—12	1	0·9	„	18 10, 1·8	0·41	28—31	3	2·5	„	18 10, 1·8	1·18
13,14	2	1·3	„	8 4, 2·0	0·65	32—35	4	1·1	ρ^2_3, 0·31	18 10, 1·8	0·62
15		0·7	„	3 2, 1·5	0·27	36—39	5	0·7	„	18 10, 1·8	0·39
16		1·1	„	3 2, 1·5	0·42	40—42	6	0·7	„	15 8, 1·9	0·41
17		1·2	„	3 2, 1·5	0·46	43,44	7	0·6	„	9 4, 2·3	0·43
18		1·0	ρ^2_2, 0·26	3 2, 1·5	0·39						

14. *The Coefficients of the Indeterminate Factors in the Values of the Unknown Quantities y and z.*

The analytical expressions for the values of the unknown quantities y and z in terms of the Indeterminate Factors are given by equations (69) page 61, and are repeated in Section 14 of Chapter III. The numerical values of the coefficients of the Indeterminate Factors in these expressions will now be given. For the First Reduction only four Indeterminate Factors were employed, for the Second six were wanted: but as the coefficients of the first four Indeterminate Factors of the Second Reduction are the same as those of the corresponding factors in the First, it will be sufficient to give them only once for both reductions.

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The Values of the 𝔅s and ℭs.

No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ
1st Equation. Linear.			*1st Equation*—(Continued).			*2nd Equation*—(Continued).		
1	+ 0·360	− 0·285	28	+ 0·261	− 0·279	9	+ 1·946	− 1·624
2	1·764	2·016	29	0·276	0·201	10	1·360	1·952
3	0·432	0·432	30	0·306	0·261	11	2·056	1·496
4	1·210	1·190	31	0·315	0·387	12	0·808	1·280
5	1·280	1·300	32	0·666	0·684	13	0·175	0·635
6	1·130	1·180	33	0·744	0·696	14	0·835	0·365
7	0·720	0·432	34	0·612	0·630	15	1·992	2·148
8	0·642	0·474	35	0·576	0·504	16	1·584	1·320
9	1·134	1·008	36	0·995	1·148	17	0·917	0·847
10	0·912	1·176	37	1·233	0.961	18	0·918	1·352
11	1·368	1·008	38	0·944	1·122	19	0·825	0·604
12	0·616	0·872	39	0·961	0·927	20	0·824	0·952
13	0·135	0·450	40	0·840	0·960	21	0·415	0·455
14	0·660	0·240	41	0·912	1·056	22	0·820	1·250
15	1·584	1·548	42	0·888	1·704	23	0·880	0·770
16	1·264	1·160	43	1·600	0·824	24	0·760	0·980
17	0·728	0·763	44	0·912	0·816	25	0·504	0·288
18	0·927	1·114				26	0·228	0·582
19	0·714	0·587	*2nd Equation. Latitude.*			27	0·787	0·345
20	0·888	0·840	1	+ 0·690	− 0·720	28	0·111	0·204
21	0·405	0·495	2	3·934	4·172	29	0·174	0·078
22	1·010	1·210	3	0·990	0·864	30	0·192	0·114
23	0·990	0·990	4	2·210	2·440	31	0·111	0·213
24	1·100	1·030	5	2·360	2·650	32	0·348	0·282
25	0·642	0·474	6	2·070	2·040	33	0·234	0·324
26	0·462	0·708	7	1·336	0·728	34	0·186	0·300
27	1·209	0·663	8	0·990	0·864	35	0·228	0·132

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The Values of the **B***s and* **C***s*.—(Continued).

2nd Equation—(Continued).

No. of Circuit Triangle	B	C
36	+ 0·238	− 0·476
37	0·374	0·162
38	0·306	0·204
39	0·068	0·264
40	0·208	0·128
41	0·016	0·176
42	0·104	0·136
43	0·168	0·048

3rd Equation. Longitude.

No. of Circuit Triangle	B	C
1	− 0·910	− 0·685
2	+ 1·750	+ 2·506
3	0·816	0·996
4	− 1·660	− 1·090
5	1·690	1·060
6	+ 1·130	+ 1·400
7	0·920	1·064
8	− 0·864	− 0·594
9	+ 1·554	+ 1·722
10	− 1·080	− 0·648
11	+ 0·792	+ 0·888
12	− 0·880	− 0·688
13	+ 0·500	+ 0·485
14	− 0·580	− 0·430
15	1·380	0·876
16	+ 0·496	+ 0·856
17	0·490	0·721

3rd Equation—(Continued).

No. of Circuit Triangle	B	C
18	− 0·901	− 0·417
19	+ 0·595	+ 0·723
20	− 0·776	− 0·416
21	+ 0·310	+ 0·400
22	− 0·900	− 0·390
23	+ 0·500	+ 0·710
24	− 0·860	− 0·320
25	+ 0·204	+ 0·384
26	− 0·432	− 0·108
27	+ 0·085	+ 0·397
28	− 0·192	− 0·057
29	+ 0·069	+ 0·150
30	0·063	0·162
31	− 0·168	− 0·024
32	+ 0·132	+ ·0·276
33	− 0·282	− 0·066
34	0·270	0·072
35	+ 0·084	+ 0·192
36	− 0·391	+ 0·017
37	0·034	0·298
38	0·000	0·332
39	0·306	0·077
40	0·000	0·216
41	0·208	0·104
42	+ 0·016	0·136
43	− 0·024	0·096

4th Equation. Azimuth.

No. of Circuit Triangle	B	C
1	− 0·525	− 0·525
2	+ 1·442	+ 1·484
3	0·618	0·636
4	− 1·040	− 1·040
5	1·040	1·040
6	+ 1·040	+ 1·040
7	0·832	0·832
8	− 0·630	− 0·612
9	+ 1·428	+ 1·470
10	− 0.840	− 0·816
11	+ 0·824	+ 0·824
12	− 0·824	− 0·824
13	+ 0·515	+ 0·515
14	− 0·515	− 0·515
15	1·236	1·236
16	+ 0·808	+ 0·832
17	0·707	0·728
18	− 0·884	− 0·859
19	+ 0·859	+ 0·884
20	− 0·832	− 0·808
21	+ 0·510	+ 0·510
22	− 1·020	− 1·020
23	+ 1·020	+ 1·020
24	− 1·020	− 1·020
25	+ 0·600	+ 0·618
26	− 0·618	− 0·600
27	+ 0·657	+ 0·657

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The Values of the 𝔅s and ℭs—(Continued).

No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ	No. of Circuit Triangle	𝔅	ℭ
4th Equation—(Continued).			*4th Equation*—(Continued).			*5th Equation*—(Continued).		
28	− 0·309	− 0·300	43	+ 0·800	+ 0·800	12	− 0·064	− 0·088
29	+ 0·303	+ 0·303	44	− 0·800	− 0·800			
30	0·303	0·303				*6th Equation. Longitude.*		
31	− 0·303	− 0·303	*5th Equation. Latitude.*			1	− 0·415	− 0·190
32	+ 0·606	+ 0·606	1	+ 0·185	− 0·340	2	+ 0·308	+ 1·190
33	− 0·606	− 0·606	2	1·484	1·330	3	0·210	0·408
34	0·606	0·606	3	0·390	0·240	4	− 0·700	− 0·070
35	+ 0·606	+ 0·606	4	0·530	0·820	5	0·730	0·040
36	− 0·867	− 0·842	5	0·550	0·860	6	+ 0·110	+ 0·440
37	+ 0·842	+ 0·867	6	0·520	0·380	7	0·112	0·280
38	0·842	0·867	7	0·352	0·104	8	− 0·282	0·006
39	− 0·867	− 0·842	8	0·084	0·222	9	+ 0·126	0·378
40	+ 0·792	+ 0·816	9	0·378	0·168	10	− 0·312	0·168
41	− 0·800	− 0·800	10	0·064	0·320	11	0·040	0·128
42	+ 0·800	+ 0·800	11	0·168	0·072	12	0·104	0·136

15. *The Equations between the Indeterminate Factors and their Solution.*

In the present Section Table I gives the numerical values of the coefficients of the Indeterminate Factors, denoted by Λ', and the values of the Absolute Terms of each of the four equations, which were presented for simultaneous solution by the First Reduction of the Series. Table II is an abstract containing the first of each group of equations, which remained after the successive elimination of the Factors; these are the equations which were used in obtaining the numerical values of the factors given at the end of this section. Table III exhibits the six equations between the Indeterminate Factors denoted by Λ'', furnished by the Second Reduction; and Table IV gives the first of each group of equations remaining after the successive elimination of the Factors; these are the equations which were used in obtaining the numerical values of the factors given at the end of this section.

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The formation of the coefficients of the Factors has been sufficiently explained in Section 15 of Chapter III. It will be observed that for the first four factors in the group of equations for the Second Reduction, the coefficients are the same as for the First Reduction. A similar identity must also hold in Tables II and IV from which the numerical values of the factors are derived.

The Absolute Terms for the First Reduction are the products of those of the primary equations of condition by their respective equalizing factors, as shewn at the end of Section 10 of this Appendix. For the Second Reduction they are the residual errors remaining after the final completion of the First Reduction, also multiplied by the equalizing factors. These too will be found at the end of Section 10.

The solution was performed with the aid of the 5-place Logarithm Tables—comprised in three 'openings'—in the *Auxiliary Tables to facilitate the Calculations of the Survey Department of India.*

TABLE I.—*First Simultaneous Reduction.*

No of Equation	The Indeterminate Factors, and their Coefficients before Solution				The Absolute Terms
	$_1A'$	$_2A'$	$_3A'$	$_4A'$	
1	+30·649	+29·168	− 3·848	+ 1·512	+ 9·078
2	+29·168	+42·462	− 0·164	+ 6·763	+15·030
3	− 3·848	− 0·164	+50·286	+49·562	+ 4·605
4	+ 1·512	+ 6·763	+49·562	+69·479	+ 8·284

TABLE II.—*First Simultaneous Reduction.*

No. of Equation	The Indeterminate Factors, and their Coefficients after the Successive Elimination				The Absolute Terms
	$_1A'$	$_2A'$	$_3A'$	$_4A'$	
1	+30·649	+29.168	− 3·848	+ 1·512	+ 9·078
2		+14.703	+ 3·498	+ 5·324	+ 6·390
3			+48·971	+48·485	+ 4·224
4				+19·472	+ 1·343

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Table III.—*Second Simultaneous Reduction.*

No. of Equation	The Indeterminate Factors, and their Coefficients before Solution						The Absolute Terms
	$_1\Lambda''$	$_2\Lambda''$	$_3\Lambda''$	$_4\Lambda''$	$_5\Lambda''$	$_6\Lambda''$	
1	+30·649	+29·168	− 3·848	+ 1·512	+3·754	−1·829	−0·003
2	+29·168	+42·462	− 0·164	+ 6·763	+7·529	−2·819	−0·090
3	− 3·848	− 0·164	+50·286	+49·562	+2·229	+8·958	−0·075
4	+ 1·512	+ 6·763	+49·562	+69·479	+2·364	+6·453	−0·018
5	+ 3·754	+ 7·529	+ 2·229	+ 2·364	+2·342	−0·147	+1·50
6	− 1·829	− 2·819	+ 8·958	+ 6·453	−0·147	+2·886	−0·30

Table IV.—*Second Simultaneous Reduction.*

No. of Equation	The Indeterminate Factors, and their Coefficients, after the Successive Eliminations						The Absolute Terms
	$_1\Lambda''$	$_2\Lambda''$	$_3\Lambda''$	$_4\Lambda''$	$_5\Lambda''$	$_6\Lambda''$	
1	+30·649	+29·168	− 3·848	+ 1·512	+3·754	−1·829	−0·003
2		+14·703	+ 3·498	+ 5·324	+3·956	−1·078	−0·087
3			+48·971	+48·485	+1·759	+8·984	−0·054
4				+19·472	−0·995	−1·962	+0·067
5					+0·704	−0·056	+1·528
6						+0·848	−0·167

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The Values of the Factors to 3 places of decimals, as deduced from the equations in Tables II and IV are now given.

The Values of the Indeterminate Factors.

First Simultaneous Reduction.

$${}_1\Lambda' = -0{\cdot}091;\quad {}_2\Lambda' = +0{\cdot}406;\quad {}_3\Lambda' = +0{\cdot}018;\quad {}_4\Lambda' = +0{\cdot}069.$$

Second Simultaneous Reduction.

$${}_1\Lambda'' = +0{\cdot}275;\quad {}_2\Lambda'' = -0{\cdot}602;\quad {}_3\Lambda'' = -0{\cdot}135;$$

$${}_4\Lambda'' = +\ {\cdot}094;\quad {}_5\Lambda'' = +2{\cdot}155;\quad {}_6\Lambda'' = -\ {\cdot}197.$$

16. *The Final Values of the Angular Errors x, y and z.*

The same formulæ which were employed for calculating the angular errors of the North-East Quadrilateral, and which are given in Section 16 of Chapter III, were employed here also.

Making use of the Λ's furnished by the First Reduction the first portions of x, y and z were obtained. Afterwards, the second portions were derived with the Λ"s furnished by the Second Reduction. Thus—see page 242—denoting the two portions of y_p, obtained by the First and Second Reductions, by y_p (1) and y_p (2) we have

$$y_p\,(1) = +\frac{u_p}{3}\left\{2\sum_1^n[f\mathfrak{b}_p\,\Lambda'] - \sum_1^n[f\mathfrak{c}_p\,\Lambda']\right\}$$

and

$$y_p\,(2) = +\frac{u_p}{3}\left\{2\sum_1^n[f\mathfrak{b}_p\,\Lambda''] - \sum_1^n[f\mathfrak{c}_p\,\Lambda'']\right\}$$

The several components of the angular errors are given in the following table, being distinguished by the numbers (1), (2) and (3).

(1). The values given by the First Simultaneous Reduction.

(2). The values given by the Second Simultaneous Reduction; and

(3). The Arbitrary Adjustments.

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Final Values of the Angular Errors.

No. of Triangle		x	y	z	No. of Triangle		x	y	z	No. of Triangle		x	y	z
		″	″	″			″	″	″			″	″	″
	(1)	+ ·12	+ ·20	− ·32		(1)	− ·23	+ ·59	− ·36		(1)	+ ·08	− ·01	− ·07
	(2)	+ ·06	+ ·23	− ·30		(2)	+ ·16	− ·60	+ ·44		(2)	− ·01	+ ·02	− ·01
1		+ ·18	+ ·43	− ·61	16		− ·07	− ·01	+ ·08	31		+ ·07	+ ·01	− ·08
	(1)	− ·21	+ 1·57	− 1·36		(1)	− ·15	+ ·36	− ·21		(1)	− ·11	+ ·12	− ·01
	(2)	+ ·19	+ 1·15	− 1·34		(2)	+ ·08	− ·35	+ ·27		(2)	− ·03	+ ·02	+ ·01
2		− ·02	+ 2·72	− 2·70	17		− ·07	+ ·01	+ ·06	32		− ·14	+ ·14	·00
	(1)	− ·17	+ ·42	− ·25		(1)	+ ·30	+ ·21	− ·51		(1)	+ ·13	− ·02	− ·11
	(2)	·00	+ ·27	− ·27		(2)	− ·22	− ·26	+ ·48		(2)	·00	+ ·05	− ·05
3		− ·17	+ ·69	− ·52	18		+ ·08	− ·05	− ·03	33		+ ·13	+ ·03	− ·16
	(1)	+ ·29	+ ·69	− ·98		(1)	− ·22	+ ·34	− ·12		(1)	+ ·14	− ·03	− ·11
	(2)	+ ·15	+ ·41	− ·56		(2)	+ ·11	− ·30	+ ·19		(2)	·00	+ ·04	− ·04
4		+ ·44	+ 1·10	− 1·54	19		− ·11	+ ·04	+ ·07	34		+ ·14	+ ·01	− ·15
	(1)	+ ·31	+ ·74	− 1·05		(1)	+ ·19	+ ·18	− ·37		(1)	− ·12	+ ·08	+ ·04
	(2)	+ ·17	+ ·39	− ·56		(2)	− ·10	− ·22	+ ·32		(2)	− ·04	+ ·07	− ·03
5		+ ·48	+ 1·13	− 1·61	20		+ ·09	− ·04	− ·05	35		− ·16	+ ·15	+ ·01
	(1)	− ·21	+ ·83	− ·62		(1)	− ·07	+ ·17	− ·10		(1)	+ ·21	− ·06	− ·15
	(2)	− ·01	+ ·11	− ·10		(2)	·00	− ·13	+ ·13		(2)	+ ·01	+ ·10	− ·11
6		− ·22	+ ·94	− ·72	21		− ·07	+ ·04	+ ·03	36		+ ·22	+ ·04	− ·26
	(1)	− ·37	+ ·55	− ·18		(1)	+ ·32	+ ·15	− ·47		(1)	− ·19	+ ·10	+ ·09
	(2)	− ·06	+ ·09	− ·03		(2)	− ·18	− ·19	+ ·37		(2)	− ·06	+ ·19	− ·13
7		− ·43	+ ·64	− ·21	22		+ ·14	− ·04	− ·10	37		− ·25	+ ·29	− ·04
	(1)	+ ·07	+ ·29	− ·36		(1)	− ·21	+ ·35	− ·14		(1)	− ·19	+ ·10	+ ·09
	(2)	+ ·20	− ·13	− ·07		(2)	+ ·04	− ·23	+ ·19		(2)	·00	+ ·15	− ·15
8		+ ·27	+ ·16	− ·43	23		− ·17	+ ·12	+ ·05	38		− ·19	+ ·25	− ·06
	(1)	− ·38	+ ·82	− ·44		(1)	+ ·26	+ ·12	− ·38		(1)	+ ·21	− ·13	− ·08
	(2)	− ·02	− ·15	+ ·17		(2)	− ·12	− ·13	+ ·25		(2)	+ ·01	+ ·19	− ·18
9		− ·40	+ ·67	− ·27	24		+ ·14	− ·01	− ·13	39		+ ·20	+ ·06	− ·26
	(1)	+ ·36	+ ·39	− ·75		(1)	− ·16	+ ·19	− ·03		(1)	− ·16	+ ·06	+ ·10
	(2)	+ ·16	− ·30	+ ·14		(2)	+ ·05	− ·10	+ ·05		(2)	− ·04	+ ·19	− ·15
10		+ ·52	+ ·09	− ·61	25		− ·11	+ ·09	+ ·02	40		− ·20	+ ·25	− ·05
	(1)	− ·34	+ ·78	− ·44		(1)	+ ·22	·00	− ·22		(1)	+ ·16	− ·13	− ·03
	(2)	+ ·12	− ·52	+ ·40		(2)	− ·11	− ·01	+ ·12		(2)	+ ·08	+ ·19	− ·27
11		− ·22	+ ·26	− ·04	26		+ ·11	− ·01	− ·10	41		+ ·24	+ ·06	− ·30
	(1)	+ ·31	+ ·20	− ·51		(1)	− ·23	+ ·26	− ·03		(1)	− ·18	+ ·02	+ ·16
	(2)	+ ·06	− ·39	+ ·33		(2)	+ ·06	− ·09	+ ·03		(2)	+ ·08	+ ·25	− ·33
12		+ ·37	− ·19	− ·18	27		− ·17	+ ·17	·00	42		− ·10	+ ·27	− ·17
	(1)	+ ·07	+ ·10	− ·17		(1)	+ ·08	·00	− ·08		(1)	− ·09	− ·02	+ ·11
	(2)	− ·16	− ·08	+ ·24		(2)	− ·03	·00	+ ·03		(2)	− ·29	+ ·42	− ·13
13		− ·09	+ ·02	+ ·07	28		+ ·05	·00	− ·05	43		− ·38	+ ·40	− ·02
	(1)	− ·06	+ ·23	− ·17		(1)	− ·08	+ ·07	+ ·01		(1)	+ ·12	− ·14	+ ·02
	(2)	+ ·13	− ·29	+ ·16		(2)	+ ·01	− ·01	·00		(2)	+ ·12	+ ·18	− ·30
14		+ ·07	− ·06	− ·01	29		− ·07	+ ·06	+ ·01		(3)	− ·03	+ ·09	− ·06
										44		+ ·21	+ ·13	− ·34
	(1)	+ ·27	+ ·56	− ·83		(1)	− ·07	+ ·07	·00					
	(2)	− ·16	− ·70	+ ·86		(2)	+ ·00	− ·01	+ ·01					
15		+ ·11	− ·14	+ ·03	30		− ·07	+ ·06	+ ·01					

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The values of the Angular Errors are the results of the general solution of the problem that was presented by the Budhon Meridional Series. The first components of the errors were severally applied with changed signs, to the values of the figurally corrected angles given in the first table of Section 8 before the second components were obtained. The corrected sides and angles are shewn in the second table in Section 8; and with these the new values of latitude, longitude and azimuth in the second table of Section 9 were obtained. The second components of the errors were in turn applied to the corrected angles in the second table of Section 8 and the resulting changes in angles and sides applied to finally correcting the values of latitude, longitude and azimuth in the second table of Section 9. After these final corrections, the closing values in latitude and longitude at Ráepur Station agreed exactly but there were small residuals at Mahesari Station in latitude, longitude and azimuth and in the closing value of the side Mahesari-Sheopuri, *viz.*,

Latitude	+ 0″·005
Longitude	− 0·004
Azimuth	− 0·027
Log side	+ 1·8 in the 7th place of decimals.

The discrepancies in latitude and longitude being so small were allowed to stand, but those in azimuth and side were reduced by the arbitrary corrections in triangle No. 44, shewn on the preceding page, the former to +0″·003 and the latter to zero.

January, 1882.

W. H. COLE.

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APPENDIX.

No. 2.

REDUCTION OF THE NORTH-EAST QUADRILATERAL.

THE NON-CIRCUIT TRIANGLES AND THEIR FINAL FIGURAL ADJUSTMENTS.

The primary chains of triangles being composed of various compound trigonometrical figures, as well as single triangles, and only as many triangles of those figures having been introduced into the Simultaneous Reduction as were necessary for the construction of the circuits—for reasons already explained at page 45—it remained, on the completion of the said reduction, to bring the excluded or *non*-circuit triangles of each figure into adjustment with the circuit triangles. This had to be done by the calculation of certain corrections to be applied to the excluded angles only, so as to produce consistency without disturbing the included angles, the values of which by the Simultaneous Reduction must necessarily be regarded as final.

The details of the corrections to the *Non*-circuit angles form the subject of this Appendix. They present themselves in groups which are referred to by the numbers of the figures to which they respectively appertain.

In explanation it is only necessary to say that, since the values of the angles entering the Circuit triangles might not alter, each group of *Non*-circuit triangles had to be adjusted so as to satisfy the following conditions, *viz.*,

1. That at any station falling within the circuit at which angles had been measured completely round the horizon, the sum of the *Non*-circuit angles + the sum of the Circuit angles should be equal to 360°.

2. That the ratios of sides common both to Circuit and *Non*-circuit triangles, must be the same by the latter as by the former.

3. That the algebraical sum of the corrections to the angles of each *Non*-circuit triangle should = 0.

These three conditions alone sufficed, in every case save one, to furnish the necessary equations of condition for reducing the angles.*

The number of equations in each group ranges from 2 to 16. When only two presented themselves

* The exception is Figure No. 35 which falls within the Eastern Frontier Series—Section 23° to 26°. In this figure there are ten triangles numbered 677 to 686. The first six of these connect sides of Circuit triangles and are therefore governed by the same conditions, Nos. 1 to 3, as other *Non*-circuit triangles; but the last four do not connect sides of Circuit triangles; they, however, with Nos. 681 and 682 form a polygon round Mama Bhagna Tíla (Station xxvi), and thus furnish, in addition to the triangular equations given by the 3rd condition, one *central* equation and one *side* equation of the forms described on page 26, Chapter II.

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the case was that of a triangle of which two sides and the included angle had been fixed by the Simultaneous Reduction, and the unknown quantities were the errors of the other two angles. Conditions Nos. 2 and 3 furnished the necessary equations; and being equal in number to the unknown quantities they have been solved algebraically as ordinary simultaneous equations.

In all other cases the unknown quantities are greater in number than the equations connecting them; the latter had therefore to be solved by the method of minimum squares, the weights of the angles in each group being considered equal.

The following table exhibits the number of groups of *Non*-circuit triangles in each Series, classed according to the number of equations of condition which each furnishes.

Series	Equations of Condition									Total for each Series	
	2	3	4	5	7	8	10	12	16	Groups	Triangles
	Number of Groups										
North-East Longitudinal ...	7		2							9	11
Budhon Meridional ...	2		4	1						7	13
Rangír Meridional ...	1									1	1
Karára „ ...	2								1	3	10
Gora „ ...	1		1							2	3
Hurîláong „ ...	1		1					1		3	9
Chendwár „ ...	1		2							3	5
North Malúncha Meridional ...			1	2						3	8
East Calcutta Longitudinal ...	1		1							2	3
Brahmaputra ...			10							10	20
Eastern Frontier, Sec. 23° to 26°	2	1	5			1	1	1		11	30
Assam Longitudinal ...	2	1	5		1	1				10	21
Totals,	20	2	32	3	1	2	1	2	1	64	134

The 64 groups involve 402 angles, or more than one-sixth of the whole of the angles contained in the Quadrilateral; the magnitudes of the final corrections and the number of corrections of each magnitude are as follows:—

161 errors between 0″·0 and 0″·1	88 errors between 0″·1 and 0″·2	59 errors between 0″·2 and 0″·3
28 „ „ 0·3 „ 0·4	23 „ „ 0·4 „ 0·5	15 „ „ 0·5 „ 0·6
12 „ „ 0·6 „ 0·7	2 „ „ 0·7 „ 0·8	4 „ „ 0·8 „ 0·9
2 „ „ 0·9 „ 1·0	1 error between 1·0 „ 1·1	2 „ „ 1·1 „ 1·2
1 error between 1·2 „ 1·3	1 „ „ 1·5 „ 1·6	1 error between 1·6 „ 1·7
1 „ „ 1·9 „ 2·0	1 „ „ 2·4 „ 2·5	

In the pages of tabular matter which follow, are given, separately for each Series, the data of the *Non*-circuit triangles similar to those of the Circuit triangles shewn on pages 92 to 112, and in the same terms

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with them; these are followed by the "Final Figural Adjustments" of the groups. In connection with the sides and angles are shewn first the Figure to which each *Non*-circuit triangle belongs, secondly, the number of the triangle, and thirdly the Figural numbers of the angles employed in the Preliminary Reductions and again made use of here, as shewn on the Plates at the end of the numerical details of each Series. In the column giving the serial number of the station, those stations of which the positions stand fixed by the Simultaneous Reduction are printed in Roman type, the rest in Italic type.

In the abstracts of the final adjustments, each group of triangles is designated by the figure to which it appertains and by the numbers of triangles it includes. The constants furnished by the Simultaneous Reduction are given, with a reference to the page from which they are taken; these are followed by the equations of condition which have to be satisfied, and where the method of minimum squares has been employed, by the equations between the Indeterminate Factors, and the values of these factors. Lastly are shewn the *adopted* angular errors. They are so designated because they differ occasionally, but only in the last place of decimals, from those which actually resulted from the calculations; slight arbitrary corrections having been applied in order to make the logarithmic values of common sides agree where the number of places of decimals employed in the calculations had not sufficed to do so.

Two examples of the process of reduction will now be given.

Example 1.—Figure 14, a hexagon (see the Reduction Chart and the Plate at the end of the details of the Huríláong Meridional Series) of which the four Triangles 225 to 228 were fixed by the Circuit chains; Triangles 601 and 602 have now to be adjusted. The constants known are, sides V to VII and VII to X and the angle contained between them; hence the equations to be satisfied are, two triangular, one central and one side. Stated symbolically they are:—

Triangular $\begin{cases} x_{16} + x_{17} + x_{18} = e_1 \\ x_{13} + x_{14} + x_{15} = e_2 \end{cases}$

Central . . . . $x_{16} + x_{13} = e_3$

Side . . . . $\left.\begin{matrix} \text{t.d. log sin } 18 \times x_{18} - \text{t.d. log sin } 17 \times x_{17} \\ + \text{ t.d. log sin } 15 \times x_{15} - \text{t.d. log sin } 14 \times x_{14} \end{matrix}\right\}$* . . . . $= e_4$

the 7th place of logs being taken as unity.

The errors e_1, e_2, e_3 and e_4 are found as follows:—

e_1 and e_2 (the errors of Triangles 601 and 602) are each = 0

$$e_3 = \begin{cases} 109^\circ\ 19'\ 6''\cdot71 & \text{. . Angles 16 + 13 of Triangles 601 and 602, p. 52.} \\ -109\ \ 19\ \ 5\ \cdot59 & \text{. . } 360^\circ - \text{Angles } 1+4+7+10 \text{ of Triangles 225, 226, 227 \& 228, p. } \sout{44}\text{—}P. \end{cases}$$

$$= +1''\cdot12$$

$$e_4 = 10{,}000{,}000 \begin{cases} \{\log[\text{VII to X}] - \log[\text{V to VII}]\} & \text{. . . Triangles 602 and 601, p. 52.} \\ -\{\log[\text{VII to X}] - \log[\text{V to VII}]\} & \text{. . . ,, 228 \& 225, p. } \sout{44}\text{—}P. \end{cases}$$

$$= 10{,}000{,}000\ \{(4\cdot7911420{,}8 - 5\cdot2081686{,}0) - (4\cdot7911364{,}4 - 5\cdot2081660{,}2)\}$$

$$= +30\cdot6$$

* See the foot-note on page 27, Chapter II.

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Example 2.—Figure 39 is a double polygon (see Reduction Chart, and Plate 2 of the Eastern Frontier Series—Section 23° to 26°). Triangles 542 to 546 were fixed by the Circuit chains; Triangles 668 to 671 have now to be adjusted. The constants known and the symbolical expressions of the equations are given in full on page 77, and need not be repeated here. Stated generally, the equations to be satisfied are, four triangular, two central, and two side. The absolute terms are found as follows, the *variables* in all cases being taken from this Appendix and the *constants* from the final results of the Simultaneous Reduction.

Triangular . . . e_1, e_2, e_3 and e_4 (the errors of Triangles 668 to 671) are each = 0

Central

$$e_5 = \left\{ \begin{array}{l} 184^\circ\ 34'\ 33''\cdot 359 \\ -184\ \ 34\ \ 33\ \cdot 757 \end{array} \right\} \begin{array}{l} \ldots \text{Angles } 4 + 7 + 10 \text{ of Triangles 671, 670 and 669, page 70.} \\ \ldots 360^\circ - \text{Angles } 13 + 16 + 1 \text{ of Triangles 544 to 546, page } 85\text{—}_W. \end{array}$$

$$= -0''\cdot 398$$

$$e_6 = \left\{ \begin{array}{l} 159^\circ\ 34'\ 51''\cdot 912 \\ -159\ \ 34\ \ 52\ \cdot 365 \end{array} \right\} \begin{array}{l} \ldots \text{Angles } 12 + 19 \text{ of Triangles 669 and 668, page 70.} \\ \ldots 360^\circ - \text{Angles } 22 + 25 + 14 \text{ of Triangles 542 to 544, pages } 85\text{—}_W \text{ and } 86\text{—}_W. \end{array}$$

$$= -0''\cdot 453$$

Side

$$e_7 = 10{,}000{,}000 \left\{ \begin{array}{l} \{\log\ [\text{XL to XLIV}] - \log\ [\text{XXXVIII to XL}]\} \\ -\{\log\ [\text{XL to XLIV}] - \log\ [\text{XXXVIII to XL}]\} \end{array} \right\} \begin{array}{l} . \text{ Triangles 669 \& 671, page 70.} \\ . \quad ,, \quad 544 \text{ \& } 546, \ ,, \ 85\text{—}_W. \end{array}$$

$$= 10{,}000{,}000 \left\{ (4\cdot 8075974{,}2 - 4\cdot 7434846{,}9) - (4\cdot 8076063{,}5 - 4\cdot 7434937{,}1) \right\}$$

$$= +\ 0\cdot 9$$

$$e_8 = 10{,}000{,}000 \left\{ \begin{array}{l} \{\log\ [\text{XLIV to XLV}] - \log\ [\text{XL to XLIV}]\} \\ -\{\log\ [\text{XLIV to XLV}] - \log\ [\text{XL to XLIV}]\} \end{array} \right\} \begin{array}{l} . \text{ Triangles 668 \& 669, page 70.} \\ . \quad ,, \ 542 \text{ \& } 544, \text{ pp. } 85\text{—}_W \text{ \& } 86\text{—}_W. \end{array}$$

$$= 10{,}000{,}000 \left\{ (4\cdot 7503366{,}9 - 4\cdot 8075974{,}2) - (4\cdot 7503458{,}6 - 4\cdot 8076063{,}5) \right\}$$

$$= -\ 2\cdot 4$$

Thus the whole of the principal triangulation of the North-East Quadrilateral has been made consistent, *inter se*, so that if the co-ordinates of any one station are computed from the given co-ordinates of any other station, or the length and azimuth of any side from the corresponding values of any other side, the results will always be the same by whatever possible route they are calculated.

The values of the final angles corrected for Figural and Circuit or *Non*-circuit error—as the case may be—are given for each Series among the details of the calculations of the principal triangles at pages 142—_I, 45—_J, 31—_K, 27—_L, 39—_M of Part II of this Volume, and pages 27—_N, 46—_O, 43—_P, 41—_Q, 27—_R, 37—_S, 49—_T, 56—_U, 71—_V, 81—_W, and 66—_X of Volume VIII.

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Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″							° ′ ″		
		5	A* LIV	83 18 46·49	1·05	5·2235712,0			18	I C	57 39 18·87	·20	4·7223584,2
1	579	4	I I	65 23 37·77	1·05	5·1851911,2	6	618	16	CII	61 34 22·36	·20	4·7397798,0
		6	A LII	31 17 35·74	1·05	4·9420533,4			17	*CIV*	60 46 18·77	·20	4·7364381,2
		8	LII	48 41 18·79	1·75	5·1529618,2			15	*CIV*	64 56 1·47	·20	4·7528491,0
,,	578	7	I I	69 12 51·38	1·76	5·2480171,0	,,	617	13	CII	57 27 29·08	·19	4·7216345,3
		9	III	62 5 49·83	1·75	5·2235712,0			14	CV	57 36 29·45	·20	4·7223584,2
		4	III	18 35 56·64	·50	5·0292853,5			26	CVIII	55 34 53·54	·21	4·7267416,4
2	577	3+2	V	144 4 3·06	·50	5·2940845,1	,,	616	25	CVI	60 52 35·20	·21	4·7516226,0
		1	VI	17 20 0·30	·49	4·9996877,2			27	CIX	63 32 31·26	·21	4·7622736,4
		4	V	41 3 53·50	2·47	5·2017297,5			18	CXX	56 14 47·74	·24	4·7640166,7
3	576	3+2	VII	84 4 25·10	2·47	5·3818945,7	7	620	16	CXXII	55 34 0·48	·24	4·7605288,0
		1	VIII	54 51 41·40	2·47	5·2968494,5			17	*CXXIII*	68 11 11·78	·25	4·8119221,5
		15	VIII	19 20 32·53	·71	4·8320377,4			15	*CXXIII*	84 41 2·62	·20	4·8391242,2
4	575	13	IX	115 4 47·50	·71	5·2689242,6	,,	619	13	CXXII	38 25 54·02	·19	4·6344938,5
		14	XII	45 34 39·97	·71	5·1657519,0			14	CXXIV	56 53 3·36	·20	4·7640166,7
		11	LVIII	57 15 58·89	·22	4·7499001,1							
5	593	10	LV	67 42 29·75	·23	4·7912701,3							
		12	LIX	55 1 31·36	·22	4·7385033,9							

Final Figural Adjustments of the Non-Circuit Triangles.

Figure 1.

Triangle 579.

Constants (from pages 23—a and 142—I).

Contained Angle.

LII to LIV	Log feet	5·1851626,8	} ...	5	... 83° 18′ 47″·65
LIV ,, I	,,	4·9420246,4			

Equations to be satisfied.	Adopted Errors.
$x_4 + x_6 = + .11$	$x_4 = + ″·03$
$35\,x_6 - 10\,x_4 = + 2·6$	$x_6 = + ·08$

* A is the serial letter for the Great Arc Series which appertains to the North-West Quadrilateral.

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 1—(Continued).

Triangle 578.

Constants (from page 142_{I}).

							Contained Angle.
LII to I	Log feet	5·2235428,1	}	...	7	...	69° 12′ 52″·94
I „ III	„	5·1529342,1					

Equations to be satisfied.					Adopted Errors.		
x_8	$+\ x_9$	=	$-$	·20	x_8	=	$-$ ″·33
$18\ x_8$	$-\ 12\ x_9$	=	$-$	7·8	x_9	=	$+$ ·13

Figure 2.

Triangle 577.

Constants (from page 143_{I}).

							Contained Angle.
III to V	Log feet	4·9996613,2	}	...	8+2	...	144° 4′ 3″·27
V „ VI	„	5·0292610,0					

Equations to be satisfied.					Adopted Errors.		
x_1	$+\ x_4$	=	$-$	·29	x_1	=	$+$ ″·02
$62\ x_4$	$-\ 68\ x_1$	=	$-$	20·5	x_4	=	$-$ ·31

Figure 3.

Triangle 576.

Constants (from page 143_{I}).

							Contained Angle.
V to VII	Log feet	5·2968281,0	}	...	8+2	...	84° 4′ 26″·61
VII „ VIII	„	5·2017094,9					

Equations to be satisfied.					Adopted Errors.		
x_1	$+\ x_4$	=	$-$	·96	x_1	=	$-$ ″·31
$24\ x_4$	$-\ 15\ x_1$	=	$-$	10·9	x_4	=	$-$ ·65

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 4.

Triangle 575.

Constants (from page 143_{-I}).

							Contained Angle.
VIII	to IX	Log feet	5·1657314,4	}	...	13	... 115° 4′ 47″·23
IX	„ XII	„	4·8320241,7				

Equations to be satisfied.

$x_{14} + x_{15} = -\cdot 98$

$60\,x_{15} - 21\,x_{14} = -68\cdot 9$

Adopted Errors.

$x_{14} = +\,''\cdot 12$

$x_{15} = -1\cdot 10$

Figure 5.

Triangle 593.

Constants (from page 147_{-I}).

							Contained Angle.
LVIII	to LV	Log feet	4·7385054,2	}	...	10	... 67° 42′ 30″·00
LV	„ LIX	„	4·7499025,7				

Equations to be satisfied.

$x_{11} + x_{12} = +\cdot 02$

$13\,x_{11} - 15\,x_{12} = -4\cdot 3$

Adopted Errors.

$x_{11} = -\,''\cdot 15$

$x_{12} = +\cdot 17$

Figure 6.

Triangles 618 and 617.

Constants (from page 151_{-I}).

							Contained Angle.
C	to CII	Log feet	4·7364566,8	}	...	16+13	... 119° 1′ 51″·76
CII	„ CV	„	4·7528678,7				

Equations to be satisfied.

					Factor
$x_{16} + x_{17} + x_{18}$	...	$= e_1$	=	·00,	λ_1
$x_{13} + x_{14} + x_{15}$	...	$= e_2$	=	·00,	λ_2
$x_{16} + x_{13}$	... ...	$= e_3$	=	+ ·07,	λ_3
$14\,x_{18} - 12\,x_{17} + 10\,x_{15}$	$- 13\,x_{14}$	$= e_4$	=	−2·1,	λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 6—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·00	+3	...	+1	+2	$\lambda_1 = -\cdot015$	$x_{13} = +''\cdot03$ $x_{16} = +''\cdot04$
2	·00		+3	+1	−3	$\lambda_2 = -\cdot021$	$x_{14} = +\cdot02$ $x_{17} = +\cdot03$
3	+ ·07		*	+2	...	$\lambda_3 = +\cdot053$	$x_{15} = -\cdot05$ $x_{18} = -\cdot07$
4	−2·1				+609	$\lambda_4 = -\cdot004$	

Figure 6—(Continued).

Triangle 616.

Constants (from pages 151—$_I$ and 152—$_I$).

						Contained Angle.
CVIII to CVI	Log feet	4·7622911,2	} ...	25	...	60° 52′ 34″·75
CVI „ CIX	„	4·7267589,4				

Equations to be satisfied.

$$x_{26} + x_{27} = -\cdot66$$
$$14\,x_{26} - 10\,x_{27} = +1\cdot8$$

Adopted Errors.

$$x_{26} = -''\cdot20$$
$$x_{27} = -\cdot46$$

Figure 7.

Triangles 620 and 619.

Constants from (page 153—$_I$).

						Contained Angle.
CXX to CXXII	Log feet	4·8119176,3	} ...	16+18	...	93° 59′ 54″·82
CXXII „ CXXIV	„	4·8391201,0				

Equations to be satisfied.

									Factor
x_{16}	+	x_{17}	+	x_{18}	...	$= e_1$	=	·00,	λ_1
x_{13}	+	x_{14}	+	x_{15}	...	$= e_2$	=	·00,	λ_2
x_{16}	+	x_{13}	...		...	$= e_3$	=	+ ·11,	λ_3
$14\,x_{18}$	−	$8\,x_{17}$	+	$2\,x_{15}$	$-\,13\,x_{14}$	$= e_4$	=	−4·0,	λ_4

* In the tables of the equations between the factors the co-efficients of the terms below the diagonal are omitted for convenience, the co-efficient of the *p*th term in the *q*th line being always the same as the co-efficient of the *q*th term in the *p*th line.

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 7 †—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·00	+3	...	+1	+6	$\lambda_1 = -\cdot010$	$x_{13} = +''\cdot02$	$x_{16} = +''\cdot09$
2	·00		+3	+1	−11	$\lambda_2 = -\cdot072$	$x_{14} = +\cdot08$	$x_{17} = +\cdot07$
3	+ ·11		*	+2	...	$\lambda_3 = +\cdot096$	$x_{15} = -\cdot10$	$x_{18} = -\cdot16$
4	−4·0				+433	$\lambda_4 = -\cdot011$		

† For figure 8 of this sequence see page 47, Rangír Series.

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Budhon Meridional Series.—Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″							° ′ ″		
1	45	18	J VIII	56 45 54·90	1·50	5·1568045,7	4	52	8	J XXXVII	48 55 49·93	0·34	4·7968785,8
		16	X	61 8 20·84	1·50	5·1767760,2			7	*XXXV*	70 3 27·57	·34	4·8927016,7
		17	XI	62 5 44·26	1·50	5·1806935,0			9	*XXXIX*	61 0 42·50	·34	4·8614258,6
,,	46	15	XI	30 52 39·61	·59	4·8830256,5	5	53	18	XXXVIII	58 50 3·46	·37	4·8615492,3
		13	X	43 41 56·42	·60	5·0121294,7			16	XL	54 31 11·82	·36	4·8400346,6
		14	XII	105 25 23·97	·60	5·1568045,7			17	XLI	66 38 44·72	·37	4·8921173,5
,,	47	12	XII	73 33 51·66	·53	5·0039719,9	,,	54	15	XLI	56 19 22·16	·36	4·8476334,5
		10	X	59 53 1·68	·53	4·9591117,5			13	XL	64 26 32·17	·37	4·8826980,0
		11	XIII	46 33 6·66	·52	4·8830256,5			14	XLIII	59 14 5·67	·37	4·8615492,3
2	48	3	*XIV*	46 7 14·12	·98	5·0124748,4	6	55	5	*XLIV*	56 29 1·37	·41	4·8802115,6
		4+5	XIII	69 18 45·98	·98	5·1257142,8			4	*XLV*	70 2 47·63	·42	4·9323008,4
		6	XV	64 33 59·90	·98	5·1103887,0			6	XLVII	53 28 11·00	·41	4·8641955,4
3	49	18	XXVIII	58 56 22·82	·33	4·8372280,6	,,	56	8	XLVII	69 13 39·70	·86	5·1642335,8
		16	XXX	66 33 57·71	·33	4·8670526,2			7	*XLV*	81 40 59·29	·87	5·1888317,1
		17	XXXI	54 29 39·47	·32	4·8150927,9			9	*XLVIII*	29 5 21·01	·86	4·8802115,6
,,	50	15	XXXI	56 7 56·35	·36	4·8497859,6	7	57	8	*XLVIII*	91 57 49·27	·94	5·2235732,6
		13	XXX	70 5 48·10	·37	4·9037888,1			7	A† *LII*	30 0 47·67	·94	4·9229722,0
		14	XXXIII	53 46 15·55	·36	4·8372280,6			9	I I	58 1 23·06	·94	5·1523580,7
4	51	5	*XXXIV*	58 29 29·77	·37	4·8614258,6							
		4	*XXXV*	54 48 30·60	·36	4·8430435,6							
		6	XXXVII	66 41 59·63	·37	4·8937525,3							

Final Figural Adjustments of the Non-Circuit Triangles.

***Figure* 1.‡**

Triangles 45 to 47.

Constants from (page 46—J).

				Contained Angle.
VIII to X	Log feet 5·1806703,8	} ...	16+13+10 ...	164° 43′ 20″·55
X ,, XIII	,, 5·0039476,2			

Equations to be satisfied. **Factor**

$$x_{16} \; ... \; + \; x_{17} \; ... \; + \; x_{18} \; ... \; = e_1 = \cdot 00, \qquad \lambda_1$$
$$x_{13} \; ... \; + \; x_{14} \; ... \; + \; x_{15} \; ... \; = e_2 = \cdot 00, \qquad \lambda_2$$
$$x_{10} \; ... \; + \; x_{11} \; ... \; + \; x_{12} \; ... \; = e_3 = \cdot 00, \qquad \lambda_3$$
$$x_{16} \; ... \; + \; x_{13} \; ... \; + \; x_{10} \; ... \; = e_4 = +1 \cdot 02, \qquad \lambda_4$$
$$14\,x_{18} - 11\,x_{17} + 36\,x_{15} + 5\,x_{14} + 7\,x_{12} - 20\,x_{11} = e_5 = +12 \cdot 5, \qquad \lambda_5$$

† A is the Serial letter for the Great Arc Series—Section 24° to 30°—which appertains to the North-West Quadrilateral.

‡ As the Budhon Series was reduced by itself and not simultaneously with the North-East Quadrilateral, the figure numbers of the former have a sequence of their own.

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Final Figural Adjustments of the Non-Circuit Triangles.

***Figure* 1—(Continued).**

Equations between the Factors							Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of							
		λ_1	λ_2	λ_3	λ_4	λ_5			
1	·00	+3	...	...	+1	+3	$\lambda_1 = -\cdot205$	$x_{10} = +''\cdot44$	$x_{15} = +''\cdot09$
2	·00		+3	...	+1	+41	$\lambda_2 = -\cdot370$	$x_{11} = -\cdot40$	$x_{16} = +\cdot37$
3	·00			+3	+1	−13	$\lambda_3 = -\cdot136$	$x_{12} = -\cdot04$	$x_{17} = -\cdot34$
4	+ 1·02		*		+3	...	$\lambda_4 = +\cdot577$	$x_{13} = +\cdot21$	$x_{18} = -\cdot03$
5	+12·5					+2087	$\lambda_5 = +\cdot013$	$x_{14} = -\cdot30$	

***Figure* 2.**

Triangle 48.

Constants (from page 46—J).

					Contained Angle.
XIII to XIV	Log feet	5·1103651,3	} ...	4+5	... 69° 18′ 47″·11
XIII „ XV	„	5·0124512,4			

Equations to be satisfied.

$$x_3 + x_6 = +\cdot15$$
$$20\,x_3 - 10\,x_6 = +\cdot3$$

Adopted Errors.

$$x_3 = +''\cdot06$$
$$x_6 = +\cdot09$$

***Figure* 3.**

Triangles 49 and 50.

Constants (from page 48—J).

					Contained Angle.
XXVIII to XXX	Log feet	4·8150686,9	} ...	16+18	... 136° 39′ 46″·33
XXX „ XXXIII	„	4·8497616,1			

Equations to be satisfied.

		Factor
$x_{16} + x_{17} + x_{18}$ ...	$= e_1 = \cdot00,$	λ_1
$x_{13} + x_{14} + x_{15}$ ...	$= e_2 = \cdot00,$	λ_2
$x_{16} + x_{13}$	$= e_3 = +\cdot18,$	λ_3
$12\,x_{18} - 15\,x_{17} + 15\,x_{15} - 15\,x_{14}$	$= e_4 = +2\cdot5,$	λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 3—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·00	+3	...	+1	−3	$\lambda_1 = -\cdot 041$	$x_{13} = +''\cdot 09$ $x_{16} = +''\cdot 09$
2	·00		+3	+1	0	$\lambda_2 = -\cdot 044$	$x_{14} = -\cdot 09$ $x_{17} = -\cdot 09$
3	+ ·18			+2	...	$\lambda_3 = +\cdot 133$	$x_{15} = \cdot 00$ $x_{18} = \cdot 00$
4	+2·5		*		+819	$\lambda_4 = +\cdot 003$	

Figure 4.

Triangles 51 and 52.

Constants (from page 48—J).

Contained Angle.

XXXIV to XXXV Log feet 4·8937283,6 }
XXXV „ XXXIX „ 4·7968539,4 } ... 4+7 ... 124° 51′ 59″·29

Equations to be satisfied. Factor

$$x_4 + x_5 + x_6 \quad ... \quad = e_1 = \cdot 00, \qquad \lambda_1$$
$$x_7 + x_8 + x_9 \quad ... \quad = e_2 = \cdot 00, \qquad \lambda_2$$
$$x_4 + x_7 \quad ... \quad ... \quad = e_3 = -\cdot 42, \qquad \lambda_3$$
$$13\,x_5 - 9\,x_6 + 18\,x_8 - 11\,x_9 = e_4 = +4\cdot 7, \qquad \lambda_4$$

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·00	+3	...	+1	+4	$\lambda_1 = +\cdot 094$	$x_4 = -''\cdot 21$ $x_7 = -''\cdot 21$
2	·00		+3	+1	+7	$\lambda_2 = +\cdot 089$	$x_5 = +\cdot 17$ $x_8 = +\cdot 18$
3	−0·42			+2	...	$\lambda_3 = -\cdot 301$	$x_6 = +\cdot 04$ $x_9 = +\cdot 03$
4	+4·7		*		+695	$\lambda_4 = +\cdot 005$	

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 5.

Triangles 53 and 54.

Constants (from page 49_{-J}).

								Contained Angle.
XXXVIII	to XL	Log feet	4·8920916,1	}	...	16+13	...	118° 57′ 44″·08
XL	„ XLIII	„	4·8476064,4					

Equations to be satisfied.

x_{16}	+	x_{17}	+	x_{18}	...		=	e_1	=	·00,		Factor	λ_1
x_{13}	+	x_{14}	+	x_{15}	...		=	e_2	=	·00,			λ_2
x_{16}	+	x_{13}	...		...		=	e_3	=	+ ·64,			λ_3
$13\,x_{18}$	−	$10\,x_{17}$	+	$14\,x_{15}$	−	$12\,x_{14}$	=	e_4	=	+12·7,			λ_4

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·00	+3	...	+1	+3	λ_1 = − ·191	x_{13} = +″·32 x_{16} = +″·32
2	·00		+3	+1	+2	λ_2 = − ·184	x_{14} = − ·46 x_{17} = − ·41
3	+ ·64		*	+2	...	λ_3 = + ·508	x_{15} = + ·14 x_{18} = + ·09
4	+12·7				+609	λ_4 = + ·022	

Figure 6.

Triangles 55 and 56.

Constants (from page 49_{-J}).

								Contained Angle.
XLIV	to XLV	Log feet	4·8641688,1	}	...	4+7	...	151° 43′ 48″·67
XLV	„ XLVIII	„	5·1642053,2					

Equations to be satisfied.

x_4	+	x_5	+	x_6	...		=	e_1	=	·00,	Factor	λ_1
x_7	+	x_8	+	x_9	...		=	e_2	=	·00,		λ_2
x_4	+	x_7	...		...		=	e_3	=	− ·46,		λ_3
$14\,x_5$	−	$16\,x_6$	+	$8\,x_8$	−	$38\,x_9$	=	e_4	=	+15·3,		λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 6—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·00	+3	...	+1	−2	$\lambda_1 = + \cdot 155$	$x_4 = -''\cdot 29$ $x_7 = -''\cdot 17$
2	·00		+3	+1	−30	$\lambda_2 = + \cdot 267$	$x_5 = + \cdot 33$ $x_8 = + \cdot 36$
3	− ·46		*	+2	...	$\lambda_3 = - \cdot 441$	$x_6 = - \cdot 04$ $x_9 = - \cdot 19$
4	+15·3				+1960	$\lambda_4 = + \cdot 012$	

Figure 7.

Triangle 57.

Constants (from pages 50_J and 142_I).

						Contained Angle.
XLVIII to LII	Log feet	5·1523301,6	} ...	7	...	30° 0′ 49″·02
LII „ I	„	5·2235428,1				

Equations to be satisfied.	Adopted Errors.
$x_8 + x_9 = + \cdot 41$	$x_8 = + 2''\cdot 40$
$- x_8 - 14\, x_9 = + 25\cdot 4$	$x_9 = - 1\cdot 99$

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Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″	
8	574	9	K XX	3 23 29·57	·03	4·4743755,1
		7	XXII	168 22 3·54	·04	5·0069111,6
		8	XXIII	8 14 26·89	·03	4·8587024,3

Final Figural Adjustments of the Non-Circuit Triangles.

Figure 8.†

Triangle 574.

Constants (from page 33—K).

Contained Angle.

XX to XXII	Log feet	4·8586873,9	} ...	7	...	168° 22′ 3″51
XXII „ XXIII	„	4·4743603,3				

Equations to be satisfied.

$x_8 + x_9 = - ·07$

$356\, x_9 - 145\, x_8 = + 1·4$

Adopted Errors.

$x_8 = - ''·05$

$x_9 = - ·02$

† Note.—In continuation of Figure 7, page 41.

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Karára Meridional Series.—Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
		4+5	B* XXIII	114 47 12·00	1·02	5·3408881,7			25	M VII	100 55 44·69	·19	4·8762855,2
9	580	3	XXVI	20 2 43·40	1·01	4·9178578,5	10	585	27	*IX*	38 40 51·44	·18	4·6801031,4
		6	M I	45 10 4·60	1·02	5·2336163,3			26	X	40 23 23·87	·18	4·6958007,8
		21	I	48 42 38·33	·70	4·9601054,6			42	*IX*	62 1 43·58	·56	4·9913707,3
10	581	19	III	56 5 49·89	·70	5·0033121,8	,,	586	40	X	75 18 56·84	·57	5·0308979,9
		20	*IV*	75 11 31·78	·70	5·0695734,0			41	*XI*	42 39 19·58	·56	4·8762855,2
		18	*IV*	53 2 21·09	·48	4·8958663,3			37	X	41 58 6·52	·65	4·9258580,8
,,	582	16	III	59 4 34·28	·49	4·9267060,5	,,	587	39	*XI*	86 59 23·57	·65	5·1000130,4
		17	*VI*	67 53 4·63	·49	4·9601054,6			38	XIII	51 2 29·91	·65	4·9913707,3
		13	III	53 50 4·12	·54	4·9448990,2			54	*XI*	50 30 6·48	·63	4·9780401,4
,,	583	15	*VI*	80 1 5·08	·54	5·0312313,5	,,	588	52	XIII	86 19 8·45	·63	5·0897259,7
		14	VII	46 8 50·80	·54	4·8958663,3			53	XIV	43 10 45·07	·63	4·9258580,8
		30	*VI*	33 39 38·80	·31	4·6958007,8			12	XIX	29 36 18·94	·14	4·6410571,2
,,	584	28	VII	66 43 36·14	·31	4·9152166,3	11	589	10	XXI	118 42 6·19	·14	4·8903759,2
		29	*IX*	79 36 45·06	·32	4·9448990,2			11	XXII	31 41 34·87	·14	4·6677747,0

Final Figural Adjustments of the Non-Circuit Triangles.

Figure 9.

Triangle 580.

Constants (from page 39—$_M$).

				Contained Angle.
XXIII to XXVI	Log feet	5·2336163,3	} ... 4+5 ...	114° 47′ 13″·59
XXIII ,, I	,,	4·9178545,2		

Equations to be satisfied.

$$x_3 + x_6 = +\ ·57$$
$$57\, x_3 - 21\, x_6 = +\ 33·3$$

Adopted Errors.

$$x_3 = +\ ''·58$$
$$x_6 = -\ ·01$$

* B is the serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 10.

Triangles 581 to 588.

Constants (from pages 89_{M} and 40_{M}).

						Contained Angles.	
I	to III	Log feet	5·0695674,2	...	19+16+13	...	169° 0′ 28″·78
III	„ VII	„	5·0312218,9	...	14+28+25	...	213 48 12 ·14
VII	„ X	„	4·6800900,2	...	26+40+37	...	157 40 29 ·02
X	„ XIII	„	5·0999923,9	...	38+52	...	137 21 39 ·73
XIII	„ XIV	„	4·9780165,9				

Equations to be satisfied.

								Factor
x_{19}	$+ x_{20}$	$+ x_{21}$	...	...	...	$= e_1$	$=$ ·00,	λ_1
x_{16}	$+ x_{17}$	$+ x_{18}$	...	...	...	$= e_2$	$=$ ·00,	λ_2
x_{13}	$+ x_{14}$	$+ x_{15}$	...	...	...	$= e_3$	$=$ ·00,	λ_3
x_{28}	$+ x_{29}$	$+ x_{30}$	...	...	...	$= e_4$	$=$ ·00,	λ_4
x_{25}	$+ x_{26}$	$+ x_{27}$	...	...	...	$= e_5$	$=$ ·00,	λ_5
x_{40}	$+ x_{41}$	$+ x_{42}$	...	...	...	$= e_6$	$=$ ·00,	λ_6
x_{37}	$+ x_{38}$	$+ x_{39}$	...	...	...	$= e_7$	$=$ ·00,	λ_7
x_{52}	$+ x_{53}$	$+ x_{54}$	...	...	...	$= e_8$	$=$ ·00,	λ_8
x_{19}	$+ x_{16}$	$+ x_{13}$	...	...	...	$= e_9$	$= +$ 1·24,	λ_9
x_{14}	$+ x_{28}$	$+ x_{25}$	...	...	...	$= e_{10}$	$= +$ ·53,	λ_{10}
x_{26}	$+ x_{40}$	$+ x_{37}$	...	...	...	$= e_{11}$	$= -$ ·39,	λ_{11}
x_{38}	$+ x_{52}$	...	...	...	...	$= e_{12}$	$= -$ ·09,	λ_{12}
$19 x_{21}$	$- 6 x_{20}$	$+ 16 x_{18}$	$- 9 x_{17}$	$+ 3 x_{15}$	$- 20 x_{14}$	$= e_{13}$	$= +$34·8,	λ_{13}
$16 x_{13}$	$- 3 x_{15}$	$+ 31 x_{30}$	$- 4 x_{29}$	$+ 26 x_{27}$	$- 25 x_{26}$	$= e_{14}$	$= +$36·6,	λ_{14}
$- 4 x_{25}$	$- 26 x_{27}$	$+ 11 x_{42}$	$- 23 x_{41}$	$+ x_{39}$	$- 17 x_{38}$	$= e_{15}$	$= +$75·3,	λ_{15}
$23 x_{37}$	$- x_{39}$	$+ 17 x_{54}$	$- 23 x_{53}$	...	...	$= e_{16}$	$= +$29·0,	λ_{16}

Equations between the Factors

No. of e	Value of e	Co-efficients of															
		λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8	λ_9	λ_{10}	λ_{11}	λ_{12}	λ_{13}	λ_{14}	λ_{15}	λ_{16}
1	·00	+3	...	...	...	...	...	...	...	+1	...	...	...	+ 13	...	...	...
2	·00		+3	...	...	...	...	...	...	+1	...	...	...	+ 7	...	...	...
3	·00			+3	...	...	...	...	...	+1	+1	...	...	− 17	+ 13	...	...
4	·00				+3	...	...	...	...	...	+1	...	...	...	+ 27	...	...
5	·00					+3	...	...	...	...	+1	+1	...	...	+ 1	− 30	...
6	·00						+3	...	...	...	...	+1	...	...	...	− 12	...
7	·00							+3	...	...	...	+1	+1	...	...	− 16	+ 22
8	·00								+3	...	...	...	+1	...	...	...	− 6
9	+ 1·24									+3	...	...	...	...	+ 16	...	...
10	+ ·53										+3	...	...	− 20	...	− 4	...
11	− ·39						*					+3	...	...	− 25	...	+ 23
12	− ·09												+2	...	...	− 17	...
13	+34·8													+1143	− 9	...	...
14	+36·6														+2543	− 676	...
15	+75·3															+1632	− 1
16	+29·0																+1348

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 10—(Continued).

Values of the Factors		Adopted Errors		
λ_1 = − ·348	λ_9 = + ·511	x_{13} = +″·83	x_{21} = + ″·44	x_{38} = − ″·62
λ_2 = − ·266	λ_{10} = + ·495	x_{14} = − ·59	x_{25} = +1 ·12	x_{39} = + ·36
λ_3 = − ·260	λ_{11} = − ·674	x_{15} = − ·24	x_{26} = − ·58	x_{40} = − ·07
λ_4 = − ·492	λ_{12} = + ·716	x_{16} = + ·25	x_{27} = − ·54	x_{41} = −1 ·59
λ_5 = +1·005	λ_{13} = + ·041	x_{17} = − ·66	x_{28} = ·00	x_{42} = +1 ·66
λ_6 = + ·607	λ_{14} = + ·036	x_{18} = + ·41	x_{29} = − ·65	x_{52} = + ·53
λ_7 = + ·295	λ_{15} = + ·096	x_{19} = + ·16	x_{30} = + ·65	x_{53} = − ·81
λ_8 = − ·184	λ_{16} = + ·028	x_{20} = − ·60	x_{37} = + ·26	x_{54} = + ·28

Figure 11.

Triangle 589.

Constants (from page 41—$_M$).

					Contained Angle.
XIX to XXI	Log feet	4·6677467,0	} ...	10	... 118° 42′ 6″·53
XXI „ XXII	„	4·6410274,0			

Equations to be satisfied.					Adopted Errors.		
x_{11}	+ x_{12}	=	+ ·20		x_{11}	=	− ″·13
$+38\,x_{12}$	$-\,35\,x_{11}$	=	+ 17·2		x_{12}	=	+ ·33

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Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
		23	O II	50 52 20·79	·79	5·0065598,1			10	O III	57 50 48·43	·95	5·1249098,2
12	590	21	III	49 51 56·93	·78	5·0002404,4	12	592	11+12	VI	86 53 51·55	·96	5·1965802,2
		22	*IV*	79 15 42·28	·79	5·1091694,8			13	VIII	35 15 20·02	·95	4·9585619,2
		20	*IV*	57 51 2·15	·90	5·0689782,1							
,,	591	18	III	74 59 2·80	·91	5·1261788,9							
		19	VII	47 9 55·05	·90	5·0065598,1							

Final Figural Adjustments of the Non-Circuit Triangles.

Figure 12.

Triangles 590 and 591.

Constants (from pages 46—0 and 47—0).

						Contained Angle.
II to III	Log feet	5·1091678,7	}	... 21+18	...	124° 51′ 1″·12
III ,, VII	,,	5·0689758,9				

Equations to be satisfied. **Factor**

$$x_{21} + x_{22} + x_{23} \ldots = e_1 = \cdot 00, \qquad \lambda_1$$
$$x_{18} + x_{19} + x_{20} \ldots = e_2 = \cdot 00, \qquad \lambda_2$$
$$x_{21} + x_{18} \ldots \ldots = e_3 = + \cdot 30, \qquad \lambda_3$$
$$17\,x_{23} - 4\,x_{22} + 13\,x_{20} - 20\,x_{19} = e_4 = +7 \cdot 1, \qquad \lambda_4$$

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·00	+3	...	+1	+13	$\lambda_1 = -\ \cdot 121$	$x_{18} = +''\cdot 18$ $x_{21} = +''\cdot 12$
2	·00		+3	+1	− 7	$\lambda_2 = -\ \cdot 058$	$x_{19} = -\ \cdot 25$ $x_{22} = -\ \cdot 15$
3	+ ·30			+2	...	$\lambda_3 = +\ \cdot 239$	$x_{20} = +\ \cdot 07$ $x_{23} = +\ \cdot 03$
4	+ 7·1		*		+874	$\lambda_4 = +\ \cdot 010$	

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 12—(Continued).

Triangle 592.

Constants (from pages 46—$_0$ and 47—$_0$).

						Contained Angle.
III to VI	Log feet	4·9585600,5	}	... 11+12 ...		86° 53′ 52″·32
VI „ VIII	„	5·1249077,5				

Equations to be satisfied.	Adopted Errors.
$x_{10} + x_{13} = -\ ·19$	$x_{10} = -\ ''·08$
$13\,x_{10} - 29\,x_{13} = +\ 2·0$	$x_{13} = -\ ·11$

Huríláong Meridional Series.—Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
		a+8	B‡ XL	101 46 14·16	1·15	5·2899073,6			25	P III	48 43 12·82	0·68	4·9779804,6
13	594	12	P I	47 52 22·48	1·15	5·1693411,3	13	599	20+21	*IV*	85 40 4·27	·68	5·1008106,1
		1	B XXXVIII	30 21 23·36	1·14	5·0027539,2			30	VI	45 36 42·91	·67	4·9561272,9
		4	XLII	42 58 43·19	·60	4·8933349,0			21	*IV*	60 2 54·73	1·07	5·1561301,9
„	595	16	P I	76 33 49·75	·60	5·0476724,4	„	600	30+31	VI	84 51 31·53	1·07	5·2166365,5
		9	*II*	60 27 27·06	·60	4·9992395,3			27	V	35 5 33·74	1·07	4·9779804,6
		10	*II*	99 5 21·49	·52	5·0932402,4			18	V	45 57 52·35	·95	5·0660019,4
„	596	15	I	42 21 45·62	·52	4·9272727,2	14	601	16	VII	39 51 5·47	·94	5·0160502,2
		17	*IV*	38 32 52·89	·51	4·8933349,0			17	*VIII*	94 11 2·18	·95	5·2081686,0
		14	I	45 4 6·31	·75	4·9561272,9			15	*VIII*	31 25 53·27	·53	4·7911420,8
„	597	18+19	*IV*	58 49 8·52	·75	5·0383628,2	„	602	13	VII	69 27 59·77	·53	5·0453987,8
		26	III	76 6 45·17	·76	5·0932402,4			14	X	79 6 6·96	·54	5·0660019,4
		19	*IV*	28 49 7·21	·64	5·0642131,7							
„	598	22+26	III	129 6 19·59	·64	5·2709850,5							
		6	B XL	22 4 33·20	·64	4·9561272,9							

‡ B is the Serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

Note.—The symbol *a* here denotes an angle of the West Calcutta Longitudinal Series, already fixed by the Simultaneous Reduction of the South-East Quadrilateral.

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 13.

Triangle 594.

Constants (from pages 43_{-P} and 150_{-B}).

					Contained Angle.	
I to XL	Log feet	5·0027530,2	} ...	$a+8$	...	101° 46′ 15″·48
XL „ XXXVIII	„	5·1693413,7				

Equations to be satisfied.	Adopted Errors.
$x_1 + x_{12} = + \cdot 17$	$x_1 = + {}''\cdot 26$
$19\, x_{12} - 36\, x_1 = - 11\cdot 4$	$x_{12} = - \cdot 09$

Figure 13—(Continued).

Triangles 595 to 600.

Constants (from page 43_{-P}).

					Contained Angles.	
XLII to I	Log feet	4·9992404,5	} ...	16+15+14	...	163° 59′ 43″·67
I „ III	„	5·0383618,3	} ...	22	...	52 59 34 ·34
XL „ III	„	5·0642121,0	} ...	22+26+25	...	177 49 33 ·87
III „ VI	„	5·1008087,8	} ...	31	...	39 14 49 ·08
V „ VI	„	5·1561284,2				

Equations to be satisfied. Factor

$x_4 + x_9 + x_{16}$	$= e_1 = \cdot 00,$	λ_1
$x_{10} + x_{15} + x_{17}$	$= e_2 = \cdot 00,$	λ_2
$x_{14} + x_{18} + x_{19} + x_{26}$	$= e_3 = \cdot 00,$	λ_3
$x_{20} + x_{21} + x_{25} + x_{30}$	$= e_4 = \cdot 00,$	λ_4
$x_6 + x_{19} + x_{26}$	$= e_5 = + \cdot 04,$	λ_5
$x_{21} + x_{27} + x_{30}$	$= e_6 = + \cdot 06,$	λ_6
$x_{16} + x_{15} + x_{14}$	$= e_7 = - \cdot 12,$	λ_7
$x_{26} + x_{25}$	$= e_8 = - \cdot 10,$	λ_8
$23\, x_4 - 12\, x_9 - 3\, x_{10} - 26\, x_{17} + 13\,(x_{18}+x_{19}) - 6\, x_{26}$	$= e_9 = + 19\cdot 1,$	λ_9
$21\, x_{14} - 13\,(x_{18}+x_{19}) + (x_{20}+x_{21}) - 21\, x_{30}$	$= e_{10} = + 8\cdot 4,$	λ_{10}
$52\, x_6 - 39\, x_{19} + (x_{20}+x_{21}) - 21\, x_{30}$	$= e_{11} = + 7\cdot 6,$	λ_{11}
$18\, x_{25} - (x_{20}+x_{21}) + 13\, x_{21} - 30\, x_{27}$	$= e_{12} = - \cdot 6,$	λ_{12}

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 13—(Continued).

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8	λ_9	λ_{10}	λ_{11}	λ_{12}
1	·00	+3	...	...	...	...	...	+1	...	+ 11	...	...	...
2	·00		+3	...	...	...	...	+1	...	− 29	...	...	...
3	·00			+4	...	+2	...	+1	+1	+ 20	− 5	− 39	...
4	·00				+4	...	+2	...	+1	...	− 19	− 19	+ 29
5	+ ·04					+3	...	...	+1	+ 7	− 13	+ 13	...
6	+ ·06						+3	...	...	...	− 20	− 20	− 18
7	− ·12							+3	...	...	+ 21	...	...
8	− ·10								+2	− 6	...	...	+ 18
9	+19·1									+1732	− 338	− 507	...
10	+ 8·4										+1222	+ 950	+ 11
11	+ 7·6											+4668	+ 11
12	− ·6												+1369

Values of the Factors

λ_1 = + ·018	λ_7 = − ·269
λ_2 = + ·279	λ_8 = − ·045
λ_3 = − ·056	λ_9 = + ·020
λ_4 = + ·023	λ_{10} = + ·021
λ_5 = + ·114	λ_{11} = − ·001
λ_6 = + ·151	λ_{12} = + ·001

Adopted Errors

x_4 + ″·48	x_{16} − ″·28	x_{25} + ″·04
x_6 + ·11	x_{17} − ·22	x_{26} − ·14
x_9 − ·20	x_{18} − ·10	x_{27} + ·11
x_{10} + ·23	x_{19} + ·07	x_{30} − ·21
x_{14} + ·17	x_{20} + ·01	
x_{15} − ·01	x_{21} + ·16	

Figure 14.

Triangles 601 and 602.

Constants (from page 44—p).

				Contained Angle.
V to VII	Log feet	5·2081660,2	} ... 16+18 ...	109° 19′ 5″·59
VII „ X	„	4·7911364,4		

Equations to be satisfied. Factor

x_{16}	+ x_{17}	+ x_{18}	...	=	e_1	= ·00,	λ_1
x_{13}	+ x_{14}	+ x_{15}	...	=	e_2	= ·00,	λ_2
x_{16}	+ x_{13}	...	...	=	e_3	= + 1·12,	λ_3
$20\,x_{18}$	+ $2\,x_{17}$	+ $34\,x_{15}$	− $4\,x_{14}$	=	e_4	= +30·6,	λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

***Figure* 14—(Continued).**

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·00	+3	...	+1	+ 22	$\lambda_1 = -\ \cdot873$	$x_{13} = +''\cdot49$ $x_{16} = +''\cdot63$
2	·00		+3	+1	+ 30	$\lambda_2 = -1\cdot008$	$x_{14} = -1\cdot20$ $x_{17} = -\ \cdot77$
3	+ 1·12		*	+2	...	$\lambda_3 = +1\cdot500$	$x_{15} = +\ \cdot71$ $x_{18} = +\ \cdot14$
4	+30·6				+1576	$\lambda_4 = +\ \cdot051$	

Chendwár Meridional Series.—Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
15	603	15	B‡ XLIV	44 9 18·204	·957	4·9967269,4	17	606	18	Q V	61 48 8·45	·82	5·0471679,9
		13	Q I	67 13 39·399	·958	5·1184962,5			16	VII	58 34 55·52	·81	5·0331794,7
		14	*II*	68 37 2·397	·958	5·1227691,1			17	*VIII*	59 36 56·03	·82	5·0378681,3
,,	604	12	*II*	64 10 32·776	·628	5·0017082,3	,,	607	15	*VIII*	49 46 55·89	·75	4·9736472,4
		10	I	52 58 2·686	·627	4·9495631,5			13	VII	65 28 7·16	·76	5·0496985,0
		11	IV	62 51 24·538	·627	4·9967269,4			14	X	64 44 56·95	·75	5·0471679,9
16	605	5	III	27 42 46·67	·61	4·9896041,0							
		6+7	IV	125 0 23·88	·61	5·2354409,0							
		8	V	27 16 49·45	·60	4·9833046,7							

‡ B is the serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 15.

Triangles 603 and 604.

Constants (from page 41_{Q}).

						Contained Angle.
XLIV	to I	Log feet	5·1227685,1	} ...	13+10 ...	120° 11′ 43″·333
I	„ IV	„	5·0017099,3			

Equations to be satisfied.								Factor
x_{13}	$+ \; x_{14}$	$+ \; x_{15}$	...	...	$= e_1$	=	·000,	λ_1
x_{10}	$+ \; x_{11}$	$+ \; x_{12}$	...	...	$= e_2$	=	·000,	λ_2
x_{13}	$+ \; x_{10}$	...	...		$= e_3$	=	+ ·337,	λ_3
$22\,x_{15}$	$- \; 8\,x_{14}$	$+ \; 10\,x_{12}$	$- \; 11\,x_{11}$		$= e_4$	=	−23·0, .	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	+14	$\lambda_1 = +$ ·099	$x_{10} = +''$·089	$x_{13} = +''$·248
2	·000		+3	+1	−1	$\lambda_2 = -$ ·060	$x_{11} = +$ ·290	$x_{14} = +$ ·353
3	+ ·337		*	+2	...	$\lambda_3 = +$ ·149	$x_{12} = -$ ·379	$x_{15} = -$ ·601
4	−23·0				+769	$\lambda_4 = -$ ·032		

Figure 16.

Triangle 605.

Constants (from pages 41_{Q} and 42_{Q}).

						Contained Angle.
III	to IV	Log feet	4·9833067,6	} ...	6+7 ...	125° 0′ 25″·50
IV	„ V	„	4·9896074,2			

Equations to be satisfied.				Adopted Errors.		
x_5	$+ \; x_8$	=	+ 1·01	x_5	=	+ ″·36
$40\,x_5$	$- \; 41\,x_8$	=	− 12·3	x_8	=	+ ·65

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 17.

Triangles 606 and 607.

Constants (from page 42—Q).

						Contained Angle.
V to VII	Log feet	5·0378721,4	} ...	16+18	...	124° 3′ 3″·70
VII " X	"	4·9736543,6				

Equations to be satisfied. **Factor**

x_{16}	+ x_{17}	+ x_{18}	...	=	e_1	=	·00,	λ_1
x_{13}	+ x_{14}	+ x_{15}	...	=	e_2	=	·00,	λ_2
x_{16}	+ x_{13}	...	...	=	e_3	=	+ ·55,	λ_3
$11\, x_{18}$	$- 13\, x_{17}$	$+ 18\, x_{15}$	$- 10\, x_{14}$	=	e_4	=	−31·1,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·00	+3	...	+1	− 2	λ_1 = − ·145	x_{13} = +″·35	x_{16} = +″·20
2	·00		+3	+1	+ 8	λ_2 = + ·002	x_{14} = + ·45	x_{17} = + ·43
3	+ ·55		*	+2	...	λ_3 = + ·347	x_{15} = − ·80	x_{18} = − ·63
4	−31·1				+714	λ_4 = − ·044		

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North Malúncha Meridional Series.—Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
18	608	5	B‡ LXIV	68 15 0·40	·91	5·1184047,3	19	612	18	S *VIII*	64 19 35·18	1·02	5·1255744,9
		4	S I	41 2 53·14	·90	4·9678396,5			16	VII	43 26 42·55	1·02	5·0080899,2
		6	*III*	70 42 6·46	·91	5·1253628,8			17	*X*	72 13 42·27	1·03	5·1494812,7
,,	609	8	*III*	81 16 44·50	1·49	5·2560849,8	,,	613	15	*X*	51 53 30·55	·92	5·0382104,9
		7	I	52 40 30·45	1·48	5·1616173,5			13	VII	53 55 1·72	·93	5·0498209,3
		9	*VI*	46 2 45·05	1·48	5·1184047,3			14	XI	74 11 27·73	·93	5·1255744,9
,,	610	11	*VI*	56 20 21·51	1·62	5·1888761,1	20	614	18	XI	43 53 57·21	·39	4·8077466,9
		10	I	47 20 16·53	1·61	5·1350801,6			16	XIII	59 23 55·03	·39	4·9016346,7
		12	V	76 19 21·96	1·62	5·2560849,8			17	*XIV*	76 42 7·76	·40	4·9549644,1
19	611	21	IV	50 1 10·50	1·19	5·1494812,7	,,	615	15	*XIV*	51 51 48·01	·29	4·7827213,3
		19	VII	35 30 51·88	1·18	5·0292099,1			13	XIII	71 42 30·24	·29	4·8644824,8
		20	*VIII*	94 27 57·62	1·19	5·2637821,5			14	XVI	56 25 41·75	·29	4·8077466,9

Final Figural Adjustments of the Non-Circuit Triangles.

Figure 18.

Triangles 608 to 610.

Constants from (page 37—8).

Contained Angle.

LXIV to I	Log feet	5·1253642,4	}	... 4+7+10 ...		141° 3′ 43″·96
I ,, V	,,	5·1888798,9				

Equations to be satisfied. **Factor**

$$x_4 + x_5 + x_6 \quad \dots \quad \dots \quad \dots = e_1 = \cdot 00, \qquad \lambda_1$$
$$x_7 + x_8 + x_9 \quad \dots \quad \dots \quad \dots = e_2 = \cdot 00, \qquad \lambda_2$$
$$x_{10} + x_{11} + x_{12} \quad \dots \quad \dots \quad \dots = e_3 = \cdot 00, \qquad \lambda_3$$
$$x_4 + x_7 + x_{10} \quad \dots \quad \dots \quad \dots = e_4 = + \cdot 15, \qquad \lambda_4$$
$$8\,x_5 - 8\,x_6 + 3\,x_8 - 20\,x_9 + 14\,x_{11} - 5\,x_{12} = e_5 = -24\cdot 2, \qquad \lambda_5$$

‡ B is the serial letter for the West Calcutta Longitudinal Series which appertains to the South-East Quadrilateral.

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 18—(Continued).

Equations between the Factors							Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of							
		λ_1	λ_2	λ_3	λ_4	λ_5			
1	·00	+3	...	...	+1	0	$\lambda_1 = -\ ·042$	$x_4 = +''·08$	$x_9 = +''·51$
2	·00		+3	...	+1	− 17	$\lambda_2 = -\ ·262$	$x_5 = -\ ·35$	$x_{10} = +\ ·20$
3	·00			+3	+1	+ 9	$\lambda_3 = +\ ·074$	$x_6 = +\ ·27$	$x_{11} = -\ ·47$
4	+ ·15		*		+3	...	$\lambda_4 = +\ ·127$	$x_7 = -\ ·13$	$x_{12} = +\ ·27$
5	−24·2					+758	$\lambda_5 = -\ ·039$	$x_8 = -\ ·38$	

Figure 19.

Triangles 611 to 613.

Constants (from page 38—$_8$).

				Contained Angle.
IV to VII	Log feet	5·2637872,0	... 19+16+13 ...	132° 52′ 39″·69
VII „ XI	„	5·0382180,5		

Equations to be satisfied. — Factor

x_{19}	+ x_{20}	+ x_{21}	...	...	...	$= e_1 =$	·00,	λ_1
x_{16}	+ x_{17}	+ x_{18}	...	...	...	$= e_2 =$	·00,	λ_2
x_{13}	+ x_{14}	+ x_{15}	...	...	...	$= e_3 =$	·00,	λ_3
x_{19}	+ x_{16}	+ x_{13}	...	...	...	$= e_4 =$	− ·41,	λ_4
$18\,x_{21}$	+ $2\,x_{20}$	+ $10\,x_{18}$	− $6\,x_{17}$	+ $17\,x_{15}$	− $6\,x_{14}$	$= e_5 =$	−25·1,	λ_5

Equations between the Factors							Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of							
		λ_1	λ_2	λ_3	λ_4	λ_5			
1	·00	+3	...	...	+1	+ 20	$\lambda_1 = +\ ·505$	$x_{13} = -''·15$	$x_{18} = -''·27$
2	·00		+3	...	+1	+ 4	$\lambda_2 = +\ ·235$	$x_{14} = +\ ·65$	$x_{19} = +\ ·01$
3	·00			+3	+1	+ 11	$\lambda_3 = +\ ·353$	$x_{15} = -\ ·50$	$x_{20} = +\ ·40$
4	− ·41		*		+3	...	$\lambda_4 = -\ ·501$	$x_{16} = -\ ·27$	$x_{21} = -\ ·41$
5	−25·1					+789	$\lambda_5 = -\ ·051$	$x_{17} = +\ ·54$	

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Final Figural Adjustments of the Non-Circuit Triangles.

***Figure* 20.**

Triangles 614 and 615.

Constants (from pages $38_{\_\_S}$ and $39_{\_\_S}$).

						Contained Angle.
XI to XIII	Log feet	4·9549729,2	}	... 16+13 ...		131° 6′ 26″·41
XIII „ XVI	„	4·7827317,8				

Equations to be satisfied.

Equation			Factor
$x_{16} + x_{17} + x_{18}$ ...	$= e_1 =$	·00,	λ_1
$x_{13} + x_{14} + x_{15}$ ...	$= e_2 =$	·00,	λ_2
$x_{16} + x_{13}$	$= e_3 =$	− ·46,	λ_3
$22\,x_{18} - 5\,x_{17} + 17\,x_{15} - 13\,x_{14}$	$= e_4 =$	−19·4,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4		
1	·00	+3	...	+1	+ 17	$\lambda_1 = +$ ·310	$x_{13} = -$″·29 $x_{16} = -$″·17
2	·00		+3	+1	+ 4	$\lambda_2 = +$ ·196	$x_{14} = +$ ·54 $x_{17} = +$ ·44
3	− ·46		*	+2	...	$\lambda_3 = -$ ·483	$x_{15} = -$ ·25 $x_{18} = -$ ·27
4	−19·4				+967	$\lambda_4 = -$ ·026	

East Calcutta Longitudinal Series.—Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
21	632	18	T I	59 29 50·356	·231	4·7631210,2	22	634	12	U XXI	68 18 53·171	·212	4·7809368,0
		16	U I	57 59 11·837	·231	4·7561696,8			10	XIX	57 56 55·781	·212	4·7409924,5
		17	*III*	62 30 57·807	·232	4·7758048,8			11	XXIII	53 44 11·048	·211	4·7193135,3
„	633	15	*III*	66 30 40·970	·240	4·8001580,9							
		13	I	56 7 8·257	·239	4·7569038,8							
		14	V	57 22 10·773	·240	4·7631210,2							

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 21.

Triangles 632 and 633.

Constants (from page 56—$_U$).

						Contained Angle.
I‡ to I	Log feet	4·7758084,5	} ...	16+18	...	114° 6′ 20″·651
I „ V	„	4·8001621,6				

Equations to be satisfied. Factor

x_{16}	$+ x_{17}$	$+ x_{18}$	...	$= e_1$	=	·000,	λ_1
x_{13}	$+ x_{14}$	$+ x_{15}$	...	$= e_2$	=	·000,	λ_2
x_{16}	$+ x_{13}$	...	...	$= e_3$	=	− ·087,	λ_3
$12\, x_{18}$	$- 11\, x_{17}$	$+ 9\, x_{15}$	$- 13\, x_{14}$	$= e_4$	=	−5·0,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	+ 1	$\lambda_1 = +$ ·023	$x_{13} = -$″·052	$x_{16} = -$″·035
2	·000		+3	+1	− 4	$\lambda_2 = +$ ·006	$x_{14} = +$ ·132	$x_{17} = +$ ·129
3	− ·087		*	+2	...	$\lambda_3 = -$ ·058	$x_{15} = -$ ·080	$x_{18} = -$ ·094
4	−5·0				+515	$\lambda_4 = -$ ·010		

Figure 22.

Triangle 634.

Constants (from page 58—$_U$).

						Contained Angle.
XIX to XXI	Log feet	4·7193211,5	} ...	10	...	57° 56′ 56″·444
XIX „ XXIII	„	4·7809446,5				

Equations to be satisfied.

x_{11}	$+ x_{12}$	=	+	·451
$8\, x_{12}$	$- 15\, x_{11}$	=	−	2·3

Adopted Errors.

x_{11}	=	+	″·252
x_{12}	=	+	·199

‡ Of the Calcutta Meridional Series.

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Assam Longitudinal Series.—Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″	
23	621	18	I CXXIV	41 35 28·451	·260	4·7009321,8
		16	X I	65 25 0·220	·261	4·8376219,2
		17	*III*	72 59 31·329	·261	4·8594650,3
„	622	15	*III*	54 45 45·995	·212	4·7406114,0
		13	I	77 2 20·913	·213	4·8173038,7
		14	*V*	48 11 53·092	·212	4·7009321,8
„	623	10	I	63 9 39·868	·211	4·7585991,9
		12	*V*	57 57 35·854	·211	4·7363290,5
		11	IV	58 52 44·278	·211	4·7406114,0
„	624	30	*V*	55 21 56·519	·197	4·7107875,5
		28	IV	57 55 8·186	·197	4·7235311,6
		29	VIII	66 42 55·295	·197	4·7585991,9
24	625	18	VIII	48 21 13·288	·201	4·6805936,7
		16	IX	63 1 16·528	·201	4·7570842,0
		17	*XI*	68 37 30·184	·201	4·7761712,9
„	626	15	*XI*	59 18 11·822	·180	4·7118801,4
		13	IX	67 33 20·481	·180	4·7432314,8
		14	XIII	53 8 27·697	·180	4·6805936,7
25	627	18	XIII	60 1 28·499	·199	4·7356602,6
		16	XIV	54 20 32·899	·199	4·7078539,1
		17	*XVI*	65 37 58·602	·200	4·7575028,0
„	628	15	*XVI*	56 2 20·911	·204	4·7208461,0
		13	XIV	64 50 44·976	·205	4·7588008,0
		14	XVIII	59 6 54·113	·204	4·7356602,6
26	629	18	XVIII	48 52 19·928	·236	4·7172488,5
		16	XIX	64 32 39·077	·236	4·7959608,6
		17	*XXI*	66 35 0·995	·236	4·8029857,8
„	630	15	*XXI*	69 13 28·995	·313	4·9006727,9
		13	XIX	72 58 37·168	·313	4·9104139,1
		14	XXIII	37 47 53·837	·312	4·7172488,5
27	631	15	XXIII	68 53 34·334	·369	4·9164601,5
		13	XXIV	67 3 35·189	·368	4·9108391,3
		14	XXVII	44 2 50·477	·368	4·7887636,3

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″	
28	655	15	X XXVII	39 11 43·799	·327	4·7382308,8
		13	XXVIII	76 28 56·750	·328	4·9253349,8
		14	*XXIX*	64 19 19·451	·328	4·8923778,5
„	656	12	*XXIX*	59 24 50·254	·230	4·7650251,6
		10	XXVIII	66 33 9·598	·231	4·7926607,0
		11	XXXI	54 2 0·148	·230	4·7382308,8
29	657	15	XXXI	74 2 52·745	·354	4·9181561,3
		13	XXXII	47 20 8·313	·353	4·8016964,1
		14	*XXXIII*	58 36 58·942	·353	4·8665155,0
„	658	12	*XXXIII*	51 46 30·085	·405	4·8496036,0
		10	XXXII	61 18 41·505	·405	4·8975289,7
		11	XXXV	66 54 48·410	·406	4·9181561,3
30	659	4	XXXV	41 37 1·758	·475	4·8625321,3
		2+3	XXXIV	89 28 59·605	·475	5·0402482,1
		1	XXXVI	48 53 58·637	·475	4·9173832,2
31	660	5	XXXVI	45 17 3·052	·332	4·8128650,5
		4	XXXVIII	89 41 59·028	·332	4·9612306,4
		6	*XXXIX*	45 0 57·920	·331	4·8108435,7
„	661	7	XXXVIII	65 55 45·944	·317	4·8583675,3
		8	*XXXIX*	58 45 45·752	·316	4·8298556,7
		9	XLI	55 18 28·304	·316	4·8128650,5
„	662	17	*XXXIX*	34 12 38·268	·246	4·6442752,7
		16	XLI	78 47 38·076	·246	4·8859960,7
		18	XLII	66 59 43·656	·246	4·8583675,3
32	663	3	XLII	40 26 39·130	·416	4·7969912,0
		4+5	XLIII	74 42 18·486	·417	4·9692812,1
		6	*XLV*	64 51 2·384	·417	4·9416885,5
„	664	6+7	*XLV*	92 22 48·053	·311	4·9569395,0
		5	XLIII	43 53 8·086	·310	4·7981857,0
		8	XLIV	43 44 3·861	·310	4·7969912,0

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 23.

Triangles 621 to 624.

Constants (from pages 66—$_x$ and 67—$_x$).

							Contained Angles.
CXXIV	to	I	Log feet	4·8594604,6	} ...	16+13+10 ...	205° 37′ 1″·604
I	„	IV	„	4·7363234,7	}		
IV	„	VIII	„	4·7107796,2	} ...	11+28 ...	116 47 52 ·841

Equations to be satisfied.

								Factor
x_{16}	$+\ x_{17}$	$+\ x_{18}$	...	...	...	$= e_1 =$	·000,	λ_1
x_{13}	$+\ x_{14}$	$+\ x_{15}$	...	...	...	$= e_2 =$	·000,	λ_2
x_{10}	$+\ x_{11}$	$+\ x_{12}$	...	...	...	$= e_3 =$	·000,	λ_3
x_{28}	$+\ x_{29}$	$+\ x_{30}$	...	...	...	$= e_4 =$	·000,	λ_4
x_{16}	$+\ x_{13}$	$+\ x_{10}$	...	...	...	$= e_5 =$	+ ·082,	λ_5
x_{11}	$+\ x_{28}$	...	...	...	...	$= e_6 =$	+ ·031,	λ_6
$24\,x_{18}$	$-\ 7\,x_{17}$	$+15\,x_{15}$	$-19\,x_{14}$	$+13\,x_{12}$	$-13\,x_{11}$	$= e_7 =$	+ 10·1,	λ_7
$11\,x_{10}$	$-13\,x_{12}$	$+14\,x_{30}$	$-\ 9\,x_{29}$	...	...	$= e_8 =$	+ 23·5,	λ_8

Equations between the Factors										Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of										
		λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8			
1	·000	+3	...	...	...	+1	...	+ 17	...	$\lambda_1 = -$ ·010		
2	·000		+3	...	...	+1	...	− 4	...	$\lambda_2 = +$ ·086	$x_{10} = +$″·410	$x_{16} = -$″·212
3	·000			+3	...	+1	+1	0	− 2	$\lambda_3 = +$ ·053	$x_{11} = +$ ·020	$x_{17} = -$ ·105
4	·000				+3	...	+1	...	+ 5	$\lambda_4 = -$ ·133	$x_{12} = -$ ·430	$x_{18} = +$ ·317
5	+ ·082					+3	...	...	+ 11	$\lambda_5 = -$ ·202	$x_{13} = -$ ·116	$x_{28} = +$ ·011
6	+ ·031			*			+2	− 13	...	$\lambda_6 = +$ ·144	$x_{14} = -$ ·173	$x_{29} = -$ ·588
7	+10·1							+1549	−169	$\lambda_7 = +$ ·014	$x_{15} = +$ ·289	$x_{30} = +$ ·577
8	+23·5								+567	$\lambda_8 = +$ ·051		

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 24.

Triangles 625 and 626.

Constants (from page $67_{\overline{X}}$).

						Contained Angle.
VIII to IX	Log feet	4·7761622,6	}	... 16+13 ...		130° 34′ 37″·210
IX „ XIII	„	4·7118692,5				

Equations to be satisfied.								Factor
x_{16}	$+ x_{17}$	$+ x_{18}$	...	$= e_1$	=		·000,	λ_1
x_{13}	$+ x_{14}$	$+ x_{15}$	...	$= e_2$	=		·000,	λ_2
x_{16}	$+ x_{13}$	...	...	$= e_3$	=	+	·180,	λ_3
$19\,x_{18}$	$- 9\,x_{17}$	$+ 12\,x_{15}$	$- 15\,x_{14}$	$= e_4$	=	+	18·6,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	+ 10	$\lambda_1 = -$ ·141	$x_{13} = +$″·143	$x_{16} = +$″·037
2	·000		+3	+1	− 3	$\lambda_2 = -$ ·035	$x_{14} = -$ ·399	$x_{17} = -$ ·359
3	+ ·180		*	+2	...	$\lambda_3 = +$ ·178	$x_{15} = +$ ·256	$x_{18} = +$ ·322
4	+18·6				+811	$\lambda_4 = +$ ·025		

Figure 25.

Triangles 627 and 628.

Constants (from pages $67_{\overline{X}}$ and $68_{\overline{X}}$).

						Contained Angle.
XIII to XIV	Log feet	4·7574916,4	}	... 16+13 ...		119° 11′ 18″·223
XIV „ XVIII	„	4·7208339,4				

Equations to be satisfied.								Factor
x_{16}	$+ x_{17}$	$+ x_{18}$	...	$= e_1$	=		·000,	λ_1
x_{13}	$+ x_{14}$	$+ x_{15}$	...	$= e_2$	=		·000,	λ_2
x_{16}	$+ x_{13}$	...	...	$= e_3$	=	+	·056,	λ_3
$13\,x_{18}$	$- 9\,x_{17}$	$+ 14\,x_{15}$	$- 12\,x_{14}$	$= e_4$	=	+	10·0,	λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 25—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	+ 4	$\lambda_1 = -$ ·046	$x_{13} = +''$·034 $x_{16} = +''$·022
2	·000		+3	+1	+ 2	$\lambda_2 = -$ ·034	$x_{14} = -$ ·243 $x_{17} = -$ ·204
3	+ ·056		*	+2	...	$\lambda_3 = +$ ·068	$x_{15} = +$ ·209 $x_{18} = +$ ·182
4	+10·0				+590	$\lambda_4 = +$ ·017	

Figure 26.

Triangles 629 and 630.

Constants (from page 68—X).

						Contained Angle.
XVIII	to XIX	Log feet	4·8029730,0 }	...	16+18 ...	137° 31′ 16″·665
XIX	„ XXIII	„	4·9006589,1 }			

Equations to be satisfied. Factor

$x_{16} + x_{17} + x_{18} \ldots = e_1 =$ ·000, λ_1

$x_{13} + x_{14} + x_{15} \ldots = e_2 =$ ·000, λ_2

$x_{16} + x_{13} \ldots \ldots = e_3 = +$ ·129, λ_3

$18\,x_{18} - 9\,x_{17} + 8\,x_{15} - 27\,x_{14} = e_4 = +$ 11·0, λ_4

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	+ 9	$\lambda_1 = -$ ·054	$x_{13} = +''$·112 $x_{16} = +''$·017
2	·000		+3	+1	− 19	$\lambda_2 = +$ ·041	$x_{14} = -$ ·236 $x_{17} = -$ ·146
3	+ ·129		*	+2	...	$\lambda_3 = +$ ·071	$x_{15} = +$ ·124 $x_{18} = +$ ·129
4	+11·0				+1198	$\lambda_4 = +$ ·010	

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 27.

Triangle 631.

Constants (from pages 68_X and 69_X).

							Contained Angle.
XXIII to XXIV	Log feet	4·7887494,7	}	...	13	...	67° 3′ 35″·612
XXIV „ XXVII	„	4·9164447,5					

Equations to be satisfied.

$$x_{14} + x_{15} = +\cdot055$$
$$8\,x_{15} - 22\,x_{14} = +12\cdot4$$

Adopted Errors.

$$x_{14} = -\cdot398$$
$$x_{15} = +\cdot453$$

Figure 28.

Triangles 655 and 656.

Constants (from page 69_X).

							Contained Angle.
XXVII to XXVIII	Log feet	4·8923854,4	}	...	13+10	...	143° 2′ 7″·016
XXVIII „ XXXI	„	4·7650326,4					

Equations to be satisfied.

								Factor.
x_{13}	+ x_{14}	+ x_{15}	...	=	e_1	=	·000,	λ_1
x_{10}	+ x_{11}	+ x_{12}	...	=	e_2	=	·000,	λ_2
x_{13}	+ x_{10}	...	...	=	e_3	=	− ·109,	λ_3
$26\,x_{15}$	− $10\,x_{14}$	+ $13\,x_{12}$	− $15\,x_{11}$	=	e_4	=	+1·1,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	+ 16	$\lambda_1 = +\cdot023$	$x_{10} = -''\cdot052$	$x_{13} = -''\cdot057$
2	·000		+3	+1	− 2	$\lambda_2 = +\cdot027$	$x_{11} = +\cdot016$	$x_{14} = +\cdot017$
3	− ·109		*	+2	...	$\lambda_3 = -\cdot079$	$x_{12} = +\cdot036$	$x_{15} = +\cdot040$
4	+1·1				+1170	$\lambda_4 = +\cdot001$		

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 29.

Triangles 657 and 658.

Constants (from page 69_{-x}).

						Contained Angle.
XXXI to XXXII	Log feet	4·8665228,7	}	... 13+10 ...		108° 38′ 50″·647
XXXII „ XXXV	„	4·8496111,7				

Equations to be satisfied.

						Factor
x_{13}	$+ x_{14}$	$+ x_{15}$	...	$= e_1 =$	·000,	λ_1
x_{10}	$+ x_{11}$	$+ x_{12}$	...	$= e_2 =$	·000,	λ_2
x_{13}	$+ x_{10}$	...	...	$= e_3 =$	− ·071,	λ_3
$6 x_{15}$	$- 13 x_{14}$	$+ 17 x_{12}$	$- 9 x_{11}$	$= e_4 =$	− 2·0,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	− 7	$\lambda_1 = +$ ·009	$x_{10} = -''$·026 $x_{13} = -''$·045
2	·000		+3	+1	+ 8	$\lambda_2 = +$ ·028	$x_{11} = +$ ·063 $x_{14} = +$ ·059
3	− ·071		*	+2	...	$\lambda_3 = -$ ·054	$x_{12} = -$ ·037 $x_{15} = -$ ·014
4	−2·0				+575	$\lambda_4 = -$ ·004	

Figure 30.

Triangle 659.

Constants (from pages 69_{-x} and 70_{-x}).

						Contained Angle.
XXXV to XXXIV	Log feet	4·9173907,4	}	... 8+2 ...		89° 29′ 0″·213
XXXIV „ XXXVI	„	4·8625396,0				

Equations to be satisfied.

$x_1 + x_4 = +\ ·133$

$24 x_4 - 19 x_1 = +\ ·5$

Adopted Errors.

$x_1 = +\ ''·064$

$x_4 = +\ ·069$

Final Figural Adjustments of the Non-Circuit Triangles.

Figure 31.

Triangles 660 to 662.

Constants (from page $70_{—X}$).

						Contained Angles.
XXXVI	to XXXVIII	Log feet	4·8108512,3	} ...	4+7 ...	155° 37′ 45″·508
XXXVIII	„ XLI	„	4·8298638,5	}		
XLI	„ XLII	„	4·6442840,8	} ...	9+16 ...	134 6 6 ·916

Equations to be satisfied.

										Factor
x_4	+	x_5	+	x_6	...	=	e_1	=	·000,	λ_1
x_7	+	x_8	+	x_9	...	=	e_2	=	·000,	λ_2
x_{16}	+	x_{17}	+	x_{18}	...	=	e_3	=	·000,	λ_3
x_4	+	x_7	...		...	=	e_4	=	+ ·113,	λ_4
x_9	+	x_{16}	...		...	=	e_5	=	+ ·026,	λ_5
$21\, x_5$	−	$21\, x_6$	+	$13\, x_8$	$-\ 15\, x_9$	=	e_6	=	− 5·2,	λ_6
$10\, x_7$	−	$13\, x_8$	+	$31\, x_{17}$	$-\ 9\, x_{18}$	=	e_7	=	− 6·3,	λ_7

Equations between the Factors									Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of								
		λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7		
1	·000	+3	...	...	+1	...	0	...	$\lambda_1 = -$ ·048	
2	·000		+3	...	+1	+1	− 2	− 3	$\lambda_2 = -$ ·045	$x_4 = +''·093$ $x_9 = -''·003$
3	·000			+3	...	+1	...	+ 22	$\lambda_3 = +$ ·073	$x_5 = -$ ·165 $x_{16} = +$ ·029
4	+ ·113				+2	...	...	+ 10	$\lambda_4 = +$ ·143	$x_6 = +$ ·072 $x_{17} = -$ ·175
5	+ ·026				*	+2	− 15	...	$\lambda_5 = -$ ·044	$x_7 = +$ ·020 $x_{18} = +$ ·146
6	−5·2						+1276	− 169	$\lambda_6 = -$ ·006.	$x_8 = -$ ·017
7	−6·3							+1311	$\lambda_7 = -$ ·008	

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 32.

Triangles 663 and 664.

Constants (from pages 70—$_X$ and 71—$_X$).

				Contained Angle.
XLII to XLIII	Log feet 4·9416973,7	} ...	4 ...	30° 49′ 10″·767
XLIII „ XLIV	„ 4·9569482,9			

Equations to be satisfied.

								Factor
x_3	$+ x_5$	$+ x_6$	...	$= e_1$	$=$	$+ \cdot 260$,		λ_1
x_5	$+ x_6$	$+ x_7$	$+ x_8$	$= e_2$	$=$	$\cdot 000$,		λ_2
$25\,x_3$	$- 10\,x_6$	$+ (x_6 + x_7)$	$- 22\,x_8$	$= e_3$	$=$	$+ \cdot 3$,		λ_3

Equations between the Factors					Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3			
1	+ ·260	+3	+2	+ 16	$\lambda_1 = + \cdot 249$	$x_3 = + \cdot 021$	$x_7 = - \cdot 203$
2	·000		+4	− 30	$\lambda_2 = - \cdot 182$	$x_5 = + \cdot 127$	$x_8 = - \cdot 036$
3	+ ·3		*	+1191	$\lambda_3 = - \cdot 008$	$x_6 = + \cdot 112$	

Eastern Frontier Series—Section 23° to 26°.—Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
		5	X XLII	51 6 30·097	·176	4·6738200,1			20	W *IV*	81 28 58·526	·221	4·8430426,8
33	694	4	W I	74 50 58·391	·177	4·7672901,8	33	691	19	V	46 5 2·255	·221	4·7054065,6
		6	*II*	54 2 31·512	·176	4·6908428,2			21	*VII*	52 25 59·219	·221	4·7469359,7
		8	*II*	76 59 58·368	·176	4·7746698,6			22	V	58 16 2·651	·365	4·8595758,0
„	693	7	I	52 25 32·077	·176	4·6849799,3	„	690	23	*VII*	66 46 24·543	·366	4·8931886,4
		9	*IV*	50 34 29·555	·175	4·6738200,1			24	VIII	54 57 32·806	·365	4·8430426,8
		10	I	60 12 49·190	·207	4·7469359,7			32	*VII*	47 55 19·779	·355	4·8085512,3
„	692	11	*IV*	52 6 2·539	·206	4·7056018,0	„	689	31	VIII	75 29 9·973	·356	4·9239241,3
		12	V	67 41 8·271	·207	4·7746698,6			33	IX	56 35 30·248	·356	4·8595758,0

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Eastern Frontier Series—Section 23° to 26°.—Sides and Angles of the Non-Circuit Triangles—**(Continued).**

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
		5	W IX	104 56 40·515	·270	4·9777804,7			15	W XXV	42 32 52·506	·361	4·8215002,8
34	688	4	XI	41 38 32·701	·270	4·8152060,6	36	676	13	XXX	92 33 41·148	·362	4·9909868,1
		6	*XII*	33 24 46·784	·269	4·7336158,9			14	*XXXI*	44 53 26·346	·362	4·8400754,8
		8	*XII*	48 3 12·920	·552	4·8983083,1			12	*XXXI*	63 9 27·522	·299	4·8338686,3
,,	687	7	XI	68 40 41·269	·553	4·9960767,8	,,	675	10	XXX	56 42 26·878	·298	4·8055242,9
		9	XIV	63 16 5·811	·552	4·9777804,7			11	XXXIII	60 8 5·600	·298	4·8215002,8
		5	XIV	56 27 14·871	·250	4·8101168,5			5	XXXIII	44 1 15·081	·307	4·8531413,8
35	680	4	XVI	39 28 56·703	·249	4·6925894,6	37	674	6+7	XXXV	102 56 16·740	·307	5·0000387,0
		6	*XVII*	84 3 48·426	·250	4·8869052,6			8	XXXIV	33 2 28·179	·306	4·7477952,9
		8	*XVII*	42 16 38·820	·205	4·6545105,9			5	XXXIV	36 48 48·065	·172	4·6463412,1
,,	679	7	XVI	63 26 38·490	·206	4·7782547,9	38	673	4	XXXVI	42 44 9·231	·172	4·7003886,6
		9	XIX	74 16 42·690	·206	4·8101168,5			6	*XXXVII*	100 27 2·704	·173	4·8614971,5
		23	XIX	56 59 16·873	·329	4·8281969,0			8	*XXXVII*	60 12 1·739	·255	4·8629347,9
,,	678	22	XXI	62 38 32·415	·330	4·8531533,4	,,	672	7	XXXVI	87 59 47·434	·255	4·9242647,4
		24	*XXII*	60 22 10·712	·329	4·8438007,3			9	XXXVIII	31 48 10·827	·254	4·6463412,1
		26	*XXII*	82 28 21·723	·395	4·9730176,1			5	XXXVIII	40 32 42·550	·203	4·6674955,8
,,	677	25	XXI	52 16 14·844	·395	4·8749042,4	39	671	4	XL	88 42 33·317	·204	4·8544405,6
		27	XXIV	45 15 23·433	·394	4·8281969,0			6	*XLI*	50 44 44·133	·203	4·7434846,9
		53	XVIII	41 53 31·320	·236	4·6855611,6			8	*XLI*	83 8 13·010	·204	4·8341120,7
,,	682	54	XX	77 11 18·850	·237	4·8500123,2	,,	670	7	XL	54 17 35·549	·203	4·7467988,9
		52	*XXVI*	60 55 9·830	·237	4·8024409,0			9	*XLIII*	42 34 11·441	·203	4·6674955,8
		37	*XXVI*	84 48 21·852	·281	4·9268515,0			10	XL	41 34 23·857	·229	4·6735785,4
,,	681	38	XX	60 20 51·466	·281	4·8676796,7	,,	669	11	*XLIII*	64 37 1·650	·229	4·8075974,2
		39	XXIII	34 50 46·682	·280	4·6855611,6			12	XLIV	73 48 34·493	·230	4·8341120,7
		51	XVIII	81 20 3·071	·372	4·9543333,3			20	*XLIII*	52 32 7·460	·209	4·7503366,9
,,	686	49	*XXVI*	47 38 5·475	·371	4·8278851,0	,,	668	19	XLIV	85 46 16·980	·209	4·8494803,5
		50	*XXVII*	51 1 51·454	·371	4·8500123,2			21	XLV	41 41 35·560	·208	4·6735785,4
		48	*XXVII*	65 17 18·365	·468	4·9489246,9			2	XLV	27 47 52·175	·273	4·6927341,3
,,	685	46	*XXVI*	47 48 48·774	·467	4·8604329,3	40	667	1+8	XLVII	107 55 15·628	·273	5·0024196,7
		47	*XXIX*	66 53 52·861	·468	4·9543333,3			7	XLVIII	44 16 52·197	·273	4·8679866,6
		45	*XXIX*	47 41 42·574	·325	4·8183278,5			5	XLVIII	52 6 15·939	·386	4·8429506,1
,,	684	43	*XXVI*	44 49 42·105	·325	4·7975261,8	41	666	8	XLIX	58 12 20·654	·387	4·8751922,6
		44	*XXVIII*	87 28 35·321	·326	4·9489246,9			6+7	*L*	69 41 23·407	·387	4·9179241,4
		42	*XXVIII*	57 18 32·303	·368	4·8676795,8			7	*L*	36 50 0·999	·299	4·7366225,1
,,	683	40	*XXVI*	73 59 49·915	·368	4·9254118,1	,,	665	1+8	XLIX	93 11 19·114	·300	4·9581653,0
		41	XXIII	48 41 37·782	·368	4·8183278,5			2	XLVII	49 58 39·887	·299	4·8429506,1

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 33.

Triangles 694 to 689.

Constants (from pages 81_{W} and 82_{W}).

							Contained Angles.
XLII to I	Log feet	4·6908426,1	}	...	4+7+10	...	187° 29′ 20″·201
I „ V	„	4·7056020,6	}	...	12+19+22	...	172 2 13 ·872
V „ VIII	„	4·8931899,4	}	...	24+31	...	130 26 43 ·678
VIII „ IX	„	4·8085539,0					

Equations to be satisfied.

							Factor
x_4	$+ x_5$	$+ x_6$	...	...	...	$= e_1 =$ ·000,	λ_1
x_7	$+ x_8$	$+ x_9$	...	...	...	$= e_2 =$ ·000,	λ_2
x_{10}	$+ x_{11}$	$+ x_{12}$	...	...	...	$= e_3 =$ ·000,	λ_3
x_{19}	$+ x_{20}$	$+ x_{21}$	...	...	...	$= e_4 =$ ·000,	λ_4
x_{22}	$+ x_{23}$	$+ x_{24}$	...	...	...	$= e_5 =$ ·000,	λ_5
x_{31}	$+ x_{32}$	$+ x_{33}$	...	...	...	$= e_6 =$ ·000,	λ_6
x_4	$+ x_7$	$+ x_{10}$	...	...	...	$= e_7 = +$ ·017,	λ_7
x_{12}	$+ x_{19}$	$+ x_{22}$	...	...	...	$= e_8 = +$ ·098,	λ_8
x_{24}	$+ x_{31}$	...	...	...	...	$= e_9 = -$ ·178,	λ_9
$17 x_5$	$-15 x_6$	$+ 4 x_8$	$-18 x_9$	$+16 x_{11}$	$- 8 x_{12}$	$= e_{10} = -$ 4·7,	λ_{10}
$12 x_{10}$	$-16 x_{11}$	$+ 3 x_{20}$	$-16 x_{21}$	$+ 9 x_{23}$	$-14 x_{24}$	$= e_{11} = -$ 10·4,	λ_{11}
$13 x_{22}$	$- 9 x_{23}$	$+19 x_{32}$	$-14 x_{33}$	...	...	$= e_{12} = -$ 13·7,	λ_{12}

Equations between the Factors

No. of e	Value of e	Co-efficients of											
		λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8	λ_9	λ_{10}	λ_{11}	λ_{12}
1	·000	+3	...	...	...	...	...	+1	...	...	+ 2	...	...
2	·000		+3	...	...	...	...	+1	...	...	− 14	...	...
3	·000			+3	...	...	...	+1	+1	...	+ 8	− 4	...
4	·000				+3	...	...	...	+1	...	...	− 13	...
5	·000					+3	...	...	+1	+1	...	− 5	+ 4
6	·000						+3	...	...	+1	...	...	+ 5
7	+ ·017							+3	...	...	...	+ 12	...
8	+ ·098					*			+3	...	− 8	...	+ 13
9	− ·178									+2	...	− 14	...
10	− 4·7										+1174	−256	...
11	−10·4											+942	− 81
12	−13·7												+807

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 33—(Continued).

Values of the Factors		Adopted Errors		
$\lambda_1 = -\cdot072$	$\lambda_7 = +\cdot234$	$x_4 = +''\cdot161$	$x_{10} = -''\cdot259$	$x_{22} = -''\cdot056$
$\lambda_2 = -\cdot118$	$\lambda_8 = +\cdot220$	$x_5 = -\cdot217$	$x_{11} = +\cdot134$	$x_{23} = +\cdot017$
$\lambda_3 = -\cdot165$	$\lambda_9 = -\cdot387$	$x_6 = +\cdot056$	$x_{12} = +\cdot125$	$x_{24} = +\cdot039$
$\lambda_4 = -\cdot192$	$\lambda_{10} = -\cdot009$	$x_7 = +\cdot115$	$x_{19} = +\cdot029$	$x_{31} = -\cdot217$
$\lambda_5 = +\cdot043$	$\lambda_{11} = -\cdot027$	$x_8 = -\cdot152$	$x_{20} = -\cdot274$	$x_{32} = -\cdot296$
$\lambda_6 = +\cdot170$	$\lambda_{12} = -\cdot025$	$x_9 = +\cdot037$	$x_{21} = +\cdot245$	$x_{33} = +\cdot513$

Figure 34.

Triangles 688 and 687.

Constants (from page 82_W).

						Contained Angle.
IX to XI	Log feet	4·7336184,1	}	... 4+7 ...		110° 19′ 15″·007
XI „ XIV	„	4·8983116,8	}			

Equations to be satisfied. **Factor**

$$
\begin{array}{rrrrclcl}
x_4 & + x_5 & + x_6 & \ldots & = & e_1 & = \cdot000, & \lambda_1 \\
x_7 & + x_8 & + x_9 & \ldots & = & e_2 & = \cdot000, & \lambda_2 \\
x_4 & + x_7 & \ldots & \ldots & = & e_3 & = -\cdot214, & \lambda_3 \\
-6x_5 & -32x_6 & +19x_8 & -10x_9 & = & e_4 & = -8\cdot5, & \lambda_4
\end{array}
$$

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	−38	$\lambda_1 = -\cdot058$	$x_4 = -''\cdot165$	$x_7 = -''\cdot049$
2	·000		+3	+1	+9	$\lambda_2 = +\cdot058$	$x_5 = -\cdot014$	$x_8 = -\cdot083$
3	−·214		*	+2	...	$\lambda_3 = -\cdot107$	$x_6 = +\cdot179$	$x_9 = +\cdot132$
4	−8·5				+1521	$\lambda_4 = -\cdot007$		

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 35.

Triangles 680 and 679.

Constants (from page $83_{\overline{W}}$).

						Contained Angle.
XIV to XVI	Log feet	4·8869088,7	} ...	4+7	...	102° 55′ 36″·226
XVI „ XIX	„	4·6545164,5				

Equations to be satisfied.

											Factor
x_4	+	x_5	+	x_6	...	=	e_1	=		·000,	λ_1
x_7	+	x_8	+	x_9	...	=	e_2	=		·000,	λ_2
x_4	+	x_7		...	...	=	e_3	=	−	·578,	λ_3
$14\,x_5$	−	$2\,x_6$	+	$23\,x_8$	$-\,5\,x_9$	=	e_4	=		−22·5,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	+12	$\lambda_1 = +\,·478$	$x_4 = -''·338$	$x_7 = -''·240$
2	·000		+3	+1	+18	$\lambda_2 = +\,·580$	$x_5 = -\,·226$	$x_8 = -\,·571$
3	− ·578		*	+2	...	$\lambda_3 = -\,·818$	$x_6 = +\,·564$	$x_9 = +\,·811$
4	−22·5				+754	$\lambda_4 = -\,·051$		

Figure 35—(Continued).

Triangles 678 and 677.

Constants (from page $83_{\overline{W}}$).

						Contained Angle.
XIX to XXI	Log feet	4·8438064,8	} ...	22+25	...	114° 54′ 48″·690
XXI „ XXIV	„	4·9730249,6				

Equations to be satisfied.

											Factor
x_{22}	+	x_{23}	+	x_{24}	...	=	e_1	=		·000,	λ_1
x_{25}	+	x_{26}	+	x_{27}	...	=	e_2	=		·000,	λ_2
x_{22}	+	x_{25}		...	...	=	e_3	=	−	·706,	λ_3
$14\,x_{23}$	−	$12\,x_{24}$	+	$3\,x_{26}$	$-\,21\,x_{27}$	=	e_4	=		−16·0,	λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 35—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	+ 2	$\lambda_1 = + \cdot 163$	$x_{22} = -'' \cdot 286$	$x_{25} = -'' \cdot 420$
2	·000		+3	+1	− 18	$\lambda_2 = + \cdot 030$	$x_{23} = - \cdot 117$	$x_{26} = - \cdot 029$
3	− ·706		*	+2	...	$\lambda_3 = - \cdot 449$	$x_{24} = + \cdot 403$	$x_{27} = + \cdot 449$
4	−16·0				+790	$\lambda_4 = - \cdot 020$		

Figure 35—(Continued).

Triangles 686 to 681.

Constants (from page 83—$_{W}$).

						Contained Angle.
XVIII to XX	Log feet	4·8024459,5	}	...	54+38	... 137° 32′ 10″·310
XX „ XXIII	„	4·9268573,8	}			

Equations to be satisfied.   Factor

$$x_{52} + x_{53} + x_{54} \quad \ldots \quad \ldots \quad \ldots \quad = e_1 = \cdot 000, \qquad \lambda_1$$

$$x_{49} + x_{50} + x_{51} \quad \ldots \quad \ldots \quad \ldots \quad = e_2 = \cdot 000, \qquad \lambda_2$$

$$x_{46} + x_{47} + x_{48} \quad \ldots \quad \ldots \quad \ldots \quad = e_3 = \cdot 000, \qquad \lambda_3$$

$$x_{43} + x_{44} + x_{45} \quad \ldots \quad \ldots \quad \ldots \quad = e_4 = \cdot 000, \qquad \lambda_4$$

$$x_{40} + x_{41} + x_{42} \quad \ldots \quad \ldots \quad \ldots \quad = e_5 = \cdot 000, \qquad \lambda_5$$

$$x_{37} + x_{38} + x_{39} \quad \ldots \quad \ldots \quad \ldots \quad = e_6 = \cdot 000, \qquad \lambda_6$$

$$x_{54} + x_{38} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad = e_7 = + \cdot 524, \qquad \lambda_7$$

$$x_{52} + x_{49} + x_{46} + x_{43} + x_{40} + x_{37} = e_8 = \cdot 000, \qquad \lambda_8$$

$$24\,x_{53} - 11\,x_{52} + x_{37} - 30\,x_{39} \quad \ldots \quad \ldots \quad = e_9 = - 8 \cdot 3, \qquad \lambda_9$$

$$\left.\begin{array}{l} 5\,x_{54} - 11\,x_{52} + 4\,x_{51} - 18\,x_{50} + 9\,x_{48} - 9\,x_{47} \\ +19\,x_{45} - x_{44} + 14\,x_{42} - 19\,x_{41} + x_{37} - 12\,x_{38} \end{array}\right\} = e_{10} = - 9 \cdot 2, \qquad \lambda_{10}$$

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 35—(Continued).

Equations between the Factors

No. of e	Value of e	Co-efficients of									
		λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8	λ_9	λ_{10}
1	·000	+3	...	...	...	...	...	+1	+1	+ 13	− 6
2	·000		+3	...	...	...	...	...	+1	...	− 14
3	·000			+3	...	...	...	...	+1	...	0
4	·000				+3	...	...	...	+1	...	+ 18
5	·000					+3	...	...	+1	...	− 5
6	·000						+3	+1	+1	− 29	− 11
7	+ ·524				*			+2	...	...	− 7
8	·000								+6	− 10	− 10
9	− 8·3									+1598	+ 122
10	− 9·2										+1712

Values of the Factors

λ_1 = − ·146	λ_6 = − ·268
λ_2 = − ·045	λ_7 = + ·450
λ_3 = − ·020	λ_8 = + ·060
λ_4 = + ·012	λ_9 = − ·008
λ_5 = − ·029	λ_{10} = − ·005

Adopted Errors

x_{37} = −″·222	x_{43} = +″·073	x_{49} = +″·015
x_{38} = + ·247	x_{44} = + ·017	x_{50} = + ·052
x_{39} = − ·025	x_{45} = − ·090	x_{51} = − ·067
x_{40} = + ·031	x_{46} = + ·040	x_{52} = + ·063
x_{41} = + ·074	x_{47} = + ·029	x_{53} = − ·340
x_{42} = − ·105	x_{48} = − ·069	x_{54} = + ·277

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 36.

Triangles 676 and 675.

Constants (from page $84\_\_W$).

						Contained Angle.
XXV to XXX	Log feet	4·8400819,2	} ...	13+10	...	149° 16′ 8″·332
XXX „ XXXIII	„	4·8338755,4				

Equations to be satisfied. Factor

x_{13}	+	x_{14}	+	x_{15}	...	=	e_1	= ·000,	λ_1
x_{10}	+	x_{11}	+	x_{12}	...	=	e_2	= ·000,	λ_2
x_{13}	+	x_{10}	...		...	=	e_3	= + ·354,	λ_3
$23\,x_{15}$	−	$22\,x_{14}$	+	$11\,x_{12}$	$-\ 12\,x_{11}$	=	e_4	= −4·7,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	+ 1	λ_1 = − ·087	x_{10} = +″·176	x_{13} = +″·178
2	·000		+3	+1	− 1	λ_2 = − ·090	x_{11} = − ·046	x_{14} = − ·007
3	+ ·354		*	+2	...	λ_3 = + ·266	x_{12} = − ·130	x_{15} = − ·171
4	−4·7				+1278	λ_4 = − ·004		

Figure 37.

Triangle 674.

Constants (from page $85\_\_W$).

						Contained Angle.
XXXIII to XXXV	Log feet	4·7478019,6	} ...	6+7	...	102° 56′ 17″·315
XXXV „ XXXIV	„	4·8531484,0				

Equations to be satisfied.

$$x_5 + x_8 = +\ {\cdot}268$$
$$22\,x_5 - 33\,x_8 = -\ 3{\cdot}5$$

Adopted Errors.

$$x_5 = +\ {''}{\cdot}097$$
$$x_8 = +\ {\cdot}171$$

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 38.

Triangles 673 and 672.

Constants (from page 85—$_W$).

						Contained Angle.
XXXIV to XXXVI	Log feet	4·8615048,5	} ...	4+7	...	130° 43′ 57″·584
XXXVI „ XXXVIII	„	4·8629436,1				

Equations to be satisfied.

							Factor
x_4	$+ x_5$	$+ x_6$	...	$= e_1$	=	·000,	λ_1
x_7	$+ x_8$	$+ x_9$	...	$= e_2$	=	·000,	λ_2
x_4	$+ x_7$	...	...	$= e_3$	=	− ·492,	λ_3
$28 x_5$	$+ 4 x_6$	$+ 12 x_8$	$- 34 x_9$	$= e_4$	=	− 11·2,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	+ 32	λ_1 = + ·213	x_4 = −″·176 x_7 = −″·316
2	·000		+3	+1	− 22	λ_2 = + ·072	x_5 = − ·005 x_8 = − ·022
3	− ·492		*	+2	...	λ_3 = − ·389	x_6 = + ·181 x_9 = + ·338
4	−11·2				+2100	λ_4 = − ·008	

Figure 39.

Triangles 671 to 668.

Constants (from pages 85—$_W$ and 86—$_W$).

							Contained Angles.
XXXVIII	to XL	Log feet	4·7434937,1	} ...	4+7+10	...	184° 34′ 33″·757
XL	„ XLIV	„	4·8076063,5	} ...	12+19	...	159 34 52 ·365
XLIV	„ XLV	„	4·7503458,6				

Equations to be satisfied.

									Factor
x_4	$+ x_5$	$+ x_6$	...	...	...	$= e_1$	=	·000,	λ_1
x_7	$+ x_8$	$+ x_9$	...	...	...	$= e_2$	=	·000,	λ_2
x_{10}	$+ x_{11}$	$+ x_{12}$	...	...	...	$= e_3$	=	·000,	λ_3
x_{19}	$+ x_{20}$	$+ x_{21}$	...	...	...	$= e_4$	=	·000,	λ_4
x_4	$+ x_7$	$+ x_{10}$	...	...	...	$= e_5$	=	− ·398,	λ_5
x_{12}	$+ x_{19}$	...	...	...	...	$= e_6$	=	− ·453,	λ_6
$24 x_5$	$-17 x_6$	$+ 3 x_8$	$-23 x_9$	$+10 x_{11}$	$- 6 x_{12}$	$= e_7$	=	+ ·9,	λ_7
$23 x_{10}$	$-10 x_{11}$	$+16 x_{20}$	$-23 x_{21}$	...	...	$= e_8$	=	− 2·4,	λ_8

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 39—(Continued).

Equations between the Factors										Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of										
		λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8			
1	·000	+3	...	...	...	+1	...	+ 7	...	λ_1 = + ·088		
2	·000		+3	...	...	+1	...	− 20	...	λ_2 = + ·095	x_4 = −″·184	x_{10} = −″·022
3	·000			+3	...	+1	+1	+ 4	+ 13	λ_3 = + ·141	x_5 = + ·076	x_{11} = + ·204
4	·000				+3	...	+1	...	− 7	λ_4 = + ·225	x_6 = + ·108	x_{12} = − ·182
5	− ·398					+3	...	...	+ 23	λ_5 = − ·279	x_7 = − ·192	x_{19} = − ·271
6	− ·453				*		+2	− 6	...	λ_6 = − ·412	x_8 = + ·088	x_{20} = + ·162
7	+ ·9							+1539	− 100	λ_7 = − ·001	x_9 = + ·104	x_{21} = + ·109
8	−2·4								+1414	λ_8 = + ·001		

Figure 40.

Triangle 667.

Constants (from page 86—$_W$).

						Contained Angle.
XLV to XLVII	Log feet	4·8679957,0	}	...	1+8	... 107° 55′ 15″·543
XLVII „ XLVIII	„	4·6927431,4	}			

Equations to be satisfied.

$$x_2 + x_7 = - \cdot358$$
$$39\,x_2 - 2\dot{1}\,x_7 = + \cdot3$$

Adopted Errors.

x_2 = − ″·120

x_7 = − ·238

Figure 41.

Triangles 666 and 665.

Constants (from page 86—$_W$).

						Contained Angle.
XLVIII to XLIX	Log feet	4·9179331,2	}	...	1	... 34° 58′ 58″·437
XLIX „ XLVII	„	4·7366317,9	}			

Equations to be satisfied.

				Factor
$x_5 + x_6 + x_7 + x_8$	= e_1	=	·000,	λ_1
$x_2 + x_7 + x_8$ ...	= e_2	=	+ ·064,	λ_2
$16\,x_5 - 8\,(x_6 + x_7) + 28\,x_7 - 18\,x_2$	= e_3	=	− 3·0,	λ_3

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 41—(Continued).

Equations between the Factors					Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3			
1	·000	+4	+2	+ 28	$\lambda_1 = + \cdot 018$	$x_2 = +'' \cdot 063$	$x_7 = -'' \cdot 038$
2	+ ·064		+3	+ 2	$\lambda_2 = + \cdot 012$	$x_5 = - \cdot 045$	$x_8 = + \cdot 039$
3	−3·0		*	+1044	$\lambda_3 = - \cdot 003$	$x_6 = + \cdot 044$	

Brahmaputra Series.—Sides and Angles of the Non-Circuit Triangles.

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
		5	U XXI	58 42 46·821	·212	4·7403794,5			8	V *XVII*	54 41 21·340	·219	4·7298258,2
42	635	4	V I	60 14 36·844	·212	4·7472196,9	45	642	7	XVI	64 11 10·560	·220	4·7724660,7
		6	*II*	61 2 36·335	·212	4·7506299,5			9	XIX	61 7 28·100	·220	4·7604610,2
		8	*II*	64 46 55·487	·201	4·7558675,2			5	XIX	56 3 45·507	·171	4·6943354,2
,,	636	7	I	54 24 32·161	·201	4·7095587,7	46	643	4	XXI	50 6 19·322	·171	4·6603641,9
		9	IV	60 48 32·352	·201	4·7403794,5			6	*XXII*	73 49 55·171	·172	4·7579157,3
		5	IV	59 44 29·810	·233	4·7654141,0			8	*XXII*	60 1 1·719	·201	4·7417636,4
43	637	4	VI	61 13 28·657	·233	4·7717788,2	,,	644	7	XXI	69 2 8·785	·201	4·7744137,1
		6	*VII*	59 2 1·533	·233	4·7622393,7			9	XXV	50 56 49·496	·201	4·6943354,2
		8	*VII*	55 21 11·763	·226	4·7392205,5			5	XXV	58 27 32·374	·239	4·7656292,0
,,	638	7	VI	63 44 28·992	·226	4·7766919,0	47	645	4	XXVIII	58 30 46·758	·239	4·7658801,0
		9	IX	60 54 19·245	·226	4·7654141,0			6	*XXIX*	63 1 40·868	·239	4·7850430,6
		5	IX	63 28 49·287	·235	4·7838026,4			8	*XXIX*	56 56 25·494	·225	4·7453423,2
44	639	4	XI	55 36 25·830	·235	4·7486366,7	,,	646	7	XXVIII	61 38 8·614	·225	4·7665000,7
		6	*XII*	60 54 44·883	·235	4·7735365,8			9	XXXI	61 25 25·892	·225	4·7656292,0
		8	*XII*	55 20 56·354	·223	4·7378137,6			5	XXXI	63 47 23·088	·227	4·7772907,1
,,	640	7	XI	58 30 47·563	·224	4·7534360,9	48	647	4	XXXIII	59 52 50·455	·227	4·7614186,7
		9	XIV	66 8 16·083	·224	4·7838026,4			6	*XXXIV*	56 19 46·457	·227	4·7446601,6
		5	XIV	59 15 36·354	·229	4·7604610,2			8	*XXXIV*	61 36 5·864	·225	4·7676376,6
45	641	4	XVI	62 55 10·985	·230	4·7757871,8	,,	648	7	XXXIII	54 18 52·940	·224	4·7330026,2
		6	*XVII*	57 49 12·661	·229	4·7537827,3			9	XXXVI	64 5 1·196	·225	4·7772907,1

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Brahmaputra Series.—Sides and Angles of the Non-Circuit Triangles—(Continued).

Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet	Number of Figure	Number of Triangle	Figural No. of Angle	Serial Letter and Number of Station	Corrected Plane Angle	Spherical Excess	Logarithm of Side-length in Feet
				° ′ ″	″						° ′ ″	″	
		30	V XXXV	60 26 3·952	·252	4·7855538,0			12	V *XLII*	61 28 31·339	·251	4·7977834,5
48	649	28	XXXVII	58 39 45·473	·252	4·7776573,7	49	652	10	XLI	69 18 59·236	·251	4·8250512,3
		29	*XXXVIII*	60 54 10·575	·252	4·7875491,9			11	XLIV	49 12 29·425	·250	4·7331328,5
		27	*XXXVIII*	66 48 32·453	·246	4·8085180,0			18	XLIV	43 40 51·545	·306	4·7707021,6
„	650	25	XXXVII	52 30 57·624	·245	4·7446689,9	50	653	16	XLV	50 37 25·704	·306	4·8196268,3
		26	XL	60 40 29·923	·246	4·7855538,0			17	*XLVII*	85 41 42·751	·306	4·9302219,1
		15	XL	48 30 35·160	·237	4·7331328,5			15	*XLVII*	109 53 34·129	·308	5·0256092,9
49	651	13	XLI	80 9 32·835	·237	4·8521736,8	„	654	13	XLV	38 35 1·879	·308	4·8472760,6
		14	*XLII*	51 19 52·005	·237	4·7511342,6			14	X XXII	31 31 23·992	·307	4·7707021,6

Final Figural Adjustments of the Non-Circuit Triangles.

Figure 42.

Triangles 635 and 636.

Constants (from page 71—V).

						Contained Angle.
XXI	to	I	Log feet	4·7506376,5	… 4+7 …	114° 39′ 9″·915
I	„	IV	„	4·7558749,9		

Equations to be satisfied.

											Factor
x_4	+	x_5	+	x_6	…	=	e_1	=	·000,		λ_1
x_7	+	x_8	+	x_9	…	=	e_2	=	·000,		λ_2
x_4	+	x_7		…	…	=	e_3	=	− ·497,		λ_3
$13 x_5$	−	$11 x_6$	+	$10 x_8$	$- 12 x_9$	=	e_4	=	+2·3,		λ_4

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	…	+1	+ 2	$\lambda_1 = +$ ·121	$x_4 = -$″·251 $x_7 = -$″·246
2	·000		+3	+1	− 2	$\lambda_2 = +$ ·127	$x_5 = +$ ·177 $x_8 = +$ ·170
3	− ·497		*	+2	…	$\lambda_3 = -$ ·373	$x_6 = +$ ·074 $x_9 = +$ ·076
4	+2·3				+534	$\lambda_4 = +$ ·004	

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 43.

Triangles 637 and 638.

Constants (from page 72—v).

						Contained Angle.
IV to VI	Log feet	4·7622469,4	}	...	4+7	... 124° 57′ 58″·594
VI „ IX	„	4·7392280,0				

Equations to be satisfied.

						Factor
x_4	$+ x_5$	$+ x_6$	...	$= e_1$	$= \cdot 000,$	λ_1
x_7	$+ x_8$	$+ x_9$	...	$= e_2$	$= \cdot 000,$	λ_2
x_4	$+ x_7$	...	...	$= e_3$	$= - \cdot 486,$	λ_3
$12 x_5$	$- 12 x_6$	$+ 15 x_8$	$- 12 x_9$	$= e_4$	$= + 1\cdot 2,$	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	0	$\lambda_1 = + \cdot 121$	$x_4 = -''\cdot 242$	$x_7 = -''\cdot 244$
2	·000		+3	+1	+ 3	$\lambda_2 = + \cdot 120$	$x_5 = + \cdot 137$	$x_8 = + \cdot 140$
3	− ·486		*	+2	...	$\lambda_3 = - \cdot 364$	$x_6 = + \cdot 105$	$x_9 = + \cdot 104$
4	+1·2				+657	$\lambda_4 = + \cdot 001$		

Figure 44.

Triangles 639 and 640.

Constants (from page 72—v).

						Contained Angle.
IX to XI	Log feet	4·7735439,7	}	...	4+7	... 114° 7′ 14″·159
XI „ XIV	„	4·7378211,7				

Equations to be satisfied.

						Factor
x_4	$+ x_5$	$+ x_6$	...	$= e_1$	$= \cdot 000,$	λ_1
x_7	$+ x_8$	$+ x_9$	...	$= e_2$	$= \cdot 000,$	λ_2
x_4	$+ x_7$	...	...	$= e_3$	$= - \cdot 307,$	λ_3
$11 x_5$	$- 12 x_6$	$+ 14 x_8$	$- 10 x_9$	$= e_4$	$= - .2,$	λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 44—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	− 1	$\lambda_1 = +\ \cdot077$	$x_4 = -''\cdot154$	$x_7 = -''\cdot153$
2	·000		+3	+1	+ 4	$\lambda_2 = +\ \cdot078$	$x_5 = +\ \cdot068$	$x_8 = +\ \cdot064$
3	− ·307		*	+2	...	$\lambda_3 = -\ \cdot231$	$x_6 = +\ \cdot086$	$x_9 = +\ \cdot089$
4	− ·2				+561	$\lambda_4 = -\ \cdot001$		

Figure 45.

Triangles 641 and 642.

Constants (from page 73—$_V$).

					Contained Angle.
XIV to XVI	Log feet	4·7537901,1	} ...	4+7 ...	127° 6′ 22″·167
XVI „ XIX	„	4·7298332,3			

Equations to be satisfied.

						Factor
x_4	$+\ x_5$	$+\ x_6$	...	$= e_1 =$	·000,	λ_1
x_7	$+\ x_8$	$+\ x_9$	...	$= e_2 =$	·000,	λ_2
x_4	$+\ x_7$	...	...	$= e_3 =$	− ·172,	λ_3
$12\,x_5$	$-\ 14\,x_6$	$+\ 15\,x_8$	$-\ 11\,x_9$	$= e_4 =$	− ·3,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of						
		λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	− 2	$\lambda_1 = +\ \cdot043$	$x_4 = -''\cdot087$	$x_7 = -''\cdot085$
2	·000		+3	+1	+ 4	$\lambda_2 = +\ \cdot044$	$x_5 = +\ \cdot037$	$x_8 = +\ \cdot035$
3	− ·172		*	+2	...	$\lambda_3 = -\ \cdot129$	$x_6 = +\ \cdot050$	$x_9 = +\ \cdot050$
4	− ·3				+686	$\lambda_4 = -\ \cdot001$		

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 46.

Triangles 643 and 644.

Constants from (page 73—V).

									Contained Angle.
XIX	to	XXI	Log feet	4·7579231,6	}	...	4+7	...	119° 8′ 28″·662
XXI	„	XXV	„	4·7417710,9					

Equations to be satisfied.

												Factor
x_4	+	x_5	+	x_6	...	=	e_1	=		·000,		λ_1
x_7	+	x_8	+	x_9	...	=	e_2	=		·000,		λ_2
x_4	+	x_7	...		...	=	e_3	=	−	·183,		λ_3
$14x_5$	−	$7x_6$	+	$12x_8$	$-17x_9$	=	e_4	=	−	·2,		λ_4

Equations between the Factors: No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	Values of the Factors	Adopted Errors	
1	·000	+3	...	+1	+ 7	λ_1 = + ·047	x_4 = −″·091	x_7 = −″·092
2	·000		+3	+1	− 5	λ_2 = + ·045	x_5 = + ·041	x_8 = + ·040
3	− ·183		*	+2	...	λ_3 = − ·138	x_6 = + ·050	x_9 = + ·052
4	− ·2				+678	λ_4 = ·000		

Figure 47.

Triangles 645 and 646.

Constants (from page 74—V).

									Contained Angle.
XXV	to	XXVIII	Log feet	4·7850506,0	}	...	4+7	...	120° 8′ 56″·159
XXVIII	„	XXXI	„	4·7453498,7					

Equations to be satisfied.

												Factor
x_4	+	x_5	+	x_6	...	=	e_1	=		·000,		λ_1
x_7	+	x_8	+	x_9	...	=	e_2	=		·000,		λ_2
x_4	+	x_7	...		...	=	e_3	=	−	·323,		λ_3
$13x_5$	−	$11x_6$	+	$14x_8$	$-12x_9$	=	e_4	=	−	·1,		λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 47—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	+ 2	$\lambda_1 = +\cdot 082$	$x_4 = -''\cdot 162$ $x_7 = -''\cdot 161$
2	·000		+3	+1	+ 2	$\lambda_2 = +\cdot 082$	$x_5 = +\cdot 071$ $x_8 = +\cdot 071$
3	− ·323		*	+2	...	$\lambda_3 = -\cdot 243$	$x_6 = +\cdot 091$ $x_9 = +\cdot 090$
4	− ·1				+630	$\lambda_4 = -\cdot 001$	

Figure 48.

Triangles 647 and 648.

Constants (from page $74\frac{}{V}$).

					Contained Angle.
XXXI to XXXIII	Log feet	4·7446676,7	} ...	4+7 ...	114° 11′ 43″·933
XXXIII „ XXXVI	„	4·7676453,0			

Equations to be satisfied.

						Factor
x_4	$+ x_5$	$+ x_6$	...	$= e_1 =$	·000,	λ_1
x_7	$+ x_8$	$+ x_9$	...	$= e_2 =$	·000,	λ_2
x_4	$+ x_7$	...	...	$= e_3 =$	− ·087,	λ_3
$10 x_5$	$- 14 x_6$	$+ 11 x_8$	$- 10 x_9$	$= e_4 =$	− 1·3,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	− 4	$\lambda_1 = +\cdot 018$	$x_4 = -\cdot 046$ $x_7 = -\cdot 041$
2	·000		+3	+1	+ 1	$\lambda_2 = +\cdot 022$	$x_5 = -\cdot 006$ $x_8 = -\cdot 005$
3	− ·087		*	+2	...	$\lambda_3 = -\cdot 064$	$x_6 = +\cdot 052$ $x_9 = +\cdot 046$
4	−1·3				+517	$\lambda_4 = -\cdot 002$	

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 48—(Continued).

Triangles 649 and 650.

Constants (from pages 74—r and 75—r).

XXXV	to	XXXVII	Log feet	4·7875566,4	}	... 28+25 ...	Contained Angle.	111° 10′ 43″·557
XXXVII	„	XL	„	4·8085256,6				

Equations to be satisfied.

									Factor
x_{28}	+ x_{29}	+ x_{30}	...	=	e_1	=		·000,	λ_1
x_{25}	+ x_{26}	+ x_{27}	...	=	e_2	=		·000,	λ_2
x_{28}	+ x_{25}	...	...	=	e_3	=	+	·037,	λ_3
$12\,x_{30}$	$-11\,x_{29}$	$+9\,x_{27}$	$-12\,x_{26}$	=	e_4	=	−	2·1,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors	
No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4			
1	·000	+3	...	+1	+ 1	λ_1 = − ·009	x_{25} = +″·016	x_{28} = +″·021
2	·000		+3	+1	− 3	λ_2 = − ·014	x_{26} = + ·038	x_{29} = + ·039
3	+ .037		*	+2	...	λ_3 = + ·030	x_{27} = − ·054	x_{30} = − ·060
4	−2·1				+490	λ_4 = − ·004		

Figure 49.

Triangles 651 and 652.

Constants (from page 75—r).

XL	to	XLI	Log feet	4·7511418,9	}	... 13+10 ...	Contained Angle.	149° 28′ 32″·590
XLI	„	XLIV	„	4·7977912,1				

Equations to be satisfied.

									Factor
x_{13}	+ x_{14}	+ x_{15}	...	=	e_1	=		·000,	λ_1
x_{10}	+ x_{11}	+ x_{12}	...	=	e_2	=		·000,	λ_2
x_{13}	+ x_{10}	...	...	=	e_3	=	−	·031,	λ_3
$19\,x_{15}$	$-17\,x_{14}$	$+12\,x_{12}$	$-19\,x_{11}$	=	e_4	=	−	1·3,	λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 47—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	+ 2	$\lambda_1 = + \cdot 082$	$x_4 = -'' \cdot 162$ $x_7 = -'' \cdot 161$
2	·000		+3	+1	+ 2	$\lambda_2 = + \cdot 082$	$x_5 = + \cdot 071$ $x_8 = + \cdot 071$
3	− ·323		*	+2	...	$\lambda_3 = - \cdot 243$	$x_6 = + \cdot 091$ $x_9 = + \cdot 090$
4	− ·1				+630	$\lambda_4 = - \cdot 001$	

Figure 48.

Triangles 647 and 648.

Constants (from page 74—v).

				Contained Angle.
XXXI to XXXIII	Log feet	4·7446676,7	} ... 4+7 ...	114° 11′ 43″·933
XXXIII „ XXXVI	„	4·7676453,0		

Equations to be satisfied.

						Factor
x_4	$+ x_5$	$+ x_6$	...	$= e_1 =$	·000,	λ_1
x_7	$+ x_8$	$+ x_9$	...	$= e_2 =$	·000,	λ_2
x_4	$+ x_7$	...	...	$= e_3 =$	− ·087,	λ_3
$10 x_5$	$- 14 x_6$	$+ 11 x_8$	$- 10 x_9$	$= e_4 =$	− 1·3,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	− 4	$\lambda_1 = + \cdot 018$	$x_4 = - \cdot 046$ $x_7 = - \cdot 041$
2	·000		+3	+1	+ 1	$\lambda_2 = + \cdot 022$	$x_5 = - \cdot 006$ $x_8 = - \cdot 005$
3	− ·087		*	+2	...	$\lambda_3 = - \cdot 064$	$x_6 = + \cdot 052$ $x_9 = + \cdot 046$
4	−1·3				+517	$\lambda_4 = - \cdot 002$	

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 48—(Continued).

Triangles 649 and 650.

Constants (from pages 74—$_r$ and 75—$_r$).

							Contained Angle.
XXXV	to	XXXVII	Log feet	4·7875566,4	} ...	28+25 ...	111° 10′ 43″·557
XXXVII	„	XL	„	4·8085256,6			

Equations to be satisfied.

							Factor
x_{28}	+ x_{29}	+ x_{30}	...	=	e_1	= ·000,	λ_1
x_{25}	+ x_{26}	+ x_{27}	...	=	e_2	= ·000,	λ_2
x_{28}	+ x_{25}	...	...	=	e_3	= + ·037,	λ_3
$12\,x_{30}$	$-\,11\,x_{29}$	$+\,9\,x_{27}$	$-\,12\,x_{26}$	=	e_4	= − 2·1,	λ_4

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	+ 1	$\lambda_1 = -$ ·009	
2	·000		+3	+1	− 3	$\lambda_2 = -$ ·014	$x_{25} = +$″·016 $x_{28} = +$″·021
3	+ .037		*	+2	...	$\lambda_3 = +$ ·030	$x_{26} = +$ ·038 $x_{29} = +$ ·039
4	−2·1				+490	$\lambda_4 = -$ ·004	$x_{27} = -$ ·054 $x_{30} = -$ ·060

Figure 49.

Triangles 651 and 652.

Constants (from page 75—$_r$).

							Contained Angle.
XL	to	XLI	Log feet	4·7511418,9	} ...	13+10 ...	149° 28′ 32″·590
XLI	„	XLIV	„	4·7977912,1			

Equations to be satisfied.

							Factor
x_{13}	+ x_{14}	+ x_{15}	...	=	e_1	= ·000,	λ_1
x_{10}	+ x_{11}	+ x_{12}	...	=	e_2	= ·000,	λ_2
x_{13}	+ x_{10}	...	...	=	e_3	= − ·031,	λ_3
$19\,x_{15}$	$-\,17\,x_{14}$	$+\,12\,x_{12}$	$-\,19\,x_{11}$	=	e_4	= − 1·3,	λ_4

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Final Figural Adjustments of the Non-Circuit Triangles.

Figure 49—(Continued).

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	+ 2	$\lambda_1 = +\ {\cdot}008$	$x_{10} = -''{\cdot}018$ $x_{13} = -''{\cdot}013$
2	·000		+3	+1	− 7	$\lambda_2 = +\ {\cdot}005$	$x_{11} = +\ {\cdot}026$ $x_{14} = +\ {\cdot}025$
3	− ·031		*	+2	...	$\lambda_3 = -\ {\cdot}022$	$x_{12} = -\ {\cdot}008$ $x_{15} = -\ {\cdot}012$
4	−1·3				+1155	$\lambda_4 = -\ {\cdot}001$	

Figure 50.

Triangles 653 and 654.

Constants (from pages $75_{—V}$ and $76_{—V}$).

						Contained Angle.
XLIV to XLV	Log feet	4·9302297,7	}	... 16+13 ...		89° 12′ 28″·329
XLV „ XXII	„	5·0256179,3				

Equations to be satisfied. Factor

$$x_{16} + x_{17} + x_{18} \ldots = e_1 = {\cdot}000, \quad \lambda_1$$
$$x_{13} + x_{14} + x_{15} \ldots = e_2 = {\cdot}000, \quad \lambda_2$$
$$x_{16} + x_{13} \ldots \ldots = e_3 = -\ {\cdot}132, \quad \lambda_3$$
$$22\,x_{18} - 2\,x_{17} - 8\,x_{15} - 34\,x_{14} = e_4 = -7{\cdot}8, \quad \lambda_4$$

Equations between the Factors						Values of the Factors	Adopted Errors
No. of e	Value of e	Co-efficients of					
		λ_1	λ_2	λ_3	λ_4		
1	·000	+3	...	+1	+ 20	$\lambda_1 = +\ {\cdot}069$	$x_{13} = -''{\cdot}144$ $x_{16} = +''{\cdot}012$
2	·000		+3	+1	− 42	$\lambda_2 = -\ {\cdot}086$	$x_{14} = +\ {\cdot}169$ $x_{17} = +\ {\cdot}084$
3	− ·132		*	+2	...	$\lambda_3 = -\ {\cdot}058$	$x_{15} = -\ {\cdot}025$ $x_{18} = -\ {\cdot}096$
4	−7·8				+1708	$\lambda_4 = -\ {\cdot}008$	

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APPENDIX.

No. 3.

ON THE THEORETICAL ERRORS GENERATED RESPECTIVELY IN SIDE, AZIMUTH, LATITUDE AND LONGITUDE IN A CHAIN OF TRIANGLES.

The subject of the theoretical errors of functions of the angles of a triangulation, has been already fully dealt with in Chapter XV of Volume II, and it would have been unnecessary to add anything to what is there stated had not a flaw in the formulæ on pages 205 and 207, for the theoretical errors at the end of chains of single triangles, been discovered. This error would have escaped notice, but that General Walker's attention was attracted to certain discrepancies between theory and practice, which were subsequently met with in the relations between the magnitudes of the errors respectively generated in side, azimuth, latitude and longitude.

A careful examination of the formulæ was then undertaken, which led to the discovery that some of the terms in the expressions employed for deducing them had obtained wrong signs. The correct formulæ, which are given in this Appendix, have been verified in several ways, leaving no present doubt of their accuracy.

To save reference to Volume II it will be desirable to quote some of the results therein arrived at.

Let $X_1, X_2, X_3, \ldots$ denote the values of the observed angles in any chain of triangles, $u_1, u_2, u_3, \ldots$ the reciprocals of their relative weights, and $x_1, x_2, x_3, \ldots$ the most probable values of their errors; and let $F(X_1, X_2, X_3, \ldots)$ denote any function of the observed angles, and $F(X_1 - x_1, X_2 - x_2, X_3 - x_3, \ldots)$ the same function of the corrected angles. By Taylor's Theorem, if we neglect terms involving higher powers of $x_1, x_2, x_3, \ldots$ than the first, because these errors are supposed to be very small,

$$F(X_1 - x_1, X_2 - x_2, X_3 - x_3, \ldots) - F(X_1, X_2, X_3, \ldots) = -\{f_1 x_1 + f_2 x_2 + f_3 x_3 + \ldots\} \quad \text{(i)}$$

where

$$f_1 = \frac{dF}{dX_1}, \quad f_2 = \frac{dF_2}{dX_2}, \quad f_3 = \frac{dF_3}{dX_3}, \text{ \&c.} \quad \text{(ii)}$$

Thus the most probable value of the error of any function of the observed angles $F(X_1, X_2, X_3, \ldots)$ is $f_1 x_1 + f_2 x_2 + f_3 x_3 + \ldots$

Now ρ being the modulus for reducing *relative* weights to *absolute* weights, we have

$$e.m.s.^2 X = \frac{u}{\rho^2}$$

and

$$e.m.s.^2 \text{ of } F(X_1, X_2, X_3, \ldots) = \frac{1}{\rho^2}\{f_1^2 u_1 + f_2^2 u_2 + f_3^2 u_3 + \ldots\} = \frac{1}{\rho^2}[f^2 u] \text{ written briefly} \quad \text{(iii)}$$

the brackets [ ], as usual, denoting summation.

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If the angles $X_1, X_2, X_3, \ldots$ are connected together by a group of geometrical conditions—such as those furnished by a single polygonal figure or network of triangles—or by several independent groups of geometrical conditions—such as are given by a chain of independent polygonal figures —each group will furnish equations between the errors of the angles involved in it of the form of equations (18) page 28, *viz.*,

$$\left.\begin{array}{l} a_1 x_1 + a_2 x_2 + a_3 x_3 + \ldots = e_a \\ b_1 x_1 + b_2 x_2 + b_3 x_3 + \ldots = e_b \\ c_1 x_1 + c_2 x_2 + c_3 x_3 + \ldots = e_c \\ \ldots\ldots\ldots\ldots \end{array}\right\} \quad \ldots\ldots \quad \text{(iv)}$$

and every such series of equations may be so treated as to give the most probable values of the errors of the observed angles, so far as the available data can furnish them.

Each group (iv) contains fewer equations than unknown quantities, thus their solution requires the previous evaluation of 'indeterminate factors', $\lambda_a, \lambda_b, \lambda_c, \ldots$ which may be expressed in terms of the right-hand members, thus :—

$$\left.\begin{array}{l} \lambda_a = A_a e_a + A_b e_b + A_c e_c + \ldots \\ \lambda_b = B_a e_a + B_b e_b + B_c e_c + \ldots \\ \lambda_c = C_a e_a + C_b e_b + C_c e_c + \ldots \\ \ldots\ldots\ldots\ldots \end{array}\right\} \quad \ldots\ldots \quad \text{(v)}$$

in which expressions $B_a = A_b$, $C_a = A_c$, ... $C_b = B_c$, ... and so on.

The resulting values of the angular errors are given symbolically by equations (20) page 28 of this volume. The corresponding *e. m. s.*^{2} of $F(X_1 - x_1, X_2 - x_2, X_3 - x_3, \ldots)$ may be expressed by a summation of terms of the form

$$\left.\begin{array}{l} \frac{1}{\rho^2}\Big\{[f^2u]^* - [fa.u]\,\big\{[fa.u]\,A_a + [fb.u]\,A_b + [fc.u]\,A_c + \ldots\big\} \\ \qquad - [fb.u]\,\big\{[fa.u]\,B_a + [fb.u]\,B_b + [fc.u]\,B_c + \ldots\big\} \\ \qquad - [fc.u]\,\big\{[fa.u]\,C_a + [fb.u]\,C_b + [fc.u]\,C_c + \ldots\big\} \\ \qquad - \&c.\Big\} \ldots\ldots\ldots\ldots \end{array}\right\} \quad \ldots \quad \text{(vi)}$$

one such term being furnished by each independent polygonal figure in the chain of triangles.

---

* In explanation of the summations

$$\begin{array}{l} [f^2.u] = f_1^2 u_1 + f_2^2 u_2 + f_3^2 u_3 + \ldots \\ [fa.u] = f_1 a_1 u_1 + f_2 a_2 u_2 + f_3 a_3 u_3 + \ldots \\ [fb.u] = f_1 b_1 u_1 + f_2 b_2 u_2 + f_3 b_3 u_3 + \ldots \\ [fc.u] = f_1 c_1 u_1 + f_2 c_2 u_2 + f_3 c_3 u_3 + \ldots \\ \ldots\ldots\ldots\ldots \end{array}$$

but it is to be understood that only those terms are significant which involve coefficients in (iv) of the angular errors, $x_1, x_2, x_3, \ldots$ entering (i); all other terms vanish.

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It is thus that the *e.m.s.* of any function of the corrected angles of any triangulation may be found. If the function involves angles entering many polygonal figures, the determination of its *e.m.s.* would be too laborious an undertaking to be generally attempted. In the present investigation we shall therefore confine our attention to a chain of single triangles, in which each triangle furnishes only one geometrical condition, *viz.*, that the sum of its angles must equal 180° + the *spherical excess* of the triangle.

It will now be convenient to make a change in the notation hitherto employed, by denoting the observed values of the angles of a triangle by X, Y and Z, with X for flank angles and Y and Z for angles opposite sides of continuation; denoting their reciprocal weights by u, v and w, and the most probable values of their errors by x, y and z respectively. Putting e for the actual triangular error, and distinguishing each symbol where necessary by the numerical subscript designating the number of the triangle to which it belongs, each triangle will give an equation of the following form :—

$$x + y + z = e \qquad \text{(vii)}$$

for which the indeterminate factor

$$\lambda = Ae = \frac{e}{u+v+w} \qquad \text{(viii)}$$

see page 29 of Part I of this Volume, A being $= \frac{1}{[aa.u]}$ or $= \frac{1}{u+v+w}$, because $a_x = a_y = a_z = 1$.

Thus, on reference to (vi) it will be seen that each triangle, after its angles have been corrected, furnishes towards the summation determining the $e.m.s.^2$ of a function of the corrected angles, a term of the form

$$\frac{1}{\rho^2}\left\{ f_x^2\, u + f_y^2\, v + f_z^2\, w - \frac{(f_x\, u + f_y\, v + f_z\, w)^2}{u + v + w} \right\} \qquad \text{(ix)}$$

in which expression sometimes one and sometimes even two of the coefficients f for any triangle may $= 0$.

Hence, generally, for any function of the angles of a chain of n single triangles of which the weights of the angles are all in the same terms, *i.e.*, require the same modulus ρ to reduce them to absolute weights,

$$e.m.s.^2 \text{ of } F\,(X - x,\ Y - y,\ Z - z) = \frac{1}{\rho^2} \sum_1^n \left[f_x^2\, u + f_y^2\, v + f_z^2\, w - \frac{(f_x\, u + f_y\, v + f_z\, w)^2}{u + v + w} \right] \qquad \text{(x)}$$

If, for each triangle, $u = v = w$, the last expression becomes

$$e.m.s.^2 \text{ of } F\,(X - x,\ Y - y,\ Z - z) = \frac{1}{\rho^2} \sum_1^n \left[\left([f^2] - \frac{1}{3}\,[f]^2 \right) u \right] \qquad \text{(xi)}$$

In order to avoid for the future the frequent introduction of the modulus ρ we will assume that the weights of the angles have been previously made absolute.

The functions of the angles of a chain of triangles of the precision of which it is usually desirable to have some knowledge are :—

(1). The linear (or side) ratios.

(2). The inclinations of the sides to the adopted axes of coordinates.

(3). The coordinates of the stations relatively to the adopted origin of coordinates.

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When the coordinates are spherical and geodetic, the functions for examination under (2) are the computed azimuths of the sides of the triangulation relatively to the fundamental azimuth, and under (3) the differential latitudes and longitudes of the stations relatively to the station of origin.

The functions of whose precision a knowledge is usually most interesting, are the ratios of the terminal to the initial sides, and the differences between the terminal and the initial azimuths, latitudes and longitudes. The former appertain to what have invariably been termed in the present and the preceding volumes, the Linear Functions of the triangulation, and the latter to the Geodetic Functions. It will now be convenient as formerly to investigate the precision of these functions separately.

Theoretical Errors Generated in Side.

Let R be the ratio of the terminal to the initial side as obtained with the uncorrected observed angles; then

$$F(X, Y, Z) = R = \frac{\sin Y_1 \sin Y_2 \ldots}{\sin Z_1 \sin Z_2 \ldots} \quad \ldots \ldots \ldots \quad \text{(xii)}$$

Hence

$$\frac{dF}{dX} = f_x = 0; \quad \frac{dF}{dY} = f_y = R \cot Y \sin 1'' ; \quad \frac{dF}{dZ} = f_z = -R \cot Z \sin 1'';$$

and if dR represent the error of R,

$$dR = R \sin 1'' \left\{\cot Y_1\, y_1 - \cot Z_1\, z_1 + \cot Y_2\, y_2 - \cot Z_2\, z_2 + \ldots \right\} \quad \ldots \quad \text{(xiii)}$$

Now if we assume that the three angles of every triangle have been observed and corrected to satisfy the geometrical condition $x + y + z = e$, we have, when we substitute in (x),

$$F(X - x, Y - y, Z - z) = R - dR,$$

and

$$e.m.s.^2 \text{ of } (R - dR) = R^2 \sin^2 1'' \sum_1^n \left[v \cot^2 Y + w \cot^2 Z - \frac{(v \cot Y - w \cot Z)^2}{u + v + w} \right] \quad \ldots \quad \text{(xiv)}$$

This expression, with slightly different symbols, has already been given on page 198 of Volume II and is repeated here to make the subject complete.*

---

* In order to employ (xiv) it is necessary to know the cotangents of the angles. As however these cotangents may not be needed for any other purpose, they can be replaced by 'tabular logarithmic differences' thus:—multiply the numerator and denominator of the right-hand member of (xiv) by the square of M, the modulus of common logs. Then since

$$M \cot Y \sin 1'' = \text{tab. diff. (t.d.) of log sin } Y \text{ for } 1''$$

$$M \cot Z \sin 1'' = \ldots \ldots \ldots \text{ log sin } Z \ldots$$

$$e.m.s.^2 \text{ of } (R - dR) = \frac{R^2}{M^2} \left[(\text{t.d. log sin } Y)^2 v + (\text{t.d. log sin } Z)^2 w - \frac{(\text{t.d. log sin } Y.\, v - \text{t.d. log sin } Z.\, w)^2}{u + v + w} \right]$$

Further if the $e.m.s.^2$ of log $(R - dR)$ is required it is obtained by multiplying the $e.m.s.^2$ of $(R - dR)$ by $\frac{M^2}{R^2}$.

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Equation (xiv) is in the form which is applicable to any chain of single triangles. If we assume the triangles to be equilateral, the angles to be of equal weight, and the weight to be $= \frac{1}{\epsilon^2}$, where ϵ is the *e. m. s.* of any angle, then R becomes $= 1$ and $\cot Y = \cot Z = \frac{1}{\sqrt{3}}$; hence

$$e.\ m.\ s.^2 \text{ of } (R - dR) = \frac{2}{3} \epsilon^2 n \sin^2 1'' . \qquad \text{(xv)}$$

Theoretical Errors generated in Azimuth, Latitude and Longitude.

Before investigating the *e. m. s.* of the Geodetic Functions of angles, we may quote the following passage regarding them from Vol. II, page 201 :—

" Strictly speaking these quantities are functions, not only of the angles but also of the fundamental " elements in terms of which they are obtained. They are influenced by errors in the adopted elements of " the figure of the earth ; in the adopted values of the astronomically determined coordinates of, and the " azimuth at, the initial station ; and in the length of the base of the figure. Here however we are dealing " with errors of the angular measurements only, and of their influence on the geodetic results, we must there- " fore disregard the influence of errors in the geodetic and linear data". These remarks apply equally to the following investigations.

It is unnecessary in this place to express the differentials, $\frac{dF}{dX}, \frac{dF}{dY}, \frac{dF}{dZ}$, for the Geodetic Functions of the angles, because this has been already done in the present Volume in which we have two forms for expressing the geodetic error at the end of a chain of triangles; one is equation (57), page 54, and the other is equation (62), page 57. The former applies when the calculations have been carried along one flank of the chain, and the latter when a zig-zag course from flank to flank has been adopted. But from both these expressions the angular error x has been eliminated by aid of the equation

$$x + y + z = 0,$$

an equation which may not be employed here; for we must deal with the observed angles—the original independent facts of observation—and therefore we have instead equation (vii).

With the aid of the rule given at the bottom of page 54, it is easy to write down the expressions for the geodetic errors at the end of a chain of triangles, from which none of the angular errors are eliminated.

For the flank or *direct* traverse the following formulæ will hold :—

First. If the pth triangle have no side on the line of traverse, but only an angle, at traverse station l, we have

$$\phi_l x_p + \mu_l \beta_p y_p - \mu_l \gamma_p z_p \qquad \text{(xvi)}$$

Secondly. If the qth triangle have a side in the traverse between traverse stations l and $l + 1$, the coefficients of the angular errors are given in the following expression

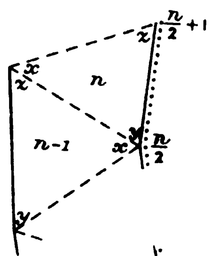
$$(\mu_l - \mu_{l+1})\, a_q x_q + (\mu_{l+1} \beta_q + \phi_l)\, y_q - (\mu_l \gamma_q - \phi_{l+1})\, z_q \quad \ldots\ldots\ldots \quad \text{(xvii)}$$

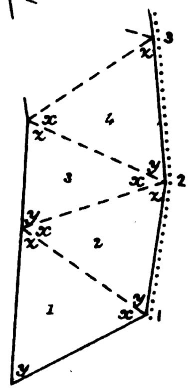
For the *zig-zag* traverse the form is

$$\pm\, \phi_p x_p + \mu_p \beta_p y_p - \mu_p \gamma_p z_p \quad \ldots\ldots\ldots\ldots\ldots \quad \text{(xviii)}$$

the upper sign being applicable when the pth triangle lies to the left of the traverse and the lower when to the right.

Let the diagram in the margin represent a chain of n single triangles, the dotted line along the right flank being the course of the direct traverse and the broken line representing the course of the zig-zag traverse. Then if $F(X, Y, Z)$ = the difference of *latitude* or *longitude* between stations 1 and $\frac{n}{2} + 1$ or the *azimuth* at $\left(\frac{n}{2} + 1\right)$ as deduced from 1 obtained by employing the observed angles, uncorrected for triangular error, in the calculation, and if the error of this value due to the angular errors be E, the expressions for this error in terms of the angular errors will be as follows:—





First. In the case of the *direct* traverse

$$\left.\begin{aligned} E = {} & \phi_1 x_1 + \mu_1 \beta_1 y_1 - \mu_1 \gamma_1 z_1 \\ & + (\mu_1 - \mu_2)\, a_2 x_2 + (\mu_2 \beta_2 + \phi_1)\, y_2 - (\mu_1 \gamma_2 - \phi_2)\, z_2 \\ & + \phi_2 x_3 + \mu_2 \beta_3 y_3 - \mu_2 \gamma_3 z_3 \\ & + (\mu_2 - \mu_3)\, a_4 x_4 + (\mu_3 \beta_4 + \phi_2)\, y_4 - (\mu_2 \gamma_4 - \phi_3)\, z_4 \\ & + \;\ldots \\ & + \phi_{\frac{n}{2}} x_{n-1} + \mu_{\frac{n}{2}} \beta_{n-1} y_{n-1} - \mu_{\frac{n}{2}} \gamma_{n-1} z_{n-1} \\ & + \mu_{\frac{n}{2}} a_n x_n + \phi_{\frac{n}{2}} y_n - \mu_{\frac{n}{2}} \gamma_n z_n \end{aligned}\right\} \text{(xix)}$$

in which the subscripts of the μs and ϕs are the traverse station numbers.

When this equation is employed to represent the error in azimuth at station $\left(\frac{n}{2} + 1\right)$ due to the errors of the observed angles, it is the error of the azimuth of station $\frac{n}{2}$. The error in azimuth of the last side of the chain is given by adding *unity* to the coefficient of z_n and the term then becomes

$$+ \left(1 - \mu_{\frac{n}{2}} \gamma_n\right) z_n$$

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Secondly. In the case of the *zig-zag* traverse,

$$\left.\begin{aligned} E = {} & \phi'_1 x_1 + \mu'_1 \beta_1 y_1 - \mu'_1 \gamma_1 z_1 \\ & - \phi'_2 x_2 + \mu'_2 \beta_2 y_2 - \mu'_2 \gamma_2 z_2 \\ & + \phi'_3 x_3 + \mu'_3 \beta_3 y_3 - \mu'_3 \gamma_3 z_3 \\ & - \phi'_4 x_4 + \mu'_4 \beta_4 y_4 - \mu'_4 \gamma_4 z_4 \\ & + \;\ldots \\ & + \phi'_{n-1} x_{n-1} + \mu'_{n-1} \beta_{n-1} y_{n-1} - \mu'_{n-1} \gamma_{n-1} z_{n-1} \\ & - \phi'_n x_n + \mu'_n \beta_n y_n - \mu'_n \gamma_n z_n \end{aligned}\right\} \quad \ldots\ldots\ldots \quad \text{(xx)}$$

in which μ' and ϕ' are substituted for μ and ϕ as their subscripts are the triangle numbers, and there is no separate numbering of the traverse stations.

A table of substitutions for μ and ϕ is given on page 55, but as this is better adapted for arithmetical calculations than for theoretical investigations, it will be more convenient here to use that given on page 177 of Volume II, which is as follows, and in correspondence with which

$$a = \cot X, \quad \beta = \cot Y, \quad \gamma = \cot Z \quad \ldots\ldots\ldots\ldots \quad \text{(xxi)}$$

Table of Substitutions for μ and ϕ.

	Latitude.	Longitude.	Azimuth.
For E	$d\lambda_{n+1}$	dL_{n+1}	dB_n
,, μ	${}_\lambda\mu$	${}_L\mu$	${}_A\mu$
,, ϕ	${}_\lambda\phi$	${}_L\phi$	${}_A\phi$
——	——	——	——
,, μ_1	$+\overset{n}{\underset{1}{\left[\Delta\lambda\right]}} \sin 1''$	$+\overset{n}{\underset{1}{\left[\Delta L\right]}} \sin 1''$	$+\overset{n}{\underset{1}{\left[\Delta A\right]}} \sin 1''$
,, μ_2	$+\overset{n}{\underset{2}{\left[\Delta\lambda\right]}} \sin 1''$	$+\overset{n}{\underset{2}{\left[\Delta L\right]}} \sin 1''$	$+\overset{n}{\underset{2}{\left[\Delta A\right]}} \sin 1''$
,, .	. . . . . .	. . . . . .	. . . . . .
,, μ_n	$+\Delta\lambda_n \sin 1''$	$+\Delta L_n \sin 1''$	$+\Delta A_n \sin 1''$
——	——	——	——
,, ϕ_1	$-\overset{n}{\underset{1}{\left[\Delta\lambda \tan A\right]}} \sin 1''$	$+\overset{n}{\underset{1}{\left[\Delta L \cot A\right]}} \sin 1''$	$1 + \overset{n}{\underset{1}{\left[\Delta A \cot A\right]}} \sin 1''$
,, ϕ_2	$-\overset{n}{\underset{2}{\left[\Delta\lambda \tan A\right]}} \sin 1''$	$+\overset{n}{\underset{2}{\left[\Delta L \cot A\right]}} \sin 1''$	$1 + \overset{n}{\underset{2}{\left[\Delta A \cot A\right]}} \sin 1''$
,, .	. . . . . .	. . . . . .	. . . . . .
,, ϕ_n	$-\Delta\lambda_n \tan A_n \sin 1''$	$+\Delta L_n \cot A_n \sin 1''$	$1 + \Delta A_n \cot A_n \sin 1''$

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The errors of the functions of the observed angles which respectively enter the *direct* and the *zig-zag* traverses being expressed by (xix) and (xx) we now have from (x), omitting the weight modulus ρ,

$$e.m.s.^2\, F\,(X-x,\ Y-y,\ Z-z)$$

by the *direct* traverse

$$\left.\begin{aligned}
&= \phi_1^2 u_1 + \mu_1^2 \beta_1^2 v_1 + \mu_1^2 \gamma_1^2 w_1 - \frac{(\phi_1 u_1 + \mu_1 \beta_1 v_1 - \mu_1 \gamma_1 w_1)^2}{u_1 + v_1 + w_1} \\
&+ (\mu_1 - \mu_2)^2 a_2^2 u_2 + (\mu_2 \beta_2 + \phi_1)^2 v_2 + (\mu_1 \gamma_2 - \phi_2)^2 w_2 \\
&\qquad - \frac{\{(\mu_1 - \mu_2)\, a_2 u_2 + (\mu_2 \beta_2 + \phi_1)\, v_2 - (\mu_1 \gamma_2 - \phi_2)\, w_2\}^2}{u_2 + v_2 + w_2} \\
&+ \ \cdot \ \cdot \ \cdot
\end{aligned}\right\} \quad . \quad . \quad . \quad \text{(xxii)}$$

and, by the *zig-zag* traverse, it is

$$\left.\begin{aligned}
&= \phi'^2_1 u_1 + \mu'^2_1 \beta_1^2 v_1 + \mu'^2_1 \gamma_1^2 w_1 - \frac{\{\phi'_1 u_1 + \mu'_1 \beta_1 v_1 - \mu'_1 \gamma_1 w_1\}^2}{u_1 + v_1 + w_1} \\
&+ \phi'^2_2 u_2 + \mu'^2_2 \beta_2^2 v_2 + \mu'^2_2 \gamma_2 w_2 - \frac{\{\phi'_2 u_2 + \mu'_2 \beta_2 v_2 - \mu'_2 \gamma_2 w_2\}^2}{u_2 + v_2 + w_2} \\
&+ \ \cdot \ \cdot \ \cdot
\end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(xxiii)}$$

Thus the *e.m.s.* of any geodetic function of the corrected angles may be computed, whether by the *direct* or by the *zig-zag* traverse; the results obtained from either process of computation should of course be identical.

In order to obtain simple expressions for the *e.m.s.* of the geodetic function, it is necessary to assume, as in (xv), that our chain of triangles consists of sensibly equilateral triangles, and that the weights of the observed angles are all equal, the *e.m.s.* of each angle being $= \epsilon$: then $a = \beta = \gamma = \cot 60^\circ = \frac{1}{\sqrt{3}}$, and from equation (xxii) we find that

by the *direct* traverse, *e.m.s.*^{2} of $F\,(X-x,\ Y-y,\ Z-z)$,

$$\begin{aligned}
&= \frac{2}{3}\epsilon^2 \Big\{ \phi_1^2 + \mu_1^2 \\
&+ \mu_1^2 - \mu_1 \mu_2 + \mu_2^2 + \sqrt{3}\,(\mu_2 \phi_1 - \mu_1 \phi_2) + \phi_1^2 - \phi_1 \phi_2 + \phi_2^2 \\
&+ \phi_2^2 + \mu_2^2 \\
&+ \mu_2^2 - \mu_2 \mu_3 + \mu_3^2 + \sqrt{3}\,(\mu_3 \phi_2 - \mu_2 \phi_3) + \phi_2^2 - \phi_2 \phi_3 + \phi_3^2 \\
&+ \ \cdot \ \cdot \ \cdot \Big\}
\end{aligned}$$

$$\left.\begin{aligned}
&= \frac{2}{3}\epsilon^2 \Big\{ 2\,(\phi_1^2 + \mu_1^2) + 3\,(\phi_2^2 + \mu_2^2 + \phi_3^2 + \mu_3^2 + \ . \ . \ .) \\
&\qquad - (\mu_1 \mu_2 + \phi_1 \phi_2 + \mu_2 \mu_3 + \phi_2 \phi_3 + \ . \ . \ .) \Big\}
\end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad \text{(xxiv)}$$

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since the terms involving the coefficients $\sqrt{3}$ will be found, on substituting the values of μ and ϕ, to vanish.

Also from equation (xxiv) we find that

by the *zig-zag* traverse *e. m. s.*² of $F(X-x,\ Y-y,\ Z-z)$

$$= \frac{2}{3}\epsilon^2\left\{\phi'^2_1+\mu'^2_1+\phi'^2_2+\mu'^2_2+\phi'^2_3+\mu'^2_3+\ldots\ldots\right\} \quad \ldots\ldots \quad \text{(xxv)}$$

The last expression appears at first sight by far the simpler; but while the direction of the traverse is practically constant for a direct traverse, for a zig-zag traverse it changes between consecutive sides by $\pm$ 120°, a fact which has to be carefully borne in mind when obtaining the values of μ' and ϕ'. It was partly owing to this being lost sight of in investigating the expressions which are given at pages 205 to 207 by formulæ of the zig-zag traverse, which were then adopted for the first time because of their apparently greater simplicity that the mistakes were made which it is the object of the present investigation to rectify.*

Before we are able to particularize the theoretical errors of the three geodetic functions, it is necessary to make a further assumption, *viz.*, that the direction of the series is sensibly rectilinear.

First. Let the function be the Difference of Latitude between Stations 1 and $\left(\frac{n}{2}+1\right)$ which are connected by n triangles. We will in this case make use of both the *direct* and *zig-zag* traverse and, having shewn that the same result is arrived at by either, we will afterwards employ only the *direct* traverse.

Adopting the *direct* traverse we may put

$$\Delta\lambda_1 = \Delta\lambda_2 = \Delta\lambda_3 = \text{\&c.}$$

and

$$\Delta\lambda_1 \tan A_1 = \Delta\lambda_2 \tan A_2 = \Delta\lambda_3 \tan A_3 = \text{\&c.}$$

Substituting the corresponding values of the μs and ϕs, and inserting in (xxiv) we find

$$e.\,m.\,s.^2 \text{ of } F(X-x,\ Y-y,\ Z-z) = e.\,m.\,s.^2 \text{ of } (\lambda_{\frac{n}{2}+1}-\lambda_1)$$

$$= \frac{2}{3}\epsilon^2\Delta\lambda^2\sin^2 1''(1+\tan^2 A)\left\{2\left(\frac{n}{2}\right)^2+3\left(\left(\frac{n}{2}-1\right)^2+\left(\frac{n}{2}-2\right)^2+\ \ldots\ +1^2\right)\right.$$

$$\left.-\left(\frac{n}{2}\cdot\left(\frac{n}{2}-1\right)+\left(\frac{n}{2}-1\right)\left(\frac{n}{2}-2\right)+\ \ldots\ +2.1\right)\right\}$$

$$= \epsilon^2\frac{\Delta\lambda^2\sin^2 1''}{\cos^2 A}\left\{\frac{2n^3+3n^2+10n}{36}\right\} \quad \ldots\ldots\ldots\ldots \quad \text{(xxvi)}$$

$$= \epsilon^2\frac{c^2}{r^2}\,\frac{2n^3+3n^2+10n}{36} \quad \ldots\ldots\ldots\ldots\ldots \quad \text{(xxvii)}$$

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* Equation (185) page 207 of Volume II should be

$$e.\,m.\,s.^2 \text{ of inclination} = \frac{2}{3}\epsilon^2 n.$$

The two first terms of equation (183) page 205 should be multiplied by $\frac{2}{3}$.

The factor $\frac{2n^3+3n^2+10n}{36}$ should be substituted for $\frac{n(n+1)(2n+1)}{9}$ in equations (179) to (184) inclusive.

Corresponding corrections are required for the numerical values of the *e. m. s.* in page 206; correct values will be found at page 104 of the present appendix.

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by equation (25) page 30, but with the substitution of r for ρ, the symbol there used for the ***radius of curvature***, as ρ is used in this Appendix and in all investigations of theoretical error in the present and previous volumes, to indicate the modulus which is required for reducing relative weights to absolute weights. The last equation is independent of A the direction of the series.

When we employ the *zig-zag* traverse, it is necessary to remember that the azimuth of the traverse is alternately $A - 60°$ and $A + 60°$, whence we have

$$\mu'_1 = {}_1^n\Big[\Delta\lambda\Big]\sin 1'' = -\frac{c}{r}\cdot\frac{n}{2}\Big\{\cos(A - 60°) + \cos(A + 60°)\Big\} = -\frac{c}{r}\cdot\frac{n}{2}\cos A$$

$$\phi'_1 = -{}_1^n\Big[\Delta\lambda\tan(A \pm 60°)\Big]\sin 1'' = +\frac{c}{r}\cdot\frac{n}{2}\Big\{\sin(A - 60°) + \sin(A + 60°)\Big\}$$

$$= +\frac{c}{r}\cdot\frac{n}{2}\sin A$$

$$\mu'_2 = {}_2^n\Big[\Delta\lambda\Big]\sin 1'' = -\frac{c}{r}\Big\{\Big(\frac{n}{2} - 1\Big)\cos(A - 60°) + \frac{n}{2}\cos(A + 60°)\Big\}$$

$$= -\frac{c}{r}\Big\{\frac{n-1}{2}\cos A - \frac{\sqrt{3}}{2}\sin A\Big\}$$

$$\phi'_2 = -{}_2^n\Big[\Delta\lambda\tan(A \pm 60°)\Big]\sin 1'' = +\frac{c}{r}\Big\{\Big(\frac{n}{2} - 1\Big)\sin(A - 60°) + \frac{n}{2}\sin(A + 60°)\Big\}$$

$$= +\frac{c}{r}\Big\{\frac{n-1}{2}\sin A + \frac{\sqrt{3}}{2}\cos A\Big\}$$

and so on.

Substituting these values of the μ's and ϕ's in (xxv) we find that

$$e.m.s.^2 \text{ of } F(X - x, Y - y, Z - z) = e.m.s.^2 \text{ of } (\lambda_{\frac{n}{2}+1} - \lambda_1)$$

$$= \frac{2}{3}\epsilon^2\frac{c^2}{r^2}\Big\{\Big(\frac{n}{2}\Big)^2 + \Big(\frac{n-1}{2}\Big)^2 + \frac{3}{4} + \Big(\frac{n-2}{2}\Big)^2 + \Big(\frac{n-3}{2}\Big)^2 + \frac{3}{4} + \ldots\Big\}$$

$$= \epsilon^2\frac{c^2}{r^2}\cdot\frac{2n^3 + 3n^2 + 10n}{36} \qquad \text{(xxviii)}$$

which is identical with (xxvii).

Secondly. Let the function be the Difference of Longitude between the Stations 1 and $\left(\frac{n}{2} + 1\right)$, which are connected by n equilateral triangles. We shall now have by the *direct* traverse

$$\Delta L_1 \cos\lambda_1 = \Delta L_2 \cos\lambda_2 = \Delta L_3 \cos\lambda_3 = \&c.$$

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very nearly; and for an *e. m. s.* investigation, where the series is of ordinary length, we may assume without sensible error

$$\Delta L_1 = \Delta L_2 = \Delta L_3 = \&c.$$

and

$$\Delta L_1 \cot A_1 = \Delta L_2 \cot A_2 = \Delta L_3 \cot A_3 = \&c.$$

and substituting for ΔL from equation (26) page 31 we have,

$$e.m.s.^2 \text{ of } F(X - x, Y - y, Z - z) = e.m.s.^2 \text{ of } (L_{\frac{n}{2}+1} - L_1)$$

$$= \epsilon^2 \frac{c^2}{\nu^2} \sec^2\lambda \frac{2n^3 + 3n^2 + 10n}{36} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(xxix)}$$

Thirdly. When the function is the azimuth of the last side of the chain at station $\left(\frac{n}{2} + 1\right)$ as derived from the first side, we have by the *direct* traverse

$$\Delta A_1 \cot \lambda_1 = \Delta A_2 \cot \lambda_2 = \Delta A_3 \cot \lambda_3 = \&c.,$$

very nearly. Here again, for the present purpose, we may assume

$$\Delta A_1 = \Delta A_2 = \Delta A_3 = \&c.$$

and

$$\Delta A_1 \cot A_1 = \Delta A_2 \cot A_2 = \Delta A_3 \cot A_3 = \&c.$$

Substituting for ΔA from equation (27) page 31

$e.m.s.^2$ of $F(X - x, Y - y, Z - z) = e.m.s.^2$ at station $\left(\frac{n}{2} + 1\right)$ of azimuth of last side of chain as derived from azimuth of first side

$$= \epsilon^2 \left\{ \frac{2}{3} n - \frac{c}{\nu} \tan\lambda \left(\frac{\overline{n+1} \cdot n}{3} \cos A + \frac{n \sin A}{\sqrt{3}} \right) + \frac{c^2}{\nu^2} \tan^2\lambda \frac{2n^3 + 3n^2 + 10n}{36} \right\} \quad . \quad . \quad \text{(xxx)}$$

The units employed in (xxviii) and (xxix) are *a second of arc* in latitude and *a second of arc* in longitude. If it be desired to reduce both these units to feet, we must multiply the right-hand member of (xxviii) by the square of $r \sin 1''$, the length of $1''$ of latitude in feet, and that of (xxix) by the square of $\nu \cos \lambda \sin 1''$, the length of $1''$ of longitude in feet; we shall then obtain the following value for the *e. m. s.* of either function of the corrected angles :—

$$e.m.s.^2 \text{ in feet} = \epsilon^2 c^2 \sin^2 1'' \frac{2n^3 + 3n^2 + 10n}{36} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(xxxi)}$$

That is, for a series of n *equilateral* triangles the *e. m. s.* is the same for both co-ordinates when both are expressed in the same linear unit.

In the preceding investigations it has happened that n has been an even number, owing to the form of

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diagram adopted for illustration. If we assumed the chain to commence one triangle in advance of its present adopted origin, or to terminate a triangle in advance of its present adopted terminus, n will become an odd number; and in the formulæ for *e.m.s.* of geodetic functions we must write $(n - 1)$ for n. For example, the expression

$$\epsilon^2 \frac{c^2}{r^2}\left\{\frac{2n^3 + 3n^2 + 10n}{36}\right\}$$

becomes

$$\epsilon^2 \frac{c^2}{r^2}\left\{\frac{2n^3 - 3n^2 + 10n - 9}{36}\right\}$$

Bearing this in mind, we will continue, for the sake of convenience, to consider n an even number, and also to assume even numbers of triangles in the groups employed in the geodetic formulæ.

Application to a Plane Surface.

It appears from (xxxi) that if a chain of equilateral triangles is only of such an extent that we may consider it as situated on a plane surface, and we wish to refer our errors to rectangular axes passing through station 1, then whatever be the direction of the series with reference to the axes, we shall have

$$e.m.s. \text{ of ordinate parallel to the axis of } X = e.m.s. \text{ of ordinate parallel to the axis of } Y$$

$$= \epsilon \frac{c \sin 1''}{6} \sqrt{2n^3 + 3n^2 + 10n}. \quad \ldots \ldots \ldots \quad \text{(xxxii)}$$

the unit being that adopted for c in the side length.

Further in (xxx), when the surface is a plane, $\tan \lambda = 0$, therefore

$$e.m.s. \text{ in bearing of either of the two sides at station } \left(\frac{n}{2} + 1\right) = \epsilon \sqrt{\frac{2}{3}n} \quad \ldots \quad \text{(xxxiii)}$$

The preceding *e.m.s.* formulæ (xxviii), (xxix) and (xxx), for the errors generated in latitude, longitude and azimuth, have been obtained sequentially to the formulæ which are employed in the investigations of the most probable values of the angular errors, in the course of the simultaneous reduction of the triangulation. As however only the first terms of the expressions for $\Delta\lambda$ and ΔL are employed in the investigations, the second and following terms being ignored, it will be obvious that similar expressions for *e.m.s.* will be obtained if spherical co-ordinates are ignored from the outset, and the triangulation is assumed to be carried over a plane instead of a sphere, and is referred to rectangular co-ordinates. Thus :—

Let the side of origin of the chain be inclined at an angle θ to the axis of X. Then the ordinate parallel to the axis of X of station $\left(\frac{n}{2} + 1\right)$

$$= c_1 \cos(\theta + X_1 + Y_2) + c_2 \cos(\theta + X_1 + Y_2 + \pi + Z_2 + X_3 + Y_4) + \quad \ldots \quad \text{(xxxiv)}$$

or if for the sum of the angles at stations 1, 2, 3, &c., we write $\Sigma_1, \Sigma_2, \Sigma_3$, &c., the ordinate parallel to the axis of X

$$= c_1 \cos(\theta + \Sigma_1) + c_2 \cos(\theta + \Sigma_1 + \pi + \Sigma_2) + \quad \ldots \ldots \ldots \quad \text{(xxxv)}$$

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Hence the error in the ordinate parallel to the axis of X

$$\left.\begin{aligned} &= dc_1 \cos(\theta + \Sigma_1) - c_1 \sin(\theta + \Sigma_1)\, d\Sigma_1 \sin 1'' \\ &+ dc_2 \cos(\theta + \Sigma_1 + \pi + \Sigma_2) - c_2 \sin(\theta + \Sigma_1 + \pi + \Sigma_2)\,(d\Sigma_1 + d\Sigma_2) \sin 1'' \\ &+ \ . \ . \ . \end{aligned}\right\} \quad . \quad \text{(xxxvi)}$$

And since in the present instance $\Sigma_2 = \Sigma_3 = \&c. = \pi$, and $c_1 = c_2 = \&c. = c$, the error in the ordinate parallel to the axis of X

$$= \sum_1^{\frac{n}{2}} \left[d\,c\right] \cos(\theta + \Sigma_1) - c \sin(\theta + \Sigma_1) \left\{\frac{n}{2} d\Sigma_1 + \left(\frac{n}{2} - 1\right) d\Sigma_2 + \ . \ . \ . \right\} \sin 1'' . \quad . \quad \text{(xxxvii)}$$

Similarly the error in the ordinate parallel to the axis of Y

$$= \sum_1^{\frac{n}{2}} \left[d\,c\right] \sin(\theta + \Sigma_1) + c \cos(\theta + \Sigma_1) \left\{\frac{n}{2} d\Sigma_1 + \left(\frac{n}{2} - 1\right) d\Sigma_2 + \ . \ . \ . \right\} \sin 1'' \quad . \quad \text{(xxxviii)}$$

Now

$$\begin{aligned} d\Sigma_1 &= x_1 + y_2 \\ d\Sigma_2 &= z_2 + x_3 + y_4 \\ &\ . \ . \ . \ . \ . \end{aligned}$$

and as

$$\begin{aligned} c_1 &= c \frac{\sin Y_1}{\sin Z_1} \cdot \frac{\sin X_2}{\sin Z_2} \\ c_2 &= c \frac{\sin Y_1}{\sin Z_1} \cdot \frac{\sin Y_2}{\sin Z_2} \cdot \frac{\sin Y_3}{\sin Z_3} \cdot \frac{\sin X_4}{\sin Z_4} \\ &\ . \ . \ . \ . \ . \end{aligned}$$

therefore putting $\alpha = \cot X$, $\beta = \cot Y$ and $\gamma = \cot Z$

$$\begin{aligned} dc_1 &= c_1 \{\beta_1 y_1 - \gamma_1 z_1 + \alpha_2 x_2 - \gamma_2 z_2\} \sin 1'' \\ dc_2 &= c_2 \{\beta_1 y_1 - \gamma_1 z_1 + \beta_2 y_2 - \gamma_2 z_2 + \beta_3 y_3 - \gamma_3 z_3 + \alpha_4 x_4 - \gamma_4 z_4\} \sin 1'' \\ &\ . \ . \ . \ . \ . \ . \end{aligned}$$

and since $\alpha = \beta = \gamma = \cot 60^\circ = \frac{1}{\sqrt{3}}$,

the error in the ordinate parallel to the axis of X

$$\left.\begin{aligned} &= c \sin 1'' \left\{ -\frac{n}{2} \sin(\theta + \Sigma_1)\, x_1 + \frac{n}{2} \cdot \frac{1}{\sqrt{3}} \cos(\theta + \Sigma_1)\, y_1 - \frac{n}{2} \frac{1}{\sqrt{3}} \cos(\theta + \Sigma_1)\, z_1 \right. \\ &+ \frac{1}{\sqrt{3}} \cos(\theta + \Sigma_1)\, x_2 + \left\{ \left(\frac{n}{2} - 1\right) \frac{1}{\sqrt{3}} \cos(\theta + \Sigma_1) - \frac{n}{2} \sin(\theta + \Sigma_1) \right\} y_2 \\ &\qquad - \left\{ \frac{n}{2} \cdot \frac{1}{\sqrt{3}} \cos(\theta + \Sigma_1) + \left(\frac{n}{2} - 1\right) \sin(\theta + \Sigma_1) \right\} z_2 \\ &\left. + \ . \ . \ . \right\} \end{aligned}\right\} \quad . \quad \text{(xxxix)}$$

Therefore

$$e.\,m.\,s.^2 \text{ of ordinate parallel to the axis of } X = \epsilon^2 c^2 \sin^2 1'' \left\{\frac{2}{3}\left(\frac{n}{2}\right)^2 \left(\sin^2(\theta + \Sigma_1) + \cos^2(\theta + \Sigma_1)\right)\right.$$

$$+ \frac{1}{3}\cos^2(\theta + \Sigma_1) + \left(\left(\frac{n}{2}\right)^2 + \left(\frac{n}{2} - 1\right)^2\right)\left(\frac{1}{3}\cos^2(\theta + \Sigma_1) + \sin^2(\theta + \Sigma_1)\right) - \frac{1}{3}(n-1)^2 \sin^2(\theta + \Sigma_1)$$

$$\left. + \ \ldots \right\}$$

$$= \epsilon^2 c^2 \sin^2 1'' \left\{\frac{2}{3}\cdot\left(\frac{n}{2}\right)^2 + \frac{1}{3}\left\{\left(\frac{n}{2}\right)^2 + \left(\frac{n}{2} - 1\right)^2\right\} + \frac{1}{3} + \ \ldots \right\}$$

$$= \epsilon^2 c^2 \sin^2 1'' \left\{\frac{2n^3 + 3n^2 + 10n}{36}\right\} \quad \ldots\ldots\ldots\ldots \quad \text{(xl)}$$

From which the θ has disappeared, and therefore the direction of the chain as regards the axes of the co-ordinates is immaterial, as it was shewn to be in the case of geodetic co-ordinates.

It is easy to see that the error in the ordinate parallel to the axis of Y must be the same as that parallel to the axis of X.

The inclination at station $\left(\frac{n}{2} + 1\right)$ of either of the sides meeting at that point to the axis of X

$$= \theta + X_1 + Y_2 + \pi + Z_2 + X_3 + Y_4 + \ \ldots \ + Y_n + \pi + \left\{Z_n\right\} \quad \ldots\ldots \quad \text{(xli)}$$

the last term, in brackets, being omitted or employed according as the side is the flank side of triangle n, or the advanced side. Therefore the error in direction

$$= x_1 + y_2 + z_2 + x_3 + y_4 + \ \ldots \ + y_n + \left\{z_n\right\} \quad \ldots\ldots\ldots \quad \text{(xlii)}$$

Hence the $e.\,m.\,s.^2$ of the direction obtained with the corrected angles is in both cases

$$= \epsilon^2 \frac{2}{3} n. \quad \ldots\ldots\ldots\ldots\ldots \quad \text{(xliii)}$$

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Application to Functions of the Observed Angles, wholly uncorrected.

We may, if we please, by the aid of (iii) obtain the theoretical errors of the several results as calculated with the *observed angles* unadjusted for triangular error; when we shall have as follows:—

$$e.m.s.^2 \text{ of } R = \epsilon^2 \frac{2}{3} n \sin^2 1'' \quad \text{(xliv)}$$

*e. m. s.*² of $\left(\lambda_{\frac{n}{2}+1} - \lambda_1\right)$

$$\text{by the Direct Traverse} = \epsilon^2 \frac{c^2}{r^2} \left\{ \frac{n^3+n^2+2n}{8} \sin^2 A + \frac{2n^3+3n^2+10n}{36} \cos^2 A \right\} \quad \text{(xlv)}$$

$$\text{by the Zig-zag ,,} = \epsilon^2 \frac{c^2}{r^2} \left\{ \frac{2n^3+3n^2+10n}{24} \left(\sin^2 A + \frac{2}{3} \cos^2 A \right) + \frac{n}{8} \cos 2A + \frac{\sqrt{3}}{48} n^2 \sin 2A \right\} \quad \text{(xlvi)}$$

*e. m. s.*² of $\left(L_{\frac{n}{2}+1} - L_1\right)$

$$\text{by the Direct Traverse} = \epsilon^2 \frac{c^2}{\nu^2} \sec^2\lambda \left\{ \frac{n^3+n^2+2n}{8} \cos^2 A + \frac{2n^3+3n^2+10n}{36} \sin^2 A \right\} \quad \text{(xlvii)}$$

$$\text{by the Zig-zag ,,} = \epsilon^2 \frac{c^2}{\nu^2} \sec^2\lambda \left\{ \frac{2n^3+3n^2+10n}{24} \left(\cos^2 A + \frac{2}{3} \sin^2 A \right) - \frac{n}{8} \cos 2A - \frac{\sqrt{3}}{48} n^2 \sin 2A \right\} \quad \text{(xlviii)}$$

*e. m. s.*² of azimuth of last side at station $\left(\frac{n}{2}+1\right)$

$$\text{by the Direct Traverse} = \epsilon^2 \left\{ \frac{3}{2} n - \frac{c}{\nu} \tan\lambda \left(\frac{\overline{n.n+1}}{2} \cos A + \frac{n}{2\sqrt{3}} \sin A \right) + \frac{c^2}{\nu^2} \tan^2\lambda \left(\frac{n^3+n^2+2n}{8} \cos^2 A + \frac{2n^3+3n^2+10n}{36} \sin^2 A \right) \right\} \quad \text{(xlix)}$$

$$\text{by the Zig-zag Traverse} = \epsilon^2 \left\{ n - \frac{c}{\nu} \tan\lambda \left(\frac{\overline{n.n+1}}{2} \cos A - \frac{\sqrt{3}}{2} \sin A \right) + \frac{c^2}{\nu^2} \tan^2\lambda \left\{ \frac{2n^3+3n^2+10n}{24} \left(\cos^2 A + \frac{2}{3} \sin^2 A \right) - \frac{n}{8} \cos 2A - \frac{\sqrt{3}}{48} n^2 \sin^2 A \right\} \right\} \quad \text{(l)}$$

and for rectangular co-ordinates

$$e.m.s.^2 \text{ of ordinate parallel to the axis of } X = \epsilon^2 c^2 \sin^2 1'' \left\{ \frac{n^3+n^2+2n}{8} \sin^2(\theta+\Sigma_1) + \frac{2n^3+3n^2+10n}{36} \cos^2(\theta+\Sigma_1) \right\} \quad \text{(li)}$$

$$e.m.s.^2 \text{ of ordinate parallel to the axis of } Y = \epsilon^2 c^2 \sin^2 1'' \left\{ \frac{n^3+n^2+2n}{8} \cos^2(\theta+\Sigma_1) + \frac{2n^3+3n^2+10n}{36} \sin^2(\theta+\Sigma_1) \right\} \quad \text{(lii)}$$

$$\text{and } e.m.s.^2 \text{ of directions of sides terminating at station } \left(\frac{n}{2}+1\right) = \epsilon^2 \left(\frac{3n}{2} - 1\right) \text{ or } \epsilon^2 \frac{3n}{2} \quad \text{(liii)}$$

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It appears from comparing (xliii) with (xv) that the theoretical error of the ratio of the terminal to the initial side of the chain of equilateral triangles of which the angles are of equal weight is the same whether obtained with the observed or corrected angles. This apparent anomaly is easily explained; for when in each triangle

$$u = v = w$$

$$x = y = z = \frac{1}{3} e$$

and, see equation (xiii), dR, the error of R, due to the angular errors $x, y, z, = 0$. Further, since the angle X does not enter into the calculation, it appears that if merely the length of the terminal side is required in terms of the side of origin, no more accuracy is obtained *theoretically* by observing the three angles of each triangle, than by observing the backward and forward angles Y and Z only. See also footnote to page 203, Vol. II.

Again from (xliv) when the direction of the chain is meridional, *i.e.*, $A = 0$ or $A = 180°$, the *Direct Traverse* gives

$$e.m.s.^2 \text{ of } \left(\lambda_{\frac{n}{2}+1} - \lambda_1\right) = \epsilon^2 \frac{c^2}{r^2} \left\{\frac{2n^3 + 3n^2 + 10n}{36}\right\} \qquad \text{(liv)}$$

which is identical with the value obtained with the *corrected* angles, see equation (xxvii). The meaning of this is that, so far as the first term of equation (25) page 30 is concerned, which is the only term that has been considered in these investigations, if the latitude of station $\left(\frac{n}{2} + 1\right)$ is computed from station 1, through a chain of equilateral triangles, the same result will be arrived at whether the *observed angles*, or these angles *corrected for triangular error*, are used. That this is the case is susceptible of other proofs: we may arrive at the value of the function of the corrected angles $F(X - x,\ Y - y,\ Z - z)$ in two ways; either by performing the calculation with the corrected angles $X - x,\ Y - y,\ Z - z$, when we have the value of the function directly; or we may employ the uncorrected angles, X, Y, Z, in the calculation of the value of the function, and correct this value by $-E$, obtained by substituting for x, y, z, in equation (xix). In the special case here contemplated E will be found to vanish, giving $F(X, Y, Z) = F(X - x,\ Y - y,\ Z - z)$. Again, if we take the expression $\Delta\lambda = -\frac{c}{r}\cos A \operatorname{cosec} 1''$, we see at once that when A is nearly 0° or 180° a small change in azimuth cannot affect the value of $\Delta\lambda$. It further appears that the $e.m.s.$ of $\left(\lambda_{\frac{n}{2}+1} - \lambda_1\right)$ as obtained with the *observed angles* is then a minimum; but as the azimuth of the chain varies from the meridional direction towards the longitudinal, the $e.m.s.$ also varies, and becomes a maximum when $A = 90°$ or 270°, and then

$$e.m.s.^2 \left(\lambda_{\frac{n}{2}+1} - \lambda_1\right) = \epsilon^2 \frac{c^2}{r^2} \left(\frac{n^3 + n^2 + 2n}{8}\right) \qquad \text{(lv)}$$

That is, the value of latitude of station $\left(\frac{n}{2} + 1\right)$ is most affected by the errors of the observed angles when the chain is longitudinal.

It is easy to see that the converse is the case as regards the longitude of station $\left(\frac{n}{2} + 1\right)$, when the *uncorrected observed angles* are employed in its calculation; the longitude being unaffected by the angular errors when the chain is longitudinal and most affected by them when the chain is meridional.

A similar comparison cannot be made between the azimuths at station $\left(\frac{n}{2} + 1\right)$ as obtained with the *observed* and *corrected* angles by the *Direct Traverse*; for the first and largest terms, which are independent of the direction of the chain, are essentially different, that for the *observed* angles being $\frac{9}{4}$ths of that for the *corrected* angles.

When we examine the formulæ for the *Zig-zag Traverse* we find no instance where the *observed* and *corrected* angles give the same value of the function.

For the $e.m.s.^2$ of $\left(\lambda_{\frac{n}{2}+1} - \lambda_1\right)$ as obtained with the uncorrected angles the expression becomes a minimum when $\tan 2A = -\frac{3n^2\sqrt{3}}{2n^3 + 3n^2 - 8n}$. Its value for a meridional or longitudinal chain can be ascertained by putting $\sin A = 0$ or $\cos A = 0$. Similar remarks apply to the expression for the $e.m.s.^2$ of $\left(L_{\frac{n}{2}+1} - L_1\right)$. The formula for $e.m.s.$ in azimuth does not seem to offer occasion for special consideration.

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Application to Chains in which the Weights are not constant throughout, but vary in different Groups of Triangles.

Hitherto we have assumed the weights of all the angles of the chain of equilateral triangles to be equal; but it may be convenient to consider the case when successive groups of triangles have different weights.

For example suppose the chain to consist of three groups of triangles p, q and s in number $(p+q+s=n)$, and that the reciprocal weights in each group are the same; but that they are different for different groups, and represent them by ϵ_p^2, ϵ_q^2 and ϵ_s^2 respectively. Then, in the case of the linear error, it is easy to see at a glance from (xiv) that

$$e.m.s.^2\,(R - dR) = \frac{2}{3} R^2 \sin^2 1'' \left\{ p\epsilon_p^2 + q\epsilon_q^2 + s\epsilon_s^2 \right\} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(lvi)}$$

and here the form does not alter whether p, q and s are odd or even numbers.

For the geodetic errors we must refer to (xxii) or (xxiii) when we shall find that

$$e.m.s.^2 \text{ of } (\lambda_{\frac{n}{2}+1} - \lambda_1) = \frac{c^2}{r^2} \left\{ \epsilon_p^2 \frac{2(p+q+s)^3 + 3(p+q+s)^2 + 10(p+q+s)}{36} \right.$$

$$\left. + (\epsilon_q^2 - \epsilon_p^2) \frac{2(q+s)^3 + 3(q+s)^2 + 10(q+s)}{36} + (\epsilon_s^2 - \epsilon_q^2) \frac{2s^3 + 3s^2 + 10s}{36} \right\} . \quad . \quad . \quad \text{(lvii)}$$

The formula for the $e.m.s.^2$ of $(L_{\frac{n}{2}+1} - L_1)$ only differs from this in that the coefficient outside the brackets, $\frac{c^2}{r^2}$, is replaced by $\frac{c^2}{\nu^2} \sec^2 \lambda$.

For the azimuth we shall have $e.m.s.^2$ of the azimuth of the last side of chain at station $\left(\frac{n}{2} + 1\right)$ as derived from the azimuth of the first side

$$= \left\{ \frac{2}{3} (p\epsilon_p^2 + q\epsilon_q^2 + s\epsilon_s^2) \right.$$

$$- \frac{c}{\nu} \tan\lambda \left(\frac{\overline{p + 2(q+r) + 1} \,.\, p\epsilon_p^2 + \overline{q + 2r + 1} \,.\, q\epsilon_q^2 + \overline{s + 1} \,.\, s\epsilon_s^2}{3} \cos A + \frac{p\epsilon_p^2 + q\epsilon_q^2 + s\epsilon_r^2}{\sqrt{3}} \sin A \right)$$

$$+ \frac{c^2}{\nu^2} \tan^2\lambda \left(\epsilon_p^2 \frac{2(p+q+s)^3 + 3(p+q+s)^2 + 10(p+q+s)}{36} \right.$$

$$\left. \left. + (\epsilon_q^2 - \epsilon_p^2) \frac{2(q+s)^3 + 3(q+s)^2 + 10(q+s)}{36} + (\epsilon_s^2 - \epsilon_q^2) \frac{2s^3 + 3s^2 + 10s}{36} \right) \right\} \quad . \quad . \quad \text{(lviii)}$$

It is unnecessary to write down the expression applicable to rectangular co-ordinates.

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Practical Application.

The formulæ which have now been investigated enable us to arrive at very fair approximations to the magnitudes of the errors which Theory leads us to expect to meet with at the extremity of a chain of symmetrical triangles. Employing these formulæ we may avoid making rigorous calculations, which are ordinarily far too intricate and laborious to be undertaken for determinations of theoretical error.

Let us now apply formulæ (xxviii), (xxix) and (xxx) numerically. It will be noticed from the two first expressions that the *e. m. s.* in both latitude and longitude is independent of the direction of the chain, and from the third, that the *e. m. s.* in azimuth is influenced by the direction though very slightly.

Assume the sides of the triangles to be about 15 miles long making c = say 80,000 feet; also that the arc-length of the chain is 8°, making n, the number of the triangles, about 72; then putting $\lambda = 20°$, the middle latitude of India, we obtain the following values of the *e. m. s*:—

e. m. s. in Latitude $= 0''\cdot 55\ \epsilon$

„ in Longitude $= 0\cdot 59\ \epsilon$

„ in Azimuth $= \epsilon\sqrt{48\cdot 040 - 2\cdot 413\cos A - \cdot 057\sin A}$

$= 7\cdot 10\ \epsilon$ for a chain going north

$= 6\cdot 75\ \epsilon$ „ „ south

$= 6\cdot 94\ \epsilon$ „ „ east

$= 6\cdot 93\ \epsilon$ „ „ west

$= 6\cdot 93\ \epsilon$ in the average.

It may be here noted that for the angles measured with the 36-inch and 24-inch theodolites of this Survey—which form a very considerable majority of the whole—the value of ϵ may be taken as ranging from $\pm\ 0''\cdot 22$ to $\pm\ 0''\cdot 66$, and averaging $\pm\ 0''\cdot 44$; while for the angles which were measured with the 18-inch and 15-inch theodolites, it ranges from $\pm\ 0''\cdot 75$ to $\pm\ 1''\cdot 70$*.

The formulæ being intended for a single chain of equilateral triangles require the application of two factors to make them more general; *viz.*, one factor to take account of geometrical irregularity, the other to allow for the chain being double instead of single, that is to say, composed of polygonal figures and networks instead of single triangles. The direction of the chain does not affect the *e. m. s.* in latitude and longitude, and it affects the *e. m. s.* in azimuth so slightly that further consideration of direction may be neglected as of less importance than geometrical irregularity and the general strength of the chain. Thus it will be sufficient to substitute for the formulæ for the geodetic co-ordinates, those for the rectangular co-ordinates of a plane which are given by (xl), and which express the *e. m. s.* of each co-ordinate in feet, instead of seconds of latitude and longitude; and for the formulæ for the azimuth it will be sufficient to substitute that for the inclination to the axes of co-ordinates which is given by (xliii).

The value of a factor κ, to take cognizance of geometrical irregularity, may be readily obtained for the

* See page 95 of Vol. II and page 64 of the present volume.

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e. m. s. of side ratios, when the weights of all the angles are assumed to be equal; for by (xiv) we have for a chain of n equilateral triangles

$$\text{the } e.m.s. \text{ of } (R-dR) = \epsilon R \sin 1'' \sqrt{\frac{2}{3} n},$$

and therefore

$$\text{the } e.m.s. \text{ of } \log (R-dR) = \epsilon M \sin 1'' \sqrt{\frac{2}{3} n}.$$

If we suppose the chain to consist of two equilateral triangles only, *viz.*, ABD and DBC, and put $R = BC \div AB$, then by the second of these equations

$$e.m.s. \text{ of } \log (R-dR) = \cdot 000{,}0024\, \epsilon.$$

Now the angles of the triangulations are not all equal to 60°, but they usually range in magnitude from 30° to 90°; to take account of this, suppose the side BD to be either reduced in magnitude until the angles at D become 90°, or increased until they become 30°, the angles at B remaining constant, then in either case we have

$$e.m.s. \text{ of } \log (R-dR) = \cdot 000{,}0042\, \epsilon.$$

Thus we see that the result of employing two triangles with angles of the extreme values admissible, instead of with angles of 60°, to stretch over the common distance AC, is nearly to double the *e. m. s.* of $\log (R - dR)$. If the distance AC were increased or diminished—as by increasing or diminishing the angle at B, BD remaining constant—the *e. m. s.* of $\log (R - dR)$ would in like manner be increased or diminished; but when the distance is preserved, and the symmetry of the angles is alone disturbed, the *e. m. s.* is invariably increased. Thus since the angles of triangulations in hilly country are usually of average irregularity, while those of the triangulations in the plains are only slightly unsymmetrical, we may as a rule put

$$\kappa = \begin{cases} 1 \cdot 4 \text{ in hilly country, and} \\ 1 \cdot 1 \text{ in the plains.} \end{cases}$$

or more generally

$$\kappa = \sqrt{\frac{[\cot^2 Y + \cot^2 Z + \cot Y . \cot Z]}{n'}}$$

where n' represents the number of equilateral triangles of a side-length equal to the mean side-length of the given chain which would form a chain of about the same length as the given chain. Thus if l = length of chain and c = average length then

$$n' = \frac{2\,l}{c}.$$

The value of a factor to take account of a chain being double instead of single may also be readily obtained for the *e. m. s.* of side ratios.

From (xi) we may find, as previously shewn at page 199 of Vol. II,

that *e. m. s.* of $(R - dR) = 0 \cdot 82\, \epsilon R \sin 1''$ in an equilateral triangle

„ $= 1 \cdot 29\, \epsilon R \sin 1''$ „ „ hexagon

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and as under similar conditions in the configuration of the ground 7 single triangles span about the same distance as two hexagons—the side-lengths being the same in both—it is evident that *e. m. s.* of $(R-dR)$ by the chain of hexagons is to the *e. m. s.* by the chain of single triangles

$$:: 1\cdot 29\sqrt{2} : 0\cdot 82\sqrt{7} \text{ or } :: 0\cdot 84 : 1$$

If then we put

$$\zeta = 0\cdot 84$$

we shall have a fairly approximate factor to apply when the chain is composed of polygonal figures and net-works instead of single triangles.

Thus we obtain finally, for any chain of triangles

$$e.m.s. \text{ of } (R-dR) = \kappa\,\zeta\,\epsilon\,R\sin 1''\sqrt{\frac{2}{3}n}$$

$$= \cdot 000{,}004\,\kappa\,\zeta\,\epsilon\,R\sqrt{n}$$

$$e.m.s. \text{ of } \log(R-dR) = \kappa\,\zeta\,\epsilon\,M\sin 1''\sqrt{\frac{2}{3}n}$$

$$= \cdot 000{,}0017\,\kappa\,\zeta\,\epsilon\sqrt{n}$$

$$e.m.s. \text{ of either co-ordinate in feet} \begin{cases} = \kappa\,\zeta\,\epsilon\,c\sin 1''\sqrt{\dfrac{2n^3+3n^2+10n}{36}} \\ = \cdot 000{,}0008\,\kappa\,\zeta\,\epsilon\,c\sqrt{2n^3+3n^2+10n} \end{cases}$$

the value of ζ being $= 1$ when the chain is single.

When the weights of the angles in different portions of the chain differ so materially that it would not be desirable to employ a constant value of ϵ throughout, formulæ (lvi) to (lviii) can be employed. These formulæ can also be made applicable to the cases when a chain is partly single and partly double, or partly in the hills and partly in the plains, if the corresponding ϵs are multiplied by κ or ζ as the case may require.

DEHRA DUN, June 1882. J. T. W. & W. H. C.

Addendum to page 106 *of Appendix to Part I of Volume VII of the Account of the Operations of the Great Trigonometrical Survey.*

The following formula should be inserted between the formulæ for the *e. m. s.* of log $(R - dR)$ and the *e. m. s.* of either co-ordinate.

$$e.m.s. \text{ of azimuth} = \kappa\,\zeta\,\epsilon\sqrt{\frac{2}{3}n}$$

$$= \cdot 82\,\kappa\,\zeta\,\epsilon\sqrt{n}$$

NOTE.—In all instances it is assumed that the three angles of every triangle have been observed.

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APPENDIX.

No. 4.

ON THE DISPERSION OF THE RESIDUAL ERRORS OF A SIMULTANEOUS REDUCTION OF SEVERAL CHAINS OF TRIANGLES.

On the completion of each Simultaneous Reduction of the large sections of the triangulation of India, known as the North-West, South-East and North-East Quadrilaterals, it has been found that whatever the arithmetical rigor that may have been adopted, there remained discrepancies, or residual errors, at the junctions of the branches of the circuits, and where chains of triangles closed on base-lines: these residuals are almost wholly due to the circumstance that calculations had been made with logarithm tables to 7 places, whereas the natural numbers were occasionally of a magnitude requiring 8 significant figures. Where the arithmetical rigor was great these residual errors were, it is true, very small, as in the two former Quadrilaterals; but where the arithmetical rigor was relaxed, as in the last Quadrilateral, they were large. The dispersion of the residuals in the North-West and South-East Quadrilaterals was easily effected by inspection, by minute changes rarely exceeding $0''\cdot001$ in a few of the values of y and z; the choice being governed by reference to the coefficients $\mathfrak{b}$ and $\mathfrak{c}$ of the primary equations of condition. The arbitrary corrections being so trifling and the mode of applying them so simple, it was not at the time considered necessary to draw special attention to them. Thus when the North-East Quadrilateral was completed and large discrepancies presented themselves, see the table on page 244, Major Herschel had not the information before him regarding what had been previously done. He knew, indeed, that arbitrary corrections had been applied; but in view of the large residual errors he had to deal with, he was of opinion that their dispersion should be of a more theoretical character; and hence he adopted the methods of Section 17, Chapter III, methods which were still arbitrary and led in many instances to comparatively large angular changes.

It is now proposed to describe the method originally employed for the dispersion of residuals, which method appears equally applicable when the residuals to be eliminated are of the magnitude of those of the North-East Quadrilateral as when they are small like those previously met with, and to illustrate it by an example derived from the last named Quadrilateral.

The original errors of the triangulation, in side, latitude, longitude and azimuth, are, for dispersion, equated to functions of the angular errors of the form

$$[\mathfrak{b}y + \mathfrak{c}z].$$

Thus we have a series of equations of the form

$$[\mathfrak{b}y + \mathfrak{c}z] = E,$$

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see equations (66) page 59. When these equations have been solved and the values of the angular errors thus obtained have been applied in the several linear and geodetic calculations, any residuals, δE, should theoretically be dispersed by a second simultaneous solution of the equations of condition, symbolized thus:—

$$[\mathfrak{b}\,\delta y + \mathfrak{c}\,\delta z] = \delta E,$$

where $\mathfrak{b}$ and $\mathfrak{c}$ have the same values as before. But if δE is very small we may, by inspection, be able to assign trifling values to a few of the δys and δzs, while putting the rest $= 0$, such as to satisfy all the equations simultaneously, and the arbitrary value assigned to each δy or δz may be so small in proportion to the original value of the corresponding y or z, as not to lessen the character of the reduction from that of one based on the theory of minimum squares. This is what was actually done in the two first Quadrilaterals.

In order to facilitate the selection of the δys and δzs for arbitrary treatment, a few remarks must be made. An examination of the numerical coefficients in the several equations will shew that those in the side equations are not in any way dependent for their magnitude on their position in the equation; while in the geodetic equations the case is different, and the more remote the angles are from the closing point of the circuit, the larger in general will be the coefficients $\mathfrak{b}$ and $\mathfrak{c}$. The reason in each case will be apparent on reference to equation (35) page 47, and to the formulæ (58) and (59) and the 'Table of Substitutions' on pages 54 and 55 respectively. The proportional increase in the coefficients of the geodetic equations, in receding from the closing point of the circuit, is most marked in those in latitude and longitude; it is much smaller in the azimuth equations and in these the coefficients may almost be considered constant.

From this we see without further consideration that in our arbitrary endeavours to satisfy the equations

$$[\mathfrak{b}\delta y + \mathfrak{c}\delta z] = \delta E,$$

we should, in the case of residuals in latitude and longitude, choose for the arbitrary assignment of values, triangles as far removed as possible from the junction of the branches of the circuit, because the δys and δzs will then be of minimum magnitude; but where we are only concerned with side and azimuth residuals, the δys and δzs may be taken near the terminus of the branch of the circuit to save the labour of subsequent calculation. The selection of δys and δzs is somewhat further complicated by the fact that they will enter several equations; and the influence on all must be first ascertained before any values are adopted. In practice it will be found best to eliminate the latitude and longitude residuals first even at the expense of the linear and azimuth residuals; because the latter can be eliminated by a few changes at the end of the chain of triangles without sensibly affecting the former.

In the practical application of the foregoing method we find that a triangle may enter two circuits, in the right-hand branch of one and the left-hand of the other, and each circuit may furnish 4 residuals, perhaps a 5th if a base-line intervene; hence any angular changes in the angles of a triangle may possibly influence 8 residuals; or, in other words, we may have to deal simultaneously with 8 equations of the form

$$[\mathfrak{b}\delta y + \mathfrak{c}\delta z] = \delta E.$$

But we may not need to entirely eliminate the whole of the 8 residuals at once. It may be sufficient to eliminate only the 4 or 5 in one circuit, and portions of those in the other circuit, leaving the balance in the second circuit to be disposed of in the other branch. Still in this case we should carefully examine the coefficients of the unknown quantities and only choose those angles for treatment which, while disposing of those residuals which it is necessary to get rid of, do not injuriously affect the rest. It will not of course happen that the sum $(\mathfrak{b}\delta y + \mathfrak{c}\delta z)$ for every triangle in each equation will invariably be of the right sign as

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regards the whole of the residuals; but triangles can generally be found in which arbitrary values assigned to δy and δz, while considerably reducing the larger residuals, will increase the others but slightly, or injuriously affect only the side and azimuth residuals, which, as has been already indicated, can be disposed of at the end of the chain.

As an example for treatment we will take the residual errors of Circuit *I* of the North-East Quadrilateral; these residuals are:—

Equation	(1) in Log side	=	0·0	in the 7th place of decimals
„	(2) „ Latitude	=	+ 0″·014	
„	(3) „ Longitude	=	− 0 ·031	
„	(4) „ Azimuth	=	+ 0 ·080	

The right-hand branch of this circuit is alone susceptible of change. It contains 44 triangles of which the first 34 enter Circuit *II*, and the residuals of this circuit are:—

Equation	(5) in Log side	=	− 6·5	in the 7th place of decimals
„	(6) „ Latitude	=	− 0″·008	
„	(7) „ Longitude	=	+ 0 ·021	
„	(8) „ Azimuth	=	+ 0 ·272	

Hence in making any angular changes in the earlier part of the chain of triangles regard must be had to their effect on all 8 residuals. It is not necessary however that the residuals of Circuit *II* should be entirely eliminated because it is only right that the other branch should bear a share.

As the residuals have already been dispersed by another method it is not desirable to waste time in endeavours to make δy and δz as small as possible; but we will adopt values of 0″·1 as convenient to work with. In practice 0″·05 would probably have been the maximum value allowed.

An abstract of the calculation is given on page 111, and it was performed as follows:—The largest residuals in latitude and longitude are in longitude in both circuits. Turning to the values of $\mathfrak{b}$ and $\mathfrak{c}$ in Section 12 of Chapter III, we shall find that we can largely reduce these residuals if we put $\delta y = -$ ″·10 and $\delta z = -$ ″·10 in Triangle No. 9. After each $(\mathfrak{b}\delta y + \mathfrak{c}\delta z)$ has been subtracted from the corresponding residual, we find that the latitude residual in Circuit *I* is a little larger and the azimuth residual considerably so, while the other residuals are either not altered or are reduced.

The latitude residual of Circuit *I* is now the largest in latitude and longitude, and the coefficients $\mathfrak{b}$ and $\mathfrak{c}$ of Triangle No. 2 appear very suitable for reducing it if we put $\delta y = +$ ″·10 and $\delta z = -$ ″·10. Subtracting $(\mathfrak{b}\delta y + \mathfrak{c}\delta z)$ the residuals, except in side and azimuth, are now very small.

Turning our attention now to the latter we shall seek for suitable coefficients among the triangles at the end of the branch, and Triangle No. 43 will be found to answer our purpose if we put $\delta y = +$ ″·10 and $\delta z = +$ ″·10. As this triangle does not enter Circuit *II* the residuals of that circuit are not affected.

The residuals in longitude of Circuit *I*, − ″·010, is still too large to be allowed to stand and we must again seek for coefficients among the earlier triangles to reduce this. In Triangle No. 8 put $\delta y = +$ ″·10 and $\delta z = 0$, and the longitude residuals are reduced at the expense of the azimuth and side in Circuit *I*, and at the expense of the latitude in Circuit *II*.

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The residuals of Circuit *I* are now such as can be disposed of among the last triangles of the branch which do not enter any other circuit; and those of Circuit *II* have been so much reduced that they may be well left for dispersion in the right-hand branch of that circuit.

Confining our attention therefore to the residuals of Circuit *I*, Triangles Nos. 36 and 44 will be found suitable for treatment for reducing these residuals within rejectaneous amounts, when they will stand as follows:—

Circuit *I*.

Equation	(1)	in	Log side	= 0·0 in the 7th place of decimals
„	(2)	„	Latitude	= + 0″·001
„	(3)	„	Longitude	= − 0 ·001
„	(4)	„	Azimuth	= + 0 ·004

The residuals of the other circuit are:—

Circuit *II*.

Equation	(5)	in	Log side	= − 2·3 in the 7th place of decimals
„	(6)	„	Latitude	= + 0″·009
„	(7)	„	Longitude	= + 0 ·002
„	(8)	„	Azimuth	= − 0 ·037

We have now to apply the arbitrary values of δy and δz to the linear and geodetic calculations; and when this has been done we find that the residuals never differ by more than 0″·001 from the magnitudes indicated on the substitution of the values of δy and δz in the equations: these differences are of course due to the adopted limit of arithmetical accuracy. The actual residuals of both circuits are now:—

Circuit *I*.

Equation	(1)	in	Log side	= 0·0	*Final residuals.*
„	(2)	„	Latitude	= 0″·000	
„	(3)	„	Longitude	= − 0 ·001	
„	(4)	„	Azimuth	= + 0 ·005	

Circuit *II*.

Equation	(5)	in	Log side	= − 2·3	*Residuals left for dispersion in the right-hand branch.*
„	(6)	„	Latitude	= + 0″·008	
„	(7)	„	Longitude	= + 0 ·003	
„	(8)	„	Azimuth	= − 0 ·038	

If the arbitrary changes here shewn to suffice are compared with those that have actually been employed (see page 254), and the remaining residuals of Circuit *II*, with those on page 245, it will be seen that the method of adjustment now put forward is the more suitable to adopt.

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Abstract of the Calculation.

Circuit	Equation No.	Residual Errors after Simultaneous Reduction	Triangle 9: Coefficients of y and z, b	Triangle 9: Coefficients of y and z, c	Triangle 9: Portion of Error Eliminated by Putting $\delta y = -\cdot 10$ and $\delta z = -\cdot 10$	Balance	Triangle 2: Coefficients of y and z, b	Triangle 2: Coefficients of y and z, c	Triangle 2: Portion of Error Eliminated by Putting $\delta y = +\cdot 10$ and $\delta z = -\cdot 10$	Balance	Triangle 43: Coefficients of y and z, b	Triangle 43: Coefficients of y and z, c	Triangle 43: Portion of Error Eliminated by Putting $\delta y = +\cdot 10$ and $\delta z = +\cdot 10$	Balance
I	1	S = 0·0	+13	−13	0·0	0·0	+22	−11	+3·3	−3·3	+7	−15	−0·8	−2·5
I	2	λ = + ·014	+ ·066	− ·037	− ·003	+ ·017	+ ·096	− ·069	+ ·017	·000	+ ·002	− ·004	·000	·000
I	3	L = − ·031	+ ·084	+ ·103	− ·019	− ·012	− ·135	− ·108	− ·003	− ·009	+ ·006	+ ·006	+ ·001	− ·010
I	4	A = + ·080	+1·038	+1·049	− ·209	+ ·289	−1·062	−1·049	− ·001	+ ·290	+1·004	+1·004	+ ·200	+ ·090
II	5	S = −6·5	−13	+13	0·0	−6·5	−22	+11	−3·3	−3·2	...	...	...	−3·2
II	6	λ = − ·008	− ·033	+ ·041	− ·001	− ·007	− ·088	+ ·38	− ·013	+ ·006	...	...	...	+ ·006
II	7	L = + ·021	− ·069	− ·063	+ ·013	+ ·008	+ ·086	+ ·092	− ·001	+ ·009	...	...	...	+ ·009
II	8	A = + ·272	−1·032	−1·029	+ ·206	+ ·066	+1·038	+1·041	·000	+ ·066	...	...	...	+ ·066

Abstract of the Calculation—(Continued).

Circuit	Equation No.	Balance	Triangle 8: Coefficients of y and z, b	Triangle 8: Coefficients of y and z, c	Triangle 8: Portion of Error Eliminated by Putting $\delta y = +\cdot 10$ and $\delta z = \cdot 0$	Balance	Triangle 36: Coefficients of y and z, b	Triangle 36: Coefficients of y and z, c	Triangle 36: Portion of Error Eliminated by Putting $\delta y = -\cdot 10$ and $\delta z = +\cdot 10$	Balance	Triangle 44: Coefficients of y and z, b	Triangle 44: Coefficients of y and z, c	Triangle 44: Portion of Error Eliminated by Putting $\delta y = -\cdot 13$ and $\delta z = -\cdot 06$	Balance	By subsequent Calculation
I	1	−2·5	+9	*Not required.*	+0·9	−3·4	+4	−28	−3·2	−0·2	+6	−10	−0·2	0·0	0·0
I	2	·000	+ ·017		+ ·002	− ·002	+ ·018	− ·014	− ·003	+ ·001	...	...	...	+ ·001	·000
I	3	− ·010	− ·107		− ·011	+ ·001	+ ·022	+ ·046	+ ·002	− ·001	...	...	...	− ·001	− ·001
I	4	+ ·090	−1·050		− ·105	+ ·195	+1·011	+1·023	+ ·001	+ ·194	−1·000	−1·000	+ ·190	+ ·004	+ ·005
II	5	−3·2	−9		−0·9	−2·3	...	...	...	...	...	...	...	−2·3	−2·3
II	6	+ ·006	− ·025		− ·003	+ ·009	...	...	...	...	...	...	...	+ ·009	+ ·008
II	7	+ ·009	+ ·071		+ ·007	+ ·002	...	...	...	...	...	...	...	+ ·002	+ ·003
II	8	+ ·066	+1·033		+ ·103	− ·037	...	...	...	...	...	...	...	− ·037	− ·038

DEHRA DUN;
July 1882.

W. H. COLE.

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PART II.

THE DETAILS OF THE OBSERVATIONS

AND

THE FINAL RESULTS

OF THE TRIANGULATION OF FIVE OF THE COMPONENT SERIES

INCLUDED IN

THE NORTH-EAST QUADRILATERAL.

THE NORTH-EAST LONGITUDINAL

THE BUDHON MERIDIONAL	THE AMUA MERIDIONAL
THE RANGIR MERIDIONAL	THE KARARA MERIDIONAL

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NORTH-EAST LONGITUDINAL SERIES.

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NORTH-EAST LONGITUDINAL SERIES.

INTRODUCTION.

The North-East Longitudinal Series is the chain of triangles which extends from the northern extremity of the Great Arc to that of the Calcutta Meridional Series, passing mostly through the belt of Tarái which lies at the foot of the Himalayan Mountains on the frontier of the British Territories. It extends from the vicinity of the Dehra Dún Base-Line to a little beyond the Sonákhoda Base-Line, and connects together the northern extremities of the several meridional chains of triangles which emanate from the Calcutta Longitudinal Series and lie between the meridians of the Great Arc and of the Calcutta Meridional Series. It was wholly executed under the superintendence of Captain—afterwards Colonel Sir Andrew—Waugh.

That by far the greater portion—about nine-tenths—of this important chain of triangles was carried almost entirely through the plains at the foot of the outer Himalayan ranges, instead of over those ranges themselves, was due to the circumstance that this portion of the Himalayas falls within the Nepalese Territories, and unfortunately a treaty had been made between the British and the Nepalese Governments, one of the articles of which prohibited Europeans from entering Nepal. More than once Colonel Everest had urged the Government of India to move the Nepalese to sanction the extension of the operations of this survey through their territories, as had invariably been permitted by all the Native States in India; but his requests were always refused. Had the triangulation been carried over the hills, the lengths of the sides might have been materially increased and the number of stations correspondingly diminished; the heavy cost of building towers at each of the stations in the plains, and clearing the lines between them, would have been avoided; and serious mortality in the survey establishments, which was caused by the operations having to be conducted through the deadly forests and jungles of the Tarái, might have been prevented.

In its execution this Series differs from all the other chains of principal triangles in that, instead of having been accomplished continuously from end to end, portions of it were executed on the completion and in continuation of the operations on the meridional series, with the object of tying together the northern extremities of those chains as soon as possible after each was completed.

Before any portion of the existing North-East Longitudinal Series—the details of

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which are given in this volume—was commenced, a chain of triangles, originally called "The North Connecting Series in the Sub-Himalayan Range," was carried from the side Doíwála to Banog of the Great Arc, eastwards, to the northern extremity of the Budhon Meridional Series and then on to the west flank of some triangulation which had been extended beyond the present Rangír Meridional Series to points on the Sub-Himalayan Range. It was executed during the field seasons of 1841-43 by Captain Du'Vernet of the Madras European Regiment, with Saiyad Mohsin's 18-inch theodolite which is described at page 67 of the Appendices to Vol. II. The triangulation to the north of the Rangír Series—as at present constituted, and described in the introductory account thereof in Vol. VII—was executed by Mr. C. Lane, in the field seasons of 1839-42 with an 18-inch theodolite by Cary which is described at page 68 of the Appendices to Volume II. Then a chain of triangles, originally called "The North Connecting Series in the Pilibhít Tarái," was carried from the side Baheri-Atária on the east flank of the Rangír northern triangulation to the side Rámuápur-Kokra of the Amua Series, by Captain Waugh of the Bengal Engineers, in the field season of 1842-43; the instrument employed is believed to have been one of the 15-inch theodolites which were then available for the principal triangulation. The whole of the preceding operations were executed under the superintendence of Colonel Everest. In the field season of 1843-44 a chain of triangles, originally called "The North Longitudinal or Connecting Series," was carried by Captain Du'Vernet—under the superintendence of Captain Waugh who had then succeeded to the Surveyor Generalship—from the side Sultánpur-Karái of the Pilibhít Series to the side Khánpur-Mási of the Karára Series; the instrument which was employed is unknown, but it was probably one of the old 15-inch or 18-inch theodolites.

Full details of the above mentioned triangulations are given in Parts 2, 4, and 5 of Volume IX, and Part 2 of Volume X of the series of volumes entitled "The Trigonometrical Survey of the Peninsula of India" of which three copies were prepared in manuscript, one for record in the East India Office in London, the two others for the requirements of the Offices of the Surveyor General in Calcutta and of the Superintendent of the Great Trigonometrical Survey in Dehra Dún.

Shortly after the completion of these operations, the Survey was supplied—through the liberality of the Hon'ble Court of Directors of the East India Company—with instruments far superior in telescopic power and accuracy of graduation to those which had been available hitherto; moreover the operations on the Great Arc were completed about this time, and thus the two great theodolites which had been specially constructed for the requirements of the Great Arc, and are described at pages 28 to 37 of the Appendices to Vol. II, became available for employment on other series of triangles. The very marked superiority of the results obtained by the great (36-inch) theodolites and the new 24-inch theodolites, over those obtained by the older and much smaller instruments, induced Captain Waugh to have the whole of the angles of the several North Connecting Series re-measured with instruments of a better class, and to discard the first measurements. It happened that almost all the numerous towers which had been erected in the plains as stations of observation were still standing and available for re-employment; and it has already been shown in Chapter IV of Volume II, that when the object in view in revisionary operations is merely to remeasure the angles with

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a superior instrument, without modifying the original design of the triangulation by altering the positions of the first stations or introducing new ones, the revision may usually be accomplished in very much less time than would be required for a new triangulation over virgin ground.

It thus happened that the final triangulation of the North-East Longitudinal Series was commenced simultaneously in two places in the field season of 1845-46; at the northern extremity of the Chendwár Meridional Series by Mr. Logan, and at that of the Malúncha Meridional Series by Lieut. Reginald Walker. Mr. Logan, working westwards from stations LXXXIV-LXXXV, carried the new triangulation to the head of the Amua Series—connecting the Huriláong, Gora, Gurwáni and Karára Series *en-route*—and then commenced the revision of the contiguous portions of the North Connecting Series, which he completed up to the side Donau-Kaliánpur (XII-XIII), in 1849-50. The revision of the remaining westerly portion up to the Great Arc, was accomplished in 1850-51 by Captain Renny and Mr. John Peyton. Lieut. Reginald Walker, working northwards and then eastwards, carried the triangulation from stations C-CI to CXVII-CXVIII in 1845-47. In the following year it was extended by Mr. C. Lane to its eastern limit, at the side CXXIV-CXXVI, a little beyond the Sonákhoda Base-Line. The portion of the Series included between the sides LXXXIV-LXXXV and C-CI was completed by Mr. Peyton in 1848-49. An account of these several operations will now be given.

The Triangulation between Stations XII-XIII and LXXXIV-LXXXV, by Mr. George Logan.

Season 1845-46.
PERSONNEL.
Mr. G. Logan, 1st Assistant.
„ H. Keelan, 1st Class Sub-Assistant.
„ J. W. Rossenrode, 1st Class Sub-Assistant.
„ J. B. N. Hennessey, 3rd „ „

The Chendwár Meridional Series had been carried up to the side Harpur-Sáwajpur (XXII-XXIII of Chendwár) by the end of the field season of 1844-45, and then only five triangles remained to complete the Series. In the following field season Mr. Logan proceeded to measure the angles of those triangles, and carry a longitudinal chain of triangles westwards from their northern extremity. It had been conjectured that the triangulation might at first be carried northwards, through the country of the Raja of Rámnagar, to the Sumeshar range of the outer Himalayas, and then be turned westwards; and had it been possible to establish both flanks of the Series on the hills, this plan would have been followed; but it was found that one flank must necessarily be located in the plains, and that a considerable bend in the direction of the chain would be introduced by resorting to the hills. Thus Mr. Logan, who had been authorized by the Surveyor General to adopt whichever course he thought most judicious, decided on selecting the direct course through the plains. The north flank of the Series was carried as closely as possible to the boundary line between the British and the Nepal Territories, which the surveyors were prevented from crossing because of the treaty between the two Governments which has already been alluded to, and in virtue of which no Europeans were allowed to cross the Frontier.

During the first field season sites were selected for the three remaining stations (XXIV to XXVI) of the Chendwár Meridional Series, and for stations LXXXV to LXXII of the Longitudinal Series. Towers—ranging in height from 25 to 35 feet, and composed of solid masonry

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pillars surrounded by solid earthen platforms—were built by the surveyors themselves on the sites selected for the principal stations; and the whole of the lines between these towers were cleared of trees and other obstacles of which the removal was necessary to secure the requisite mutual visibility along each 'ray'.

The whole of the principal angles—both horizontal and vertical—at these stations were measured and an astronomical azimuth of verification was observed at station XXV of the Chendwár Series, by Mr. Logan, during the last three months of the season, with Barrow's 36-inch theodolite.

After a long field season, lasting from early in October to the end of May, the party proceeded to Dinapore, there to spend the recess season.

Season 1846-47.

PERSONNEL.

Mr. G. Logan, 1st Assistant.
„ H. Keelan, Senior 1st Class Sub-Assistant.
„ J. W. Rossenrode, 1st „ „
„ J. B. N. Hennessey, 3rd „ „
„ J. O. N. James, 3rd „ „

Field operations were resumed in the month of October 1846, and by the 20th of the following month sites had been selected for 9 stations and 19 'rays' had been traced, when two of the European Assistants and the greater portion of the native establishment were suddenly prostrated by a virulent malarious fever, contracted in the forests of the Tarái which had unfortunately been entered too soon after the termination of the rainy season. It is reported that two-thirds of the natives "had to be literally carried into the Civil Station of Goruckpore for medical aid"; about thirty-five of them died outright, and of the survivors not a few "felt the effects of that jungle fever for several years after". A small party remained in the field throughout, collecting materials for the construction of the tower stations, with the aid of the inhabitants of the neighbouring villages. Towards the end of December the convalescents were sufficiently numerous to permit of Mr. Logan resuming field operations, the party being strengthened by the entertainment of new hands, though not without much difficulty, as work in the Tarái was regarded with considerable apprehension and alarm. Heavy rains fell in January which destroyed large quantities of the sun-dried bricks that had been prepared for the construction of the towers, but the health of the party was unaffected and was generally good from the time of returning into the field until the end of the season. The principal triangulation was concluded in the month of March, at stations LXIII-LXIV, terminating at an earlier date than usual to permit of Mr. Logan's return to Dinapore, in order to commence preparations for the base-line which was to be measured in the following field season at Sonákhoda. Mr. Keelan and the other assistants were employed until the end of April in selecting stations in advance and executing minor triangulations from the principal series along the Gunduk river and towards Bettiah.

Season 1848-49.

PERSONNEL.

Mr. G. Logan, 1st Assistant.
„ J. W. Rossenrode, 1st Class Sub-Assistant.
„ J. B. N. Hennessey, 2nd „ „
„ J. O. N. James, 2nd „ „

During the field season of 1847-48, Mr. Logan, his European assistants and his native establishment were wholly employed on the measurement of the Sonákhoda Base-Line, which is situated at the eastern extremity of the North-East Longitudinal Series. They spent the summer of 1848 in recess quarters at Allahabad, the nearest cantonment to the triangulation of the ensuing field season. Operations were commenced by marching to the station of Mási (XXXV), at the

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northern extremity of the Karára Meridional Series, with a view to examining the condition of the towers thereat and at the contiguous stations of the North Longitudinal or Connecting Series, which Major Du'Vernet had constructed in 1843-44. The summits of the pillars at each station had moreover to be enlarged to adapt them for supporting the stand of the great theodolite which Mr. Logan was employing, and which required pillars of a larger diameter than was needed for the stands of the smaller theodolites employed in the previous triangulation. At Mási the station pillar was a solid one, containing a series of markstones at different heights above the ground; the upper markstone was found to have been removed with a portion of the top of the pillar; but the markstones below were uninjured, and thus the mischief which had been done was readily repaired.

Mr. Logan then proceeded eastwards, towards the station of Chanda (LXIV) at which he had closed operations in 1847, selecting sites for the intermediate stations and clearing the rays on the lines. He also availed himself of the fine weather which usually occurs at this season of the year to take observations with the great theodolite, at stations XXXVII, XLI and XLVI, to fix the principal peaks of the snowy ranges of the Himalayas. Meanwhile the construction of the towers was progressing; the operations were however again impeded by an outbreak of fever which temporarily prostrated upwards of a third of the establishment, but fortunately the fever was of a less virulent and lasting nature than during the outburst of 1846, and it did not necessitate a complete suspension of the operations. Several of the rays had to be cleared with great labour through dense *sál* forest, in doing which considerable opposition was offered by the Raja of Akauna to Mr. Hennessey in clearing a line which passed near his fort; he sent out a party of matchlock men which compelled Mr. Hennessey to suspend operations until the district authorities could interfere in his support. The measurement of the principal angles was resumed by Mr. Logan towards the end of December, commencing at LXIII; by the middle of March they had been completed westwards up to stations XLIII and XLIV at the northern extremity of the Gurwáni Meridional Series; an azimuth of verification was observed at XLV; and the principal observations were continued up to stations XXXIX and XL, where they were brought to a close towards the end of April. The party then proceeded for the recess season to Dehra Dún, where Mr. Hennessey was transferred to the Head Quarters' Office, for duty immediately under the Surveyor General; his services during the field season had been specially commended, as he had cleared over 200 miles of rays, much of it through dense forest and jungle, besides measuring 140 minor triangles, and laying down the positions of 720 villages.

Season 1849-50.

PERSONNEL.

Mr. G. Logan, 1st Assistant.
„ G. E. Terry, 1st Class Sub-Assistant.
„ J. O. N. James, 2nd „ „
„ C. J. Carty, 3rd „ „

Warned by the experience of previous years of the danger of entering the malarious tracts of the Tarái early in the field season, Mr. Logan did not leave Dehra Dún until late in October. The great theodolite was set up for observation at the station of Dadaura (XXXVIII) on the 7th December, between which and the 4th April observations were taken at 27 stations, completing up to the stations of Donau and Kaliánpur (XII-XIII), at the eastern end of, what was then called, the Pilibhít Series. Observations of circumpolar stars, for the determination of azimuths of verification, were taken at Stations XXXV and XIII.

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The services of Mr. James, during this season, were most favorably reported on by Mr. Logan to the Surveyor General. Mr. James had re-cleared 138 miles of rays between stations of the principal triangulation; he had also executed a chain of minor triangles 100 miles in length towards Shájahánpur, in the course of which he determined the position of 634 points; he had also laid down the course of the Gogra river for 36 miles, by means of route surveys carried along both banks and connected with principal stations XXXII and XXXIII.

The Triangulation from Stations LXXXIV–LXXXV Eastwards to the Terminal Side CXXIV–CXXVI.

This portion of the North-East Longitudinal Series was accomplished in three sections by as many observers.

The Section LXXXIV–LXXXV to C–CI was executed in the field season of 1848-49 by Mr. John Peyton, who employed Barrow's 24-inch theodolite No. 1—described at page 46 of the Appendices to Volume II—in measuring the principal angles. No record of the season's operations is now forthcoming. Towers ranging in height from 20 to 30 feet, with solid pillars having markstones at the summit and basement, were constructed at each of the stations. Mr. Peyton had been directed to take observations for fixing the positions of the peaks on the snowy ranges of the Himalayas which ran parallel to his operations; but he appears to have been unable to do so, probably because the atmospheric conditions had become unfavourable by the time his stations, all towers, were ready for use; these observations were therefore carried out by Mr. J. O. Nicolson subsequently.

Season 1845-46.

PERSONNEL.

Lieutenant R. Walker, R.E., 2nd Assistant.
Mr. G. Terry, 1st Class Sub-Assistant.
" W. C. Rossenrode, 1st " "
" C. R. Webb, 3rd " "

The Section C-CI to CV-CIX was executed by Lieutenant Reginald Walker, R.E., during the field season of 1845-46, as the northern portion of the Malúncha Meridional Series. Reference should be made to the introduction to that Series for an account of the difficulties under which the operations were conducted, owing partly to malarious fever contracted in the forests of the Tarái, partly to unfavourable climatic conditions, and partly to the extreme length of the sides of the triangles. Towers with solid pillars were constructed at each of the stations. The observations at the several stations which are now included in the North-East Longitudinal Series were taken in the months of May and June 1846, when, after a long period of hot winds from the west which greatly obscured the atmosphere, the easterly winds set in, the weather became favourable, and mutual observations between the principal stations of the triangulation again became possible.

The theodolite employed in the measurement of the principal angles was Cary's 15-inch which is described at page 71 of the Appendices to Vol. II. The results obtained by Lieutenant Walker with this little instrument are most accordant and satisfactory, as regards the smallness both of the errors of observation and graduation (see Section 3, Chapter VII, Vol. II) and of the triangular and other geometrical errors. Thus, whereas all other portions of the

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triangulation of this Series which had been executed with the smaller and more antiquated theodolites were subsequently revised with the 36- and the 24-inch theodolites, this portion was not revised. The instrument was however discarded at the end of the field season, and one of the great theodolites substituted for it.

Season 1846-47.

PERSONNEL.

Lieutenant R. Walker, R.E., 1st Assistant.
Mr. C. Lane, Principal Sub-Assistant.
„ W. C. Rossenrode, 1st Class „
„ C. R. Webb, 3rd „ „
„ J. H. Lawrence, 3rd „ „

In October 1846, Lieutenant Walker proceeded with four assistants, from his recess quarters at Titalya, to extend the triangulation eastwards to the Sonakhoda Base-Line. The operations lay wholly in the plains of the Tarái at the foot of the Himalayas, much of it through tracts of forest and jungle which necessitated the usual laborious process of selecting sites, erecting a tower of a height generally ranging from 20 to 30 feet at each station, and clearing the lines between the towers. The preliminary arrangements occupied much time, so that the measurement of the principal angles could not be undertaken before the month of March 1847. The measures of all the angles, both horizontal and vertical, were made with Troughton and Simms' 36-inch theodolite, which is described at pages 28 to 31 of the Appendices to Volume II. Lieutenant Walker had completed the observations at 9 stations, bringing the work up to station CXVIII, when he was struck down with fever, contracted in the malarious region on which he had so long been working. He proceeded to the Hill Sanatarium of Darjeeling for change of air and medical treatment; but on the arrival at Darjeeling of the dooly in which he was being carried, the sad discovery was made that he had died *en route*, without the cognizance of any of his attendants. In announcing his death to the Government, the Surveyor General stated that "by his lamented demise Government has lost a very talented and energetic officer, and "this Department has sustained an irreparable loss. The great practical success which "attended his labors from the commencement, together with his scientific acquirements and "entire devotion to the Great Trigonometrical Survey, marked him out from the first as an "officer of the highest order. During my recent inspection of his operations, I was particu-"larly struck with his great energy and force of character among difficulties of no ordinary "kind. No inclemency of climate, nor fear of danger, neither fatigue, heat nor inconvenience, "loneliness nor protracted bodily exertion, could quench the enthusiasm with which he re-"garded his work, nor repress his emulation to excel in his profession."

Observations of the principal angles at stations CXIX to CXXVI were still required to complete the eastern extension of this Series, which terminates at the east flank of the Rámganj polygon, the figure of which one of the sides is the Sonakhoda Base-Line. The whole of the angles were measured by Mr. Lane during the field season of 1847-48, with Troughton and Simms' 36-inch theodolite which had been employed during the previous field season by Lieutenant Walker. Subsequently, early in 1855, all the angles at the stations—CXX to CXXVI—which appertain to the Rámganj polygon were again measured by Mr. J. O. Nicolson, some with Colonel Waugh's 24-inch theodolite No. 2, and others with Barrow's 24-inch theodolite No. 1. For the Surveyor General apparently mistrusted the first measures, apprehending that they might have been vitiated by deflection of the towers at

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some of the stations. The triangulation had exhibited a very much larger linear error on closing at the Sonakhoda Base-Line than had ever been met with previously, and there can be little doubt that this error must have been mainly due to the cause to which it was attributed—*viz.*, deflection of the tower stations and consequent displacement of the station marks on their summits—as the pillars were all solid, and there were no means of measuring the displacement by reference to the marks at their basements otherwise than by the expensive and tedious process of pulling them down to the ground, in order to obtain access to the lowest mark. This subject is fully discussed at pages 65 to 67 of Vol. VII; thus it is unnecessary to say more in this place than that the experience of the disadvantages of tower stations with solid pillars which was gained in the course of the operations on this Series, led shortly afterwards to the introduction of towers with perforated pillars, and with vaults leading to the basement mark, to which mark reference has since been made invariably; the upper mark is either dispensed with altogether, or a temporary substitute is provided, in the shape of a cross with a small hole in the centre which is carefully plumbed over the basement mark.

The second measures of the angles of the Rámganj polygon gave values which agreed so closely with the first that the differences may be fairly attributed to errors of observation rather than to errors caused by pillar deflection; thus there being no decisive evidence of errors of the latter kind, both values have been adopted; they have been combined together with their respective weights, in order to arrive at the 'concluded' or finally adopted value of each angle which results from the actual observations.

The Triangulation between the Eastern flank of the Great Arc and the Side XII–XIII of the North-East Longitudinal Series.

Season 1850-51
PERSONNEL.
Captain T. Renny, R.E., Astronomical Assistant.
Mr. J. Peyton, Chief Civil Assistant.
„ F. C. Blewitt, 2nd Class Sub-Assistant.
„ A. T. Haycock, 3rd „ „

The final measurement of the angles of these triangles was executed in the field season of 1850-51 by Captain Renny (now Colonel Renny-Tailyour) and Mr. J. Peyton. The following account of the operations is extracted almost *verbatim* from a report by Captain Renny to the Surveyor General, dated 10th June 1853.

Mr. J. Peyton, Chief Civil Assistant, and two Sub-Assistants having been placed under my orders, I kept Mr. Haycock with me to assist in the observatory and office, and detached Messrs. Peyton and Blewitt in the beginning of October (1850), the former to build the towers that were wanted at stations in the plains, and the latter to construct platforms and cut roads at hill stations for the 24-inch theodolite.

Having received your instructions to make the revised section a double triangulation, I carried this improvement into effect by observing the angles made by the diagonals Banog to Chándípahár, and Dhela to Birond, so as to form two quadrilaterals; by adopting Mahesari Station of the Budhon Series, to complete a polygon round Mábegarh H.S.; and by connecting Birond and Donau Stations, in order to obtain a polygon round Baheri T.S.

The four stations of the Rangír Series, in the plains at the eastern end of my triangulation, had tall pillars about 40 feet high for the support of the theodolite, and in former operations a temporary scaffolding was erected around them for the observer and his tent; but as this arrangement was not nearly so convenient as a tower, and moreover the pillars had been found to vibrate with a little wind, it was considered advisable on this occasion to encase them in a solid tower of unburnt brick.

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Mr. Peyton on leaving Dehra proceeded first to Mahesari Station, from whence he cleared the ray to Girjwála H.S., and after making arrangements for the repairs of the tower at Mahesari, of which the outer portion of unburnt brick was much dilapidated, he marched on to Sísgarh. He now commenced work on the towers at Sísgarh and Atária and also in repairing those at Kaliánpur and Donau, where Mr. Logan had left men for the preservation of the station marks; but he had a great deal of difficulty in getting workmen to proceed to Bagwára and Baheri, which are situated in unhealthy parts of the Tarái, as several masons had died there formerly when building the pillars at these stations for the Rangír Series. The delay in obtaining workmen and the unusual wetness of the season, which interfered greatly with the drying of bricks, prevented the towers being got ready at the two last named stations until near the middle of February. The original pillars were built with a hollow core and an open passage to it at bottom, in order to plumb down from the top to a mark below, but they were all found to incline so much as to prevent such a reference being made. It therefore became necessary to throw down a great part of each pillar and rebuild it; but after the towers were complete, the pillars again moved out of the perpendicular to a small extent, caused most probably from pressure of the outside casing of unburnt brick owing to unequal settlement of its foundation. As Mr. Peyton did not like to trust the lampmen to plumb down the great depth to the bottom of the pillar, he directed them to use an upper mark, which was carefully transferred to the bottom on the arrival of the observing party. This arrangement generally threw the lower mark out of the centre of the aperture at bottom of the pillar, and except in the case of Bagwára, caused them to differ from the station mark used in former operations; but the maximum difference does not exceed 3½ inches, and they are noted in the description of stations inserted in the angle books.

At the Hill stations, platforms were constructed of stone and earth, 14 feet square, with a central pillar of masonry 3 feet 4 inches diameter for the theodolite. There are markstones at top and bottom of these pillars, and a masonry annulus is built round them at a clear interval of an inch or two, to isolate them from the remainder of the platform. Lime had to be brought from a great distance for the pillars and annuli, for although limestone generally abounded, the paháris [hill men] are not in the habit of burning it for their own use. A practicable path was always cut up the hill side for the theodolite from the nearest village road to the station. As the original platforms with exception of those at Banog and Doíwála had no masonry pillar for the theodolite, they had all to be rebuilt or altered accordingly, but the lower markstones were retained and the upper marks were also replaced at their previous heights, except in a few instances which are noted in the description of stations.

As it was not considered safe to send lampmen to Doíwála Station until near the end of October for fear of jungle fever, and it was also necessary to let Mr. Blewitt obtain a start in advance of the observing party, I only commenced taking the angles at Banog H.S. on the 23rd October. From Banog I proceeded regularly from station to station until I reached Dhela H.S. on the 10th January, when heavy snow fell on the mountains and interrupted the observations to Ghungti, Birond and Saunchália. In the course of 5 or 6 days the lampmen managed to show their signals at the first two of these stations, but Saunchália being full a thousand feet higher, or upwards of 8,500 feet above the level of the sea, all access to it was cut off for nearly a month. When the snow commenced falling, Mr. Blewitt was making the road up the hill at Birond, so I felt no anxiety respecting the lampmen at that station, as I knew he would assist them if necessary. I had previously caused huts to be constructed and wood stored at all these stations, and I had ordered the lampmen always to keep a month's supply of food by them in case of being snowed up; but still, fearing lest the men should have been careless in taking all the necessary precautions from ignorance of the danger they incurred in neglecting them, I was apprehensive that the lampmen at Ghungti and Saunchália might be in difficulty if not in actual danger, and I therefore despatched a couple of messengers to each of these stations particularly selecting active and energetic men for those sent to Saunchália, and I directed them to report to me immediately in case of any difficulty occurring, which they could not overcome, in communicating with the lampmen. I shortly heard of the welfare of the men at Ghungti, where the head lampman had been provident as respected supplies for his party, and the road to the station had not been much impeded with snow, but at Saunchália the snow had fallen very deep, and two of the lampmen had been snowed up for 4 days with scarcely any food, and were only rescued by the energy of the messengers I sent, who with great difficulty got a party of paháris to assist them and pushed their way through the snow. I had posted 4 men at Saunchália, but the day before the snow fell, two of them came down the hill to buy food for the party and were afraid to go up again until my messengers arrived, and the men on the hill being also unaccustomed to snow, were afraid or unable to venture down through the deep snow, after making an unsuccessful attempt.

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Having taken all the angles at Dhela except those in connection with Saunchália, I marched to Bagwára Tower Station to assist Mr. Peyton in completing the towers, with the view of making over the remainder of the observations to him and returning to your office at Dehra, to enable me, agreeably to your orders, to take early measures for erecting an observatory at Banog. Accordingly on the 9th February I made over charge to Mr. Peyton, and he took the remainder of the observations, visiting all the tower stations first and ending with the hill stations of Birond, Saunchália and Dhela. At first he progressed very slowly on account of the length of the rays between the stations of Bagwára, Sísgarh, Baheri and Atária, and the necessity of reclearing these rays, but he eventually got all the angles satisfactorily completed by the 3rd of June.

There were two theodolites employed on this work, being the two you constructed from the original 24-inch Azimuth Circles of the 3-feet Astronomical Circles. It was at first intended to use No. 1, which was considered the best, but as it was on its way up from Calcutta when I commenced work, I observed with No. 2 at the first two stations I visited, *viz.*, Banog and Ghandiál. These theodolites, especially No. 1, appear to be but little inferior to the great theodolites, and when used with care and the signals are tolerably good, the differences in the mean angles at different zeros do not appear to exceed 3 to 4 seconds in No. 1 and 4 to 6 seconds in No. 2.

The best mode of conveying the boxes of the theodolite in the mountains, is by means of a single bamboo or pole attached as in a palanquin, so that the carriers may move in single file, which enables them to take the instrument safely along any of the ordinary village tracks, and only necessitates the cutting of a small path to the station; whereas if two carriers are placed abreast, the village tracks must generally be widened for the purpose, and expensive roads made up to the stations. The ordinary bearers of the plains are preferable as carriers to the paháris, and get on very well in the hills after a little practice, but 2 to 6 paháris with drag-ropes for each box are necessary to assist when the roads are steep.

The result of the revision appears satisfactory as shown in the following instances. 1*st*. The uncorrected polygons and quadrilaterals re-enter with small differences. 2*nd*. The triangular error is generally under 1 second, and only in one instance exceeds 2 seconds, which occurs in the triangle Bagwára, Baheri, and Sísgarh, where the error amounts to 2"·80, but the sides of that triangle are long and unfavourably situated for good angles. 3*rd*. In the heights, the differences by two or three independent deductions of the same stations are frequently under 1 foot, and seldom exceed 2 feet, whereas in the orginal work these differences were usually upwards of 10 feet and in two instances amounted to 37·7 and 46·1 feet respectively. And 4*thly*,—The comparison with the Rangír Series is more favourable than previously, and an extraordinary anomaly has also disappeared, which existed in the comparisons of the Budhon with the Great Arc and Himalaya Series (which the hill portion of my revised section was formerly called) as shewn in pages IV and V of the Introduction to the General Report of the Budhon Series.

The comparison of the Rangír Series at the common side (of the two series) Saunchália-Bagwára, formerly gave a difference of 5·4 inches per mile in excess, and this difference is now reduced to 2·9 inches per mile. The Budhon Series compared with the side Sheopuri to Godhna of the Great Arc was 6·24 feet in excess in 21¾ miles, which amounted to 3·5 inches per mile, but when compared with the side Chándípahár to Mábegarh of the Himalaya Series there was only a difference in excess of 0·25 feet in 16½ miles, or about 0·2 of an inch per mile; from which comparisons there resulted a discrepancy of 3·3 inches per mile in the short triangulation from Godhna and Sheopuri to Chándípahár and Mábegarh, occupying only three triangles of the Budhon Series. As these three triangles formed part of the Mahesari polygon which re-entered very fairly, the discrepancy was supposed to be chiefly due to the Himalaya Series, and the result of the revision of the latter has proved this to be the case, for comparing the common triangle Chándípahár, Mábegarh, and Mahesari, of the Budhon and North-East Longitudinal Series, the former now gives an excess of 3·2 inches per mile, being a difference of only 0·3 of an inch from the result given by the Great Arc, and if the revised angles of the triangle Chándípahár, Mábegarh, and Mahesari were introduced into the Budhon Series, this difference would be still further reduced.*

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* It is to be remembered that the numerical values of discrepancies given in this and the preceding para. were derived from the preliminary computations, before any general adjustment of the triangulation had been attempted, and while the Budhon and the Rangír Meridional Series were still dependent for their initial elements on the old triangulation of the Calcutta Longitudinal Series the revision of which was not commenced until the year 1863.

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My party being specially intended for the revision of Principal Triangulation, and composed only of such members of the Civil Establishment as could be spared for the purpose and a detachment of the Native Establishment of the North-West Himalaya Series, containing but a limited number of trained men, I was quite unable to carry on any Secondary Operations until Mr. Blewitt had completed the work assigned to him in preparing the platforms and roads at the hill stations. The Secondary Triangulation has been confined to laying down the position of the Roorkee College, and a Minor Series in the Rúdarpur Tarái to fixed points on the edge of the forest for the Rohilkhand Revenue Survey. There exist however all the secondary points laid down in the operations of the Himalaya Series and sections of the Rangír and Pilibhít Series, of which only the principal triangles are superseded by the revised triangulation.

I beg to acknowledge having received the most cordial assistance from Mr. Peyton, who exerted himself very diligently to get the towers ready in proper time, notwithstanding the great natural impediments of the unhealthy situations of Bagwára and Baheri and an unusually wet season. After receiving charge of the party from me on the 9th February, he finished the remaining observations of the Revised Section between Dhela and Kaliánpur in a very satisfactory manner.

Thus was completed this chain of triangles, the length of which is 740 miles, and which is only 40 miles shorter than the Great Indus Series, the longest of any of the chains of the Indian triangulation that run directly from one base-line to another. As soon as was convenient after the completion of the triangulation, steps were taken to adjust the angles for the linear error generated between the two base-lines, and for the azimuthal error generated between certain stations, near the origin and the terminus of the Series, at which azimuths had been determined astronomically. A full description of the treatment to which the angles were subjected, in order to bring them into accordance with the verificatory base-lines and azimuths, is given in manuscript Volume XV of the "Trigonometrical Survey of the Peninsula of India", in the Introduction—dated 14th October 1861—which was written by Mr. Hennessey under the instructions of the then Surveyor-General, Colonel Waugh. There too will be found a statement of the discrepancies between the respective geodetic elements of latitude, longitude and azimuth, and between the side-lengths and the heights of the principal stations common to this Series and to the several meridional series closing on it, which were met with on the completion of the calculations of each series. These discrepancies were believed to be largely due to the circumstance that the initial elements of all the meridional series were derived from the triangulation of the Calcutta Longitudinal Series which had been executed—under considerable difficulties and with a very inferior instrument—during the years 1826-32, when as yet the Survey Department was unfurnished with suitable instruments for the execution of so important a chain of triangles; see page 71 of Volume II. Thus no attempt was made to proceed with further reductions of any portion of the system of triangulation now known as the North-East Quadrilateral—which comprises the Calcutta and the North-East Longitudinal Series and the whole of the chains emanating from the former and closing on the latter—until after the revision of the southern Series which was accomplished in the years 1863-69. The reduction was further postponed until the completion of that of both the North-West and the South-East Quadrilaterals, for reasons which are fully explained in Section 7 of Chapter I of Volume II. Thus it was not taken in hand until 1876, when it was commenced under the immediate supervision of Major Herschel, in accordance with the principles which are set forth in Chapter XIV of Volume II.

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The several circuits into which the chains of triangles were arranged for the final reductions of the North-East Quadrilateral were all made to close at stations appertaining to the North-East Longitudinal Series. The closing errors in Side, Latitude, Longitude and Azimuth and the portions of those errors which were thrown on the Series in the course of the final reductions, are given, the former in Section 10 and the latter in Section 18 of Chapter III of Volume VII; a full description of the method of treatment as regards the final evaluation of the linear and geodetic elements of the triangulation is given with complete numerical details in the same chapter. Here then it is only necessary to state that the heights have been checked by connection with the Spirit Leveling Operations of this Survey at twenty-one of the principal stations (specified at pages 179—$_I$ and 180—$_I$ of Volume VII); the magnitude of the errors of height which were generated in the course of the triangulation, and the methods by which they were dispersed, are set forth at pages 36 and 37 of Volume VII.

Secondary Triangulation.

The Secondary Triangulation which was executed in connection with the operations of this Series may be divided into three classes.

(1). Triangles to fix the peaks of the Himalayan mountains.

(2). Minor chains of triangles with off-shoots to fix points of importance at a distance from the principal series.

(3). Ray traces.

(1). *The Himalayan Snowy Peak Triangulation.*—The whole of the most prominent peaks on the snowy ranges situated between the meridians of 78° and 89½° were fixed by observations taken mainly at the principal stations, but partly also at auxiliary stations situated at the eastern and western extremities of the Series, *viz.*, in that portion of Sikkim which now belongs to the British Government and is known as the Darjeeling Hill Tracts, and also in the neighbourhood of Dehra Dún and Mussooree. The operations in Sikkim were executed in person by the then Surveyor General, Colonel Waugh. The observations at the hill stations, whether principal or secondary, were collaterally of much service in determining values of the coefficients of refraction to be employed in reducing the vertical observations which were made at the stations in the plains. For the mutual observations between the stations which were situated on the mountains furnished values of the coefficient of refraction which might safely be adopted in computing the heights of all the snowy peaks observed at those stations, as the atmospheric conditions to which the rays between the stations and the rays between the stations and the peaks, were subjected, were fairly similar. But in the mutual observations between the principal stations situated in the plains, which considerably preponderated over the hill stations, the rays of light grazed the surface of

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the ground, passing through an atmosphere of which the lower strata were very generally rarified by heat radiated from the surface of the ground, at the usual time for vertical observations; and this induced a refraction which was very slight in all cases, and was sometimes even negative in sign instead of positive, as in the "Observations of Terrestrial Refractions on the Plains of the Punjab", which form the subject of Appendix 3 of Volume II; on the other hand the rays of light between the principal stations and the snowy peaks passed high above the ground, and were refracted to a very much greater degree and always positively. Thus it is obvious that the values of the coefficient of refraction resulting from the mutual observations between the stations in the plains could not be employed in the reduction of the vertical angles at those stations to the snowy peaks. Consequently the heights of all the peaks which were observed at the hill stations—in Sikkim, and afterwards at the western extremity of the principal series—were regarded as fixed by the observations at those stations, and were employed in calculating the probable values of refraction in the observations to the same peaks from the stations in the plains; and then these values were employed in obtaining coefficients of refraction to be used in reducing the observations to such of the peaks as were observed only at the stations in the plains.

(2). *Other Chains of Triangles.*—Of these the most important was the triangulation to the subsidiary stations in Sikkim, at the eastern extremity of the Series, which was undertaken by the Surveyor General in person. It emanated from a base formed on the line CXVIII to CXXIII, and was executed with the largest theodolites which could be conveniently transported to the hill stations; thus Troughton's 36-inch theodolite was employed at Darjeeling, an 18-inch theodolite at Senchál and Birch hill, and a 12-inch at Tonglo, in measuring both the angles of the triangles and those to the snowy peaks.

On the western extremity of the Series auxiliary stations were fixed on the well known mountains of Nágtibba, Kidárkánta, Sirkanda &c., from which observations were taken—some by Colonel Everest when Surveyor General—to Gangotri, Jamnotri, and all the other prominent peaks of the Himalayas in this region. Observations were also taken at the hill stations of Jagesar and Khánkra, situated on the prolongation of the Rangír Meridional Series, which were principal stations of that Series as originally executed, but were omitted from the revisionary operations, probably because of the difficulty of conveying the large theodolites to them, and are now classed among the auxiliary stations.

A chain of minor triangles of which the angles were measured with a 7-inch theodolite was executed for a boundary survey of Nepal. It stretches from Station LII (Paragawa) to Station LXXXIV (Bulákípur).

A chain of first class triangulation with a 14-inch theodolite was carried, from the side Dahlelnagar (XXV of N.-E. L. S.) to Jarúra (XXXII of Amua Series), down to the town of Sháhjahánpur.

(3). *Ray Traces.*—These consist of chains of triangles which were carried over the sides of some of the principal triangles in the plains, with the primary object of enabling the direction of the lines between the stations to be exactly determined, before the 'ray cutting', as it was called, was commenced. The stations were about 2 miles apart, and were marked by a stout wooden pin, driven firmly into the ground, over which a flagstaff—usu-

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ally a long bamboo—was erected for observation. The three angles of each triangle were measured with 12-inch theodolites. The requisite directions could be and usually were computed from the triangulation, without any knowledge of the side-lengths; this could only be obtained with accuracy after the lengths of the sides of the principal triangles had been determined; see Chapter II, Part IV, of the Manual of Survey for India by Colonels Thuillier and Smyth. In the course of the execution of the ray traces, observations were taken to all visible points in the immediate neighbourhood which it might be useful to fix for topographical purposes; thus some of the ray traces became of additional importance, and the details of thirty of them, fixing about 400 points, are given in manuscript Volume XV of the Trigonometrical Survey.

It is intended to publish all necessary information regarding the results of the secondary triangulation which has been executed in connection with the operations of this Series, hereafter, in the Synoptical Volume for the Series, as is usual for all the secondary triangulation of this Survey; the preparation of that volume has however been postponed for the present, owing to a press of work of more immediate importance.

DEHRA DÚN: *November* 1881.

J. T. WALKER.

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ALPHABETICAL LIST OF STATIONS.

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ALPHABETICAL LIST OF STATIONS—(*Continued.*)

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NUMERICAL LIST OF STATIONS.

LII	Mehesari. (of Great Arc Meridional Series).
LIV	Chándípahár. (of Great Arc Meridional Series).
LVI	Ghandiál. (of Great Arc Meridional Series).
I	Mábegarh.
II	Ránígarh.
III	Girjwála.
IV	Ghungti.
V	Dhela.
VI	Sáonchália.
VII	Bagwára.
VIII	Birond.
IX	Beheri.
X	Sísgarh.
XI	Atária.
XII	Donáo.
XIII	Kalíánpúr.
XIV	Káimkhera.
XV	Umra.
XVI	Shágarh.
XVII	Semráo.
XVIII	Udepúr.
XIX	Piparía.
XX	Sultánpúr.
XXI	Karái.
XXII	Rámuápúr.
XXIII	Kokra.
XXIV	Rámnagar.
XXV	Dahlelnagar.
XXVI	Hilgi.
XXVII	Saidara.
XXVIII	Kutía.
XXIX	Asogápúr.
XXX	Daorára.
XXXI	Lákún.
XXXII	Chelúa.
XXXIII	Bela.
XXXIV	Kháñpúr.
XXXV	Mási.
XXXVI	Atkonawa.
XXXVII	Anárkali.
XXXVIII	Dadaora.
XXXIX	Tilakpúr.
XL	Newáda.
XLI	Isrápúr.
XLII	Mánícháok.
XLIII	Saibara.
XLIV	Lohápánia.
XLV	Bansídíla.
XLVI	Tulsípúr.
XLVII	Majháwa.
XLVIII	Ganespúr.
XLIX	Pipári.
L	Pathardi.
LI	Bankata.
LII	Paragawa.
LIII	Bángra.
LIV	Gháos.
LV	Púrena.
LVI	Dharamsingua.
LVII	Bharmi.
LVIII	Gharbaria.
LIX	Sáonbarsa.
LX	Bánarsi.
LXI	Bágápár.
LXII	Súpúr.
LXIII	Morairi.
LXIV	Chanda.
LXV	Mathia.
LXVI	Balúa.
LXVII	Upasai.
LXVIII	Bájra.
LXIX	Bakwa.
LXX	Rámnagar.
LXXI	Naonangarhi.
LXXII	Tarharwa.
LXXIII	Sathwária.

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NUMERICAL LIST OF STATIONS—(*Continued.*)

LXXIV	Sikta.	CI	Barháta.
LXXV	Bíarwa.	CII	Dewánganj.
LXXVI	Harnáhi.	CIII	Latona.
LXXVII	Bigoía.	CIV	Baisi.
LXXVIII	Batwaia.	CV	Minai.
LXXIX	Rúpdi	CVI	Chúni.
LXXX	Dipái.	CVII	Rámnagar.
LXXXI	Masáha.	CVIII	Manúla.
LXXXII	Sinaría.	CIX	Ghiba.
LXXXIII	Amúa.	CX	Nirpúr.
LXXXIV	Bulákípúr.	CXI	Mánikpúr.
LXXXV	Madanpúr.	CXII	Kamaldáha.
LXXXVI	Sundai.	CXIII	Bánghora.
LXXXVII	Himáonpúr.	CXIV	Dipnagar.
LXXXVIII	Pargáwa.	CXV	Músaldanga.
LXXXIX	Shápúr.	CXVI	Lachmípúr.
XC	Jirol.	CXVII	Tagría.
XCI	Chandarsanpúr.	CXVIII	Bandarjúla.
XCII	Narhar.	CXIX	Kharkhari.
XCIII	Bhería Bisanpúr.	CXX	Thákúrganj.
XCIV	Mirzápúr.	CXXI	Sonákhoda.
XCV	Barsám.	CXXII	Rámganj.
XCVI	Janjpati.	CXXIII	Dúmdángi.
XCVII	Bhela.	CXXIV	Kanchábári.
XCVIII	Ladnía.	CXXV	Chotáki.
XCIX	Semráha.	CXXVI	Newáni.
C	Harpúr.		

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NORTH-EAST LONGITUDINAL SERIES.

DESCRIPTION OF STATIONS.

LIII. Mehesari Tower Station *(for description, see Great Arc Meridional Series).*

LIV. Chándípahár Hill Station *(for description, see Great Arc Meridional Series).*

LVI. Ghandiál Hill Station *(for description, see Great Arc Meridional Series).*

I. Mábegarh Hill Station, lat. 29° 53′, long. 78° 30′, is situated on the hill of that name in the Ajmere pargana of the Garhwal district. A rude temple adjoins the station to the south. The villages of Nahli and Budholi are distant about 3 miles to the N., and the encampment of Sahor, on the road from Kotdwára, is about 9 miles off.

The pillar is solid, and 6·9 feet high. It has a mark-stone at top, and another 5·9 feet below.

II. Ránigarh Hill Station, lat. 30° 4′, long. 78° 45′, stands on the highest part of the hill of that name, in the Baraseo pargana of the Garhwal district. The adjacent places are,—the civil station of Paori, distant about 7 miles to the N.N.E.; the village of Naiáthána, about 6 miles, and the spring of Adwani, on the high-road from Kotdwára to Srínagar, about half a mile to the E.

The pillar is solid, and 2·5 feet high. It has a mark-stone at top, and another at bottom.

III. Girjwála Hill Station, lat. 29° 33′, long. 78° 45′, is built on the high peak of that name, which is one of the low range of hills that divides the Patli Doon from the Doab. It is situated in the Garhwal district. The circumjacent places, with their distances and bearings, are,—Barápúra village (in the Bijnor district), about 10 miles W.; Kálúsaiud choki, about 4 miles N.W.; Kiloli cattle sheds, about 1½ miles S., and the small village of Bhogpúr, about 4½ miles in the same direction.

The pillar is solid, and 2 feet high. It has one mark-stone at top, and another at bottom.

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IV. Ghungti Hill Station, lat. 29° 46′, long. 78° 58′, stands on the hill of Ghungti or Ghungtígarh, in the Iríagarh pargana of the Garhwal district. The circumjacent places, with their distances and bearings, are,—Samroli village, about 2 miles N.W.; Naosera village, about 4 miles, and Kimúsera village, about 5 miles distant.

The pillar is solid, and 3 feet high. It has a mark-stone at top, and another at bottom.

V. Dhela Hill Station, lat. 29° 27′, long. 79° 2′, is situated in the Kumaon district, and stands near the south-eastern extremity of the Patli Doon, on the low range of hills which divides this Doon from the plains of Rohilcund. The adjacent places, with their distances and bearings, are,—the small village of Dhela, in tahsil Kashípúr of the Moradabad district, about 2 miles to the S.E.; and the mandi or mart of Chilkia, about 10 miles in the same direction.

The pillar is solid, and 1·7 feet high. It has a mark-stone at top, and another at bottom.

VI. Sáonchália Hill Station, lat. 29° 30′, long. 79° 22′, is situated in pargana Kota, thana Kálidongi of the Kumaon district, and stands on a lofty peak in the southern range of the Sub-Himalaya mountains. The circumjacent villages, with their distances and bearings, are,—Halsan, about 6 miles to the N.E.; Kanamajot, about 7½ miles to the W., and Begni, about 5 miles to the S.S.W.

The pillar is solid, and 4 feet high. It has a mark-stone at top, and a mark engraved on the rock *in situ*.

VII. Bagwára Tower Station, lat. 28° 59′, long. 79° 22′, is situated in the Rúdarpúr pargana of the Tarai district, and stands on an elevated mound, distant about 500 yards to the N. of the village of Bagwára. The adjacent villages, with their distances and bearings, are,—Rúdarpúr about 5 miles to the E., and Lambákhera, about 2 miles to the W.

The pillar is perforated, and 38·5 feet high. It has a mark-stone at level of ground floor.

VIII. Birond Hill Station, lat. 29° 15′, long. 79° 45′, is situated in pargana Díánirao, thana Haldwáni of the Kumaon district, and stands on the southern range of the Sub-Himalaya mountains. The village of Birond is distant about 2½ miles to the N.N.E.

The pillar is solid. It has a mark-stone at top, and a mark engraved on the rock *in situ*.

IX. Beheri Tower Station, lat. 28° 52′, long. 79° 38′, is situated in pargana Rúdarpúr of the Tarai district, and stands on an eminence close to the west side of the village after which it is named. The circumjacent villages, with their distances and bearings, are,—Ajítpúr, about 1 mile S.; Bára, about ¼ of a mile E.; Ratangarh, about 3 miles S.S.W.; and Shágarh, about 8 miles S.W. The low forest of the Tarai runs within 2 miles of the village of Beheri.

The pillar is perforated, and 37·8 feet high. It has a mark-stone at level of ground floor.

X. Sísgarh Tower Station, lat. 28° 44′, long. 79° 21′, is situated in pargana Sirsáñwan, thana Dhunka, and tahsil Shai of the Bareilly district. It is in the centre of a fort, after which it is named. The fort is built on a mound, elevated about 40 feet above the level of the surrounding country. The high-road from Bareilly to Almora passes by the station. The large village of Sísgarh is situated immediately to the N.

The pillar is perforated, and 38 feet high. It has a mark-stone at level of ground floor.

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XI. Atária Tower Station, lat. 28° 38′, long. 79° 38′, is situated in pargana Richa, tahsil Jehánábád of the Bareilly district, and stands on a mound near the left or east bank of the Baigul river. The circumjacent places, with their distances and bearings, are,—the small village of Atária, about ½ a mile N.E.; Beraor village, about 2 miles S.W.; Nawábganj, a town on the Pilibhít and Bareilly road, about 8 miles S.S.E.; and the large town of Richa, about 7 miles N.N.W.

The pillar is perforated, and 37·8 feet high. It has a mark-stone at level of ground floor.

XII. Donáo Tower Station, lat. 28° 45′, long. 79° 48′, is situated in pargana Parewa, thana and tahsil Jehánábád of the Bareilly district, and stands on a low mound, said to be the site on which the village of Donáo stood. The circumjacent villages, with their distances and bearings, are,—Bára Manjilia, about 1 mile to the S.E.; Udepúr, 1·4 miles N.N.W.; Bare, 1 mile E.S.E.; Pinjára, 2·13 miles S. by W., and Omiria, 1·6 miles W. by N. The minarets of Pilibhít are visible from the tower, being distant 7·9 miles towards the S.S.E.

The pillar is solid, and 24 feet high. It contains five mark-stones, one at top, another 2 feet above the bottom, and three others at distances of 4, 10, and 16 feet respectively below the former.

XIII. Kalíánpúr Tower Station, lat. 28° 35′, long. 79° 47′, is situated in pargana Parewa, thana and tahsil Jehánábád of the Bareilly district, and stands on a mound about 15 feet high, the eastern declivity of which is occupied by the small village from which the name of the station is derived. The adjacent villages are,—Seopuri and Senjána to the N.E., and Kamaría and Dáñría to the S.W., the large village of Jehánábád being distant about 4 miles to the N.W.

The pillar is solid, and 20 feet high. It has four mark-stones, one at top, the other three placed at 2, 8, and 14 feet respectively above the level of ground floor.

XIV. Káimkhera Tower Station, lat. 28° 37′, long. 79° 55′, is situated in pargana Pilibhít of the Bareilly district, and stands on a flat piece of cultivated land almost midway between the villages of Káimkhera and Naogáoñ-Kalíánpúr. The minarets of Pilibhít are visible from the station, being distant 4·9 miles to the W. by N.

The pillar is solid, and 24 feet high. It has five mark-stones, one at top, the others at 2, 8, 14, and 20 feet respectively above the level of ground floor.

XV. Umra Tower Station, lat. 28° 29′, long. 79° 55′, is situated in pargana Bisalpúr of the Bareilly district, and stands on a low mound elevated about 10 feet above the general level of the surrounding country. The adjacent villages, with their distances and bearings, are,—Umra, about 300 yards S.S.W., and Amdar, about 0·7 of a mile S.S.E.

The pillar is solid, and 20 feet high. It has four mark-stones, one at top, the others at 2, 8, and 14 feet respectively above the level of ground floor.

XVI. Shágarh Tower Station, lat. 28° 33′, long. 80° 4′, is situated in pargana Powain of the Sháhjehánpúr district, and stands on the centre of a mound said to be the site of the ancient fort of Shágarh. The broad belt of forest which borders the Malan river approaches within ½

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of a mile of the station. The adjacent villages, with their distances and bearings, are,—Shágarh, on the eastern declivity of the mound, about 100 yards to the E., and Púranpúr, about 6 miles in the same direction.

The pillar is solid, and 20 feet high. It has four mark-stones, one at top, the others at 2, 8, and 14 feet respectively above the level of ground floor.

XVII. Semráo Tower Station, lat. 28° 23′, long. 80° 4′, is situated in pargana Powain of the Sháhjehánpúr district, and stands on a small low mound adjoining a tank. The adjacent villages, with their distances and bearings, are,—Semráo, about 1¼ miles towards the N.N.E., and Gunsíai, about 4½ miles N.E. The dense forest which borders the Kanont and Malan rivers lies about ¼ of a mile W. of the station.

The pillar is solid, and 27 feet high. It has four mark-stones, one at top, the others at 5, 13, and 21 feet respectively above the level of ground floor.

XVIII. Udepúr Tower Station, lat. 28° 29′, long. 80° 13′, is situated in pargana Powain, of the Sháhjehánpúr district. The circumjacent villages, with their distances and bearings, are,—Udepúr, about ½ a mile to the N.E. by N.; Lálpúr, about ½ a mile to the N.N.E.; and Púranpúr, about 4½ miles to the N.W.

The pillar is solid, and 22 feet high. It has five mark-stones, one at top, the others at 4, 11, 19, and 21 feet respectively above the level of ground floor.

XIX. Piparía Tower Station, lat. 28° 20′, long. 80° 13′, is situated in pargana Kothar, of the Sháhjehánpúr district, and stands on an extensive grassy plain, about midway between the Gumti and Juknía rivers. The adjacent villages, with their distances and bearings, are,—Piparía, about 0·6 miles towards the N.W. by W., and Guluria, 3·3 miles to the W.N.W.

The pillar is solid, and 25 feet high. It has five mark-stones, one at top, the others at 4, 12, 20, and 24 feet respectively above the level of the ground floor.

XX. Sultánpúr Tower Station, lat. 28° 25′, long. 80° 21′, is situated in pargana Kothar, of the Sháhjehánpúr district. The circumjacent places, with their distances and bearings, are,—Sultánpúr village, about ¾ of a mile to the S.S.E.; Seramao village, about 5 miles to the S.E., and the ruins of the ancient fortress of Mathi, 2 miles to the S.W.

The pillar is solid, and 28 feet high. It has a mark-stone at top, and two others at 5 and 13 feet respectively above the level of ground floor.

XXI. Karái Tower Station, lat. 28° 16′, long. 80° 21′, is situated in the Kothar pargana of the Sháhjehánpúr district, and stands on low ground in the midst of a dense forest. The Katna stream is not far distant to the E. The adjacent villages, with their distances and bearings, are,—Karái, about 1 mile to the W.S.W.; Nanaota, about 1¾ miles S.W., and Kothar, about 4 miles to the S.

The pillar is solid, and 26 feet high. It has five mark-stones, one at top, the others at 5, 12, 19, and 25 feet respectively above the level of ground floor.

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XXII. Rámuápúr Tower Station, lat. 28° 22′, long. 80° 31′, is situated in pargana Nighásan of the Khairábád district. The village of Pipáría is distant 1·05 miles to the S.E.

The pillar is solid, and 28 feet high. It has a mark-stone at top, and another at bottom.

XXIII. Kokra Tower Station, lat. 28° 12′, long. 80° 31′, is situated in tehsíl Haidarábád of the Mahamdi district, and stands on flat ground on the verge of an extensive jungle. The village of Kokra is distant about 1½ miles to the S.W.

The pillar is solid, and 26 feet high. It has a mark-stone at top, a second at level of ground floor, a third 2 feet below, and two others at 4 and 10 feet respectively above, this level.

XXIV. Rámnagar Tower Station, lat. 28° 17′, long. 80° 42′, is situated in tehsíl Nighásan of the Khairábád district. The Chaoka river flows about ¾ of a mile away, and the village of Rámnagar is close by to the E.

The pillar is 27·9 feet high. It has a mark-stone at top, another at bottom, and a third at 23·8 feet above the latter.

XXV. Dahlelnagar Tower Station, lat. 28° 4′, long. 80° 41′, is situated in tehsíl Alíganj of the Mahamdi district, and occupies the highest part of the mound on which the village of Dahlelnagar stands.

The pillar is solid, and 28 feet high. It has a mark-stone at top, and another at bottom.

XXVI. Hilgi Tower Station, lat. 28° 8′, long. 80° 50′, is situated in pargana Nighásan of the Khairábád district, and stands on a slightly elevated piece of ground, the site of the ancient village of Hilgi. The station is situated on the right bank of the Chaoka river, from which it is distant about 500 yards.

The pillar is solid, and 38 feet high. It has a mark-stone at top, another at bottom, and some others between.

XXVII. Saidara Tower Station, lat. 27° 58′, long. 80° 49′, is situated in pargana Kheri of the Khairábád district, and stands on the site of an ancient town elevated about 40 feet above the surrounding country. The adjacent places, with their distances and bearings, are,—Máháwáganj village, about 1 mile to the N., and Kheri, a town, about 3 miles to the S.E. The station is on the right bank of the river Ul, which, in part, forms the boundary of the Tarai.

The pillar is solid, and 22·5 feet high. It has a mark-stone at top, another at bottom, and five others at 4, 8, 12, 16, and 20 feet respectively above the latter.

XXVIII. Kutía Tower Station, lat. 28° 3′, long. 80° 58′, is situated in pargana Nighásan, of the Khairábád district, and is built on the elevated site on which the village of Kutía stands. The Ghágra, a small river which falls into the Chaoka, flows at the distance of ½ a mile to the N.E.

The pillar is solid, and 22·5 feet high. It has a mark-stone at top, another at bottom, and three others at 6, 12, and 18 feet respectively above the latter.

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XXIX. Asogápúr Tower Station, lat. 27° 53′, long. 80° 59′, is situated in pargana and tehsíl Oel of the Khairábád district, and stands on a mound elevated about 12 feet above the level of the annual inundation of the Chaoka river. The station is about 50 yards to the W. of the village of Asogápúr.

The pillar is solid, and 24 feet high. It has a mark-stone at top, another at bottom, and two others at 6 and 15 feet respectively above the latter.

XXX. Daorára Tower Station, lat. 28° 0′, long. 81° 8′, is situated in tehsíl Daorára of the Khairábád district, and stands within an old fortress in the centre of the village of Daorára. The site of the tower is elevated about 16 feet above the level of the surrounding country.

The pillar is solid, and 22 feet high. It has a mark-stone at top, another at bottom, and three others at 6, 12, and 18 feet respectively above the latter.

XXXI. Lákún Tower Station, lat. 27° 49′, long. 81° 9′, is situated in pargana Tambaor of the Khairábád district, and stands in the centre of the village of Lákún. The site of the tower is elevated about 13 feet above the level of the annual inundation.

The pillar is solid, and 24 feet high. It has a mark-stone at top, another at bottom, and two others at 2 and 8 feet respectively above the latter.

XXXII. Chelúa Tower Station, lat. 27° 56′, long. 81° 17′, is situated in pargana Isánagar of the Khairábád district, and stands between the small village of Chelúa and the Ghágra or Sárju river. It is distant about ½ a mile from the former, and some 1½ miles from the latter. The village of Isánagar is distant about 2 miles to the S.S.W.

The pillar is solid, and 24 feet high. It has a mark-stone at top, another at bottom, and two others at 8 and 16 feet above the latter.

XXXIII. Bela Tower Station, lat. 27° 47′, long. 81° 21′, is situated in pargana Mulápúr of the Khairábád district. It stands on a slightly elevated piece of ground, on an island in the Ghágra or Sárju river.

The pillar is solid, and 24 feet high. It has a mark-stone at top, another at bottom, and two others at 2 and 8 feet respectively above the latter.

XXXIV. Khánpúr Tower Station, lat. 27° 39′, long. 81° 12′, is situated in pargana Mulápúr of the Khairábád district, and stands in the centre of an old fortress within the village of Khánpúr. The site of the station is elevated about 40 feet above the level of the surrounding country.

The pillar is solid, and 12 feet high. It has a mark-stone at top, and another at midheight.

XXXV. Mási Tower Station, lat. 27° 38′, long. 81° 26′, is situated in pargana Baori of the Baráich district, and stands in the centre of the village of Mási. The site of the station is elevated about 8 feet above the level of the annual inundation. The village of Mulápúr is distant about 6 miles to the N.W., and Chalári village, about the same distance to the S.W.

The pillar is solid, and 24 feet high. It has a mark-stone at top, and two others at 3 and 8 feet respectively above the level of foundation.

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XXXVI. Atkonawa Tower Station, lat. 27° 46′, long. 81° 32′, is situated in pargana and thána Nándpára of the Baráich district, and is built on the site of a deserted village on the western extremity of the high ground bounding the kádar of the Ghágra river.

The pillar is solid, and 30 feet high. It has a mark-stone on its upper surface.

XXXVII. Anárkali Tower Station, lat. 27° 36′, long. 81° 39′, is situated in pargana, thána and district Baráich, and stands on the site of a deserted village on the western extremity of the high ground which bounds the kádar of the Ghágra river. The city of Baráich is distant about 2 miles to the S.S.W.

The pillar is solid, and 30 feet high. It has a mark-stone on its upper surface.

XXXVIII. Dadaora Tower Station, lat. 27° 43′, long. 81° 45′, is situated in pargana Nándpára of the Baráich district, and stands on the N.W. corner of an old fortress, in the lands belonging to the village of Dadaora.

The pillar is solid, and 30 feet high. It has a mark-stone on its upper surface.

XXXIX. Tilakpúr Tower Station, lat. 27° 33′, long. 81° 49′, is situated in máoza Tilakpúr, thána and tehsíl Akaona of the Baráich district, and stands on the eastern bank of a tank distant about 2½ miles to the S.W. of Kaliánpúr village. The other adjacent villages, with their distances and bearings, are,—Gilaolia, 1¾ miles E., and Bhataora, 1¼ miles N.E.

The pillar is solid, and 28 feet high. It has a mark-stone at top, and another 2 feet below.

XL. Newáda Tower Station, lat. 27° 40′, long. 81° 57′, is situated in máoza Newáda, pargana, thána and tehsíl Bhinga of the Baráich district. The circumjacent places, with their distances and bearings, are,—Bhinga, a town, about 2½ miles N.E. by N.; Kowálpúr village, about 1½ miles S.E., and Amúa village, nearly 2 miles W.S.W.

The pillar is solid, and 28 feet high. It has a mark-stone at top, and another 2 feet below.

XLI. Isrápúr Tower Station, lat. 27° 29′, long. 81° 59′, is situated in máoza Bálápúr, pargana, thána and tehsíl Akaona of the Baráich district, and stands on the site of a deserted village distant 4 miles to the S.S.W. of Akaona temple. The village of Majháwa is about 5¾ miles to the N.E. by N.

The pillar is solid, and 27 feet high. It has a mark-stone at top, and another 2 feet below.

XLII. Máníchāok Tower Station, lat. 27° 37′, long. 82° 7′, is situated in the centre of the small village of that name in pargana, thána and tehsíl of Balrámpúr, district Baráich.

The pillar is solid, and 28 feet high. It has a mark-stone at top, and another 2 feet below.

XLIII. Saibara Tower Station, lat. 27° 27′, long. 82° 8′, is situated in the district of Gonda Baráich, and stands at the N.W. angle of a square tank to the N. of the village of Saibara. The adjacent villages, with their distances and bearings, are,—Gidhuraia, about 1½ miles to the N.E., and Hasuadol, about 2·8 miles in the same direction.

The pillar is solid, and 24 feet high. It has four mark-stones, one at top, another at bottom, and other two at 8 and 16 feet respectively above the latter.

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XLIV. Lohápánia Tower Station, lat. 27° 33′, long. 82° 17′, is situated in pargana, thána and tehsíl of Balrámpúr of the Baráich district. The adjacent places, with their distances and bearings, are,—Baghaia village, about 0·7 of a mile to the S.S.W.; Sugánagar village, about 2 miles in the same direction, and Juráwandi mosque, about 3 miles to the S.E.

The pillar is solid, and 24 feet high. It has a mark-stone at top, and another 2 feet below.

XLV. Bansídíla Tower Station, lat. 27° 24′, long. 82° 19′, is situated in pargana Balrámpúr of the Gonda Baráich district. The circumjacent villages, with their distances and bearings, are,—Birádi and Kimeria, 1 mile to the N.; Kankíra, on the Rápti river, 1 mile to the W.; Misaraolia and Kusha Balrámpúr, 5 miles to the W., and Dharamnagar, 2 miles to the S.

The pillar is solid, and 20 feet high. It has a mark-stone at top, and another at bottom.

XLVI. Tulsípúr Tower Station, lat. 27° 31′, long. 82° 28′, is situated in pargana, thána and tehsíl Tulsípúr of the Baráich district, and stands on the southern bank of a river, distant about ½ a mile S. by E. of the village of Tulsípúr. The adjacent villages, with their distances and bearings, are,—Sukrámpúr, about 1·3 miles to the S.W.; Madnagar, about 1 mile to the S.S.E., and Giráháwa, about ½ a mile to the S.

The pillar is solid, and 25 feet high. It has a mark-stone at top, and another 2 feet below.

XLVII. Majháwa Tower Station, lat. 27° 21′, long. 82° 32′, is situated in máoza Majháwa, pargana, thána and tehsíl Balrámpúr of the Baráich district. The circumjacent villages, with their distances and bearings, are,—Birda, about 2½ miles to the W.; Intai, about 1 mile N., and Singárjot, about 2¼ miles to the S. by E.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another 2 feet below.

XLVIII. Ganespúr Tower Station, lat. 27° 28′, long. 82° 39′, is situated in máoza Ganespúr, pargana Baber, thána and tehsíl Panchpirwa of the Baráich district. The circumjacent villages, with their distances and bearings, are,—Bhagwánpúr, about 1¾ miles N.; Semrána, about 1½ miles S.E., and Sisowa, about ¾ of a mile to the S. by W.

The pillar is solid, and 25 feet high. It has a mark-stone at top, and another 2 feet below.

XLIX. Pipári Tower Station, lat. 27° 18′, long. 82° 42′, is situated in pargana Ratanpúr Báñsi, thána and tehsíl Báñsí, of the Goruckpúr district, and stands on the S.W. corner of an old fort in the village of Pipári. The circumjacent villages, with their distances and bearings, are,—Sihoria, about 1½ miles N.; Pirela, about 2 miles N. by E., and Semera, about 1·6 miles to the N.E. by E.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another at bottom.

L. Pathardi Tower Station, lat. 27° 26′, long. 82° 47′, stands on an elevated piece of ground, in máoza Biarwa, pargana Ratanpúr Báñsi, thána Jákub Itwa, tehsíl Báñsi, district Goruckpúr. The adjacent villages, with their distances and bearings, are,—Pathardi, about ½ a mile to the S.E. by E.; Bairchawa, about ½ of a mile to the N.E., and Semára, about 1 mile N.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another at bottom.

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LI. Bankata Tower Station, lat. 27° 16′, long. 82° 52′, stands on a slightly elevated piece of ground, in máoza Bankata, pargana Ratanpúr Báñsi, thána Jákub Itwa, tehsíl Báñsi, district Goruckpúr. The adjacent villages, with their distances and bearings, are,—Asangáwa, somewhat less than ½ a mile to the S., and Tálpúrwa, nearly a mile to the S.S.W.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another at bottom.

LII. Paragawa Tower Station, lat. 27° 24′, long. 82° 58′, is situated in máoza Paragawa, pargana Ratanpúr Báñsi, thána Tharaoli, tehsíl Báñsi, district Goruckpúr. The station stands on the ruins of an old building, and is distant about 350 yards to the N. of the village of Paragawa; the other adjacent villages, with their distances and bearings, are,—Athari, about ¾ of a mile W.S.W., and Kárídia, 1 mile N.E.

The pillar is solid, and 16 feet high. It has a mark-stone at top, and another at bottom.

LIII. Bángra Tower Station, lat. 27° 13′, long. 83° 3′, stands on the west side of the village of that name, in máoza Bángra, pargana Ratanpúr Báñsi, thána and tehsíl Báñsi, district Goruckpúr. The circumjacent villages, with their distances and bearings, are,—Kelália, about 0·6 miles W.; Gonália, about 1 mile N.W. by N., and Sikaoda, about 1¾ miles N.E.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another at bottom.

LIV. Gháos Tower Station, lat. 27° 21′, long. 83° 8′, stands on the summit of an elevated piece of ground, the site of an ancient village, in pargana Ratanpúr Báñsi, thána and tehsíl Báñsi, district Goruckpúr. The adjacent villages, with their distances and bearings, are,—Rámpúr, about 1¼ miles W.S.W., and Birdpúr, somewhat more than 2 miles N.E. by N.

The pillar is solid, and 26 feet high. It has a mark-stone at top, and another at bottom.

LV. Púrena Tower Station, lat. 27° 11′, long. 83° 13′, stands in the village of that name, in pargana Haveli Goruckpúr, thána Deopúr, tehsíl Mansúrganj, district Goruckpúr. The adjacent villages, with their distances and bearings, are,—Mandúr, about 1¼ miles S.; Rattúpúr, about 1½ miles N.E., and Pipári, about 2 miles N.

The pillar is solid, and 26 feet high. It has a mark-stone at top, and another at bottom.

LVI. Dharamsingua Tower Station, lat. 27° 5′, long. 83° 7′, is situated in pargana Báñsi of the Goruckpúr district, and stands on the bund of a tank 200 yards E.S.E. of Dharamsingua village, and 300 yards S.W. of that of Gaori-Rái.

The pillar is solid, and 25 feet high. It has a mark-stone at top, and another at bottom.

LVII. Bharmi Tower Station, lat. 27° 20′, long. 83° 18′, is situated in máoza Bharmi, pargana Benaikpúr west, thána Tharaoli, tehsíl Báñsi, district Goruckpúr. The circumjacent villages, with their distances and bearings, are,—Barwás, 0·8 miles S. by E.; Basaola, 2 miles S.W. by S.; Pikápár, about 2½ miles W. by S., and Sikári, about 3 miles W.N.W.

The pillar is solid, and 26 feet high. It has a mark-stone at top, and another at bottom.

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LVIII. Gharbaria Tower Station, lat. 27° 3′, long. 83° 18′, is situated in pargana Haveli Goruckpúr of the Goruckpúr district, and stands 50 yards within the western verge of the forest. The Gúñghi nadi flows at about 1·8 miles to the W. The village of Gharbaria, near the road from Karmeni Ghat to Máhádeoa, is distant about 80 yards to the N.W.

The pillar is solid, and 25 feet high. It has a mark-stone at top, and another at bottom.

LIX. Sáonbarsa Tower Station, lat. 27° 14′, long. 83° 24′, stands at a distance of about 200 yards from the village of that name, and is situated in máoza Porandarpúr, pargana Haveli Goruckpúr, thána Deopúr, tehsíl Mansúrganj, and district Goruckpúr. The circumjacent villages, with their distances and bearings, are,—Máhádeoa, nearly 2 miles to the E.N.E.; Jampta, 1¼ miles N.W. by N., and Kaolda, nearly 2¼ miles N.W. by N.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another at bottom.

LX. Bánarsi Tower Station, lat. 27° 19′, long. 83° 29′, stands on the site of an ancient town, situated in máoza Bánarsi, pargana Haveli Goruckpúr, thána Deopúr, tehsíl Mansúrganj, district Goruckpúr. The circumjacent villages, with their distances and bearings, are,—Barwára, nearly ¾ of a mile to the N.W. by N.; Karela, 2 miles N.W. by W.; Piprâhia, 1 mile S. by E., and Harmandil, 1¼ miles S.W.

The pillar is solid, and 16 feet high. It has a mark-stone at top, and another at bottom.

LXI. Bágápár Tower Station, lat. 27° 11′, long 83° 34′, stands on the site of a deserted village situated in máoza Bágápár, pargana Haveli Goruckpúr, thána and tehsíl Mansúrganj of the Goruckpúr district. The circumjacent villages, with their distances and bearings, are,—Bágápár, 1 mile N. by W.; Nadúa, 2 miles N.E., and Lakima, about 1½ miles S.S.E.

The pillar is solid, and 25 feet high. It has a mark-stone at top, and another at bottom.

LXII. Súpúr Tower Station, lat. 27° 18′, long. 83° 41′, stands on a slight swell of ground, situated in máoza Súpúr, pargana Tilpúr, thána Kothíbhár, tehsíl Mansúrganj, and district Goruckpúr. The circumjacent villages, with their distances and bearings, are,—Súpúr, 1¼ miles N.E. by E.; Ganespúr, nearly 1½ miles S.E. by E., and Kohorawál, nearly 2¾ miles E. by N.

The pillar is solid, and 26 feet high. It has a mark-stone at top, and another at bottom.

LXIII. Morairi Tower Station, lat. 27° 10′, long. 83° 44′, stands on a mound, elevated 15 feet above the level of the surrounding country, and situated in pargana Tilpúr, thána Kothíbhár, district Goruckpúr. The site of the deserted village of Morairi is distant about ¼ of a mile to the S.W. The circumjacent villages, with their distances and bearings, are,—Majhána, nearly 1½ miles N.W.; Rámpúr, 1 mile N., and Karmáhi, 2 miles N.E. by N.

The pillar is solid, and 15 feet high. It has a mark-stone at top, and another at bottom.

LXIV. Chanda Tower Station, lat. 27° 16′, long. 83° 51′, is situated in pargana Tilpúr, thána Kothíbhár, district Goruckpúr, and stands on the western bank of a large tank, distant about 2 miles to the N.E. of the village of Chanda, belonging to the rája of Nichlaol.

The pillar is solid, and 26 feet high. It has a mark-stone at top, and another at bottom.

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LXV. Mathia Tower Station, lat. 27° 8′, long. 83° 54′, is situated in máoza Mathia, pargana Sidhoa Jabuna, thána Nimua, and district Goruckpúr, and is distant 1¼ miles to the S.W. by W. of the village of Mathia. The adjacent villages, with their distances and bearings, are,—Langari, 1 mile to the N.W., and Phatakdaona, ¼ of a mile to the S. by E.

The pillar is solid, and 27 feet high. It has a mark-stone at top, and another at bottom.

LXVI. Balúa Tower Station, lat. 27° 14′, long. 84° 3′, stands on a swell of ground situated in máoza Balúa, pargana Majhowa, thána Bágha, and district Champáran. The station is on the outskirts of a forest which runs along the east bank of the Gandak river. The circumjacent villages, with their distances and bearings, are,—Balúa, 1¼ miles N. by E.; Bailawa, 1½ miles N.N.W., and Tulsundi, ½ a mile S.

The pillar is solid, and 20 feet high. It has a mark-stone at top, and another at bottom.

LXVII. Upasai Tower Station, lat. 27° 5′, long. 84° 4′, is situated in máoza Upasai, pargana Sidhoa Jabuna, thána Nimua, of the Goruckpúr district. The station stands on the western bank of a branch of the Gandak river which separates the Sáran from the Goruckpúr district. The circumjacent villages, with their distances and bearings, are,—Upasai, 1¼ miles S.W.; Upasai-tola, 1 mile W., and Belwanía, 2 miles W.N.W.

The pillar is solid, and 27 feet high. It has a mark-stone at top, and another at bottom.

LXVIII. Bájra Tower Station, lat. 27° 12′, long. 84° 11′, stands on the site of a deserted village, situated in máoza Bhikaolia, pargana Majhowa, thána Bágha, and district Champáran. The circumjacent villages, with their distances and bearings, are,—Dhakdhía, nearly 1 mile S. by E., and Semra, 1¼ miles W. by N.

The pillar is solid, and 20 feet high. It has a mark-stone at top, and another at bottom.

LXIX. Bakwa Tower Station, lat. 27° 3′, long. 84° 14′, is situated in máoza Bakwa, pargana Majhowa, thána Bágha, and district Champáran. The village of Bakwa is distant 0·4 of a mile to the W.S.W.; the other circumjacent villages, with their distances and bearings, are,—Mathia, rather more than ¼ of a mile to the E.N.E., and Bisambharpúr, 2¾ miles to the N.N.E.

The pillar is solid, and 20 feet high. It has a mark-stone at top, and another at bottom.

LXX. Rámnagar Tower Station, lat. 27° 9′, long. 84° 22′, stands nearly 1 mile to the S. by E. of the Rámnagar rája's house, and is situated in máoza Bela, pargana Rámnagar, thána Banjaría, and district Champáran. Bela temple is distant nearly ¾ of a mile to the W.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another at bottom.

LXXI. Naonangarhi Station, lat. 26° 59′, long. 84° 26′, is situated in máoza Marahia, pargana Majhowa, thána Betia, district Champáran, and stands on the highest part of the ruins of an ancient fortress, elevated about 82 feet above the level of the surrounding country. The village of Laoríha is distant nearly ¾ of a mile to the N.E. by E.

The pillar is solid, and 2 feet high. It has a mark-stone at top, and another at bottom.

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LXXII. Tarharwa Tower Station, lat. 27° 6′, long. 84° 33′, is situated in máoza Tarharwa, pargana Rámnagar, thána Banjaría, district Champáran, and stands on a slight swell of ground ¼ of a mile S.E. of the village after which it is named. The adjacent villages, with their distances and bearings, are,—Katgarhoa, 1 mile S.W., and Sissai, 1¼ miles to the N.E.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another at bottom.

LXXIII. Sathwária Tower Station, lat. 26° 58′, long. 84° 34′, stands on the northern bank of the Sikrana river, in máoza Sathwária, pargana Majhowa, thána Betia, and district Champáran. The circumjacent places, with their distances and bearings, are,—Sathwária village, 1 mile to the N., and Boudi-tola temple, 1½ miles to the N.W. by N.

The pillar is solid, and 25½ feet high. It has a mark-stone at top, and another at bottom.

LXXIV. Sikta Tower Station, lat. 27° 2′, long. 84° 43′, stands on the northern bank of a tank, in máoza Sikta, pargana Majhowa, thána Betia, district Champáran. The boundary between the British and Nepal territories runs 0·2 of a mile to the N. of the station, and a triple-junction boundary pillar of the Majhowa, Rámnagar and Naringa (in Nepal) parganas is 2½ miles to the W. The adjacent villages, with their distances and bearings, are,—Sikta, nearly 1¼ miles to the S.E., and Parsa, ½ a mile W. by N.

The pillar is solid, and 22 feet high. It has a mark-stone at top, and another at bottom.

LXXV. Bíarwa Tower Station, lat. 26° 52′, long. 84° 42′, stands to the west of the village of that name, and is situated in máoza Burwa, pargana Majhowa, thána Betia, and district Champáran. The adjacent villages, with their distances and bearings, are,—Gharáwa, 1½ miles to the E.N.E., and Burwa temple, about ½ a mile to the S.S.W.

The pillar is solid, and 26 feet high. It has a mark-stone at top, and another at bottom.

LXXVI. Harnáhi Tower Station, lat. 26° 56′, long. 84° 51′, is situated in máoza Harnáhi, pargana Majhowa, thána Motíhári, district Champáran, and is built on a mound occupied by the old village from which it derives its name. The circumjacent villages, with their distances and bearings, are,—Ghamaria, ¾ of a mile to the E.; Ghona, the same distance to the N.N.W., and Dánar, 1½ miles S.W. by S.

The pillar is solid, and 24 feet high. It has a mark-stone at top, and another at bottom.

LXXVII. Bigoía Tower Station, lat. 26° 46′, long. 84° 50′, stands on the south side of the village of that name, in máoza Bigoía, pargana Majhowa, thána Motíhári, and district Champáran. The circumjacent villages, with their distances and bearings, are,—Bhaonipúr, ½ a mile to the S. by W.; Masoa, ¾ of a mile to the S.E., and Harmoa, 2½ miles to the N.

The pillar is solid, and 28 feet high. It has a mark-stone at top, and another at bottom.

LXXVIII. Batwaia Tower Station, lat. 26° 50′, long. 84° 59′, stands on the west bank of a tank near the small village of Batwaia, in máoza Narkatia, pargana Majhowa, thána Motíhári, and district Champáran. The circumjacent villages, with their distances and bearings, are,—Jítpúr, 1½ miles to the S.E. by S., and Pakaria, rather more than 1¼ miles to the W.S.W.

The pillar is solid, and 18 feet high. It has a mark-stone at top, and another at bottom.

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LXXIX. Rúpdi Tower Station, lat. 26° 40′, long. 85° 0′, is situated in máoza Rúpdi, pargana Majhowa, thána Motíhári, and district Champáran. The circumjacent villages, with their distances and bearings, are,—Rúpdi, 0·4 miles to the S. by E.; Chetaona, 1¼ miles N. by W., and Malkonia, nearly the same distance to the N.W. by N.

The pillar is solid, and 25 feet high. It has a mark-stone at top, and another at bottom.

LXXX. Dipái Tower Station, lat. 26° 45′, long. 85° 8′, stands on the south-west corner of a tank bank, in máoza Dipái, pargana Simraol, thána Daka, and district Champáran. The circumjacent villages, with their distances and bearings, are,—Bádhar, 2 miles S.; Dipái, ½ mile W., and Maowai, 1 mile to the N.E. by N.

The pillar is solid, and 24 feet high. It has a mark-stone at top, and another at bottom.

LXXXI. Masáha Tower Station, lat. 26° 37′, long. 85° 11′, is situated in máoza Masáha, pargana Mehesi, thána Daka, and district Champáran. The adjacent villages, with their distances and bearings, are,—Masáha, ½ a mile N.W. by N., and Hátihaol, 1 mile to the W.

The pillar is solid, and 29 feet high. It has a mark-stone at top, and another at bottom.

LXXXII. Sinaría Tower Station, lat. 26° 45′, long. 85° 22′, is situated in máoza Karímábád, pargana Majhowa, thána Maisaora, district Champáran, and stands on the south bank of a tank, along the north bank of which runs the boundary line between the British and Nepal territories. The adjacent villages, with their distances and bearings, are,—Sinaría, a little more than ¼ of a mile to the E.N.E., and Asogi, about ¾ of a mile to the S.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another at bottom.

LXXXIII. Amúa Tower Station, lat. 26° 36′, long. 85° 19′, stands on the boundary between the Amúa and Bailwa máozas, in pargana Bábra, thána Maisaora, and district Champáran. The circumjacent villages, with their distances and bearings, are,—Amúa, 0·68 miles to the S.; Belwa, 1·15 miles to the N., and Inarwa, 1·09 miles to the N.N.E.

The pillar is solid, and 35 feet high. It has a mark-stone at top, and another at bottom.

LXXXIV. Bulákípúr Tower Station, lat. 26° 41′, long. 85° 29′, stands on the south-east corner of a tank bank, about ¼ of a mile S.W. of the village of that name, in máoza Bulákípúr, pargana Míla, thána Ríga, and district Tirhoot. The adjacent villages, with their distances and bearings, are,—Ríga, 1¾ miles S. by W., and Sonár, ¾ of a mile N.W. by N.

The pillar is solid, and 30 feet high. It has a mark-stone at top, and another at bottom.

LXXXV. Madanpúr Tower Station, lat. 26° 31′, long. 85° 29′, stands on a slightly elevated piece of ground to the west of the village of that name, and is situated in máoza Madanpúr, pargana Míla, thána Ríga, and district Tirhoot. The circumjacent places, with their distances and bearings, are as follows:—Dhúrwa village, 2·04 miles to the S.W. by W.; Chota Parsoni temple, 3·02 miles to the W.S.W.; Dhoadni village, 0·83 miles to the N.W., and Dhanga village, 0·81 miles to the N.

The pillar is solid, and 25 feet high. It has a mark-stone at top, and another at bottom.

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The adjacent villages, with their distances and bearings, are,—Batnáha, ¾ of a mile to the N.E. by E., and Bangra, rather more than 1¼ miles to the S.

The pillar is solid, and 25¾ feet high. It has a mark-stone at top, and another at bottom.

LXXXVII. Himáonpúr Tower Station, lat. 26° 29′, long. 85° 40′, stands on the southern skirt of the village of that name, in pargana Nanpúr, thána Jhála, and district Tirhoot. The village of Baloia is distant 1·4 miles to the E. by S., and that of Mádopúr, 1¾ miles to the S.W. by W.

The pillar is solid, and 21 feet high. It has a mark-stone at top, and another at bottom.

LXXXVIII. Pargáwa Tower Station, lat. 26° 34′, long. 85° 49′, stands about ½ a mile to the E. by N. of the village of that name, in pargana Basotara, thána Jhála, and district Tirhoot. The adjacent villages, with their distances and bearings, are,—Jádupati, 1¼ miles to the N.N.E., and Chandarsána, 2½ miles to the S.S.E.

The pillar is solid, and 24½ feet high. It has a mark-stone at top, and another at bottom.

LXXXIX. Shápúr Tower Station, lat. 26° 25′, long. 85° 50′, stands about ¼ of a mile to the N.W. of the village of that name, in pargana Tajpúr, thána Jhála, and district Tirhoot. The adjacent villages, with their distances and bearings, are,—Bagotipúr, nearly 1 mile W., and Rámpúr, nearly ¾ of a mile to the N.N.E.

The pillar is solid, and 24¾ feet high. It has a mark-stone at top, and another at bottom.

XC. Jirol Tower Station, lat. 26° 31′, long. 85° 58′, stands about ¼ of a mile to the S.W. of the village of that name, in pargana Bhála, thána Kanjaoli, and district Tirhoot. The adjajent villages, with their distances and bearings, are,—Baingra, about ¾ of a mile to the W., and Durgaoti, 1½ miles to the S.S.E.

The pillar is solid, and 26¾ feet high. It has a mark-stone at top, and another at bottom.

XCI. Chandarsanpúr Tower Station, lat. 26° 23′, long. 86° 1′, stands about ¼ of a mile to the S.W. of a portion of the straggling village of that name, in pargana Jarel, thána Dhanga, and district Tirhoot. The adjacent villages, with their distances and bearings, are,—Tigra, 1¼ miles to the W.N.W., and Kamálpúr, nearly ¾ of a mile to the S.E.

The pillar is solid, and 24¾ feet high. It has a mark-stone at top, and another at bottom.

XCII. Narhar Tower Station, lat. 26° 32′, long. 86° 9′, stands about 250 yards to the N.W. of the nearest portion of the long and straggling village of that name, in pargana Bachaor, thána Dhanga, and district Tirhoot. The village of Chaprári is distant 1¼ miles to the N.E.

The pillar is solid, and 25½ feet high. It has a mark-stone at top, and another at bottom.

XCIII. Bhería Bisanpúr Tower Station, lat. 26° 23′, long. 86° 11′, is situated in pargana Abti, thána Dhanga, and district Tirhoot. The station takes its name from the two villages Bhería and Bisanpúr, from the latter of which it is distant 0·4 miles to the E. The other adjacent villages, with their distances and bearings, are,—Rámkhetári, 1¼ miles to the S.E., and Kavaia, 2 miles to the N.

The pillar is solid, and 25¼ feet high. It has a mark-stone at top, and another at bottom.

XCIV. Mirzápúr Tower Station, lat. 26° 31′, long. 86° 19′, stands about 200 yards to the S. of the village of that name, in pargana Bachaor, thána Kanjaoli, and district Tirhoot. The adjacent villages, with their distances and bearings, are,—Dholakar, rather more than 1¼ miles to the S.S.W., and Juktia-atsára, 1½ miles to the S.E. by E.

The pillar is solid, and 26 feet high. It has a mark-stone at top, and another at bottom.

XCV. Barsám Tower Station, lat. 26° 21′, long. 86° 21′, stands about 1 mile to the N.E. by E. of the village of that name, in pargana Jabdi, thána Bháwára, and district Tirhoot. The village of Rudpúr is distant about ¾ of a mile to the S.E., and that of Basua, 2¾ miles to to the N.N.W.

The pillar is solid, and 25½ feet high. It has a mark-stone at top, and another at bottom.

XCVI. Janjpati Tower Station, lat. 26° 28′, long. 86° 29′, stands about ¾ of a mile to the W. of the straggling village of that name, in pargana Jabdi, thána Bháwára, and district Tirhoot. The adjacent villages, with their distances and bearings, are,—Largápati, 1 mile to tha S.S.W., and Siswar, nearly the same distance to the S.W.

The pillar is solid, and 24¾ feet high. It has a mark-stone at top, and another at bottom.

XCVII. Bhela Tower Station, lat. 26° 19′, long. 86° 31′, stands about 180 yards to the E. of the centre of the straggling village of that name, in pargana Ahlapúr, thána Bháwára, and district Tirhoot. The village of Barhámpúr is distant 2¾ miles to the N.W. by N.

The pillar is solid, and 25¾ feet high. It has a mark-stone at top, and another at bottom.

XCVIII. Ladnía Tower Station, lat. 26° 26′, long. 86° 40′, stands about 150 yards to the S.W. of the nearest portion of the straggling village of that name, in pargana Ahlapúr, thána Bháwára, and district Tirhoot. The adjacent villages, with their distances and bearings, are,—Makhára, 1¼ miles to the N.N.E., and Kusmai, 2 miles to the S.S.W.

The pillar is solid, and 24½ feet high. It has a mark-stone at top, and another at bottom.

XCIX. Semráha Tower Station, lat. 26° 16′, long. 86° 40′ stands about ¾ of a mile to the N.N.W. of the village of that name, in pargana Náràdigar, thána Supaol, and district Bhágalpúr. The adjacent villages, with their distances and bearings, are,—Sunbarsa, ¾ of a mile to the N.E., and Parsa, 1¼ miles to the N.W.

The pillar is solid, and 24·4 feet high. It has a mark-stone at top, and another at bottom.

C. Harpúr Tower Station, lat. 26° 22′, long. 86° 49′, stands about 100 yards N.E. of the straggling village of that name, in pargana Náràdigar, thána Supaol, and district Bhágalpúr. The adjacent villages, with their distances and bearings, are,—Thakia, nearly ¾ of a mile to the E.N.E., and Kabiai, ½ a mile to the W.S.W.

The pillar is solid, and 20 feet high. It has a mark-stone at top, and another at bottom.

CI. Barháta Tower Station, lat. 26° 13′, long. 86° 48′, stands 0·4 of a mile to the W. of the village of that name, in pargana Náràdigar, thána Supaol, and district Bhágalpúr. The adjacent villages, with their distances and bearings, are,—Míásambar, about 2 miles N.W. by N., and Modára, about 1¾ miles to the S.W.

The pillar is solid, and 22 feet high. It has a mark-stone at top, and another at bottom.

The adjacent villages, with their distances and bearings, are,—Thakia, nearly ¾ of a mile to the E.N.E., and Kabiai, ½ a mile to the W.S.W.

The pillar is solid, and 20 feet high. It has a mark-stone at top, and another at bottom.

CI. Barháta Tower Station, lat. 26° 13′, long. 86° 48′, stands 0·4 of a mile to the W. of the village of that name, in pargana Nárádigar, thána Supaol, and district Bhágalpúr. The adjacent villages, with their distances and bearings, are,—Míásambar, about 2 miles N.W. by N., and Modára, about 1¾ miles to the S.W.

The pillar is solid, and 22 feet high. It has a mark-stone at top, and another at bottom.

CII. Dewánganj Tower Station, lat. 26° 17′, long. 86° 57′, stands in the midst of a strip of forest at about ½ a mile to the N.W. of the village of that name, and is situated in pargana Haraot, and district Púrnea. The village of Chakla is distant 0·4 of a mile to the N.W.

The pillar is solid, and 20 feet high. It has five mark-stones, one at top, another at bottom, and the others at 6, 12, and 18 feet respectively above the latter.

CIII. Latona Tower Station, lat. 26° 7′, long. 86° 56′, stands in the midst of a strip of forest at about 1 mile N.E. of the village of that name, and is situated in pargana Nárádigar of the Bhágalpúr district. The circumjacent villages, with their distances and bearings, are,—Latona-Gádi-Hát, 1¼ miles W.; Daparka, 1 mile E.N.E., and Kasaka, 2¾ miles E.S.E.

The pillar is solid, and 26 feet high. It has five mark-stones, one at top, another at bottom, and the others at 6, 14, and 22 feet above the latter.

CIV. Baisi Tower Station, lat. 26° 25′, long. 86° 58′, stands about 1 mile to the N. of the large village of that name, in pargana Dhasowar of the Púrnea district. The Nepal boundary runs about 4 miles to the N. of the station. The adjacent villages, with their distances and bearings, are,—Ratanpúra, 1·4 miles to the N.W., and Kamálpúr, 1¾ miles in the same direction.

The pillar is solid, and 20 feet high. It has five mark-stones, one at top, another at bottom, and the others at 6, 12, and 18 feet respectively above the latter.

CV. Minai Tower Station, lat. 26° 20′, long. 87° 6′, stands at 0·6 of a mile to the S.W. of the large village of that name, in pargana Haraot, district Púrnea. The large town of Náthpúr is about 1½ miles to the E. by S. The circumjacent villages, with their distances and bearings, are,—Chápin, 2¼ miles N. by W.; Dhárára, 2½ miles N.E. by N., and Madura, 1¼ miles E. by N.

The pillar is solid, and 32 feet high. It has six mark-stones, one at top, another at bottom, and four others at 6, 14, 22, and 26 feet above the latter.

CVI. Chúni Tower Station, lat. 26° 11′, long. 87° 5′, stands about 200 yards S.E. of the hamlet of that name in the Púrnea district. The circumjacent villages, with their distances and bearings, are,—Shápúr, 1½ miles to the N.E.; Mírápati, 1½ miles to the E., and Ratansarpati, 2 miles to the S.S.E.

The pillar is solid, and 19 feet high. It has a mark-stone at top, another at bottom, and three others at 7, 13, and 18 feet respectively above the latter.

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CVII. Rámnagar Tower Station, lat. 26° 2′, long. 87° 4′, stands at ¾ of a mile N.N.W. of the village of Rhata Rámnagar, in pargana Dharampúr, of the Púrnea district. The adjacent villages, with their distances and bearings, are,—Puráni, 1 mile N. by E., and Dakária, 1¼ miles to the W.

The pillar is solid, and 20 feet high. It has five mark-stones, one at top, the others at 1 foot below, and 6, 13, and 19 feet respectively above, the level of ground floor.

CVIII. Manúla Tower Station, lat. 26° 5′, long. 87° 13′, stands about 1 mile N.N.W. of the village of Manúla-Páti, in pargana Dharampúr, of the Púrnea district. The adjacent villages, with their distances and bearings, are,—Bargonia, 1·4 miles to the S.W., and Rámganj, nearly 1¾ miles N.E. by N.

The pillar is solid, and 20 feet high. It has five mark-stones, one at top, the others at 1½ feet below, and 7, 13, and 19 feet respectively above, the level of ground floor.

CIX. Ghiba Tower Station, lat. 26° 14′, long. 87° 15′, stands about 0·3 of a mile to the N.E. of the village of that name, in pargana Haraot, of the Púrnea district. The adjacent villages, with their distances and bearings, are,—Majháwa, 1 mile N., and Pairwáha, the same distance E. by S.

The pillar is solid, and 22 feet high. It has a mark-stone at top, the others at 1½ feet below, and 7, 13, 19, and 20 feet respectively above, the level of ground floor.

CX. Nirpúr Tower Station, lat. 26° 22′, long. 87° 18′, stands on an elevated part of the right bank of a small stream called Gaoria, in pargana Sultánpúr, of the Púrnea district. The village of Nirpúr is distant about ½ a mile to the E. The circumjacent villages, with their distances and bearings, are,—Maiásiri, ¾ of a mile N. by E.; Semnagar, 2½ miles W. by S., and Pipra, nearly 3¾ miles to the E.S.E.

The pillar is solid, and 28 feet high. It has a mark-stone at top, another at bottom, and three others placed at 9, 18, and 27 feet respectively above the latter.

CXI. Mánikpúr Tower Station, lat. 26° 12′, long. 87° 24′, stands on the eastern edge of an extensive undulating tract of elevated land, situated in pargana Sultánpúr, of the Púrnea district. The circumjacent villages, with their distances and bearings, are,—Mánikpúr Bardáha, about 1 mile to the E. by S.; Madárganj, about 2¼ miles to the S.S.W., and Puran, about 3¾ miles E. by S.

The pillar is solid, and 29 feet high. It has a mark-stone at top, another at bottom, and several others intermediate.

CXII. Kamaldáha Tower Station, lat. 26° 21′, long. 87° 28′, stands on a flat piece of ground, about ¼ of a mile N.E. of the village of that name in thána Báhádúrganj, of the Púrnea district. The circumjacent villages, with their distances and bearings, are,—Balchentha, 1½ miles to the N.N.W.; Khesri, ¾ of a mile N.E., and Batráha, 3½ miles W. by S.

The pillar is solid, and 28 feet high. It has a mark-stone at top, another at bottom, and three others at 9, 18, and 27 feet respectively above the latter.

CXIII. Bánghora Tower Station, lat. 26° 13′, long. 87° 35′, stands on the north bank of

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a tank, distant about ½ a mile to the S. of the small village of that name, in pargana Sultánpúr, of the Púrnea district. The circumjacent villages, with their distances and bearings, are,—Kakuruha, 1¼ miles N.E. by N.; Chedarmi, 3¾ miles W. by S., and Relawa, 3¼ miles S.E. by E.

The pillar is solid, and 25 feet high. It has a mark-stone at top, another at bottom, and several others intermediate.

CXIV. Dipnagar Tower Station, lat. 26° 21′, long. 87° 39′, stands immediately to the W. of the small village of that name, in pargana Fatepúr Singhía, of the Púrnea district. To the north of the station, and at a distance of about 200 yards from it, is a small stream, on the opposite bank of which are the ruins of a fort called Báligarh. The circumjacent villages, with their distances and bearings, are,—Parindáha and Bhattábári, 5 miles to the S.E. and S.W. respectively.

The pillar is solid, and 28 feet high. It has a mark-stone at top, another at bottom, and three others at 9, 18, and 27 feet respectively above the latter.

CXV. Músaldanga Tower Station, lat. 26° 13′, long. 87° 45′, stands at about 50 yards to the N.W. of the small village of that name, in thána Báhádúrganj, of the Púrnea district. The large village of Majkúri Gola is distant about 2¾ miles to the S.S.W. The other circumjacent villages, with their distances and bearings, are,—Khopra, 2¼ miles W.S.W.; Haldikora, nearly 2¾ miles E.S.E.; and Ruponi, 1¾ miles N. by W.

The pillar is solid, and 28 feet high. It has a mark-stone at top, another at bottom, and three others at 9, 18, and 27 feet respectively above the latter.

CXVI. Lachmípúr Tower Station, lat. 26° 22′, long. 87° 51′, is situated in thána Báhádúrganj, of the Púrnea district. The southern of two villages, named Lachmípúr, on the right bank of the Ratwa, is distant about ½ a mile to the W., and the large village of Dálibhát stands on the other bank of the river, just opposite to Lachmípúr. The other adjacent villages, with their distances and bearings, are,—Patargháti, 2¼ miles W. by N., and Kúlri, 3 miles S.W. by S.

The pillar is solid, and 26 feet high. It has a mark-stone at top, another at bottom, and three others at 8, 16, and 25 feet respectively above the latter.

CXVII. Tagría Tower Station, lat. 26° 13′, long. 87° 56′, is situated in thána Báhádúrganj of the Púrnea district. The southern of two small villages, named Tagría, on the banks of a small nala, is distant about ½ a mile to the S.W., and about 200 yards further on to the E. is the Baríkankai river. The village of Gangi Sáhibganj is distant a little more than ¼ of a mile to the E. by N.

The pillar is solid, and 22 feet high. It has a mark-stone at top, another at bottom, and three others at 7½, 12, and 21 feet respectively above the latter.

CXVIII. Bandarjúla Tower Station, lat. 26° 22′, long. 88° 0′, stands on the northern of two contiguous mounds, distant about ¼ of a mile to the S.S.W. of the southern of two villages, named Bandarjúla, and is situated in thána Kalíáganj, of the Púrnea district. The other adjacent villages, with their distances and bearings, are,—Terhari, ½ a mile to the S. by E., and Pokhar, 1¾ miles to the N.W.

The pillar is solid, and 18 feet high. It has a mark-stone at top, another at bottom, and two others at 6 and 17 feet respectively above the latter.

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CXIX. Kharkhari Tower Station, lat. 26° 14′, long. 88° 5′, is situated in thána Kishanganj, of the Púrnea district. The large village of Kharkhari lies about 1 mile to the N.N.W., and stands between the Máhánada and Doñk rivers, the former of which is about half a mile, and the latter 250 yards, distant from it. The circumjacent villages, with their distances and bearings, are,—Jehángírpúr, 3 miles S.E. by E., and Dhántola, 5¾ miles in the same direction.

The pillar is solid, and 30 feet high. It has a mark-stone at top, another at bottom, and three others at 10, 20, and 29 feet respectively above the latter.

CXX. Thákúrganj Tower Station, lat. 26° 25′, long. 88° 10′, stands on the edge of some high land, distant about 200 yards to the S. by W. of the small deserted village of Thákúrganj, and is situated in thána Kalíáganj, of the Púrnea district. The town of Kalíáganj is about 2 miles to the S.; the village of Barri Patesri is 1·1 miles towards the S.E. by S., and that of Bhaispára about 1¾ miles towards the W.N.W.

The pillar is solid, and 10 feet high. It has mark-stones at top, bottom and intermediately.

CXXI. Sonákhoda Tower Station, lat. 26° 15′, long. 88° 15′, is situated in thána Kalíáganj of the Púrnea district, and stands at a distance of 200 yards to the N. of the village of Sonákhoda, and close to a cart road leading to Kishanganj. The village of Hátgáon is about 3 miles towards the S.W.; Páhárkáta, nearly 5 miles to the W. by S., and Gernábári, about 2½ miles nearly due west.

The tower at this station is entirely of masonry, 24 feet high and 14 feet square at top, and as it marks the S.W. extremity of a base-line, its construction is adapted to that purpose by means of a vaulted passage running through it, on a level with the ground, in the direction of the base-line. In the centre of the tower, on the floor of the vaulted passage, is a small piece of brass on which the station mark is cut, and this mark has been transferred to the top of the tower by means of a hole in the vault, and the pillar raised above it for the theodolite. This pillar is built on the vault of the passage, and is separated by a small annular space from the rest of the building so as to be isolated from it. When all the observations had been taken at this station, the two ends of the vaulted passage were closed with masonry, and a cone of masonry 3 feet high was built on the top of the tower over the theodolite pillar. The distance between the upper mark on the top of the pillar, and the mark on the floor of the vaulted passage is 21·6 feet. A flight of steps is built along one side of the tower with a landing place at top, the portion which adjoins the tower being of masonry like it, but the lower part which projects beyond it was of mud, and was removed after the observations had been all taken, so as to prevent idle people gaining access to the top.

CXXII. Rámganj Tower Station, lat. 26° 19′, long. 88° 20′, is situated in thána Kalíáganj of the Púrnea district, and stands close to the S.W. side of the village of Rámganj. The village of Ghágra, is about 1¼ miles towards the S.S.E., and that of Manikpúr about 1½ miles nearly due W.

The station is marked in the same manner as Sonákhoda Tower Station, with the difference that the height of the tower here is 20 feet above the surface of the ground, and the distance between the upper and lower marks is 18 feet.

CXXIII. Dúmdángi Tower Station, lat. 26° 29′, long. 88° 20′, is situated in thána Kalíáganj of the Púrnea district, and stands on the western extremity of some high land which extends to the eastward of the station, and has a command of about 60 feet over the country to the south, and 30 feet over that to the west. The river Máhánada flows at a distance of 250 yards, and the village of Jagarchi lies about 200 yards to the S.W. of the station. The other circumjacent villages, with their distances and bearings, are,—Sítalghati, 1½ miles to the S.W.

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by W.; Patargácha, nearly 1 mile towards the N.N.W., and Púrangácha, about 1¼ miles towards the E.N.E.

The pillar is solid, and 10 feet high. It has a mark-stone at top, and another at bottom.

CXXIV. Kanchábári Tower Station, lat. 26° 28′, long. 88° 28′, is situated in thána Kalíáganj of the Púrnea district, and stands near the S.E. extremity of the same high land on which Dúmdángi Tower Station is built. The small village of Kanchábári lies at a distance of 70 yards to the S.; Khotágách, at about 50 yards towards the N. by E., and Rátígách, about 1 mile to the W.N.W.

The tower is solid, 60 feet square at base, 14 feet square at top, and 20 feet high. It has an isolated central paka pillar for the theodolite to rest on, with markstones at top, bottom and intermediately.

CXXV. Chotáki Tower Station, lat. 26° 11′, long. 88° 23′, is situated in thána Thákúrgáon of the Dinájpore district, and stands on the north bank of a tank distant about ¼ of a mile to the N. of the village of Chotáki, and half a mile S. of Bunágáon.

The pillar is solid, and 23 feet high. It has mark-stones at top, bottom and intermediately.

CXXVI. Newáni Tower Station, lat. 26° 16′, long. 88° 32′, is situated in thána Boda or Kaonrikot of the Rungpore district, and stands at the N.W. corner of a tank distant about ½ of a mile to the N.W. of the principal portion of the straggling village of Jholai. Newáni is the name of the locality in which the station is placed. The circumjacent villages, with their distances and bearings, are,—Dúngápára, about half a mile to the W.; Ghogochodi, about 1¼ miles to the N.E. by N., and Kúlúganj, 1¾ miles towards the S.S.E.

The pillar is solid, and 24 feet high. It has mark-stones at top, bottom and intermediately.

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NORTH-EAST LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. ADDENDUM TO DESCRIPTION OF STATIONS.

Note.—Consequent on modern alterations of district and other boundaries, the sites occupied by the stations are in some instances now included in civil divisions of territory which differ from the district, pargana, or village, recorded in the preceding descriptions of stations: a complete list of all the stations of the series including a suitably modified statement of the altered subdivisions in question is accordingly given in the following table, and is derived chiefly from the annual reports, up to 1881, made by the Civil Officials to whose care the stations have been committed. The statement also gives additional information as to position, construction, and present condition of certain of the stations; where no entry regarding present condition is made against a station it is to be assumed that the station when last reported on by the district Official was in good order.

The spelling of names is in accordance with that given in the lists of more important places published under the orders of Government whenever such names occur in the lists.

No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
LII	...	Bijnor	Tah. Bijnor, P. Mandáwar	Mahesari	miles Mandáwar S. S. W. 1¼ Sháhbazpur W. 1¼ Ratanpur Raiya N. N. W. ¾ Kíratpur (town) E. 3	The station consists of a tower of unburnt bricks and mud cement, 14 feet square at top, enclosing a central, isolated pillar of masonry 13·5 feet high and 3½ feet in diameter at top, which is solid to a height of 12 feet above ground level and perforated thereafter: it has a mark-stone at the level of the ground, and others at 7 and 12 feet respectively above this level. The station of 1843—which was 12 feet in height—was revisited in 1851 in the course of the operations of the North-East Longitudinal Series, when the masonry pillar was found in good order and the upper mark-stone undisturbed. When again visited in 1865-66 in connection with the Great Arc Meridional Series, Section 24°—30°, the pillar and upper mark-stone were found in good preservation: on this occasion the height of the pillar was raised to 13½ feet, but no mark-stone was placed at its summit, a hollow cylindrical space, 4 inches in diameter, having been left for reference to the old mark-stone. Reported as greatly injured by the heavy rains of 1881.
LIV	...	Bijnor	Tah. and P. Najíbabad	Chándi	Shámpur S. 4	The platform is built of stones and earth. It was considerably damaged by a land slip, and one side of the pillar has given way, as reported in 1870.
LVI	...	Tehri (Foreign Garhwál)	Thá. Bhogpur	On waste land	... ...	The pillar is isolated and enclosed in a platform of stones and earth 14 feet square.

Note.—Stations LII, LIV and LVI appertain to the Great Arc Meridional Series, Section 24° to 30°. P. stands for pargana, Tah. for tahsíl, and Thá for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
I	...	Garhwál	P. Ganga Salán, Patti Ajmir	Nahli-Badholi	miles Simalna S. 2 Shalni W. by S. 1½ Badholi N. N. E. 1¾ Mahera S. S. E. 1⅓	The station consists of a platform of stones and earth, 14 feet square at top, enclosing a central, isolated pillar of masonry which has a mark-stone at 1 foot above ground level, and another at summit. The original station of 1842-43 which was common to the Budhon Meridional and the North Connecting Series—was revisited in 1850 in the course of the operations of the North-East Longitudinal Series, and again in 1865 to originate the Kumaun and Garhwál Survey; on neither of these occasions was any alteration made in the construction of the station. A portion of the masonry given way, as reported in 1878.
II	Adwáni	Garhwál	P. Barasiún, Patti Patwalsiúm	Gidrásu Bania-gaon	Gidrásu E. S. E. 1⅓ Dungra S. S. E. 1¾ Sutar S. S.W. 1¾	The pillar is isolated, 3⅓ feet in diameter, and is enclosed in a platform of stones and earth 14 feet square.
III	...	,,	P. Tallásalán, Patti Bhábar	...	Kálusaiyyid W. N. W. 2⅓ Kálagarh S. E. 5 Gotkolari S. W. 2½	The pillar is isolated, 3⅓ feet in diameter, and is enclosed in a platform of stones and earth.
IV	...	,,	P. Mallasalán, Patti Iriakot	Samroli	Iriakot N.N.W. 1⅓ Páli W. by S. 2½ Dhangalgaon E. 1⅔	The pillar is isolated, 3⅓ feet in diameter, and is enclosed in a platform of stones and earth 14 feet square.
V	...	Kumaun	P. Kota, Thá. Rámnagar	Dhela	Dhela S. by E. 1¾ Sawaldi S. E. 4½ Rámnagar E.S.E. 8¾	Ditto.
VI	...	,,	P. Kota, Thá. Káladhúngi	Bagni	Halsán N. E. by N. 3 Bismoli N. W. 4½ Bagni S. 2½	There is no pillar, the platform is solid.
VII	...	Tarái	P. and Thá. Rudarpur	Bagwára	Saiduliganj N. W. 1½ Chandain S. 1¾ Kulerah E. 2	The pillar is isolated and enclosed in a tower of sun-dried bricks to within 4 feet of the summit; an arched passage gives access to the ground level mark. In 1866 Mr. W. Ivey, Assistant Surveyor, found the tower partly washed down and bricks extracted from the central pillar through the open archway; he raised a conical pile over the pillar and closed the arched passage.
VIII	...	Kumaun	P. Dhianirau, Thá. Haldwáni	Birond	Chamli N.E. 2⅓ Babiar N.W. by N. 3 Udua W.S.W. 3½	... ...
IX	...	Tarái	P. and Thá. Rudarpur	Baheri	Ajitpur S. by E. ½ Bara E. by N. ½ Ratangarh S.W. 2¾	The pillar is isolated and enclosed in a tower of sun-dried bricks; an arched passage gives access to the ground level mark. In 1866 Mr. W. Ivey, Assistant Surveyor, found the tower washed down, the central pillar cracked horizontally at 7½ feet from top and the upper portion shifted 7 inches to S.E. He closed up the arched passage and raised a pile of kacha masonry all round the base to a height of 30 feet.

NOTE.—P. stands for pargana and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
X	...	Bareilly	P. Sirsáwán	Sísgarh	miles Ghulámganj W. S. W. 1½ Bísalpur E.S.E. 1 Girdhárpur S. ¾	The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central perforated pillar of masonry whose summit is 38·0 feet above the mark-stone: the latter is 2 feet higher than the level of the ground. The station of 1839 was a perforated masonry column standing 38·3 feet above the mark-stone, 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter; the column, when revisited in the course of the operations of the North-East Longitudinal Series, was found to be so deflected as to necessitate the dismantling of a considerable portion of it; it was then rebuilt to its present height and enclosed in a kacha tower—the upper 5 feet of it being isolated therefrom: at the same time a second mark 1·8 inches N.W. by W. of the former one was cut on the original mark-stone.
XI	...	Bareilly	P. Richha	Atária	Town of Richha N. W. 6 Nawábganj S. S. E. 6¾ Jahánabad E. 8	The station consists of a tower of unburnt bricks and mud cement, about 14 feet in diameter at top, enclosing a central perforated pillar of masonry whose summit is 37·8 feet above the mark-stone: the latter is 2 feet higher than the level of the ground. The station of 1839 was a perforated masonry column 37·3 feet above the mark-stone, 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter; the column was found greatly deflected when the observations on the Rangír Meridional Series came to be made, so that the mark-stone in the basement could not be plumbed from the summit of the pillar; the point of observation was indicated by the intersection of the diagonals of a quadrilateral, each angular point of which was denoted by a dot engraved on an iron bolt imbedded in an external masonry pillar built in the adjacent fields. When the station was revisited in 1843 in the course of the operations of the North Connecting Series, the pillar was found still further deflected, and no trace of the four external pillars was forthcoming; the instrument was accordingly plumbed over a mark engraved on a new mark-stone let into the basement. On again visiting the station in 1851 in the course of the operations of the North-East Longitudinal Series, it was found necessary to dismantle a considerable portion of the pillar, which was then rebuilt to its present height and enclosed in a kacha tower: at the same time a second mark 3·5 inches W. N. W. of the mark of 1843 was engraved on the mark-stone of that year.
XII	Bara Danwán	Pilibhít	P. Jahánabad	Bara Danwán	... ...	The pillar is isolated and enclosed in a circular kacha tower 18 feet in diameter at top.
XIII	...	„	Tah. Pilibhít	Kaliánpur	Khamaria W. by N. 2 Jahánabad N. N. W. 3½ Nawábganj (on road Bareilly to Pilibhít) W. S. W. 7½	The pillar is isolated and enclosed in a circular tower of sun-dried bricks.
XIV	...	„	...	...	Káim N. W. 1½ Santokhpura (on road from Pilibhít to Púranpur) S. W. 1½ Sardha S. E. by S. 2	The pillar is isolated and enclosed in a circular tower of sun-dried bricks. Reported in 1867 as fallen down and now merely a heap of debris.
XV	...	„	P. Bísalpur	Omrakhán Singh	Rámnagar E. S. E. 3 Sohan N. E. 2½	The pillar is isolated and enclosed in a paka tower.

NOTE.—P. stands for pargana and Tah. for tahsil.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
XVI	...	Pilibhít	P. Púranpur	Sháhgarh	Púranpur S. E. by E. 7¾ Mádho Tánda N. E. 7	The pillar is isolated and enclosed in a paka tower.
XVII	Simraia	„	...	Simraia	Kasganja E. 2¾ Deoria W. by S. 6½	The pillar is isolated and enclosed in a kacha tower.
XVIII	...	„	...	Udepur	Púranpur N. W. 3¼ Jitpura E. N. E. 3½	Ditto.
XIX	Rámpur	Sháhjahánpur	Tah. Pawáyan, P. Khutár	Rámpur	Dundwa S. by E. 1¼ Gutia E. 1½	The pillar is isolated and enclosed in a kacha tower. Reported as much injured by the heavy rains of 1879.
XX	...	„	Ditto.	Sultánpur	Gopálpur W. by N. 2¼ Chatipur N. W. 1½	Ditto.
XXI	Hirpur	„	Ditto.	Hirpur	Chándpur N. 3½ Khutár S. S. W. 4¾ Damodarpur N. E. by N. 2¾	The pillar is isolated and enclosed in a circular kacha tower. Reported as much injured by the heavy rains of 1879.
XXII	Piparia	Kheri	P. Bhúr, Tah. Lakhímpur, Thá. Bhira	...	Bhira S. by E. 2¾ Jankapur S. by E. 1 Nagria N. E. 1½	The pillar is isolated, 6 feet square at base and 3½ feet in diameter at top, and is enclosed in a square kacha tower supported by wooden posts and branches of trees.
XXIII	Kokra	„	Tah. Muhamdi, P. Haidarabad	...	Gauri E. by S. 2½ Hardua W. 2 Khamaria S. 1½	The station was constructed in 1833 for the Amua Meridional Series as a tower of sun-dried bricks and mud cement, 25 feet in height, with two mark-stones, one 2 feet below the level of the ground, the other at the surface of the tower. The upper mark-stone was found wanting, and the tower in a dilapidated condition when visited in 1843, in the course of the operations of the Pilibhít Tarái Series. The old structure was then dismantled to the level of the lower mark, and a new tower 26 feet high constructed, with an isolated central paka pillar which contained mark-stones at distances of 2, 6, 12, 18, 24, 27, and 28 feet, respectively, above the lowest mark-stone. When the station was subsequently visited in 1850, in the course of the North-East Longitudinal Series, the upper portion of the pillar and tower were found to have been destroyed. The structure was again dismantled to within 10 feet of the surface of the ground, and a mark-stone having been found there, it was used as a centre over which a new pillar, with an earthen tower around it, was constructed to the height of 26 feet above the level of the ground, which carried a mark-stone at its surface placed in the normal of the lower mark. Pillar partly fallen down, as reported in 1871.
XXIV	...	Kheri	Tah. Lakhímpur, P. Bhúr	...	Bijua W. by S. 3 Gauri E. 1¼ Khánpur N. N. W. 2½	The pillar is solid and isolated, 3½ feet in diameter at top, and is enclosed in a circular kacha tower 18 feet in diameter at top.
XXV	...	„	Tah. Lakhímpur, P. Aliganj	...	Bhúrpur S. W. 1½ Aliganj N. W. 4 Khánpur E. N. E. 1	The central pillar as constructed about the year 1838, was enclosed in a tower of sun-dried bricks and mud cement. It was found in good preservation when visited in 1850 in the course of the operations of the North-East Longitudinal Series. Pillar partly fallen down, as reported in 1871.

NOTE.—P. stands for pargana, Tah. for tahsíl, and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
XXVI	Halgi	Kheri	Tah. Lakhímpur, P. Bhúr	...	Srinagar S. 2½ Basaha S. W. 1¼ Gangapur N. E. 1½	The pillar was isolated and enclosed in a kacha tower. Washed away by the river Chauka in 1869.
XXVII	Sideri	"	Tah. and Thá. Lakhímpur, P. Kheri	...	Lakhímpur S. by E. 1½ Kheri S. S. E. 4½	The pillar is isolated and enclosed in a kacha tower. Partly fallen down as reported in 1869.
XXVIII	...	"	Tah. Lakhímpur, P. Srinagar, Thá. Dhaurahra	...	Udara E. 2¼ Bel S. W. ¾ Jamunhia N.W. 1¾	The pillar is isolated and enclosed in a kacha tower.
XXIX	...	"	Tah. and Thá. Lakhímpur, P. Kheri	...	Atkona N.N.W. 4 Sakethu N. E. 4½	Ditto.
XXX	...	"	Tah. Nighásan, P. and Thá. Dhaurahra	...	Kufara N.N.W. 5½ Matera N. E. 7½	Ditto.
XXXI	...	"	Tah. Nighásan, P. and Thá. Dhaurahra	...	Parsia N. by W. 1 Fatehpur S. W. ½ Nidaura E. 2½	Ditto.
XXXII	...	"	Tah. Nighásan, P. Firozabad, Thá. Dhaurahra	...	Bírsinghpur S. S. W. 4 Isanagar S. W. 3¼ Palha W. S. W. 2½	The pillar is isolated and enclosed in a kacha tower supported by strong posts and earth. Pillar partly fallen down as reported in 1871.
XXXIII	...	Bahraich	Tah. Nánpára, Taluka Mallapur	Patak Purwa	Firozabad N. W. 4 Benda E. by S. 4½ Belamohan S.E. 1	The pillar is isolated and enclosed in a kacha tower supported by wooden posts. Reported in 1878 as being only 11 feet high.
XXXIV	...	Sitapur	Tah. Biswán, P. Kundri, Thá. Tambaur	Khánpur	Seota S.E. by S. 4 Sikri N. 1 Zálimpur S. W. 3¼	The station consists of an earthen tower—with diameters at top and bottom, respectively, of 13 and 17 feet—enclosing a central, solid pillar of masonry having mark-stones at 6 and 12 feet, respectively, above the base. The station of 1844 was revisited in 1845, at the conclusion of the Karára Meridional Series, and was then apparently found in good preservation. It was again visited in 1850 in the course of the operations of the North-East Longitudinal Series; the mark-stone and pillar having been found intact, it was only necessary to repair the earthen tower.
XXXV	...	Bahraich	P. Fakhrpur, Thá. Sisia	Masi	Pachdeori N. W. 4 Sisia S. S. W. 5 Rewamansúr E. S. E. 4½	The station consists of an earthen tower—with diameters at top and bottom, respectively, of 18 and 40 feet—enclosing a central, solid pillar of masonry having mark-stones at 3, 8, and 24 feet, respectively, above the base. The station of 1844—which had the surrounding tower with diameters at top and bottom, of 11 and 18 feet—was revisited in 1845 at the conclusion of the Karára Meridional Series, and was then apparently found in good preservation. It was again visited in 1849 in the course of the operations of the North-East Longitudinal Series; the mark-stone at summit and the upper 4 or 5 feet of the central pillar, which were then found removed, were replaced, and the surrounding tower extended to its present dimensions.

NOTE.—P. stands for pargana, Tah. for tahsíl, and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
XXXVI	Atkanna	Bahraich	Tah. and P. Nánpára	Aswa Muhamad-pur	Asua S.E. 1½ Intuha S. W. 3½ Matera Kalán W. by N. 6	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 14 feet square at top.
XXXVII	...	"	Tah. and P. Bahraich	Ratnapur	Singhapurási S.E. by S. 1 Bakshiganj S. 1½	Ditto.
XXXVIII	...	"	Tah. and P. Nánpára	Dadaura	Madewa E.N.E. 3½ Phulwaria S.S.E. 1½ Ramuapur W. by N. 3	Ditto.
XXXIX	...	"	Tah. Bahraich, P. Ikauna	Tilakpur	Subkha E. by N. 2½ Kamaulia W. S. W. 1	The pillar is isolated, 6½ feet square at base and 3¾ feet in diameter at top, and is enclosed in a kacha tower 18½ feet square at base and 14 feet at top.
XL	...	"	Tah. Bahraich, P. Bhinga	Newáda	Naubasta S. by E. 3¼	The pillar was isolated, 6½ feet square at base and 3¾ feet in diameter at top, and was enclosed in a kacha tower 20 feet square at base and 14 feet at top. Washed away by the river Rápti in 1877.
XLI	...	"	Tah. Bahraich, P. Ikauna	Isrápur	Bálapur W. 1 Lalitnagar N. ¾	The pillar is isolated, 6½ feet square at base and 3¾ feet in diameter at top, and is enclosed in a kacha tower 20 feet square at base and 14 feet at top.
XLII	...	Gonda	Tah. Utraula, P., Taluka and Thá. Balrám-pur	Manichauk	Arnahwa W. by N. ½ Chatauni N. by E. 1¼ Amarnagar S.E. 1¼	Ditto.
XLIII	Sabaira	"	Tah. Utraula, P. and Thá. Bal-rámpur	Sabaira	Sekharpur Gan-gapur E. 2¼ Balrámpur E. by S. 6	The station as built in 1847 consists of an earthen tower enclosing a central, isolated pillar of masonry. When again visited in 1849, in the course of the North-East Longitudinal Series operations, no alteration in its construction appears to have been made.
XLIV	Lohápania	"	Tah. Utraula, P., Taluka and Thá. Balrám-pur	Lohápania	Sáhebnagar E. by S. ¼	The pillar is isolated, 6½ feet square at base and 3¾ feet in diameter at top, and is enclosed in a kacha tower 14 feet square at top.

NOTE.—P. stands for pargana, Tah. for tahsíl, and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
XLV	Básadela	Gonda	Tah. Utraula, P., Taluka and Thá. Balrámpur	Básadela	Tendua N. E. 1 Fatehjot W. 1½	The station as built in 1847 consists of an earthen tower enclosing a central, isolated pillar of masonry which has a mark-stone at top, another at bottom, and others at 7 and 13 or 14 feet, respectively, above the latter. When again visited in 1849, in the course of the North-East Longitudinal Series operations, no alteration in its construction appears to have been made.
XLVI	...	Gonda	Tah. Utraula, P., Taluka and Thá. Tulsipur	Tulsipur Khás	Pátan N. W. 2 Tulsipur N. 1½	The pillar is isolated, 6½ feet square at base and 3¾ feet in diameter at top, and is enclosed in a kacha tower 20 feet square at base and 14½ feet at top.
XLVII	...	„	Tah. and Thá. Utraula, P. and Taluka Balrámpur	Majhawa	Pipra N. by E. 2 Utraula S. W. 5	The pillar is isolated, 7 feet square at base and 3¾ feet in diameter at top, and is enclosed in a kacha tower 20 feet square at base and 14 feet at top.
XLVIII	...	„	P., Taluka and Thá. Tulsipur, Tah. Utraula	Ganespur	Panchpirwa N. E. by N. 4 Budhi S. 5¾	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet square at base and 14½ feet at top.
XLIX	...	Basti	Tah. Domariaganj, P. Bánsi, Thá. Tilakpur	Pipri Buzurg	Chaukuda S. 3½ Hír N. N. E. 3½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha-paka tower 20 feet square at base and 14 feet at top. No upper mark-stone found in 1867.
L	...	„	Tah. Domariaganj, P. Bánsi, Thá. Dhebarua	Pathárdaghi	Dhebarua E. N. E. 3½	Ditto.
LI	...	„	Tah. Domariaganj, P. Bánsi, Thá. Misraulia	Bankata	Pacher S. S. E. 1¾ Karhi S. W. 3½	Ditto.
LII	...	„	Tah. and P. Bánsi, Thá. Chilhia	Pairagwa	Chilhia S. E. 5	Ditto.
LIII	...	„	Ditto.	Tigra	Kundri W. N. W. 4¼ Bánsi S. W. 5½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha-paka tower 20 feet square at base and 14 feet at top. Upper part of the masonry pillar broken and mark-stone missing, as reported in 1867.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
LIV	...	Basti	Tah. and P. Bánsi, Thá. Chilhia	Ghaus Khás	Shiupur N. W. by N. 2 Dargudewa S.E. 5	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha-paka tower 20 feet square at base and 14 feet at top.
LV	...	Gorakhpur	Tah. Maharájganj, P. Haveli, Thá. Semra	Púrena	Menkhai N. W. 1½ Bhirewa S. W. by W. 1½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha-paka tower 20 feet square at base and 14 feet at top. Greater portion of the tower fallen down, only about 6 feet of it standing, and no mark-stone found, as reported in 1867.
LVI	...	Basti	Tah. and P. Bánsi, Thá. Májhra	Dharamsingua	Sapti W. 1 Fatehpur N. W. 1½ Jamia E. by S. 2½	The station as built in 1847 consists of a solid tower, 20 feet square at base, 14 feet at top, and about 25 feet high, enclosing a central, isolated pillar of masonry which contains mark-stones. When again visited in 1849, in the course of the North-East Longitudinal Series operations, it was found in good preservation, and no alteration in its construction appears to have been made.
LVII	...	Basti	Tah. Bánsi, P. Bináyakpur, Thá. Lotan	Bharmi	Lotan S. 3½	The pillar is isolated and perforated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha-paka tower 20 feet square at base and 14 feet at top. Upper portion of the central pillar much broken, and mark-stone missing, as reported in 1867.
LVIII	...	Gorakhpur	Tah. Maharájganj, P. Haveli, Thá. Ragauli	Gharbaria	Ragauli S. W. 2½	The station as built in 1847 consists of a solid tower, 20 feet square at base, 14 feet at top, and about 25 feet high, enclosing a central, isolated and perforated pillar of masonry which contains mark-stones. When again visited in 1849, in the course of the North-East Longitudinal Series operations, it was found in good preservation, and no alteration in its construction appears to have been made. Part of the tower injured, and no mark-stone found, as reported in 1867.
LIX	...	Gorakhpur	Tah. Maharájganj, P. Haveli, Thá. Semra	Púrandarpur Saunbarsa	...	The pillar is isolated and perforated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha-paka tower 20 feet square at base and 14 feet at top. Part of the tower injured, and no mark-stone found, as reported in 1867.
LX	...	"	Tah. Maharájganj, P. Haveli, Thá. Sirsia	Banarsia	Sirsia N. N. E. 5½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha-paka tower 20 feet square at base and 14 feet at top. Part of the tower injured, and no mark-stone found, as reported in 1867.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
LXI	...	Gorakhpur	Tah. and Thá. Maharájganj, P. Haveli	Bágápár	miles Rámpur S. E. 1½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha-paka tower 20 feet square at base and 14 feet at top. Part of the tower injured, and no mark-stone found, as reported in 1867.
LXII	...	"	Tah. and Thá. Maharájganj, P. Tilpur	Sehpur	Chauk S. W. 5¼ Nichlaul E. by N. 5¼	Ditto.
LXIII	...	"	Tah. Maharájganj, P. Tilpur, Thá. Kothibhár	Morairi	Kothibhár S. E. by E. 4¾	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 17 feet square at base and 14 feet at top. Part of the tower injured, and no mark-stone found, as reported in 1867.
LXIV	...	"	Tah. Maharájganj, P. Tilpur, Thá. Nichlaul	Jelda	Doma N. by W. 2 Basodi S. W. 2½ Baja N. W. 2½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet square at base and 14 feet at top. Part of the tower injured, and no mark-stone found, as reported in 1867.
LXV	...	"	Tah. Parauna, P. Sidhua Jobna, Thá. Kothibhár	Mathia	Kardah N. E. 2	Ditto.
LXVI	...	Chumparun	P. Majhauwa, Thá. Bagaha	Balua	...	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 18 feet square at base and 14 feet at top.
LXVII	...	Gorakhpur	Tah. Parauna, P. Sidhua Jobna, Thá. Kothibhár	Tola Upasai of Katai Bhurpurwa	Batsura N. E. 3½ Bagua E. 4	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 18 feet square at base and 14 feet at top. Part of the tower injured, and no mark-stone found, as reported in 1867.
LXVIII	...	Chumparun	P. Majhauwa, Thá. Bagaha	Bijrah	...	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet square at base and 14 feet at top.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
LXIX	...	Chumparun	P. Majhauwa, Thá. Bagaha	Bakwa	miles Chandrapur W. 1¼ Ratwal S. by W. 2	The station consists of an earthen tower, 20 feet square at base and 14 feet at top, enclosing a central, perforated pillar of masonry, 6½ feet square at base, 4 feet in diameter at top, having a mark-stone at summit and another in the ground floor. The station was built in 1847 in the course of the operations of the North-East Longitudinal Series, and no change in its construction appears to have been made in 1852, when again visited at the conclusion of the Huríláong Meridional Series.
LXX	...	Chumparun	P. Rámgir, Thá. Lauria	Baita	Beláspurwa N. W. ¾ Pachrukha E. by S. 1 Bahuari N. E. 1	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet square at base and 14 feet at top.
LXXI	...	„	...	...	Gondauli N. W. by N. 3 Dubaulia E.S.E. 1 Dumra S. S. E. 1¼	The station consists of a platform of burnt bricks and mud cement, 14 feet square, enclosing a central pillar of masonry 2 feet high and 4 feet in diameter, having a mark-stone at its upper surface and another below. The station was built in 1847 in the course of the North-East Longitudinal Series operations, and no change in its construction appears to have been made in 1852, when again visited at the conclusion of the Huríláong Meridional Series.
LXXII	...	Chumparun	P. Rámgir, Thá. Lauria	Tarharwa	Singárpur W. N. W. 2½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet square at base and 14 feet at top. Tower and pillar fallen down as reported in 1872.
LXXIII	...	„	Ditto.	Sathwaria	Sáthi N. N. W. 2½ Pokharia Rai S. W. 3½ Jaintia S. E. by E. 3	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet in diameter at base and 14 feet at top.
LXXIV	...	„	P. Majhauwa, Thá. Bettiah	Sikta	Balthur W. 3¼	Ditto.
LXXV	...	„	Ditto.	Birwa	Sirsiwa W.N.W. 2 Ratanmála W. 2½	Ditto.
LXXVI	...	„	P. Majhauwa, Thá. Adápur	Harnáhi	Champápur S. S. E. 3	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet in diameter at base and 14 feet at top. The pillar half fallen down as reported in 1872.
LXXVII	...	„	P. Majhauwa, Thá. Motiharee	Bigoia	Segowlie Cantonment W.N.W. 2½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet in diameter at base and 14 feet at top.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
LXXVIII	...	Chumparun	P. Majhauwa, Thá. Adápur	Narkatia	Narkatia W. by N. 2½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet in diameter at base and 14 feet at top.
LXXIX	...	„	P. Majhauwa, Thá. Motiharee	Rúpdi	Siswa N. W. 3½ Pataura Bhilha Nizamat S. 2½	Ditto.
LXXX	...	„	P. Semraun, Thá. Dháka	Dipái	Nonaura E. 1 Murshadabad N. by E. ½	Ditto.
LXXXI	...	„	P. Mehsi, Thá. Dháka	Masáha	Barashankar E. 4½ Dháka Rámchandar N. E. by N. 4½	Ditto.
LXXXII	...	Mozufferpore	P. Babra, Thá. Shiuhar	Sinduria	Bhawánipur W. by S. 2	Ditto.
LXXXIII	...	„	Ditto.	Amua	Amua Kalán S. 1½	The station consists of a tower of unburnt bricks—with diameters at top and bottom, respectively, of 15 and 22 feet—enclosing a central pillar of masonry, 6½ feet square at base and 4 feet in diameter at top: the latter has a mark-stone at its summit, in the normal of which—it is assumed—other mark-stones have been fixed in the solid pillar. It was not necessary to revisit this station in the course of the Chendwár Meridional Series operations, as all the observations both for the North-East Longitudinal and the Chendwár Meridional Series were completed at the same time.
LXXXIV	...	Mozufferpore	P. Mahalla, Thá. Seetamurhee	Bulákipur	Ríga S. S. W. 2½	The pillar is isolated, 6½ feet square at base and 4 feet in diameter at top, and is enclosed in a kacha tower 20 feet in diameter at base and 14 feet at top.
LXXXV	...	„	Ditto.	Madanpur	Bisanpur W. 2¼	The station as built in 1846 consists of a tower of unburnt bricks—with diameters at top and bottom, respectively, of 14 and 20 feet—enclosing a central pillar of masonry, 6½ feet square at base and 4 feet in diameter at top: the latter has a mark-stone at its summit, in the normal of which—it is assumed—other mark-stones have been fixed in the solid pillar. The station was revisited in 1849, in the course of the North-East Longitudinal Series operations, but no alterations in its construction appears to have been made.
LXXXVI	...	Mozufferpore	P. Mahind, Thá. Pupri	Kararbana	Jujhárpati W. N. W. 2	The pillar is isolated and enclosed in a kacha tower.
LXXXVII	...	„	P. Nánpur, Thá. Pupri	Himaunpur	Sherpur N. E. 2½ Bhasaipur N. W. by W. 2½	Ditto.
LXXXVIII	...	„	P. Basotra, Thá. Pupri	Pargáwa	Basotra S. W. by W. 1½ Chorwat S. E. by S. 2¾	The pillar is isolated and enclosed in a kacha tower. A portion of the upper part was reported as broken down in 1868; in 1874 it was found 18¾ feet high.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
LXXXIX	...	Durbhunga	P. Tájpur, Thá. Benipati	Sháhpur	Jogiadah W. 2¼ Páli E. S. E. 3½	The pillar is isolated and enclosed in a kacha tower.
XC	Basantnagar	"	Ditto.	Jarel	Hassár N. N. E. 2¾ Jhakti N. E. 3¼	Ditto.
XCI	...	"	P. Jarel, Thá. Benipati	Chandarsanpur	Kukraul E. by S. 2 Araiud N. by E. 2½	The station as built in 1849 consists of a tower of sun-dried bricks enclosing an isolated pillar of masonry. When again visited in 1852, in the course of the North-East Longitudinal Series operations, no alteration in its construction appears to have been made.
XCII	...	"	P. Bachhaur, Thá. Khajauli	Narhar	Narath S. W. ½ Chitáhi W. by N. 1¾	The pillar is isolated and enclosed in a kacha tower. Much injured by floods in 1880.
XCIII	Simri	"	P. Háti, Thá. Mudhoo-bunnee	Simri	Mirzapur N. E. 1½ Pariharpurjabdi N. W. 1¾	The station as built in 1849 consists of a tower of sun-dried bricks enclosing an isolated pillar of masonry. When again visited in 1852, in the course of the North-East Longitudinal Series operations, no alteration in its construction appears to have been made.
XCIV	...	"	P. Bachhaur, Thá. Ladnia	Mirzapur	Sidhap Kalán N. W. by W. 3½	The pillar is isolated and enclosed in a kacha tower.
XCV	Dakohi	"	P. Gaur, Thá. Mudhoo-bunnee	Rudarpur	Rakhwári W. 1¾ Andhara N. E. by N. 8	The pillar is isolated and enclosed in a kacha tower. Found 18 feet high in 1868, not known when the upper portion fell.
XCVI	...	"	P. Jabdi, Thá. Phulprás	Laukaha	Bijnaha N. 1½ Parsáhi Siswár S. by E. 3½	The pillar is isolated and enclosed in a kacha tower. Found only 12 feet high in 1868, not known when the upper portion fell.
XCVII	Belaha	"	P. Álápur, Thá. Phulprás	Barhampur	Urgaon Asli N. E. by N. 2½	The pillar is isolated and enclosed in a kacha tower.
XCVIII	...	"	P. Álápur, Thá. Laukaha	Ladnia	Mesápur Madhubani W. 4½ Bingaon Birbati S. W. by S. 4½	The pillar was isolated and enclosed in a kacha tower. Entirely fallen down as reported in 1868.
XCIX	...	Bhágalpur	P. Náridigar, Thá. Soopole	Sunbarsa	Khánpur E. by N. 1½	The pillar is isolated and enclosed in a kacha tower.

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					miles	
C	...	Bhágalpur	P. Náridigar, Outpost Dagmara	Harpur	Dagmara Piprahi N. N. W. 2 Nandipur W. ½	The pillar is isolated, 3½ feet in diameter at top, and is enclosed in a kacha tower.
CI	...	"	P. Náridigar, Thá. Soopole	Barháta	Srípur N. 1¼ Jharka S. W. by W. 2	Ditto.
CII	...	"	P. Haraut, Thá. Pratápganj	Diwánganj	Baijnáthpur W. by S. 1¾ Sukhanagar E. N. E. 1¼	The pillar is isolated and perforated, and is enclosed in a kacha tower.
CIII	...	"	P. Náridigar, Thá. Soopole	Latona	Kabia E. by S. 2¼	The pillar is isolated, and enclosed in a square kacha tower.
CIV	...	"	P. Dhapur, Thá. Pratápganj	Chakla Rám Missir's Baisi	Sibnagar S. E. by E. 2 Kamálpur N. E. by E. 1½	Ditto.
CV	...	"	P. Haraut, Thá. Pratápganj	Minai	Rajganj E. by N. 1½ Náthpur E. S. E. 2	The pillar was isolated and enclosed in a kacha tower 13½ feet square at top, having an embankment of earth thrown up around the base. Washed away by the river Koosee in 1873.
CVI	...	Purneah	P. Dharampur, Thá. Rániganj	Chúni	Husanpur W. by S. 1½	The pillar is isolated and enclosed in a kacha tower 15 feet square at top, having an embankment of earth thrown up around the base.
CVII	...	"	Ditto.	Rámnagar Rahta	Puráni Kararia, N. E. by N. 1¼ Rámnagar Mahesh S. E. ¾	The pillar is isolated and enclosed in a square kacha tower. It was not necessary to revisit this station as all the observations, both for the North-East Longitudinal and North Malúncha Meridional Series, were completed about the same time. Greater portion of the station fallen down as reported in 1872 and 1873.
CVIII	Manúlapati	Purneah	P. Dharampur, Tha. Rániganj	Manúlapati	...	The pillar is isolated and enclosed in a kacha tower. It was not necessary to revisit this station as all the observations, both for the North-East Longitudinal, and North Malúncha Series, were completed at the same time.
CIX	...	Bhágalpur	P. Haraut, Thá. Pratápganj	Ghiba	Sulda N. 1½ Bishanpur W. by S. 2¼	The pillar is isolated and enclosed in a kacha tower 14 feet square at top, having an embankment of earth thrown up around the base.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
CX	...	Purneah	P. Sultánpur, Thá. Matiári	Nirpur	...	The pillar is isolated and enclosed in a kacha tower 14 feet square at top, having an embankment of earth thrown up around the base.
CXI	...	„	Ditto.	Mánikpur	miles Barha W. 1	Ditto.
CXII	...	„	P. Tirakhardah, Thá. Matiári	Kamaldáha	Tirakhardah N. E. 3	Ditto.
CXIII	...	„	P. Sultánpur, Thá. Arrareah	Bhenigara	Arrareah S. by W. 5½	The pillar is isolated and enclosed in a kacha tower 13 feet square at top, having an embankment of earth thrown up around the base.
CXIV	...	„	P. Fatehpur, Thá. Arrareah	Dipnagar	Balua S. E. by S. 1½ Pararia W. by N. 1	The pillar is isolated and enclosed in a kacha tower 14 feet square at top, having an embankment of earth thrown up around the base.
CXV	...	„	P. Srípur, Thá. Bahádurganj	Músaldánga	...	The pillar is isolated and enclosed in a kacha tower 13 feet square at top, having an embankment of earth thrown up around the base.
CXVI	...	„	P. Fatehpur Singhia, Thá. Bahádurganj	Lachmipur	Bhág Kálpi Pír W. 2	Ditto.
CXVII	...	„	...	...	Bahádurganj N. W. 4¾	The pillar was isolated and enclosed in a kacha tower 13 feet square at top, having an embankment of earth thrown up around the base. Swept away in 1880.
CXVIII	...	„	P. Fatehpur Singhia, Thá. Káliaganj	Bandarjúla	Powakháli S. by W. 2½	The pillar is isolated and enclosed in a kacha-paka tower 14 feet square at top.
CXIX	...	„	P. Súrajpur, Thá. Káliaganj	Kharkhari	Haldagaon S. W. by W. ½ Keshijra N. W. by W. 1	The pillar is isolated, 4 feet in diameter, and is enclosed in a kacha-paka tower 14 feet square at top.
CXX	...	„	P. Fatehpur Singhia, Thá. Káliaganj	Thákurganj	Furabári N. W. ½ Káliaganj S. S. E. 3	The pillar is isolated, 13 feet high and 4 feet in diameter at top, and is enclosed in a kacha-paka tower 14 feet square at top, having an embankment of earth thrown up around the base.
CXXI	...	„	P. Súrajpur, Thá. Káliaganj	Sonakhoda	Gobindpur W. 2½	...

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					miles	
CXXII	...	Purneah	P. Súrajpur, Thá. Káliaganj	Rámganj	Khojagaon E. N. E. $1\frac{1}{4}$ Badangáchh W. N. W. $1\frac{1}{2}$	...
CXXIII	...	"	P. Fatehpur Singhia, Thá. Káliaganj	Dúmdángi	Tentulia E. N. E. $3\frac{1}{4}$	The pillar is isolated, 4 feet in diameter at top, and is enclosed in a kacha tower 14 feet square at top, having an embankment of earth thrown up around the base.
CXXIV	...	"	Ditto.	Kanchabári	Tentulia W. N. W. $5\frac{3}{4}$ Babud Bhajanpur N. N. E. 4	The station, as originally constructed in 1848, consists of a mound of earth (*i.e.*, tower) 60 feet square at base, 14 feet at top, and 20 feet in height, thrown up against an annular wall of masonry, 1 foot thick, enclosing a solid, isolated masonry pillar with mark-stones at top, bottom and intermediately. When subsequently visited the upper mark-stone was found undisturbed, and no change appears to have been made in the construction of the station.
CXXV	...	Dinagepore	P. Salbári, Thá. Thákurgaon	Chotáki	Bámankumár E. N. E. $1\frac{3}{4}$ Belia N. by E. $2\frac{1}{2}$	The pillar as built in 1848 is isolated, 4 feet in diameter, and is enclosed in a kacha tower 14 feet square at top. When again visited in 1855, in the course of the operations of the Assam Longitudinal Series, no alteration was made in the construction of the pillar.
CXXVI	...	Jalpáiguri	Tah. Rajnagar, P. and Thá. Boda	Cherakute	Taria W. $5\frac{1}{2}$	The pillar is 29·2 feet high. As originally constructed, the pillar was 4 feet in diameter at top, and 24 feet in height. No change was made when it was visited in 1853 and 1854; but in 1855, when visited again in the course of the Assam Longitudinal Series operations, the height was increased by 5·2 feet, and a mark-stone placed on the top in the prolongation of the normal through the original upper mark-stone, which was found undisturbed: the pillar is isolated and of the solid kind; in the original construction it carried mark-stones at top, bottom and intermediately, and was enclosed in a kacha tower 14 feet square at top.

NOTE.—P. stands for pargana, Tah. for tahsíl, and Thá. for tháná.

August, 1882.

J. B. N. HENNESSEY,
In charge of Computing Office.

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NORTH-EAST LONGITUDINAL SERIES.

OBSERVED ANGLES.

At LII

January 1851, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
LIV & I	″ l 38·44 l 38·52	″ l 36·26 l 35·90	″ l 38·60 l 37·10	″ l 37·62 l 37·24	″ l 37·46 l 37·16	″ l 36·00 l 36·28	″ l 36·78 l 37·12	″ l 37·36 l 37·34	″ l 37·14 l 36·38	″ l 37·46 l 36·08	Probability = 0·22
Means	38·48	36·08	37·85	37·43	37·31	36·14	36·95	37·35	36·76	36·77	31° 17′ 37″·11
I & III	h 19·36 h 18·58	h 20·72 h 21·32	h 19·68 h 19·78	h 21·42 h 19·58	h 22·16 h 22·60	h 20·32 h 19·98	l 21·94 l 22·86	l 22·68 l 22·82	h 20·22 h 21·06	h 20·02 h 20·56	Probability = 0·38
Means	18·97	21·02	19·73	20·50	22·38	20·15	22·40	22·75	20·64	20·29	48° 41′ 20″·88

NOTE.—LII and LIV of Great Arc Meridional Series.

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At LIV

November 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
LVI & I	*h* 5·62 *h* 6·12	*l* 5·26 *l* 3·90	*l* 4·86 *l* 4·02	*l* 5·92 *l* 5·88	*l* 6·64 *l* 5·52	*l* 4·28 *l* 4·54	*l* 7·16 *l* 8·14 *l* 6·18 *l* 5·60	*l* 6·96 *l* 6·56	*l* 8·00 *l* 7·76	*h* 5·30 *l* 7·76 *l* 7·00	Probability = 0·35
Means	5·87	4·58	4·44	5·90	6·08	4·41	6·77	6·76	7·88	6·69	66° 35′ 5″·94
LVI & LII	*h* 55·46 *h* 55·10	*h* 54·84 *h* 54·36 *h* 53·94	*l* 52·08 *l* 51·02	*l* 53·86 *l* 55·90 *l* 54·38	*l* 53·98 *l* 54·70	*l* 55·34 *l* 54·30	*l* 54·26 *l* 53·44	*l* 56·24 *l* 56·24	*l* 55·82 *l* 55·68	*l* 57·12 *l* 57·08	Probability = 0·45
Means	55·28	54·38	51·55	54·71	54·34	54·82	53·85	56·24	55·75	57·10	149° 53′ 54″·80
I & LII	+55·28 − 5·87	+54·38 − 4·58	+51·55 − 4·44	+54·71 − 5·90	+54·34 − 6·08	+54·82 − 4·41	+53·85 − 6·77	+56·24 − 6·76	+55·75 − 7·88	+57·10 − 6·69	Probability = 0·37
149° 53′ −66° 35′	49·41	49·80	47·11	48·81	48·26	50·41	47·08	49·48	47·87	50·41	83° 18′ 48″·86

At LVI

November 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
II & I	*l* 38·14 *l* 37·06	*l* 35·52 *l* 35·80	*l* 34·88 *l* 35·42	*l* 37·46 *l* 38·06	*l* 38·36 *l* 37·96	*l* 37·92 *l* 35·76	*l* 37·88 *l* 36·72	*l* 38·92 *l* 38·84	*h* 40·90 *h* 41·24	*h* 36·36 *h* 37·32	Probability = 0·50
Means	37·60	35·66	35·15	37·76	38·16	36·84	37·30	38·88	41·07	36·84	53° 43′ 37″·53

NOTE.—LII, LIV and LVI of Great Arc Meridional Series.

At LVI—(Continued.)

November 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
I & LIV	*l* 25·60 *l* 26·36	*l* 25·44 *l* 27·00 *l* 26·46	*h* 29·22 *h* 28·26	*h* 26·88 *h* 26·54	*l* 27·26 *l* 26·22	*l* 29·76 *l* 29·18	*l* 25·58 *l* 25·66	*l* 28·92 *l* 30·20	*l* 23·12 *l* 25·52 *l* 25·92 *h* 25·10	*h* 28·66 *h* 28·20	Probability = 0·50
Means	25·98	26·30	28·74	26·71	26·74	29·47	25·62	29·56	24·92	28·43	39° 29′ 27″·25

At I

December 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
LVI & II	*l* 20·56 *l* 20·46	*l* 20·32 *l* 21·16	*h* 23·20 *h* 22·36	*l* 21·88 *l* 22·50	*h* 22·14 *h* 22·02	*l* 22·54 *l* 22·02	*l* 21·28 *l* 21·28	*h* 22·30 *h* 21·92	*h* 22·54 *h* 21·80	*h* 21·78 *h* 22·02	Probability = 0·22
Means	20·51	20·74	22·78	22·19	22·08	22·28	21·28	22·11	22·17	21·90	54° 22′ 21″·80
II & IV	*h* 23·60 *h* 24·42	*h* 22·40 *h* 23·30	*l* 23·80 *l* 24·78	*l* 23·80 *l* 22·28	*h* 23·00 *h* 21·86	*l* 22·80 *l* 23·84	*l* 21·92 *l* 23·34	*h* 22·96 *h* 22·66	*h* 22·62 *h* 22·88	*h* 23·66 *h* 23·84	Probability = 0·19
Means	24·01	22·85	24·29	23·04	22·43	23·32	22·63	22·81	22·75	23·75	56° 21′ 23″·19
II & III	*l* 36·10 *l* 36·66	*l* 37·62 *l* 34·44	*l* 39·38 *l* 39·56	*l* 36·40 *l* 36·48	*l* 38·36 *l* 39·00	*l* 39·98 *l* 38·76	*l* 36·56 *l* 37·74	*h* 37·86 *h* 37·82	*h* 36·72 *h* 37·54	*h* 37·04 *h* 37·44	Probability = 0·37
Means	36·38	36·03	39·47	36·44	38·68	39·37	37·15	37·84	37·13	37·24	97° 5′ 37″·57
IV & III	+36·38 −24·01	+36·03 −22·85	+39·47 −24·29	+36·44 −23·04	+38·68 −22·43	+39·37 −23·32	+37·15 −22·63	+37·84 −22·81	+37·13 −22·75	+37·24 −23·75	Probability = 0·38
97° 5′ −56° 21′	12·37	13·18	15·18	13·40	16·25	16·05	14·52	15·03	14·38	13·49	40° 44′ 14″·38

NOTE.—LIV and LVI of Great Arc Meridional Series.

At I—(Continued.)

December 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
III & LII	″ *l* 53·62 *l* 53·84	″ *l* 53·52 *l* 53·70	″ *l* 52·00 *l* 51·78	″ *l* 54·06 *l* 53·48	″ *l* 50·76 *l* 52·96	″ *l* 51·12 *l* 54·14	″ *h* 51·38 *l* 52·80	″ *l* 51·84 *l* 52·36	″ *l* 52·30 *l* 52·26	″ *l* 52·94 *l* 53·52	Probability = 0·24
Means	53·73	53·61	51·89	53·77	51·86	52·63	52·09	52·10	52·28	53·23	69° 12′ 52″·72
LII & LIV	*l* 38·92 *l* 40·26	*l* 37·92 *l* 39·90	*h* 38·04 *h* 36·62 *h* 37·46	*l* 40·98 *l* 38·42	*h* 40·18 *h* 42·48	*l* 37·54 *l* 36·96	*h* 40·46 *l* 37·16	*l* 39·44 *l* 38·20	*l* 37·32 *l* 37·84	*l* 38·84 *l* 38·32	Probability = 0·37
Means	39·59	38·91	37·37	39·70	41·33	37·25	38·81	38·82	37·58	38·58	65° 23′ 38″·79
LIV & LVI	*l* 30·80 *l* 28·78	*l* 30·62 *l* 30·80	*h* 27·84 *h* 28·18	*l* 27·68 *l* 29·12	*h* 29·02 *h* 29·24	*l* 28·82 *l* 29·10	*l* 29·70 *l* 29·76	*h* 27·56 *h* 28·06	*h* 26·96 *h* 28·06	*h* 29·70 *h* 28·38	Probability = 0·30
Means	29·79	30·71	28·01	28·40	29·13	28·96	29·73	27·81	27·51	29·04	73° 55′ 28″·91

At II

December 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
IV & I	″ *l* 44·00 *l* 44·70	″ *l* 43·32 *l* 42·92 *l* 43·26	″ *l* 44·82 *l* 44·24	″ *l* 43·62 *l* 42·08	″ *l* 43·54 *l* 43·02	″ *l* 44·14 *l* 42·88	″ *l* 42·26 *l* 41·60	″ *l* 43·38 *l* 42·14	″ *l* 40·12 *l* 42·72 *l* 43·34	″ *l* 42·20 *l* 42·68	Probability = 0·26
Means	44·35	43·17	44·53	42·85	43·28	43·51	41·93	42·76	42·06	42·44	80° 15′ 43″·09

NOTE.—LII, LIV and LVI of Great Arc Meridional Series.

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At II—(Continued.)

December 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
I & LVI	*l* 2·26 *l* 2·18	*l* 3·14 *l* 1·02 *l* 0·64 *l* 2·94	*l* 3·52 *l* 4·14	*l* 2·12 *l* 3·30	*l* 3·60 *l* 5·46	*l* 2·84 *l* 3·40	*l* 3·76 *l* 4·80	*l* 3·78 *l* 4·56	*l* 5·06 *l* 3·84 *l* 2·62	*l* 2·82 *l* 2·76	Probability = 0·27
Means	2·22	1·93	3·83	2·71	4·53	3·12	4·28	4·17	3·84	2·79	71° 54′ 3″·34

At III

December 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
LII & I	*l* 51·00 *l* 51·30	*l* 52·74 *l* 51·68	*l* 52·48 *l* 51·68	*l* 52·10 *l* 52·02	*l* 51·44 *l* 51·12	*l* 50·92 *l* 50·46	*l* 47·80 *l* 49·68	*l* 50·24 *l* 50·44	*l* 50·24 *l* 49·74	*l* 50·12 *l* 50·76	Probability = 0·33
Means	51·15	52·21	52·98	52·06	51·28	50·69	48·74	50·34	49·99	50·44	62° 5′ 50″·90
I & IV	*l* 15·00 *l* 13·44 *l* 13·66	*l* 12·28 *l* 12·26	*l* 14·10 *l* 14·12	*l* 13·42 *l* 13·28	*l* 14·20 *l* 14·16	*l* 14·18 *l* 13·14	*l* 14·46 *l* 13·60	*l* 15·02 *l* 13·58	*l* 12·32 *l* 14·06	*l* 13·14 *l* 14·20 *l* 13·70	Probability = 0·18
Means	14·03	12·27	14·11	13·35	14·18	13·66	14·03	14·30	13·19	13·68	75° 35′ 13″·68

NOTE.—LII and LVI of Great Arc Meridional Series.

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At III—(Continued.)

December 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
IV & VI	*l* 7·82 *l* 6·28 *l* 5·18	*l* 6·92 *l* 7·94	*l* 6·12 *l* 6·12	*l* 9·14 *l* 8·78	*l* 7·10 *l* 7·26	*l* 8·54 *l* 8·12	*l* 8·28 *l* 7·48	*l* 7·66 *l* 7·96	*l* 7·16 *l* 8·74	*l* 6·58 *l* 6·82	Probability = 0·27
Means	6·43	7·43	6·12	8·96	7·18	8·33	7·88	7·81	7·95	6·70	52° 0′ 7″·48
IV & V	*l* 4·80 *l* 4·04 *l* 3·18	*l* 4·80 *l* 4·96	*l* 4·34 *l* 4·86	*l* 4·20 *l* 4·72	*l* 4·88 *l* 3·78	*l* 4·04 *l* 4·98	*l* 7·30 *l* 6·30	*l* 4·38 *l* 5·24	*l* 5·84 *l* 6·34	*l* 5·98 *l* 4·56 *l* 4·88	Probability = 0·26
Means	4·01	4·88	4·60	4·46	4·33	4·51	6·80	4·81	6·09	5·14	70° 36′ 4″·96
VI & V	+64·01 − 6·43	+64·88 − 7·43	+64·60 − 6·12	+64·46 − 8·96	+64·33 − 7·18	+64·51 − 8·33	+66·80 − 7·88	+64·81 − 7·81	+66·09 − 7·95	+65·14 − 6·70	Probability = 0·32
70° 35′ −52° 0′	57·58	57·45	58·48	55·50	57·15	56·18	58·92	57·00	58·14	58·44	18° 35′ 57″·48

At IV

December 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
VI & V	*l* 21·82 *l* 22·60	*l* 20·30 *l* 20·92	*l* 21·50 *l* 20·36 *l* 20·92	*l* 20·36 *l* 23·12 *l* 22·44	*l* 21·72 *l* 21·44	*l* 24·28 *l* 24·22	*l* 21·58 *l* 23·04	*l* 23·68 *l* 23·40	*l* 23·08 *l* 22·78	*l* 23·76 *l* 24·86	Probability = 0·39
Means	22·21	20·61	20·93	21·97	21·58	24·25	22·31	23·54	22·93	24·31	43° 13′ 22″·46

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At IV—(Continued.)

December 1850, *observed by Captain T. Renny Tailyour with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
V & III	″ *l* 35·94 *l* 37·06	″ *l* 36·02 *l* 36·84	″ *l* 37·28 *l* 36·64	″ *l* 35·54 *l* 35·92	″ *l* 36·48 *l* 36·40	″ *l* 35·74 *l* 36·54	″ *h* 35·60 *h* 35·52	″ *h* 37·08 *h* 36·36	″ *l* 33·88 *l* 34·04 *l* 36·00 *l* 36·14	″ *l* 34·88 *l* 35·68 *l* 37·10 *l* 37·56	Probability = 0·18
Means	36·50	36·43	36·96	35·73	36·44	36·14	35·56	36·72	35·02	36·30	53° 15′ 36″·18
III & I	*l* 36·88 *l* 36·74	*l* 34·14 *l* 34·76	*l* 37·46 *l* 36·84	*l* 36·18 *l* 35·04	*l* 37·98 *l* 37·52	*l* 37·00 *l* 35·38	*h* 38·24 *h* 38·02	*h* 36·38 *h* 36·82	*l* 36·04 *l* 36·90 *l* 37·88 *l* 37·40	*l* 34·32 *l* 36·48	Probability = 0·34
Means	36·81	34·45	37·15	35·61	37·75	36·19	38·13	36·60	37·06	35·40	63° 40′ 36″·52
I & II	*l* 56·46 *l* 56·28	*l* 58·66 *l* 57·14	*l* 57·28 *l* 56·86	*l* 56·56 *l* 55·96	*l* 56·02 *l* 56·78	*l* 56·34 *h* 56·48 *h* 57·42	*h* 56·56 *h* 56·72	*h* 57·74 *h* 57·68	*l* 58·34 *l* 56·76 *l* 56·36 *l* 56·78	*l* 57·78 *l* 55·80	Probability = 0·17
Means	56·37	57·90	57·07	56·26	56·40	56·75	56·64	57·71	57·06	56·79	43° 22′ 56″·90
VI & III	+22·21 +36·50	+20·61 +36·43	+20·93 +36·96	+21·97 +35·73	+21·58 +36·44	+24·25 +36·14	+22·31 +35·56	+23·54 +36·72	+22·93 +35·02	+24·31 +36·30	Probability = 0·39
43° 13′ +53° 15′	58·71	57·04	57·89	57·70	58·02	60·39	57·87	60·26	57·95	60·61	96° 28′ 58″·64

At V

January and June 1851, *observed by Captain T. Renny Tailyour and Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
III & IV	″ *l* 20·92 *l* 20·52	″ *l* 20·04 *l* 19·54 *l* 20·14	″ *l* 19·98 *l* 19·48	″ *l* 22·00 *l* 20·72	″ *l* 21·02 *l* 21·10	″ *l* 21·44 *l* 21·70	″ *l* 21·82 *l* 20·94	″ *l* 22·24 *l* 23·40	″ *l* 21·66 *l* 22·10	″ *l* 21·48 *l* 20·68	Probability = 0·27
Means	20·72	19·91	19·73	21·36	21·06	21·57	21·38	22·82	21·88	21·08	56° 8′ 21″·15

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At V—(Continued.)

***January and June* 1851, *observed by Captain T. Renny Tailyour and Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.**

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
III & VI	*h* 2·88 *h* 4·34	*h* 2·98 *h* 2·74	*l* 4·68 *l* 3·30	*l* 4·92 *l* 2·94	*l* 4·46 *l* 1·74 *l* 2·78	*l* 5·20 *l* 4·76	*l* 5·82 *l* 4·86	*l* 4·48 *l* 2·62	*h* 4·16 *h* 3·02	*l* 3·88 *l* 3·66	Probability = 0·23
Means	3·61	2·86	3·99	3·93	2·99	4·98	5·34	3·55	3·59	3·77	144° 4′ 3″·86
IV & VI	+63·61 −20·72	+62·86 −19·91	+63·99 −19·73	+63·93 +21·36	+62·99 −21·06	+64·98 −21·57	+65·34 −21·38	+63·55 −22·82	+63·59 −21·88	+63·77 −21·08	Probability = 0·32
144° 3′ −56° 8′	42·89	42·95	44·26	42·57	41·93	43·41	43·96	40·73	41·71	42·69	87° 55′ 42″·71
III & VIII	*l* 6·12 *l* 5·94	*l* 7·06 *l* 6·32	*l* 7·38 *l* 8·78	*l* 5·78 *l* 6·28	*l* 7·34 *l* 6·22	*l* 7·24 *l* 6·86	*l* 5·38 *l* 6·84	*l* 8·04 *l* 8·00	*l* 5·58 *l* 6·38 *l* 6·56	*l* 7·38 *l* 6·64	
Means	6·03	6·69	8·08	6·03	6·78	7·05	6·11	8·02	6·17	7·01	173° 5′ 6″·80
VI & VIII	+ 6·03 − 3·61	+ 6·69 − 2·86	+ 8·08 − 3·99	+ 6·03 − 3·93	+ 6·78 − 2·99	+ 7·05 − 4·98	+ 6·11 − 5·34	+ 8·02 − 3·55	+ 6·17 − 3·59	+ 7·01 − 3·77	Probability = 0·34
173° 5′ −144° 4′	2·42	3·83	4·09	2·10	3·79	2·07	0·77	4·47	2·58	3·24	29° 1′ 2″·94
III & VII	*l* 2·38 *l* 1·30	*l* 1·66 *l* 1·94	*l* 0·44 *l* 0·88	*l* 3·30 *l* 3·20	*l* 3·14 *l* 2·06	*l* 2·80 *l* 2·68	*l* 1·92 *l* 1·90	*l* 2·26 *l* 3·64	*l* 3·22 *l* 2·08	*l* 3·36 *l* 2·72	
Means	1·84	1·80	0·66	3·25	2·60	2·74	1·91	2·95	2·65	3·04	214° 9′ 2″·34
VI & VII	+61·84 − 3·61	+61·80 − 2·86	+60·66 − 3·99	+63·25 − 3·93	+62·60 − 2·99	+62·74 − 4·98	+61·91 − 5·34	+62·95 − 3·55	+62·65 − 3·59	+63·04 − 3·77	Probability = 0·34
214° 8′ −144° 4′	58·23	58·94	56·67	59·32	59·61	57·76	56·57	59·40	59·06	59·27	70° 4′ 58″·48
VIII & VII	+61·84 − 6·03	+61·80 − 6·69	+60·66 − 8·08	+63·25 − 6·03	+62·60 − 6·78	+62·74 − 7·05	+61·91 − 6·11	+62·95 − 8·02	+62·65 − 6·17	+63·04 − 7·01	Probability = 0·37
214° 8′ −173° 5′	55·81	55·11	52·58	57·22	55·82	55·69	55·80	54·93	56·48	56·03	41° 3′ 55″·55

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At VI

May 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
VIII & V	″ h17·00 h16·34	″ h14·86 h14·94	″ h14·94 h14·38	″ h15·50 h14·46	″ h14·08 h14·74	″ h16·76 h16·12	″ h15·28 h16·74	″ h18·00 h16·44	″ h12·84 h12·30	″ h12·52 h13·38	Probability = 0·46
Means	16·67	14·90	14·66	14·98	14·41	16·44	16·01	17·22	12·57	12·95	131° 35′ 15″·08
VII & V	h38·18 h37·42	h37·92 h37·40	h40·52 h40·14	h39·04 h39·86	h37·00 h38·50	h36·66 h38·18	h40·38 h38·54	h39·46 h38·28	h37·26 h37·74 h37·02	h35·28 h34·56	Probability = 0·46
Means	37·80	37·66	40·33	39·45	38·75	37·42	39·46	38·87	37·34	34·92	78° 1′ 38″·10
VIII & VII	+76·67 −37·80	+74·90 −37·66	+74·66 −40·33	+74·98 −39·45	+74·41 −37·75	+76·44 −37·42	+76·01 −39·46	+77·22 −38·87	+72·57 −37·34	+72·95 −34·92	Probability = 0·48
131° 34′ −78° 1′	38·87	37·24	34·33	35·53	36·66	39·02	36·55	38·35	35·23	38·03	53° 33′ 36″·98
V & III	h61·62 h62·62	h61·52 h61·40	h60·62 h59·94	h61·54 h58·28 h57·98	h60·10 h60·12	h58·80 h58·34	h60·02 h59·20	h61·34 h61·32	h62·12 h64·02	h63·90 h61·62	Probability = 0·46
Means	62·12	61·46	60·28	59·27	60·11	58·57	59·61	61·33	63·07	62·76	17° 19′ 60″·86
V & IV	h57·08 h57·12	h56·32 h58·12	h54·38 h55·36	h56·28 h56·72	h57·76 h57·02	h56·10 h55·24	h53·36 h55·70 h54·96	h56·42 h56·64	h58·04 h56·82	h59·10 h58·40	Probability = 0·38
Means	57·10	57·22	54·87	56·50	57·39	55·67	54·67	56·53	57·43	58·75	48° 50′ 56″·61
III & IV	+117·10 − 62·12	+117·22 − 61·46	+114·87 − 60·28	+116·50 − 59·27	+117·39 − 60·11	+115·67 − 58·57	+114·67 − 59·61	+116·53 − 61·33	+117·43 − 63·07	+118·75 − 62·76	Probability = 0·33
48° 49′ −17° 19′	54·98	55·76	54·59	57·23	57·28	57·10	55·06	55·20	54·36	55·99	31° 30′ 55″·76

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At VII

***February and March* 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.**

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
V & VI	*l* 29·34 *l* 28·78	*l* 29·40 *l* 29·24	*l* 25·66 *l* 28·34	*l* 27·70 *l* 28·02	*h* 27·94 *h* 28·12	*h* 29·04 *h* 28·36	*h* 27·96 *h* 27·24	*h* 29·98 *h* 28·72	*h* 30·18 *h* 29·92	*h* 31·04 *h* 28·68 *h* 29·08	Probability = 0·30
Means	29·06	29·32	27·00	27·86	28·03	28·70	27·60	29·35	30·05	29·60	31° 53′ 28″·66
VI & VIII	*l* 60·04 *l* 58·90	*l* 57·72 *l* 56·80 *l* 57·80 *l* 57·44	*l* 59·76 *l* 57·58	*l* 57·48 *l* 57·90	*h* 61·34 *h* 58·36 *h* 59·78	*h* 58·78 *h* 59·40	*h* 58·82 *h* 59·74	*h* 58·84 *h* 59·76	*h* 57·90 *h* 57·46	*h* 58·22 *h* 58·70	Probability = 0·25
Means	59·47	57·44	58·67	57·69	59·83	59·09	59·28	59·30	57·68	58·46	52° 10′ 58″·69
V & VIII	+29·06 +59·47	+29·32 +57·44	+27·00 +58·67	+27·86 +57·69	+28·03 +59·83	+28·70 +59·09	+27·60 +59·28	+29·35 +59·30	+30·05 +57·68	+29·60 +58·46	Probability = 0·33
31° 53′ +52° 10′	88·53	86·76	85·67	85·55	87·86	87·79	86·88	88·65	87·73	88·06	84° 4′ 27″·35
VIII & IX	*l* 35·72 *l* 35·62	*l* 37·90 *l* 39·28	*l* 37·90 *l* 38·48	*l* 38·20 *l* 38·90	*h* 37·16 *h* 36·38	*h* 37·78 *h* 37·76	*l* 35·24 *l* 35·12	*l* 34·22 *l* 33·80	*l* 36·78 *l* 36·60	*h* 38·74 *h* 39·94 *h* 39·20	Probability = 0·51
Means	35·67	38·59	38·19	38·55	36·77	37·77	35·18	34·01	36·69	39·29	64° 29′ 37″·07
VIII & X	*h* 47·10 *h* 47·28	*h* 54·68 *h* 55·12	*h* 54·66 *h* 53·82	*h* 54·70 *h* 55·22	*h* 53·00 *h* 53·24	*h* 53·90 *h* 54·26	*h* 55·02 *h* 55·12	*h* 55·88 *h* 54·58	*h* 57·50 *h* 55·18 *h* 55·62	*h* 55·10 *h* 54·92	
Means	47·19	54·90	54·24	54·96	53·12	54·08	55·07	55·23	56·10	55·01	130° 30′ 53″·99
IX & X	+47·19 −35·67	+54·90 −38·59	+54·24 −38·19	+54·96 −38·55	+53·12 −36·77	+54·08 −37·77	+55·07 −35·18	+55·23 −34·01	+56·10 −36·69	+55·01 −39·29	Probability = 0·81
130° 30′ −64° 29′	11·52	16·31	16·05	16·41	16·35	16·31	19·89	21·22	19·41	15·72	66° 1′ 16″·92

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At VIII

April and May 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
XII & IX	*h*34·20 *h*33·76	*h*30·66 *h*32·34	*h*31·92 *h*31·92	*h*31·86 *h*32·64	*h*35·68 *h*35·16	*h*34·72 *h*34·80	*h*34·88 *h*33·08	*h*32·10 *h*33·92	*h*32·00 *h*30·66	*h*30·68 *h*30·44	Probability = 0·48
Means	33·98	31·50	31·92	32·25	35·42	34·76	33·98	33·01	31·33	30·56	19° 20′ 32″·87
IX & VII	*h*41·34 *h*39·86	*h*43·24 *h*41·34	*h*41·20 *h*39·44	*h*40·20 *h*40·12	*h*37·98 *h*38·28	*h*38·94 *h*39·32	*h*38·38 *h*38·04	*h*39·60 *h*39·56	*h*39·84 *h*38·90	*h*39·86 *h*39·04	Probability = 0·36
Means	40·60	42·29	40·32	40·16	38·13	39·13	38·21	39·58	39·37	39·45	36° 50′ 39″·72
VII & VI	*h*28·38 *h*29·38	*h*30·30 *h*31·28	*h*28·64 *h*30·58	*h*31·56 *h*29·46	*h*28·08 *h*28·96	*h*29·56 *h*30·32	*h*32·76 *h*32·86	*h*29·96 *h*29·82	*h*31·16 *h*32·16	*h*29·06 *h*29·76	Probability = 0·39
Means	28·88	30·79	29·61	30·51	28·52	29·94	32·81	29·89	31·66	29·41	74° 15′ 30″·20
V & VI	*h*46·06 *h*45·80	*h*47·78 *h*48·02	*h*49·40 *h*48·08	*h*46·66 *h*46·28	*h*46·62 *h*47·34	*h*46·22 *h*44·94	*h*47·10 *h*47·60	*h*46·76 *h*45·72	*h*46·04 *h*47·54	*h*44·64 *h*44·44	Probability = 0·36
Means	45·93	47·90	48·74	46·47	46·98	45·58	47·35	46·24	46·79	44·54	19° 23′ 46″·65
VII & V	+88·88 −45·93	+90·79 −47·90	+89·61 −48·74	+90·51 −46·47	+88·52 −46·98	+89·94 −45·58	+92·81 −47·35	+89·89 −46·24	+91·66 −46·79	+89·41 −44·54	Probability = 0·45
74° 14′ −19° 23′	42·95	42·89	40·87	44·04	41·54	44·36	45·46	43·65	44·87	44·87	54° 51′ 43″·55

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At IX

March 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
XII & RM	″ *h* 8·78 *h* 8·14	″ *h* 7·78 *h* 7·60	″ *h* 9·44 *h* 7·62	″ *h* 8·72 *h* 9·22	″ *h* 6·74 *h* 6·24	″ *h* 7·94 *h* 9·06	″ *h* 7·44 *h* 7·52	″ *l* 9·02 *l* 8·92 *l* 9·36	″ *l* 9·44 *l* 8·54	″ *l* 9·44 *l* 9·38	
Means	8·46	7·69	8·53	8·97	6·49	8·50	7·48	9·10	8·99	9·41	67° 7′ 8″·36
Supplemental Angle	51·54	52·31	51·47	51·03	53·51	51·50	52·52	50·90	51·01	50·59	292° 52′ 51″·64
XI & RM	*h* 19·70 *l* 17·24 *l* 18·34	*h* 18·90 *h* 19·64	*l* 16·32 *l* 15·90	*h* 15·02 *l* 16·82	*l* 15·04 *l* 17·02	*l* 12·04 *l* 18·52 *l* 16·02	*l* 13·70 *l* 16·00	*l* 13·94 *l* 13·78	*l* 17·86 *l* 17·80	*l* 12·60 *l* 17·52 *l* 17·20	
Means	18·43	19·27	16·11	15·92	16·03	15·53	14·85	13·86	17·83	15·77	14° 53′ 16″·36
XII & XI	+68·46 −18·43	+67·69 −19·27	+68·53 −16·11	+68·97 −15·92	+66·49 −16·03	+68·50 −15·53	+67·48 −14·85	+69·10 −13·86	+68·99 −17·83	+69·41 −15·77	Probability = 0·60
67° 6′ −14° 53′	50·03	48·42	52·42	53·05	50·46	52·97	52·63	55·24	51·16	53·64	52° 13′ 52″·00
RM & X	*h* 44·74 *h* 45·70 *h* 44·36	*h* 44·22 *h* 43·32	*h* 45·22 *h* 43·94	*l* 43·52 *l* 44·20	*h* 41·68 *h* 43·86 *h* 39·50 *h* 41·70 *h* 39·00	*h* 40·36 *h* 39·96	*h* 43·40 *l* 44·52	*l* 45·56 *l* 45·58	*l* 42·76 *l* 45·06	*l* 44·28 *l* 44·28	
Means	44·93	43·77	44·58	43·86	41·15	40·16	43·96	45·57	43·91	44·28	44° 8′ 43″·62
XI & X	+18·43 +44·93	+19·27 +43·77	+16·11 +44·58	+15·92 +43·86	+16·03 +41·15	+15·53 +40·16	+14·85 +43·96	+13·86 +45·57	+17·83 +43·91	+15·77 +44·28	Probability = 0·72
14° 53′ +44° 8′	63·36	63·04	60·69	59·78	57·18	55·69	58·81	59·43	61·74	60·05	59° 1′ 59″·98

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At IX—(Continued.)

March 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
R M & VII	*l* 19·00 *l* 19·08	*h* 16·94 *h* 17·94	*l* 13·40 *l* 13·86	*l* 14·32 *l* 14·06	*l* 17·56 *l* 18·62	*l* 15·18 *l* 11·66 *l* 15·54	*l* 18·00 *l* 16·38	*l* 17·60 *l* 16·70	*l* 15·14 *l* 16·10	*l* 16·36 *l* 17·40	
Means	19·04	17·44	13·63	14·19	18·09	14·13	17·19	17·15	15·62	16·88	99° 8′ 16″·33
X & VII	+79·04 −44·93	+77·44 −43·77	+73·63 −44·58	+74·19 −43·86	+78·09 −41·15	+74·13 −40·16	+77·19 −43·96	+77·15 −45·57	+75·62 −43·91	+76·88 −44·28	Probability = 0·66
99° 7′ −44° 8′	34·11	33·67	29·05	30·33	36·94	33·97	33·23	31·58	31·71	32·60	54° 59′ 32″·72
R M & VIII	*h* 5·14 *h* 6·68	*h* 3·48 *h* 4·40	*h* 2·28 *h* 3·76	*h* 3·66 *h* 4·46	*h* 1·44 *h* 2·16	*h* 3·56 *h* 3·74	*h* 5·22 *h* 3·46	*h* 3·06 *h* 2·98	*l* 3·34 *l* 3·10	*l* 2·94 *l* 1·98	
Means	5·91	3·94	3·02	4·06	1·80	3·65	4·34	3·02	3·22	2·46	177° 48′ 3″·54
VII & VIII	+65·91 −19·04	+63·94 −17·44	+63·02 −13·63	+64·06 −14·19	+61·80 −18·09	+63·65 −14·13	+64·34 −17·19	+63·02 −17·15	+63·22 −15·62	+62·46 −16·88	Probability = 0·59
177° 47′ −99° 8′	46·87	46·50	49·39	49·87	43·71	49·52	47·15	45·87	47·60	45·58	78° 39′ 47″·21
VIII & XII	+51·54 − 5·91	+52·31 − 3·94	+51·47 − 3·02	+51·03 − 4·06	+53·51 − 1·80	+51·50 − 3·65	+52·52 − 4·34	+50·90 − 3·02	+51·01 − 3·22	+50·59 − 2·46	Probability = 0·46
292° 52′ −177° 48′	45·63	48·37	48·45	46·97	51·71	47·85	48·18	47·88	47·79	48·13	115° 4′ 48″·09

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At X

March 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	21° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
VI & IX	*l* 7·70 *l* 8·82	*h* 9·18 *h* 9·70	*h* 8·14 *h* 10·42	*h* 11·52 *h* 10·84	*h* 10·42 *h* 9·30	*h* 8·50 *h* 9·08	*h* 9·74 *h* 8·32	*h* 10·58 *h* 10·98	*h* 8·66 *h* 9·44 *h* 8·80	*h* 10·92 *h* 8·06	Probability = 0·27
Means	8·26	9·44	9·28	11·18	9·86	8·79	9·03	10·78	8·97	9·49	58° 59′ 9″·51
IX & XI	*h* 10·34 *h* 11·08	*h* 13·34 *h* 11·64 *h* 11·30	*h* 11·68 *h* 10·00	*h* 11·04 *h* 10·76	*h* 12·26 *h* 11·86	*h* 11·20 *h* 9·84	*h* 9·64 *h* 11·16	*h* 10·46 *h* 11·70	*h* 10·18 *h* 12·18	*h* 7·54 *h* 9·72	Probability = 0·29
Means	10·71	12·09	10·84	10·90	12·06	10·52	10·40	11·08	11·18	8·63	49° 31′ 10″·84

At XI

April 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
X & XII	*h* 22·48 *h* 23·60	*h* 27·28 *h* 25·90	*l* 24·18 *l* 23·46	*l* 26·52 *l* 27·68	*l* 25·50 *l* 25·72	*l* 25·34 *l* 24·34	*h* 23·50 *h* 24·70	*h* 26·04 *h* 24·86	*h* 25·36 *h* 27·86	*h* 25·98 *h* 27·72	
Means	23·04	26·59	23·82	27·10	25·61	24·84	24·10	25·45	26·61	26·85	123° 39′ 25″·40
IX & XII	*h* 31·20 *h* 33·60	*l* 31·16 *h* 35·10 *h* 32·94 *h* 33·60	*h* 31·04 *h* 29·88	*h* 32·14 *h* 33·66	*l* 30·58 *h* 34·00 *h* 35·64	*h* 34·00 *h* 34·86	*h* 33·96 *h* 30·56 *h* 31·56	*h* 34·48 *h* 37·14 *h* 37·32	*h* 35·22 *h* 37·26	*h* 35·94 *h* 35·24	Probability = 0·58
Means	32·40	33·20	30·46	32·90	33·41	34·43	32·03	36·31	36·24	35·59	52° 12′ 33″·70

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At XI—(Continued.)

April 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
X & IX	+83·04 −32·40	+86·59 −33·20	+83·82 −30·46	+87·10 −32·90	+85·61 −33·41	+84·84 −34·43	+84·10 −32·03	+85·45 −36·31	+86·61 −36·24	+86·85 −35·59	Probability = 0·49
123° 38′ −52° 12′	50·64	53·39	53·36	54·20	52·20	50·41	52·07	49·14	50·37	51·26	71° 26′ 51″·70
XII & XIII	*h*45·08 *h*45·38	*h*42·32 *h*44·08	*l* 47·88 *l* 48·08	*l* 43·90 *l* 42·78	*l* 43·40 *l* 42·66	*l* 42·08 *l* 42·66	*h*45·60 *h*45·62	*h*44·32 *h*44·14	*h*41·38 *h*40·92	*h*42·92 *h*44·54	Probability = 0·57
Means	45·23	43·20	47·98	43·34	43·03	42·37	45·61	44·23	41·15	43·73	55° 25′ 43″·99

At XII

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIV & XIII	*l*16·50 *l*14·87	*l*13·90 *l*16·30	*l*16·86 *l*15·83	*l*16·80 *l*17·40	*l*14·83 *l*16·90	*l*13·90 *l*14·66	*l*14·90 *l*14·87	*l*16·77 *l*15·63	*l*15·37 *l*15·43	*l*13·30 *l*12·30	*l*17·84 *l*17·90	*l*16·14 *l*15·36	Probability = 0·36
Means	15·69	15·10	16·35	17·10	15·87	14·28	14·89	16·20	15·40	12·80	17·87	15·75	47° 16′ 15″·61

April 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

	Seconds of Observed Angles at each Zero										
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
XIII & XI	*h*61·08 *h*58·84	*h*57·76 *h*57·40	*h*58·54 *h*61·72 *l* 59·86	*h*58·40 *h*59·08	*l* 61·06 *l* 62·24	*l* 58·30 *l* 60·08	*h*59·74 *h*62·46 *h*63·38	*h*63·20 *h*60·84	*h*59·46 *h*58·62	*h*57·18 *l* 58·96 *l* 58·98	Probability = 0·47
Means	59·96	57·58	60·04	58·74	61·65	59·19	61·86	62·02	59·04	58·37	48° 59′ 59″·85

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At XII—(Continued.)

April 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
XI & IX	*h*33·84 *h*34·20	*h*35·58 *h*37·06	*h*37·86 *h*35·28 *l* 33·64 *l* 33·42	*h*33·54 *h*35·12 *l* 32·14	*l* 33·66 *l* 34·50	*l* 35·40 *l* 35·00	*h*33·00 *h*31·82 *h*31·88	*h*32·60 *h*32·90	*h*35·88 *h*36·96	*h*33·56 *h*33·80 *l* 37·98 *l* 36·24	Probability = 0·43
Means	34·02	36·32	35·05	33·60	34·08	35·20	32·23	32·75	36·42	35·40	75° 33′ 34″·51
XI & VIII	*l* 14·14 *l* 18·34 *l* 19·36	*h*14·14 *h*13·90	*h*16·30 *h*16·14	*h*15·12 *h*13·74	*h*15·20 *h*15·86	*h*15·16 *h*13·92	*h*14·00 *h*12·12	*h*15·66 *h*13·82	*h*17·28 *h*13·96 *h*13·78	*h*12·70 *h*12·24	
Means	17·28	14·02	16·22	14·43	15·53	14·54	13·06	14·74	15·01	12·47	121° 8′ 14″·73
IX & VIII	+77·28 −34·02	+74·02 −36·32	+76·22 −35·05	+74·43 −33·60	+75·53 −34·08	+74·54 −35·20	+73·06 −32·23	+74·74 −32·75	+75·01 −36·42	+72·47 −35·40	Probability = 0·59
121° 7′ −75° 33′	43·26	37·70	41·17	40·83	41·45	39·34	40·83	41·99	38·59	37·07	45° 34′ 40″·22

At XIII

April 1851, *observed by Mr. J. Peyton with Lieut.-Colonel Waugh's* 24-*inch Theodolite No.* 1.

Angles.	Seconds of Observed Angles at each Zero										Probabilities and General Means.
	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 36′	28° 48′	208° 48′	
	″	″	″	″	″	″	″	″	″	″	
XI & XII	*h*20·14 *h*16·98 *h*17·94	*h*18·46 *h*16·48	*h*17·56 *h*16·14	*h*19·66 *h*18·12	*h*16·70 *h*18·26	*h*19·96 *h*19·20	*h*16·50 *h*18·90	*h*16·54 *h*17·78	*h*15·20 *h*18·02	*h*16·50 *h*18·20	Probability = 0·28
Means	18·35	17·47	16·85	18·89	17·48	19·58	17·70	17·16	16·61	17·35	75° 34′ 17″·74

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At XIII—(Continued.)

March and April 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
R M & XII	*l*37·53 *l*39·23	*h*39·20 *h*36·94	*h*35·20 *h*34·20	*h*37·23 *h*38·00	*h*37·74 *h*36·37	*h*37·40 *h*36·10	*l*36·44 *l*38·07 *l*36·90	*l*38·13 *l*36·07	*h*38·97 *h*39·00	*h*38·36 *h*37·07	*h*34·76 *h*34·73	*h*38·10 *h*36·83	
Means	38·38	38·07	34·70	37·62	37·06	36·75	37·14	37·10	38·99	37·72	34·75	37·47	2° 32′ 37″·15
XII & XIV	*l*26·87 *l*27·14	*h*25·66 *h*24·76	*h*25·43 *h*26·03	*h*23·43 *h*24·23	*h*25·90 *h*24·96	*h*24·66 *h*25·63	*l*28·46 *l*22·03 *l*27·73	*l*25·90 *l*26·07	*h*24·77 *h*25·33	*h*24·87 *h*26·17	*h*26·44 *h*27·10	*h*25·76 *h*27·30	Probability = 0·24
Means	27·01	25·21	25·73	23·83	25·43	25·15	26·07	25·99	25·05	25·52	26·77	26·53	67° 35′ 25″·69
XIV & XV	*l*35·87 *l*37·70	*h*37·10 *h*38·54	*h*38·97 *h*39·97	*h*40·67 *h*41·40	*h*40·33 *h*40·07	*l*40·07 *l*39·50	*l*34·14 *l*39·20 *l*34·63	*l*37·17 *l*38·46	*h*37·26 *h*37·47	*h*38·00 *h*38·20	*h*38·83 *h*38·77	*h*35·67 *h*36·74	Probability = 0·44
Means	36·79	37·82	39·47	41·04	40·20	39·79	35·99	37·82	37·37	38·10	38·80	36·21	59° 0′ 38″·28

At XIV

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVI & XV	*h*36·97 *h*35·77	*h*34·66 *h*34·64 *h*33·27	*l*34·87 *l*33·73 *l*31·27	*l*29·20 *l*30·07	*l*29·44 *l*29·37	*h*32·57 *h*33·07	*h*33·50 *h*34·83	*h*32·80 *h*33·40	*h*32·10 *h*33·93	*h*30·66 *h*32·73	*l*31·67 *l*30·87	*l*33·20 *l*34·34	Probability = 0·55
Means	36·37	34·19	33·29	29·64	29·41	32·82	34·17	33·10	33·02	31·70	31·27	33·77	62° 17′ 32″·73

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At XIV—(Continued.)

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XV & XIII	h25·84 h23·77	h23·40 h24·94	l22·87 l25·00	l23·26 l24·43	l26·46 l25·90	h23·24 h24·03	h24·43 h25·57	h22·60 h24·00	h24·13 h24·00	h25·20 h24·47	l24·03 l26·07	l22·90 l25·70	Probability = 0·22
Means	24·81	24·17	23·94	23·85	26·18	23·64	25·00	23·30	24·07	24·84	25·05	24·30	72° 0′ 24″·43
XIII & XII	h21·46 h18·13	h16·36 h18·13	l20·93 l19·94	l19·94 l19·37	l16·87 l18·73	h20·60 h20·00	h16·40 h18·83	h19·10 h18·87	h19·20 h18·57	h18·04 h19·16	l20·97 l20·83	l19·00 l17·30	Probability = 0·33
Means	19·80	17·25	20·44	19·66	17·80	20·30	17·62	18·99	18·89	18·60	20·90	18·15	65° 8′ 19″·03

At XV

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIII & XIV	h55·80 h55·34	h59·80 h57·83	h55·56 h56·70 l57·14	h56·03 h58·17	h60·16 h61·30	h57·23 h56·56	h59·63 h58·26	h58·03 h58·80	l55·20 l57·40	l59·34 l56·83	l59·43 l59·17	l57·27 l56·34	Probability = 0·42
Means	55·57	58·82	56·47	57·10	60·73	56·90	58·95	58·42	56·30	58·09	59·30	56·81	48° 58′ 57″·79
XIV & XVI	h45·16 h41·80 h43·30	h40·80 h42·37	h42·90 l45·60	h42·90 h41·43	h42·14 h42·30	h41·77 h42·97	h41·24 h42·90	h40·43 h41·13	l45·17 l43·20	l42·16 l43·03	l42·77 l42·63	l43·73 l44·46	Probability = 0·30
Means	43·42	41·59	44·25	42·17	42·22	42·37	42·07	40·78	44·19	42·60	42·70	44·10	58° 6′ 42″·71

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At XV—(Continued.)

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVI & XVII	*h*48·17 *h*50·36 *h*51·63	*h*50·40 *h*51·60	*h*54·30 *l*52·26	*h*54·03 *h*53·27	*h*52·06 *h*51·84	*h*52·47 *h*53·20	*h*53·63 *h*53·57	*h*51·67 *h*51·63	*l*50·33 *l*53·17	*l*52·44 *l*52·24	*l*49·73 *l*52·27	*l*54·03 *l*54·50	Probability = 0·35
Means	50·05	51·00	53·28	53·65	51·95	52·84	53·60	51·65	51·75	52·34	51·00	54·27	66° 32′ 52″·28

At XVI

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVIII & XVII	*h*21·14 *h*21·17	*h*21·54 *h*24·16	*l*25·67 *l*26·30	*l*26·00 *l*25·17	*l*25·47 *h*23·24	*h*25·37 *h*22·37	*h*23·30 *h*24·17	*h*23·94 *h*23·83	*h*25·13 *h*24·20	*h*25·50 *h*24·60	*h*23·67 *h*24·23	*h*24·53 *h*23·33	Probability = 0·35
Means	21·16	22·85	25·99	25·59	24·36	23·87	23·74	23·89	24·67	25·05	23·95	23·93	58° 39′ 24″·09
XVII & XV	*h*57·73 *h*58·60	*h*58·73 *h*59·20	*l*57·73 *l*55·83	*l*59·53 *l*58·97	*l*58·16 *h*55·86	*h*58·10 *h*56·37	*h*61·53 *h*58·90	*h*58·60 *h*57·77	*h*57·87 *h*58·20	*h*55·87 *h*57·36	*h*56·53 *h*57·23	*h*57·10 *h*57·34	Probability = 0·31
Means	58·17	58·97	56·78	59·25	57·01	57·24	60·22	58·19	58·04	56·62	56·88	57·22	61° 10′ 57″·88
XV & XIV	*l*42·03 *l*41·53	*l*43·73 *l*44·67	*l*44·17 *l*44·10	*l*45·20 *l*44·60	*l*43·80 *l*45·94	*l*46·56 *l*45·10	*h*46·47 *h*45·77	*h*47·26 *h*47·63	*h*48·93 *h*46·73	*h*48·30 *h*46·57	*h*45·97 *h*44·67	*h*46·43 *h*47·70	Probability = 0·49
Means	41·78	44·20	44·14	44·90	44·87	45·83	46·12	47·45	47·83	47·44	45·32	47·07	59° 35′ 45″·58

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At XVII

***March* 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.**

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XV & XVI	*l* 8·13	*l* 7·70	*l* 8·67	*l* 12·53	*l* 8·10	*h* 9·96	*l* 11·43	*l* 8·63	*l* 11·06	*l* 11·03	*l* 8·90	*l* 8·63	Probability = 0·30
	l 7·23	*l* 8·74	*l* 11·07	*l* 9·10	*l* 9·60	*h* 9·43	*l* 8·60	*l* 10·80	*l* 10·90	*l* 10·40	*l* 13·17	*l* 10·70	
Means	7·68	8·22	9·87	10·82	8·85	9·70	10·02	9·72	10·98	10·72	11·04	9·67	52° 16′ 9″·77
XVI & XVIII	*l* 40·04	*l* 41·00	*l* 40·73	*l* 38·10	*l* 41·70	*h* 36·40	*l* 40·90	*l* 41·57	*l* 37·87	*l* 40·43	*l* 41·04	*l* 40·40	Probability = 0·32
	l 41·37	*l* 40·70	*l* 39·43	*l* 40·37	*l* 40·40	*h* 37·90	*l* 38·64	*l* 40·37	*l* 38·60	*l* 39·56	*l* 38·16	*l* 38·40	
Means	40·71	40·85	40·08	39·24	41·05	37·15	39·77	40·97	38·24	40·00	39·60	39·40	55° 30′ 39″·76
XVIII & XIX	*h* 30·86	*h* 29·33	*l* 25·37	*l* 27·30	*l* 26·76	*h* 29·40	*l* 26·24	*l* 26·00	*l* 28·00	*l* 26·94	*l* 27·86	*l* 28·27	Probability = 0·26
	h 26·77	*h* 26·53	*l* 27·07	*l* 28·63	*l* 28·60	*h* 26·44	*l* 24·63	*l* 27·10	*l* 27·47	*l* 27·17	*l* 29·60	*l* 27·83	
	h 26·90												
Means	28·18	27·93	26·22	27·97	27·68	27·92	25·44	26·55	27·74	27·06	28·73	28·05	58° 11′ 27″·46

At XVIII

***March* 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.**

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XX & XIX	*h* 20·60	*l* 17·00	*l* 19·73	*l* 18·03	*l* 17·07	*l* 14·80	*l* 16·04	*l* 19·93	*l* 17·87	*l* 21·84	*l* 20·10	*l* 19·07	Probability = 0·37
	h 19·34	*l* 16·14	*l* 18·94	*l* 17·63	*l* 19·60	*l* 16·54	*l* 19·90	*l* 17·66	*l* 17·30	*l* 18·70	*l* 18·67	*l* 17·36	
	l 19·97												
Means	19·97	16·57	19·34	17·83	18·34	15·67	17·97	18·80	17·59	20·27	19·39	18·22	64° 23′ 18″·33

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At XVIII—(Continued.)

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIX & XVII	*h*53·90 *l*53·63	*l*55·70 *l*55·76	*l*55·27 *l*53·30	*l*53·44 *l*53·50	*l*57·24 *l*55·43	*l*57·53 *l*56·80	*l*56·33 *l*54·43	*l*55·80 *l*56·67	*l*55·36 *l*54·60	*l*54·80 *l*57·60	*l*55·60 *l*54·90	*l*54·07 *l*57·34	Probability = 0·30
Means	53·77	55·73	54·29	53·47	56·34	57·17	55·38	56·24	54·98	56·20	55·25	55·71	53° 6′ 55″·38
XVII & XVI	*h*58·17 *l*55·17	*l*57·94 *l*57·00	*l*52·80 *l*56·26	*l*57·50 *l*55·43	*l*55·76 *l*55·60	*l*58·37 *l*57·30	*l*55·40 *l*55·33	*l*56·37 *l*56·87	*l*59·34 *l*59·20	*l*55·33 *l*56·27	*l*55·03 *l*56·17	*l*57·66 *l*56·40	Probability = 0·35
Means	56·67	57·47	54·53	56·47	55·68	57·84	55·37	56·62	59·27	55·80	55·60	57·03	65° 49′ 56″·53

At XIX

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	80° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVII & XVIII	*l*36·37 *l*36·94	*l*39·56 *l*39·20	*l*38·06 *l*37·96	*l*37·00 *l*37·00	*l*39·96 *l*39·37	*l*36·00 *l*36·14	*h*36·37 *h*38·20	*h*38·24 *h*39·20	*h*40·77 *h*36·73	*h*34·23 *h*35·34	*h*37·60 *h*37·13	*h*38·03 *h*38·20	Probability = 0·40
Means	36·66	39·38	38·01	37·00	39·67	36·07	37·29	38·72	38·75	34·79	37·37	38·12	68° 41′ 37″·65
XVIII & XX	*h* 6·07 *h* 6·53	*h* 7·17 *h* 7·00	*h* 5·07 *h* 5·53	*l* 6·30 *l* 6·63	*l* 6·04 *l* 6·14	*l* 6·00 *l* 5·70	*l* 3·50 *l* 4·57	*h* 7·96 *h* 6·10	*h* 5·13 *h* 6·37	*h* 7·13 *h* 8·60	*h* 7·03 *h* 7·50	*h* 5·54 *h* 6·03	Probability = 0·28
Means	6·30	7·09	5·30	6·47	6·09	5·85	4·04	7·03	5·75	7·87	7·27	5·79	51° 57′ 6″·24
XX & XXI	*h* 4·73 *h* 3·97	*h* 5·16 *h* 3·66	*h* 4·53 *h* 3·14	*l* 3·44 *l* 2·64	*l* 3·36 *l* 3·30	*l* 5·56 *l* 3·17	*l* 3·97 *l* 4·20	*h* 5·00 *h* 3·93	*h* 2·90 *h* 3·23	*h* 3·50 *h* 2·86	*h* 2·30 *h* 2·07	*h* 3·80 *h* 4·97 *h* 2·37	Probability = 0·20
Means	4·35	4·41	3·84	3·04	3·33	4·37	4·09	4·47	3·07	3·18	2·19	3·71	65° 36′ 3″·67

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At XX

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXII & XXI	*h*16·76 *h*16·20	*h*15·07 *h*15·20	*h*15·10 *h*17·44	*h*13·76 *h*18·17	*h*17·80 *h*16·66	*h*16·34 *h*16·87	*h*13·00 *h*14·83	*h*15·80 *h*16·20	*h*12·66 *h*15·87	*l*15·90 *l*15·03	*l*15·64 *l*16·70	*l*15·10 *l*17·47	Probability = 0·27
Means	16·48	15·14	16·27	15·97	17·23	16·61	13·92	16·00	14·27	15·47	16·17	16·29	72° 41′ 15″·82
XXI & XIX	*h*58·47 *h*60·07	*h*59·80 *h*58·74	*h*59·24 *h*59·23	*h*57·67 *h*58·40	*h*59·50 *h*57·77	*h*60·00 *h*59·47	*h*60·20 *h*59·07	*h*58·03 *h*59·57	*h*60·37 *h*57·96	*l*56·04 *l*56·83	*l*57·80 *l*57·60	*l*59·63 *l*58·66	Probability = 0·26
Means	59·27	59·27	59·24	58·04	58·64	59·74	59·64	58·80	59·17	56·44	57·70	59·15	51° 19′ 58″·76
XIX & XVIII	*h*32·90 *h*31·60	*h*33·80 *h*35·03	*h*36·06 *h*34·63	*h*34·40 *h*34·63	*h*37·07 *h*35·20	*h*37·30 *h*38·50	*h*38·00 *h*36·37	*h*37·50 *h*37·40	*h*35·97 *h*36·77	*l*37·56 *l*36·47	*l*37·93 *l*38·63	*l*36·77 *l*37·14	Probability = 0·48
Means	32·25	34·42	35·35	34·52	36·14	37·90	37·19	37·45	36·37	37·02	38·28	36·96	63° 39′ 36″·15

At XXI

March 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIX & XX	*h*58·20 *h*58·64	*h*55·07 *h*56·70	*l*59·14 *l*58·10	*l*55·57 *l*56·40	*l*56·50 *l*57·44	*l*57·90 *l*59·24	*l*57·63 *l*59·16	*l*60·36 *l*59·30	*l*60·63 *l*58·77	*l*58·77 *l*58·00	*l*60·37 *l*60·43	*l*59·56 *l*59·53	Probability = 0·40
Means	58·42	55·89	58·62	55·99	56·97	58·57	58·40	59·83	59·70	58·39	60·40	59·55	63° 3′ 58″·39
XX & XXII	*h*39·70 *h*40·93	*h*39·56 *h*37·43	*l*33·80 *l*38·56	*l*39·86 *l*41·67	*l*38·40 *l*38·06	*l*39·73 *l*42·63	*l*37·70 *l*37·97	*l*39·54 *l*40·57	*l*40·04 *l*39·50	*l*41·83 *l*37·80	*l*36·30 *l*38·97	*l*39·90 *l*40·54	Probability = 0·42
Means	40·32	38·50	36·18	40·77	38·23	41·18	37·84	40·06	39·77	39·82	37·64	40·22	53° 55′ 39″·21
XXII & XXIII	*h*46·73 *h*49·53	*h*48·94 *h*51·44	*l*49·66 *l*49·40	*l*50·37 *l*46·63	*l*49·43 *l*51·50	*l*47·04 *l*47·60	*l*48·57 *l*51·43	*l*49·90 *l*49·66	*l*47·66 *l*50·90	*l*52·40 *l*51·07	*l*49·86 *l*48·70	*l*49·60 *l*49·96	Probability = 0·32
Means	48·13	50·19	49·53	48·50	50·47	47·32	50·00	49·78	49·28	51·74	49·28	49·78	59° 0′ 49″·50

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At XXII

February and March 1850, *observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIV & XXIII	h59·17 h60·80	l63·40 l65·00	l63·70 l62·06	l59·20 l63·20 l59·87	h59·54 h61·60	l61·36 l61·93	h64·16 h65·37	l64·30 l64·37	l62·84 l61·63	l61·73 l61·10	l61·63 l62·77	l63·83 l60·93	Probability = 0·43
Means	59·99	64·20	62·88	60·76	60·57	61·65	64·77	64·34	62·24	61·42	62·20	62·38	61° 33′ 62″·28
XXIII & XXI	l33·66 l34·17	l35·44 l34·30	l34·07 l33·00	l38·10 l32·73 l37·70	h33·33 h35·73	l33·44 l33·34	l37·67 l33·64 l34·14	l36·24 l34·20	l36·06 l37·74	l35·20 l35·87	l32·70 l32·50	l33·00 l32·47	Probability = 0·37
Means	33·92	34·87	33·54	36·18	34·53	33·39	35·15	35·22	36·90	35·54	32·60	32·74	52° 52′ 34″·55
XXI & XX	l9·07 l9·03	l8·23 l7·36	l6·73 l7·20	l4·47 l5·90 l5·90	l3·90 l4·57 l6·10	l6·40 l5·10	l3·33 l5·13	l2·76 l3·93	l6·50 l5·13	l4·50 l3·76	l3·47 l4·27	l5·00 l5·13	Probability = 0·47
Means	9·05	7·80	6·97	5·42	4·86	5·75	4·23	3·35	5·82	4·13	3·87	5·07	53° 23′ 5″·53

At XXIII

February 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	.190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXI & XXII	l32·57 l35·54	l34·47 l35·47	l35·63 l35·30	l32·44 l37·07	l37·87 l37·50	l34·10 l35·54	l38·07 l39·57	l37·46 l36·10	h35·33 h34·57 l34·84	l35·94 l39·17	l35·87 l35·76	l41·90 l40·86	Probability = 0·59
Means	34·06	34·97	35·47	34·76	37·69	34·82	38·82	36·78	34·91	37·56	35·82	41·38	68° 6′ 36″·42

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At XXIII—(Continued.)

***February* 1850, *observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No.* 2.**

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXII & XXIV	*l* 18·33 *l* 21·93	*l* 21·13 *l* 20·23	*l* 22·13 *l* 20·84	*l* 18·76 *l* 18·73	*l* 18·43 *l* 20·07	*l* 23·73 *l* 21·50	*l* 16·77 *l* 14·73	*l* 16·90 *l* 17·73	*l* 18·36 *l* 17·24	*l* 16·93 *l* 19·03	*l* 22·74 *l* 15·93	*l* 16·67 *l* 18·90	Probability = 0·53
Means	20·13	20·68	21·49	18·75	19·25	22·62	15·75	17·32	17·80	17·98	19·34	17·79	62° 47′ 19″·08
XXIV & XXV	*l* 60·80 *l* 58·10	*l* 59·14 *l* 60·67	*l* 60·80 *l* 58·53	*l* 56·43 *l* 57·34	*l* 56·80 *l* 57·10	*l* 60·07 *l* 58·84	*l* 57·93 *l* 58·43	*l* 60·44 *l* 61·00	*l* 60·54 *l* 57·83	*l* 60·30 *l* 58·57	*l* 61·34 *l* 57·53	*l* 59·90 *l* 57·67	Probability = 0·32
Means	59·45	59·91	59·67	56·89	56·95	59·46	58·18	60·72	59·19	59·44	59·44	58·79	64° 42′ 59″·01

At XXIV

***February* 1850, *observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No.* 2.**

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXVI & XXV	*l* 45·20 *l* 45·00	*l* 42·90 *l* 44·24	*l* 47·27 *l* 44·40	*l* 43·47 *l* 42·53	*l* 45·37 *l* 42·73	*l* 43·80 *l* 45·43	*l* 43·37 *l* 43·36 *h* 44·03	*h* 42·63 *h* 45·43	*h* 45·87 *h* 47·50	*l* 42·37 *l* 44·87	*l* 44·76 *l* 45·17	*l* 43·47 *l* 44·70	Probability = 0·29
Means	45·10	43·57	45·84	43·00	44·05	44·62	43·59	44·03	46·69	43·62	44·97	44·09	44° 55′ 44″·43
XXV & XXII	*l* 43·93 *l* 41·40	*l* 44·04 *l* 43·00	*l* 43·83 *l* 44·13	*l* 42·73 *l* 43·80	*l* 44·50 *l* 44·40	*l* 43·70 *l* 43·53	*l* 42·16 *l* 42·90 *h* 43·87	*h* 43·37 *h* 44·37	*h* 42·76 *h* 43·04	*l* 44·33 *l* 44·60	*l* 43·40 *l* 43·86	*l* 44·46 *l* 45·64	
Means	42·67	43·52	43·98	43·27	44·45	43·62	42·98	43·87	42·90	44·47	43·63	45·05	119° 7′ 43″·70
XXIII & XXII	*l* 39·70 *l* 38·33	*l* 38·60 *l* 38·17	*l* 44·60 *l* 43·43	*l* 39·77 *l* 41·43	*l* 37·14 *l* 39·03	*l* 39·37 *l* 39·14	*l* 37·44 *l* 38·93	*l* 40·83 *l* 41·10	*l* 40·86 *l* 38·80	*l* 41·63 *l* 38·40	*l* 41·26 *l* 39·96	*l* 38·56 *l* 39·24	Probability = 0·45
Means	39·02	38·39	44·02	40·60	38·09	39·26	38·19	40·97	39·83	40·02	40·61	38·90	55° 38′ 39″·83

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At XXIV—(Continued.)

February 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.	
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′		
XXV & XXIII	″ + 102·67 − 39·02	″ + 103·52 − 38·39	″ + 103·98 − 44·02	″ + 103·27 − 40·60	″ + 104·45 − 38·09	″ + 103·62 − 39·26	″ + 102·98 − 38·19	″ + 103·87 − 40·97	″ + 102·90 − 39·83	″ + 104·47 − 40·02	″ + 103·63 − 40·61	+ 105·05 − 38·90	Probability = 0·48	63° 28′ 63″·88
119° 6′ −55° 38′	63·65	65·13	59·96	62·67	66·36	64·36	64·79	62·90	63·07	64·45	63·02	66·15		

At XXV

February 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probablities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXIII & XXIV	″ *l*58·90 *l*57·10	″ *l*59·63 *l*57·36	″ *l*56·00 *l*58·86	″ *l*59·50 *l*60·53	″ *l*59·37 *l*56·97	″ *l*59·77 *l*60·80	″ *l*58·30 *l*58·73	″ *l*57·20 *l*56·67	″ *l*58·37 *l*58·53	″ *l*57·96 *l*57·50	″ *l*56·20 *l*56·43	″ *l*59·96 *l*59·90	Probability = 0·34
Means	58·00	58·50	57·43	60·02	58·17	60·29	58·52	56·94	58·45	57·73	56·32	59·93	51° 47′ 58″·36
XXIV & XXVI	*l*25·97 *l*24·83	*l*25·16 *l*24·90	*l*24·56 *l*25·70	*l*23·10 *l*22·53	*l*26·77 *l*27·17	*l*26·80 *l*28·60	*l*26·70 *l*26·43	*l*22·67 *l*23·80	*l*27·54 *l*27·90	*l*25·24 *l*24·67	*l*26·74 *l*23·87	*l*27·64 *l*27·96	Probability = 0·46
Means	25·40	25·03	25·13	22·82	26·97	27·70	26·57	23·24	27·72	24·96	25·31	27·80	60° 29′ 25″·72
XXVI & XXVII	*h*48·57 *h*48·67	*h*49·50 *h*49·84	*l*50·00 *l*50·86	*l*47·53 *l*49·54	*l*46·73 *l*47·77	*l*49·96 *l*48·70	*l*49·86 *l*48·40	*l*49·53 *l*48·94	*l*47·83 *l*48·03	*l*49·63 *l*45·77	*l*50·23 *l*51·90	*l*47·56 *l*47·57	Probability = 0·32
Means	48·62	49·67	50·43	48·54	47·25	49·33	49·13	49·24	47·93	47·70	51·07	47·57	68° 17′ 48″·87

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At XXVI

February 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXVIII & XXVII	″ h45·27 h44·13	″ h45·57 h43·84	″ h43·40 h45·10	″ h46·70 h46·46 h44·80	″ h44·40 h43·67	″ h43·84 h42·94 h45·37	″ l45·83 l45·57	″ l44·63 l44·77	″ l45·30 l44·70	″ l42·33 l44·43 l44·30	″ l45·60 l44·14	″ l43·50 l46·23	Probability = 0·18
Means	44·70	44·71	44·25	45·99	44·04	44·05	45·70	44·70	45·00	43·69	44·87	44·87	55° 25′ 44″·71
XXVII & XXV	h35·63 h36·34	h36·74 h37·94	h39·26 h37·03	h35·24 h38·17 h38·43	h37·73 h38·97	h37·06 h38·16	l39·13 l38·50	l38·30 l38·20	l40·93 l40·07	l38·44 l38·13	l42·10 l39·63	h42·10 h36·83 h38·64	Probability = 0·37
Means	35·99	37·34	38·15	37·28	38·35	37·61	38·82	38·25	40·50	38·29	40·87	39·19	57° 39′ 38″·39
XXV & XXIV	h51·00 h50·43	h52·63 h49·43	h48·00 h50·27	h52·90 h49·23 h51·40	h50·74 h50·73	h51·67 h52·57	l48·07 l46·53	l48·40 l49·96	l51·07 l52·17	l51·80 l51·20	l49·04 l51·10	h49·17 h52·17 h52·00	Probability = 0·37
Means	50·72	51·03	49·14	51·18	50·74	52·12	47·30	49·18	51·62	51·50	50·07	51·11	74° 34′ 50″·48

At XXVII

February 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXV & XXVI	″ h32·87 h32·77	″ h34·67 h33·40	″ h32·94 h33·90	″ h33·63 h32·50	″ h31·76 h36·27 h33·94	″ h31·56 h33·20	″ h34·17 h34·93	″ h34·76 h34·63	″ h33·98 h33·37	″ h32·83 h33·77	″ h35·14 h34·13	″ h33·10 h33·03	Probability = 0·21
Means	32·82	34·04	33·42	33·07	33·99	32·38	34·55	34·70	33·68	33·30	34·64	33·07	54° 2′ 33″·64
XXVI & XXVIII	h24·16 h25·40	h22·33 h24·33	h25·56 h24·34	h24·53 h24·20	h26·57 h25·13	h26·00 h25·47	h22·77 h22·80	h24·70 h23·93	h25·20 h25·77	h24·26 h26·50	h25·40 h24·90	h23·60 h24·24	Probability = 0·27
Means	24·78	23·33	24·95	24·37	25·85	25·74	22·79	24·32	25·49	25·38	25·15	23·92	55° 14′ 24″·67

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At XXVII—(Continued.)

February 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXVIII & XXIX	*h*62·24 *h*61·03	*h*62·47 *h*61·73	*h*59·47 *h*60·43	*h*61·10 *h*61·86	*h*62·33 *h*62·07	*h*62·94 *h*61·43	*h*61·63 *h*60·60	*h*60·97 *h*62·97	*h*61·90 *h*59·97	*h*63·07 *h*60·30	*h*59·43 *h*60·57	*h*62·67 *h*61·86	Probability = 0·23
Means	61·64	62·10	59·95	61·48	62·20	62·19	61·12	61·97	60·94	61·69	60·00	62·27	58° 42′ 61″·46

At XXVIII

February 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXX & XXIX	*h*40·27 *h*40·77	*h*40·90 *h*39·67	*h*38·33 *h*37·17 *h*38·27	*h*38·03 *h*37·96	*h*39·56 *h*39·43	*h*39·57 *h*39·93	*h*38·40 *h*39·80	*h*40·50 *h*39·87	*h*37·34 *h*38·23	*h*38·74 *h*41·03	*h*39·70 *h*38·77 *h*38·93	*h*38·97 *h*41·67 *h*41·03	Probability = 0·28
Means	40·52	40·29	37·92	38·00	39·50	39·75	39·10	40·19	37·79	39·89	39·13	40·56	68° 22′ 39″·39
XXIX & XXVII	*h*46·36 *h*48·33	*h*46·27 *h*48·66	*h*50·17 *h*48·06 *h*49·50	*h*48·70 *h*49·14	*h*50·00 *h*50·37	*h*48·83 *h*49·57	*h*50·20 *h*48·43	*h*49·20 *h*49·30	*h*50·06 *h*47·74	*h*50·46 *h*49·70	*h*50·53 *h*51·47 *h*48·40	*h*50·10 *h*47·70 *h*47·87	Probability = 0·26
Means	47·35	47·47	49·24	48·92	50·19	49·20	49·32	49·25	48·90	50·08	50·13	48·56	63° 51′ 49″·05
XXVII & XXVI	*h*50·74 *h*49·67	*h*52·87 *h*52·37	*h*51·30 *h*54·80 *h*51·13	*h*54·50 *h*53·56	*h*49·77 *h*51·37	*h*51·24 *h*50·56	*h*49·16 *h*50·24	*h*51·37 *h*51·60	*h*49·80 *h*51·83	*h*50·30 *h*50·54	*h*47·60 *h*51·03 *h*49·23	*h*51·16 *h*52·80 *h*50·66	Probability = 0·37
Means	50·21	52·62	52·41	54·03	50·57	50·90	49·70	51·49	50·82	50·42	49·29	51·54	69° 19′ 51″·17

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At XXIX

***February* 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.**

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXVII & XXVIII	″ h 9.13 h 10.87 h 10.40	″ h 10.43 h 8.36 h 9.23	″ h 8.03 h 10.33	″ h 9.20 h 11.13	″ h 10.20 h 10.10	″ h 10.00 h 8.94	″ h 10.80 h 10.00	″ h 10.36 h 11.47	″ h 10.63 h 10.86	″ h 10.00 h 10.93	″ h 10.83 h 10.84	″ h 8.94 h 10.03	Probability = 0.17
Means	10.13	9.34	9.18	10.17	10.15	9.47	10.40	10.92	10.75	10.47	10.84	9.49	57° 25′ 10″.11
XXVIII & XXX	h 41.67 h 44.93 h 44.50	h 43.53 h 44.30 h 43.33	h 40.77 h 40.94	h 40.47 h 40.90	h 41.87 h 41.27	h 41.77 h 42.00	h 42.73 h 42.00	h 41.74 h 41.60	h 42.63 h 41.07	h 40.63 h 41.10	h 41.13 h 41.33	h 42.00 h 41.10	Probability = 0.28
Means	43.70	43.72	40.86	40.69	41.57	41.89	42.37	41.67	41.85	40.87	41.23	41.55	55° 6′ 41″.83
XXX & XXXI	h 5.77 h 3.40 h 2.50	h 0.87 h 3.90 h 1.47	h 3.40 h 2.70	h 2.83 h 3.30	h 2.63 h 3.40	h 3.60 h 3.90	h 1.53 h 3.20	h 3.16 h 3.13	h 2.97 h 4.37	h 4.50 h 2.40	h 0.77 h 2.53 h 3.74	h 2.50 h 4.17	Probability = 0.16
Means	3.89	2.08	3.05	3.07	3.02	3.75	2.37	3.15	3.67	3.45	2.35	3.34	65° 3′ 3″.10

At XXX

***January and February* 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.**

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXII & XXXI	″ h 7.70 h 7.80	″ h 5.83 h 7.20	″ h 6.76 h 7.40	″ h 6.87 h 7.67	″ h 7.70 h 6.64	″ h 8.30 h 8.27	″ h 8.00 h 7.83	″ h 6.00 h 6.56	″ h 5.36 h 5.96	″ h 7.03 h 6.04	″ h 9.03 h 7.50	″ h 6.80 h 7.50	Probability = 0.22
Means	7.75	6.52	7.08	7.27	7.17	8.29	7.92	6.28	5.66	6.54	8.27	7.15	57° 33′ 7″.16

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At XXX—(Continued.)

January and February 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXI & XXIX	″ *h*13·50 *h*13·33	″ *h*14·57 *h*14·30	″ *h*14·43 *h*14·93	″ *h*14·93 *h*13·60	″ *l*11·00 *l*14·86 *l*13·47	″ *h*13·84 *h*13·90	″ *h*14·37 *h*14·33	″ *h*14·13 *h*14·83	″ *h*13·40 *h*13·26	″ *h*16·40 *h*16·14	″ *h*12·37 *h*12·20	″ *h*13·53 *h*12 27	Probability = 0·29
Means	13·42	14·44	14·68	14·27	13·11	13·87	14·35	14·48	13·33	16·27	12·29	12·90	57° 8′ 13″·95
XXIX & XXVIII	*h*39·14 *h*39·33	*h*38·70 *h*39·13	*h*38·80 *h*39·07	*h*41·67 *h*41·90	*l*41·14 *l*39·40 *l*41·10	*h*38·33 *h*40·76	*h*39·60 *h*38·84	*h*38·37 *h*37·40	*h*41·20 *h*38·80	*h*39·80 *h*37·36	*h*39·10 *h*40·67	*h*36·40 *h*37·50	Probability = 0·34
Means	39·24	38·92	38·94	41·79	40·55	39·55	39·22	37·89	40·00	38·58	39·89	36·95	56° 30′ 39″·29

At XXXI

January 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXIX & XXX	″ *h*43·43 *h*43·94	″ *h*43·90 *h*42·90	″ *h*44·43 *h*43·90	″ *h*42·50 *h*44·03	″ *h*45·54 *h*44·04	″ *h*44·50 *h*47·10 *h*41·57	″ *h*44·10 *h*44·34	″ *h*44·10 *h*44·40	″ *h*43·53 *h*42·03	″ *h*42·23 *h*43·13	″ *h*45·14 *h*42·80	″ *h*39·37 *h*44·00 *h*44·46	Probability = 0·20
Means	43·69	43·40	44·17	43·27	44·79	44·39	44·22	44·25	42·78	42·68	43·97	42·61	57° 48′ 43″·69
XXX & XXXII	*h*27·70 *h*27·96	*h*26·74 *h*27·03	*h*27·14 *h*28·07	*h*27·97 *h*27·57	*h*29·20 *h*30·63	*h*31·80 *h*27·13 *h*29·00	*h*27·43 *h*27·56	*h*27·83 *h*27·47	*h*29·27 *h*28·03	*h*29·60 *h*29·50	*h*29·03 *h*28·96	*h*32·53 *h*31·17	Probability = 0·38
Means	27·83	26·89	27·61	27·77	29·92	29·31	27·50	27·65	28·65	29·55	29·00	31·85	52° 7′ 28″·63

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At XXXI—(Continued.)

January 1850, *observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXII & XXXIII	*h*45·23 *h*46·34	*h*46·50 *h*46·74	*h*46·66 *h*46·57	*h*45·87 *h*46·80	*h*45·56 *h*46·70	*h*43·80 *h*44·00 *h*47·36	*h*45·87 *h*45·30	*h*46·27 *h*46·20	*h*44·13 *h*46·10	*h*44·27 *h*44·67	*h*43·93 *h*43·97	*h*45·80 *h*46·63	Probability = 0·24
Means	45·79	46·62	46·62	46·34	46·13	45·05	45·59	46·24	45·12	44·47	43·95	46·22	52° 34′ 45″·68
XXXIII & XXXIV	*h*56·47 *h*55·46	*h*55·60 *h*55·23	*h*55·40 *h*56·70	*h*56·33 *h*55·36	*h*56·14 *h*54·87	*h*58·77 *h*60·47 *h*57·44	*h*55·73 *h*56·64	*h*55·07 *h*57·00	*h*56·34 *h*54·34	*h*56·83 *h*54·40	*h*58·47 *h*56·77 *h*53·76	*h*54·40 *h*53·20	Probability = 0·32
Means	55·97	55·42	56·05	55·85	55·51	58·89	56·19	56·04	55·34	55·62	56·33	53·80	67° 31′ 55″·92

At XXXII

January 1850, *observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXIII & XXXI	*h*58·96 *h*61·90 *h*57·83	*h*58·80 *h*57·53	*h*56·73 *h*59·64 *h*60·33	*h*59·54 *h*58·80	*h*60·70 *h*59·90	*h*58·23 *l*60·14	*h*58·77 *h*58·07	*h*59·43 *h*61·90	*h*58·90 *h*58·00	*h*58·44 *h*59·84	*h*61·10 *h*59·93	*h*58·86 *h*57·44	Probability = 0·25
Means	59·56	58·17	58·90	59·17	60·30	59·19	58·42	60·67	58·45	59·14	60·52	58·15	65° 28′ 59″·22

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At XXXII—(Continued.)

January 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXI & XXX	*h*27·17	*h*27·06	*h*27·14	*h*24·76	*h*24·30	*h*24·27	*h*26·87	*h*22·50	*h*25·70	*h*24·50	*h*24·53	*h*26·67	Probability = 0·34
	*h*23·80	*h*25·97	*h*25·96	*h*24·90	*h*23·66	*l*25·66	*h*25·10	*h*22·90	*h*26·33	*h*23·66	*h*23·67	*h*26·36	
	*h*24·67												
Means	25·21	26·52	26·55	24·83	23·98	24·97	25·99	22·70	26·02	24·08	24·10	26·52	70° 19′ 25″·12

At XXXIII

January 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXVI & XXXV	*h*17·17	*h*12·73	*h*17·57	*h*15·46	*h*17·90	*h*17·23	*h*15·94	*h*17·70	*h*15·44	*h*16·04	*h*16·27	*h*16·16	Probability = 0·24
	*h*17·34	*h*14·27	*h*16·37	*h*15·03	*h*15·90	*h*16·24	*h*15·47	*h*16·93	*h*15·17	*h*15·90	*h*15·77	*h*16·96	
		*h*16·70											
Means	17·26	14·57	16·97	15·25	16·90	16·74	15·71	17·32	15·31	15·97	16·02	16·56	56° 28′ 16″·22
XXXV & XXXIV	*h*47·33	*h*44·90	*h*44·57	*h*45·20	*h*43·87	*h*47·10	*h*46·80	*h*43·54	*h*45·20	*h*44·23	*l*41·83	*l*43·97	Probability = 0·38
	*h*46·83	*h*46·16	*h*45·33	*h*45·47	*h*43·67	*h*45·60	*h*46·60	*h*42·17	*h*43·10	*h*46·00	*l*44·00	*l*45·87	
Means	47·08	45·53	44·95	45·34	43·77	46·35	46·70	42·86	44·15	45·12	42·92	44·92	69° 55′ 44″·97
XXXIV & XXXI	*h*13·64	*h*17·10	*h*14·90	*h*14·90	*h*17·30	*h*16·73	*h*13·83	*h*14·96	*h*16·40	*h*16·60	*l*15·53	*l*16·07	Probability = 0·31
	*h*14·90	*h*16·10	*h*16·16	*h*14·57	*h*18·17	*h*17·46	*h*14·60	*h*16·67	*h*18·26	*h*16·73	*l*15·26	*l*16·83	
							*h*15·64						
Means	14·27	16·60	15·53	14·74	17·74	17·10	14·69	15·82	17·33	16·67	15·39	16·45	56° 1′ 16″·03
XXXI & XXXII	*h*14·77	*h*17·93	*h*14·87	*h*14·94	*h*13·43	*h*14·87	*h*15·97	*h*16·87	*h*16·93	*h*15·60	*l*18·40	*l*15·03	Probability = 0·29
	*h*16·20	*h*16·94	*h*15·34	*h*16·33	*h*15·70	*h*14·34	*h*15·30	*h*15·73	*h*16·74	*h*13·97	*l*16·54	*l*14·84	
							*h*15·20						
Means	15·49	17·44	15·11	15·64	14·57	14·61	15·49	16·30	16·84	14·79	17·47	14·94	61° 56′ 15″·72

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At XXXI—(Continued.)

January 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXII & XXXIII	″ h45·23 h46·34	″ h46·50 h46·74	″ h46·66 h46·57	″ h45·87 h46·80	″ h45·56 h46·70	″ h43·80 h44·00 h47·36	″ h45·87 h45·30	″ h46·27 h46·20	″ h44·13 h46·10	″ h44·27 h44·67	″ h43·93 h43·97	″ h45·80 h46·63	Probability = 0·24
Means	45·79	46·62	46·62	46·34	46·13	45·05	45·59	46·24	45·12	44·47	43·95	46·22	52° 34′ 45″·68
XXXIII & XXXIV	h56·47 h55·46	h55·60 h55·23	h55·40 h56·70	h56·33 h55·36	h56·14 h54·87	h58·77 h60·47 h57·44	h55·73 h56·64	h55·07 h57·00	h56·34 h54·34	h56·83 h54·40	h58·47 h56·77 h53·76	h54·40 h53·20	Probability = 0·32
Means	55·97	55·42	56·05	55·85	55·51	58·89	56·19	56·04	55·34	55·62	56·33	53·80	67° 31′ 55″·92

At XXXII

January 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXIII & XXXI	″ h58·96 h61·90 h57·83	″ h58·80 h57·53	″ h56·73 h59·64 h60·33	″ h59·54 h58·80	″ h60·70 h59·90	″ h58·23 l60·14	″ h58·77 h58·07	″ h59·43 h61·90	″ h58·90 h58·00	″ h58·44 h59·84	″ h61·10 h59·93	″ h58·86 h57·44	Probability = 0·25
Means	59·56	58·17	58·90	59·17	60·30	59·19	58·42	60·67	58·45	59·14	60·52	58·15	65° 28′ 59″·22

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At XXXII—(Continued.)

January 1850, *observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXI & XXX	″ *h*27·17 *h*23·80 *h*24·67	″ *h*27·06 *h*25·97	″ *h*27·14 *h*25·96	″ *h*24·76 *h*24·90	″ *h*24·30 *h*23·66	″ *h*24·27 *l*25·66	″ *h*26·87 *h*25·10	″ *h*22·50 *h*22·90	″ *h*25·70 *h*26·33	″ *h*24·50 *h*23·66	″ *h*24·53 *h*23·67	″ *h*26·67 *h*26·36	Probability = 0·34
Means	25·21	26·52	26·55	24·83	23·98	24·97	25·99	22·70	26·02	24·08	24·10	26·52	70° 19′ 25″·12

At XXXIII

January 1850, *observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXVI & XXXV	″ *h*17·17 *h*17·34	″ *h*12·73 *h*14·27 *h*16·70	″ *h*17·57 *h*16·37	″ *h*15·46 *h*15·03	″ *h*17·90 *h*15·90	″ *h*17·23 *h*16·24	″ *h*15·94 *h*15·47	″ *h*17·70 *h*16·93	″ *h*15·44 *h*15·17	″ *h*16·04 *h*15·90	″ *h*16·27 *h*15·77	″ *h*16·16 *h*16·96	Probability = 0·24
Means	17·26	14·57	16·97	15·25	16·90	16·74	15·71	17·32	15·31	15·97	16·02	16·56	56° 28′ 16″·22
XXXV & XXXIV	*h*47·33 *h*46·83	*h*44·90 *h*46·16	*h*44·57 *h*45·33	*h*45·20 *h*45·47	*h*43·87 *h*43·67	*h*47·10 *h*45·60	*h*46·80 *h*46·60	*h*43·54 *h*42·17	*h*45·20 *h*43·10	*h*44·23 *h*46·00	*l*41·83 *l*44·00	*l*43·97 *l*45·87	Probability = 0·38
Means	47·08	45·53	44·95	45·34	43·77	46·35	46·70	42·86	44·15	45·12	42·92	44·92	69° 55′ 44″·97
XXXIV & XXXI	*h*13·64 *h*14·90	*h*17·10 *h*16·10	*h*14·90 *h*16·16	*h*14·90 *h*14·57	*h*17·30 *h*18·17	*h*16·73 *h*17·46	*h*13·83 *h*14·60 *h*15·64	*h*14·96 *h*16·67	*h*16·40 *h*18·26	*h*16·60 *h*16·73	*l*15·53 *l*15·26	*l*16·07 *l*16·83	Probability = 0·31
Means	14·27	16·60	15·53	14·74	17·74	17·10	14·69	15·82	17·33	16·67	15·39	16·45	56° 1′ 16″·03
XXXI & XXXII	*h*14·77 *h*16·20	*h*17·93 *h*16·94	*h*14·87 *h*15·34	*h*14·94 *h*16·33	*h*13·43 *h*15·70	*h*14·87 *h*14·34	*h*15·97 *h*15·30 *h*15·20	*h*16·87 *h*15·73	*h*16·93 *h*16·74	*h*15·60 *h*13·97	*l*18·40 *l*16·54	*l*15·03 *l*14·84	Probability = 0·29
Means	15·49	17·44	15·11	15·64	14·57	14·61	15·49	16·30	16·84	14·79	17·47	14·94	61° 56′ 15″·72

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At XXXIV

January 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXI & XXXIII	″ *h*48·44 *h*48·56	″ *h*49·73 *h*51·43	″ *h*48·94 *h*47·50	″ *h*49·50 *h*50·60	″ *h*49·90 *h*47·70	″ *h*48·54 *h*48·97	″ *l*49·47 *l*50·50	″ *l*47·10 *l*48·34	″ *h*51·87 *h*49·23	*h* *h*45·83 *h*49·83	″ *l*51·60 *l*48·47	″ *l*47·37 *l*49·80	Probability = 0·29
Means	48·50	50·58	48·22	50·05	48·80	48·76	49·99	47·72	50·55	47·83	50·04	48·59	56° 26′ 49″·14
XXXIII & XXXV	*h*10·13 *h*10·17	*h* 7·77 *h* 8·70	*h* 8·66 *h* 8·53	*h* 9·43 *h* 9·53	*h*10·76 *h*13·03 *h* 9·57	*h*10·60 *h*10·43	*l*10·70 *l* 8·47	*l*10·50 *l* 7·96	*h* 8·83 *h*11·87	*h*10·40 *h* 9·43	*l* 8·63 *l* 7·13	*l*11·60 *l* 7·90	Probability = 0·26
Means	10·15	8·24	8·60	9·48	11·12	10·52	9·59	9·23	10·35	9·92	7·88	9·75	49° 47′ 9″·57

At XXXV

December 1849, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXIV & XXXIII	″ *h* 5·73 *h* 7·10	″ *h* 5·36 *h* 5·24	″ *h* 5·60 *h* 6·37	″ *h* 4·90 *h* 7·16	″ *h* 4·44 *h* 5·16	″ *h* 6·64 *h* 7·03	″ *h* 7·60 *h* 4·44 *h* 8·73	″ *h* 7·43 *h* 5·53	″ *h* 7·07 *h* 6·63	″ *h* 7·23 *h* 6·07 *h* 6·83	″ *h* 7·57 *h* 7·54	″ *h* 5·97 *h* 5·94	Probability = 0·21
Means	6·42	5·30	5·99	6·03	4·80	6·84	6·92	6·48	6·85	6·71	7·56	5·96	60° 17′ 6″·32
XXXIII & XXXVI	*h*16·60 *h*16·80	*h*17·00 *h*19·43	*h*14·37 *h*17·16	*h*17·40 *h*16·50	*h*17·20 *h*16·87	*h*14·70 *h*16·17	*h*16·00 *h*18·43 *h*15·67	*h*15·54 *h*15·80	*h*16·40 *h*18·17	*h*17·07 *h*16·56 *h*17·47	*h*18·17 *h*17·83	*h*12·46 *h*13·06	Probability = 0·40
Means	16·70	18·22	15·77	16·95	17·04	15·44	16·70	15·67	17·29	17·03	18·00	12·76	65° 9′ 16″·46

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At XXXV—(Continued.)

December 1849, *observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXVI & XXXVII	″ h 4·33 h 4·17	″ h 2·40 h 0·33	″ h 3·70 h 2·90	″ h 2·30 h 0·14	″ h 4·06 h 2·00	″ h 4·73 h 2·57	″ h 3·74 h 1·60 h 5·03	″ h 1·46 h 3·63	″ h 4·47 h 3·07	″ h 0·66 h 0·87 h 2·23	″ h 0·83 h 1·57	″ h 7·07 h 5·94	Probability = 0·44
Means	4·25	1·37	3·30	1·22	3·03	3·65	3·46	2·55	3·77	1·25	1·20	6·51	61° 13′ 2″·96
XXXIII & R M	h18·13 h19·17	h18·17 h17·60	h16·30 h17·96	h17·60 h17·50	h18·66 h17·57	h17·93 h16·80	h17·44 h19·03 h18·90	h16·37 h16·60	h20·60 h20·80	h18·77 h17·56 h17·30	h18·17 h18·53	h18·43 h18·13	
Means	18·65	17·89	17·13	17·55	18·12	17·37	18·46	16·49	20·70	17·88	18·35	18·28	27° 12′ 18″·07

At XXXVI

January 1850, *observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXVIII & XXXVII	″ l45·23 l43·23	″ l45·37 l46·73	″ l42·97 l44·67	″ l42·30 l45·07	″ h42·77 h42·76	″ h43·17 h42·40	″ h45·43 h44·40	″ h42·73 h45·50	″ h45·70 h46·64	″ h42·70 h43·70	″ l44·40 l44·94	″ h44·87 h43·03	Probability = 0·31
Means	44·23	46·05	43·82	43·69	42·77	42·79	44·92	44·12	46·17	43·20	44·67	43·95	44° 49′ 44″·20
XXXVII & XXXV	l45·33 l46·33	l45·80 l44·17	l48·70 l45·63	l47·90 l44·70	h48·17 h46·50	h46·53 h46·80	h47·54 h50·83 h48·53	h50·20 h47·57 h47·40	h46·80 h45·30	h45·74 h46·16	l45·60 l43·70	h47·06 h46·17	Probability = 0·35
Means	45·8	44·99	47·17	46·30	47·34	46·67	48·97	48·39	46·05	45·95	44·65	46·62	69° 49′ 46″·58

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At XXXVI—(Continued.)

January 1850, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXV & XXXIII	″ *l* 29·84 *l* 30·17	″ *l* 25·80 *l* 27·20	″ *l* 26·80 *l* 30·67	″ *l* 29·23 *l* 28·46	″ *l* 25·17 *l* 24·30	″ *l* 30·67 *l* 28·27	″ *h* 25·20 *h* 24·70	″ *h* 25·54 *h* 27·56	″ *h* 30·00 *h* 31·03	″ *h* 31·66 *h* 30·10	″ *l* 25·56 *l* 28·10	″ *h* 25·77 *h* 28·47	Probability = 0·58
Means	30·01	26·50	28·74	28·85	24·74	29·47	24·95	26·55	30·52	30·88	26·83	27·12	58° 22′ 27″·93

At XXXVII

December 1849, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XXXV & XXXVI	″ *h* 14·50 *h* 12·17	″ *h* 12·73 *h* 13·27	″ *h* 11·77 *h* 11·00	″ *h* 11·30 *h* 13·60	″ *h* 12·96 *h* 12·44	″ *h* 11·87 *h* 11·87	″ *h* 8·67 *h* 9·84	″ *h* 11·04 *h* 10·17	″ *l* 9·70 *l* 13·14	″ *l* 12·84 *l* 10·00	″ *l* 16·50 *l* 12·90	″ *l* 13·04 *l* 14·03	Probability = 0·40
Means	13·34	13·00	11·39	12·45	12·70	11·87	9·26	10·61	11·42	11·42	14·70	13·54	48° 57′ 12″·14
XXXVI & XXXVIII	*h* 4·90 *h* 5·56	*h* 5·43 *h* 5·57	*h* 4·93 *h* 5·43	*h* 4·43 *h* 6·64	*h* 5·30 *h* 4·86	*h* 6·53 *h* 7·63	*h* 10·20 *h* 7·60	*h* 6·96 *h* 6·80	*l* 4·97 *l* 5·63	*l* 8·93 *l* 9·44	*l* 7·60 *l* 7·93	*l* 4·06 *l* 5·04	Probability = 0·43
Means	5·23	5·50	5·18	5·54	5·08	7·08	8·90	6·88	5·30	9·19	7·77	4·55	69° 51′ 6″·35
XXXVIII & XXXIX	*h* 55·74 *h* 55·70	*h* 54·57 *h* 54·40	*h* 53·97 *h* 54·20	*h* 54·04 *h* 53·00	*h* 54·27 *h* 54·70	*h* 54·20 *h* 53·10	*h* 50·73 *h* 51·73	*h* 53·04 *h* 53·86	*l* 54·00 *l* 55·00	*l* 49·07 *l* 49·53	*l* 52·30 *l* 54·83	*l* 54·57 *l* 51·40	Probability = 0·47
Means	55·72	54·49	54·09	53·52	54·49	53·65	51·23	53·45	54·50	49·30	53·57	52·99	71° 20′ 53″·42

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At XXXVIII

December 1849, *observed by Mr. G. Logan with Troughton and Simms'* 24-*inch Theodolite No.* 2.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
XL & XXXIX	″ *h* 39·43 *h* 40·17	″ *h* 45·03 *h* 40·34 *l* 43·70	″ *h* 38·03 *h* 39·86	″ *h* 42·47 *h* 41·33	″ *l* 36·86 *l* 41·66 *l* 42·60	″ *h* 41·04 *h* 38·84 *h* 39·80	″ *h* 37·83 *h* 39·94 *h* 42·87	″ *h* 37·10 *h* 38·50	″ *h* 39·70 *h* 42·53 *h* 38·97	″ *h* 42·73 *h* 42·93	″ *h* 39·58 *h* 40·10	″ *h* 41·07 *h* 40·87	Probability = 0·42
Means	39·80	43·02	38·95	41·90	40·37	39·89	40·21	37·80	40·40	42·83	39·84	40·97	52° 49′ 40″·50
XXXIX & XXXVII	*h* 14·10 *h* 12·17	*h* 8·80 *h* 9·96	*h* 13·90 *h* 12·57	*h* 5·83 *h* 5·77 *h* 9·84 *h* 8·53	*l* 16·60 *l* 15·87	*h* 8·86 *h* 10·13	*h* 14·90 *h* 14·43	*h* 13·54 *h* 10·80	*h* 10·06 *h* 6·73 *h* 8·17	*h* 10·40 *h* 6·90 *h* 7·94	*l* 12·30 *l* 11·53	*h* 10·17 *h* 10·10	Probability = 0·76
Means	13·14	9·38	13·24	7·49	16·24	9·50	14·67	12·17	8·32	8·41	11·92	10·14	57° 36′ 11″·22
XXXVII & XXXVI	*h* 13·57 *h* 12·93	*h* 10·87 *h* 9·77	*h* 6·33 *h* 9·80 *h* 8·86	*h* 11·23 *h* 12·27	*l* 7·53 *l* 8·20	*h* 6·40 *h* 6·70	*h* 7·87 *h* 7·30	*h* 9·33 *h* 11·97	*h* 14·67 *h* 9·67 *h* 10·30	*h* 10·87 *h* 13·77 *h* 12·86	*l* 9·30 *h* 9·73	*h* 13·30 *h* 10·40	Probability = 0·60
Means	13·25	10·32	8·33	11·75	7·87	6·55	7·59	10·65	11·55	12·50	9·52	11·85	65° 19′ 10″·14

At XXXIX

April 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XXXVII & XXXVIII	″ *h* 57·16 *h* 57·50	″ *h* 56·12 *h* 57·02	″ *h* 57·00 *h* 57·84	″ *h* 56·94 *h* 57·00	″ *l* 55·54 *l* 57·24 *l* 58·32	″ *l* 58·42 *l* 58·62	″ *l* 58·46 *l* 57·88	″ *l* 57·38 *l* 57·50	Probability = 0·21
Means	57·33	56·57	57·42	56·97	57·03	58·52	58·17	57·44	51° 2′ 57″·43

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At XXXIX—(Continued.)

April 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XXXVIII & XL	″ *h* 7·86 *h* 7·60	″ *h* 9·04 *h* 10·52	″ *h* 7·98 *h* 6·28	″ *h* 7·74 *h* 8·04	″ *l* 6·36 *l* 9·88 *l* 8·36	″ *l* 9·90 *l* 8·44	″ *l* 8·68 *l* 9·24	″ *l* 8·10 *l* 8·22	Probability = 0·29
Means	7·73	9·78	7·13	7·89	8·20	9·17	8·96	8·16	64° 13′ 8″·38
XL & XLI	*h* 18·20 *h* 18·46	*h* 17·28 *h* 17·08	*h* 16·56 *h* 17·76	*h* 16·78 *h* 17·42	*l* 15·86 *l* 16·74 *l* 17·84	*l* 17·90 *l* 18·62	*l* 17·24 *l* 17·20	*l* 17·60 *l* 17·74	Probability = 0·19
Means	18·33	17·18	17·16	17·10	16·81	18·26	17·22	17·67	70° 35′ 17″·47

At XL

April 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLII & XLI	″ *h* 0·48 *h* 1·16	″ *h* 0·06 *h* 1·88	″ *h* 1·94 *h* 3·10	″ *h* 2·50 *h* 1·08	″ *h* 1·24 *h* 0·90	″ *h* 1·34 *h* 1·66	″ *h* 2·56 *h* 1·12	″ *h* 1·06 *h* 1·50	Probability = 0·19
Means	0·82	0·97	2·52	1·79	1·07	1·50	1·84	1·28	61° 0′ 1″·47
XLI & XXXIX	*h* 29·02 *h* 28·36	*h* 30·48 *h* 29·04	*h* 30·00 *h* 29·22	*h* 30·00 *h* 28·46	*h* 29·22 *h* 29·66	*h* 32·18 *h* 29·94	*h* 30·38 *h* 30·68	*h* 30·50 *h* 30·16	Probability = 0·25
Means	28·69	29·76	29·61	29·23	29·44	31·06	30·53	30·33	55° 57′ 29″·83

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At XL—(Continued.)

April 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XXXIX & XXXVIII	″ h 11·72 h 11·86	″ h 11·08 h 12·24	″ h 12·68 h 12·86 h 12·98	″ h 15·10 h 12·66	″ h 10·56 h 11·68	″ h 11·52 h 11·78	″ h 11·96 h 12·96	″ h 12·12 h 12·02	Probability = 0·29
Means	11·79	11·66	12·84	13·88	11·12	11·65	12·46	12·07	62° 57′ 12″·18

At XLI

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XXXIX & XL	″ h 13·48 h 13·04	″ h 12·86 h 13·12 h 13·18	″ h 12·54 h 13·60	″ h 12·60 h 12·96	″ h 14·40 h 14·36	″ h 14·70 l 13·52	″ l 12·76 h 14·52	″ h 12·70 h 12·24	Probability = 0·22
Means	13·26	13·05	13·07	12·78	14·38	14·11	13·64	12·47	53° 27′ 13″·35
XL & XLII	h 5·26 h 4·28	h 4·84 h 5·60	h 4·24 h 4·90	h 5·10 h 5·04	h 3·42 h 2·10	h 3·34 l 4·00	h 3·06 h 4·08	h 4·40 h 5·40	Probability = 0·29
Means	4·77	5·22	4·57	5·07	2·76	3·67	3·57	4·90	54° 4′ 4″·32
XLII & XLIII	h 43·14 h 42·62	h 43·20 h 42·60	h 44·12 h 43·18	h 43·38 h 42·86	h 41·42 h 42·66	h 41·36 l 42·78	h 41·10 h 41·64	h 40·28 h 41·94 h 43·06	Probability = 0·26
Means	42·88	42·90	43·65	43·12	42·04	42·07	41·37	41·76	60° 15′ 42″·47

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At XLII

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLIV & XLIII	″ *l* 54·74 *l* 53·88	″ *l* 53·90 *l* 53·50	″ *l* 52·48 *l* 53·74	″ *l* 53·22 *l* 54·20	″ *h* 52·62 *h* 53·44	″ *l* 53·80 *l* 53·78	″ *l* 52·72 *l* 54·24	″ *l* 54·22 *l* 53·84	Probability = 0·14
Means	54·31	53·70	53·11	53·71	53·03	53·79	53·48	54·03	66° 13′ 53″·65
XLIII & XLI	*l* 22·92 *l* 22·62	*l* 23·68 *l* 22·76	*h* 22·44 *h* 21·36	*h* 23·26 *h* 22·24	*h* 23·12 *h* 22·48	*h* 22·38 *h* 22·90	*h* 24·22 *h* 22·24	*l* 23·18 *l* 23·68	Probability = 0·16
Means	22·77	23·22	21·90	22·75	22·80	22·64	23·23	23·43	45° 55′ 22″·84
XLI & XL	*l* 55·16 *l* 55·56	*l* 56·06 *l* 56·68	*h* 54·94 *h* 56·20	*h* 53·44 *h* 53·94	*h* 53·26 *h* 54·96	*h* 53·50 *h* 53·62	*h* 54·82 *h* 56·74	*l* 52·90 *l* 53·78	Probability = 0·39
Means	55·36	56·37	55·57	53·69	54·11	53·56	55·78	53·34	64° 55′ 54″·72

At XLIII

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLI & XLII	″ *h* 54·62 *h* 55·58	″ *h* 55·72 *h* 55·74	″ *l* 56·08 *l* 55·36	″ *l* 54·36 *l* 54·42	″ *h* 55·40 *h* 55·14	″ *h* 57·26 *h* 56·20	″ *l* 53·46 *l* 53·48	″ *l* 55·02 *l* 54·56	Probability = 0·32
Means	55·10	55·73	55·72	54·39	55·27	56·73	53·47	54·79	73° 48′ 55″·15

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At XLIII—(Continued.)

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLII & XLIV	″ *h* 15·00 *h* 14·18 *h* 14·78	″ *h* 11·34 *h* 11·56 *h* 12·76	″ *l* 14·34 *l* 14·54	″ *l* 15·54 *l* 14·64	″ *h* 13·40 *h* 14·74	″ *h* 14·44 *h* 14·32	″ *l* 13·84 *l* 13·80	″ *l* 14·98 *l* 14·22	Probability = 0·32
Means	14·65	11·89	14·44	15·09	14·07	14·38	13·82	14·60	55° 26′ 14″·12
XLIV & XLV	*h* 21·66 *h* 23·98	*h* 23·32 *h* 23·52	*l* 24·22 *l* 22·50	*l* 23·56 *l* 22·58	*h* 24·28 *l* 24·64	*l* 21·70 *l* 23·16	*l* 22·88 *l* 23·28	*l* 24·86 *l* 23·74	Probability = 0·23
Means	22·82	23·42	23·36	23·07	24·46	22·43	23·08	24·30	53° 19′ 23″·37

At XLIV

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLVI & XLV	″ *l* 17·90 *l* 15·68 *l* 16·46	″ *l* 14·86 *l* 14·34	″ *h* 16·62 *h* 15·36	″ *l* 14·90 *l* 15·62	″ *h* 16·10 *h* 15·78	″ *h* 15·54 *l* 14·38	″ *l* 15·80 *l* 13·56	″ *l* 14·44 *l* 15·88	Probability = 0·24
Means	16·68	14·60	15·99	15·26	15·94	14·96	14·68	15·16	65° 14′ 15″·41
XLV & XLIII	*l* 4·32 *l* 3·04	*l* 4·98 *l* 5·52	*h* 3·68 *h* 3·30	*l* 2·74 *l* 2·22	*h* 3·62 *h* 3·26	*h* 3·18 *l* 3·64	*l* 2·92 *l* 4·12	*l* 4·00 *l* 2·54	Probability = 0·26
Means	3·68	5·25	3·49	2·48	3·44	3·41	3·52	3·27	62° 54′ 3″·57

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At XLIV—(Continued.)

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLIII & XLII	″ *l* 51·10 *l* 52·44	″ *l* 50·54 *l* 51·14	″ *h* 53·10 *h* 52·34	″ *l* 51·86 *l* 52·74	″ *h* 54·42 *l* 55·86	″ *h* 51·92 *h* 52·30	″ *l* 54·88 *l* 53·10	″ *l* 53·88 *l* 53·48	Probability = 0·46
Means	51·77	50·84	52·72	52·30	55·14	52·11	53·99	53·68	58° 19′ 52″·82

At XLV

March and April 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLIII & XLIV	″ *h* 34·22 *h* 34·46	″ *h* 34·98 *h* 34·46	″ *h* 33·86 *h* 35·30	″ *h* 35·24 *h* 33·40	″ *l* 31·46 *l* 32·90	″ *l* 36·02 *l* 34·54	″ *h* 33·48 *h* 34·96	″ *h* 35·30 *h* 34·72	Probability = 0·31
Means	34·34	34·72	34·58	34·32	32·18	35·28	34·22	35·01	63° 46′ 34″·33
XLIV & XLVI	*h* 27·18 *h* 26·76	*h* 28·76 *h* 28·46	*h* 27·50 *h* 27·66	*h* 27·90 *h* 27·68	*l* 28·52 *l* 28·84	*l* 29·98 *l* 28·90	*h* 28·02 *h* 27·18	*h* 27·56 *h* 26·92	Probability = 0·28
Means	26·97	28·61	27·58	27·79	28·68	29·44	27·60	27·24	57° 22′ 27″·99
XLVI & XLVII	*h* 29·80 *h* 29·20	*h* 28·14 *h* 28·30	*h* 28·38 *h* 28·44	*h* 30·10 *h* 29·62	*l* 29·16 *l* 31·16	*l* 30·06 *l* 29·16	*h* 30·86 *h* 30·04	*h* 29·72 *h* 29·92	Probability = 0·26
Means	29·50	28·22	28·41	29·86	30·16	29·61	30·45	29·82	56° 50′ 29″·50
XLIII & R M	*h* 20·58 *h* 20·86	*h* 21·66 *h* 20·64	*h* 20·12 *h* 21·34	*h* 22·66 *h* 23·44	*l* 25·32 *l* 24·30 *l* 24·40	*l* 22·40 *l* 22·16	*h* 22·58 *h* 23·12	*h* 22·56 *h* 23·04	
Means	20·72	21·15	20·73	23·05	24·67	22·28	22·85	22·80	69° 23′ 22″·28

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At XLVI

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLVIII & XLVII	″ *h* 6·06 *h* 3·90	″ *l* 4·02 *l* 3·62	″ *h* 6·48 *h* 6·02	″ *h* 3·72 *h* 5·72	″ *h* 4·98 *h* 4·26	″ *h* 4·74 *h* 4·36	″ *h* 5·20 *h* 3·46	″ *h* 3·76 *h* 3·78	Probability = 0·26
Means	4·98	3·82	6·25	4·72	4·62	4·55	4·33	3·77	54° 33′ 4″·63
XLVII & XLV	*h* 3·20 *h* 2·28	*l* 3·92 *l* 4·64	*h* 5·24 *h* 3·76	*h* 5·12 *h* 3·56	*h* 3·42 *h* 4·92	*h* 3·38 *h* 4·32	*l* 4·50 *l* 4·52	*l* 3·06 *l* 4·32	Probability = 0·20
Means	2·74	4·28	4·50	4·34	4·17	3·85	4·51	3·69	67° 8′ 4″·01
XLV & XLIV	*h* 18·90 *h* 18·96	*l* 19·42 *l* 19·06	*h* 16·38 *h* 15·38	*h* 17·84 *h* 19·62	*h* 16·60 *h* 17·56	*h* 16·08 *h* 15·90	*l* 17·58 *l* 16·60	*l* 14·96 *l* 16·86	Probability = 0·47
Means	18·93	19·24	15·88	18·73	17·08	15·99	17·09	15·91	57° 23′ 17″·36

At XLVII

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLV & XLVI	″ *h* 31·24 *h* 28·12	″ *h* 28·00 *h* 27·94	″ *h* 27·22 *h* 27·56	″ *h* 27·10 *h* 27·04	″ *l* 26·02 *l* 26·94	″ *l* 27·76 *l* 27·58	″ *l* 26·06 *l* 26·80	″ *l* 26·96 *l* 26·18	Probability = 0·36
Means	29·68	27·97	27·39	27·07	26·48	27·67	26·43	26·57	56° 1′ 27″·41
XLVI & XLVIII	*l* 44·26 *l* 43·32	*h* 44·46 *h* 44·40	*h* 45·38 *h* 44·28	*h* 46·56 *h* 44·54	*l* 46·00 *l* 46·08	*l* 44·50 *l* 44·62	*l* 46·14 *l* 46·44	*l* 45·82 *l* 45·56	Probability = 0·29
Means	43·79	44·43	44·83	45·55	46·04	44·56	46·29	45·69	61° 48′ 45″·15

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At XLVII—(Continued.)

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLVIII & XLIX	″ *h* 14·48 *h* 14·34	″ *h* 13·88 *h* 15·06	″ *h* 14·58 *h* 14·88	″ *h* 14·46 *h* 14·32	″ *l* 14·78 *l* 13·64	″ *l* 14·78 *l* 14·52	″ *l* 14·56 *l* 14·64	″ *l* 14·16 *l* 14·44	Probability = 0·06
Means	14·41	14·47	14·73	14·39	14·21	14·65	14·60	14·30	65° 3′ 14″·47

At XLVIII

March 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
L & XLIX	″ *h* 35·20 *h* 36·82 *h* 37·76	″ *h* 36·76 *h* 37·92	″ *l* 35·60 *l* 37·94	″ *h* 37·40 *h* 38·18	″ *h* 36·26 *h* 36·76	″ *h* 38·62 *h* 36·90	″ *h* 36·44 *h* 36·44	″ *l* 36·26 *l* 37·14	Probability = 0·18
Means	36·59	37·34	36·77	37·79	36·51	37·76	36·44	36·70	59° 24′ 36″·99
XLIX & XLVII	*h* 47·86 *h* 47·58	*h* 47·52 *h* 47·08	*l* 48·68 *l* 45·54	*h* 47·26 *h* 47·08	*h* 49·24 *l* 47·58	*h* 47·20 *h* 47·50	*h* 46·98 *l* 47·72	*l* 48·58 *l* 47·54	Probability = 0·15
Means	47·72	47·30	47·11	47·17	48·41	47·35	47·35	48·06	59° 5′ 47″·56
XLVII & XLVI	*h* 11·74 *h* 11·96	*h* 11·24 *h* 11·24	*l* 9·76 *l* 10·48	*h* 10·66 *h* 10·54	*l* 12·00 *l* 11·12	*h* 9·68 *h* 11·00	*h* 11·42 *h* 11·70	*l* 10·20 *l* 11·06	Probability = 0·21
Means	11·85	11·24	10·12	10·60	11·56	10·34	11·56	10·63	63° 38′ 10″·99

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At XLIX

February 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
	″	″	″	″	″	″	″	″	
XLVII & XLVIII	*l* 57·40 *l* 58·76	*l* 57·38 *l* 58·08	*l* 59·00 *l* 59·64	*h* 59·96 *h* 59·26	*h* 58·88 *h* 58·88	*h* 58·48 *l* 58·34	*l* 58·22 *l* 57·30	*l* 58·68 *l* 57·98	Probability = 0·23
Means	58·08	57·73	59·32	59·61	58·88	58·41	57·76	58·33	55° 50′ 58″·52
XLVIII & L	*h* 50·04 *h* 51·30	*h* 51·60 *h* 51·68	*l* 50·18 *l* 49·52	*h* 50·04 *h* 50·72	*h* 50·56 *h* 51·38	*h* 49·10 *h* 49·28	*l* 50·92 *l* 51·66	*l* 49·86 *l* 50·52	Probability = 0·26
Means	50·67	51·64	49·85	50·38	50·97	49·19	51·29	50·19	49° 2′ 50″·52
L & LI	*h* 20·02 *h* 19·76	*h* 19·64 *h* 19·20	*l* 19·76 *l* 20·40	*h* 19·68 *h* 20·16	*h* 19·42 *l* 18·02	*h* 19·72 *h* 19·34	*l* 20·54 *l* 18·98	*l* 18·08 *l* 19·18	Probability = 0·18
Means	19·89	19·42	20·08	19·92	18·72	19·53	19·76	18·63	74° 44′ 19″·49

At L

February 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
	″	″	″	″	″	″	″	″	
LII & LI	*h* 39·98 *h* 38·86	*h* 40·16 *h* 40·34	*l* 40·34 *l* 42·16	*l* 41·00 *l* 41·84	*h* 41·36 *h* 41·58	*h* 42·60 *h* 40·44	*l* 38·78 *l* 39·32	*l* 41·92 *l* 41·86	Probability = 0·35
Means	39·42	40·25	41·25	41·42	41·47	41·52	39·05	41·89	53° 7′ 40″·78
LI & XLIX	*h* 42·70 *h* 42·02	*h* 41·82 *h* 40·60	*l* 38·44 *l* 39·06	*l* 42·02 *l* 40·84	*h* 39·66 *h* 39·92	*h* 38·70 *h* 40·74	*l* 40·56 *l* 40·18	*l* 40·02 *l* 38·52	Probability = 0·40
Means	42·36	41·21	38·75	41·43	39·79	39·72	40·37	39·27	53° 59′ 40″·36

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At L—(Continued.)

February* 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLIX & XLVIII	″ h 31·80 h 32·32	″ h 33·46 h 32·80	″ l 33·26 l 31·92	″ l 30·44 l 31·42	″ h 32·06 h 32·92	″ h 32·80 h 32·30	″ l 33·66 l 34·18	″ l 30·80 l 32·00	Probability = 0·31
Means	32·06	33·13	32·59	30·93	32·49	32·55	33·92	31·40	71° 32′ 32″·38

At LI

February* 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
XLIX & LII	″ l 39·08 l 38·76	″ l 38·76 l 38·88	″ h 38·60 h 38·78	″ h 36·60 h 36·70	″ l 36·56 h 36·64	″ h 35·50 h 35·40	″ h 37·12 l 37·86	″ l 40·58 l 40·48	
Means	38·92	38·82	38·69	36·65	36·60	35·45	37·49	40·53	107° 3′ 37″·89
L & LII	h 38·06 h 36·84	h 38·22 h 38·72	h 37·96 h 36·88	h 33·98 h 35·26	l 34·96 h 36·88	h 35·26 h 35·92	h 36·30 l 38·22	l 39·58 l 38·98	Probability = 0·51
Means	37·45	38·47	37·42	34·62	35·92	35·59	37·26	39·28	55° 47′ 37″·00
XLIX & L	+98·92 −37·45	+98·82 −38·47	+98·69 −37·42	+96·65 −34·62	+96·60 −35·92	+95·45 −35·59	+97·49 −37·26	+100·53 − 39·28	Probability = 0·24
107° 2′ −55° 47′	61·47	60·35	61·27	62·03	60·68	59·86	60·23	61·25	51° 16′ 0″·89
LII & LIII	h 54·90 h 56·96	h 55·84 h 56·30	h 54·92 h 55·66	h 55·80 h 55·28	l 54·34 h 56·94	h 54·10 h 56·52	h 55·94 l 57·34	l 53·86 l 55·34	Probability = 0·20
Means	55·93	56·07	55·29	55·54	55·64	55·31	56·64	54·60	70° 9′ 55″·63

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At LII

February* 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LIV & LIII	″ *h* 22·86 *h* 23·22	″ *h* 24·50 *h* 22·54	″ *h* 25·26 *h* 24·10	″ *h* 22·40 *h* 21·60 *h* 22·90	″ *h* 21·92 *h* 24·14 *h* 24·36	″ *h* 23·22 *h* 23·66	″ *h* 21·50 *h* 22·64	″ *h* 22·78 *h* 22·88	Probability = 0·27
Means	23·04	23·52	24·68	22·30	23·47	23·44	22·07	22·83	50° 41′ 23″·17
LIV & LI	*h* 53·44 *h* 51·76	*h* 48·88 *h* 51·24	*h* 52·60 *h* 52·94	*h* 51·88 *h* 52·20	*l* 51·66 *l* 51·88	*l* 53·26 *l* 52·94	*h* 54·10 *h* 52·28	*h* 52·02 *h* 52·22	
Means	52·60	50·06	52·77	52·04	51·77	53·10	53·19	52·12	107° 54′ 52″·21
LIII & LI	+ 52·60 − 23·04	+ 50·06 − 23·52	+ 52·77 − 24·68	+ 52·04 − 22·30	+ 51·77 − 23·47	+ 53·10 − 23·44	+ 53·19 − 22·07	+ 52·12 − 22·83	Probability = 0·45
107° 54′ − 50° 41′	29·56	26·54	28·09	29·74	28·30	29·66	31·12	29·29	57° 13′ 29″·04
LI & L	*h* 42·92 *h* 43·20	*h* 44·86 *h* 44·20	*h* 42·04 *h* 42·64	*h* 44·68 *h* 44·00	*l* 41·76 *l* 43·62	*l* 42·98 *l* 43·62	*h* 42·20 *h* 43·60	*h* 43·70 *h* 43·42	Probability = 0·26
Means	43·06	44·53	42·34	44·34	42·69	43·30	42·90	43·56	71° 4′ 43″·34

At LIII

February* 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LI & LII	″ *h* 35·70 *h* 34·56	″ *h* 35·86 *h* 36·10	″ *h* 36·56 *h* 37·16	″ *h* 34·24	″ *h* 36·56 *h* 36·90	″ *h* 34·44 *h* 37·68	″ *h* 34·68 *h* 36·98	″ *h* 37·60 *h* 35·88	Probability = 0·30
Means	35·13	35·98	36·86	34·24	36·73	36·06	35·83	36·74	52° 36′ 35″·95

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At LIII—(Continued.)

February 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LII & LIV	″ *h* 14·04 *h* 15·48	″ *h* 16·00 *h* 15·94	″ *h* 14·80 *h* 14·20	″ *h* 15·78	″ *h* 14·98 *h* 14·82	″ *h* 15·32 *h* 14·46	″ *h* 16·56 *h* 15·58	″ *h* 13·22 *h* 15·48	Probability = 0·23
Means	14·76	15·97	14·50	15·78	14·90	14·89	16·07	14·35	50° 25′ 15″·15
LIV & LV	*h* 44·26 *h* 47·34 *h* 45·36	*h* 45·28 *h* 43·52	*h* 45·20 *h* 45·88	*l* 44·50 *l* 44·62	*l* 45·64 *l* 46·80	*l* 45·58 *l* 46·92	*h* 45·54 *h* 44·14	*h* 44·70 *h* 43·96 *h* 46·28	Probability = 0·24
Means	45·65	44·40	45·54	44·56	46·22	46·25	44·84	44·98	74° 39′ 45″·31
LV & LVI	*h* 31·42 *h* 31·38	*h* 32·76 *h* 33·96	*h* 33·90 *h* 32·38	*l* 32·18 *l* 31·58	*l* 34·40 *l* 30·84 *l* 32·40	*l* 32·16 *l* 31·40	*h* 31·94 *h* 32·00	*h* 34·98 *h* 34·94	Probability = 0·38
Means	31·40	33·36	33·14	31·88	32·55	31·78	31·97	34·96	59° 6′ 32″·63

At LIV

February 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LVII & LV	″ *l* 18·90 *l* 18·28	″ *l* 17·62 *l* 17·52	″ *l* 20·70 *l* 17·38	″ *l* 17·52 *l* 18·06	″ *l* 18·08 *h* 18·54	″ *h* 19·50 *h* 19·08	″ *h* 17·64 *h* 18·50	″ *h* 18·14 *h* 17·52	Probability = 0·20
Means	18·59	17·57	19·04	17·79	18·31	19·29	18·07	17·83	59° 5′ 18″·31

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At LIV—(Continued.)

February 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LV & LIII	″ *l* 42·92 *l* 43·88	″ *l* 46·26 *l* 45·42	″ *l* 44·26 *l* 46·88	″ *l* 47·88 *l* 44·48	″ *l* 46·30 *h* 44·62	″ *h* 45·46 *h* 46·66	″ *h* 46·94 *h* 46·04	″ *h* 43·76 *h* 47·42 *l* 46·02	Probability = 0·31
Means	43·40	45·84	45·57	46·18	45·46	46·06	46·49	45·73	52° 47′ 45″·59
LIII & LII	*l* 22·14 *l* 23·04	*l* 20·38 *l* 21·72	*l* 22·82 *l* 22·76	*l* 20·10 *l* 21·60	*l* 22·56 *h* 23·54	*h* 22·06 *h* 22·18	*h* 21·60 *h* 22·50	*l* 21·70 *l* 22·18	Probability = 0·26
Means	22·59	21·05	22·79	20·85	23·05	22·12	22·05	21·94	78° 53′ 22″·06

At LV

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LIII & LIV	″ *l* 27·68 *l* 28·30	″ *l* 31·06 *h* 33·50 *h* 32·52	″ *h* 32·14 *l* 32·06	″ *h* 27·56 *h* 29·26	″ *l* 27·44 *l* 28·22	″ *l* 30·28 *l* 27·14	″ *h* 32·90 *h* 30·84	″ *h* 28·28 *h* 29·42	Probability = 0·65
Means	27·99	32·36	32·10	28·41	27·83	28·71	31·87	28·85	52° 32′ 29″·77
LIV & LVII	*h* 13·14 *h* 12·58	*l* 14·66 *h* 14·02	*h* 14·14 *l* 12·24	*h* 14·30 *h* 13·88	*l* 12·54 *l* 11·70	*l* 15·90 *l* 14·06	*h* 13·84 *h* 15·94	*h* 13·46 *h* 14·70	Probability = 0·33
Means	12·86	14·34	13·19	14·09	12·12	14·98	14·89	14·08	48° 22′ 13″·82
LVII & LIX	*h* 25·70 *h* 25·96	*l* 24·44 *l* 25·16	*h* 24·80 *l* 23·54	*h* 23·02 *h* 22·90	*l* 24·74 *l* 24·28	*l* 23·12 *l* 24·38	*h* 26·66 *h* 25·92	*h* 25·16 *h* 23·00	Probability = 0·36
Means	25·83	24·80	24·17	22·96	24·51	23·75	26·29	24·08	64° 58′ 24″·55

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At LV—(Continued.)

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LIX & LVIII	″ *h* 29·00 *h* 31·38	″ *l* 30·22 *l* 30·74	″ *h* 26·48 *l* 30·16 *l* 30·90	″ *h* 32·22 *h* 33·22	″ *l* 31·06 *l* 31·38	″ *l* 30·80 *l* 31·06	″ *h* 27·44 *h* 27·88	″ *l* 29·34 *h* 32·86 *h* 32·36	Probability = 0·51
Means	30·19	30·48	29·18	32·72	31·22	30·93	27·66	31·52	67° 42′ 30″·49
LVIII & LVI	*h* 26·62 *h* 24·60	*l* 24·78 *l* 25·14	*h* 25·18 *l* 25·86	*h* 27·30 *h* 27·88	*l* 26·84 *l* 27·52	*l* 29·50 *l* 26·60	*h* 24·08 *h* 24·44	*l* 29·17 *h* 26·56 *h* 24·80	Probability = 0·45
Means	25·61	24·96	25·52	27·59	27·18	28·05	24·26	26·84	68° 33′ 26″·25
LVI & LIII	*l* 57·96 *l* 56·86	*l* 54·84 *l* 55·26	*h* 57·26 *l* 56·14	*h* 55·60 *h* 52·86	*l* 57·38 *l* 56·90	*l* 56·76 *l* 55·86	*h* 55·08 *h* 54·98	*h* 57·00 *h* 53·46 *h* 56·00	Probability = 0·38
Means	57·41	55·05	56·70	54·23	57·14	56·31	55·03	55·49	57° 50′ 55″·92

At LVI

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LIII & LV	″ *h* 31·78 *h* 32·38	″ *h* 31·96 *h* 31·14	″ *h* 33·16 *h* 32·58	″ *h* 32·08 *h* 31·66	″ *h* 32·72 *h* 32·20	″ *h* 32·76 *h* 32·06	″ *h* 31·26 *h* 31·70	″ *h* 31·54 *h* 31·44	Probability = 0·17
Means	32·08	31·55	32·87	31·87	32·46	32·41	31·48	31·49	63° 2′ 32″·03

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At LVI—(Continued.)

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LV & LVIII	″ *h* 39·84 *h* 39·56	″ *h* 40·74 *h* 40·34	″ *h* 39·66 *h* 40·82	″ *h* 38·54 *h* 40·94	″ *h* 40·06 *h* 39·92	″ *h* 40·00 *h* 40·00	″ *h* 38·86 *h* 41·12	″ *h* 40·60 *h* 39·56	Probability = 0·09
Means	39·70	40·54	40·24	39·74	39·99	40·00	39·99	40·08	56° 59′ 40″·04

At LVII

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LX & LIX	″ *l* 60·02 *l* 57·88	″ *l* 60·08 *l* 57·48 *l* 58·52	″ *l* 57·84 *l* 59·08	″ *l* 59·40 *l* 58·68	″ *l* 59·44 *l* 57·60	″ *l* 59·16 *l* 57·86	″ *l* 57·36 *l* 59·24	″ *l* 58·66 *l* 59·70	Probability = 0·10
Means	58·95	58·69	58·46	59·04	58·52	58·51	58·30	59·18	49° 7′ 58″·71
LIX & LV	*l* 7·50 *l* 7·76	*l* 7·26 *l* 9·38	*l* 7·06 *l* 7·20	*l* 7·28 *l* 7·62	*l* 9·36 *l* 7·12	*l* 8·14 *l* 8·28	*l* 6·72 *l* 7·76	*l* 8·70 *l* 9·30	Probability = 0·21
Means	7·63	8·32	7·13	7·45	8·24	8·21	7·24	9·00	54° 31′ 7″·90
LV & LIV	*l* 30·12 *l* 30·74	*l* 28·28 *l* 28·44	*l* 29·06 *l* 28·92	*l* 27·22 *h* 28·14	*l* 30·08 *l* 28·36	*l* 28·80 *l* 28·72	*l* 30·64 *l* 29·28	*l* 28·00 *l* 27·26	Probability = 0·33
Means	30·43	28·36	28·99	27·68	29·22	28·76	29·96	27·63	72° 32′ 28″·88

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At LVIII

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LVI & LV	″ *h* 53·18 *h* 52·30	″ *h* 56·94 *h* 55·18	″ *l* 56·58 *l* 56·60	″ *h* 54·22 *h* 54·72	″ *h* 53·46 *h* 52·62	″ *h* 54·44 *h* 53·30	″ *h* 53·74 *h* 53·34	″ *h* 53·18 *h* 54·00	Probability = 0·46
Means	52·74	56·06	56·59	54·47	53·04	53·87	53·54	53·59	54° 26′ 54″·24
LV & LIX	*h* 58·88 *h* 57·82	*h* 57·02 *h* 58·04	*l* 59·04 *l* 59·18	*l* 59·04 *l* 57·58	*h* 57·70 *h* 60·00	*h* 57·62 *h* 58·56	*h* 60·02 *h* 60·22	*h* 59·34 *h* 58·54	Probability = 0·26
Means	58·35	57·53	59·11	58·31	58·85	58·09	60·12	58·94	57° 15′ 58″·66

At LIX

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	198° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LVIII & LV	″ *h* 32·22 *h* 31·76	″ *h* 30·82 *l* 31·50	″ *h* 34·62 *h* 33·40	″ *h* 32·60 *h* 33·02	″ *h* 31·88 *h* 32·82	″ *h* 34·16 *h* 32·38	″ *l* 31·58 *h* 32·26	″ *h* 33·52 *h* 31·96	Probability = 0·29
Means	31·99	31·16	34·01	32·81	32·35	33·27	31·92	32·74	55° 1′ 32″·53
LV & LVII	*h* 28·12 *h* 27·92	*h* 29·90 *l* 31·12	*h* 26·40 *h* 25·12 *h* 26·98	*h* 26·16 *h* 26·44	*h* 27·82 *h* 28·60	*h* 25·82 *h* 26·74	*l* 26·56 *h* 25·06	*h* 25·78 *h* 26·54	Probability = 0·54
Means	28·02	30·51	26·17	26·30	28·21	26·28	25·81	26·16	60° 30′ 27″·18

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At LIX—(Continued.)

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LVII & LX	″ *h* 6·56 *h* 5·12	″ *h* 2·40 *l* 2·98 *l* 3·44	″ *h* 3·24 *h* 4·74	″ *h* 4·64 *h* 1·96	″ *h* 2·62 *h* 3·76	″ *h* 4·32 *h* 4·18	″ *l* 6·24 *l* 3·30	″ *l* 2·84 *h* 3·04	Probability = 0·34
Means	5·84	2·94	3·99	3·30	3·19	4·25	4·77	2·94	67° 6′ 3″·90
LX & LXI	*h* 60·52 *h* 60·08	*h* 63·58 *l* 62·96	*h* 61·86 *h* 63·32	*h* 62·86 *h* 61·24	*h* 62·82 *h* 62·34	*h* 63·38 *h* 61·74	*l* 61·94 *l* 60·44	*h* 59·50 *h* 61·20	Probability = 0·37
Means	60·30	63·27	62·59	62·05	62·58	62·56	61·19	60·35	57° 35′ 1″·86

At LX

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXII & LXI	″ *h* 49·62 *h* 49·34	″ *l* 46·72 *l* 46·36	″ *l* 48·44 *l* 47·34	″ *h* 47·04 *h* 45·74	″ *l* 45·30 *l* 45·94	″ *l* 46·18 *l* 46·18	″ *l* 47·34 *l* 48·06	″ *l* 46·20 *l* 47·24	Probability = 0·41
Means	49·48	46·54	47·89	46·39	45·62	46·18	47·70	46·72	61° 27′ 47″·07
LXI & LIX	*h* 39·60 *h* 38·58	*l* 36·94 *l* 37·46	*l* 38·16 *l* 39·72	*h* 36·08 *h* 38·44	*l* 36·48 *l* 37·24	*h* 39·32 *h* 38·70	*l* 39·70 *l* 36·82	*l* 39·82 *l* 39·14	Probability = 0·34
Means	39·09	37·20	38·94	37·26	36·86	39·01	38·26	39·48	62° 27′ 38″·26

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At LX—(Continued.)

January 1849, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LIX & LVII	″ *h* 60·66 *h* 60·62	″ *l* 59·52 *h* 62·90 *h* 59·16	″ *l* 56·72 *l* 56·12 *l* 56·74	″ *h* 60·20 *h* 58·36	″ *h* 60·12 *h* 59·44	″ *h* 58·20 *h* 58·44	″ *l* 58·20 *l* 58·36	″ *l* 56·64 *l* 59·38	Probability = 0·46
Means	60·64	60·53	56·53	59·28	59·78	58·32	58·28	58·01	63° 45′ 58″·92

At LXI

December 1848, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LIX & LX	″ *h* 18·04 *h* 18·76	″ *h* 17·96 *h* 19·84	″ *l* 19·36 *l* 20·02 *l* 19·98	″ *h* 19·00 *h* 19·94	″ *h* 20·56 *l* 19·66	″ *l* 21·34 *l* 22·80	″ *h* 19·98 *h* 19·34	″ *l* 18·78 *l* 20·48	Probability = 0·36
Means	18·40	18·90	19·79	19·47	20·11	22·07	19·66	19·63	59° 57′ 19″·75
LX & LXII	*h* 7·30 *h* 7·40	*h* 7·54 *h* 6·52	*l* 10·84 *l* 7·72 *l* 8·20	*h* 9·10 *h* 8·50	*l* 5·80 *l* 7·68	*l* 10·96 *l* 9·16	*h* 9·34 *h* 9·50	*l* 9·16 *l* 6·66	Probability = 0·40
Means	7·35	7·03	8·92	8·80	6·74	10·06	9·42	7·91	67° 59′ 8″·28
LXII & LXIII	*h* 34·20 *h* 33·20	*h* 36·00 *h* 34·18	*l* 33·12 *l* 34·38	*h* 32·42 *h* 34·22 *h* 35·82	*l* 33·90 *l* 34·16	*l* 32·50 *l* 33·86	*h* 33·34 *h* 33·30	*h* 34·84 *h* 34·58	Probability = 0·22
Means	33·70	35·09	33·75	34·15	34·03	33·18	33·32	34·71	54° 1′ 33″·99

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At LXII

December 1848, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXIV & LXIII	″ h 27·66 l 27·42 l 28·28	″ l 25·08 l 25·64	″ h 29·84 h 28·12 l 29·00	″ l 28·50 l 26·56	″ h 25·88 l 27·26	″ h 28·60 h 28·50	″ l 27·20 l 27·02	″ l 28·42 l 27·98	Probability = 0·39
Means	27·79	25·36	28·99	27·53	26·57	28·55	27·11	28·20	59° 40′ 27″·51
LXIII & LXI	l 36·78 l 36·16	l 37·38 l 36·54	h 39·62 l 32·40 l 35·00 l 37·92	l 34·14 l 36·24	h 36·62 l 40·96 l 38·44	h 39·64 h 35·28 l 35·46	l 35·76 l 36·50	l 35·06 l 37·70	Probability = 0·33
Means	36·47	36·96	36·24	35·19	38·67	36·79	36·13	36·38	60° 48′ 36″·60
LXI & LX	l 5·42 l 8·14 l 3·92	l 8·04 l 5·82	l 4·06 l 5·32	l 2·38 l 5·04	l 7·04 l 3·64 l 5·42	h 4·72 h 5·18	l 5·38 l 6·22	l 4·24 h 3·82 h 8·02	Probability = 0·31
Means	5·83	6·93	4·69	3·71	5·37	4·95	5·80	5·36	50° 33′ 5″·33

At LXIII

December 1848, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXI & LXII	″ l 50·48 l 50·30	″ l 47·80 l 50·26	″ h 49·84 h 49·46	″ l 51·18 l 50·56	″ l 49·90 l 48·72	″ l 49·02 l 48·14	″ h 49·30 h 49·98	″ h 48·66 l 49·34	Probability = 0·25
Means	50·39	49·03	49·65	50·87	49·31	48·58	49·64	49·00	65° 9′ 49″·56

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At LXIII—(Continued.)

December 1848, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXII & LXIV	″ *l* 38·50 *l* 36·92	″ *l* 36·86 *l* 36·28	″ *h* 39·80 *h* 39·04	″ *l* 40·78 *l* 39·46 *l* 38·92	″ *l* 37·20 *l* 39·38	″ *l* 40·94 *l* 40·72	″ *h* 39·38 *h* 39·04	″ *h* 39·40 *l* 38·64	Probability = 0·43
Means	37·71	36·57	39·42	39·72	38·29	40·83	39·21	39·02	62° 44′ 38″·85

March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

	Seconds of Observed Angles at each Zero						
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXIV & LXV	″ *h* 60·10 *h* 60·70	″ *h* 60·18 *h* 60·36	″ *h* 60·26 *h* 60·70	″ *h* 61·68 *l* 61·08	″ *l* 60·20 *l* 61·31	″ *l* 61·22 *l* 59·08	Probability = 0·17
Means	60·40	60·27	60·48	61·38	60·76	60·15	59° 17′ 0″·57

At LXIV

March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXVI & LXV	″ *h* 43·26 *h* 44·60	″ *h* 43·38 *h* 43·68	″ *l* 44·12 *l* 42·78	″ *l* 42·88 *l* 42·60	″ *l* 42·96 *l* 43·14	″ *l* 42·64 *l* 43·94	Probability = 0·15
Means	43·93	43·53	43·45	42·74	43·05	43·29	60° 21′ 43″·33

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At LXIV—(Continued.)

March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXV & LXIII	″ h 22·26 h 21·22	″ h 23·64 h 23·12	″ l 23·78 l 22·92	″ l 23·26 l 24·08	″ l 23·70 l 23·76	″ l 22·92 l 22·72	Probability = 0·28
Means	21·74	23·38	23·35	23·67	23·73	22·82	62° 0′ 23″·12

December 1848, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

	Seconds of Observed Angles at each Zero								
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXIII & LXII	″ l 55·68 l 57·10 l 57·92	″ l 53·98 l 54·00	″ l 56·50 l 57·56	″ l 55·66 l 56·78	″ l 55·48 l 55·28	″ l 56·12 l 56·20	″ l 56·06 l 56·44	″ l 55·46 l 55·54	Probability = 0·32
Means	56·90	53·99	57·03	56·22	55·38	56·16	56·25	55·50	57° 34′ 55″·93

At LXV

March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXIII & LXIV	″ h 36·60 h 36·92	″ h 36·62 h 37·04	″ l 36·26 l 37·66	″ l 37·04 l 36·28	″ l 37·88 l 37·54	″ l 37·64 l 37·52	Probability = 0·17
Means	36·76	36·83	36·96	36·66	37·71	37·58	58° 42′ 37″·08

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At LXV—(Continued.)

March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
	″	″	″	″	″	″	
LXIV & LXVI	*h* 32·36 *h* 32·32	*h* 33·28 *h* 33·36	*l* 33·72 *l* 33·40	*l* 33·30 *l* 33·74	*l* 32·54 *l* 32·56	*l* 33·66 *l* 32·96	Probability = 0·19
Means	32·34	33·32	33·56	33·52	32·55	33·31	70° 41′ 33″·10
LXVI & LXVII	*h* 28·84 *h* 29·24	*h* 29·54 *h* 29·36	*l* 29·88 *l* 28·84	*l* 29·00 *l* 28·80	*l* 30·16 *l* 29·06	*l* 28·58 *l* 29·58	Probability = 0·10
Means	29·04	29·45	29·36	28·90	29·61	29·08	57° 20′ 29″·24

At LXVI

March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
	″	″	″	″	″	″	
LXVIII & LXVII	*h* 49·08 *h* 49·42	*l* 49·02 *l* 48·68	*h* 47·70 *h* 47·70	*l* 47·80 *l* 48·74	*l* 48·42 *l* 48·18	*l* 48·84 *l* 47·88	Probability = 0·20
Means	49·25	48·85	47·70	48·27	48·30	48·36	70° 40′ 48″·46
LXVII & LXV	*h* 3·16 *h* 2·14 *h* 1·12	*l* 1·34 *h* 1·08	*h* 1·72 *h* 1·02	*l* 1·38 *l* 0·88	*l* 1·26 *l* 1·24	*l* 1·82 *l* 1·92	Probability = 0·15
Means	2·14	1·21	1·37	1·13	1·25	1·87	57° 11′ 1″·50
LXV & LXIV	*h* 43·20 *h* 44·72	*l* 43·70 *h* 43·26	*h* 44·46 *l* 44·80	*l* 42·52 *l* 43·02	*l* 44·34 *l* 44·30	*l* 44·64 *l* 43·66	Probability = 0·25
Means	43·96	43·48	44·63	42·77	44·32	44·15	48° 56′ 43″·89

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At LXVII

March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXV & LXVI	″ *h* 30·56 *h* 29·56	″ *h* 29·02 *l* 30·88	″ *l* 30·56 *l* 30·10	″ *l* 29·12 *l* 29·30	″ *h* 29·34 *h* 29·14	″ *h* 30·14 *h* 29·42	″ *h* 30·14 *l* 28·36	″ *l* 30·54 *l* 29·72	Probability = 0·15
Means	30·06	29·95	30·33	29·21	29·24	29·78	29·25	30·13	65° 28′ 29″·74
LXVI & LXVIII	*h* 30·90 *h* 29·46	*h* 31·16 *l* 31·66	*l* 32·56 *l* 33·22	*l* 31·88 *l* 32·22	*h* 32·50 *h* 32·46	*h* 31·32 *h* 31·28	*h* 30·30 *l* 31·34	*l* 31·22 *l* 33·18	Probability = 0·30
Means	30·18	31·41	32·89	32·05	32·48	31·30	30·82	32·20	46° 40′ 31″·67
LXVIII & LXIX	*h* 28·80 *h* 30·00	*h* 29·72 *l* 29·90	*l* 29·64 *l* 30·14	*l* 30·22 *l* 29·10	*h* 29·28 *h* 29·42	*h* 29·14 *h* 29·86	*h* 29·30 *l* 29·70	*l* 29·60 *l* 28·64	Probability = 0·08
Means	29·40	29·81	29·89	29·66	29·35	29·50	29·50	29·12	62° 11′ 29″·53

At LXVIII

March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXX & LXIX	″ *h* 33·68 *h* 34·26	″ *l* 34·20 *l* 35·00	″ *l* 35·02 *h* 34·92	″ *h* 33·78 *h* 33·28	″ *l* 34·44 *l* 33·56	″ *l* 33·06 *l* 34·10	″ *l* 34·02 *l* 33·48	″ *l* 33·52 *l* 34·78	Probability = 0·17
Means	33·97	34·60	34·97	33·53	34·00	33·58	33·75	34·15	58° 14′ 34″·07

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At LXVIII—(Continued.)

March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
	″	″	″	″	″	″	″	″	
LXIX & LXVII	*h* 17·08 *h* 17·22	*l* 17·80 *l* 16·94	*l* 16·58 *h* 17·92	*h* 18·42 *h* 18·08	*l* 17·46 *l* 18·06	*l* 18·00 *l* 18·34	*l* 18·24 *l* 17·44	*l* 17·32 *l* 17·12	Probability = 0·15
Means	17·15	17·37	17·25	18·25	17·76	18·17	17·84	17·22	54° 0′ 17″·63
LXVII & LXVI	*h* 42·26 *h* 42·34	*l* 41·56 *l* 41·86	*l* 41·24 *h* 40·74	*h* 40·20 *h* 39·14	*l* 39·12 *l* 39·50	*l* 42·62 *l* 41·16	*l* 39·44 *l* 42·30	*l* 39·20 *l* 39·68	Probability = 0·39
Means	42·30	41·71	40·99	39·67	39·31	41·89	40·87	39·44	62° 38′ 40″·77

At LXIX

February and March 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
	″	″	″	″	″	″	″	″	
LXVII & LXVIII	*l* 12·74 *l* 13·62	*l* 12·68 *l* 14·24	*h* 11·32 *h* 10·84 *h* 13·94 *h* 13·40	*l* 13·34 *h* 13·04 *h* 12·54	*h* 12·84 *l* 12·33	*l* 13·26 *l* 12·98	*h* 13·08 *h* 12·34	*l* 14·76 *l* 12·62	Probability = 0·15
Means	13·18	13·46	12·38	12·97	12·59	13·12	12·71	13·69	63° 48′ 13″·01
LXVIII & LXX	*h* 14·36 *h* 13·68	*h* 13·12 *h* 13·44	*h* 15·02 *h* 14·46	*h* 13·60 *h* 13·12	*h* 13·00 *h* 13·88	*l* 14·08 *l* 12·84	*h* 13·12 *h* 12·48	*h* 13·18 *h* 13·04	Probability = 0·20
Means	14·02	13·28	14·74	13·36	13·44	13·46	12·80	13·11	61° 57′ 13″·53
LXX & LXXI	*h* 29·68 *h* 30·20	*h* 28·88 *h* 29·10	*h* 28·38 *h* 30·68	*h* 28·60 *h* 29·74	*h* 29·70 *h* 29·40	*l* 30·34 *l* 30·56	*h* 29·10 *h* 29·92	*h* 30·18 *h* 29·88	Probability = 0·16
Means	29·94	28·99	29·53	29·17	29·55	30·45	29·51	30·03	58° 8′ 29″·65

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At LXX

February 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXXII & LXXI	″ *h* 28·50 *h* 28·94	″ *l* 29·74 *l* 28·40	″ *l* 28·78 *h* 28·46	″ *h* 28·98 *h* 29·28	″ *l* 29·32 *l* 28·52	″ *l* 28·88 *l* 30·14	″ *l* 29·80 *l* 31·18	″ *l* 28·40 *l* 30·24	Probability = 0·20
Means	28·72	29·07	28·62	29·13	28·92	29·51	30·49	29·32	52° 25′ 29″·22
LXXI & LXIX	*h* 9·88 *h* 8·56	*l* 8·74 *l* 9·90	*l* 8·14 *l* 8·54	*h* 8·88 *h* 8·36	*l* 10·34 *l* 9·44	*l* 9·04 *l* 9·88	*l* 9·86 *l* 8·64	*l* 9·64 *l* 7·96	Probability = 0·17
Means	9·22	9·32	8·34	8·62	9·89	9·46	9·25	8·80	70° 28′ 9″·11
LXIX & LXVIII	*h* 13·14 *h* 13·98	*l* 13·24 *l* 13·14	*l* 13·56 *l* 13·12	*h* 12·48 *h* 13·76	*l* 14·12 *l* 14·36	*l* 12·60 *l* 14·30	*l* 13·56 *l* 13·20	*l* 12·40 *l* 14·38	Probability = 0·11
Means	13·56	13·19	13·34	13·12	14·24	13·45	13·38	13·39	59° 48′ 13″·46

At LXXI

February 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXIX & LXX	″ *h* 23·74 *h* 22·82 *h* 21·22 *h* 21·74	″ *h* 21·06 *h* 20·76 *h* 21·06	″ *h* 24·00 *h* 23·40 *h* 24·72	″ *h* 23·22 *h* 22·18	″ *h* 22·68 *h* 21·40	″ *h* 22·54 *h* 22·42	″ *h* 22·66 *h* 21·42	″ *h* 22·42 *h* 21·24	Probability = 0·29
Means	22·38	20·96	24·04	22·70	22·04	22·48	22·04	21·83	51° 23′ 22″·31

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At LXXI—(Continued.)

February 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXX & LXXII	″ h 25·54 h 27·22	″ h 26·60 h 26·66	″ l 24·64 h 25·80 h 24·90	″ h 24·38 h 25·08	″ h 25·00 l 24·94	″ l 25·02 l 26·08	″ l 25·80 l 25·36	″ l 25·96 l 24·82	Probability = 0·22
Means	26·38	26·63	25·11	24·73	24·97	25·55	25·58	25·39	61° 45′ 25″·54
LXXII & LXXIII	h 28·22 h 29·02 h 30·10	h 29·18 h 30·26	l 30·78 l 29·68	h 29·64 h 29·04	h 29·58 l 29·14	l 30·04 l 29·68	l 30·08 l 30·44	l 29·00 l 30·06	Probability = 0·14
Means	29·11	29·72	30·23	29·34	29·36	29·86	30·26	29·53	60° 19′ 29″·68

At LXXII

February 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXXIV & LXXIII	″ h 40·08 l 40·28	″ h 40·86 h 41·70	″ l 38·68 h 39·90	″ h 39·72 h 39·72	″ h 38·18 h 39·62	″ l 41·10 l 39·06	″ l 40·38 l 40·72	″ l 38·70 l 40·56	Probability = 0·25
Means	40·18	41·28	39·29	39·72	38·90	40·08	40·55	39·63	55° 40′ 39″·95
LXXIII & LXXI	h 24·74 l 24·44	h 25·46 h 24·14	l 26·36 h 24·64	l 24·96 l 26·34	h 26·04 h 26·40	l 24·50 l 24·76	l 25·88 l 24·92	l 23·90 l 25·40	Probability = 0·20
Means	24·59	24·80	25·50	25·65	26·22	24·63	25·40	24·65	50° 15′ 25″·18

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At LXXII—(Continued.)

February 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXXI & LXX	″ *h* 5·34 *l* 5·52	″ *h* 4·96 *h* 8·18 *h* 6·28	″ *l* 6·34 *l* 7·76 *h* 7·14	″ *l* 6·14 *l* 5·30	″ *h* 6·26 *h* 5·92	″ *l* 5·90 *l* 7·08	″ *l* 4·72 *l* 5·38	″ *l* 7·38 *l* 4·60	Probability = 0·21
Means	5·43	6·47	7·08	5·72	6·09	6·49	5·05	5·99	65° 49′ 6″·04

At LXXIII

February 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXXI & LXXII	″ *l* 4·22 *l* 5·10	″ *l* 4·80 *l* 4·52	″ *h* 4·32 *h* 5·46	″ *h* 5·06 *h* 4·98	″ *l* 4·54 *l* 5·18	″ *l* 6·62 *l* 4·30	″ *l* 5·54 *l* 5·16	″ *l* 5·62 *l* 5·16	Probability = 0·11
Means	4·66	4·66	4·89	5·02	4·86	5·46	5·35	5·39	69° 25′ 5″·04
LXXII & LXXIV	*l* 53·48 *l* 52·66	*l* 52·78 *l* 52·98	*h* 53·24 *h* 53·06	*h* 52·18 *h* 52·94	*l* 51·84 *l* 51·64	*l* 53·30 *l* 51·82	*l* 51·64 *l* 51·76	*l* 51·32 *l* 52·04	Probability = 0·21
Means	53·07	52·88	53·15	52·56	51·74	52·56	51·70	51·68	72° 4′ 52″·42

May 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

	Seconds of Observed Angles at each Zero						
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXIV & LXXV	″ *l* 16·12 *l* 14·60 *l* 14·02	″ *l* 15·46 *l* 14·84	″ *l* 15·30 *l* 14·32	″ *l* 14·20 *l* 13·42	″ *l* 14·20 *l* 14·90	″ *l* 15·70 *l* 14·26	Probability = 0·18
Means	14·91	15·15	14·81	13·81	14·55	14·98	67° 25′ 14″·70

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At LXXIV

May 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXVI & LXXV	″ *l* 10·40 *l* 10·16	″ *l* 11·52 *l* 10·98	″ *l* 9·84 *l* 10·46	″ *l* 9·92 *l* 10·94	″ *l* 9·96 *l* 11·14	″ *l* 10·32 *l* 11·06	Probability = 0·15
Means	10·28	11·25	10·15	10·43	10·55	10·69	56° 5′ 10″·56
LXXV & LXXIII	*l* 9·22 *l* 10·16	*l* 9·72 *l* 10·10	*l* 9·86 *l* 9·76	*l* 9·76 *l* 8·50	*l* 10·10 *l* 10·46	*l* 9·94 *l* 10·30	Probability = 0·15
Means	9·69	9·91	9·81	9·13	10·28	10·12	57° 43′ 9″·82

February 1847, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

	Seconds of Observed Angles at each Zero								
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXXIII & LXXII	″ *h* 27·08 *l* 27·26	″ *l* 27·66 *l* 27·68	″ *l* 29·28 *l* 29·88 *l* 29·56	″ *l* 28·44 *l* 27·90	″ *h* 29·64 *h* 29·10	″ *h* 29·20 *h* 27·68	″ *h* 27·28 *h* 28·10	″ *h* 27·94 *h* 26·18 *h* 26·88 *h* 28·30	Probability = 0·30
Means	27·17	27·67	29·57	28·17	29·37	28·44	27·69	27·33	52° 14′ 28″·18

At LXXV

May 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXIII & LXXIV	″ *l* 37·18 *l* 37·20 *l* 36·00	″ *l* 35·24 *l* 36·10	″ *l* 36·20 *l* 36·38	″ *l* 36·06 *l* 36·32	″ *l* 36·16 *l* 37·32	″ *l* 35·74 *l* 36·82	Probability = 0·15
Means	36·79	35·67	36·29	36·19	36·74	36·28	54° 51′ 36″·33

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At LXXV—(Continued.)

May 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXIV & LXXVI	″ *l* 25·04 *l* 25·58 *l* 26·26	″ *l* 27·90 *l* 27·62	″ *l* 26·52 *l* 26·62	″ *l* 27·84 *l* 26·84	″ *l* 27·36 *l* 26·64	″ *l* 26·82 *l* 27·02	Probability = 0·27
Means	25·63	27·76	26·57	27·34	27·00	26·92	57° 7′ 26″·87
LXXVI & LXXVII	*l* 57·80 *l* 57·32	*l* 57·36 *l* 58·06	*l* 58·22 *l* 57·40	*l* 56·18 *l* 58·36	*l* 58·14 *l* 57·96	*l* 57·76 *l* 58·08	Probability = 0·10
Means	57·56	57·71	57·81	57·27	58·05	57·92	66° 37′ 57″·72

At LXXVI

April 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXVIII & LXXVII	″ *l* 11·12 *l* 12·08	″ *l* 10·78 *l* 11·08	″ *l* 13·40 *l* 12·60	″ *l* 13·02 *l* 10·96	″ *l* 12·26 *l* 11·44	″ *h* 10·90 *h* 11·94	Probability = 0·26
Means	11·60	10·93	13·00	11·99	11·85	11·42	54° 6′ 11″·80
LXXVII & LXXV	*l* 54·04 *l* 53·86	*l* 52·40 *l* 53·18	*l* 53·70 *l* 53·74	*l* 53·56 *l* 52·60	*l* 53·72 *l* 53·82	*h* 52·54 *h* 53·56	Probability = 0·18
Means	53·95	52·79	53·72	53·08	53·77	53·05	57° 3′ 53″·39

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At LXXVI—(Continued.)

April 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXV & LXXIV	″ *l* 23·60 *l* 22·60	″ *l* 24·12 *l* 23·68	″ *l* 23·72 *l* 23·70	″ *l* 23·92 *l* 22·60	″ *l* 23·68 *l* 23·44	″ *h* 24·00 *h* 22·74	Probability = 0·11
Means	23·10	23·90	23·71	23·26	23·56	23·37	66° 47′ 23″·48

At LXXVII

April 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXV & LXXVI	″ *l* 8·78 *l* 10·20	″ *l* 9·76 *l* 11·26 *l* 10·26	″ *h* 8·40 *h* 9·40	″ *l* 9·46 *l* 10·28	″ *l* 10·52 *l* 10·40	″ *l* 9·20 *l* 11·08	Probability = 0·22
Means	9·49	10·43	8·90	9·87	10·46	10·14	56° 18′ 9″·88
LXXVI & LXXVIII	*l* 54·86 *l* 53·56	*l* 54·94 *l* 55·02	*h* 55·24 *h* 56·76 *l* 55·86	*l* 53·52 *l* 52·88	*l* 56·18 *l* 55·82	*l* 56·16 *l* 54·32	Probability = 0·40
Means	54·21	54·98	55·95	53·20	56·00	55·24	58° 6′ 54″·93
LXXVIII & LXXIX	*l* 25·24 *l* 27·30	*l* 26·88 *l* 25·60	*l* 25·46 *l* 26·10	*l* 25·98 *l* 27·48	*l* 25·26 *l* 26·56	*l* 25·44 *l* 26·34	Probability = 0·13
Means	26·27	26·24	25·78	26·73	25·91	25·89	61° 2′ 26″·14

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At LXXVIII

April 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXX & LXXIX	″ *l* 17·70 *l* 17·56	″ *l* 17·34 *l* 18·02	″ *h* 17·78 *h* 18·70	″ *h* 18·44 *h* 17·74	″ *l* 18·46 *l* 17·28	″ *l* 16·06 *l* 17·18 *l* 17·90	Probability = 0·16
Means	17·63	17·68	18·24	18·09	17·87	17·05	55° 52′ 17″·76
LXXIX & LXXVII	*l* 29·46 *l* 29·10	*l* 29·92 *l* 28·94	*h* 31·16 *h* 30·98	*h* 30·10 *h* 29·12	*l* 28·84 *l* 30·06	*l* 27·34 *l* 28·16 *l* 28·56	Probability = 0·36
Means	29·28	29·43	31·07	29·61	29·45	28·02	67° 29′ 29″·48
LXXVII & LXXVI	*l* 53·60 *l* 54·60	*l* 52·54 *l* 52·86	*h* 54·34 *h* 54·62	*h* 52·52 *h* 53·70	*l* 54·76 *l* 54·08	*l* 54·40 *l* 53·38	Probability = 0·27
Means	54·10	52·70	54·48	53·11	54·42	53·89	67° 46′ 53″·78

At LXXIX

April 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXVII & LXXVIII	″ *l* 5·16 *l* 4·18	″ *h* 4·84 *h* 4·88	″ *l* 3·62 *h* 6·08 *h* 7·04	″ *l* 6·14 *l* 5·32	″ *l* 3·50 *l* 4·80	″ *l* 4·64 *l* 4·78	Probability = 0·22
Means	4·67	4·86	5·58	5·73	4·15	4·71	51° 28′ 4″·95

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At LXXIX—(Continued.)

April 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXVIII & LXXX	″ *l* 43·56 *l* 41·68	″ *h* 41·44 *h* 43·50	″ *l* 43·42 *h* 43·18 *h* 42·24	″ *l* 41·06 *l* 41·62	″ *l* 43·34 *l* 42·14	″ *l* 41·68 *l* 42·16	Probability = 0·22
Means	42·62	42·47	42·95	41·34	42·74	41·92	58° 59′ 42″·34
LXXX & LXXXI	*l* 57·36 *l* 58·38	*h* 57·02 *h* 57·60	*l* 58·44 *l* 58·78	*l* 58·28 *l* 58·84	*l* 57·96 *l* 58·98	*l* 57·76 *l* 57·00	Probability = 0·22
Means	57·87	57·31	58·61	58·56	58·47	57·38	51° 56′ 58″·03

At LXXX

April 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXXII & LXXXI	″ *h* 52·88 *h* 51·74	″ *h* 52·04 *h* 52·12	″ *l* 53·82 *l* 53·86	″ *l* 52·28 *l* 51·74	″ *l* 53·68 *l* 52·92	″ *l* 51·94 *l* 52·48	Probability = 0·28
Means	52·31	52·08	53·84	52·01	53·30	52·21	74° 7′ 52″·63
LXXXI & LXXIX	*h* 16·52 *h* 15·78	*h* 16·02 *h* 15·02	*l* 14·48 *l* 14·16	*l* 13·98 *l* 14·28	*l* 13·98 *l* 14·10	*l* 13·96 *l* 13·72	Probability = 0·35
Means	16·15	15·52	14·32	14·13	14·04	13·84	71° 13′ 14″·67

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At LXXX—(Continued.)

April 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXIX & LXXVIII	″ *h* 3·56 *h* 2·34	″ *h* 0·96 *h* 1·46	″ *l* 1·56 *l* 2·42	″ *l* 0·14 *l* 1·18	″ *l* 0·26 *l* 1·30	″ *l* 0·38 *l* 0·58	Probability = 0·36
Means	2·95	1·21	1·99	0·66	0·78	0·48	65° 8′ 1″·35

At LXXXI

April 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero						Probabilities and General Means.
	0° 0′	180° 0′	12° 0′	192° 0′	24° 0′	204° 0′	
LXXIX & LXXX	″ *l* 50·34 *l* 49·36	″ *h* 47·08 *h* 47·36 *h* 47·34	″ *h* 48·44 *h* 48·46	″ *h* 48·16 *h* 48·84	″ *l* 47·86 *l* 48·48	″ *l* 48·28 *l* 48·40	Probability = 0·31
Means	49·85	47·26	48·45	48·50	48·17	48·34	56° 49′ 48″·43
LXXX & LXXXII	*l* 27·40 *l* 27·50	*h* 28·82 *h* 28·88 *h* 29·22	*h* 28·46 *h* 28·32	*h* 28·00 *h* 27·62	*l* 28·68 *l* 27·86	*l* 28·90 *l* 28·72	Probability = 0·22
Means	27·45	28·97	28·39	27·81	28·27	28·81	56° 49′ 28″·28
LXXXII & LXXXIII	*l* 6·66 *l* 7·66	*h* 8·02 *h* 7·34 *h* 6·46	*h* 6·06 *h* 5·98	*h* 6·12 *h* 6·22	*l* 5·76 *l* 6·74	*l* 6·36 *l* 6·54	Probability = 0·20
Means	7·16	7·27	6·02	6·17	6·25	6·45	58° 59′ 6″·55

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At LXXXII

March 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0'	180° 0'	9° 0'	189° 0'	18° 0'	198° 0'	27° 0'	207° 0'	
LXXXIV & LXXXIII	″ *h* 9·76 *h* 9·96	″ *l* 9·62 *h* 7·38 *h* 8·18	″ *l* 10·34 *l* 9·30	″ *l* 9·50 *l* 10·04	″ *h* 9·38 *h* 9·86	″ *h* 9·60 *l* 7·88 *l* 9·18	″ *h* 9·48 *h* 9·08	″ *h* 8·46 *h* 8·28	Probability = 0·21
Means	9·86	8·39	9·82	9·77	9·62	8·89	9·28	8·37	61° 23′ 9″·25
LXXXIII & LXXXI	*h* 21·92 *h* 22·14	*h* 22·86 *h* 23·30	*l* 21·18 *l* 22·28	*l* 23·02 *l* 23·22	*l* 21·80 *l* 20·62	*l* 22·50 *h* 23·22 *h* 23·06	*h* 24·26 *h* 22·60	*h* 20·90 *h* 21·68	Probability = 0·29
Means	22·03	23·08	21·73	23·12	21·21	22·93	23·43	21·29	45° 16′ 22″·35
LXXXI & LXXX	*h* 38·26 *h* 39·18	*h* 38·54 *h* 37·92	*l* 38·84 *l* 39·72	*l* 38·60 *l* 38·90	*l* 37·66 *l* 38·46	*l* 39·48 *h* 41·90 *h* 39·54	*h* 40·90 *h* 40·38	*h* 39·72 *h* 39·86	Probability = 0·31
Means	38·72	38·23	39·28	38·75	38·06	40·31	40·64	39·79	49° 2′ 39″·22

At LXXXIII

March 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0'	180° 0'	9° 0'	189° 0'	18° 0'	198° 0'	27° 0'	207° 0'	
LXXXI & LXXXII	″ *l* 33·02 *l* 32·58	″ *l* 30·68 *l* 30·76	″ *l* 33·12 *l* 31·68	″ *l* 31·64 *l* 30·40	″ *l* 32·90 *l* 32·94	″ *l* 31·54 *l* 31·58	″ *l* 33·22 *l* 33·14	″ *l* 31·58 *l* 33·02	Probability = 0·30
Means	32·80	30·72	32·40	31·02	32·92	31·56	33·18	32·30	75° 44′ 32″·11

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At LXXXIII—(Continued.)

March 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXXXII & LXXXIV	″ l 54·72 l 55·18	″ l 55·94 l 56·68	″ l 55·44 l 55·38	″ l 55·26 l 55·26	″ l 54·60 l 54·62	″ l 55·36 l 54·44	″ l 54·62 l 56·40	″ l 54·08 l 54·30	Probability = 0·21
Means	54·95	56·31	55·41	55·26	54·61	54·90	55·51	54·19	63° 55′ 55″·14
LXXXIV & LXXXV	l 43·20 l 43·50	l 43·40 l 43·28	l 44·44 l 44·92	l 42·34 l 43·82	l 43·50 l 44·00	l 44·04 l 44·22	l 44·04 l 43·06	l 42·86 l 42·40	Probability = 0·21
Means	43·35	43·34	44·68	43·08	43·75	44·13	43·55	42·63	58° 46′ 43″·56

At LXXXIV

January and February 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
LXXXVI & LXXXV	″ l 12·00 l 12·43	″ h 13·80 h 16·90	″ l 12·70 l 13·23	″ l 18·77 l 20·60 l 16·53	″ l 12·00 l 13·80	″ l 13·37 l 15·07	″ h 12·67 h 15·10	″ h 17·07 h 15·50	″ h 17·43 h 15·67	″ h 12·30 h 13·83	″ h 12·80 h 12·73	″ h 13·20 l 14·37	Probability = 0·53
Means	12·22	15·35	12·97	18·63	12·90	14·22	13·89	16·29	16·55	13·07	12·77	13·79	70° 0′ 14″·39

March 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXXXV & LXXXIII	″ h 20·56 h 20·24	″ h 22·24 h 20·04	″ h 21·54 h 22·28	″ h 20·28 h 20·62	″ h 20·80 h 22·26	″ l 20·00 l 22·02	″ l 19·92 l 21·26	″ l 20·52 l 20·34	Probability = 0·19
Means	20·40	21·14	21·91	20·45	21·53	21·01	20·59	20·43	58° 40′ 20″·93

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At LXXXIV—(Continued.)

March 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXXXIII & LXXXII	″ *h* 56·72 *h* 56·56	″ *h* 57·42 *h* 57·96	″ *h* 55·44 *h* 55·46	″ *h* 55·56 *h* 56·32	″ *l* 58·90 *l* 58·36	″ *l* 55·48 *l* 56·88	″ *l* 57·30 *l* 55·98	″ *l* 56·58 *l* 57·44	Probability = 0·33
Means	56·64	57·69	55·45	55·94	58·63	56·18	56·64	57·01	54° 40′ 56″·77

At LXXXV

March 1846, *observed by Mr. G. Logan with Barrow's* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
LXXXIII & LXXXIV	″ *l* 58·58 *l* 58·52	″ *h* 56·36 *l* 56·40	″ *h* 56·70 *h* 56·76	″ *h* 56·54 *h* 55·64	″ *h* 56·56 *h* 56·52	″ *h* 57·26 *h* 56·36	″ *h* 56·42 *l* 56·04	″ *l* 58·30 *l* 55·90	Probability = 0·26
Means	58·55	56·38	56·73	56·09	56·54	56·81	56·23	57·10	62° 32′ 56″·80

February 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

	Seconds of Observed Angles at each Zero												
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
LXXXIV & LXXXVI	″ *h*57·73 *h*53·20	″ *h*53·53 *h*54·03	″ *h*54·07 *h*52·70	″ *h*53·33 *h*53·73	″ *h*50·63 *h*52·27	″ *h*53·47 *h*49·97 *h*49·27	″ *h*54·93 *h*55·30	″ *h*55·93 *h*53·87	″ *l*54·33 *h*56·63 *h*53·20 *h*58·73	″ *h*57·10 *h*57·00	″ *l*54·20 *l*54·57	″ *l*56·93 *l*52·73 *l*54·13	Probability = 0·48
Means	55·47	53·78	53·39	53·53	51·45	50·90	55·12	54·90	55·72	57·05	54·39	54·60	51° 18′ 54″·19

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At LXXXV—(Continued.)

February 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
LXXXVI & LXXXVII	*h*34·83 *h*38·80	*h*36·77 *h*40·40 *h*40·57	*h*39·40 *h*41·40	*h*40·47 *h*38·27	*h*43·60 *h*45·67	*h*37·93 *h*40·17	*h*39·87 *h*37·30	*h*39·57 *h*37·83	*h*38·83 *h*36·83 *h*41·50	*h*37·97 *h*36·40	*l*36·43 *l*34·50	*l*38·97 *l*40·80 *l*42·27	Probability = 0·63
Means	36·82	39·25	40·40	39·37	44·64	39·05	38·59	38·70	39·05	37·19	35·47	40·68	48° 1′ 39″·10

At LXXXVI

February 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
LXXXVIII & LXXXVII	*h*50·30 *h*49·33	*h*49·67 *h*48·10 *h*52·03	*h*49·43 *h*49·37	*h*55·47 *h*53·77	*l*49·10 *h*48·30	*h*50·80 *h*50·60	*l*49·97 *l*51·70	*h*47·73 *h*47·80	*l*49·47 *l*48·37	*l*48·77 *l*50·87	*l*48·37 *h*47·22	*h*45·83 *h*45·67	Probability = 0·59
Means	49·82	49·93	49·40	54·62	48·70	50·70	50·84	47·77	48·92	49·82	47·80	45·75	57° 52′ 49″·51
LXXXVII & LXXXV	*h*20·60 *h*20·33	*h*22·07 *h*18·80 *h*17·60	*h*19·77 *h*21·20	*h*17·03 *h*18·20	*l*22·97 *h*22·90	*h*19·97 *h*20·97	*l*20·83 *h*20·57	*h*25·07 *h*23·43	*l*24·13 *l*23·33	*l*23·57 *l*24·10	*l*24·47 *h*22·93	*h*23·40 *h*25·23 *h*24·33	Probability = 0·62
Means	20·47	19·49	20·49	17·62	22·94	20·47	20·70	24·25	23·73	23·84	23·70	24·32	63° 41′ 21″·84
LXXXV & LXXXIV	*h*51·77 *h*49·30	*h*48·87 *h*50·03	*h*52·37 *h*51·00	*h*53·00 *h*54·03	*l*49·87 *h*50·10	*h*54·13 *h*52·53	*l*47·27 *h*45·63	*h*52·73 *h*52·90	*h*50·87 *l*50·70 *l*50·70	*l*50·00 *l*48·83	*l*48·80 *l*50·00	*l*50·17 *l*51·03	Probability = 0·55
Means	50·54	49·45	51·69	53·52	49·99	53·33	46·45	52·82	50·76	49·42	49·40	50·60	58° 40′ 50″·66

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At LXXXVII

February and March* 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.

<table>
<tr><th rowspan="2">Angles.</th><th colspan="12">Seconds of Observed Angles at each Zero</th><th rowspan="2">Probabilities and General Means.</th></tr>
<tr><th>0°0′</th><th>180°0′</th><th>20°0′</th><th>200°0′</th><th>40°0′</th><th>220°0′</th><th>0°0</th><th>180°0′</th><th>20°0′</th><th>200°0′</th><th>40°0′</th><th>220°0′</th></tr>
<tr><td>LXXXV & LXXXVI</td><td colspan="6">″ ″ ″ ″ ″ ″
h58·13 h56·87 h58·17 h60·70 h55·50 l57·57
h59·07 h57·90 l55·90 h63 87 h58·00 l59·27
h56·20 l56·20 h57·30
h57·87</td><td colspan="6">″ ″ ″ ″ ″ ″
h60·93 h61·17 h60·40 h58·43 l59·57 h58·40
h55·80 h60·73 h59·40 h59·67 l60·93 l56·17
h57·20</td><td>Probability =0·38</td></tr>
<tr><td>Means</td><td>58·60</td><td>57·39</td><td>56·76</td><td>59·66</td><td>56·93</td><td>58·42</td><td>57·98</td><td>60·95</td><td>59·90</td><td>59·05</td><td>60·25</td><td>57·29</td><td>68° 16′ 58″·60</td></tr>
<tr><td>LXXXVI & LXXXVIII</td><td colspan="6">h36·67 h39·17 l38·43 h38·60 h37·50 l35·90
h37·90 h40·00 l37·70 h34·53 h37·57 l36·30
h38·73
h36·63</td><td colspan="6">h39·37 l40·17 l37·80 l34·43 h40·67 h40·43
h39·37 h40·67 l37·03 l35·30 h40·47 h38·27
h38·80</td><td>Probability = 0·48</td></tr>
<tr><td>Means</td><td>37·29</td><td>39·59</td><td>38·07</td><td>37·12</td><td>37·54</td><td>36·10</td><td>39·18</td><td>40·42</td><td>37·42</td><td>34·87</td><td>40·57</td><td>39·35</td><td>69° 23′ 38″·13</td></tr>
<tr><td>LXXXVIII & LXXXIX</td><td colspan="6">h13·53 h11·50 l15·20 h13·77 h19·10 h18·27
h13·27 h14·00 h19·83 h18·50 h17·90 l19·17
h18·47 h14·87</td><td colspan="6">h17·77 h21·90 h15·47 h21·00 h19·53 h18·33
h14·10 h20·53 l16·27 h19·20 h21·00 h19·50
h15·46</td><td>Probability = 0·75</td></tr>
<tr><td>Means</td><td>13·40</td><td>12·75</td><td>17·83</td><td>15·71</td><td>18·50</td><td>18·72</td><td>15·78</td><td>21·22</td><td>15·87</td><td>20·10</td><td>20·27</td><td>18·92</td><td>59° 30′ 17″·42</td></tr>
</table>

At LXXXVIII

March* 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.

<table>
<tr><th rowspan="2">Angles.</th><th colspan="12">Seconds of Observed Angles at each Zero</th><th rowspan="2">Probabilities and General Means.</th></tr>
<tr><th>0°0′</th><th>180°0′</th><th>20°0′</th><th>200°0′</th><th>40°0′</th><th>220°0′</th><th>0°0′</th><th>180°0′</th><th>20°0′</th><th>200°0′</th><th>40°0′</th><th>220°0′</th></tr>
<tr><td>XC & LXXXIX</td><td colspan="6">″ ″ ″ ″ ″ ″
h57·10 h58·50 l56·03 h60·27 h64·03 h61·30
h58·77 h59·87 l55·90 h62·10 h61·50 h61·70
h60·20</td><td colspan="6">″ ″ ″ ″ ″ ″
h62·13 h57·27 l57·57 l60·83 h59·13 h63·10
h62·80 h56·20 h58·37 l61·47 h58·87 h63·03</td><td>Probability =0·66</td></tr>
<tr><td>Means</td><td>58·69</td><td>59·19</td><td>55·97</td><td>61·19</td><td>62·77</td><td>61·50</td><td>62·47</td><td>56·74</td><td>57·97</td><td>61·15</td><td>59·00</td><td>63·07</td><td>63° 22′ 59″·98</td></tr>
</table>

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At LXXXVIII—(Continued.)

March 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
LXXXIX & LXXXVII	″ *h*56·77 *h*54·90	″ *h*53·90 *h*55·17	″ *l*54·67 *l*55·40	″ *h*49·43 *h*51·80	″ *l*50·17 *l*50·90	″ *h*54·00 *h*52·70	″ *h*53·37 *h*53·80	″ *h*57·00 *h*57·70	″ *l*53·57 *h*53·70	″ *l*55·53 *l*54·67	″ *h*52·77 *h*55·40	″ *h*54·87 *h*57·47	Probability = 0·56
Means	55·84	54·54	55·04	50·62	50·54	53·35	53·59	57·35	53·64	55·10	54·09	56·17	63° 16′ 54″·16
LXXXVII & LXXXVI	*l*27·37 *l*29·27	*l*35·10 *l*34·43	*l*33·10 *l*29·97 *l*27·63	*l*33·00 *l*32·53	*l*30·13 *l*31·40	*h*31·00 *h*31·07	*h*31·13 *h*29·73	*h*28·10 *h*28·87	*l*32·23 *h*33·03 *h*31·93	*l*30·20 *l*32·40	*h*32·53 *h*30·70 *l*34·33 *l*33·33	*h*27·67 *h*28·37 *l*31·47	Probability = 0·53
Means	28·32	34·77	30·23	32·77	30·77	31·04	30·43	28·49	32·40	31·30	32·72	29·17	52° 43′ 31″·03

At LXXXIX

March 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
LXXXVII & LXXXVIII	″ *l*50·17 *l*48·93	″ *l*51·57 *l*48·63	″ *l*48·67 *l*50·37	″ *l*52·07 *l*48·23 *l*50·63	″ *l*52·90 *l*52·37	″ *l*51·93 *l*54·90 *l*53·13	″ *h*50·07 *l*49·80	″ *h*47·37 *h*47·40	″ *l*50·97 *l*49·10	″ *l*48·30 *l*50·03	″ *l*47·40 *l*46·27	″ *l*52·63 *l*51·43	Probability = 0·53
Means	49·55	50·10	49·52	50·31	52·64	53·32	49·94	47·39	50·04	49·17	46·84	52·03	57° 12′ 50″·07
LXXXVIII & XC	*h*10·20 *h*11·03	*h*8·40 *h*5·83	*h*5·60 *h*9·57 *h*6·97	*h*6·73 *h*6·80	*h*8·53 *h*7·07	*h*7·53 *h*5·93	*h*7·17 *h*8·50	*h*9·30 *h*8·10	*l*8·00 *l*7·47	*l*11·63 *l*10·83	*l*9·57 *l*10·33	*l*5·23 *l*6·27	Probability = 0·46
Means	10·62	7·12	7·38	6·77	7·80	6·73	7·84	8·70	7·74	11·23	9·95	5·75	54° 49′ 8″·14

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At LXXXIX—(Continued.)

March* 1849, *observed by Mr. J. Peyton with Barrow's* 24*-inch Theodolite.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XC & XCI	*h*29·27 *h*27·57	*h*29·90 *h*30·83	*h*31·50 *h*31·43	*h*31·27 *h*32·27	*h*34·37 *h*33·90	*h*30·00 *h*29·20	*h*31·70 *h*30·97	*l*29·47 *l*29·97	*h*31·00 *h*28·23	*h*28·63 *h*27·00	*h*32·17 *h*31·90	*h*30·60 *h*30·27	Probability = 0·48
Means	28·42	30·37	31·47	31·77	34·14	29·60	31·34	29·72	29·62	27·82	32·04	30·44	52° 18′ 30″·56

At XC

March* 1849, *observed by Mr. J. Peyton with Barrow's* 24*-inch Theodolite.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCII & XCI	*h*39·87 *h*41·50	*h*44·10 *h*47·30 *h*45·60	*h*43·57 *h*42·33	*h*41·50 *h*42·40	*l*41·37 *l*46·47 *l*43·27	*l*45·00 *l*42·83	*l*43·27 *l*43·70	*l*43·67 *l*44·67	*l*43·90 *l*41·70	*l*38·27 *l*38·67	*l*39·47 *l*40·63	*l*45·30 *l*44·47	Probability = 0·51
Means	40·69	45·67	42·95	41·95	43·70	43·92	43·49	44·17	42·80	38·47	40·05	44·89	75° 2′ 42″·73
XCI & LXXXIX	*h*39·10 *h*36·67	*h*43·40 *h*40·97	*l*39·20 *l*39·27	*l*42·50 *l*41·53	*l*37·53 *l*38·70	*l*39·30 *l*37·83 *l*39·03	*h*36·77 *h*39·33	*h*38·50 *h*38·57	*h*40·50 *h*39·20	*l*38·60 *l*36·23	*l*36·73 *l*38·63	*l*33·60 *l*35·00 *l*35·17	Probability = 0·56
Means	37·89	42·19	39·24	42·02	38·12	38·72	38·05	38·54	39·85	37·42	37·68	34·59	69° 40′ 38″·69
LXXXIX & LXXXVIII	*h*53·20 *h*55·27	*h*50·53 *h*51·73	*l*52·67 *l*53·83	*l*50·50 *l*51·23	*l*49·80 *l*52·57 *l*51·07	*l*52·00 *l*52·40	*h*54·17 *h*53·17	*h*54·20 *h*53·73	*h*52·43 *l*50·03	*l*53·13 *l*55·20	*l*52·90 *l*53·93	*l*51·57 *l*51·23	Probability = 0·37
Means	54·24	51·13	53·25	50·87	51·15	52·20	53·67	53·97	51·23	54·17	53·42	51·40	61° 47′ 52″·56

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At XCI

April 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
LXXXIX & XC	*l* 49·17	*l* 52·53	*l* 51·93	*l* 55·43	*l* 52·17	*h* 50·80	*l* 52·30	*h* 49·60	*h* 53·93	*h* 53·50	*l* 53·83	*l* 52·83	Probability = 0·38
	l 50·13	*l* 51·73	*l* 53·40	*l* 53·87	*h* 51·97	*h* 52·47	*h* 51·90	*h* 51·43	*h* 52·57	*h* 53·83	*l* 52·70	*l* 52·63	
					h 51·80								
Means	49·65	52·13	52·67	54·65	51·98	51·64	52·10	50·52	53·25	53·67	53·27	52·73	58° 0′ 52″·36
XC & XCII	*h* 47·20	*l* 43·07	*h* 45·07	*h* 43·73	*h* 43·57	*h* 43·97	*l* 42·97	*h* 45·23	*h* 46·17	*h* 49·33	*l* 44·33	*l* 46·73	Probability = 0·45
	h 46·53	*l* 44·93	*h* 44·10	*h* 46·63	*h* 44·43	*h* 45·17	*h* 44·97	*h* 45·37	*h* 48·40	*h* 50·00	*l* 44·93	*l* 45·33	
						h 46·20	*h* 46·83						
Means	46·87	44·00	44·59	45·18	44·00	45·11	44·92	45·30	47·29	49·67	44·63	46·03	55° 9′ 45″·63
XCII & XCIII	*h* 14·43	*h* 20·53	*h* 12·80	*h* 13·93	*h* 14·93	*h* 12·57	*l* 19·47	*h* 13·67	*h* 13·87	*h* 11·73	*l* 13·80	*l* 12·77	Probability = 0·76
	h 16·77	*h* 21·30	*h* 11·93	*h* 12·87	*h* 15·03	*h* 12·30	*l* 17·07	*h* 12·77	*h* 11·43	*h* 11·07	*l* 12·47	*l* 14·50	
Means	15·60	20·92	12·37	13·40	14·98	12·44	18·27	13·22	12·65	11·40	13·14	13·64	52° 55′ 14″·34

At XCII

April 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCIV & XCIII	*h* 59·67	*h* 61·10	*l* 64·10	*l* 62·50	*l* 58·13	*l* 63·17	*h* 63·20	*h* 56·73	*h* 64·70	*h* 65·87	*l* 62·97	*l* 66·27	Probability = 0·77
	h 60·43	*h* 62·13	*l* 62·67	*l* 62·40	*l* 57·27	*l* 62·97	*h* 61·23	*h* 58·17	*h* 62·80	*l* 66·57	*l* 63·23	*l* 66·23	
Means	60·05	61·62	63·39	62·45	57·70	63·07	62·22	57·45	63·75	66·22	63·10	66·25	70° 59′ 2″·27
XCIII & XCI	*h* 31·50	*l* 31·20	*l* 32·23	*l* 36·83	*l* 37·17	*l* 36·27	*l* 38·33	*l* 34·47	*l* 32·80	*l* 32·43	*l* 30·93	*l* 29·73	Probability = 0·57
	h 32·53	*l* 34·67	*l* 35·87	*l* 37·47	*l* 36·00	*l* 36·33	*l* 34·10	*l* 36·00	*l* 34·80	*l* 34·43	*l* 32·60	*l* 31·83	
				l 35·33			*l* 36·93						
Means	32·02	32·94	34·05	36·54	36·59	36·30	36·45	35·24	33·80	33·43	31·77	30·78	49° 51′ 34″·16

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At XCII—(Continued.)

April* 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCI & XC	*h*33·53 *l*34·23	*l*32·83 *l*33·77	*l*31·87 *l*30·47	*h*30·53 *l*29·90 *l*28·67	*l*27·77 *l*30·40	*l*30·33 *l*28·93	*h*29·87 *h*32·17 *h*33·83	*h*31·53 *h*30·37	*h*30·13 *h*30·80	*h*30·97 *h*28·70 *h*31·90	*l*33·73 *l*30·80	*l*33·27 *l*28·23 *l*27·80	Probability = 0·42
Means	33·88	33·30	31·17	29·70	29·09	29·63	31·96	30·95	30·47	30·52	32·27	29·77	49° 47′ 31″·06

At XCIII

April* 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCI & XCII	*h*11·00 *h*10·77	*h*9·13 *h*9·67	*l*8·87 *l*9·93	*l*13·30 *l*13·53	*h*12·53 *h*12·50	*h*11·50 *h*12·97	*h*12·17 *h*11·23	*h*14·10 *h*11·73	*l*7·90 *l*9·03	*l*10·50 *l* 8·07	*l*14·77 *l*15·03	*l*10·87 *l*11·63	Probability = 0·54
Means	10·89	9·40	9·40	13·42	12·52	12·24	11·70	12·92	8·47	9·29	14·90	11·25	77° 13′ 11″·37
XCII & XCIV	*h*46·80 *h*46·60	*h*43·30 *h*44·33	*h*43·23 *h*44·33	*l*43·96 *l*45·00	*l*42·63 *l*43·47	*l*44·33 *l*43·10	*h*45·77 *h*48·00	*h*48·37 *h*48·33	*h*49·13 *l*49·03	*l*51·03 *l*51·40	*l*43·73 *l*45·20	*l*45·60 *l*43·33	Probability = 0·72
Means	46·70	43·82	43·78	44·48	43·05	43·72	46·89	48·35	49·08	51·22	44·47	44·47	55° 16′ 45″·84
XCIV & XCV	*h*30·93 *h*28·50	*h*33·23 *h*32·53	*h*30·23 *h*28·87	*l*30·77 *l*26·03 *l*28·47	*l*30·23 *l*23·87 *l*27·30	*l*29·00 *l*27·93	*l*31·10 *l*28·70	*l*27·13 *l*27·07	*l*31·30 *l*30·60	*l*30·07 *l*30·87	*l*28·80 *l*26·60	*l*28·33 *l*27·30	Probability = 0·48
Means	29·72	32·88	29·55	28·42	27·13	28·47	29·90	27·10	30·95	30·47	27·70	27·82	58° 6′ 29″·18

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At XCIV

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCVI & XCV	l51·43 l53·83	l47·87 l46·03	l47·67 l49·33	l47·93 l48·23	h49·43 h50·50	h52·13 h47·40 h49·43	l47·80 l50·67	l50·33 l52·10	l48·30 l51·37 l49·80	l52·73 l51·30	l56·77 l56·50	l47·03 l49·90 l47·20	Probability = 0·73
Means	52·63	46·95	48·50	48·08	49·97	49·65	49·24	51·22	49·82	52·02	56·64	48·04	61° 43′ 50″·23
XCV & XCIII	h27·77 h26·87	h32·20 h31·50	h29·30 h30·33	h32·70 h31·10	l29·40 l30·93	l30·53 l30·40	l28·63 l28·10	l28·67 l31·43	h27·80 h26·10	h26·90 h28·00	h28·20 h27·40	h26·90 h27·73	Probability = 0·50
Means	27·32	31·85	29·82	31·90	30·17	30·47	28·37	30·05	26·95	27·45	27·80	27·32	53° 6′ 29″·12
XCIII & XCII	h13·07 h15·93	h11·57 h11·37	h12·90 h13·97	h11·13 h11·23	l13·63 l13·93	l11·77 l10·47	l16·47 l14·50	l12·13 l 9·30	l15·20 l14·33	l13·40 l12·20	h16·93 h15·34	h11·23 h 9·80	Probability = 0·55
Means	14·50	11·47	13·44	11·18	13·78	11·12	15·49	10·72	14·77	12·80	16·14	10·52	53° 44′ 12″·99

At XCV

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCIII & XCIV	l56·93 l57·10	l67·60 l65·80	l63·63 l63·97	l63·33 l63·77	h63·13 h63·27	h63·03 h62·80	l63·73 l62·83	h60·80 h62·20 l62·33	l60·27 l65·97 l63·16 l64·73	l60·33 l62·40	l62·63 l63·63	l61·47 l62·63 l60·30	Probability = 0·62
Means	57·02	66·70	63·80	63·55	63·20	62·92	63·28	61·78	63·53	61·37	63·13	61·47	68° 47′ 2″·65

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At XCV—(Continued.)

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
XCIV & XCVI	″ *l* 18·70 *l* 20·60	″ *l* 17·60 *l* 16·80	″ *l* 16·47 *l* 19·60 *l* 15·70	″ *l* 16·33 *l* 15·43	″ *h* 16·23 *h* 17·67	″ *h* 17·17 *h* 17·67	″ *l* 16·40 *l* 17·03	″ *h* 16·53 *l* 17·83	″ *l* 17·60 *l* 16·73	″ *l* 20·33 *l* 21·10	″ *l* 19·17 *l* 20·87	″ *l* 19·50 *l* 16·97 *l* 17·67	Probability = 0·41
Means	19·65	17·20	17·26	15·88	16·95	17·42	16·72	17·18	17·17	20·72	20·02	18·05	57° 4′ 17″·85
XCVI & XCVII	*l* 16·80 *l* 15·96	*l* 17·93 *l* 20·23	*l* 12·13 *l* 12·66	*l* 17·50 *l* 19·23	*h* 19·27 *h* 18·17	*h* 19·67 *h* 19·53	*l* 15·10 *l* 15·57	*h* 15·10 *l* 12·70	*l* 14·53 *l* 15·53	*l* 14·33 *l* 16·17	*l* 19·33 *l* 14·37 *l* 11·73	*l* 14·33 *l* 16·43	Probability = 0·62
Means	16·38	19·08	12·40	18·37	18·72	19·60	15·34	13·90	15·03	15·25	15·14	15·38	60° 57′ 16″·22

At XCVI

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
XCVIII & XCVII	″ *h* 9·53 *h* 9·57	″ *l* 5·30 *l* 3·73	″ *l* 6·60 *l* 6·33	″ *l* 5·30 *l* 4·37	″ *l* 10·40 *l* 9·03	″ *l* 3·03 *l* 6·63 *l* 4·67	″ *h* 9·40 *h* 7·57	″ *h* 6·67 *h* 6·90	″ *h* 7·73 *h* 6·87	″ *h* 8·57 *h* 7·73	″ *h* 8·10 *h* 10·43	″ *h* 8·40 *h* 8·23	Probability = 0·52
Means	9·55	4·52	6·47	4·84	9·72	4·78	8·49	6·79	7·30	8·15	9·27	8·32	65° 39′ 7″·35
XCVII & XCV	*l* 55·23 *l* 55·90	*l* 61·63 *l* 60·43	*l* 60·37 *l* 59·97	*l* 60·93 *l* 59·93	*l* 57·73 *l* 58·67	*l* 59·10 *l* 59·37	*l* 58·00 *l* 59·27	*l* 57·63 *l* 55·43	*l* 56·00 *l* 55·53	*l* 54·03 *l* 54·57	*l* 58·87 *l* 57·93	*l* 57·17 *l* 55·97	Probability = 0·59
Means	55·57	61·03	60·17	60·43	58·20	59·24	58·64	56·53	55·77	54·30	58·40	56·57	53° 43′ 57″·90

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At XCVI—(Continued.)

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20′ 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCV & XCIV	*l* 49·50 *l* 51·77	*l* 48·57 *l* 51·10	*l* 50·30 *l* 48·57	*l* 48·37 *l* 49·20	*l* 47·43 *l* 49·67 *l* 50·03	*l* 48·80 *l* 49·60	*l* 49·23 *l* 48·20	*l* 54·97 *l* 52·53	*l* 49·60 *l* 50·27	*l* 54·30 *l* 54·03	*l* 48·87 *l* 48·50	*l* 52·53 *l* 52·73	Probability = 0·55
Means	50·64	49·84	49·44	48·79	49·04	49·20	48·72	53·75	49·94	54·17	48·69	52·63	61° 11′ 50″·40

At XCVII

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCV & XCVI	*h* 45·47 *h* 45·43	*h* 44·70 *h* 44·50	*l* 45·70 *l* 45·53	*l* 44·10 *l* 44·50	*l* 45·60 *l* 46·50	*l* 43·37 *l* 45·57 *l* 46·03	*l* 47·10 *l* 47·90	*l* 40·27 *l* 39·80 *h* 41·53 *h* 42·77	*h* 44·00 *h* 45·03	*h* 45·30 *h* 44·17	*h* 46·07 *h* 47·77	*h* 46·60 *h* 47·40	Probability = 0·47
Means	45·45	44·60	45·62	44·30	46·05	44·99	47·50	41·09	44·52	44·74	46·92	47·00	65° 18′ 45″·23
XCVI & XCVIII	*h* 16·40 *h* 16·20	*h* 14·43 *h* 14·80	*l* 16·60 *l* 15·97	*l* 16·73 *l* 15·17	*l* 14·23 *l* 16·10	*l* 16·73 *l* 16·00	*l* 14·77 *l* 12·13	*l* 18·77 *h* 16·90 *h* 17·37 *l* 19·00	*h* 16·07 *h* 15·73	*h* 17·90 *h* 17·57	*h* 18·40 *h* 17·13	*h* 14·06 *h* 14·73	Probability = 0·39
Means	16·30	14·62	16·29	15·95	15·17	16·37	13·45	18·01	15·90	17·74	17·77	14·40	58° 17′ 16″·00
XCVIII & XCIX	*l* 24·67 *l* 23·47	*l* 26·83 *l* 27·13	*l* 24·93 *l* 25·33	*l* 25·30 *l* 25·97	*l* 17·17 *l* 17·53	*l* 23·17 *l* 22·63	*l* 25·40 *l* 24·33	*l* 25·00 *l* 24·23	*h* 25·00 *h* 23·50	*h* 24·37 *h* 23·63	*h* 22·17 *h* 22·47	*h* 23·43 *h* 22·70	Probability = 0·66
Means	24·07	26·98	25·13	25·64	17·35	22·90	24·87	24·62	24·25	24·00	22·32	23·07	62° 13′ 23″·77

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At. XCV—(Continued.)

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCIV & XCVI	*l*18·70 *l*20·60	*l*17·60 *l*16·80	*l*16·47 *l*19·60 *l*15·70	*l*16·33 *l*15·43	*h*16·23 *h*17·67	*h*17·17 *h*17·67	*l*16·40 *l*17·03	*h*16·53 *l*17·83	*l*17·60 *l*16·73	*l*20·33 *l*21·10	*l*19·17 *l*20·87	*l*19·50 *l*16·97 *l*17·67	Probability = 0·41
Means	19·65	17·20	17·26	15·88	16·95	17·42	16·72	17·18	17·17	20·72	20·02	18·05	57° 4′ 17″·85
XCVI & XCVII	*l*16·80 *l*15·96	*l*17·93 *l*20·23	*l*12·13 *l*12·66	*l*17·50 *l*19·23	*h*19·27 *h*18·17	*h*19·67 *h*19·53	*l*15·10 *l*15·57	*h*15·10 *l*12·70	*l*14·53 *l*15·53	*l*14·33 *l*16·17	*l*19·33 *l*14·37 *l*11·73	*l*14·33 *l*16·43	Probability = 0·62
Means	16·38	19·08	12·40	18·37	18·72	19·60	15·34	13·90	15·03	15·25	15·14	15·38	60° 57′ 16″·22

At XCVI

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCVIII & XCVII	*h*9·53 *h*9·57	*l*5·30 *l*3·73	*l*6·60 *l*6·33	*l*5·30 *l*4·37	*l*10·40 *l* 9·03	*l*3·03 *l*6·63 *l*4·67	*h*9·40 *h*7·57	*h*6·67 *h*6·90	*h*7·73 *h*6·87	*h*8·57 *h*7·73	*h* 8·10 *h*10·43	*h*8·40 *h*8·23	Probability = 0·52
Means	9·55	4·52	6·47	4·84	9·72	4·78	8·49	6·79	7·30	8·15	9·27	8·32	65° 39′ 7″·35
XCVII & XCV	*l*55·23 *l*55·90	*l*61·63 *l*60·43	*l*60·37 *l*59·97	*l*60·93 *l*59·93	*l*57·73 *l*58·67	*l*59·10 *l*59·37	*l*58·00 *l*59·27	*l*57·63 *l*55·43	*l*56·00 *l*55·53	*l*54·03 *l*54·57	*l*58·87 *l*57·93	*l*57·17 *l*55·97	Probability = 0·59
Means	55·57	61·03	60·17	60·43	58·20	59·24	58·64	56·53	55·77	54·30	58·40	56·57	53° 43′ 57″·90

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At XCVI—(Continued.)

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20′ 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCV & XCIV	*l* 49.50 *l* 51.77	*l* 48.57 *l* 51.10	*l* 50.30 *l* 48.57	*l* 48.37 *l* 49.20	*l* 47.43 *l* 49.67 *l* 50.03	*l* 48.80 *l* 49.60	*l* 49.23 *l* 48.20	*l* 54.97 *l* 52.53	*l* 49.60 *l* 50.27	*l* 54.30 *l* 54.03	*l* 48.87 *l* 48.50	*l* 52.53 *l* 52.73	Probability = 0.55
Means	50.64	49.84	49.44	48.79	49.04	49.20	48.72	53.75	49.94	54.17	48.69	52.63	61° 11′ 50″.40

At XCVII

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCV & XCVI	*h* 45.47 *h* 45.43	*h* 44.70 *h* 44.50	*l* 45.70 *l* 45.53	*l* 44.10 *l* 44.50	*l* 45.60 *l* 46.50	*l* 43.37 *l* 45.57 *l* 46.03	*l* 47.10 *l* 47.90	*l* 40.27 *l* 39.80 *h* 41.53 *h* 42.77	*h* 44.00 *h* 45.03	*h* 45.30 *h* 44.17	*h* 46.07 *h* 47.77	*h* 46.60 *h* 47.40	Probability = 0.47
Means	45.45	44.60	45.62	44.30	46.05	44.99	47.50	41.09	44.52	44.74	46.92	47.00	65° 18′ 45″.23
XCVI & XCVIII	*h* 16.40 *h* 16.20	*h* 14.43 *h* 14.80	*l* 16.60 *l* 15.97	*l* 16.73 *l* 15.17	*l* 14.23 *l* 16.10	*l* 16.73 *l* 16.00	*l* 14.77 *l* 12.13	*l* 18.77 *h* 16.90 *h* 17.37 *l* 19.00	*h* 16.07 *h* 15.73	*h* 17.90 *h* 17.57	*h* 18.40 *h* 17.13	*h* 14.06 *h* 14.73	Probability = 0.39
Means	16.30	14.62	16.29	15.95	15.17	16.37	13.45	18.01	15.90	17.74	17.77	14.40	58° 17′ 16″.00
XCVIII & XCIX	*l* 24.67 *l* 23.47	*l* 26.83 *l* 27.13	*l* 24.93 *l* 25.33	*l* 25.30 *l* 25.97	*l* 17.17 *l* 17.53	*l* 23.17 *l* 22.63	*l* 25.40 *l* 24.33	*l* 25.00 *l* 24.23	*h* 25.00 *h* 23.50	*h* 24.37 *h* 23.63	*h* 22.17 *h* 22.47	*h* 23.43 *h* 22.70	Probability = 0.66
Means	24.07	26.98	25.13	25.64	17.35	22.90	24.87	24.62	24.25	24.00	22.32	23.07	62° 13′ 23″.77

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At XCVIII

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
C & XCIX	h57·80 h59·33	l59·67 l58·70	l58·67 l58·47	l56·97 l58·90	l58·30 l57·53	l62·13 l61·40	l58·17 l57·10	l63·03 l62·73	l58·93 l58·30	l63·10 l59·90 l62·17	l61·07 l59·47	l59·80 l60·57	Probability = 0·48
Means	58·57	59·19	58·57	57·94	57·92	61·77	57·64	62·88	58·62	61·72	60·27	60·19	67° 13′ 59″·61
XCIX & XCVII	h12·63 l12·07	l13·33 l13·40	l14·13 l12·63	l13·40 l14·40	l13·87 l13·63	l15·47 l15·60	l15·43 l14·10	h13·60 h13·47	l12·73 l12·53	l10·77 l12·70	l10·73 l11·27	l11·70 l12·93	Probability = 0·35
Means	12·35	13·37	13·38	13·90	13·75	15·54	14·77	13·54	12·63	11·74	11·00	12·32	49° 56′ 13″·19
XCVII & XCVI	h33·90 l35·70	l37·40 l34·40 l34·07	l36·90 l38·70	l36·53 l33·90	l41·03 l36·53 l38·83	l33·77 l34·00	l38·17 l36·80	h37·10 h39·80	l39·63 l38·67	l36·07 l34·47	l39·73 l38·23	l37·00 l36·40	Probability = 0·51
Means	34·80	35·29	37·80	35·22	38·80	33·89	37·49	38·45	39·15	35·27	38·98	36·70	56° 3′ 36″·82

At XCIX

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	0°0′	180°0′	20°0′	200°0′	40°0′	220°0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCVII & XCVIII	l24·20 l23·13	l26·07 l24·77	l24·37 l24·77	l28·63 l26·83	l26·97 l25·30	l25·77 l23·97	l27·37 l26·13	l24·07 l22·90	l21·67 l22·17	l22·57 l21·54	l26·00 l23·17	l24·00 l21·43	Probability = 0·51
Means	23·67	25·42	24·57	27·73	26·14	24·87	26·75	23·49	21·92	22·06	24·59	22·72	67° 50′ 24″·49

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At XCIX—(Continued.)

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XCVIII & C	*l* 55·20 *l* 55·30	*l* 51·80 *l* 51·53	*l* 55·63 *l* 54·53	*l* 56·97 *l* 56·10	*l* 54·00 *l* 52·87	*l* 55·63 *l* 53·87	*l* 53·37 *l* 53·03	*l* 57·27 *l* 55·80	*l* 54·77 *l* 54·93	*l* 57·03 *l* 55·96	*l* 55·33 *l* 57·73	*l* 55·93 *l* 55·47	Probability = 0·43
Means	55·25	51·67	55·08	56·54	53·44	54·75	53·20	56·54	54·85	56·50	56·53	55·70	51° 52′ 55″·00
C & CI	*h* 23·40 *h* 22·97	*h* 28·77 *h* 26·67	*l* 25·33 *l* 24·97	*l* 22·67 *l* 22·33	*l* 25·07 *l* 27·10	*l* 26·60 *l* 26·20	*l* 26·00 *l* 25·27	*l* 25·60 *l* 25·70	*l* 27·70 *l* 26·90	*l* 24·67 *l* 24·60	*l* 25·77 *l* 23·37	*l* 22·33 *l* 24·27	Probability = 0·45
Means	23·19	27·72	25·15	22·50	26·09	26·40	25·64	25·65	27·30	24·64	24·57	23·30	58° 10′ 25″·18

At C

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
CIV & CII	*l* 21·34 *l* 23·84	*l* 15·26 *l* 15·44	*l* 20·00 *l* 17·67	*l* 18·16 *l* 18·16	*l* 19·76 *l* 18·76	*l* 18·84 *l* 19·83	*l* 12·40 *h* 14·56 *h* 13·66	*l* 20·93 *l* 20·50	*h* 17·70 *h* 16·40	*h* 19·80 *h* 19·16	*l* 15·60 *l* 13·50	*l* 22·63 *l* 24·50	Probability = 0·84
Means	22·59	15·35	18·84	18·16	19·26	19·34	13·54	20·72	17·05	19·48	14·55	23·57	57° 39′ 18″·54
CII & CI	*h* 54·57 *h* 53·87	*h* 54·57 *h* 55·00	*l* 53·67 *l* 54·83	*l* 50·90 *l* 51·17	*l* 52·40 *l* 53·84	*l* 46·50 *l* 46·50	*h* 57·50 *h* 57·77	*l* 50·40 *l* 50·00	*h* 53·33 *h* 54·50	*h* 49·20 *h* 49·44	*l* 56·40 *l* 57·33	*l* 48·10 *l* 46·34	Probability = 0·99
Means	54·22	54·79	54·25	51·04	53·12	46·50	57·64	50·20	53·92	49·32	56·87	47·22	56° 48′ 52″·42

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At C—(Continued.)

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
CI & XCIX	″ *h*14·67 *h*13·13	″ *h*14·47 *h*13·07	″ *h*12·70 *h*12·67	″ *l*11·97 *l*13·17	″ *l*12·57 *l*10·90	″ *l*15·57 *l*15·57	″ *l*12·13 *l*11·40	″ *l* 8·60 *l* 6·37	″ *l*10·60 *l*11·93	″ *l*12·10 *l*10·53	″ *l*10·63 *l*11·10	″ *l*10·97 *l*11·53	Probability = 0·55
Means	13·90	13·77	12·69	12·57	11·74	15·57	11·77	7·49	11·27	11·32	10·87	11·25	46° 13′ 12″·02
XCIX & XCVIII	*h*65·57 *h*66·10	*h*61·86 *h*63·80	*h*64·53 *h*62·60	*l*62·60 *l*59·93	*l*65·43 *l*68·43	*l*62·70 *l*62·57	*l*65·20 *l*66·23	*l*71·23 *l*65·43 *l*64·80	*l*67·83 *l*67·67	*l*65·57 *l*64·13	*l*69·93 *l*69·83	*l*64·73 *l*62·97	Probability = 0·69
Means	65·84	62·83	63·57	61·27	66·93	62·64	65·72	67·15	67·75	64·85	69·88	63·85	60° 53′ 5″·19

At CI

May 1849, *observed by Mr. J. Peyton with Barrow's* 24-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	0° 0′	180° 0′	20° 0′	200° 0′	40° 0′	220° 0′	
XCIX & C	″ *l*22·07 *l*21·40	″ *l*23·53 *l*22·00	″ *l*21·40 *l*21·20	″ *l*21·30 *l*19·63	″ *l*23·30 *l*24·77	″ *l*23·30 *l*23·37	″ *l*20·63 *l*21·23	″ *l*19·40 *l*22·67 *l*19·57	″ *l*24·43 *l*23·73	″ *l*23·20 *l*21·97	″ *l*23·63 *l*24·70	″ *l*22·23 *l*21·73	Probability = 0·38
Means	21·74	22·77	21·30	20·47	24·04	23·34	20·93	20·55	24·08	22·59	24·17	21·98	75° 36′ 22″·33

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

	Seconds of Observed Angles at each Zero												
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
C & CII	″ *h*20·63 *h*22·33	″ *h*17·50 *h*16·50	″ *l*16·67 *l*18·16	″ *l*20·00 *l*19·50	″ *l*14·63 *l*17·67	″ *l*20·67 *l*17·67	″ *l*18·16 *l*15·24	″ *l*25·36 *l*22·17	″ *l*19·97 *l*21·67	″ *l*21·56 *l*20·63	″ *l*20·10 *l*18·34	″ *l*27·00 *l*24·67	Probability = 0·81
Means	21·48	17·00	17·42	19·75	16·15	19·17	16·70	23·77	20·82	21·10	19·22	25·84	59° 56′ 19″·87

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At CI—(Continued.)

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
CII & CIII	h42·53 h42·83	h43·34 h44·34	l48·83 l49·34	l43·26 l42·43	l50·30 l50·33	l42·00 l44·00	l48·57 l50·50	l40·10 l41·67	l48·36 l46·83	l41·74 l41·53	l44·67 l45·66	l37·73 l37·00	Probability = 1·09
Means	42·68	43·84	49·09	42·85	50·32	43·00	49·54	40·89	47·60	41·64	45·17	37·37	64° 34′ 44″·50

At CII

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
C & CIV	l20·43 l20·00	l21·33 l25·67	l21·66 l20·50	l20·67 l21·67	l21·84 l22·50	l25·50 l24·00	l28·47 l27·67	l17·84 l18·66	l23·00 l23·00	l19·33 l19·66	l28·50 l28·20	l13·17 l17·33	Probability = 1·05
Means	20·22	23·50	21·08	21·17	22·17	24·75	28·07	18·25	23·00	19·50	28·35	15·25	61° 34′ 22″·11
CIV & CV	l31·80 l31·34	l24·90 l25·00	l25·00 l30·50	l27·33 l28·16	l31·20 l29·17	l29·00 l28·33	l23·76 l24·66	l31·13 l31·84	l29·53 l29·50	l33·00 l33·67	l27·50 l27·40	l39·00 l35·00	Probability = 0·98
Means	31·57	24·95	27·75	27·75	30·19	28·67	24·21	31·49	29·52	33·34	27·45	37·00	57° 27′ 29″·50
CV & CVI	l54·00 l53·33	l61·23 l55·00 l54·00	l58·84 l57·50	l54·27 l52·84	l55·90 l57·66	l50·33 l50·84	l60·54 l60·00	l50·97 l50·50	l62·33 l60·67	l48·33 l48·53	l58·90 l60·43	l48·33 l47·50	Probability = 1·30
Means	53·67	56·74	58·17	53·56	56·78	50·59	60·27	50·74	61·50	48·43	59·67	47·92	59° 20′ 54″·84

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At CII—(Continued.)

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
CVI & CIII	″ l 21·43 l 21·50	″ l 12·17 l 15·66	″ l 16·34 l 17·50	″ l 18·33 l 17·16	″ l 12·56 l 14·17	″ l 21·54 l 21·33	″ l 13·80 l 13·00	″ l 25·23 l 24·00	″ l 16·44 l 14·66	″ l 20·34 l 20·97	″ l 15·60 l 13·84	″ l 23·10 l 23·00	Probability = 1·11
Means	21·47	13·92	16·92	17·75	13·37	21·44	13·40	24·62	15·55	20·66	14·72	23·05	58° 51′ 18″·07
CIII & CI	l 1·57 l 2·67	l 7·50 l 10·17	l 4·33 l 4·17	l 9·57 l 10·50	l 8·44 l 6·83	l 6·46 l 7·67	l 9·06 l 10·10	l 4·87 l 4·00	l 9·73 l 9·50	l 8·66 l 6·17	l 9·03 l 9·16	l 4·87 l 4·84	Probability = 0·71
Means	2·12	8·84	4·25	10·04	7·64	7·07	9·58	4·44	9·62	7·42	9·10	4·86	59° 31′ 7″·08
CI & C	l 50·77 l 51·16	l 52·87 l 48·50	l 51·34 l 49·83	l 49·83 l 49·67	l 50·06 l 49·67	l 47·17 l 47·83	l 44·37 l 44·57	l 49·96 l 51·00	l 43·17 l 45·00	l 50·34 l 51·00	l 40·47 l 40·97	l 51·53 l 52·33	Probability = 0·97
Means	50·97	50·69	50·59	49·75	49·87	47·50	44·47	50·48	44·09	50·67	40·72	51·93	63° 14′ 48″·48

At CIII

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
CI & CII	″ l 8·03 l 8·33	″ l 8·00 l 1·83 l 2·50	″ l 11·26 l 10·84	″ l 9·50 l 6·83	″ l 10·56 l 9·00	″ l 8·27 l 9·16	″ l 8·63 l 7·84	″ l 16·26 l 13·00	″ l 5·74 l 7·16	″ l 7·37 l 7·06	″ l 5·73 l 7·50	″ l 13·17 l 13·00	Probability = 0·81
Means	8·18	4·11	11·05	8·17	9·78	8·72	8·24	14·64	6·45	7·22	6·62	13·09	55° 54′ 8″·86

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At CIII—(Continued.)

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
CII & CVI	*l* 25·27 *l* 24·17	*l* 30·00 *l* 32·80	*l* 19·64 *l* 24·00	*l* 24·10 *l* 25·17	*l* 28·44 *l* 27·00	*l* 27·57 *l* 26·34	*l* 29·60 *l* 31·00	*l* 22·23 *l* 24·16	*l* 30·50 *l* 32·00	*l* 25·83 *l* 27·90	*l* 34·64 *l* 32·50	*l* 23·33 *l* 24·17	Probability = 1·04
Means	24·72	31·40	21·82	24·64	27·72	26·96	30·30	23·20	31·25	26·87	33·57	23·75	61° 9′ 27″·18
CVI & CVII	*l* 7·50 *l* 8·50	*l* 13·03 *l* 11·37	*l* 11·93 *l* 7·83	*l* 11·07 *l* 9·67	*l* 8·16 *l* 10·17	*l* 8·16 *l* 9·16	*l* 9·07 *l* 10·00	*l* 19·83 *l* 20·67	*l* 8·33 *l* 7·00	*l* 17·34 *l* 16·50	*l* 6·50 *l* 7·83	*l* 16·17 *l* 16·67	Probability = 1·17
Means	8·00	12·20	9·88	10·37	9·17	8·66	9·54	20·25	7·67	16·92	7·17	16·42	58° 8′ 11″·35

At CIV

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
CV & CII	*l* 65·13 *l* 65·00	*l* 61·37 *l* 58·90	*l* 59·93 *l* 62·17	*l* 63·46 *l* 64·33	*l* 64·57 *l* 62·74	*l* 61·44 *l* 59·04	*l* 58·84 *l* 59·00	*l* 66·16 *l* 64·00	*l* 59·80 *l* 60·03	*l* 65·73 *l* 63·20	*l* 55·00 *l* 55·66	*l* 62·07 *l* 61·66	Probability = 0·81
Means	65·07	60·14	61·05	63·90	63·66	60·24	58·92	65·08	59·92	64·47	55·33	61·87	64° 55′ 61″·64
CII & C	*l* 20·74 *l* 19·34	*l* 17·66 *l* 19·67	*l* 22·90 *l* 19·83	*l* 14·60 *l* 14·67	*l* 17·93 *l* 20·66	*l* 19·46 *l* 21·13	*l* 23·23 *l* 22·50	*l* 11·67 *l* 13·67	*l* 19·80 *l* 21·10	*l* 14·27 *l* 16·63	*l* 20·87 *l* 20·84	*l* 17·17 *l* 18·00	Probability = 0·84
Means	20·04	18·67	21·37	14·64	19·30	20·30	22·87	12·67	20·45	15·45	20·86	17·59	60° 46′ 18″·68

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At CV

May 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0'	180° 0'	9° 0'	189° 0'	18° 0'	198° 0'	27° 0'	207° 0'	
CX & CIX	" h 8·50 h 6·22 h 5·98	" h 8·52 h 11·40 h 6·98	" h 10·42 h 9·40 h 7·62	" h 9·72 h 7·64 h 7·02	" h 9·76 h 9·28 h 8·02	" h 11·14 h 9·50 h 7·42	" h 8·44 h 7·16 h 7·92	" h 5·94 h 8·54 h 7·64	Probability = 0·30
Means	6·90	8·97	9·15	8·13	9·02	9·35	7·84	7·37	49° 52' 8"·34

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0'	180° 0'	10° 0'	190° 0'	20° 0'	200° 0'	30° 0'	210° 2'	40° 0'	220° 0'	50° 0'	230° 0'	
CIX & CVI	" h55·33 h53·34	" h49·66 h49·23	" l49·60 l51·00	" l48·24 l48·00	" l48·50 l48·83	" l47·33 l49·33	" l48·50 l48·66	" l49·70 l47·84	" l46·17 l46·07	" l56·13 l57·17	" l43·33 h43·30 h43·50	" h56·83 h57·50	Probability = 1·13
Means	54·34	49·45	50·30	48·12	48·67	48·33	48·58	48·77	46·12	56·65	43·38	57·17	54° 47' 49"·99
CVI & CII	h46·63 h46·66	h49·27 h48·77	l48·34 l47·33	l50·03 l51·50	l50·40 l50·83	l44·17 l44·67	l55·07 l53·17	l44·50 l45·66	l51·27 l51·17	l44·33 l43·67	l54·17 h54·40 h55·00	h42·17 h42·50	Probability = 1·10
Means	46·65	49·02	47·84	50·77	50·62	44·42	54·12	45·08	51·22	44·00	54·52	42·34	61° 40' 48"·38
CII & CIV	l32·84 l32·00	h30·16 l24·84 l23·53	l31·90 l31·84	l27·57 l25·83	l30·00 l30·50	l33·53 l31·33	l27·27 l29·13	l33·17 l33·84	l24·23 l25·20	l35·67 l36·00	l27·17 l26·50 l23·74 l25·84	h30·00 l31·47 l30·66	Probability = 0·97
Means	32·42	26·18	31·87	26·70	30·25	32·43	28·20	33·51	24·72	35·84	25·81	30·71	57° 36' 29"·89

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At CVI

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
CII & CV	*h*14·57 *h*16·40	*h*25·50 *h*25·00	*l*18·04 *l*17·00	*l*15·67 *l*12·84	*l*13·00 *l*13·83	*l*17·00 *l*16·00	*l*15·07 *l*17·33	*l*17·50 *l*19·33	*l*18·66 *l*21·00	*l*15·66 *l*14·67	*l*24·17 *l*27·50	*l*11·83 *l*14·00	Probability = 1·17
Means	15·49	25·25	17·52	14·26	13·42	16·50	16·20	18·42	19·83	15·17	25·84	12·92	58° 58′ 17″·57
CV & CIX	*h*36·26 *h*37·33	*h*27·50 *h*29·50	*l*34·73 *l*38·00	*l*34·00 *l*37·00	*l*35·17 *l*37·67	*l*32·50 *l*32·80	*l*34·43 *l*31·67	*l*42·00 *l*39·17	*l*37·67 *l*38·50	*l*38·67 *l*37·33	*l*29·00 *l*33·33	*l*45·50 *l*42·00	Probability = 1·15
Means	36·80	28·50	36·37	35·50	36·42	32·65	33·05	40·59	38·09	38·00	31·17	43·75	64° 36′ 35″·91
CIX & CVII	*h*14·07 *h*11·17	*h* 8·50 *h* 7·00	*l* 7·43 *l* 7·33	*l*14·17 *l*10·33	*l*11·83 *l*10·50	*l* 7·94 *l* 5·20	*l*16·24 *l*14·00	*l* 8·17 *l* 8·00 *l* 7·17	*l* 6·33 *l* 4·34	*l*11·00 *l* 8·67	*l* 9·33 *l* 5·17	*l* 2·34 *l* 7·00	
Means	12·62	7·75	7·38	12·25	11·17	6·57	15·12	7·78	5·34	9·84	7·25	4·67	116° 50′ 8″·98
CVIII & CVII	*l*34·10 *l*33·50	*l*32·66 *l*30·66	*l*29·57 *l*30·83	*l*31·67 *l*35·50	*l*32·50 *l*29·66	*l*28·00 *l*28·17	*h*29·34 *l*30·17 *l*30·50	*l*34·00 *l*35·17	*l*33·00 *l*30·17	*l*39·00 *l*35·84	*l*33·50 *l*32·00	*l*43·34 *l*45·00	Probability = 1·17
Means	33·80	31·66	30·20	33·59	31·08	28·09	30·00	34·59	31·59	37·42	32·75	44·17	55° 57′ 33″·25
CIX & CVIII	+72·62 −33·80	+67·75 −31·66	+67·38 −30·20	+72·25 −33·59	+71·17 −31·08	+66·57 −28·09	+75·12 −30·00	+67·78 −34·59	+65·34 −31·59	+69·84 −37·42	+67·25 −32·75	+64·67 −44·17	Probability = 1·65
+116° 49′ − 55° 57′	38·82	36·09	37·18	38·66	40·09	38·48	45·12	33·19	33·75	32·42	34·50	20·50	60° 52′ 35″·73
CVII & CIII	*h*36·50 *h*39·50	*h*46·84 *h*49·17	*l*45·87 *l*43·17	*l*39·96 *l*42·33	*l*44·60 *l*42·00	*l*44·56 *l*46·63	*l*41·93 *l*45·00	*l*49·67 *l*45·83	*l*43·50 *l*43·83	*l*36·33 *l*40·66	*l*43·00 *l*45·33	*l*40·33 *l*37·67	Probability = 0·93
Means	38·00	48·01	44·52	41·15	43·30	45·60	43·47	47·75	43·67	38·50	44·17	39·00	59° 35′ 43″·10
CIII & CII	*h*18·60 *h*15·60	*h*11·66 *h* 9·33	*l*13·63 *l*14·50	*l*16·20 *l*17·50	*l*15·40 *l*16·00	*l*18·00 *l*19·37	*l*12·33 *l*12·00	*l*12·70 *l*15·67	*l*11·50 *l*13·84 *l*12·33	*l*18·34 *l*18·67	*l*14·50 *l* 8·67	*l*20·00 *l*19·33	Probability = 0·85
Means	17·10	10·50	14·07	16·85	15·70	18·69	12·17	14·19	12·56	18·51	11·59	19·67	59° 59′ 15″·13

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At CVI—(Continued.)

December 1846, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CV & R M	″ h 37·96 h 39·64 h 41·56	″ h 41·60 h 39·44 h 39·90	″ h 41·16 h 43·42 h 44·48	″ h 41·44 h 39·20 h 39·00	″ h 41·92 h 40·74 h 41·52	″ h 39·86 h 41·16 h 38·04	″ h 40·82 h 41·12 h 43·10	″ h 40·34 h 39·84 h 40·46	
Means	39·72	40·31	43·02	39·88	41·39	39·69	41·68	40·21	8° 23′ 40″·74

At CVII

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
CIII & CVI	″ h 9·64 h 7·50	″ h 6·16 h 5·17	″ l 4·84 l 4·16	″ l 10·00 l 9·33	″ l 1·83 l 4·67	″ l 7·83 l 10·66	″ l 6·00 l 5·83	″ l 10·67 l 12·00	″ l 5·17 l 4·34	″ l 14·50 l 12·16	″ l 5·66 l 4·00	″ l 11·84 l 14·83	Probability = 0·97
Means	8·57	5·67	4·50	9·67	3·25	9·25	5·92	11·34	4·76	13·33	4·83	13·34	62° 16′ 7″·87
CVI & CVIII	h 45·66 h 45·83	h 46·17 h 45·33	l 47·20 l 47·17	l 39·53 l 41·34	l 47·67 l 48·50	l 43·27 l 40·84	l 48·84 l 50·00	l 38·17 l 38·00	l 50·67 l 48·66	l 37·17 l 41·50	l 42·84 l 41·50	l 38·83 l 39·60	Probability = 1·16
Means	45·75	45·75	47·19	40·44	48·09	42·06	49·42	38·09	49·67	39·34	42·17	39·22	65° 12′ 43″·93

At CVIII

May and June 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
CVII & CVI	″ l 45·56 l 43·07	″ l 40·84 l 41·90	″ l 35·37 l 35·66	″ l 42·17 l 40·67	″ l 36·33 l 36·00	″ l 43·54 l 42·67	″ l 35·50 l 39·34	″ l 45·00 l 44·66	″ h 40·53 h 39·57	″ l 46·00 l 45·33	″ l 39·26 l 41·67	″ l 44·00 l 44·50	Probability = 0·95
Means	44·32	41·37	35·52	41·42	36·17	43·11	37·42	44·83	40·05	45·67	40·47	44·25	58° 49′ 41″·22

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At CVIII—(Continued.)

May and June 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
CVI & CIX	″ *l* 51·94 *l* 51·93	″ *l* 54·83 *l* 55·60	″ *l* 58·13 *l* 56·17	″ *l* 49·16 *l* 50·43	″ *l* 54·34 *l* 52·66	″ *l* 53·30 *l* 54·50	″ *l* 59·00 *l* 54·16 *l* 57·00	″ *l* 49·33 *l* 48·84	″ *h* 52·83 *h* 53·00	″ *l* 50·84 *l* 50·17	″ *l* 57·74 *l* 59·00	″ *l* 51·50 *l* 51·50	Probability = 0·83
Means	51·94	55·22	57·15	49·80	53·50	53·90	56·72	49·09	52·92	50·51	58·37	51·50	55° 34′ 53″·39

At CIX

May 1846, *observed by Lieutenant R. Walker with Cary's* 15-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero												Probabilities and General Means.
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
CVIII & CVI	″ *l* 32·83 *l* 32·66	″ *l* 29·00 *l* 30·33	″ *h* 33·44 *h* 33·00	″ *h* 38·17 *h* 36·17	″ *h* 28·40 *h* 28·83	″ *h* 35·16 *h* 33·17	″ *l* 27·90 *l* 29·33	″ *l* 34·66 *l* 35·00	″ *l* 31·50 *l* 30·50	″ *l* 35·34 *l* 33·63	″ *l* 23·24 *l* 22·50 *l* 23·00	″ *l* 34·83 *l* 34·67	Probability = 1·08
Means	32·75	29·67	33·22	37·17	28·62	34·17	28·62	34·83	31·00	34·49	22·91	34·75	63° 32′ 31″·85
CVI & CV	*l* 35·50 *l* 37·67	*l* 37·16 *l* 36·17	*h* 37·20 *h* 37·34	*h* 31·83 *h* 32·83	*h* 36·77 *l* 35·73 *l* 37·33	*h* 32·57 *h* 31·66	*l* 38·50 *l* 38·67	*l* 34·40 *l* 32·83	*l* 39·33 *l* 39·33	*l* 30·83 *l* 32·00 *l* 31·00	*l* 45·50 *l* 44·83 *l* 41·66	*l* 26·50 *l* 27·67	Probability = 1·23
Means	36·59	36·67	37·27	32·33	36·28	32·12	38·59	33·62	39·33	31·28	44·00	27·09	60° 35′ 35″·43

March 1847, *observed by Lieutenat R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

	Seconds of Observed Angles at each Zero								
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CV & CX	″ *h* 21·68 *h* 22·04	″ *h* 22·00 *h* 23·70	″ *h* 22·02 *h* 22·96	″ *h* 25·86 *h* 23·66	″ *l* 19·92 *l* 21·72	″ *l* 22·78 *l* 23·94	″ *h* 24·86 *h* 24·24 *h* 23·16	″ *h* 23·80 *h* 23·62	Probability = 0·42
Means	21·86	22·85	22·49	24·76	20·82	23·36	24·09	23·71	69° 1′ 22″·99

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At CIX—(Continued.)

March 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CX & CXI	″ *h* 54·82 *h* 55·32	″ *h* 54·62 *h* 55·28	″ *h* 53·26 *h* 53·74	″ *h* 54·94 *h* 56·60	″ *l* 53·46 *l* 54·00	″ *l* 52·06 *l* 51·54 *l* 53·54	″ *h* 49·36 *h* 51·48 *h* 52·22	″ *h* 53·98 *h* 53·50	Probability = 0·51
Means	55·07	54·95	53·50	55·77	53·73	52·38	51·02	53·74	81° 46′ 53″·77

At CX

March 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXII & CIX	″ *h* 48·42 *h* 49·42	″ *h* 46·78 *h* 47·20	″ *l* 47·00 *l* 48·82 *l* 48·54	″ *l* 46·80 *l* 47·42	″ *h* 48·22 *l* 48·00 *l* 46·84	″ *h* 49·32 *h* 49·60	″ *h* 49·88 *h* 51·52	″ *h* 48·42 *h* 49·08	
Means	48·92	46·99	48·12	47·11	47·69	49·46	50·70	48·75	105° 8′ 48″·47
CXI & CIX	*h* 11·20 *h* 12·38	*h* 14·14 *h* 12·66 *h* 11·96	*h* 15·32 *l* 15·40 *l* 13·38	*h* 11·60 *h* 10·42 *h* 10·92	*h* 12·74 *h* 13·38	*h* 12·66 *h* 11·94	*h* 15·76 *h* 16·34	*h* 12·64 *h* 12·02	Probability = 0·54
Means	11·79	12·92	14·70	10·98	13·06	12·30	16·05	12·33	48° 52′ 13″·02
CXII & CXI	+ 48·92 − 11·79	+ 46·99 − 12·92	+ 48·12 − 14·70	+ 47·11 − 10·98	+ 47·69 − 13·06	+ 49·46 − 12·30	+ 50·70 − 16·05	+ 48·75 − 12·33	Probability = 0·48
105° 8′ −48° 52′	37·13	34·07	33·42	36·13	34·63	37·16	34·65	36·42	56° 16′ 35″·45

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At CX—(Continued.)

March 1847, *observed by Lieutenant R. Walker with Troughton and Simms' 36-inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CIX & CV	″ h 30·50 h 30·00	″ h 28·58 h 29·66 h 29·86	″ h 28·92 h 27·40 h 29·50	″ h 34·60 h 31·90 h 31·48	″ h 29·32 h 29·02	″ h 31·62 h 30·62	″ h 28·12 h 27·46	″ h 28·82 h 30·14	Probability = 0·50
Means	30·25	29·37	28·61	32·66	29·17	31·12	27·79	29·48	61° 6′ 29″·81

At CXI

March 1847, *observed by Lieutenant R. Walker with Troughton and Simms' 36-inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CIX & CXII	″ h 3·98 h 4·70 h 6·76 h 7·96 h 6·26	″ h 8·78 h 8·18 h 6·78 h 6·38 h 6·22	″ h 9·12 h 7·34 h 6·04	″ h 7·12 h 6·74	″ h 4·98 h 5·48	″ l 4·00 l 7·10 l 7·38	″ h 8·28 h 6·40	″ h 5·10 h 6·58	
Means	5·93	7·27	7·50	6·93	5·23	6·16	7·34	5·84	102° 47′ 6″·53
CX & CXII	h 11·24 h 12·98 h 13·28	h 10·40 h 12·56 h 11·92	h 14·58 h 13·44 h 13·30	h 14·74 h 13·02 h 13·58	h 12·36 h 10·74 h 10·42	h 15·64 l 13·50 l 13·72	h 12·64 h 11·34	h 10·14 h 10·40	Probability = 0·47
Means	12·50	11·63	13·77	13·78	11·17	14·29	11·99	10·27	53° 26′ 12″·43
CIX & CX	+ 65·93 − 12·50	+ 67·27 − 11·63	+ 67·50 − 13·77	+ 66·93 − 13·78	+ 65·23 − 11·17	+ 66·16 − 14·29	+ 67·34 − 11·99	+ 65·84 − 10·27	Probability = 0·44
102° 46′ −53° 26′	53·43	55·64	53·73	53·15	54·06	51·87	55·35	55·57	49° 20′ 54″·10

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At CXI—(Continued.)

March 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXII & CXIII	″ *h* 43·24 *l* 39·18 *l* 40·24 *h* 43·18 *h* 44·10	″ *h* 42·42 *h* 44·80 *h* 45·06	″ *h* 45·44 *h* 40·46 *h* 42·52	″ *h* 39·72 *h* 40·72	″ *h* 44·68 *h* 41·62 *l* 42·90	″ *l* 43·52 *l* 42·56 *l* 42·54	″ *h* 38·92 *h* 39·86	″ *h* 42·06 *h* 43·40	Probability = 0·52
Means	41·99	44·09	42·81	40·22	43·07	42·87	39·39	42·73	59° 19′ 42″·15

At CXII

March 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXIV & CXIII	″ *h* 56·66 *h* 54·94	″ *h* 55·60 *h* 55·92	″ *h* 54·76 *h* 54·58	″ *h* 54·32 *h* 53·86	″ *h* 53·02 *h* 54·32	″ *h* 55·26 *h* 55·68	″ *h* 53·92 *h* 54·44	″ *h* 54·06 *h* 54·48	Probability = 0·27
Means	55·80	55·76	54·67	54·09	53·67	55·47	54·18	54·27	54° 31′ 54″·74
CXIII & CXI	*h* 37·66 *h* 38·72	*h* 40·88 *h* 40·36	*h* 41·28 *h* 40·46	*h* 39·90 *h* 39·64 *h* 41·54	*h* 42·00 *h* 41·12	*h* 42·56 *h* 41·78	*h* 40·48 *h* 39·68	*h* 37·86 *h* 38·74	Probability = 0·47
Means	38·19	40·62	40·87	40·36	41·56	42·17	40·08	38·30	60° 42′ 40″·27
CXI & CX	*h* 11·16 *h* 12·52	*h* 14·18 *h* 13·64	*h* 13·78 *h* 14·32 *h* 14·12	*h* 14·12 *h* 12·84	*h* 13·96 *h* 13·26 *h* 13·00	*h* 11·52 *h* 12·18	*h* 12·46 *h* 12·40	*h* 14·36 *h* 13·68	Probability = 0·31
Means	11·84	13·91	14·07	13·48	13·41	11·85	12·43	14·02	70° 17′ 13″·13

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At CXIII

March 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXI & CXII	″ *h* 39·48 *h* 40·00	″ *h* 39·46 *h* 39·68	″ *h* 38·24 *h* 39·26 *h* 39·06	″ *h* 38·10 *h* 37·98	″ *h* 39·84 *h* 38·86	″ *h* 37·34 *h* 37·82	″ *h* 38·52 *h* 38·44 *h* 37·96 *h* 38·74	″ *h* 38·46 *h* 39·14	Probability = 0·25
Means	39·74	39·57	38·85	38·04	39·35	37·58	38·42	38·80	59° 57′ 38″·79
CXII & CXIV	*h* 50·54 *h* 49·92	*h* 49·22 *h* 48·94	*h* 49·84 *h* 51·30 *h* 51·16	*h* 48·08 *h* 48·98	*h* 51·04 *h* 49·92	*h* 50·22 *h* 49·66	*h* 49·72 *h* 49·04	*h* 51·36 *h* 48·14 *h* 48·18	Probability = 0·26
Means	50·23	49·08	50·77	48·53	50·48	49·94	49·38	49·23	63° 50′ 49″·71
CXIV & CXV	*h* 53·60 *h* 53·38	*h* 53·38 *h* 53·66	*h* 52·26 *h* 51·94	*h* 54·16 *h* 52·62	*h* 54·96 *h* 53·46 *h* 53·18	*h* 51·40 *h* 52·58 *h* 53·56	*h* 52·36 *h* 51·46	*h* 52·22 *h* 54·78 *h* 53·04	Probability = 0·24
Means	53·49	53·52	52·10	53·39	53·87	52·51	51·91	53·35	63° 31′ 53″·02

At CXIV

March 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXVI & CXV	″ *h* 34·14 *h* 33·68	″ *h* 38·46 *h* 38·42	″ *l* 36·46 *l* 36·06	″ *l* 36·72 *l* 36·86	″ *h* 36·66 *h* 37·94	″ *h* 40·38 *h* 39·78	″ *h* 39·30 *h* 38·58 *h* 39·20	″ *h* 37·60 *h* 37·80	Probability = 0·62
Means	33·91	38·44	36·26	36·79	37·30	40·08	39·03	37·70	60° 19′ 37″·44

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At CXIV—(Continued.)

March 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXV & CXIII	″ h 56·36 h 55·72	″ h 53·18 h 54·34	″ l 55·20 l 54·98	″ l 54·34 l 54·88 l 54·26	″ h 55·26 h 54·90	″ h 53·90 h 54·64	″ h 56·64 h 54·56 h 53·64	″ h 54·82 h 55·84	Probability = 0·23
Means	56·04	53·76	55·09	54·49	55·08	54·27	54·95	55·33	60° 23′ 54″·88
CXIII & CXII	h 14·94 h 14·44	h 17·44 h 17·10 h 17·20	l 15·38 l 14·84 l 15·78	l 19·18 l 17·38 l 18·10	h 13·86 h 14·96 h 15·12	h 15·94 h 15·96	h 17·24 h 16·68	h 14·92 h 16·26	Probability = 0·42
Means	14·69	17·25	15·33	18·20	14·65	15·95	16·96	15·59	61° 37′ 16″·08

At CXV

April 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXIII & CXIV	″ l 11·82 l 11·46	″ h 12·94 h 11·54	″ l 10·80 l 12·24 l 12·70	″ l 13·50 l 12·72	″ l 12·22 l 14·56 l 15·30	″ l 12·12 l 12·68	″ h 15·16 h 14·54	″ h 12·58 h 14·36 h 13·92	Probability = 0·37
Means	11·64	12·24	11·91	13·11	14·03	12·40	14·85	13·62	56° 4′ 12″·98
CXIV & CXVI	h 3·38 h 3·76	h 3·20 h 3·44 h 4·50	l 4·00 l 3·62 l 3·88	l 3·48 l 3·76	l 2·74 l 2·66 l 3·84	l 5·28 l 4·26	h 1·86 h 2·62	h 0·84 h 1·74 h 2·18	Probability = 0·33
Means	3·57	3·71	3·83	3·62	3·08	4·77	2·24	1·59	62° 51′ 3″·30

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At CXV—(Continued.)

April 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXVI & CXVII	″ h 9·34 h 9·70	″ h 11·86 h 12·04	″ l 11·02 l 10·04	″ l 9·96 l 11·60 l 10·26	″ l 12·46 l 10·36 l 9·78	″ l 9·12 l 10·50	″ h 11·56 h 10·60	″ h 12·38 h 12·62	Probability = 0·33
Means	9·52	11·95	10·53	10·61	10·87	9·81	11·08	12·50	58° 35′ 10″·86

At CXVI

April 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXVIII & CXVII	″ h 43·04 h 43·56 h 42·56	″ h 46·32 h 45·28 h 45·24	″ h 41·86 h 42·54 h 42·62	″ h 42·98 h 42·92	″ h 43·04 h 44·34 h 44·30	″ h 44·42 h 43·70	″ h 44·46 h 45·04	″ h 44·04 l 44·06 l 45·18	Probability = 0·35
Means	43·05	45·61	42·34	42·95	43·89	44·06	44·75	44·43	63° 43′ 43″·89
CXVII & CXV	h 46·72 h 46·06	h 44·36 h 43·68 h 43·14 h 43·36	h 43·32 h 43·78	h 43·92 h 43·44 h 43·80 h 43·44	h 40·82 h 42·36 h 45·42 h 43·40	h 43·92 h 44·44 h 43·68 h 44·10	h 42·52 h 42·70	h 42·38 h 42·94 l 43·98	Probability = 0·38
Means	46·39	43·64	43·55	43·65	43·00	44·04	42·61	43·10	59° 14′ 43″·75
CXV & CXIV	h 19·32 h 18·12 h 18·00 h 18·72	h 18·12 h 19·70 h 19·34	h 19·96 h 22·08 h 21·90 h 21·50	h 18·06 h 17·74 h 17·00 h 16·88	h 21·68 h 20·46	h 17·38 h 18·48	h 19·44 h 19·90	h 18·98 h 18·54	Probability = 0·47
Means	18·54	19·05	21·36	17·42	21·07	17·93	19·67	18·76	56° 49′ 19″·23

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At CXVII

April 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXV & CXVI	″ h 8·22 h 7·38 h 7·84	″ l 5·04 l 5·68	″ l 5·68 l 5·84	″ l 5·68 l 5·56	″ h 4·44 h 4·50	″ h 5·84 h 6·48	″ l 5·20 l 4·74	″ l 7·14 l 6·98	Probability = 0·36
Means	7·81	5·36	5·76	5·62	4·47	6·16	4·97	7·06	62° 10′ 5″·90
CXVI & CXVIII	h 15·70 h 16·96 h 16·24	l 16·40 l 16·04	l 16·70 l 15·46	l 13·98 l 15·18	h 16·10 h 15·82	l 16·20 h 15·50 h 15·10	l 13·32 l 14·04	l 14·48 l 14·20	Probability = 0·33
Means	16·30	16·22	16·08	14·58	15·96	15·60	13·68	14·34	53° 18′ 15″·35
CXVIII & CXIX	l 1·60 l 0·74	l 2·54 l 2·46	l 1·36 l 1·00	l 1·04 l 1·44	h 1·56 h 2·68	l 1·66 h 0·78 h 1·60	l 6·68 l 5·06 l 4·26	h 2·44 l 2·20 l 2·60	Probability = 0·46
Means	1·17	2·50	1·18	1·24	2·12	1·35	5·33	2·41	58° 33′ 2″·16

At CXVIII

April 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXX & CXIX	″ h 9·14 h 8·38	″ h 7·16 h 7·00 h 6·94	″ h 7·84 h 7·90	″ h 8·52 h 9·24	″ l 9·24 l 9·22	″ l 6·18 l 7·50 l 6·92	″ l 8·08 l 7·76	″ l 9·24 l 8·08	Probability = 0·29
Means	8·76	7·03	7·87	8·88	9·23	6·87	7·92	8·66	83° 26′ 8″·15

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At CXVIII—(Continued.)

April 1847, *observed by Lieutenant R. Walker with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXIX & CXVII	″ h 2·44 h 3·36	″ h 6·40 h 4·94 h 4·62	″ h 3·68 h 3·10	″ h 3·92 h 3·88	″ l 2·86 l 1·94	″ l 4·74 l 3·72	″ l 4·78 l 4·46	″ l 4·46 l 3·84	Probability = 0·31
Means	2·90	5·32	3·39	3·90	2·40	4·23	4·62	4·15	49° 49′ 3″·86
CXVII & CXVI	h 59·06 h 59·84 h 60·42	h 61·68 h 62·94 h 62·48	h 60·58 h 61·00	h 61·82 h 61·32	l 58·00 l 59·44	l 61·64 l 60·70	l 61·64 l 61·98	l 57·92 l 59·76 l 59·92	Probability = 0·43
Means	59·77	62·37	60·79	61·57	58·72	61·17	61·81	59·20	62° 57′ 60″·68

At CXIX

March 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0′	180° 0′	9° 0′	189° 0′	18° 0′	198° 0′	27° 0′	207° 0′	
CXVII & CXVIII	″ l 49·32 l 49·72	″ l 52·46 l 52·54	″ h 50·98 l 51·84	″ l 52·28 h 51·96	″ h 51·28 h 52·56	″ h 52·90 h 53·66 h 55·30 h 54·68	″ l 49·66 l 49·96	″ l 53·46 h 53·04	Probability = 0·52
Means	49·52	52·50	51·41	52·12	51·92	54·14	49·81	53·25	71° 37′ 51″·83
CXVII & CXX	l 33·42 h 33·92	h 32·98 h 36·46 h 36·16	h 32·14 h 33·34	h 36·22 h 37·50 h 37·44	h 32·98 h 30·28 l 31·26	h 35·44 h 35·38	l 31·94 h 35·32 h 33·50 h 33·60	h 34·18 h 34·98	
Means	33·67	35·20	32·74	37·05	31·51	35·41	33·59	34·58	121° 38′ 34″·22

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At CXIX—(Continued.)

March* 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.

Angles.	Seconds of Observed Angles at each Zero								Probabilities and General Means.
	0° 0'	180° 0'	9° 0'	189° 0'	18° 0'	198° 0'	27° 0'	207° 0'	
	"	"	"	"	"	"	"	"	
CXVIII & CXX	+93.67 −49.52	+95.20 −52.50	+92.74 −51.41	+97.05 −52.12	+91.51 −51.92	+95.41 −54.14	+93.59 −49.81	+94.58 −53.25	Probability = 0.60
121° 37' −71° 37'	44.15	42.70	41.33	44.93	39.59	41.27	43.78	41.33	50° 0' 42".39
CXVII & CXXI	*l* 18.32 *l* 17.30	*l* 18.80 *l* 19.68	*l* 17.26 *l* 20.26 *l* 16.98	*l* 16.98 *l* 17.72	*l* 18.16 *l* 16.26 *l* 17.84	*h* 20.72 *h* 18.06 *h* 19.58	*l* 17.86 *l* 19.32 *l* 17.30	*l* 18.14 *h* 18.04	
Means	17.81	19.24	18.17	17.35	17.42	19.45	18.16	18.09	178° 45' 18".21
CXX & CXXI	+77.81 −33.67	+79.24 −35.20	+78.17 −32.74	+77.35 −37.05	+77.42 −31.51	+79.45 −35.41	+78.16 −33.59	+78.09 −34.58	Probability = 0.56
178° 44' −121° 38'	44.14	44.04	45.43	40.30	45.91	44.04	44.57	43.51	57° 6' 43".99

At CXX

March* 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.

Angle between	Circle readings, telescope being set on CXXIII								*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	0° 1'	180° 1'	9° 2'	189° 2'	18° 4'	198° 4'	27° 5'	207° 4'	
	"	"	"	"	"	"	"	"	
CXXIII & CXXI	*l* 50.42 *h* 49.04 *h* 50.08	*h* 51.38 *h* 50.52	*l* 49.76 *l* 47.44 *h* 48.24	*l* 49.30 *l* 49.68	*l* 49.12 *l* 47.68 *l* 47.32	*l* 50.44 *l* 49.48	*h* 47.90 *l* 53.30 *l* 53.88 *l* 53.72	*l* 49.10 *l* 49.70	
	49.85	50.95	48.48	49.49	48.04	49.96	52.20	49.40	89° 30'

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At CXX—(Continued.)

March* 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.
†*February* 1855, *observed by Mr. J. O. Nicolson with Barrow's* 24-*inch Theodolite No.* 1.

Angle between	Circle readings, telescope being set on CXXIII								M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	9° 2′	189° 2′	18° 4′	198° 4′	27° 5′	207° 4′	
* CXXIII & CXXII	″ h 48·92 h 49·88 d 48·57	″ h 48·84 h 48·56	″ l 46·82 l 47·94 h 46·96	″ l 48·26 l 49·92 l 48·26	″ l 47·26 l 45·94 d 45·52	″ l 49·32 l 48·20	″ h 46·38 l 52·72 l 51·16 l 51·20 d 50·23 d 48·09	″ l 47·28 l 48·58	
	49·12	48·70	47·24	48·81	46·24	48·76	49·96	47·93	M = 48″·35 w = 4 ·23

Lesser circle readings	0° 1′	180° 1′	7° 12′	187° 12′	14° 25′	194° 25′	21° 37′	201° 37′	28° 49′	208° 49′	
† CXXIII & CXXII	h 47·34 h 47·42 h 46·10	h 44·80 h 46·52 h 46·18	l 45·84 h 44·24 h 48·44 h 49·52	h 47·16 h 48·68 h 49·32	h 46·88 h 46·76 l 46·32	l 52·98 l 49·98 l 46·80 l 50·24 h 51·00	h 44·28 h 46·66 h 47·04 h 47·60	h 49·24 h 49·90 h 47·16 h 47·58	h 47·32 h 45·84 h 47·16	h 44·08 h 43·86 h 48·30 h 46·90 h 45·14	w = 8 ·27 $\frac{1}{w}$ = 0 ·12 C = 56° 14′ 47″·82
	46·95	45·83	47·01	48·39	46·65	50·20	46·40	48·47	46·77	45·66	M = 47″·23 w = 4 ·04

Lesser circle readings	56° 16′	236° 16′	65° 17′	245° 17′	74° 19′	254° 19′	83° 19′	263° 19′	
* CXXII & CXXI	h 61·16 d 60·81 d 59·85	h 62·54 h 61·96	l 62·94 l 59·50 h 61·28	l 59·38 l 61·42 d 60·97	l 61·86 l 61·74 d 60·72	d 61·68 d 60·72	l 60·58 l 62·72 d 57·53 d 63·35 d 64·63	l 61·82 l 61·12	
	60·61	62·25	61·24	60·59	61·44	61·20	61·76	61·47	M = 61″·32 w = 8 ·19

Lesser circle readings	56° 15′	236° 15′	63° 27′	243° 27′	70° 40′	250° 40′	77° 51′	257° 51′	85° 3′	265° 3′	
† CXXII & CXXI	h 60·30 h 60·60 h 61·08	h 61·06 h 59·80 h 59·50	l 61·98 h 61·44 h 63·28 h 61·48	h 61·86 h 62·72 h 63·38	h 61·44 h 61·30 h 61·12	l 62·62 l 62·86 h 60·48	h 60·46 h 61·08 h 61·14	h 62·12 h 60·86 h 61·94 h 61·16	h 58·54 h 61·26 h 61·66	h 63·52 h 63·16 h 62·28	w = 17 ·57 $\frac{1}{w}$ = 0 ·06 C = 33° 16′ 1″·39
	60·66	60·12	62·05	62·65	61·29	61·99	60·89	61·52	60·49	62·99	M = 61″·47 w = 9 ·38

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At CXX—(Continued.)

March 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Circle readings, telescope being set on CXXIII								Probabilities and General Means.
	0°1′	180°1′	9°2′	189°2′	18°4′	198°4′	27°5′	207°4′	
CXXIII & CXIX	″ l 31·76 l 32·58	″ h 30·02 h 30·12	″ l 28·70 l 29·20 h 28·64	″ l 30·36 l 30·18	″ l 28·90 l 27·18 l 28·94	″ l 29·64 l 28·32	″ h 28·50 l 32·68 l 35·64 l 35·30	″ l 30·76 l 30·14	
Means	32·17	30·07	28·85	30·27	28·34	28·98	33·03	30·45	136° 23′
CXXI & CXIX	+92·17 −49·85	+90·07 −50·95	+88·85 −48·48	+90·27 −49·49	+88·34 −48·04	+88·98 −49·96	+93·03 −52·20	+90·45 −49·40	Probability = 0·35
136° 22′ −89° 30′	42·32	39·12	40·37	40·78	40·30	39·02	40·83	41·05	46° 52′ 40″·47
CXXIII & CXVIII	l 40·96 l 43·68 l 41·12	l 41·32 l 41·38	h 38·46 l 39·96	l 41·40 l 42·52 l 40·80	l 41·90 h 42·42	l 40·92 l 40·86	h 37·24 l 40·52 l 43·82 l 42·54 l 44·66	l 40·34 l 39·62	
Means	41·92	41·35	39·21	41·57	42·16	40·89	41·76	39·98	182° 56′
CXIX & CXVIII	+41·92 −32·17	+41·35 −30·07	+39·21 −28·85	+41·57 −30·27	+42·16 −28·34	+40·89 −28·98	+41·76 −33·03	+39·98 −30·45	Probability = 0·53
182° 56′ − 136° 23′	9·75	11·28	10·36	11·30	13·82	11·91	8·73	9·53	46° 33′ 10″·84

At CXXI

March 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.*

Angles.	Circle readings, telescope being set on CXIX								Probabilities and General Means.
	208°11′	28°11′	217°11′	37°11′	226°13′	46°13′	235°14′	55°14′	
CXIX & CXXII	″ h 58·26 h 57·50	″ h 58·92 l 58·24	″ l 59·60 l 57·98	″ l 56·90 l 58·58	″ l 60·52 l 57·84 l 58·76	″ l 62·68 l 62·34	″ l 58·64 l 57·86	″ l 58·52 l 58·80	
Means	57·88	58·58	58·79	57·74	59·04	62·51	58·25	58·66	151° 51′

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At CXXI—(Continued.)

***_March_ 1848, _observed by Mr. C. Lane with Troughton and Simms' 36-inch Theodolite._**
†_February_ 1855, _observed by Mr. J. O. Nicolson with Barrow's 24-inch Theodolite No._ 1.

Angle between	Circle readings, telescope being set on CXIX								*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	208° 11′	28° 11′	217° 11′	37° 11′	226° 13′	46° 13′	235° 14′	55° 14′	
* CXX & CXXII	″ *h* 22·10 *h* 23·36 *h* 22·86	″ *h* 23·52 *h* 22·70	″ *l* 25·28 *l* 25·76	″ *l* 21·90 *l* 24·32 *l* 21·92	″ *l* 22·30 *l* 21·92	″ *l* 25·80 *l* 25·04	″ *l* 21·60 *l* 19·96	″ *l* 22·58 *l* 21·84	
	22·77	23·11	25·52	22·71	22·11	25·42	20·78	22·21	*M* = 23″·08 *w* = 2 ·82

Lesser circle readings	284° 9′	104° 9′	291° 21′	111° 21′	298° 33′	118° 33′	305° 45′	125° 45′	312° 57′	132° 57′	
† CXX & CXXII	*h* 22·84 *h* 23·74 *h* 23·32	*h* 22·80 *h* 21·80 *h* 24·04 *h* 26·10 *h* 26·30 *h* 22·26 *h* 21·04	*h* 24·36 *h* 23·48 *h* 24·90	*h* 22·98 *h* 20·64 *h* 22·90	*h* 26·54 *h* 22·58 *h* 25·02	*h* 22·14 *h* 25·70 *h* 21·06 *l* 24·98	*h* 22·00 *h* 21·50 *h* 22·16	*h* 21·12 *h* 21·32 *h* 22·56	*h* 18·88 *h* 17·58 *h* 18·90 *h* 23·28 *h* 22·00 *h* 23·92	*h* 26·80 *h* 25·32 *h* 24·16	*w* = 6 ·28 $\frac{1}{w}$ = 0 ·16 *C* = 75° 51′ 23″·08
	23·30	23·48	24·25	22·17	24·71	23·47	21·89	21·67	20·76	25·43	*M* = 23″·11 *w* = 3 ·46

Lesser circle readings	208° 11′	28° 11′	217° 11′	37° 11′	226° 13′	46° 13′	235° 14′	55° 14′	
* CXIX & CXX	+57·88 −22·77	+58·58 −23·11	+58·79 −25·52	+57·74 −22·71	+59·04 −22·11	+62·51 −25·42	+58·25 −20·78	+58·66 −22·21	Probability = 0·46
151° 51′ −75° 51′	35·11	35·47	33·27	35·03	36·93	37·09	37·47	36·45	76° 0′ 35″·85
* CXXII & CXXV	*h* 56·50 *h* 57·50	*h* 56·96 *h* 56·64	*h* 54·84 *h* 56·64	*l* 59·26 *l* 56·36 *l* 58·42	*l* 54·86 *l* 55·12	*l* 53·04 *l* 54·24	*l* 60·98 *l* 61·68 *l* 58·18 *l* 57·54	*l* 58·10 *l* 58·94	
	57·00	56·80	55·74	58·01	54·99	53·64	59·60	58·52	*M* = 56″·79 *w* = 1 ·86

Lesser circle readings	0° 1′	180° 0′	7° 13′	187° 12′	14° 25′	194° 24′	21° 36′	201° 37′	28° 49′	208° 48′	
† CXXII & CXXV	*l* 57·58 *l* 58·08 *l* 59·96 *h* 56·04 *h* 55·06 *h* 55·84	*h* 57·34 *h* 56·70 *h* 54·86	*h* 57·78 *h* 56·78 *h* 56·92	*h* 55·60 *h* 56·66 *h* 56·44	*h* 54·58 *h* 54·84 *h* 54·14	*h* 57·46 *h* 55·94 *l* 56·52	*h* 56·48 *h* 56·62 *h* 56·74	*h* 57·92 *h* 58·06 *h* 58·54	*h* 62·98 *h* 63·50 *h* 62·74 *h* 56·88 *h* 58·06 *h* 56·92	*h* 57·74 *h* 54·46 *h* 56·04 *h* 55·78	*w* = 5 ·38 $\frac{1}{w}$ = 0 ·19 *C* = 69° 0′ 56″·89
	57·09	56·30	57·16	56·23	54·52	56·64	56·61	58·17	60·18	56·01	*M* = 56″·89 *w* = 3 ·52

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At CXXII

* *February and March* 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.*

† *January and February* 1855, *observed by Mr. J. O. Nicolson with Colonel Waugh's* 24-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on CXXI										M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 2′	180° 2′	9° 4′	189° 4′	18° 5′	198° 5′	27° 5′	207° 5′			
	″	″	″	″	″	″	″	″			
* CXXI & CXX	h 35·38 h 35·60 d 32·40	h 35·58 h 36·08	h 33·22 h 33·10 d 33·51	h 35·90 h 33·82 h 34·46	l 33·22 l 32·70 d 34·30	l 34·42 l 35·40	h 35·38 h 34·16	h 32·88 h 34·66 h 32·38			
	34·46	35·83	33·28	34·73	33·41	34·91	34·77	33·31			M = 34″·34 w = 7 ·09
Lesser circle readings	0° 1′	180° 2′	7° 12′	187° 13′	14° 24′	194° 25′	21° 36′	201° 37′	28° 48′	208° 49′	
† CXXI & CXX	h 35·06 h 35·96 h 35·40	h 31·16 h 33·32 h 33·54 h 34·58	h 38·04 h 36·76	h 35·28 h 37·50 h 36·72 h 37·30 h 37·12	h 39·94 h 37·52 h 38·12 h 37·46	h 32·92 h 35·36 h 34·02	h 36·10 h 35·90 h 37·90 h 35·74	h 37·38 h 34·66 h 35·72 h 36·32	h 36·96 h 35·94 h 33·74 h 35·86	h 31·52 h 32·72 h 32·96	w = 9 ·79 1/w = 0 ·10 C = 70° 52′ 34″·65
	35·47	33·15	37·40	36·78	38·26	34·10	36·41	36·02	35·63	32·40	M = 35″·56 w = 2 ·70
Lesser circle readings	70° 55′	250° 55′	79° 56′	259° 56′	88° 58′	268° 58′	97° 58′	277° 58′			
* CXX & CXXIII	h 61·24 h 60·84 d 57·95	h 60·20 h 60·34	h 60·90 d 61·19 d 61·31	h 59·30 d 60·97	l 62·20 l 60·68 d 62·78	l 60·14 l 59·02	h 60·22 d 58·93	h 60·08 d 60·83			
	60·01	60·27	61·13	60·14	61·89	59·58	59·58	60·46			M = 60″·38 w = 8 ·82
Lesser circle readings	70° 54′	250° 54′	78° 5′	258° 5′	85° 17′	265° 17′	92° 29′	272° 29′	99° 41′	279° 41′	
† CXX & CXXIII	d 58·60 d 57·70 d 58·26 d 59·22	d 62·45 d 62·15 d 62·53 d 62·13	h 56·72 h 59·24 h 59·52	h 57·60 h 62·74 h 61·18 h 63·28 h 61·96 h 62·22	h 58·58 h 58·38 h 59·68	h 65·22 h 60·04 d 64·80	h 60·64 d 61·03 d 62·19	h 58·34 h 58·72 h 59·34	h 59·74 h 62·12 h 63·48	h 60·86 h 61·38 h 63·68	w = 11 ·36 1/w = 0 ·09 C = 55° 34′ 0″·47
	58·45	62·31	58·49	61·50	58·88	63·35	61·29	58·80	61·78	61·97	M = 60″·68 w = 2 ·54

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At CXXII—(Continued.)

******February and March* 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.*

†*January and February* 1855, *observed by Mr. J. O. Nicolson with Colonel Waugh's* 24-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on CXXI										M = Mean of Groups w = Relative Weight C = Concluded Angle
	126° 29′	306° 29′	135° 30′	315° 30′	144° 32′	324° 32′	153° 32′	333° 32′			
* CXXIII & CXXIV	″ l 55·10 d 53·23	″ d 52·88 d 52·86	″ h 55·80 d 56·11	″ h 54·52 d 55·44	″ l 54·18 l 54·86	″ l 53·84 l 53·96	″ d 57·87 d 60·01	″ d 54·49 d 54·21			
	54·17	52·87	55·96	54·98	54·52	53·90	58·94	54·35			M = 54″·96 w = 2 ·24
Lesser circle readings	126° 28′	306° 28′	133° 39′	313° 39′	140° 51′	320° 51′	148° 3′	328° 3′	155° 15′	335° 15′	
† CXXIII & CXXIV	h 53·52 h 52·20 h 53·60	h 52·16 h 52·64 h 52·40	h 55·46 h 53·24 h 53·18	h 53·62 h 54·98 h 54·82 h 51·56 h 54·00	h 50·48 h 54·20 h 54·76	d 50·72 d 52·76 d 51·44	h 53·04 h 53·84 h 55·20	d 55·77 d 58·11 d 56·43	h 53·26 h 51·92 h 49·70	h 53·74 h 53·02 h 55·18	w = 6 ·07 $\frac{1}{w}$ = 0 ·16 C = 38° 25′ 54″·01
	53·11	52·40	53·96	53·80	53·15	51·64	54·03	56·77	51·63	53·98	M = 53″·45 w = 3 ·83
Lesser circle readings	164° 55′	344° 55′	173° 56′	353° 56′	182° 58′	2° 58′	191° 58′	11° 58′			
* CXXIV & CXXVI	l 18·36 d 17·84	d 18·38 d 18·40	h 16·26 h 16·34	d 16·36 d 17·53	l 17·26 l 18·68	l 15·78 l 17·62	d 14·17 d 13·59	d 17·17 d 16·94			
	18·10	18·39	16·30	16·95	17·97	16·70	13·88	17·06			M = 16″·92 w = 3 ·68
Lesser circle readings	164° 54′	344° 54′	172° 5′	352° 5′	179° 17′	359° 17′	186° 29′	6° 29′	193° 41′	13° 41′	
† CXXIV & CXXVI	h 13·88 h 16·66 h 15·92 h 17·96	h 17·84 h 18·88	h 19·80 h 20·84	h 17·20 h 16·24	d 16·31 d 15·51	d 15·96 d 17·02 d 16·44	d 14·42 d 14·60	d 16·17 d 13·83 d 14·15 d 15·49	h 17·22 d 17·29	h 14·80 d 15·45 d 15·84	w = 6 ·74 $\frac{1}{w}$ = 0 ·15 C = 66° 31′ 16″·76
	16·11	18·36	20·32	16·72	15·91	16·47	14·51	14·91	17·25	15·36	M = 16″·59 w = 3 ·06

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At CXXII—(Continued.)

**February and March* 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.*

†*January and February* 1855, *observed by Mr. J. O. Nicolson with Colonel Waugh's* 24-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on CXXI										*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	231° 26′	51° 26′	240° 28′	60° 27′	249° 29′	69° 29′	258° 29′	78° 29′			
* CXXVI & CXXV	″ *l* 20·72 *d* 19·46	″ *d* 22·52 *d* 21·70	″ *h* 20·78 *d* 21·27 *d* 20·33	″ *l* 22·58 *l* 22·64	″ *l* 23·18 *l* 22·16	″ *l* 25·00 *l* 23·10	″ *h* 21·90 *d* 21·93	″ *h* 24·16 *h* 24·00			
	20·09	22·11	20·79	22·61	22·67	24·05	21·92	24·08			*M* = 22″·29 *w* = 3 ·85
Lesser circle readings	231° 25′	51° 25′	238° 36′	58° 36′	245° 48′	65° 48′	253° 0′	73° 0′	260° 12′	80° 12′	
† CXXVI & CXXV	*h* 20·76 *h* 20·94 *h* 21·64 *d* 18·70 *d* 20·66 *d* 20·46	*d* 19·69 *d* 21·57 *d* 21·47	*d* 20·28 *d* 21·24	*d* 20·26 *d* 19·04	*h* 21·24 *d* 18·41 *d* 20·17	*h* 19·46 *h* 22·26	*h* 21·66 *h* 18·02 *h* 21·14	*h* 19·78 *h* 20·86 *h* 18·70	*h* 19·36 *h* 20·16 *h* 21·24	*h* 23·14 *d* 23·79 *d* 22·50	*w* = 11 ·28 $\frac{1}{w}$ = 0 ·09 *C* = 57° 48′ 21″·19
	20·53	20·91	20·76	19·65	19·94	20·86	20·27	19·78	20·25	23·14	*M* = 20″·61 *w* = 7 ·43
Lesser circle readings	289° 14′	109° 14′	298° 16′	118° 16′	307° 17′	127° 17′	316° 18′	136° 17′			
* CXXV & CXXI	*l* 52·78 *d* 52·82	*h* 50·42 *h* 50·94	*h* 52·34 *h* 52·58	*h* 51·48 *h* 50·10	*l* 50·62 *l* 51·16	*l* 50·44 *l* 50·14	*h* 50·90 *h* 51·46	*h* 51·34 *h* 51·92			
	52·80	50·68	52·46	50·79	50·89	50·29	51·18	51·63			*M* = 51″·34 *w* = 9 ·52
Lesser circle readings	289° 14′	109° 14′	296° 25′	116° 25′	303° 37′	123° 37′	310° 49′	130° 49′	318° 0′	138° 1′	
† CXXV & CXXI	*h* 54·62 *h* 52·66 *h* 52·86 *d* 52·56 *d* 52·38 *d* 51·68	*h* 55·64 *h* 53·76 *h* 53·86	*h* 50·76 *h* 51·32 *h* 52·36	*h* 53·98 *h* 50·88 *h* 51·68 *h* 51·84	*h* 52·04 *h* 50·74 *h* 52·84	*h* 53·86 *h* 51·08 *h* 49·76 *h* 51·22	*h* 51·26 *h* 50·68 *h* 49·14 *h* 51·72	*h* 51·08 *h* 52·50 *h* 51·66	*h* 51·88 *h* 50·68 *h* 51·28	*h* 52·90 *h* 52·78	*w* = 16 ·75 $\frac{1}{w}$ = 0 ·06 *C* = 70° 47′ 51″·65
	52·79	54·42	51·48	52·10	51·87	51·48	50·70	51·75	51·28	52·84	*M* = 52″·07 *w* = 7 ·23

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At CXXIII

**March* 1848, *observed by Mr. C. Lane with Troughton and Simms' 36-inch Theodolite.*

†March 1855, *observed by Mr. J. O. Nicolson with Barrow's 24-inch Theodolite No.* 1.

M = Mean of Groups; w = Relative Weight; C = Concluded Angle

Angle between	Circle readings, telescope being set on CXXIV: 275° 20′	95° 20′	284° 21′	104° 21′	293° 23′	113° 22′	302° 23′	122° 23′	M, w, C
* CXXIV & CXXII	″ h 61·90 h 63·06	″ h 63·38 h 64·70 l 64·70	″ l 62·40 l 63·42 l 62·10	″ l 65·42 l 63·10 l 63·78	″ l 61·42 l 59·64 l 62·36	″ l 61·48 l 61·54	″ l 62·58 l 62·88	″ l 63·48 l 64·00	
	62·48	64·26	62·64	64·10	61·14	61·51	62·73	63·74	M = 62″·83 w = 5 ·24

Lesser circle readings	0° 0′	180° 0′	7° 12′	187° 12′	14° 24′	194° 24′	21° 36′	201° 37′	28° 49′	208° 49′	
† CXXIV & CXXII	h 62·26 h 62·90 h 63·18	h 62·12 h 59·76 h 62·50	h 62·20 h 65·56 h 65·78 h 63·22	l 62·46 l 59·08 l 62·20 l 60·44	h 63·96 h 64·06 h 63·20	h 62·82 h 63·24 h 63·18	h 61·08 h 63·98 h 63·68 h 63·20	h 64·40 h 60·98 h 61·88 h 61·88	l 62·98 l 64·68 l 61·64 l 63·74	l 62·12 h 60·74 h 63·52 h 60·30 h 60·76	w = 12 ·18 $\frac{1}{w}$ = 0 ·08 C = 84° 41′ 2″·71
	62·78	61·46	64·19	61·05	63·74	63·08	62·98	62·29	63·26	61·49	M = 62″·63 w = 6 ·94

Lesser circle readings	0° 1′	180° 1′	9° 2′	189° 2′	18° 4′	198° 3′	27° 4′	207° 4′	
* CXXII & CXX	h 11·86 h 11·88	h 8·76 h 8·38	l 11·22 l 10·36 l 11·18	l 12·28 l 11·34	l 12·20 l 12·02	l 12·50 l 12·10	l 13·10 l 11·50	l 10·22 l 10·22	
	11·87	8·57	10·92	11·81	12·11	12·30	12·30	10·22	M = 11″·26 w = 4 ·49

Lesser circle readings	84° 41′	264° 41′	91° 53′	271° 53′	99° 5′	279° 5′	106° 17′	286° 18′	113° 30′	293° 30′	
† CXXII & CXX	h 11·14 h 10·98 h 10·84	h 13·54 h 15·32 h 11·88	h 11·68 h 12·24 h 13·88	l 9·38 l 12·58 l 11·46 l 13·92	h 11·98 h 11·80 h 14·42 h 13·24	h 9·02 h 12·18 h 13·28 h 13·72	h 10·04 h 9·02 h 10·16	h 8·38 h 9·86 h 9·36 h 10·02	l 13·50 l 12·52 l 14·50	l 10·66 h 12·62 h 9·40 h 14·34 h 13·34	w = 8 ·41 $\frac{1}{w}$ = 0 ·12 C = 68° 11′ 11″·54
	10·99	13·58	12·60	11·84	12·86	12·05	9·74	9·40	13·51	12·07	M = 11″·86 w = 3 ·92

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At CXXIV

April* 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.

†*March* 1855, *observed by Mr. J. O. Nicolson with Barrow's* 24-*inch Theodolite No.* 1.

M = Mean of Groups; w = Relative Weight; C = Concluded Angle

Angle between	Circle readings, telescope being set on CXXVI: 305° 7′	125° 6′	314° 9′	134° 8′	323° 10′	143° 10′	332° 11′	152° 11′	M, w, C
* CXXVI & CXXII	″ *l* 13·12 *l* 13·44	″ *l* 14·30 *l* 13·44	″ *l* 12·94 *l* 12·88	″ *l* 13·22 *l* 12·64	″ *l* 11·30 *l* 11·48	″ *l* 12·60 *l* 13·12	″ *l* 14·10 *l* 13·10	″ *l* 13·58 *l* 12·12	
	13·28	13·87	12·91	12·93	11·39	12·86	13·60	12·85	M = 12″·96 w = 12 ·72

Lesser circle readings	0° 0′	180° 1′	7° 12′	187° 13′	14° 25′	194° 25′	21° 37′	201° 37′	28° 48′	208° 49′	
† CXXVI & CXXII	*h* 12·02 *h* 12·22 *h* 12·10	*h* 13·94 *h* 12·58 *l* 10·30 *l* 12·14	*h* 11·00 *h* 15·38 *h* 10·50 *h* 14·14 *h* 9·88 *h* 9·96 *h* 9·60	*h* 13·48 *h* 12·64 *h* 12·64	*h* 9·34 *h* 9·84 *h* 11·36	*h* 15·82 *h* 12·92 *h* 11·52 *h* 13·26	*h* 11·10 *h* 11·18 *l* 11·74	*h* 9·46 *h* 10·20 *h* 10·08	*l* 11·66 *h* 13·54 *h* 14·32 *h* 11·04	*h* 12·30 *l* 10·06 *l* 12·78	w = 18 ·46 $\frac{1}{w}$ = 0 ·05 C = 54° 55′ 12″·60
	12·11	12·24	11·49	12·92	10·18	13·38	11·34	9·91	12·64	11·71	M = 11″·79 w = 5 ·74

Lesser circle readings	0° 2′	180° 2′	9° 4′	189° 4′	18° 6′	198° 5′	27° 7′	207° 7′	
* CXXII & CXXIII	*l* 2·90 *l* 2·94	*l* 2·54 *l* 2·34	*l* 3·82 *l* 4·34	*l* 4·36 *l* 3·80	*l* 4·18 *l* 3·98	*l* 4·80 *l* 4·42	*l* 2·58 *l* 3·00	*l* 2·14 *l* 2·82	
	2·92	2·44	4·08	4·08	4·08	4·61	2·79	2·48	M = 3″·44 w = 10 ·56

Lesser circle readings	54° 56′	234° 56′	62° 8′	242° 8′	69° 20′	249° 20′	76° 32′	256° 32′	83° 44′	263° 44′	
† CXXII & CXXIII	*h* 61·60 *h* 60·60 *h* 61·68	*h* 62·90 *h* 61·16 *l* 63·46	*h* 65·36 *h* 61·04 *h* 64·00 *h* 64·04	*h* 63·44 *h* 63·18 *h* 63·26	*h* 64·86 *h* 62·96 *h* 63·08	*h* 65·06 *h* 62·86 *h* 64·54 *h* 60·98 *h* 62·80	*h* 63·72 *h* 59·34 *l* 66·24 *l* 61·16 *h* 62·64	*h* 66·80 *h* 65·48 *h* 65·22	*l* 65·26 *h* 61·74 *h* 61·60 *l* 59·04 *l* 61·04	*h* 62·62 *l* 63·84 *l* 62·80	w = 15 ·28 $\frac{1}{w}$ = 0 ·07 C = 56° 53′ 3″·33
	61·29	62·51	63·61	63·29	63·63	63·25	62·62	65·83	61·74	63·09	M = 63″·09 w = 4 ·72

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At CXXV

******April* 1848, *observed by Mr. C. Lane with Troughton and Simms' 36-inch Theodolite.*

†*April* 1855, *observed by Mr. J. O. Nicolson with Barrow's 24-inch Theodolite No.* 1.

Angle between	Circle readings, telescope being set on CXXI								M = Mean of Groups w = Relative Weight C = Concluded Angle
	319° 51′	139° 51′	328° 52′	148° 52′	337° 54′	157° 54′	346° 56′	166° 56′	
* CXXI & CXXII	″ *l* 10·82 *l* 11·74	″ *l* 12·20 *l* 11·48	″ *l* 10·04 *l* 9·92	″ *l* 10·98 *l* 11·16	″ *l* 11·68 *l* 12·08	″ *l* 10·76 *l* 10·46	″ *l* 11·62 *l* 10·80	″ *l* 11·08 *l* 10·98	
	11·28	11·84	9·98	11·07	11·88	10·61	11·21	11·03	*M* = 11″·11 *w* = 18 ·64

Lesser circle readings	319° 49′	139° 49′	327° 1′	147° 1′	334° 14′	154° 14′	341° 25′	161° 25′	348° 37′	168° 38′	
† CXXI & CXXII	*h* 12·82 *h* 12·74 *h* 11·40	*h* 12·64 *h* 10·72 *h* 10·94	*l* 8·36 *l* 8·68 *l* 8·40	*l* 11·34 *h* 9·76 *h* 8·30 *h* 9·42	*l* 13·44 *l* 12·76 *l* 11·60	*l* 8·50 *l* 12·96 *l* 10·58 *l* 8·46	*h* 9·74 *h* 12·28 *h* 12·96 *l* 10·58	*l* 9·46 *l* 8·14 *l* 9·58	*h* 12·94 *h* 10·62 *h* 10·54	*h* 11·72 *h* 11·74 *h* 10·38	*w* = 23 ·10 $\frac{1}{w}$ = 0 ·04 *C* = 40° 11′ 11″·05
	12·32	11·43	8·48	9·71	12·60	10·12	11·39	9·06	11·37	11·28	*M* = 10″·78 *w* = 4 ·46

Lesser circle readings	0° 2′	180° 2′	9° 3′	189° 3′	18° 5′	198° 5′	27° 8′	207° 7′	
* CXXII & CXXVI	*l* 51·34 *l* 50·18	*l* 49·98 *l* 50·58	*l* 52·08 *l* 51·88	*l* 51·10 *l* 51·50	*l* 51·24 *l* 50·86	*l* 51·86 *l* 52·42	*l* 50·78 *l* 51·36	*l* 50·76 *l* 50·46	
	50·76	50·28	51·98	51·30	51·05	52·14	51·07	50·61	*M* = 51″·15 *w* = 17 ·04

Lesser circle readings	0° 0′	180° 1′	7° 12′	187° 13′	14° 25′	194° 25′	21° 36′	201° 36′	28° 48′	208° 49′	
† CXXII & CXXVI	*h* 51·54 *h* 50·26 *l* 50·38	*h* 51·32 *l* 52·88 *l* 51·68 *l* 51·58	*l* 51·00 *l* 50·78 *l* 50·34	*h* 48·76 *h* 48·46 *h* 48·18	*l* 51·48 *l* 53·22 *l* 53·12	*l* 49·98 *h* 49·44 *h* 50·16	*h* 53·36 *h* 50·52 *l* 51·48 *l* 50·88	*l* 49·22 *l* 51·82 *l* 53·64 *l* 52·24	*h* 52·98 *h* 52·12 *h* 51·68	*h* 52·88 *h* 50·70 *h* 51·34	*w* = 22 ·70 $\frac{1}{w}$ = 0 ·04 *C* = 72° 22′ 51″·15
	50·73	51·87	50·71	48·47	52·61	49·86	51·56	51·73	52·26	51·64	*M* = 51″·14 *w* = 5 ·66

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At CXXVI

******April* 1848, *observed by Mr. C. Lane with Troughton and Simms' 36-inch Theodolite.*

†*March and April* 1855, *observed by Mr. J. O. Nicolson with Barrow's 24-inch Theodolite No.* 1.

Angle between	Circle readings, telescope being set on CXXV										M = Mean of Groups w = Relative Weight C = Concluded Angle
	310° 13′	130° 12′	319° 14′	139° 13′	328° 12′	148° 12′	337° 16′	157° 16′			
* CXXV & CXXII	″ l 47·56 l 47·26	″ l 49·66 l 50·18	″ l 48·66 l 48·18	″ l 48·72 l 48·80	″ l 47·30 l 48·32	″ l 47·44 l 46·88	″ l 47·36 l 46·78	″ l 46·54 l 46·96			
	47·41	49·92	48·42	48·76	47·81	47·16	47·07	46·75			M = 47″·91 w = 6 ·80
Lesser circle readings	139° 36′	319° 36′	146° 48′	326° 48′	153° 59′	334° 0′	161° 12′	341° 12′	168° 24′	348° 24′	
† CXXV & CXXII	l 46·54 l 49·84 l 49·72 l 50·26	h 44·02 h 44·76 h 43·64 l 46·92 l 46·86	l 44·56 l 44·64 l 44·60	l 45·08 l 45·16 l 45·36	h 44·90 h 46·28 h 46·08 h 47·16	h 48·18 h 48·70 h 49·06	l 47·28 l 48·94 l 47·78	l 51·54 h 51·30 h 47·44 h 47·48	l 49·82 l 50·78 l 49·42	l 49·44 l 50·50 l 49·80	w = 8 ·84 $\frac{1}{w}$ = 0 ·11 C = 49° 48′ 47″·85
	49·09	45·24	44·60	45·20	46·11	48·65	48·00	49·44	50·01	49·91	M = 47″·63 w = 2 ·04
Lesser circle readings	0° 2′	180° 1′	9° 2′	189° 2′	18° 1′	198° 1′	27° 5′	207° 5′			
* CXXII & CXXIV	l 31·58 l 31·80	l 31·74 l 30·92	l 30·26 l 30·18	l 32·44 l 31·56	l 30·14 l 31·26	l 31·82 l 32·66	l 31·90 l 32·04	l 30·44 l 30·26			
	31·69	31·33	30·22	32·00	30·70	32·24	31·97	30·35			M = 31″·31 w = 11 ·60
Lesser circle readings	189° 24′	9° 24′	196° 36′	16° 37′	203° 48′	23° 48′	211° 1′	31° 1′	218° 12′	38° 13′	
† CXXII & CXXIV	h 35·04 h 32·42 l 34·56 l 33·60	h 32·78 h 32·62 h 36·44 l 33·44 l 33·24	h 32·12 h 36·68 l 35·58 l 35·36 l 34·86	l 34·44 l 34·10 l 35·08 l 33·58	h 31·94 h 30·98 h 30·12	h 30·76 h 30·92 h 30·40	l 30·68 l 28·26 l 29·90	l 32·50 h 33·74 h 32·10	l 30·16 l 29·32 l 31·06	l 31·36 l 32·20 l 30·64	w = 14 ·19 $\frac{1}{w}$ = 0 ·07 C = 58° 33′ 31″·48
	33·91	33·70	34·92	34·30	31·01	30·69	29·61	32·78	30·18	31·40	M = 32″·25 w = 2 ·59

April 1877.

J. B. N. HENNESSEY,

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NORTH-EAST LONGITUDINAL SERIES

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

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Figure No. 1.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	73	55	28·91	·09
2	39	29	27·25	·25
3	66	35	5·94	·12
4	65	23	38·79	·14
5	83	18	48·86	·14
6	31	17	37·11	·05
7	69	12	52·72	·07
8	48	41	20·88	·14
9	62	5	50·90	·11
10	40	44	14·38	·14
11	75	35	13·68	·03
12	63	40	36·52	·12
13	56	21	23·19	·04
14	43	22	56·90	·03
15	80	15	43·09	·07
16	54	22	21·80	·05
17	71	54	3·34	·07
18	53	43	37·53	·25

Fixed data†

Log. Ratio of side *A* to side *B* (see diagram) = $\bar{1}\cdot9361139{,}5$

Sum of angles 3 and 5 = 149° 53′ 53″·51

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = -0\cdot41,$	λ_1
$x_4 + x_5 + x_6 = e_2 = +1\cdot61,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -0\cdot76,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = +1\cdot20,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = -0\cdot07,$	λ_5
$x_{16} + x_{17} + x_{18} = e_6 = +0\cdot07,$	λ_6
$x_3 + x_5 = e_7 = +1\cdot29,$	λ_7
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_8 = -0\cdot21,$	λ_8
$-1\cdot213x_2 + \cdot29x_1 - \cdot46x_4 + 1\cdot645x_6 = e_9 = +0\cdot812,$	λ_9
$-1\cdot213x_2 + \cdot43x_3 - \cdot12x_5 + 1\cdot645x_6 - \cdot88x_8 + \cdot53x_9 - \cdot26x_{11} + \cdot49x_{12} - 1\cdot058x_{14} + \cdot17x_{15} - \cdot33x_{17} + \cdot73x_{18} = e_{10} = -0\cdot399,$	λ_{10}

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8	λ_9	λ_{10}
1	− 0·41	+·46						+·12	+·09	−·2772	−·2517
2	+ 1·61		+·33					+·14	+·14	+·0179	+·0655
3	− 0·76			+·32					+·07		−·0649
4	+ 1·20				+·29				+·14		+·0510
5	− 0·07					+·14			+·04		−·0198
6	+ 0·07						+·37		+·05		+·1594
7	+ 1·29				*			+·26			+·0348
8	− 0·21								+·53	−·0383	
9	+ 0·812									+·5405	+·5033
10	− 0·399										+·8739

Values of the Factors

$\lambda_1 = -0\cdot4318$
$\lambda_2 = +5\cdot8112$
$\lambda_3 = -2\cdot9583$
$\lambda_4 = +6\cdot6760$
$\lambda_5 = -0\cdot5043$
$\lambda_6 = +3\cdot2411$
$\lambda_7 = +2\cdot8529$
$\lambda_8 = -3\cdot0222$
$\lambda_9 = +6\cdot5879$
$\lambda_{10} = -6\cdot1360$

Angular errors in seconds

$x_1 = -\cdot14$	$x_7 = -\cdot42$	$x_{13} = -\cdot14$
$x_2 = -\cdot24$	$x_8 = +\cdot34$	$x_{14} = +\cdot18$
$x_3 = -\cdot03$	$x_9 = -\cdot68$	$x_{15} = -\cdot11$
$x_4 = -\cdot03$	$x_{10} = +\cdot51$	$x_{16} = +\cdot01$
$x_5 = +1\cdot32$	$x_{11} = +\cdot25$	$x_{17} = +\cdot37$
$x_6 = +\cdot32$	$x_{12} = +\cdot44$	$x_{18} = -\cdot31$

$[wx^2] = 32\cdot17$

† The fixed data here given are obtained from Figure No. 8 of the Great Arc Meridional Series, Section 24° to 30°, which was previously reduced. They differ slightly from the final values shewn in Vol. IV of the *Operations of the Great Trigonometrical Survey of India*, Figure No. 1 of this Series having been calculated prior to the reduction of the North-West Quadrilateral.

* In the tables of the equations between the factors the co-efficients of the terms below the diagonal are omitted for convenience, the co-efficient of the *p*th term in the *q*th line being always the same as the co-efficient of the *q*th term in the *p*th line.

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Figure No. 2.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	17	19	60·86	·21
2	87	55	42·71	·10
3	56	8	21·15	·07
4	18	35	57·48	·10
5	52	0	7·48	·07
6	53	15	36·18	·03
7	43	13	22·46	·15
8	31	30	55·76	·11

Equations to be satisfied — **Factor**

$x_1 + x_2 + x_3 + x_4 = e_1 = +0·71,$ λ_1

$x_3 + x_4 + x_5 + x_6 = e_2 = -0·02,$ λ_2

$x_5 + x_6 + x_7 + x_8 = e_3 = -1·92,$ λ_3

$$\left.\begin{array}{l} 3·2040x_1 + 1·380x_2 + 2·050x_3 \\ - ·86\ x_6 - ·11\ x_7 - 1·631x_8 \end{array}\right\} = e_4 = +1·81, \quad \lambda_4$$

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	+0·71	+0·48	+0·17		+0·954
2	−0·02		+0·27	+0·10	+0·118
3	−1·92		*	+0·36	−0·222
4	+1·81				+2·957

Values of the Factors

$\lambda_1 = +2·596$

$\lambda_2 = +0·821$

$\lambda_3 = -5·998$

$\lambda_4 = -0·708$

Angular errors in seconds

$x_1 = +·07$	$x_5 = -·36$
$x_2 = +·16$	$x_6 = -·14$
$x_3 = +·14$	$x_7 = -·89$
$x_4 = +·34$	$x_8 = -·53$

$[wx^2] = 12·06$

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Figure No. 3.

Observed Angles

No.	Value			Reciprocal Weight = (Probability)²
	°	′	″	
1	54	51	43·55	·20
2	52	10	58·69	·06
3	31	53	28·66	·09
4	41	3	55·55	·14
5	29	1	2·94	·12
6	78	1	38·10	·21
7	53	33	36·98	·23
8	19	23	46·65	·13

Equations to be satisfied

Equations	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = -0·96,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = +0·55,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = +1·71,$	λ_3
$+·70x_1 - ·10x_2 + 1·507x_3 - 1·10x_6 - ·89x_7 - 2·840x_8 = e_4 = -1·45,$	λ_4

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 0·96	+0·49	+0·23		+0·270
2	+ 0·55		+0·56	+0·33	−0·095
3	+ 1·71		*	+0·69	−0·805
4	− 1·45				+1·788

Values of the Factors

$\lambda_1 = -2·713$

$\lambda_2 = -0·261$

$\lambda_3 = +4·461$

$\lambda_4 = +1·593$

Angular errors in seconds

$x_1 = -·32$	$x_5 = +·51$
$x_2 = -·17$	$x_6 = +·51$
$x_3 = -·05$	$x_7 = +·70$
$x_4 = -·42$	$x_8 = -·01$

$[wx^2] = 7·78$

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Figure No. 4.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	78	39	47·21	·35
2	36	50	39·72	·13
3	64	29	37·07	·26
4	54	59	32·72	·44
5	66	1	16·92	·66
6	58	59	9·51	·07
7	59	1	59·98	·52
8	49	31	10·84	·08
9	71	26	51·70	·24
10	52	13	52·00	·36
11	52	12	33·70	·34
12	75	33	34·51	·18
13	115	4	48·09	·21
14	45	34	40·22	·35
15	19	20	32·87	·23

Equations to be satisfied — Factor

$$x_1 + x_2 + x_3 = e_1 = +0·69, \quad \lambda_1$$

$$x_4 + x_5 + x_6 = e_2 = -2·81, \quad \lambda_2$$

$$x_7 + x_8 + x_9 = e_3 = +0·77, \quad \lambda_3$$

$$x_{10} + x_{11} + x_{12} = e_4 = -0·85, \quad \lambda_4$$

$$x_{13} + x_{14} + x_{15} = e_5 = -0·95, \quad \lambda_5$$

$$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = 0·00, \quad \lambda_6$$

$$\left.\begin{array}{l} +·48x_3 - 1·335x_2 + ·60x_6 - ·44\,x_5 + ·34x_9 \\ -·85x_8 + ·26\,x_{12} - ·78x_{11} + 2·8488x_{15} - ·98x_{14} \end{array}\right\} = e_7 = +0·27, \quad \lambda_7$$

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7
1	+0·69	+0·74					+0·35	−0·049
2	−2·81		+1·17				+0·44	−0·248
3	+0·77			+0·84			+0·52	+0·014
4	−0·85				+0·88		+0·36	−0·218
5	−0·95					+0·79	+0·21	+0·312
6	0·00						+1·88	
7	+0·27							+2·952

Values of the Factors

$\lambda_1 = +0·528$

$\lambda_2 = -2·737$

$\lambda_3 = +0·396$

$\lambda_4 = -1·332$

$\lambda_5 = -1·394$

$\lambda_6 = +0·843$

$\lambda_7 = -0·083$

Angular errors in seconds

$x_1 = +·48$	$x_6 = -·20$	$x_{11} = -·43$
$x_2 = +·08$	$x_7 = +·65$	$x_{12} = -·24$
$x_3 = +·13$	$x_8 = +·04$	$x_{13} = -·12$
$x_4 = -·83$	$x_9 = +·08$	$x_{14} = -·46$
$x_5 = -1·78$	$x_{10} = -·18$	$x_{15} = -·37$

$[wx^2] = 10·79$

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Figure No. 5.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	52	32	29·77	·42
2	52	47	45·59	·10
3	74	39	45·31	·06
4	57	50	55·92	·14
5	59	6	32·63	·14
6	63	2	32·03	·03
7	68	33	26·25	·20
8	56	59	40·04	·01
9	54	26	54·24	·21
10	67	42	30·49	·26
11	57	15	58·66	·07
12	55	1	32·53	·08
13	64	58	24·55	·13
14	60	30	27·18	·29
15	54	31	7·90	·04
16	48	22	13·82	·11
17	72	32	28·88	·11
18	59	5	18·31	·04

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = -0·02,$	λ_1
$x_4 + x_5 + x_6 = e_2 = 0·00,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -0·11,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = +1·01,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = -1·09,$	λ_5
$x_{16} + x_{17} + x_{18} = e_6 = +0·30,$	λ_6
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = +0·80,$	λ_7
$+ ·27\,x_3 - ·76\,x_2 + ·51\,x_6 - ·60\,x_5 + ·71\,x_9 - ·65\,x_8 + ·70\,x_{12} - ·64\,x_{11} + ·71\,x_{15} - ·57\,x_{14} + ·60\,x_{18} - ·31\,x_{17} = e_8 = +4·77,$	λ_8

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8
1	− 0·02	+0·58						−0·42	−0·060
2	0·00		+0·31					+0·14	−0·069
3	− 0·11			+0·42				+0·20	+0·142
4	+ 1·01				+0·41			+0·26	+0·011
5	− 1·09					+0·46		+0·13	−0·137
6	+ 0·30				*		+0·26	+0·11	−0·010
7	+ 0·80							+1·26	
8	+ 4·77								+0·438

Values of the Factors

$\lambda_1 = +1·597$

$\lambda_2 = +3·174$

$\lambda_3 = -4·731$

$\lambda_4 = +2·290$

$\lambda_5 = +1·780$

$\lambda_6 = +1·804$

$\lambda_7 = -0·303$

$\lambda_8 = +13·649$

Angular errors in seconds

$x_1 = +·54$	$x_7 = -1·01$	$x_{13} = +·19$
$x_2 = -·88$	$x_8 = -·14$	$x_{14} = -1·74$
$x_3 = +·32$	$x_9 = +1·04$	$x_{15} = +·46$
$x_4 = +·40$	$x_{10} = +·51$	$x_{16} = +·17$
$x_5 = -·70$	$x_{11} = -·45$	$x_{17} = -·27$
$x_6 = +·30$	$x_{12} = +·95$	$x_{18} = +·40$

$[wx^2] = 66·27$

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Figure No. 6.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²	No.	Value °	′	″	Reciprocal Weight = (Probability)²	No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	63	14	48·48	·94	11	58	58	17·57	1·37	21	62	16	7·87	·94
2	56	48	52·42	·98	12	61	40	48·38	1·21	22	55	57	33·25	1·37
3	59	56	19·87	·66	13	57	27	29·50	·96	23	65	12	43·93	1·35
4	59	31	7·08	·50	14	57	36	29·89	·94	24	58	49	41·22	·90
5	64	34	44·50	1·19	15	64	56	1·64	·66	25	60	52	35·73	2·72
6	55	54	8·86	·66	16	61	34	22·11	1·10	26	55	34	53·39	·69
7	58	51	18·07	1·23	17	60	46	18·68	·71	27	63	32	31·85	1·17
8	61	9	27·18	1·08	18	57	39	18·54	·71	28	64	36	35·91	1·32
9	59	59	15·13	·72	19	59	35	43·10	·86	29	60	35	35·43	1·51
10	59	20	54·84	1·69	20	58	8	11·35	1·37	30	54	47	49·99	1·28

Equations to be satisfied	Factor
$x_1 + x_2 + x_3 \;\ldots\;\ldots = e_1 = +0{\cdot}17,$	λ_1
$x_4 + x_5 + x_6 \;\ldots\;\ldots = e_2 = -0{\cdot}17,$	λ_2
$x_7 + x_8 + x_9 \;\ldots\;\ldots = e_3 = -0{\cdot}29,$	λ_3
$x_{10} + x_{11} + x_{12} \;\ldots\;\ldots = e_4 = +0{\cdot}12,$	λ_4
$x_{13} + x_{14} + x_{15} \;\ldots\;\ldots = e_5 = +0{\cdot}44,$	λ_5
$x_{16} + x_{17} + x_{18} \;\ldots\;\ldots = e_6 = -1{\cdot}27,$	λ_6
$x_{19} + x_{20} + x_{21} \;\ldots\;\ldots = e_7 = +1{\cdot}69,$	λ_7
$x_{22} + x_{23} + x_{24} \;\ldots\;\ldots = e_8 = -2{\cdot}21,$	λ_8
$x_{25} + x_{26} + x_{27} \;\ldots\;\ldots = e_9 = +0{\cdot}34,$	λ_9
$x_{28} + x_{29} + x_{30} \;\ldots\;\ldots = e_{10} = +0{\cdot}69,$	λ_{10}
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} \;\ldots\;\ldots = e_{11} = +0{\cdot}08,$	λ_{11}
$x_9 + x_{11} + x_{19} + x_{22} + x_{25} + x_{28} \;\ldots\;\ldots = e_{12} = +0{\cdot}69,$	λ_{12}
$\left.\begin{matrix} +{\cdot}58x_3 - {\cdot}65x_2 + {\cdot}68x_6 - {\cdot}48x_5 + {\cdot}58x_9 - {\cdot}55x_8 \\ +{\cdot}54x_{12} - {\cdot}60x_{11} + {\cdot}47x_{15} - {\cdot}63x_{14} + {\cdot}63x_{18} - {\cdot}56x_{17} \end{matrix}\right\} \;\ldots\;\ldots = e_{13} = -1{\cdot}62,$	λ_{13}
$\left.\begin{matrix} +{\cdot}55x_8 - {\cdot}60x_7 + {\cdot}59x_{10} - {\cdot}54x_{12} + {\cdot}53x_{21} - {\cdot}62x_{20} \\ +{\cdot}60x_{24} - {\cdot}46x_{23} + {\cdot}50x_{27} - {\cdot}69x_{26} + {\cdot}71x_{30} - {\cdot}56x_{29} \end{matrix}\right\} \;\ldots\;\ldots = e_{14} = +3{\cdot}54,$	λ_{14}

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Figure No. 6—(Continued).

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8	λ_9	λ_{10}	λ_{11}	λ_{12}	λ_{13}	λ_{14}
1	+ 0·17	+2·58										+0·94		−0·254	
2	− 0·17		+2·35									+0·50		−0·122	
3	− 0·29			+3·03								+1·23	+0·72	−0·176	−0·144
4	+ 0·12				+4·27							+1·69	+1·37	−0·169	+0·344
5	+ 0·44					+2·56						+0·96		−0·282	
6	− 1·27						+2·52					+1·10		+0·050	
7	+ 1·69							+3·17					+0·86		−0·351
8	− 2·21								+3·62				+1·37		−0·081
9	+ 0·34									+4·58			+2·72		+0·109
10	+ 0·69										+4·11		+1·32		+0·063
11	+ 0·08											+6·42			+0·259
12	+ 0·69												+8·36	−0·404	
13	− 1·62													+3·654	−0·680
14	+ 3·54														+4·851

Values of the Factors

λ_1	=	−0·020
λ_2	=	−0·121
λ_3	=	−0·177
λ_4	=	−0·150
λ_5	=	+0·081
λ_6	=	−0·565
λ_7	=	+0·572
λ_8	=	−0·651
λ_9	=	−0·031
λ_{10}	=	+0·109
λ_{11}	=	+0·154
λ_{12}	=	+0·148
λ_{13}	=	−0·301
λ_{14}	=	+0·715

Angular errors in seconds

$x_1 = +·12$	$x_{11} = +·23$	$x_{21} = +·89$
$x_2 = +·17$	$x_{12} = −·83$	$x_{22} = −·69$
$x_3 = −·12$	$x_{13} = +·23$	$x_{23} = −1·32$
$x_4 = +·02$	$x_{14} = +·24$	$x_{24} = −·20$
$x_5 = +·02$	$x_{15} = −·03$	$x_{25} = +·32$
$x_6 = −·21$	$x_{16} = −·45$	$x_{26} = −·36$
$x_7 = −·56$	$x_{17} = −·29$	$x_{27} = +·38$
$x_8 = +·40$	$x_{18} = −·53$	$x_{28} = +·34$
$x_9 = −·13$	$x_{19} = +·62$	$x_{29} = −·44$
$x_{10} = +·72$	$x_{20} = +·18$	$x_{30} = +·79$

$[wx^2] = 6·41$

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Figure No. 7.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	70	52	34·65	·10
2	33	16	1·39	·06
3	75	51	23·08	·16
4	70	47	51·65	·06
5	69	0	56·89	·19
6	40	11	11·05	·04
7	57	48	21·19	·09
8	72	22	51·15	·04
9	49	48	47·85	·11
10	66	31	16·76	·15
11	58	33	31·48	·07
12	54	55	12·60	·05
13	38	25	54·01	·16
14	56	53	3·33	·07
15	84	41	2·71	·08
16	55	34	0·47	·09
17	68	11	11·54	·12
18	56	14	47·82	·12

Equations to be satisfied

Equations to be satisfied	Factor
$x_1 + x_2 + x_3 = e_1 = -1·412,$	λ_1
$x_4 + x_5 + x_6 = e_2 = -0·845,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -0·514,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = -0·152,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = -0·540,$	λ_5
$x_{16} + x_{17} + x_{18} = e_6 = -0·905,$	λ_6
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = -1·27,$	λ_7
$\left.\begin{array}{l} 6x_3 - 32x_2 + 25x_6 \\ -8x_5 + 18x_9 - 7x_8 \\ +15x_{12} - 13x_{11} + 2x_{15} \\ -13x_{14} + 14x_{18} - 8x_{17} \end{array}\right\} = e_8 = +25·1,$	λ_8

Equations between the factors

No. of e	Value of e	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8
1	− 1·412	+ ·32						+ ·10	−0·96
2	− 0·845		+ ·29					+ ·06	−0·52
3	− 0·514			+ ·24				+ ·09	+1·70
4	− 0·152				+ ·27			+ ·15	−0·16
5	− 0·540					+ ·31		+ ·16	−0·75
6	− 0·905			*			+ ·33	+ ·09	+0·72
7	− 1·27							+ ·65	
8	+25·1								+208·39

Values of the Factors

$\lambda_1 = -4·1538$
$\lambda_2 = -2·7666$
$\lambda_3 = -3·1679$
$\lambda_4 = -0·6963$
$\lambda_5 = -1·6319$
$\lambda_6 = -3·1173$
$\lambda_7 = +0·3732$
$\lambda_8 = +0·1251$

Angular errors in seconds

$x_1 = -·378$	$x_7 = -·251$	$x_{13} = -·201$
$x_2 = -·489$	$x_8 = -·162$	$x_{14} = -·228$
$x_3 = -·545$	$x_9 = -·101$	$x_{15} = -·111$
$x_4 = -·144$	$x_{10} = -·049$	$x_{16} = -·247$
$x_5 = -·715$	$x_{11} = -·162$	$x_{17} = -·494$
$x_6 = +·014$	$x_{12} = +·059$	$x_{18} = -·164$

$[wx^2] = 16·31$

December 1877.

J. B. N. HENNESSEY,
In charge of Computing Office.

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At CXXVI

* *April* 1848, *observed by Mr. C. Lane with Troughton and Simms'* 36-*inch Theodolite.*

† *March and April* 1855, *observed by Mr. J. O. Nicolson with Barrow's* 24-*inch Theodolite No.* 1.

Angle between	Circle readings, telescope being set on CXXV										M = Mean of Groups w = Relative Weight C = Concluded Angle
	310° 13′	130° 12′	319° 14′	139° 13′	328° 12′	148° 12′	337° 16′	157° 16′			
* CXXV & CXXII	″ l 47·56 l 47·26	″ l 49·66 l 50·18	″ l 48·66 l 48·18	″ l 48·72 l 48·80	″ l 47·30 l 48·32	″ l 47·44 l 46·88	″ l 47·36 l 46·78	″ l 46·54 l 46·96			
	47·41	49·92	48·42	48·76	47·81	47·16	47·07	46·75			M = 47″·91 w = 6 ·80
Lesser circle readings	139° 36′	319° 36′	146° 48′	326° 48′	153° 59′	334° 0′	161° 12′	341° 12′	168° 24′	348° 24′	
† CXXV & CXXII	l 46·54 l 49·84 l 49·72 l 50·26	h 44·02 h 44·76 h 43·64 l 46·92 l 46·86	l 44·56 l 44·64 l 44·60	l 45·08 l 45·16 l 45·36	h 44·90 h 46·28 h 46·08 h 47·16	h 48·18 h 48·70 h 49·06	l 47·28 l 48·94 l 47·78	l 51·54 h 51·30 h 47·44 h 47·48	l 49·82 l 50·78 l 49·42	l 49·44 l 50·50 l 49·80	w = 8 ·84 $\frac{1}{w}$ = 0 ·11 C = 49° 48′ 47″·85
	49·09	45·24	44·60	45·20	46·11	48·65	48·00	49·44	50·01	49·91	M = 47″·63 w = 2 ·04
Lesser circle readings	0° 2′	180° 1′	9° 2′	189° 2′	18° 1′	198° 1′	27° 5′	207° 5′			
* CXXII & CXXIV	l 31·58 l 31·80	l 31·74 l 30·92	l 30·26 l 30·18	l 32·44 l 31·56	l 30·14 l 31·26	l 31·82 l 32·66	l 31·90 l 32·04	l 30·44 l 30·26			
	31·69	31·33	30·22	32·00	30·70	32·24	31·97	30·35			M = 31″·31 w = 11 ·60
Lesser circle readings	189° 24′	9° 24′	196° 36′	16° 37′	203° 48′	23° 48′	211° 1′	31° 1′	218° 12′	38° 13′	
† CXXII & CXXIV	h 35·04 h 32·42 l 34·56 l 33·60	h 32·78 h 32·62 h 36·44 l 33·44 l 33·24	h 32·12 h 36·68 l 35·58 l 35·36 l 34·86	l 34·44 l 34·10 l 35·08 l 33·58	h 31·94 h 30·98 h 30·12	h 30·76 h 30·92 h 30·40	l 30·68 l 28·26 l 29·90	l 32·50 h 33·74 h 32·10	l 30·16 l 29·32 l 31·06	l 31·36 l 32·20 l 30·64	w = 14 ·19 $\frac{1}{w}$ = 0 ·07 C = 58° 33′ 31″·48
	33·91	33·70	34·92	34·30	31·01	30·69	29·61	32·78	30·18	31·40	M = 32″·25 w = 2 ·59

April 1877.

J. B. N. HENNESSEY,

In charge of Computing Office

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NORTH-EAST LONGITUDINAL SERIES

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

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Figure No. **1.**

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	73	55	28·91	·09
2	39	29	27·25	·25
3	66	35	5·94	·12
4	65	23	38·79	·14
5	83	18	48·86	·14
6	31	17	37·11	·05
7	69	12	52·72	·07
8	48	41	20·88	·14
9	62	5	50·90	·11
10	40	44	14·38	·14
11	75	35	13·68	·03
12	63	40	36·52	·12
13	56	21	23·19	·04
14	43	22	56·90	·03
15	80	15	43·09	·07
16	54	22	21·80	·05
17	71	54	3·34	·07
18	53	43	37·53	·25

Fixed data†

Log. Ratio of side *A* to side *B* (see diagram) = $\bar{1}\cdot9361139{,}5$

Sum of angles 3 and 5 = 149° 53′ 53·″51

Equations to be satisfied

Equation		Factor
$x_1 + x_2 + x_3$	$= e_1 = -0\cdot41,$	λ_1
$x_4 + x_5 + x_6$	$= e_2 = +1\cdot61,$	λ_2
$x_7 + x_8 + x_9$	$= e_3 = -0\cdot76,$	λ_3
$x_{10} + x_{11} + x_{12}$	$= e_4 = +1\cdot20,$	λ_4
$x_{13} + x_{14} + x_{15}$	$= e_5 = -0\cdot07,$	λ_5
$x_{16} + x_{17} + x_{18}$	$= e_6 = +0\cdot07,$	λ_6
$x_3 + x_5$	$= e_7 = +1\cdot29,$	λ_7
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16}$	$= e_8 = -0\cdot21,$	λ_8
$-1\cdot213x_2 + \cdot29x_1 - \cdot46x_4 + 1\cdot645x_6$	$= e_9 = +0\cdot812,$	λ_9
$-1\cdot213x_2 + \cdot43x_3 - \cdot12x_5 + 1\cdot645x_6 - \cdot88x_8 + \cdot53x_9 - \cdot26x_{11} + \cdot49x_{12} - 1\cdot058x_{14} + \cdot17x_{15} - \cdot33x_{17} + \cdot73x_{18}$	$= e_{10} = -0\cdot399,$	λ_{10}

Equations between the factors

No. of e	Value of e	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8	λ_9	λ_{10}
1	− 0·41	+·46						+·12	+·09	−·2772	−·2517
2	+ 1·61		+·33					+·14	+·14	+·0179	+·0655
3	− 0·76			+·32					+·07		−·0649
4	+ 1·20				+·29				+·14		+·0510
5	− 0·07					+·14			+·04		−·0198
6	+ 0·07						+·37		+·05		+·1594
7	+ 1·29				*			+·26			+·0348
8	− 0·21								+·53	−·0383	
9	+ 0·812									+·5405	+·5033
10	− 0·399										+·8739

Values of the Factors

$\lambda_1 = -0\cdot4318$

$\lambda_2 = +5\cdot8112$

$\lambda_3 = -2\cdot9583$

$\lambda_4 = +6\cdot6760$

$\lambda_5 = -0\cdot5043$

$\lambda_6 = +3\cdot2411$

$\lambda_7 = +2\cdot8529$

$\lambda_8 = -3\cdot0222$

$\lambda_9 = +6\cdot5879$

$\lambda_{10} = -6\cdot1360$

Angular errors in seconds

$x_1 = -\cdot14$	$x_7 = -\cdot42$	$x_{13} = -\cdot14$
$x_2 = -\cdot24$	$x_8 = +\cdot34$	$x_{14} = +\cdot18$
$x_3 = -\cdot03$	$x_9 = -\cdot68$	$x_{15} = -\cdot11$
$x_4 = -\cdot03$	$x_{10} = +\cdot51$	$x_{16} = +\cdot01$
$x_5 = +1\cdot32$	$x_{11} = +\cdot25$	$x_{17} = +\cdot37$
$x_6 = +\cdot32$	$x_{12} = +\cdot44$	$x_{18} = -\cdot31$

$[wx^2] = 32\cdot17$

† The fixed data here given are obtained from Figure No. 8 of the Great Arc Meridional Series, Section 24° to 30°, which was previously reduced. They differ slightly from the final values shewn in Vol. IV of the *Operations of the Great Trigonometrical Survey of India*, Figure No. 1 of this Series having been calculated prior to the reduction of the North-West Quadrilateral.

* In the tables of the equations between the factors the co-efficients of the terms below the diagonal are omitted for convenience, the co-efficient of the *pth* term in the *qth* line being always the same as the co-efficient of the *qth* term in the *pth* line.

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Figure No. 2.

Observed Angles

No.	Value			Reciprocal Weight = (Probability)²
	°	′	″	
1	17	19	60·86	·21
2	87	55	42·71	·10
3	56	8	21·15	·07
4	18	35	57·48	·10
5	52	0	7·48	·07
6	53	15	36·18	·03
7	43	13	22·46	·15
8	31	30	55·76	·11

Equations to be satisfied

Equations	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = +0·71,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = -0·02,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = -1·92,$	λ_3
$\left.\begin{matrix} 3·2040x_1 + 1·380x_2 + 2·050x_3 \\ - ·86\ x_6 - ·11\ x_7 - 1·631x_8 \end{matrix}\right\} = e_4 = +1·81,$	λ_4

Equations between the factors

No. of e	Value of e	Co-efficients of			
		λ_1	λ_2	λ_3	λ_4
1	+0·71	+0·48	+0·17		+0·954
2	−0·02		+0·27	+0·10	+0·118
3	−1·92		*	+0·36	−0·222
4	+1·81				+2·957

Values of the Factors

$\lambda_1 = +2·596$

$\lambda_2 = +0·821$

$\lambda_3 = -5·998$

$\lambda_4 = -0·708$

Angular errors in seconds

$x_1 = +·07$	$x_5 = -·36$
$x_2 = +·16$	$x_6 = -·14$
$x_3 = +·14$	$x_7 = -·89$
$x_4 = +·34$	$x_8 = -·53$

$[wx^2] = 12·06$

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Figure No. 3.

Observed Angles

No.	Value (° ′ ″)	Reciprocal Weight = (Probability)²
1	54 51 43·55	·20
2	52 10 58·69	·06
3	31 53 28·66	·09
4	41 3 55·55	·14
5	29 1 2·94	·12
6	78 1 38·10	·21
7	53 33 36·98	·23
8	19 23 46·65	·13

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = -0·96,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = +0·55,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = +1·71,$	λ_3
$+·70x_1 - ·10x_2 + 1·507x_3 - 1·10x_6 - ·89x_7 - 2·840x_8 = e_4 = -1·45,$	λ_4

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 0·96	+0·49	+0·23		+0·270
2	+ 0·55		+0·56	+0·33	−0·095
3	+ 1·71		*	+0·69	−0·805
4	− 1·45				+1·788

Values of the Factors

$\lambda_1 = -2·713$

$\lambda_2 = -0·261$

$\lambda_3 = +4·461$

$\lambda_4 = +1·593$

Angular errors in seconds

$x_1 = -·32$	$x_5 = +·51$
$x_2 = -·17$	$x_6 = +·51$
$x_3 = -·05$	$x_7 = +·70$
$x_4 = -·42$	$x_8 = -·01$

$[wx^2] = 7·78$

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Figure No. 4.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	78	39	47·21	·35
2	36	50	39·72	·13
3	64	29	37·07	·26
4	54	59	32·72	·44
5	66	1	16·92	·66
6	58	59	9·51	·07
7	59	1	59·98	·52
8	49	31	10·84	·08
9	71	26	51·70	·24
10	52	13	52·00	·36
11	52	12	33·70	·34
12	75	33	34·51	·18
13	115	4	48·09	·21
14	45	34	40·22	·35
15	19	20	32·87	·23

Equations to be satisfied — Factor

$$x_1 + x_2 + x_3 = e_1 = +0·69, \quad \lambda_1$$
$$x_4 + x_5 + x_6 = e_2 = -2·81, \quad \lambda_2$$
$$x_7 + x_8 + x_9 = e_3 = +0·77, \quad \lambda_3$$
$$x_{10} + x_{11} + x_{12} = e_4 = -0·85, \quad \lambda_4$$
$$x_{13} + x_{14} + x_{15} = e_5 = -0·95, \quad \lambda_5$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = 0·00, \quad \lambda_6$$
$$\left.\begin{array}{l} +·48x_3 - 1·335x_2 + ·60x_6 - ·44\ x_5 + ·34x_9 \\ -·85x_8 + ·26\ x_{12} - ·78x_{11} + 2·8488x_{15} - ·98x_{14} \end{array}\right\} = e_7 = +0·27, \quad \lambda_7$$

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7
1	+0·69	+0·74					+0·35	−0·049
2	−2·81		+1·17				+0·44	−0·248
3	+0·77			+0·84			+0·52	+0·014
4	−0·85			*	+0·88		+0·36	−0·218
5	−0·95					+0·79	+0·21	+0·312
6	0·00						+1·88	
7	+0·27							+2·952

Values of the Factors

$\lambda_1 = +0·528$
$\lambda_2 = -2·737$
$\lambda_3 = +0·396$
$\lambda_4 = -1·332$
$\lambda_5 = -1·394$
$\lambda_6 = +0·843$
$\lambda_7 = -0·083$

Angular errors in seconds

$x_1 = +·48$	$x_6 = -·20$	$x_{11} = -·43$
$x_2 = +·08$	$x_7 = +·65$	$x_{12} = -·24$
$x_3 = +·13$	$x_8 = +·04$	$x_{13} = -·12$
$x_4 = -·83$	$x_9 = +·08$	$x_{14} = -·46$
$x_5 = -1·78$	$x_{10} = -·18$	$x_{15} = -·37$

$[wx^2] = 10·79$

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Figure No. 5.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	52	32	29·77	·42
2	52	47	45·59	·10
3	74	39	45·31	·06
4	57	50	55·92	·14
5	59	6	32·63	·14
6	63	2	32·03	·03
7	68	33	26·25	·20
8	56	59	40·04	·01
9	54	26	54·24	·21
10	67	42	30·49	·26
11	57	15	58·66	·07
12	55	1	32·53	·08
13	64	58	24·55	·13
14	60	30	27·18	·29
15	54	31	7·90	·04
16	48	22	13·82	·11
17	72	32	28·88	·11
18	59	5	18·31	·04

Equations to be satisfied — Factor

$$x_1 + x_2 + x_3 = e_1 = -0{\cdot}02, \quad \lambda_1$$
$$x_4 + x_5 + x_6 = e_2 = 0{\cdot}00, \quad \lambda_2$$
$$x_7 + x_8 + x_9 = e_3 = -0{\cdot}11, \quad \lambda_3$$
$$x_{10} + x_{11} + x_{12} = e_4 = +1{\cdot}01, \quad \lambda_4$$
$$x_{13} + x_{14} + x_{15} = e_5 = -1{\cdot}09, \quad \lambda_5$$
$$x_{16} + x_{17} + x_{18} = e_6 = +0{\cdot}30, \quad \lambda_6$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = +0{\cdot}80, \quad \lambda_7$$
$$\left.\begin{array}{l} +\cdot27\,x_3 - \cdot76\,x_2 + \cdot51\,x_6 \\ -\cdot60\,x_5 + \cdot71\,x_9 - \cdot65\,x_8 \\ +\cdot70\,x_{12} - \cdot64\,x_{11} + \cdot71\,x_{15} \\ -\cdot57\,x_{14} + \cdot60\,x_{18} - \cdot31\,x_{17} \end{array}\right\} = e_8 = +4{\cdot}77, \quad \lambda_8$$

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8
1	− 0·02	+0·58						−0·42	−0·060
2	0·00		+0·31					+0·14	−0·069
3	− 0·11			+0·42				+0·20	+0·142
4	+ 1·01				+0·41			+0·26	+0·011
5	− 1·09					+0·46		+0·13	−0·137
6	+ 0·30				*		+0·26	+0·11	−0·010
7	+ 0·80							+1·26	
8	+ 4·77								+0·438

Values of the Factors

$\lambda_1 = +1{\cdot}597$
$\lambda_2 = +3{\cdot}174$
$\lambda_3 = -4{\cdot}731$
$\lambda_4 = +2{\cdot}290$
$\lambda_5 = +1{\cdot}780$
$\lambda_6 = +1{\cdot}804$
$\lambda_7 = -0{\cdot}303$
$\lambda_8 = +13{\cdot}649$

Angular errors in seconds

$x_1 = +\cdot54$	$x_7 = -1{\cdot}01$	$x_{13} = +\cdot19$
$x_2 = -\cdot88$	$x_8 = -\cdot14$	$x_{14} = -1{\cdot}74$
$x_3 = +\cdot32$	$x_9 = +1{\cdot}04$	$x_{15} = +\cdot46$
$x_4 = +\cdot40$	$x_{10} = +\cdot51$	$x_{16} = +\cdot17$
$x_5 = -\cdot70$	$x_{11} = -\cdot45$	$x_{17} = -\cdot27$
$x_6 = +\cdot30$	$x_{12} = +\cdot95$	$x_{18} = +\cdot40$

$[wx^2] = 66{\cdot}27$

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Figure No. 6.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²	No.	Value °	′	″	Reciprocal Weight = (Probability)²	No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	63	14	48·48	·94	11	58	58	17·57	1·37	21	62	16	7·87	·94
2	56	48	52·42	·98	12	61	40	48·38	1·21	22	55	57	33·25	1·37
3	59	56	19·87	·66	13	57	27	29·50	·96	23	65	12	43·93	1·35
4	59	31	7·08	·50	14	57	36	29·89	·94	24	58	49	41·22	·90
5	64	34	44·50	1·19	15	64	56	1·64	·66	25	60	52	35·73	2·72
6	55	54	8·86	·66	16	61	34	22·11	1·10	26	55	34	53·39	·69
7	58	51	18·07	1·23	17	60	46	18·68	·71	27	63	32	31·85	1·17
8	61	9	27·18	1·08	18	57	39	18·54	·71	28	64	36	35·91	1·32
9	59	59	15·13	·72	19	59	35	43·10	·86	29	60	35	35·43	1·51
10	59	20	54·84	1·69	20	58	8	11·35	1·37	30	54	47	49·99	1·28

Equations to be satisfied									Factor
x_1	$+x_2$	$+x_3$	..	..	..	..	..	$= e_1 = +0·17,$	λ_1
x_4	$+x_5$	$+x_6$	..	..	..	..	..	$= e_2 = -0·17,$	λ_2
x_7	$+x_8$	$+x_9$	..	..	..	..	..	$= e_3 = -0·29,$	λ_3
x_{10}	$+x_{11}$	$+x_{12}$	..	..	..	..	..	$= e_4 = +0·12,$	λ_4
x_{13}	$+x_{14}$	$+x_{15}$	..	..	..	..	..	$= e_5 = +0·44,$	λ_5
x_{16}	$+x_{17}$	$+x_{18}$	..	..	..	..	..	$= e_6 = -1·27,$	λ_6
x_{19}	$+x_{20}$	$+x_{21}$	..	..	..	..	..	$= e_7 = +1·69,$	λ_7
x_{22}	$+x_{23}$	$+x_{24}$	..	..	..	..	..	$= e_8 = -2·21,$	λ_8
x_{25}	$+x_{26}$	$+x_{27}$	..	..	..	..	..	$= e_9 = +0·34,$	λ_9
x_{28}	$+x_{29}$	$+x_{30}$	..	..	..	..	..	$= e_{10} = +0·69,$	λ_{10}
x_1	$+x_4$	$+x_7$	$+x_{10}$	$+x_{13}$	$+x_{16}$	..	..	$= e_{11} = +0·08,$	λ_{11}
x_9	$+x_{11}$	$+x_{19}$	$+x_{22}$	$+x_{25}$	$+x_{28}$	..	..	$= e_{12} = +0·69,$	λ_{12}
$+·58x_3$ $+·54x_{12}$	$-·65x_2$ $-·60x_{11}$	$+·68x_6$ $+·47x_{15}$	$-·48x_5$ $-·63x_{14}$	$+·58x_9$ $+·63x_{18}$	$-·55x_8$ $-·56x_{17}$	..	..	$= e_{13} = -1·62,$	λ_{13}
$+·55x_8$ $+·60x_{24}$	$-·60x_7$ $-·46x_{23}$	$+·59x_{10}$ $+·50x_{27}$	$-·54x_{12}$ $-·69x_{26}$	$+·53x_{21}$ $+·71x_{30}$	$-·62x_{20}$ $-·56x_{29}$	..	..	$= e_{14} = +3·54,$	λ_{14}

Figure No. 6—(Continued).

Equations between the factors

No. of e	Value of e	Co-efficients of													
		λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8	λ_9	λ_{10}	λ_{11}	λ_{12}	λ_{13}	λ_{14}
1	+ 0·17	+2·58										+0·94		−0·254	
2	− 0·17		+2·35									+0·50		−0·122	
3	− 0·29			+3·03								+1·23	+0·72	−0·176	−0·144
4	+ 0·12				+4·27							+1·69	+1·37	−0·169	+0·344
5	+ 0·44					+2·56						+0·96		−0·282	
6	− 1·27						+2·52					+1·10		+0·050	
7	+ 1·69							+3·17					+0·86		−0·351
8	− 2·21								+3·62				+1·37		−0·081
9	+ 0·34									+4·58			+2·72		+0·109
10	+ 0·69										+4·11		+1·32		+0·063
11	+ 0·08											+6·42			+0·259
12	+ 0·69												+8·36	−0·404	
13	− 1·62													+3·654	−0·680
14	+ 3·54														+4·851

Values of the Factors

λ_1	=	−0·020
λ_2	=	−0·121
λ_3	=	−0·177
λ_4	=	−0·150
λ_5	=	+0·081
λ_6	=	−0·565
λ_7	=	+0·572
λ_8	=	−0·651
λ_9	=	−0·031
λ_{10}	=	+0·109
λ_{11}	=	+0·154
λ_{12}	=	+0·148
λ_{13}	=	−0·301
λ_{14}	=	+0·715

Angular errors in seconds

$x_1 = +\cdot12$	$x_{11} = +\cdot23$	$x_{21} = +\ \cdot89$
$x_2 = +\cdot17$	$x_{12} = -\cdot83$	$x_{22} = -\ \cdot69$
$x_3 = -\cdot12$	$x_{13} = +\cdot23$	$x_{23} = -1\cdot32$
$x_4 = +\cdot02$	$x_{14} = +\cdot24$	$x_{24} = -\ \cdot20$
$x_5 = +\cdot02$	$x_{15} = -\cdot03$	$x_{25} = +\ \cdot32$
$x_6 = -\cdot21$	$x_{16} = -\cdot45$	$x_{26} = -\ \cdot36$
$x_7 = -\cdot56$	$x_{17} = -\cdot29$	$x_{27} = +\ \cdot38$
$x_8 = +\cdot40$	$x_{18} = -\cdot53$	$x_{28} = +\ \cdot34$
$x_9 = -\cdot13$	$x_{19} = +\cdot62$	$x_{29} = -\ \cdot44$
$x_{10} = +\cdot72$	$x_{20} = +\cdot18$	$x_{30} = +\ \cdot79$

$[wx^2] = 6\cdot41$

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Figure No. 7.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	70	52	34·65	·10
2	33	16	1·39	·06
3	75	51	23·08	·16
4	70	47	51·65	·06
5	69	0	56·89	·19
6	40	11	11·05	·04
7	57	48	21·19	·09
8	72	22	51·15	·04
9	49	48	47·85	·11
10	66	31	16·76	·15
11	58	33	31·48	·07
12	54	55	12·60	·05
13	38	25	54·01	·16
14	56	53	3·33	·07
15	84	41	2·71	·08
16	55	34	0·47	·09
17	68	11	11·54	·12
18	56	14	47·82	·12

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = -1{\cdot}412,$	λ_1
$x_4 + x_5 + x_6 = e_2 = -0{\cdot}845,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -0{\cdot}514,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = -0{\cdot}152,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = -0{\cdot}540,$	λ_5
$x_{16} + x_{17} + x_{18} = e_6 = -0{\cdot}905,$	λ_6
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = -1{\cdot}27,$	λ_7
$\left.\begin{array}{rrr} 6x_2 & -32x_3 & +25x_6 \\ -8x_5 & +18x_9 & -7x_8 \\ +15x_{12} & -13x_{11} & +2x_{15} \\ -13x_{14} & +14x_{18} & -8x_{17} \end{array}\right\} = e_8 = +25{\cdot}1,$	λ_8

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8
1	− 1·412	+ ·32						+ ·10	−0·96
2	− 0·845		+ ·29					+ ·06	−0·52
3	− 0·514			+ ·24				+ ·09	+1·70
4	− 0·152				+ ·27			+ ·15	−0·16
5	− 0·540					+ ·31		+ ·16	−0·75
6	− 0·905			*			+ ·33	+ ·09	+0·72
7	− 1·27							+ ·65	
8	+25·1								+208·39

Values of the Factors

$\lambda_1 = -4{\cdot}1538$
$\lambda_2 = -2{\cdot}7666$
$\lambda_3 = -3{\cdot}1679$
$\lambda_4 = -0{\cdot}6963$
$\lambda_5 = -1{\cdot}6319$
$\lambda_6 = -3{\cdot}1173$
$\lambda_7 = +0{\cdot}3732$
$\lambda_8 = +0{\cdot}1251$

Angular errors in seconds

$x_1 = -{\cdot}378$	$x_7 = -{\cdot}251$	$x_{13} = -{\cdot}201$
$x_2 = -{\cdot}489$	$x_8 = -{\cdot}162$	$x_{14} = -{\cdot}228$
$x_3 = -{\cdot}545$	$x_9 = -{\cdot}101$	$x_{15} = -{\cdot}111$
$x_4 = -{\cdot}144$	$x_{10} = -{\cdot}049$	$x_{16} = -{\cdot}247$
$x_5 = -{\cdot}715$	$x_{11} = -{\cdot}162$	$x_{17} = -{\cdot}494$
$x_6 = +{\cdot}014$	$x_{12} = +{\cdot}059$	$x_{18} = -{\cdot}164$

$[wx^2] = 16{\cdot}31$

December 1877.

J. B. N. HENNESSEY,
In charge of Computing Office.

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NORTH-EAST LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
		LIV	·84	+ ·03	+ ·11		+ ·14	66 35 5·24	5·1012759,8	126262·96	23·913
44		LVI	·83	+ ·24	− ·02		+ ·22	39 29 26·64	4·9420246,4	87503·35	16·573
		I	·84	+ ·14	− ·09		+ ·05	73 55 28·12	5·1212764,1	132213·68	25·040
			2·51				+ ·41	180 0 0·00			
		LVI	·86	+ ·31	+ ·18		+ ·49	53 43 37·16	5·0297618,7	107093·19	20·283
43		I	·87	− ·01	− ·04		− ·05	54 22 20·88	5·0333102,2	107971·77	20·449
		II	·87	− ·37	− ·14		− ·51	71 54 1·96	5·1012759,8	126262·96	23·913
			2·60				− ·07	180 0 0·00			
		I	1·08	+ ·14	+ ·07		+ ·21	56 21 22·32	5·1132768,0	129800·63	24·583
42		II	1·09	+ ·11	+ ·15		+ ·26	80 15 42·26	5·1865902,5	153670·41	29·104
		IV	1·08	− ·18	− ·22		− ·40	43 22 55·42	5·0297618,7	107093·19	20·283
			3·25				+ ·07	180 0 0·00			
		I	1·12	− ·51	+ ·29		− ·22	40 44 13·04	5·0151177,8	103542·29	19·610
41		IV	1·13	− ·44	− ·12		− ·56	63 40 34·83	5·1529342,1	142211·34	26·934
		III	1·13	− ·25	− ·17		− ·42	75 35 12·13	5·1865902,5	153670·41	29·104
			3·38				−1·20	180 0 0·00			
		LIV	1·05	−1·32		+ ·11	−1·21	83 18 46·60	5·2235428,1	167318·04	31·689
	579	I	1·05	+ ·03		− ·03	·00	65 23 37·74	5·1851626,7	153166·10	29·009
		LII	1·05	− ·32		− ·08	− ·40	31 17 35·66	4·9420246,4	87503·35	16·573
			3·15				−1·61	180 0 0·00			

NOTES.—1. The values of the side are given in the same line with the opposite angle.
2. Stations LII, LIV and LVI appertain to the Great Arc Meridional Series, Section 24° to 30°.

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No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Corrections to Observed Angle: Circuit	Corrections to Observed Angle: Non-circuit	Corrections to Observed Angle: Total	Corrected Plane Angle	Distance: Log. feet	Distance: Feet	Distance: Miles
			"	"	"	"	"	° ′ "			
	578	LII	1·75	− ·34		+ ·33	− ·01	48 41 19·12	5·1529342,0	142211·34	26·934
		I	1·76	+ ·42		− ·20	+ ·22	69 12 51·18	5·2479887,1	177006·29	33·524
		III	1·75	+ ·68		− ·13	+ ·55	62 5 49·70	5·2235428,1	167318·04	31·689
			5·26				+ ·76	180 0 0·00			
40		IV	·77	+ ·14	+ ·03		+ ·17	53 15 35·58	4·9996613,2	99922·05	18·925
		III	·77	+ ·02	+ ·22		+ ·24	70 36 4·43	5·0704527,9	117612·32	22·275
		V	·77	− ·14	− ·25		− ·39	56 8 19·99	5·0151177,8	103542·29	19·610
			2·31				+ ·02	180 0 0·00			
39		IV	·99	+ ·89	+ ·49		+1·38	43 13 22·85	5·0292610,0	106969·75	20·259
		V	1·00	− ·16	− ·04		− ·20	87 55 41·51	5·1933879,4	156094·62	29·563
		VI	·99	+ ·46	− ·45		+ ·01	48 50 55·64	5·0704527,9	117612·32	22·275
			2·98				+1·19	180 0 0·00			
	577	III	·50	− ·34		+ ·31	− ·03	18 35 56·95	5·0292610,1	106969·76	20·259
		V	·50	− ·30		− ·29	− ·59	144 4 2·77	5·2940590,9	196815·40	37·276
		VI	·49	− ·07		− ·02	− ·09	17 20 0·28	4·9996613,2	99922·05	18·925
			1·49				− ·71	180 0 0·00			
38		V	1·57	− ·09	+ ·56		+ ·47	70 4 57·39	5·2795938,6	190367·96	36·055
		VI	1·57	− ·51	+ ·28		− ·23	78 1 36·30	5·2968281,0	198074·29	37·514
		VII	1·56	+ ·05	− ·84		− ·79	31 53 26·31	5·0292610,0	106969·75	20·259
			4·70				− ·55	180 0 0·00			
37		VI	1·89	− ·70	+ ·43		− ·27	53 33 34·82	5·2017094,9	159114·39	30·135
		VII	1·89	+ ·17	− ·12		+ ·05	52 10 56·85	5·1938056,1	156244·82	29·592
		VIII	1·89	+ ·33	− ·31		+ ·02	74 15 28·33	5·2795938,6	190367·96	36·055
			5·67				− ·20	180 0 0·00			
	576	V	2·47	+ ·42		+ ·65	+1·07	41 3 54·15	5·2017095,1	159114·40	30·135
		VII	2·47	+ ·22		− ·96	− ·74	84 4 24·14	5·3818725,6	240919·81	45·629
		VIII	2·47	+ ·32		+ ·31	+ ·63	54 51 41·71	5·2968281,0	198074·29	37·514
			7·41				+ ·96	180 0 0·00			
36		VII	1·10	− ·13	− ·53		− ·66	64 29 35·31	5·1657314,4	146464·19	27·739
		VIII	1·10	− ·08	+1·26		+1·18	36 50 39·80	4·9881613,7	97310·88	18·430
		IX	1·11	− ·48	− ·73		−1·21	78 39 44·89	5·2017094,9	159114·39	30·135
			3·31				− ·69	180 0 0·00			
35		VII	·66	+1·78	+ ·67		+2·45	66 1 18·71	5·0159650,8	103744·51	19·649
		IX	·65	+ ·83	+ ·08		+ ·91	54 59 32·98	4·9684858,4	93000·63	17·614
		X	·65	+ ·20	− ·75		− ·55	58 59 8·31	4·9881613,7	97310·88	18·430
			1·96				+2·81	180 0 0·00			
34		IX	·58	− ·65	− ·16		− ·81	59 1 58·59	4·9723578,5	93833·49	17·771
		X	·58	− ·04	+ ·85		+ ·81	49 31 11·07	4·9203155,7	83236·84	15·765
		XI	·59	− ·08	− ·69		− ·77	71 26 50·34	5·0159650,8	103744·51	19·649
			1·75				− ·77	180 0 0·00			
92		IX	·35	+ ·18	+1·79		+1·97	52 13 53·62	4·8321557,7	67944·73	12·868
		XI	·35	+ ·43	− ·81		− ·38	52 12 32·97	4·8320241,7	67924·14	12·864
		XII	·36	+ ·24	− ·98		− ·74	75 33 33·41	4·9203155,7	83236·84	15·765
			1·06				+ ·85	180 0 0·00			
	575	VIII	·71	+ ·37		+1·10	+1·47	19 20 33·63	4·8320241,3	67924·13	12·864
		IX	·71	+ ·12		− ·98	− ·86	115 4 46·52	5·2689050,3	185739·84	35·178
		XII	·71	+ ·46		− ·12	+ ·34	45 34 39·85	5·1657314,4	146464·19	27·739
			2·13				+ ·95	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
91		XI	·23	− ·46	+ ·82		+ ·36	55 25 44·12	4·7616979,1	57769·41	10·941
		XII	·23	− ·31	+ ·18		− ·13	48 59 59·49	4·7238538,7	52948·52	10·028
		XIII	·24	− ·11	−1·00		−1·11	75 34 16·39	4·8321557,7	67944·73	12·868
			·70				− ·88	180 0 0·00			
90		XII	·19	+ ·11	+ ·25		+ ·36	47 16 15·78	4·6699683,7	46770·10	8·858
		XIII	·20	+ ·05	− ·04		+ ·01	67 35 25·50	4·7698326,9	58861·69	11·148
		XIV	·20	+ ·10	− ·21		− ·11	65 8 18·72	4·7616979,1	57769·41	10·941
			·59				+ ·26	180 0 0·00			
89		XIII	·19	+ ·03	+ ·16		+ ·19	59 0 38·28	4·7254172,1	53139·46	10·064
		XIV	·19	+ ·01	+ ·08		+ ·09	72 0 24·33	4·7705261,0	58955·74	11·166
		XV	·18	+ ·02	− ·24		− ·22	48 58 57·39	4·6699683,7	46770·10	8·858
			·56				+ ·06	180 0 0·00			
88		XIV	·20	− ·21	+ ·24		+ ·03	62 17 32·56	4·7367757,4	54547·61	10·331
		XV	·19	− ·06	− ·01		− ·07	58 6 42·45	4·7186185,1	52314·07	9·908
		XVI	·19	− ·17	− ·23		− ·40	59 35 44·99	4·7254172,1	53139·46	10·064
			·58				− ·44	180 0 0·00			
87		XV	·24	+ ·30	+ ·05		+ ·35	66 32 52·39	4·8012117,0	63272·01	11·983
		XVI	·24	+ ·25	+ ·10		+ ·35	61 10 57·99	4·7812405,4	60428·33	11·445
		XVII	·23	+ ·23	− ·15		+ ·08	52 16 9·62	4·7367757,4	54547·61	10·331
			·71				+ ·78	180 0 0·00			
86		XVI	·24	+ ·12	+ ·07		+ ·19	58 39 24·04	4·7725410,5	59229·91	11·218
		XVII	·24	+ ·10	+ ·04		+ ·14	55 30 39·66	4·7571007,9	57161·13	10·826
		XVIII	·25	+ ·13	− ·11		+ ·02	65 49 56·30	4·8012117,0	63272·01	11·983
			·73				+ ·35	180 0 0·00			
85		XVII	·20	+ ·02	+ ·05		+ ·07	58 11 27·33	4·7326090,2	54026·77	10·232
		XVIII	·20	+ ·03	+ ·01		+ ·04	53 6 55·22	4·7062936,4	50850·31	9·631
		XIX	·20	+ ·06	− ·06		·00	68 41 37·45	4·7725410,5	59229·91	11·218
			·60				+ ·11	180 0 0·00			
84		XVIII	·18	− ·06	+ ·04		− ·02	64 23 18·13	4·7352991,6	54362·47	10·296
		XIX	·18	− ·03	+ ·05		+ ·02	51 57 6·08	4·6764613,6	47474·60	8·991
		XX	·18	− ·09	− ·09		− ·18	63 39 35·79	4·7326090,2	54026·77	10·232
			·54				− ·18	180 0 0·00			
83		XIX	·19	− ·04	+ ·03		− ·01	65 36 3·47	4·7445340,9	55530·82	10·517
		XX	·18	− ·07	− ·02		− ·09	51 19 58·49	4·6776971,5	47609·88	9·017
		XXI	·18	− ·16	− ·01		− ·17	63 3 58·04	4·7352991,6	54362·47	10·296
			·55				− ·27	180 0 0·00			
82		XX	·24	+ ·02	·00		+ ·02	72 41 15·60	4·8198682,5	66049·31	12·509
		XXI	·23	+ ·05	+ ·06		+ ·11	53 55 39·09	4·7475607,3	55919·17	10·591
		XXII	·23	+ ·07	− ·06		+ ·01	53 23 5·31	4·7445340,9	55530·82	10·517
			·70				+ ·14	180 0 0·00			
81		XXI	·25	+ ·05	+ ·01		+ ·06	59 0 49·31	4·7854941,6	61023·08	11·557
		XXII	·25	+ ·07	− ·01		+ ·06	52 52 34·36	4·7540061,7	56755·27	10·749
		XXIII	·26	+ ·17	·00		+ ·17	68 6 36·33	4·8198682,5	66049·31	12·509
			·76				+ ·29	180 0 0·00			
80		XXII	·28	− ·10	− ·14		− ·24	61 34 1·76	4·8129253,7	65001·80	12·311
		XXIII	·28	− ·15	+ ·19		+ ·04	62 47 18·84	4·8178114,0	65737·23	12·450
		XXIV	·27	− ·11	− ·05		− ·16	55 38 39·40	4·7854941,6	61023·08	11·557
			·83				− ·36	180 0 0·00			

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No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Circuit	Non-Circuit	Total	Corrected Plane Angle	Distance: Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
79		XXIII	·35	− ·05	+ ·17		+ ·12	64 42 58·78	4·8738518,3	74791·44	14·165
		XXIV	·34	− ·11	− ·16		− ·27	63 29 3·27	4·8693168,5	74014·51	14·018
		XXV	·34	− ·06	− ·01		− ·07	51 47 57·95	4·8129253,7	65001·80	12·311
			1·03				− ·22	180 0 0·00			
138		XXIV	·28	+ ·04	+ ·15		+ ·19	44 55 44·34	4·7387183,4	54792·14	10·377
		XXV	·28	+ ·10	− ·05		+ ·05	60 29 25·49	4·8294280,2	67519·32	12·788
		XXVI	·28	+ ·07	− ·10		− ·03	74 34 50·17	4·8738518,3	74791·44	14·165
			·84				+ ·21	180 0 0·00			
137		XXV	·23	− ·08	+ ·05		− ·03	68 17 48·61	4·7985945,2	62891·87	11·911
		XXVI	·23	− ·10	+ ·02		− ·08	57 39 38·08	4·7573285,7	57191·11	10·832
		XXVII	·23	− ·03	− ·07		− ·10	54 2 33·31	4·7387183,4	54792·14	10·377
			·69				− ·21	180 0 0·00			
136		XXVI	·22	+ ·02	+ ·05		+ ·07	55 25 44·56	4·7431121,2	55349·30	10·483
		XXVII	·22	+ ·03	− ·01		+ ·02	55 14 24·47	4·7421218,5	55223·23	10·459
		XXVIII	·23	+ ·07	− ·04		+ ·03	69 19 50·97	4·7985945,2	62891·87	11·911
			·67				+ ·12	180 0 0·00			
135		XXVII	·22	+ ·01	+ ·04		+ ·05	58 43 1·29	4·7492423,1	56136·11	10·632
		XXVIII	·22	+ ·02	+ ·01		+ ·03	63 51 48·86	4·7706269,9	58969·44	11·168
		XXIX	·22	+ ·01	− ·05		− ·04	57 25 9·85	4·7431121,2	55349·30	10·483
			·66				+ ·04	180 0 0·00			
134		XXVIII	·23	+ ·05	+ ·07		+ ·12	68 22 39·28	4·7963925,6	62573·81	11·851
		XXIX	·22	+ ·05	+ ·01		+ ·06	55 6 41·67	4·7420368,5	55212·43	10·457
		XXX	·23	+ ·07	− ·08		− ·01	56 30 39·05	4·7492423,1	56136·11	10·632
			·68				+ ·17	180 0 0·00			
133		XXIX	·28	+ ·02	+ ·03		+ ·05	65 3 2·87	4·8263206,2	67037·94	12·697
		XXX	·27	+ ·05	+ ·01		+ ·06	57 8 13·74	4·7931302,9	62105·53	11·762
		XXXI	·28	+ ·02	− ·04		− ·02	57 48 43·39	4·7963925,6	62573·81	11·851
			·83				+ ·09	180 0 0·00			
132		XXX	·25	− ·03	+ ·07		+ ·04	57 33 6·95	4·7787297,5	60079·98	11·379
		XXXI	·25	− ·07	− ·01		− ·08	52 7 28·30	4·7497180,0	56197·63	10·643
		XXXII	·25	− ·06	− ·06		− ·12	70 19 24·75	4·8263206,2	67037·94	12·697
			·75				− ·16	180 0 0·00			
131		XXXI	·23	+ ·02	+ ·01		+ ·03	52 34 45·48	4·7329737,5	54072·17	10·241
		XXXII	·24	+ ·03	+ ·04		+ ·07	65 28 59·05	4·7920109,8	61945·67	11·732
		XXXIII	·23	+ ·03	− ·05		− ·02	61 56 15·47	4·7787297,5	60079·98	11·379
			·70				+ ·08	180 0 0·00			
130		XXXI	·28	− ·09	+ ·06		− ·03	67 31 55·61	4·8368873,8	68689·03	13·009
		XXXIII	·27	− ·09	+ ·01		− ·08	56 1 15·68	4·7898529,4	61638·63	11·674
		XXXIV	·28	− ·08	− ·07		− ·15	56 26 48·71	4·7920109,8	61945·67	11·732
			·83				− ·26	180 0 0·00			
129		XXXIII	·31	+ ·03	− ·01		+ ·02	69 55 44·68	4·8709064,7	74285·91	14·069
		XXXIV	·30	+ ·02	+ ·04		+ ·06	49 47 9·33	4·7810038,8	60395·40	11·439
		XXXV	·31	+ ·01	− ·03		− ·02	60 17 5·99	4·8368873,8	68689·03	13·009
			·92				+ ·06	180 0 0·00			
180		XXXIII	·25	+ ·02	+ ·04		+ ·06	56 28 16·03	4·7717847,7	59126·86	11·198
		XXXV	·26	+ ·04	+ ·08		+ ·12	65 9 16·32	4·8086431,5	64364·02	12·190
		XXXVI	·26	+ ·10	− ·12		− ·02	58 22 27·65	4·7810038,8	60395·40	11·439
			·77				+ ·16	180 0 0·00			

No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Corrections to Observed Angle: Circuit	Corrections to Observed Angle: Non-circuit	Corrections to Observed Angle: Total	Corrected Plane Angle	Distance: Log. feet	Distance: Feet	Distance: Miles
			"	"	"	"	"	° ' "			
		XXXV	·30	− ·31	+ ·13		− ·18	61 13 2·48	4·8370420,4	68713·50	13·014
179		XXXVI	·30	− ·20	− ·04		− ·24	69 49 46·04	4·8668267,4	73591·35	13·938
		XXXVII	·30	− ·27	− ·09		− ·36	48 57 11·48	4·7717847,7	59126·86	11·198
			·90				− ·78	180 0 0·00			
		XXXVI	·27	+ ·02	+ ·10		+ ·12	44 49 44·05	4·7268298,4	53312·60	10·097
178		XXXVII	·27	+ ·03	+ ·03		+ ·06	69 51 6·14	4·8512206,4	70993·84	13·446
		XXXVIII	·27	+ ·07	− ·13		− ·06	65 19 9·81	4·8370420,4	68713·50	13·014
			·81				+ ·12	180 0 0·00			
		XXXVII	·23	− ·36	+ ·07		− ·29	71 20 52·90	4·8125950,3	64952·38	12·302
177		XXXVIII	·23	− ·95	− ·02		− ·97	57 36 10·02	4·7625501,3	57882·88	10·963
		XXXIX	·23	− ·07	− ·05		− ·12	51 2 57·08	4·7268298,4	53312·60	10·097
			·69				−1·38	180 0 0·00			
		XXXVIII	·26	− ·14	+ ·21		+ ·07	52 49 40·31	4·7642573,9	58110·88	11·006
176		XXXIX	·27	− ·06	+ ·15		+ ·09	64 13 8·20	4·8173607,9	65669·06	12·437
		XL	·27	− ·06	− ·36		− ·42	62 57 11·49	4·8125950,3	64952·38	12·302
			·80				− ·26	180 0 0·00			
		XXXIX	·26	+ ·03	+ ·15		+ ·18	70 35 17·39	4·8339216,4	68221·56	12·921
175		XL	·26	+ ·05	− ·05		·00	55 57 29·57	4·7776994,3	59937·62	11·352
		XLI	·25	+ ·04	− ·10		− ·06	53 27 13·04	4·7642573,9	58110·88	11·006
			·77				+ ·12	180 0 0·00			
		XL	·29	+ ·05	+ ·09		+ ·14	61 0 1·32	4·8187082,0	65873·12	12·476
174		XLI	·28	+ ·10	+ ·12		+ ·22	54 4 4·26	4·7852182,4	60984·33	11·550
		XLII	·29	+ ·20	− ·21		− ·01	64 55 54·42	4·8339216,4	68221·56	12·921
			·86				+ ·35	180 0 0·00			
		XLI	·22	+ ·07	+ ·14		+ ·21	60 15 42·46	4·7749407,6	59558·09	11·280
173		XLII	·22	+ ·03	− ·10		− ·07	45 55 22·55	4·6926397,1	49276·48	9·333
		XLIII	·22	+ ·10	− ·04		+ ·06	73 48 54·99	4·8187082,0	65873·12	12·476
			·66				+ ·20	180 0 0·00			
		XLII	·25	+ ·01	+ ·06		+ ·07	66 13 53·47	4·8064686,2	64042·55	12·129
172		XLIII	·24	+ ·04	+ ·10		+ ·14	55 26 14·02	4·7606277,3	57627·23	10·914
		XLIV	·25	+ ·10	− ·16		− ·06	58 19 52·51	4·7749407,6	59558·09	11·280
			·74				+ ·15	180 0 0·00			
		XLIII	·25	− ·11	+ ·28		+ ·17	53 19 23·29	4·7578241,6	57256·42	10·844
171		XLIV	·26	− ·16	− ·08		− ·24	62 54 3·07	4·8031377,9	63553·25	12·037
		XLV	·26	− ·23	− ·20		− ·43	63 46 33·64	4·8064686,2	64042·55	12·129
			·77				− ·50	180 0 0·00			
		XLIV	·24	− ·01	+ ·17		+ ·16	65 14 15·33	4·7904477,2	61723·10	11·690
220		XLV	·23	− ·01	+ ·01		·00	57 22 27·76	4·7577578,8	57247·68	10·842
		XLVI	·23	− ·04	− ·18		− ·22	57 23 16·91	4·7578241,6	57256·42	10·844
			·70				− ·06	180 0 0·00			
		XLV	·28	− ·03	+ ·17		+ ·14	56 50 29·36	4·7945589,2	62310·16	11·801
219		XLVI	·28	− ·01	− ·01		− ·02	67 8 3·71	4·8362070,9	68581·52	12·989
		XLVII	·27	− ·05	− ·16		− ·21	56 1 26·93	4·7904477,2	61723·10	11·690
			·83				− ·09	180 0 0·00			
		XLVI	·24	− ·01	+ ·12		+ ·11	54 33 4·50	4·7532171,1	56652·25	10·730
218		XLVII	·24	− ·02	+ ·01		− ·01	61 48 44·90	4·7874304,4	61295·77	11·609
		XLVIII	·25	− ·01	− ·13		− ·14	63 38 10·60	4·7945589,2	62310·16	11·801
			·73				− ·04	180 0 0·00			

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No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Corrections to Observed Angle: Circuit	Corrections to Observed Angle: Non-circuit	Corrections to Observed Angle: Total	Corrected Plane Angle	Distance: Log. feet	Distance: Feet	Distance: Miles
			"	"	"	"	"	° ′ ″			
217		XLVII	·24	·00	+ ·01		+ ·01	65 3 14·24	4·7928805,0	62069·83	11·756
		XLVIII	·24	+ ·05	+ ·01		+ ·06	59 5 47·38	4·7689185,4	58737·91	11·125
		XLIX	·23	+ ·11	− ·02		+ ·09	55 50 58·38	4·7532171,1	56652·25	10·730
			·71				+ ·16	180 0 0·00			
216		XLVIII	·21	+ ·11	+ ·07		+ ·18	59 24 36·96	4·7507357,3	56329·48	10·668
		XLIX	·20	+ ·26	+ ·01		+ ·27	49 2 50·59	4·6939085,4	49420·66	9·360
		L	·21	+ ·36	− ·08		+ ·28	71 32 32·45	4·7928805,0	62069·83	11·756
			·62				+ ·73	180 0 0·00			
215		XLIX	·25	·00	+ ·07		+ ·07	74 44 19·31	4·8430113,8	69664·48	13·194
		L	·25	+ ·01	+ ·02		+ ·03	53 59 40·14	4·7665304,1	58415·81	11·064
		LI	·25	·00	− ·09		− ·09	51 16 0·55	4·7507357,3	56329·48	10·668
			·75				+ ·01	180 0 0·00			
214		L	·26	− ·09	+ ·16		+ ·07	53 7 40·59	4·7702144,4	58913·45	11·158
		LI	·27	− ·18	+ ·03		− ·15	55 47 36·58	4·7846510,1	60904·73	11·535
		LII	·27	− ·05	− ·19		− ·24	71 4 42·83	4·8430113,8	69664·48	13·194
			·80				− ·32	180 0 0·00			
213		LI	·27	+ ·02	+ ·10		+ ·12	70 9 55·48	4·8435499,1	69750·92	13·210
		LII	·27	+ ·12	·00		+ ·12	57 13 28·89	4·7948024,9	62345·13	11·808
		LIII	·27	+ ·05	− ·10		− ·05	52 36 35·63	4·7702144,4	58913·45	11·158
			·81				+ ·19	180 0 0·00			
212		LII	·23	+ ·12	+ ·07		+ ·19	50 41 23·13	4·7403548,8	54999·01	10·416
		LIII	·23	+ ·08	·00		+ ·08	50 25 15·00	4·7386778,6	54787·05	10·376
		LIV	·24	+ ·12	− ·07		+ ·05	78 53 21·87	4·8435499,1	69750·92	13·210
			·70				+ ·32	180 0 0·00			
211		LIII	·23	− ·32	+ ·08		− ·24	74 39 44·84	4·8248978,6	66818·67	12·655
		LIV	·23	+ ·88	− ·03		+ ·85	52 47 46·21	4·7418278,0	55185·86	10·452
		LV	·23	− ·54	− ·05		− ·59	52 32 28·95	4·7403548,8	54999·01	10·416
			·69				+ ·02	180 0 0·00			
262		LIV	·24	− ·40	+ ·10		− ·30	59 5 17·77	4·7788466,0	60096·14	11·382
		LV	·23	− ·17	+ ·01		− ·16	48 22 13·43	4·7189647,2	52355·79	9·916
		LVII	·24	+ ·27	− ·11		+ ·16	72 32 28·80	4·8248978,6	66818·67	12·655
			·71				− ·30	180 0 0·00			
261		LV	·24	− ·19	+ ·03		− ·16	64 58 24·15	4·7962972,5	62560·08	11·848
		LVII	·24	− ·46	− ·02		− ·48	54 31 7·18	4·7499025,7	56221·52	10·648
		LIX	·24	+ 1·74	− ·01		+ 1·73	60 30 28·67	4·7788466,0	60096·14	11·382
			·72				+ 1·09	180 0 0·00			
210		LIII	·19	+ ·70	− ·04		+ ·66	59 6 33·10	4·7253463,1	53130·79	10·063
		LV	·19	− ·40	+ ·01		− ·39	57 50 55·34	4·7194862,6	52418·71	9·928
		LVI	·20	− ·30	+ ·03		− ·27	63 2 31·56	4·7418278,0	55185·86	10·452
			·58				·00	180 0 0·00			
209		LV	·22	+ 1·01	− ·02		+ ·99	68 33 27·02	4·7837907,0	60784·20	11·512
		LVI	·21	+ ·14	− ·01		+ ·13	56 59 39·96	4·7385054,2	54765·29	10·372
		LVIII	·21	− 1·04	+ ·03		− 1·01	54 26 53·02	4·7253463,1	53130·79	10·063
			·64				+ ·11	180 0 0·00			
	593	LV	·23	− ·51		+ ·02	− ·49	67 42 29·77	4·7912724,2	61840·42	11·712
		LVIII	·22	+ ·45		+ ·15	+ ·60	57 15 59·04	4·7499025,8	56221·52	10·648
		LIX	·22	− ·95		− ·17	− 1·12	55 1 31·19	4·7385054,2	54765·29	10·372
			·67				− 1·01	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
		LVII	·23	− ·02	+ ·01		− ·01	49 7 58·47	4·7221596,3	52742·37	9·989
260		LIX	·23	− ·30	+ ·01		− ·29	67 6 3·38	4·8078561,2	64247·48	12·168
		LX	·23	− ·52	− ·02		− ·54	63 45 58·15	4·7962972,5	62560·08	11·848
			·69				− ·84	180 0 0·00			
		LIX	·19	+ ·25	+ ·09		+ ·34	57 35 2·01	4·7112575,5	51434·86	9·741
259		LX	·19	+ ·22	− ·06		+ ·16	62 27 38·23	4·7325973,7	54025·32	10·232
		LXI	·19	+ ·23	− ·03		+ ·20	59 57 19·76	4·7221596,3	52742·37	9·989
			·57				+ ·70	180 0 0·00			
		LX	·22	− ·01	+ ·03		+ ·02	61 27 46·87	4·7672768,1	58516·29	11·083
258		LXI	·22	− ·01	+ ·08		+ ·07	67 59 8·13	4·7906522,7	61752·19	11·695
		LXII	·22	·00	− ·11		− ·11	50 33 5·00	4·7112575,5	51434·86	9·741
			·66				− ·02	180 0 0·00			
		LXI	·21	+ ·11	+ ·05		+ ·16	54 1 33·94	4·7175258,4	52182·62	9·883
257		LXII	·21	+ ·24	− ·04		+ ·20	60 48 36·59	4·7504430,5	56291·53	10·661
		LXIII	·21	+ ·13	− ·01		+ ·12	65 9 49·47	4·7672768,1	58516·29	11·083
			·63				+ ·48	180 0 0·00			
		LXII	·19	− ·60	+ ·03		− ·57	59 40 26·75	4·7271962,4	53357·60	10·106
256		LXIII	·20	− ·71	+ ·08		− ·63	62 44 38·02	4·7399875,6	54952·51	10·408
		LXIV	·19	− ·40	− ·11		− ·51	57 34 55·23	4·7175258,4	52182·62	9·883
			·58				−1·71	180 0 0·00			
		LXIII	·20	− ·04	+ ·03		− ·01	59 17 0·36	4·7298072,0	53679·35	10·167
255		LXIV	·20	− ·10	− ·03		− ·13	62 0 22·79	4·7414184,0	55133·86	10·442
		LXV	·20	− ·03	·00		− ·03	58 42 36·85	4·7271962,4	53357·60	10·106
			·60				− ·17	180 0 0·00			
		LXIV	·25	+ ·07	·00		+ ·07	60 21 43·15	4·7914900,0	61871·41	11·718
254		LXV	·25	+ ·14	+ ·03		+ ·17	70 41 33·02	4·8272472,3	67181·11	12·724
		LXVI	·24	+ ·21	− ·03		+ ·18	48 56 43·83	4·7298072,0	53679·35	10·167
			·74				+ ·42	180 0 0·00			
		LXV	·23	+ ·04	+ ·01		+ ·05	57 20 29·06	4·7578148,9	57255·20	10·844
253		LXVI	·23	+ ·09	− ·01		+ ·08	57 11 1·35	4·7570464,0	57153·97	10·825
		LXVII	·24	+ ·09	·00		+ ·09	65 28 29·59	4·7914900,0	61871·41	11·718
			·70				+ ·22	180 0 0·00			
		LXVI	·20	− ·04	·00		− ·04	70 40 48·22	4·7841448,4	60833·78	11·522
252		LXVII	·20	− ·10	+ ·05		− ·05	46 40 31·42	4·6711373,3	46896·16	8·882
		LXVIII	·20	− ·16	− ·05		− ·21	62 38 40·36	4·7578148,9	57255·20	10·844
			·60				− ·30	180 0 0·00			
		LXVII	·23	+ ·10	+ ·02		+ ·12	62 11 29·42	4·7779175,1	59967·71	11·358
251		LXVIII	·23	+ ·21	− ·02		+ ·19	54 0 17·59	4·7391983,9	54852·75	10·389
		LXIX	·23	+ ·21	·00		+ ·21	63 48 12·99	4·7841448,4	60833·78	11·522
			·69				+ ·52	180 0 0·00			
		LXVIII	·24	− ·12	·00		− ·12	58 14 33·71	4·7708141,4	58994·86	11·173
250		LXIX	·25	− ·17	+ ·02		− ·15	61 57 13·13	4·7869974,6	61234·68	11·597
		LXX	·24	− ·04	− ·02		− ·06	59 48 13·16	4·7779175,1	59967·71	11·358
			·73				− ·33	180 0 0·00			
		LXIX	·28	− ·05	+ ·06		+ ·01	58 8 29·38	4·8070266,3	64124·89	12·145
249		LXX	·28	− ·05	− ·04		− ·09	70 28 8·74	4·8522013,6	71154·34	13·476
		LXXI	·28	− ·13	− ·02		− ·15	51 23 21·88	4·7708141,4	58994·86	11·173
			·84				− ·23	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-Circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
302		LXX	·24	− ·02	+ ·22		+ ·20	52 25 29·18	4·7459407,0	55710·96	10·551
		LXXI	·25	− ·02	− ·37		− ·39	61 45 24·90	4·7918624,0	61924·49	11·728
		LXXII	·25	− ·02	+ ·15		+ ·13	65 49 5·92	4·8070266,3	64124·89	12·145
			·74				− ·06	180 0 0·00			
301		LXXI	·17	+ ·18	− ·12		+ ·06	60 19 29·57	4·7135289,7	51704·58	9·793
		LXXII	·17	+ ·35	+ ·18		+ ·53	50 15 25·54	4·6604676,1	45758·06	8·666
		LXXIII	·18	+ ·09	− ·06		+ ·03	69 25 4·89	4·7459407,0	55710·96	10·551
			·52				+ ·62	180 0 0·00			
300		LXXII	·21	+ ·02	+ ·26		+ ·28	55 40 40·02	4·7324919,5	54012·21	10·230
		LXXIII	·21	+ ·02	− ·28		− ·26	72 4 51·95	4·7939806,9	62227·26	11·785
		LXXIV	·21	+ ·04	+ ·02		+ ·06	52 14 28·03	4·7135289,7	51704·58	9·793
			·63				+ ·08	180 0 0·00			
299		LXXIII	·22	− ·08	+ ·11		+ ·03	67 25 14·51	4·7852382,6	60987·14	11·551
		LXXIV	·22	− ·06	− ·08		− ·14	57 43 9·46	4·7469561,0	55841·37	10·576
		LXXV	·22	− ·05	− ·03		− ·08	54 51 36·03	4·7324919,5	54012·21	10·230
			·66				− ·19	180 0 0·00			
298		LXXIV	·22	− ·05	+ ·17		+ ·12	56 5 10·46	4·7409064,7	55068·91	10·430
		LXXV	·22	− ·17	− ·08		− ·25	57 7 26·40	4·7460923,9	55730·43	10·555
		LXXVI	·22	− ·03	− ·09		− ·12	66 47 23·14	4·7852382,6	60987·14	11·551
			·66				− ·25	180 0 0·00			
297		LXXV	·22	− ·04	+ ·22		+ ·18	66 37 57·68	4·7836275,2	60761·36	11·508
		LXXVI	·22	− ·11	− ·21		− ·32	57 3 52·85	4·7447032,0	55552·45	10·521
		LXXVII	·22	− ·18	− ·01		− ·19	56 18 9·47	4·7409064,7	55068·91	10·430
			·66				− ·33	180 0 0·00			
296		LXXVI	·21	+ ·03	+ ·23		+ ·26	54 6 11·85	4·7256599,2	53169·17	10·070
		LXXVII	·22	+ ·08	+ ·05		+ ·13	58 6 54·84	4·7460996,3	55731·36	10·555
		LXXVIII	·22	+ ·03	− ·28		− ·25	67 46 53·31	4·7836275,2	60761·36	11·508
			·65				+ ·14	180 0 0·00			
295		LXXVII	·23	+ ·01	+ ·41		+ ·42	61 2 26·33	4·7742986,6	59470·10	11·263
		LXXVIII	·23	+ ·08	− ·34		− ·26	67 29 28·99	4·7978970,5	62790·95	11·892
		LXXIX	·23	+ ·03	− ·07		− ·04	51 28 4·68	4·7256599,2	53169·17	10·070
			·69				+ ·12	180 0 0·00			
294		LXXVIII	·22	− ·11	·00		− ·11	55 52 17·43	4·7344682,1	54258·55	10·276
		LXXIX	·22	− ·19	+ ·03		− ·16	58 59 41·96	4·7495952,6	56181·75	10·640
		LXXX	·23	− ·48	− ·03		− ·51	65 8 0·61	4·7742986,6	59470·10	11·263
			·67				− ·78	180 0 0·00			
293		LXXIX	·20	− ·09	+ ·05		− ·04	51 56 57·79	4·7079484,2	51044·44	9·668
		LXXX	·21	− ·23	− ·04		− ·27	71 13 14·19	4·7879585,1	61370·34	11·623
		LXXXI	·21	− ·19	− ·01		− ·20	56 49 48·02	4·7344682,1	54258·55	10·276
			·62				− ·51	180 0 0·00			
292		LXXX	·22	+ ·18	− ·01		+ ·17	74 7 52·58	4·8130031,1	65013·43	12·313
		LXXXI	·22	+ ·11	+ ·05		+ ·16	56 49 28·22	4·7526019,7	56572·06	10·714
		LXXXII	·21	+ ·23	− ·04		+ ·19	49 2 39·20	4·7079484,2	51044·44	9·668
			·65				+ ·52	180 0 0·00			
291		LXXXI	·21	− ·07	+ ·02		− ·05	58 59 6·29	4·7595886,2	57489·51	10·888
		LXXXII	·20	− ·15	− ·03		− ·18	45 16 21·97	4·6781337,1	47657·77	9·026
		LXXXIII	·21	− ·17	+ ·01		− ·16	75 44 31·74	4·8130031,1	65013·43	12·313
			·62				− ·39	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
290		LXXXII	·25	− ·08	− ·01		− ·09	61 23 8·91	4·7913477,3	61851·15	11·714
		LXXXIII	·25	− ·09	+ ·03		− ·06	63 55 54·83	4·8013283,6	63289·02	11·987
		LXXXIV	·25	− ·24	− ·02		− ·26	54 40 56·26	4·7595886,2	57489·51	10·888
			·75				− ·41	180 0 0·00			
289		LXXXIII	·25	− ·15	− ·01		− ·16	58 46 43·15	4·7752788,4	59604·47	11·289
		LXXXIV	·24	− ·14	− ·04		− ·18	58 40 20·51	4·7747894,7	59537·35	11·276
		LXXXV	·25	− ·26	+ ·05		− ·21	62 32 56·34	4·7913477,3	61851·15	11·714
			·74				− ·55	180 0 0·00			
330		LXXXIV	·24	+ ·51	− ·17		+ ·34	70 0 14·49	4·8166729,8	65565·13	12·418
		LXXXV	·24	+ ·42	+ ·18		+ ·60	51 18 54·55	4·7361022,3	54463·08	10·315
		LXXXVI	·24	+ ·55	− ·01		+ ·54	58 40 50·96	4·7752788,4	59604·47	11·289
			·72				+1·48	180 0 0·00			
329		LXXXV	·24	+ ·52	+ ·07		+ ·59	48 1 39·45	4·7199085,9	52469·70	9·937
		LXXXVI	·24	+ ·49	− ·21		+ ·28	63 41 21·88	4·8011507,5	63263·14	11·982
		LXXXVII	·25	+ ·18	+ ·14		+ ·32	68 16 58·67	4·8166729,8	65565·13	12·418
			·73				+1·19	180 0 0·00			
328		LXXXVI	·22	+ ·81	− ·18		+ ·63	57 52 49·92	4·7469896,7	55845·69	10·577
		LXXXVII	·22	+ ·53	+ ·25		+ ·78	69 23 38·69	4·7904229,5	61719·58	11·689
		LXXXVIII	·21	+ ·64	− ·07		+ ·57	52 43 31·39	4·7199085,9	52469·70	9·937
			·65				+1·98	180 0 0·00			
327		LXXXVII	·22	− ·48	+ ·09		− ·39	59 30 16·81	4·7576911,6	57238·89	10·841
		LXXXVIII	·23	− ·26	− ·31		− ·57	63 16 53·36	4·7733113,7	59335·06	11·238
		LXXXIX	·22	− ·24	+ ·22		− ·02	57 12 49·83	4·7469896,7	55845·69	10·577
			·67				− ·98	180 0 0·00			
326		LXXXVIII	·22	− ·02	− ·13		− ·15	63 22 59·61	4·7639231,8	58066·17	10·997
		LXXXIX	·21	− ·01	+ ·18		+ ·17	54 49 8·10	4·7249745,6	53085·34	10·054
		XC	·21	− ·01	− ·05		− ·06	61 47 52·29	4·7576911,6	57238·89	10·841
			·64				− ·04	180 0 0·00			
325		LXXXIX	·23	− ·31	+ ·04		− ·27	52 18 30·06	4·7337822.9	54172·92	10·260
		XC	·23	− ·42	− ·17		− ·59	69 40 37·87	4·8075215,9	64198·01	12·159
		XCI	·23	− ·19	+ ·13		− ·06	58 0 52·07	4·7639231,8	58066·17	10·997
			·69				− ·92	180 0 0·00			
324		XC	·24	+ ·53	− ·13		+ ·40	75 2 42·89	4·8358917,5	68531·74	12·979
		XCI	·24	+ ·41	+ ·16		+ ·57	55 9 45·96	4·7650820,6	58221·32	11·027
		XCII	·24	+ ·36	− ·03		+ ·33	49 47 31·15	4·7337822,9	54172·92	10·260
			·72				+1·30	180 0 0·00			
323		XCI	·23	+ ·40	+ ·01		+ ·41	52 55 14·52	4·7486814,0	56063·65	10·618
		XCII	·23	+ ·22	− ·23		− ·01	49 51 33·92	4·7301440,3	53720·99	10·174
		XCIII	·23	+ ·20	+ ·22		+ ·42	77 13 11·56	4·8358917,5	68531·74	12·979
			·69				+ ·82	180 0 0·00			
361		XCII	·24	− ·16	− ·36		− ·52	70 59 1·51	4·8178079,4	65736·70	12·450
		XCIII	·24	− ·15	+ ·59		+ ·44	55 16 46·04	4·7570203,4	57150·54	10·824
		XCIV	·23	− ·08	− ·23		− ·31	53 44 12·45	4·7486814,0	56063·65	10·618
			·71				− ·39	180 0 0·00			
360		XCIII	·25	− ·06	+ ·23		+ ·17	58 6 29·10	4·7772194,3	59871·40	11·339
		XCIV	·24	− ·06	− ·47		− ·53	53 6 28·35	4·7512516,6	56396·44	10·681
		XCV	·25	− ·09	+ ·24		+ ·15	68 47 2·55	4·8178079,4	65736·70	12·450
			·74				− ·21	180 0 0·00			

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No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Corrections to Observed Angle: Circuit	Corrections to Observed Angle: Non-circuit	Corrections to Observed Angle: Total	Corrected Plane Angle	Distance: Log. feet	Distance: Feet	Distance: Miles
			"	"	"	"	"	° ′ "			
		XCIV	·24	+1·18	− ·20		+ ·98	61 43 50·97	4·7794179,2	60175·25	11·397
359		XCV	·23	+ ·38	+ ·22		+ ·60	57 4 18·22	4·7585179,7	57347·96	10·861
		XCVI	·24	+ ·67	− ·02		+ ·65	61 11 50·81	4·7772194,3	59871·40	11·339
			·71				+2·23	180 0 0·00			
		XCV	·22	+ ·53	+ ·05		+ ·58	60 57 16·58	4·7626733,8	57899·30	10·966
358		XCVI	·22	+ ·48	− ·22		+ ·26	53 43 57·94	4·7275237,4	53397·84	10·113
		XCVII	·22	+ ·30	+ ·17		+ ·47	65 18 45·48	4·7794179,2	60175·25	11·397
			·66				+1·31	180 0 0·00			
		XCVI	·25	+ ·23	− ·12		+ ·11	65 39 7·21	4·8033377,8	63582·53	12·042
357		XCVII	·25	+ ·12	+ ·13		+ ·25	58 17 16·00	4·7735675,7	59370·08	11·244
		XCVIII	·24	+ ·22	− ·01		+ ·21	56 3 36·79	4·7626733,8	57899·30	10·966
			·74				+ ·57	180 0 0·00			
		XCVII	·23	− ·40	+ ·03		− ·37	62 13 23·17	4·7834936,7	60742·64	11·504
356		XCVIII	·23	− ·11	− ·13		− ·24	49 56 12·72	4·7205157,8	52543·11	9·951
		XCIX	·24	− ·24	+ ·10		− ·14	67 50 24·11	4·8033377,8	63582·53	12·042
			·70				− ·75	180 0 0·00			
		XCVIII	·24	+ ·24	− ·14		+ ·10	67 13 59·47	4·8069315,1	64110·84	12·142
355		XCIX	·24	+ ·18	+ ·15		+ ·33	51 52 55·09	4·7379910,4	54700·47	10·360
		C	·24	+ ·50	− ·01		+ ·49	60 53 5·44	4·7834936,7	60742·64	11·504
			·72				+ ·92	180 0 0·00			
		XCIX	·20	+ ·34	+ ·03		+ ·37	58 10 25·35	4·7500229,5	56237·11	10·651
354		C	·20	+ ·51	− ·11		+ ·40	46 13 12·22	4·6793212,3	47788·26	9·051
		CI	·21	+ ·23	+ ·08		+ ·31	75 36 22·43	4·8069315,1	64110·84	12·142
			·61				+1·08	180 0 0·00			
		C	·20	− ·17	− ·12		− ·29	56 48 51·93	4·7218688,2	52707·06	9·982
353		CI	·20	+ ·12	− ·05		+ ·07	59 56 19·74	4·7364566,8	54507·55	10·323
		CII	·20	− ·12	+ ·17		+ ·05	63 14 48·33	4·7500229,5	56237·11	10·651
			·60				− ·17	180 0 0·00			
		CI	·21	− ·02	− ·28		− ·30	64 34 43·99	4·7595671,5	57486·67	10·888
352		CII	·20	− ·02	+ ·25		+ ·23	59 31 7·11	4·7391977,9	54852·67	10·389
		CIII	·20	+ ·21	+ ·03		+ ·24	55 54 8·90	4·7218688,2	52707·06	9·982
			·61				+ ·17	180 0 0·00			
		CII	·22	+ ·56	− ·17		+ ·39	58 51 18·24	4·7544946,7	56819·14	10·761
351		CIII	·23	− ·40	+ ·05		− ·35	61 9 26·60	4·7645694,8	58152·65	11·014
		CVI	·22	+ ·13	+ ·12		+ ·25	59 59 15·16	4·7595671,5	57486·67	10·888
			·67				+ ·29	180 0 0·00			
		CII	·22	− ·72	− ·18		− ·90	59 20 53·72	4·7545728,7	56829·37	10·763
423		CVI	·22	− ·23	+ ·37		+ ·14	58 58 17·49	4·7528678,7	56606·71	10·721
		CV	·23	+ ·83	− ·19		+ ·64	61 40 48·79	4·7645694,8	58152·65	11·014
			·67				− ·12	180 0 0·00			
		CVI	·22	− ·34	+ ·20		− ·14	64 36 35·55	4·7703613,4	58933·38	11·162
422		CV	·21	− ·79	− ·36		−1·15	54 47 48·63	4·7267589,4	53303·89	10·095
		CIX	·21	+ ·44	+ ·16		+ ·60	60 35 35·82	4·7545728,7	56829·37	10·763
			·64				− ·69	180 0 0·00			
		CIII	·21	− ·18	− ·08		− ·26	58 8 10·88	4·7365481,1	54519·03	10·326
350		CVI	·21	− ·62	+ ·03		− ·59	59 35 42·30	4·7432275,6	55364·01	10·486
		CVII	·21	− ·89	+ ·05		− ·84	62 16 6·82	4·7544946,7	56819·14	10·761
			·63				−1·69	180 0 0·00			

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No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Circuit	Non-circuit	Total	Corrected Plane Angle	Distance: Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
		CVI	·20	+ ·69	− ·06		+ ·63	55 57 33·68	4·7226341,6	52800·03	10·000
349		CVII	·21	+1·32	− ·03		+1·29	65 12 45·01	4·7622911,2	57848·37	10·956
		CVIII	·20	+ ·20	+ ·09		+ ·29	58 49 41·31	4·7365481,1	54519·03	10·326
			·61				+2·21	180 0 0·00			
		C	·20	+ ·53		+ ·07	+ ·60	57 39 18·94	4·7223771,1	52768·78	9·994
	618	CII	·20	+ ·45		− ·04	+ ·41	61 34 22·32	4·7397983,4	54928·57	10·403
		CIV	·20	+ ·29		− ·03	+ ·26	60 46 18·74	4·7364566,8	54507·55	10·323
			·60				+1·27	180 0 0·00			
		CII	·19	− ·23		− ·03	− ·26	57 27 29·05	4·7216532,2	52680·90	9·977
	617	CIV	·20	+ ·03		+ ·05	+ ·08	64 56 1·52	4·7528678,7	56606·71	10·721
		CV	·20	− ·24		− ·02	− ·26	57 36 29·43	4·7223771,1	52768·78	9·994
			·59				− ·44	180 0 0·00			
		CVI	·21	− ·32		− ·66	− ·98	60 52 34·54	4·7516388,5	56446·73	10·691
	616	CVIII	·21	+ ·36		+ ·20	+ ·56	55 34 53·74	4·7267589,4	53303·89	10·095
		CIX	·21	− ·38		+ ·46	+ ·08	63 32 31·72	4·7622911,2	57848·37	10·956
			·63				− ·34	180 0 0·00			
		CV	·22	− ·08	− ·14		− ·22	49 52 7·90	4·7115067,6	51464·38	9·747
421		CIX	·23	− ·16	+ ·32		+ ·16	69 1 22·92	4·7983075,8	62850·33	11·903
		CX	·22	− ·23	− ·18		− ·41	61 6 29·18	4·7703613,4	58933·38	11·162
			·67				− ·47	180 0 0·00			
		CIX	·21	− ·10	+ ·22		+ ·12	81 46 53·68	4·8269627,1	67137·12	12·715
420		CX	·20	− ·11	− ·36		− ·47	48 52 12·35	4·7083677,8	51093·75	9·677
		CXI	·20	− ·07	+ ·14		+ ·07	49 20 53·97	4·7115067,6	51464·38	9·747
			·61				− ·28	180 0 0·00			
		CX	·25	− ·11	− ·01		− ·12	56 16 35·08	4·7731717,0	59315·97	11·234
419		CXI	·25	− ·10	+ ·07		− ·03	53 26 12·15	4·7580149,2	57281·57	10·849
		CXII	·25	− ·05	− ·06		− ·11	70 17 12·77	4·8269627,1	67137·12	12·715
			·75				− ·26	180 0 0·00			
		CXI	·24	− ·24	+ ·06		− ·18	59 19 41·73	4·7703641,5	58933·76	11·162
418		CXII	·24	− ·20	− ·06		− ·26	60 42 39·77	4·7764111,5	59760·08	11·318
		CXIII	·24	− ·05	·00		− ·05	59 57 38·50	4·7731717,0	59315·97	11·234
			·72				− ·49	180 0 0·00			
		CXII	·22	+ ·03	+ ·01		+ ·04	54 31 54·56	4·7368265,0	54553·99	10·332
417		CXIII	·23	+ ·03	+ ·02		+ ·05	63 50 49·53	4·7790615,4	60125·89	11·387
		CXIV	·23	+ ·09	− ·03		+ ·06	61 37 15·91	4·7703641,5	58933·76	11·162
			·68				+ ·15	180 0 0·00			
		CXIII	·22	− ·05	+ ·03		− ·02	63 31 52·78	4·7698035,0	58857·73	11·147
416		CXIV	·22	− ·05	− ·02		− ·07	60 23 54·59	4·7571546,3	57168·21	10·827
		CXV	·22	− ·12	− ·01		− ·13	56 4 12·63	4·7368265,0	54553·99	10·332
			·66				− ·22	180 0 0·00			
		CXIV	·25	+ ·42	+ ·02		+ ·44	60 19 37·63	4·7860440,5	61100·40	11·572
415		CXV	·25	+ ·12	+ ·04		+ ·16	62 51 3·21	4·7963944,2	62574·07	11·851
		CXVI	·25	+ ·24	− ·06		+ ·18	56 49 19·16	4·7698035,0	58857·73	11·147
			·75				+ ·78	180 0 0·00			
		CXV	·24	+ ·06	+ ·05		+ ·11	58 35 10·73	4·7705994,5	58965·70	11·168
414		CXVI	·24	+ ·08	− ·03		+ ·05	59 14 43·56	4·7736113,7	59376·06	11·245
		CXVII	·25	+ ·08	− ·02		+ ·06	62 10 5·71	4·7860440,5	61100·40	11·572
			·73				+ ·22	180 0 0·00			

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No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Circuit	Non-circuit	Total	Corrected Plane Angle	Distance: Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
413		CXVI	·22	+ ·22	+ ·02		+ ·24	63 43 43·91	4·7734984,1	59360·62	11·243
		CXVII	·22	+ ·20	+ ·02		+ ·22	53 18 15·35	4·7249235,7	53079·11	10·053
		CXVIII	·22	+ ·32	− ·04		+ ·28	62 58 0·74	4·7705994,5	58965·70	11·168
			·66				+ ·74	180 0 0·00			
412		CXVII	·19	+ ·98	+ ·06		+1·04	58 33 3·01	4·7272117,0	53359·49	10·106
		CXVIII	·19	+ ·47	− ·03		+ ·44	49 49 4·11	4·6793013,9	47786·08	9·050
		CXIX	·19	+1·27	− ·03		+1·24	71 37 52·88	4·7734984,1	59360·62	11·243
			·57				+2·72	180 0 0·00			
411		CXVIII	·24	− ·08	+ ·13		+ ·05	83 26 7·96	4·8634127,9	73015·12	13·829
		CXIX	·23	− ·34	− ·13		− ·47	50 0 41·69	4·7505971,4	56311·51	10·665
		CXX	·23	− ·26	·00		− ·26	46 33 10·35	4·7272117,0	53359·49	10·106
			·70				− ·68	180 0 0·00			
410		CXIX	·27	+ ·24	·00		+ ·24	57 6 43·96	4·8006325,7	63187·71	11·967
		CXX	·26	+ ·09	+ ·20		+ ·29	46 52 40·50	4·7397527,2	54922·80	10·402
		CXXI	·27	+ ·16	− ·20		− ·04	76 0 35·54	4·8634127,9	73015·12	13·829
			·80				+ ·49	180 0 0·00			
409		CXX	·17	+ ·49	+ ·22		+ ·71	33 16 1·93	4·5644979,6	36685·79	6·948
		CXXI	·18	+ ·54	− ·35		+ ·19	75 51 23·09	4·8119176,3	64851·14	12·282
		CXXII	·18	+ ·38	+ ·13		+ ·51	70 52 34·98	4·8006325,7	63187·71	11·967
			·53				+1·41	180 0 0·00			
408		CXXI	·15	+ ·72	− ·10		+ ·62	69 0 57·36	4·7249503,5	53082·37	10·053
		CXXII	·15	+ ·14	·00		+ ·14	70 47 51·64	4·7298912,1	53689·73	10·169
		CXXV	·14	− ·01	+ ·10		+ ·09	40 11 11·00	4·5644979,6	36685·79	6·948
			·44				+ ·85	180 0 0·00			
407		CXXII	·23	+ ·25	+ ·05		+ ·30	57 48 21·26	4·7693857,8	58801·15	11·137
		CXXV	·24	+ ·16	− ·06		+ ·10	72 22 51·01	4·8210217,5	66224·96	12·543
		CXXVI	·23	+ ·10	+ ·01		+ ·11	49 48 47·73	4·7249503,5	53082·37	10·053
			·70				+ ·51	180 0 0·00			
424		CXXII	·33	+ ·05	− ·07		− ·02	66 31 16·41	4·8705496,8	74224·91	14·058
		CXXVI	·33	+ ·16	− ·01		+ ·15	58 33 31·30	4·8391201,0	69043·06	13·076
		CXXIV	·33	− ·06	+ ·08		+ ·02	54 55 12·29	4·8210217,5	66224·96	12·543
			·99				+ ·15	180 0 0·00			
	620	CXX	·24	+ ·16		+ ·16	+ ·32	56 14 47·90	4·7640124,2	58078·10	11·000
		CXXII	·24	+ ·25		− ·09	+ ·16	55 34 0·39	4·7605242,1	57613·49	10·912
		CXXIII	·25	+ ·49		− ·07	+ ·42	68 11 11·71	4·8119176,3	64851·14	12·282
			·73				+ ·90	180 0 0·00			
	619	CXXII	·19	+ ·20		− ·02	+ ·18	38 25 54·00	4·6344896,6	43101·23	8·163
		CXXIII	·20	+ ·11		+ ·10	+ ·21	84 41 2·72	4·8391201,0	69043·06	13·076
		CXXIV	·20	+ ·23		− ·08	+ ·15	56 53 3·28	4·7640124,2	58078·10	11·000
			·59				+ ·54	180 0 0·00			

February 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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NORTH-EAST LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	LII	Mehesari	29 30 18·21	78 11 18·88	184 33 18·10	5·1851626,7	4 34 26·63	LIV
	„	„	„	„	215 50 54·81	5·2235428,1	36 0 6·22	I
	„	„	„	„	264 32 15·68	5·2479887,1	84 48 39·04	III
	LIV	Chándípahár	29 55 29·73	78 13 37·13	214 40 32·90	5·1212764,1	34 47 42·61	LVI
	„	„	„	„	281 15 38·98	4·9420246,4	101 23 45·01	I
	LVI	Ghandiál	30 13 25·32	78 27 54·61	355 18 15·14	5·1012759,8	175 19 13·97	I
	„	„	„	„	301 34 37·12	5·0333102,2	121 43 22·90	II
	I	Mábegarh	29 52 39·58	78 29 52·04	229 41 35·72	5·0297618,7	49 49 20·07	II
	„	„	„	„	326 47 13·28	5·1529342,1	146 54 30·49	III
	„	„	„	„	286 2 59·12	5·1865902,5	106 16 52·34	IV
22	II	Ránígarh	30 4 4·47	78 45 21·56	329 33 36·72	5·1132768,0	149 39 48·84	IV
	III	Girjwála	29 33 0·87	78 44 34·08	222 29 43·75	5·0151177,8	42 36 16·38	IV
	„	„	„	„	293 5 48·95	4·9996613,2	113 14 20·84	V
	„	„	„	„	274 29 51·50	5·2940590,9	94 48 5·97	VI
21	IV	Ghungti	29 45 36·02	78 57 47·74	349 20 40·03	5·0704527,9	169 22 41·60	V

NOTE.—Stations LII, LIV and LVI appertain to the Great Arc Meridional Series, Section 24° to 30°.

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
21	IV	Ghungti	29 45 36·02	78 57 47·74	306 7 16·19	5·1933879,4	126 19 1·83	VI
	V	Dhela	29 26 31·67	79 1 53·73	257 18 24·11	5·0292610,0	77 28 5·20	VI
	”	”	”	”	327 23 23·07	5·2968281,0	147 33 9·73	VII
	”	”	”	”	286 19 26·45	5·3818725,6	106 40 45·81	VIII
20	VI	Sáonchália	29 30 22·91	79 21 34·86	359 26 27·33	5·2795938,6	179 26 37·60	VII
”	”	”	”	”	305 52 50·62	5·1938056,1	126 4 31·85	VIII
	VII	Bagwára	28 58 58·24	79 21 55·78	231 37 36·34	5·2017094,9	51 49 1·63	VIII
	”	”	”	”	296 7 12·75	4·9881613,7	116 15 8·00	IX
	”	”	”	”	2 8 32·12	4·9684858,4	182 8 13·28	X
19	VIII	Birond	29 15 14·15	79 45 24·18	14 58 20·73	5·1657314,4	194 54 54·00	IX
”	”	”	”	”	355 37 46·39	5·2689050,3	175 39 3·49	XII
18	IX	Beheri	28 51 53·07	79 38 18·56	61 15 34·37	5·0159650,8	241 7 22·24	X
”	”	”	”	”	2 13 35·20	4·9203155,7	182 13 17·74	XI
”	”	”	”	”	309 59 41·23	4·8320241,7	130 4 22·93	XII
	X	Sísgarh	28 43 38·07	79 21 16·72	290 38 33·89	4·9723578,5	110 46 26·81	XI
17	XI	Atária	28 38 9·53	79 37 42·26	234 25 51·06	4·8321557,7	54 30 49·16	XII
”	”	”	”	”	289 51 35·33	4·7238538,7	109 56 2·86	XIII
46	XII	Donáo	28 44 40·46	79 48 3·20	5 30 49·44	4·7616979,1	185 30 19·49	XIII
”	”	”	”	”	318 14 33·47	4·7698326,9	138 18 4·63	XIV
	XIII	Kalíánpúr	28 35 11·10	79 47 0·93	253 5 45·19	4·6699683,7	73 9 45·71	XIV
	”	”	”	”	312 6 23·66	4·7705261,0	132 10 17·80	XV
45	XIV	Káimkhera	28 37 25·50	79 55 23·13	1 9 21·19	4·7254172,1	181 9 15·37	XV
”	”	”	”	”	298 51 48·43	4·7186185,1	118 55 54·30	XVI
	XV	Umra	28 28 39·44	79 55 11·11	239 15 58·01	4·7367757,4	59 20 9·12	XVI
	”	”	”	”	305 48 50·64	4·7812405,4	125 53 11·84	XVII
44	XVI	Shágarh	28 33 15·18	80 3 56·94	358 9 10·89	4·8012117,0	178 9 21·69	XVII
”	”	”	”	”	299 29 46·61	4·7571007,9	119 34 12·79	XVIII
	XVII	Semráo	28 22 49·01	80 4 19·77	233 40 1·59	4·7725410,5	53 44 16·24	XVIII
	”	”	”	”	291 51 29·12	4·7062936,4	111 55 39·95	XIX
43	XVIII	Udepúr	28 28 36·19	80 13 14·50	0 37 20·82	4·7326090,2	180 37 17·60	XIX
”	”	”	”	”	296 14 2·51	4·6764613,6	116 17 49·72	XX
	XIX	Piparía	28 19 41·26	80 13 7·93	232 34 23·86	4·7352991,6	52 38 13·75	XX
	”	”	”	”	298 10 27·52	4·6776971,5	118 14 10·04	XXI
42	XX	Sultánpúr	28 25 8·16	80 21 11·48	1 18 15·08	4·7445340,9	181 18 8·26	XXI
”	”	”	”	”	288 36 59·24	4·7475607,3	108 41 41·37	XXII

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXI	Karái	28 15 58·44	80 20 57·34	235 13 47·58	4·8198682,5	55 18 35·83	XXII
	,,	,,	,,	,,	294 14 37·14	4·7540061,7	114 19 10·80	XXIII
41	XXII	Rámuápúr	28 22 11·04	80 31 4·77	2 26 1·22	4·7854941,6	182 25 47·39	XXIII
,,	,,	,,	,,	,,	300 51 59·18	4·8178114,0	120 56 58·64	XXIV
	XXIII	Kokra	28 12 7·34	80 30 35·80	245 13 6·51	4·8129253,7	65 18 18·97	XXIV
	,,	,,	,,	,,	309 56 5·64	4·8693168,5	130 1 4·54	XXV
40	XXIV	Rámnagar	28 16 36·69	80 41 35·94	1 49 15·36	4·8738518,3	181 49 2·83	XXV
,,	,,	,,	,,	,,	316 53 30·74	4·8294280,2	136 57 34·41	XXVI
39	XXV	Dahlelnagar	28 4 16·46	80 41 9·41	242 18 28·60	4·7387183,4	62 22 43·96	XXVI
,,	,,	,,	,,	,,	310 36 17·44	4·7573285,7	130 40 5·06	XXVII
69	XXVI	Hilgi	28 8 28·31	80 50 11·42	4 43 5·65	4·7985945,2	184 42 38·60	XXVII
,,	,,	,,	,,	,,	309 17 20·87	4·7421218,5	129 21 5·52	XXVIII
	XXVII	Saidara	27 58 7·64	80 49 13·72	239 57 3·29	4·7431121,2	60 1 14·32	XXVIII
	,,	,,	,,	,,	298 40 4·80	4·7706269,9	118 44 34·92	XXIX
68	XXVIII	Kutía	28 2 41·80	80 58 8·48	356 9 25·24	4·7492423,1	176 9 44·99	XXIX
,,	,,	,,	,,	,,	287 46 45·73	4·7420368,5	107 51 21·32	XXX
	XXIX	Asogápúr	27 53 27·16	80 58 50·41	231 16 26·88	4·7963925,6	51 20 42·04	XXX
	,,	,,	,,	,,	296 19 30·03	4·7931302,9	116 24 19·70	XXXI
67	XXX	Daorára	27 59 54·51	81 7 55·06	354 12 28·03	4·8263206,2	174 13 3·37	XXXI
,,	,,	,,	,,	,,	296 39 20·83	4·7497180,0	116 43 43·42	XXXII
	XXXI	Lákún	27 48 54·04	81 9 10·41	226 20 31·92	4·7787297,5	46 24 18·42	XXXII
	,,	,,	,,	,,	278 55 17·63	4·7920109,8	99 0 35·39	XXXIII
	,,	,,	,,	,,	346 27 13·52	4·7898529,4	166 28 28·24	XXXIV
66	XXXII	Chelúa	27 55 44·53	81 17 15·05	340 55 19·13	4·7329737,5	160 56 51·09	XXXIII
65	XXXIII	Bela	27 47 18·45	81 20 31·86	42 59 19·44	4·8368873,8	222 55 17·23	XXXIV
,,	,,	,,	,,	,,	333 3 34·45	4·7810038,8	153 5 55·97	XXXV
,,	,,	,,	,,	,,	276 35 18·17	4·8086431,5	96 40 49·93	XXXVI
	XXXIV	Kháñpúr	27 39 0·60	81 11 50·98	272 42 26·86	4·8709064,7	92 48 49·67	XXXV
64	XXXV	Mási	27 38 25·17	81 25 36·15	218 15 12·55	4·7717847,7	38 18 22·02	XXXVI
,,	,,	,,	,,	,,	279 28 15·33	4·8668267,4	99 34 29·55	XXXVII
91	XXXVI	Atkonawa	27 46 4·81	81 32 23·71	328 28 35·68	4·8370420,4	148 31 41·33	XXXVII
,,	,,	,,	,,	,,	283 38 51·36	4·8512206,4	103 44 48·78	XXXVIII
	XXXVII	Anárkali	27 36 24·60	81 39 3·11	218 22 47·74	4·7268298,4	38 25 38·70	XXXVIII
	,,	,,	,,	,,	289 43 40·87	4·7625501,3	109 48 21·16	XXXIX
90	XXXVIII	Dadaora	27 43 18·33	81 45 11·47	340 49 28·45	4·8125950,3	160 51 18·47	XXXIX

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
90	XXXVIII	Dadaora	27 43 18·33	81 45 11·47	287 59 47·88	4·8173607,9	108 5 10·73	XL
	XXXIX	Tilakpúr	27 33 10·74	81 49 8·53	225 4 26·94	4·7642573,9	45 7 58·97	XL
	,,	,,	,,	,,	295 39 44·59	4·7776994,3	115 44 21·77	XLI
89	XL	Newáda	27 39 56·93	81 56 46·16	349 10 29·14	4·8339216,4	169 11 35·06	XLI
,,	,,	,,	,,	,,	288 10 27·53	4·7852182,4	108 15 26·37	XLII
	XLI	Isrápúr	27 28 53·33	81 59 8·44	223 15 39·60	4·8187082,0	43 19 31·66	XLII
	,,	,,	,,	,,	283 31 22·28	4·6926397,1	103 35 27·58	XLIII
88	XLII	Máníchåok	27 36 48·14	82 7 30·34	357 24 8·89	4·7749407,6	177 24 22·79	XLIII
,,	,,	,,	,,	,,	291 10 15·17	4·7606277,3	111 14 51·67	XLIV
	XLIII	Saibara	27 26 58·94	82 8 0·31	232 50 37·05	4·8064686,2	52 54 58·91	XLIV
	,,	,,	,,	,,	286 10 0·59	4·8031377,9	106 15 12·51	XLV
87	XLIV	Lohápánia	27 33 21·68	82 17 27·47	350 0 55·58	4·7578241,6	170 1 46·41	XLV
,,	,,	,,	,,	,,	284 46 40·01	4·7577578,8	104 51 24·26	XLVI
86	XLV	Bansídíla	27 24 3·24	82 19 17·62	227 24 14·40	4·7904477,2	47 28 7·12	XLVI
,,	,,	,,	,,	,,	284 14 44·04	4·8362070,9	104 20 23·20	XLVII
112	XLVI	Tulsípúr	27 30 56·70	82 27 42·33	340 20 3·13	4·7945589,2	160 21 50·40	XLVII
,,	,,	,,	,,	,,	285 46 58·39	4·7874304,4	105 52 0·73	XLVIII
	XLVII	Majháwa	27 21 15·57	82 31 34·92	222 10 35·54	4·7532171,1	42 13 49·88	XLVIII
	,,	,,	,,	,,	287 13 50·02	4·7689185,4	107 18 35·59	XLIX
111	XLVIII	Ganespúr	27 28 11·17	82 38 37·25	343 8 2·26	4·7928805,0	163 9 34·20	XLIX
,,	,,	,,	,,	,,	283 43 25·09	4·6939085,4	103 47 30·77	L
	XLIX	Pipári	27 18 22·87	82 41 56·91	212 12 24·99	4·7507357,3	32 14 58·11	L
	,,	,,	,,	,,	286 56 44·55	4·7665304,1	107 1 28·41	LI
110	L	Pathardi	27 26 14·77	82 47 30·15	338 15 17·72	4·8430113,8	158 17 29·21	LI
,,	,,	,,	,,	,,	285 7 36·87	4·7846510,1	105 12 37·24	LII
	LI	Bankata	27 15 33·87	82 52 16·18	214 5 6·06	4·7702144,4	34 7 54·14	LII
	,,	,,	,,	,,	284 15 1·81	4·7948024,9	104 20 8·19	LIII
109	LII	Paragawa	27 23 36·95	82 58 22·51	336 54 24·98	4·8435499,1	156 56 44·09	LIII
,,	,,	,,	,,	,,	286 13 1·62	4·7386778,6	106 17 29·89	LIV
	LIII	Bángra	27 13 1·44	83 3 25·59	207 21 59·32	4·7403548,8	27 24 7·78	LIV
	,,	,,	,,	,,	282 1 44·39	4·7418278,0	102 6 17·56	LV
	,,	,,	,,	,,	341 8 17·68	4·7194862,6	161 9 43·24	LVI
108	LIV	Ghåos	27 21 5·08	83 8 5·99	334 36 21·34	4·8248978,6	154 38 46·74	LV
,,	,,	,,	,,	,,	275 31 3·33	4·7189647,2	95 35 28·80	LVII
107	LV	Púrena	27 11 7·18	83 13 23·34	44 15 22·03	4·7253463,1	224 12 15·00	LVI

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
107	LV	Púrena	27 11 7·18	83 13 23·34	203 1 0·40	4·7788466,0	23 2 59·76	LVII
„	„	„	„	„	335 41 54·79	4·7385054,2	155 43 48·42	LVIII
„	„	„	„	„	267 59 24·79	4·7499025,7	88 4 9·25	LIX
	LVI	Dharamsingua	27 4 50·15	83 6 33·09	281 11 55·17	4·7837907,0	101 16 55·19	LVIII
135	LVII	Bharmi	27 20 14·90	83 17 43·93	328 31 52·34	4·7962972,5	148 34 38·16	LIX
„	„	„	„	„	279 23 53·64	4·8078561,2	99 29 16·21	LX
106	LVIII	Gharbaria	27 2 52·80	83 17 32·64	212 59 47·68	4·7912724,2	33 2 37·84	LIX
	LIX	Sáonbarsa	27 11 26·33	83 23 45·63	215 40 41·77	4·7221596,3	35 43 17·83	LX
	„	„	„	„	273 15 43·97	4·7325973,7	93 20 16·89	LXI
134	LX	Bánarsi	27 18 30·51	83 29 26·69	333 15 39·41	4·7112575,5	153 17 36·84	LXI
„	„	„	„	„	271 47 52·32	4·7906523,7	91 53 6·23	LXII
	LXI	Bágápár	27 10 55·53	83 33 42·97	221 16 45·19	4·7672768,1	41 20 1·01	LXII
	„	„	„	„	275 18 19·34	4·7504430,5	95 23 2·80	LXIII
133	LXII	Súpúr	27 18 10·85	83 40 50·97	340 31 24·21	4·7175258,4	160 32 52·48	LXIII
„	„	„	„	„	280 50 57·27	4·7399875,6	100 55 31·52	LXIV
	LXIII	Morairi	27 10 3·60	83 44 3·62	223 17 30·70	4·7271962,4	43 20 36·10	LXIV
	„	„	„	„	282 34 31·26	4·7414184,0	102 39 3·09	LXV
132	LXIV	Chanda	27 16 28·06	83 50 49·16	341 20 13·11	4·7298072,0	161 21 40·14	LXV
„	„	„	„	„	280 58 29·71	4·8272472,3	101 4 4·39	LXVI
	LXV	Mathia	27 8 4·37	83 53 59·31	232 3 13·41	4·7914900,0	52 7 20·32	LXVI
	„	„	„	„	289 23 42·70	4·7570464,0	109 28 14·51	LXVII
131	LXVI	Balúa	27 14 20·87	84 2 59·93	354 56 18·74	4·7578148,9	174 56 44·34	LXVII
„	„	„	„	„	284 15 30·32	4·6711373,3	104 19 20·64	LXVIII
	LXVII	Upasai	27 4 56·05	84 3 55·81	221 37 15·96	4·7841448,4	41 40 40·08	LXVIII
	„	„	„	„	283 48 45·61	4·7391983,9	103 53 13·69	LXIX
130	LXVIII	Bájra	27 12 26·23	84 11 23·39	347 40 22·26	4·7779175,1	167 41 26·91	LXIX
„	„	„	„	„	289 25 48·31	4·7869974,6	109 30 40·35	LXX
	LXIX	Bakwa	27 2 46·00	84 13 45·01	229 38 40·29	4·7708141,4	49 42 26·95	LXX
	„	„	„	„	287 47 9·95	4·8522013,6	107 52 50·12	LXXI
129	LXX	Rámnagar	27 9 4·09	84 22 2·74	339 14 17·93	4·8070266,3	159 16 12·28	LXXI
„	„	„	„	„	286 48 48·51	4·7918624,0	106 53 47·62	LXXII
128	LXXI	Naonangarhi	26 59 10·19	84 26 14·04	221 1 37·43	4·7459407,0	41 4 41·45	LXXII
„	„	„	„	„	281 21 7·17	4·6604676,1	101 24 52·18	LXXIII
155	LXXII	Tarharwa	27 6 6·27	84 32 58·75	350 49 15·74	4·7135289,7	170 49 57·25	LXXIII
„	„	„	„	„	295 8 35·51	4·7939806,9	115 13 18·98	LXXIV

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	LXXIII	Sathwária	26 57 40·75	84 34 29·91	242 54 49·41	4·7324919,5	62 58 50·74	LXXIV
	„	„	„	„	310 20 4·14	4·7469561,0	130 23 36·90	LXXV
154	LXXIV	Sikta	27 1 44·04	84 43 21·74	5 15 41·06	4·7852382,6	185 15 13·15	LXXV
„	„	„	„	„	309 10 30·38	4·7460923,9	129 14 6·96	LXXVI
	LXXV	Bíarwa	26 51 42·57	84 42 19·98	242 22 39·77	4·7409064,7	62 26 43·60	LXXVI
	„	„	„	„	309 0 37·67	4·7447032,0	129 4 12·52	LXXVII
153	LXXVI	Harnáhi	26 55 55·15	84 51 19·14	5 22 50·53	4·7836275,2	185 22 22·21	LXXVII
„	„	„	„	„	311 16 38·47	4·7460996,3	131 20 7·55	LXXVIII
	LXXVII	Bigoía	26 45 56·02	84 50 16·27	243 29 17·27	4·7256599,2	63 33 14·02	LXXVIII
	„	„	„	„	304 31 43·83	4·7978970,5	124 36 0·22	LXXIX
152	LXXVIII	Batwaia	26 49 50·81	84 59 1·54	356 3 44·80	4·7742986,6	176 4 5·13	LXXIX
„	„	„	„	„	300 11 27·15	4·7495952,6	120 15 28·64	LXXX
	LXXIX	Rúpdi	26 40 3·20	84 59 46·56	235 3 47·31	4·7344682,1	55 7 27·80	LXXX
	„	„	„	„	287 0 45·30	4·7879585,1	107 5 35·29	LXXXI
151	LXXX	Dipái	26 45 10·71	85 7 57·29	343 54 13·40	4·7079484,2	163 55 23·52	LXXXI
„	„	„	„	„	269 46 20·60	4·7526019,7	89 51 1·55	LXXXII
	LXXXI	Masáha	26 37 4·95	85 10 33·25	220 44 51·96	4·8130031,1	40 48 22·14	LXXXII
	„	„	„	„	279 43 58·46	4·6781337,1	99 47 50·24	LXXXIII
150	LXXXII	Sinaría	26 45 12·55	85 18 21·43	355 31 59·97	4·7595886,2	175 32 22·19	LXXXIII
„	„	„	„	„	294 8 50·81	4·8013283,6	114 13 37·10	LXXXIV
	LXXXIII	Amúa	26 35 44·89	85 19 10·76	239 28 17·27	4·7913477,3	59 32 40·59	LXXXIV
	„	„	„	„	298 15 0·67	4·7747894,7	118 19 18·77	LXXXV
149	LXXXIV	Bulákípúr	26 40 55·73	85 28 58·19	0 52 19·84	4·7752788,4	180 52 15·36	LXXXV
„	„	„	„	„	290 52 5·11	4·7361022,3	110 56 16·71	LXXXVI
148	LXXXV	Madanpúr	26 31 5·45	85 28 48·20	232 11 10·15	4·8166729,8	52 15 25·51	LXXXVI
	„	„	„	„	280 12 49·84	4·8011507,5	100 17 55·71	LXXXVII
170	LXXXVI	Sundai	26 37 43·27	85 38 19·03	348 34 3·39	4·7199085,9	168 34 54·63	LXXXVII
„	„	„	„	„	290 41 13·25	4·7904229,5	110 45 58·02	LXXXVIII
	LXXXVII	Himáonpúr	26 29 13·89	85 40 13·50	237 58 33·54	4·7469896,7	58 2 26·42	LXXXVIII
	„	„	„	„	297 28 50·57	4·7733113,7	117 33 8·48	LXXXIX
169	LXXXVIII	Pargáwa	26 34 6·93	85 48 55·04	354 45 32·83	4·7576911,6	174 45 58·53	LXXXIX
„	„	„	„	„	291 22 33·00	4·7249745,6	111 26 36·20	XC
	LXXXIX	Shápúr	26 24 42·37	85 49 52·55	229 35 6·84	4·7639231,8	49 38 43·70	XC
	„	„	„	„	281 53 37·13	4·8075215,9	101 58 44·21	XCI
168	XC	Jirol	26 30 55·00	85 57 59·29	339 58 5·60	4·7337822,9	159 59 36·51	XCI

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
168	XC	Jirol	26 30 55·00	85 57 59·29	264 55 22·47	4·7650820,6	85 0 7·62	XCII
	XCI	Chandarsanpúr	26 22 30·86	86 1 23·35	215 9 22·71	4·8358917,5	35 12 36·23	XCII
	,,	,,	,,	,,	268 4 37·46	4·7301440,3	88 8 59·76	XCIII
167	XCII	Narhar	26 31 45·64	86 8 37·86	345 21 2·08	4·7486814,0	165 22 11·55	XCIII
,,	,,	,,	,,	,,	274 22 0·33	4·7570203,4	94 26 40·50	XCIV
166	XCIII	Bhería Bisanpúr	26 22 48·38	86 11 13·79	220 38 57·83	4·8178079,4	40 42 27·82	XCIV
,,	,,	,,	,,	,,	278 45 27·18	4·7512516,6	98 49 59·44	XCV
186	XCIV	Mirzápúr	26 31 2·15	86 19 5·27	347 35 59·23	4·7772194,3	167 37 2·24	XCV
,,	,,	,,	,,	,,	285 52 8·02	4·7585179,7	105 56 38·88	XCVI
	XCV	Barsám	26 21 22·96	86 21 26·63	224 41 20·69	4·7794179,2	44 44 47·83	XCVI
	,,	,,	,,	,,	285 38 37·49	4·7275237,4	105 42 48·22	XCVII
185	XCVI	Janjpati	26 28 26·48	86 29 12·38	351 0 49·67	4·7626733,8	171 1 33·92	XCVII
,,	,,	,,	,,	,,	285 21 42·21	4·7735675,7	105 26 22·77	XCVIII
	XCVII	Bhela	26 19 0·04	86 30 51·78	229 18 50·17	4·8033377,8	49 22 45·74	XCVIII
	,,	,,	,,	,,	291 32 13·57	4·7205157,8	111 36 11·39	XCIX
184	XCVIII	Ladnía	26 25 50·32	86 39 42·22	359 26 32·79	4·7834936,7	179 26 35·74	XCIX
,,	,,	,,	,,	,,	292 12 33·08	4·7379910,4	112 16 40·71	C
	XCIX	Semráha	26 15 48·71	86 39 48·72	231 19 31·07	4·8069315,1	51 23 35·03	C
	,,	,,	,,	,,	289 29 56·62	4·6793212,3	109 33 35·36	CI
183	C	Harpúr	26 22 25·23	86 48 59·10	5 10 22·61	4·7500229,5	185 9 58·00	CI
,,	,,	,,	,,	,,	308 21 30·48	4·7364566,8	128 24 58·76	CII
,,	,,	,,	,,	,,	250 42 11·34	4·7397983,4	70 46 24·91	CIV
	CI	Barháta	26 13 10·47	86 48 3·42	245 6 17·94	4·7218688,2	65 10 10·23	CII
	,,	,,	,,	,,	309 41 2·14	4·7391977,9	129 44 26·43	CIII
182	CII	Dewánganj	26 16 49·97	86 56 48·73	5 39 2·92	4·7595671,5	185 38 35·53	CIII
,,	,,	,,	,,	,,	189 59 21·28	4·7223771,1	10 0 5·97	CIV
,,	,,	,,	,,	,,	247 26 50·52	4·7528678,7	67 31 5·24	CV
,,	,,	,,	,,	,,	306 47 44·46	4·7645694,8	126 51 30·43	CVI
	CIII	Latona	26 7 23·33	86 55 46·62	246 48 2·36	4·7544946,7	66 52 15·05	CVI
	,,	,,	,,	,,	304 56 13·45	4·7432275,6	124 59 52·23	CVII
	CIV	Baisi	26 25 24·70	86 58 29·43	305 4 4·25	4·7216532,2	125 7 34·87	CV
218	CV	Minai	26 20 24·69	87 6 23·44	5 50 16·22	4·7545728,7	185 49 48·14	CVI
,,	,,	,,	,,	,,	311 2 27·38	4·7703613,4	131 6 3·67	CIX
,,	,,	,,	,,	,,	261 10 19·26	4·7983075,8	81 15 22·40	CX
181	CVI	Chúni	26 11 4·72	87 5 19·98	7 16 32·54	4·7365481,1	187 15 59·26	CVII

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
181	CVI	Chúni	26 11 4·72	87 5 19·98	311 18 58·66	4·7622911,2	131 22 28·57	CVIII
„	„	„	„	„	250 26 23·91	4·7267589,4	70 30 27·64	CIX
	CVII	Rámnagar	26 2 9·05	87 4 4·27	252 28 44·48	4·7226341,6	72 32 47·06	CVIII
180	CVIII	Manúla	26 4 46·20	87 13 16·55	186 57 22·52	4·7516388,5	6 57 55·71	CIX
	CIX	Ghíba	26 14 1·19	87 14 31·65	200 7 26·82	4·7115067,6	20 8 53·00	CX
	„	„	„	„	281 54 20·71	4·7083677,8	101 58 23·24	CXI
217	CX	Nirpúr	26 21 59·77	87 17 46·33	331 16 40·45	4·8269627,1	151 19 17·41	CXI
„	„	„	„	„	275 0 5·12	4·7580149,2	95 4 43·68	CXII
	CXI	Mánikpúr	26 12 16·49	87 23 40·61	204 45 29·81	4·7731717,0	24 47 30·66	CXII
	„	„	„	„	264 5 11·78	4·7764111,5	84 10 0·24	CXIII
216	CXII	Kamaldáha	26 21 9·93	87 28 13·71	324 4 50·65	4·7703641,5	144 7 38·98	CXIII
„	„	„	„	„	269 32 55·87	4·7790615,4	89 37 49·31	CXIV
	CXIII	Bánghora	26 13 17·06	87 34 33·41	207 58 28·74	4·7368265,0	28 0 33·17	CXIV
	„	„	„	„	271 30 21·74	4·7571546,3	91 34 59·01	CXV
215	CXIV	Dipnagar	26 21 14·19	87 39 14·75	327 36 38·36	4·7698035,0	147 39 11·86	CXV
„	„	„	„	„	267 17 0·48	4·7963944,2	87 22 5·60	CXVI
	CXV	Músaldanga	26 13 1·80	87 45 0·99	210 30 15·32	4·7860440,5	30 32 46·19	CXVI
	„	„	„	„	269 5 26·29	4·7736113,7	89 10 14·33	CXVII
214	CXVI	Lachmípúr	26 21 43·11	87 50 42·00	331 18 2·39	4·7705994,5	151 20 20·29	CXVII
„	„	„	„	„	267 34 18·26	4·7249235,7	87 38 37·22	CXVIII
	CXVII	Tagría	26 13 10·72	87 55 52·97	204 38 35·86	4·7734984,1	24 40 36·26	CXVIII
	„	„	„	„	263 11 39·06	4·6793013,9	83 15 29·38	CXIX
213	CXVIII	Bandarjúla	26 22 5·06	88 0 25·12	334 51 31·96	4·7272117,0	154 53 22·45	CXIX
„	„	„	„	„	251 25 23·76	4·7505971,4	71 29 44·77	CXX
	CXIX	Kharkhari	26 14 6·55	88 4 34·12	204 54 4·37	4·8634127,9	24 56 34·19	CXX
	„	„	„	„	262 0 48·60	4·7397527,2	82 5 12·82	CXXI
212	CXX	Thákúrganj	26 25 2·41	88 10 12·31	338 3 53·43	4·8006325,7	158 5 48·63	CXXI
„	„	„	„	„	304 47 51·33	4·8119176,3	124 52 11·27	CXXII
„	„	„	„	„	248 33 3·19	4·7605242,1	68 37 26·03	CXXIII
	CXXI	Sonákhoda	26 15 21·79	88 14 31·61	233 57 11·90	4·5644979,6	53 59 36·11	CXXII
	„	„	„	„	302 58 9·41	4·7298912,1	123 1 47·85	CXXV
211	CXXII	Rámganj	26 18 55·51	88 19 57·61	180 26 11·90	4·7640124,2	0 26 14·07	CXXIII
„	„	„	„	„	218 52 6·09	4·8391201,0	38 55 38·02	CXXIV
„	„	„	„	„	343 11 44·32	4·7249503,5	163 12 58·99	CXXV
„	„	„	„	„	285 23 22·83	4·8210217,5	105 28 33·54	CXXVI

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	CXXIII	Dúmdángi	26 28 30·74	88 20 2·49	275 45 11·15	4·6344896,6	95 48 41·50	CXXIV
	CXXIV	Kanchábári	26 27 47·73	88 27 54·42	344 0 25·40	4·8705496,8	164 2 5·17	CXXVI
	CXXV	Chotáki	26 10 32·16	88 22 46·09	235 35 50·24	4·7693857,8	55 39 45·58	CXXVI
210	CXXVI	Newáni	26 16 0·95	88 31 39·10				

November 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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NORTH-EAST LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. HEIGHTS ABOVE MEAN SEA LEVEL.

The following table gives, first, the usual data of the observed vertical angles and the heights of the signal and instrument, &c., in pairs of horizontal lines, the first line of which gives the data for the 1st or the fixed station, and the second line the data for the 2nd or the deduced station. This is followed by the arc contained between the two stations, and then by the terrestrial refraction, and the height of the 2nd station above or below the 1st, as computed from the vertical angles in the usual manner. This difference of height applied to the given height above mean sea level of the fixed station, gives that of the deduced station. Usually there are two or three independent values of the height of the deduced station; the details are so arranged as to show these consecutively and their mean in the columns of "Trigonometrical Results". The mean results thus obtained are however liable to receive corrections for the errors generated in the trigonometrical operations, which are shown up by the spirit leveling operations, whenever a junction between the two has been effected. The spirit leveled determinations, are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the leveling operations are adjusted—usually by simple proportion—to accord with the latter. In the table the spirit leveled values are printed thus **628·84**, &c., to distinguish them from the adjusted trigonometrical values. The column in which the mean trigonometrical heights are given is barred across where necessary, as after deduction of Stn. XI from Stn. IX, page 165—$_{I.}$, to indicate that one set of adjustment ends and another begins. The trigonometrical heights always refer to the upper mark-stone, or to the upper surface of the pillar on which the theodolite stood; when a spirit leveled height does not refer to either of these surfaces, it is given in combination with a correction, thus $\begin{cases} 619\cdot32 \\ +37\cdot8 \end{cases}$ and the sum of these two quantities, in this case 657·1, represents the value with which the corresponding trigonometrical mean height 665·6 is comparable. Descriptions follow these tables, exactly indicating the positions of the leveling staff during the determinations of the spirit leveled heights.

When the pillar of the station is perforated, the height given in the last column, is that between the upper surface of pillar and ground level mark-stone in floor of passage; otherwise it is the approximate height of the structure, above the ground at the base of the station.

The heights of the initial stations, are taken from the Great Arc Meridional Series, section 24° to 30°, of the North-West Quadrilateral, page 42—$_{a.}$, Vol. IV, and are as follows :—

LII	...	820·5	feet above Mean Sea Level at Karáchi.
LIV	...	1912·7	
LVI	...	7350·1	

Astronomical Date 1850	Astronomical Date: Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
(1)	3 0	LII	E 1 27 44·9	8	1·54	3·87	1652	135	·082	+4835·8	5656·3			
(2)	2 3	I	D 1 50 56·2	14	0·10	5·43								
Nov.16,17,20	3 33	LIV	E 2 20 29·5	12	1·40	5·40	864	65	·075	+3738·6	5651·3	5653·8	5653	6·9
„ 30,Dec. 4	3 24	I	D 2 33 2·1	8	1·38	5·37								

(1). The means of observations taken on 27 January 1843, and 2, 3 January 1851.
(2). „ „ 17 November 1842, and 3, 4 December 1850.

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Astronomical Date 1850	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Nov. 1,2	3 50	LVI	D 0 55 7·7	8	1·40	5·43	1247	92	·074	−1696·3	5653·8			
„ 30, Dec. 4	3 33	I	E 0 37 12·3	8	1·32	5·37								
„ 3	3 13	LVI	D 0 16 59·8	6	1·42	5·43	1066	78	·073	− 291·9	7058·2			
Dec. 10,11	2 40	II	E 0 1 34·9	8	1·34	5·38						7058·0	7055	2·5
„ 1	3 8	I	E 0 37 23·2	4	1·30	5·37	1058	77	·073	+1404·0	7057·8			
„ 10	3 22	II	D 0 52 43·0	4	1·42	5·38								
1851 Jan. 2,3	2 30	LII	E 0 24 29·6	8	0·88	3·81	1748	126	·072	+1905·8	2726·3			
1850 Dec. 26	1 41	III	D 0 49 34·6	4	*0·18	5·39								
„ 1,4	3 23	I	D 1 20 52·8	8	1·08	5·37	1404	104	·074	−2930·5	2723·3	2723·9	2721	2
„ 24,25	3 4	III	E 1 0 45·5	8	1·38	5·39								
„ 19	2 43	IV	D 2 26 52·0	4	1·08	5·40	1022	74	·072	−4203·1	2722·1			
„ 25	2 45	III	E 2 12 1·4	4	1·35	5·39								
„ 1,4	2 33	I	E 0 17 30·7	12	1·40	5·37	1517	108	·071	+1271·6	6925·4			
„ 16,19	2 18	IV	D 0 39 22·0	8	1·40	5·40								
„ 10,11	2 30	II	D 0 13 1·9	8	1·40	5·38	1282	77	·060	− 133·1	6924·9	6926·1	6922	3
„ 16,19	2 35	IV	D 0 5 59·8	8	1·04	5·40								
„ 25	2 45	III	E 2 12 1·4	4	1·35	5·39	1022	74	·072	+4203·1	6927·9			
„ 19	2 43	IV	D 2 26 52·0	4	1·08	5·40								
„ 25	3 58	III	D 0 23 53·5	4	1·52	5·39	987	69	·070	− 485·1	2238·8			
1851 Jan. 11.15,18	2 16	V	E 0 9 28·4	12	1·30	5·42								
1850 Dec. 19	3 3	IV	D 2 25 28·6	4	1·52	5·40	1161	72	·062	−4686·6	2239·5	2239·8	2235	2
1851 Jan. 16	2 15	V	E 2 8 17·2	4	1·35	5·42								
May 23,27	3 51	VI	D 3 28 56·0	8	1·17	5·40	1056	65	·062	−6265·7	2241·0			
June 3	4 33	V	E 3 13 14·6	4	1·35	5·46								
1850 Dec. 25	3 24	III	E 1 27 7·5	4	1·74	5·39	1944	137	·070	+5791·8	8515·7†			
1851 May 29	22 0	VI	D 1 55 6·2	4	1·08	5·40								
1850 Dec. 20	21 21	IV	E 0 23 26·3	10	1·67	5·40	1541	94	·061	+1580·6	8506·7	8505·8	8501	4
1851 May 14,17	20 41	VI	D 0 46 10·1	8	0·97	5·40								
June 3	4 33	V	E 3 13 14·6	4	1·35	5·46	1056	65	·062	+6265·7	8504·9			
May 23,27	3 51	VI	D 3 28 56·0	8	1·17	5·40								
Jan. 13,15,18	2 37	V	D 0 40 19·2	12	1·31	5·42	1956	130	·066	−1504·4	735·4			
Mar. 1,2	2 25	VII	E 0 11 53·9	8	1·31	5·24								
May 18,23	3 23	VI	D 2 34 25·9	8	0·90	5·40	1880	118	·063	−7794·7	711·1†	735·9	730	0
Feb. 28 Mar. 1,2,3	2 55	VII	E 2 6 52·9	16	1·25	5·24								

* This height is to be combined with a negative sign, because the pillar at LII, Mahesari, had a permanent addition made to it of 1·5 feet by a subsequent observer. † Rejected.

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Astronomical Date 1851	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Apr. 29,30	2 57	VIII	D 2 26 1·1	8	0·83	5·40	1571	110	·070	−6237·4	736·4			
Feb. 28 Mar. 1,2,4	2 58	VII	E 2 3 20·3	16	1·50	5·24								
Jan. 16	3 8	V	E 0 50 11·9	4	1·48	5·42	2379	153	·064	+4734·0	6973·8			
Apr. 30	22 11	VIII	D 1 24 51·6	4	1·17	5·40								
May 23	2 22	VI	D 0 45 32·4	4	1·03	5·40	1543	86	·056	−1546·7	6959·1†	6973·3	6967	§
Apr. 29,30 May 1	3 15	VIII	E 0 22 30·3	12	1·46	5·40								
Feb. 28 Mar. 1,2,4	2 58	VII	E 2 3 20·3	16	1·50	5·24	1571	110	·070	+6237·4	6972·8			
Apr. 29,30	2 57	VIII	D 2 26 1·1	8	0·83	5·40								
Feb. 27,28	4 27	VII	D 0 7 5·0	8	5·35	5·24	961	98	·102	− 20·1	715·8			
Mar. 26	4 25	IX	D 0 5 40·3	4	5·28	5·37						716·0	708	38
Apr. 29,30	2 45	VIII	D 2 37 12·9	8	0·75	5·40	1446	102	·070	−6257·1	716·2			
Mar. 30	2 6	IX	E 2 16 18·2	4	1·50	5·37								
Mar. 1,2,4	2 51	VII	D 0 8 59·4	12	5·34	5·24	918	46	·050	− 57·2	678·7			
„ 10,11,12, 13,14,18	2 42	X	D 0 4 46·1	22	5·28	5·35						680·4	670	38
Mar. 26	19 30	IX	D 0 7 52·6	2	5·93	5·37	1025	106	·103	− 33·8	682·2			
„ 17	4 15	X	D 0 5 38·9	4	5·58	5·35								
„ 30	5 15	IX	D 0 7 5·9	4	5·28	5·37	822	108	·131	− 49·3	666·7			
Apr. 8,9	5 13	XI	D 0 3 1·4	6	5·23	5·33						665·6	{ 619·32 + 37·8	37·8
(3)		X	D 0 5 7·5	20	8·45	5·30	927	184	·198	− 15·9	664·5			
(4)		XI	D 0 4 3·6	14	5·85	5·37								
Apr. 8,9	2 40	XI	D 0 5 58·2	8	5·35	5·33	523	− 4	·008	− 23·8	633·3	633·3	628·84	20
„ 11,12	2 53	XIII	D 0 2 51·3	8	5·78	5·33								
1843 Feb. 24 1850 Mar. 29,30,	*3 49	XIII	D 0 5 53·5	8	5·60	5·14	582	8	·014	− 20·6	612·7	612·7	609·97	20
1843 Mar. 1 1850 „ 23,24	*3 47	XV	D 0 3 31·3	8	5·07	5·10								
1851 Apr. 29, May 1	3 12	VIII	D 2 10 7·7	8	1·04	5·40	1834	121	·066	−6313·0	654·0			
„ 15,20	3 53	XII	E 1 43 26·4	8	1·47	5·34								
Mar. 25,26	4 6	IX	D 0 8 11·4	8	5·42	5·37	671	11	·017	− 55·1	652·9			
Apr. 14,16	4 23	XII	D 0 2 37·4	6	5·25	5·34						651·6	652	24
„ 2,3,4,9	3 6	XI	D 0 6 15·1	18	5·42	5·33	671	− 24	·036	− 5·2	651·9			
„ 13,14	3 3	XII	D 0 5 43·9	8	5·33	5·34								
(1)	*3 27	XIII	D 0 3 57·3	12	5·53	5·20	571	− 20	·035	+ 18·8	647·6			
(2)	*3 29	XII	D 0 6 13·4	16	5·20	5·42								
1843 Feb. 20 1850 Mar. 28	*3 59	XII	D 0 5 12·5	4	5·64	5·46	581	36	·062	− 16·8	634·8			
1843 Feb. 26,27 1850 Mar. 25,26	*4 4	XIV	D 0 3 14·2	8	5·63	5·23								

In some instances, the dates and mean of times of observation taken at two different hours either of the same day or on different days could not be entered in their proper places in columns 1 and 2 from want of space, this information is as follows :—(3) 13h 53m of 28th March 1839 and 3h 47m of 17th, 18th and 21st March 1851; (4) 13h 53m of 28th March 1839 and 3h 49m of 8th April 1851.

† Rejected. § Not forthcoming. (1) The mean of observations taken on 24th February 1843, 29th March 1850, 11th and 12th April 1851. (2) 20th February 1843, 28th March 1850, 13th 14th and 15th April 1851.

* In these instances, the chronometer error not having been recorded, the times here given are mere chronometer readings.

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Astronomical Date 1843-50	Mean of Times of observation*	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
1843 Feb. 25, 1850 Mar. 29,30	3 28	XIII	D 0 3 27.8	†8	2.76	5.14	462	16	.034	+ 4.1	632.9	633.6	634	24
1843 Feb. 26, 1850 Mar. 25,26	3 30	XIV	D 0 3 54.1	†8	5.07	5.23								
1850 Mar. 23,24	3 48	XV	D 0 2 26.6	8	5.23	5.05	525	26	.049	+ 23.1	633.1			
„ 25,26	3 48	XIV	D 0 5 24.5	8	5.50	5.03								
„ 25,26	3 40	XIV	D 0 3 16.8	8	5.50	5.03	517	25	.048	+ 8.9	642.9			
„ 20,21,22	3 40	XVI	D 0 4 28.3	12	5.23	5.08						641.8	641	20
„ 23,24	3 39	XV	D 0 2 15.0	6	5.50	5.05	539	17	.031	+ 30.7	640.7			
„ 20,21,22	3 34	XVI	D 0 6 7.9	12	5.40	5.08								
„ 23,24	4 15	XV	D 0 5 18.6	8	5.50	5.05	597	35	.059	− 16.7	593.3			
„ 18,19	4 16	XVII	D 0 3 25.3	8	5.40	5.08						595.3	593	27
„ 20,21,22	3 46	XVI	D 0 7 12.7	12	5.50	5.08	625	24	.038	− 44.6	597.2			
„ 19	3 45	XVII	D 0 2 21.9	4	5.50	5.08								
„ 20,21,22	3 30	XVI	D 0 7 5.2	12	5.60	5.08	565	− 6	.011	− 38.4	603.4			
„ 14,16,17	3 29	XVIII	D 0 2 28.5	12	5.50	5.08						602.8	599	22
„ 18,19	4 55	XVII	D 0 2 33.0	8	5.60	5.08	585	114	.194	+ 7.0	602.3			
„ 16,17	4 55	XVIII	D 0 3 21.7	8	5.50	5.08								
„ 18,19	3 40	XVII	D 0 5 40.5	8	5.40	5.08	502	−15	.030	− 18.7	576.6			
„ 13	3 41	XIX	D 0 3 8.2	4	5.50	5.05						576.7	572	25
„ 14	3 33	XVIII	D 0 6 28.8	4	5.40	5.08	534	−24	.045	− 25.9	576.9			
„ 12,13	3 33	XIX	D 0 3 10.5	8	5.60	5.05								
„ 14,15,16	3 29	XVIII	D 0 4 42.7	16	5.30	5.08	469	14	.031	− 14.6	588.2			
„ 8,11	3 34	XX	D 0 2 34.2	8	5.60	5.05						586.3	581	28
„ 12,13	3 28	XIX	D 0 3 50.7	8	5.30	5.05	537	8	.015	+ 7.7	584.4			
„ 11	3 28	XX	D 0 4 48.3	4	5.40	5.05								
„ 12,13	3 18	XIX	D 0 4 33.4	8	5.50	5.05	470	8	.017	− 11.1	565.6			
„ 5,6,7	3 18	XXI	D 0 2 57.6	12	5.40	5.08						566.0	559	26
„ 8,11	3 22	XX	D 0 5 0.7	6	5.50	5.05	548	45	.083	− 19.9	566.4			
„ 5,6,7	3 22	XXI	D 0 2 34.1	12	5.30	5.08								
„ 8,11	3 33	XX	D 0 6 52.1	8	5.75	5.05	552	− 3	.005	− 36.6	549.7			
Feb. 28, Mar. 1	3 34	XXII	D 0 2 23.1	8	5.30	5.05						549.4	541	28
Mar. 5,6	4 49	XXI	D 0 3 49.7	8	5.75	5.08	652	147	.225	− 16.9	549.1			
Feb. 28, Mar. 1	4 50	XXII	D 0 2 4.8	8	5.50	5.05								
Mar. 5,6	4 30	XXI	D 0 5 23.8	8	5.50	5.08	561	90	.161	− 37.1	528.9			
Feb. 23,24	4 32	XXIII	D 0 0 54.0	8	5.50	5.08						528.2	519	26

† Exclusive of the number of observations taken in 1843 which information is not forthcoming; the observations themselves are however all included.
* The chronometer error not having been recorded, the times given in this column are mere chronometer readings.

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Astronomical Date 1850	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	* h. m.		° ′ ″				″							feet
Feb.28, Mar.1,2	4 18	XXII	D 0 5 31·2	12	5·50	5·05	603	43	·071	− 21·9	527·5			
„ 23,24	4 18	XXIII	D 0 3 2·6	8	5·75	5·08								
Feb.28, Mar.1,2	4 44	XXII	D 0 5 18·3	12	4·58	5·05	649	80	·123	− 23·0	526·4†			
„ 21,22	4 44	XXIV	D 0 2 50·4	8	5·75	5·06						536	**524·62**	27·9
„ 23,24	4 48	XXIII	D 0 2 30·8	8	4·58	5·08	642	148	·231	+ 7·5	535·7			
„ 22	4 48	XXIV	D 0 3 15·2	4	5·50	5·06								
1839 Jan. 5	6 2	XXIII	D 0 1 14·1	8	1·25	3·42	731	314	·430	− 5·9	513·1			
„ 5	6 0	XXV	D 0 0 47·9	8	0·25	4·88								
1850 Feb. 21,22	4 28	XXIV	D 0 5 25·6	8	5·46	5·06	739	75	·101	− 11·6	513·0	513·1	512	28
„ 19	4 28	XXV	D 0 4 24·3	4	4·58	5·06								
„ 21,22	3 9	XXIV	D 0 7 0·5	8	5·37	5·06	667	7	·011	− 31·1	493·5			
„ 13,14	3 9	XXVI	D 0 3 52·9	8	4·58	5·07						497·5	499	38
„ 17,19	2 46	XXV	D 0 5 8·5	8	5·37	5·06	541	4	·008	− 11·5	501·6			
„ 14	2 48	XXVI	D 0 3 41·6	4	5·46	5·07								
„ 17,19	2 57	XXV	D 0 4 57·6	8	5·40	5·06	565	17	·030	− 9·3	503·8			
„ 10,11,12	2 52	XXVII	D 0 3 50·3	12	5·46	5·03						502·8	504	23
„ 13,14,15	3 5	XXVI	D 0 4 24·1	12	5·40	5·07	621	31	·050	+ 4·3	501·8			
„ 9,10,11,12	3 3	XXVII	D 0 4 52·4	14	5·37	5·03								
„ 13,14	3 1	XXVI	D 0 6 21·8	8	5·75	5·07	545	−13	·023	− 26·6	470·9			
„ 6,7,8	3 1	XXVIII	D 0 3 5·2	12	5·38	5·15						471·6	**474·61**	22·5
„ 9,10,12	2 57	XXVII	D 0 5 58·9	12	5·75	5·03	547	26	·047	− 30·5	472·3			
„ 6,7,8	2 57	XXVIII	D 0 2 13·5	12	5·40	5·15								
„ 9,10,11,12	2 47	XXVII	D 0 7 1·5	16	5·35	5·03	582	27	·047	− 43·4	458·6			
„ 2,3,4	2 47	XXIX	D 0 1 43·7	12	5·40	5·05						458·7	457	24
„ 6,7,8	2 52	XXVIII	D 0 5 36·6	12	5·35	5·15	554	− 2	·004	− 15·8	458·8			
„ 2,3,4	2 52	XXIX	D 0 3 38·4	12	5·75	5·05								
„ 6,7,8	2 46	XXVIII	D 0 4 49·3	12	5·65	5·15	545	8	·014	− 7·0	467·6			
Jan. 29,30,31 Feb. 1	2 45	XXX	D 0 3 56·4	16	5·75	5·15						468·2	466	22
„ 2,3,4	3 0	XXIX	D 0 4 42·6	12	5·35	5·05	618	− 7	·012	+ 10·0	468·7			
Jan. 31, Feb. 1	2 59	XXX	D 0 5 48·5	8	5·35	5·15								
Feb. 2,3,4	2 56	XXIX	D 0 5 32·3	12	5·50	5·05	613	−14	·022	− 4·1	454·6			
Jan. 23,24,25	2 56	XXXI	D 0 5 5·4	12	5·35	5·05						453·8	**448·62**	24
Feb. 1	2 41	XXX	D 0 6 18·6	4	5·60	5·15	662	− 3	·004	− 15·1	453·1			
Jan. 23,24,25	2 38	XXXI	D 0 4 45·1	12	5·63	5·05								

* The chronometer error not having been recorded, the times given in this column are mere chronometer readings.
† Rejected.

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Astronomical Date 1850	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Jan. 28,29,30	*2 52	XXX	D 0 6 19·3	12	5·50	5·15	555	− 4	·008	− 26·9	441·3	440·3	436·62	24
„ 26,27	*2 52	XXXII	D 0 3 0·7	8	5·63	5·03								
„ 23,24	*2 43	XXXI	D 0 5 47·3	8	5·50	5·05	593	− 3	·004	− 14·5	439·3			
„ 26,27	*2 44	XXXII	D 0 4 7·3	8	5·60	5·03								
„ 23,24,25	*3 7	XXXI	D 0 6 17·0	12	5·50	5·05	612	8	·013	− 24·1	424·5	423·7	425	14
„ 13,14,17	*3 8	XXXIII	D 0 3 36·8	12	5·35	5·03								
„ 26,27	*3 12	XXXII	D 0 5 30·2	8	5·50	5·03	534	−13	·024	− 13·7	422·9			
„ 13,17	*3 12	XXXIII	D 0 3 46·0	8	5·50	5·03								
„ 23,24,25	*2 47	XXXI	D 0 5 29·2	12	5·30	5·05	609	20	·032	− 13·6	435·0	435·2	439	12
„ 20,21	*2 50	XXXIV	D 0 3 58·5	8	5·35	5·08								
„ 14,17	*3 21	XXXIII	D 0 4 49·7	8	5·30	5·03	678	14	·020	+ 11·7	435·4			
„ 20,21	*3 21	XXXIV	D 0 5 59·3	8	5·50	5·08								
„ 13,14,15,17	*3 0	XXXIII	D 0 5 2·1	16	5·60	5·03	596	2	·003	− 2·3	421·4	421·5	425·89	24
1849 Dec. 26,27,28,30	3 17	XXXV	D 0 4 46·8	16	5·50	5·07								
1850 Jan. 20,21	*3 3	XXXIV	D 0 6 16·2	8	5·60	5·08	734	28	·037	− 13·7	421·5			
1849 Dec. 26,27,28,30	3 21	XXXV	D 0 5 0·7	16	5·30	5·07								
1850 Jan. 14,15,17	*2 33	XXXIII	D 0 3 24·5	12	5·75	5·03	636	6	·010	+ 32·7	457·7	459·5	460	30
„ 3,5,7,8	*2 31	XXXVI	D 0 6 54·6	12	5·50	4·90								
1849 Dec. 26,27,28,30	3 6	XXXV	D 0 2 26·9	16	5·35	5·07	584	21	·035	+ 35·4	461·3			
1850 Jan. 5,6,7,8	2 59	XXXVI	D 0 6 32·5	16	5·60	4·90								
1849 Dec. 26,27,28	3 13	XXXV	D 0 5 21·0	12	5·45	5·07	727	19	·026	+ 8·0	433·9	432·8	434	30
„ 22,23,24	3 17	XXXVII	D 0 6 6·5	12	5·30	5·07								
1850 Jan. 5,7,8	2 50	XXXVI	D 0 6 58·4	12	5·45	4·90	679	3	·004	− 27·7	431·8			
1849 Dec. 21,22,23,24	3 0	XXXVII	D 0 4 12·9	16	5·35	5·07								
1850 Jan. 5,6,8	3 19	XXXVI	D 0 5 47·9	10	5·75	4·90	701	31	·044	− 10·6	448·9	448·4	450	30
1849 Dec. 10,11,12	3 24	XXXVIII	D 0 4 48·1	12	5·35	5·18								
„ 21,22,23,24	3 7	XXXVII	D 0 3 8·0	16	5·75	5·07	527	14	·027	+ 15·1	447·9			
„ 10,11,12	3 16	XXXVIII	D 0 5 6·5	12	5·45	5·18								
„ 21,22,23,24	3 13	XXXVII	D 0 5 39·3	16	5·58	5·07	572	−15	·025	− 11·4	421·4	423·0	425·10	28
Apr. 16,17	4 45	XXXIX	D 0 4 19·9	8	5·50	5·50								
Dec. 10,11,12	3 12	XXXVIII	D 0 6 48·5	12	5·58	5·18	642	−13	·021	− 23·8	424·6			
Apr. 16,17	4 19	XXXIX	D 0 4 18·5	8	5·65	5·50								
Dec. 7,8,9,10,11,12	3 35	XXXVIII	D 0 6 45·5	24	5·75	5·18	649	34	·052	− 37·0	413·0	413·9	415	28
Apr. 11,12.13	5 0	XL	D 0 2 54·2	12	5·65	5·53								

* In these instances, the chronometer error not having been recorded, the times here given are mere chronometer readings.

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Astronomical Date 1849	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	* h. m.		° ′ ″				″							feet
Apr. 16,17	4 39	XXXIX	D 0 5 16·7	8	5·51	5·50	574	7	·012	− 10·3	414·8			
„ 11,12,13	4 40	XL	D 0 4 4·3	12	5·31	5·53								
„ 16,17	4 33	XXXIX	D 0 6 6·4	8	5·68	5·50	592	0	·000	− 20·7	404·4			
Mar. 28,30,31	3 53	XLI	D 0 3 45·1	12	5·31	5·53						403·6	406	27
Apr. 11,12,13	4 54	XL	D 0 5 34·4	12	5·68	5·53	674	36	·053	− 11·1	402·8			
Mar. 28,30,31	4 13	XLI	D 0 4 27·8	12	5·51	5·53								
Apr. 11,13	4 31	XL	D 0 5 20·2	8	5·60	5·53	602	52	·086	− 21·1	392·8			
Mar. 26,27	3 55	XLII	D 0 2 58·0	6	5·51	5·55						391·2	395	28
„ 28,29,30,31	3 40	XLI	D 0 5 42·8	16	5·60	5·53	651	35	·054	− 13·9	389·7			
„ 25,26,27	3 39	XLII	D 0 4 16·3	12	5·50	5·55								
„ 28,29,30	3 15	XLI	D 0 5 8·2	12	5·80	5·53	487	6	·013	− 17·2	386·4			
„ 22,23,24	3 17	XLIII	D 0 2 46·0	12	5·50	5·65						384·8	389·90	24
„ 25,26,27	3 6	XLII	D 0 5 32·6	12	5·80	5·55	588	−11	·019	− 8·1	383·1			
„ 22,23	3 5	XLIII	D 0 4 37·4	8	5·60	5·65								
„ 25,26	4 47	XLII	D 0 3 41·2	8	5·65	5·55	569	99	·173	− 10·0	385·0			
„ 19	4 47	XLIV	D 0 2 30·1	4	5·60	5·53						385·7	386	24
„ 22,23	3 10	XLIII	D 0 5 18·5	8	5·65	5·65	633	9	·015	− 3·6	386·3			
„ 21	3 8	XLIV	D 0 4 54·8	6	5·80	5·53								
(1)	4 34	XLIII	D 0 5 2·8	16	8·49	5·64	628	52	·083	− 15·5	374·4			
(2)	4 39	XLV	D 0 3 21·3	14	8·65	5·59						374·8	377	20
Mar. 18,19,20	3 11	XLIV	D 0 5 0·1	6	5·31	5·53	566	21	·037	− 10·4	375·3			
„ 16,17	3 12	XLV	D 0 3 43·4	8	5·75	5·50								
„ 19	3 48	XLIV	D 0 4 42·9	4	5·43	5·53	565	47	·083	− 13·0	372·7			
„ 13	3 48	XLVI	D 0 3 7·7	4	5·75	5·50						373·4	376	25
„ 15,16,17	3 20	XLV	D 0 4 42·2	12	5·43	5·50	610	25	·041	− 0·6	374·2			
„ 12,13	3 20	XLVI	D 0 4 38·5	8	5·31	5·50								
„ 15,16,17	3 4	XLV	D 0 6 38·2	12	5·50	5·50	677	5	·008	− 21·6	353·2			
„ 10,11	3 3	XLVII	D 0 4 28·5	8	5·31	5·50						353·4	356	30
„ 12,13,14	3 13	XLVI	D 0 5 57·7	10	5·50	5·50	615	16	·025	− 19·9	353·5			
„ 9,10,11	3 13	XLVII	D 0 3 46·5	12	5·43	5·50								
„ 12,13,14	3 36	XLVI	D 0 5 38·1	12	5·60	5·50	605	29	·047	− 19·2	354·2			
„ 3,5,7,8	3 37	XLVIII	D 0 3 29·2	14	5·51	5·50						354·7	358	25
„ 9,10,11	3 25	XLVII	D 0 4 15·1	12	5·60	5·50	560	18	·032	+ 1·9	355·3			
„ 5,7	3 25	XLVIII	D 0 4 29·1	8	5·50	5·50								

* The chronometer error not having been recorded, the times given in this column are mere chronometer readings.

(1) The mean of observations taken on 16th March 1847, and 22nd, 23rd, 24th March 1849. (2) The mean of observations taken on 15th March 1847, and 15th, 16th, 17th March 1849.

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Astronomical Date 1849	Mean of Times of observation*	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Mar. 9,10	2 52	XLVII	D 0 5 17·7	12	5·43	5·50	580	3	·006	− 8·8	344·6			
Feb. 24,25	2 51	XLIX	D 0 4 15·8	8	5·50	5·50						344·8	349	30
Mar. 3,4,5,7	3 4	XLVIII	D 0 5 20·2	16	5·43	5·50	613	18	·030	− 9·6	345·1			
Feb. 21,22,23,24,25	3 4	XLIX	D 0 4 16·6	20	5·44	5·50								
Mar. 3,4,5,7	3 20	XLVIII	D 0 5 30·0	16	5·75	5·50	488	14	·029	− 24·3	330·4			
Feb. 18,19	3 20	L	D 0 2 8·9	8	5·44	5·50						331·2	336	30
„ 21,22,23,24,25	3 13	XLIX	D 0 5 11·6	20	5·75	5·50	556	13	·023	− 12·9	331·9			
„ 18,19	3 13	L	D 0 3 38·7	8	5·31	5·50								
„ 21,22,24	2 36	XLIX	D 0 6 24·1	12	5·43	5·50	577	2	·004	− 27·6	317·2			
„ 15,16,17	2 35	LI	D 0 3 9·7	12	5·31	5·53						316·0	322	30
„ 18,19	4 1	L	D 0 4 9·4	12	5·43	5·50	688	143	·208	− 16·4	314·8			
„ 15,16,17	4 0	LI	D 0 2 31·3	12	5·75	5·53								
„ 18,19	2 39	L	D 0 5 5·7	8	5·58	5·50	602	4	·007	− 2·7	328·5			
„ 11,12,13	2 41	LII	D 0 4 47·3	12	5·75	5·53						327·3	334	16
„ 14,15,16,17	2 58	LI	D 0 4 0·0	16	5·58	5·53	582	15	·026	+ 10·2	326·2			
„ 11,12,13	3 0	LII	D 0 5 14·5	12	4·70	5·53								
„ 14,15,16	3 10	LI	D 0 5 23·6	12	5·43	5·53	616	24	·038	− 11·8	304·2			
„ 6,7,8	3 10	LIII	D 0 4 8·1	12	4·70	5·50						303·7	311	5
„ 10,11,12	3 53	LII	D 0 5 31·4	12	5·43	5·53	689	85	·123	− 24·1	303·2			
„ 6,7,8	3 48	LIII	D 0 3 8·5	12	5·58	5·50								
„ 10,11,12,13	2 44	LII	D 0 4 41·9	20	5·44	5·53	541	16	·030	− 7·3	320·0			
„ 2,4,5	2 50	LIV	D 0 3 46·7	12	5·58	5·53						319·0	327	26
„ 6,7,8	2 28	LIII	D 0 3 22·9	12	5·44	5·50	543	15	·028	+ 14·2	317·9			
„ 4,5	2 28	LIV	D 0 5 8·7	8	5·75	5·53								
„ 6,7,8	2 52	LIII	D 0 5 10·5	12	5·43	5·50	545	14	·026	− 13·9	289·8			
Jan. 21,22,23,25	2 52	LV	D 0 3 25·7	16	5·75	5·51						289·5	299·25	26
Feb. 4,5	3 2	LIV	D 0 6 50·9	8	5·43	5·53	660	11	·017	− 29·7	289·3			
Jan. 21,22,24	3 2	LV	D 0 3 47·1	12	5·58	5·51								
Feb. 6,7,8	3 2	LIII	D 0 4 1·7	12	5·43	5·50	518	28	·055	− 2·7	301·0			
Jan. 30,31	3 3	LVI	D 0 3 39·2	8	5·75	5·54						300·4	309	25
„ 21,22,23,24	2 42	LV	D 0 3 21·4	16	5·43	5·51	525	22	·041	+ 10·3	299·8			
„ 30,31	2 43	LVI	D 0 4 41·3	8	5·43	5·54								
Feb. 3,4,5	2 46	LIV	D 0 4 26·9	12	5·44	5·53	517	23	·044	− 7·9	311·1			
Jan. 17,18,20	2 45	LVII	D 0 3 24·4	12	5·58	5·50						312·7	297·35 + 26	26

* The chronometer error not having been recorded, the times given in this column are mere chronometer readings.

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Astronomical Date 1849	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	* h. m.		° ′ ″				″							feet
Jan. 21,22,23,25	3 26	LV	D 0 2 55·6	16	5·44	5·51	594	36	·061	+ 24·9	314·4			
„ 17,19,20	3 26	LVII	D 0 5 45·6	12	5·75	5·50								
„ 21,22,23,24	3 12	LV	D 0 3 42·4	16	4·70	5·51	541	30	·056	+ 5·6	295·1			
„ 27,28	3 11	LVIII	D 0 4 21·5	6	5·44	5·51						295·5	{ 279·60 { +25	25
(1)	5 18	LVI	D 0 5 2·9	16	5·01	5·48	600	14	·023	− 4·5	295·9			
(2)	5 11	LVIII	D 0 4 31·4	16	5·32	5·47								
Jan. 21,22,23,25	2 33	LV	D 0 3 27·8	16	5·43	5·51	555	27	·049	+ 11·7	311·0			
„ 10,11,12,13	2 32	LIX	D 0 4 52·3	16	5·75	5·43								
„ 19,20	2 40	LVII	D 0 5 34·1	8	5·43	5·50	618	− 1	·002	− 7·1	316·3	313·8	315	30
„ 9,10,11,13	2 38	LIX	D 0 4 46·8	16	5·43	5·43								
„ 27,28	3 2	LVIII	D 0 4 6·9	8	5·43	5·51	611	28	·045	+ 9·4	314·0			
„ 10,12,13	3 2	LIX	D 0 5 11·7	12	4·70	5·43								
„ 19,20	3 55	LVII	D 0 4 9·1	8	5·44	5·50	635	51	·080	+ 5·6	329·0			
„ 3,4,6,7,8	3 13	LX	D 0 4 49·3	20	4·23	5·62						327·1	329	16
„ 10,11,12,13	3 13	LIX	D 0 2 38·8	16	5·44	5·43	521	57	·109	+ 11·4	325·2			
„ 4,5,6,7,8	3 13	LX	D 0 4 8·9	20	5·45	5·62								
„ 10,11,12,13	2 28	LIX	D 0 3 37·1	16	5·33	5·43	534	41	·077	+ 2·4	316·2			
(3)	2 29	LXI	D 0 3 54·8	12	5·45	5·46						318·3	322	25
Jan. 3,4,5,6,7	2 47	LX	D 0 4 4·1	20	5·33	5·62	508	38	·074	− 6·6	320·5			
1848-49 Dec. 28,30,31 Jan. 1	2 47	LXI	D 0 3 9·6	16	5·53	5·46								
Jan. 3,4,5,6,7	2 59	LX	D 0 2 44·8	20	5·60	5·62	610	145	·238	− 1·5	325·6			
Dec. 24,25,26	3 4	LXII	D 0 2 34·3	10	5·53	5·48						324·7	329	26
Dec. 28,30,31, Jan. 1	3 0	LXI	D 0 3 1·8	16	5·60	5·46	578	88	·152	+ 5·4	323·7			
„ 23,24,25,26	3 0	LXII	D 0 3 40·7	16	5·42	5·48								
1848 „ 28,30,31	2 38	LXI	D 0 3 25·0	12	5·27	5·46	556	0	·000	+ 20·2	338·5†			
„ 14,15,16	2 38	LXIII	D 0 5 52·1	12	5·46	5·48						328·7	334	15
„ 23,24,25,26	3 34	LXII	D 0 2 36·4	16	5·27	5·48	515	86	·167	+ 4·0	328·7			
„ 15,16	3 36	LXIII	D 0 3 7·1	8	5·50	5·48								
„ 25,26	3 56	LXII	D 0 0 28·6	8	5·44	5·48	543	257	·473	− 11·5	313·2†			
„ 19	3 54	LXIV	E 0 0 57·4	4	5·42	5·52						331·6	338	26
1847 Mar. 19	5 58	LXIII	D 0 4 3·6	4	4·64	5·48	527	12	·023	+ 2·9	331·6			
„ 17	6 0	LXIV	D 0 4 24·8	4	4·89	5·48								
„ 19	5 32	LXIII	D 0 4 30·5	4	4·67	5·48	545	18	·033	− 3·5	325·2			
„ 16	5 33	LXV	D 0 4 3·7	4	4·89	5·47						326·1	334	27

* The chronometer error not having been recorded, the times given in this column are mere chronometer readings. † Rejected.

(1). The mean of observations taken on 22nd April 1847, and 30th, 31st January 1849. (2) The mean of observations taken on 19th April 1847, and 27th, 28th January 1849. (3) The mean of observations taken on 28th, 30th December 1848, and 1st January 1849.

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Astronomical Date 1847	Mean of Times of observation*	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station—1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Mar. 17	5 37	LXIV	D o 4 26·0	8	4·67	5·48	530	20	·037	− 4·6	327·0			
„ 15,16	5 37	LXV	D o 3 50·8	8	4·64	5·47								
„ 17	6 8	LXIV	D o 5 28·0	4	4·79	5·48	664	14	·021	− 2·5	329·1			
„ 13	6 6	LXVI	D o 5 22·4	4	1·64	5·46								
„ 15,16	5 52	LXV	D o 4 25·9	8	4·79	5·47	611	20	·033	+ 6·5	332·6	330·9	339	20
„ 12,13	5 47	LXVI	D o 5 9·5	6	4·67	5·46								
„ 15,16	6 0	LXV	D o 5 36·4	8	4·76	5·47	565	28	·051	− 22·1	304·0			
„ 9,10	6 1	LXVII	D o 2 57·5	8	4·67	5·48								
„ 12,13	5 53	LXVI	D o 5 49·4	8	4·63	5·46	566	36	·063	− 27·5	303·4	303·7	313	17
„ 9,10	5 53	LXVII	D o 2 31·6	8	4·62	5·48								
„ 12,13	5 34	LXVI	D o 3 21·6	8	4·79	5·46	463	3	·007	+ 8·2	339·1			
„ 5,6,7	5 34	LXVIII	D o 4 34·3	12	4·62	5·48								
„ 9,10	5 40	LXVII	D o 2 50·4	8	4·79	5·48	601	8	·013	+ 36·7	340·4	339·7	350	20
„ 5,6,7	5 36	LXVIII	D o 6 59·7	12	4·63	5·48								
„ 9,10	5 47	LXVII	D o 4 53·1	8	4·63	5·48	542	14	·025	− 8·6	295·1			
„ 3,4	5 47	LXIX	D o 3 54·7	8	2·88	5·47								
„ 6,7	5 43	LXVIII	D o 7 44·2	8	4·63	5·48	592	− 4	·006	− 47·1	292·6	293·8	{ 285·60 +20·0	20·0
„ 3,4	5 45	LXIX	D o 2 20·5	8	4·64	5·47								
(1)	5 22	LXIX	D o 3 26·7	12	4·90	5·69	703	42	·059	+ 36·4	342·0	342·0	344	2
(2)	5 28	LXXI	D o 6 56·6	16	4·96	5·41								
Mar. 5,6,7	6 28	LXVIII	D o 4 35·1	12	4·79	5·48	605	60	·100	− 9·1	340·9			
Feb. 25,26,27	6 28	LXX	D o 3 34·2	12	4·64	5·48								
„ 28, Mar. 1	5 42	LXIX	D o 2 31·7	8	4·79	5·47	583	20	·034	+ 35·0	340·6	341·6	342	30
„ 26, 27	5 43	LXX	D o 6 36·8	8	4·63	5·48								
„ 21,22,23,24	5 34	LXXI	D o 4 43·2	16	4·65	5·47	633	38	·060	− 0·6	343·4			
„ 25,26,27	5 34	LXX	D o 4 39·6	12	4·63	5·48								
„ 25,26,27	5 38	LXX	D o 6 57·0	12	4·79	5·48	612	20	·032	− 38·6	303·0			
„ 18,19,20	5 39	LXXII	D o 2 40·3	12	4·65	5·46								
„ 21,22,23	5 39	LXXI	D o 6 30·2	12	4·79	5·47	550	36	·066	− 40·2	303·8	303·4	304	30
„ 18,19,20	5 38	LXXII	D o 1 33·1	12	4·63	5·46								
„ 21,23	5 21	LXXI	D o 8 45·5	8	4·63	5·47	452	25	·056	− 71·2	272·8			
„ 13,14	5 24	LXXIII	E o 1 56·9	8	4·63	5·45								
„ 18,19	5 23	LXXII	D o 6 7·9	8	4·63	5·46	511	21	·041	− 32·6	270·8	271·8	272	25·5
„ 12,13,14	5 24	LXXIII	D o 1 47·6	10	4·62	5·45								

* The chronometer error not having been recorded, the times given in this column are mere chronometer readings.

(1). The mean of observations taken on 28th February, 1st March 1847, and 11th June 1852. (2). The mean of observations taken on 21st, 22nd, 23rd February 1847, and 16th June 1852.

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Astronomical Date: 1847	Astronomical Date: Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Feb. 18,19	*5 34	LXXII	D 0 5 39·0	8	4·79	5·46	615	21	·034	− 15·1	288·3			
„ 15,16	*5 34	LXXIV	D 0 3 59·7	8	4·62	5·47						288·4	289	22
1846														
May 6,7	4 56	LXXIII	D 0 3 4·3	16	4·63	5·49	534	22	·041	+ 16·7	288·5			
„ 4,5	5 57	LXXIV	D 0 5 12·1	8	4·63	5·49								
„ 6,7	5 19	LXXIII	D 0 4 53·5	6	4·69	5·49	552	25	·044	− 10·6	261·2			
„ 2,3	5 22	LXXV	D 0 3 35·7	8	4·63	5·48						260·9	261	26
„ 4,5	4 48	LXXIV	D 0 6 17·9	8	4·69	5·49	602	20	·033	− 27·8	260·6			
„ 2,3	4 48	LXXV	D 0 3 9·9	8	4·63	5·48								
„ 4,5	4 47	LXXIV	D 0 5 34·5	8	4·83	5·49	550	7	·012	− 17·2	271·2			
Apr. 30	4 50	LXXVI	D 0 3 27·9	4	4·63	5·48						272·0	273	24
May 2,3	4 35	LXXV	D 0 3 40·8	8	4·83	5·48	544	9	·016	+ 11·9	272·8			
Apr.30,May1	4 41	LXXVI	D 0 5 11·1	8	4·63	5·48								
May 2,3	4 33	LXXV	D 0 4 58·4	6	4·69	5·48	549	10	·017	− 8·2	252·7			
Apr. 28,29	4 34	LXXVII	D 0 3 57·5	6	4·63	5·48						252·0	253	28
May 1	4 47	LXXVI	D 0 5 51·0	8	4·69	5·48	600	22	·036	− 20·7	251·5			
Apr. 28,29	4 44	LXXVII	D 0 3 31·0	8	4·63	5·48								
„ 30, May 1	4 25	LXXVI	D 0 6 25·1	8	4·83	5·48	550	7	·013	− 31·1	240·9			
„ 24,25,26	4 34	LXXVIII	D 0 2 35·9	10	4·63	5·48						242·2	243	18
„ 28,29	4 36	LXXVII	D 0 4 24·2	8	4·83	5·48	525	34	·065	− 8·6	243·4			
„ 24	4 39	LXXVIII	D 0 3 18·4	4	4·56	5·48								
„ 28	4 55	LXXVII	D 0 5 29·2	8	4·69	5·48	620	26	·042	− 13·0	239·0			
„ 20,21,22,23	5 0	LXXIX	D 0 4 4·5	18	4·54	5·45						238·7	{ 214·64 +25 }	25
„ 24	4 31	LXXVIII	D 0 5 19·1	4	4·69	5·48	587	−10	·017	− 3·8	238·4			
„ 20,22,23	4 34	LXXIX	D 0 4 53·0	12	4·67	5·45								
„ 24,25	4 32	LXXVIII	D 0 3 38·5	8	4·83	5·48	555	6	·011	+ 15·1	258·1			
„ 17,18	4 31	LXXX	D 0 5 30·2	8	4·67	5·48						258·9	260	24
„ 20,21,22,23	4 23	LXXIX	D 0 3 0·0	16	4·83	5·45	536	14	·027	+ 20·0	259·6			
„ 17,18	4 25	LXXX	D 0 5 32·9	8	4·62	5·48								
„ 20,21,22,23	4 51	LXXIX	D 0 4 51·5	18	4·63	5·45	606	34	·056	− 5·9	233·7			
„ 12	4 52	LXXXI	D 0 4 11·8	4	4·62	5·48						233·8	235	29
„ 16,17	4 11	LXXX	D 0 5 40·4	8	4·63	5·48	504	16	·031	− 24·9	234·0			
„ 14,15	4 5	LXXXI	D 0 2 19·7	6	4·59	5·48								
„ 16,17	4 13	LXXX	D 0 3 48·6	10	4·83	5·48	559	24	·043	+ 8·0	266·9			
Mar.19,20,21	4 11	LXXXII	D 0 4 47·1	12	4·83	5·47								
												266·3	269	30

* In these instances, the chronometer error not having been recorded, the times here given are mere chronometer readings.

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Astronomical Date 1846	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Apr. 13,15	4 4	LXXXI	D 0 3 37·1	10	4·83	5·48	642	5	·008	+ 31·8	265·6			
Mar. 19,21	4 5	LXXXII	D 0 6 59·2	8	4·64	5·47								
Apr. 12,15	4 31	LXXXI	D 0 3 15·6	8	4·61	5·48	471	23	·048	+ 4·8	238·6			
„ 11	4 31	LXXXIII	D 0 3 57·2	4	4·63	5·48						237·7	241	35
Mar. 19,20,21	3 59	LXXXII	D 0 6 7·6	12	4·61	5·47	568	25	·044	− 29·4	236·9			
„ 17	3 57	LXXXIII	D 0 2 35·8	4	4·83	5·48								
„ 16,17	4 34	LXXXIII	D 0 5 27·3	8	4·63	5·48	588	38	·065	− 19·8	221·2	221·2	226	15
„ 29,31	4 32	LXXXV	D 0 3 9·8	8	4·67	5·48								
„ 19,21	4 14	LXXXII	D 0 5 36·8	8	4·63	5·47	625	25	·039	− 14·1	254·9			
„ 23,26	4 13	LXXXIV	D 0 4 4·0	8	4·83	5·44								
„ 17	3 27	LXXXIII	D 0 3 49·3	4	4·63	5·48	611	13	·022	+ 19·7	260·7	258·5	258	30
„ 28	3 28	LXXXIV	D 0 6 0·6	4	4·67	5·44								
(1)	3 43	LXXXV	D 0 2 35·7	22	5·17	5·28	589	22	·038	+ 33·8	259·8			
(2)	3 44	LXXXIV	D 0 6 30·2	16	4·90	5·25								
1849														
Feb. 1,2,3,5	3 47	LXXXIV	D 0 5 54·9	14	5·58	5·06	538	25	·046	− 29·8	228·7			
„ 16,17,18	4 12	LXXXVI	D 0 2 8·8	12	5·71	5·08						227·5	227	16
„ 7,8,9,11,12	4 20	LXXXV	D 0 4 14·3	16	5·25	5·08	648	68	·105	+ 0·3	226·3			
„ 15,16,17,18	4 37	LXXXVI	D 0 4 14·8	14	5·63	5·08								
„ 7,8,11,12	3 58	LXXXV	D 0 5 20·0	16	5·63	5·08	625	33	·052	− 12·9	213·1			
„ 21,22,24,25	4 17	LXXXVII	D 0 3 57·3	14	5·29	5·10						213·4	213	31
„ 16,18	3 17	LXXXVI	D 0 5 24·1	8	5·29	5·08	518	−12	·023	− 13·8	213·7			
„ 22,23, Mar. 5	3 17	LXXXVII	D 0 3 34·2	10	5·71	5·10								
„ 16,17,18	3 50	LXXXVI	D 0 5 53·5	12	5·25	5·08	610	− 5	·008	− 13·3	214·2			
Mar. 11	4 37	LXXXVIII	D 0 4 23·5	4	5·71	5·10						213·6	213	15
Feb. 21,25	3 37	LXXXVII	D 0 4 38·3	8	5·63	5·10	552	− 3	·006	− 0·3	213·1			
Mar. 9,10,11	4 9	LXXXVIII	D 0 4 37·7	12	5·29	5·10								
Feb. 21,22,25	4 33	LXXXVII	D 0 4 40·5	12	5·25	5·10	586	64	·109	− 15·0	198·4			
Mar. 15,19	4 52	LXXXIX	D 0 2 56·3	8	5·29	5·10						198·3	198	25
„ 13	4 30	LXXXVIII	D 0 5 4·6	4	10·65	5·10	565	14	·024	− 15·4	198·2			
„ 15,19,20	4 21	LXXXIX	D 0 3 17·9	12	9·42	5·10								
„ 9,10,11	3 57	LXXXVIII	D 0 4 1·1	12	5·71	5·10	524	− 4	·007	+ 5·8	219·4			
„ 25,31	4 13	XC	D 0 4 46·0	8	5·71	5·10						220·8	220	27
„ 16,20,21,22	3 57	LXXXIX	D 0 3 19·1	12	5·71	5·10	574	1	·001	+ 23·9	222·2			
„ 25,31	3 55	XC	D 0 6 10·2	8	5·34	5·10								

In some instances, the dates of observations could not be entered in their proper places in column 1 from want of space, this information is as follows:—(1) 29th March 1846, and 7th, 8th, 9th, 11th, 12th February 1849; (2) 23rd, 24th, 26th March 1846, and 3rd, 5th February 1849.

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Astronomical Date: 1849	Astronomical Date: Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Mar. 22,23	4 36	LXXXIX	D 0 4 58·2	8	4·77	5·10	634	7	·011	+ 4·0	202·3			
Apr. 5,6	5 6	XCI	D 0 5 21·9	8	5·34	5·10						202·6	202	25
Mar. 25,27,31	4 12	XC	D 0 5 29·2	12	4·77	5·10	535	8	·015	− 17·9	202·9			
Apr. 3,4,6	4 7	XCI	D 0 3 9·2	12	5·71	5·10								
(1)	4 11	XCI	D 0 4 11·2	12	4·99	5·09	531	1	·002	+ 3·5	205·5	205·5	206	26
(2)	4 14	XCIII	D 0 4 35·4	12	5·74	5·09								
Mar. 31	4 36	XC	D 0 4 15·8	4	5·71	5·10	575	6	·010	+ 6·8	226·8			
Apr. 8,9	4 42	XCII	D 0 5 3·6	8	5·71	5·10								
" 5,6	4 56	XCI	D 0 3 55·2	8	5·71	5·10	677	20	·029	+ 27·2	229·2	229·0	229	26
" 8	5 3	XCII	D 0 6 40·1	4	5·40	5·10								
Apr. 18,20,21, 22,23,29	4 21	XCIII	D 0 3 1·1	24	5·71	5·10	554	2	·003	+ 25·0	231·0			
" 8,9,14,15	4 43	XCII	D 0 6 8·8	16	4·77	5·10								
" 14,15	4 25	XCII	D 0 3 51·9	8	4·90	5·10	565	− 7	·012	+ 16·1	245·1			
May 1,5	4 24	XCIV	D 0 5 45·6	8	5·71	5·10						245·2	245	26
Apr. 20,22,23,24	4 55	XCIII	D 0 2 42·4	14	4·90	5·10	649	39	·061	+ 39·3	245·3			
May 1,5	5 13	XCIV	D 0 6 47·7	6	5·40	5·10								
Apr. 29	4 35	XCIII	D 0 4 11·9	6	5·33	5·10	557	16	·029	+ 2·6	208·6			
May 7	5 1	XCV	D 0 4 30·7	4	5·40	5·10						209·2	209	26
" 1,3,5	4 49	XCIV	D 0 6 56·1	12	5·33	5·10	591	1	·001	− 35·4	209·8			
" 7	4 53	XCV	D 0 2 50·7	4	5·71	5·10								
" 5	5 6	XCIV	D 0 4 17·8	4	4·83	5·10	566	−10	·018	+ 10·0	255·2			
" 9,12	5 10	XCVI	D 0 5 26·8	8	5·71	5·10						254·9	255	25
" 7	4 30	XCV	D 0 2 18·7	4	4·92	5·10	594	4	·006	+ 45·3	254·5			
" 12	4 47	XCVI	D 0 7 27·6	4	5·40	5·10								
" 7	4 20	XCV	D 0 5 2·1	4	5·33	5·10	527	− 1	·001	− 10·1	199·1			
" 16	4 26	XCVII	D 0 3 44·2	4	5·40	5·10						199·0	200	26
" 9,12	4 37	XCVI	D 0 8 15·8	8	5·33	5·10	572	−12	·020	− 55·9	199·0			
" 15,16,17	4 50	XCVII	D 0 1 36·4	10	5·71	5·10								
" 14	4 48	XCVI	D 0 6 13·5	4	4·83	5·10	586	−13	·022	− 19·2	235·7			
" 19	4 42	XCVIII	D 0 3 58·4	4	5·71	5·40						234·8	235	25
" 15,16,17	5 17	XCVII	D 0 3 30·6	12	4·83	5·10	628	− 9	·014	+ 34·9	233·9			
" 18,19	5 18	XCVIII	D 0 7 16·0	8	5·40	5·40								
" 17	4 40	XCVII	D 0 4 54·3	4	5·33	5·10	519	1	·002	− 9·3	189·7			
" 20,21	4 1	XCIX	D 0 3 40·9	8	5·40	5·10						191·4	192	24

(1) The mean of observations taken on 4th, 6th April 1849, and 19th May 1852. (2) The mean of observations taken on 22nd, 23rd April 1849, and 22nd May 1852.

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Astronomical Date 1846	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station—1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Apr. 13,15	4 4	LXXXI	D 0 3 37·1	10	4·83	5·48	642	5	·008	+ 31·8	265·6	237·7	241	35
Mar. 19,21	4 5	LXXXII	D 0 6 59·2	8	4·64	5·47								
Apr. 12,15	4 31	LXXXI	D 0 3 15·6	8	4·61	5·48	471	23	·048	+ 4·8	238·6			
„ 11	4 31	LXXXIII	D 0 3 57·2	4	4·63	5·48								
Mar. 19,20,21	3 59	LXXXII	D 0 6 7·6	12	4·61	5·47	568	25	·044	− 29·4	236·9			
„ 17	3 57	LXXXIII	D 0 2 35·8	4	4·83	5·48								
„ 16,17	4 34	LXXXIII	D 0 5 27·3	8	4·63	5·48	588	38	·065	− 19·8	221·2	221·2	226	35
„ 29,31	4 32	LXXXV	D 0 3 9·8	8	4·67	5·48								
„ 19,21	4 14	LXXXII	D 0 5 36·8	8	4·63	5·47	625	25	·039	− 14·1	254·9	258·5	258	30
„ 23,26	4 13	LXXXIV	D 0 4 4·0	8	4·83	5·44								
„ 17	3 27	LXXXIII	D 0 3 49·3	4	4·63	5·48	611	13	·022	+ 19·7	260·7			
„ 23	3 28	LXXXIV	D 0 6 0·6	4	4·67	5·44								
(1)	3 43	LXXXV	D 0 2 35·7	22	5·17	5·28	589	22	·038	+ 33·8	259·8			
(2)	3 44	LXXXIV	D 0 6 30·2	16	4·90	5·25								
1849														
Feb. 1,2,3,5	3 47	LXXXIV	D 0 5 54·9	14	5·58	5·06	538	25	·046	− 29·8	228·7	227·5	227	26
„ 16,17,18	4 12	LXXXVI	D 0 2 8·8	12	5·71	5·08								
„ 7,8,9,11,12	4 20	LXXXV	D 0 4 14·3	16	5·25	5·08	648	68	·105	+ 0·3	226·3			
„ 15,16,17,18	4 37	LXXXVI	D 0 4 14·8	14	5·63	5·08								
„ 7,8,11,12	3 58	LXXXV	D 0 5 20·0	16	5·63	5·08	625	33	·052	− 12·9	213·1	213·4	213	31
„ 21,22,24,25	4 17	LXXXVII	D 0 3 57·3	14	5·29	5·10								
„ 16,18	3 17	LXXXVI	D 0 5 24·1	8	5·29	5·08	518	−12	·023	− 13·8	213·7			
„ 22,23, Mar. 5	3 17	LXXXVII	D 0 3 34·2	10	5·71	5·10								
„ 16,17,18	3 50	LXXXVI	D 0 5 53·5	12	5·25	5·08	610	− 5	·008	− 13·3	214·2	213·6	213	25
Mar. 11	4 37	LXXXVIII	D 0 4 23·5	4	5·71	5·10								
Feb. 21,25	3 37	LXXXVII	D 0 4 38·3	8	5·63	5·10	552	− 3	·006	− 0·3	213·1			
Mar. 9,10,11	4 9	LXXXVIII	D 0 4 37·7	12	5·29	5·10								
Feb. 21,22,25	4 33	LXXXVII	D 0 4 40·5	12	5·25	5·10	586	64	·109	− 15·0	198·4	198·3	198	25
Mar. 15,19	4 52	LXXXIX	D 0 2 56·3	8	5·29	5·10								
„ 13	4 30	LXXXVIII	D 0 5 4·6	4	10·65	5·10	565	14	·024	− 15·4	198·2			
„ 15,19,20	4 21	LXXXIX	D 0 3 17·9	12	9·42	5·10								
„ 9,10,11	3 57	LXXXVIII	D 0 4 1·1	12	5·71	5·10	524	− 4	·007	+ 5·8	219·4	220·8	220	27
„ 25,31	4 13	XC	D 0 4 46·0	8	5·71	5·10								
„ 16,20,21,22	3 57	LXXXIX	D 0 3 19·1	12	5·71	5·10	574	1	·001	+ 23·9	222·2			
„ 25,31	3 55	XC	D 0 6 10·2	8	5·34	5·10								

In some instances, the dates of observations could not be entered in their proper places in column 1 from want of space, this information is as follows:—(1) 29th March 1846, and 7th, 8th, 9th, 11th, 12th February 1849; (2) 23rd, 24th, 26th March 1846, and 3rd, 5th February 1849.

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Astronomical Date 1849	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Mar. 22,23	4 36	LXXXIX	D 0 4 58·2	8	4·77	5·10	634	7	·011	+ 4·0	202·3			
Apr. 5,6	5 6	XCI	D 0 5 21·9	8	5·34	5·10						202·6	202	25
Mar. 25,27,31	4 12	XC	D 0 5 29·2	12	4·77	5·10	535	8	·015	− 17·9	202·9			
Apr. 3,4,6	4 7	XCI	D 0 3 9·2	12	5·71	5·10								
(1)	4 11	XCI	D 0 4 11·2	12	4·99	5·09	531	1	·002	+ 3·5	205·5	205·5	206	26
(2)	4 14	XCIII	D 0 4 35·4	12	5·74	5·09								
Mar. 31	4 36	XC	D 0 4 15·8	4	5·71	5·10	575	6	·010	+ 6·8	226·8			
Apr. 8,9	4 42	XCII	D 0 5 3·6	8	5·71	5·10								
„ 5,6	4 56	XCI	D 0 3 55·2	8	5·71	5·10	677	20	·029	+ 27·2	229·2	229·0	229	26
„ 8	5 3	XCII	D 0 6 40·1	4	5·40	5·10								
Apr. 18,20,21, 22,23,29	4 21	XCIII	D 0 3 1·1	24	5·71	5·10	554	2	·003	+ 25·0	231·0			
„ 8,9,14,15	4 43	XCII	D 0 6 8·8	16	4·77	5·10								
„ 14,15	4 25	XCII	D 0 3 51·9	8	4·90	5·10	565	− 7	·012	+ 16·1	245·1			
May 1,5	4 24	XCIV	D 0 5 45·6	8	5·71	5·10						245·2	245	26
Apr. 20,22,23,24	4 55	XCIII	D 0 2 42·4	14	4·90	5·10	649	39	·061	+ 39·3	245·3			
May 1,5	5 13	XCIV	D 0 6 47·7	6	5·40	5·10								
Apr. 29	4 35	XCIII	D 0 4 11·9	6	5·33	5·10	557	16	·029	+ 2·6	208·6			
May 7	5 1	XCV	D 0 4 30·7	4	5·40	5·10						209·2	209	26
„ 1,3,5	4 49	XCIV	D 0 6 56·1	12	5·33	5·10	591	1	·001	− 35·4	209·8			
„ 7	4 53	XCV	D 0 2 50·7	4	5·71	5·10								
„ 5	5 6	XCIV	D 0 4 17·8	4	4·83	5·10	566	−10	·018	+ 10·0	255·2			
„ 9,12	5 10	XCVI	D 0 5 26·8	8	5·71	5·10						254·9	255	25
„ 7	4 30	XCV	D 0 2 18·7	4	4·92	5·10	594	4	·006	+ 45·3	254·5			
„ 12	4 47	XCVI	D 0 7 27·6	4	5·40	5·10								
„ 7	4 20	XCV	D 0 5 2·1	4	5·33	5·10	527	− 1	·001	− 10·1	199·1			
„ 16	4 26	XCVII	D 0 3 44·2	4	5·40	5·10						199·0	200	26
„ 9,12	4 37	XCVI	D 0 8 15·8	8	5·33	5·10	572	−12	·020	− 55·9	199·0			
„ 15,16,17	4 50	XCVII	D 0 1 36·4	10	5·71	5·10								
„ 14	4 48	XCVI	D 0 6 13·5	4	4·83	5·10	586	−13	·022	− 19·2	235·7			
„ 19	4 42	XCVIII	D 0 3 58·4	4	5·71	5·40						234·8	235	25
„ 15,16,17	5 17	XCVII	D 0 3 30·6	12	4·83	5·10	628	− 9	·014	+ 34·9	233·9			
„ 18,19	5 18	XCVIII	D 0 7 16·0	8	5·40	5·40								
„ 17	4 40	XCVII	D 0 4 54·3	4	5·33	5·10	519	1	·002	− 9·3	189·7			
„ 20,21	4 1	XCIX	D 0 3 40·9	8	5·40	5·10						191·4	192	24

(1) The mean of observations taken on 4th, 6th April 1849, and 19th May 1852. (2) The mean of observations taken on 22nd, 23rd April 1849, and 22nd May 1852.

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Astronomical Date 1849	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
May 18,19	4 51	XCVIII	D 0 7 25·7	8	5·33	5·40	600	− 4	·007	− 41·7	193·1			
" 21	4 15	XCIX	D 0 2 40·3	4	5·71	5·10								
" 18,19	4 35	XCVIII	D 0 5 27·5	8	4·83	5·40	540	4	·008	− 15·8	219·0			
" 22	4 17	C	D 0 3 24·9	4	5·69	5·25						218·1	219	20
" 20,21	5 9	XCIX	D 0 2 52·5	8	4·83	5·10	633	62	·097	+ 25·9	217·3			
" 22	4 58	C	D 0 5 38·0	4	5·40	5·25								
" 21	3 55	XCIX	D 0 3 26·1	4	5·33	5·10	472	27	·056	+ 0·6	192·0			
" 23	4 3	CI	D 0 3 54·5	4	*0·00	5·25								
(1)	3 41	C	D 0 5 45·5	10	5·41	5·32	556	10	·018	− 21·2	196·9	194·5	195	22
(2)	3 31	CI	D 0 3 20·0	12	2·82	5·37								
Dec. 22,23,24,25,26,28	4 7	C	D 0 4 5·1	22	12·71	5·26	538	21	·039	− 6·7	211·4			
1850 Feb. 19,21	4 25	CII	D 0 3 14·9	8	12·50	5·27								
1846 May 23	3 26	CI	D 0 2 42·4	4	5·96	5·48	521	30	·057	+ 17·0	211·5	211·5	{ 192·03 +20	20
" 21	3 32	CII	D 0 4 55·1	4	5·75	5·23								
" 23	1 58	CI	D 0 4 50·3	8	6·75	5·48	542	−36	·067	+ 3·3	197·8			
" 20	2 6	CIII	D 0 5 18·7	8	5·54	5·27								
" 21	3 5	CII	D 0 5 41·4	8	6·63	5·23	568	−14	·024	− 13·6	197·9	197·8	{ 173·39 +26	26
" 20	3 4	CIII	D 0 4 7·0	6	5·88	5·27								
" 19	1 41	CIII	D 0 5 33·2	8	5·25	5·27	547	− 8	·014	− 13·9	185·5	185·5	{ 160·30 +20	20
" 14	2 39	CVII	D 0 3 50·5	6	5·33	5·56								
" 21	3 51	CII	D 0 4 51·6	4	5·50	5·23	574	40	·069	− 12·7	199·3			
" 16	3 6	CVI	D 0 3 20·7	6	5·92	5·44								
" 19	2 4	CIII	D 0 4 59·9	8	5·46	5·27	561	− 9	·016	− 3·1	196·3	196·7	197	19
" 16	2 3	CVI	D 0 4 36·1	6	6·00	5·44								
" 14	2 58	CVII	D 0 3 27·1	6	5·13	5·56	539	11	·020	+ 14·1	194·4			
" 16	2 56	CVI	D 0 5 10·2	6	5·88	5·44								
1850 Apr. 9	5 0	CVI	D 0 4 42·5	4	11·00	5·20	571	23	·040	− 11·3	185·4			
May 8,4	5 6	CVIII	D 0 3 16·0	6	12·63	5·14								
" 14	2 29	CVII	D 0 4 34·5	6	3·72	5·56	522	−14	·027	+ 2·0	182·3	183·8	185	20
June 1	2 47	CVIII	D 0 4 33·4	6	6·17	3·72								
1846 May 16	2 44	CVI	D 0 3 39·5	6	3·65	5·44	527	16	·031	+ 9·0	205·7			
" 29	2 42	CIX	D 0 4 34·1	8	5·54	3·48								
June 1	3 20	CVIII	D 0 2 45·5	6	4·75	3·72	558	32	·058	+ 21·2	205·0	205·4	{ 184·94 +22	22
May 29	3 30	CIX	D 0 5 24·3	8	3·43	3·48								

(1) The mean of observations taken on 24th May 1846, and 22nd May 1849. (2) The mean of observations taken on 23rd May 1846, and 23rd May 1849.
* Summit of tower observed to.

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Astronomical Date 1849	Mean of Times of observation h. m.	Station	Observed Vertical Angle ° ′ ″	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc ″	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower feet
Dec. 28,31	4 5	C	D 0 3 1·0	8	10·89	5·26	543	1	·001	+ 18·3	237·3			
1850 Jan. 3,6	4 6	CIV	D 0 5 12·0	8	12·50	5·08								
1846 May 21	3 40	CII	D 0 2 6·9	4	5·30	5·23	521	52	·100	+ 20·7	232·7	234·3	234	20
„ 26	3 38	CIV	D 0 4 47·1	6	5·81	5·25								
„ 28	1 58	CV	D 0 3 19·3	6	5·21	*0·75	520	17	·032	+ 5·2	233·0			
„ 26	1 45	CIV	D 0 4 42·1	8	0·50	5·25								
„ 21	3 48	CII	D 0 3 0·8	4	0·50	5·23	559	55	·097	+ 16·9	228·9			
„ 28	3 19	CV	D 0 4 22·2	6	5·94	*0·75								
„ 16	1 51	CVI	D 0 3 42·7	6	0·25	5·44	561	−30	·053	+ 29·3	226·3	227·8	228	32
„ 28	1 42	CV	D 0 6 34·4	6	5·42	*0·75								
1847 Mar. 16	3 58	CIX	D 0 2 48·2	4	8·08	5·40	582	39	·067	+ 21·2	228·1			
„ 4,6	4 0	CV	D 0 5 27·4	8	4·98	5·40								
„ 5,6	4 11	CV	D 0 4 28·6	8	5·23	5·40	621	28	·045	+ 4·6	232·6			
„ 10	4 14	CX	D 0 4 48·8	4	8·21	5·40								
												231·5	231	28
„ 16	3 51	CIX	D 0 2 34·3	4	5·33	5·40	508	6	·011	+ 23·6	230·5			
„ 10,12	3 41	CX	D 0 5 44·3	8	5·04	5·40								
„ 17	3 53	CIX	D 0 4 43·0	4	5·04	5·40	505	−15	·029	− 3·6	203·3			
„ 18,19	3 53	CXI	D 0 4 14·0	8	5·04	5·40								
												205·1	204	29
„ 13	3 39	CX	D 0 6 46·3	4	5·13	5·40	663	2	·003	− 24·7	206·8			
„ 18	4 1	CXI	D 0 4 14·0	4	5·23	5·40								
„ 12	3 11	CX	D 0 5 17·5	4	5·00	5·40	566	− 2	·003	− 8·7	222·8			
„ 22	3 13	CXII	D 0 4 14·4	4	5·23	5·40								
												221·3	220	28
„ 19	3 2	CXI	D 0 3 51·4	4	5·00	5·40	586	12	·020	+ 14·7	219·8			
„ 23	3 12	CXII	D 0 5 33·3	4	5·13	5·40								
„ 18,19	3 39	CXI	D 0 5 34·3	8	5·00	5·40	590	4	·006	− 12·1	193·0			
„ 26	3 40	CXIII	D 0 4 11·4	6	5·04	5·60								
												194·6	193	25
„ 23	3 27	CXII	D 0 6 19·0	6	5·00	5·40	582	1	·001	− 25·0	196·3			
„ 26	3 29	CXIII	D 0 3 18·6	4	6·83	5·60								
„ 22	3 30	CXII	D 0 4 28·3	4	5·04	5·40	594	6	·010	+ 6·9	228·2			
„ 30	3 37	CXIV	D 0 5 9·9	4	6·75	5·40								
												228·0	226	28
„ 26	3 6	CXIII	D 0 2 26·7	6	5·17	5·60	539	− 1	·002	+ 33·2	227·8			
„ 30	3 13	CXIV	D 0 6 37·4	4	4·96	5·40								
„ 27	3 23	CXIII	D 0 5 3·6	4	5·25	5·60	565	−10	·017	− 2·8	191·8			
Apr. 2	3 56	CXV	D 0 4 43·2	6	5·04	5·40								
												192·8	191	28

* This height is to be combined with a negative sign because the pillar at CV, Minai, had a permanent addition made to it of 6 feet by a subsequent observer.

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Astronomical Date 1847	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Mar. 30	4 49	CXIV	D o 6 59·9	4	5·00	5·40	581	– 8	·014	– 34·2	193·8			
Apr. 1	4 10	CXV	D o 2 58·8	4	5·33	5·40								
Mar. 31	4 35	CXIV	D o 5 6·0	4	6·63	5·40	618	1	·002	– 0·7	227·3			
Apr. 3	4 59	CXVI	D o 4 58·3	4	7·58	5·35						227·0	224	26
" 1	4 30	CXV	D o 3 1·4	4	6·29	5·40	604	3	·005	+ 33·9	226·7			
" 3	4 52	CXVI	D o 6 55·6	4	4·68	5·35								
" 2	4 27	CXV	D o 5 8·6	4	5·04	5·40	587	– 5	·008	– 2·6	190·2			
" 10	5 4	CXVII	D o 4 40·7	4	7·92	5·44						191·7	189	21
" 4	5 7	CXVI	D o 6 19·7	6	8·00	5·35	582	21	·035	– 33·8	193·2			
" 10	5 9	CXVII	D o 2 27·4	4	6·79	5·44								
" 4	4 11	CXVI	D o 3 27·8	6	8·63	5·35	524	– 7	·013	+ 12·5	239·5			
" 12	3 55	CXVIII	D o 5 5·0	4	8·58	5·40						241·4	238	18
" 11	4 25	CXVII	D o 2 9·3	4	5·00	5·44	586	–14	·024	+ 51·6	243·3			
" 12	4 11	CXVIII	D o 7 58·4	4	7·67	5·40								
1848 Mar. 20	3 39	CXVII	D o 2 47·5	4	4·98	5·10	472	–24	·051	+ 21·6	213·3			
" 9,10	3 43	CXIX	D o 5 51·2	10	5·92	5·43						211·0	207	30
" 21	4 10	CXVIII	D o 6 21·3	8	4·98	5·11	527	9	·017	– 32·7	208·7			
" 9	4 4	CXIX	D o 2 7·8	4	5·48	5·43								
" 21	3 40	CXVIII	D o 3 1·9	4	3·21	5·11	556	1	·002	+ 27·9	269·3			
" 19	3 42	CXX	D o 6 6·5	4	5·89	2·41						267·7	264	13
" 9,11,12	4 44	CXIX	D o 2 36·2	14	3·77	5·43	721	53	·074	+ 55·2	266·2			
" 22,24	4 45	CXX	D o 7 35·1	8	5·24	2·41								
" 11	4 13	CXIX	D o 3 38·2	4	1·48	5·43	543	– 6	·011	+ 19·7	230·7			
" 5	4 10	CXXI	D o 5 47·6	4	6·21	5·23						232·8	{ 208·16 + 21·6	21·6
(1)	3 58	CXX	D o 6 35·4	12	6·46	3·86	624	15	·024	– 32·8	234·9			
(2)	3 59	CXXI	D o 3 11·2	12	4·79	5·25								
(3)	3 48	CXX	D o 5 43·4	14	4·27	3·86	641	13	·021	– 11·7	256·0			
(4)	3 47	CXXII	D o 4 35·8	14	4·09	5·27						255·1	{ 231·49 + 18	18
(5)	3 40	CXXI	D o 1 25·6	8	2·16	5·25	362	– 8	·022	+ 21·5	254·3			
(6)	3 41	CXXII	D o 5 31·4	8	1·38	5·27								
(7)	3 50	CXXI	D o 4 43·7	10	6·70	5·25	530	6	·011	– 7·8	222·0			
(8)	4 29	CXXV	D o 3 49·4	12	5·35	5·37						223·3	224	23

NOTE.—In some instances, the dates of observations could not be entered in their proper places in column 1 from want of space, this information is as follows:— (1) 19th March 1848, and 26th, 27th February 1855; (2) 4th March 1848, and 20th, 22nd February 1855; (3) 27th March 1848, and 26th, 27th February 1855; (4) 29th February 1848, and 21st January, 4th February 1855; (5) 4th March 1848, and 18th February 1855; (6) 22nd February 1848, and 5th February 1855; (7) 4th March 1848, and 18th, 21st February 1855; (8) 8th April 1848, and 6th, 11th April 1855.

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Astronomical Date		Station	Observed Vertical Angle	Number of observations	Height in feet		Contained Arc	Terrestrial Refraction		Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level			Height of Pillar or Tower
	Mean of Times of observation				Signal	Instrument		In seconds	Decimals of Contained Arc		Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	
	h. m.		° ′ ″				″							feet
(9)	3 58	CXXII	D 0 6 2·0	8	6·65	5·27	524	− 8	·016	− 25·0	224·5			
(10)	4 6	CXXV	D 0 2 57·4	8	4·26	5·37								
(11)	4 22	CXXII	D 0 4 21·9	8	1·54	5·29	654	21	·032	+ 18·0	267·5			
(12)	4 58	CXXVI	D 0 5 45·7	8	5·49	0·23						267·5	267	29
(13)	*4 32	CXXV	D 0 2 37·0	12	2·28	5·19	581	− 9	·015	+ 43·5	267·5			
(14)	*4 17	CXXVI	D 0 7 15·0	18	6·64	1·78								
(15)	3 28	CXXII	D 0 0 59·5	16	6·60	5·27	574	19	·033	+ 57·5	307·0			
(16)	3 31	CXXIII	D 0 7 56·3	10	4·28	5·32								
(17)	3 44	CXX	D 0 1 38·5	16	6·53	3·86	569	23	·041	+ 42·8	306·8	306·8	307	10
(18)	3 48	CXXIII	D 0 6 58·6	8	4·20	5·32								
(19)	4 17	CXXIV	D 0 5 14·9	12	4·23	5·22	426	− 8	·018	− 18·7	306·6			
(20)	4 20	CXXIII	D 0 2 6·0	8	6·38	5·32								
(21)	4 8	CXXII	D 0 1 51·7	8	6·50	5·27	682	1	·001	+ 75·3	324·8			
(22)	3 49	CXXIV	D 0 9 24·5	8	5·64	5·27								
(23)	4 9	CXXVI	D 0 3 13·0	8	6·57	2·81	733	0	·000	+ 58·7	325·7	325·4	325	20
(24)	4 9	CXXIV	D 0 9 0·5	12	1·47	5·27								
(25)	4 20	CXXIII	D 0 2 6·0	8	6·38	5·32	426	− 8	·018	+ 18·7	325·6			
(26)	4 17	CXXIV	D 0 5 14·9	12	4·23	5·22								

NOTE.—In some instances, the dates of observations could not be entered in their proper places in column 1 from want of space, this information is as follows:—(9) 20th February 1848, and 6th February 1855; (10) 8th April 1848, and 6th April 1855; (11) 22nd February 1848, and 25th March 1854; (12) 13th April 1848, and 6th April 1854; (13) 8th April, 13th May 1848, and 6th April 1855; (14) 13th April, 15th May 1848, and 31st March, 18th April 1855; (15) 20th February 1848, and 14th January, 3rd, 6th February 1855; (16) 16th April 1848, and 3rd March 1855; (17) 19th, 20th March 1848, and 26th, 27th February 1855; (18) 16th April 1848, and 3rd March 1855; (19) 15th April 1848, and 13th, 15th March 1855; (20) 16th April 1848, and 3rd March 1855; (21) 29th February 1848, and 6th February 1855; (22) 15th April 1848, and 21st March 1854; (23) 10th April 1848, and 25th March 1855; (24) 15th April 1848, and 18th, 20th March 1854; (25) 16th April 1848, and 3rd March 1855; (26) 15th April 1848, and 13th, 15th March 1855. * In these instances, the chronometer error not having been recorded, the times here given are mere chronometer readings.

Descriptions of Spirit-leveled Points.

The spirit-leveled heights given on pages 165—I. to 178—I., were determined by the operations either of the G. T. Survey or the Revenue Survey; these connections are hereafter indicated in the former case by the letters (G. T. S.), and in the latter by (R. S.) immediately following the name of each station; the surface on which the leveling staff stood is also described.

XI or *Atária Tower Station,* (G. T. S.); On the mark-stone imbedded at 2 feet above the level of the ground, over which the perforated masonry pillar has been built.

XIII „ *Kaliánpúr Tower Station,* „ } On the mark-stone let into the upper surface of the pillar.

XV „ *Umra Tower Station,* „ }

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Descriptions of Spirit-leveled Points—(Continued).

XXIV	or	*Rámnagar Tower Station,* (R. S.);	On the 2nd step of a flight of 32 steps leading to the summit of the tower, height = 498·82 feet. To this value, 25·80 feet (the height of the upper mark-stone of tower above this step) being added, the height of the *upper* mark-stone is found to be 524·62 feet.
XXVIII	,,	*Kutía Tower Station,* ,,	On a peg imbedded in the ruins of the earthen tower, height = 460·61 feet. To this value, 14·00 feet (the height of the upper mark-stone of tower above this peg) being added, the height of the *upper* mark-stone is found to be 474·61 feet.
XXXI	,,	*Lákún Tower Station,* ,,	On the upper surface of the pillar.
XXXII	,,	*Chelúa Tower Station,* ,,	
XXXV	,,	*Mási Tower Station,* ,,	
XXXIX	,,	*Tilakpúr Tower Station,* ,,	
XLIII	,,	*Saibara Tower Station,* ,,	On the mark-stone let at 1½ inches below the upper surface of the pillar.
LV	,,	*Púrena Tower Station,* (G. T. S.);	At foot of the tower, height = 274·33 feet. To this value, 24·92 feet (the height of the upper mark above this spot determined by subtense angles) being added, the height of the *upper* mark-stone is found to be 299·25 feet.
LVII	,,	*Bharmi Tower Station,* ,,	On the mark-stone let into the ground floor of the tower.
LVIII	,,	*Gharbaria Tower Station,* ,,	
LXIX	,,	*Bakwa Tower Station,* ,,	
LXXIX	,,	*Rúpdi Tower Station,* ,,	
CII	,,	*Dewánganj Tower Station,* ,,	
CIII	,,	*Latona Tower Station,* ,,	On the mark-stone imbedded at 2 feet below the level of the ground, over which the masonry pillar has been built.
CVII	,,	*Rámnagar Tower Station,* ,,	On the mark-stone imbedded at 1 foot below the level of the ground, over which the masonry pillar has been built.
CIX	,,	*Ghíba Tower Station,* ,,	On the mark-stone imbedded at 1¼ feet below the level of the ground, over which the masonry pillar has been built.
CXXI	,,	*Sonákhoda Tower Station,* ,,	On the mark-stone, in floor of vaulted passage, which carries the small piece of brass on which the mark denoting the end of the base-line is cut.
CXXII	,,	*Rámganj Tower Station,* ,,	

For further particulars of these stations, see pages 7—I. to 23—I.

November 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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NORTH-EAST LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XIII (Kaliánpúr)

Lat. N. 28° 35′ 11″·10; Long. E. 79° 47′ 0″·93 = 5^h 19^m 8^s·1; Height above Mean Sea Level, 629 feet.
March and April 1850; observed by Mr. G. Logan with Troughton and Simms' 24-inch Theodolite No. 2.

Star observed	α Ursæ Minoris (West and East).
Mean Right Ascension 1850·0	1^h 5^m 1^s
Mean North Polar Distance 1850·0	1° 29′ 24″·72
Local Mean Times of Elongation, Mar. 29	Western 6^h 35^m; Eastern 18 39

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Mar. 29	W.	0 2	+ 4 39 27·73	5 40	+ 0 1·86	+ 4 39 29·59	+ 4 39 29·50	0 2	+ 0 0·00	+ 4 39 29·50
		&	39 26·97	4 21	0 1·10	28·07	39 27·87	1 17	0 0·09	27·96
		180 2	39 32·43	5 31	0 1·77	34·20	39 24·70	10 17	0 6·14	30·84
			39 28·07	6 31	0 2·47	30·54	39 20·93	11 32	0 7·73	28·66
,, 29	E.	0 2	+ 1 16 44·13	30 34	− 0 54·13	+ 1 15 50·00	+ 1 16 28·83	21 34	− 0 27·00	+ 1 15 61·83
		&	16 37·76	29 24	0 50·07	47·69	16 20·90	20 27	0 24·28	56·62
		180 2	15 59·86	13 53	0 11·20	48·66	16 1·63	7 55	0 3·65	57·98
			15 57·00	12 44	0 9·42	47·58	16 0·33	6 23	0 2·37	57·96
			15 46·60	1 14	0 0·09	46·51				
			15 52·87	4 53	0 1·38	51·49				
,, 30	W.	20 4	+ 4 38 59·84	22 17	+ 0 28·90	+ 4 39 28·74	+ 4 39 16·50	14 44	+ 0 12·63	+ 4 39 29·13
		&	39 5·10	20 36	0 24·69	29·79	39 23·97	10 59	0 7·01	30·98
		200 4	39 29·73	6 11	0 2·22	31·95	39 22·67	6 8	0 2·19	24·86
			39 33·13	0 17	0 0·00	33·13	39 19·77	9 18	0 5·02	24·79
,, 31	E.	20 4	+ 1 16 11·70	19 28	− 0 21·98	+ 1 15 49·72	+ 1 16 2·77	11 8	− 0 7·21	+ 1 15 55·56
		&	16 9·27	18 8	0 19·07	50·20	15 59·50	9 52	0 5·66	53·84
		200 4	15 55·63	5 58	0 2·06	53·57	15 56·00	0 28	0 0·01	55·99
			15 51·93	4 38	0 1·25	50·68	15 57·03	4 12	0 1·03	56·00
			15 54·83	10 5	0 5·91	48·92				
			15 57·30	12 16	0 8·76	48·54				

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark – Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark – Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark – Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark – Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Apr. 4	W.	10 3	+ 4 39 22·97	12 5	+ 0 8·50	+ 4 39 31·47	+ 4 39 31·07	5 53	+ 0 2·01	+ 4 39 33·08
		&	39 21·27	10 34	0 6·49	27·76	39 28·77	4 51	0 1·37	30·14
		190 3	39 26·50	0 2	0 0·00	26·50	39 33·14	7 25	0 3·20	36·34
			39 24·77	4 3	0 0·96	25·73	39 32·57	8 19	0 4·02	36·59
„ 4	E.	10 3	+ 1 16 11·16	20 12	− 0 23·67	+ 1 15 47·49	+ 1 15 47·43	0 9	− 0 0·00	+ 1 15 47·43
		&	16 6·63	18 50	0 20·57	46·06	15 49·30	1 14	0 0·09	49·21
		190 3	15 49·17	5 41	0 1·88	47·29	15 58·56	11 36	0 7·84	50·72
			15 50·20	7 0	0 2·84	47·36	16 0·66	12 35	0 9·22	51·44

Abstract of Astronomical Azimuth observed at XIII (Kaliánpúr) 1850.

1. By Eastern Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°
Date	March 29		April 4		March 31	
	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	50·00 47·69 48·66 47·58 46·51 51·49	61·83 56·62 57·98 57·96	47·49 46·06 47·29 47·36	47·43 49·21 50·72 51·44	49·72 50·20 53·57 50·68 48·92 48·54	55·56 53·84 55·99 56·00
Means	48·66	58·60	47·05	49·70	50·27	55·35
	° ′ ″		″		″	
Means of both faces	+ 1 15 53·63		48·38		52·81	
Az. of Star fr. S., by W.	181 41 49·40		51·45		50·09	
Az. of Ref. M. „	182 57 43·03		39·83		42·90	

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Abstract of Astronomical Azimuth observed at XIII (Kaliánpúr) 1850—(*Continued*).

2. By Western Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°
Date	March 29		April 4		March 30	
	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	29·59 28·07 34·20 30·54	29·50 27·96 30·84 28·66	31·47 27·76 26·50 25·73	33·08 30·14 36·34 36·59	28·74 29·79 31·95 33·13	29·13 30·98 24·86 24·79
Means	30·60	29·24	27·87	34·04	30·90	27·44
	° ' "		"		"	
Means of both faces	+ 4 39 29·92		30·96		29·17	
Az. of Star fr. S., by W.	178 18 10·78		8·73		10·44	
Az. of Ref. M. „	182 57 40·70		39·69		39·61	

		° ' "
Astronomical Azimuth of Referring Mark	by Eastern Elongation	182 57 41·92
	by Western „	„ 40·00
	Mean	„ 40·96
Angle Referring Mark and XII (Donáo) *see* page 41—I.		+ 2 32 37·15
Astronomical Azimuth of Donáo by observation		185 30 18·11
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* page 155—I. *ante*		185 30 19·49
Astronomical—Geodetical Azimuth at XIII (Kaliánpúr)		— 1·38

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At Rámuápúr Azimuth Station*.

Lat. N. 28° 22′ 38″·72; Long. E. 80° 31′ 5″·51 = 5ʰ 22ᵐ 4ˢ·4; Height above Mean Sea Level, 546 feet.
December 1838; observed by Mr. C. Murphy, with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed	δ Ursæ Minoris (West and East).
Mean Right Ascension 1838·0	18ʰ 24ᵐ 35ˢ
Mean North Polar Distance 1838·0	3° 24′ 35″·43
Local Mean Times of Elongation, Dec. 23	Western 6ʰ 10ᵐ; Eastern 18 23

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 23	W.	220 0	+ 6 11 45·50	26 10	+ 1 31·00	+ 6 13 16·50	+ 6 12 54·33	13 10	+ 0 23·04	+ 6 13 17·37
		&	12 8·17	23 28	1 13·17	21·34	13 9·00	7 53	0 8·26	17·26
		40 1	13 19·50	1 8	0 0·17	19·67	12 56·00	13 42	0 24·82	20·82
			13 14·50	6 49	0 6·15	20·65	12 40·67	16 54	0 37·79	18·46
„ 23	E.	220 1	− 1 31 28·50	14 11	− 0 26·62	− 1 31 55·12	− 1 30 47·00	24 13	− 1 17·39	− 1 31 64·39
		&	31 38·17	11 47	0 18·37	56·54	30 59·33	21 50	1 2·96	62·29
		40 1	31 25·00	15 41	0 32·70	57·70	31 59·17	1 15	0 0·21	59·38
			31 17·67	17 33	0 40·97	58·64	31 54·33	7 32	0 7·53	61·86
„ 24	W.	230 1	+ 6 12 8·67	22 50	+ 1 9·33	+ 6 13 18·00	+ 6 13 11·50	7 48	+ 0 8·08	+ 6 13 19·58
		&	12 36·17	18 21	0 44·79	20·96	13 15·50	5 12	0 3·58	19·08
		50 1					13 11·50	8 6	0 8·70	20·20
„ 24	E.	230 1	− 1 31 33·50	13 38	− 0 24·58	− 1 31 58·08	− 1 30 56·67	22 31	− 1 6·97	− 1 31 63·64
		&	31 40·67	11 29	0 17·48	58·15	31 6·00	20 15	0 54·17	60·17
		50 1	31 58·50	1 24	0 0·26	58·76	31 41·17	11 50	0 18·59	59·76
			31 55·83	4 49	0 3·08	58·91	31 32·17	14 2	0 26·18	58·35
„ 25	W.	210 1	+ 6 13 2·83	9 19	+ 0 11·52	+ 6 13 14·35	+ 6 12 23·83	19 32	+ 0 50·74	+ 6 13 14·57
		&	13 7·67	6 30	0 5·62	13·29	12 36·17	16 32	0 36·31	12·48
		30 1	13 11·83	1 23	0 0·25	12·08	12 41·67	17 5	0 38·59	20·26
			13 0·83	9 32	0 12·03	12·86	12 26·17	19 37	0 50·88	17·05
„ 27	W.	200 1	+ 6 13 8·50	9 41	+ 0 12·46	+ 6 13 20·96	+ 6 12 35·67	16 45	+ 0 37·25	+ 6 13 12·92
		&	13 13·33	8 7	0 8·76	22·09	12 44·17	15 12	0 30·72	14·89
		20 1	13 21·17	1 30	0 0·30	21·47	11 56·33	24 41	1 20·40	16·73
			13 17·83	3 53	0 2·00	19·83	11 33·50	27 38	1 40·73	14·23
„ 27	E.	200 0	− 1 31 54·00	7 32	− 0 7·51	− 1 31 61·51	− 1 31 15·00	19 21	− 0 49·52	− 1 31 64·52
		&	31 56·33	4 43	0 2·95	59·28	31 30·00	16 33	0 36·22	66·22
		20 1	32 2·33	1 2	0 0·14	62·47	31 43·67	12 27	0 20·60	64·27
			31 57·17	4 42	0 2·93	60·10	31 25·17	17 2	0 38·52	63·69

* See Addendum on page 186—*I.*

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark − Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark − Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 28	W.	190 0 & 10 0	+ 6 13 16·83	7 1	+ 0 6·53	+ 6 13 23·36	+ 6 12 48·00	14 38	+ 0 28·43	+ 6 13 16·43
			13 17·67	5 14	0 3·64	21·31	12 54·00	12 45	0 21·62	15·62
			13 23·33	2 9	0 0·61	23·94	12 56·50	12 51	0 21·85	18·35
			13 16·07	5 36	0 4·14	20·81	12 48·67	14 52	0 29·24	17·91
„ 28	E.	190 1 & 10 1	− 1 31 51·83	6 9	− 0 5·01	− 1 31 56·84	− 1 31 28·50	15 38	− 0 32·36	− 1 31 60·86
			31 55·67	2 29	0 0·81	56·48	31 40·00	12 58	0 22·25	62·25
			31 59·67	1 52	0 0·46	60·13	31 33·50	14 26	0 27·67	61·17
			31 58·00	4 16	0 2·42	60·42	31 27·33	16 6	0 34·45	61·78
„ 29	E.	180 1 & 0 1	− 1 31 12·00	18 13	− 0 43·90	− 1 31 55·90	− 1 31 52·17	9 19	− 0 11·50	− 1 31 63·67
			31 19·33	16 4	0 34·16	53·49	31 56·83	7 19	0 7·09	63·92
							32 2·00	1 46	0 0·42	62·42
							31 57·83	4 15	0 2·39	60·22
„ 30	W.	180 1 & 0 1	+ 6 12 50·50	16 1	+ 0 34·10	+ 6 13 24·60	+ 6 13 8·33	8 12	+ 0 8·93	+ 6 13 17·26
			12 55·50	14 41	0 28·65	24·15	13 8·67	5 36	0 4·16	12·83
			12 57·83	13 47	0 25·15	22·98	13 15·00	3 46	0 1·87	16·87
			12 46·50	16 36	0 36·47	22·97	13 9·83	6 14	0 5·15	14·98
„ 30	E.	210 1 & 30 1	− 1 30 47·33	23 20	− 1 11·94	− 1 31 59·27	− 1 31 51·50	11 8	− 0 16·42	− 1 31 67·92
			31 4·33	20 56	0 57·90	62·23	31 55·00	9 18	0 11·47	66·47
			31 26·00	16 21	0 35·55	61·55	32 6·67	1 3	0 0·15	66·82
			31 16·83	18 42	0 46·45	63·28	31 59·17	6 28	0 5·55	64·72

Abstract of Astronomical Azimuth observed at Rámuápúr Azimuth Station 1838.

1. By Eastern Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	210°	30°	220°	40°	230°	50°
Date	December 29		December 28		December 27		December 30		December 23		December 24	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M. − Star reduced to Elongation	55·90	63·67	56·84	60·86	61·51	64·52	59·27	67·92	55·12	64·39	58·08	63·64
	53·49	63·92	56·48	62·25	59·28	66·22	62·23	66·47	56·54	62·29	58·15	60·17
		62·42	60·13	61·17	62·47	64·27	61·55	66·82	57·70	59·38	58·76	59·76
		60·22	60·42	61·78	60·10	63·69	63·28	64·72	58·64	61·86	58·91	58·35
Means	54·70	62·56	58·47	61·52	60·84	64·68	61·58	66·48	57·00	61·98	58·48	60·48

	° ′ ″	″	″	″	″	″
Means of both faces	− 1 31 58·63	60·00	62·76	64·03	59·49	59·48
Az. of Star fr. S., by W.	183 52 42·13	41·79	41·45	42·47	39·97	40·31
Az. of Ref. M. „	182 20 43·50	41·79	38·69	38·44	40·48	40·83

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Abstract of Astronomical Azimuth observed at Rámuápúr Azimuth Station 1838—(*Continued*).

2. By Western Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	210°	30°	220°	40°	230°	50°
Date	December 30		December 28		December 27		December 25		December 23		December 24	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference	24·60	17·26	23·36	16·43	20·96	12·92	14·35	14·57	16·50	17·37	18·00	19·58
of Circle-Readings,	24·15	12·83	21·31	15·62	22·09	14·89	13·29	12·48	21·34	17·26	20·96	19·08
Ref. M.—Star	22·98	16·87	23·94	18·35	21·47	16·73	12·08	20·26	19·67	20·82	.	20·20
reduced to Elongation	22·97	14·98	20·81	17·91	19·83	14·23	12·86	17·05	20·65	18·46		
Means	23·68	15·49	22·36	17·08	21·09	14·69	13·15	16·09	19·54	18·48	19·48	19·62
	° ′ ″		″		″		″		″		″	
Means of both faces	+ 6 13 19·59		19·72		17·89		14·62		19·01		19·55	
Az. of Star fr. S., by W.	176 7 17·75		18·43		18·77		19·57		20·26		19·92	
Az. of Ref. M. „	182 20 37·34		38·15		36·66		34·19		39·27		39·47	

		° ′ ″
Astronomical Azimuth of Referring Mark	by Eastern Elongation	182 20 40·62
	by Western „	„ 37·51
	Mean	„ 39·07
Angle Referring Mark and XXIV (Rámnagar) *see* following page		+120 35 54·35
Astronomical Azimuth of Rámnagar by observation		302 56 33·42
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* following page		302 56 33·59
Astronomical—Geodetical Azimuth at Rámuápúr Azimuth Station		— 0·17

Addendum to the Astronomical Azimuth observed at Rámuápúr Azimuth Station.

The station herein designated Rámuápúr Azimuth Station was selected and fixed at the termination of the operations of the Amua Meridional Series in 1838, when the Astronomical Azimuth which precedes this note and the angles of the triangle as well as the connecting angle to the Referring Mark which follow hereafter were measured. The tower marking the station stood in an open plain, 300 yards from the southern bank of the Chauka river and about 2 miles N.W. of the large village of Bhira; but in time the whole structure was washed away by the river, so that when Rámuápúr village was revisited in 1850, in course of the

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Addendum to the Astronomical Azimuth observed at Rámuápúr Azimuth Station—(Continued).

operations of the North-East Longitudinal Series, a new station, designated Rámuápúr XXII, was selected and fixed instead of the one destroyed. No Astronomical azimuth however was observed on the latter occasion and hence the comparison between Astronomical and Geodetical Azimuths in this locality is necessarily made at the station of 1838 or Rámuápúr Azimuth Station. It will be seen from what follows that the two points were nearly on the same meridian and about 2,796 feet apart.

Station	Probability	Spherical Excess	Correction to Observed Angle	Corrected Plane Angle	Distance		
					Log. Feet	Feet	Miles
		"	"	° ' "			
XXIV	0·60	0·29	+0·12	57 43 13·47	4·8049431	63817·99	12·087
XXIII	1·03	·29	+ ·21	62 50 7·17	4·8270967	67157·83	12·719
Rámuápúr Azimuth Station	·88	·29	+ ·18	59 26 39·36	4·8129254	65001·80	12·311
		·87	+ ·51	180 0 0·00			

Proceeding in the usual manner, we find,

At XXIV, Rámnagar

Azimuth of Rámuápúr Azimuth Station 123° 1′ 32″·73

At Rámuápúr Azimuth Station

Latitude N.	28°	22′	38″·72
Longitude East of Greenwich	80	31	5 ·51
Azimuth of XXIV, Rámnagar	302	56	33 ·59

Also from above data and those given on page 156—I., the following are deduced :—

At Rámuápúr or XXII, Azimuth of Rámuápúr Azimuth Station, 181° 21′ 16″

Rámuápúr or XXII to Rámuápúr Azimuth Station, Log. feet 3·4465695, feet 2796·21, mile 0·530.

The observed values of the angle at Rámuápúr Azimuth Station, connecting the Referring Mark with XXIV, Rámnagar, are as follows :—

At Rámuápúr Azimuth Station.

December 1838; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle-readings, telescope being set on R. M.												General Mean
	239° 25′	59° 25′	249° 25′	69° 25′	259° 25′	79° 25′	269° 25′	89° 25′	279° 25′	99° 25′	289° 25′	109° 25′	
	"	"	"	"	"	"	"	"	"	"	"	"	
R. M. & XXIV	l54·50 l54·50	l52·50 l53·00	l52·67 l53·67	l50·67 l50·33	l56·83 l56·00	l54·17 l55·50	l51·83 l52·17	l55·00 l55·33	l57·00 l57·33	l54·00 l55·83	l56·00 l57·17	l54·17 l54·33	
	54·50	52·75	53·17	50·50	56·42	54·83	52·00	55·17	57·16	54·92	56·58	54·25	120° 35′ 54″·35

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At XXXV (Mási)

Lat. N. 27° 38′ 25″·17; Long. E. 81° 25′ 36″·15 = 5ʰ 25ᵐ 42ˢ·4; Height above Mean Sea Level, 426 feet.
December 1849 and January 1850; observed by Mr. G. Logan, with Troughton and Simms' 24-inch Theodolite No. 2.

Star observed	δ Ursæ Minoris (West and East).
Mean Right Ascension 1850·0	$18^h\ 20^m\ 44^s$
Mean North Polar Distance 1850·0	$3°\ 24'\ 9''{\cdot}99$
Local Mean Times of Elongation, Dec. 26	Western $5^h\ 54^m$; Eastern $18^h\ 6^m$

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark − Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark − Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 26	W.	0 3	+ 4 8 19·67	7 51	+ 0 8·08	+ 4 8 27·75	+ 4 8 30·27	3 3	+ 0 1·23	+ 4 8 31·50
		&	8 9·23	10 17	0 13·88	23·11	8 27·80	5 20	0 3·72	31·52
		180 3	8 6·80	11 34	0 17·52	24·32	8 0·00	16 2	0 33·70	33·70
			7 28·44	21 0	0 57·72	26·16				
			6 38·20	28 32	1 46·40	24·60				
" 26	E.	0 3	− 3 30 38·40	26 48	− 1 33·85	− 3 32 12·25	− 3 31 34·40	17 27	− 0 39·90	− 3 32 14·30
		&	30 56·20	24 12	1 16·62	12·82	31 36·40	15 47	0 32·64	9·04
		180 3	32 1·66	9 42	0 12·34	14·00	32 13·67	1 35	0 0·33	14·00
			32 2·97	7 20	0 7·05	10·02	32 16·67	0 47	0 0·08	16·75
			32 2·00	9 16	0 11·29	13·29	31 31·66	17 55	0 42·27	13·93
			31 53·64	11 12	0 16·51	10·15	31 24·56	19 39	0 50·77	15·33
" 27	W.	20 4	+ 4 7 17·56	23 2	+ 1 9·85	+ 4 8 27·41	+ 4 7 52·90	15 29	+ 0 31·53	+ 4 8 24·43
		&	7 30·50	21 23	1 0·17	30·67	8 2·40	13 18	0 23·25	25·65
		200 4	8 25·60	5 32	0 4·03	29·63	8 26·03	0 19	0 0·01	26·04
			8 28·74	3 52	0 1·97	30·71	8 22·90	3 34	0 1·67	24·57
			8 13·27	10 55	0 15·63	28·90				
			8 8·53	12 22	0 20·02	28·55				
" 27	E.	20 4	− 3 31 17·20	19 8	− 0 47·92	− 3 32 5·12	− 3 31 58·73	9 7	− 0 10·91	− 3 32 9·64
		&	31 37·77	15 42	0 32·25	10·02	32 7·03	7 33	0 7·48	14·51
		200 4	32 12·33	2 21	0 0·73	13·06	32 6·10	6 55	0 6·29	12·39
			32 9·90	0 21	0 0·02	9·92	31 59·60	9 8	0 10·95	10·55
" 28	W.	30 5	+ 4 7 38·56	19 56	+ 0 52·31	+ 4 8 30·87	+ 4 8 4·73	12 32	+ 0 20·66	+ 4 8 25·39
		&	7 51·97	17 57	0 42·39	34·36	8 12·94	10 29	0 14·44	27·38
		210 5	8 31·20	3 7	0 1·27	32·47	8 22·17	7 2	0 6·49	28·66
			8 31·93	0 29	0 0·03	31·96	8 15·26	10 6	0 13·35	28·61
" 28	E.	30 5	− 3 31 47·67	13 54	− 0 25·30	− 3 32 12·97	− 3 32 11·64	5 27	− 0 3·91	− 3 32 15·55
		&	31 57·97	11 36	0 17·66	15·63	32 15·37	3 45	0 1·85	17·22
		210 5	32 16·40	1 26	0 0·27	16·67	31 56·10	12 7	0 19·33	15·43
			32 9·97	4 26	0 2·59	12·56	31 49·93	14 12	0 26·50	16·43
" 29	W.	50 2	+ 4 7 58·20	15 43	+ 0 32·50	+ 4 8 30·70	+ 4 8 20·37	8 54	+ 0 10·41	+ 4 8 30·78
		&	8 5·43	13 55	0 25·46	30·89	8 25·67	7 21	0 7·09	32·76
		230 2	8 31·17	0 6	0 0·00	31·17	8 16·70	7 50	0 8·04	24·74
			8 30·26	1 51	0 0·45	30·71	8 13·50	9 35	0 12·04	25·54

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT				FACE RIGHT			
			Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation	Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 29	E.	50 2	− 3 31 56·36	9 29	− 0 11·80	− 3 32 8·16	− 3 32 10·10	1 18	− 0 0·22	− 3 32 10·32
		&	32 1·83	7 43	0 7·80	9·63	32 12·50	0 38	0 0·05	12·55
		230 2	32 2·40	7 31	0 7·41	9·81	31 20·80	20 1	0 52·69	13·49
			31 49·37	13 17	0 23·18	12·55	31 13·20	21 26	1 0·44	13·64
„ 31	W.	40 5	+ 4 8 33·54	0·27	+ 0 0·03	+ 4 8 33·57	+ 4 8 22·90	6 46	+ 0 6·01	+ 4 8 28·91
		&	8 31·37	1 28	0 ·0·28	31·65	8 26·80	4 54	0 3·16	29·96
		220 5	7 49·60	17 46	0 41·34	30·94	8 17·13	9 5	0 10·82	27·95
			7 42·83	19 24	0 49·22	32·05	8 12·43	10 50	0 15·39	27·82
„ 31	E.	40 5	− 3 31 40·80	15 43	− 0 32·35	− 3 32 13·15	− 3 32 13·87	4 45	− 0 2·96	− 3 32 16·83
		&	31 49·40	12 13	0 19·58	8·98	32 17·44	1 11	0 0·18	17·62
		220 5	32 8·56	6 18	0 5·21	13·77	31 41·43	16 33	0 36·06	17·49
			32 5·17	7 48	0 7·99	13·16	31 35·87	18 0	0 42·60	18·47
Jan. 1	W.	10 2	+ 4 8 38·96	0 40	+ 0 0·06	+ 4 8 39·02	+ 4 8 24·24	5 52	+ 0 4·50	+ 4 8 28·74
		&	8 33·63	1 48	0 0·42	34·05	8 21·83	7 14	0 6·86	28·69
		190 2	8 15·83	11 44	0 18·02	33·85	7 44·07	17 58	0 42·23	26·30
			8 10·43	13 1	0 22·19	32·62	7 38·04	19 19	0 48·82	26·86
			6 43·80	28 35	1 46·75	30·55				
„ 1	E.	10 2	− 3 31 58·00	8 56	− 0 10·45	− 3 32 8·45	− 3 32 17·03	0 27	− 0 0·03	− 3 32 17·06
		&	32 5·54	7 35	0 7·55	13·09	32 17·20	1 37	0 0·34	17·54
		190 3	31 56·50	10 13	0 13·71	10·21	30 38·03	27 1	1 36·13	14·16
			31 57·70	11 33	0 17·53	15·23				

Abstract of Astronomical Azimuth observed at XXXV (Mási) 1849-50.

1. By Eastern Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°
Date	December 26		January 1		December 27		December 28		December 31		December 29	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	12·25	14·30	8·45	17·06	5·12	9·64	12·97	15·55	13·15	16·83	8·16	10·32
	12·82	9·04	13·09	17·54	10·02	14·51	15·63	17·22	8·98	17·62	9·63	12·55
	14·00	14·00	10·21	14·16	13·06	12·39	16·67	15·43	13·77	17·49	9·81	13·49
	10·02	16·75	15·23		9·92	10·55	12·56	16·43	13·16	18·47	12·55	13·64
	13·29	13·93										
	10·15	15·33										
Means	12·09	13·89	11·75	16·25	9·53	11·77	14·46	16·16	12·27	17·60	10·04	12·50
	° ′ ″		″		″		″		″		″	
Means of both faces	− 3 32 12·99		14·00		10·65		15·31		14·94		11·27	
Az. of Star fr. S., by W.	183 50 21·29		23·71		21·70		22·10		23·30		22·50	
Az. of Ref. M. „	180 18 8·30		9·71		11·05		6·79		8·36		11·23	

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Abstract of Astronomical Azimuth observed at XXXV (Mási) 1849-50—(*Continued*).

2. By Western Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°
Date	December 26		January 1		December 27		December 28		December 31		December 29	
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	27″·75	31″·50	39″·02	28″·74	27″·41	24″·43	30″·87	25″·39	33″·57	28″·91	30″·70	30″·78
	23·11	31·52	34·05	28·69	30·67	25·65	34·36	27·38	31·65	29·96	30·89	32·76
	24·52	33·70	33·85	26·30	29·63	26·04	32·47	28·66	30·94	27·95	31·17	24·74
	26·16		32·62	26·86	30·71	24·57	31·96	28·61	32·05	27·82	30·71	25·54
	24·60		30·55		28·90							
					28·55							
Means	25·19	32·24	34·02	27·65	29·31	25·17	32·42	27·51	32·05	28·66	30·87	28·46
Means of both faces	+ 4° 8′ 28″·72		30″·84		27″·24		29″·97		30″·36		29″·67	
Az. of Star fr. S., by W.	176 9 38·91		36·49		38·50		38·10		36·89		37·70	
Az. of Ref. M. ,,	180 18 7·63		7·33		5·74		8·07		7·25		7·37	

			° ′ ″
Astronomical Azimuth of Referring Mark	by Eastern Elongation	... ...	180 18 9·24
	by Western ,,	... ...	,, 7·23
	Mean ...	... ...	,, 8·24
Angle Referring mark and XXXIII (Bela) *see* page 57—I.		... ...	− 27 12 18·07
Astronomical Azimuth of Bela by observation ...		... ...	153 5 50·17
Geodetical Azimuth of ,, by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* page 156—I. *ante*		... ...	153 5 55·97
Astronomical—Geodetical Azimuth at XXXV (Mási) ...		... ...	− 5·80

At XLV (Bansídíla)

Lat. N. 27° 24′ 3″·24; Long. E. 82° 19′ 17″·62 = 5h 29m 17s·2; Height above Mean Sea Level, 377 feet.
April 1849; observed by Mr. G. Logan with Barrow's 36-inch Theodolite.

Star observed	α Ursæ Minoris (West and East).
Mean Right Ascension 1849·0	1h 4m 43s
Mean North Polar Distance 1849·0	1° 29′ 43″·99
Local Mean Times of Elongation, Apr. 4	Western 6h 10m; Eastern 18 15

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	Face Left: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Face Left: Interval in Time from Elongation	Face Left: Reduction in Arc to Time of Elongation	Face Left: Reduced Observation Ref. Mark—Star at Elongation	Face Right: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Face Right: Interval in Time from Elongation	Face Right: Reduction in Arc to Time of Elongation	Face Right: Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Apr. 4	W.	9 3	− 2 40 49·56	22 46	+ 0 29·94	− 2 40 19·62	− 2 40 31·88	11 31	+ 0 7·67	− 2 40 24·21
		&	40 40·22	18 25	0 19·57	20·65	40 27·90	9 29	0 5·20	22·70
		189 3	40 24·44	2 6	0 0·25	24·19	40 27·26	5 58	0 2·06	25·20
			40 22·98	0 7	0 0·00	22·98	40 29·24	8 9	0 3·83	25·41
			40 42·42	17 0	0 16·66	25·76				
			40 48·14	19 8	0 21·10	27·04				

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark − Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark − Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Apr. 4	E.	9 3	− 6 0 46·52	43 18	− 1 47·61	− 6 2 34·13	− 6 1 34·28	31 51	− 0 58·35	− 6 2 32·63
		&	1 0·56	40 32	1 34·32	34·88	1 41·26	29 46	0 50·97	32·23
		189 3	2 5·20	22 44	0 29·75	34·95	2 23·28	12 30	0 9·01	32·29
			2 9·34	20 24	0 23·96	33·30	2 26·24	10 29	0 6·34	32·58
			2 31·36	3 9	0 0·57	31·93	2 25·74	8 3	0 3·74	29·48
			2 33·00	0 20	0 0·01	33·01	2 21·16	10 24	0 6·25	27·41
" 5	E.	18 3	− 6 1 1·06	40 7	− 1 32·43	− 6 2 33·49	− 6 1 37·40	31 30	− 0 57·06	− 6 2 34·46
		&	1 10·86	37 59	1 22·87	33·73	1 45·12	29 33	0 50·21	35·33
		198 3	2 11·84	20 56	0 25·25	37·09	2 24·74	13 14	0 10·10	34·84
			2 15·14	18 54	0 20·57	35·71	2 27·64	11 16	0 7·31	34·95
			2 34·84	4 14	0 1·03	35·87	2 33·48	5 50	0 1·96	35·44
			2 36·46	0 1	0 0·00	36·46	2 31·02	8 10	0 3·86	34·88
" 6	W.	27 3	− 2 41 10·32	27 49	+ 0 44·69	− 2 40 25·63	− 2 40 43·92	18 3	+ 0 18·81	− 2 40 25·11
		&	41 5·34	25 29	0 37·49	27·85	40 37·24	14 27	0 12·06	25·18
		207 3	40 30·06	8 44	0 4·41	25·65	40 27·36	2 30	0 0·36	27·00
			40 28·02	7 24	0 3·16	24·86	40 26·46	0 5	0 0·00	26·46
			40 29·30	5 0	0 1·44	27·86	40 34·88	11 46	0 7·98	26·90
			40 29·78	6 30	0 2·44	27·34	40 36·80	13 27	0 10·43	26·37
" 6	E.	27 3	− 6 1 7·56	39 0	− 1 27·40	− 6 2 34·96	− 6 1 40·94	30 6	− 0 52·12	− 6 2 33·06
		&	1 14·10	36 43	1 17·47	31·57	1 47·12	28 12	0 45·75	32·87
		207 3	2 7·90	21 49	0 27·40	35·30	2 26·76	12 26	0 8·92	35·68
			2 10·64	19 40	0 22·30	32·94	2 28·32	10 0	0 5·77	34·09
			2 32·16	4 21	0 1·09	33·25	2 33·46	6 14	0 2·24	35·70
			2 34·70	0 5	0 0·00	34·70	2 27·90	8 44	0 4·41	32·31
" 7	W.	18 3	− 2 41 3·70	26 48	+ 0 41·49	− 2 40 22·21	− 2 40 41·72	14 10	+ 0 11·60	− 2 40 30·12
		&	40 44·02	20 52	0 25·16	18·86	40 37·86	11 56	0 8·22	29·64
		198 3	40 26·30	2 53	0 0·48	25·82	40 29·68	7 7	0 2·92	26·76
			40 24·24	0 14	0 0·00	24·24	40 32·02	8 53	0 4·56	27·46
			40 36·02	14 2	0 11·36	24·66	40 52·62	21 7	0 25·69	26·93
			40 40·34	15 35	0 14·01	26·33	40 57·12	22 37	0 29·48	27·64
" 7	E.	0 3	− 6 1 1·78	38 37	− 1 25·68	− 6 2 27·46	− 6 1 44·90	29 22	− 0 49·60	− 6 2 34·50
		&	1 16·40	36 12	1 15·30	31·70	1 52·34	27 0	0 41·98	34·32
		180 3	2 5·36	21 26	0 26·44	31·80	2 23·98	14 44	0 12·50	36·48
			2 11·46	20 2	0 23·13	34·59	2 25·58	12 58	0 9·70	35·28
			2 34·56	5 31	0 1·76	36·32	2 30·50	7 57	0 3·65	34·15
			2 34·98	0 1	0 0·00	34·98	2 27·30	10 17	0 5·96	33·26
" 8	W.	0 3	− 2 41 8·30	29 17	+ 0 49·52	− 2 40 18·78	− 2 40 39·70	16 52	+ 0 16·43	− 2 40 23·27
		&	40 52·10	24 35	0 34·92	17·18	40 35·28	14 52	0 12·76	22·52
		180 3	40 26·14	8 59	0 4·66	21·48	40 28·96	0 12	0 0·00	28·96
			40 23·48	5 51	0 1·97	21·51	40 22·72	1 39	0 0·16	22·56
			40 29·94	9 0	0 4·67	25·27	40 37·98	15 46	0 14·32	23·66
			40 30·64	10 41	0 6·58	24·06	40 39·88	17 13	0 17·08	22·80

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Abstract of Astronomical Azimuth observed at XLV (Bansídíla) 1849.

1. By Eastern Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R
Zero	0°	180°	9°	189°	18°	198°	27°	207°
Date	April 7		April 4		April 5		April 6	
	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	27·46	34·50	34·13	32·63	33·49	34·46	34·96	33·06
	31·70	34·32	34·88	32·23	33·73	35·33	31·57	32·87
	31·80	36·48	34·95	32·29	37·09	34·84	35·30	35·68
	34·59	35·28	33·30	32·58	35·71	34·95	32·94	34·09
	36·32	34·15	31·93	29·48	35·87	35·44	33·25	35·70
	34·98	33·26	33·01	27·41	36·46	34·88	34·70	32·31
Means	32·81	34·67	33·70	31·10	35·39	34·98	33·79	33·95
	° ′ "		"		"		"	
Means of both faces	— 6 2 33·74		32·40		35·19		33·87	
Az. of Star fr. S., by W.	181 41 5·74		4·71		5·06		5·39	
Az. of Ref. M. "	175 38 32·00		32·31		29·87		31·52	

2. By Western Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R
Zero	0°	180°	9°	189°	18°	198°	27°	207°
Date	April 8		April 4		April 7		April 6	
	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	18·78	23·27	19·62	24·21	22·21	30·12	25·63	25·11
	17·18	22·52	20·65	22·70	18·86	29·64	27·85	25·18
	21·48	28·96	24·19	25·20	25·82	26·76	25·65	27·00
	21·51	22·56	22·98	25·41	24·24	27·46	24·86	26·46
	25·27	23·66	25·76		24·66	26·93	27·86	26·90
	24·06	22·80	27·04		26·33	27·64	27·34	26·37
Means	21·38	23·96	23·37	24·38	23·69	28·09	26·53	26·17
	° ′ "		"		"		"	
Means of both faces	— 2 40 22·67		23·88		25·89		26·35	
Az. of Star fr. S., by W.	178 18 54·08		55·45		54·42		54·76	
Az. of Ref. M. "	175 38 31·41		31·57		28·53		28·41	

		° ′ "
Astronomical Azimuth of Referring Mark	by Eastern Elongation	175 38 31·43
	by Western "	" 29·98
	Mean	" 30·71
Angle Referring Mark and XLIII (Saibara) *see* page 64—*I.*		— 69 23 22·28
Astronomical Azimuth of Saibara by observation		106 15 8·43
Geodetical Azimuth of " by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* page 157—*I.* *ante*		106 15 12·51
Astronomical—Geodetical Azimuth at XLV (Bansídíla)		— 4·08

At LXXI (Naonangarhi)

Lat. N. 26° 59′ 10″·19; Long. E. 84° 26′ 14″·04 = 5ʰ 37ᵐ 44ˢ·9; Height above Mean Sea Level, 344 feet.
June 1852; observed by Mr. J. W. Armstrong with Barrow's 24-inch Theodolite No. 2.

Star observed	λ Ursæ Minoris (East).
Mean Right Ascension 1852·0	20ʰ 11ᵐ 15ˢ
Mean North Polar Distance 1852·0	1° 7′ 59″·94
Local Mean Time of Elongation, June 13	Eastern 8ʰ 46ᵐ

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
June 13	E.	0 1 & 180 1	− 1 16 11·10	32 0	− 0 44·59	− 1 16 55·69	− 1 16 38·76	17 52	− 0 13·92	− 1 16 52·68
			16 16·77	29 30	0 37·89	54·66	16 44·80	14 31	0 9·20	54·00
			16 52·50	5 45	0 1·45	53·95	16 51·26	5 58	0 1·56	52·82
			16 50·56	3 14	0 0·46	51·02	16 52·00	9 0	0 3·54	55·54
			16 39·30	17 41	0 13·67	52·97	16 14·60	29 40	0 38·42	53·02
			16 35·60	20 15	0 17·92	53·52	16 8·40	31 45	0 44·02	52·42
" 14	E.	10 1 & 190 1	− 1 16 23·60	25 42	− 0 28·77	− 1 16 52·37	− 1 16 47·07	13 17	− 0 7·70	− 1 16 54·77
			16 28·50	23 4	0 23·18	51·68	16 48·03	10 49	0 5·11	53·14
			16 50·77	2 38	0 0·30	51·07	16 47·13	9 46	0 4·17	51·30
			16 50·20	0 11	0 0·00	50·20	16 45·94	12 12	0 6·51	52·45
			16 32·73	20 2	0 17·55	50·28	15 49·66	36 56	0 59·53	49·19
			16 28·27	22 35	0 22·28	50·55	15 47·10	38 57	1 6·19	53·29
" 16	E.	20 21 & 200 20	− 1 16 24·00	25 37	− 0 28·61	− 1 16 52·61	− 1 16 50·30	11 47	− 0 6·05	− 1 16 56·35
			16 29·74	23 23	0 23·82	53·56	16 53·80	9 21	0 3·81	57·61
" 22	E.	50 55 & 230 55	− 1 16 24·46	24 16	− 0 25·64	− 1 16 50·10	− 1 16 38·36	14 14	− 0 8·84	− 1 16 47·20
			16 31·07	21 55	0 20·93	52·00	16 43·03	12 29	0 6·80	49·83
			16 48·70	4 57	0 1·07	49·77	16 44·67	5 55	0 1·53	46·20
			16 50·14	2 41	0 0·31	50·45	16 48·10	7 53	0 2·71	50·81
			16 37·50	17 46	0 13·79	51·29	16 13·03	27 15	0 32·41	45·44
			16 33·76	19 47	0 17·08	50·84	16 7·83	28 49	0 36·23	44·06
" 24	E.	40 44 & 220 44	− 1 16 26·07	25 6	− 0 27·45	− 1 16 53·52	− 1 16 39·90	13 58	− 0 8·50	− 1 16 48·40
			16 28·93	22 48	0 22·66	51·59	16 44·90	11 30	0 5·78	50·68
			16 52·84	1 52	0 0·15	52·99	16 41·74	8 46	0 3·35	45·09
			16 52·23	0 27	0 0·01	52·24	16 45·27	10 48	0 5·10	50·37
			16 34·94	19 30	0 16·59	51·53	16 3·40	31 46	0 44·02	47·42
			16 33·07	21 23	0 19·98	53·05	15 59·30	34 9	0 50·86	50·16
			14 23·80	57 59	2 26·39	50·19	15 18·36	45 35	1 30·57	48·93
			14 5·97	60 39	2 40·05	46·02	15 9·47	47 22	1 37·80	47·27
" 25	E.	30 33 & 210 33	− 1 16 38·37	16 39	− 0 12·09	− 1 16 50·46	− 1 16 40·83	4 20	− 0 0·82	− 1 16 41·65
			16 39·87	12 41	0 7·01	46·88	16 46·60	2 30	0 0·27	46·87
			16 42·90	5 30	0 1·32	44·22	16 34·57	14 46	0 9·51	44·08
			16 44·77	7 19	0 2·34	47·11	16 35·07	16 29	0 11·86	46·93
			16 22·50	23 33	0 24·19	46·69	15 34·30	39 56	1 9·56	43·86
			16 19·44	25 24	0 28·17	47·61	14 53·63	50 43	1 52·06	45·69

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
June 26	E.	20 24	− 1 16 26·80	21 57	− 0 21·05	− 1 16 47·85	− 1 16 41·56	11 26	− 0 5·71	− 1 16 47·27
		&	16 24·37	23 53	0 24·89	49·26	16 36·86	13 36	0 8·07	44·93
		200 24	15 24·23	42 59	1 20·57	44·80	15 53·43	33 39	0 49·40	42·83
			15 14·23	46 40	1 34·88	49·11	15 48·30	35 41	0 55·56	43·86
			13 36·53	66 12	3 10·52	47·05	14 33·87	54 46	2 10·62	44·49
			13 21·30	68 37	3 24·54	45·84	14 27·13	56 28	2 18·77	45·90
			11 26·60	86 8	5 21·31	47·91	12 25·50	77 9	4 18·27	43·77
			11 9·20	88 17	5 37·30	46·50	12 7·93	80 9	4 38·58	46·51

Abstract of Astronomical Azimuth observed at LXXI (Naonangarhi) 1852.

By Eastern Elongation of λ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°	31°	211°	41°	221°	51°	231°
Date	June 13		June 14		June 26		June 25		June 24		June 22	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	55·69	52·68	52·37	54·77	*49·29	*53·03	50·46	41·65	53·52	48·40	50·10	47·20
	54·66	54·00	51·68	53·14	*50·24	*54·29	46·88	46·87	51·59	50·68	52·00	49·83
	53·95	52·82	51·07	51·30	47·85	47·27	44·22	44·08	52·99	45·09	49·77	46·20
	51·02	55·54	50·20	52·45	49·26	44·93	47·11	46·93	52·24	50·37	50·45	50·81
	52·97	53·02	50·28	49·19	44·80	42·83	46·69	43·86	51·53	47·42	51·29	45·44
	53·52	52·42	50·55	53·29	49·11	43·86	47·61	45·69	53·05	50·16	50·84	44·06
					47·05	44·49			50·19	48·93		
					45·84	45·90			46·02	47·27		
					47·91	43·77						
					46·50	46·51						
Means	53·64	53·41	51·03	52·36	47·79	46·69	47·16	44·85	51·39	48·54	50·74	47·26
	° ′ ″		″		″		″		″		″	
Means of both faces	− 1 16 53·53		51·70		47·24		46·01		49·97		49·00	
Az. of Star fr. S., by W.	181 16 29·82		29·50		25·54		25·88		26·22		26·88	
Az. of Ref. M. „	179 59 36·29		37·80		38·30		39·87		36·25		37·88	

	° ′ ″
Astronomical Azimuth of Referring Mark by Eastern Elongation	179 59 37·73
Angle Referring Mark and LXIX (Bakwa) *see* following page	− 72 6 54·97
Astronomical Azimuth of Bakwa by observation	107 52 42·76
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* page 158—I. *ante*	107 52 50·12
Astronomical—Geodetical Azimuth at LXXI (Naonangarhi)	− 7·36

NOTE.—Where observations occurred on the same pair of zeros on different nights they are reduced in this abstract to one date—the most convenient—by allowing for star's change of place. The date so adopted appears at the head of the column, and the reduced observation is preceded by an asterisk.

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At LXXI (Naonangarhi)

June 1852; *observed by Mr. J. W. Armstrong with Barrow's* 24*-inch Theodolite No.* 2.

Angle between	Seconds of Observed Angles at each Zero												General Mean
	0° 2′	180° 2′	10° 1′	190° 1′	20° 21′	200° 21′	30° 32′	210° 33′	40° 43′	220° 43′	50° 55′	230° 55′	
	″	″	″	″	″	″	″	″	″	″	″	″	
LXIX & R. M.	h56·67 h56·97 h56·17	h55·83 h53·07 h50·30 h51·46	h57·17 h57·30 h53·56	h54·90 h54·46	h52·00 h53·84	h59·93 h55·64 h57·03 h49·86 h50·16	h56·14 h53·14 h51·60 h56·10 h58·80	h57·80 h57·83	h53·44 h53·07	h56·27 h56·76	h54·90 h56·43 h53·36	h53·33 h56·46 h53·90	
	56·60	52·67	56·01	54·68	52·92	54·52	55·16	57·82	53·26	56·52	54·90	54·56	72° 6′ 54″·97

At CVI (Chúni)

Lat. N. 26° 11′ 4″·72; Long. E. 87° 5′ 19″·98 = 5^h 48^m 21^s·3; Height above Mean Sea Level, 197 feet.
December 1846; observed by Lieutenant R. Walker with Troughton and Simms' 36-inch Theodolite.

Star observed	δ Ursæ Minoris (West and East).
Mean Right Ascension 1846·0	18^h 22^m 1^s
Mean North Polar Distance 1846·0	3° 24′ 17″·42
Local Mean Times of Elongation, Dec. 27	Western 5^h 52^m Eastern 18 4

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark − Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark − Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 27	W.	18 5	+ 1 13 14·38	9 39	+ 0 12·10	+ 1 13 26·48	+ 1 12 15·90	24 27	+ 1 17·71	+ 1 13 33·61
		&	13 19·96	7 19	0 6·94	26·90	12 39·52	20 50	0 56·37	35·89
		198 5	12 58·64	14 18	0 26·47	25·11	13 33·64	1 23	0 0·25	33·89
			12 44·44	17 56	0 41·56	26·00	13 29·24	4 56	0 3·15	32·39
„ 28	W.	27 6	+ 1 12 14·18	22 53	+ 1 8·07	+ 1 13 22·25	+ 1 13 20·06	9 44	+ 0 12·31	+ 1 13 32·37
		&	12 35·40	19 39	0 50·15	25·55	13 22·24	7 28	0 7·24	29·48
		207 5	13 25·08	1 27	0 0·27	25·35	12 46·98	19 14	0 47·80	34·78
			13 23·96	4 30	0 2·62	26·58	12 33·52	21 29	0 59·65	33·17
„ 28	E.	27 6	− 6 21 13·78	12 18	− 0 19·56	− 6 21 33·34	− 6 18 54·16	34 47	− 2 35·85	− 6 21 30·01
		&	21 26·34	7 36	0 7·48	33·82	19 18·64	32 11	2 13·47	32·11
		207 5	21 23·66	9 22	0 11·40	35·06	21 31·48	3 40	0 1·74	33·22
			21 13·72	12 38	0 20·72	34·44	21 27·36	5 50	0 4·41	31·77

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark − Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark − Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 29	E.	18 6	− 6 18 30·82	37 50	− 3 4·24	− 6 21 35·06	− 6 20 20·72	23 18	− 1 10·10	− 6 21 30·82
		&	19 10·96	33 25	2 23·95	34·91	20 43·98	19 11	0 47·59	31·57
		198 5	21 25·58	8 36	0 9·57	35·15	21 32·36	1 3	0 0·14	32·50
			21 29·18	6 30	0 5·48	34·66	21 30·84	3 3	0 1·21	32·05
			20 47·28	18 56	0 46·59	33·87				
			20 34·26	21 20	0 59·09	33·35				
„ 30	W.	9 2	+ 1 12 50·12	15 47	+ 0 32·35	+ 1 13 22·47	+ 1 13 33·78	2 10	+ 0 0·61	+ 1 13 34·39
		&	13 3·18	12 42	0 20·92	24·10	13 32·70	0 15	0 0·01	32·71
		189 1	12 40·96	18 39	0 44·96	25·92	11 36·28	30 8	1 57·06	33·34
			12 21·20	22 13	1 3·81	25·01	11 18·96	32 27	2 15·73	34·69
„ 30	E.	9 2	− 6 21 17·54	10 52	− 0 15·27	− 6 21 32·81	− 6 19 49·34	27 24	− 1 36·88	− 6 21 26·22
		&	21 25·78	8 50	0 10·11	35·89	20 5·00	25 4	1 21·08	26·08
		189 1	21 30·62	7 8	0 6·60	37·22	21 28·76	0 49	0 0·09	28·85
			21 26·78	9 53	0 12·70	39·48	21 27·92	1 34	0 0·32	28·24
„ 31	W.	0 5	+ 1 13 21·12	0 9	+ 0 0·00	+ 1 13 21·12	+ 1 13 18·24	11 40	+ 0 17·65	+ 1 13 35·89
		&	13 23·56	2 24	0 0·75	24·31	13 25·58	8 37	0 9·64	35·22
		180 4	12 24·42	22 15	1 3·98	28·40	13 13·26	11 6	0 15·93	29·19
			12 1·78	24 49	1 19·48	21·26	13 7·06	14 9	0 25·91	32·97
„ 31	E.	0 5	− 6 18 31·20	37 32	− 3 1·31	− 6 21 32·51	− 6 20 15·66	24 7	− 1 15·07	− 6 21 30·73
		&	18 56·80	35 4	2 38·45	35·25	20 28·08	22 1	1 2·66	30·74
		180 4	21 19·56	11 23	0 16·76	36·32	21 28·66	3 52	0 1·93	30·59
			21 26·40	9 17	0 11·14	37·54	21 30·36	1 36	0 0·33	30·69

Abstract of Astronomical Azimuth observed at CVI (Chúni) 1846.

1. By Eastern Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R
Zero	0°	180°	9°	189°	18°	198°	27°	207°
Date	December 31		December 30		December 29		December 28	
	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M. − Star reduced to Elongation	32·51	30·73	32·81	26·22	35·06	30·82	33·34	30·01
	35·25	30·74	35·89	26·08	34·91	31·57	33·82	32·11
	36·32	30·59	37·22	28·85	35·15	32·50	35·06	33·22
	37·54	30·69	39·48	28·24	34·66	32·05	34·44	31·77
					33·87			
					33·35			
Means	35·41	30·69	36·35	27·35	34·50	31·74	34·17	31·78

	December 31	December 30	December 29	December 28
	° ′ ″	″	″	″
Means of both faces	− 6 21 33·05	31·85	33·12	32·98
Az. of Star fr. S., by W.	183 47 30·24	29·88	29·52	29·17
Az. of Ref. M. „	177 25 57·19	58·03	56·40	56·19

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Abstract of Astronomical Azimuth observed at CVI (Chúni) 1846—(*Continued*).

2. By Western Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R
Zero	0°	180°	9°	189°	18°	198°	27°	207°
Date	December 31		December 30		December 27		December 28	
	"	"	"	"	"	"	"	"
Observed difference	21·12	35·89	22·47	34·39	26·48	33·61	22·25	32·37
of Circle-Readings,	24·31	35·22	24·10	32·71	26·90	35·89	25·55	29·48
Ref. M.—Star	28·40	29·19	25·92	33·34	25·11	33·89	25·35	34·78
reduced to Elongation	21·26	32·97	25·01	34·69	26·00	32·39	26·58	33·17
Means	23·77	33·32	24·38	33·78	26·12	33·95	24·93	32·45
	° ′ "		"		"		"	
Means of both faces	+ 1 13 28·55		29·08		30·04		28·69	
Az. of Star fr. S., by W.	176 12 29·94		30·30		31·37		31·01	
Az. of Ref. M. „	177 25 58·49		59·38		61·41		59·70	

		° ′ "
Astronomical Azimuth of Referring Mark	by Eastern Elongation	177 25 56·95
	by Western „	„ 59·75
	Mean	„ 58·35
Angle Referring Mark and CV (Minai) *see* page 112—I.	... ...	+ 8 23 40·74
Astronomical Azimuth of Minai by observation	... ...	185 49 39·09
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* page 160—I. *ante*	... ...	185 49 48·14
Astronomical—Geodetical Azimuth at CVI (Chúni)	... ...	— 9·05

At CXXII (Rámganj)

Lat. N. 26° 18′ 55″·51; Long. E. 88° 19′ 57″·61 = 5^h 53^m 19^s·8; Height above Mean Sea Level, 249 feet.
December 1852 and January 1853; observed by Mr. J. O. Nicolson with Barrow's 24-inch Theodolite No. 2.

Star observed	δ Ursæ Minoris (West and East).
Mean Right Ascension 1853·0	18^h 19^m 46^s
Mean North Polar Distance 1853·0	3° 24′ 4″·62
Local Mean Times of Elongation, Dec. 27	Western 5^h 48^m; Eastern 18 0

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ "	m s	′ "	° ′ "	° ′ "	m s	′ "	° ′ "
Dec. 27	W.	0 0	+165 41 9·60	11 47	+ 0 18·04	+165 41 27·64	+165 41 6·87	2 21	+ 0 0·72	+165 41 7·59
		&	41 12·83	10 1	0 13·06	25·89	41 6·97	0 41	0 0·06	7·03
		180 1	40 53·30	14 53	0 28·68	21·98	41 7·40	4 58	0 3·20	10·60
			40 50·00	16 27	0 35·04	25·04	41 4·67	6 25	0 5·35	10·02

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Ol Ref. Mar at Elon
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	°
Dec. 28	W.	20 0 & 200 1	+165 41 25·40	6 26	+ 0 5·37	+165 41 30·77	+165 40 48·57	13 37	+ 0 24·11	+165 41
			41 29·10	4 54	0 3·11	32·21	40 58·63	12 7	0 19·07	
			41 32·33	0 24	0 0·02	32·35	41 11·90	7 50	0 7·94	
			41 34·47	1 42	0 0·37	34·84	41 7·43	9 15	0 11·09	
" 28	E.	20 0 & 200 0	+158 6 8·00	6 23	− 0 5·29	+158 5 62·71	+158 5 46·50	2 2	− 0 0·54	+158 5
			6 3·30	4 47	0 2·96	60·34	5 45·20	0 34	0 0·04	
			6 48·40	19 16	0 48·31	60·09	5 56·77	10 13	0 13·56	
			6 56·00	20 43	0 55·79	60·21	6 7·53	11 52	0 18·31	
			7 50·00	27 53	1 41·14	68·86				
			8 4·33	30 32	2 1·35	62·98				
" 29	W.	40 0 & 220 1	+165 41 1·23	12 14	+ 0 19·45	+165 41 20·68	+165 41 8·17	4 9	+ 0 2·25	+165 41
			41 2·80	10 38	0 14·68	17·48	41 10·77	2 45	0 0·98	
			41 3·77	10 58	0 15·59	19·36	41 12·27	2 15	0 0·66	
			41 1·13	12 23	0 19·89	21·02	41 13·10	3 40	0 1·74	
			40 42·23	17 52	0 41·35	23·58				
			40 31·47	19 18	0 48·17	19·64				
" 29	E.	40 0 & 220 0	+158 5 52·30	1 36	− 0 0·33	+158 5 51·97	+158 6 0·00	11 9	− 0 16·13	+158 5
			5 51·00	0 2	0 0·00	51·00	6 4·10	9 20	0 11·30	
			5 53·93	7 42	0 7·70	46·23	6 28·00	17 46	0 41·02	
			6 1·73	9 43	0 12·28	49·45	6 39·10	19 53	0 51·42	
" 30	W.	236 59 & 56 59	+165 41 24·33	3 4	+ 0 1·22	+165 41 25·55	+165 41 12·00	5 43	+ 0 4·24	+165 41
			41 21·80	4 27	0 2·57	24·37	41 15·27	4 19	0 2·43	
			41 2·13	11 37	0 17·51	19·64	40 9·23	23 26	1 11·04	
			41 0·37	13 42	0 24·30	24·67	39 59·40	24 49	1 19·58	
" 30	E.	236 59 & 56 59	+158 6 4·03	9 27	− 0 11·56	+158 5 52·47	+158 5 44·00	0 53	− 0 0·10	+158 5
			6 7·57	7 58	0 8·24	59·33	5 46·23	0 7	0 0·00	
			6 52·43	20 1	0 52·07	60·36	5 51·97	6 33	0 5·58	
			7 3·10	21 43	1 1·34	61·76	5 55·73	8 6	0 8·51	
			7 9·50	23 13	1 10·14	59·36				
			7 18·60	24 27	1 17·81	60·79				
" 31	W.	256 59 & 76 59	+165 41 15·80	6 26	+ 0 5·37	+165 41 21·17	+165 41 12·83	0 41	+ 0 0·06	+165 41
			41 20·93	4 49	0 3·02	23·95	41 14·07	1 25	0 0·26	
			40 43·40	16 14	0 34·13	17·53	41 7·40	7 29	0 7·25	
			40 38·53	17 36	0 40·13	18·66	40 59·17	8 56	0 10·34	
			39 58·37	25 8	1 21·62	19·99				
			39 47·67	26 21	1 29·72	17·39				
" 31	E.	256 59 & 76 59	+158 5 58·80	5 27	− 0 3·84	+158 5 54·96	+158 6 15·70	15 45	− 0 32·09	+158 5
			5 55·63	4 17	0 2·37	53·26	6 11·27	13 23	0 23·21	
			5 54·47	0 35	0 0·05	54·42	6 1·33	11 9	0 16·17	
			5 54·43	2 24	0 0·74	53·69	6 4·90	12 33	0 20·50	

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark – Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark – Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark – Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark – Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Jan. 1	W.	276 59	+165 41 18·67	4 45	+ 0 2·92	+165 41 21·59	+165 41 8·67	3 32	+ 0 1·62	+165 41 10·29
		&	41 19·87	6 19	0 5·17	25·04	41 10·97	1 44	0 0·39	11·36
		96 59	40 59·63	12 59	0 21·84	21·47	40 8·27	21 55	1 2·08	10·35
			40 55·73	14 31	0 27·31	23·04	39 54·00	25 5	1 21·33	15·33
			39 51·93	28 25	1 44·26	36·19				
			39 35·13	29 47	1 54·53	29·66				
" 1	E.	276 59	+158 6 10·90	14 11	− 0 26·06	+158 5 44·84	+158 5 52·27	4 25	− 0 2·54	+158 5 49·73
		&	6 3·53	12 19	0 19·64	43·89	5 48·70	2 56	0 1·12	47·58
		96 59	6 10·20	14 23	0 26·89	43·31	5 45·03	3 27	0 1·55	43·48
			6 20·43	16 8	0 33·86	46·57	5 47·43	5 8	0 3·43	44·00
			6 26·90	17 39	0 40·47	46·43				
" 2	E.	0 0	+158 5 54·23	5 37	− 0 4·09	+158 5 50·14	+158 6 7·57	13 46	− 0 24·52	+158 5 43·05
		&	5 48·00	4 10	0 2·25	45·75	6 0·60	11 53	0 18·31	42·29
		180 0	5 51·23	1 11	0 0·18	51·05	6 1·73	11 54	0 18·41	43·32
			5 46·27	2 49	0 1·03	45·24	6 7·03	13 14	0 22·78	44·25
			5 52·43	4 26	0 2·55	49·88				

Abstract of Astronomical Azimuth observed at CXXII (Rámganj) 1852-53.

1. By Eastern Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	20°	200°	40°	220°	237°	57°	257°	77°	277°	97°
Date	January 2		December 28		December 29		December 30		December 31		January 1	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M. – Star reduced to Elongation	50·14	43·05	62·71	45·96	51·97	43·87	52·47	43·90	54·96	43·61	44·84	49·73
	45·75	42·29	60·34	45·16	51·00	52·80	59·33	46·23	53·26	48·06	43·89	47·58
	51·05	43·32	60·09	43·21	46·23	46·98	60·36	46·39	54·42	45·16	43·31	43·48
	45·24	44·25	60·21	49·22	49·45	47·68	61·76	47·22	53·69	44·40	45·57	44·00
	49·88		68·86				59·36				46·43	
			62·98				60·79					
Means	48·41	43·23	62·53	45·89	49·66	47·83	59·01	45·94	54·08	45·31	45·01	46·20
	° ′ ″		″		″		″		″		″	
Means of both faces	+158 5 45·82		54·21		48·75		52·48		49·70		45·61	
Az. of Star fr. S., by W.	183 47 45·49		43·48		43·87		44·32		44·76		45·15	
Az. of Ref. M. "	341 53 31·31		37·69		32·62		36·80		34·46		30·76	

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Abstract of Astronomical Azimuth observed at CXXII (Rámganj) 1852-53—(*Continued*).

2. By Western Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	20°	200°	40°	220°	237°	57°	257°	77°	277°	97°
Date	December 27		December 28		December 29		December 30		December 31		January 1	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	27·64 25·89 21·98 25·04	7·59 7·03 10·60 10·02	30·77 32·21 32·35 34·84	12·68 17·70 19·84 18·52	20·68 17·48 19·36 21·02 23·58 19·64	10·42 11·75 12·93 14·84	25·55 24·37 19·64 24·67	16·24 17·70 20·27 18·98	21·17 23·95 17·53 18·66 19·99 17·39	12·89 14·33 14·65 9·51	21·59 25·04 21·47 23·04 36·19 29·66	10·29 11·36 10·35 15·33
Means	25·14	8·81	32·54	17·19	20·29	12·49	23·56	18·30	19·78	12·85	26·17	11·83
	° ′ "		"		"		"		"		"	
Means of both faces	+165 41 16·98		24·87		16·39		20·93		16·32		19·00	
Az. of Star fr. S., by W.	176 12 17·02		16·69		16·35		15·91		15·46		15·01	
Az. of Ref. M. „	341 53 34·00		41·56		32·74		36·84		31·78		34·01	

		° ′ "
Astronomical Azimuth of Referring Mark	by Eastern Elongation	341 53 33·94
	by Western „	„ 35·16
	Mean	„ 34·55
Angle Referring Mark and CXXIV (Kanchábári) *see* below		—123 1 38·62
Astronomical Azimuth of Kanchábári by observation		218 51 55·93
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* page 161—I. *ante*		218 52 6·09
Astronomical—Geodetical Azimuth at CXXII (Rámganj)		— 10·16

At CXXII (Rámganj)

December 1852 *and January* 1853; *observed by Mr. J. O. Nicolson with Barrow's* 24-*inch Theodolite No.* 2.

Angle between	Seconds of Observed Angles at each Zero												General Mean
	0° 1′	180° 1′	20° 1′	200° 1′	40° 1′	220° 1′	236° 59′	56° 59	256° 59′	76° 59′	276° 59′	96° 59′	
	"	"	"	"	"	"	"	"	"	"	"	"	
CXXIV & R. M.	*h*34·87 *h*34·50	*h*36·93 *h*35·67	*h*40·50 *h*39·63	*h*39·60 *h*37·97	*h*36·33 *h*38·13	*h*40·63 *h*38·53	*h*36·83 *h*40·70 *h*41·70	*h*40·03 *h*40·17	*h*37·37 *h*39·07	*h*41·33 *h*39·43	*h*38·10 *h*37·17	*h*40·70 *h*40·83	
	34·69	36·30	40·06	38·79	37·23	39·58	39·74	40·10	38·22	40·38	37·63	40·77	123° 1′ 38″·62

November 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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NORTH-EAST LONGITUDINAL SERIES.

ALPHABETICAL LIST OF PROPER NAMES SHOWING LATEST AUTHORISED SPELLINGS.

A portion of the text of this Series in which Indian proper names occur having been printed prior to **1871**, the spelling of such names was necessarily in accordance with the rules introduced by Colonel Everest for use in the Survey Department. Subsequently the Government issued a modification of these rules, but as it was not desirable to introduce a change of system in the middle of the publication, Colonel Everest's method was adopted throughout the Series, excepting in the Addendum, beginning with page 25*—I, which, being printed only recently, is in accordance with the Government method. Now that the publication of the series is finished, it appears desirable to give the proper names in question by both systems of spelling; this is accordingly done in the following table, where the first column of each pair states the spelling adopted and the second column gives the corrected orthography as required by Government rules. Where the methods are identical the second column is left blank.

Orthography		Orthography		Orthography	
By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules
Adwani	Adwáni	Bagwára		Baori	Bauri
Ahlapúr	Álápur	Báhádúrganj	Bahádurganj	Bára	Bara
Ahti	Háti	Baigul	Bahgul	Baráich	Bahraich
Ajítpúr	Ajítpur	Bailawa		Bára Manjilia	Bara Manjilia
Ajmere	Ajmir	Bailwa	Belwa	Barápúra	Barhapura
Akaona	Ikauna	Baingra		Baraseo	
Alíganj	Aliganj	Bairchawa		Bare	
Almora		Baisi		Bareilly	
Amdar		Bájra		Bargonia	
Amúa	Amua	Bakwa		Barhámpúr	Barhampur
Anárkali		Bálápúr	Bálapur	Barháta	
Asangáwa	Asangawa	Balchentha		Baríkankai	Barikankai
Asogápúr	Asogapur	Báligarh		Barri Patesri	
Asogi		Baloia		Barsám	
Atária		Balrámpúr	Balrámpur	Barwára	
Athari		Balúa	Balua	Barwás	
Atkonawa		Bánarsi	Banarsi	Basaola	Basaula
Baber		Bandarjúla		Basotara	Basotra
Bábra	Babra	Bánghora		Basua	
Bachaor	Bachhaur	Bangra		Batnáha	
Bádhar		Bángra	Bangra	Batráha	
Bágápár		Banjaría	Banjaria	Batwaia	
Bágha	Bagaha	Bankata		Begni	Bagni
Baghaia		Báñsi	Bánsi	Beheri	Baheri
Bagotipúr	Bagotipur	Bansídíla		Bela	

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Orthography		Orthography		Orthography	
By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules
Belwa		Chilkia		Gharáwa	
Belwanía	Belwania	Chotáki		Gharbaria	
Benaikpúr	Bináyakpur	Chota Parsoni		Ghiba	
Beraor	Beraur	Chúni		Ghogochodi	
Betia	Bettiah	Dadaora	Dadaura	Ghona	
Bhágalpúr	Bhágalpur	Dahlelnagar		Ghungti	
Bhagarati	Bhágirathi	Daka	Dháka	Ghungtígarh	Ghungtigarh
Bhagwánpúr	Bhagwánpur	Dakária		Gidhuraia	Gidhraia
Bhaispára		Dálibhát		Gilaolia	Gilaulia
Bhála		Dánar		Giráháwa	Girawa
Bhaonipúr	Bhaunipur	Dáñría	Dánria	Girjwála	
Bharmi		Daorára	Dhaurahra	Gonália	
Bhataora	Bhataura	Daparka		Gonda Baráich	Gonda Bahraich
Bhattábári	Bhattabári	Deopúr	Deopur	Goruckpúr	Gorakhpur
Bháwára	Bharwára	Dewánganj	Diwánganj	Guluria	Gularia
Bhela		Dhakdhía	Dhakdhia	Gumti	
Bhería	Bheria	Dhanga		Gúñghi	Gúnghi
Bhería Bisanpúr	Bheria Bisanpur	Dhántola		Gunsíai	
Bhikaolia	Bhikaulia	Dharamnagar		Haidarábád	Haidarabad
Bhinga		Dharampúr	Dharampur	Haiúl	
Bhogpúr	Bhogpur	Dharamsingua		Haldikora	
Bíarwa	Biarwa	Dhárára		Haldwáni	
Biarwa		Dhasowar	Duhosuho	Halsan	Halsán
Bigoía	Bigoia	Dhela		Haraot	Haraut
Bijnor		Dhoadni	Dhaudni	Harmandil	
Birádi	Biradi	Dholakar	Dhalokar	Harmoa	Harmuwa
Birda		Dhunka		Harnáhi	
Birdpúr	Birdpur	Dhúrwa		Harpúr	Harpur
Birond		Díánirao	Dhianirau	Hasuadol	Hanswadol
Bisalpúr	Bísalpur	Dinájpore	Dinagepore	Hátgáon	Hátgaon
Bisambharpúr	Bisambharpur	Dipái		Hátihaol	Hátihaul
Bisanpúr	Bisanpur	Dipnagar		Haveli Goruckpúr	Haveli Gorakhpur
Boda		Doab		Hilgi	
Boudi-tola	Baudi-tola	Donáo	Donau	Himáonpúr	Himaunpur
Budholi	Badholi	Doñk	Donk	Hurdwar	Hardwár
Bulákípúr	Bulákipur	Dúmdángi		Inarwa	
Bunágáon	Bunagaon	Dúngápára	Dúngapára	Intai	
Burwa		Durgaoti	Durgauti	Iríagarh	Iriagarh
Chakla		Fatepúr Singhía	Fatehpur Singhia	Isánagar	
Chalári	Chalari	Gandak	Gunduk	Isrápúr	Isrápur
Champáran	Chumparun	Ganespúr	Ganespur	Jabdi	
Chanda		Ganges		Jádupati	
Chandarsána		Gangi Sáhibganj	Gangi Sáhebganj	Jagarchi	
Chandarsanpúr	Chandarsanpur	Gaoria	Gauria	Jákub Itwa	Jakúb Intwa
Chándípahár		Gaori-Rái	Gauri-Rai	Jampta	
Chaoka	Chauka	Garhwal	Garhwál	Janjpati	
Chápin		Gernábári	Gernabári	Jarel	
Chaprári		Ghágra	Gogra	Jehánábád	Jahánabad
Chedarmi		Ghamaria		Jehángírpúr	Jahángírpur
Chelúa	Chelua	Ghandiál		Jhála	Jála
Chetaona	Chetauna	Gháos	Ghaus	Jholai	

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Orthography		Orthography		Orthography	
By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules
Jirol		Kothíbhár	Kothibhár	Masoa	Masuwa
Jítpúr	Jitpur	Kowálpúr	Kewalpur	Mathi	Máthi
Juknía	Jakania	Kúlri	Kulri	Mathia	
Juktia-atsára		Kúlúganj		Mehesari	Mahesari
Juráwandi	Jurawandi	Kumaon	Kumaun	Mehesi	Mehsi
Kabiai		Kusha Balrámpúr	Kusha Balrámpur	Mehnd	Mahind
Káimkhera		Kusmai		Míásambar	Miasambar
Kakuruha		Kutía	Kutia	Míla	
Kalíáganj	Káliaganj	Lachmípúr	Lachmipur	Minai	
Kaliánpúr	Kaliánpur	Ladnía	Ladnia	Mírápati	Mirapati
Kalíánpúr	Kaliánpur	Lakima		Mirzápúr	Mirzapur
Kálidongi	Káladhúngi	Lákún		Misaraolia	Misraulia
Kálúsaiud	Kálusayyid	Lálpúr	Lálpur	Modára	
Kamaldáha		Lambákhera	Lambakhera	Moradabad	
Kamálpúr	Kamálpur	Langari		Morairi	
Kamaría	Khamaria	Laoríha	Lauria	Motíhári	Motiharee
Kanamajot		Largápati	Largapati	Mulápúr	Mulapur
Kanchábári	Kanchabári	Latona		Mundawar	Mandáwar
Kanjaoli	Khajauli	Latona-Gádi-Hát		Músaldanga	Músaldánga
Kankíra		Lohápánia	Lohápania	Nadúa	Nadua
Kanont	Khanaut	Mábegarh	Mabegarh	Nágal	
Kaolda	Kaulda	Madanpúr	Madanpur	Nahli	
Kaonrikot	Kaunrikot	Madárganj		Naiáthána	
Karái		Madnagar		Nanaota	Nánauta
Karela		Mádopúr	Mádhopur	Nándpára	
Káridia		Madura		Nanpúr	Nánpur
Karímábád	Karímabad	Máhádeoa	Mahádewa	Naogáoṅ-Kaliánpúr	Naugaon-Kaliánpur
Karmáhi		Mahamdi	Muhamdi	Naonangarhi	Naunangarhi
Karmeni Ghat	Karmeni Ghát	Máhánada	Mahánada	Naosera	Nausera
Kasaka		Máháwáganj	Mahawaganj	Nárádigar	Náridigar
Kashípúr	Káshipur	Maiásiri		Narhar	
Katgarhoa	Katgarhwa	Maisaora	Maisaura	Naringa	
Katna	Kathna	Majhána		Narkatia	
Kavaia		Majháwa	Majhawa	Náthpúr	Náthpur
Kelália		Majhowa	Majhauwa	Nawábganj	
Khairábád	Khairabad	Majkúri Gola	Majkuri Gola	Nepal	Nepál
Khánpúr	Khánpur	Makhára		Newáda	
Kharkhari		Malan		Newáni	
Kheri		Malkonia		Nichlaol	Nichlaul
Khesri		Mandúr		Nighásan	
Khopra		Mánícháok	Manichauk	Nimua	
Khotágách	Khotagáchh	Mánikpúr	Mánikpur	Nirpúr	Nirpur
Kiloli		Manikpúr	Mánikpur	Oel	
Kimeria	Kumeria	Mánikpúr-Bardáha	Mánikpur-Bardáha	Omiria	
Kimúsera		Mansúrganj		Páhárkáta	Pahárkáta
Kishanganj	Kissengunge	Manúla		Pairwáha	
Kohorawál		Manúla-Páti	Manúlapati	Pakaria	
Kokra		Maowai	Mauwai	Panchpirwa	
Kota		Marahia		Paori	Pauri
Kotdwára		Masáha		Paragawa	
Kothar	Khutár	Mási	Masi	Parewa	

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Orthography		Orthography		Orthography	
By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules
Pargáwa		Rhata Rámnagar		Sirsáñwan	Sirsáwán
Parindáha		Richa	Richha	Sísgarh	
Parsa		Ríga		Sisowa	
Patargácha	Patargáchha	Rohilcund		Sissai	Sisai
Patargháti		Rúdarpúr	Rudarpur	Siswar	
Pathardi		Rudpúr	Rudpur	Sítalghati	Sítalgháti
Patli Doon	Patli Dún	Rungpore		Sonákhoda	Sonakhoda
Phatakdaona	Phatakdauna	Rúpdi		Sonár	
Pikápár		Ruponi		Srínagar	Srinagar
Pilibhít		Sahor		Sugánagar	Suganagar
Pinjára		Saibara		Sukrámpúr	Sukrámpur
Pipári	Pipari	Saidara		Sultánpúr	Sultánpur
Piparía	Piparia	Samroli		Sunbarsa	
Pipáría	Piparia	Sáonbarsa	Saunbarsa	Sundai	
Pipra		Sáonchália	Saunchalia	Supaol	Soopole
Pipráhia	Piprahia	Sáran	Sarun	Súpúr	Supur
Pirela		Sárju	Sarju	Tagría	Tagria
Pokhar		Sathwária	Sathwaria	Tajpúr	Tájpur
Porandarpúr	Púrandarpur	Semára	Semara	Tálpúrwa	Tálpura
Powain	Pawáyan	Semera	Semara	Tambaor	Tambaur
Puran	Púran	Semnagar		Tarai	Tarái
Púrangácha	Púrangáchha	Semra		Tarharwa	
Puráni		Semráha	Semraha	Teeree	Tehri
Púranpúr	Púranpur	Semrána	Simrana	Terhari	
Púrena		Semráo	Semrau	Thakia	
Púrnea	Purneah	Senjána		Thákúrganj	Thákurganj
Rámganj		Seopuri		Thákúrgáon	Thákurgaon
Rámkhetári		Seramao	Seramau	Tharaoli	Tharauli
Rámnagar		Shágarh	Sháhgarh	Tigra	
Rámpúr	Rámpur	Sháhjehánpúr	Sháhjahánpur	Tilakpúr	Tilakpur
Rámuápúr	Ramuapur	Shai	Sháhi	Tilpúr	Tilpur
Ránigarh		Shápúr	Sháhpur	Tirhoot	
Rápti		Sidhoa Jabuna	Sidhua Jobna	Tulsípúr	Tulsipur
Ratangarh		Sihoria		Tulsundi	
Ratanpúra	Ratanpura	Sikaoda	Sikauda	Udepúr	Udepur
Ratanpúr Báñsi	Ratanpur Bánsi	Sikári		Ul	
Ratansarpati		Sikrana		Umra	
Rátígách	Rátígáchh	Sikta		Upasai	
Rattúpúr	Rattúpur	Simraol	Semraun	Upasai-tola	
Ratwa		Sinaría	Sinaria		
Relawa	Reláwa	Singárjot			

August, 1882.

J. B. N. HENNESSEY,
In charge of Computing Office.

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Fig. No. 5

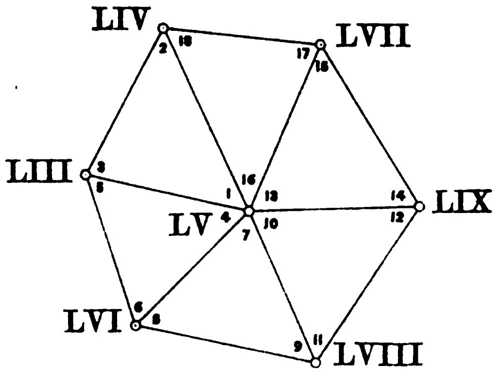


Fig. No. 6

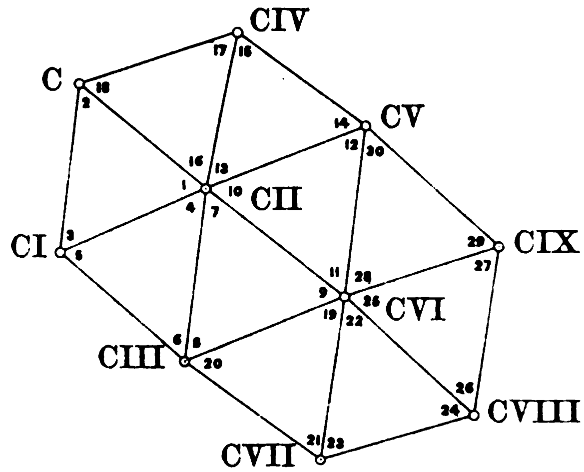


Fig. No. 3

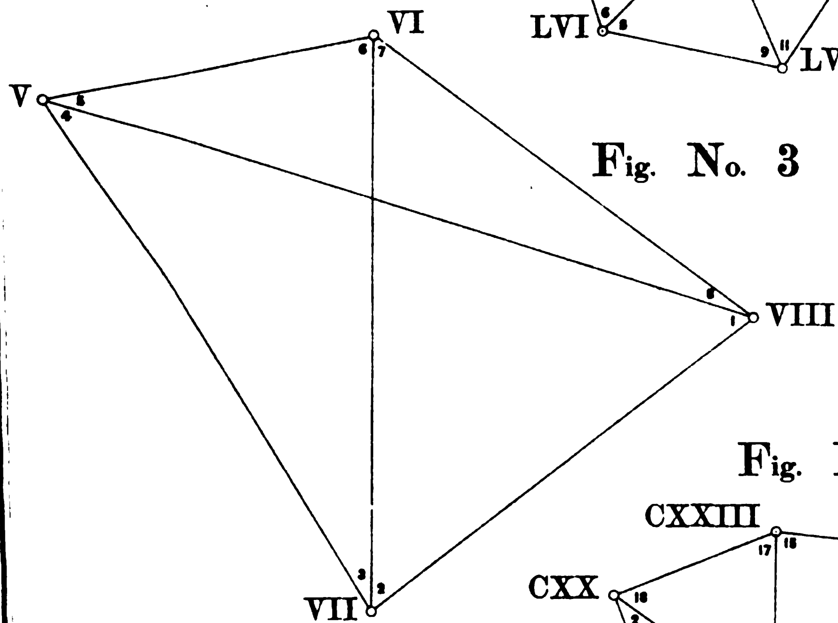


Fig. No. 7

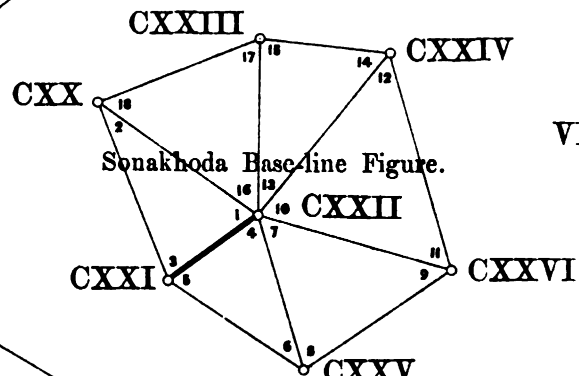


Fig. No. 4

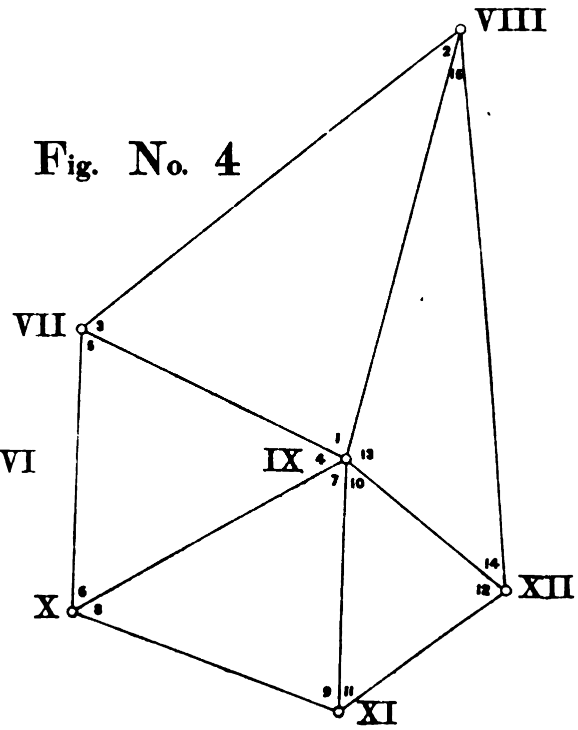


Fig. No. 1

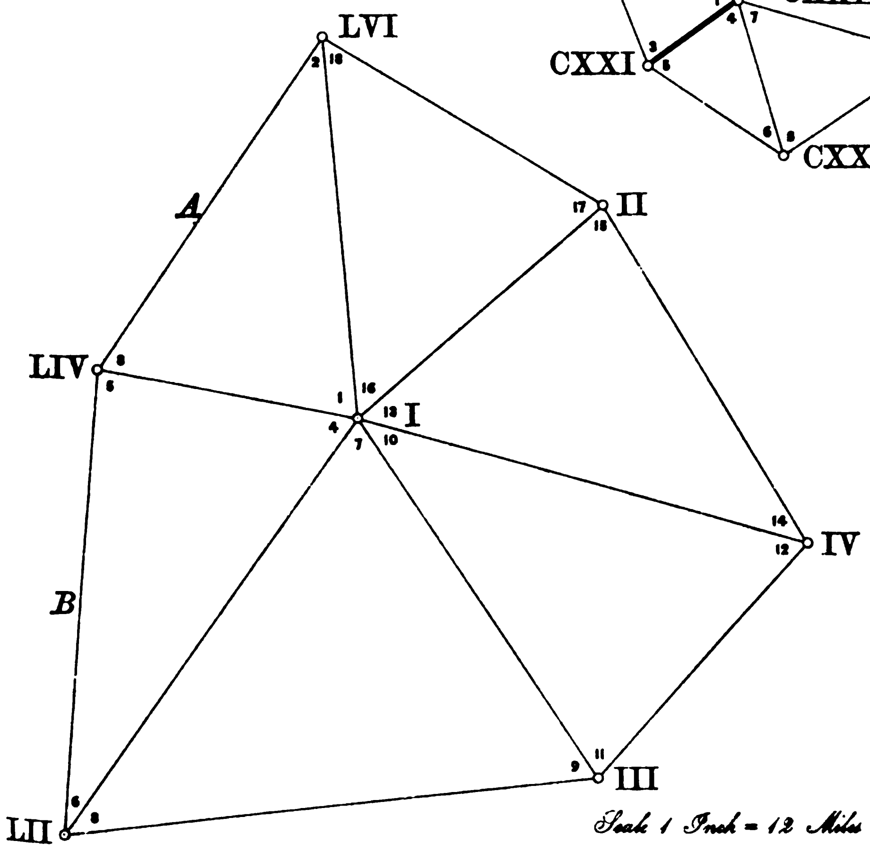
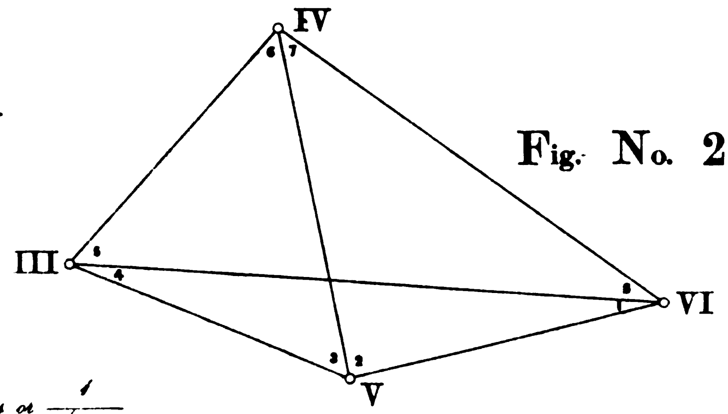


Fig. No. 2



Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

[?]ANJIT SING, PHOTO. *Photozincographed at the Office of the Superintendent Great Trigonometrical Survey, Dehra Dún, December 1877.* C. G. OLLENBACH, ZINCO.

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BUDHON MERIDIONAL SERIES.

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BUDHON MERIDIONAL SERIES—(LONG. 78° 30′.)

INTRODUCTION.

In the year 1830 when the first measurement of the Calcutta Longitudinal Series was approaching completion, the Hon'ble the Court of Directors of the East India Company expressed a wish that a number of series of triangles should be carried northwards and southwards from certain sides of this triangulation, in order to connect together the isolated surveys which had already been made in various provinces and districts, and to furnish reliable bases for future surveys. The Surveyor General—then Captain G. Everest of the Bengal Artillery—in an exhaustive letter dated 12th October 1831, discussed all preliminaries for giving effect to the wishes of the Hon'ble Court, in regard to the number of the series to be undertaken, the character of the country to be traversed by each, the necessary additions to the then-existing establishment, and the probable cost of the operations.

During the year 1831-32 the requisite instruments for carrying out this scheme of triangulation were procured and instruction given to the officers and assistants selected for the work—one of a high order of accuracy—in which they had had no previous experience.

The first series undertaken was the Budhon, one of the 13 meridional chains now included in the North-East Quadrilateral. It follows the meridian of 78° 30′ as nearly as was practicable, and lies immediately to the east of the Northern Section of the Great Arc Series (E. Long. 78° and N. Lat. 24° to 30°). It was begun in 1832-33 at its southern end in the Saugor (Ságar) District, based on the side Budhon-Tinsmál of the Calcutta Longitudinal Series.

For about the first two and a half degrees (155 miles) of its length it was carried for the most part as a single chain of triangles across the north-eastern spurs and outliers of the Vindhya range which forms the southern watershed of the great Gangetic plain, traversing the modern districts of Saugor, Lalitpur, and Jhánsi, the Native States at the N. W. corner of Bundelkhand, and that of Gwalior, in which a good many secondary stations and places of interest or importance were fixed, including Tehri, the ancient town of Orchha and its modern successor Jhánsi, Datia, Narwar, and Gwalior.

To the north of Gwalior the Series left the hills and descended into the valley of the Chambal and Jumna, requiring henceforward the aid of towers and the heavy labour of ray-clearing, which greatly retarded its progress. Leaving Gwalior it passed through the districts of Agra, Mainpuri, Etah and Aligarh, striking the Ganges in latitude 28°, whence it was con-

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tinued as a double series, with shorter sides, arranged in five polygonal figures, to its northern limit about latitude 30° where it reached the outlying hills at the foot of the Himalayas and closed upon stations of the Great Arc and N. E. Longitudinal Series, having traversed the districts of Budaun, Moradabad, Bijnor, and Muzaffarnagar, with one station in the Tarái and two in British Garhwál. The Budhon Series was brought to a close in the year 1842-43, a period of ten years having been occupied in completing about six degrees of distance along the meridian or about 400 miles.

The officer selected for the conduct of this Series was Lieutenant Roderick Macdonald of the 69th Bengal Native Infantry, an officer of the Revenue Survey who had been reported by the head of that department as "well fitted for employment in the Great Trigonometrical Survey and desirous of obtaining it". He was appointed a Second Assistant in the Department in March 1832, and in October the sanction of Government was obtained for a party to be employed under his orders, as follows :—A Principal and one Junior Sub-Assistant with a Native Establishment of the usual strength.

1st Season 1832-33.

PERSONNEL.

Lieut. R. Macdonald, 2nd Assistant.
Mr. W. N. James, Principal Sub-Assistant.
„ J. H Scully, 3rd Class „

Subsequently in March 1833.

„ E. Cropley, 3rd Class Sub-Assistant.
„ R. Loane, „ „

The party was organized in Calcutta under the supervision of the Surveyor General himself, and started on its long march to the field on the 23rd November 1832 provided with a 15-inch Theodolite by Harris and Barrow for the principal observations. It reached the town of Saugor (Ságar) on the 28th of January 1833 when a part of the native establishment struck for higher wages, and had to be replaced by new hands picked up on the spot; but Lieutenant Macdonald pushed on and arrived at Budhon H. S. his first station, 22 miles N. W. from Saugor, on the 2nd February. This station and that of Tinsmál distant 30 miles to the eastward, defined the west and east ends of the base or side of origin for the new Series. They were both found intact, but much overgrown by jungle infested with wild beasts, since last visited and observed at for the Calcutta Longitudinal Series by Mr. Olliver eight years previously (in 1825).

The selection of the requisite stations in advance was taken in hand at once, and the junior Sub-Assistant sent on to select the best point available in the desired direction and to burn lights thereat; these however could not be seen without some artificial elevation, and it was only on the 23rd February that the final observations at Budhon could be begun. They were finished by the 27th, and the main party marched to Tinsmál where it was found necessary to raise the station platform by 8·5 feet to command the ray to Patna (I)* and overlook a small temple that obstructed the view. Whilst the building was going on, Lieutenant Macdonald proceeded to select the next two stations in advance on the east flank, Dargawa (II) and Dhandkúa (III) and having returned to Tinsmál, completed the observations by the 15th of March. Whilst there, the Surveyor General, who was on his way to resume the operations on the Great Arc, visited the party, and before going on, left two more Sub-Assistants, Messrs. E. Cropley and R. Loane with Lieutenant Macdonald.

* The Roman number in brackets after the name of a station indicates its position in numerical order from south to north.

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The signals observed during this season and for some seasons to come, were flags by day and vase lights by night.

Patna (I) was next visited, but hazy weather prevented the completion of the principal angles before the 23rd of April, the time between the two short periods of clearer weather being utilized by fixing as many secondary stations and points as practicable. Dargawa (II) and Dhandkúa (III) were next visited and the observations completed by the 3rd of May, when the principal observing was stopped by hazy weather and by obstruction met with from the inhabitants, who regarded the survey operations with suspicion and dislike, and hindered the advanced party continually.

Lieutenant Macdonald endeavoured to complete another triangle but failed, although he waited at Sirsaud (afterwards abandoned for Andhiári, IV) from 13th May to 25th June without having a single good night for observing. Indeed, the length of the rays here—over 30 miles—was too great for the requisite visibility at this season, unless the air were cleared by a general fall of rain. The party then went into recess quarters at Saugor.

The out-turn of work for the first season (1832-33) shews but three principal triangles completed, covering about 1000 square miles of country and stretching to a point nearly 50 miles north of the origin of the Series. But a good deal of secondary or minor triangulation had been accomplished, by which a number of points were determined, especially in and around the first triangle, when the weather was comparatively clear and suitable. A few commanding points were selected and observed at whilst marching between the principal stations, whereby many other places and landmarks which could be seen from two or more of the stations were fixed. For this work Lieutenant Macdonald appears to have used his large theodolite, employing his principal Sub-Assistant with a smaller instrument to supplement his work at the minor stations which he was unable to visit, whilst to the junior Sub-Assistant was entrusted the difficult task of selecting and building the principal stations in advance.

2nd Season 1833-34.

PERSONNEL.

Lieut. R. Macdonald, 1st Assistant.
„ P. Bridgman, Bengal Artillery, 2nd Asst. (*sick and ineffective.*)
Mr. W. N. James, Principal Sub-Assistant.
„ J. H. Scully, 3rd Class „
„ E. Cropley, „ „ (*sick and died 27th Oct.*)
„ R. Loane, 3rd Class Sub-Assistant.

At the close of the recess an epidemic fever broke out at Saugor and attacked three of the Sub-Assistants, one of whom, Mr. E. Cropley, died on the 27th October. It may be now noted that Lieutenant Bridgman who had recently been appointed as 2nd Assistant to the party, was prevented by sickness from joining until 15th February 1834 and further incapacitated for field duties until April, when he was entrusted with the execution of a secondary series in the vicinity of Gwalior, with Mr. Loane for his assistant: but although he kept the field until the end of July he appears to have contributed little or nothing worth mentioning to the season's work. Shortly afterwards he was transferred to the South Párasnáth Series; but his health failed completely, and he died on his voyage home.

The party was thus in fact no stronger than during the previous season, and the persistent opposition of the inhabitants in the Native States, was a source of great hindrance and anxiety; but the results of this season's work proved nevertheless very much more favourable than the preceding or many succeeding seasons, and appear to reflect no little credit on Lieutenant Macdonald and his assistants.

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Lieutenant Macdonald took the field about the middle of October 1833, and found that Dhandkúa (III), the terminal station of the previous season, had been destroyed during the recess; this necessitated the remeasurement of the angles thereat, as well as at Patna (I) and Dargawa (II). These were completed by the 18th November, after which the new stations were visited in the following order:—Andhiári (IV), Gwáli (V), Kathera (VI) a remarkable Bundela stronghold, Bhitári (VII) first visit, Algi (VIII) first visit, Bhitári (VII) second visit, Daryapur (IX) first visit, Maharájpur (X), Karaia (XII), Narwar (XI), Algi (VIII) second visit, Daryapur (IX) second visit, Majhár (XIV) and Ráepur (XIII), by the 30th April 1834. No further observations could be made throughout the month of May owing to the hazy weather, and the season's work closed on the side Ráepur (XIII)—Majhár (XIV), on the 1st of June, when the party marched into recess quarters at Agra where it arrived on the 30th.

In all, twelve new principal triangles had been measured, extending the Series to a point near Gwalior, distant 140 miles north of its origin.

The secondary triangulation accomplished this season was considerable, the points fixed being numerous and fairly well spread over the country traversed, including the important towns of Tehri, the ancient Bundela capital Orchha, its modern successor Jhánsi, the large artificial lake Barwa Ságar, Datia, and Gwalior, besides others of less note.

Some of the chief secondary stations were made to form a minor series by which an independent value was obtained of the side Gwáli-Bhitári, as a check against certain unusually large discrepancies in the observations of some of the previous angles.

In addition to the principal and secondary triangulation accomplished, the preliminary selection of the stations in advance was carried to a distance of 60 miles, well into the plains across the Chambal and Jumna rivers, rendering this season's out-turn of work, notwithstanding many drawbacks and hindrances, one of the most successful noticed in this account.

At the commencement of the Budhon Series, the Surveyor General had directed that a connection should be made, as soon as it could be done without going out of the way, with the Great Arc Series adjacent, recently laid out by Mr. Rossenrode but not yet finally observed with the great theodolite.

The first opportunity of carrying out this connection occurred between Jhánsi and Gwalior, where the Great Arc Series approaches the Budhon Series in the secondary hill stations of Ladára and Karaia, and the principal station on the Ráepur hill, the first of which is visible from Algi (VIII), the second from Ráepur (XIII), and both first and second from Maharájpur (X). Lieutenant Macdonald therefore, occupied the sites of the two Great Arc Series secondary stations of Ladára and Karaia as principal stations, rebuilding the platforms, which had been destroyed by the inhabitants from superstitious motives; but he built a fresh principal station on the Ráepur hill, because the Great Arc Series station thereat could not be observed from the Budhon Series side owing to a small temple that occupied the peak of the hill and precluded the establishment of a common station suitable for both series. Thus a hexagonal figure was formed round Maharájpur (X), and, after measuring the angles, Lieutenant Macdonald reported that he had effected a connection with the Great Arc Series on the side Narwar (XI)—Karaia (XII), Narwar being identical with Ladára h.s. of the Great Arc. These two stations being only secondary points this connection could not be accepted. The three prin-

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cipal stations of the Great Arc Series, Shergarh, Dhobái, and Ráepur, although they are near to Narwar, Karaia and Ráepur of the Budhon Series, respectively, are in reality different points, and in fact no proper connection was effected. Subsequently however in 1877, the Surveyor General, then Colonel J. T. Walker, R.E., caused a more exact connection to be made between the two principal stations on the Ráepur hill, which were only about 41 feet apart, the temple above mentioned being on the summit of the peak, between them. The details of this connection will be found at page 73—J. of Volume VII of the *Account of the Operations of the Great Trigonometrical Survey of India.*

3rd Season 1834-35.

PERSONNEL.

Lieut. R. Macdonald, 1st Assistant.
Mr. W. N. James, Principal Sub-Assistant.
" J. H. Scully, 3rd Class "
" R. Loane, " "

The Budhon Series had now been carried for one-third of its entire length in two seasons, to the northern limit of the hilly tract in which it began, and the provision of towers or artificial elevations, to carry the Series across the plain country to the north, became indispensable. The Surveyor General had already applied to the Government to sanction the erection of high towers for the purpose, like those being built by the Public Works Department for the Great Arc Series, which had been sanctioned during the year 1833. Those towers however promised to be so expensive that the Government hesitated to sanction any more for the time, or until their precise cost was known, and put forward a memorandum by the Hon'ble Colonel Morrison suggesting the adoption of a reflecting circle and a portable wooden mast, in place of a big theodolite and a masonry tower. The Surveyor General could not accept this suggestion, but proposed the construction of a lofty central pier of masonry for the instrument and signals to stand on, supplemented by a scaffolding with a stage for the observatory, the cost of which he estimated at Rs. 140 to Rs. 270; and if this should prove too costly, then he believed that a mast, such as he himself had recently used for the approximate Series of the Great Arc, would answer. He did not think such costly towers as those just erected for the Great Arc necessary, and pointed out the excessive depth given to their foundations by the Public Works Department, by whose officers they were built. Finally he expressed a hope that the Survey Officers should not be required to build their own towers or supervise the expenditure of large sums of public money, having already as much to attend to in their own proper professional line as they could well do. This representation however seems to have produced little or no effect, for we find the surveyors generally from that time forwards building their own towers as best they could, in a more modest but sufficiently effective way; and, notwithstanding some failures, this arrangement has probably proved the most economical.

Meanwhile, pending the settlement of the question as to what kind of tower stations should be adopted, Lieutenant Macdonald took the field on the 1st October 1834, and having taken extra precautions for the preservation of the two terminal stations observed at during the previous season—Ráepur (XIII) and Majhár (XIV)—proceeded by direction of the Surveyor General to select the stations in advance by the "ray trace" system, using small theodolites and perambulators. Much skill and judgment is necessary in carrying out this method, and some time was spent in acquiring the requisite accuracy; in short, a good deal of the work had to be revised. Moreover, progress was retarded by sickness, the services of the

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principal Sub-Assistant Mr. James being lost through this cause for nearly three months of the field season. The principal station sites were finally selected across the Doáb as far as the Ganges, and the preliminary selection pushed on into the districts of Budaun and Moradabad beyond, before the party returned to recess quarters at Agra early in June.

No observing of principal angles was done this season, but the approximate series was completed for a distance of 100 miles, as far north as the Ganges, by 12 stations forming a single series of symmetrical triangles, and operations were in progress for a considerable distance beyond.

Lieutenant Macdonald himself was obliged by ill health to quit the field in April, and suffered so much from jungle fever during the ensuing recess that he applied to be relieved of his charge in September, and obtained sick leave. Unhappily he did not recover, but died before the end of the year. He was succeeded by Lieutenant E. L. Ommanney, of the Bengal Engineers, who had been appointed to the party in May to learn the practical duties of the Trigonometrical Survey, he having hitherto been employed on a survey of the Brahmaputra river. He joined the Budhon Series at Agra on the 13th June.

4th Season 1835-36.

PERSONNEL.

Lieut. E. L. Ommanney, Bengal Engineers, 2nd Assistant.
Mr. J. H. Scully, 2nd Class Sub-Assistant.

Mr. James was transferred to the Great Arc and his place not filled up until 1st March 1836, when Mr. J. Olliver, Chief Civil Assistant, joined, and the transfer of Mr. Scully also to the Great Arc towards the end of this season left the Series without any of its original staff. Lieutenant Ommanney took the field on the 8th November 1835, and having received no sanction as yet for the erection of the towers, proceeded at once to run trial lines along the rays between the selected station sites, to ascertain that no serious obstacle existed in them which could not be readily removed, and he was engaged in this work until March 1836. But hitherto no rays were actually cleared owing to Lieutenant Ommanney's inexperience and to the refusal of the inhabitants to allow trees to be cut down.

The Government had recently (April 1835) considered the subject of ray clearing, and had directed that equitable compensation should be given in all cases of injury to the owners; and to enable a just valuation to be speedily made in the case of recusant proprietors, the civil authorities were ordered to direct the personal attendance of the *tahsíldár* or *peshkár* (local subordinate Revenue Officers) at the spot, when called upon by the Survey Officers. At the same time the Survey Officers were enjoined to use every means to avoid bringing any highly prized or sacred tree in the ray passing from one station to another.

The latter part of this season was spent in clearing the rays between the stations in the plains, and in determining the height of the towers of observation which would inevitably be required to command them. Approximate angles were observed from the top of masts erected for the purpose, and before the close of the field season this work had been completed as far as Pondri (XXIV) in the middle of the Doáb.

In the case of the two first stations in the plain country—Gúrmi T.S. (XVII) and Bhind S. (XVIII)—the forts at these places offered suitable sites for stations, in the one case on a high bastion, and in the other on the gateway tower, on which during this season stations were built.

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The final selection of stations forming a single series of symmetrical angles was extended as far as Moradabad in Lat. 29°, but this advanced part of the approximate series north of the Ganges was afterwards abandoned in favour of a double series of smaller triangles.

5th Season 1836-37.

PERSONNEL.

Lieut. E. L. Ommanney, Bengal Engineers, 2nd Assistant.
Mr. J. Olliver, Chief Civil Assistant.

Several principal stations being now ready, Lieutenant Ommanney commenced the field season of 1836-37 by resuming the final observations which he completed at the undermentioned stations as follows:—at Jhánkri H.S. (XVI) 18th to 27th October 1836, at Majhár H.S. (XIV) 28th to 31st October, at Ráepur H.S. (XIII) 1st to 4th November, at Sánichri (XV) 5th to 8th November, at Gúrmi T.S. (XVII) 11th to 23rd November, and at Bhind S. (XVIII) by 2nd December.

By the time the observing party arrived at Gúrmi T.S. the next forward station on the west flank had been built on the gateway of Panáhat Fort, and the first tower station erected, that at Athgath, had been sufficiently prepared to be observed to.

Lieutenant Ommanney had intended to build solid, conical, mud towers, 22 feet in diameter at base, 15 feet at top, and about 40 feet high, at an estimated cost of from Rs. 200 to Rs. 300 each, but this plan did not meet the Surveyor General's approval; as, *firstly*, the lower centre, or station mark must be on the ground, so as not to be affected by dilapidation of the superstructure; and, *secondly*, the upper centre mark for the frequent adjustment of instrument and signals, must be always plumb over the lower centre, for which purpose the latter must be easily accessible both at first and for subsequent re-examination. Lieutenant Ommanney modified his towers accordingly, having a masonry core pierced with a vertical shaft or central opening 18 inches in diameter, and a horizontal arched passage of masonry at ground level giving light and access to the lower centre or station mark, with an easy spiral slope or ramp winding round the tower and leading to the summit.

The first tower erected, Athgath T.S. (XIX) on the banks of the Chambal, was only built in the first instance to a height of 26 feet, which appears to have been sufficient for the back rays, but afterwards (in 1840) it was rebuilt and raised 10 feet higher.

No further principal observations were taken this season, after those concluded at Bhind S. on the 2nd December, and the rest of the season was spent in building the towers and in taking approximate angles with the aid of masts and scaffolds, as far as the Ganges.

By the close of the season four towers Sherpur, Firozabad, Baragaon and Pondri, were reported as "well advanced" towards completion, and four others, Kilármáo, Salímpur, Jamálpur and Sankráo, begun. But the earthwork of the Firozabad tower gave way and fell down twice, after it had been built up to a height of 28 feet.

By the end of the fourth season's work the following method of carrying on the principal triangulation in the plains, had been arrived at:—The country having been reconnoitred generally and no hills or artificial elevations suitable for stations met with, a ray trace, traverse or route survey was made in the desired direction for each new station, from which its precise bearing could be computed. A trial line was then run to ascertain that it contained no insurmountable obstacle, after which the line was cleared and the angles between adjacent lines measured by means of a small theodolite raised on the top of a high mast surrounded by a

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scaffold with a stage for the observer. This measurement was termed the "Approximate Series," a term which in more recent times has been applied to the laying out and preparation of the principal triangulation generally. After this it only remained to build the towers requisite for the final observations with a large theodolite.

The apparently small progress made may be attributed to the want of officers and assistants experienced in the work of triangulating in a plain country and of building high towers in mud without professional aid. But the prime cause of delay was the attempt to maintain almost as large triangles in the plains as in the hills, thus necessitating observations over distances much too great for distinct vision, except in very unusually clear weather.

Final observations were made at 6 principal stations, forming a quadrilateral figure and two single triangles, by which the Series was advanced a meridional distance of 32 miles and reached the south bank of the Chambal river, the boundary between the Gwalior State and the Agra District.

On 31st May 1837 Lieutenant Ommanney resigned his appointment in the Department, and left the Series in charge of Mr. Olliver, Chief Civil Assistant, the only officer remaining with the party.

6th Season 1837-38.

PERSONNEL.

Mr. J. Olliver, Chief Civil Assistant.
" J. Driberg, 3rd Class Sub-Assistant.

Before resuming the field work for Season 1837-38, the Surveyor General directed Mr. Olliver to reduce the size of the triangles in laying out the Series to the north of the Ganges, and in place of a single series of triangles having 15 to 20 mile sides, to adopt a double series of consecutive polygonal figures, with sides from 8 to 15 miles in length, by which lower towers would suffice, greatly improved signals would be obtained, and some of the mounds which frequently obstructed the view on the longer rays might be utilized for station sites, whilst the double series would afford an effective check against error. Having regard however to the very backward state of the Series, none of the previous work which would serve, could be abandoned.

Mr. Olliver therefore, in great hopes of completing the section of the Series already laid out to the south of the Ganges, set to work to finish the 8 or 9 towers commenced under Lieutenant Ommanney the previous season. The more advanced of these—Athgath (XIX), Sherpur (XXI), Firozabad (XXII) and Pondri (XXIV)—still required much additional height which however their foundations were not calculated to bear with safety. Firozabad had already fallen twice from this cause. Mr. Olliver therefore pulled them down and rebuilt them afresh upon deeper and more solid foundations. In the case of Firozabad firm soil was only found at a depth of 16 feet below the surface. Having commenced work at all the towers at once to economize time, he was greatly impeded for want of funds; and was constrained to advance sums from his own private purse.

In his half-yearly report, dated 1st March 1838, he said that the progress hitherto had been rapid. The towers at Pondri (XXIV) and Baragaon (XXIII) were finished, Athgath (XIX) 25 feet high, and Kilármáo (XXV) 27 feet; but that Firozabad tower had fallen again after reaching a height of 40 feet.

This was the last of his (Mr. Olliver's) work here, for his services being urgently

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required with the new party just formed for the Great Arc (Section 18° to 24°) under Lieutenant Waugh, B.E., he suddenly left on the 4th March, having made over charge to the Sub-Assistant, Mr. Driberg. Early next month (April 1838) and before he could have made much progress, Mr. Driberg was ordered to repair with the whole of the Budhon Series party to the Head Quarters of the Surveyor General at Dehra Dún.

During the following season, 1838-39, this party was employed under Lieutenant Renny on the southern section of the Great Arc, and the Budhon Series was thus left in abeyance.

7th Season 1839-40.

PERSONNEL.

Lieut. T. Renny, Bengal Engineers, 1st Assistant, (*absent on other duty*).
Mr. C. Murphy, 1st Class Sub-Assistant.
" W. Rossenrode, 2nd " "
(*with Troughton and Simms' 18-inch Theodolite No. 2*).

On the 13th November 1839 Lieutenant Renny was put in charge of the Budhon Series in the hope that his experience and ability would conduce to its more rapid progress and early completion. He was directed to re-organize an efficient party from the former Budhon Series party and from that of the Amua Series recently completed by Mr. Murphy, and to resume the operations where Lieutenant Ommanney had left off; but as his personal assistance was required in the astronomical observations at Kaliána, Mr. Murphy was placed in temporary executive charge.

The work of the season consisted in completing the towers and extending the approximate series. The stations of Bhind (XVIII), Gúrmi (XVII), and the towers at Firozabad (XXII), Baragaon (XXIII) and Pondri (XXIV) were repaired, the last-built tower of Athgath (XIX) raised from 25 to 36 feet, and that of Kilármáo (XXV) from 19 to 44 feet, a new tower at Sherpur (XXI) built, and those at Salímpur (XXVI), Jamálpur (XXVII) and Sankráo (XXVIII) completed, leaving Parauli (XXXI) alone unfinished of all those south of the Ganges.

As soon as Mr. Murphy had set on foot the tower building he proceeded to take up the approximate series to the north of the Ganges as a double series of consecutive polygons with shorter sides, ordered by the Surveyor General in 1837-38, abandoning the sixty miles of approximate series ahead which had been carried as far as Moradabad (Lat. 29°). By March 1840 he had laid out the Sakrora hexagon.

Lieutenant Renny now (March 1840) visited the party and remained long enough to satisfy himself that the work was being carried on in a correct and systematic way.

By the end of this field season the Sakrora tower had been built, and the ground in advance for the next polygon reconnoitred. The towers built under Mr. Murphy north of the Ganges appear to have been solid, as first intended by Lieutenant Ommanney.

8th Season 1840-41.

PERSONNEL.

Lieut. T. Renny, Bengal Engineers, 1st Assistant, (*absent on other duty*).
Mr. C. Murphy, 1st Class Sub-Assistant (*in executive charge*).
" O. Mulheran, 2nd " "
" W. Glynn, 3rd " "

Lieutenant Renny being engaged in the astronomical observations at Kaliánpur and in the measurement of the Bider Base-line, Mr. Murphy remained in executive charge all this season. He began the season's work by selecting a second hexagon about the advanced station of Bánsgopál (XXXV), whilst the towers that had been damaged during the recent rainy season were being restored. One of them, Jamálpur (XXVII), had fallen, although the precaution had been taken of thatching the towers before the rains

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set in. He then hastened southwards to resume the final observing which had been in abeyance four years since Lieutenant Ommanney finished at Bhind S. on the 2nd December 1836.

The final horizontal angles were now taken up and completed at the undermentioned stations as follows:—

at	Firozabad	T.S.	(XXII)	between 7th and 9th November 1840
„	Panáhat	S.	(XX)	„ 10th „ 15th „ „
„	Athgath	T.S.	(XIX)	„ 16th „ 18th „ „
„	Sherpur	„	(XXI)	„ 19th „ 20th „ „
„	Baragaon	„	(XXIII)	„ 21st „ 30th „ „
„	Pondri	„	(XXIV)	in all December 1840
„	Kilármáo	„	(XXV)	
„	Salímpur	„	(XXVI)	„ January, February, and to 8th March 1841.
„	Jamálpur	„	(XXVII)	
„	Sankráo	„	(XXVIII)	

The towers in advance were not sufficiently advanced for any further observations to be made; but before the end of the field season a third hexagon—that round Sirsa (XL)—was selected and marked by masonry pillars, up to the side Milik (XLIII)—Akbarpur (XLIV), the rays of the Sakrora and Bánsgopál polygons all cleared, and the angles approximately measured with a small theodolite.

No vertical angles were measured this season, and scarcely any secondary triangulation at all accomplished. The vertical angles were not measured, doubtless because the signals on these comparatively long rays in the plains were not visible at the time of least refraction, the only safe time for a single observer to measure them, and they were deferred until the year 1842-43 when a pair of observers with two good instruments became available for the simultaneous reciprocal measurement, requisite at any other time of day. The party returned to recess quarters at Dehra Dún on the 4th June 1841.

9th Season 1841-42.

PERSONNEL.

Lieut. T. Renny, Bengal Engineers, 1st Assistant. (*absent on other duty*).
Mr. C. Murphy, 1st Class Sub-Assistant, (*in executive charge*).
Mr. O. Mulheran, 2nd „ „
„ W. Glynn, 3rd „ „

The approximate series having now been brought up from the south to within 50 miles of the out-lying hills of the Sub-Himalayas about Hardwár (Haridwár), Mr. Murphy took the field in the middle of October 1841 at the north end, as being nearest to Dehra Dún, and proceeded to lay out the figures by which the junction with the Great Arc Series was to be effected.

Starting from the stations of Sheopuri T.S., Godhna T.S., and Chándípahár H.S., of the Great Arc, he selected Mahesari T.S., (now also belonging to the Great Arc) as the centre of a very irregular hexagonal figure, the north and north-east stations being on hills and one of them (Máhegarh) common to this and to the N.E. Longitudinal Series. Two more stations were then selected to form a pentagonal figure about Sarkára T.S. (XLV) by which the entire plan of the Series was completed about the end of February 1842. The rays

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of these two polygons having been cleared at the same time, and the necessary tower stations built to the required height (16 to 20 feet), there remained only a few rays in the Sirsa hexagon to clear, and the towers to build or complete in the southern polygons before having all ready for the final measurement of the angles.

But it required the utmost exertions of all concerned to finish the towers by the beginning of July, when the party returned to recess quarters, having accomplished a very laborious season's work successfully.

10th Season 1842-43.

PERSONNEL.

Budhon Series Party (1).	Lieut. T. Renny, B.E., 1st Assistant. Mr. C. Murphy, 1st Class Sub-Assistant. „ O. Mulheran, 2nd „ „ „ W. Glynn, 3rd „ „	(1). Equipped with Troughton and Simms' 18-inch theodolite No. 2 and two 12-inch theodolites by Troughton and Simms for simultaneous reciprocal verticals.
Extra Party (2).	Mr. W. N. James, 1st Principal Sub-Assistant. „ N. Parsick, Sub-Assistant. „ T. Olliver, „	(2). With probably an 18-inch theodolite by Cary.
Extra Party (3).	Mr. G. Logan, 1st Assistant. „ G. Terry, Sub-Assistant. „ A. Olliver, „	(3). With 15-inch theodolite by Cary.

In view of the large amount of observing to be done, no astronomical observations for azimuth having yet been taken since the Series was begun, and no vertical angles observed since it entered the plains across the Chambal, (owing to want of visibility at time of minimum refraction), and to ensure its completion, the Surveyor General appointed two extra observing parties, and divided the work into three sections to be taken up simultaneously by the three parties as follows:—

In Lieutenant Renny's absence on military duty as Field Engineer to the Army of Reserve assembling at Ferozpur, Mr. Murphy with the main party was to complete the horizontal angles of the southern (Sakrora) polygon, and the unobserved triangle to the south of it, the whole of the verticals, and two Azimuths.

A third Azimuth was to be observed by one (or other) of the two extra parties.

Mr. James with two Sub-Assistants was to observe the horizontal angles of the next two polygons, the Bánsgopál and Sirsa hexagons, measuring the vertical angles also in the afternoon whenever practicable.

Mr. Logan with two Sub-Assistants was to observe the angles of the two northernmost polygons, the Sarkára pentagon and the Mahesari hexagon.

Accordingly Mr. Murphy took the field on the 15th October 1842 and reached Firozabad his first station for observation on the 11th November. Here in conjunction with his sub-assistants he measured three of the four vertical angles by simultaneous reciprocal observations, after which he proceeded to Panáhat and Gúrmi, where by the 10th December he had completed a set of azimuth observations (to ϵ Ursæ Minoris at both E. and W. elongations), besides the requisite vertical angles.

He then visited in succession the stations of Bhind (XVIII), Sherpur (XXI), Baragaon

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(XXIII), Pondri (XXIV), Kilármáo (XXV), Jamálpur (XXVII), and Sarsotha (XXIX), where by the 25th January 1843 he had completed the vertical angles on all but seven rays of the single portion of the Series to the south, and by the middle of February, the horizontal angles at Jamálpur (XXVII), Sarsotha (XXIX), Kariámái (XXXII), Sakrora (XXX), Mehtra (XXXIV), and Rajauli (XXXIII) of the Sakrora hexagon were also finished besides vertical observations on three rays of this figure. On the 10th February Lieutenant Renny rejoined and assumed charge at Sankráo T.S. (XXVIII), where he at once took up the final observing and by the 25th had completed the second Azimuth (using 29 Camelopardalis Hev. at both elongations), the necessary horizontal and the simultaneous reciprocal verticals.

Lieutenant Renny then completed the horizontal and vertical angles remaining to be observed in the following order:— at Parauli (XXXI) by the 4th March, Chandanpur (XXXVI) by the 14th, whilst Messrs. Murphy and Glynn with the two 12-inch theodolites co-operated in observing the simultaneous reciprocal verticals. The main party now returned to Kilármáo, Pondri, and Kariámái, completing or re-observing the angles which Mr. Murphy had been unable to obtain satisfactorily on his first visit, all which were made good by the 9th April. Having completed the work assigned to the main party on the southern section, Lieutenant Renny marched northwards re-observing or supplementing the observations which were still wanting to complete the Series.

A good half of the vertical angles were, practically speaking, simultaneous, *i.e.* taken at both ends of a ray within five minutes of one another, but some only within 15 minutes, whilst in a few cases the observations of the vertical angle at one end of a ray were taken at a widely different time from the corresponding observations at the other. The verticals had necessarily to be observed at any time of day when the signals were visible, with the natural result of giving great variations in the deduced co-efficient of refraction.

Meanwhile the two extra parties under Messrs. Logan and James leaving Head Quarters, Dehra Dún, on 2nd November reached Agra on the 26th, and having completed their equipment proceeded to the section of the field work allotted to them.

Mr. James reached his first station Rajauli (XXXIII) on the 23rd December 1842, and completed his two horizontal angles there on the 30th. The two next angles occupied him at Mehtra (XXXIV) from the 4th to the 21st January 1843. He next measured the six angles at Bánsgopál (XXXV) between the 24th January and 4th February, after which he proceeded to Sirsa (XL) where he was employed nearly a whole month, from 7th February till 3rd March, observing an azimuth and completing five of the six angles. He observed 29 Camelopardalis Hev. at both elongations, the same star that Lieutenant Renny was simultaneously observing at Sankráo. He next visited Bhatauli (XLII), near Moradabad town which he observed to, and whilst here his party was inspected by the Surveyor General. The four angles at Atora T.S. (XXXIX) occupied from the 14th to 26th March, and the two at Barauli (XXXVII) till after the middle of April. He then returned to Sirsa and was occupied from 20th April till the 3rd May in making good the angle which he had been unable to complete during his former long visit. The rest of the observing allotted to him having been completed by the other two parties, Mr. James helped to complete the vertical angles for a few days before returning to recess quarters.

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Mr. Logan on the northern section of the work was rather more fortunate. He completed the angles at his first station Akbarpur (XLIV) by the 25th December 1842, then those at Nandi (XLVII), and three of the five angles at Sarkára (XLV) by the 10th January 1843; Harpálsid H. S. (XLVIII) was next observed at, and then Mahesari T.S., where however a portion of the angles had to be left unmeasured, by the 3rd of February. The Surveyor General visited and inspected the party whilst at Mahesari. The angles at Chándípahár near Hardwár, Godhna and Sheopuri, the stations of the Great Arc, were completed by the 16th February, after which the missing angles at Mahesari were observed, and all the four at Haldaur (XLVI), by 6th March. The missing angles at Sarkára (XLV) were next observed, and the party then proceeded to Milik (XLIII) where the measurement of the 4 angles occupied from the 12th to the 25th March, when the northernmost section allotted to Mr. Logan was finished, but Mr. James's work being backward, he continued his southward progress, completing the angles at Lút (XLI) and Kandarki (XXXVIII) by the end of the month.

Seeing Mr. James to be now in a fair way to complete the angles at the centre and east flank of the Series, and those on the west flank and to the southward being finished, Mr. Logan proceeded to co-operate with Lieutenant Renny in observing the remaining vertical angles all of which were completed by the middle of May, when all three parties marched to Head Quarters at Dehra Dún.

Three other angles were measured at the northern extremity of this season's work and in connection with the triangulation above described, by Captain J. S. Du'Vernet, when commencing the "North Connecting Series" afterwards named the North-East Longitudinal Series, in October and November 1842; but two of them were eventually superseded by re-measurements made by Lieutenant Renny eight years later, with superior instruments, which two are now incorporated with the North-East Longitudinal Series.

The calculations of the triangulation of this Series having been carried up from the side of origin, Budhon-Tinsmál of the Calcutta Longitudinal Series, to the terminal side, Sheopuri-Mahesari of the Great Arc, the following discrepancies were met with between the original values of the length and azimuth of the terminal side above named and those of the latitude and longitude of the terminal station Mahesari, and the values of the same as derived from the Great Arc after the reduction of the North-West Quadrilateral.

In Logarithm of the side	+ 0·000,0302,6	= 4·5 inches per mile nearly.
„ Latitude	+ 1″·002	
„ Longitude	+ 0 ·307	
„ Azimuth	+ 8 ·284	

These discrepancies were treated as errors in the Budhon Series and were dispersed by the method of least squares, as described in Part I of Volume VII of the *Account of the Operations, &c.*

Soon afterwards, the two principal stations at Ráepur of this Series and the Great Arc which are only about 41 feet apart, (see page VII—J. above), were connected in the manner described at page 73—J. of Vol. VII quoted above.

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The following discrepancies between the first corrected Budhon Series values, and the adopted values of the Great Arc were then met with at Ráepur H.S. (XIII) belonging to the Budhon Series :—

In Latitude	$+ 0''\cdot 10$
„ Longitude	$- 0\ \cdot 02$

These discrepancies were treated as errors in the first corrected results of the Budhon Series, and they were dispersed over the whole triangulation by introducing two additional equations of condition for satisfaction, the four primary equations which were required to dispose of the terminal errors being simultaneously maintained. For full description of the procedure see Part I of Vol. VII of the *Account of the Operations, &c.*

The trigonometrical heights above sea-level were checked at several stations (see page 63—*J.*) by the spirit leveling operations of the Trigonometrical and Revenue Surveys, and the errors thus disclosed, together with those of the terminal side Sheopuri-Mahesari, dispersed over the Series in four sections indicated at pages 37 and 38 of Part I of the above named volume.

In the section Budhon-Tinsmál to Firozabad-Baragaon, a distance of about 212 miles, the cumulative error was + 12 feet nearly. In the next section ending at Mehtra-Bánsgopál, a distance of about 88 miles, it was as much as — 17 feet. In the next section ending at Bhatauli-Sirsa-Milik, a distance of about 34 miles, it was less than 1 foot; and in the last section, a distance of about 50 miles, it was nearly — 7 feet. For further details see pages 37 and 38 quoted above.

Secondary Triangulation.

As long as the Series lay in hilly country under Lieutenant Macdonald, the number of secondary stations, landmarks, and places of importance or interest fixed, was very considerable, including the towns of Tehri, Orchha, Jhánsi, Datia, Narwar, Gwalior, Barwa Ságar, and many hill forts, temples &c.

But after entering the plains in lat. 26° 30′ where no view was to be had except by clearing the rays of trees and building high towers, scarcely any secondary points could be fixed without making special arrangements, and the whole strength of the establishment was barely sufficient for the principal triangulation until its close. Nevertheless, Shikohabad, Jalesar, Moradabad, Bijnor, and Kankhal were fixed.

Compiled from the very extensive and complete materials collected by Mr. Charles Wood.

May 1881. B. R. BRANFILL.

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BUDHON MERIDIONAL SERIES.

ALPHABETICAL LIST OF PRINCIPAL STATIONS.

Akbarpur	XLIV.
Algi	VIII.
Andhiári	IV.
Athgath	XIX.
Atora	XXXIX.
Bánsgopál	XXXV.
Baragaon	XXIII.
Barauli	XXXVII.
Bhatauli	XLII.
Bhind	XVIII.
Bhitári	VII.
Budhon (of Calcutta Longitudinal Series).	III.
Chandanpur	XXXVI.
Dargawa	II.
Daryapur	IX.
Dhandkúa	III.
Firozabad	XXII.
Gúrmi	XVII.
Gwáli	V.
Haldaur	XLVI.
Harpálsid	XLVIII.
Jamálpur	XXVII.
Jhánkri	XVI.
Kandarki	XXXVIII.
Karaia	XII.
Kariámái	XXXII.
Kathera	VI.
Kilármáo	XXV.
Lút	XLI.
Mábegarh (of North-East Longitudinal Series).	I.
Maharájpur	X.
Mahesari (of Great Arc Meridional Series).	LII.
Majhár	XIV.
Mehtra	XXXIV.
Milik	XLIII.
Nandi	XLVII.
Narwar	XI.
Panáhat	XX.
Parauli	XXXI.
Patna	I.
Pondri	XXIV.
Ráepur	XIII.
Rajauli	XXXIII.
Sakrora	XXX.
Salímpur	XXVI.
Sánichri	XV.
Sankráo	XXVIII.
Sarkára	XLV.
Sarsotha	XXIX.
Sheopuri (of Great Arc Meridional Series).	XLVIII.
Sherpur	XXI.
Sirsa	XL.
Tinsmál (of Calcutta Longitudinal Series).	VII.

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BUDHON MERIDIONAL SERIES.

NUMERICAL LIST OF PRINCIPAL STATIONS.

III	Budhon. (of Calcutta Longitudinal Series).
VII	Tinsmál. (of Calcutta Longitudinal Series).
I	Patna.
II	Dargawa.
III	Dhandkúa.
IV	Andhiári.
V	Gwáli.
VI	Kathera.
VII	Bhitári.
VIII	Algi.
IX	Daryapur.
X	Maharájpur.
XI	Narwar.
XII	Karaia.
XIII	Ráepur.
XIV	Majhár.
XV	Sánichri.
XVI	Jhánkri.
XVII	Gúrmi.
XVIII	Bhind.
XIX	Athgath.
XX	Panáhat.
XXI	Sherpur.
XXII	Firozabad.
XXIII	Baragaon.
XXIV	Pondri.
XXV	Kilármáo.
XXVI	Salímpur.
XXVII	Jamálpur.
XXVIII	Sankráo.
XXIX	Sarsotha.
XXX	Sakrora.
XXXI	Parauli.
XXXII	Kariámái.
XXXIII	Rajauli.
XXXIV	Mehtra.
XXXV	Bánsgopál.
XXXVI	Chandanpur.
XXXVII	Barauli.
XXXVIII	Kandarki.
XXXIX	Atora.
XL	Sirsa.
XLI	Lút.
XLII	Bhatauli.
XLIII	Milik.
XLIV	Akbarpur.
XLV	Sarkára.
XLVI	Haldaur.
XLVII	Nandi.
XLVIII	Harpálsid.
I	Mábegarh. (of North-East Longitudinal Series).
XLVIII	Sheopuri. (of Great Arc Meridional Series).
LII	Mahesari. (of Great Arc Meridional Series).

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BUDHON MERIDIONAL SERIES.

DESCRIPTION OF PRINCIPAL STATIONS.

Of the 48 Principal Stations composing this Series, the first 16 are on hills occupying the southern half of its extent. They are low solid platforms, either level with the rock, marked in such case *in sitú*, or raised above it. Where the platform is thus raised there is (presumably) a rock-mark or stone, above which one or more mark-stones, with the usual engraved circle and dot, are inserted in the platform, the uppermost even with its surface. When the Series entered the plains, artificial elevations had to be constructed; the necessity for constructing these was sometimes avoided, either in part or entirely, by taking advantage of existing buildings and bastions of forts with which the country abounded. The special erections consisted at first, generally speaking, of *kacha* towers, 20 to 30 feet square at base, having about 7 feet square in the interior made of *paka* brick laid in mud cement, with a central hollow about 1½ feet in diameter running vertically through it, and a mark-stone laid in masonry at about the level of the ground: an arched doorway and passage led to the mark-stone for convenience in plumbing; and a staircase exterior to the tower gave access to the top. Subsequently, the *paka* pillar instead of being perforated was made solid, of about 42 inches diameter at top and having one or more mark-stones built vertically within it: in certain instances no definite information is forthcoming as to the number of marks which were built into the pillar; in these cases no allusion is made in the descriptions to any mark save that at the summit.

The following descriptions have been compiled from those given in the original MS. General Report and other original records of this Series, supplemented in respect to the neighboring villages, by information obtained from the Revenue Survey, Topographical Survey, and other reliable maps of the country traversed. The orthography is in literal agreement with the Gazetted List for the N.W. Provinces, wherever the locality is identified; and conforms to the spirit of the orders of Government on the subject, as worked out in this and other provincial lists, where there is no clear literal authority. The information as to the local sub-divisions in which the several stations occur has been derived where practicable from the Annual Reports received from the civil authorities to whose charge the stations have been committed.

III.—(*Of the Calcutta Longitudinal Series*). Budhon Hill Station, lat. 24° 5′, long. 78° 34′—observed at in 1826, 1833 and 1864—is situated immediately above the village of that name: thána Barodia, tahsíl Kurai, pargana Banda, district Saugor.

The pillar is solid and contains three marks, the two upper respectively 9 and 4 feet above the lowest. The station of 1826 was re-visited in 1833 for the purpose of originating the Budhon Meridional Series, but no alteration in its construction appears to have been made. When again visited in 1864 the mark-stones were found untampered with, the upper being accurately plumbed over the lower, which was adopted for the new station. The bearings and distances of surrounding villages are:—Jáman Kheri 1·5 miles N.W; Burruho 1·5 miles N; Dubri 1·3 miles E.N.E.; Khirea 1·1 miles E.S.E.; and Kanera 2 miles due S.

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VII.—(*Of the Calcutta Longitudinal Series*). Tinsmál Hill Station, lat. 24° 7′, long. 79° 2′—observed at in 1826, 1833, 1834 and 1864—is situated on the top of a very conspicuous hill about three quarters of a mile S. by E. of the village of Tinsua from which it is approached: thána, tahsíl and pargana Banda, district Saugor.

The pillar is solid and has three marks, one engraved on the rock *in sitû* and the others 3·5 and 8·5 feet above it respectively. The station of 1826 was re-visited in 1833 for the purpose of originating the Budhon Meridional Series, when its height was increased by 8·5 feet. It was again visited in 1834 to originate the Rangír Meridional Series, but no further alteration in its construction appears to have been made. On visiting it in 1864 the upper mark was found displaced and the position of the lower was adopted for the new station The bearings and distances of other surrounding villages are:—Dalpatpur, from which a road leads up to the station, 1·5 miles N.E.; Lamnau 1·3 miles towards the W.; and the deserted village of Tinsi 0·8 mile S.S.E.

I. Patna Hill Station, lat. 24° 20′, long. 78° 40′—observed at in 1833—is situated on a sandstone hill, standing on an elevated plateau, on the N. E. face of which is the large village of Patna distant half a mile from the station: tahsíl Mahroni, pargana Máraura Nárhat, district Lalitpur.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of other surrounding villages are:—Dongraa Kalán 2·2 miles N. by W.; Chanaura 2·2 miles N.E. by N.; and Baraudia 2·4 miles due E.

II. Dargawa Hill Station, lat. 24° 37′, long. 79° 4′—observed at in 1833—is situated on a steep rocky ridge, running nearly north and south, at the northern foot of which is the village of Dargawa distant 0·4 mile from the station: pargana Baldeogarh of the Orchha or Tehri state.

The station is marked on the rock *in sitû*. The bearings and distances of other surrounding villages are:—Parra 0·3 mile N.W; Rasoí 1 mile N.N.W.; Bhadaura 1·4 miles S.S.W.; and Magarkhera 1·6 miles E.S.E.

III. Dhandkúa Hill Station, lat. 24° 48′, long. 78° 46′—observed at in 1833 and 1834— is situated on a detached hill, which is deemed sacred by the inhabitants of those parts, and at the northern foot of which at a distance of 500 feet is the village of Dhandkúa: tahsíl Mahroni, pargana Bánpur, distrct Lalitpur.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of other surrounding villages are:—Pura 0·8 mile N.W. by N.; Billahta 0·8 mile S.S.W.; and Khakhron 2·3 miles S.E. by E.

IV. Andhiári Hill Station, lat. 24° 41′, long. 78° 16′—observed at in 1833—is situated on the highest point of the sandstone range of that name, and about 100 yards north of a remarkable cave: in the Gwalior state.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of surrounding villages are:—Sirsod 0·4 mile N. by W.; Jamursa 2·1 miles S.E.; and Larheri 2 miles S.W.

V. Gwáli Hill Station, lat. 25° 10′, long. 78° 28′—observed at in 1833—is situated on a rocky ridge running north and south, and takes its name from a small village which is distant about ¼ of a mile to the E.: pargana Jhánsi, district Jhánsi.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of surrounding villages are:—Bíjpur 1·2 miles N.E.; Lakhanpur 1·3 miles S.E. by S.; and Busai 1·6 miles S.W. by S.

VI. Kathera Hill Station, lat. 25° 14′, long. 79° 0′—observed at in 1834—is situated on a high and steep hill which was formerly used as a stronghold: pargana Mau, district Jhánsi.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of surrounding villages are:—Laraun 1 mile S.W.; Katehra Muáf 1·6 miles W.; and Hanspura 0·4 mile E. by N.

VII. Bhitári Hill Station, lat. 25° 28′, long. 78° 47′—observed at in 1834—is situated on a hill on the E. bank of the Betwa river, and distant 0·4 mile S.S.W. of the village after which it is named. The high road from Jhánsi to Garotha passes about a mile north of the station: in the Orchha or Tehri state.

The station is marked on a large block of quartz around which a platform has been built. The bearings and distances of neighboring villages are:—Tiletha 1·1 miles S. by W.; Bagat, on the left bank of the Dangrai Nadí, 2·8 miles E. by S.

VIII. Algi Hill Station, lat. 25° 30′, long. 78° 24′—observed at in 1834—is situated on a hill about 3 miles north of the hill fort and large village of Dinara: in the Gwalior state.

The station is marked on the rock *in sitû* around which a platform has been built. The bearings and distances of surrounding villages are:—Khirk 1·2 miles N.N.W.; Algi 1·1 miles S.W.; and Guraira Ráj Orchha 0·5 mile due S.

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IX. Daryapur Hill Station, lat. 25° 42′, long. 78° 41′—observed at in 1834—is built on the site of a dilapidated fort surmounting a low isolated hill, on the southern brow of which is the village of Daryapur: tahsíl and pargana Datiya of the Datiya state.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of surrounding villages are:—Bhúla 0·9 mile S.; Dúrsara 1·3 miles N.E.; and Karkhara 1·6 miles N.N.W.

X. Maharájpur Hill Station, lat. 25° 54′, long. 78° 17′—observed at in 1834—is situated on a hill rising immediately above the village of Maharájpur and surrounded by several lower hills: in the Gwalior state.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of surrounding villages are:—Rajare and Lailiapura 0·8 mile towards the W. by S.; Kanwai 1·5 miles N.N.E.; and Chetauni 1·8 miles S.E. by S.

XI. Narwar Hill Station, lat. 25° 37′, long. 77° 58′—observed at in 1834—is situated on the N.E. extremity of a sandstone hill on which, at a few feet to the E.S.E., the secondary station Ladára h.s. (of the Great Arc Meridional Series, Section 24° to 30°) is built: in the Gwalior state.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of surrounding places are:—the large town and fort of Narwar about 1½ miles N.W. by N.; Surkharia village 1·3 miles N.E.; and Shergarh 1·5 miles S. by E.

XII. Karaia Hill Station, lat. 25° 54′, long. 78° 3′—observed at in 1834—is situated in the centre of an unfinished fort which occupies an eminence of the great sandstone range extending to the vicinity of Gwalior: in the Gwalior state.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of surrounding villages are:—Karaia 0·5 mile E.S.E.; Rethaunda 2 miles S. by W.; and Dhobai 1·8 miles N. by E.

NOTE.—*This station is almost certainly identical with the secondary point Karaia h.s. of the Great Arc Meridional Series, Section* 24° *to* 30°, *in the original records of which however it is described as on the W. turret of a well known detached fortified hill on road Gwalior to Sironj; Karaia village lies on the eastern slope: it is marked by a circular platform with a mark-stone, having a* ⊙ *engraved on it.*

XIII. Ráepur Hill Station, lat. 26° 8′, long. 78° 7′—observed at in 1834 and 1836—is situated on a lofty conical peak of the Vindhyáchal range surmounted by a Hindu temple, on the western side of which Ráepur H.S. of the Great Arc Meridional Series, Section 24° to 30°, is built. The station commands a good view of the town and fort of Gwalior which lie about 9½ miles to the N.E.: in the Gwalior state.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of neighboring villages are:—Ráepur 1½ miles W.S.W.; and Naigaon 1·5 miles S.

XIV. Majhár Hill Station, lat. 26° 6′, long. 78° 31′—observed at in 1834 and 1836—is situated on the same elevated plateau as Gujara fort from which it is distant about 1¼ miles due north: in the Gwalior state.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of neighboring places are:—Jamrúha fort 2 miles E.N.E.; and Naugamo village 3·1 miles E.S.E.

XV. Sánichri Hill Station, lat. 26° 24′, long. 78° 15′—observed at in 1836—is built adjoining some ruins on a sacred hill which is the residence of a *guru* or religious instructor of the Raja, and stands above the ruins of the ancient town of Ainti: in the Gwalior state.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of surrounding places are:—Khitoro fort 2 miles E. by N.; Burrúli village 1·4 miles N.N.W.; and Parbat village 0·6 mile W.S.W.

XVI. Jhánkri Hill Station, lat. 26° 19′, long. 78° 35′—observed at in 1836—is situated on a low range of hills which runs nearly north and south, and has a couple of hamlets lying at the foot of the hill on the eastern side: in the Gwalior state.

The pillar is solid, and has a mark-stone at its upper surface. The bearings and distances of surrounding villages are:—Silauli 1·3 miles N.E. by E.; Makata 1·1 miles S.E.; and Chimara 1·9 miles W.S.W.

XVII. Gúrmi Tower Station, lat. 26° 36′, long. 78° 33′—observed at in 1836 and 1842—is situated

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on a bastion at the northern angle of the mud fort attached to the village of Gúrmi which lies between the Sánichri hills and the Chambal river: in the Gwalior state.

The station consists of a tower of sun-dried bricks and mud cement, raised to a height of 27 feet above the terreplein of the rampart, and having a mark-stone at top and another at bottom. The bearings and distances of surrounding villages are:—Silauli 1·6 miles N.W. by W.; Kaliánpura 1·6 miles S.W. by W.; and Gopálpura 1·4 miles E. by S.

XVIII. Bhind Station, lat. 26° 34′, long. 78° 50′—observed at in 1836 and 1842—is situated on the roof of the gateway in the north face of the masonry fort attached to the large village of Bhind which lies on the plain south of the Chambal river. The station is 34 feet above the level of the interior of the fort: in the Gwalior state.

The station consists of a masonry pillar, 5 feet high and 9 feet square, which carries the usual mark-stone at its upper surface. The bearings and distances of surrounding villages are:—Pura 0·4 mile N. by E.; Khirpura 1·3 miles S. S. W.; Haibatpura 1·8 miles W.; and Kumaroa 1·7 miles N.W. by W.

XIX. Athgath Tower Station, lat. 26° 48′, long. 78° 45′—observed at in 1840 and 1842—is situated amidst the ravines on the north bank of the Chambal river, and close to the northern skirts of the village of Athgath or Hathkanth: tahsíl Panáhat, pargana Hathkanth, district Agra.

The station consists of a tower, 36 feet high and 14 feet square at top, having a central hollow core of masonry: it has a mark-stone at level of ground floor. The bearings and distances of surrounding villages are:—Kiári 1·3 miles W. by S.; Piárampura 1·1 miles N.E.; and Surekhipura 1·3 miles N.E. by E.

XX. Panáhat Station, lat. 26° 53′, long. 78° 25′—observed at in 1840 and 1842—is situated on the roof of a vaulted building (apparently an interior gateway) of the dilapidated masonry fort at the south side of the village of Panáhat: tahsíl and pargana Panáhat, district Agra.

The station mark is elevated 30 feet above the ground at the south side of the building, the walls of which were raised to form a platform around a pillar 3 feet high. The bearings and distances of surrounding villages are:—Biprauli 1·4 miles W.N.W.; Utsana 1·1 miles S.S.E.; and Sikthura 2·5 miles E.

XXI. Sherpur Tower Station, lat. 27° 1′, long. 78° 42′—observed at in 1840 and 1842—is situated on the terreplein of the rampart at the northern corner of an old mud fort standing a short distance east of the village of Sherpur: thána Sarsaganj, tahsíl and pargana Shikohabad, district Mainpuri.

The station consists of a tower of sun-dried bricks and mud cement, 30·8 feet high and 14 feet in diameter at top, having a central hollow core of burnt brick: it has a mark-stone at level of ground floor. The bearings and distances of surrounding villages are:—Madanpur 1 mile N.N.W.; Pandrawan 0·3 mile S. by E.; and Aidalpur 0·3 mile N.E.

XXII. Firozabad Tower Station, lat. 27° 9′, long. 78° 26′—observed at in 1840, 1842 and 1843—is situated on the terreplein of the rampart at the S. E. corner of an old mud fort standing about ¼ mile W. of the town of Firozabad: pargana and tahsíl Firozabad, district Agra.

The station consists of a tower of sun-dried bricks and mud cement, 43·8 feet high and 14 feet square at top, having a central hollow core of burnt brick: it has a mark-stone at 1 foot below the level of the terreplein. The bearings and distances of surrounding places are:—Firozabad station, of the E. I. Railway, 0·3 mile S.S.E.; Rasúlpur village 1·1 miles E.S.E.; Datauji 1·1 miles W.S.W.; and Humáyúnpur 1·2 miles N.W.

XXIII. Baragaon Tower Station, lat. 27° 15′, long. 78° 45′—observed at in 1840, 1842 and 1843—is situated on the crest of a mound distant ¼ mile to the S. E. of the village of Baragaon: thána Jasrána, tahsíl and pargana Mustafabad, district Mainpuri.

The station consists of a tower of sun-dried bricks and mud cement, 45·4 feet high and 14 feet square at top, having a central core of burnt brick: it has a mark-stone at 1 foot below the ground floor. The Etáwah Branch of the Ganges Canal runs at ¼ mile S.W. of the station; and the bearings and distances of surrounding villages are:—Nahu 1·1 miles N.; Jasrána 2·8 miles S.S.W.; Kuiari 2·2 miles S.E.; and Kanchgahi 2·6 miles N.E.

XXIV. Pondri Tower Station, lat. 27° 28′, long. 78° 27′—observed at in 1840 and 1843—is situated on a mound (about 25 feet in height) within the ruins of the mud fort attached to the small village of Pondri: tahsíl and pargana Jalesar, district Agra.

The station consists of a tower of sun-dried bricks and mud cement, 44·3 feet high and 13 feet square at top, having a central hollow core of burnt brick: it has a mark-stone at 1 foot below the ground floor. The bearings and distances of surrounding villages are:—Punhara 1·5 miles W. by N.; Kasua 1·3 miles N.; Khaira Taj 1·2 miles E. by N.; and Mahaki 1·8 miles S.S.W.

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XXV. Kilármáo Tower Station, lat. 27° 33′, long. 78° 49′—observed at in 1840, 1842 and 1843—is situated on the crest of a mound (about 20 feet in height) distant ½ mile west of the small village of Kilármáo: thána, tahsíl, pargana and district Etah.

The station consists of a tower of sun-dried bricks and mud cement, 44·5 feet high and 14 feet square at top, having a central hollow core of burnt brick: it has a mark-stone at 1 foot below the ground floor. The bearings and distances of surrounding places are:—Etah town 6 miles W.; Nehchalpur village 0·9 mile W.N.W.; Jísukhpur 0·5 mile S.W.; and Murjadpur 0·6 mile N. by W.

XXVI. Salímpur Tower Station, lat. 27° 47′, long. 78° 33′—observed at in 1841 and 1843—is situated on the crest of a mound (about 20 feet in height) distant 600 yards west of the small village of Salímpur: thána and tahsíl Kásganj, pargana Bilrám, district Etah.

The station consists of a tower of sun-dried bricks and mud cement, 48 feet high and 13 feet square at top, having a central hollow core of burnt brick: it has a mark-stone at 1 foot below the ground floor. The bearings and distances of surrounding villages are:—Badampur 0·9 mile E.S.E.; Naráinpur 0·5 mile S.; Kutubpur 1·2 miles N.W.; and Dharampur 1·3 miles N.E. by N.

XXVII. Jamálpur Tower Station, lat. 27° 48′, long. 78° 52′—observed at in 1841 and 1843—is situated on a mound (about 12 feet in height) within the ruins of a mud fort distant nearly half-a-mile to the N.W. of the small village of Jamálpur: thána Saháwar, tahsíl Kásganj, pargana Saháwar, district Etah.

The station consists of a tower of sun-dried bricks and mud cement, 28 feet high and 14 feet in diameter at top, having a central hollow core of burnt brick: it has a mark-stone at 1 foot below the ground floor. The bearings and distances of surrounding villages are:—Firozpur 0·5 mile S.S.W.; Chadpur 0·5 mile N.W.; and Bhaloli 0·7 mile N.E.

XXVIII. Sankráo Tower Station, lat. 28° 2′, long. 78° 35′—observed at in 1841 and 1843—is situated on the site of an old fort on a high spur of the bank which bounds the southern edge of the *khádar* or low lands of the Ganges, and stands close to the west side of the village of Sankráo which is distant within half-a-mile to the south of the old bed of that river: tahsíl Atrauli, pargana Gangíri, district Aligarh.

The station consists of a tower of burnt bricks and mud cement, 37·3 feet high and 14 feet in diameter at top, having a central hollow core of masonry: it has a mark-stone at 1 foot below the ground floor. The bearings and distances of surrounding villages are:—Rustamnala 1·1 miles W. by N.; Mohkampur 1·2 miles S.S.E.; and Síkri 1·1 miles E. by S.

XXIX. Sarsotha Tower Station, lat. 28° 6′, long. 78° 48′—observed at in 1843—is situated on the northern edge of the *khádar* or low lands of the Ganges, and stands about half-a-mile N.E. of the hamlet of Sarsotha a place of Hindu pilgrimage: thána, tahsíl and pargana Sahaswán, district Budaun.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 23·8 feet high: it has a mark-stone in the foundation, another at 7 feet above ground level, and a third at summit. The bearings and distances of surrounding villages are:—Manikpur 1 mile S.W.; Alipur 0·6 mile N.W.; and Guhlaul 2·3 miles N.E. by E.

XXX. Sakrora Tower Station, lat. 28° 13′, long. 78° 36′—observed at in 1843—is situated on a mound (about 10 feet in height) within half-a-mile S. by W. of the village of Sakrora: thána Asadpur, tahsíl Gunnaur, pargana Asadpur, district Budaun.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 21 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Lahra 0·5 mile W.N.W.; Mirzapur 0·6 mile S.; and Baudrái 1·3 miles N.E. by E.

XXXI. Parauli Tower Station, lat. 28° 10′, long. 78° 24′—observed at in 1843—is situated on high ground about 350 yards due north of the village of Parauli or Parhauli: thána Ramghat, tahsíl Anúpshahr, pargana Dibai, district Bulandshahr.

The station consists of a tower of unburnt bricks and mud cement, 15 feet in diameter at top, enclosing a central solid pillar of masonry 18·8 feet high: it has a mark-stone at ground level, another at 7 feet above it, and a third at summit. The bearings and distances of surrounding villages are:—Rampur 0·7 mile E.; Bajhera 0·6 mile S.E.; Jírajpur Khurd 1·2 miles W.; and Belon Nagla 0·9 mile N.

XXXII. Kariámái Tower Station, lat. 28° 15′, long. 78° 48′—observed at in 1843—is situated on a slight elevation distant half-a-mile east of the village of Kariámái: thána Islámnagar, tahsíl Bisauli, pargana Islámnagar, district Budaun.

The station consists of a tower of unburnt bricks and mud cement, 15 feet in diameter at top, enclosing a central solid pillar of masonry 17·3 feet high: it has a mark-stone at ground level, and another at summit. The bearings and distances of surrounding villages are:—Bhartpur 0·4 mile S.S.E.; Udaipur 0·8 mile N.E.; and Firozpur 1·1 miles due N.

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XXXIII. Rajauli Tower Station, lat. 28° 22′, long 78° 28′—observed at in 1843—is situated on the *khádar* or low lands of the Ganges, and stands 0·4 mile S.E. of the village of Rajauli or Rajawali: thána Rajpura, tahsíl Gunnaur, pargana Rajpura, district Budaun.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 23 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Paniwara 1·3 miles S.W.; Neora 1·3 miles S. by E.; and Gobindpur 1·1 miles due E.

XXXIV. Mehtra Tower Station, lat. 28° 22′, long. 78° 41′—observed at in 1843—is situated on a mound (about 10 feet in height) distant ¼ mile north of the small village of Mehtra: tahsíl and pargana Sambhal, district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 16 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Bahpur Patti 1·1 miles E.; Sultánpur 2·4 miles W.; Mirzapur 0·9 mile N.N.E.; and Yazafpur 0·8 mile N.W. by N.

XXXV. Bánsgopál Tower Station, lat. 28° 33′, long. 78° 34′—observed at in 1843—is situated on a sandy mound (7 or 8 feet in height) distant 500 yards west of the temple of Bánsgopál a place of Hindu pilgrimage: tahsíl and pargana Sambhal, district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 18·8 feet high: it has a mark-stone at a little below ground level, and another at summit. The bearings and distances of surrounding places are:—Sambhal town 3 miles N.E.; Turrano Sarai 1·8 miles E. by S.; Gandhipura village 1 mile N. by E.; Busla village 1·7 miles W. by S.; and Bahádurpur Sarai 1·1 miles S.W. by S.

XXXVI. Chandanpur Tower Station, lat. 28° 34′, long. 78° 21′—observed at in 1843—is situated at the distance of half-a-mile to the E.S.E. of the village of Chandanpur: tahsíl and pargana Hasanpur, district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 16·5 feet high: it has a mark-stone at ground level, another 7 feet above it, and a third at summit. The bearings and distances of surrounding villages are:—Deorara 0·8 mile S.; Khanraua 1·8 miles W.S.W.; and Chhapna 2·1 miles N.W. by N.

XXXVII. Barauli Tower Station, lat. 28° 32′, long. 78° 48′—observed at in 1843—is situated on a mound (about 20 feet in height) which is apparently the site of a deserted village, and is distant nearly 1½ miles N. E. of the village of Barauli: tahsíl and pargana Bilári, district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 16·5 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Khásepur 0·6 mile W.; Pípli 0·8 mile N.E.; and Akrauli Auliapur 1·1 miles E.S.E.

XXXVIII. Kandarki Tower Station, lat. 28° 44′, long. 78° 27′—observed at in 1843—is situated close to the eastern side of the village of Kandarki: tahsíl and pargana Hasanpur, district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 18·7 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Khairpur 1·1 miles E.S.E.; Begpur 1 mile S.W. by W.; and Jehul 1 mile W.N.W.

XXXIX. Atora Tower Station, lat. 28° 43′, long. 78° 40′—observed at in 1843—is situated on a mound (about 30 feet in height) immediately N. W. of the village of Atora or Athaura on the high road from Moradabad to Sambhal and Aligarh: tahsíl and pargana Sambhal, district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 17·8 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Athauri 0·4 mile S.; Bháuddínpur 0·8 mile W.; Harthali 1·3 miles N.W.; and Sháhpur 1·6 miles E.N.E.

XL. Sirsa Tower Station, lat. 28° 55′, long. 78° 35′—observed at in 1843—is situated on a mound (about 15 feet in height) distant 600 yards north of the village of Sirsa: tahsíl and pargana Amroha, district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 26 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Daryapur 0·7 mile S.W. by W.; Mauye Chak 0·4 mile N.E. by N.; Raghunáthpur 1 mile S.E. by S.; and Háshampur 0·9 mile N.W.

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XLI. Lút Tower Station, lat. 28° 54′, long. 78° 21′—observed at in 1843—is situated in the lands of the village of Lút: tahsíl and pargana Hasanpur, district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 20 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Mahamdi 0·1 mile N.N.W.; Afzalpur 0·6 mile S. by E.; Kurala 0·6 mile N.E.; and Lakhania 1·2 miles S.W.

XLII. Bhatauli Tower Station, lat. 28° 54′, long. 78° 46′—observed at in 1843—is situated at the distance of about 1 mile west of the village of Bhatauli: tahsíl, pargana and district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 14·5 feet high: it has a mark-stone at summit. The bearings and distances of surrounding places are:—Moghalpur town 1·6 miles N.; Mahtakpur 1·2 miles W.S.W.; and Gopálpur 1·9 miles W. by N.

XLIII. Milik Tower Station, lat. 29° 5′, long. 78° 28′—observed at in 1843—is situated in the lands of the village of Lodhipur Milik: tahsíl Chándpur, pargana Burhpur or Nurpur, district Bijnor.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 17·3 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Sahela 1·1 miles E.; Ber 0·6 mile S.S.E.; Shehbonpur 0·6 mile W.S.W.; and Mor Makdúmpur 1·2 miles N.E. by N.

XLIV. Akbarpur Tower Station, lat. 29° 5′, long. 78° 41′—observed at in 1842 and 1843—is situated close to the high road from Hardwár to Moradabad, and distant about half-a-mile N.W. of the village of Akbarpur: tahsíl and pargana Amroha, district Moradabad.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 15 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Garhi 0·4 mile S. by W.; Burhpur 0·8 mile W. by S.; and Salímpur 0·5 mile N.E. by E.

XLV. Sarkára Tower Station, lat. 29° 16′, long. 78° 35′—observed at in 1843—is situated close to the high road from Hardwár to Moradabad, and distant about 0·6 mile S.S.E. of the village of Sarkára: tahsíl Dhámpur, pargana Sherkot, district Bijnor.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 16·3 feet high: it has a mark-stone at summit. The bearings and distances of surrounding villages are:—Rajmul 0·3 mile S.S.E.; Nasírpur Bhunwari 1·3 miles W.S.W.; and Salímpur Sarai 0·8 mile S. by W.

XLVI. Haldaur Tower Station, lat. 29° 17′, long. 78° 19′—observed at in 1843—is situated on a sandy mound (8 or 9 feet in height) in the lands of the village of Rasúlpur, and is distant about 1 mile S.W. of the large village of Haldaur: tahsíl Bijnor, pargana Daranagar, district Bijnor.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 19·7 feet high: it has a mark-stone at top. The bearings and distances of surrounding villages are:—Chajjupura 0·8 mile S.E. by E.; Uttapur 0·8 mile S.W.; and Sikandarpur Sani 1·1 miles nearly due N.

XLVII. Nandi Tower Station, lat. 29° 17′, long. 78° 49′—observed at in 1842 and 1843—is situated in the lands of the village of Púranpur, and is distant about half-a-mile E.S.E. of the village of Nandi: tahsíl and pargana Káshipur, district Tarái.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central solid pillar of masonry 12 feet high: it has a mark-stone at summit. The surrounding villages are:—Púranpur 0·6 mile N.; Raipur; Haripura; and Mowa Dabra.

XLVIII. Harpálsid Hill Station, lat. 29° 40′, long. 78° 36′—observed at in 1843—is situated on the peak immediately west of the hill of Harpálsid on the southern border of the Sub-Himalaya mountains, and is approached from Najíbabad by Kotkadr and Bagnala: district Garhwál.

The station is denoted by the centre of a circle engraved on a stone which is fixed in the middle of a platform and is flush with the level of the ground. The station of 1843 was re-visited in 1866 in the course of the secondary operations of the Kumaun and Garhwál Survey, but, from the absence of information to the contrary, no alteration in its construction appears to have been made.

I.—(*Of the North-East Longitudinal Series*). Mábegarh Hill Station, lat. 29° 53′, long. 78° 30′—observed at in 1842, 1843, 1850 and 1865—is situated on the hill of that name, and adjoins a rude temple to the north: pargana Ajmir, district Garhwál.

The station consists of a platform of stones and earth, 14 feet square at top, enclosing a central isolated pillar of masonry 6·9 feet

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high: it has a mark-stone at 1 foot above ground level, and another at summit. The original station of 1842-43 which was common to the Budhon Meridional and the North Connecting Series—was re-visited in 1850 in the course of the operations of the North-East Longitudinal Series, and again in 1865 to originate the Kumaun and Garhwál Survey; on neither of these occasions was any alteration made in the construction of the station. The bearings and distances of surrounding villages are:—Kundra 1 mile S. by W.; Jaurási 1·8 miles W.; Harsu 1·6 miles N.; and Badoli 1·8 miles N.N.E.

XLVIII.—(*Of the Great Arc Meridional Series, Section* 24° to 30°). Sheopuri Tower Station, lat. 29° 19′, long. 78° 2′—observed at in 1836, 1837, 1843 and 1866—is built on an elevated mound, apparently the site of a ruined fort, standing on a high bank which bounds the bed of the Ganges on the west, and distant about half-a-mile east of the village of Sheopuri: tahsíl Jánsath, pargana Bhúma Sambalhera, district Muzaffarnagar.

The station consists of a hollow masonry tower 40·5 feet high, having a mark-stone in the ground floor. It was originally constructed as a station of the Great Arc Meridional Series, Section 24° to 30°, in the course of the operations of which it was visited in 1836, 1837 and 1866, the Budhon Series having connected with it in 1843: no change was however made on the occasion of the subsequent visits to the original tower. The bearings and distances of surrounding places are:—Miránpur town 3 miles S.W.; Jaspur village 1 mile N.N.E.; and Alampur 1·2 miles E.

LII.—(*Of the Great Arc Meridional Series, Section* 24° to 30°). Mahesari Tower Station, lat. 29° 30′, long. 78° 11′—observed at in 1843, 1851, 1865 and 1866—is built on a sand ridge (about 20 feet in height), near the S.W. corner of the village of Mahesari: tahsíl Bijnor, pargana Mandáwar, district Bijnor.

The station consists of a tower of unburnt bricks and mud cement, 14 feet square at top, enclosing a central pillar of masonry 13·5 feet high which is solid to a height of 12 feet above ground level and perforated thereafter: it has a mark-stone at the level of the ground, and others at 7 and 12 feet respectively above this level. The station of 1843—which was 12 feet in height—was re-visited in 1851 in the course of the operations of the North-East Longitudinal Series, when the masonry pillar was found in good order and the upper mark-stone undisturbed. When again visited in 1865-66 in connection with the Great Arc Meridional Series, Section 24° to 30°, the pillar and upper mark-stone were found in good preservation: on this occasion however the height of the pillar was raised to 13½ feet, but no mark-stone was placed at its summit, a hollow cylindrical space, 4 inches in diameter, having been left for reference to the old mark-stone. The bearings and distances of surrounding places are:—Mandáwar 1·6 miles S.S.W.; Shahbazpur 1·2 miles W.; Ratanpur Raiya 0·8 mile N.N. W.; and the town of Kíratpur about 3 miles E.

February 1877.

J. B. N. HENNESSEY,

In charge of Computing Office.

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BUDHON MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. ADDENDUM TO DESCRIPTION OF STATIONS.

NOTE.—Consequent on modern alterations of district and other boundaries, the sites occupied by the stations are in some instances now included in civil divisions of territory which differ from the district, pargana, or village, recorded in the preceding descriptions of stations: a complete list of all the stations of the Series including a suitably modified statement of the altered sub-divisions in question is accordingly given in the following table, and is derived chiefly from the annual reports, up to 1881, made by the Civil Officials to whose care the stations have been committed. The statement also gives additional information as to position, construction, and present condition of certain of the stations; where no entry regarding present condition is made against a station it is to be assumed that the station when last reported on by the district Official was in good order.

The spelling of names is in accordance with that given in the lists of more important places published under the orders of Government whenever such names occur in the lists.

No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Remarks on the Construction and Condition of the Station
III*	...	Saugor	Tah. Kurai, Táluka Pitihra, Thá. Baraudia	Budhon	... ...
VII*	...	"	P., Tah. and Thá. Banda	Tinsi	... ...
I	...	Lalitpur	Tah. Mahroni, P. Máraura	Patna	The upper mark-stone wanting as reported in January 1870.
II	...	Bundelkhand Political Agency	P. Baldeogarh	Dargawa	... ...
III	...	Lalitpur	Tah. Mahroni, P. Bánpur	Dhandkua	The pillar fallen down as reported in May 1867.
IV	Andheri	I'sagarh (Gwalior territory)	P. Marguli	Sarsud	No trace of the station found as reported in 1877.
V	...	Jhánsi	Tah. Jhánsi	Gwáli	No mark-stone found as reported in May 1867.
VI	Hanspura	"	Tah. Mau	Hanspura	No mark-stone found as reported in May 1867. A pile of earth and stones raised over the pillar in 1879.
VII	...	...	... ...	...	*No report received.*
VIII	...	Jhánsi (Gwalior territory)	P. Karera	Algi Dinara	... ...

NOTE.—Stations III* and VII* appertain to the Calcutta Longitudinal Series of the South-East Quadrilateral. P. stands for pargana, Tah. for tahsíl, and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Remarks on the Construction and Condition of the Station
IX	...	Bundelkhand Political Agency	Tah. Datia	Daryapur	... ...
X	...	Narwar (Gwalior territory)	P. Karhia	Mahárájpur	... ...
XI	...	„	P. Narwar	...	... ...
XII	...	I'sagarh (Gwalior territory)	P. Chanderi	Karehra	... ...
XIII	...	Gwalior	P. Gird Gwalior	Raepur	... ...
XIV	...	„	P. Pichhor	Gujara	... ...
XV	Saníchari	„	P. Kotwál	Ántri	The pillar fallen down, only the mark remains, as reported in May 1877.
XVI	...	Sikarwári (Gwalior)	... ...	...	... ...
XVII	Gormín	Tonwarghár (Gwalior)	P. Gormín	Gormín	The tower fallen down as reported in May 1877.
XVIII	...	Bhind (Gwalior)	P. Bhind	Bhind	... ...
XIX	Hathkanth	Agra	P. Panáhat	Hathkanth	... ...
XX	...	„	Ditto.	Panáhat	... ...
XXI	Sarsaganj	Mainpuri	Tah. Shikohabad, Thá. Sarsaganj	Madanpur	The arch and the lower portion of the central pillar were found dug into up to the perforation.
XXII	...	Agra	P. Firozabad	Raepur	... ...
XXIII	Jasrána	Mainpuri	Tah. Mustafabad, Thá. Jasrána	Kushiari	About 20 feet of the pillar fallen down as reported in March 1873.
XXIV	...	...	... ...	...	The station was connected with the Revenue Survey line of levels in 1873, under Colonel Anderson, when the lower mark-stone was found intact and the height of summit of pillar above this mark to be 42·5 feet.
XXV	...	Etah	Tah., P. and Thá. Etah	Kilármau	The pillar 42 feet high as reported in 1874.
XXVI	Salímpur	„	Tah. and Thá. Kásganj, P. Bilrám	Salímpur	The pillar 35 feet high as reported in 1874.
XXVII	...	„	Tah. Kásganj, P. and Thá. Sahávar	Jamálpur	The pillar 25 feet high as reported in 1874.
XXVIII	Minár Sankra	Aligarh	Tah. Atrauli, P. Gangiri	Sankra	The mark-stone wanting as reported in 1867.

NOTE.—Stations XXI to XLVII were visited in 1865-66 by Mr. W. Ivey, Assistant Surveyor, who was especially deputed for the purpose. With regard to the central paka pillars, their condition when visited and the repairs effected are given in detail above. As respects the kacha towers, around the pillars, these were found either partially or wholly washed away; nor were any measures taken specially for their restoration. Mr. Ivey protected the stations in the following manner:—the summits of the pillars were capped by conical mounds of sun-dried bricks or earthwork to carry off the rainfall, and the pillars themselves were enclosed in same materials up to varying heights. After this he transferred all these stations to the charge of local officials.

P. stands for pargana, Tah. for tahsíl, and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Remarks on the Construction and Condition of the Station
XXIX	Mánikpur	Budaun	Tah., P. and Thá. Sahaswán	Mánikpur	The central pillar and its upper mark-stone were found uninjured.
XXX	...	„	Tah. Gunnaur, P. Asadpur	Sakrora	The central pillar and its upper mark engraved on a burnt brick were found uninjured.
XXXI	...	Bulandshahr	Tah. Anúpshahr, P. Dibai, Thá. Rámghat	Parauli	The central pillar and its upper mark-stone were found all right.
XXXII	...	Budaun	Tah. Bisauli, P. and Thá. Islámnagar	Kariámái	Ditto.
XXXIII	...	„	Tah. Gunnaur, P. and Thá. Rajpura	Rajauli	The central pillar was found half thrown down, it was raised by 3 feet with burnt bricks and mud cement, making its height about 14 feet above ground.
XXXIV	Mehtra Dharampur	Moradabad	P. Sambhal	Mehtra	The upper mark-stone was found intact, the central pillar partially dug into at base and summit.
XXXV	Benipur Chak	„	Ditto.	Bánsgopálpur	The central pillar and the upper mark-stone were found all right.
XXXVI	Chandanpur Khádar	„	P. Hasanpur	Chandanpur Khádar	Ditto.
XXXVII	Umra	„	P. Bilári	Barauli	The upper mark-stone was missing, and portion of the summit of the central pillar broken.
XXXVIII	Kandarki	„	P. Hasanpur	Kandarki	The central pillar and its upper mark engraved on a burnt brick were found perfect.
XXXIX	...	„	P. Sambhal	Atora	The upper mark-stone was missing, and portion of the summit of the pillar broken.
XL	...	„	P. Amroha	Sirsa	The central pillar and the mark-stone on its summit were found perfect.
XLI	Mahamdí	„	P. Hasanpur	Lút	The whole structure was found fallen down, with the exception of 4 feet of the central pillar above ground. The pillar was raised 4 feet in height above the old remains, with burnt bricks and mud cement.
XLII	Kázipur	„	Tah. Moradabad	Bhatauli	The central pillar and the mark-stone on its summit were found perfect.
XLIII	Lodipur Milik	Bijnor	Tah. Chándpur, P. Burhpur	Lodipur Milik	The central pillar and the mark engraved on a burnt brick, on its summit, were found perfect.

NOTE.—P. stands for pargana, Tah. for tahsíl, and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Remarks on the Construction and Condition of the Station
XLIV	...	Moradabad	Tah. Amroha	Akbarpur	The central pillar was found standing and slightly dug into at the base, and the mark-stone missing.
XLV	...	Bijnor	Tah. and P. Dhámpur	Bhíka Ját	The central pillar and the mark-stone on its summit were found perfect, the edges of the pillar slightly decayed.
XLVI	...	„	Tah. Bijnor, P. Dáranagar	Rasúlpur	The central pillar and the mark-stone on its summit were found perfect.
XLVII	Nanda	Tarái	P. Káshipur	Púranpur	The central pillar was found fallen down to within 1½ feet of the ground level, this was repaired, raised to 2½ feet above ground, with burnt bricks laid in mud cement, and a mark-stone placed on it.
XLVIII	...	Garhwál	P. Talla Salán, Táluka Bhábar	Bágnála	A portion of the masonry given way as reported in 1879.
I	...	„	P. Ganga Salán, Patti Ajmír	Nali Badholi	A portion of the masonry given way as reported in 1878.
XLVIII *	...	Muzaffarnagar	P. and Tah. Jánsath, Thá. Míránpur	Sheopuri	... ...
LII	...	Bijnor	Tah. Bijnor, P. Mandáwar	Mahesari	... ...

NOTE.—Station I appertains to the North-East Longitudinal Series. Stations XLVIII* and LII appertain to the Great Arc Meridional Series, Section 24° to 30°. P. stands for pargana, Tah. for tahsíl, and Thá. for thána.

September, 1882.

J. B. N. HENNESSEY,
In charge of Computing Office.

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BUDHON MERIDIONAL SERIES.

OBSERVED ANGLES.

At III (Budhon) *of Calcutta Longitudinal Series.*

February 1833; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on I												General Means and Probabilities.
	27°	207°	32°	212°	37°	217°	42°	222°	47°	227°	52°	232°	
I & VII*	″ 10·83$_2$	″ 10·83$_2$	″ 7·50$_2$	″ 8·83$_2$	″ 11·00$_2$	″ 11·67$_2$	″ 14·50$_2$	″ 10·67$_2$	″ 14·33$_2$	″ 9·17$_2$	″ 10·67$_2$	″ 6·00$_2$	65° 18′ 10″·96 Prob. = 0·59
	57°	237°	62°	242°	67°	247°	72°	252°	77°	257°			
	19·50$_2$	12·00$_2$	9·33$_2$	9·33$_2$	13·83$_2$	11·17$_2$	12·00$_2$	9·50$_2$	10·83$_2$	7·67$_2$			

At VII (Tinsmál) *of Calcutta Longitudinal Series.*

March 1833; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on III*												General Means and Probabilities.
	300°	120°	310°	130°	320°	140°	330°	150°	340°	160°	350°	170°	
III* & I	″ 43·34$_2$	″ 45·08$_2$	″ 45·17$_2$	″ 44·83$_2$	″ 42·92$_2$	″ 40·50$_2$	″ 40·50$_2$	″ 37·50$_2$	″ 35·83$_2$	″ 40·00$_2$	″ 46·00$_2$	″ 41·00$_2$	36° 17′ 41″·89 Prob. = 0·89
	Circle readings, telescope being set on I												
	27°	207°	37°	217°	47°	227°	57°	237°	67°	247°	77°	257°	
I & II	19·50$_2$	28·83$_2$	25·83$_2$	29·17$_2$	30·50$_2$	29·67$_2$	35·17$_2$	26·50$_2$	32·83$_2$	30·50$_2$	39·83$_2$	32·34$_2$	61° 1′ 30″·06 Prob. = 1·39

* Of Calcutta Longitudinal Series.

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At I (Patna)

†*March, April*; *and* ‡*October* 1833; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on IV												General Means and Probabilities.
	180°	0°	190°	10°	196°	16°	200°	20°	211°	31°	231°	51°	
‡ IV & III	$43{\cdot}17_{2}$	$45{\cdot}00_{2}$	$43{\cdot}17_{2}$	$45{\cdot}33_{2}$	$51{\cdot}67_{2}$	$42{\cdot}00_{1}$	$50{\cdot}50_{2}$	$42{\cdot}00_{2}$	$47{\cdot}00_{1}$	$40{\cdot}33_{1}$	$39{\cdot}00_{1}$	$46{\cdot}33_{1}$	56° 48′ 44″·63 Prob. = 1·06
	Circle readings, telescope being set on III												
‡	180°	0°	190°	10°	200°	20°	210°	30°	220°	40°	230°	50°	
III & II	$39{\cdot}11_{3}$	$37{\cdot}67_{2}$	$40{\cdot}00_{1}$	$34{\cdot}17_{2}$	$37{\cdot}00_{1}$	$39{\cdot}67_{1}$	$41{\cdot}33_{2}$	$30{\cdot}33_{1}$	$41{\cdot}34_{1}$	$34{\cdot}17_{2}$	$42{\cdot}33_{2}$	$42{\cdot}00_{2}$	40° 43′ 38″·24 Prob. = 0·75
	221°	41°	231°	51°	241°	61°	251°	71°	261°	81°	271°	91°	
†	$42{\cdot}67_{2}$	$37{\cdot}67_{2}$	$32{\cdot}33_{2}$	$37{\cdot}33_{2}$	$40{\cdot}00_{2}$	$43{\cdot}33_{2}$	$36{\cdot}33_{4}$	$43{\cdot}11_{3}$	$30{\cdot}83_{2}$	$39{\cdot}50_{2}$	$38{\cdot}67_{2}$	$36{\cdot}83_{2}$	
† II & VII*	$20{\cdot}67_{2}$	$19{\cdot}33_{2}$	$25{\cdot}67_{2}$	$24{\cdot}33_{2}$	$26{\cdot}00_{2}$	$24{\cdot}50_{2}$	$22{\cdot}33_{2}$	$17{\cdot}50_{2}$	$30{\cdot}50_{2}$	$27{\cdot}78_{2}$	$29{\cdot}34_{2}$	$26{\cdot}50_{2}$	69° 29′ 24″·54 Prob. = 1·10
	Circle readings, telescope being set on VII*												
	281°	101°	291°	111°	301°	121°	310°	130°	321°	141°	331°	151°	
† VII* & III*	$11{\cdot}00_{2}$	$12{\cdot}33_{2}$	$7{\cdot}67_{2}$	$4{\cdot}00_{2}$	$11{\cdot}17_{2}$	$6{\cdot}83_{2}$	$8{\cdot}83_{2}$	$13{\cdot}17_{2}$	$10{\cdot}83_{2}$	$5{\cdot}33_{2}$	$6{\cdot}34_{2}$	$6{\cdot}83_{2}$	78° 24′ 8″·69 Prob. = 0·82

At II (Dargawa)

§*April*; *and* ¶*November* 1833; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on VII*												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
§ VII* & I	$69{\cdot}33_{2}$	$72{\cdot}17_{2}$	$58{\cdot}67_{2}$	$69{\cdot}50_{2}$	$73{\cdot}83_{2}$	$76{\cdot}83_{2}$	$64{\cdot}33_{2}$	$74{\cdot}67_{2}$	$63{\cdot}00_{2}$	$77{\cdot}17_{2}$	$68{\cdot}50_{2}$	$67{\cdot}50_{2}$	49° 29′ 9″·63 Prob. = 1·57
§	$32{\cdot}83_{2}$	$34{\cdot}50_{2}$	$33{\cdot}17_{2}$	$39{\cdot}17_{2}$	$37{\cdot}33_{2}$	$30{\cdot}83_{2}$	$45{\cdot}33_{2}$	$35{\cdot}50_{2}$	$39{\cdot}00_{2}$	$37{\cdot}67_{2}$	$37{\cdot}00_{2}$	$48{\cdot}83_{2}$	69° 43′ 36″·76 Prob. = 1·00
I & III	Circle readings, telescope being set on I												
	51°	231°	61°	241°	71°	251°	81°	261°	91°	271°	101°	281°	
¶	$25{\cdot}67_{2}$	$34{\cdot}33_{2}$	$36{\cdot}55_{3}$	$44{\cdot}67_{2}$	$39{\cdot}08_{4}$	$33{\cdot}67_{2}$	$33{\cdot}67_{2}$	$32{\cdot}00_{2}$	$39{\cdot}50_{2}$	$38{\cdot}67_{1}$	$33{\cdot}50_{2}$	$39{\cdot}67_{1}$	

* Of Calcutta Longitudinal Series.

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At III (Dhandkúa)

†May; ‡November, December 1833, *and January* 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on II												General Means and Probabilities.
	110°	290°	120°	300°	130°	310°	140°	320°	150°	330°	160°	340°	
† II & I	″ 47·33$_{2}$	″ 47·50$_{2}$	″ 46·67$_{2}$	″ 58·67$_{2}$	″ 54·00$_{2}$	″ 57·67$_{2}$	″ 49·00$_{2}$	″ 47·00$_{2}$	″ 51·50$_{2}$	″ 50·83$_{2}$	″ 51·33$_{2}$	″ 41·83$_{2}$	69° 32′ 51″·76 Prob. = 0·83
	89°	269°	99°	279°	109°	289°	119°	299°	129°	309°	139°	319°	
‡	55·33$_{1}$	48·83$_{2}$	48·67$_{5}$	56·33$_{2}$	51·67$_{2}$	53·67$_{2}$	53·17$_{2}$	55·00$_{1}$	58·00$_{1}$	53·67$_{1}$	52·66$_{1}$	52·00$_{1}$	
	Circle readings, telescope being set on I												
	339°	169°	349°	179°	359°	189°	9°	199°	19°	209°	29°	219°	
‡ I & IV	+96·33$_{1}$	99·67$_{6}$	98·80$_{5}$	90·89$_{3}$	93·67$_{2}$	98·67$_{3}$	96·17$_{2}$	99·00$_{1}$	96·00$_{2}$	95·67$_{1}$	95·00$_{1}$	100·83$_{2}$	65° 2′ 4″·70 Prob. = 1·51
	−33·67$_{2}$	24·75$_{4}$	39·78$_{3}$	28·17$_{2}$	32·67$_{1}$	27·78$_{3}$	37·33$_{3}$	31·08$_{4}$	39·11$_{3}$	31·00$_{2}$	26·67$_{2}$	32·33$_{2}$	
+ 233° 55′ − 168° 54′	62·66	74·92	59·02	62·72	61·00	70·89	58·84	67·92	56·89	64·67	68·33	68·50	
	Circle readings, telescope being set on IV												
	234°	54°	244°	64°	254°	74°	264°	84°	274°	94°	284°	104°	
‡ IV & V	26·33$_{3}$	32·11$_{3}$	34·33$_{2}$	29·33$_{1}$	31·83$_{2}$	34·44$_{3}$	31·67$_{1}$	34·33$_{1}$	34·00$_{1}$	26·50$_{2}$	34·92$_{4}$	27·00$_{1}$	68° 20′ 31″·40 Prob. = 0·91
‡ V & VI	43·92$_{4}$	40·42$_{4}$	43·00$_{2}$	39·83$_{2}$	45·67$_{1}$	41·50$_{2}$	42·67$_{1}$	44·33$_{1}$	41·67$_{1}$	44·17$_{2}$	35·67$_{2}$	47·67$_{3}$	60° 23′ 42″·54 Prob. = 0·85

At IV (Andhiári)

November and December 1833; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on V												General Means and Probabilities.
	48°	228°	57°	238°	67°	247°	78°	258°	88°	268°	98°	278°	
V & III	″ 30·89$_{3}$	″ 40·33$_{3}$	″ 44·33$_{2}$	″ 39·33$_{2}$	″ 41·83$_{2}$	″ 40·00$_{2}$	″ 42·67	″ 35·67	″ 45·83$_{2}$	″ 41·50$_{2}$	″ 46·67$_{1}$	″ 35·50$_{2}$	56° 13′ 40″·38 Prob. = 1·27
III & I	13·67$_{2}$	11·66$_{1}$	5·00$_{1}$	6·33$_{1}$	7·00$_{1}$	3·67$_{2}$	9·67	11·33	8·17$_{2}$	6·42$_{4}$	7·66$_{3}$	3·67$_{4}$	58° 9′ 7″·85 Prob. = 0·88

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At V (Gwáli)

December 1833; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on VIII 196°	16°	206°	26°	216°	36°	226°	46°	236°	56°	246°	66°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
VIII & VII	+76·00$_{4}$	69·33$_{2}$	78·67$_{2}$	66·67$_{2}$	80·67$_{2}$	71·17$_{2}$	78·83$_{2}$	74·33$_{2}$	67·00$_{1}$	75·33$_{2}$	70·67$_{2}$	74·17$_{2}$	
	−15·67$_{2}$	18·67$_{1}$	27·00$_{1}$	21·50$_{2}$	24·83$_{2}$	19·83$_{2}$	17·83$_{4}$	19·50$_{4}$	19·56$_{3}$	20·00$_{4}$	19·83$_{2}$	22·11$_{3}$	54° 35′ 53″·04 Prob. = 1·30
+163° 44′ −109° 9′	60·33	50·66	51·67	45·17	55·84	51·34	61·00	54·83	47·44	55·33	50·84	52·06	
VII & VI	+75·67$_{2}$	78·67$_{1}$	87·00$_{1}$	81·50$_{2}$	84·83$_{2}$	79·83$_{2}$	77·83$_{4}$	79·50$_{4}$	79·56$_{3}$	80·00$_{4}$	79·83$_{2}$	82·11$_{3}$	
	−57·67$_{4}$	55·33$_{1}$	69·67$_{1}$	59·50$_{2}$	63·00$_{1}$	55·67$_{1}$	59·33$_{2}$	63·67$_{2}$	57·17$_{2}$	63·67$_{2}$	59·00$_{1}$	61·67$_{1}$	38° 27′ 20″·08 Prob. = 0·78
+109° 8′ − 70° 41′	18·00	23·34	17·33	22·00	21·83	24·16	18·50	15·83	22·39	16·33	20·83	20·44	
VI & III	+57·67$_{4}$	55·33$_{1}$	69·67$_{1}$	59·50$_{2}$	63·00$_{1}$	55·67$_{1}$	59·33$_{2}$	63·67$_{2}$	57·17$_{2}$	63·67$_{2}$	59·00$_{1}$	61·67$_{1}$	
	−47·17$_{2}$	53·83$_{2}$	52·33$_{1}$	51·00$_{2}$	54·33$_{2}$	52·17$_{2}$	50·67$_{1}$	56·67$_{3}$	53·33$_{2}$	51·33$_{2}$	49·33$_{2}$	50·33$_{2}$	62° 40′ 8″·57 Prob. = 1·19
+70° 41′ − 8° 1′	10·50	1·50	17·34	8·50	8·67	3·50	8·66	7·00	3·84	12·34	9·67	11·34	
III & IV	+47·17$_{2}$	53·83$_{2}$	52·33$_{1}$	51·00$_{2}$	54·33$_{2}$	52·17$_{2}$	50·67$_{1}$	56·67$_{3}$	53·33$_{2}$	51·33$_{2}$	49·33$_{2}$	50·33$_{2}$	
	+14·33$_{5}$	19·17$_{4}$	9·83$_{2}$	18·17$_{2}$	13·84$_{2}$	15·50$_{2}$	14·33$_{1}$	15·33$_{2}$	15·33$_{1}$	12·78$_{3}$	14·34$_{2}$	15·67$_{2}$	55° 26′ 6″·76 Prob. = 1·01
+ 8° 1′ +47° 24′	61·50	73·00	62·16	69·17	68·17	67·67	65·00	72·00	68·66	64·11	63·67	66·00	

At VI (Kathera)

January 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on III 9°	189°	19°	199°	29°	209°	39°	219°	49°	229°	59°	239°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
III & V	+44·33$_{2}$	50·00$_{2}$	42·67$_{2}$	53·67$_{2}$	49·66$_{2}$	45·17$_{2}$	48·83$_{2}$	51·67$_{1}$	47·00$_{2}$	46·17$_{2}$	48·00$_{2}$	50·67$_{1}$	
	−34·67$_{2}$	34·50$_{2}$	38·33$_{2}$	35·78$_{3}$	36·66$_{1}$	26·00$_{1}$	36·17$_{2}$	34·00$_{1}$	35·83$_{2}$	43·00$_{2}$	32·17$_{2}$	37·50$_{2}$	56° 56′ 12″·82 Prob. = 1·43
+113° 56′ − 57° 0′	9·66	15·50	4·34	17·89	13·00	*19·83	12·66	17·67	11·17	3·17	15·83	13·17	
V & VII	34·67$_{2}$	34·50$_{2}$	38·33$_{2}$	35·78$_{3}$	36·66$_{1}$	26·00$_{1}$	36·17$_{2}$	34·00$_{1}$	35·83$_{2}$	43·00$_{2}$	32·17$_{2}$	37·50$_{2}$	57° 0′ 35″·38 Prob. = 1·10

* This value should be 19·17: the error was not detected until after completion of the calculations.

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At VII (Bhitári)

January and February 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle-readings, telescope being set on VI												General Means and Probabilities.
	308°	128°	318°	138°	328°	148°	338°	158°	348°	168°	358°	178°	
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & V	8.83_{2}	11.50_{2}	5.33_{1}	3.00_{1}	12.33_{1}	14.67_{1}	0.67_{1}	11.67_{1}	13.33_{1}	4.67_{1}	7.66_{1}	6.67_{1}	84° 32′ 8″·36 Prob. = 1·22
V & VIII	23.00_{1}	28.67_{2}	26.00_{1}	25.67_{1}	23.67_{1}	21.67_{1}	28.66_{1}	24.67_{1}	28.00_{1}	28.33_{1}	25.00_{1}	23.33_{1}	50° 59′ 25″·56 Prob. = 0·67
VIII & IX	$+42.00_{1}$	32.00_{1}	34.67_{1}	34.67_{1}	43.33_{1}	36.67_{1}	28.33_{1}	30.00_{1}	32.00_{1}	42.17_{2}	31.83_{2}	32.33_{1}	65° 3′ 15″·71 Prob. = 1·50
	$+41.50_{2}$	40.33_{2}	40.00_{1}	43.00_{1}	36.67_{1}	43.00_{1}	40.67_{1}	39.00_{1}	39.00_{1}	42.66_{1}	43.67_{1}	39.00_{1}	
+ 46° 0′ + 19° 2′	83·50	72·33	74·67	77·67	80·00	79·67	69·00	69·00	71·00	84·83	75·50	71·33	

At VIII (Algi)

January, February and March 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XI												General Means and Probabilities.
	249°	69°	259°	79°	269°	89°	279°	99°	289°	109°	299°	119°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XI & X	$+94.83_{2}$	90.67_{1}	89.67_{1}	86.33_{1}	93.67_{1}	92.00_{1}	92.66_{1}	98.67_{1}	90.67_{1}	89.67_{1}	94.17_{2}	96.33_{1}	56° 45′ 56″·12 Prob. = 1·34
	-34.89_{3}	37.00_{1}	39.67_{1}	33.66_{1}	40.67_{2}	37.83_{2}	35.33_{1}	42.00_{1}	31.67_{1}	37.00_{2}	25.67_{2}	40.50_{2}	
+ 111° 14′ − 54° 29′	59·94	53·67	50·00	52·67	53·00	54·17	57·33	56·67	59·00	52·67	68·50	55·83	
X & IX	$+34.89_{3}$	37.00_{1}	39.67_{1}	33.66_{1}	40.67_{2}	37.83_{2}	35.33_{1}	42.00_{1}	31.67_{1}	37.00_{2}	25.67_{2}	40.50_{2}	66° 16′ 17″·57 Prob. = 1·51
	$+43.89_{3}$	42.67_{1}	41.00_{1}	46.67_{1}	35.00_{1}	39.33_{1}	40.67_{1}	41.67_{1}	43.33_{1}	46.67_{2}	37.16_{2}	36.83_{2}	
+ 54° 29′ + 11° 46′	78·78	79·67	80·67	80·33	75·67	77·16	76·00	83·67	75·00	83·67	62·83	77·33	
IX & VII	$+75.33_{1}$	80.67_{1}	80.00_{1}	81.67_{1}	73.83_{2}	79.67_{1}	69.67_{1}	83.33_{2}	74.33_{1}	75.00_{1}	78.33_{1}	72.00_{1}	43° 38′ 35″·75 Prob. = 1·33
	-43.89_{3}	42.67_{1}	41.00_{1}	46.67_{1}	35.00_{1}	39.33_{1}	40.67_{1}	41.67_{1}	43.33_{1}	46.67_{2}	37.16_{2}	36.83_{2}	
+ 55° 24′ − 11° 46′	31·44	38·00	39·00	35·00	38·83	40·34	29·00	41·66	31·00	28·33	41·17	35·17	
VII & V	47.33_{1}	45.67_{1}	49.89_{3}	46.83_{2}	46.00_{2}	40.34_{1}	46.67_{1}	46.33_{2}	42.33_{1}	45.00_{1}	39.33_{1}	47.67_{1}	74° 24′ 45″·28 Prob. = 0·86

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At IX (Daryapur)

February and April 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on VII 257°	77°	267°	87°	277°	97°	287°	107°	297°	117°	307°	127°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
VII & VIII	9.83_2	9.00_1	5.33_1	8.00_1	12.34_1	17.00_1	4.33_1	3.67_1	7.00_1	9.00_1	7.33_1	0.67_1	71° 18′ 7″.79 Prob. = 1.18
VIII & X	$+30.33_2$	24.67_1	16.00_1	16.67_1	16.67_1	31.00_1	12.33_1	9.00_1	14.33_1	15.00_1	20.33_1	20.67_1	67° 2′ 11″.13 Prob. = 1.53
	-9.83_2	9.00_1	5.33_1	8.00_1	12.34_1	17.00_1	4.33_1	3.67_1	7.00_1	9.00_1	7.33_1	0.67_1	
+138° 20′ − 71° 18′	20.50	15.67	10.67	8.67	4.33	14.00	8.00	5.33	7.33	6.00	13.00	20.00	
X & XIV	5.22_3	9.33_1	9.00_1	7.00_1	6.00_1	2.67_1	9.67_1	5.00_1	11.00_1	0.67_1			40° 58′ 6″.56 Prob. = 0.99

At X (Mahárájpur)

February and March 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on IX 1°	181°	11°	191°	21°	201°	81°	211°	42°	222°	51°	231°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
IX & VIII	27.45_3	42.83_2	25.34_1	30.33_1	31.00_2	37.33_2	30.33_1	34.67_1	34.00_2	37.67_2	28.33_1	31.50_2	46° 41′ 32″.57 Prob. = 1.37
VIII & XI	$+74.17_2$	79.67_1	79.67_1	87.67_1	76.33_1	88.33_1	75.50_2	84.33_1	79.50_2	80.56_3	76.33_2	78.11_3	61° 8′ 22″.85 Prob. = 1.09
	-53.17_2	58.00_1	57.00_1	58.83_2	56.00_1	59.67_1	60.33_1	56.67_1	57.00_1	57.00_1	56.33_1	56.00_1	
+104° 49′ − 43° 41′	21.00	21.67	22.67	28.84	20.33	28.66	15.17	27.66	22.50	23.56	20.00	22.11	
XI & XII	53.17_2	58.00_1	57.00_1	58.83_2	56.00_1	59.67_1	60.33_1	56.67_1	57.00_1	57.00_1	56.33_1	56.00_1	43° 41′ 57″.17 Prob. = 0.52
XII & XIII	61.33_2	57.00_1	60.33_1	65.67_1	64.33_1	56.00_1	67.33_2	48.00_1	59.00_1	51.67_1	68.00_1	61.00_1	59° 52′ 59″.97 Prob. = 1.69
XIII & XIV	$+67.67_2$	62.67_1	64.33_1	51.00_1	63.33_1	59.33_1	64.83_2	70.00_1	61.34_1	64.00_1	61.33_1	58.00_1	76° 21′ 35″.63 Prob. = 1.39
	$+69.17_2$	56.67_1	70.34_1	65.33_1	67.33_1	63.33_1	62.33_1	64.67_1	59.00_2	65.33_2	66.67_1	74.00_2	
	-94.33_1	86.67_1	94.50_2	87.00_1	94.00_1	89.33_1	91.00_1	94.67_1	95.67_1	92.00_1	92.66_1	92.67_1	
+ 79° 41′ + 68° 52′ − 72° 12′	42.51	32.67	40.17	29.33	36.66	33.33	36.16	40.00	24.67	37.33	35.34	39.33	
XIV & IX	34.33_1	26.67_1	34.50_2	27.00_1	34.00_1	29.33_1	31.00_1	34.67_1	35.67_1	32.00_1	32.66_1	32.67_1	72° 13′ 32″.04 Prob. = 0.83

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At XI (Narwar)

March 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XII 0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities.
XII & X	″ 39·00 2	″ 37·00 1	″ 40·00 1	″ 46·67 1	″ 40·83 2	″ 49·00 1	″ 37·00 1	″ 37·00 2	″ 36·17 2	″ 38·00 1	″ 36·33 1	″ 34·00 1	30° 52′ 39″·25 Prob. = 1·22
X & VIII	46·83 2	46·33 1	43·17 2	38·67 2	45·33 1	50·00 1	47·33 1	48·67 2	49·50 2	42·33 1	53·67 1	45·33 1	62° 5′ 46″·43 Prob. = 1·09

At XII (Karaia)

March 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XIII 286°	106°	296°	116°	306°	126°	317°	137°	326°	146°	336°	156°	General Means and Probabilities.
XIII & X	″ ‡51·67 2	″ 46·67 1	″ 55·33 1	″ 46·67 1	″ 51·33 1	″ 49·33 1	″ 54·67 1	″ 52·33 1	″ 50·67 1	″ 50·33 1	″ 50·33 1	″ 57·00 1	73° 33′ 51″·32 Prob. = 0·88
X & XI	24·67 2	30·00 1	23·33 1	28·33 1	21·67 1	27·00 1	19·34 1	24·33 1	27·33 1	27·33 1	20·33 1	23·33 1	105° 25′ 24″·75 Prob. = 0·92

At XIII (Ráepur)

**April* 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

†*November* 1836; *observed by Lieutenant Ommanney with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XV 0°	180°	12°	192°	24°	204°	36°	216°	48°	228°			General Means and Probabilities.
† XV & XVI	″ 32·62 2	″ 35·47 2	″ 32·03 2	″ 37·42 2	″ 24·33 2	″ 29·55 2	″ 25·57 2	″ 30·50 2	″ 27·52 2	″ 30·28 2			40° 42′ 30″·53 Prob. = 1·23
† XVI & XIV	11·27 2	13·73 2	14·17 2	12·47 2	21·22 2	19·28 2	22·15 2	17·60 2	19·47 2	15·40 2			28° 36′ 16″·68 Prob. = 1·14
	Circle readings, telescope being set on XIV 259°	79°	269°	89°	279°	99°	289°	109°	299°	119°	309°	129°	
* XIV & X	30·50 2	32·00 1	23·33 1	31·33 1	32·00 1	31·67 1	31·00 1	20·34 1	31·33 1	24·33 1	26·00 1	21·34 1	54° 7′ 27″·93 Prob. = 1·25
X &* XII	61·50 2	63·00 1	73·33 1	62·00 1	61·67 1	67·00 1	62·67 1	71·67 1	59·67 1	71·33 1	67·33 1	75·00 1	46° 33′ 6″·35 Prob. = 1·47

‡ This value should be 51·17: the error was not detected until after completion of the calculations.

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At XIV (Majhár)

* *April* 1834; *observed by Lieutenant R. MacDonald with Harris and Barrow's* 15-*inch Theodolite.*

† *October* 1836; *observed by Lieutenant Ommanney with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on IX												General Means and Probabilities.
	293°	113°	303°	123°	313°	133°	323°	143°	333°	153°	343°	163°	
	″	″	″	″	″	″	″	″	″	″	″	″	
* IX & X	$27·33_{1}$	$15·34_{1}$	$25·33_{1}$	$26·33_{1}$	$30·67_{1}$	$23·33_{1}$	$26·33_{1}$	$23·33_{1}$	$14·67_{1}$	$22·67_{1}$	$17·00_{1}$	$28·00_{1}$	66° 48′ 23″·36 Prob. = 1·43
* X & XIII	$68·67_{1}$	$71·67_{1}$	$61·33_{1}$	$56·00_{1}$	$64·67_{1}$	$67·00_{1}$	$61·33_{1}$	$68·00_{1}$	$64·33_{1}$	$66·33_{1}$	$76·33_{1}$	$68·67_{1}$	49° 31′ 6″·19 Prob. = 1·46

Angle between	Circle readings, telescope being set on XIII										General Means and Probabilities.
	260°	80°	272°	92°	284°	104°	296°	116°	308°	128°	
† XIII & XVI	$47·92_{2}$	$49·05_{2}$	$43·07_{2}$	$46·02_{2}$	$46·65_{2}$	$46·03_{2}$	$42·23_{2}$	$42·18_{2}$	$42·57_{2}$	$52·00_{2}$	100° 21′ 45″·77 Prob. = 0·99
† XVI & XV	$28·12_{2}$	$27·40_{2}$	$31·72_{2}$	$31·47_{2}$	$33·27_{2}$	$30·11_{2}$	$25·26_{2}$	$32·90_{2}$	$22·58_{2}$	$35·27_{2}$	54° 14′ 29″·81 Prob. = 1·18
† XV & XIII	+47·92 −28·12	49·05 27·40	43·07 31·72	46·02 31·47	46·65 33·27	46·03 30·11	42·23 25·26	42·18 32·90	42·57 22·58	52·00 35·27	46° 7′ 15″·96 Prob. = 1·18
+ 100° 21′ − 54° 14′	19·80	21·65	11·35	14·55	13·38	15·92	16·97	9·28	19·99	16·73	

At XV (Sánichri)

November 1836; *observed by Lieutenant Ommanney with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XVII										General Means and Probabilities.
	0°	180°	12°	192°	24°	204°	36°	216°	48°	228°	
	″	″	″	″	″	″	″	″	″	″	
XVII & XVI	$60·18_{2}$	$69·42_{2}$	$55·74_{2}$	$62·63_{2}$	$53·30_{2}$	$59·18_{2}$	$54·58_{2}$	$64·05_{2}$	$58·55_{2}$	$59·37_{2}$	53° 2′ 59″·70 Prob. = 1·44
XVI & XIV	$4·27_{2}$	$4·37_{2}$	$6·33_{2}$	$5·78_{2}$	$6·62_{2}$	$2·53_{2}$	$6·25_{2}$	$1·55_{2}$	$3·85_{2}$	$6·52_{2}$	36° 28′ 4″·81 Prob. = 0·54
XIV & XIII	$63·93_{2}$	$59·15_{2}$	$60·73_{2}$	$64·58_{2}$	$56·63_{2}$	$58·72_{2}$	$60·62_{2}$	$62·22_{2}$	$61·98_{2}$	$60·17_{2}$	64° 34′ 0″·87 Prob. = 0·72

At XVI (Jhánkri)

October 1836; *observed by Lieutenant Ommanney with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XIV										General Means and Probabilities.
	0°	180°	12°	192°	24°	204°	36°	216°	48°	228°	
	″	″	″	″	″	″	″	″	″	″	
XIV & XIII	$60·58_{2}$	$64·68_{2}$	$56·09_{2}$	$60·37_{2}$	$55·60_{2}$	$64·60_{2}$	$62·18_{2}$	$59·10_{2}$	$61·40_{2}$	$61·12_{2}$	51° 2′ 0″·57 Prob. = 0·92

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At XVI (Jhánkri)—(*Continued*).

Angle between	Circle readings, telescope being set on XIV: 0°	180°	12°	192°	24°	204°	36°	216°	48°	228°	General Means and Probabilities.
XIV & XV	″ 26·78	″ 33·60	″ 26·82	″ 29·03	″ 28·88	″ 31·38	″ 23·75	″ 28·62	″ 31·70	″ 22·47	89° 17′ 28″·30 Prob. = 1·05
XIII & XV	+26·78	33·60	26·82	29·03	28·88	31·38	23·75	28·62	31·70	22·47	38° 15′ 27″·73 Prob. = 1·16
	−60·58	64·68	56·09	60·37	55·60	64·60	62·18	59·10	61·40	61·12	
+ 89° 17′ − 51° 1′	26·20	28·92	30·73	28·66	33·28	26·78	21·57	29·52	30·30	21·35	
XV & XVII	+35·55	39·67	31·12	42·38	35·43	41·50	35·20	33·35	41·18	37·08	70° 45′ 8″·94 Prob. = 1·06
	−26·78	33·60	26·82	29·03	28·88	31·38	23·75	28·62	31·70	22·47	
+160° 2′ − 89° 17′	8·77	6·07	4·30	13·35	6·55	10·12	11·45	4·73	9·48	14·61	
XVII & XVIII	+36·05	39·20	31·70	35·32	34·05	38·57	38·67	31·03	37·90	31·33	47° 50′ 58″·14 Prob. = 0·94
	−35·55	39·67	31·12	42·38	35·43	41·50	35·20	33·35	41·18	37·08	
+207° 53′ −160° 2′	60·50	59·53	60·58	52·93	58·62	57·07	63·47	57·68	56·72	54·25	

At XVII (Gúrmi)

**November* 1836; *observed by Lieutenant Ommanney with Harris and Barrow's* 15-*inch Theodolite.*
†*November* 1842; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XX: 205°	25°	215°	35°	225°	45°	235°	55°	245°	65°	255°	75°	General Means and Probabilities.
† XX & R.M.	″ 35·25	″ 34·42	″ 39·92	″ 42·83	″ 39·58	″ 38·42	″ 34·66	″ 39·42	″ 37·75	″ 30·25	″ 35·08	″ 31·50	23° 14′ 36″·59
	104°	284°	116°	296°	128°	308°	140°	320°	152°	332°			
* XX & XIX	+36·72	39·65	36·70	37·32	39·57	36·28	38·86	36·43	43·92	32·35			65° 42′ 21″·17 Prob. = 1·51
	−10·43	11·32	13·53	12·90	10·07	14·18	7·63	13·62	17·12	16·20			
	−68·05	58·27	68·28	64·53	65·90	55·48	65·43	57·30	64·22	59·82			
+199° 56′ − 76° 29′ − 57° 44′	18·24	30·06	14·89	19·89	23·60	‡ 24·84	25·80	15·51	22·58	16·33			
* XIX & XVIII	68·05	58·27	68·28	64·53	65·90	55·48	65·43	57·30	64·22	59·82			57° 45′ 2″·73 Prob. = 1·39
* XVIII & XVI	10·43	11·32	13·53	12·90	10·07	14·18	7·63	13·62	17·12	16·20			76° 29′ 12″·70 Prob. = 0·87
* XVI & XV	52·28	52·90	50·30	56·65	54·65	54·43	46·55	56·47	47·10	56·58			56° 11′ 52″·79 Prob. = 1·13

R.M. denotes Referring Mark. ‡ This value should be 26·62: the error was not detected until after completion of the calculations.

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At XVIII (Bhind)

November and December 1836; *observed by Lieutenant Ommanney with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XVI										General Means and Probabilities.
	0°	180°	12°	192°	24°	204°	36°	216°	48°	228	
	″	″	″	″	″	″	″	″	″	″	
XVI & XVII	52·40$_2$	55·70$_2$	44·77$_2$	52·42$_2$	44·13$_2$	55·27$_2$	53·75$_2$	53·42$_2$	53·60$_2$	51·33$_2$	55° 39′ 51″·68 Prob. = 1·21
XVII & XIX	7·97$_2$	2·12$_2$	5·67$_2$	7·78$_2$	10·06$_2$	3·58$_2$	1·43$_2$	7·63$_2$	2·42$_2$	5·67$_2$	62° 47′ 5″·43 Prob. = 0·88

At XIX (Athgath)

November 1840; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVIII												General Means and Probabilities.
	291°	111°	301°	121°	311°	131°	321°	141°	331°	151°	341°	161°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVIII & XVII	51·08$_2$	50·17$_2$	53·92$_2$	49·00$_2$	49·58$_2$	50·75$_2$	44·58$_2$	52·33$_2$	48·92$_2$	46·75$_2$	47·42$_2$	52·67$_2$	59° 27′ 49″·76 Prob. = 0·74
XVII & XX	23·17$_2$	28·42$_2$	23·25$_2$	24·67$_2$	25·58$_2$	21·08$_2$	26·33$_2$	19·17$_2$	21·58$_2$	18·17$_2$	26·67$_2$	29·25$_2$	62° 56′ 23″·94 Prob. = 0·97
XX & XXI	8·17$_2$	5·58$_2$	3·42$_2$	7·08$_2$	3·17$_2$	13·75$_2$	4·75$_2$	11·83$_2$	11·33$_2$	13·83$_2$	6·25$_2$	3·42$_2$	61° 29′ 7″·72 Prob. = 1·11

At XX (Panáhat)

November 1840; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXII												General Means and Probabilities.
	35°	215°	45°	225°	55°	235°	65°	245°	75°	255°	85°	265°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXII & XXI	45·92$_2$	45·25$_2$	43·50$_2$	45·91$_2$	41·00$_2$	40·75$_2$	44·50$_2$	44·42$_2$	40·42$_2$	46·00$_2$	36·08$_2$	50·58$_2$	58° 26′ 43″·69 Prob. = 1·02
XXI & XIX	29·25$_2$	28·17$_2$	27·42$_2$	31·25$_2$	21·58$_2$	27·00$_2$	32·41$_2$	25·08$_2$	26·67$_2$	26·92$_2$	29·92$_2$	22·50$_2$	42° 54′ 27″·35 Prob. = 0·89
	Circle readings, telescope being set on XIX												
	166°	346°	176°	356°	186°	6°	196°	16°	206°	26°	216°	36°	
XIX & XVII	14·58$_2$	12·33$_2$	11·75$_2$	13·92$_2$	17·17$_2$	20·00$_2$	18·75$_2$	15·67$_2$	15·00$_2$	12·75$_2$	9·92$_2$	14·25$_2$	51° 21′ 14″·67 Prob. = 0·81

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At XXI (Sherpur)

November 1840; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIX												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIX & XX	28·83$_2$	25·75$_2$	23·75$_2$	26·50$_2$	24·83$_2$	17·00$_2$	21·92$_2$	28·50$_2$	27·50$_2$	29·67$_2$	24·92$_2$	28·16$_2$	75° 36′ 25″·61 Prob. = 0·98
XX & XXII	17·67$_2$	19·67$_2$	20·42$_2$	23·58$_2$	22·58$_2$	21·25$_2$	24·42$_2$	18·33$_2$	18·83$_2$	19·83$_2$	23·17$_2$	12·83$_2$	58° 0′ 20″·22 Prob. = 0·88
XXII & XXIII	65·17$_2$	64·08$_2$	62·50$_2$	62·92$_2$	59·50$_2$	65·50$_2$	65·33$_2$	69·92$_2$	65·92$_2$	67·75$_2$	66·33$_2$	72·25$_2$	71° 28′ 5″·60 Prob. = 0·93

At XXII (Firozabad)

November 1840; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIV												General Means and Probabilities.
	1°	181°	11°	191°	21°	201°	31°	211°	41°	221°	51°	231°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIV & XXIII	21·83$_2$	22·42$_2$	25·83$_2$	18·75$_2$	25·92$_2$	16·83$_2$	23·00$_2$	23·83$_2$	24·75$_2$	21·50$_2$	28·92$_2$	24·50$_2$	66° 30′ 23″·17 Prob. = 0·90
	Circle readings, telescope being set on XXIII												
	118°	298°	128°	308°	138°	318°	148°	328°	158°	338°	168°	348°	
XXIII & XXI	28·00$_2$	31·75$_2$	31·92$_2$	34·50$_2$	32·33$_2$	24·67$_2$	35·33$_2$	30·17$_2$	34·00$_2$	32·58$_2$	33·42$_2$	31·08$_2$	50° 32′ 31″·65 Prob. = 0·82
XXI & XX	65·67$_2$	61·42$_2$	59·92$_2$	62·67$_2$	63·67$_2$	70·67$_2$	61·67$_2$	63·67$_2$	63·25$_2$	58·33$_2$	63·50$_2$	56·08$_2$	63° 33′ 2″·54 Prob. = 1·01

At XXIII (Baragaon)

November 1840; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXI												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXI & XXII	22·83$_2$	21·58$_2$	21·17$_2$	22·58$_2$	21·67$_2$	19·83$_2$	25·00$_2$	24·17$_2$	26·33$_2$	19·67$_2$	19·17$_2$	23·33$_2$	57° 59′ 22″·28 Prob. = 0·61
XXII & XXIV	21·50$_2$	22·33$_2$	21·25$_2$	19·17$_2$	23·00$_2$	19·67$_2$	20·75$_2$	23·33$_2$	17·58$_2$	30·50$_2$	18·58$_2$	19·25$_2$	59° 47′ 21″·41 Prob. = 0·93
XXIV & XXV	53·25$_2$	58·83$_2$	61·50$_2$	61·33$_2$	61·75$_2$	61·08$_2$	55·92$_2$	53·83$_2$	57·42$_2$	51·84$_2$	65·00$_2$	64·25$_2$	62° 54′ 58″·83 Prob. = 1·21

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At XXIV (Pondri)

December 1840; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXVI												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXVI & XXV	50·42	45·50	49·00	55·92	50·42	50·58	50·08	48·00	48·75	48·33	46·92	38·83	57° 55′ 48″·56 Prob. = 1·10
XXV & XXIII	34·92	32·75	31·17	30·25	33·42	36·33	28·75	44·50	33·17	34·58	26·58	42·42	53° 57′ 34″·07 Prob. = 1·43
XXIII & XXII	6·92	19·08	26·75	23·83	19·58	20·58	25·92	13·25	23·33	21·25	29·25	14·58	53° 42′ 20″·36 Prob. = 1·75

At XXV (Kilármáo)

December 1840; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIII												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXIII & XXIV	34·42	29·25	33·42	29·75	29·75	25·33	30·67	27·58	26·17	31·42	30·92	26·25	63° 7′ 29″·58 Prob. = 0·79
XXIV & XXVI	12·08	17·08	11·34	20·25	16·50	23·42	14·08	18·33	18·42	16·75	10·42	19·75	58° 53′ 16″·54 Prob. = 1·08
XXVI & XXVII	18·17	12·67	15·75	15·58	16·58	10·50	17·58	17·83	13·92	13·34	18·08	13·33	54° 56′ 15″·28 Prob. = 0·69

At XXVI (Salímpur)

January and March 1841; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXVIII												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXVIII & XXVII	43·83	37·33	38·58	40·25	39·58	33·67	34·58	40·00	37·75	41·50	35·25	38·25	80° 27′ 38″·38 Prob. = 0·81
XXVII & XXV	9·42	12·67	7·92	8·17	6·58	5·67	6·50	9·50	9·50	4·58	15·25	7·75	49° 20′ 8″·63 Prob. = 0·82
XXV & XXIV	49·58	50·33	61·17	53·00	52·25	55·75	60·25	58·42	59·00	54·42	57·33	53·25	63° 10′ 55″·40 Prob. = 1·07

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At XXVII (Jamálpur)

**March* 1841; *and †January* 1843; *observed by Mr. C. Murphy with Troughton and Simms' 18-inch Theodolite No. 2.*

Angle between													General Means and Probabilities.
	Circle readings, telescope being set on XXV												
	125°	305°	135°	315°	145°	325°	155°	335°	165°	345°	175°	355°	
* XXV & XXVI	″ $37\cdot50_2$	″ $33\cdot33_2$	″ $32\cdot92_2$	″ $32\cdot08_2$	″ $29\cdot67_2$	″ $33\cdot00_2$	″ $38\cdot50_2$	″ $41\cdot58_2$	″ $43\cdot92_2$	″ $43\cdot92_2$	″ $41\cdot25_2$	″ $39\cdot83_2$	75° 43′ 37″·29 Prob. = 1·37
	Circle readings, telescope being set on XXVI												
	71°	251°	81°	261°	91°	271°	101°	281°	111°	291°	121°	301°	
* XXVI & XXVIII	$3\cdot00_2$	$10\cdot92_2$	$2\cdot67_2$	$5\cdot00_2$	$6\cdot25_2$	$11\cdot92_2$	$4\cdot83_2$	$0\cdot83_2$	$11\cdot83_2$	$6\cdot50_2$	$5\cdot25_2$	$5\cdot33_2$	48° 49′ 6″·19 Prob. = 1·00
	Circle readings, telescope being set on XXVI												
	72°	252°	82°	262°	92°	272°	102°	282°	112°	292°	122°	302°	
† XXVIII & XXIX	+ $32\cdot17_2$	$27\cdot33_2$	$37\cdot92_2$	$30\cdot75_2$	$32\cdot42_2$	$32\cdot42_2$	$25\cdot08_2$	$32\cdot08_2$	$28\cdot08_2$	$30\cdot25_2$	$20\cdot83_2$	$28\cdot42_2$	35° 36′ 23″·62 Prob. = 1·72
	− 3·00	10·92	2·67	5·00	6·25	11·92	4·83	0·83	11·83	6·50	5·25	5·33	
+ 84° 25′ − 48° 49′	29·17	16·41	35·25	25·75	26·17	20·50	20·25	31·25	16·25	23·75	15·58	23·09	

At XXVIII (Sankráo)

**February* 1841; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.
†February 1843; *observed by Lieutenant T. Renny with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between													General Means and Probabilities.
	Circle readings, telescope being set on XXXI												
	227°	47°	237°	57°	247°	67°	257°	77°	267°	87°	277°	97°	
† XXXI & XXX	″ $22\cdot08_2$	″ $19\cdot17_2$	″ $18\cdot00_2$	″ $20\cdot25_2$	″ $22\cdot08_2$	″ $19\cdot42_2$	″ $24\cdot42_2$	″ $20\cdot58_2$	″ $24\cdot50_2$	″ $23\cdot17_2$	″ $24\cdot50_2$	″ $21\cdot33_2$	58° 56′ 21″·63 Prob. = 0·61
† XXX & XXIX	$57\cdot58_2$	$53\cdot33_2$	$54\cdot42_2$	$52\cdot75_2$	$52\cdot34_2$	$53\cdot58_2$	$48\cdot25_2$	$55\cdot08_2$	$48\cdot00_2$	$50\cdot00_2$	$50\cdot92_2$	$53\cdot17_2$	67° 27′ 52″·45 Prob. = 0·77
* XXIX & XXVII	+ $46\cdot83_2$	$48\cdot59_2$	$52\cdot08_2$	$44\cdot42_2$	$47\cdot25_2$	$48\cdot92_2$	$50\cdot33_2$	$48\cdot08_2$	$48\cdot50_2$	$54\cdot67_2$	$48\cdot00_2$	$50\cdot33_2$	60° 2′ 31″·31 Prob. = 0·78
	−15·83	16·67	16·75	18·25	15·75	20·92	14·83	20·33	16·25	22·25	16·25	18·25	
+ 110° 45′ − 50° 43′	31·00	31·92	35·33	26·17	31·50	28·00	35·50	27·75	32·25	32·42	31·75	32·08	
* XXVII & XXVI	$15\cdot83_2$	$16\cdot67_2$	$16\cdot75_2$	$18\cdot25_2$	$15\cdot75_2$	$20\cdot92_2$	$14\cdot83_2$	$20\cdot33_2$	$16\cdot25_2$	$22\cdot25_2$	$16\cdot25_2$	$18\cdot25_2$	50° 43′ 17″·69 Prob. = 0·65
	Circle readings, telescope being set on R. M.												
	280°	100°	290°	110°	300°	120°	310°	130°	320°	140°	330°	150°	
† R.M. & XXX	$40\cdot50_2$	$40\cdot50_2$	$43\cdot00_2$	$42\cdot17_2$	$41\cdot92_2$	$39\cdot42_2$	$41\cdot75_2$	$39\cdot58_2$	$37\cdot25_2$	$39\cdot00_2$	$41\cdot58_2$	$38\cdot50_2$	5° 44′ 40″·43 Prob. = 0·48

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At XXIX (Sarsotha)

January 1843; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities.
	Circle readings, telescope being set on XXVII												
XXVII & XXVIII	″ +27·92$_2$ +40·41$_2$	″ 28·25$_2$ 34·67$_2$	″ 22·17$_2$ 41·75$_2$	″ 25·92$_2$ 37·50$_2$	″ 26·83$_2$ 39·17$_2$	″ 20·17$_2$ 40·50$_2$	″ 25·00$_2$ 41·42$_2$	″ 27·67$_2$ 38·33$_2$	″ 27·66$_2$ 36·67$_2$	″ 26·25$_2$ 42·83$_2$	″ 27·92$_2$ 38·83$_2$	″ 23·58$_2$ 37·17$_2$	84° 21′ 4″·88 Prob. = 0·75
+ 24° 0′ + 60° 20′	68·33	62·92	63·92	63·42	66·00	60·67	66·42	66·00	64·33	69·08	66·75	60·75	
XXVIII & XXX	8·83$_2$	11·42$_2$	12·25$_2$	16·25$_2$	12·83$_2$	12·25$_2$	8·75$_2$	14·42$_2$	11·17$_2$	10·58$_2$	11·42$_2$	9·83$_2$	50° 59′ 11″·67 Prob. = 0·60
XXX & XXXII	27·58$_2$	25·33$_2$	29·58$_2$	20·17$_2$	24·58$_2$	21·42$_2$	24·50$_2$	25·08$_2$	26·33$_2$	20·58$_2$	25·67$_2$	27·08$_2$	57° 42′ 24″·83 Prob. = 0·79

At XXX (Sakrora)

January and February 1843; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities.
	Circle readings, telescope being set on XXVIII												
XXVIII & XXXI	″ 59·67$_2$	″ 59·83$_2$	″ 55·83$_2$	″ 57·08$_2$	″ 57·58$_2$	″ 52·83$_2$	″ 59·00$_2$	″ 57·42$_2$	″ 54·92$_2$	″ 53·67$_2$	″ 57·92$_2$	″ 58·50$_2$	66° 33′ 57″·02 Prob. = 0·63
XXXI & XXXIII	+107·92$_2$ − 59·67	109·25$_2$ 59·83	106·33$_2$ 55·83	107·42$_2$ 57·08	103·92$_2$ 57·58	102·33$_2$ 52·83	109·92$_2$ 59·00	105·50$_2$ 57·42	110·08$_2$ 54·92	109·17$_2$ 53·67	107·17$_2$ 57·92	102·83$_2$ 58·50	70° 5′ 49″·80 Prob. = 0·88
+136° 38′ − 66° 33′	48·25	49·42	50·50	50·34	46·34	49·50	50·92	48·08	55·16	55·50	49·25	44·33	
XXXIII & XXXIV	52·50$_2$	50·42$_2$	50·42$_2$	48·17$_2$	54·33$_2$	51·67$_2$	55·67$_2$	55·25$_2$	51·42$_2$	53·08$_2$	51·17$_2$	55·58$_2$	67° 2′ 52″·47 Prob. = 0·66
XXXIV & XXXII	4·33$_2$	12·25$_2$	8·17$_2$	12·92$_2$	8·00$_2$	8·08$_2$	1·58$_2$	7·33$_2$	7·92$_2$	9·33$_2$	9·17$_2$	8·17$_2$	50° 32′ 8″·10 Prob. = 0·84
XXXII & XXIX	+ 74·17$_2$ − 55·75	69·83$_2$ 56·17	75·08$_2$ 53·92	71·50$_2$ 54·08	73·75$_2$ 53·25	77·92$_2$ 61·08	72·83$_2$ 54·92	71·92$_2$ 52·67	70·58$_2$ 53·58	68·42$_2$ 58·92	72·50$_2$ 55·83	73·42$_2$ 59·50	44° 12′ 16″·85 Prob. = 0·89
+105° 44′ − 61° 32′	18·42	13·66	21·16	17·42	20·50	16·84	17·91	19·25	17·00	9·50	16·67	13·92	
XXIX & XXVIII	55·75$_2$	56·17$_2$	53·92$_2$	54·08$_2$	53·25$_2$	61·08$_2$	54·92$_2$	52·67$_2$	53·58$_2$	58·92$_2$	55·83$_2$	59·50$_2$	61° 32′ 55″·81 Prob. = 0·75

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At XXXI (Parauli)

February and March 1843; *observed by Lieutenant T. Renny with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXIII 0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXIII & XXX	59·58$_{2}$	58·33$_{2}$	57·08$_{2}$	52·75$_{2}$	57·17$_{2}$	52·83$_{2}$	58·25$_{2}$	58·58$_{2}$	56·50$_{2}$	56·58$_{2}$	57·25$_{2}$	56·33$_{2}$	56° 7′ 56″·77 Prob. = 0·58
XXX & XXVIII	35·92$_{2}$	35·50$_{2}$	39·75$_{2}$	40·17$_{2}$	36·25$_{2}$	42·42$_{2}$	37·83$_{2}$	41·83$_{2}$	40·58$_{2}$	39·17$_{2}$	37·50$_{2}$	38·33$_{2}$	54° 29′ 38″·77 Prob. = 0·63

At XXXII (Kariámái)

April 1843; *observed by Lieutenant T. Renny with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIX 0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIX & XXX	+65·58$_{2}$	65·83$_{2}$	67·75$_{2}$	66·33$_{2}$	65·25$_{2}$	62·67$_{2}$	64·92$_{2}$	69·42$_{2}$	68·25$_{2}$	69·33$_{2}$	66·78$_{2}$	66·94$_{2}$	78° 5′ 22″·27 Prob. = 0·39
	−40·92	44·67	45·25	43·75	42·75	43·67	43·92	46·50	45·17	46·08	45·17	44·00	
+ 137° 55′ − 59° 50′	24·66	21·16	22·50	22·58	22·50	19·00	21·00	22·92	23·08	23·25	21·61	22·94	
XXX & XXXIV	40·92$_{2}$	44·67$_{2}$	45·25$_{2}$	43·75$_{2}$	42·75$_{2}$	43·67$_{2}$	43·92$_{2}$	46·50$_{2}$	45·17$_{2}$	46·08$_{2}$	45·17$_{2}$	44·00$_{2}$	59° 50′ 44″·32 Prob. = 0·42

At XXXIII (Rajauli)

†*December* 1842; *observed by Mr. W. N. James with Cary's* 15-*inch Theodolite.*
**February* 1843; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXVI 235°	55°	245°	65°	255°	75°	265°	85°	275°	95°	285°	105°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
† XXXVI & XXXV	+101·90$_{3}$	100·12$_{2}$	106·66$_{2}$	103·15$_{2}$	104·05$_{2}$	110·73$_{2}$	106·98$_{2}$	105·91$_{3}$	106·03$_{4}$	104·77$_{2}$	105·13$_{2}$	108·08$_{2}$	55° 37′ 38″·07 Prob. = 1·48
	− 58·47$_{2}$	54·22$_{2}$	71·89$_{2}$	65·48$_{2}$	64·87$_{2}$	66·27$_{2}$	62·91$_{2}$	69·48$_{2}$	75·42$_{2}$	68·58$_{2}$	72·05$_{2}$	77·05$_{2}$	
+ 125° 21′ − 69° 44′	43·43	45·90	34·77	37·67	39·18	44·46	44·07	36·43	30·61	36·19	33·08	31·03	
† XXXV & XXXIV	+118·47$_{2}$	114·22$_{2}$	131·89$_{2}$	125·48$_{2}$	124·87$_{2}$	126·27$_{2}$	122·91$_{2}$	129·48$_{2}$	135·42$_{2}$	128·58$_{2}$	132·05$_{2}$	137·05$_{2}$	63° 6′ 8″·20 Prob. = 1·19
	− 55·79$_{4}$	54·32$_{3}$	64·65$_{2}$	52·41$_{2}$	58·75$_{2}$	59·80$_{2}$	57·61$_{2}$	59·38$_{3}$	61·41$_{4}$	57·02$_{2}$	61·43$_{2}$	65·69$_{3}$	
+ 69° 43′ − 6° 38′	62·68	59·90	67·24	73·07	66·12	66·47	65·30	70·10	74·01	71·56	70·62	71·36	

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At XXXIII (Rajauli)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXIV												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
* XXXIV & XXX	″ 25·00$_2$	″ 23·25$_2$	″ 30·58$_2$	″ 30·92$_2$	″ 30·92$_2$	″ 26·08$_2$	″ 33·50$_2$	″ 32·08$_2$	″ 27·33$_2$	″ 29·00$_2$	″ 25·50$_2$	″ 34·42$_2$	50° 42′ 29″·05 Prob. = 0·99
XXX & * XXXI	15·08$_2$	18·08$_2$	17·33$_2$	14·75$_2$	14·08$_2$	17·67$_2$	13·25$_2$	18·50$_2$	18·25$_2$	18·17$_2$	14·25$_2$	17·50$_2$	53° 46′ 16″·41 Prob. = 0·54

At XXXIV (Mehtra)

**January* 1843; *observed by Mr. W. N. James with Cary's* 15-*inch Theodolite.*
†*February* 1843; *observed by Mr. C. Murphy with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXII												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
† XXXII & XXX	″ 63·67$_2$	″ 65·33$_2$	″ 70·50$_2$	″ 65·83$_2$	″ 62·92$_2$	″ 58·67$_2$	″ 62·17$_2$	″ 65·92$_2$	″ 62·75$_2$	″ 67·50$_2$	″ 65·42$_2$	″ 65·58$_2$	69° 37′ 4″·69 Prob. = 0·82
† XXX & XXXIII	34·08$_2$	34·42$_2$	29·92$_2$	36·17$_2$	35·75$_2$	34·75$_2$	35·67$_2$	34·33$_2$	38·83$_2$	38·25$_2$	38·42$_2$	32·67$_2$	62° 14′ 35″·27 Prob. = 0·70

Angle between	Circle readings, telescope being set on XXXIII												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
* XXXIII & XXXV	+46·27$_2$	51·95$_2$	40·52$_2$	48·32$_2$	43·20$_2$	48·52$_2$	40·57$_2$	44·52$_2$	46·51$_2$	48·88$_2$	35·30$_2$	48·53$_2$	59° 54′ 6″·13 Prob. = 1·15
	−39·54$_2$	39·23$_2$	37·60$_2$	43·74$_3$	39·74$_3$	45·15$_4$	36·77$_2$	39·91$_2$	36·61$_2$	41·83$_2$	34·87$_2$	34·49$_2$	
+89° 33′ −29° 39′	6·73	12·72	2·92	4·58	3·46	3·37	3·80	4·61	9·90	7·05	0·43	14·04	
* XXXV & XXXVII	+39·54$_2$	39·23$_2$	37·60$_2$	43·74$_3$	39·74$_3$	45·15$_4$	36·77$_2$	39·91$_2$	36·61$_2$	41·83$_2$	34·87$_2$	34·49$_2$	58° 29′ 33″·70 Prob. = 1·44
	+55·21$_2$	54·64$_2$	55·07$_2$	53·31$_2$	56·74$_2$	57·03$_3$	49·62$_2$	58·17$_2$	57·00$_2$	46·96$_2$	61·92$_2$	49·20$_2$	
+29° 39′ +28° 49′	94·75	93·87	92·67	97·05	96·48	102·18	86·39	98·08	93·61	88·79	96·79	83·69	

At XXXV (Bánsgopál)

January and February 1843; *observed by Mr. W. N. James with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXVII												General Means and Probabilities.
	35°	215°	45°	225°	55°	235°	65°	245°	75°	255°	85°	265°	
XXXVII & XXXIV	″ +57·97$_2$	″ 54·25$_2$	″ 49·87$_2$	″ 47·89$_2$	″ 56·53$_2$	″ 57·52$_2$	″ 52·10$_3$	″ 50·52$_2$	″ 51·36$_2$	″ 47·95$_2$	″ 43·40$_2$	″ 51·60$_2$	54° 48′ 33″·43 Prob. = 1·47
	−23·60$_2$	24·89$_2$	20·85$_2$	16·67$_2$	24·32$_2$	16·78$_2$	25·92$_2$	12·88$_3$	17·28$_2$	10·72$_2$	16·80$_2$	9·10$_2$	
+ 90° 10′ − 35° 22′	34·37	29·36	29·02	31·22	32·21	40·74	26·18	37·64	34·08	37·23	26·60	42·50	

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At XXXV (Bánsgopál)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVII: 35°	215°	45°	225°	55°	235°	65°	245°	75°	255°	85°	265°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXIV & XXXIII	+ 108·27$_{2}$	106·75$_{2}$	97·94$_{2}$	100·05$_{2}$	111·79$_{2}$	102·18$_{2}$	105·12$_{2}$	97·88$_{3}$	99·88$_{2}$	92·14$_{2}$	103·04$_{2}$	96·03$_{2}$	56° 59′ 50″·01
	− 57·97$_{2}$	54·25$_{2}$	49·87$_{2}$	47·89$_{2}$	56·53$_{2}$	57·52$_{2}$	52·10$_{3}$	50·52$_{2}$	51·36$_{2}$	47·95$_{2}$	43·40$_{2}$	51·60$_{2}$	Prob. = 1·31
+ 147° 9′ − 90° 10′	50 30	52·50	48·07	52·16	55·26	44·66	53·02	47·36	48·52	44·19	59·64	44·43	
XXXIII & XXXVI	+ 72·51$_{2}$	73·85$_{2}$	62·68$_{2}$	71·14$_{2}$	74·59$_{3}$	72·25$_{2}$	74·29$_{2}$	68·45$_{3}$	73·22$_{2}$	65·82$_{2}$	61·90$_{2}$	64·59$_{3}$	63° 56′ 27″·85
	− 48·27$_{2}$	46·75$_{2}$	37·94$_{2}$	40·05$_{2}$	51·79$_{2}$	42·18$_{2}$	45·12$_{2}$	37·88$_{3}$	39·88$_{2}$	32·14$_{2}$	43·04$_{2}$	36·03$_{2}$	Prob. = 1·23
+ 211° 6′ − 147° 10′	24·24	27·10	24·74	31·09	22·80	30·07	29·17	30·57	33·34	33·68	18·86	28·56	
XXXVI & XXXVIII	+ 20·43$_{2}$	29·07$_{2}$	16·54$_{2}$	20·30$_{2}$	27·12$_{2}$	19·32$_{2}$	24·79$_{2}$	15·02$_{3}$	22·68$_{2}$	10·08$_{2}$	13·56$_{2}$	15·25$_{3}$	54° 44′ 9″·91
	− 12·51$_{2}$	13·85$_{2}$	2·68$_{2}$	11·14$_{2}$	14·59$_{3}$	12·25$_{2}$	14·29$_{2}$	8·45$_{3}$	13·22$_{2}$	5·82$_{2}$	1·89$_{2}$	4·59$_{3}$	Prob. = 0·88
+ 265° 51′ − 211° 7′	7·92	15·22	13·86	9·16	12·53	7·07	10·50	6·57	9·46	4·26	11·67	10·66	
XXXVIII & XXXIX	+ 53·87$_{2}$	58·69$_{2}$	50·00$_{2}$	53·57$_{2}$	55·65$_{2}$	53·90$_{2}$	55·78$_{2}$	50·01$_{3}$	52·62$_{2}$	49·02$_{2}$	49·53$_{2}$	48·51$_{3}$	59° 27′ 33″·08
	− 20·43$_{2}$	29·07$_{2}$	16·54$_{2}$	20·30$_{2}$	27·12$_{2}$	19·32$_{2}$	24·79$_{2}$	15·02$_{3}$	22·68$_{2}$	10·08$_{2}$	13·56$_{2}$	15·25$_{3}$	Prob. = 0·82
+ 325° 18′ − 265° 51′	33·44	29·62	33·46	33·27	28·53	34·58	30·99	34·99	29·94	38·94	35·97	33·26	
XXXIX & XXXVII	+ 83·60$_{2}$	84·89$_{2}$	80·85$_{2}$	76·67$_{2}$	84·32$_{2}$	76·78$_{2}$	85·92$_{2}$	72·88$_{3}$	77·28$_{2}$	70·72$_{2}$	76·80$_{2}$	69·10$_{2}$	70° 3′ 25″·72
	− 53·87$_{2}$	58·69$_{2}$	50·00$_{2}$	53·57$_{2}$	55·65$_{2}$	53·90$_{2}$	55·78$_{2}$	50·01$_{2}$	52·62$_{2}$	49·02$_{2}$	49·53$_{2}$	48·51$_{3}$	Prob. = 0·99
+ 35° 21′ − 325° 18′	29·73	26·20	30·85	23·10	28·67	22·88	30·14	22·87	24·66	21·70	27·27	20·59	

At XXXVI (Chandanpur)

March 1843; *observed by Lieutenant T. Renny with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXVIII: 0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXVIII & XXXV	64·17$_{2}$	60·58$_{2}$	64·92$_{2}$	63·25$_{2}$	64·50$_{2}$	59·25$_{2}$	62·33$_{2}$	63·92$_{2}$	62·17$_{2}$	64·93$_{2}$	66·42$_{2}$	62·67$_{2}$	63° 27′ 3″·26 Prob. = 0·55
XXXV & XXXIII	52·58$_{2}$	58·08$_{2}$	55·25$_{2}$	55·42$_{2}$	52·50$_{2}$	55·66$_{2}$	53·67$_{2}$	54·75$_{2}$	56·50$_{2}$	52·67$_{2}$	53·92$_{2}$	57·25$_{2}$	60° 25′ 54″·85 Prob. = 0·51

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At XXXVII (Barauli)

April 1843; *observed by Mr. W. N. James with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXIV: 0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXIV & XXXV	+73·92 $_{2}$	73·07 $_{2}$	65·53 $_{4}$	69·59 $_{2}$	65·77 $_{2}$	65·27 $_{2}$	61·57 $_{2}$	68·24 $_{2}$	57·45 $_{2}$	66·74 $_{2}$	58·32 $_{2}$	68·82 $_{2}$	66° 42′ 3″·42
	−61·57 $_{2}$	68·59 $_{2}$	58·98 $_{4}$	74·05 $_{2}$	57·50 $_{2}$	68·11 $_{3}$	58·39 $_{2}$	65·34 $_{2}$	56·22 $_{2}$	61·93 $_{2}$	56·78 $_{2}$	65·85 $_{2}$	Prob. = 1·25
+161° 53′ −95° 11′	72·35	64·48	66·55	55·54	68·27	57·16	63·18	62·90	61·23	64·81	61·54	62·97	
XXXV & XXXIX	+61·57 $_{2}$	68·59 $_{2}$	58·98 $_{4}$	74·05 $_{2}$	57·50 $_{2}$	68·11 $_{3}$	58·39 $_{2}$	65·34 $_{2}$	56·22 $_{2}$	61·93 $_{2}$	56·78 $_{2}$	65·85 $_{2}$	48° 55′ 47″·54
	−13·25 $_{2}$	23·82 $_{2}$	13·84 $_{3}$	16·87 $_{2}$	11·99 $_{2}$	20·35 $_{3}$	8·54 $_{2}$	18·67 $_{2}$	15·95 $_{2}$	18·85 $_{2}$	4·78 $_{2}$	15·88 $_{2}$	Prob. = 1·22
+95° 11′ −46° 16′	48·32	44·77	45·14	57·18	45·51	47·76	49·85	46·67	40·27	43·08	52·00	49·97	

At XXXVIII (Kandarki)

March 1843; *observed by Mr. G. Logan with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XLI: 330°	150°	340°	160°	350°	170°	0°	180°	10°	190°	20°	200°	General Means and Probabilities.
	″	″	″	″	″	″	″	″	″	″	″	″	
XLI & XL	+108·22 $_{2}$	92·42 $_{2}$	103·88 $_{2}$	98·05 $_{2}$	107·45 $_{2}$	93·78 $_{2}$	93·90 $_{2}$	100·26 $_{2}$	96·20 $_{2}$	104·15 $_{2}$	98·60 $_{2}$	105·52 $_{2}$	58° 50′ 0″·81
	−45·20 $_{2}$	39·57 $_{2}$	38·15 $_{2}$	44·03 $_{2}$	34·57 $_{2}$	45·78 $_{2}$	33·62 $_{2}$	40·58 $_{2}$	36·73 $_{2}$	39·50 $_{2}$	34·05 $_{2}$	40·94 $_{2}$	Prob. = 1·85
+28° 23′ −329° 34′	63·02	52·85	65·73	54·02	72·88	48·00	60·28	59·68	59·47	64·65	64·55	64·58	
XL & XXXIX	+68·77 $_{2}$	69·15 $_{2}$	73·68 $_{2}$	67·87 $_{2}$	68·57 $_{2}$	71·83 $_{2}$	60·84 $_{2}$	72·83 $_{2}$	69·70 $_{2}$	69·68 $_{2}$	63·25 $_{2}$	73·75 $_{2}$	63° 45′ 28″·96
	−48·22 $_{2}$	32·42 $_{2}$	43·88 $_{2}$	38·05 $_{2}$	47·45 $_{2}$	33·78 $_{2}$	33·90 $_{2}$	40·26 $_{2}$	36·20 $_{2}$	44·15 $_{2}$	38·60 $_{2}$	45·52 $_{2}$	Prob. = 1·55
+92° 9′ −28° 24′	20·55	36·73	29·80	29·82	21·12	38·05	26·94	32·57	33·50	25·53	24·65	28·23	
XXXIX & XXXV	+78·93 $_{2}$	72·57 $_{2}$	79·97 $_{2}$	77·52 $_{2}$	81·18 $_{2}$	70·98 $_{2}$	71·52 $_{2}$	76·15 $_{2}$	69·73 $_{2}$	78·43 $_{2}$	75·28 $_{2}$	74·60 $_{2}$	52° 33′ 6″·41
	−8·77 $_{2}$	9·15 $_{2}$	13·68 $_{2}$	7·87 $_{2}$	8·57 $_{2}$	11·83 $_{2}$	0·83 $_{2}$	12·83 $_{2}$	9·70 $_{2}$	9·68 $_{2}$	3·25 $_{2}$	13·75 $_{2}$	Prob. = 1·35
+144° 42′ −92° 10′	70·16	63·42	66·29	69·65	72·61	59·15	70·69	63·32	60·03	68·75	72·03	60·85	
XXXV & XXXVI	+70·63 $_{2}$	68·55 $_{2}$	67·07 $_{2}$	64·92 $_{2}$	65·77 $_{2}$	67·57 $_{2}$	58·80 $_{2}$	68·07 $_{2}$	64·46 $_{2}$	66·20 $_{2}$	63·85 $_{2}$	67·23 $_{2}$	61° 48′ 50″·52
	−18·93 $_{2}$	12·57 $_{2}$	19·97 $_{2}$	17·52 $_{2}$	21·18 $_{2}$	10·98 $_{2}$	11·52 $_{2}$	16·15 $_{2}$	9·73 $_{2}$	18·43 $_{2}$	15·28 $_{2}$	14·60 $_{2}$	Prob. = 1·09
+206° 31′ −144° 43′	51·70	55·98	47·10	47·40	44·59	56·59	47·28	51·92	54·73	47·77	48·57	52·63	

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At XXXIX (Atora)

March 1843; *observed by Mr. W. N. James with Cary's* 15-*inch Theodolite.*

Angle between	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities.
	Circle readings, telescope being set on XXXVII												
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXVII & XXXV	38·71	48·90	33·20	48·48	32·52	43·40	38·75	44·03	34·10	38·75	29·95	42·16	61° 0′ 39″·41 Prob. = 1·71
XXXV & XXXVIII	24·55	25·43	24·65	19·89	26·99	17·78	30·80	25·45	22·09	26·34	27·47	21·10	67° 59′ 24″·38 Prob. = 1·00
XXXVIII & XL	4·11	2·27	9·86	5·77	10·87	15·90	1·09	7·69	12·28	9·32	5·10	9·87	64° 26′ 7″·84 Prob. = 1·20
XL & XLII	28·38	22·74	25·65	26·12	19·11	25·09	27·65	15·82	28·57	20·30	35·85	23·29	46° 52′ 24″·88 Prob. = 1·44

At XL (Sirsa)

February, April and May 1843; *observed by Mr. W. N. James with Cary's* 15-*inch Theodolite.*

Angle between	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities.
	Circle readings, telescope being set on R.M.												
	″	″	″	″	″	″	″	″	″	″	″	″	
R.M. & XLIII	43·54	45·61	41·35	43·32	43·55	42·57	42·18	43·68	41·17	41·66	38·40	39·88	31° 40′ 42″·24
	47·22	42·40	44·06	46·31	43·65	44·68	42·86	44·75	39·04	47·56	44·28	42·94	31° 40′ 44″·15
XLIII & XLIV	+82·30	82·50	78·02	74·35	83·39	84·87	77·85	79·83	80·17	76·88	73·25	78·87	58° 19′ 37″·11 Prob. = 0·80
	−43·54	45·61	41·35	43·32	43·55	42·57	42·18	43·68	41·17	41·66	38·40	39·88	
+89° 59′ −31° 40′	38·76	36·89	36·67	31·03	39·84	42·30	35·67	36·15	39·00	35·22	34·85	38·99	
XLIV & XLII	+73·22	76·25	71·36	68·34	73·07	68·08	74·06	70·02	72·67	68·52	66·33	64·35	65° 23′ 51″·17 Prob. = 1·02
	−22·30	22·50	18·02	14·35	23·39	24·87	17·85	19·83	20·17	16·88	13·25	18·87	
+155° 23′ − 90° 0′	50·92	53·75	53·34	53·99	49·68	43·21	56·21	50·19	52·50	51·64	53·08	45·48	
XLII & XXXIX	+33·41	30·57	34·00	22·44	36·64	28·45	39·15	24·07	29·52	26·57	28·55	24·42	65° 30′ 19″·29 Prob. = 1·06
	−13·22	16·25	11·36	8·34	13·07	8·08	14·06	10·02	12·67	8·52	6·33	4·35	
+220° 54′ −155° 24′	20·19	14·32	22·64	14·10	23·57	20·37	25·09	14·05	16·85	18·05	22·22	20·07	
XXXIX & XXXVIII	+63·37	63·23	61·70	52·20	68·74	60·07	61·78	57·70	55·01	45·36	61·40	54·10	51° 48′ 28″·91 Prob. = 1·26
	−33·41	30·57	34·00	22·44	36·64	28·45	39·15	24·07	29·52	26·57	28·55	24·42	
+272° 42′ −220° 54′	29·96	32·66	27·70	29·76	32·10	31·62	22·63	33·63	25·49	18·79	32·85	29·68	

R.M. denotes Referring Mark.

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At XL (Sirsa)—(*Continued*).

Angle between	Circle readings, telescope being set on R.M.												General Means and Probabilities.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXXVIII & XLI	+ 103·54$_2$	105·61$_2$	101·35$_2$	103·32$_2$	103·55$_2$	102·57$_2$	102·18$_2$	103·68$_2$	101·17$_2$	101·66$_2$	98·40$_2$	99·88$_2$	54° 31′ 10″·37
	− 63·37$_2$	63·23$_2$	61·70$_2$	52·20$_2$	68·74$_2$	60·07$_2$	61·78$_2$	57·70$_2$	55·01$_2$	45·36$_2$	61·40$_2$	54·10$_2$	Prob. = 1·51
+ 31° 39′	− 33·27	30·42	35·18	35·50	29·05	30·53	29·26	33·27	26·37	40·11	35·68	39·23	
−272° 42′ − 64° 26′	6·90	11·96	4·47	15·62	5·76	11·97	11·14	12·71	19·79	16·19	1·32	6·55	
XLI & XLIII	+ 46·05$_2$	48·02$_2$	51·12$_2$	49·19$_2$	45·40$_2$	45·85$_2$	46·40$_2$	48·52$_2$	47·33$_2$	52·54$_2$	51·40$_2$	56·29$_2$	64° 26′ 33″·15
	+ 47·22$_2$	42·40$_2$	44·06$_2$	46·31$_2$	43·65$_2$	44·68$_2$	42·86$_2$	44·75$_2$	39·04$_2$	47·56$_2$	44·28$_2$	42·94$_2$	Prob. = 1·16
+32° 45′ +31° 40′	93·27	90·42	95·18	95·50	89·05	90·53	89·26	93·27	86·37	100·10	95·68	99·23	

At XLI (Lút)

March 1843; *observed by Mr. G. Logan with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XLIII												General Means and Probabilities.
	311°	131°	321°	141°	331°	151°	341°	161°	351°	171°	1°	181°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XLIII & XL	+ 71·35$_2$	82·25$_2$	69·95$_2$	80·82$_2$	68·62$_2$	85·85$_2$	66·60$_2$	94·68$_2$	68·88$_2$	77·50$_2$	70·77$_2$	78·02$_2$	56° 19′ 22″·82
	− 48·88$_2$	60·48$_2$	47·28$_2$	63·05$_2$	42·72$_2$	58·54$_2$	41·75$_2$	72·90$_2$	42·10$_2$	60·52$_2$	46·28$_3$	56·90$_2$	Prob. = 0·90
+ 7° 3′ −310° 44′	22·47	21·77	22·67	17·77	25·90	27·31	24·85	21·78	26·78	16·98	24·49	21·12	
XL & XXXVIII	+ 57·27$_2$	67·07$_2$	61·87$_2$	64·02$_2$	53·35$_2$	62·40$_2$	50·35$_2$	67·70$_2$	49·00$_2$	63·78$_2$	52·40$_3$	68·45$_2$	66° 38′ 43″·53
	− 11·35$_2$	22·25$_2$	9·95$_2$	20·82$_2$	8·62$_2$	25·85$_2$	6·60$_2$	34·68$_2$	8·88$_2$	17·50$_2$	10·77$_2$	18·02$_2$	Prob. = 1·47
+73° 42′ − 7° 4′	45·92	44·82	51·92	43·20	44·73	36·55	43·75	33·02	40·12	46·28	41·63	50·43	

At XLII (Bhatauli)

March 1843; *observed by Mr. W. N. James with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXIX												General Means and Probabilities.
	292°	112°	302°	122°	312°	132°	322°	142°	332°	152°	342°	162°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXXIX & XL	4·43$_3$	2·75$_2$	9·50$_2$	8·50$_3$	5·94$_2$	15·67$_2$	0·67$_2$	12·72$_2$	4·75$_2$	18·58$_3$	13·79$_2$	15·24$_2$	67° 37′ 9″·38 Prob. = 1·60
XL & XLIV	52·65$_2$	57·21$_3$	45·13$_2$	52·80$_2$	49·05$_2$	53·78$_2$	53·82$_2$	48·03$_2$	48·82$_2$	50·06$_3$	49·10$_2$	48·72$_2$	63° 44′ 50″·76 Prob. = 0·92

R.M. denotes Referring Mark.

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At XLIII (Milik)

March 1843; *observed by Mr. G. Logan with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XLVI												General Means and Probabilities.
	282°	102°	292°	112°	302°	122°	312°	132°	322°	142°	332°	152°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XLVI & XLV	+95·62$_{2}$	104·07$_{3}$	83·83$_{2}$	93·95$_{2}$	87·59$_{2}$	89·45$_{2}$	87·32$_{3}$	89·02$_{2}$	86·32$_{2}$	90·08$_{2}$	85·95$_{2}$	92·53$_{2}$	62° 57′ 44″·78
	−46·07$_{2}$	51·42$_{2}$	45·35$_{2}$	45·83$_{2}$	43·43$_{3}$	44·97$_{2}$	40·34$_{2}$	49·07$_{2}$	38·05$_{2}$	50·27$_{2}$	36·12$_{2}$	57·45$_{2}$	Prob. = 1·49
+344° 58′ −282° 1′	49·55	52·65	38·48	48·07*	44·16	44·48	46·98	39·95	48·27	39·81	49·83	35·08	
XLV & XLIV	+48·63$_{2}$	46·98$_{2}$	46·45$_{2}$	47·15$_{2}$	43·98$_{3}$	37·82$_{2}$	39·50$_{2}$	47·08$_{2}$	41·28$_{2}$	45·60$_{2}$	36·13$_{2}$	51·58$_{2}$	60° 14′ 13″·87
	−35·62$_{2}$	44·07$_{2}$	23·83$_{2}$	33·95$_{2}$	27·59$_{3}$	29·45$_{2}$	27·32$_{2}$	29·02$_{2}$	26·32$_{2}$	30·08$_{2}$	25·95$_{2}$	32·53$_{2}$	Prob. = 1·44
+ 45° 13′ −344° 59′	13·01	2·91	22·62	13·20	16·39	8·37	12·18	18·06	14·96	15·52	10·18	19·05	
XLIV & XL	+85·73$_{2}$	93·23$_{2}$	88·05$_{2}$	91·83$_{2}$	87·64$_{3}$	88·87$_{2}$	84·75$_{2}$	88·20$_{2}$	85·12$_{2}$	88·93$_{2}$	84·70$_{2}$	93·12$_{2}$	61° 6′ 44″·00
	−48·63$_{2}$	46·98$_{2}$	46·45$_{2}$	47·15$_{2}$	43·98$_{3}$	37·82$_{2}$	39·50$_{2}$	47·08$_{2}$	41·28$_{2}$	45·60$_{2}$	36·13$_{2}$	51·58$_{2}$	Prob. = 1·01
+106° 19′ − 45° 13′	37·10	46·25	41·60	44·68	43·66	51·05	45·25	41·12	43·84	43·33	48·57	41·54	
XL & XLI	+102·35$_{2}$	102·82$_{2}$	94·72$_{3}$	97·05$_{2}$	81·17$_{3}$	98·10$_{2}$	94·20$_{2}$	103·23$_{2}$	89·77$_{2}$	98·27$_{2}$	92·58$_{2}$	96·08$_{2}$	59° 14′ 7″·51
	− 25·73$_{2}$	33·23$_{2}$	28·05$_{2}$	31·83$_{2}$	27·64$_{3}$	28·87$_{2}$	24·75$_{2}$	28·20$_{2}$	25·12$_{2}$	28·93$_{2}$	24·70$_{2}$	33·12$_{2}$	Prob. = 1·63
+165° 33′ −106° 20′	76·62	69·59	66·67	65·22	53·53	69·23	69·45	75·03	64·65	69·34	67·88	62·96	

At XLIV (Akbarpur)

December 1842; *observed by Mr. G. Logan with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XLII												General Means and Probabilities.
	208°	28°	218°	38°	228°	48°	238°	58°	248°	68°	258°	78°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XLII & XL	+68·37$_{2}$	64·32$_{2}$	72·23$_{2}$	70·63$_{2}$	73·17$_{2}$	69·62$_{2}$	75·23$_{2}$	73·75$_{2}$	77·75$_{2}$	72·77$_{2}$	72·33$_{2}$	69·25$_{2}$	50° 51′ 25″·51
	−44·50$_{2}$	44·25$_{2}$	43·17$_{2}$	48·48$_{2}$	44·57$_{2}$	46·27$_{2}$	43·57$_{2}$	47·27$_{2}$	47·68$_{2}$	47·03$_{2}$	55·48$_{2}$	41·05$_{2}$	Prob. = 1·21
+152° 13′ −101° 22′	23·87	20·07	29·06	22·15	28·60	23·35	31·66	26·48	30·07	25·74	16·85	28·20	
XL & XLIII	+44·50$_{2}$	44·25$_{2}$	43·17$_{2}$	48·48$_{2}$	44·57$_{2}$	46·27$_{2}$	43·57$_{2}$	47·27$_{2}$	47·68$_{2}$	47·03$_{2}$	55·48$_{2}$	41·05$_{2}$	60° 33′ 36″·74
	− 0·42$_{3}$	6·73$_{3}$	11·58$_{2}$	6·85$_{2}$	9·27$_{2}$	9·17$_{2}$	11·97$_{2}$	9·65$_{2}$	15·32$_{2}$	5·95$_{2}$	15·92$_{2}$	9·63$_{2}$	Prob. = 1·20
+101° 22′ − 40° 49′	44·08	37·52	31·59	41·63	35·30	37·10	31·60	37·62	32·36	41·08	39·56	31·42	

* This value should be 48·12: the error was not detected until after completion of the calculations.

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At XLIV (Akbarpur)—(*Continued*).

Angle between	Circle readings, telescope being set on XLII												General Means and Probabilities.
	208°	28°	218°	38°	228°	48°	238°	58°	248°	68°	258°	78°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XLIII & XLV	+ 0·42$_{3}$	6·73$_{3}$	11·58$_{2}$	6·85$_{2}$	9·27$_{2}$	9·17$_{2}$	11·97$_{2}$	9·65$_{2}$	15·32$_{2}$	5·95$_{2}$	15·92$_{2}$	9·63$_{2}$	65° 1′ 8″·77
	+ 59·67$_{2}$	60·15$_{2}$	58·80$_{2}$	58·37$_{2}$	61·18$_{2}$	59·55$_{2}$	60·42$_{2}$	57·22$_{2}$	58·42$_{2}$	57·88$_{2}$	58·55$_{2}$	62·62$_{2}$	Prob. = 1·20
+ 40° 49′ + 24° 11′	60·09	66·88	70·38	65·22	70·45	68·72	72·39	66·87	73·74	63·83	74·47	72·25	
XLV & XLVII	+ 121·23$_{2}$	129·03$_{2}$	118·45$_{2}$	123·30$_{2}$	117·67$_{2}$	120·72$_{2}$	119·32$_{2}$	122·38$_{2}$	116·70$_{2}$	122·68$_{2}$	116·35$_{2}$	123·93$_{2}$	56° 29′ 1″·58
	− 59·67$_{2}$	60·15$_{2}$	58·80$_{2}$	58·37$_{2}$	61·18$_{2}$	59·55$_{2}$	60·42$_{2}$	57·22$_{2}$	58·42$_{2}$	57·88$_{2}$	58·55$_{2}$	62·62$_{2}$	Prob. = 1·02
+ 80° 39′ − 24° 11′	61·56	68·88	59·65	64·93	56·49	61·17	58·90	65·16	58·28	64·80	57·80	61·31	

At XLV (Sarkára)

January and March* 1843 ; *observed by Mr. G. Logan with Cary's* 15*-inch Theodolite.

Angle between	Circle readings, telescope being set on XLVIII												General Means and Probabilities.
	38°	218°	48°	228°	58°	238°	68°	248°	78°	258°	88°	268°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XLVIII & XLVII	+ 97·17$_{2}$	101·43$_{2}$	97·45$_{2}$	101·88$_{2}$	102·90$_{2}$	100·32$_{2}$	97·68$_{2}$	96·43$_{2}$	96·28$_{2}$	107·85$_{2}$	95·23$_{2}$	102·98$_{3}$	81° 40′ 59″·58
	− 41·53$_{2}$	46·58$_{2}$	40·37$_{2}$	41·37$_{2}$	39·12$_{2}$	41·58$_{2}$	34·03$_{2}$	40·68$_{3}$	31·13$_{2}$	43·20$_{2}$	35·00$_{2}$	48·03$_{3}$	Prob. = 1·10
+ 119° 8′ − 37° 28′	55·64	54·85	57·08	60·51	63·78	58·74	63·65	55·75	65·15	64·65	60·23	54·95	
XLVII & XLIV	+ 85·38$_{2}$	86·83$_{2}$	88·20$_{2}$	92·75$_{2}$	84·93$_{2}$	91·22$_{2}$	82·18$_{2}$	93·83$_{2}$	76·62$_{2}$	93·87$_{2}$	81·35$_{2}$	95·97$_{2}$	70° 2′ 47″·96
	− 37·17$_{2}$	41·43$_{2}$	37·45$_{2}$	41·88$_{2}$	42·90$_{2}$	40·32$_{2}$	37·68$_{2}$	36·43$_{2}$	36·28$_{2}$	47·85$_{2}$	35·23$_{2}$	42·98$_{3}$	Prob. = 1·34
+ 189° 11′ − 119° 9′	48·21	45·40	50·75	50·87	42·03	50·90	44·50	57·40	40·34	46·02	46·12	52·99	
XLIV & XLIII	+ 69·31$_{2}$	71·00$_{2}$	69·75$_{2}$	71·72$_{2}$	66·10$_{2}$	74·50$_{2}$	67·45$_{2}$	74·88$_{2}$	66·03$_{2}$	76·42$_{2}$	62·65$_{2}$	70·62$_{2}$	54° 44′ 42″·28
	− 25·38$_{2}$	26·83$_{2}$	28·20$_{2}$	32·75$_{2}$	24·93$_{2}$	31·22$_{2}$	22·18$_{2}$	33·83$_{2}$	16·62$_{2}$	33·87$_{2}$	21·35$_{2}$	35·97$_{2}$	Prob. = 0·99
+ 243° 56′ − 189° 12′	43·93	44·17	41·55	38·97	41·17	43·28	45·27	41·05	49·41	42·55	41·30	34·65	
XLIII & LXVI	+ 49·75$_{2}$	58·92$_{2}$	53·08$_{3}$	55·33$_{2}$	50·99$_{2}$	60·85$_{2}$	52·47$_{2}$	60·93$_{3}$	47·48$_{2}$	65·88$_{2}$	45·18$_{2}$	59·75$_{2}$	65° 7′ 45″·02
	− 9·31$_{2}$	11·00$_{2}$	9·75$_{2}$	11·72$_{2}$	6·10$_{2}$	14·50$_{2}$	7·45$_{2}$	14·88$_{2}$	6·03$_{2}$	16·42$_{2}$	2·65$_{2}$	10·62$_{2}$	Prob. = 0·81
+ 309° 4′ − 243° 57′	40·44	47·92	43·33	43·61	44·89	46·35	45·02	46·05	41·45	49·46	42·53	49·13	

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At XLV (Sarkára)—(*Continued*).

Angle between	Circle readings, telescope being set on XLVIII												General Means and Probabilities.
	38°	218°	48°	228°	58°	238°	68°	248°	78°	258°	88°	268°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XLVI & XLVIII	+ 101·53$_{2}$	106·58$_{2}$	100·37$_{2}$	101·37$_{2}$	99·12$_{2}$	101·58$_{2}$	94·03$_{2}$	100·68$_{3}$	91·13$_{2}$	103·20$_{2}$	95·00$_{2}$	108·03$_{2}$	88° 23′ 45″·17
	− 49·75$_{2}$	58·92$_{2}$	53·08$_{3}$	55·33$_{2}$	50·99$_{2}$	60·85$_{2}$	52·47$_{2}$	60·93$_{2}$	47·48$_{2}$	65·88$_{2}$	45·18$_{2}$	59·75$_{2}$	Prob. = 1·24
+ 37° 27′ − 309° 4′	51·78	47·66	47·29	46·04	48·13	40·73	41·56	39·75	43·65	37·32	49·82	48·28	

At XLVI (Haldaur)

March* 1843; *observed by Mr. G. Logan with Cary's* 15-*inch Theodolite.

Angle between	Circle readings, telescope being set on XLVIII*												General Means and Probabilities.
	299°	119°	309°	129°	319°	139°	329°	149°	339°	159°	349°	169°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XLVIII* & LII	+ 61·77$_{2}$	59·38$_{2}$	62·95$_{2}$	70·60$_{2}$	63·12$_{2}$	66·65$_{2}$	61·07$_{2}$	71·95$_{2}$	61·48$_{2}$	62·95$_{2}$	60·50$_{2}$	70·15$_{2}$	56° 0′ 35″·42
	− 29·30$_{2}$	26·53$_{2}$	25·52$_{2}$	35·70$_{2}$	30·78$_{2}$	32·82$_{2}$	20·93$_{2}$	37·45$_{2}$	21·20$_{3}$	31·55$_{2}$	19·67$_{2}$	36·03$_{2}$	Prob. = 0·93
+ 354° 50′ − 298° 50′	32·47	32·85	37·43	34·90	32·34	33·83	40·14	34·50	40·28	31·40	40·83	34·12	
LII & XLVIII	+ 132·05$_{2}$	140·82$_{2}$	131·52$_{2}$	124·68$_{2}$	128·08$_{2}$	131·57$_{2}$	124·00$_{2}$	128·68$_{2}$	124·42$_{2}$	129·08$_{2}$	121·03$_{2}$	138·67$_{2}$	57° 57′ 5″·17
	− 61·77$_{2}$	59·38$_{2}$	62·95$_{2}$	70·60$_{2}$	63·12$_{2}$	66·65$_{2}$	61·07$_{2}$	71·95$_{2}$	61·48$_{2}$	62·95$_{2}$	60·50$_{2}$	70·15$_{2}$	Prob. = 1·94
+ 52° 46′ − 354° 50′	70·28	81·44	68·57	54·08	64·96	64·92	62·93	56·73	62·94	66·13	60·53	68·52	
XLVIII & XLV	+ 44·30$_{2}$	37·03$_{2}$	36·90$_{2}$	44·20$_{2}$	42·20$_{2}$	45·12$_{2}$	36·33$_{2}$	49·20$_{2}$	38·73$_{2}$	35·27$_{2}$	35·12$_{2}$	43·92$_{2}$	60° 33′ 31″·14
	− 12·05$_{2}$	20·82$_{2}$	11·52$_{2}$	4·68$_{2}$	8·08$_{2}$	11·57$_{2}$	4·00$_{2}$	8·68$_{2}$	4·42$_{2}$	9·08$_{2}$	1·03$_{2}$	18·67$_{2}$	Prob. = 1·88
+ 113° 21′ − 52° 48′	32·25	16·21	25·38	39·52	34·12	33·55	32·33	40·52	34·31	26·19	34·09	25·25	
XLV & XLIII	+ 73·93$_{2}$	68·82$_{2}$	73·42$_{2}$	75·62$_{2}$	70·38$_{2}$	74·13$_{3}$	62·87$_{2}$	78·88$_{2}$	66·87$_{2}$	75·92$_{2}$	59·55$_{2}$	76·52$_{2}$	51° 54′ 30″·72
	− 44·30$_{2}$	37·03$_{2}$	36·90$_{2}$	44·20$_{2}$	42·20$_{2}$	45·12$_{2}$	36·33$_{2}$	49·20$_{2}$	38·73$_{2}$	35·27$_{2}$	35·12$_{2}$	43·92$_{2}$	Prob. = 1·22
+ 165° 15′ − 113° 21′	29·63	31·79	36·52	31·42	28·18	29·01	26·54	29·68	28·14	40·65	24·43	32·60	

NOTE.—XLVIII* and LII appertain to Great Arc Meridional Series, Section 24° to 30°.

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At XLVII (Nandi)

December 1842 *and January* 1843; *observed by Mr. G. Logan with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XLIV 335°	155°	345°	165°	355°	175°	5°	185°	15°	195°	25°	205°	General Means and Probabilities.
	"	"	"	"	"	"	"	"	"	"	"	"	
XLIV & XLV	+ 52.77_{3}	37.61_{3}	49.55_{2}	41.05_{2}	50.83_{2}	45.38_{2}	56.12_{2}	48.28_{2}	48.37_{2}	52.32_{2}	59.10_{2}	46.60_{2}	53° 28′ 13″.50
	+ 27.36_{3}	23.06_{3}	24.75_{2}	31.38_{2}	28.60_{2}	26.58_{2}	18.50_{2}	21.43_{2}	16.62_{2}	32.27_{2}	16.42_{2}	27.00_{2}	Prob. = 1.79
+ 25° 4′ + 28° 23′	80.13	60.67	74.30	72.43	79.43	71.96	74.62	69.71	64.99	84.59	75.52	73.60	
XLV & XLVIII	+ 66.15_{3}	65.58_{3}	62.93_{2}	71.31_{2}	57.23_{2}	66.88_{2}	56.17_{2}	68.00_{2}	60.85_{2}	63.22_{2}	61.89_{2}	68.22_{2}	69° 13′ 39″.54
	− 27.36_{3}	23.06_{3}	24.75_{2}	31.38_{2}	28.60_{2}	26.58_{2}	18.50_{2}	21.43_{2}	16.62_{2}	32.27_{2}	16.42_{2}	27.00_{2}	Prob. = 1.49
+ 97° 36′ − 28° 23′	38.79	42.52	38.18	39.93	28.63	40.30	37.67	46.57	44.23	30.95	45.47	41.22	

At XLVIII (Harpálsid)

January 1843; *observed by Mr. G. Logan with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XLVII 288°	108°	298°	118°	308°	128°	318°	138°	328°	148°	338°	158°	General Means and Probabilities.
	"	"	"	"	"	"	"	"	"	"	"	"	
XLVII & XLV	+ 38.35_{2}	38.25_{2}	41.68_{2}	42.97_{2}	46.07_{2}	32.18_{2}	53.93_{2}	40.27_{2}	46.17_{2}	43.53_{2}	50.30_{2}	36.82_{2}	29° 5′ 22″.33
	− 19.58_{2}	16.63_{2}	19.32_{2}	14.03_{2}	26.30_{2}	9.05_{2}	28.70_{2}	18.37_{2}	24.97_{2}	21.68_{3}	27.58_{2}	16.37_{2}	Prob. = 0.74
+ 71° 54′ − 42° 49′	18.77	21.62	22.36	28.94	19.77	23.13	25.23	21.90	21.20	21.85	22.72	20.45	
XLV & XLVI	+ 79.58_{2}	76.63_{2}	79.32_{2}	74.03_{2}	86.30_{2}	69.05_{2}	88.70_{2}	78.37_{2}	84.97_{2}	81.68_{3}	87.58_{2}	76.37_{2}	31° 2′ 48″.32
	− 35.72_{3}	25.08_{2}	35.78_{2}	27.82_{2}	40.82_{2}	31.45_{2}	35.17_{2}	22.17_{2}	34.40_{2}	33.23_{2}	33.30_{2}	27.77_{2}	Prob. = 1.47
+ 42° 48′ − 11° 46′	43.86	51.55	43.54	46.21	45.48	37.60	53.53	56.20	50.57	48.45	54.28	48.60	
XLVI & LII	+ 35.72_{3}	25.08_{2}	35.78_{2}	27.82_{2}	40.82_{2}	31.45_{2}	35.17_{2}	22.17_{2}	34.40_{2}	33.23_{2}	33.30_{2}	27.77_{2}	32° 54′ 29″.92
	+ 55.58_{3}	61.30_{2}	58.42_{2}	59.85_{2}	59.95_{2}	63.73_{2}	55.13_{2}	56.05_{2}	54.10_{2}	54.60_{2}	54.80_{2}	62.80_{2}	Prob. = 1.52
+ 11° 46′ + 21° 7′	91.30	86.38	94.20	87.67	100.77	95.18	90.30	78.22	88.50	87.83	88.10	90.57	
LII & I	+ 105.25_{2}	112.98_{2}	100.85_{2}	110.58_{2}	104.62_{2}	104.38_{2}	103.15_{2}	103.85_{2}	109.83_{2}	102.42_{2}	109.97_{2}	111.78_{2}	91° 57′ 48″.61
	− 55.58_{3}	61.30_{2}	58.42_{2}	59.85_{2}	59.95_{2}	63.73_{2}	55.13_{2}	56.05_{2}	54.10_{2}	54.60_{2}	54.80_{2}	62.80_{2}	Prob. = 1.26
+ 113° 4′ − 21° 7′	49.67	51.68	42.43	50.73	44.67	40.65	48.02	47.80	55.73	47.82	55.17	48.98	

NOTE 1.—LII appertains to Great Arc Meridional Series, Section 24° to 30°.
2.—I appertains to North-East Longitudinal Series.

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At XLVIII* (Sheopuri)

February 1843; *observed by Mr. G. Logan with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on LII												General Means and Probabilities.
	50°	230°	60°	240°	70°	250°	80°	260°	90°	270°	100°	280°	
LII & XLVI	″ 43·64$_{3}$	″ 56·35$_{2}$	″ 48·45$_{2}$	″ 55·82$_{2}$	″ 52·55$_{2}$	″ 50·37$_{2}$	″ 36·18$_{2}$	″ 52·05$_{2}$	″ 53·25$_{2}$	″ 45·55$_{2}$	″ 49·27$_{2}$	″ 45·32$_{2}$	63° 6′ 50″·73 Prob. = 1·21

At LII (Mahesari)

January, February and March 1843; *observed by Mr. G. Logan with Cary's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on I												General Means and Probabilities.
	15°	195°	25°	205°	35°	215°	45°	225°	55°	235°	65°	245°	
I & XLVIII	″ +58·92$_{2}$	″ 50·90$_{2}$	″ 56·77$_{2}$	″ 50·95$_{2}$	″ 49·50$_{2}$	″ 46·08$_{2}$	″ 48·37$_{2}$	″ 52·50$_{2}$	″ 48·47$_{2}$	″ 54·67$_{2}$	″ 46·35$_{2}$	″ 59·27$_{2}$	30° 0′ 47″·68 Prob. = 1·17
	−13·18$_{2}$	3·10$_{2}$	8·62$_{2}$	0·67$_{2}$	4·52$_{2}$	3·45$_{2}$	5·60$_{2}$	4·23$_{2}$	0·98$_{2}$	2·17$_{2}$	2·10$_{2}$	1·97$_{2}$	
+44° 43′ −14° 43′	45·74	47·80	48·15	50·28	44·98	42·63	42·77	48·27	47·49	52·50	44·25	57·30	
XLVIII & XLVI	+91·25$_{2}$	74·27$_{2}$	87·71$_{3}$	72·27$_{2}$	90·23$_{2}$	70·20$_{2}$	86·02$_{2}$	75·30$_{2}$	79·83$_{2}$	77·62$_{2}$	83·55$_{2}$	81·10$_{2}$	89° 8′ 28″·88 Prob. = 1·94
	−58·92$_{2}$	50·90$_{2}$	56·77$_{2}$	50·95$_{2}$	49·50$_{2}$	46·08$_{2}$	48·37$_{2}$	52·50$_{2}$	48·47$_{2}$	54·67$_{2}$	46·35$_{2}$	59·27$_{2}$	
+133° 51′ − 44° 43′	32·33	23·37	30·94	21·32	40·73	24·12	37·65	22·80	31·36	22·95	37·20	21·83	
XLVI & XLVIII*	+58·75$_{2}$	55·75$_{2}$	56·43$_{2}$	57·32$_{2}$	52·18$_{2}$	57·40$_{2}$	53·05$_{2}$	60·57$_{2}$	52·75$_{2}$	57·10$_{2}$	52·40$_{2}$	60·58$_{2}$	60° 52′ 35″·41 Prob. = 2·37
	−31·25$_{2}$	14·27$_{2}$	27·71$_{3}$	12·27$_{2}$	30·23$_{2}$	10·20$_{2}$	26·02$_{2}$	15·30$_{2}$	19·83$_{2}$	17·62$_{2}$	23·55$_{2}$	21·10$_{2}$	
+194° 44′ −133° 52′	27·50	41·48	28·72	45·05	21·95	47·20	27·03	45·27	32·92	39·48	28·85	39·48	

At I (Mábegarh)

November 1842; *observed by Captain J. S. Du' Vernet with Saiyad Mir Mohsin's* 18-*inch Theodolite.*

Angle between	Circle readings and telescope setting unknown												General Means and Probabilities.
XLVIII & LII	″ 19·60$_{2}$	″ 19·85$_{2}$	″ 20·10$_{2}$	″ 23·39$_{4}$	″ 27·70$_{2}$	″ 17·93$_{2}$	″ 22·07$_{2}$	″ 22·03$_{2}$	″ 26·68$_{2}$	″ 24·53$_{2}$	″ 29·77$_{4}$	″ 23·55$_{2}$	58° 1′ 23″·10 Prob. = 0·99

NOTE 1.—XLVIII* and LII appertain to Great Arc Meridional Series, Section 24° to 30°.
2.—I appertains to North-East Longitudinal Series.

J. B. N. HENNESSEY,
In charge of Computing Office.

May 1877.

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BUDHON MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

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Figure No. 1.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	46	41	32·57	1·88
2	66	16	17·57	2·27
3	67	2	11·13	2·33
4	72	13	32·04	0·69
5	40	58	6·56	0·98
6	66	48	23·36	2·04
7	76	21	35·63	1·94
8	49	31	6·19	2·12
9	54	7	27·93	1·57
10	59	52	59·97	2·85
11	46	33	6·35	2·17
12	73	33	51·32	0·77
13	43	41	57·17	0·27
14	105	25	24·75	0·84
15	30	52	39·25	1·50
16	61	8	22·85	1·20
17	62	5	46·43	1·19
18	56	45	56·12	1·80

Equations to be satisfied — **Factor**

$$x_1 + x_2 + x_3 = e_1 = -2{\cdot}66, \qquad \lambda_1$$
$$x_4 + x_5 + x_6 = e_2 = -1{\cdot}69, \qquad \lambda_2$$
$$x_7 + x_8 + x_9 = e_3 = +7{\cdot}26, \qquad \lambda_3$$
$$x_{10} + x_{11} + x_{12} = e_4 = -3{\cdot}94, \qquad \lambda_4$$
$$x_{13} + x_{14} + x_{15} = e_5 = -0{\cdot}62, \qquad \lambda_5$$
$$x_{16} + x_{17} + x_{18} = e_6 = +0{\cdot}90, \qquad \lambda_6$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = +0{\cdot}23, \qquad \lambda_7$$
$$\left.\begin{array}{lll} {\cdot}42x_3 & -{\cdot}44x_2 & +{\cdot}43x_6 \\ -1{\cdot}15x_5 & +{\cdot}72x_9 & -{\cdot}85x_8 \\ +{\cdot}29x_{12} & -{\cdot}95x_{11} & +1{\cdot}67x_{15} \\ +{\cdot}28x_{14} & +{\cdot}66x_{18} & -{\cdot}53x_{17} \end{array}\right\} = e_8 = -5{\cdot}197, \qquad \lambda_8$$

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8
1	− 2·66	+6·48						+1·88	−0·020
2	− 1·69		+3·71					+0·69	−0·250
3	+ 7·26			+5·63				+1·94	−0·672
4	− 3·94				+5·79			+2·85	−1·839
5	− 0·62					+2·61		+0·27	+2·740
6	+ 0·90				*		+4·19	+1·20	+0·557
7	+ 0·23							+8·83	
8	− 5·197								+12·259

Values of the Factors

$\lambda_1 = -0{\cdot}464$

$\lambda_2 = -0{\cdot}530$

$\lambda_3 = +1{\cdot}155$

$\lambda_4 = -0{\cdot}963$

$\lambda_5 = +0{\cdot}390$

$\lambda_6 = +0{\cdot}246$

$\lambda_7 = +0{\cdot}178$

$\lambda_8 = -0{\cdot}615$

Angular errors in seconds

$x_1 = -{\cdot}54$	$x_7 = +2{\cdot}59$	$x_{13} = +{\cdot}15$
$x_2 = -{\cdot}44$	$x_8 = +3{\cdot}55$	$x_{14} = +{\cdot}18$
$x_3 = -1{\cdot}68$	$x_9 = +1{\cdot}12$	$x_{15} = -{\cdot}95$
$x_4 = -{\cdot}24$	$x_{10} = -2{\cdot}24$	$x_{16} = +{\cdot}51$
$x_5 = +{\cdot}16$	$x_{11} = -{\cdot}83$	$x_{17} = +{\cdot}67$
$x_6 = -1{\cdot}61$	$x_{12} = -{\cdot}87$	$x_{18} = -{\cdot}28$

$[wx^2] = 17{\cdot}53$

* In the tables of the equations between the factors the co-efficients of the terms below the diagonal are omitted for convenience, the co-efficient of the *pth* term in the *qth* line being always the same as the co-efficient of the *qth* term in the *pth* line.

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Figure No. 2.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	51	2	0·57	·84
2	54	14	29·81	1·39
3	46	7	15·96	1·39
4	28	36	16·68	1·30
5	40	42	30·53	1·52
6	64	34	0·87	·52
7	36	28	4·81	·29
8	38	15	27·73	1·34

Equations to be satisfied

					Factor
x_1	$+x_2$	$+x_3$	$+x_4$	$=e_1=+0{\cdot}64$,	λ_1
x_3	$+x_4$	$+x_5$	$+x_6$	$=e_2=+1{\cdot}10$,	λ_2
x_5	$+x_6$	$+x_7$	$+x_8$	$=e_3=+1{\cdot}35$,	λ_3

$$\left.\begin{array}{lll} -{\cdot}81x_1 & -{\cdot}18x_2 & -1{\cdot}14\,x_3 \\ +{\cdot}68x_6 & +{\cdot}20x_7 & +1{\cdot}268x_8 \end{array}\right\} = e_4 = -1{\cdot}720, \quad \lambda_4$$

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	+0·64	+4·92	+2·69		−2·515
2	+1·10		+4·73	+2·04	−1·231
3	+1·35		*	+3·67	+2·111
4	−1·720				+4·809

Values of the Factors

$\lambda_1 = -0{\cdot}165$

$\lambda_2 = -0{\cdot}580$

$\lambda_3 = +1{\cdot}379$

$\lambda_4 = -1{\cdot}198$

Angular errors in seconds

$x_1 = +{\cdot}68$	$x_5 = +1{\cdot}22$
$x_2 = +{\cdot}07$	$x_6 = -{\cdot}01$
$x_3 = +{\cdot}86$	$x_7 = +{\cdot}33$
$x_4 = -{\cdot}97$	$x_8 = -{\cdot}19$

$[wx^2] = 3{\cdot}18$

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Figure No. 3.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	61	32	55·81	·56
2	67	27	52·45	·59
3	50	59	11·67	·36
4	44	12	16·85	·79
5	57	42	24·83	·63
6	78	5	22·27	·16
7	50	32	8·10	·70
8	59	50	44·32	·18
9	69	37	4·69	·67
10	67	2	52·47	·43
11	62	14	35·27	·50
12	50	42	29·05	·98
13	70	5	49·80	·77
14	53	46	16·41	·29
15	56	7	56·77	·34
16	66	33	57·02	·40
17	54	29	38·77	·40
18	58	56	21·63	·38

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = -1 \cdot 13,$	λ_1
$x_4 + x_5 + x_6 = e_2 = +3 \cdot 10,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -3 \cdot 64,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = -4 \cdot 17,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = +1 \cdot 89,$	λ_5
$x_{16} + x_{17} + x_{18} = e_6 = -3 \cdot 56,$	λ_6
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = +0 \cdot 05,$	λ_7
$\left.\begin{array}{lll} \cdot 81x_3 & -\cdot 41x_2 & +\cdot 21x_6 \\ -\cdot 63x_5 & +\cdot 37x_9 & -\cdot 58x_8 \\ +\cdot 82x_{12} & -\cdot 53x_{11} & +\cdot 67x_{15} \\ -\cdot 73x_{14} & +\cdot 60x_{18} & -\cdot 71x_{17} \end{array}\right\} = e_8 = -4 \cdot 104,$	λ_8

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8
1	−1·13	+1·51						+0·56	+0·050
2	+3·10		+1·58					+0·79	−0·363
3	−3·64			+1·55				+0·70	+0·144
4	−4·17				+1·91			+0·43	+0·539
5	+1·89					+1·40		+0·77	+0·016
6	−3·56						+1·18	+0·40	−0·056
7	+0·05							+3·65	
8	−4·104								+2·191

Values of the Factors

$\lambda_1 = -1 \cdot 010$
$\lambda_2 = +1 \cdot 324$
$\lambda_3 = -2 \cdot 612$
$\lambda_4 = -2 \cdot 069$
$\lambda_5 = +0 \cdot 924$
$\lambda_6 = -3 \cdot 336$
$\lambda_7 = +0 \cdot 798$
$\lambda_8 = -1 \cdot 041$

Angular errors in seconds

$x_1 = -\ \cdot 12$	$x_7 = -1 \cdot 27$	$x_{13} = +1 \cdot 33$
$x_2 = -\ \cdot 34$	$x_8 = -\ \cdot 36$	$x_{14} = +\ \cdot 50$
$x_3 = -\ \cdot 67$	$x_9 = -2 \cdot 01$	$x_{15} = +\ \cdot 06$
$x_4 = +1 \cdot 68$	$x_{10} = -\ \cdot 55$	$x_{16} = -1 \cdot 02$
$x_5 = +1 \cdot 25$	$x_{11} = -\ \cdot 74$	$x_{17} = -1 \cdot 02$
$x_6 = +\ \cdot 17$	$x_{12} = -2 \cdot 88$	$x_{18} = -1 \cdot 52$

$[wx^2] = 41 \cdot 32$

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Figure No. 4.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	56	59	50·01	1·71
2	63	6	8·20	1·42
3	59	54	6·13	1·31
4	54	48	33·43	2·16
5	58	29	33·70	2·08
6	66	42	3·42	1·57
7	70	3	25·72	·97
8	48	55	47·54	1·50
9	61	0	39·41	2·93
10	59	27	33·08	·67
11	67	59	24·38	1·00
12	52	33	6·41	1·81
13	54	44	9·91	·77
14	61	48	50·52	1·19
15	63	27	3·26	·30
16	63	56	27·85	1·52
17	60	25	54·85	·26
18	55	37	38·07	2·19

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = +3\cdot16,$	λ_1
$x_4 + x_5 + x_6 = e_2 = +9\cdot45,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -8\cdot35,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = +2\cdot94,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = +2\cdot67,$	λ_5
$x_{16} + x_{17} + x_{18} = e_6 = -0\cdot40,$	λ_6
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = 0\cdot00,$	λ_7
$\cdot58x_3 - \cdot51x_2 + \cdot43x_6 - \cdot61x_5 + \cdot55x_9 - \cdot87x_8 + \cdot77x_{12} - \cdot40x_{11} + \cdot50x_{15} - \cdot54x_{14} + \cdot68x_{18} - \cdot57x_{17} = e_8 = +1\cdot634,$	λ_8

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8
1	+ 3·16	+4·44						+1·71	+0·036
2	+ 9·45		+5·81					+2·16	−0·594
3	− 8·35			+5·40				+0·97	+0·307
4	+ 2·94				+3·48			+0·67	+0·994
5	+ 2·67					+2·26		+0·77	−0·493
6	− 0·40						+3·97	+1·52	+1·341
7	0·00							+7·80	
8	+ 1·634								+6·648

Values of the Factors

$\lambda_1 = +1\cdot033$

$\lambda_2 = +1\cdot987$

$\lambda_3 = -1\cdot420$

$\lambda_4 = +0\cdot878$

$\lambda_5 = +1\cdot568$

$\lambda_6 = +0\cdot069$

$\lambda_7 = -0\cdot844$

$\lambda_8 = +0\cdot454$

Angular errors in seconds

$x_1 = +\ \cdot32$	$x_7 = -2\cdot19$	$x_{13} = +\ \cdot56$
$x_2 = +1\cdot14$	$x_8 = -2\cdot73$	$x_{14} = +1\cdot57$
$x_3 = +1\cdot70$	$x_9 = -3\cdot43$	$x_{15} = +\ \cdot54$
$x_4 = +2\cdot47$	$x_{10} = +\ \cdot02$	$x_{16} = -1\cdot18$
$x_5 = +3\cdot56$	$x_{11} = +\ \cdot70$	$x_{17} = -\ \cdot05$
$x_6 = +3\cdot42$	$x_{12} = +2\cdot22$	$x_{18} = +\ \cdot83$

$[wx^2] = 41\cdot38$

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Figure No. 5.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	51	48	28·91	1·58
2	63	45	28·96	2·40
3	64	26	7·84	1·44
4	65	30	19·29	1·12
5	46	52	24·88	2·08
6	67	37	9·38	2·55
7	65	23	51·17	1·04
8	63	44	50·76	·84
9	50	51	25·51	1·47
10	58	19	37·11	·65
11	60	33	36·74	1·45
12	61	6	44·00	1·01
13	64	26	33·15	1·35
14	59	14	7·51	2·67
15	56	19	22·82	·81
16	54	31	10·37	2·27
17	66	38	43·53	2·15
18	58	50	0·81	3·44

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = +4{\cdot}58,$	λ_1
$x_4 + x_5 + x_6 = e_2 = -7{\cdot}48,$	λ_2
$x_7 + x_8 + x_9 = e_3 = +6{\cdot}51,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = -3{\cdot}16,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = +2{\cdot}38,$	λ_5
$x_{16} + x_{17} + x_{18} = e_6 = -6{\cdot}39,$	λ_6
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = 0{\cdot}00,$	λ_7
$\cdot48x_3 - \cdot94x_5 + \cdot55x_{12} - \cdot60x_{14} - \cdot49x_2 + \cdot81x_9 - \cdot56x_{11} + \cdot60x_{18} + \cdot41x_6 - \cdot49x_8 + \cdot67x_{15} - \cdot43x_{17} = e_8 = +0{\cdot}062,$	λ_8

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8
1	+4·58	+5·42						+1·58	−0·485
2	−7·48		+5·75					+1·12	−0·909
3	+6·51			+3·35				+1·04	+0·779
4	−3·16				+3·11			+0·65	−0·256
5	+2·38					+4·83		+1·35	−1·059
6	−6·39				*		+7·86	+2·27	+1·139
7	0·00							+8·01	
8	+0·062								+8·064

Values of the Factors

$\lambda_1 = +0{\cdot}834$

$\lambda_2 = -1{\cdot}322$

$\lambda_3 = +1{\cdot}979$

$\lambda_4 = -1{\cdot}026$

$\lambda_5 = +0{\cdot}463$

$\lambda_6 = -0{\cdot}790$

$\lambda_7 = -0{\cdot}007$

$\lambda_8 = -0{\cdot}143$

Angular errors in seconds

$x_1 = +1{\cdot}31$	$x_7 = +2{\cdot}05$	$x_{13} = +\cdot61$
$x_2 = +2{\cdot}17$	$x_8 = +1{\cdot}72$	$x_{14} = +1{\cdot}47$
$x_3 = +1{\cdot}10$	$x_9 = +2{\cdot}74$	$x_{15} = +\cdot30$
$x_4 = -1{\cdot}49$	$x_{10} = -\cdot67$	$x_{16} = -1{\cdot}81$
$x_5 = -2{\cdot}46$	$x_{11} = -1{\cdot}37$	$x_{17} = -1{\cdot}56$
$x_6 = -3{\cdot}53$	$x_{12} = -1{\cdot}12$	$x_{18} = -3{\cdot}02$

$[wx^2] = 35{\cdot}97$

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Figure No. 6.

Observed Angles

No.	Value °	′	″	Reciprocal Weight=(Probability)²
1	54	44	42·28	·98
2	60	14	13·87	2·08
3	65	1	8·77	1·44
4	70	2	47·96	1·79
5	56	29	1·58	1·04
6	53	28	13·50	3·21
7	81	40	59·58	1·20
8	69	13	39·54	2·21
9	29	5	22·33	·54
10	88	23	45·17	1·54
11	31	2	48·32	2·16
12	60	33	31·14	3·54
13	65	7	45·02	·64
14	51	54	30·72	1·48
15	62	57	44·78	2·22

Equations to be satisfied — Factor

$x_1 + x_2 + x_3 = e_1 = +3{\cdot}84$, λ_1

$x_4 + x_5 + x_6 = e_2 = +1{\cdot}80$, λ_2

$x_7 + x_8 + x_9 = e_3 = -1{\cdot}14$, λ_3

$x_{10} + x_{11} + x_{12} = e_4 = +1{\cdot}64$, λ_4

$x_{13} + x_{14} + x_{15} = e_5 = -0{\cdot}90$, λ_5

$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = +0{\cdot}01$, λ_6

$$\left.\begin{array}{l}{\cdot}47x_3 - {\cdot}57x_2 + {\cdot}74x_6 - {\cdot}66x_5 + 1{\cdot}80x_9 \\ -{\cdot}38x_8 + {\cdot}56x_{12} - 1{\cdot}66x_{11} + {\cdot}51x_{15} - {\cdot}78x_{14}\end{array}\right\} = e_7 = +7{\cdot}443, \quad \lambda_7$$

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7
1	+3·84	+4·50					+0·98	−0·509
2	+1·80		+6·04				+1·79	+1·689
3	−1·14			+3·95			+1·20	+0·132
4	+1·64				+7·24		+1·54	−1·604
5	−0·90				*	+4·34	+0·64	−0·022
6	+0·01						+6·15	
7	+7·443							+13·814

Values of the Factors

$\lambda_1 = +0{\cdot}977$

$\lambda_2 = +0{\cdot}206$

$\lambda_3 = -0{\cdot}231$

$\lambda_4 = +0{\cdot}414$

$\lambda_5 = -0{\cdot}167$

$\lambda_6 = -0{\cdot}255$

$\lambda_7 = +0{\cdot}600$

Angular errors in seconds

$x_1 = +{\cdot}71$	$x_6 = +2{\cdot}09$	$x_{11} = -1{\cdot}27$
$x_2 = +1{\cdot}31$	$x_7 = -{\cdot}58$	$x_{12} = +2{\cdot}67$
$x_3 = +1{\cdot}82$	$x_8 = -1{\cdot}02$	$x_{13} = -{\cdot}27$
$x_4 = -{\cdot}09$	$x_9 = +{\cdot}46$	$x_{14} = -{\cdot}95$
$x_5 = -{\cdot}20$	$x_{10} = +{\cdot}24$	$x_{15} = +{\cdot}32$

$[wx^2] = 9{\cdot}68$

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Figure No. 7.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	60	52	35·41	5·60
2	63	6	50·73	1·47
3	56	0	35·42	·87
4	89	8	28·88	3·76
5	57	57	5·17	3·75
6	32	54	29·92	2·30
7	30	0	47·68	1·36
8	91	57	48·61	1·58
9	58	1	23·10	·98

Fixed data†

Log. Ratio of side *A* to side *B* (see diagram) = $\bar{1}$·7039306,5

Sum of angles 1, 4 and 7 = 180° 1′ 51″·29

Equations to be satisfied — **Factor**

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = -0·03,$	λ_1
$x_4 + x_5 + x_6 = e_2 = +0·91,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -3·43,$	λ_3
$x_1 + x_4 + x_7 = e_4 = +0·68,$	λ_4
$\left.\begin{matrix} ·67x_3 - ·51x_2 + 1·55x_6 \\ -·63x_5 + ·62x_9 + ·03x_8 \end{matrix}\right\} = e_5 = +0·561,$	λ_5

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5
1	−0·03	+7·94			+ 5·60	−0·167
2	+0·91		+9·81		+ 3·76	+1·202
3	−3·43			+3·92	+ 1·36	+0·655
4	+0·68			*	+10·72	
5	+0·561					+8·167

Values of the Factors

$\lambda_1 = -0·237$

$\lambda_2 = -0·054$

$\lambda_3 = -1·017$

$\lambda_4 = +0·335$

$\lambda_5 = +0·153$

Angular errors in seconds

$x_1 = +·55$	$x_4 = +1·06$	$x_7 = -·93$
$x_2 = -·47$	$x_5 = -·57$	$x_8 = -1·60$
$x_3 = -·11$	$x_6 = +·42$	$x_9 = -·90$

$[wx^2] = 3·76$

† The fixed data here given are obtained from Figure No. 8 of the Great Arc Meridional Series, Section 24° to 30°, and Figure No. 1 of the North-East Longitudinal Series, both of which were previously reduced. These data depend on the figurally corrected angles only, not on the finally corrected angles as published in the Volumes of the *Operations of the Great Trigonometrical Survey of India;* because this figure (No. 7) was reduced before the final values were obtained.

October 1877.

J. B. N. HENNESSEY,

In charge of Computing Office.

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BUDHON MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
1		III*	1·10	+ ·34	− ·43		− ·09	65 18 9·77	5·1693275,5	147681·99	27·970
		VII	1·10	+ ·77	− ·18		+ ·59	36 17 41·38	4·9832672,6	96220·41	18·224
		I	1·10	+ ·65	+ ·61		+ 1·26	78 24 8·85	5·2020309,0	159232·20	30·158
			3·30				+ 1·76	180 0 0·00			
2		VII	1·85	+ ·46	−2·72		− 2·26	61 1 25·95	5·2302895,6	169937·63	32·185
		I	1·86	+ ·28	+ ·02		+ ·30	69 29 22·98	5·2599285,0	181940·12	34·458
		II	1·85	+ ·59	+2·70		+ 3·29	49 29 11·07	5·1693275,5	147681·99	27·970
			5·56				+ 1·33	180 0 0·00			
3		I	1·48	− ·58	+ ·17		− ·41	40 43 36·35	5·0731170,7	118336·04	22·412
		II	1·49	−1·02	− ·69		− 1·71	69 43 33·56	5·2307924,4	170134·53	32·222
		III	1·49	− ·70	+ ·52		− ·18	69 32 50·09	5·2302895,6	169937·63	32·185
			4·46				− 2·30	180 0 0·00			
4		I	2·03	+2·39	−1·10		+ 1·29	56 48 43·89	5·2243153,8	167615·98	31·745
		III	2·04	+4·88	− ·44		+ 4·44	65 2 7·10	5·2590521,3	181573·36	34·389
		IV	2·04	+1·66	+1·54		+ 3·20	58 9 9·01	5·2307924,4	170134·53	32·222
			6·11				+ 8·93	180 0 0·00			
5		III	2·08	−2·95	− ·48		− 3·43	68 20 25·89	5·2768654,1	189175·72	35·829
		IV	2·08	−5·69	−1·13		− 6·82	56 13 31·48	5·2283873,7	169194·93	32·044
		V	2·07	−3·67	+1·61		− 2·06	55 26 2·63	5·2243153,8	167615·98	31·745
			6·23				−12·31	180 0 0·00			

NOTES.—1. The values of the side are given in the same line with the opposite angle.
2. Stations III* and VII appertain to the Calcutta Longitudinal Series.

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No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Corrections to Observed Angle: Circuit	Corrections to Observed Angle: Non-circuit	Corrections to Observed Angle: Total	Corrected Plane Angle	Distance: Log. feet	Distance: Feet	Distance: Miles
			″	″	″	″	″	° ′ ″			
6		III	2·08	+ ·40	− ·94		− ·54	60 23 39·92	5·2443503,2	175529·57	33·244
		V	2·08	+ ·79	+ ·22		+1·01	62 40 7·50	5·2536996,7	179349·29	33·968
		VI	2·08	+1·12	+ ·72		+1·84	56 56 12·58	5·2283873,7	169194·93	32·044
			6·24				+2·31	180 0 0·00			
7		V	1·27	·00	+ ·43		+ ·43	38 27 19·24	5·0400523,8	109661·06	20·769
		VI	1·27	·00	− ·64		− ·64	57 0 33·47	5·1699658,2	147899·19	28·011
		VII	1·28	·00	+ ·21		+ ·21	84 32 7·29	5·2443503,2	175529·57	33·244
			3·82				·00	180 0 0·00			
8		V	1·13	− ·28	− ·16		− ·44	54 35 51·47	5·0974530,0	125156·37	23·704
		VII	1·13	− ·08	− ·27		− ·35	50 59 24·08	5·0766814,3	119311·27	22·597
		VIII	1·14	− ·12	+ ·43		+ ·31	74 24 44·45	5·1699658,2	147899·19	28·011
			3·40				− ·48	180 0 0·00			
9		VII	·82	+1·34	− ·67		+ ·67	65 3 15·56	5·0784683,2	119803·17	22·690
		VIII	·81	+1·04	+ ·40		+1·44	43 38 36·38	4·9599559,0	91191·83	17·271
		IX	·82	+ ·82	+ ·27		+1·09	71 18 8·06	5·0974530,0	125156·37	23·704
			2·45				+3·20	180 0 0·00			
10		VIII	1·31	+ ·44	− ·09		+ ·35	66 16 16·61	5·1781671,5	150718·70	28·545
		IX	1·31	+1·68	− ·52		+1·16	67 2 10·98	5·1806703,8	151589·92	28·710
		X	1·31	+ ·54	+ ·61		+1·15	46 41 32·41	5·0784683,2	119803·17	22·690
			3·93				+2·66	180 0 0·00			
11		IX	1·21	− ·16	− ·26		− ·42	40 58 4·93	5·0314302,7	107505·39	20·361
		X	1·22	+ ·24	+ ·22		+ ·46	72 13 31·28	5·1935238,4	156143·47	29·573
		XIV	1·22	+1·61	+ ·04		+1·65	66 48 23·79	5·1781671,5	150718·70	28·545
			3·65				+1·69	180 0 0·00			
12		X	·83	−2·59	+ ·19		−2·40	76 21 32·40	5·1103651,3	128933·30	24·419
		XIV	·83	−3·55	− ·37		−3·92	49 31 1·44	5·0039476,2	100913·12	19·112
		XIII	·83	−1·12	+ ·18		− ·94	54 7 26·16	5·0314302,7	107505·39	20·361
			2·49				−7·26	180 0 0·00			
	45	VIII	1·50	+ ·28		+ ·03	+ ·31	56 45 54·93	5·1567811,2	143476·61	27·174
		X	1·50	− ·51		− ·37	− ·88	61 8 20·47	5·1767520,8	150228·40	28·452
		XI	1·50	− ·67		+ ·34	− ·33	62 5 44·60	5·1806703,8	151589·92	28·710
			4·50				− ·90	180 0 0·00			
	46	X	·60	− ·15		− ·21	− ·36	43 41 56·21	5·0121057,4	102826·67	19·475
		XI	·59	+ ·95		− ·09	+ ·86	30 52 39·52	4·8830020,5	76383·94	14·467
		XII	·60	− ·18		+ ·30	+ ·12	105 25 24·27	5·1567811,2	143476·61	27·174
			1·79				+ ·62	180 0 0·00			
	47	X	·53	+2·24		− ·44	+1·80	59 53 1·24	4·9590868,2	91009·53	17·237
		XII	·53	+ ·87		+ ·04	+ ·91	73 33 51·70	5·0039476,2	100913·12	19·112
		XIII	·52	+ ·83		+ ·40	+1·23	46 33 7·06	4·8830020,5	76383·94	14·467
			1·58				+3·94	180 0 0·00			
13		XIV	·80	− ·93	− ·02		− ·95	100 21 44·02	5·2125180,7	163124·09	30·895
		XIII	·79	+ ·97	+ ·09		+1·06	28 36 16·95	4·8997811,9	79392·82	15·037
		XVI	·79	− ·68	− ·07		− ·75	51 1 59·03	5·1103651,3	128933·30	24·419
			2·38				− ·64	180 0 0·00			
14		XIII	·86	−1·22	+ ·06		−1·16	40 42 28·51	5·0350054,9	108394·06	20·529
		XVI	·86	+ ·19	− ·07		+ ·12	38 15 26·99	5·0124512,4	102908·49	19·490
		XV	·87	− ·32	+ ·01		− ·31	101 2 4·50	5·2125180,7	163124·09	30·895
			2·59				−1·35	180 0 0·00			

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No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Corrections to Observed Angle: Circuit	Corrections to Observed Angle: Non-circuit	Corrections to Observed Angle: Total	Corrected Plane Angle	Distance: Log. feet	Distance: Feet	Distance: Miles
			″	″	″	″	″	° ′ ″			
		XIV	·98	− ·86		− ·06	− ·92	46 7 14·06	5·0124512,4	102908·49	19·490
	48	XIII	·98	− ·25		+ ·15	− ·10	69 18 46·13	5·1256909,2	133564·47	25·296
		XV	·98	+ ·01		− ·09	− ·08	64 33 59·81	5·1103651,3	128933·30	24·419
			2·94				−1·10	180 0 0·00			
		XVI	·84	+ ·28	− ·11		+ ·17	70 45 8·27	5·0904425,9	123152·32	23·324
15		XV	·84	+ ·50	+ ·14		+ ·64	53 2 59·50	5·0180567,2	1c4245·35	19·743
		XVII	·84	+ ·31	− ·03		+ ·28	56 11 52·23	5·0350054,9	108394·06	20·529
			2·52				+1·09	180 0 0·00			
		XVI	·74	− ·08	+ ·01		− ·07	47 50 57·33	4·9712527,4	93595·03	17·726
16		XVII	·75	− ·07	+ ·07		·00	76 29 11·95	5·0890179,9	122749·00	23·248
		XVIII	·75	− ·13	− ·08		− ·21	55 39 50·72	5·0180567,2	104245·35	19·743
			2·24				− ·28	180 0 0·00			
		XVII	·60	+2·30	+ ·07		+2·37	57 45 4·50	4·9633306,4	91903·20	17·406
17		XVIII	·61	+ ·94	− ·01		+ ·93	62 47 5·75	4·9851404,7	96636·35	18·302
		XIX	·60	+ ·65	− ·06		+ ·59	59 27 49·75	4·9712527,4	93595·03	17·726
			1·81				+3·89	180 0 0·00			
		XVII	·77	+1·48	+ ·05		+1·53	65 42 21·93	5·0522101,9	112774·31	21·359
18		XIX	·76	+ ·61	− ·08		+ ·53	62 56 23·71	5·0421273,4	110186·23	20·869
		XX	·76	+ ·42	+ ·03		+ ·45	51 21 14·36	4·9851404,7	96636·35	18·302
			2·29				+2·51	180 0 0·00			
		XIX	·62	+ ·48	− ·04		+ ·44	61 29 7·54	5·0098981,0	102305·29	19·376
19		XX	·62	+ ·32	+ ·11		+ ·43	42 54 27·16	4·8990901,8	79266·60	15·013
		XXI	·62	+ ·38	− ·07		+ ·31	75 36 25·30	5·0522101,9	112774·31	21·359
			1·86				+1·18	180 0 0·00			
		XX	·67	−1·64	+ ·04		−1·60	58 26 41·42	4·9884271,1	97370·43	18·442
20		XXI	·66	−1·20	− ·09		−1·29	58 0 18·27	4·9863624,1	96908·62	18·354
		XXII	·67	−1·61	+ ·05		−1·56	63 33 0·31	5·0098981,0	102305·29	19·376
			2·00				−4·45	180 0 0·00			
		XXI	·65	+1·10	− ·04		+1·06	71 28 6·01	5·0369327,3	108876·15	20·620
21		XXII	·64	+ ·84	+ ·07		+ ·91	50 32 31·92	4·9477260,8	88659·67	16·792
		XXIII	·65	+ ·47	− ·03		+ ·44	57 59 22·07	4·9884271,1	97370·43	18·442
			1·94				+2·41	180 0 0·00			
		XXII	·92	− ·38	+ ·04		− ·34	66 30 21·91	5·0930261,3	123887·10	23·463
22		XXIII	·92	− ·40	− ·14		− ·54	59 47 19·95	5·0672110,5	116737·67	22·109
		XXIV	·91	−1·41	+ ·10		−1·31	53 42 18·14	5·0369327,3	108876·15	20·620
			2·75				−2·19	180 0 0·00			
		XXIII	·98	+ ·16	− ·12		+ ·04	62 54 57·89	5·0922214,3	123657·79	23·420
23		XXIV	·97	+ ·22	+ ·17		+ ·39	53 57 33·49	5·0503985,9	112304·87	21·270
		XXV	·98	+ ·07	− ·05		+ ·02	63 7 28·62	5·0930261,3	123887·10	23·463
			2·93				+ ·45	180 0 0·00			
		XXIV	·98	+ ·84	+ ·01		+ ·85	57 55 48·43	5·0697293,3	117416·55	22·238
24		XXV	·98	+ ·82	− ·14		+ ·68	58 53 16·24	5·0741939,6	118629·85	22·468
		XXVI	·99	+ ·79	+ ·13		+ ·92	63 10 55·33	5·0922214,3	123657·79	23·420
			2·95				+2·45	180 0 0·00			
		XXV	·70	+ ·14	− ·09		+ ·05	54 56 14·63	4·9963783,1	99169·55	18·782
25		XXVI	·69	+ ·20	+ ·11		+ ·31	49 20 8·25	4·9633247,1	91901·94	17·406
		XXVII	·70	+ ·55	− ·02		+ ·53	75 43 37·12	5·0697293,3	117416·55	22·238
			2·09				+ ·89	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
26		XXVI	·75	− ·01	+ ·01		·00	80 27 37·63	5·1015467,9	126341·72	23·928
		XXVII	·74	− ·01	− ·11		− ·12	48 49 5·33	4·9841721,3	96421·12	18·262
		XXVIII	·74	− ·01	+ ·10		+ ·09	50 43 17·04	4·9963783,1	99169·55	18·782
			2·23				− ·03	180 0 0·00			
27		XXVII	·63	+1·51	− ·17		+1·34	35 36 24·33	4·8687471,8	73917·49	14·000
		XXVIII	·64	+ ·31	+ ·17		+ ·48	60 2 31·15	5·0413750,7	109995·54	20·832
		XXIX	·64	+ ·28	·00		+ ·28	84 21 4·52	5·1015467,9	126341·72	23·928
			1·91				+2·10	180 0 0·00			
28		XXVIII	·36	+ ·34	·00		+ ·34	67 27 52·43	4·8901520,8	77651·91	14·707
		XXIX	·35	+ ·67	− ·05		+ ·62	50 59 11·94	4·8150686,9	65323·39	12·372
		XXX	·35	+ ·12	+ ·05		+ ·17	61 32 55·63	4·8687471,8	73917·49	14·000
			1·06				+1·13	180 0 0·00			
29		XXIX	·28	−1·25	− ·06		−1·31	57 42 23·24	4·8266264,7	67085·16	12·706
		XXX	·28	−1·68	+ ·07		−1·61	44 12 14·96	4·7429722,8	55331·48	10·479
		XXXII	·29	− ·17	− ·01		− ·18	78 5 21·80	4·8901520,8	77651·91	14·707
			·85				−3·10	180 0 0·00			
30		XXX	·25	+1·27	+ ·07		+1·34	50 32 9·19	4·7423343,4	55250·26	10·464
		XXXII	·25	+ ·36	− ·06		+ ·30	59 50 44·37	4·7915573,0	61881·00	11·720
		XXXIV	·25	+2·01	− ·01		+2·00	69 37 6·44	4·8266264,7	67085·16	12·706
			·75				+3·64	180 0 0·00			
31		XXX	·32	+ ·55	− ·01		+ ·54	67 2 52·69	4·8670316,5	73626·08	13·944
		XXXIV	·32	+ ·74	− ·07		+ ·67	62 14 35·62	4·8497616,1	70755·73	13·401
		XXXIII	·32	+2·88	+ ·08		+2·96	50 42 31·69	4·7915573,0	61881·00	11·720
			·96				+4·17	180 0 0·00			
	49	XXVIII	·33	+1·52		·00	+1·52	58 56 22·82	4·8372038,3	68739·10	13·019
		XXX	·33	+1·02		− ·09	+ ·93	66 33 57·62	4·8670283,1	73625·51	13·944
		XXXI	·32	+1·02		+ ·09	+1·11	54 29 39·56	4·8150686,9	65323·39	12·372
			·98				+3·56	180 0 0·00			
	50	XXX	·37	−1·33		− ·09	−1·42	70 5 48·01	4·9037643,8	80124·33	15·175
		XXXI	·36	− ·06		·00	− ·06	56 7 56·35	4·8497616,0	70755·73	13·401
		XXXIII	·36	− ·50		+ ·09	− ·41	53 46 15·64	4·8372038,3	68739·10	13·019
			1·09				−1·89	180 0 0·00			
32		XXXIV	·39	−1·70	− ·14		−1·84	59 54 3·90	4·8805517,4	75954·18	14·385
		XXXIII	·40	−1·14	+ ·14		−1·00	63 6 6·80	4·8937283,6	78293·98	14·828
		XXXV	·39	− ·32	·00		− ·32	56 59 49·30	4·8670316,5	73626·08	13·944
			1·18				−3·16	180 0 0·00			
33		XXXIII	·39	− ·83	− ·03		− ·86	55 37 36·82	4·8578008,7	72077·70	13·651
		XXXV	·39	+1·18	− ·13		+1·05	63 56 28·51	4·8945903,5	78449·54	14·858
		XXXVI	·39	+ ·05	+ ·16		+ ·21	60 25 54·67	4·8805517,4	75954·18	14·385
			1·17				+ ·40	180 0 0·00			
34		XXXV	·34	− ·56	− ·14		− ·70	54 44 8·87	4·8245757,7	66769·13	12·646
		XXXVI	·34	− ·54	− ·01		− ·55	63 27 2·37	4·8642248,7	73151·77	13·855
		XXXVIII	·34	−1·57	+ ·15		−1·42	61 48 48·76	4·8578008,7	72077·70	13·651
			1·02				−2·67	180 0 0·00			
35		XXXV	·31	− ·02	− ·15		− ·17	59 27 32·60	4·8322276,0	67955·97	12·870
		XXXVIII	·31	−2·22	+ ·16		−2·06	52 33 4·04	4·7968539,4	62640·32	11·864
		XXXIX	·31	− ·70	− ·01		− ·71	67 59 23·36	4·8642248,7	73151·77	13·855
			·93				−2·94	180 0 0·00			

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No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Corrections to Observed Angle: Circuit	Corrections to Observed Angle: Non-circuit	Corrections to Observed Angle: Total	Corrected Plane Angle	Distance: Log. feet	Distance: Feet	Distance: Miles
			″	″	″	″	″	° ′ ″			
	51	XXXIV	·37	−3·56		− ·17	−3·73	58 29 29·60	4·8614015,1	72677·75	13·765
		XXXV	·36	−2·47		+ ·21	−2·26	54 48 30·81	4·8430197,5	69665·82	13·194
		XXXVII	·37	−3·42		− ·04	−3·46	66 41 59·59	4·8937283,6	78293·98	14·828
			1·10				−9·45	180 0 0·00			
	52	XXXV	·34	+2·19		+ ·21	+2·40	70 3 27·78	4·8926775,1	78104·77	14·793
		XXXVII	·34	+2·73		− ·18	+2·55	48 55 49·75	4·7968539,4	62640·32	11·864
		XXXIX	·34	+3·43		− ·03	+3·40	61 0 42·47	4·8614015,1	72677·75	13·765
			1·02				+8·35	180 0 0·00			
36		XXXVIII	·38	−2·17	− ·04		−2·21	63 45 26·37	4·8895967,8	77552·68	14·688
		XXXIX	·38	−1·10	− ·22		−1·32	64 26 6·14	4·8920916,1	77999·47	14·773
		XL	·37	−1·31	+ ·26		−1·05	51 48 27·49	4·8322276,0	67955·97	12·870
			1·13				−4·58	180 0 0·00			
37		XXXIX	·34	+2·46	− ·29		+2·17	46 52 26·71	4·7868407,6	61212·59	11·593
		XL	·34	+1·49	+ ·25		+1·74	65 30 20·69	4·8826480,3	76321·70	14·455
		XLII	·35	+3·53	+ ·04		+3·57	67 37 12·60	4·8895967,8	77552·68	14·688
			1·03				+7·48	180 0 0·00			
38		XL	·31	−2·05	+ ·19		−1·86	65 23 49·00	4·8558888,8	71761·06	13·591
		XLII	·31	−1·72	− ·25		−1·97	63 44 48·48	4·8499416,6	70785·07	13·406
		XLIV	·31	−2·74	+ ·06		−2·68	50 51 22·52	4·7868407,6	61212·59	11·593
			·93				−6·51	180 0 0·00			
39		XL	·33	+ ·67	− ·06		+ ·61	58 19 37·39	4·8376105,2	68803·50	13·031
		XLIV	·34	+1·37	− ·20		+1·17	60 33 37·57	4·8476064,4	70405·47	13·334
		XLIII	·34	+1·12	+ ·26		+1·38	61 6 45·04	4·8499416,6	70785·07	13·406
			1·01				+3·16	180 0 0·00			
	53	XXXVIII	·37	+3·02		− ·09	+2·93	58 50 3·37	4·8615229,7	72698·08	13·769
		XL	·36	+1·81		− ·32	+1·49	54 31 11·50	4·8400080,4	69184·38	13·103
		XLI	·37	+1·56		+ ·41	+1·97	66 38 45·13	4·8920916,1	77999·47	14·773
			1·10				+6·39	180 0 0·00			
	54	XL	·37	− ·61		− ·32	− ·93	64 26 31·85	4·8826708,5	76325·71	14·456
		XLI	·36	− ·30		− ·14	− ·44	56 19 22·02	4·8476064,3	70405·47	13·334
		XLIII	·37	−1·47		+ ·46	−1·01	59 14 6·13	4·8615229,7	72698·08	13·769
			1·10				−2·38	180 0 0·00			
40		XLIV	·36	−1·82	− ·25		−2·07	65 1 6·34	4·8829477,7	76374·40	14·465
		XLIII	·36	−1·31	+ ·20		−1·11	60 14 12·40	4·8641688,1	73142·34	13·853
		XLV	·36	− ·71	+ ·05		− ·66	54 44 41·26	4·8376105,2	68803·50	13·031
			1·08				−3·84	180 0 0·00			
41		XLIII	·47	− ·32	− ·06		− ·38	62 57 43·93	4·9366917,4	86435·42	16·371
		XLV	·48	+ ·27	− ·24		+ ·03	65 7 44·57	4·9446873,9	88041·49	16·675
		XLVI	·47	+ ·95	+ ·30		+1·25	51 54 31·50	4·8829477,7	76374·40	14·465
			1·42				+ ·90	180 0 0·00			
42		XLV	1·00	− ·24	− ·27		− ·51	88 23 43·66	5·2240912,1	167529·46	31·729
		XLVI	1·00	−2·67	+ ·10		−2·57	60 33 27·57	5·1642053,2	145950·41	27·642
		XLVIII	·99	+1·27	+ ·17		+1·44	31 2 48·77	4·9366917,4	86435·42	16·371
			2·99				−1·64	180 0 0·00			
	55	XLIV	·41	+ ·20		− ·33	− ·13	56 29 1·04	4·8801843,1	75889·95	14·373
		XLV	·42	+ ·09		+ ·29	+ ·38	70 2 47·92	4·9322742,9	85560·68	16·205
		XLVII	·41	−2·09		+ ·04	−2·05	53 28 11·04	4·8641688,1	73142·34	13·853
			1·24				−1·80	180 0 0·00			

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No of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
	56	XLV	·87	+ ·58		+ ·17	+ ·75	81 40 59·46	5·1888037,9	154455·65	29·253
		XLVII	·86	+1·02		− ·36	+ ·66	69 13 39·34	5·1642053,2	145950·41	27·642
		XLVIII	·86	− ·46		+ ·19	− ·27	29 5 21·20	4·8801843,1	75889·95	14·373
			2·59				+1·14	180 0 0·00			
43		XLVI	1·02	+ ·57	+ ·38		+ ·95	57 57 5·10	5·1523301,6	142013·68	26·897
		XLVIII	1·02	− ·42	− ·40		− ·82	32 54 28·08	4·9591706,9	91027·10	17·240
		LII	1·02	−1·06	+ ·02		−1·04	89 8 26·82	5·2240912,1	167529·46	31·729
			3·06				− ·91	180 0 0·00			
44		XLVI	·53	+ ·11	− ·13		− ·02	56 0 34·87	4·9274737,0	84620·13	16·027
		LII	·53	− ·55	− ·21		− ·76	60 52 34·12	4·9501475,2	89155·37	16·885
		XLVIII*	·53	+ ·47	+ ·34		+ ·81	63 6 51·01	4·9591706,9	91027·10	17·240
			1·59				+ ·03	180 0 0·00			
	57	XLVIII	·94	+1·60		−2·40	− ·80	91 57 46·87	5·2235428,0	167318·04	31·689
		LII	·94	+ ·93		+ ·41	+1·34	30 0 48·08	4·9229430,9	83741·96	15·860
		I	·94	+ ·90		+1·99	+2·89	58 1 25·05	5·1523301,6	142013·68	26·897
			2·82				+3·43	180 0 0·00			

NOTE.—Stations XLVIII* and LII appertain to the Great Arc Series—Section 24° to 30°, and I appertains to the North-East Longitudinal Series.

March 1878.

J. B. N. HENNESSEY,
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BUDHON MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	III*	Budhon	24 5 8·41	78 33 39·07	265 22 28·10	5·2020309,0	85 34 7·81	VII*
	„	„	„	„	200 4 17·23	4·9832672,6	20 6 43·66	I
1	VII*	Tinsmál	24 7 12·97	79 2 12·45	121 51 50·29	5·1693275,5	301 42 33·71	I
„	„	„	„	„	182 53 18·09	5·2599285,0	2 53 59·09	II
	I	Patna	24 20 3·70	78 39 36·15	232 13 8·87	5·2302895,6	52 23 12·01	II
	„	„	„	„	191 29 31·04	5·2307924,4	11 32 3·97	III
	„	„	„	„	134 40 45·12	5·2590521,3	314 31 4·34	IV
2	II	Dargawa	24 37 13·21	79 3 51·81	122 6 47·06	5·0731170,7	301 59 12·39	III
3	III	Dhandkúa	24 47 35·33	78 45 44·02	76 34 13·11	5·2243153,8	256 21 53·29	IV
„	„	„	„	„	144 54 41·08	5·2283873,7	324 47 13·89	V
„	„	„	„	„	205 18 23·08	5·2536996,7	25 24 16·20	VI
	IV	Andhiári	24 41 6·77	78 16 16·17	200 8 19·73	5·2768654,1	20 13 18·59	V
	V	Gwáli	25 10 25·82	78 28 5·22	262 7 4·31	5·2443503,2	82 20 30·86	VI
	„	„	„	„	223 39 43·80	5·1699658,2	43 47 40·36	VII
	„	„	„	„	169 3 51·20	5·0766814,3	349 2 5·49	VIII

NOTE.—Stations III* and VII* appertain to the Calcutta Longitudinal Series of the South-East Quadrilateral.

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
4	VI	Kathera	25 14 20·91	78 59 39·05	139 21 5·60	5·0400523,8	319 15 31·79	VII
5	VII	Bhitári	25 28 4·54	78 46 39·51	94 47 5·57	5·0974530,0	274 37 19·90	VIII
,,	,,	,,	,,	,,	159 50 21·95	4·9599559,0	339 47 53·54	IX
	VIII	Algi	25 29 46·20	78 23 58·16	230 58 42·71	5·0784683,2	51 6 2·42	IX
	,,	,,	,,	,,	164 42 24·79	5·1806703,8	344 39 14·91	X
	,,	,,	,,	,,	107 56 28·36	5·1767520,8	287 45 14·56	XI
6	IX	Daryapur	25 42 12·41	78 40 55·86	118 8 14·71	5·1781671,5	297 57 41·19	X
,,	,,	,,	,,	,,	159 6 20·85	5·1935238,4	339 1 53·95	XIV
	X	Mahárájpur	25 53 54·44	78 16 40·27	45 47 36·88	5·1567811,2	225 39 28·46	XI
	,,	,,	,,	,,	89 29 33·69	4·8830020,5	269 23 28·33	XII
	,,	,,	,,	,,	149 22 35·46	5·0039476,2	329 18 28·00	XIII
	,,	,,	,,	,,	225 44 8·69	5·0314302,7	45 50 18·96	XIV
	XI	Narwar	25 37 22·30	77 57 56·47	194 46 48·35	5·0121057,4	14 48 53·20	XII
	XII	Karaia	25 53 47·07	78 2 43·76	195 49 36·10	4·9590868,2	15 51 35·58	XIII
	XIII	Ráepur	26 8 14·29	78 7 16·15	275 11 1·01	5·1103651,3	95 21 21·23	XIV
	,,	,,	,,	,,	205 52 13·90	5·0124512,4	25 55 52·44	XV
	,,	,,	,,	,,	246 34 43·27	5·2125180,7	66 46 50·27	XVI
7	XIV	Majhár	26 6 17·00	78 30 44·91	141 28 36·27	5·1256909,2	321 21 51·65	XV
,,	,,	,,	,,	,,	195 43 6·05	4·8997811,9	15 44 50·45	XVI
	XV	Sánichri	26 23 31·20	78 15 30·00	284 53 47·07	5·0350054,9	105 2 18·12	XVI
	,,	,,	,,	,,	231 50 46·73	5·0904425,9	51 58 42·77	XVII
8	XVI	Jhánkri	26 18 53·92	78 34 41·30	175 47 27·23	5·0180567,2	355 46 49·70	XVII
,,	,,	,,	,,	,,	223 38 25·30	5·0890179,9	43 45 20·70	XVIII
	XVII	Gúrmi	26 36 3·63	78 33 17·00	279 17 37·00	4·9712527,4	99 25 12·17	XVIII
	,,	,,	,,	,,	221 32 31·90	4·9851404,7	41 37 49·70	XIX
	,,	,,	,,	,,	155 50 9·20	5·0421273,4	335 46 25·06	XX
9	XVIII	Bhind	26 33 32·92	78 50 14·33	162 12 18·53	4·9633306,4	342 9 59·35	XIX
10	XIX	Athgath	26 47 59·51	78 45 4·33	104 34 14·17	5·0522101,9	284 25 9·94	XX
,,	,,	,,	,,	,,	166 3 22·33	4·8990901,8	346 1 46·75	XXI
	XX	Panáhat	26 52 39·07	78 24 58·83	241 30 42·16	5·0098981,0	61 38 12·67	XXI
	,,	,,	,,	,,	183 4 0·07	4·9863624,1	3 4 26·14	XXII
11	XXI	Sherpur	27 0 41·38	78 41 33·12	119 38 31·60	4·9884271,1	299 31 25·16	XXII
,,	,,	,,	,,	,,	191 6 38·26	4·9477260,8	11 8 4·60	XXIII
	XXII	Firozabad	27 8 37·46	78 25 56·23	248 58 52·60	5·0369327,3	69 7 27·32	XXIII
	,,	,,	,,	,,	182 28 29·77	5·0672110,5	2 28 55·44	XXIV

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
12	XXIII	Baragaon	27 15 2·94	78 44 42·45	128 54 48·19	5·0930261,3	308 46 36·39	XXIV
,,	,,	,,	,,	,,	191 49 47·06	5·0503985,9	11 51 44·79	XXV
	XXIV	Pondri	27 27 52·48	78 26 52·19	254 49 1·93	5·0922214,3	74 59 14·39	XXV
	,,	,,	,,	,,	196 53 12·52	5·0741939,6	16 56 10·40	XXVI
13	XXV	Kilármáo	27 33 11·44	78 48 58·27	133 52 31·61	5·0697293,3	313 45 14·08	XXVI
,,	,,	,,	,,	,,	188 48 46·94	4·9633247,1	8 49 59·78	XXVII
	XXVI	Salímpur	27 46 36·46	78 33 15·88	264 25 5·14	4·9963783,1	84 33 37·60	XXVII
	,,	,,	,,	,,	183 57 26·76	4·9841721,3	3 58 1·53	XXVIII
14	XXVII	Jamálpur	27 48 10·77	78 51 35·08	133 22 43·67	5·1015467,9	313 14 43·75	XXVIII
,,	,,	,,	,,	,,	168 59 8·63	5·0413750,7	348 57 18·63	XXIX
	XXVIII	Sankráo	28 2 28·99	78 34 30·15	253 12 11·96	4·8687471,8	73 18 23·79	XXIX
	,,	,,	,,	,,	185 44 19·17	4·8150686,9	5 44 53·60	XXX
	,,	,,	,,	,,	126 47 56·02	4·8670283,1	306 42 45·71	XXXI
15	XXIX	Sarsotha	28 5 59·88	78 47 40·39	124 17 36·08	4·8901520,8	304 11 57·62	XXX
,,	,,	,,	,,	,,	181 59 59·60	4·7429722,8	2 0 9·80	XXXII
	XXX	Sakrora	28 13 12·59	78 35 43·17	72 18 51·55	4·8372038,3	252 13 5·83	XXXI
	,,	,,	,,	,,	259 59 42·38	4·8266264,7	80 5 31·89	XXXII
	,,	,,	,,	,,	142 24 39·93	4·8497616,1	322 20 50·86	XXXIII
	,,	,,	,,	,,	209 27 32·94	4·7915573,0	29 30 14·39	XXXIV
	XXXI	Parauli	28 9 45·27	78 23 31·39	196 5 9·12	4·9037643,8	16 7 6·86	XXXIII
16	XXXII	Kariámái	28 15 7·44	78 48 1·99	139 56 16·51	4·7423343,4	319 53 7·70	XXXIV
	XXXIII	Rajauli	28 22 27·53	78 27 39·95	271 38 18·85	4·8670316,5	91 44 50·33	XXXIV
	,,	,,	,,	,,	208 32 11·65	4·8805517,4	28 35 25·58	XXXV
	,,	,,	,,	,,	152 54 34·44	4·8945903,5	332 51 23·41	XXXVI
17	XXXIV	Mehtra	28 22 5·99	78 41 23·88	151 38 54·62	4·8937283,6	331 35 35·89	XXXV
,,	,,	,,	,,	,,	210 8 24·59	4·8430197,5	30 11 31·46	XXXVII
18	XXXV	Bánsgopál	28 33 28·07	78 34 26·89	92 31 54·48	4·8578008,7	272 25 28·35	XXXVI
,,	,,	,,	,,	,,	276 47 4·72	4·8614015,1	96 53 31·42	XXXVII
,,	,,	,,	,,	,,	147 16 3·69	4·8642248,7	327 12 30·73	XXXVIII
,,	,,	,,	,,	,,	206 43 36·60	4·7968539,4	26 46 8·24	XXXIX
	XXXVI	Chandanpur	28 33 58·94	78 20 59·24	208 58 25·64	4·8245757,7	29 1 19·83	XXXVIII
	XXXVII	Barauli	28 32 2·39	78 47 56·11	145 49 21·51	4·8926775,1	325 45 25·43	XXXIX
	XXXVIII	Kandarki	28 43 37·17	78 27 2·57	274 39 26·38	4·8322276,0	94 45 31·91	XXXIX
	,,	,,	,,	,,	210 53 59·63	4·8920916,1	30 57 36·91	XL
	,,	,,	,,	,,	152 3 55·89	4·8400080,4	332 1 0·15	XLI

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
19	XXXIX	Atora	28 42 41·94	78 39 43·31	159 11 38·43	4·8895967,8	339 9 9·05	XL
	„	„	„	„	206 4 5·48	4·8826480,3	26 7 7·31	XLII
	XL	Sirsa	28 54 39·64	78 34 33·32	85 28 48·77	4·8615229,7	265 22 14·65	XLI
	„	„	„	„	273 38 48·02	4·786840,76	93 44 20·26	XLII
	„	„	„	„	149 55 20·99	4·847606,44	329 52 8·21	XLIII
	„	„	„	„	208 14 58·71	4·8499416,6	28 18 1·77	XLIV
	XLI	Lút	28 53 42·23	78 20 57·91	209 2 52·27	4·8826708,5	29 6 14·71	XLIII
20	XLII	Bhatauli	28 54 0·60	78 46 0·69	157 29 9·05	4·8558888,8	337 26 38·94	XLIV
	XLIII	Milik	29 4 42·70	78 27 55·61	268 45 22·83	4·8376105,2	88 51 39·68	XLIV
	„	„	„	„	208 31 10·07	4·8829477,7	28 34 30·76	XLV
	„	„	„	„	145 33 25·67	4·9446873,9	325 28 51·51	XLVI
21	XLIV	Akbarpur	29 4 56·85	78 40 50·96	153 52 46·38	4·8641688,1	333 49 49·14	XLV
„	„	„	„	„	210 21 47·83	4·9322742,9	30 25 46·01	XLVII
22	XLV	Sarkára	29 15 46·92	78 34 47·36	93 42 15·81	4·9366917,4	273 34 19·54	XLVI
„	„	„	„	„	263 47 0·80	4·8801843,1	83 53 57·46	XLVII
„	„	„	„	„	182 6 0·47	5·1642053,2	2 6 30·29	XLVIII
	XLVI	Haldaur	29 16 41·23	78 18 33·28	213 0 50·97	5·2240912,1	33 9 20·05	XLVIII
	„	„	„	„	99 3 9·45	4·9501475,2	278 55 2·71	XLVIII*
	„	„	„	„	155 3 44·85	4·9591706,9	335 0 11·67	LII
	XLVII	Nandi	29 17 7·53	78 48 59·41	153 7 37·66	5·1888037,9	333 1 8·23	XLVIII
23	XLVIII	Harpálsid	29 39 50·90	78 35 47·99	66 3 49·15	5·1523301,6	245 51 43·83	LII
„	„	„	„	„	158 1 36·96	4·9229430,9	337 58 40·22	I
	XLVIII*	Sheopuri	29 18 59·08	78 1 58·60	215 48 11·17	4·9274737,0	35 52 46·32	LII
	LII	Mahesari	29 30 18·21	78 11 18·88	215 50 54·81	5·2235428,0	36 0 6·21	I
	I	Mábegarh	29 52 39·58	78 29 52·03				

Note.—Stations XLVIII* and LII appertain to the Great Arc Meridional Series, Section 24° to 30°; and I appertains to the North-East Longitudinal Series.

April 1878.

J. B. N. HENNESSEY,
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BUDHON MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. HEIGHTS ABOVE MEAN SEA LEVEL.

The following table gives, first, the usual data of the observed vertical angles and the heights of the signal and instrument &c., in pairs of horizontal lines, the first line of which gives the data for the 1st or the fixed station, and the second line the data for the 2nd or the deduced station. This is followed by the arc contained between the two stations, and then by the terrestrial refraction, and the height of the 2nd station above or below the 1st, as computed from the vertical angles in the usual manner. This difference of height applied to the given height above mean sea level of the fixed station, gives that of the deduced station. Usually there are two or three independent values of the height of the deduced station; the details are so arranged as to show these consecutively and their mean in the columns of "Trigonometrical Results". The mean results thus obtained are however liable to receive corrections for the errors generated in the trigonometrical operations, which are shown up by the spirit leveling operations, whenever a junction between the two has been effected. The spirit leveled determinations are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the leveling operations are adjusted—usually by simple proportion—to accord with the latter. In the table the spirit leveled values are printed thus, **557·44** &c., or, when not very exactly identified, thus, **557**, to distinguish them from the adjusted trigonometrical values. The column in which the mean trigonometrical heights are given is barred across where necessary, as after deduction of Stn. XXIII from Stn. XXII, page 58—J, to indicate that one set of adjustment ends and another begins. The trigonometrical heights always refer to the upper mark-stone, or to the upper surface of the pillar on which the theodolite stood; when a spirit leveled height does not refer to either of these surfaces, it is given in combination with a correction, thus $\left\{\begin{matrix} \mathbf{557 \cdot 44} \\ + 43 \cdot 8 \end{matrix}\right.$ and the sum of these two quantities, in this case 601·2, represents the value with which the corresponding trigonometrical mean height 612·5 is comparable. Descriptions follow these tables, exactly indicating the positions of the leveling staff during the determinations of the spirit leveled heights.

When the pillar of the station is perforated, the height given in the last column, is that between the upper surface of pillar and ground level mark-stone in floor of passage; otherwise it is the approximate height of the structure, above the ground at the base of the station.

The heights of the initial stations are taken from the Calcutta Longitudinal Series of the South-East Quadrilateral, page 179—B, Vol. VI, and are as follows:—

III 1867·4 } feet above Mean Sea Level at Karáchi.
VII 2139·2 }

Astronomical Date 1833	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Feb. 26	15	III	D 0 7 10·3	8	0·50	5·50	951	124	·130	− 31·7	1835·7			
Mar. 31	*	I	D 0 4 54·5	4	0·50	5·50						1823·3	1823	†
" 15	15	VII	D 0 17 28·5	4	0·50	11·00	1459	154	·106	− 328·2	1811·0			
" 31, Ap. 2	*	I	D 0 1 52·4	8	9·00	5·50								
Mar. 15	15	VII	D 0 25 15·9	4	0·50	11·00	1798	164	·091	− 678·5	1460·7			
Ap. 29	*	II	E 0 0 38·4	4	9·00	5·50						1453·1	1452	0
Oct. 29	11	I	D 0 19 12·9	4	0·50	5·50	1679	151	·090	− 377·9	1445·4			
Nov. 4	9 15	II	D 0 3 55·5	4	0·50	5·50								

* Denotes that the times of observation are either partially or altogether unknown. † Not forthcoming.

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Astronomical Date 1833-34	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Oct. 24,29	*	I	D 0 22 5·3	10	0·50	5·50	1681	156	·093	− 523·2	1300·1			
Nov. 14,15	9 30	III	D 0 0 56·9	8	0·50	5·50						1292·2	1291	†
" 4	9 15	II	D 0 12 23·4	4	0·50	5·50	1169	144	·123	− 168·8	1284·3			
" 12,14	10 0	III	D 0 2 35·0	8	0·50	5·50								
Oct. 24,29	*	I	D 0 15 39·7	10	0·50	5·50	1794	184	·103	− 194·6	1628·7			
Nov. 24,25	10	IV	D 0 8 17·8	12	0·50	5·50						1631·9	1630	†
" 15,17	9 30	III	D 0 3 15·4	6	0·50	5·50	1656	217	·131	+ 342·8	1635·0			
" 25	9 30	IV	D 0 17 19·1	6	0·50	5·50								
" 14,17,18	9	III	D 0 11 5·0	10	0·50	5·50	1672	282	·169	− 86·1	1206·1			
Dec. 18	9	V	D 0 7 35·1	4	0·50	5·50						1212·2	1209	†
Nov. 23,24,25	10	IV	D 0 18 47·3	18	0·50	5·50	1869	264	·141	− 413·6	1218·3			
Dec. 22,24	*	V	D 0 3 45·4	6	0·50	5·50								
Nov. 14,17,18	9	III	D 0 8 58·2	12	0·50	5·50	1772	269	·152	+ 73·9	1366·1			
Jan. 14	8	VI	D 0 11 48·2	6	0·50	5·50						1352·1	1349	†
Dec. 20	8	V	D 0 8 55·5	8	0·50	5·50	1734	189	·109	+ 126·0	1338·2			
Jan. 18	10	VI	D 0 13 51·5	4	0·50	5·50								
Dec. 18	9	V	D 0 13 11·7	4	0·50	5·50	1461	151	·104	− 147·4	1064·8			
Feb. 14	9	VII	D 0 6 20·6	6	0·50	5·50						1058·5	1055	o
Jan. 10	4	VI	D 0 17 14·5	6	0·00	5·50	1083	81	·075	− 299·9	1052·2			
Jan. 20	4	VII	E 0 1 33·4	6	0·00	5·50								
Dec. 18	9	V	D 0 8 51·2	4	0·50	5·50	1179	169	·143	− 58·8	1153·4			
Jan. 30	8	VIII	D 0 5 27·8	6	0·50	5·50						1158·4	1154	o
" 20	5	VII	D 0 6 10·7	6	0·00	5·50	1237	84	·068	+ 104·9	1163·4			
Feb. 5	4	VIII	D 0 11 56·5	4	0·00	5·50								
" 13	15	VII	D 0 14 57·7	6	0·50	5·50	901	155	·172	− 261·4	797·1			
" 17	*	IX	E 0 4 44·7	6	0·50	5·50						798·0	793	†
" 7	15	VIII	D 0 15 57·1	6	0·50	5·50	1184	263	·222	− 359·6	798·8			
" 17	*	IX	E 0 4 41·0	6	0·50	5·50								
" 13	15	VII	D 0 11 27·7	6	0·50	5·50	1039	121	·117	− 142·5	916·0			
" 18	15	Chandeva ‡	D 0 2 8·4	6	0·50	5·50						914·2	909	o
" 7	15	VIII	D 0 14 17·4	12	0·50	5·50	908	160	·176	− 246·0	912·4			
" 18	15	Chandeva ‡	E 0 4 7·2	6	0·50	5·50								
" 8	16	VIII	D 0 10 33·4	4	0·50	5·50	1498	305	·204	− 134·1	1024·3			
Mar. 1	15	X	D 0 4 28·3	6	0·50	5·50								
												1020·2	1015	†

* Denotes that the times of observation are either partially or altogether unknown. † Not forthcoming. ‡ An auxiliary station.

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Astronomical Date 1834		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Feb.	18	15	Chandeva ‡	D o 4 8·7	4	0·50	5·50	1220	200	·164	+ 101·8	1016·0			
Mar.	7	15	X	D o 9 48·9	4	0·50	5·50								
”	23	15	VIII	D o 1 45·2	6	0·50	5·50	1484	164	·110	+ 349·6	1508·0			
”	16	15	XI	D o 17 45·2	4	0·50	5·50						1494·7	1489	†
”	8	15	X	E o 1 32·0	6	0·50	5·50	1417	145	·102	+ 461·3	1481·5			
”	16	15	XI	D o 20 34·1	4	0·50	5·50								
”	7	15	X	E o 7 23·7	6	0·50	5·50	755	91	·121	+ 275·3	1295·5			
”	10	15	XII	D o 17 23·0	4	0·50	5·50						1293·0	1287	†
”	20	15	XI	D o 12 37·7	6	0·50	5·50	1016	170	·167	− 204·1	1290·6			
”	11	15	XII	E o 1 1·0	4	0·50	5·50								
Apr.	8	15	Chandeva ‡	D o 5 56·4	8	0·50	5·50	1496	214	·143	+ 135·8	1050·0			
”	24	15	XIV	D o 12 6·2	4	0·50	5·50								
Mar.	7	15	X	D o 6 13·6	4	0·50	5·50	1062	168	·158	− 0·4	1019·8	1034·1	1028	†
Apr.	22	15	XIV	D o 6 12·2	6	0·50	5·50								
1836															
Nov.	3	*	XIII	D o 14 23·6	4	0·75	5·42	1274	89	·070	− 192·4	1032·4			
Oct.	29	*	XIV	D o 4 8·0	4	0·75	5·42								
1834															
Mar.	1	15	X	E o 0 39·2	4	0·50	5·50	997	132	·132	+ 203·7	1223·9			
Apr.	29	16	XIII	D o 13 13·4	4	0·50	5·50								
Mar.	11	15	XII	D o 8 36·3	6	0·50	5·50	899	97	·108	− 67·4	1225·6	1225·6	1219	†
Apr.	29	16	XIII	D o 3 31·0	6	0·50	5·50								
1836															
Oct.	29	*	XIV	D o 4 8·0	4	0·75	5·42	1274	89	·070	+ 192·4	1227·3			
Nov.	3	*	XIII	D o 14 23·6	4	0·75	5·42								
Oct.	31	*	XIV	D o 14 53·7	4	0·75	5·42	1320	88	·066	− 203·3	830·8			
Nov.	7	*	XV	D o 4 25·7	4	0·75	5·42								
”	3	*	XIII	D o 20 34·7	4	0·75	5·42	1017	68	·067	− 391·8	833·8	832·1	825	†
”	7	*	XV	E o 5 35·0	4	0·75	5·42								
Oct.	26	*	XVI	D o 1 23·7	4	0·75	5·42	1071	80	·075	+ 199·9	831·7			
Nov.	7	*	XV	D o 14 4·4	4	0·75	5·42								
Oct.	2	*	XIV	D o 23 11·1	4	0·75	5·42	784	53	·067	− 400·2	633·9			
”	24	*	XVI	E o 11 28·4	4	0·75	5·42								
Nov.	8	*	XIII	D o 24 20·7	4	0·75	5·42	1611	104	·065	− 595·9	629·7	632·0	624	†
Oct.	25	*	XVI	E o 0 46·0	4	0·75	5·42								
Nov.	7	*	XV	D o 14 4·4	4	0·75	5·42	1071	80	·075	− 199·9	632·4			
Oct.	26	*	XVI	D o 1 23·7	4	0·75	5·42								

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Astronomical Date 1836		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Nov.	7	*	XV	D 0 15 39·2	4	0·75	5·42	1217	85	·070	− 243·4	588·7			
„	19	*	XVII	D 0 2 4·1	4	0·75	5·42								
Oct.	27	*	XVI	D 0 9 5·1	4	0·75	5·42	1030	87	·085	− 54·7	577·3	583·0	575	27†
Nov.	17	*	XVII	D 0 5 28·8	4	0·75	5·42								
Oct.	25,26	*	XVI	D 0 10 37·3	4	0·75	5·42	1213	82	·068	− 62·5	569·5			
Nov.	26	*	XVIII	D 0 7 7·4	4	0·75	5·42								
„	18	*	XVII	D 0 7 33·1	4	0·75	5·42	925	46	·049	− 11·8	571·2	570·3	562	5‡
„	25	*	XVIII	D 0 6 41·4	4	0·75	5·42								
1842															
„	28	5 51	XVII	D 0 4 30·5	8	0·92	4·75	954	200	·209	+ 7·0	590·0			
„	28	5 50	XIX	D 0 5 0·9	8	0·92	4·92								
Dec.	11	5 38	XVIII	D 0 4 21·1	8	0·92	4·92	908	177	·194	+ 11·1	581·4	585·7	577	36
„	11	5 39	XIX	D 0 5 1·6	8	5·17	4·92								
Nov.	30	5 52	XVII	D 0 3 19·1	8	0·92	4·75	1088	293	·269	+ 31·6	614·6			
„	30	5 53	XX	D 0 5 17·5	8	0·92	4·92								
„	23	5 39	XIX	D 0 4 1·6	8	0·92	4·92	1114	333	·299	− 5·5	580·2	597·4	588	30
„	23	5 38	XX	D 0 3 41·2	8	0·92	4·75								
Dec.	15	5 30	XIX	D 0 3 31·6	8	0·92	4·92	783	178	·227	+ 4·9	590·6			
„	15	5 30	XXI	D 0 3 56·5	8	0·92	4·75								
Nov.	21	5 38	XX	D 0 3 31·6	8	0·92	4·75	1011	327	·323	− 12·4	585·0	587·8	578	31†
„	21	5 41	XXI	D 0 2 42·2	8	0·92	4·92								
„	16	5 49	XX	D 0 3 41·9	8	0·92	4·92	957	238	·249	+ 12·8	610·2			
„	16	5 47	XXII	D 0 4 36·1	8	0·92	4·75								
„	13	6 1	XXI	D 0 1 29·7	8	0·92	4·92	962	343	·356	+ 27·1	614·9	612·5	{ 557·44 + 43·8	† 43·8
„	13	6 0	XXII	D 0 3 23·5	8	1·17	4·75								
Dec.	24	5 35	XXI	D 0 4 26·6	8	0·92	4·92	876	80	·091	+ 43·5	631·3			
„	24	5 34	XXIII	D 0 7 48·5	8	0·92	4·75								
Nov.	11	6 16	XXII	D 0 3 37·0	12	0·92	4·75	1075	294	·274	+ 17·6	630·1	630·7	{ 573·30 + 45·4	45·4
„	11	6 18	XXIII	D 0 4 44·1	8	0·92	4·92								
1843															
Jan.	1	6 4	XXIII	D 0 5 35·4	12	0·92	4·92	1224	242	·198	+ 24·6	643·3			
„	1	6 4	XXIV	D 0 6 56·9	8	0·92	4·75								
Mar.	27	6 58	XXII	D 0 3 27·5	8	0·92	4·92	1153	308	·267	+ 38·7	639·9	641·6	{ 594·75 + 44·3	44·3
„	27	6 56	XXIV	D 0 5 43·7	10	1·08	4·83								
1842															
Dec.	28	5 35	XXIII	D 0 6 2·4	8	0·92	4·75	1109	236	·213	− 20·0	598·7			
„	28	5 35	XXV	D 0 4 49·4	8	0·92	4·92					603·5	605	44

* Denotes that the times of observation are either partially or altogether unknown. † Above the terreplein of the rampart on which the tower stands. ‡ Above roof of gateway on which the pillar stands.

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Astronomical Date 1843		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Mar.	23	6 35	XXIV	D 0 6 40·0	8	0·92	4·92	1221	269	·220	− 30·8	608·3			
„	23	6 34	XXV	D 0 4 56·8	10	1·08	4·83								
„	23	7 5	XXV	D 0 3 42·2	8	1·08	4·83	1160	294	·253	+ 40·2	643·7			
„	23	7 7	XXVI	D 0 6 3·7	12	0·92	4·92						641·1	645	48
Jan.	7	5 49	XXIV	D 0 5 21·7	8	0·92	4·75	1172	272	·232	− 0·7	638·4			
„	7	5 51	XXVI	D 0 5 19·4	4	0·92	4·92								
„	18	5 40	XXV	D 0 3 33·2	8	0·92	4·75	908	285	·314	− 15·8	587·7			
„	18	5 41	XXVII	D 0 2 22·5	8	0·92	4·92						593·4	599	28
„	21	4 6	XXVI	D 0 8 5·3	8	0·67	4·92	980	101	·103	− 42·0	599·1			
„	21	4 7	XXVII	D 0 5 10·3	8	0·67	4·75								
Feb.	18	4 40	XXVI	D 0 6 37·5	8	0·75	4·92	952	56	·058	+ 14·9	656·0			
„	18	4 44	XXVIII	D 0 7 40·8	10	0·75	4·83						661·6	670	37
„	19	16 34	XXVII	D 0 0 50·6	4	0·92	4·92	1248	459	·368	+ 73·9	667·3			
„	19	16 34	XXVIII	D 0 4 51·7	4	0·92	4·83								
Jan.	24	4 35	XXVII	D 0 6 43·1	4	0·08	4·83	1086	156	·144	− 4·0	589·4			
„	24	4 32	XXIX	D 0 6 26·7	4	0·75	4·75						596·3	606	24
Feb.	24	3 57	XXVIII	D 0 8 13·1	16	0·13	4·83	730	48	·066	− 58·5	603·1			
„	24	3 57	XXIX	D 0 2 45·0	8	0·75	4·92								
„	25	5 13	XXVIII	D 0 7 32·2	12	0·42	4·83	645	61	·095	− 56·0	605·6			
„	25	5 16	XXX	D 0 1 37·8	8	0·75	4·92						600·7	613	21
Mar.	7	6 35	XXIX	D 0 0 53·7	8	0·58	4·33	767	341	·445	− 0·6	595·7			
„	7	6 33	XXX	D 0 0 52·7	8	0·25	4·75								
Feb.	26	7 5	XXVIII	D 0 3 50·0	8	0·33	4·92	727	254	·350	− 38·5	623·1			
„	26	7 8	XXXI	D 0 0 12·1	12	1·00	4·75						628·8	643	19
„	26	4 41	XXX	D 0 3 23·7	8	0·17	4·92	679	49	·072	+ 33·8	634·5			
„	26	4 40	XXXI	D 0 6 45·2	12	0·42	4·75								
Mar.	7	7 48	XXIX	E 0 1 11·2	8	0·25	4·33	547	231	·422	+ 11·8	608·1			
„	7	7 47	XXXII	D 0 0 18·7	8	0·25	4·92						610·4	624	17
„	7	6 53	XXX	E 0 0 59·7	8	0·25	4·75	663	295	·445	+ 12·1	612·8			
„	7	6 53	XXXII	D 0 0 14·1	8	0·58	4·92								
Feb.	11	6 20	XXX	E 0 0 56·0	12	0·92	4·92	699	385	·551	+ 11·0	611·7			
„	11	6 20	XXXIII	D 0 0 7·7	4	0·92	4·75								
„	12	6 32	XXXI	E 0 0 15·3	8	0·92	4·33	791	472	·596	− 20·2	608·6	612·6	629	23
„	12	6 31	XXXIII	E 0 1 58·3	8	0·92	4·83								

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		h. m.		° ′ ″				″							feet
May	15	7 24	XXXIV	D 0 4 6.9	8	21.79	4.91	727	126	.174	− 20.3	617.4			
"	15	7 31	XXXIII	D 0 2 7.4	12	24.33	5.41								
Mar.	6	6 39	XXX	E 0 0 22.6	12	0.33	4.75	611	226	.369	+ 35.2	635.9			
"	6	6 40	XXXIV	D 0 3 31.6	8	0.58	4.92								
Feb.	6	4 18	XXXII	D 0 2 10.0	4	0.75	4.92	546	50	.091	+ 29.2	639.6	635.3	652	16
"	6	4 18	XXXIV	D 0 5 47.2	4	0.75	4.75								
May	15	7 31	XXXIII	D 0 2 7.4	12	24.33	5.41	727	126	.174	+ 20.3	630.5			
"	15	7 24	XXXIV	D 0 4 6.9	8	21.79	4.91								
April	10	16 15	XXXIV	E 0 2 26.2	8	0.25	4.92	773	487	.631	+ 21.9	657.2			
"	10	16 15	XXXV	E 0 0 31.7	8	0.42	4.83						659.7	677	19
Mar.	13	6 59	XXXIII	E 0 0 33.1	8	0.08	4.83	750	287	.382	+ 49.5	662.1			
"	13	7 3	XXXV	D 0 3 51.9	12	0.92	4.25								
May	12	16 8	XXXIV	E 0 1 36.2	12	20.86	5.41	688	398	.579	− 1.2	650.8			
"	12	15 56	XXXVII	E 0 1 44.1	8	20.50	4.91						649.6	657	16
"	8	15 32	XXXV	D 0 4 36.4	16	21.63	5.41	718	118	.164	− 28.7	648.3			
"	8	15 17	XXXVII	D 0 1 53.7	8	21.00	4.91								
April	2	afternoon	XXXV	D 0 4 58.4	8	1.04	4.82	619	−11	.018	+ 10.5	687.5			
"	2	"	XXXIX	D 0 6 8.1	8	0.98	4.96						692.9	695.93	17.8
May	10	7 34	XXXVII	D 0 0 7.5	8	1.58	4.91	771	278	.360	+ 41.3	698.3			
"	10	7 33	XXXIX	D 0 3 47.5	14	1.36	5.42								
Feb.	19	4 31	XXXIX	D 0 3 58.3	6	*5.45	4.91	766	49	.063	+ 46.5	742.4	742.4	739.45	26.0
"	19	4 29	XL	D 0 7 21.9	12	3.75	*2.32								
Mar.	16	6 48	XXXIX	D 0 2 16.6	4	2.42	5.41	754	264	.350	− 5.6	690.3			
"	16	6 42	XLII	D 0 1 45.0	4	2.39	4.91						688.8	689.37	14.5
Feb.	21	3 57	XL	D 0 7 44.9	8	1.33	*2.32	605	2	.003	− 52.3	687.2			
"	21	3 52	XLII	D 0 2 39.6	6	*5.45	4.91								
Mar.	10	7 12	XXXIII	D 0 1 56.2	8	0.83	4.83	775	226	.292	+ 21.1	650.1			
"	10	7 12	XXXVI	D 0 3 46.4	10	1.08	4.83								
"	10	7 50	XXXV	D 0 2 17.2	8	0.83	4.25	712	315	.442	− 30.2	646.8	647.1	647	16
"	10	7 49	XXXVI	E 0 0 34.7	8	1.08	4.83								
May	5	8 2	XXXVIII	D 0 0 36.9	10	20.33	5.42	659	276	.420	− 44.0	644.3			
"	5	8 3	XXXVI	E 0 4 0.0	8	21.33	4.83								
"	5	8 3	XXXVI	E 0 4 0.0	8	21.33	4.83	659	276	.420	+ 44.0	692.5			
"	5	8 2	XXXVIII	D 0 0 36.9	10	20.33	5.42								

* NOTE.—These heights are to be combined with negative signs, because the pillar at XL, Sirsa, had a permanent addition made to it of 7.73 feet by a subsequent observer.

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Astronomical Date 1843		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Apr.	3	afternoon	XXXV	E 0 2 58·2	12	1·33	4·82	722	530	·734	+ 6·8	683·8	689·3	689	19
„	3	„	XXXVIII	E 0 2 20·0	12	1·33	4·69								
„	6	after midnight	XXXIX	D 0 1 15·5	10	1·23	4·96	671	283	·422	− 4·0	691·9			
„	6	„	XXXVIII	D 0 0 50·7	10	1·23	4·69								
May	5	7 16	XL	D 0 2 44·9	8	21·33	4·83	770	309	·402	− 50·3	689·2			
„	5	7 31	XXXVIII	E 0 1 35·9	8	20·00	5·42								
Mar.	31	5 48	XXXVIII	D 0 1 57·4	8	2·54	5·42	683	153	·223	+ 26·9	715·9	716·3	716	20
„	31	5 48	XLI	D 0 4 41·2	8	0·77	4·90								
Apr.	14	15 23	XL	D 0 1 51·2	8	31·50	4·91	718	241	·336	− 24·3	715·2			
„	14	15 23	XLI	D 0 0 33·1	8	10·50	4·92								
May	3	8 19	XLIII	D 0 0 8·4	8	21·33	4·83	754	364	·483	− 24·2	717·8			
„	3	8 27	XLI	E 0 1 54·0	8	18·75	5·45								
Feb.	24	4 47	XL	D 0 5 13·1	10	4·02	*2·32	699	94	·134	− 26·0	713·4	716·0	719	15
„	24	4 54	XLIV	D 0 3 30·0	6	*5·45	4·91								
Mar.	13	5 17	XLII	D 0 2 22·1	10	2·99	5·41	709	124	·175	+ 33·1	722·5			
„	13	5 5	XLIV	D 0 5 33·2	10	2·11	4·91								
„	16	5 43	XLIII	D 0 3 44·7	6	2·90	5·42	679	196	·289	− 24·7	712·1			
„	16	5 43	XLIV	D 0 1 21·2	6	0·87	4·90								
Feb.	26	4 53	XL	D 0 4 26·0	12	4·02	*2·32	695	71	·102	− 2·7	736·8	739·7	742	17
„	26	4 57	XLIII	D 0 4 59·2	6	*5·45	4·91								
Mar.	16	5 43	XLIV	D 0 1 21·2	6	0·87	4·90	679	196	·289	+ 24·7	742·6			
„	16	5 43	XLIII	D 0 3 44·7	6	2·90	5·42								
Apr.	17	7 17	XLIII	E 0 0 10·0	8	0·75	4·83	754	344	·456	+ 20·1	759·8	758·5	761	16
„	17	7 12	XLV	D 0 1 38·2	8	0·92	4·83								
„	17	15 7	XLIV	E 0 3 53·1	8	0·75	4·92	722	490	·678	+ 41·2	757·2			
„	17	15 6	XLV	E 0 0 2·3	8	1·25	4·83								
„	18	7 40	XLIII	E 0 1 36·2	8	0·92	4·83	870	403	·463	+ 58·8	798·5	801·7	806	20
„	18	9 27	XLVI	D 0 2 59·6	12	0·92	4·92								
„	18	8 45	XLV	E 0 1 34·2	8	0·92	4·83	854	420	·492	+ 46·4	804·9			
„	18	10 40	XLVI	D 0 2 7·8	8	0·75	4·92								
„	17	15 39	XLIV	E 0 2 35·9	8	1·18	4·92	845	380*	·449	+ 50·7	766·7	768·1	771	12
„	17	15 51	XLVII	D 0 1 29·5	14	1·25	5·46								
„	17	4 49	XLV	D 0 5 14·6	10	1·03	4·83	750	41	·055	+ 11·0	769·5			
„	17	5 0	XLVII	D 0 6 17·0	16	0·58	5·46								

*Note.—These heights are to be combined with negative signs, because the pillar at XL, Sirsa, had a permanent addition made to it of 7·73 feet by a subsequent observer.

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Astronomical Date 1843		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
May	15	7 24	XXXIV	D 0 4 6·9	8	21·79	4·91								
„	15	7 31	XXXIII	D 0 2 7·4	12	24·33	5·41	727	126	·174	− 20·3	617·4			
Mar.	6	6 39	XXX	E 0 0 22·6	12	0·33	4·75								
„	6	6 40	XXXIV	D 0 3 31·6	8	0·58	4·92	611	226	·369	+ 35·2	635·9			
Feb.	6	4 18	XXXII	D 0 2 10·0	4	0·75	4·92								
„	6	4 18	XXXIV	D 0 5 47·2	4	0·75	4·75	546	50	·091	+ 29·2	639·6	635·3	652	16
May	15	7 31	XXXIII	D 0 2 7·4	12	24·33	5·41								
„	15	7 24	XXXIV	D 0 4 6·9	8	21·79	4·91	727	126	·174	+ 20·3	630·5			
April	10	16 15	XXXIV	E 0 2 26·2	8	0·25	4·92								
„	10	16 15	XXXV	E 0 0 31·7	8	0·42	4·83	773	487	·631	+ 21·9	657·2			
Mar.	13	6 59	XXXIII	E 0 0 33·1	8	0·08	4·83						659·7	677	19
„	13	7 3	XXXV	D 0 3 51·9	12	0·92	4·25	750	287	·382	+ 49·5	662·1			
May	12	16 8	XXXIV	E 0 1 36·2	12	20·86	5·41								
„	12	15 56	XXXVII	E 0 1 44·1	8	20·50	4·91	688	398	·579	− 1·2	650·8			
„	8	15 32	XXXV	D 0 4 36·4	16	21·63	5·41						649·6	657	16
„	8	15 17	XXXVII	D 0 1 53·7	8	21·00	4·91	718	118	·164	− 28·7	648·3			
April	2	afternoon	XXXV	D 0 4 58·4	8	1·04	4·82								
„	2	„	XXXIX	D 0 6 8·1	8	0·98	4·96	619	−11	·018	+ 10·5	687·5			
May	10	7 34	XXXVII	D 0 0 7·5	8	1·58	4·91						692·9	698·93	17·8
„	10	7 33	XXXIX	D 0 3 47·5	14	1·36	5·42	771	278	·360	+ 41·3	698·3			
Feb.	19	4 31	XXXIX	D 0 3 58·3	6	*5·45	4·91								
„	19	4 29	XL	D 0 7 21·9	12	3·75	*2·32	766	49	·063	+ 46·5	742·4	742·4	739·45	26·0
Mar.	16	6 48	XXXIX	D 0 2 16·6	4	2·42	5·41								
„	16	6 42	XLII	D 0 1 45·0	4	2·39	4·91	754	264	·350	− 5·6	690·3			
Feb.	21	3 57	XL	D 0 7 44·9	8	1·33	*2·32						688·8	689·37	14·5
„	21	3 52	XLII	D 0 2 39·6	6	*5·45	4·91	605	2	·003	− 52·3	687·2			
Mar.	10	7 12	XXXIII	D 0 1 56·2	8	0·83	4·83								
„	10	7 12	XXXVI	D 0 3 46·4	10	1·08	4·83	775	226	·292	+ 21·1	650·1			
„	10	7 50	XXXV	D 0 2 17·2	8	0·83	4·25								
„	10	7 49	XXXVI	E 0 0 34·7	8	1·08	4·83	712	315	·442	− 30·2	646·8	647·1	647	16
May	5	8 2	XXXVIII	D 0 0 36·9	10	20·33	5·42								
„	5	8 3	XXXVI	E 0 4 0·0	8	21·33	4·83	659	276	·420	− 44·0	644·3			
„	5	8 3	XXXVI	E 0 4 0·0	8	21·33	4·83								
„	5	8 2	XXXVIII	D 0 0 36·9	10	20·33	5·42	659	276	·420	+ 44·0	692·5			

* Note.—These heights are to be combined with negative signs, because the pillar at XL, Sirsa, had a permanent addition made to it of 7·73 feet by a subsequent observer.

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Astronomical Date 1843		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Apr.	3	afternoon	XXXV	E 0 2 58·2	12	1·33	4·82	722	530	·734	+ 6·8	683·8			
„	3	„	XXXVIII	E 0 2 20·0	12	1·33	4·69						689·3	689	19
„	6	after mid-night	XXXIX	D 0 1 15·5	10	1·23	4·96	671	283	·422	− 4·0	691·9			
„	6	„	XXXVIII	D 0 0 50·7	10	1·23	4·69								
May	5	7 16	XL	D 0 2 44·9	8	21·33	4·83	770	309	·402	− 50·3	689·2			
„	5	7 31	XXXVIII	E 0 1 35·9	8	20·00	5·42								
Mar.	31	5 48	XXXVIII	D 0 1 57·4	8	2·54	5·42	683	153	·223	+ 26·9	715·9			
„	31	5 48	XLI	D 0 4 41·2	8	0·77	4·90								
Apr.	14	15 23	XL	D 0 1 51·2	8	31·50	4·91	718	241	·336	− 24·3	715·2	716·3	716	20
„	14	15 23	XLI	D 0 0 33·1	8	10·50	4·92								
May	8	8 19	XLIII	D 0 0 8·4	8	21·33	4·83	754	364	·483	− 24·2	717·8			
„	8	8 27	XLI	E 0 1 54·0	8	18·75	5·45								
Feb.	24	4 47	XL	D 0 5 13·1	10	4·02	*2·32	699	94	·134	− 26·0	713·4			
„	24	4 54	XLIV	D 0 3 30·0	6	*5·45	4·91								
Mar.	13	5 17	XLII	D 0 2 22·1	10	2·99	5·41	709	124	·175	+ 33·1	722·5	716·0	719	15
„	13	5 5	XLIV	D 0 5 33·2	10	2·11	4·91								
„	16	5 43	XLIII	D 0 3 44·7	6	2·90	5·42	679	196	·289	− 24·7	712·1			
„	16	5 43	XLIV	D 0 1 21·2	6	0·87	4·90								
Feb.	26	4 53	XL	D 0 4 26·0	12	4·02	*2·32	695	71	·102	− 2·7	736·8			
„	26	4 57	XLIII	D 0 4 59·2	6	*5·45	4·91						739·7	742	17
Mar.	16	5 43	XLIV	D 0 1 21·2	6	0·87	4·90	679	196	·289	+ 24·7	742·6			
„	16	5 43	XLIII	D 0 3 44·7	6	2·90	5·42								
Apr.	17	7 17	XLIII	E 0 0 10·0	8	0·75	4·83	754	344	·456	+ 20·1	759·8			
„	17	7 12	XLV	D 0 1 38·2	8	0·92	4·83						758·5	761	16
„	17	15 7	XLIV	E 0 3 53·1	8	0·75	4·92	722	490	·678	+ 41·2	757·2			
„	17	15 6	XLV	E 0 0 2·3	8	1·25	4·83								
„	18	7 40	XLIII	E 0 1 36·2	8	0·92	4·83	870	403	·463	+ 58·8	798·5			
„	18	9 27	XLVI	D 0 2 59·6	12	0·92	4·92						801·7	806	20
„	18	8 45	XLV	E 0 1 34·2	8	0·92	4·83	854	420	·492	+ 46·4	804·9			
„	18	10 40	XLVI	D 0 2 7·8	8	0·75	4·92								
„	17	15 39	XLIV	E 0 2 35·9	8	1·18	4·92	845	380*	·449	+ 50·7	766·7			
„	17	15 51	XLVII	D 0 1 29·5	14	1·25	5·46						768·1	771	12
„	17	4 49	XLV	D 0 5 14·6	10	1·03	4·83	750	41	·055	+ 11·0	769·5			
„	17	5 0	XLVII	D 0 6 17·0	16	0·58	5·46								

*Note.—Those heights are to be combined with negative signs, because the pillar at XL, Sirsa, had a permanent addition made to it of 7·73 feet by a subsequent observer.

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Astronomical Date 1843		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
April	20	4 59	XLV	E 0 39 7·8	20	1·25	4·83	1441	89	·062	+2111·8	2870·3			
„	20	4 46	XLVIII	D 1 0 21·6	8	0·58	5·08								
May	11	5 34	XLVI	E 0 30 38·1	10	1·08	4·83	1655	122	·074	+2069·6	2871·3	2871·9	2876	0
„	11	6 29	XLVIII	D 0 54 18·5	12	0·50	5·08								
April	21	4 31	XLVII	E 0 35 29·6	10	1·25	5·46	1525	86	·056	+2106·0	2874·1			
„	21	4 7	XLVIII	D 0 58 14·1	8	1·03	5·08								
May	11	4 42	XLVI	D 0 4 44·6	8	1·21	4·83	880	20	·023	+ 62·1	863·8	863·8	871	41
„	11	4 30	XLVIII†	D 0 9 33·7	8	0·50	4·92								
April	25	15 47	XLVI	E 0 0 1·2	8	*1·00	4·83	899	428	·476	+ 15·8	817·5			
„	25	16 4	LII	D 0 1 2·8	8	0·92	3·33						814·8	821	14
May	12	6 30	XLVIII	D 1 0 7·7	12	*1·17	5·08	1402	94	·067	−2059·8	812·1			
„	12	4 28	LII	E 0 39 40·9	10	0·92	3·33								
April	25	5 56	XLVIII	E 1 46 43·0	12	3·92	5·45	827	14	·017	+2764·9	5640·9			
„	25	4 51	I	D 2 0 18·3	6	‡0·37	4·89						5648·9	5652	7
(1)		3 0	LII	E 1 27 44·9	8	1·54	3·87	1652	135	·082	+4835·8	5656·8			
(2)		2 3	I	D 1 50 56·2	14	0·10	5·43								

Note.—Stations XLVIII † and LII appertain to the Great Arc Meridional Series, Section 24° to 30°; and I appertains to the North-East Longitudinal Series.

* These heights are to be combined with negative signs, because the pillar at LII, Mahesari, had a permanent addition made to it of 1·5 feet by a subsequent observer.

(1) The mean of observations taken on 27 January 1843, and 2, 3 January 1851.

(2) „ „ 17 November 1842, and 3, 4 December 1850.

‡ This height is to be combined with a negative sign, because the signal (heliotrope) at XLVIII, Harpálsid, in this instance was placed 0·37 feet *below* the mark-stone denoting the station.

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The spirit-leveled heights given on pages 58—J. and 60—J., were determined by the operations either of the G. T. Survey or the Revenue Survey; these connections are hereafter indicated in the former case by the letters (G. T. S.), and in the latter by (R. S.) immediately following the name of each station; the surface on which the leveling staff stood is also described.

XXII	or	*Firozabad Tower Station,*	(G. T. S.);	On the mark-stone imbedded at 1 foot below the level of the terreplein of the rampart on which the tower is built.
XXIII	„	*Baragaon Tower Station,*	„ ;	On the mark-stone imbedded at 1 foot below the ground floor of the tower.
XXIV	„	*Pondri Tower Station,*	(R. S.);	(same as above)
XXXIV	„	*Mehtra Tower Station,*	„ ;	On the upper surface of brick-work of the tower.
XXXV	„	*Bánsgopál Tower Station,*	„ ;	On the upper surface of the masonry pillar.
XXXVII	„	*Barauli Tower Station,*	„ ;	On the upper surface of brick-work of the tower.
XXXIX	„	*Atora Tower Station,*	„ ;	On the mark-stone let into the upper surface of the pillar.
XL	„	*Sirsa Tower Station,*	(G. T. S.);	At foot of the tower, height = 715·22 feet. To this value, 24·23 feet (the height of the upper mark above this spot determined by subtense angles) being added, the height of *upper* mark-stone is found to be 739·45 feet.
XLII	„	*Bhatauli Tower Station,*	„ ;	At foot of the tower, height = 673·88 feet. To this value, 15·49 feet (the height of the upper mark above this spot determined by subtense angles) being added, the height of *upper* mark-stone is found to be 689·37 feet.

April 1878.

J. B. N. HENNESSEY.
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BUDHON MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XVII (Gúrmi)

Lat. N. 26° 36′ 3″·63; Long. E. 78° 33′ 17″·00 = 5h 14m 13s·1; Height above Mean Sea Level, 575 feet.

December 1842; observed by Mr. C. Murphy with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed .. .. ε Ursæ Minoris (West and East).

Mean Right Ascension 17h 2m 22s

Mean North Polar Distance .. .. 7° 42′ 47″·61

Local Mean Times of Elongation, December 4 .. { Western 5h 55m; Eastern 18 24 }

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark – Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark – Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark – Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark – Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 4	W.	190 1	+ 7 42 50·83	0 53	+ 0 0·23	+ 7 42 51·06	+ 7 42 33·00	5 18	+ 0 8·24	+ 7 42 41·24
		&	42 49·33	4 23	0 5·63	54·96	42 40·67	3 17	0 3·15	43·82
		10 1	40 44·50	20 51	2 6·32	50·82	42 13·67	11 40	0 39·74	53·41
			40 26·00	22 21	2 25·13	51·13	42 2·33	13 9	0 50·48	52·81
" 4	E.	190 1	− 9 27 48·17	33 47	− 5 30·07	− 9 33 18·24	− 9 24 52·33	41 53	− 8 25·68	− 9 33 18·01
		&	28 21·33	32 11	4 59·98	21·31	25 36·00	40 2	7 42·64	18·64
		10 1	31 38·33	18 54	1 44·04	22·37	29 52·67	26 36	3 25·17	17·84
			31 55·17	17 4	1 24·86	20·03	30 9·83	25 30	3 8·86	18·69
			33 21·83	0 59	0 0·28	22·11	32 51·00	9 23	0 25·72	16·72
			33 16·33	5 14	0 8·02	24·35	32 59·67	7 13	0 15·21	14·88
" 5	W.	199 4	+ 7 42 2·17	13 27	+ 0 53·23	+ 7 42 55·40	+ 7 42 40·83	1 26	+ 0 0·60	+ 7 42 41·43
		&	42 18·00	11 7	0 36·32	54·32	42 40·17	0 3	0 0·00	40·17
		19 4	42 18·00	10 31	0 32·26	50·26	41 11·33	18 17	1 37·26	48·59
			42 9·17	11 51	0 40·95	50·12	40 55·00	19 37	1 51·96	46·96
" 5	E.	199 4	− 9 29 49·33	26 47	− 3 28·12	− 9 33 17·45	− 9 31 40·67	18 51	− 1 43·39	− 9 33 24·06
		&	30 20·83	24 47	2 58·27	19·10	31 55·00	17 16	1 26·74	21·74
		19 4	32 53·17	9 47	0 27·91	21·08	33 24·00	1 59	0 1·14	25·14
			32 59·67	7 49	0 17·87	17·54	33 22·67	0 28	0 0·06	22·73
			33 9·33	4 45	0 6·64	15·97				
			33 8·33	6 28	0 12·24	20·57				
" 6	W.	209 4	+ 7 41 4·50	18 53	+ 1 44·85	+ 7 42 49·35	+ 7 42 11·50	11 11	+ 0 36·79	+ 7 42 48·29
		&	41 23·83	17 2	1 25·39	49·22	42 25·17	8 31	0 21·29	46·45
		29 4	42 48·83	2 10	0 1·38	50·21	42 33·00	7 1	0 14·39	47·39
			42 47·00	1 5	0 0·34	47·34	42 25·83	8 26	0 20·79	46·62
			41 43·83	14 52	1 4·45	48·28	40 9·17	23 33	2 41·22	50·39
			41 29·67	16 32	1 19·68	49·35	39 47·67	25 4	3 2·33	50·00

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT				FACE RIGHT			
			Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation	Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 6	E.	209 4	− 9 28 20·17	31 58	− 4 55·88	− 9 33 16·05	− 9 30 27·50	24 37	− 2 55·98	− 9 33 23·48
		&	28 59·67	30 3	4 21·61	21·28	30 41·83	23 32	2 40·86	22·69
		29 4	31 47·00	18 1	1 34·52	21·52	32 51·83	10 25	0 31·67	23·50
			32 0·00	16 46	1 21·87	21·87	32 58·83	8 55	0 23·21	22·04
			33 17·50	3 9	0 2·90	20·40	33 7·33	7 17	0 15·59	22·92
			33 21·33	1 49	0 0·96	22·29	33 1·00	8 28	0 21·00	22·00
„ 7	W.	219 4	+ 7 42 38·00	7 23	+ 0 15·97	+ 7 42 53·97	+ 7 41 45·33	14 19	+ 1 0·20	+ 7 42 45·53
		&	42 46·00	5 48	0 9·84	55·84	41 58·67	12 59	0 49·47	48·14
		39 4	42 41·50	7 24	0 16·02	57·52	42 47·00	0 7	0 0·00	47·00
			42 31·33	9 0	0 23·60	54·93	42 46·67	1 20	0 0·53	47·20
„ 7	E.	219 4	− 9 32 27·67	13 22	− 0 52·09	− 9 33 19·76	− 9 31 14·50	21 18	− 2 11·93	− 9 33 26·43
		&	32 40·33	11 52	0 41·06	21·39	31 29·33	19 43	1 53·08	22·41
		39 4	33 17·00	2 55	0 2·50	19·50	33 13·33	5 36	0 9·17	22·50
			33 12·67	4 23	0 5·65	18·32	33 19·50	4 1	0 4·71	24·21
			31 38·83	18 2	1 35·73	14·56	33 5·67	8 16	0 20·05	25·72
			31 29·33	18 57	1 45·77	15·10	32 56·67	9 36	0 27·07	23·74
„ 8	W.	229 4	+ 7 42 10·50	12 50	+ 0 48·33	+ 7 42 58·83	+ 7 42 33·33	6 14	+ 0 11·37	+ 7 42 44·70
		&	42 21·83	11 24	0 38·20	60·03	42 39·00	4 48	0 6·77	45·77
		49 4	42 55·33	0 27	0 0·06	55·39	42 30·67	7 23	0 15·95	46·62
			42 53·00	1 48	0 0·94	53·94	42 25·50	8 48	0 22·66	48·16
„ 8	E.	229 4	− 9 32 31·00	13 44	− 0 54·93	− 9 33 25·93	− 9 31 1·33	22 20	− 2 24·90	− 9 33 26·23
		&	32 38·67	12 23	0 44·76	23·43	31 17·67	20 50	2 6·13	23·80
		49 4	33 28·00	0 38	0 0·12	28·12	33 11·83	6 8	0 10·96	22·79
			33 25·33	1 46	0 0·91	26·24	33 15·67	4 51	0 6·89	22·56
			32 35·00	13 35	0 54·25	29·25	33 12·17	7 9	0 15·02	27·19
			32 19·83	15 0	1 6·21	26·04	33 4·00	8 19	0 20·34	24·34
„ 9	W.	239 4	+ 7 42 20·83	11 34	+ 0 39·33	+ 7 42 60·16	+ 7 42 41·67	5 0	+ 0 7·35	+ 7 42 49·02
		&	42 27·83	10 16	0 30·97	58·80	42 46·00	3 40	0 3·95	49·95
		59 4	42 56·00	2 11	0 1·39	57·39	42 27·33	9 5	0 24·05	51·38
			42 54·00	3 31	0 3·61	57·61	42 18·00	10 27	0 31·85	49·85
„ 9	E.	239 4	− 9 33 12·67	5 59	− 0 10·49	− 9 33 23·16	− 9 32 20·17	15 26	− 1 9·36	− 9 33 29·53
		&	33 18·50	3 29	0 3·55	22·05	32 36·67	13 10	0 50·60	27·27
		59 4	33 2·67	8 18	0 20·18	22·85	33 24·50	1 32	0 0·68	25·18
			32 50·00	10 43	0 33·71	23·71	33 22·67	2 57	0 2·54	25·21

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Abstract of Astronomical Azimuth observed at XVII (Gúrmi) 1842.

1. By Eastern Elongation of ϵ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	190°	10°	199°	19°	209°	29°	219°	39°	229°	49°	239°	59°
Date	December 4		December 5		December 6		December 7		December 8		December 9	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference	18·24	18·01	17·45	24·06	16·05	23·48	19·76	26·43	25·93	26·23	23·16	29·53
of Circle-Readings,	21·31	18·64	19·10	21·74	21·28	22·69	21·39	22·41	23·43	23·80	22·05	27·27
Ref. M.—Star	22·37	17·84	21·08	25·14	21·52	23·50	19·50	22·50	28·12	22·79	22·85	25·18
reduced to Elongation	20·03	18·69	17·54	22·73	21·87	22·04	18·32	24·21	26·24	22·56	23·71	25·21
	22·11	16·72	15·97		20·40	22·92	14·56	25·72	29·25	27·19		
	24·35	14·88	20·57		22·29	22·00	15·10	23·74	26·04	24·34		
Means	21·40	17·46	18·62	23·42	20·57	22·77	18·11	24·17	26·50	24·49	22·94	26·80
	° ′ "		"		"		"		"		"	
Means of both faces	− 9 33 19·43		21·02		21·67		21·14		25·49		24·87	
Az. of Star fr. S., by W.	188 38 5·24		5·50		5·81		6·09		6·36		6·64	
Az. of Ref. M. „	179 4 45·81		44·48		44·14		44·95		40·87		41·77	

2. By Western Elongation of ϵ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	190°	10°	199°	19°	209°	29°	219°	39°	229°	49°	239°	59°
Date	December 4		December 5		December 6		December 7		December 8		December 9	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference	51·06	41·24	55·40	41·43	49·35	48·29	53·97	45·53	58·83	44·70	60·16	49·02
of Circle-Readings,	54·96	43·82	54·32	40·17	49·22	46·46	55·84	48·14	60·03	45·77	58·80	49·95
Ref. M.—Star	50·82	53·41	50·26	48·59	50·21	47·39	57·52	47·00	55·39	46·62	57·39	51·38
reduced to Elongation	51·13	52·81	50·12	46·96	47·34	46·62	54·93	47·20	53·94	48·16	57·61	49·85
					48·28	50·39						
					49·35	50·00						
Means	51·99	47·82	52·53	44·29	48·96	48·19	55·57	46·97	57·05	46·31	58·49	50·05
	° ′ "		"		"		"		"		"	
Means of both faces	+ 7 42 49·91		48·41		48·58		51·27		51·68		54·27	
Az. of Star fr. S., by W.	171 21 54·91		54·63		54·35		54·06		53·79		53·51	
Az. of Ref. M. „	179 4 44·82		43·04		42·93		45·33		45·47		47·78	

		° ′ "
Astronomical Azimuth of Referring Mark	by Eastern Elongation	179 4 43·67
	by Western „	„ 44·89
	Mean	„ 44·28
Angle Referring Mark and XX (Panáhat) *see page* 19—J.		− 23 14 36·59
Astronomical Azimuth of Panáhat by observation		155 50 7·69
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see page* 52—J. *ante*.		155 50 9·20
Astronomical—Geodetical Azimuth at XVII (Gúrmi)		− 1·51

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At XXVIII (Sankráo)

Lat. N. 28° 2′ 28″·99; Long. E. 78° 34′ 30″·15 = 5^h 14^m 18^s·0; Height above Mean Sea Level, 670 feet.

February 1843; observed by Lieutenant T. Renny with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed	29 Camelopardalis Hev.* (East and West).
Mean Right Ascension 1838·0	10^h 4^m 53^s
Mean North Polar Distance 1838·0	4° 56′ 1″·14
Local Mean Times of Elongation, February 16	Eastern 6^h 33^m; Western 18 10

* So called in Everest's "*Measurement of the Meridional Arc of India*" 1847, p. 98. The Star is identical with B.A.C. No. 3495 Ursæ Majoris, and with Madras General Catalogue No. 4534, 189 Camelop. [ardalis]. It is not in Pond's Cat. of 1112 stars 1833—which seems to have furnished other names, *e.g.* 146 Rangiferis observed at Somtána Hill Station of the Great Arc Meridional Series, Section 18° to 24°. No evidence remains pointing certainly to any one catalogue relied on by Everest. The place given here is from an autograph list of circumpolars furnished by "T. G. Taylor, H. C. Astronomer" for 1838, presumably at Everest's request. J. H.

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Feb. 16	E.	99 53	− 5 37 34·83	1 58	− 0 0·75	− 5 37 35·58	− 5 37 16·83	10 14	− 0 20·04	− 5 37 36·87
		&	37 33·17	5 8	0 5·06	38·23	37 30·50	7 4	0 9·58	40·08
		279 54	35 34·33	25 8	2 1·69	36·02	37 4·17	13 55	0 37·21	41·38
			35 14·83	27 5	2 21·30	36·13	36 52·83	16 24	0 51·78	44·61
" 16	W.	99 54	+ 5 35 6·33	24 20	+ 1 53·97	+ 5 36 60·30	+ 5 36 30·17	12 53	+ 0 31·93	+ 5 36 62·10
		&	35 31·00	21 40	1 30·38	61·38	36 40·83	10 4	0 19·45	60·28
		279 54	36 58·50	1 53	0 0·68	59·18	36 46·50	8 41	0 14·43	60·93
			37 2·00	0 22	0 0·03	62·03	36 40·50	10 19	0 20·34	60·84
" 17	E.	109 53	− 5 37 32·00	6 48	− 0 8·86	− 5 37 40·86	− 5 36 53·67	15 54	− 0 48·31	− 5 37 41·98
		&	37 34·33	6 10	0 7·30	41·63	37 7·00	13 51	0 36·70	43·70
		289 53	37 19·00	10 39	0 21·83	40·83	37 40·50	1 4	0 0·22	40·72
			37 7·83	13 10	0 33·34	41·17	37 37·83	3 4	0 1·79	39·62
" 17	W.	109 53	+ 5 36 40·33	10 48	+ 0 22·41	+ 5 36 62·74	+ 5 35 30·33	20 45	+ 1 22·94	+ 5 36 53·27
		&	36 50·67	8 11	0 12·88	63·55	35 50·83	18 32	1 6·07	56·90
		289 53	36 35·67	11 19	0 24·51	60·18	36 54·83	0 7	0 0·00	54·83
			36 22·00	14 13	0 38·62	60·62	36 55·67	2 20	0 1·05	56·72
" 18	E.	119 53	− 5 37 24·33	5 35	− 0 5·98	− 5 37 30·31	− 5 36 44·33	17 12	− 0 56·48	− 5 37 40·81
		&	37 28·33	4 36	0 4·06	32·39	37 0·50	14 56	0 42·62	43·12
		299 53	37 1·83	13 2	0 32·68	34·51	37 40·17	1 2	0 0·20	40·37
			36 51·17	15 13	0 44·53	35·70	37 36·17	4 13	0 3·43	39·60

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark—Star at Elongation
			° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Feb. 18	W.	119 53	+ 5 36 5·83	16 43	+ 0 53·80	+ 5 36 59·63	+ 5 34 29·50	27 38	+ 2 27·09	+ 5 36 56·59
		&	36 23·83	13 38	0 35·72	59·55	34 58·00	24 55	1 59·61	57·61
		299 53	36 37·67	9 58	0 19·01	56·68	36 56·00	3 46	0 2·73	58·73
			36 29·50	12 11	0 28·37	57·87	37 1·33	0 13	0 0·01	61·34
„ 19	E.	129 53	− 5 37 35·67	2 1	− 0 0·78	− 5 37 36·45	− 5 37 23·33	10 10	− 0 19·77	− 5 37 43·10
		&	37 35·83	0 17	0 0·02	35·85	37 26·50	8 36	0 14·15	40·65
		309 53	36 39·33	17 18	0 57·52	36·85	37 29·17	8 5	0 12·54	41·71
			36 31·83	18 37	1 6·73	38·56	37 20·67	9 44	0 18·18	38·85
„ 19	W.	129 53	+ 5 36 55·00	4 48	+ 0 4·43	+ 5 36 59·43	+ 5 35 46·83	19 18	+ 1 11·72	+ 5 36 58·55
		&	37 0·67	0 50	0 0·13	60·80	35 57·83	17 28	0 58·74	56·57
		309 53					36 32·50	11 59	0 27·51	60·01
							36 26·17	13 34	0 35·22	61·39
„ 20	E.	139 53	− 5 37 36·50	0 3	− 0 0·00	− 5 37 36·50	− 5 37 25·33	7 32	− 0 10·88	− 5 37 36·21
		&	37 35·83	2 11	0 0·92	36·75	37 29·33	6 22	0 7·79	37·12
		319 53	36 36·33	17 48	1 0·98	37·31	37 20·67	9 17	0 16·58	37·25
			36 23·33	19 39	1 14·31	37·64	37 13·50	10 41	0 21·95	35·45
„ 20	W.	139 53	+ 5 35 36·17	20 31	+ 1 21·03	+ 5 36 57·20	+ 5 36 45·17	8 51	+ 0 15·03	+ 5 36 60·20
		&	35 50·67	18 25	1 5·31	55·98	36 49·83	7 24	0 10·51	60·34
		319 53	36 56·33	0 4	0 0·00	56·33	36 39·33	10 17	0 20·22	59·55
			36 55·33	2 26	0 1·13	56·46	36 29·33	12 14	0 28·66	57·99
„ 21	E.	149 53	− 5 37 25·83	6 27	− 0 7·98	− 5 37 33·81	− 5 37 36·33	3 13	− 0 1·98	− 5 37 38·31
		&	37 20·00	8 51	0 15·08	35·08	37 38·00	0 2	0 0·00	38·00
		329 53	35 44·50	23 53	1 49·90	34·40	36 38·67	17 14	0 57·17	35·84
			35 32·50	25 18	2 3·31	35·81	36 30·67	18 15	1 4·11	34·78
„ 21	W.	149 53	+ 5 36 20·17	13 32	+ 0 35·25	+ 5 36 55·42	+ 5 35 11·00	22 54	+ 1 40·99	+ 5 36 51·99
		&	36 30·17	11 47	0 26·67	56·84	35 27·67	20 50	1 23·60	51·27
		329 53	36 32·33	10 51	0 22·55	54·88	36 48·67	1 47	0 0·61	49·28
			36 29·00	11 52	0 26·95	55·95	36 53·00	0 6	0 0·00	53·00

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Abstract of Astronomical Azimuth observed at XXVIII (Sankráo) 1843.

1. By Eastern Elongation of 29 Camelopardalis Hev.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	100°	280°	110°	290°	120°	300°	130°	310°	140°	320°	150°	330°
Date	February 16		February 17		February 18		February 19		February 20		February 21	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference	35.58	36.87	40.86	41.98	30.31	40.81	36.45	43.10	36.50	36.21	33.81	38.31
of Circle-Readings,	38.23	40.08	41.63	43.70	32.39	43.12	35.85	40.65	36.75	37.12	35.08	38.00
Ref. M.—Star	36.02	41.38	40.83	40.72	34.51	40.37	36.85	41.71	37.31	37.25	34.40	35.84
reduced to Elongation	36.13	44.61	41.17	39.62	35.70	39.60	38.56	38.85	37.64	35.45	35.81	34.78
Means	36.49	40.74	41.12	41.51	33.23	40.98	36.93	41.08	37.05	36.51	34.78	36.73
	° ′ "		"		"		"		"		"	
Means of both faces	− 5 37 38.61		41.31		37.10		39.01		36.78		35.75	
Az. of Star fr. S., by W.	185 37 17.74		17.40		17.06		16.71		16.36		16.02	
Az. of Ref. M. „	179 59 39.13		36.09		39.96		37.70		39.58		40.27	

2. By Western Elongation of 29 Camelopardalis Hev.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	100°	280°	110°	290°	120°	300°	130°	310°	140°	320°	150°	330°
Date	February 16		February 17		February 18		February 19		February 20		February 21	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference	60.30	62.10	62.74	53.27	59.63	56.59	59.43	58.55	57.20	60.20	55.42	51.99
of Circle-Readings,	61.38	60.28	63.55	56.90	59.55	57.61	60.80	56.57	55.98	60.34	56.84	51.27
Ref. M.—Star	59.18	60.93	60.18	54.83	56.68	58.73		60.01	56.33	59.55	54.88	49.28
reduced to Elongation	62.03	60.84	60.62	56.72	57.87	61.34		61.39	56.46	57.99	55.95	53.00
Means	60.72	61.04	61.77	55.43	58.43	58.57	60.12	59.13	56.49	59.52	55.77	51.39
	° ′ "		"		"		"		"		"	
Means of both faces	+ 5 36 60.88		58.60		58.50		59.62		58.01		53.58	
Az. of Star fr. S., by W.	174 22 42.42		42.77		43.12		43.46		43.80		44.15	
Az. of Ref. M. „	179 59 43.30		41.37		41.62		43.08		41.81		37.73	

		° ′ "
Astronomical Azimuth of Referring Mark	by Eastern Elongation	179 59 38.79
	by Western „	„ 41.48
	Mean	„ 40.14
Angle Referring Mark and XXX (Sakrora) *see page* 23—J.		+ 5 44 40.43
Astronomical Azimuth of Sakrora by observation		185 44 20.57
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see page* 53—J. *ante*		185 44 19.17
Astronomical—Geodetical Azimuth at XXVIII (Sankráo)		+ 1.40

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At XL (Sirsa)

Lat. N. 28° 54′ 39″·64; Long. E. 78° 34′ 33″·32 = 5ʰ 14ᵐ 18ˢ·2; Height above Mean Sea Level, 739 feet.

February 1843; observed by Mr. W. N. James with Cary's 15-inch Theodolite.

Star observed	29 Camelopardalis Hev.* (West and East).
Mean Right Ascension 1838·0	10ʰ 4ᵐ 53ˢ
Mean North Polar Distance 1838·0	4° 56′ 1″·14
Local Mean Times of Elongation, Feb. 12	Western 18ʰ 25ᵐ; Eastern 6 49

* So called in Everest's "*Measurement of the Meridional Arc of India*" 1847 p. 98. The Star is indentical with B.A.C. No. 3495 Ursæ Majoris, and with Madras General Catalogue No. 4534, 189 Camelop. [ardalis]. It is not in Pond's Cat. of 1112 stars 1833—which seems to have furnished other names, *e.g.* 146 Rangiferis observed at Somtána Hill Station of the Great Arc Meridional Series, Section 18° to 24°. No evidence remains pointing certainly to any one catalogue relied on by Everest. The place given here is from an autograph list of circumpolars furnished by "T. G. Taylor, H. C. Astronomer", for 1838, presumably at Everest's request. J. H.

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark − Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark − Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Feb. 12	W.	180 1	− 56 5 53·47	12 53	+ 0 32·22	− 56 5 21·25	− 56 7 46·70	27 30	+ 2 26·99	− 56 5 19·71
		&	5 41·40	10 14	0 20·30	21·10	6 35·60	19 49	1 16·17	19·43
		0 1	5 31·60	6 45	0 8·79	22·81	5 14·40	2 9	0 0·89	13·51
			5 37·50	8 30	0 13·95	23·55	5 10·83	0 27	0 0·04	10·79
„ 15	W.	190 1	− 56 7 1·83	23 10	+ 1 44·29	− 56 5 17·54	− 56 9 26·74	35 47	+ 4 9·14	− 56 5 17·60
		&	6 44·26	20 31	1 21·70	22·56	8 48·37	33 17	3 35·41	12·96
		10 1	5 25·40	1 55	0 0·71	24·69	5 31·74	9 48	0 18·63	13·11
			5 25·40	4 11	0 3·38	22·02	5 20·66	7 51	0 11·93	8·73
							5 56·60	14 39	0 41·35	15·25
							6 1·40	16 51	0 54·71	6·69
„ 16	E.	190 1	− 67 25 26·83	4 21	− 0 3·67	− 67 25 30·50	− 67 24 52·36	15 19	− 0 45·23	− 67 25 37·59
		&	25 36·77	1 52	0 0·67	37·44	24 59·74	12 52	0 31·92	31·66
		10 1	24 32·80	17 58	1 2·66	35·46	25 22·13	6 8	0 7·30	29·43
			24 18·43	19 58	1 17·32	35·75	25 10·23	10 59	0 23·39	33·62
„ 16	W.	200 1	− 56 7 21·00	24 2	+ 1 52·12	− 56 5 28·88	− 56 9 38·50	36 4	+ 4 12·88	− 56 5 25·62
		&	7 3·60	22 12	1 35·73	27·87	8 44·87	32 23	3 23·87	21·00
		20 1	5 23·73	3 30	0 2·38	21·35	6 2·43	14 1	0 38·09	24·34
			5 25·47	0 38	0 0·08	25·39	5 40·83	11 46	0 26·81	14·02
							5 30·57	7 48	0 11·73	18·84
							5 37·74	9 30	0 17·41	20·33
„ 17	E.	200 1	− 67 25 33·60	4 19	− 0 3·61	− 67 25 37·21	− 67 24 58·50	14 43	− 0 41·77	− 67 25 40·27
		&	25 35·13	2 16	0 1·00	36·13	25 13·33	12 31	0 30·20	43·53
		20 1	24 37·67	17 30	0 59·44	37·11	25 29·00	5 25	0 5·68	34·68
			24 19·57	20 16	1 19·68	39·25	25 22·80	7 33	0 11·06	33·86

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark − Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark − Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Feb. 17	W.	210 1	− 56 5 59·50	13 14	+ 0 33·95	− 56 5 25·55	− 56 7 4·70	23 22	+ 1 45·95	− 56 5 18·75
		&	5 48·93	11 26	0 25·31	23·62	6 45·24	21 19	1 28·25	16·99
		30 1	5 40·47	9 32	0 17·53	22·94	5 20·37	3 35	0 2·49	17·88
			5 48·06	11 28	0 25·38	22·68	5 16·63	1 45	0 0·59	16·04
„ 18	E.	210 1	− 67 25 20·77	8 35	− 0 14·23	− 67 25 35·00	− 67 24 35·63	16 35	− 0 53·03	− 67 25 28·66
		&	25 23·33	7 8	0 9·83	33·16	24 51·24	14 35	0 41·01	32·25
		30 1	25 20·67	7 36	0 11·21	31·88	25 29·70	0 52	0 0·14	29·84
			25 18·87	9 12	0 16·38	35·25	25 27·47	0 53	0 0·15	27·62
„ 18	W.	220 1	− 56 7 9·13	23 16	+ 1 45·17	− 56 5 23·96	− 56 9 6·47	34 1	+ 3 45·00	− 56 5 21·47
		&	6 44·46	20 37	1 22·49	21·97	8 29·60	31 33	3 13·41	16·19
		40 1	5 22·17	0 17	0 0·01	22·16	5 39·36	11 16	0 24·62	14·74
			5 21·67	1 45	0 0·59	21·08	5 31·27	9 4	0 15·92	15·35
„ 19	E.	220 1	− 67 25 29·50	1 50	− 0 0·65	− 67 25 30·15	− 67 25 9·10	8 33	− 0 14·10	− 67 25 23·20
		&	25 27·96	4 20	0 3·64	31·60	25 17·20	6 43	0 8·69	25·89
		40 1	23 42·43	23 52	1 50·69	33·12	24 59·20	12 46	0 31·57	30·77
			23 24·20	25 49	2 9·45	33·65	24 50·17	14 34	0 41·14	31·31
„ 20	E.	230 1	− 67 24 52·80	13 11	− 0 33·67	− 67 25 26·47	− 67 25 16·33	2 28	− 0 1·18	− 67 25 17·51
		&	24 41·80	15 28	0 46·40	28·20	25 11·40	4 59	0 4·82	16·22
		50 1	21 12·77	36 32	4 19·70	32·47	23 14·70	25 7	2 2·47	17·17
			20 32·47	38 56	4 54·97	27·44	22 52·57	27 7	2 22·84	15·41
„ 20	W.	230 1	− 56 8 49·26	32 55	+ 3 30·74	− 56 5 18·52	− 56 11 46·07	44 57	+ 6 33·38	− 56 5 12·69
		&	8 7·13	29 19	2 47·00	20·13	10 51·53	41 55	5 41·86	9·67
		50 1	5 18·63	1 21	0 0·35	18·28	6 23·67	18 37	1 7·27	16·40
			5 19·70	0 48	0 0·12	19·58	5 55·16	15 6	0 44·28	10·88
„ 21	E.	180 1	− 67 25 30·94	2 26	− 0 1·14	− 67 25 32·08	− 67 25 15·17	6 57	− 0 9·31	− 67 25 24·48
		&	25 31·40	4 46	0 4·41	35·81	25 20·30	5 14	0 5·30	25·60
		0 1					24 37·60	15 54	0 49·06	26·66
„ 22	E.	180 0	− 67 25 33·83	5 27	− 0 5·74	− 67 25 39·57	− 67 25 25·40	4 26	− 0 3·79	− 67 25 29·19
		&	25 26·84	7 20	0 10·42	37·26	25 24·56	1 51	0 0·67	25·23
		0 0	24 18·63	19 26	1 13·32	31·95				

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Abstract of Astronomical Azimuth observed at XL (Sirsa) 1843.

1. By Eastern Elongation of 29 Camelopardalis Hev.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	210°	30°	220°	40°	230°	50°
Date	February 21		February 16		February 17		February 18		February 19		February 20	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	32·08	24·48	30·50	37·59	37·21	40·27	35·00	28·66	30·15	23·20	26·47	17·51
	35·81	25·60	37·44	31·66	36·13	43·53	33·16	32·25	31·60	25·89	28·20	16·22
	*40·10	26·66	35·46	29·43	37·11	34·68	31·88	29·84	33·12	30·77	32·47	17·17
	*37·79	*29·72	35·75	33·62	39·25	33·86	35·25	27·62	33·65	31·31	27·44	15·41
	*32·48	*25·76										
Means	35·65	26·44	34·79	33·08	37·43	38·09	33·82	29·59	32·13	27·79	28·65	16·58
	° ′ ″		"		"		"		"		"	
Means of both faces	− 67 25 31·05		33·93		37·76		31·71		29·96		22·61	
Az. of Star fr. S., by W.	185 40 3·89		5·63		5·28		4·93		4·59		4·23	
Az. of Ref. M. „	118 14 32·84		31·70		27·52		33·22		34·63		41·62	

2. By Western Elongation of 29 Camelopardalis Hev.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	210°	30°	220°	40°	230°	50°
Date	February 12		February 15		February 16		February 17		February 18		February 20	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M—Star reduced to Elongation	21·25	19·71	17·54	17·60	28·88	25·62	25·55	18·75	23·96	21·47	18·52	12·69
	21·10	19·43	22·56	12·96	27·87	21·00	23·62	16·99	21·97	16·19	20·13	9·67
	22·81	13·51	24·69	13·11	21·35	24·34	22·94	17·88	22·16	14·74	18·28	16·40
	23·55	10·79	22·02	8·73	25·39	14·02	22·68	16·04	21·08	15·35	19·58	10·88
				15·25		18·84						
				6·69		20·33						
Means	22·18	15·86	21·70	12·39	25·87	20·69	23·70	17·42	22·29	16·94	19·13	12·41
	° ′ ″		"		"		"		"		"	
Means of both faces	− 56 5 19·02		17·05		23·28		20·56		19·62		15·77	
Az. of Star fr. S., by W.	174 19 53·16		54·19		54·54		54·89		55·24		55·94	
Az. of Ref. M. „	118 14 34·14		37·14		31·26		34·33		35·62		40·17	

		° ′ ″
Astronomical Azimuth of Referring Mark	by Eastern Elongation	118 14 33·59
	by Western „	„ 35·44
	Mean	„ 34·52
Angle Referring Mark and XLIII (Milik) *see page* 29—J.		+ 31 40 42·24
Astronomical Azimuth of Milik by observation		149 55 16·76
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see page* 54—J. *ante*		149 55 20·99
Astronomical—Geodetical Azimuth at XL (Sirsa)		− 4·23

NOTE.—Where observations occurred on the same pair of zeros on different nights they are reduced in this abstract to one date—the most convenient—by allowing for star's change of place. The date so adopted appears at the head of the column, and the reduced observation is preceded by an asterisk.

May 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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BUDHON MERIDIONAL SERIES.

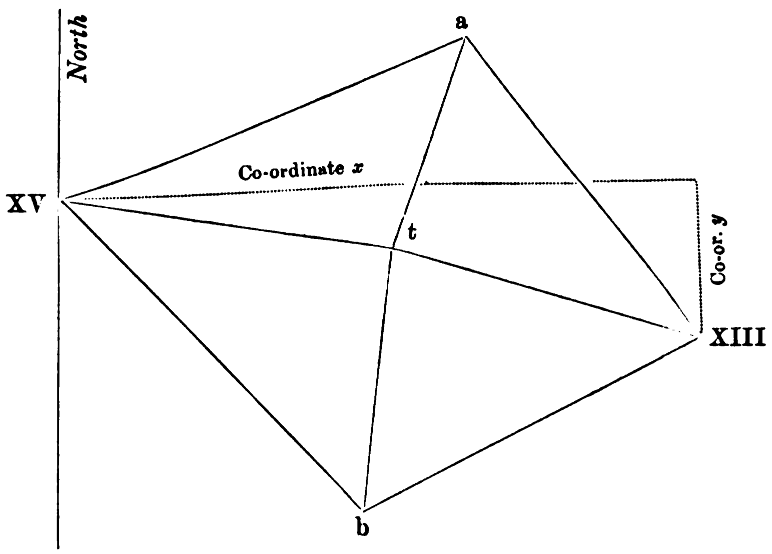
PRINCIPAL TRIANGULATION.

DETERMINATION OF THE DIFFERENCES IN LATITUDE AND LONGITUDE BETWEEN THE TWO PRINCIPAL STATIONS ON RAEPUR HILL, LAT. N. 26° 8', LONG. E. 78° 7'.

As the summit of the conical peak of Ráepur was found occupied by a Hindu Temple when the advance party of the Great Arc Series visited the hill in 1833, the station *then* selected was necessarily placed on the side of the cone, and by preference West of the Temple since some of the Great Arc Series stations lay in that direction: the point chosen is numbered XV and is described at page 5—A Volume IV of the "Account of the Operations of the Great Trigonometrical Survey of India". Subsequently, it was necessary to select another station on the same hill to suit the Budhon Meridional Series which passes East of Ráepur, so that the point now chosen was necessarily placed on the East face of the cone; this station is numbered XIII and is described at page 5—J of this volume. Thus principal stations XV and XIII stand on opposite sides of the Temple, which obstructs the view between them; they are equidistant from the Temple and are about 41 feet apart.

Stations XV and XIII were however not connected with one another until November 1877, when Mr. W. J. Cornelius, Assistant Surveyor, was instructed to make the necessary measurements, with the view of establishing, in station XIII, an additional *fixed point* on which to fit the Budhon Meridional Series. The adjustments of this series which followed, will be found explained in Part I of Volume VII; it is only necessary here to describe Mr. Cornelius' operations and to state their results.

Mr. Cornelius found the structure and mark of XV in good order. But at station XIII the isolated circular pillar had been wilfully destroyed, and this had been done so effectually that even the lower markstone could not be found: the circular pillar had however been originally enclosed, as usual, within a platform, so that on removing the former there remained in the latter a corresponding circular cavity, from which the position of the original mark was determined with ample accuracy for the object now in view and certainly within a foot of the truth. Station XIII being thus sufficiently found, three auxiliary stations a, b and t were chosen; of these t was on the Temple*: the connection between XV and XIII, thus made, is shown in the marginal diagram.



As the distances involved were only a few feet, sufficient accuracy was secured by using a Prismatic Compass and Measuring Tape. Both back and forward magnetic bearings were taken on all the lines: the forward azimuths given in the following table were found, by taking the mean on each line of the forward bearing increased by 180° and the back bearing, and correcting the mean for Magnetic Variation†. The distances were measured with the Tape. The bearing of the line t to XIII could not be determined

* This point is identical with the station of the Gwalior and Central India Topographical Survey. † Variation East 1° 13'.

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Principal Triangulation. Stations on Ráepur Hill.

with accuracy, because the dome of the Temple rose between the two to an inconvenient height.

No.	At	Azimuth of	Azimuth ° ′	Distance ft.	Distance in.	No.	At	Azimuth of	Azimuth ° ′	Distance ft.	Distance in.
1	XV	a	250 43	27	0	5	XV	t	281 5	20	8
2	a	XIII	322 5	23	9	6	t	a	200 58	13	10
3	XV	b	318 5	27	2	7	a	XIII	322 5	23	9
4	b	XIII	243 48	24	4·5	8	t	b	8 50	16	6
						9	b	XIII	243 48	24	4·5

Adopting the combinations indicated in the following table, the 4 routes between XV and XIII were plotted on a scale of 1 inch = 2 feet, with XV for origin and its meridian and perpendicular as co-ordinates, and the resulting co-ordinates of XIII given hereafter were measured off with a pair of compasses.

By Combining Nos.	Co-ordinates of XIII referred to XV: South or y ft.	in.	East or x ft.	in.
1 and 2	9	9	39	4·5
3 and 4	10	0·8	39	9·8
5, 6 and 7	9	6	39	6
5, 8 and 9	9	11·5	39	11
Means ...	9	9·8	39	7·8

The equivalents of these results are,

$$\left.\begin{array}{l}\text{Latitude, South 9 ft. 9·8 in.} = -\ 0''\cdot10 \\ \text{Longitude, East 39 ft. 7·8 in.} = +\ 0\cdot44\end{array}\right\} \quad \ldots\ldots \quad (a)$$

which are the required differences in Latitude and Longitude between XV and XIII.

Now since XV has already been fixed by the simultaneous reduction of the North-West Quadrilateral, we have only to take the Latitude and Longitude of XV thus determined and apply to them the differences (*a*), in order to find the *corresponding* values of XIII, as follows,

	Latitude N.	*Longitude E.*
Of XV, see Vol. IV Great Arc Meridional Series Page 26—a	26° 8′ 14″·39	78° 7′ 15″·71
(*a*) from above	− 0 ·10	+ 0 ·44
Corresponding values of XIII	26 8 14 ·29	78 7 16 ·15

These are the values of XIII to which the Budhon Meridional Series has been made to conform at this point.

J. B. N. HENNESSEY,
In charge of Computing Office.

28*th March* 1881.

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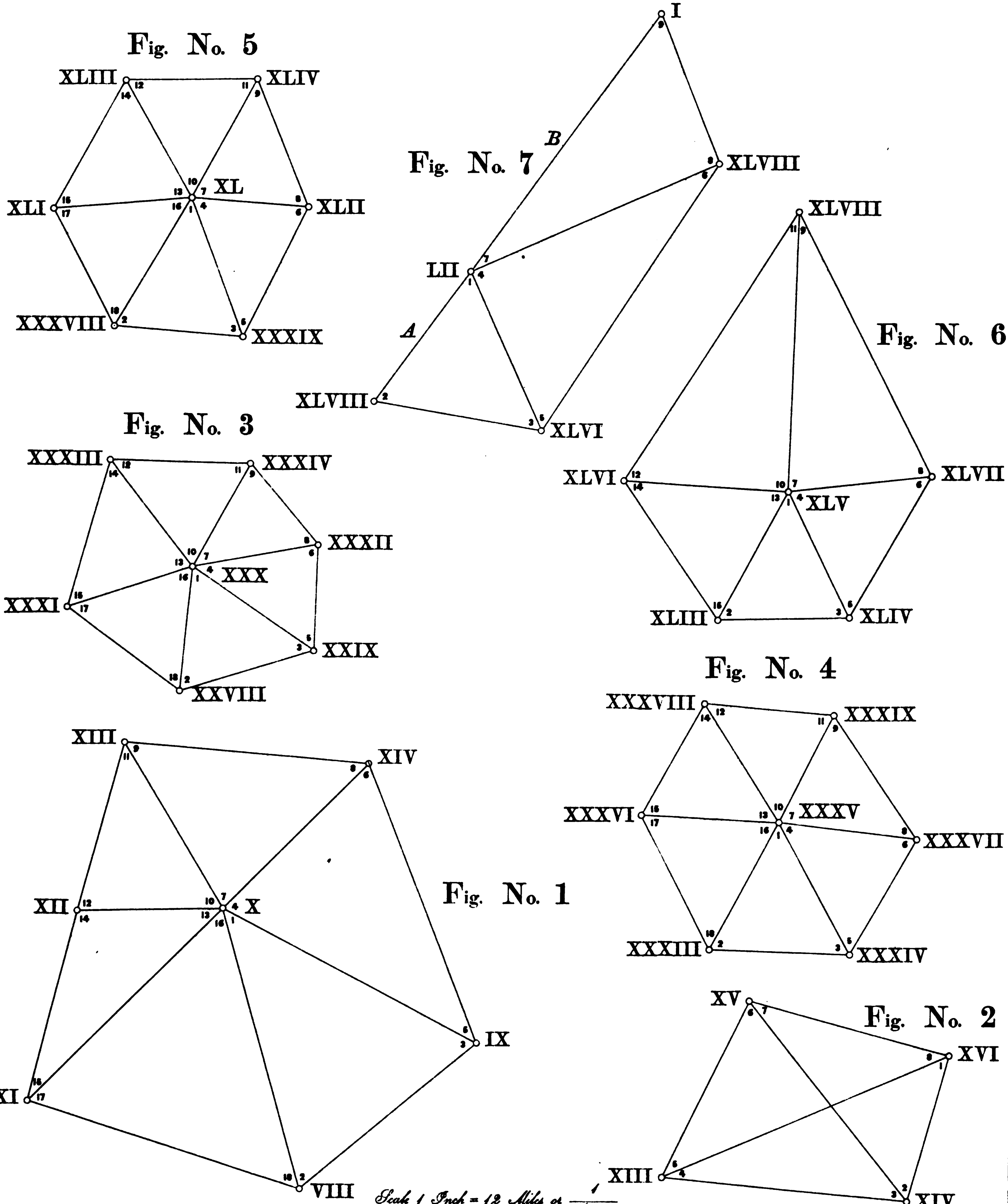
PRINCIPAL TRIANGULATION—BUDHON MERIDIONAL SERIES.



Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

O. DYSON, PHOTO. *Photozincographed at the Office of the Superintendent Great Trigonometrical Survey, Dehra Dún, November 1877.* C. G. OLLENBACH, ZINCO

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RANGIR MERIDIONAL SERIES.

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RANGIR MERIDIONAL SERIES—(LONG. 79° 30′).

INTRODUCTION.

The Rangír Series is the second in order, reckoning eastwards from the Great Arc, of the meridional chains of triangles which are included in the North-East Quadrilateral. It is aligned, as closely as the nature of the country would allow, on the meridian of Rangír, *viz.*, 79½°. It emanates from the side Tinsmál-Rangír of the Calcutta Longitudinal Series, and extends over a meridional distance of about 4½°, up to the North-East Longitudinal Series. It was constructed throughout as a chain of single triangles, but with the introduction of a trigon around the station of Muhammadabad (XXII). For the first hundred miles of its length, it crosses the low hills which, generally speaking, may be said to form the northern outliers of the Great Vindhya range; and in this part of its course, it traverses portions of the modern districts of Saugor, Damoh, Jhánsi and Hamírpur and of the Native States which are affiliated with the Bundelkhand Agency. It then enters the great plains of the Gangetic valley, and after crossing portions of the modern districts of Jálaun, Etáwah, Farrukhabad, Sháhjahánpur, Budaun and Bareilly, terminates in the forests of the Tarái at the foot of the Himalayan mountains.

The execution of the Series was originally entrusted to Lieutenant A. S. Waugh of the Bengal Engineers—afterwards Surveyor General—Lieutenant T. Renny of the same Corps being chosen at the same time to conduct the adjoining chain of triangles to the east, *viz.*, the Amua Series. Both these officers had recently been appointed to the Great Trigonometrical Survey, on the recommendation of Major Everest, the Surveyor General, with a view to the early commencement of these chains of triangles. But as they had had no previous experience of principal trigonometrical operations which were designed to subserve the requirements of Geodesy as well as Geography, Major Everest recommended that they should be primarily employed as assistants in the operations which were then being carried out on the Great Arc, in order to gain a practical knowledge of duties such as those which they were eventually intended to undertake, observing that "although both these "gentlemen are highly talented as far as theory goes, they cannot be expected to conduct "duties of this sort intuitively".

At the time when their appointments to the Great Trigonometrical Survey were sanctioned by the Government they were both in Calcutta; and as in marching from Calcutta to the scene of their operations, in Central India, they would have to pass through or near

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certain localities of which "as little was known as of the heart of Africa", Major Everest proposed that they should carry a rapid route-survey (supplemented by suitable descriptive notes) through the tracts in question. He drew up instructions for their guidance, which are given below *in extenso**, as they are interesting for the evidence they afford of the necessity which existed in those days for combining surveys of the roughest description, which were wanted to satisfy immediate geographical requirements, with operations of extreme precision, which were intended to form a permanent basis for all future survey operations.

Even the primary operation of selecting suitable sites for the stations of the principal triangulation was made to subserve the geographical requirements of the moment; it furnished approximate values of the positions of the stations themselves and of the hill

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**Extract of Instructions communicated to Lieutenants Waugh and Renny, by the Surveyor General in November* 1832.

The first obvious blank in all our maps is the mass of mountain land on which Rotasgurh is situated.

The range called "Kula Phar" to the east of this which bounds the valley of the Soane may be generally laid down.

But as to the route over the mountain at the back of Rotasgurh, this gap in our knowledge may well be filled up more particularly. I took a route of the tract between Rotasgurh and Punnoogunge near Bijeygurh in 1817, which is perhaps as accurate as route surveys in general. It was plotted very carefully by me from my field book and I lent it to Colonel Blacker for the purpose of facilitating the operations of my own people under Mr. Olliver in 1825. In that plan there is a road from Weenee branching off to Chunar left incompleted, the last place on it being Bogheelah. There is also a road from Dhobaee branching off to Chaenpoor from the road between Bijeygurh and Sheergurh, the most advanced place on it being Peeprah. If these two roads could be explored they would connect the details of my sketch with the general map, and the details would be filled up more satisfactorily still if direct roads can be found leading from Sheergurh to Rotasgurh, from Bijeygurh to Chunar, and from Bijeygurh to Rotasgurh along the face of the mountains.

I leave it to your judgment to examine or not any portion of my route again. You may perhaps lay down the hills more accurately, which is an object, and as it was a very hasty performance, you may if you find any errors correct them, but I think you will find it as good as route surveys usually are.

Rough plans of Bijeygurh and Sheergurh will be of use as well as plans of any other hill forts on that range. Historical facts connected with Sheergurh may be instructive. The tract to the southward of Sonegurra or Songurh leading to Omurkuntuk is absolutely *terra incognita* and it is one of the most interesting parts of India both geologically and geographically. The route I wish to be explored is that leading to Omurkuntuk from Rajgurh on the Soane, but you may be compelled to adopt some other route and I must rely on your prudence to take that which will afford the most information. Rajgurh appears to lie in Latitude 24° 35′ and Longitude 82° 6′, Omurkuntuk in Latitude 22° 40′ and Longitude 81° 43′. Whatever route you take however, you must cross the southern face of the Kimoor range respecting which any particulars you can give will be interesting.

Your Latitudes and Longitudes will all be referred to the nearest principal stations of the Longitudinal Series of the Great Trigonometrical Survey, whenever you can manage to discover them.

Having explored the route to Omurkuntuk, you will proceed if possible along the northern bank of the Nerbuddah to Jubbulpore and from thence to Seronj, where you will fall in with the party under Mr. Rossenrode, and I wish you to take advantage of that opportunity to acquire a practical acquaintance with the method of conducting Trigonometrical operations in the field.

I need not point out to gentlemen of your good sense and talent how necessary it is to devote your whole energy to this object, and how manifest an advantage it is to you to enter on your career as geodesists with full liberty to use the splendid instruments of my department and try your hand at any part of the operations without apprehension of doing mischief. A course of regular operations could not hold out those advantages because business requiring the most scrupulous attention to accuracy is then to be performed; but in an approximate series, if you should make a wrong reading, it is but putting the pen through it, and the work will still be accurate enough for the object in view. I shall therefore trust to your own sense of propriety to lose no opportunity of qualifying yourselves to take charge of a party on one of the independent meridians; but when you can do so without injury to this principal object, I wish you to furnish as many data for the topography of the country within the Series as you can collect.

Data.

Barometer to be observed every day three times if possible at the same hour.

Two Barometers to be observed simultaneously when the depths of the beds of rivers or the heights of mountains are required.

Angles of elevations of any high peaks to be observed from two places whose distance is known, as well as the horizontal angles, so that the distances and heights of the main features of the country may be fixed.

Courses of rivers.—Where they emerge from the mountains to the plains. Their height at flood. Their minimum if perennial. Their period of drought if dried up. Locality of their sources. The strata they pass through, and the breadth of their beds. The depth of the channel as respects the surrounding country. Whether the banks are steep or cut into ravines or sloping.

Nature of the country passed through.—If a valley, how bounded, by high hills or low? The nature of those hills. Are they of primary or secondary formation? Do they contain mines of coal or marble or asphaltum or rock-salt, &c., or is there gold, lead, copper, &c.

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peaks, towns, villages or other prominent objects seen from them, by observations taken with small theodolites or sextants during the course of the general reconnaissance of the country. The preliminary triangulation thus executed came to be called the Approximate Series, for it was intended to serve as a *pis aller* until the principal observations with the great theodolites could be completed. It was invariably pushed on as rapidly as possible without regard to nicety, observations being taken sometimes from trees and lofty scaffolds in the plains, and sometimes to distant torches and blue-lights which could be seen with the aid of nocturnal refraction over intervening obstacles, before the 'rays' between the principal stations had been cleared for the final observations.

Babu Radhanath Sikdhar, 3rd Class, Sub-Asst.
Mr. W. Martin, " "

Lieutenants Waugh and Renny started from Calcutta early in the field season of 1832-33, with two assistants. After carrying out, as fully as was possible, the instructions they had received for making route-surveys and drawing up reports of the *terra incognita* through which they had to pass, they reached the camp of the party which was then employed on the Great Arc, at the principal station of Mao, in the Gwalior territory, about 18 miles from the town of Sipri. They devoted the remainder of the field season to acquiring an insight into the nature of the operations of the principal triangulation and some practical familiarity with the details.

The following recess was spent in Agra, where both officers were for some time occupied in bringing up their maps, plans, and reports on the route-surveys which they had recently accomplished, and afterwards in making preparations for commencing—in the next field season—the chains of triangles which had been respectively allotted to them.

Lieutenant Renny's subsequent operations being described in the Introductory Account of the Amua Series, we have here to deal only with those of Lieutenant Waugh, on the Rangír Series.

Season 1833-34.
PERSONNEL.
Lieut. A. S. Waugh, Bengal Engineers, 2nd Assistant.
Mr. J. W. Armstrong, 3rd Class Sub-Assistant.
" W. R. Forster, " "

The party which was intended to break ground on this Series was constituted as shewn in the margin. It was furnished with an 18-inch theodolite by Cary for the principal observations*, with two 7-inch instruments for the secondary work, and with such other equipment as was deemed necessary. It started from Agra on the 30th of November 1833, and marching

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to be found in them? How far from water carriage? Mineral springs, hot or cold. The order of the strata shewn in the beds of rivers and the bare sides of mountains.

Manners and language of the people.—Are they Hindoos or Mahomedans, or what is their religion? Are they obliging or hostile to strangers? To what state of civilization have they attained? Their progress in agriculture, manufactures, &c. The weapons they use. The language they speak. Are they a truth-telling people or deceitful and prone to falsehood? If the inhabitants are wild, are the settlements formed by the natives of Hindoostan amongst them numerous?

Fertility of the country.—Are there means of irrigation? Does the country admit of such being constructed, as building dykes? Number of crops a year? Are the people generally comfortable or oppressed? Are they wandering tribes, or attached to their homes?

Is the country open or covered with forest? What kinds of trees are found in the forests? Enumerate the different kinds of building wood to be met with. Are ebony and other kinds of wood fit for cabinet work found there? Of building materials, what means of water carriage? Drawings of curious temples, and all objects tending to illustrate the manners, customs, history, geology, and natural and artificial features of the country will be acceptable.

* Known as Cary's 18-inch L; for a description of this instrument see page 69 of the Appendices to Volume II.

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viâ Gwalior, Datia, Jhánsi and Saugor, arrived at Rangír about the 6th of January 1834.

Here Lieutenant Waugh commenced operations by taking a set of circumpolar star observations for determining a fundamental value of the azimuth, which was to be employed instead of the value that had been brought up through the Longitudinal Series from Kaliánpur. He then proceeded to lay out the triangulation, employing the side Rangír-Tikaria as his base, in conformity with the instructions he had received from Major Everest. But the ground immediately to the north of that side proved utterly impracticable for the extension of the triangulation therefrom; for the side was of considerable length—over 30 miles—and was confronted by a portion of the Vindhyáchal range which here developes itself into a mountainous table-land of considerable breadth, covered with high forest trees and dense underwood, and devoid of any commanding eminences. Thus the selection of symmetrically situated stations was a very difficult task to accomplish.

Lieutenant Waugh reported that after "having traversed the whole range and observed from nearly every high tree and rising ground", his endeavours had all been in vain to advance the Series in any other way than by constructing a tower station 35 feet high at Saipur on the hills to the north of Rangír to command the view. The tower was commenced, and it was being built of stones set in clay instead of mortar, and had attained a height of 10 feet, when the water supply failed; the remaining 25 feet was run up with dry stones, and it came tumbling down almost immediately after completion. This disaster, combined with the circumstance that it would be necessary not merely to rebuild the tower at Saipur, but to construct a tower 60 feet high on the Sonha hills, at a considerable cost, if the originally intended side of origin was to be maintained, eventually induced Lieutenant Waugh to adopt the side Tinsmál-Rangír as the origin of the Series. At first however he loyally endeavoured to carry out the instructions he had received, reporting progress constantly and soliciting further orders; but the postal arrangements in those regions were so defective that he frequently did not receive answers to his letters to the Surveyor General in less than two months. A change of base involved the rejection of the work of several months which a young officer might well shrink from doing on his own responsibility; but immediate action was necessary, and Major Everest when all the facts were reported to him, at once approved of the change, saying that it was quite sufficient "if one flank of the Series—it did not matter which—was kept close to the meridian of the operations", and giving as an illustration the Great Arc Series which "runs as often on one side of the meridian as the other" and follows the principle of "not fighting with a difficult tract when its flank can be turned". As regards the two towers which were required for the triangulation from the original base, Major Everest wrote that he preferred "vitiating the symmetry of the triangles to having towers of 60 feet in a hilly country to start with; the notion is startling and must be abandoned".

Thus after five months of harassing anxiety and failure, during the best time of the year for field operations, Lieutenant Waugh found himself compelled to commence work on a new base at the time when the field season was nearly ending. But he had resolved that, in spite of all the difficulties which had beset the work at the very outset, the Rangír Series should not be found "to have fallen in arrears or have lagged behind its neighbours".

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He remained in the field until the end of July, so as to avail himself of the clearing of the atmosphere which usually takes place when the rainy season commences; and he succeeded in observing the angles of the principal triangles up to the side Nágonáth-Phára, (VIII-IX) thereby completing the Series for a distance of 100 miles, and achieving an admirable out-turn of work in an unusually short space of time. Even the operations in the first five months of the field season, though a failure as regards the advancement of the principal triangulation, were fruitful in results of much value for immediate geographical requirements; as a large area of country had been reconnoitered, and the positions of several towns and forts of importance, lying mostly in Native States as yet unsurveyed, had been fixed from various secondary stations at which observations were taken with the small theodolites in the course of the search after suitable sites for the principal stations.

The latter 40 miles of the season's work on the Rangír Series lay in the Hamírpur District, which was suffering so terribly at the time from famine that Mr. Pidcock, the Settlement Officer of the district, reported that the season was one of unparalleled distress to the people and loss to Government,—the miseries of famine, pestilence, and exile having denuded the district of nearly one-half of its population.

In submitting from recess quarters the computations of the field season's operations, Lieutenant Waugh noticed with much regret the presence of *triangular errors* of over six seconds in the 5th and 6th principal triangles. He stated that he would have re-observed the angles had it not been for the impossibility of procuring further supplies of food for his people; being diffident of his skill as an observer he said that though not conscious of any remissness in this particular portion of the work, he could not but suppose that the errors "arose chiefly from bad observations". It is now however quite certain that the errors were due not to the observer but to the instrument employed, which was soon found to be of inferior value and was discarded.

Lieutenant Waugh's out-turn of work during the year consisted of a set of circumpolar star observations for azimuth; 8 principal triangles; 21 secondary triangles of the first class, and 43 of the third class; the elevations of all the principal and of 26 secondary stations, also a skeleton plan of the triangulation and a reconnaissance of the tract of country operated in. The latter included a part of Bundelkhand of which Lieutenant Waugh remarked that "it "was peculiarly favourable for secondary work; the detached granite ridges command "extensive views; forts and temples perched on eminences abound; indeed a complete map "might be made by triangles of the 1st, 2nd, and 3rd classes, and had it not been for the "difficulties which beset my *debût*, I should have formed such a map without at all delaying "the Principal Series".

The chain of triangles had now been carried into the plains of the Gangetic valley, only one more hill remaining to offer its friendly assistance in presenting a suitable site for a station of observation. One-third of the chain was complete, all of which—with the exception of the first triangle, measured in the course of the operations of the Calcutta Longitudinal Series—had been achieved by Lieutenant Waugh in a single year, under many and great difficulties as already set forth. Nevertheless the completion of the remaining two-thirds occupied nearly eight years to accomplish. The great retardation in the subsequent rate of

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progress was due to two causes. *First*, at every station in advance—with the single exception of the hill of Gokulphára—towers had to be constructed to furnish stations of observation, and on sites carefully selected so as to present the fewest possible obstacles on the lines between the stations; moreover all obstacles to mutual vision had to be removed before the final observations could be commenced. *Secondly*, in order to construct a chain of triangles composed of as few links as possible, the sides of the triangles in the plains were maintained throughout at so great a length that the rays between the stations grazed the surface of the ground for a distance of several miles, thus making distinct mutual visibility impossible, excepting under unusually favourable atmospheric conditions which were of very rare occurrence.

The building of towers required the co-operation of the Department of Public Works; the Surveyor General had therefore moved the Government to issue the necessary instructions to that Department. Although anticipating that some delay would occur before the arrangements for the construction of the towers could be matured and suitable designs prepared, he was nevertheless confident that the building of artificial elevations of some sort or other would eventually be sanctioned. He accordingly issued instructions that field operations should be resumed during the ensuing field season, but that they were to be restricted to the selection of suitable sites for future tower stations. At the same time he prescribed a method of 'ray-tracing', for site-selection, by carrying a traverse with a theodolite and perambulator over each ray, with a view to effecting a close examination of the ground in each instance, before the final adoption of the sites and the commencement of ray clearing. *Vide* Section 3 of Chapter II of Vol. II.

Season 1834-35.

PERSONNEL.

Lieut. A. S. Waugh, Bengal Engineers, 1st Asst.
Mr. J. W. Armstrong, 2nd Class Sub-Assistant.
" W. R. Forster, 3rd " "

In the following field season the party started from Cawnpore on the 10th of October. Lieutenant Waugh wrote a circular letter to the Civil Officers of the various districts through which his operations would have to pass, pointing out his dependence upon them for obtaining labour and supplies, and explaining the necessity for the removal of all obstructions on the lines between the principal stations; he said that great care would be exercised both by himself and his assistants not to inflict more injury in the removal of obstacles than was absolutely necessary, and due recompense would be readily made for all property destroyed; also that as he had no leisure nor inclination for entering into disputes with the owners regarding the cutting down of trees or removing of other obstacles, he trusted the Civil Officers would issue plain and positive orders for his support. This timely explanation of matters led to very happy results in the substantial assistance which was rendered to the surveyors throughout the field season.

Writing from Kanwa (XII), where the ray-tracing was begun on the line to Gura (XI), Lieutenant Waugh reported that the country thereabouts abounded with mud forts situated on the high lands. "Some of these", he said, "are uninhabited, with defences "ruined, and presenting a rude mass with steep sloping sides; they are solid, and a station "placed in the middle would be permanent even were the sides to crumble away to a slope "of 45° which is an event improbable, considering the tenacity of the material and its dis-

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"position in successive strata or layers, according to the usual habit of the natives in build-"ing earthwork". Other forts were partially tenanted, and had solid towers which could be used as stations. Again, eminences were met with which were crowned with old and untenanted brick buildings, and occasionally with domed temples. It was expected that many of these structures might serve as basements for the stations of the principal triangulation, and thus obviate the construction of towers of the great height which would otherwise be necessary in order to secure mutual visibility over the plains.

Having reconnoitred the country and given a good start to the operations, Lieutenant Waugh was summoned by Major Everest, towards the end of November, to assist in the measurement of the Dehra Dún Base-line, leaving the work on the Rangír Series under the supervision of Mr. Armstrong, the senior of his two assistants. On the completion of the base-line he returned to the charge of the Series, joining Mr. Armstrong in camp on the 20th May.

The party kept the field till the end of June. By this time all the rays had been cleared up to the side Chandanpur-Pothári (XXI-XXIII), and stations had been selected up to the side Janjíri-Gajnera (XXIX-XXX), thus furnishing as the out-turn of the season's work a symmetrical series of 20 triangles, of the first 13 of which the rays were all cleared. In reporting on the field season's operations, Lieutenant Waugh stated that "the chief portion "of this work having been done during my absence by Mr. J. W. Armstrong, any merit it "may possess, either quantitatively or qualitatively, is entirely owing to his zeal and abilities. "I have on former occasions borne testimony to the talents and good conduct of Mr. "Armstrong as well as Mr. Forster, and I may now add that their efficiency keeps pace with "their experience. Their labours during the last season, in the novel and arduous under-"taking of carrying a series across the plains without any resource but what their judgment "might suggest, so greatly surpass my expectations that it becomes a pleasing duty to me to "bring them to the particular notice of the Superintendent".

During the following recess season, Lieutenant Waugh supplied carefully prepared drawings and estimates of the masonry columns that would be required at the first ten of the tower stations in the plains. These were designed simply for the support of the large theodolites which would be employed in the measurement of the principal angles; they were further intended to mark the station permanently. The surrounding platform for the support of the observer, his attendants, and the observatory tent, was to be constructed as a portable scaffolding, which would be removable at pleasure, in order to be employed alike at all the stations; bamboo ladders were to be erected for the use of the signallers whenever the scaffolding was not available. The early construction of the masonry pillars was very desirable; therefore, in forwarding the designs for them to the Government, the Surveyor General pressed for an early decision, as otherwise the progress of the Series would be arrested. Thereupon the Military Board—to which the general construction of all public works was then entrusted—was directed to adopt the necessary measures for the construction of the required columns of masonry, in communication with Lieutenant Waugh.

The party had already (3rd October) taken the field when the orders of Government

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were received. As the erection of the masonry columns would take some time, no final observations were contemplated this season. The party was therefore to be occupied in clearing rays, selecting stations and also in measuring the angles approximately—with small theodolites—for immediate geographical requirements.

Season 1835-36.

PERSONNEL.

Lieut. A. S. Waugh, Bengal Engineers, 1st Asst.
Mr. J. W. Armstrong, 1st Class Sub-Assistant.
„ W. R. Forster, 2nd „ „

Early in this season the services of Lieutenant Waugh were again drawn off to assist Major Everest, whose health was in such an unsatisfactory condition that his medical advisers strongly recommended him to abjure all further active field work and proceed to sea. The Surveyor General was most anxious to finish the operations on the northern section of the Great Arc; and at the same time he wished to guard against any sudden emergency, by having with him an officer in whose hands he could confidently leave the conduct of those operations, the early completion of which was of great importance in the interests of geodesy. Accordingly, with the sanction of Government, he directed Lieutenant Waugh (on 8th December) to repair with as little delay as possible to the Head Quarters of the Great Arc party which was then at Kaliána—the northern astronomical extremity of the Arc. Thus the management of the Rangír Series was again left in the hands of Mr. Armstrong, an officer to whom it could be confidently entrusted.

The ray-clearing and approximate measurement of the angles was carried on without cessation, and under many difficulties, until the 22nd of June, when the rainy season set in with such violence as to prevent further operations in the field. Fourteen rays had been cleared and approximate angles measured between stations previously selected, thus bringing this part of the operations up to the side Janjíri-Gajnera (XXIX-XXX). Five stations were selected further north, by which the Series was extended to the outer Himalayas.

Meanwhile the Executive Engineer of the Cawnpore Division was proceeding with the construction of the ten masonry columns which were required to be erected at the principal stations, in accordance with the designs previously furnished by Lieutenant Waugh. At the station of Atsu (XVI), in the Etáwah District, the overseer was completely thwarted by the determined opposition of a zemindar, Zálim Sing, the owner of a fort where a column was to be erected, the site for which he had originally given over voluntarily for the purpose; but when the overseer appeared on the scene, just one year afterwards, Zálim Sing put forward the most frivolous pretexts for holding back from his concession, and even went the length of building around the very spot which had been chosen. The overseer was compelled to suspend his operations, and a lengthened correspondence with the Civil Authorities ensued. Lieutenant Waugh pointed out that any change made in the site of the station would involve a loss to Government of Rs. 1,700, which should be defrayed by the zemindar as it would be due solely to a breach of faith on his part. This argument produced more practical results than all former persuasion had done; and it was finally settled that Mr. Armstrong should proceed to the spot, early in the following field season, and set the overseer to work, after personally arranging matters with Zálim Sing.

During the recess—which was spent at Bareilly—Mr. Armstrong prepared designs and estimates for fourteen columns remaining to be erected, and of modifications to the column

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at Bisungarh (xx), which had been found to require an increase of 9 feet to its height, in order to be seen from the two forward stations.

Season 1836-37.
Personnel.
Mr. J. W. Armstrong, 1st Class Sub-Assistant.
„ J. Mulheran, 2nd Class „

Mr. Armstrong marched, on the 26th September, from Bareilly to make the necessary arrangements regarding the construction of the column at Atsu (xvi). It was found that the zemindar still objected to give up the site which he had originally conceded; he was probably more influenced by the idea of preserving his dignity than any other reason; for he willingly gave another site, within a few feet of the first, but still at a sufficient distance to necessitate a partial reclearing of all the rays between Atsu and the surrounding principal stations, a work which occupied several days.

Mr. Armstrong then proceeded southwards to examine the columns which had been built by the Department of Public Works, and clear the rays of whatever vegetation had sprung up on them during the period of two years which had elapsed since they were first opened. He found the condition of some of the columns far from satisfactory. At Husapura (xiv) so much deflection had taken place, owing to insufficient foundation and bad workmanship, that the column was in a dangerous condition and had to be rebuilt; arrangements for this were immediately made, as the column would be soon wanted in the course of the measurement of the principal angles. The columns at other stations had also become deflected to an extent which rendered it impossible to suspend a plumb-line from the centre of the summit, through the hollow core, over the centered markstone on the ground-level at the base; but this defect was got over, partly by moving the markstone, and partly by adding a capital of larger diameter to the pillar, to increase its upper surface and thus permit of the theodolite being set up excentrically. Elsewhere the columns were found to be "correct and adapted for final work".

Mr. Armstrong then proceeded to Cawnpore to take over the portable scaffolding which was to be employed around the columns at each station; these had meanwhile been constructed by the Ordnance Department, from designs supplied by the Surveyor General. No description of the so-called portable scaffolding is now forthcoming; but some idea of its bulk may be formed from the circumstance that no less than 10 four-bullock carts were required for its transport.

By the end of November everything was ready at the first ten tower stations for the measurement of the principal angles, and arrangements had been made for constructing columns at fourteen stations in advance by the Bareilly Division of the Department of Public Works. Mr. Armstrong therefore proceeded to Gokulphára (x) to resume the final observations, taking with him an 18-inch theodolite—Cary's L, described at page 69 of the Appendices to Vol. II—to employ in the measurement of the principal angles. By the 10th April, the whole of the horizontal angles had been measured at stations viii to xvii inclusive. The measurement of the vertical angles had however terminated at stations ix and x, because satisfactory verticals could not be obtained; consequently this part of the work was postponed until arrangements could be made for taking simultaneous reciprocal observations, with the assistance of a second observer and instrument.

Observations were being taken at Birona (xviii), and two-thirds had been completed,

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when, on the night of the 10th April, the portable scaffolding was set on fire; being very inflammable it was completely destroyed in the course of a few minutes. When access to the summit of the station was obtained next morning by ladders, the instrument appeared at first "to have escaped the effects of the flames"; but eventually it was found to be so damaged as to have become practically useless. The origin of the fire remained a mystery, but is believed to have been purely accidental. This catastrophe, happening in the month of April, necessarily put a stop to all further measurements of the principal angles during this field season.

During the following recess Mr. Armstrong was furnished with another 18-inch theodolite—Cary's M.O., described at page 68 of the Appendices to Vol. II; he was also directed to proceed to Agra, to superintend the construction of another portable scaffolding, with such assistance as he might obtain from the Ordnance Magazine at that place.

Season 1837-38.

PERSONNEL.

Mr. J. W. Armstrong, 1st Class Sub-Assistant.
„ J. Mulheran, 2nd „ „

Provided with a new scaffolding, Mr. Armstrong commenced the operations of the field season of 1837-38 by final observations at Bisungarh (XX). Though detained there for sixteen days—from 24th October to 9th November—he was unable to complete the horizontal angles, but succeeded in measuring the vertical angles simultaneously with Mr. Mulheran, who took the reciprocal angles at the surrounding stations. He then proceeded to Kalsán (XIX), where, though he again succeeded in executing his share of the reciprocal verticals, he was still unfortunate as regards the horizontal angles; the condition of the atmosphere was such as to prevent him from obtaining a sufficiently satisfactory view of the signals at the surrounding stations to enable him to measure the angles between them with the requisite degree of precision. Attributing the state of the atmosphere to unprecedentedly high winds, with concomitant clouds of dust, which then prevailed in the immediate vicinity of the River Ganges, he thought it advisable to lose no more time in that neighbourhood, and, passing over three stations—XXI, XXIII and XXIV—he set up his theodolite at Guri (XXV). Here he was detained a whole month, the out-turn of which was only two principal horizontal angles and simultaneous verticals on two rays, besides a set of experimental observations to circumpolar stars for azimuth. The next three weeks sufficed but to take the principal horizontal angles at Dháka (XXVI) and the verticals on the ray to Saipur (XXVII). It was now the 5th of February, and during the next month all that he was able to finish was the measurement of the angles, horizontal and vertical, at the stations of Saipur and Kasrak (XXVIII). In writing from the latter station on the 5th of March, Mr. Armstrong reported that owing to the reverses which he had experienced from the state of the atmosphere, he had "only completed two entire triangles on the south side of the Ganges and three triangles on the north side," besides of course the vertical observations which he had advanced *pari passû* with the horizontal measurements. It was his intention at the time to continue his progress as far north as he could proceed in the month of March, and then to return and finish the work below. He made comparatively good progress during the remainder of the month, completing the horizontal and vertical angles up to and including the side Gajnera-Fatehganj (XXX-XXXI), as well as a good number of secondary angles. He then retraced his steps to Guri (XXV), where between the 15th and 19th April he ob-

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served the principal angle between the side Pothári-Mau (XXIII-XXIV), the verticals on two rays, and some secondary angles. He next moved on to Mau where he remained until the 8th of May by which time he was able to finish the three principal angles, the verticals along the ray to Dháka, and the secondary angles to surrounding stations and points. But unfavourable weather again set in, and Mr. Armstrong moved into the station of Fatehgarh where he was to spend the recess; there he employed himself on the computations, at the same time holding himself in readiness to start for his next station Pothári (XXIII) whenever the weather might permit; but dust storms continued to prevail persistently and with unusual frequency and violence; thus he was unfortunately unable to take the field again this season in order to bridge over the gap in the triangulation in the immediate vicinity of the Ganges.

The pillars built by the Department Public Works this year in the Farrukhabad and the Bareilly districts, as far north as Fatehganj, were very favorably reported on by Mr. Armstrong who found them in general well built, steady and symmetrical.

Season 1838-39.

PERSONNEL.

Mr. J. W. Armstrong, 1st Class Sub-Assistant.
" J. Mulheran, " "

The resumption of field operations in the season of 1838-39, was delayed, because the severity of the preceding rainy season had done considerable damage to the portable scaffolding. It had been left standing at the station of Pothári (XXIII), until the month of August when Mr. Armstrong brought it in to Fatehgarh, for protection against further injury and for subsequent repairs; he experienced considerable difficulty in so doing because of the state of the roads and the large number of carts required for its transport. The damage done to the scaffolding took some time to repair, which, with delays in obtaining carts, prevented Mr. Armstrong from taking the field earlier than 25th December 1838. By the 19th of the following month, he had only succeeded in measuring three principal horizontal angles at the station of Pothári and in taking verticals on the rays to Chandanpur (XXI) and Mau (XXIV). He then moved on to Chandanpur, and completed three angles at this station and the verticals on the ray to Mau, by the 3rd of February. Here he received information of the fall of the pillar at Bagwára (VII of N.E.L.S.); he therefore moved the Executive Engineer of the Bareilly Division to have the pillar rebuilt with all possible despatch, as it would be required for use by the end of March. The station next visited was Bisungarh (XX); the horizontal angles were completed by the 11th of the same month, but no verticals could be obtained. For some unexplained reason Mr. Armstrong was unable to go down southwards, and complete the angles which remained unmeasured at the stations of Birona (XVIII) and Kalsán (XIX). This deficiency was not made good for another season.

From Bisungarh Mr. Armstrong marched northwards to the station of Gajnera (XXX), where he arrived on the 12th of March; by the 18th he completed the horizontal angle between Fatehganj (XXXI) and Atária (XI of N.E.L.S.), and had taken verticals on the ray to the latter station. By the 23rd of March, the horizontal and vertical angles at Fatehganj were concluded, and the party was on its way to Atária. The pillars at this station and at Sísgarh (X of N.E.L.S) were found to be very much out of the perpendicular; the former moreover was in a somewhat dangerous condition, several cracks having taken place both

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in the shaft and the basement. Though somewhat apprehensive that the pillar at Atária might fall down, Mr. Armstrong set up his large theodolite on it, rather than postpone the observations until it could be rebuilt; it was so much deflected however that the instrument could not be plumbed over the mark-stone in the basement; four small pillars were therefore built round the station, with a mark on each, and these marks formed a quadrilateral figure the diagonals of which intersected in the normal of the point of observation. By the 16th of April, the horizontal and vertical angles at this station and at Sísgarh were disposed of; and by the 3rd of May the ray from Beheri (IX of N.E.L.S.) to Bagwára (VII of N.E.L.S.)—left uncleared in 1836—had been cleared, and the horizontal angles at Beheri had been measured. The work at Bagwára was concluded by the 19th idem, some delay having been occasioned by the necessity for further clearing on the ray to Sísgarh*. The party then proceeded to recess quarters at Bareilly.

Season 1839-40.

PERSONNEL.

Mr. J. W. Armstrong, 1st Class Sub-Assistant.
" J. Mulheran, " "

At the commencement of the field season of 1839-40 Mr. Armstrong was required to proceed to the camp of the Great Arc party in the Meerut District, to receive instructions and exchange his large theodolite for Harris and Barrow's 15-inch theodolite—described at page 72 of the Appendices to Vol. II—which had recently been employed with very satisfactory results on the Budhon Series.

Returning to resume field operations, on the 11th November he reached Fatehgarh, where he found his assistant, Mr. Mulheran, on whom he was dependent for the reciprocal observations, completely prostrated with a malarious fever. For this and other reasons the party was detained at Fatehgarh until the 6th of January.

The progress made during the next two months was very small, comprising only the measurement of the two northern horizontal angles at Kalsán (XIX), and verticals on the rays Pothári–Guri (XXIII-XXV) and Seontára–Birona (XVII-XVIII). By the 21st of April, Mr. Armstrong completed the horizontal angle that had remained unobserved at Birona as well as the simultaneous verticals on the fifteen rays that had hitherto existed as a gap between the side Phára-Gokulphára (IX-X), and Seontára-Birona (XVII-XVIII). The party then returned to Fatehgarh. Here Mr. Armstrong found instructions awaiting him from the Surveyor General, directing him to proceed to the Head Quarters at Dehra Dún with the whole of the establishment and instruments under his charge, leaving the portable scaffolding and other heavy ordnance stores in deposit at the Gun Carriage Agency in Fatehgarh.

Season 1840-41.

PERSONNEL.

Mr. J. W. Armstrong, 1st Class Sub-Assistant.
" J. Mulheran, " "
" W. C. Rossenrode, 3rd Class "

On the 1st of the following October, Mr. Armstrong started from the Head Quarters to commence the field operations of 1840-41, and proceeding *viá* Fatehgarh marched to Muhammadabad (XXII), where a new station was to be established for azimuth observations, which had also to be connected with the surrounding stations. A tower 16 feet high was erected on the bastion

* Mr. Armstrong reported that when he was observing at Sísgarh in April, the refraction was so great as to enable him to see the heliotrope at Bagwára over every obstruction. Unfortunately this was not the case during the reciprocal observations.

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of the fort at Muhammadabad, the construction of which was completed in time for the star observations to be commenced on the 25th December. The azimuth was determined by observations to δ Ursæ Minoris at both elongations. These observations, as well as the measurement of all the horizontal angles of the three triangles connecting XXII with the surrounding stations XX, XXI and XXIII, were completed by the 12th February.

Mr. Armstrong was then transferred to Lieutenant Waugh's party, which was operating near Hyderabad in the Nizam's dominions. Mr. C. Lane, 1st Class Sub-Assistant, was placed in charge of the Rangír party, which he assumed on the 1st of March. Mr. Mulheran extended the Approximate Series in advance into the outer Himalayan Mountains by four triangles, of which the northernmost station (Khánkra) was fixed beyond the 30th parallel of latitude. But these triangles were subsequently incorporated into the North-East Longitudinal Series, at the side of junction with which—Sísgarh–Atária—the Rangír Series is now considered to terminate. Anything that may have to be stated of the triangulation beyond, which was originally executed as a part of this series, will therefore appear in the Introduction to the North-East Longitudinal Series.

The remaining operations in connection with the principal triangulation of the Rangír Series, as at present constituted, were as follows. *First,* in the field season of 1841-42 the vertical angles at and between stations XX and XXI to XXIII, which had not been previously observed were measured reciprocally by Mr. Lane and Mr. Rossenrode, observing simultaneously. *Finally,* in the season 1863-64, when Mr. George Shelverton reached Rangír, during the course of the revision of the Calcutta Longitudinal Series*—the station was found to have been so much injured that there was every reason to believe that the markstone, which was forthcoming in the *débris,* must have been displaced. Happily the marks at the stations of Tinsmál and Kusmár—which, with Rangír, form the first triangle of the chain—were uninjured. Mr. Shelverton therefore constructed a new station at Rangír—in the centre of the *débris* of the first station—and measured the three angles of the triangle Rangír–Tinsmál–Kusmár, and thus connected the Rangír Series with the revised Calcutta Longitudinal Series.

The contrast between the rapid completion of the lower third part of this Series, which is situated in a hill country, with the slow execution of the upper two-thirds which is situated in the plains, has already been noticed at pages VII and VIII of this Introduction. The principal cause of the slow progress in the plains was that the sides of the triangles were made of a length which averaged from 18 to 19 miles, and occasionally exceeded 22 miles. Such sides are much too long for satisfactory observations between towers of even the considerable height of those which were erected for the principal triangulation. Thus the measurement of the horizontal angles proceeded very slowly; that of the vertical angles had frequently to be performed so long after the time of minimum refraction that simultaneous reciprocal

* See Vol. II, pages 19 and 71; also Vol. VI, page VII—B.

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verticals were often essential to secure even moderate accuracy; and this not only necessitated the employment of a second observer with a complete instrumental equipment, but greatly retarded the progress of the operations. The experience gained on the Rangír Series led to an immediate and very sensible reduction in the lengths of the sides of the triangles in the plains. And further experience showed the desirability of still further reductions in length, in order to obtain the great advantage of mutual visibility at the time of minimum refraction, between tower stations of moderate height; thus eventually an average of 11 miles—ranging from 9 to 13—has come to be recognized as the most suitable length for the sides of the principal triangles in the plains; see Chapter II of Vol. II.

The triangulation of the Rangír Series has been included in the Simultaneous Reduction of the North-East Quadrilateral. The errors actually dispersed on this Series between the origin, Tinsmál-Rangír, and the terminus, Sísgarh-Atária, are:—

In side	Logarithm	+ 0·000,0144,9
	giving a ratio of about $2\frac{1}{8}$ inches per mile.	
,,	Latitude	+ 0″·433
,,	Longitude	+ 0 ·796
,,	Azimuth	+11 ·597

The dispersion of these errors by the Simultaneous Reduction of the North-East Quadrilateral was effected by the method of least squares, as described in Part I of Vol. VII.

The trigonometrical determinations of the heights of the stations of this Series above the mean sea level have been corrected by connecting the stations, wherever possible, with the lines of spirit levels which have been executed of late years in the course of operations in the Trigonometrical and Revenue branches of the Survey Department. A list of the stations which have been so connected will be found on page 43—K. [of Vol. VII]; a statement of the several sections into which the series is divided, as well as the method of adjustment employed is given in detail on page 38 of Part I of Vol. VII. It will here suffice to state that the spirit levels shew that occasional errors of a magnitude which reaches a maximum of 14·5 feet between contiguous stations were made in the trigonometrical determinations; and that the cumulative error in the entire Series, from origin to terminus, is about 52 feet. This large accumulation of error is unquestionably due to the great lengths of the sides of the triangles in the plains, which has already been shewn to have been a cause of great delay in the progress of the operations, and which frequently compelled the measurement of the vertical angles to be made at other times than that of minimum refraction. An inspection of the values of the refraction—in seconds, and in decimals of the 'contained' arc—which are given at pages 38—K. to 43—K. [of Vol. VII] will show many instances of greatly abnormal variations of refraction, such as are fatal to accuracy in the resulting determinations of height.

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Secondary Triangulation.

The secondary triangulation accomplished in connection with this Series was mainly executed by the measurement—with the large theodolites—of the angles at the principal stations, to the surrounding secondary stations and other prominent objects, and by the measurement—with smaller theodolites—of the angles at the secondary stations which were required for combination with the former, in order to complete the secondary and minor triangles. The whole is shown in the chart accompanying the Synoptical Volume for this Series, in which volume all the requisite numerical details of angles and side-lengths, and of latitudes, longitudes, azimuths and heights, are given, both for the secondary stations and for the 'intersected' but unvisited points.

Most of the angles at the secondary stations were measured by Mr. Mulheran, who was specially commended for the vigour with which he succeeded in laying down the very large number of points between the parallels of 25°¾ and 27°¼ in a single field season, 1836-37.

Compiled, with Addenda by the Surveyor General, by

C. WOOD,

Surveyor 2nd Grade.

MUSSOOREE:
August 1881.

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ALPHABETICAL LIST OF STATIONS.

NUMERICAL LIST OF STATIONS.

VII	Tinsmál. (of Calcutta Longitudinal Series).
X	Rangír. (of Calcutta Longitudinal Series).
I	Kusmár.
II	Dálípúr.
III	Chandla.
IV	Bhoraj.
V	Datiára.
VI	Thanela.
VII	Manang.
VIII	Nagonáth.
IX	Phára.
X	Gokalphára.
XI	Gura.
XII	Kanwa.
XIII	Nipenía.
XIV	Husápúra.
XV	Gandaspúr.
XVI	Atsu.
XVII	Seontára.
XVIII	Birona.
XIX	Kalsán.
XX	Bisungarh.
XXI	Chandanpúr.
XXII	Mamdábád.
XXIII	Pothári.
XXIV	Máo.
XXV	Guri.
XXVI	Dháka.
XXVII	Saipúr.
XXVIII	Kasrak.
XXIX	Janjíri.
XXX	Gajnera.
XXXI	Fateganj.
X	Sísgarh. (of North-East Longitudinal Series).
XI	Atária. (of North-East Longitudinal Series).

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RANGIR MERIDIONAL SERIES.

DESCRIPTION OF PRINCIPAL STATIONS.

Of the 31 Principal Stations composing this Series, the 10 southernmost are on hills, and are low solid platforms carrying a mark engraved either on the rock *in sitû* or (presumably) on a stone imbedded at about the level of the ground: above this mark one or more other mark-stones, with the usual engraved circle and dot, are inserted in the platform, the uppermost being flush with the structure. When the Series entered the plains, artificial elevations had to be constructed. These special erections at the first 9 stations consisted of perforated columns of masonry of the following description;—*foundation* a foot or two in depth and having a mark-stone sunk flush with its surface; *plinth* either 4½ or 5½ feet square and 3½ feet high; *shaft* composed of two or more cylinders with diameters varying from 4 or 5 feet at base to 3 feet at summit; surmounted in nearly all instances with *capitals* 4 feet in diameter and about 3 feet in depth; an aperture about a foot across passed vertically through the column to admit of plumbing over the mark-stone to which access was obtained by means of a vaulted passage in the plinth. For the remainder of the Series the construction of these columns of masonry was slightly modified, and the structures, generally speaking, were built as follows;—*foundation* 3 feet in depth; *plinth* 9 feet square and 2 feet high having a mark-stone sunk flush with its surface; *basement* circular, 7 feet in diameter and 5 feet high; *shaft* starting in a curve from the edge of the basement and subsequently continued in the form of a truncated cone with a diameter of 3 feet at summit; surmounted with a *capital* and having an aperture as before described. For the accommodation of the observatory tent, temporary scaffolding platforms were erected around the columns: when the last 2 stations were subsequently visited in the course of the operations of the North-East Longitudinal Series, the columns were surrounded with a *kacha* tower about 14 feet in diameter at top. Exceptions to the general rules in point of construction of the towers will be found at the stations of Bisungarh and Muhammadabad, in the descriptions of which such details as are forthcoming have been embodied.

The following descriptions have been compiled from those given in the original MS. General Report and other original records of this Series, supplemented in respect to the neighboring villages by information obtained from the Revenue and Topographical Survey maps of the country traversed. The information as to the local sub-divisions in which the several stations occur has been derived where practicable from the latest Annual Reports received from the District officers to whose charge the stations have been committed.

VII.—(*Of the Calcutta Longitudinal Series*). Tinsmál Hill Station, lat. 24° 7′, long. 79° 2′—observed at in 1826, 1833, 1834 and 1864—is situated on the top of a very conspicuous hill about three-quarters of a

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mile S. by E. of the village of Tinsua from which it is approached: thána, tahsíl and pargana Banda, district Saugor.

The pillar is solid and has three marks, one engraved on the rock *in sitú* and the others at 3·5 and 8·5 feet above it respectively. The station of 1826 was revisited in 1833 for the purpose of originating the Budhon Meridional Series, when its height was increased by 8·5 feet. It was again visited in 1834 to originate the Rangír Meridional Series, but no further alteration in its construction appears to have been made. On visiting it in 1864, the upper mark being found displaced, a new mark was substituted in the normal of the lower mark. The distances and bearings of surrounding villages are:—Dalpatpur, from which a road leads up to the station, 1·5 miles N.E.; Lamnau 1·3 miles towards the W.; and the deserted village of Tinsi 0·8 mile S.S.E.

X.—(*Of the Calcutta Longitudinal Series*). Rangír Platform Station, lat. 24° 0′, long. 79° 28′—observed at in 1827, 1834 and 1864—is situated in a ploughed field about half a mile S.E. of the little village of Rangír: thána Narsinghgarh, tahsíl and district Damoh.

The pillar is solid and contains two marks, the upper being 5 feet above the lower. The station of 1827 was revisited in 1834 for the purpose of originating the Rangír Meridional Series, and was then raised 4 feet in height. On again visiting it in 1864 the station was found destroyed, and although a mark-stone was discovered amongst the debris it was impossible to say if this mark was in its original position. The new station established in 1864 is identical in height with the old station and it also agrees as closely in position with the latter, as this point could be conjectured. The distances and bearings of surrounding places are:—Narsinghgarh town 2¼ miles W. by S.; Murhiya village 1·4 miles S.E.; and the town of Sítanagar 3·1 miles N.N.E.

I. Kusmár Hill Station, lat. 24° 15′, long. 79° 23′—observed at in 1826, 1834 and 1864—is situated on a low range of hills which extend from Panna towards Saugor, and is named after the village of Kusmár which lies at the foot of the hill at a distance of about a mile N. by W. of the station: pargana Baxwáho of the Panna state.

The station consists of a platform enclosing a central solid pillar of masonry 7·2 feet high which has a mark-stone at its upper surface, another at 2·9 feet below this, and a third at the level of the ground. The station of 1826 was revisited in 1834 in the course of the operations of the Rangír Meridional Series, and again in 1864 in the prosecution of the Calcutta Longitudinal Series, but no alteration in its construction appears to have been made on either of the two latter occasions. The distances and bearings of surrounding places are:—Hírapur iron mine about 11 miles towards the N.W.; Baxwáho town 3 miles W.; Machandri village 1·4 miles N.; and Semra village 1·5 miles S.S.W.

II. Dálípur *(Dálípúr)* Hill Station, lat. 24° 27′, long. 79° 12′—observed at in 1834—is situated on the northern face of the Vindhyáchal range and is named after the small hill fort of Dálípur which stands at the base: pargana Bijáwar of the Bijáwar state.

The station consists of a platform enclosing a central solid pillar of masonry which has a mark-stone at its upper surface. The distances and bearings of surrounding places are:—Hírapur iron mine 6·6 miles S.E. by S.; Patera village 0·6 mile W. by S.; and Singhpur village 2·7 miles E.N.E.

III. Chandla Hill Station, lat. 24° 37′, long. 79° 30′—observed at in 1834—is situated on a hill so called, on the northern face of the Vindhyáchal range: pargana Bijáwar of the Bijáwar state.

The station consists of a platform enclosing a central solid pillar of masonry which has a mark-stone at its upper surface. The distances and bearings of surrounding places are:—Bijáwar town 2¼ miles E.N.E.; Gulganj town on high road from Saugor to Cawnpore 8 miles N.W. by N.; and the villages of Andiáro and Pokhrelo at 3 miles and 2·5 miles to the S.S.W. and W. respectively.

IV. Bhoraj Hill Station, lat. 24° 50′, long. 79° 6′—observed at in 1834—is situated on a lofty range, on which stands a temple dedicated to the Hindu goddess Bhawáni: pargana Baldeogarh of the Orchha or Tehri state.

The station consists of a platform enclosing a central solid pillar of masonry which has a mark-stone at its upper surface and a mark engraved on the rock *in sitú*. The distances and bearings of surrounding villages are:—Serkunpur about 0·7 mile N. by E.; Dauhit-Singh-ka-pura 0·6 mile S.W.; and Khena 1·5 miles E.

V. Datiára Hill Station, lat. 25° 6′, long. 79° 25′—observed at in 1834—is situated on the highest point of a cluster of hills, along whose western base the Dhasán river winds: thána Ajnár, tahsíl and pargana Panwári, district Hamírpur.

The station consists of a platform enclosing a central solid pillar of masonry which has a mark-stone at its upper surface and a mark engraved on the rock *in sitú*. The distances and bearings of surrounding villages are:—Narwara 0·5 mile N. by W.; Purainia 1·6 miles S.E. by S.; Daurea 1·7 miles E. by S.; and the town of Gerauli 2·1 miles S.W. by S.

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VI. Thanela Hill Station, lat. 24° 58′, long. 79° 47′—observed at in 1834—is situated on a detached hill, at the foot of which lies the village of Sela: pargana Chhatarpur of the Chattarpur state.

The station consists of a platform enclosing a central solid pillar of masonry which has a mark-stone at its upper surface. The distances and bearings of surrounding villages are:—Mau 0·9 mile N.W.; Naddia 3·1 miles E. by S.; and Kotah 1·6 miles S.S.E.

VII. Manang Hill Station, lat. 25° 17′, long. 79° 46′—observed at in 1834—is situated on the summit of a hill so called, at the foot of which—and due south of the station—lies the village of Salat Malat: jagír Garhauli which adjoins thána Kulpahár, tahsíl and pargana Panwári of the Hamírpur district.

The station consists of a circular paka platform, 16 feet in diameter, enclosing a central solid pillar of masonry which has a mark-stone at its upper surface and a mark engraved on the rock *in situ*. The distances and bearings of surrounding villages are:—Narari 1·8 miles S.E. by E.; Larpur 1·3 miles N.W. by N.; Kamálpur 1·5 miles W.; Supa 2·9 miles N.E.; and a Revenue Survey Bench-Mark fixed on a rock 1·04 chains S. by W.

VIII. Nágonáth *(Nagonáth)* Hill Station, lat. 25° 27′, long. 79° 23′—observed at in 1834 and 1836—is named after the Hindu deity Nágonáth whose temple stands on the same hill along the eastern side of which the river Dhasán winds: pargana Garotha, district Jhánsi.

The station consists of a platform enclosing a central solid pillar of masonry which has a mark-stone at its upper surface. The distances and bearings of adjacent villages are:—Gura 1·1 miles S.W. by S.; and Karora about 1·2 miles N.W.

IX. Phára Hill Station, lat. 25° 41′, long. 79° 43′—observed at in 1834 and 1836—is situated on a hill, on which at the distance of a few yards S.S.E. of the station a temple—dedicated to the Hindu deity Mahádeo—is erected; it is named after the village of Phára or Pahra which lies at the foot of the hill and is due east of the station: thána Jariya, tahsíl and pargana Ráth, district Hamírpur.

The station consists of a platform enclosing a central solid pillar of masonry which has a mark-stone at its upper surface. The distances and bearings of surrounding villages are:—Umaría 2 miles W. by N.; Jarmauli 1·6 miles N.N.W.; Turnan 2 miles E.S.E.; and Chilli 1·4 miles S.W.

X. Gokulphára *(Gokalphára)* Hill Station, lat. 25° 46′, long. 79° 20′—observed at in 1836—is situated on the highest of several eminences clustered in this vicinity, and is named after the small village of Gokulphára which lies at the western foot of the hill: in the Gursarai state within pargana Garotha of the Jhánsi district.

The station consists of a platform enclosing a central solid pillar of masonry 12 feet high: it has a mark-stone at its upper surface and a mark engraved on the rock *in situ*. The distances and bearings of surrounding villages are:—Gogul 0·6 mile N. by W.; Donri 2·6 miles W. by S.; Dhanora 2·1 miles S.S.E.; and Dhanori 2 miles E. by S.

XI. Gura Tower statian, lat. 25° 58′, long. 79° 36′—observed at in 1837—is situated on a slight eminence and is named after the ruined village of Gura: thána Orai, tahsíl Kálpi, district Jálaun.

The station consists of a perforated masonry column 5½ feet square to a height of 3½ feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 33·3 feet above the mark-stone imbedded at the level of the ground and into which a brass plug with the mark engraved thereon has been countersunk. The distances and bearings of surrounding villages are:—Kurmir 1·8 miles N.N.W.; Burdar 1 mile E. by N.; Kurwi Buzurg 1·6 miles S.S.W.; and Dhani Buzurg 2·5 miles W.

XII. Kanwa Tower Station, lat. 26° 4′, long. 79° 19′—observed at in 1837—is situated on the terreplein and close to the N.W. tower of the fort of Kanwa distant about 6 miles S.W. by S. of the town and station of Jálaun: thána, tahsíl, pargana and district Jálaun.

The station consists of a perforated masonry column 4½ feet square to a height of 3½ feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the colmun is 28·8 feet above the mark-stone imbedded at the level of the ground. The distances and bearings of surrounding villages are:—Lachura 1·5 miles N.W.; Purwári 1·4 miles N.E.; Dunora 2·8 miles S.E.; and Bhair 2 miles W.S.W.

XIII. Nipania *(Nipenia)* Tower Station, lat. 26° 14′, long. 79° 38′—observed at in 1837—is situated on the right bank of the Jumna, and stands on the lands of the village of Pal Sarania at a distance of 1¼ miles N. by W. of the village of Nipania: thána Nipania, tahsíl Kálpi, district Jálaun.

The station consists of a perforated masonry column 5½ feet square to a height of 3½ feet, and circular thereafter—the

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diameter at top of shaft being 3 feet: the summit of the column is 39 feet above the mark-stone imbedded at the level of the ground. The distances and bearings of surrounding villages are:—Simra Shaikhpur 1 mile E.S.E.; Sikunui 1·9 miles S.; and Sunni Ser 1·5 miles W. by N.

XIV. Husapura (*Husápúra*) Tower Station, lat. 26° 22′, long. 79° 21′—observed at in 1837—is situated in an open field due S. of the village of Husapura, and distant about 2½ miles from the right bank of the Jumna: thána Gohan, tahsíl Mádhogarh, district Jálaun.

The station consists of a perforated masonry column 5½ feet square to a height of 3½ feet, and circular thereafter—the diameter at top of shaft being 3 feet: the summit of the column is 33·8 feet above the mark-stone imbedded at the level of the ground. The distances and bearings of surrounding villages are:—Pánípur 0·6 mile S.W.; Magtoa 1·1 miles due W.; Shaikhpur Ahir 0·5 mile E.; and Nímgaon 1·3 miles S.E. by E.

XV. Gandaspur (*Gandaspúr*) Tower Station, lat. 26° 28′, long. 79° 38′—observed at in 1837—is situated on a low mound which stands on the west side of the village of Gandaspur, and is distant about three-quarters of a mile from the right bank of the Sengar nadi: thána and pargana Derapur, district Cawnpore.

The station consists of a perforated masonry column 4½ feet square to a height of 3½ feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 28 feet above the mark-stone imbedded at the level of the ground. The distances and bearings of neighboring villages are:—Napallapur 1·3 miles E.; and Mahásinghpur 0·8 mile S.E.

XVI. Atsu Tower Station, lat. 26° 35′, long. 79° 24′—observed at in 1837—is situated on the elevated platform which surrounds the exterior of the N.E. tower of the fort of Atsu or Arsu: táluka Bhareh, thána Ajítmal, tahsíl and pargana Auraiya, district Etáwah.

The station consists of a perforated masonry column 4½ feet square at base to a height of 3½ feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 25·7 feet above the mark-stone imbedded at the level of the platform. The distances and bearings of surrounding villages are:—Mahíuddín 0·6 mile S.; Durhaspur 1·6 miles W.; Alamgírpur 0·9 mile N.N.W.; and Rasúlpur 1 mile N.E. by N.

XVII. Seontára Tower Station, lat. 26° 42′, long. 79° 38′—observed at in 1837—is situated on the western solid tower of a small brick fort which is built on an extensive elevated mound (about 50 feet in height) down the eastern slope of which lies the village of Seontára, the western declivity being washed by the Rind or Arind nadi: thána Bela, tahsíl and pargana Bidhúna, district Etáwah.

The station consists of a perforated masonry column 4½ feet square at base to a height of 3½ feet, and circular thereafter—the diameter at top of shaft being 4 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 16·8 feet above the mark-stone imbedded at the level of the tower. The distances and bearings of surrounding villages are:—Dunwamau 1 mile W.N.W.; Rámpur 1·1 miles N.E.; Baryáraimau 0·9 mile E.S.E.; and Ekghara 1·5 miles W.S.W.

XVIII. Birona Tower Station, lat. 26° 51′, long. 79° 25′—observed at in 1837 and 1840—is situated on the terreplein between the outer and inner walls of the fort in the village of Birona Kalán: thána Kudarkot, tahsíl and pargana Bidhúna, district Etáwah.

The station consists of a perforated masonry column 4½ feet square to a height of 3½ feet, and circular thereafter—the diameter at top of shaft being 3 feet: the summit of the column is 23·2 feet above the mark-stone imbedded at the level of the ground. The distances and bearings of surrounding villages are:—Shaikhpur 1·6 miles N.W.; Morcha 1·3 miles N. by E.; Balpur 2·4 miles S.E.; and Ujuhruh 1·6 miles S.S.W.

XIX. Kalsán Tower Station, lat. 26° 57′, long. 79° 41′—observed at in 1837 and 1840—is situated on the S.W. corner of an elevated mound in the village of Kalsán: pargana Tirwa, district Farrukhabad.

The station consists of a perforated masonry column 4½ feet square at base to a height of 3½ feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 23·1 feet above the mark-stone imbedded at the level of the ground. The distances and bearings of surrounding villages are:—Mírpura 1·6 miles W.; Bagulhai 2·1 miles N.N.E.; Munkapur 2·7 miles E.; and Rámpur 1·3 miles S.

XX. Bisungarh Tower Station, lat. 27° 7′, long. 79° 27′—observed at in 1839 and 1841—is situated on a narrow mound to the south of the *bárádari* (summer-house) and outside the fort of Bisungarh or Binsia: pargana Chhibramau, district Farrukhabad.

The station consists of a perforated masonry column 5½ feet square to a height of 1 foot, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 24 feet above the

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mark-stone which is imbedded at 1 foot above the level of the ground. The distances and bearings of surrounding villages are:—Surdamai 0·9 mile N. by E.; Astutabad 1·2 miles E.; and Shaikhpur 2·3 miles S.E.

XXI. Chandanpur (*Chandanpúr*) Tower Station, lat. 27° 14′, long. 79° 41′—observed at in 1839 and 1841—is situated in an open field, and stands on the northern bank of a small tank at a distance of about 350 yards S.W. of the village of Chandanpur: pargana Bhojpur, district Farrukhabad.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 38 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. The Ganges flows about 1 mile N.E. of the station, and the high road from Farrukhabad to Cawnpore passes within a mile to the west of it; the distances and bearings of surrounding villages are:—Rájípur 0·6 mile W.; Singirámpur 0·9 mile N.E.; and Mukrandnagar 0·8 mile S. by E.

XXII. Muhammadabad (*Mamdábád*) Tower Station, lat. 27° 18′, long. 79° 28′—observed at in 1841—is situated on the east bastion of the fort of Muhammadabad, and is distant about 400 yards W.S.W. of the town of that name: thána and pargana Muhammadabad, district Farrukhabad.

The station consists of a tower of burnt bricks and mud cement 24 feet square at base and 18 feet square at top, enclosing a central isolated pier of masonry 3½ feet in diameter and 16·7 feet high—with a foundation of 4½ feet— which is marked in the usual manner. The high road from Agra to Fatehgarh passes about 600 yards E. of the station; and the distances and bearings of neighboring villages are:—Nandu Takípur 0·7 mile S.W.; and Kabírpur the same distance N.W. by N.

XXIII. Pothári Tower Station, lat. 27° 23′, long. 79° 27′—observed at in 1838, 1839 and 1841—is situated on an elevated mound in the village of Pothári: pargana Muhammadabad, district Farrukhabad.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 37·6 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. The distances and bearings of surrounding villages are:—Karanpur 0·6 mile E. by N.; Chandtokh 1·4 miles S.E.; Buruh 2 miles S.W.; and Pithua 2·1 miles W. by S.

XXIV. Mau (*Máo*) Tower Station, lat. 27° 30′, long. 79° 43′—observed at in 1838—is situated on a high mound in the village of Mau which lies on the left bank of the Rámganga: pargana Imratpur, district Farrukhabad.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 38·2 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. The distances and bearings of surrounding villages are:—Maulaganj 0·7 mile N.W.; Sháhjahánpur 1·1 miles E.; and Aligarh 0·9 mile S.S.W.

XXV. Guri Tower Station, lat. 27° 40′, long. 79° 29′—observed at in 1837 and 1838—is situated on a small mound in the village of Guri distant about 2 miles N. of the Ganges: pargana Meherabad, district Sháhjahánpur.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 37·9 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. The distances and bearings of surrounding villages are:— Usmánpur 0·4 mile S.W.; Lakhanpur 0·4 mile N. by E.; and Pítampur 1·7 miles S.E. by S.

XXVI. Dháka Tower Station, lat. 27° 45′, long. 79° 43′—observed at in 1838—is situated on a low sandy elevation in an open field to the west of the village of Dháka: pargana Meherabad, district Sháhjahánpur.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 37·7 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. The distances and bearings of surrounding places are:—Jalálabad town 2·2 miles S.S.W.; Malupur 0·9 mile W.; Jugnah 0·9 mile N.E. by N.; and Gularia 0·8 mile S.S.E.

XXVII. Saipur (*Saipúr*) Tower Station, lat. 27° 55′, long. 79° 27′—observed at in 1838— is situated on an elevated mound said to be the site of the ancient village of Saipur: thána and pargana Hazratpur, tahsíl Dátaganj, district Budaun.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 38 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. The distances and bearings of surrounding villages

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are:—Chungosi 0·9 mile N.W.; Chithri 0·8 mile S.E.; Sikutia about 1 mile S.W.; and Garhia 1·6 miles E.

XXVIII. Kasrak Tower Station, lat. 28° 3′, long. 79° 42′—observed at in 1838— is situated on the crest of an elevated mound 600 yards south of the village of Kasrak: pargana Míránpur Katra, district Sháhjahánpur.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 38 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. The high road from Farrukhabad to Bareilly passes about half a mile west of the station; and the distances and bearings of surrounding places are:—the town of Míránpur Katra 1·6 miles S.; Kusak village 1·2 miles N. by W.; and Sahupur 0·5 mile N.E.

XXIX. Janjíri Tower Station, lat. 28° 11′, long. 79° 27′—observed at in 1838—is situated on a mound in the village of Janjíri, and is distant 2 miles from the right bank of the Rámganga: pargana Ballia, district Bareilly.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 37·8 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. The distances and bearings of surrounding villages are:—Kíratpur 0·6 mile W. by N.; Turkuni 1·2 miles N.E.; and Himpatpur Behárípur 0·8 mile E.

XXX. Gajnera Tower Station, lat. 28° 20′, long. 79° 41′—observed at in 1838 and 1839— is situated on a mound about 350 yards south of the village of Gajnera the eastern extremity of which is washed by the Kailás nadi: pargana Farídpur, district Bareilly.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 38 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. The distances and bearings of surrounding places are:—the town of Bhuta 2·2 miles W.; Suraur village 1·4 miles N.N.E.; and Khurduha 0·8 mile S.E.

XXXI. Fatehganj (*Fateganj*) Tower Station, lat. 28° 27′, long. 79° 21′—observed at in 1838 and 1839—is situated on a mound distant about 500 yards S.E. of the town of Fatehganj on the high road from Bareilly to Moradabad; this locality is memorable in the annals of Rohilkhand as the scene of the last struggle made (in 1794) by the Patháns under their leader Naju Khán against the power of the British: pargana Karor, district Bareilly.

The station consists of a perforated masonry column 9 feet square to a height of 2 feet, and circular thereafter—the diameter at top of shaft being 3 feet—surmounted by a capital of 4 feet diameter: the summit of the column is 37·9 feet above the mark-stone which is imbedded at 2 feet above the level of the ground. In a large enclosure about 200 yards E. of the station are the tombs of the Patháns who fell in the struggle, and a cenotaph erected on the spot by order of Government commemorates their heroism; the mausoleum of their brave leader stands at about 40 yards from the station: the distances and bearings of surrounding villages are:—Unási 0·9 mile W.; Ballia 2·5 miles E.; and Rukumpur 1·3 miles S.E.

X.—(*Of the North-East Longitudinal Series*). Sísgarh Tower Station, lat. 28° 44′, long. 79° 21′—observed at in 1839 and 1851—is situated on a platform in the centre of the fort which stands on a mound raised considerably above the general level of the surrounding country, and immediately south of the large village of Sísgarh: pargana Sirsáwán, district Bareilly.

The station consists of a tower of unburnt bricks and mud cement, 14 feet in diameter at top, enclosing a central perforated pillar of masonry whose summit is 38·0 feet above the mark-stone which * is 2 feet higher than the level of the ground. The station of 1839 was a column standing 38·3 feet above the mark-stone and similar in construction to the stations which precede; it was found, when revisited in the course of the operations of the North-East Longitudinal Series, to be so deflected as to necessitate the dismantling of a considerable portion of it; it was then rebuilt to its present height and enclosed in a *kacha* tower—the upper 5 feet of it being isolated therefrom: at the same time a second mark 1·8 inches N.W. by W. of the former one was cut on the original mark-stone. The road from Bareilly to Almora passes by the station; and the distances and bearings of surrounding villages are:—Ghulámganj 1·4 miles W.; Tigri 1·4 miles E.N.E.; and Girdhárpur 0·6 mile S.

XI.—(*Of the North-East Longitudinal Series*). Atária Tower Station, lat. 28° 38′, long. 79° 38′—observed at in 1839, 1843 and 1851—is situated on a mound near the east bank of the Baigul nadi, and distant about half a mile S.W. of the village of Atária: pargana Richha, district Bareilly.

The station consists of a tower of unburnt bricks and mud cement, about 14 feet in diameter at top, enclosing a central

* In the description of this station given in the North-East Longitudinal Series p. 7—I, the height of this mark-stone above ground level is stated at 0 feet as erroneously entered in the field records of that series.

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perforated pillar of masonry whose summit is 37·8 feet above the mark-stone which* is 2 feet higher than the level of the ground. The station of 1839 was a column 37·3 feet above the mark-stone and similar in manner of construction to the stations which precede; it was found greatly deflected when the observations on the Rangír Series came to be made so that the mark-stone in the basement could not be plumbed from the summit of the tower; the point of observation was indicated by the intersection of the diagonals of a quadrilateral each angular point of which was denoted by a dot engraved on an iron bolt imbedded in an external masonry pillar built in the adjacent fields. When the station was revisited in 1843 in the course of the operations of the North Connecting Series, the pillar was found still further deflected, and no trace of the four external pillars was forthcoming; the instrument was accordingly plumbed over a mark engraved on a new mark-stone let into the basement. On again visiting the station in 1851 in the course of the operations of the North-East Longitudinal Series, it was found necessary to dismantle a considerable portion of the pillar, which was then rebuilt to its present height and enclosed in a *kacha* tower: at the same time a second mark 3·5 inches W.N.W. of the mark of 1843 was engraved on the mark-stone of that year. The distances and bearings of surrounding villages are:—Ináyatpur 0·9 mile N.E.; Sayyidpur 1·2 miles E.; Uturia Mádhopur 0·5 mile S.S.W.; and Jumunián 0·8 mile N.W.

* In the description of this station given in the North-East Longitudinal Series p. 7—I, the height of this mark-stone above ground level is stated at 0 feet as erroneously entered in the field records of that series.

July 1877.

J. B. N. HENNESSEY,

In charge of Computing Office.

RANGIR MERIDIONAL SERIES.

OBSERVED ANGLES.

At VII (Tinsmál)

**June* 1834; *observed by Lieutenant A. S. Waugh with Cary's* 18-*inch Theodolite, L.*

†*March* 1864; *observed by Mr. G. Shelverton with Troughton and Simms'* 36-*inch Theodolite.*

Angle between	Circle readings, telescope being set on II												General Means and Probabilities.
	330°	150°	340°	160°	350°	170°	0°	180°	10°	190°	20°	200°	
* II & I	″ $26{\cdot}83_{2}$	″ $43{\cdot}66_{3}$	″ $29{\cdot}66_{3}$	″ $40{\cdot}66_{2}$	″ $32{\cdot}11_{3}$	″ $38{\cdot}00_{2}$	″ $36{\cdot}50_{2}$	″ $39{\cdot}11_{3}$	″ $33{\cdot}33_{2}$	″ $38{\cdot}33_{2}$	″ $27{\cdot}83_{2}$	″ $41{\cdot}83_{2}$	44° 20′ 35″·66 Prob. = 1·55

Angle between	Circle readings, telescope being set on I										*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	0° 2′	180° 2′	79° 13′	259° 13′	158° 24′	338° 24′	237° 37′	57° 37′	316° 48′	136° 48′	
† I & X	″ *l* 19·90 *l* 21·60 *l* 20·36	″ *h* 18·54 *h* 17 94 *l* 18·08	″ *h* 20·04 *h* 21·08 *h* 21·08	″ *h* 20·70 *l* 20·74 *l* 20·88	″ *l* 22·56 *l* 22·60 *l* 21·94	″ *l* 21·96 *l* 21·12 *l* 20·66	″ *h* 19·86 *h* 20·44 *h* 20·28	″ *l* 18·96 *h* 18·52 *h* 17·86 *h* 18·36	″ *h* 22·14 *h* 20·84 *h* 21·06	″ *l* 19·94 *l* 21·06 *l* 19·80	*M* = 20″·42 *w* = 5·91 $\frac{1}{w}$ = 0·17 *C* = 37° 36′ 20″·42
	20·62	18·19	20·73	20·77	22·37	21·25	20·19	18·43	21·35	20·27	

NOTE.—VII and X appertain to the Calcutta Longitudinal Series.

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At X (Rangír)

** June 1834; observed by Lieutenant A. S. Waugh with Cary's 18-inch Theodolite, L.*

† April 1864; observed by Mr. G. Shelverton with Troughton and Simms' 36-inch Theodolite.

Angle between	Circle readings, telescope being set on VII										M = Mean of Groups w = Relative Weight C = Concluded Angle
	169° 20′	349° 20′	248° 31′	68° 31′	327° 43′	147° 43′	46° 55′	226° 55′	126° 7′	306° 7′	
† VII & I	″ h 15·22 h 16·76 h 17·32	″ l 14·58 l 15·80 l 15·42	″ l 17·20 l 17·86 l 16·98	″ l 16·44 l 16·88 l 17·94	″ h 17·10 h 16·68 h 16·60	″ l 18·02 h 16·98 h 16·56	″ h 19·36 h 18·34 h 17·10	″ h 16·78 h 17·30 h 15·90	″ h 15·36 h 15·58 l 15·44	″ l 17·02 l 16·44 l 15·56	$M = 16''\cdot69$ $w = 11\cdot00$ $\frac{1}{w} = 0\cdot09$ $C = 54^\circ\ 24'\ 16''\cdot69$
	16·43	15·27	17·35	17·09	16·79	17·19	18·27	16·66	15·46	16·34	

Angle between	Circle readings, telescope being set on I												General Mean
	340°	160°	351°	171°	1°	181°	11°	191°	21°	201°	31°	211°	
* I & R.M.	$44\cdot50_2$	$37\cdot16_2$	$44\cdot50_2$	$40\cdot83_2$	$51\cdot83_2$	$47\cdot16_2$	$49\cdot83_2$	$40\cdot16_2$	$47\cdot33_2$	$45\cdot33_2$	$53\cdot33_2$	$38\cdot66_2$	$19^\circ\ 33'\ 45''\cdot06$

At I (Kusmár)

‡ June 1834; observed by Lieutenant A. S. Waugh with Cary's 18-inch Theodolite, L.

§ April 1864; observed by Mr. G. Shelverton with Troughton and Simms' 36-inch Theodolite.

Angle between	Circle readings, telescope being set on X										M = Mean of Groups w = Relative Weight C = Concluded Angle
	272° 3′	92° 2′	351° 13′	171° 12′	70° 26′	250° 25′	149° 37′	329° 37′	228° 49′	48° 49′	
§ X & VII	″ h 24·94 h 25·58 h 25·18	″ l 27·56 l 27·06 l 26·78	″ l 26·48 l 26·60 l 25·22	″ l 26·08 l 25·32 l 25·38	″ l 27·20 l 25·82 l 24·70	″ l 25·80 l 25·74 l 26·40	″ l 25·44 l 24·22 l 25·00	″ l 27·80 l 26·54 l 27·36	″ l 25·42 l 25·66 l 25·48	″ l 26·76 l 25·74 l 24·58	$M = 25''\cdot93$ $w = 14\cdot90$ $\frac{1}{w} = 0\cdot07$ $C = 87^\circ\ 59'\ 25''\cdot93$
	25·23	27·13	26·10	25·59	25·91	25·98	24·89	27·23	25·52	25·69	

Angle between	Circle readings, telescope being set on VII												General Means and Probabilities
	349°	169°	359°	179°	9°	189°	19°	199°	29°	209°	39°	219°	
‡ VII & II	$49\cdot16_2$	$49\cdot16_2$	$49\cdot16_2$	$52\cdot16_2$	$55\cdot16_2$	$53\cdot83_2$	$53\cdot33_2$	$47\cdot83_2$	$43\cdot50_2$	$45\cdot83_2$	$52\cdot66_2$	$48\cdot00_3$	$71^\circ\ 53'\ 49''\cdot99$ Prob. = 0·97
‡ II & III	$19\cdot83_2$	$11\cdot33_2$	$22\cdot83_2$	$13\cdot16_2$	$12\cdot83_2$	$7\cdot50_2$	$16\cdot33_2$	$11\cdot33_3$	$23\cdot88_3$	$15\cdot33_2$	$16\cdot00_2$	$14\cdot16_2$	$55^\circ\ 51'\ 15''\cdot38$ Prob. = 1·34

NOTE.—VII and X appertain to the Calcutta Longitudinal Series. R.M. denotes Referring Mark.

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At II (Dálípur)

July 1834; *observed by Lieutenant A. S. Waugh with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on IV												General Means and Probabilities
	53°	233°	63°	243°	73°	253°	83°	263°	93°	273°	103°	283°	
IV & III	″ 41·55 3	″ 36·55 3	″ 42·16 4	″ 37·66 3	″ 45·50 2	″ 41·33 4	″ 39·66 3	″ 41·88 3	″ 37·88 3	″ 34·94 4	″ 34·93 5	″ 38·83 4	73° 16′ 39″·41 Prob. = 0·89
III & I	19·00 3	18·77 3	17·33 2	19·92 4	8·33 2	14·33 2	14·83 2	20·88 3	17·66 2	14·22 3	15·33 2	11·33 2	80° 31′ 16″·00 Prob. = 1·02
I & VII	34·44 3	24·55 3	38·00 2	31·33 4	43·66 2	30·16 2	39·00 2	29·25 4	32·33 2	31·88 3	42·16 2	40·00 2	63° 45′ 34″·73 Prob. = 1·61

At III (Chandla)

June 1834; *observed by Lieutenant A. S. Waugh with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on I												General Means and Probabilities
	190°	10°	200°	20°	210°	30°	220°	40°	230°	50°	240°	60°	
I & II	″ 38·83 2	″ 27·83 2	″ 35·50 2	″ 27·50 2	″ 38·66 2	″ 30·50 2	″ 41·11 3	″ 25·33 2	″ 39·00 3	″ 18·33 2	″ 39·66 2	″ 23·88 3	43° 37′ 32″·18 Prob. = 2·09
II & IV	35·33 3	46·77 3	38·83 2	42·33 2	43·67 2	50·17 2	40·22 3	47·83 2	39·22 3	47·83 2	40·33 2	50·00 2	62° 27′ 43″·55 Prob. = 1·35
IV & V	55·83 2	60·33 3	62·83 2	63·16 2	57·66 2	60·33 2	53·55 3	55·33 3	68·33 2	61·33 2	60·33 2	66·00 2	49° 15′ 0″·42 Prob. = 1·21
V & VI	70·11 3	70·11 3	68·66 2	61·83 2	68·00 2	74·16 2	70·16 2	68·22 3	58·16 2	70·16 2	73·16 2	74·16 2	45° 37′ 8″·91 Prob. = 1·31

At IV (Bhoraj)

July 1834; *observed by Lieutenant A. S. Waugh with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on V												General Means and Probabilities
	213°	33°	223°	43°	233°	53°	243°	63°	253°	73°	263°	83°	
V & III	″ 67·16 2	″ 58·33 2	″ 59·00 2	″ 51·33 2	″ 72·66 2	″ 59·16 2	″ 59·33 2	″ 61·33 2	″ 64·00 2	″ 68·16 2	″ 69·16 2	″ 65·00 2	74° 12′ 2″·89 Prob. = 1·64
III & II	47·16 2	38·66 2	43·50 2	44·66 2	38·66 2	43·83 2	40·50 2	35·50 2	44·16 2	36·16 2	37·00 2	39·50 2	44° 15′ 40″·78 Prob. = 1·05

NOTE.—VII appertains to the Calcutta Longitudinal Series.

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At V (Datiára)

July 1834; *observed by Lieutenant A. S. Waugh with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on VIII												General Means and Probabilities
	206°	26°	216°	36°	226°	46°	236°	56°	246°	66°	256°	76°	
VIII & VII	$47''{\cdot}00_{3}$	$45''{\cdot}16_{2}$	$53''{\cdot}50_{2}$	$43''{\cdot}55_{3}$	$61''{\cdot}00_{2}$	$44''{\cdot}33_{2}$	$56''{\cdot}50_{2}$	$44''{\cdot}16_{2}$	$51''{\cdot}33_{2}$	$46''{\cdot}50_{2}$	$55''{\cdot}33_{2}$	$48''{\cdot}50_{2}$	$64^\circ\ 59'\ 49''{\cdot}74$ Prob. = 1·58
VII & VI	$26{\cdot}55_{3}$	$25{\cdot}16_{2}$	$19{\cdot}83_{2}$	$28{\cdot}44_{3}$	$19{\cdot}66_{2}$	$22{\cdot}50_{2}$	$23{\cdot}33_{2}$	$19{\cdot}83_{2}$	$19{\cdot}50_{2}$	$19{\cdot}00_{2}$	$20{\cdot}83_{2}$	$21{\cdot}33_{2}$	$52^\circ\ 50'\ 22''{\cdot}17$ Prob. = 0·86
VI & III	$62{\cdot}66_{2}$	$47{\cdot}92_{4}$	$57{\cdot}50_{2}$	$57{\cdot}16_{2}$	$55{\cdot}66_{2}$	$51{\cdot}16_{2}$	$60{\cdot}11_{3}$	$56{\cdot}33_{2}$	$57{\cdot}46_{5}$	$42{\cdot}66_{2}$	$58{\cdot}00_{2}$	$54{\cdot}00_{2}$	$59^\circ\ 12'\ 55''{\cdot}06$ Prob. = 1·52
III & IV	$51{\cdot}50_{2}$	$58{\cdot}50_{2}$	$51{\cdot}33_{2}$	$53{\cdot}00_{2}$	$49{\cdot}22_{3}$	$64{\cdot}33_{2}$	$57{\cdot}88_{3}$	$60{\cdot}00_{2}$	$52{\cdot}75_{4}$	$61{\cdot}50_{2}$	$52{\cdot}50_{2}$	$57{\cdot}58_{4}$	$56^\circ\ 32'\ 55''{\cdot}84$ Prob. = 1·31

At VI (Thanela)

July 1834; *observed by Lieutenant A. S. Waugh with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on III												General Means and Probabilities
	100°	280°	111°	290°	121°	301°	131°	310°	141°	321°	151°	331°	
III & V	$9''{\cdot}50_{2}$	$7''{\cdot}77_{3}$	$7''{\cdot}55_{3}$	$6''{\cdot}33_{2}$	$7''{\cdot}55_{3}$	$7''{\cdot}75_{4}$	$4''{\cdot}33_{2}$	$8''{\cdot}58_{4}$	$6''{\cdot}88_{3}$	$5''{\cdot}50_{2}$	$7''{\cdot}16_{4}$	$9''{\cdot}75_{4}$	$75^\circ\ 1'\ 7''{\cdot}39$ Prob. = 0·43
V & VII	$36{\cdot}55_{3}$	$37{\cdot}88_{3}$	$40{\cdot}00_{2}$	$36{\cdot}33_{3}$	$43{\cdot}16_{2}$	$44{\cdot}16_{2}$	$39{\cdot}66_{2}$	$40{\cdot}16_{4}$	$40{\cdot}33_{3}$	$44{\cdot}16_{2}$	$39{\cdot}33_{3}$	$40{\cdot}11_{3}$	$62^\circ\ 30'\ 40''{\cdot}16$ Prob. = 0·72

At VII (Manang)

July 1834; *observed by Lieutenant A. S. Waugh with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on VI												General Means and Probabilities
	335°	155°	345°	165°	355°	175°	5°	185°	15°	195°	25°	205°	
VI & V	$61''{\cdot}66_{2}$	$59''{\cdot}33_{2}$	$59''{\cdot}50_{2}$	$58''{\cdot}16_{2}$	$60''{\cdot}50_{2}$	$61''{\cdot}50_{2}$	$61''{\cdot}33_{2}$	$61''{\cdot}83_{2}$	$59''{\cdot}88_{3}$	$58''{\cdot}50_{2}$	$60''{\cdot}50_{2}$	$65''{\cdot}00_{2}$	$64^\circ\ 39'\ 0''{\cdot}64$ Prob. = 0·51
V & VIII	$5{\cdot}33_{2}$	$7{\cdot}66_{2}$	$6{\cdot}83_{2}$	$6{\cdot}00_{2}$	$9{\cdot}33_{2}$	$9{\cdot}33_{2}$	$2{\cdot}16_{2}$	$6{\cdot}66_{2}$	$10{\cdot}11_{3}$	$15{\cdot}66_{2}$	$5{\cdot}16_{2}$	$5{\cdot}66_{2}$	$54^\circ\ 52'\ 7''{\cdot}50$ Prob. = 0·93
VIII & IX	$20{\cdot}66_{2}$	$25{\cdot}33_{2}$	$23{\cdot}16_{2}$	$25{\cdot}16_{2}$	$24{\cdot}33_{2}$	$22{\cdot}00_{2}$	$28{\cdot}00_{2}$	$17{\cdot}83_{2}$	$25{\cdot}44_{3}$	$17{\cdot}00_{2}$	$21{\cdot}00_{2}$	$26{\cdot}00_{2}$	$59^\circ\ 42'\ 23''{\cdot}00$ Prob. = 0·93

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At VIII (Nágonáth)

**July* 1834; *observed by Lieutenant A. S. Waugh with Cary's* 18-*inch Theodolite, L.*

†*December* 1836; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on X												General Means and Probabilities
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
† X & IX	″ $10\cdot83_{2}$	″ $11\cdot75_{2}$	″ $7\cdot00_{3}$	″ $15\cdot75_{2}$	″ $2\cdot75_{2}$	″ $15\cdot66_{3}$	″ $6\cdot92_{2}$	″ $15\cdot50_{2}$	″ $0\cdot61_{3}$	″ $16\cdot61_{3}$	″ $10\cdot25_{2}$	″ $17\cdot17_{2}$	60° 8′ 10″·90 Prob. = 1·55
	Circle readings, telescope being set on IX												
	54°	234°	64°	244°	74°	254°	84°	264°	94°	274°	104°	284°	
* IX & VII	$27\cdot66_{2}$	$25\cdot16_{2}$	$33\cdot00_{2}$	$24\cdot50_{2}$	$29\cdot33_{2}$	$31\cdot16_{2}$	$31\cdot16_{2}$	$25\cdot50_{2}$	$30\cdot00_{2}$	$27\cdot83_{2}$	$28\cdot50_{2}$	$24\cdot50_{2}$	62° 6′ 28″·19 Prob. = 0·79
* VII & V	$9\cdot83_{2}$	$8\cdot50_{2}$	$8\cdot00_{2}$	$8\cdot33_{2}$	$3\cdot66_{2}$	$11\cdot00_{2}$	$9\cdot33_{2}$	$9\cdot66_{3}$	$7\cdot50_{2}$	$8\cdot16_{2}$	$11\cdot50_{2}$	$10\cdot50_{2}$	60° 8′ 8″·83 Prob. = 0·57

At IX (Phára)

‡*July* 1834; *observed by Lieutenant A. S. Waugh with Cary's* 18-*inch Theodolite, L.*

§*December* 1836, *and January* 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on VII												General Means and Probabilities
	81°	261°	91°	271°	101°	281°	111°	291°	121°	301°	131°	311°	
‡ VII & VIII	″ $10\cdot66_{2}$	″ $18\cdot83_{2}$	″ $15\cdot33_{2}$	″ $13\cdot66_{2}$	″ $13\cdot16_{2}$	″ $17\cdot00_{2}$	″ $12\cdot50_{2}$	″ $16\cdot50_{2}$	″ $11\cdot83_{2}$	″ $14\cdot16_{2}$	″ $13\cdot16_{2}$	″ $10\cdot33_{2}$	58° 11′ 13″·93 Prob. = 0·71
	Circle readings, telescope being set on VIII												
	245°	65°	255°	75°	265°	85°	275°	95°	285°	105°	295°	115°	
§ VIII & X	$+74\cdot56_{3}$	$73\cdot67_{2}$	$73\cdot58_{2}$	$72\cdot75_{2}$	$69\cdot92_{2}$	$65\cdot17_{2}$	$67\cdot08_{2}$	$67\cdot58_{2}$	$75\cdot58_{2}$	$64\cdot75_{4}$	$68\cdot08_{2}$	$66\cdot50_{2}$	
	$-38\cdot00_{3}$	$32\cdot50_{4}$	$26\cdot17_{2}$	$36\cdot08_{2}$	$35\cdot97_{5}$	$28\cdot50_{2}$	$24\cdot83_{2}$	$26\cdot92_{2}$	$33\cdot58_{2}$	$25\cdot67_{2}$	$33\cdot08_{2}$	$31\cdot50_{2}$	
+ 115° 16′ − 65° 25′	36·56	41·17	47·41	36·67	33·95	36·67	42·25	40·66	42·00	39·08	35·00	35·00	49° 51′ 38″·87 Prob. = 1·09
§ X & XI	$+38\cdot00_{3}$	$32\cdot50_{4}$	$26\cdot17_{2}$	$36\cdot08_{2}$	$35\cdot97_{5}$	$28\cdot50_{2}$	$24\cdot83_{2}$	$26\cdot92_{2}$	$33\cdot58_{2}$	$25\cdot67_{2}$	$33\cdot08_{2}$	$31\cdot50_{2}$	
	$-23\cdot00_{2}$	$18\cdot94_{3}$	$22\cdot89_{3}$	$21\cdot22_{3}$	$28\cdot38_{4}$	$22\cdot25_{2}$	$16\cdot58_{4}$	$19\cdot25_{2}$	$26\cdot79_{4}$	$15\cdot29_{4}$	$22\cdot25_{2}$	$17\cdot42_{2}$	
+ 65° 25′ − 7° 47′	15·00	13·56	3·28	14·86	7·59	6·25	8·25	7·67	6·79	10·38	10·83	14·08	57° 38′ 9″·88 Prob. = 1·06

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At X (Gokulphára)

December 1836; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	173°	353°	183°	3°	193°	13°	203°	23°	213°	33°	223°	43°	General Means and Probabilities
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & XI	+48·75$_{2}$	60·83$_{2}$	55·58$_{2}$	64·58$_{2}$	49·75$_{2}$	47·83$_{3}$	39·50$_{2}$	55·83$_{2}$	54·58$_{2}$	56·92$_{2}$	52·50$_{2}$	61·58$_{2}$	53° 8′ 38″·57
	−14·67$_{2}$	22·08$_{2}$	10·00$_{2}$	23·33$_{2}$	6·94$_{3}$	18·92$_{2}$	3·72$_{3}$	17·92$_{2}$	15·25$_{2}$	19·17$_{2}$	8·21$_{4}$	25·17$_{2}$	Prob. = 1·28
+ 187° 6′ − 133° 58′	34·08	38·75	45·58	41·25	42·81	28·91	35·78	37·91	39·33	37·75	44·29	36·41	
XI & IX	+74·67$_{2}$	82·08$_{2}$	70·00$_{2}$	83·33$_{2}$	66·94$_{3}$	78·92$_{2}$	63·72$_{3}$	77·92$_{2}$	75·25$_{2}$	79·17$_{2}$	68·21$_{4}$	85·17$_{2}$	51° 11′ 50″·20
	−19·25$_{2}$	31·33$_{2}$	29·92$_{2}$	32·33$_{2}$	24·42$_{2}$	27·58$_{2}$	18·25$_{2}$	26·67$_{2}$	22·75$_{2}$	23·58$_{2}$	17·25$_{2}$	29·67$_{2}$	Prob. = 1·39
+ 133° 57′ − 82° 46′	55·42	50·75	40·08	51·00	42·52	51·34	45·47	51·25	52·50	55·59	50·96	55·50	
IX & VIII	+19·25$_{2}$	31·33$_{2}$	29·92$_{2}$	32·33$_{2}$	24·42$_{2}$	27·58$_{2}$	18·25$_{2}$	26·67$_{2}$	22·75$_{2}$	23·58$_{2}$	17·25$_{2}$	29·67$_{2}$	70° 0′ 7″·91
	−17·25$_{2}$	19·42$_{2}$	20·75$_{2}$	16·58$_{2}$	21·67$_{2}$	15·00$_{2}$	15·94$_{3}$	14·17$_{2}$	16·58$_{2}$	17·67$_{2}$	16·83$_{2}$	16·25$_{2}$	Prob. = 1·46
+ 82° 46′ − 12° 46′	2·00	11·91	9·17	15·75	2·75	12·58	2·31	12·50	6·17	5·91	0·42	13·42	

Circle readings, telescope being set on XII

At XI (Gura)

January 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	179°	359°	189°	9°	199°	19°	209°	29°	219°	39°	229°	49°	General Means and Probabilities
	″	″	″	″	″	″	″	″	″	″	″	″	
IX & X	+118·50$_{4}$	117·00$_{2}$	113·67$_{2}$	106·00$_{2}$	120·33$_{2}$	115·44$_{3}$	109·17$_{2}$	121·39$_{3}$	114·50$_{2}$	120·33$_{2}$	112·00$_{2}$	116·75$_{2}$	71° 10′ 1″·27
	− 48·67$_{3}$	54·89$_{3}$	52·92$_{2}$	46·08$_{4}$	58·83$_{2}$	60·67$_{2}$	54·08$_{2}$	55·17$_{2}$	53·42$_{2}$	51·72$_{3}$	53·17$_{2}$	60·29$_{4}$	Prob. = 1·35
+181° 18′ −110° 9′	69·83	62·11	60·75	59·92	61·50	54·77	55·09	66·22	61·08	68·61	58·83	56·46	
X & XII	+108·67$_{3}$	114·89$_{3}$	112·92$_{2}$	106·08$_{4}$	118·83$_{2}$	120·67$_{2}$	114·08$_{2}$	115·17$_{2}$	113·42$_{2}$	111·72$_{3}$	113·17$_{2}$	120·29$_{4}$	61° 37′ 0″·45
	− 52·33$_{2}$	55·42$_{2}$	56·08$_{2}$	55·50$_{2}$	52·33$_{2}$	51·00$_{2}$	57·00$_{2}$	52·33$_{2}$	51·58$_{2}$	52·00$_{2}$	58·00$_{3}$	50·92$_{2}$	Prob. = 1·62
+110° 8′ − 48° 32′	56·34	59·47	56·84	50·58	66·50	69·67	57·08	62·84	61·84	59·72	55·17	69·37	
XII & XIII	+52·33$_{2}$	55·42$_{2}$	56·08$_{2}$	55·50$_{2}$	52·33$_{2}$	51·00$_{2}$	57·00$_{2}$	52·33$_{2}$	51·58$_{2}$	52·00$_{2}$	58·00$_{3}$	50·92$_{2}$	72° 58′ 45″·44
	+45·08$_{2}$	46·08$_{2}$	51·17$_{2}$	52·17$_{2}$	55·00$_{2}$	52·75$_{2}$	57·00$_{2}$	53·67$_{3}$	52·83$_{2}$	46·75$_{2}$	52·33$_{2}$	56·00$_{2}$	Prob. = 1·29
+48° 32′ +24° 25′	37·41	41·50	47·25	47·67	47·33	43·75	54·00	46·00	44·41	38·75	50·33	46·92	

Circle readings, telescope being set on IX

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At XII (Kanwa)

January and February 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	19°	199°	29°	209°	39°	219°	49°	229°	59°	239°	69°	249°	General Means and Probabilities
	″	″	″	″	″	″	″	″	″	″	″	″	
XIV & XIII	+33·67$_2$	36·00$_2$	44·83$_2$	44·00$_2$	38·22$_3$	48·00$_1$	45·20$_5$	39·83$_2$	37·33$_2$	40·83$_2$	37·67$_2$	44·50$_2$	53° 40′ 13″·56
	−26·33$_3$	23·50$_2$	32·17$_2$	28·33$_2$	27·50$_2$	27·50$_2$	25·67$_2$	28·00$_2$	25·00$_2$	25·50$_2$	26·50$_2$	31·33$_2$	Prob. = 1·02
+ 72° 11′ − 18° 31′	7·34	12·50	12·66	15·67	10·72	20·50	19·53	11·83	12·33	15·33	11·17	13·17	
XIII & XI	+69·17$_2$	64·00$_2$	72·83$_2$	72·67$_2$	70·50$_2$	66·67$_2$	68·42$_4$	69·50$_2$	62·00$_2$	67·83$_2$	68·50$_2$	60·83$_2$	51° 14′ 26″·90
	−33·67$_2$	36·00$_2$	44·83$_2$	44·00$_2$	38·22$_3$	48·00$_1$	45·20$_5$	39·83$_2$	37·33$_2$	40·83$_2$	37·67$_2$	44·50$_2$	Prob. = 1·51
+123° 25′ − 72° 11′	35·50	28·00	28·00	28·67	32·28	18·67	23·22	29·67	24·67	27·00	30·83	16·33	
XI & X	+35·50$_2$	25·00$_2$	32·00$_2$	34·00$_2$	36·50$_2$	36·00$_2$	37·00$_2$	35·83$_2$	28·50$_2$	31·58$_2$	33·83$_2$	29·83$_2$	65° 14′ 25″·22
	− 9·17$_2$	4·00$_2$	12·83$_2$	12·67$_2$	10·50$_2$	6·67$_2$	8·42$_4$	9·50$_2$	2·00$_2$	7·83$_2$	8·50$_2$	0·83$_2$	Prob. = 0·91
+188° 40′ −123° 26′	26·33	21·00	19·17	21·33	26·00	29·33	28·58	26·33	26·50	23·75	25·33	29·00	

Circle readings, telescope being set on XIV.

At XIII (Nipania)

February 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	150°	330°	160°	340°	170°	350°	180°	0°	190°	10°	200°	20°	General Means and Probabilities
	″	″	″	″	″	″	″	″	″	″	″	″	
XI & XII	+100·00$_2$	102·33$_2$	97·50$_2$	107·17$_2$	91·83$_2$	105·50$_2$	94·50$_2$	107·33$_2$	97·17$_2$	103·83$_2$	90·83$_2$	101·17$_2$	55° 46′ 47″·82
	− 56·33$_2$	52·33$_2$	56·33$_2$	52·33$_2$	55·58$_4$	53·50$_2$	43·56$_3$	50·17$_2$	46·67$_2$	54·67$_2$	50·33$_2$	53·50$_2$	Prob. = 1·72
+209° 40′ −153° 54′	43·67	50·00	41·17	54·84	36·25	52·00	50·94	57·16	50·50	49·16	40·50	47·67	
XII & XIV	+56·33$_2$	52·33$_2$	56·33$_2$	52·33$_2$	55·58$_4$	53·50$_2$	43·56$_3$	50·17$_2$	46·67$_2$	54·67$_2$	50·33$_2$	53·50$_2$	57° 47′ 39″·51
	−10·22$_3$	6·50$_2$	14·67$_2$	14·17$_2$	17·50$_2$	4·50$_2$	15·17$_2$	12·83$_2$	19·67$_2$	9·33$_2$	15·17$_2$	11·50$_2$	Prob. = 1·91
+153° 54′ − 96° 7′	46·11	45·83	41·66	38·16	38·08	49·00	28·39	37·34	27·00	45·34	35·16	42·00	
XIV & XV	+70·22$_3$	66·50$_2$	74·67$_2$	74·17$_2$	77·50$_2$	64·50$_2$	75·17$_2$	72·83$_2$	79·67$_2$	69·33$_2$	75·17$_2$	71·50$_2$	62° 33′ 50″·46
	−16·00$_2$	25·00$_2$	22·67$_2$	23·83$_2$	22·17$_2$	27·00$_2$	25·50$_2$	18·50$_2$	17·00$_2$	25·00$_2$	15·17$_2$	27·83$_2$	Prob. = 2·09
+ 96° 6′ − 33° 33′	54·22	41·50	52·00	50·34	55·33	37·50	49·67	54·33	62·67	44·33	60·00	43·67	

Circle readings, telescope being set on XI.

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At XIV (Husapura)

February and March 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on XVI: 350°	170°	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	General Means and Probabilities
	″	″	″	″	″	″	″	″	″	″	″	″	
XVI & XV	+25·67$_2$	30·83$_2$	39·92$_4$	23·50$_2$	34·00$_2$	28·75$_4$	36·17$_2$	27·00$_2$	35·00$_2$	27·33$_2$	34·17$_2$	26·17$_2$	57° 49′ 41″·00
	+ 7·50$_2$	9·83$_2$	9·00$_2$	10·33$_2$	9·17$_2$	11·17$_2$	8·67$_2$	6·67$_2$	10·67$_2$	15·50$_2$	13·83$_2$	11·17$_2$	Prob. = 1·53
+ 47° 17′ + 10° 32′	33·17	40·66	48·92	33·83	43·17	39·92	44·84	33·67	45·67	42·83	48·00	37·34	
XV & XIII	+55·17$_2$	56·67$_2$	54·00$_2$	56·17$_2$	51·56$_3$	55·33$_2$	61·33$_2$	62·00$_2$	58·00$_2$	61·67$_2$	50·83$_2$	59·83$_2$	53° 7′ 26″·17
	−25·67$_2$	30·83$_2$	39·92$_4$	23·50$_2$	34·00$_2$	28·75$_4$	36·17$_2$	27·00$_2$	35·00$_2$	27·33$_2$	34·17$_2$	26·17$_2$	Prob. = 2·00
+ 100° 24′ − 47° 17′	29·50	25·84	14·08	32·67	17·56	26·58	25·16	35·00	23·00	34·34	16·66	33·66	
XIII & XII	+59·00$_2$	57·25$_4$	67·00$_2$	62·50$_2$	64·17$_2$	59·33$_2$	64·17$_2$	62·67$_2$	60·00$_2$	63·17$_2$	63·50$_2$	74·50$_2$	68° 32′ 6″·22
	−55·17$_2$	56·67$_2$	54·00$_2$	56·17$_2$	51·56$_3$	55·33$_2$	61·33$_2$	62·00$_2$	58·00$_2$	61·67$_2$	50·83$_2$	59·83$_2$	Prob. = 1·50
+ 168° 56′ − 100° 24′	3·83	0·58	13·00	6·33	12·61	4·00	2·84	0·67	2·00	1·50	12·67	14·67	

At XV (Gandaspur)

March 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on XIII: 205°	25°	215°	35°	225°	45°	235°	55°	245°	65°	255°	75°	General Means and Probabilities
	″	″	″	″	″	″	″	″	″	″	″	″	
XIII & XIV	+92·33$_2$	96·33$_2$	89·17$_2$	94·00$_2$	97·00$_2$	90·00$_2$	89·67$_2$	92·33$_2$	98·00$_2$	96·83$_2$	91·50$_2$	98·33$_2$	64° 18′ 42″·94
	−49·67$_2$	46·33$_2$	48·00$_2$	53·50$_2$	56·17$_2$	50·83$_2$	52·50$_2$	44·33$_2$	54·17$_2$	49·00$_2$	55·00$_2$	50·67$_3$	Prob. = 1·25
+ 155° 12′ − 90° 54′	42·66	50·00	41·17	40·50	40·83	39·17	37·17	48·00	43·83	47·83	36·50	47·66	
XIV & XVI	+49·67$_2$	46·33$_2$	48·00$_2$	53·50$_2$	56·17$_2$	50·83$_2$	52·50$_2$	44·33$_2$	54·17$_2$	49·00$_2$	55·00$_2$	50·67$_3$	51° 16′ 12″·31
	−40·50$_2$	39·83$_2$	36·17$_2$	40·67$_2$	41·67$_3$	36·33$_2$	42·33$_2$	36·83$_2$	42·83$_2$	40·33$_2$	34·66$_2$	30·33$_3$	Prob. = 1·25
+ 90° 54′ − 39° 38′	9·17	6·50	11·83	12·83	14·50	14·50	10·17	7·50	11·34	8·67	20·34	20·34	
XVI & XVII	+40·50$_2$	39·83$_2$	36·17$_2$	40·67$_2$	41·67$_2$	36·33$_2$	42·33$_2$	36·83$_2$	42·83$_2$	40·33$_2$	34·66$_2$	30·33$_3$	61° 21′ 26″·04
	+46·67$_2$	45·17$_2$	53·50$_2$	50·00$_2$	41·17$_2$	48·83$_2$	50·67$_2$	45·50$_2$	43·50$_2$	51·00$_2$	44·67$_2$	49·25$_4$	Prob. = 1·25
+ 39° 38′ + 21° 42′	27·17	25·00	29·67	30·67	22·84	25·16	33·00	22·33	26·33	31·33	19·33	19·58	

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At XVI (Atsu)

March 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on XVIII												General Means and Probabilities
	357°	177°	7°	187°	17°	197°	27°	207°	37°	217°	47°	227°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVIII & XVII	+33·67$_{2}$	35·00$_{2}$	25·83$_{2}$	32·83$_{2}$	24·00$_{2}$	28·83$_{2}$	26·17$_{2}$	30·33$_{2}$	26·00$_{2}$	33·33$_{2}$	29·83$_{2}$	34·17$_{2}$	58° 5′ 48″·10
	+13·33$_{2}$	14·83$_{2}$	19·67$_{2}$	19·17$_{2}$	16·00$_{2}$	13·33$_{2}$	24·00$_{2}$	20·67$_{2}$	22·67$_{2}$	12·67$_{2}$	22·67$_{2}$	18·17$_{2}$	Prob. = 1·12
+ 2° 53′ +55° 12′	47·00	49·83	45·50	52·00	40·00	42·16	50·17	51·00	48·67	46·00	52·50	52·34	
XVII & XV	+33·67$_{2}$	26·83$_{2}$	27·67$_{2}$	27·50$_{2}$	34·33$_{2}$	26·00$_{2}$	33·00$_{2}$	28·33$_{2}$	35·17$_{2}$	21·42$_{4}$	33·17$_{2}$	26·83$_{2}$	56° 11′ 11″·40
	−13·33$_{2}$	14·83$_{2}$	19·67$_{2}$	19·17$_{2}$	16·00$_{2}$	13·33$_{2}$	24·00$_{2}$	20·67$_{2}$	22·67$_{2}$	12·67$_{2}$	22·67$_{2}$	18·17$_{2}$	Prob. = 1·14
+111° 23′ − 55° 12′	20·34	12·00	8·00	8·33	18·33	12·67	9·00	7·66	12·50	8·75	10·50	8·66	
XV & XIV	+39·00$_{2}$	41·33$_{2}$	36·83$_{2}$	41·00$_{2}$	44·50$_{2}$	36·00$_{2}$	41·50$_{2}$	37·17$_{2}$	42·17$_{2}$	36·17$_{2}$	40·17$_{2}$	43·33$_{2}$	70° 54′ 10″·44
	−33·67$_{2}$	26·83$_{2}$	27·67$_{2}$	27·50$_{2}$	34·33$_{2}$	26·00$_{2}$	33·00$_{2}$	28·33$_{2}$	35·17$_{2}$	21·42$_{4}$	33·17$_{2}$	26·83$_{2}$	Prob. = 0·98
+182° 17′ −111° 23′	5·33	14·50	9·16	13·50	10·17	10·00	8·50	8·84	7·00	14·75	7·00	16·50	

At XVII (Seontára)

March 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

Angle between	Circle readings, telescope being set on XV												General Means and Probabilities
	127°	307°	137°	317°	147°	327°	157°	337°	167°	347°	177°	357°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XV & XVI	+54·00$_{2}$	57·00$_{2}$	56·50$_{2}$	55·17$_{2}$	58·00$_{2}$	58·67$_{2}$	52·00$_{2}$	53·33$_{2}$	49·67$_{2}$	63·08$_{4}$	47·67$_{2}$	54·50$_{2}$	62° 27′ 27″·24
	−24·00$_{2}$	24·33$_{2}$	26·67$_{2}$	29·67$_{2}$	30·83$_{2}$	27·50$_{2}$	25·67$_{2}$	25·33$_{2}$	29·00$_{2}$	31·33$_{2}$	30·83$_{2}$	27·50$_{2}$	Prob. = 1·28
+232° 57′ −170° 30′	30·00	32·67	29·83	25·50	27·17	31·17	26·33	28·00	20·67	31·75	16·84	27·00	
XVI & XVIII	+24·00$_{2}$	24·33$_{2}$	26·67$_{2}$	29·67$_{2}$	30·83$_{2}$	27·50$_{2}$	25·67$_{2}$	25·33$_{2}$	29·00$_{2}$	31·33$_{2}$	30·83$_{2}$	27·50$_{2}$	64° 27′ 14″·33
	− 9·83$_{2}$	14·67$_{2}$	8·67$_{2}$	17·17$_{2}$	14·33$_{2}$	12·50$_{2}$	9·67$_{2}$	12·17$_{2}$	16·33$_{2}$	19·00$_{2}$	12·17$_{2}$	14·17$_{2}$	Prob. = 0·72
+170° 30′ −106° 3′	14·17	9·66	18·00	12·50	16·50	15·00	16·00	13·16	12·67	12·33	18·66	13·33	
XVIII & XIX	+69·83$_{2}$	74·67$_{2}$	68·67$_{2}$	77·17$_{2}$	74·33$_{2}$	72·50$_{2}$	69·67$_{2}$	72·17$_{2}$	76·33$_{2}$	79·00$_{2}$	72·17$_{2}$	74·17$_{2}$	65° 16′ 17″·54
	−54·00$_{2}$	57·83$_{2}$	56·67$_{2}$	56·83$_{2}$	53·33$_{2}$	59·00$_{2}$	47·00$_{2}$	55·00$_{2}$	58·67$_{2}$	57·50$_{2}$	57·00$_{2}$	57·33$_{2}$	Prob. = 0·91
+106° 2′ − 40° 46′	15·83	16·84	12·00	20·34	21·00	13·50	22·67	17·17	17·66	21·50	15·17	16·84	

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At XVIII (Birona)

**March and April* 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, L.*

†*March* 1840; *observed by Mr. J. W. Armstrong with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XX												General Means and Probabilities
	31°	211°	41°	221°	51°	231°	61°	241°	71°	251°	81°	261°	
† XX & XIX	″ $52·00_{2}$	″ $57·33_{2}$	″ $54·83_{2}$	″ $55·16_{2}$	″ $57·83_{2}$	″ $54·66_{2}$	″ $58·33_{2}$	″ $54·83_{2}$	″ $55·00_{2}$	″ $57·16_{2}$	″ $61·33_{2}$	″ $58·83_{2}$	58° 33′ 56″·44 Prob. = 0·69
	Circle readings, telescope being set on XIX												
	87°	267°	97°	277°	108°	288°	117°	297°	127°	307°	137°	317°	
* XIX & XVII	$+95·50_{2}$	$98·11_{2}$	$99·50_{2}$	$97·50_{2}$	$96·50_{2}$	$93·67_{3}$	$96·33_{2}$	$98·83_{2}$	$96·67_{2}$	$88·83_{2}$	$97·17_{2}$	$95·33_{2}$	57° 53′ 0″·31 Prob. = 0·69
	$-35·33_{2}$	$40·33_{2}$	$36·00_{2}$	$37·00_{2}$	$30·50_{2}$	$35·00_{4}$	$36·92_{4}$	$41·33_{2}$	$34·33_{2}$	$29·00_{2}$	$37·67_{2}$	$36·83_{2}$	
+ 145° 19′ − 87° 27′	60·17	57·84	63·50	60·50	66·00	58·67	59·41	57·50	62·34	59·83	59·50	58·50	
	Circle readings, telescope being set on XVII												
	135°	315°	145°	325°	155°	335°	165°	345°	175°	355°	185°	5°	
* XVII & XVI	$55·75_{4}$	$55·33_{2}$	$55·00_{2}$	$54·00_{2}$	$55·33_{2}$	$57·00_{2}$	$56·17_{2}$	$59·83_{2}$	$58·50_{2}$	$57·83_{2}$	$60·83_{2}$	$57·33_{2}$	57° 26′ 56″·91 Prob. = 0·57

At XIX (Kalsán)

‡*November* 1837; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M. O.*

§*February* 1840; *observed by Mr. J. W. Armstrong with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XVII												General Means and Probabilities
	343°	163°	353°	173°	3°	183°	13°	193°	23°	203°	33°	213°	
‡ XVII & XVIII	″ $+33·78_{3}$	″ $28·17_{2}$	″ $35·50_{2}$	″ $32·17_{2}$	″ $28·67_{2}$	″ $25·17_{2}$	″ $28·50_{2}$	″ $36·33_{2}$	″ $36·17_{2}$	″ $32·67_{2}$	″ $32·00_{2}$	″ $35·50_{2}$	56° 50′ 41″·01 Prob. = 0·83
	$+10·78_{3}$	$12·67_{2}$	$8·33_{2}$	$11·33_{2}$	$10·33_{2}$	$17·33_{2}$	$13·25_{4}$	$8·00_{2}$	$4·63_{4}$	$2·67_{4}$	$4·63_{4}$	$3·58_{4}$	
+ 16° 39′ + 40° 11′	44·56	40·84	43·83	43·50	39·00	42·50	41·75	44·33	40·80	35·34	36·63	39·08	
	Circle readings, telescope being set on XVIII												
	42°	222°	52°	232°	62°	242°	72°	252°	82°	262°	92°	272°	
§ XVIII & XX	$+75·00_{2}$	$75·33_{2}$	$74·66_{2}$	$76·66_{2}$	$70·16_{6}$	$77·16_{2}$	$73·16_{2}$	$71·50_{2}$	$72·83_{2}$	$72·66_{2}$	$72·83_{2}$	$72·16_{2}$	59° 18′ 9″·69 Prob. = 0·75
	$-66·00_{2}$	$68·58_{4}$	$60·50_{4}$	$69·50_{2}$	$57·46_{5}$	$66·00_{2}$	$61·22_{3}$	$63·33_{2}$	$60·00_{4}$	$66·33_{2}$	$64·25_{4}$	$64·66_{2}$	
+ 101° 39′ − 42° 21′	9·00	6·75	14·16	7·16	12·70	11·16	11·94	8·17	12·83	6·33	8·58	7·50	

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At XIX (Kalsán)—(*Continued*).

Angle between	Circle readings, telescope being set on XVIII												General Means and Probabilities
	42°	222°	52°	232°	62°	242°	72°	252°	82°	262°	92°	272°	
	"	"	"	"	"	"	"	"	"	"	"	"	
§ XX & XXI	+35·83$_2$	38·83$_2$	37·16$_2$	36·66$_2$	34·33$_2$	38·50$_2$	32·83$_2$	36·22$_8$	40·33$_2$	39·16$_2$	35·00$_2$	35·66$_2$	54° 11′ 23″·03
	−15·00$_2$	15·33$_2$	14·66$_2$	16·66$_2$	10·16$_6$	17·16$_2$	13·16$_2$	11·50$_2$	12·83$_2$	12·66$_2$	12·83$_2$	12·16$_2$	Prob. = 0·68
+155° 51′ −101° 40′	20·83	23·50	22·50	20·00	24·16	21·34	19·67	24·72	27·50	26·50	22·17	23·50	

At XX (Bisungarh)

* *February* 1839; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M. O.*

† *January* 1841; *observed by Mr. J. W. Armstrong with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXIII												General Means and Probabilities
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	
† XXIII & XXII	+18·67$_2$	20·17$_2$	19·00$_2$	20·00$_2$	18·83$_2$	14·17$_2$	17·00$_2$	22·67$_2$	20·33$_2$	22·67$_2$	19·67$_2$	20·17$_2$	3° 23′ 29″·78
	+ 9·33$_2$	8·50$_2$	10·17$_2$	10·67$_2$	11·17$_2$	9·50$_2$	13·83$_2$	8·50$_2$	8·83$_2$	11·67$_2$	11·67$_2$	10·17$_2$	Prob. = 0·70
+ 0° 21′ + 3° 2′	28·00	28·67	29·17	30·67	30·00	23·67	30·83	31·17	29·16	34·34	31·34	30·34	
† XXII & XXI	+75·50$_2$	73·17$_2$	75·83$_2$	80·17$_2$	74·33$_2$	74·17$_2$	70·67$_2$	78·67$_2$	78·17$_2$	72·33$_2$	76·17$_2$	76·83$_2$	57° 15′ 5″·17
	− 9·33$_2$	8·50$_2$	10·17$_2$	10·67$_2$	11·17$_2$	9·50$_2$	13·83$_2$	8·50$_2$	8·83$_2$	11·67$_2$	11·67$_2$	10·17$_2$	Prob. = 1·05
+ 60° 16′ − 3° 2′	66·17	64·67	65·66	69·50	63·16	64·67	56·84	70·17	69·34	60·66	64·50	66·66	

Angle between	Circle readings, telescope being set on XXI												General Means and Probabilities
	22°	202°	32°	212°	42°	222°	52°	232°	62°	242°	72°	252°	
	"	"	"	"	"	"	"	"	"	"	"	"	
* XXI & XIX	+70·17$_2$	82·33$_2$	76·33$_2$	72·00$_2$	78·83$_2$	80·50$_2$	69·50$_2$	74·50$_2$	74·67$_2$	75·50$_2$	75·00$_2$	76·17$_2$	65° 54′ 36″·19
	−36·67$_2$	39·50$_2$	40·77$_3$	37·67$_2$	40·50$_2$	38·83$_2$	37·50$_2$	36·83$_2$	45·17$_2$	43·50$_2$	38·00$_2$	36·33$_2$	Prob. = 1·14
+ 87° 40′ − 21° 46′	33·50	42·83	35·56	34·33	38·33	41·67	32·00	37·67	29·50	32·00	37·00	39·84	
* XIX & XVIII	+69·33$_4$	74·33$_2$	69·33$_2$	65·67$_2$	76·33$_2$	72·66$_2$	67·17$_2$	68·00$_2$	64·67$_2$	68·17$_2$	67·83$_2$	63·83$_2$	62° 7′ 53″·49
	−10·17$_2$	22·33$_2$	16·33$_2$	12·00$_2$	18·83$_2$	20·50$_2$	9·50$_2$	14·50$_2$	14·67$_2$	15·50$_2$	15·00$_2$	16·17$_2$	Prob. = 0·90
+149° 48′ − 87° 41′	59·16	52·00	53·00	53·67	57·50	52·16	57·67	53·50	50·00	52·67	52·83	47·66	

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At XXI (Chandanpur)

******January and February* 1839; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M.O.*

†*February* 1841; *observed by Mr. J. W. Armstrong with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XIX												General Means and Probabilities
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
* XIX & XX	$+56''\cdot67_{2}$	$58''\cdot50_{2}$	$62''\cdot33_{2}$	$62''\cdot00_{2}$	$60''\cdot17_{2}$	$57''\cdot00_{2}$	$62''\cdot83_{2}$	$61''\cdot33_{2}$	$57''\cdot83_{2}$	$62''\cdot17_{2}$	$58''\cdot00_{2}$	$57''\cdot83_{2}$	59° 54′ 3″·03
	$+1\cdot00_{2}$	$8\cdot17_{2}$	$2\cdot67_{2}$	$0\cdot83_{2}$	$4\cdot83_{2}$	$3\cdot17_{2}$	$6\cdot00_{2}$	$4\cdot83_{2}$	$1\cdot33_{2}$	$5\cdot83_{2}$	$0\cdot83_{2}$	$0\cdot20_{5}$	Prob. = 1·13
+ 0° 14′ +59° 39′	57·67	66·67	65·00	62·83	65·00	60·17	68·83	66·16	59·16	68·00	58·83	58·03	
	Circle readings, telescope being set on XX												
	300°	120°	310°	130°	320°	140°	330°	150°	340°	160°	350°	170°	
† XX & XXII	$+77\cdot33_{2}$	$75\cdot92_{4}$	$70\cdot33_{4}$	$71\cdot33_{2}$	$73\cdot17_{2}$	$78\cdot33_{2}$	$76\cdot17_{2}$	$77\cdot50_{2}$	$69\cdot67_{2}$	$80\cdot50_{2}$	$74\cdot67_{2}$	$79\cdot83_{2}$	51° 1′ 1″·32
	$-14\cdot25_{4}$	$16\cdot83_{2}$	$9\cdot00_{2}$	$12\cdot83_{2}$	$12\cdot50_{2}$	$13\cdot83_{2}$	$18\cdot00_{2}$	$15\cdot00_{2}$	$14\cdot33_{2}$	$14\cdot17_{2}$	$11\cdot67_{2}$	$16\cdot50_{2}$	Prob. = 0·67
+110° 36′ − 59° 36′	63·08	59·09	61·33	58·50	60·67	64·50	58·17	62·50	55·34	66·33	63·00	63·33	
† XXII & XXIII	$+57\cdot83_{2}$	$57\cdot17_{2}$	$48\cdot67_{2}$	$53\cdot00_{2}$	$56\cdot67_{2}$	$58\cdot00_{2}$	$61\cdot83_{2}$	$59\cdot83_{2}$	$59\cdot44_{3}$	$62\cdot17_{2}$	$53\cdot33_{2}$	$58\cdot83_{2}$	15° 31′ 41″·84
	$-17\cdot33_{2}$	$15\cdot92_{4}$	$10\cdot33_{4}$	$11\cdot33_{2}$	$13\cdot17_{2}$	$18\cdot33_{2}$	$16\cdot17_{2}$	$17\cdot50_{2}$	$9\cdot67_{2}$	$20\cdot50_{2}$	$14\cdot67_{2}$	$19\cdot83_{2}$	Prob. = 0·91
+126° 8′ −110° 37′	40·50	41·25	38·34	41·67	43·50	39·67	45·66	42·33	49·77	41·67	38·66	39·00	
	Circle readings, telescope being set on XXIII												
	126°	306°	136°	316°	146°	326°	156°	336°	166°	346°	176°	356°	
* XXIII & XXIV	$+100\cdot33_{2}$	$100\cdot17_{2}$	$94\cdot33_{2}$	$98\cdot00_{2}$	$99\cdot42_{4}$	$97\cdot83_{2}$	$94\cdot83_{2}$	$94\cdot17_{2}$	$89\cdot50_{2}$	$95\cdot50_{2}$	$89\cdot11_{3}$	$97\cdot33_{2}$	56° 33′ 51″·69
	$-43\cdot67_{4}$	$46\cdot83_{2}$	$43\cdot17_{2}$	$45\cdot50_{2}$	$46\cdot67_{2}$	$43\cdot67_{2}$	$44\cdot83_{2}$	$44\cdot33_{2}$	$44\cdot00_{2}$	$42\cdot44_{3}$	$46\cdot33_{2}$	$38\cdot83_{2}$	Prob. = 1·20
+182° 44′ −126° 11′	56·66	53·34	51·16	52·50	52·75	54·16	50·00	49·84	45·50	53·06	42·78	58·50	

At XXII (Muhammadabad)

January 1841; *observed by Mr. J. W. Armstrong with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on R. M.												General Mean
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
R.M. & XXI	$45''\cdot67_{2}$	$43''\cdot00_{2}$	$43''\cdot67_{2}$	$44''\cdot78_{3}$	$36''\cdot83_{2}$	$42''\cdot33_{2}$	$44''\cdot00_{2}$	$42''\cdot50_{2}$	$40''\cdot33_{2}$	$42''\cdot17_{2}$	$36''\cdot92_{4}$	$42''\cdot50_{2}$	102° 48′ 42″·06

R. M. denotes Referring Mark.

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At XXII (Muhammadabad)—(*Continued*).

Angle between	Circle readings, telescope being set on R.M. 0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	General Means and Probabilities
	"	"	"	"	"	"	"	"	"	"	"	"	
XXI & XX	+74·33$_{2}$	77·00$_{2}$	76·33$_{2}$	75·22$_{3}$	83·17$_{2}$	77·67$_{2}$	76·00$_{2}$	77·50$_{2}$	79·67$_{2}$	77·83$_{2}$	83·08$_{4}$	77·50$_{2}$	71° 43′ 54″·98
	−23·16$_{2}$	20·17$_{2}$	23·67$_{2}$	19·22$_{3}$	26·00$_{2}$	24·17$_{2}$	20·56$_{3}$	23·83$_{2}$	23·33$_{2}$	22·66$_{2}$	23·00$_{2}$	25·83$_{2}$	Prob. = 0·71
+257° 10′ −185° 27′	51·17	56·83	52·66	56·00	57·17	53·50	55·44	53·67	56·34	55·17	60·08	51·67	
XX & XXIII	+83·16$_{2}$	80·17$_{2}$	83·67$_{2}$	79·22$_{3}$	86·00$_{2}$	84·17$_{2}$	80·56$_{3}$	83·83$_{2}$	83·33$_{2}$	82·66$_{2}$	83·00$_{2}$	85·83$_{2}$	168° 22′ 3″·62
	−18·33$_{2}$	15·17$_{2}$	21·17$_{2}$	19·66$_{3}$	19·66$_{2}$	18·00$_{2}$	20·00$_{2}$	20·83$_{2}$	21·00$_{3}$	23·16$_{2}$	17·33$_{2}$	17·89$_{3}$	Prob. = 0·77
+185° 26′ − 17° 5′	64·83	65·00	62·50	59·56	66·34	66·17	60·56	63·00	62·33	59·50	65·67	67·94	
XXIII & XXI	+45·67$_{2}$	43·00$_{2}$	43·67$_{2}$	44·78$_{3}$	36·83$_{2}$	42·33$_{2}$	44·00$_{2}$	42·50$_{2}$	40·33$_{2}$	42·17$_{3}$	36·92$_{4}$	42·50$_{2}$	119° 54′ 1″·41
	+18·33$_{2}$	15·17$_{2}$	21·17$_{2}$	19·66$_{3}$	19·66$_{2}$	18·00$_{2}$	20·00$_{2}$	20·83$_{2}$	21·00$_{3}$	23·16$_{2}$	17·33$_{2}$	17·89$_{3}$	Prob. = 0·99
+102° 48′ + 17° 5′	64·00	58·17	64·84	64·44	56·49	60·33	64·00	63·33	61·33	65·33	54·25	60·39	

At XXIII (Pothári)

**December* 1838, *and January* 1839; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M. O.*

†*January* 1841; *observed by Mr. J. W. Armstrong with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXV 354°	174°	4°	184°	14°	194°	24°	204°	34°	214°	44°	224°	General Means and Probabilities
	"	"	"	"	"	"	"	"	"	"	"	"	
* XXV & XXIV	+ 12·83$_{2}$	7·33$_{3}$	16·50$_{2}$	12·50$_{2}$	11·17$_{2}$	9·67$_{2}$	10·83$_{2}$	12·17$_{2}$	12·67$_{2}$	11·83$_{2}$	15·83$_{2}$	11·22$_{3}$	59° 36′ 30″·17
	+ 23·58$_{4}$	19·00$_{2}$	17·00$_{2}$	16·50$_{2}$	21·22$_{3}$	21·50$_{2}$	19·67$_{2}$	14·67$_{2}$	19·83$_{2}$	14·83$_{2}$	13·67$_{2}$	16·00$_{2}$	Prob. = 0·88
+ 5° 37′ + 53° 59′	36·41	26·33	33·50	29·00	32·39	31·17	30·50	26·84	32·50	26·66	29·50	27·22	
* XXIV & XXI	+ 72·00$_{2}$	66·83$_{2}$	69·17$_{2}$	67·83$_{2}$	75·17$_{2}$	72·00$_{2}$	73·00$_{2}$	65·00$_{2}$	70·67$_{2}$	70·00$_{2}$	73·50$_{2}$	66·67$_{2}$	63° 44′ 52″·03
	− 23·58$_{4}$	19·00$_{2}$	17·00$_{2}$	16·50$_{2}$	21·22$_{3}$	21·50$_{2}$	19·67$_{2}$	14·67$_{2}$	19·83$_{2}$	14·83$_{2}$	13·67$_{2}$	16·00$_{2}$	Prob. = 0·90
+117° 43′ − 53° 59′	48·42	47·83	52·17	51·33	53·95	50·50	53·33	50·33	50·84	55·17	59·83	50·67	

Angle between	Circle readings, telescope being set on XXI 36°	216°	46°	226°	56°	236°	66°	246°	76°	256°	86°	266°	General Means and Probabilities
† XXI & XXII	+ 64·67$_{2}$	56·67$_{2}$	67·33$_{2}$	64·17$_{2}$	68·83$_{2}$	69·50$_{2}$	62·17$_{2}$	59·50$_{2}$	61·50$_{2}$	64·00$_{2}$	64·00$_{2}$	65·83$_{2}$	44° 34′ 17″·53
	+ 14·33$_{2}$	17·33$_{2}$	12·67$_{2}$	11·00$_{2}$	15·33$_{2}$	12·17$_{2}$	12·50$_{2}$	10·83$_{2}$	15·17$_{2}$	13·33$_{2}$	13·83$_{2}$	13·67$_{2}$	Prob. = 1·03
+ 35° 55′ + 8° 38′	79·00	74·00	80·00	75·17	84·16	81·67	74·67	70·33	76·67	77·33	77·83	79·50	

R. M. denotes Referring Mark.

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At XXIII (Pothári)—(*Continued*).

Angle between	Circle readings, telescope being set on XXI 36°	216°	46°	226°	56°	236°	66°	246°	76°	256°	86°	266°	General Means and Probabilities
	"	"	"	"	"	"	"	"	"	"	"	"	
† XXII & XX	+36·00$_{2}$	40·50$_{2}$	38·83$_{2}$	38·83$_{2}$	43·17$_{2}$	43·50$_{2}$	39·00$_{2}$	39·33$_{2}$	44·00$_{2}$	41·83$_{2}$	41·50$_{2}$	40·17$_{2}$	8° 14′ 27″·04
	−14·33$_{2}$	17·33$_{2}$	12·67$_{2}$	11·00$_{2}$	15·33$_{2}$	12·17$_{2}$	12·50$_{2}$	10·83$_{2}$	15·17$_{2}$	13·33$_{2}$	13·83$_{2}$	13·67$_{2}$	Prob. = 0·71
+ 16° 52′ − 8° 38′	21·67	23·17	26·16	27·83	27·84	31·33	26·50	28·50	28·83	28·50	27·67	26·50	

At XXIV (Mau)

April and May 1838; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M. O.*

Angle between	Circle readings, telescope being set on XXI 176°	356°	186°	6°	196°	16°	206°	26°	216°	36°	226°	46°	General Means and Probabilities
	"	"	"	"	"	"	"	"	"	"	"	"	
XXI & XXIII	+87·83$_{2}$	81·50$_{2}$	80·50$_{2}$	90·17$_{2}$	84·50$_{2}$	80·17$_{2}$	82·83$_{2}$	86·67$_{2}$	86·00$_{2}$	89·17$_{2}$	88·78$_{3}$	84·83$_{2}$	59° 41′ 23″·75
	−63·83$_{2}$	60·33$_{2}$	64·83$_{4}$	66·00$_{2}$	58·83$_{2}$	56·67$_{2}$	55·67$_{2}$	58·33$_{2}$	62·83$_{2}$	63·50$_{2}$	63·33$_{2}$	63·83$_{2}$	Prob. = 0·93
+ 183° 55′ − 124° 14′	24·00	21·17	15·67	24·17	25·67	23·50	27·16	28·34	23·17	25·67	25·45	21·00	
XXIII & XXV	+63·83$_{2}$	60·33$_{2}$	64·83$_{4}$	66·00$_{2}$	58·83$_{2}$	56·67$_{2}$	55·67$_{2}$	58·33$_{2}$	62·83$_{2}$	63·50$_{2}$	63·33$_{2}$	63·83$_{2}$	64° 29′ 10″·99
	−48·67$_{2}$	52·33$_{2}$	49·67$_{2}$	54·50$_{2}$	48·17$_{2}$	50·33$_{2}$	47·50$_{2}$	51·00$_{2}$	47·16$_{2}$	52·50$_{2}$	49·50$_{2}$	54·83$_{2}$	Prob. = 0·92
+ 124° 14′ − 59° 45′	15·16	8·00	15·16	11·50	10·66	6·34	8·17	7·33	15·67	11·00	13·83	9·00	
XXV & XXVI	+48·67$_{2}$	52·33$_{2}$	49·67$_{2}$	54·50$_{2}$	48·17$_{2}$	50·33$_{2}$	47·50$_{2}$	51·00$_{2}$	47·16$_{2}$	52·50$_{2}$	49·50$_{2}$	54·83$_{2}$	53° 37′ 20″·06
	−24·50$_{2}$	23·33$_{2}$	31·67$_{2}$	34·67$_{2}$	31·83$_{2}$	31·33$_{2}$	33·00$_{2}$	25·00$_{2}$	32·17$_{2}$	33·67$_{2}$	29·00$_{2}$	35·33$_{2}$	Prob. = 1·21
+ 59° 45′ − 6° 8′	24·17	29·00	18·00	19·83	16·34	19·00	14·50	26·00	14·99	18·83	20·50	19·50	

At XXV (Guri)

**December* 1837, *January* 1838; *and* †*April* 1838; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M.O.*

Angle between	Circle readings, telescope being set on XXVII 357°	177°	7°	187°	17°	197°	27°	207°	37°	217°	47°	227°	General Means and Probabilities
	"	"	"	"	"	"	"	"	"	"	"	"	
* XXVII & XXVI	+67·17$_{2}$	67·50$_{2}$	66·56$_{3}$	69·00$_{2}$	68·83$_{2}$	61·89$_{3}$	67·83$_{2}$	58·00$_{4}$	64·67$_{2}$	60·83$_{2}$	59·25$_{4}$	57·67$_{2}$	74° 42′ 23″·95
	+22·00$_{2}$	18·50$_{2}$	21·00$_{3}$	19·17$_{2}$	21·00$_{2}$	15·17$_{2}$	16·33$_{2}$	19·83$_{2}$	22·00$_{2}$	21·50$_{2}$	21·83$_{2}$	19·83$_{2}$	Prob. = 1·30
+ 72° 7′ + 2° 34′	89·17	86·00	87·56	88·17	89·83	77·06	84·16	77·83	86·67	82·33	81·08	77·50	

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At XXV (Guri)—(*Continued*).

Angle between	Circle readings, telescope being set on XXVII												General Means and Probabilities
	357°	177°	7°	187°	17°	197°	27°	207°	37°	217°	47°	227°	
	"	"	"	"	"	"	"	"	"	"	"	"	
* XXVI & XXIV	+97·00 $_2$	107·33 $_3$	96·44 $_3$	111·00 $_2$	97·17 $_2$	103·67 $_2$	102·33 $_2$	101·83 $_2$	99·17 $_2$	98·17 $_2$	97·83 $_2$	101·33 $_2$	59° 3′ 37″·01
	−67·17 $_2$	67·50 $_2$	66·56 $_3$	69·00 $_2$	68·83 $_2$	61·89 $_3$	67·83 $_2$	58·00 $_4$	64·67 $_2$	60·83 $_2$	59·25 $_4$	57·67 $_2$	Prob. = 1·54
+131° 10′ − 72° 7′	29·83	39·83	29·88	42·00	28·34	41·78	34·50	43·83	34·50	37·34	38·58	43·66	

Angle between	Circle readings, telescope being set on XXIV												General Means and Probabilities
	6°	186°	16°	196°	26°	206°	36°	216°	46°	226°	56°	236°	
† XXIV & XXIII	+25·50 $_2$	25·11 $_3$	22·00 $_2$	24·50 $_2$	30·17 $_2$	29·17 $_2$	20·17 $_2$	24·17 $_2$	28·33 $_3$	22·33 $_4$	18·67 $_4$	23·33 $_2$	55° 54′ 16″·83
	− 6·50 $_2$	12·67 $_2$	8·50 $_2$	4·00 $_2$	11·00 $_2$	8·33 $_2$	7·83 $_2$	4·50 $_2$	12·17 $_2$	4·83 $_2$	8·17 $_2$	3·00 $_2$	Prob. = 1·03
+ 61° 40′ − 5° 46′	19·00	12·44	13·50	20·50	19·17	20·84	12·34	19·67	16·16	17·50	10·50	20·33	

At XXVI (Dháka)

January and February 1838; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M. O.*

Angle between	Circle readings, telescope being set on XXIV												General Means and Probabilities
	321°	141°	331°	151°	341°	161°	351°	171°	1°	181°	11°	191°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXIV & XXV	+39·67 $_2$	31·00 $_3$	41·17 $_2$	36·00 $_2$	35·17 $_2$	36·00 $_2$	38·17 $_2$	35·00 $_2$	36·67 $_2$	32·83 $_2$	41·00 $_2$	39·67 $_2$	67° 19′ 1″·81
	+22·67 $_2$	25·83 $_2$	26·22 $_3$	26·67 $_2$	28·00 $_2$	26·50 $_2$	20·67 $_2$	25·83 $_2$	25·17 $_2$	23·83 $_2$	22·17 $_2$	25·83 $_2$	Prob. = 0·88
+ 38° 44′ + 28° 34′	62·34	56·83	67·39	62·67	63·17	62·50	58·84	60·83	61·84	56·66	63·17	65·50	
XXV & XXVII	+68·33 $_2$	66·50 $_2$	69·17 $_2$	66·67 $_2$	70·00 $_2$	68·33 $_2$	70·17 $_2$	69·50 $_2$	71·33 $_2$	65·33 $_2$	65·33 $_2$	67·83 $_2$	55° 20′ 43″·26
	−22·67 $_2$	25·83 $_2$	26·22 $_3$	26·67 $_2$	28·00 $_2$	26·50 $_2$	20·67 $_2$	25·83 $_2$	25·17 $_2$	23·83 $_2$	22·17 $_2$	25·83 $_2$	Prob. = 0·74
+ 83° 54′ − 28° 34′	45·66	40·67	42·95	40·00	42·00	41·83	49·50	43·67	46·16	41·50	43·16	42·00	
XXVII & XXVIII	+62·67 $_2$	63·67 $_2$	67·33 $_2$	65·33 $_2$	63·33 $_2$	70·33 $_3$	60·33 $_2$	59·75 $_4$	65·00 $_2$	62·67 $_2$	56·50 $_4$	62·58 $_4$	51° 57′ 55″·08
	− 8·33 $_2$	6·50 $_2$	9·17 $_2$	6·67 $_2$	10·00 $_2$	8·33 $_2$	10·17 $_2$	9·50 $_2$	11·33 $_2$	5·33 $_2$	5·33 $_2$	7·83 $_2$	Prob. = 1·01
+135° 52′ − 83° 55′	54·34	57·17	58·16	58·66	53·33	62·00	50·16	50·25	53·67	57·34	51·17	54·75	

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At XXVII (Saipur)

February 1838; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M.O.*

Angle between	Circle readings, telescope being set on XXIX: 1°	181°	11°	191°	21°	201°	31°	211°	41°	221°	51°	231°	General Means and Probabilities
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIX & XXVIII	+80·00$_2$	83·17$_2$	78·33$_2$	77·00$_2$	83·83$_2$	79·17$_2$	85·83$_2$	81·33$_2$	79·50$_2$	81·67$_3$	85·33$_2$	81·17$_4$	59° 5′ 49″·55
	−30·00$_2$	33·67$_2$	29·67$_2$	32·33$_2$	30·67$_2$	33·33$_2$	30·67$_2$	32·67$_2$	35·11$_3$	32·67$_2$	28·50$_2$	32·50$_2$	Prob. = 1·07
+59° 35′ − 0° 30′	50·00	49·50	48·66	44·67	53·16	45·84	55·16	48·66	44·39	49·00	56·83	48·67	
XXVIII & XXVI	+75·67$_2$	73·50$_2$	67·50$_2$	66·00$_2$	70·00$_2$	69·33$_2$	68·17$_2$	71·16$_2$	69·00$_2$	70·67$_2$	67·33$_2$	64·17$_2$	66° 36′ 48″·01
	−20·00$_2$	23·17$_2$	18·33$_2$	17·00$_2$	23·83$_2$	19·17$_2$	25·83$_2$	21·33$_2$	19·50$_2$	21·67$_2$	25·33$_2$	21·17$_4$	Prob. = 1·10
+126° 12′ − 59° 36′	55·67	50·33	49·17	49·00	46·17	50·16	42·34	49·83	49·50	49·00	42·00	43·00	
XXVI & XXV	+67·33$_2$	67·67$_2$	62·50$_2$	68·83$_2$	67·50$_2$	71·83$_2$	60·00$_2$	68·50$_2$	66·83$_2$	61·67$_2$	62·50$_2$	64·50$_2$	49° 56′ 56″·43
	−15·67$_2$	13·50$_2$	7·50$_2$	6·00$_2$	10·00$_2$	9·33$_2$	8·17$_2$	11·16$_2$	9·00$_2$	10·67$_2$	7·33$_2$	4·17$_2$	Prob. = 1·12
+176° 9′ −126° 13′	51·66	54·17	55·00	62·83	57·50	62·50	51·83	57·34	57·83	51·00	55·17	60·33	

At XXVIII (Kasrak)

February and March 1838; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M.O.*

Angle between	Circle readings, telescope being set on XXVI: 175°	355°	185°	5°	195°	15°	205°	25°	215°	35°	225°	45°	General Means and Probabilities
	″	″	″	″	″	″	″	″	″	″	″	″	
XXVI & XXVII	+61·17$_2$	64·00$_2$	62·67$_2$	64·83$_2$	62·66$_2$	59·50$_2$	62·67$_2$	65·00$_2$	69·50$_2$	69·50$_2$	72·00$_2$	60·67$_2$	61° 25′ 14″·92
	−40·17$_2$	45·83$_2$	45·17$_2$	54·50$_2$	43·83$_2$	51·00$_2$	48·17$_2$	55·83$_2$	50·50$_2$	55·08$_4$	53·33$_2$	51·67$_2$	Prob. = 1·27
+184° 40′ −123° 15′	21·00	18·17	17·50	10·33	18·83	8·50	14·50	9·17	19·00	14·42	18·67	9·00	
XXVII & XXIX	+40·17$_2$	45·83$_2$	45·17$_2$	54·50$_2$	43·83$_2$	51·00$_2$	48·17$_2$	55·83$_2$	50·50$_2$	55·08$_4$	53·33$_2$	51·67$_2$	60° 39′ 9″·69
	−34·67$_2$	40·17$_2$	40·67$_2$	45·00$_2$	35·00$_2$	39·33$_2$	35·83$_2$	46·83$_2$	35·83$_2$	40·33$_2$	44·50$_2$	40·67$_2$	Prob. = 0·93
+123° 15′ − 62° 36′	5·50	5·66	4·50	9·50	8·83	11·67	12·34	9·00	14·67	14·75	8·83	11·00	
XXIX & XXX	+34·67$_2$	40·17$_2$	40·67$_2$	45·00$_2$	35·00$_2$	39·33$_2$	35·83$_2$	46·83$_2$	35·83$_2$	40·33$_2$	44·50$_2$	40·67$_2$	57° 34′ 5″·92
	−29·83$_2$	30·50$_2$	35·50$_2$	37·17$_2$	30·33$_2$	37·67$_2$	33·50$_2$	39·17$_2$	32·67$_2$	33·67$_2$	33·83$_2$	34·00$_2$	Prob. = 0·77
+ 62° 36′ − 5° 2′	4·84	9·67	5·17	7·83	4·67	1·66	2·33	7·66	3·16	6·66	10·67	6·67	

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At XXIX (Janjíri)

March 1838; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M. O.*

Angle between	Circle readings, telescope being set on XXXI												General Means and Probabilities
	344°	164°	354°	174°	4°	184°	14°	194°	24°	204°	34°	214°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXXI & XXX	+29·50$_2$	35·67$_2$	20·50$_2$	24·67$_2$	27·33$_2$	21·83$_2$	29·67$_2$	24·83$_2$	28·83$_2$	25·83$_2$	21·00$_2$	19·83$_2$	70° 35′ 33″·53
	+ 1·83$_2$	4·00$_2$	12·00$_2$	6·50$_2$	3·33$_2$	6·17$_2$	7·00$_2$	5·33$_2$	11·17$_2$	7·83$_2$	15·67$_2$	12·00$_2$	Prob. = 1·07
+ 54° 5′ + 16° 30′	31·33	39·67	32·50	31·17	30·66	28·00	36·67	30·16	40·00	33·66	36·67	31·83	
XXX & XXVIII	+47·00$_2$	53·17$_2$	44·33$_2$	45·83$_2$	52·00$_2$	47·17$_2$	45·50$_2$	49·00$_2$	49·17$_2$	46·50$_2$	43·33$_2$	41·66$_2$	64° 37′ 21″·26
	−29·50$_2$	35·67$_2$	20·50$_2$	24·67$_2$	27·33$_2$	21·83$_2$	29·67$_2$	24·83$_2$	28·83$_2$	25·83$_2$	21·00$_2$	19·83$_2$	Prob. = 0·85
+118° 42′ − 54° 5′	17·50	17·50	23·83	21·16	24·67	25·34	15·83	24·17	20·34	20·67	22·33	21·83	
XXVIII & XXVII	+110·67$_2$	113·00$_2$	101·33$_2$	109·33$_2$	110·00$_2$	109·17$_2$	103·50$_2$	108·83$_2$	106·17$_2$	105·83$_2$	95·22$_3$	107·00$_2$	60° 14′ 59″·62
	−47·00$_2$	53·17$_2$	44·33$_2$	45·83$_2$	52·00$_2$	47·17$_2$	45·50$_2$	49·00$_2$	49·17$_2$	46·50$_2$	43·33$_2$	41·66$_2$	Prob. = 1·02
+178° 56′ −118° 42′	63·67	59·83	57·00	63·50	58·00	62·00	58·00	59·83	57·00	59·33	51·89	65·34	

At XXX (Gajnera)

**March* 1838; *and* †*March* 1839; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M. O.*

Angle between	Circle readings, telescope being set on XXVIII												General Means and Probabilities
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	
* XXVIII & XXIX	+91·83$_2$	95·50$_2$	90·50$_2$	93·67$_2$	88·50$_2$	91·00$_2$	90·50$_2$	94·17$_2$	96·33$_2$	90·50$_2$	94·33$_2$	91·00$_2$	57° 48′ 35″·25
	−58·17$_2$	57·00$_2$	54·00$_2$	59·33$_2$	57·67$_2$	58·50$_2$	54·33$_2$	59·17$_2$	57·33$_2$	55·67$_2$	57·83$_2$	55·83$_2$	Prob. = 0·64
+ 57° 51′ − 0° 3′	33·66	38·50	36·50	34·34	30·83	32·50	36·17	35·00	39·00	34·83	36·50	35·17	
* XXIX & XXXI	+61·50$_2$	61·17$_2$	62·33$_2$	56·83$_2$	58·17$_2$	57·00$_2$	57·33$_2$	64·67$_2$	63·50$_2$	61·00$_2$	56·17$_2$	58·33$_2$	58° 59′ 27″·51
	−31·83$_2$	35·50$_2$	30·50$_2$	33·67$_2$	28·50$_2$	31·00$_2$	30·50$_2$	34·17$_2$	36·33$_2$	30·50$_2$	34·33$_2$	31·00$_2$	Prob. = 0·85
+116° 51′ − 57° 52′	29·67	25·67	31·83	23·16	29·67	26·00	26·83	30·50	27·17	30·50	21·84	27·33	
	Circle readings, telescope being set on XXXI												
	302°	122°	312°	132°	322°	142°	332°	152°	342°	162°	352°	172°	
† XXXI & XI	+23·50$_2$	33·17$_2$	31·17$_2$	37·17$_2$	24·17$_4$	23·00$_2$	30·00$_2$	31·00$_2$	31·00$_2$	33·67$_2$	32·67$_2$	34·33$_2$	57° 55′ 52″·17
	+28·60$_5$	22·00$_4$	20·50$_2$	19·11$_3$	20·83$_2$	31·50$_2$	20·17$_2$	20·50$_2$	18·83$_2$	19·83$_2$	19·00$_2$	20·33$_2$	Prob. = 0·84
+ 57° 40′ + 0° 15′	52·10	55·17	51·67	56·28	45·00	54·50	50·17	51·50	49·83	53·50	51·67	54·66	

NOTE.—XI appertains to the North-East Longitudinal Series.

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At XXXI (Fatehganj)

* *March and April* 1838; *and* † *March* 1839; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M. O.*

Angle between	Circle readings, telescope being set on X												General Means and Probabilities
	353°	173°	8°	183°	13°	193°	23°	203°	33°	213°	43°	223°	
	″	″	″	″	″	″	″	″	″	″	″	″	
† X & XI	+22·75$_{4}$	31·33$_{2}$	33·50$_{2}$	35·50$_{2}$	29·17$_{2}$	31·50$_{2}$	30·83$_{2}$	33·00$_{2}$	29·83$_{2}$	32·50$_{2}$	33·84$_{2}$	34·00$_{2}$	53° 17′ 52″·97
	+22·50$_{2}$	26·50$_{2}$	22·33$_{2}$	24·00$_{2}$	22·17$_{2}$	23·50$_{2}$	19·67$_{2}$	24·50$_{2}$	19·50$_{2}$	17·33$_{4}$	18·83$_{2}$	17·00$_{2}$	Prob. = 1·16
+ 6° 57′ + 46° 20′	45·25	57·83	55·83	59·50	51·34	55·00	50·50	57·50	49·33	49·83	52·67	51·00	
† XI & XXX	+33·00$_{2}$	38·50$_{2}$	36·67$_{2}$	33·00$_{2}$	35·67$_{2}$	33·67$_{2}$	36·83$_{2}$	35·33$_{2}$	34·00$_{2}$	26·83$_{2}$	30·33$_{2}$	26·00$_{2}$	59° 1′ 11″·83
	−22·50$_{2}$	26·50$_{2}$	22·33$_{2}$	24·00$_{2}$	22·17$_{2}$	23·50$_{2}$	19·67$_{2}$	24·50$_{2}$	19·50$_{2}$	17·33$_{4}$	18·83$_{2}$	17·00$_{2}$	Prob. = 0·71
+ 105° 21′ − 46° 20′	10·50	12·00	14·34	9·00	13·50	10·17	17·16	10·83	14·50	9·50	11·50	9·00	

Angle between	Circle readings, telescope being set on XXX												General Means and Probabilities
	252°	72°	262°	82°	272°	92°	282°	102°	292°	112°	302°	122°	
* XXX & XXIX	+115·17$_{2}$	117·67$_{2}$	118·83$_{2}$	111·33$_{2}$	119·67$_{2}$	122·33$_{2}$	114·50$_{2}$	115·33$_{2}$	114·50$_{2}$	115·50$_{2}$	122·00$_{2}$	120·33$_{2}$	50° 25′ 1″·35
	− 50·17$_{2}$	56·00$_{2}$	59·17$_{2}$	53·00$_{2}$	56·33$_{2}$	55·00$_{2}$	60·33$_{2}$	55·33$_{2}$	55·17$_{2}$	60·17$_{2}$	57·17$_{2}$	53·17$_{2}$	Prob. = 1·19
+ 108° 7′ − 57° 43′	65·00	61·67	59·66	58·33	63·34	67·33	54·17	60·00	59·33	55·33	64·83	67·16	

At X (Sísgarh)

April 1839; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M. O.*

Angle between	Circle readings, telescope being set on XI												General Means and Probabilities
	106°	286°	116°	296°	126°	306°	136°	316°	146°	326°	156°	336°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XI & XXXI	+72·00$_{2}$	69·83$_{2}$	68·00$_{2}$	68·17$_{2}$	68·33$_{2}$	73·17$_{2}$	67·17$_{2}$	69·50$_{2}$	65·00$_{2}$	69·66$_{2}$	62·83$_{2}$	68·33$_{2}$	69° 55′ 26″·19
	−45·17$_{2}$	44·00$_{2}$	42·33$_{2}$	41·17$_{2}$	41·00$_{2}$	46·33$_{2}$	42·83$_{2}$	41·83$_{2}$	44·67$_{2}$	37·33$_{2}$	40·83$_{2}$	40·17$_{2}$	Prob. = 0·84
+ 175° 38′ − 105° 43′	26·83	25·83	25·67	27·00	27·33	26·84	24·34	27·67	20·33	32·33	22·00	28·16	

At XI (Atária)

March and April 1839; *observed by Mr. J. W. Armstrong with Cary's* 18-*inch Theodolite, M.O.*

Angle between	Circle readings, telescope being set on XXX												General Means and Probabilities
	178°	358°	188°	8°	198°	18°	208°	28°	218°	38°	228°	48°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXX & XXXI	+65·17$_{2}$	65·17$_{2}$	68·67$_{2}$	67·17$_{2}$	62·67$_{2}$	64·33$_{2}$	68·67$_{2}$	69·17$_{2}$	60·67$_{2}$	63·33$_{2}$	64·83$_{2}$	70·00$_{2}$	63° 2′ 57″·53
	− 7·17$_{2}$	7·50$_{2}$	11·50$_{2}$	7·56$_{3}$	2·17$_{2}$	10·33$_{2}$	9·83$_{2}$	8·89$_{3}$	8·83$_{2}$	12·50$_{2}$	1·50$_{2}$	11·67$_{2}$	Prob. = 1·01
+ 181° 43′ − 118° 41′	58·00	57·67	57·17	59·61	60·50	54·00	58·84	60·28	51·84	50·83	63·33	58·33	

NOTE.—X and XI appertain to the North-East Longitudinal Series.

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At XI (Atária)—(*Continued*).

Angle between	Circle readings, telescope being set on XXX												General Means and Probabilities
	178°	358°	188°	8°	198°	18°	208°	28°	218°	38°	228°	48°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXXI & X	+67·17$_{2}$	67·50$_{2}$	71·50$_{2}$	67·56$_{8}$	62·17$_{2}$	70·33$_{2}$	69·83$_{2}$	68·89$_{8}$	68·83$_{2}$	72·50$_{2}$	61·50$_{2}$	71·67$_{2}$	56° 46′ 39″·93
	−27·33$_{2}$	33·00$_{6}$	32·33$_{2}$	29·83$_{2}$	22·83$_{2}$	25·33$_{2}$	25·33$_{2}$	31·50$_{2}$	24·67$_{2}$	27·83$_{2}$	28·50$_{2}$	31·83$_{2}$	Prob. = 1·11
+118° 40′ − 61° 54′	39·84	34·50	39·17	37·73	39·34	45·00	44·50	37·39	44·16	44·67	33·00	39·83	

NOTE.—X and XI appertain to the North-East Longitudinal Series.

August 1877.

J. B. N. HENNESSEY,

In charge of Computing Office.

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RANGIR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. ADDENDUM TO DESCRIPTION OF STATIONS.

NOTE.—Consequent on modern alterations of district and other boundaries, the sites occupied by the stations are in some instances now included in civil divisions of territory which differ from the district, pargana, or village, recorded in the descriptions of stations: a complete list of all the stations of the Series including a suitably modified statement of the altered subdivisions in question is accordingly given in the following table, and is derived chiefly from the annual reports, up to 1881, made by the Civil Officials to whose care the stations have been committed. The statement also gives the present condition of certain of the stations; where no entry regarding present condition is made against a station it is to be assumed that the station when last reported on by the district Official was in good order.

The spelling of names is in accordance with that given in the lists of more important places published under the orders of Government whenever such names occur in the lists.

No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Remarks on the Construction and Condition of the Station
VII*	...	Saugor	Thá., Tah. and P. Banda	Tinsi	... ...
X*	...	Damoh	Tah. Damoh	Rangír	... ...
I	...	Bundelkhand Political Agency	P. Bakswáho	Kusmár	... ...
II	...	„	P. Bijawar	Dálípur	... ...
III	...	„	Ditto.	...	... ...
IV	Bhojraj	„	P. Baldeogarh	Sarkanpur	... ...
V	Chabútara	Hamírpur	Thá. Ajnár, Tah. Kulpahár, P. Panwári-Jaitpur	Narwara	... ...
VI	...	Bundelkhand Political Agency	P. Chhatarpur	Sela	... ...
VII	Chabútara	Hamírpur	Tah. and Thá. Kulpahár, P. Panwári-Jaitpur	Salat Malat of Garhauli Jágír	... ...
VIII	...	Jhánsi	Tah. Garotha	Gura	... ...
IX	Chabútara	Hamírpur	Thá. Jariya, Tah. and P. Ráth	Phára	... ...

NOTE.—Stations VII* and X* appertain to the Calcutta Longitudinal Series of the South-East Quadrilateral. P. stands for pargana, Tah. for tahsíl, and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Remarks on the Construction and Condition of the Station
X	Firangi-ka-Chabútara	Jhánsi-Gursarai State	Tah. Garotha	Gokulphára	... ...
XI	Sorái	Jálaun	Thá. and Tah. Orai	Gura Khurd	In 1872, the District Officer reported the station as completely destroyed by the rains of 1871. In 1873, a paka platform was built by the same Officer for the protection of the mark-stone.
XII	„	„	Thá. and Tah. Jálaun	Kanwa	... ...
XIII	„	„	Thá. Damrás, Tah. Kálpi	Nipania	... ...
XIV	„	„	Thá. Kuthaund, Tah. Mádhogarh	Husapura	... ...
XV	...	Cawnpore	Thá. and P. Derapur	Gandaspur	The mark-stone in the floor of the arched passage was found intact. The corners at the base of the pillar and the interior of the arched passage much injured by the digging out of bricks.
XVI	...	Etáwah	Tah. and P. Auraiya, Táluka Bhareh, Thá. Ajítmal	Atsu	... ...
XVII	...	„	Thá. Sahail, Tah. and P. Bidhúna	Seontára	The corners at the base of the pillar and the interior of the arched passage were found considerably injured as at (XV) Gandaspur Station. The hollow in the passage was filled in with burnt bricks.
XVIII	Barona Kalán	„	Thá. Kudarkat, Tah. and P. Bidhúna	Barona Kalán	The mark-stone in the floor of the arched passage was found all right, the corners of the pillar injured at the base.
XIX	Minára	Farrukhabad	Tah. and P. Tirwa	Kalsán	The mark-stone in the floor of the arched passage was found all right, the pillar above the arch cracked.
XX	Mastúl or Minár	„	Tah. and P. Chhibramau	Bisungarh	The mark-stone in the floor of the arched passage was found perfect, as also the pillar.
XXI	Minára or Gargaj	„	P. Bhojpur, Tah. Farrukhabad	Rájípur	The mark-stone in the arched passage was found perfect, the arch cracked on one side by the digging out of bricks.
XXII	„	„	P. Muhammadabad, Tah. Farrukhabad	Muhammadabad Khás	The tower considerably dug into at the base, on the east face the excavation reaching the central pillar, the tower was repaired with burnt bricks.

NOTE.—Stations XV to XXXI, also X and XI of the North-East Longitudinal Series, were visited in 1866 by Mr. W. Ivey, Assistant Surveyor, especially deputed for the purpose. The perforated masonry pillars at these stations were found more or less dug into at their bases and bricks extracted from the interior of the arched passages, and otherwise injured by cracks. These pillars were protected by Mr. Ivey as follows:—the arched passages were closed, platforms of sun-dried bricks built around the bases of the pillars to height of from 10 to 14 feet, and the openings at their summits capped by conical mounds to carry off the rain fall; after which all these stations were transferred to the charge of the chief local Official.

P. stands for pargana, Tah. for tahsíl, and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Remarks on the Construction and Condition of the Station
XXIII	Minára or Gargaj	Farrukhabad	P. Muhammadabad, Tah. Farrukhabad	Pothári	The mark-stone in the floor of the arched passage was found perfect, the interior of the passage and its floor injured.
XXIV	Minára	„	P. Imratpur, Tah. Aligarh	Mau Rasúlpur	The mark-stone in the floor of the arched passage was found dug out, the pillar much injured and dug into.
XXV	Gundi	Sháhjahánpur	Tah. and P. Jalálabad	Gundi	The mark-stone in the floor of the passage was found perfect, the pillar injured at the base on all sides, and its arch cracked on the east side.
XXVI	Dháka	„	Ditto.	Dháka	Ditto.
XXVII	Sháhpur	Budaun	Thá. and P. Hazratpur, Tah. Dátaganj	Sháhpur	The mark-stone in the floor of the arched passage was found cracked, its central iron pin extracted though the stone appeared to be firmly imbedded, the pillar was slightly injured at the base.
XXVIII	...	Sháhjahánpur	Tah. Tilhar, P. Mirán-pur Katra	Kasrak	The station was found completely destroyed down to the very foundation; below the *debris* the mark-stone was found lying loose, this was embedded below the ground level and a conical pillar, 12 feet in height, built over it to mark the site of the station.
XXIX	Chanjiri	Bareilly	P. Ballia	Chanjiri	The mark-stone in the floor of the arched passage was found all right, the base of the pillar much injured by the digging out of bricks.
XXX	...	„	P. Farídpur	Gajnera	Ditto.
XXXI	...	„	P. Karor	Fatehganj	... ...
X	...	„	P. Sirsáwán	Sísgarh	... ...
XI	...	„	P. Richha	Atária	... ...

NOTE.—Stations X and XI appertain to the North-East Longitudinal Series. P. stands for pargana, Tah. for tahsíl, and Thá for thána.

September, 1882.

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RANGIR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

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Figure No. 8.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	71	43	54·98	·50
2	57	15	5·17	1·11
3	51	1	1·32	·45
4	119	54	1·41	·98
5	15	31	41·84	·82
6	44	34	17·53	1·06
7	168	22	3·62	·60
8	8	14	27·04	·51
9	3	23	29·78	·48

Equations to be satisfied

Equations to be satisfied	Factor
$x_1 + x_2 + x_3 = e_1 = +0·20,$	λ_1
$x_4 + x_5 + x_6 = e_2 = +0·30,$	λ_2
$x_7 + x_8 + x_9 = e_3 = +0·34,$	λ_3
$x_1 + x_4 + x_7 = e_4 = +0·01,$	λ_4
$\left.\begin{array}{l}·81x_3 - ·64x_2 + 1·015x_6 \\ -3·599x_5 + 16·874x_9 - 6·905x_8\end{array}\right\} = e_5 = +1·91,$	λ_5

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5
1	+0·20	+2·06			+0·50	−0·345
2	+0·30		+2·86		+0·98	−1·875
3	+0·34			+1·59	+0·60	+4·578
4	+0·01			*	+2·08	
5	+1·91					+173·461

Values of the Factors

$\lambda_1 = +0·144$

$\lambda_2 = +0·173$

$\lambda_3 = +0·268$

$\lambda_4 = -0·189$

$\lambda_5 = +0·006$

Angular errors in seconds

$x_1 = -·02$	$x_4 = -·01$	$x_7 = +·04$
$x_2 = +·15$	$x_5 = +·12$	$x_8 = +·12$
$x_3 = +·07$	$x_6 = +·19$	$x_9 = +·18$

$[wx^2] = 0·18$

* In the tables of the equations between the factors the co-efficients of the terms below the diagonal are omitted for convenience, the co-efficient of the *pth* term in the *qth* line being always the same as the co-efficient of the *qth* term in the *pth* line.

October 1877.

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RANGIR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of triangle: Circuit	No. of triangle: Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Corrections to Observed Angle: Circuit	Corrections to Observed Angle: Non-circuit	Corrections to Observed Angle: Total	Corrected Plane Angle	Distance: Log. feet	Distance: Feet	Distance: Miles
			″	″	″	″	″	° ′ ″			
		VII	·90	− ·18	+ ·09		− ·09	37 36 19·43	4·9667210,1	92623·47	17·542
1		X	·90	− ·09	− ·08		− ·17	54 24 15·62	5·0914026,8	123424·88	23·376
		I	·90	− ·07	− ·01		− ·08	87 59 24·95	5·1809675,5	151693·69	28·730
			2·70				− ·34	180 0 0·00			
		VII	·89	+ ·93	− ·44		+ ·49	44 20 35·26	4·9830825,7	96179·50	18·216
2		I	·90	+ ·37	−1·10		− ·73	71 53 48·36	5·1165854,2	130793·29	24·771
		II	·89	+1·00	+1·54		+2·54	63 45 36·38	5·0914026,8	123424·88	23·376
			2·68				+2·30	180 0 0·00			
		I	·86	− ·24	−1·59		−1·83	55 51 12·69	5·0620943,3	115370·38	21·850
3		II	·87	− ·14	+ ·95		+ ·81	80 31 15·94	5·1383004,4	137499·28	26·042
		III	·86	− ·59	+ ·64		+ ·05	43 37 31·37	4·9830825,7	96179·50	18·216
			2·59				− ·97	180 0 0·00			
		II	1·28	+ ·02	+ ·07		+ ·09	73 16 38·22	5·1995153,0	158312·55	29·983
4		III	1·28	+ ·04	− ·94		− ·90	62 27 41·37	5·1660587,8	146574·62	27·760
		IV	1·27	+ ·03	+ ·87		+ ·90	44 15 40·41	5·0620943,3	115370·38	21·850
			3·83				+ ·09	180 0 0·00			
		III	1·72	+1·50	−1·75		− ·25	49 14 58·45	5·1575789,1	143740·43	27·224
5		IV	1·73	+2·76	+ ·27		+3·03	74 12 4·19	5·2614378,1	182573·53	34·578
		V	1·73	+1·77	+1·48		+3·25	56 32 57·36	5·1995153,0	158312·55	29·983
			5·18				+6·03	180 0 0·00			

Notes.—1. The values of the side are given in the same line with the opposite angle.
2. Stations VII and X appertain to the Calcutta Longitudinal Series.

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
6		III	1·67	−2·59	− ·31		−2·90	45 37 4·34	5·1302726,4	134981·01	25·565
		V	1·67	−3·49	+ ·30		−3·19	59 12 50·20	5·2101902,9	162252·09	30·730
		VI	1·67	− ·27	+ ·01		− ·26	75 10 5·46	5·2614378,1	182573·53	34·578
			5·01				−6·35	180 0 0·00			
7		V	1·12	+ ·19	+ ·24		+ ·43	52 50 21·48	5·0756724,3	119034·39	22·544
		VI	1·12	+ ·14	− ·24		− ·10	62 30 38·94	5·1222159,9	132500·03	25·095
		VII	1·13	+ ·07	·00		+ ·07	64 38 59·58	5·1302726,4	134981·01	25·565
			3·37				+ ·40	180 0 0·00			
8		V	1·19	−1·71	+ ·10		−1·61	64 59 46·94	5·1413569,6	138470·40	26·225
		VII	1·18	− ·59	− ·40		− ·99	54 52 5·33	5·0967571,1	124956·00	23·666
		VIII	1·18	− ·22	+ ·30		+ ·08	60 8 7·73	5·1222159,9	132500·03	25·095
			3·55				−2·52	180 0 0·00			
9		VII	1·36	− ·46	− ·37		− ·83	59 42 20·81	5·1482904,9	140698·83	26·648
		VIII	1·36	− ·32	+ ·34		+ ·02	62 6 26·85	5·1584221,6	144019·79	27·276
		IX	1·35	− ·27	+ ·03		− ·24	58 11 12·34	5·1413569,6	138470·40	26·225
			4·07				−1·05	180 0 0·00			
10		VIII	1·10	+2·35	·00		+2·35	60 8 12·15	5·1134244,5	129844·76	24·592
		IX	1·10	+1·17	− ·86		+ ·31	49 51 38·08	5·0586622,1	114462·24	21·678
		X	1·11	+2·11	+ ·86		+2·97	70 0 9·77	5·1482904,9	140698·83	26·648
			3·31				+5·63	180 0 0·00			
11		IX	·92	+ ·33	− ·74		− ·41	57 38 8·55	5·0640036,5	115878·71	21·947
		X	·92	+ ·56	+ ·72		+1·28	51 11 50·56	5·0290306,8	106913·04	20·249
		XI	·93	+ ·53	+ ·02		+ ·55	71 10 0·89	5·1134244,5	129844·76	24·592
			2·77				+1·42	180 0 0·00			
12		X	·82	− ·57	− ·08		− ·65	53 8 37·10	5·0090505,4	102105·83	19·338
		XI	·82	− ·92	− ·54		−1·46	61 36 58·17	5·0502589,8	112268·78	21·263
		XII	·82	− ·29	+ ·62		+ ·33	65 14 24·73	5·0640036,5	115878·71	21·947
			2·46				−1·78	180 0 0·00			
13		XI	·74	+ ·50	− ·63		− ·13	72 58 44·57	5·0721535,1	118073·79	22·362
		XII	·74	+ ·68	+ ·61		+1·29	51 14 27·45	4·9835810,4	96289·96	18·237
		XIII	·74	+ ·88	+ ·02		+ ·90	55 46 47·98	5·0090505,4	102105·83	19·338
			2·22				+2·06	180 0 0·00			
14		XII	·80	+ ·47	+ ·21		+ ·68	53 40 13·44	5·0095019,7	102212·02	19·358
		XIII	·80	+1·64	− ·71		+ ·93	57 47 39·64	5·0308130,0	107352·72	20·332
		XIV	·81	+1·01	+ ·50		+1·51	68 32 6·92	5·0721535,1	118073·79	22·362
			2·41				+3·12	180 0 0·00			
15		XIII	·65	+1·04	− ·69		+ ·35	62 33 50·16	5·0028778,3	100664·84	19·065
		XIV	·65	+ ·96	+ ·84		+1·80	53 7 27·32	4·9577536,6	90730·58	17·184
		XV	·65	+ ·38	− ·15		+ ·23	64 18 42·52	5·0095019,7	102212·02	19·358
			1·95				+2·38	180 0 0·00			
16		XIV	·56	−1·00	+ ·23		− ·77	57 49 39·67	4·9550639,9	90170·39	17·078
		XV	·56	− ·66	− ·49		−1·15	51 16 10·60	4·9196119,4	83102·08	15·739
		XVI	·56	− ·41	+ ·26		− ·15	70 54 9·73	5·0028778,3	100664·84	19·065
			1·68				−2·07	180 0 0·00			
17		XV	·53	−1·07	− ·25		−1·32	61 21 24·19	4·9506117,0	89250·71	16·904
		XVI	·52	− ·90	+ ·38		− ·52	56 11 10·36	4·9268274,9	84494·31	16·003
		XVII	·53	−1·13	− ·13		−1·26	62 27 25·45	4·9550639,9	90170·39	17·078
			1·58				−3·10	180 0 0·00			

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No. of triangle: Circuit	Non-circuit	Station	Spherical Excess	Corrections to Observed Angle: Figure	Circuit	Non-circuit	Total	Corrected Plane Angle	Distance: Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
18		XVI	·57	+1·42	+ ·09		+1·51	58 5 49·04	4·9537073,7	89889·18	17·024
		XVII	·57	+ ·59	− ·16		+ ·43	64 27 14·19	4·9801501,1	95532·27	18·093
		XVIII	·57	+ ·36	+ ·07		+ ·43	57 26 56·77	4·9506117,0	89250·71	16·904
			1·71				+2·37	180 0 0·00			
19		XVII	·59	+1·20	− ·07		+1·13	65 16 18·08	4·9891121,7	97524·15	18·470
		XVIII	·59	+ ·69	+ ·17		+ ·86	57 53 0·58	4·9587495,0	90938·85	17·223
		XIX	·58	+1·01	− ·10		+ ·91	56 50 41·34	4·9537073,7	89889·18	17·024
			1·76				+2·90	180 0 0·00			
20		XVIII	·62	+ ·57	+ ·13		+ ·70	58 33 56·52	4·9737187,7	94127·99	17·827
		XIX	·62	+ ·69	− ·17		+ ·52	59 18 9·59	4·9770840,0	94860·20	17·966
		XX	·63	+ ·99	+ ·04		+1·03	62 7 53·89	4·9891121,7	97524·15	18·470
			1·87				+2·25	180 0 0·00			
21		XIX	·59	− ·07	− ·02		− ·09	54 11 22·35	4·9456218,4	88231·13	16·710
		XX	·60	− ·20	+ ·13		− ·07	65 54 35·52	4·9970493,3	99322·89	18·811
		XXI	·60	− ·19	− ·11		− ·30	59 54 2·13	4·9737187,7	94127·99	17·827
			1·79				− ·46	180 0 0·00			
22		XX	·42	− ·15	+ ·08		− ·07	57 15 4·68	4·8929037,1	78145·45	14·800
		XXI	·42	− ·07	− ·09		− ·16	51 1 0·74	4·8586873,9	72224·97	13·679
		XXII	·43	+ ·02	+ ·01		+ ·03	71 43 54·58	4·9456218,4	88231·13	16·710
			1·27				− ·20	180 0 0·00			
23		XXI	·16	− ·12	− ·05		− ·17	15 31 41·51	4·4743603,3	29809·89	5·646
		XXII	·16	+ ·01	+ ·06		+ ·07	119 54 1·32	4·9846573,7	96528·90	18·282
		XXIII	·16	− ·19	− ·01		− ·20	44 34 17·17	4·8929037,1	78145·45	14·800
			·48				− ·30	180 0 0·00			
	574	XX	·03	− ·18		+ ·02	− ·16	3 23 29·59	4·4743604,6	29809·89	5·646
		XXII	·04	− ·04		− ·07	− ·11	168 22 3·47	5·0068961,2	101600·57	19·243
		XXIII	·03	− ·12		+ ·05	− ·07	8 14 26·94	4·8586873,9	72224·97	13·679
			·10				− ·34	180 0 0·00			
24		XXI	·63	−2·58	− ·02		−2·60	56 33 48·46	4·9699195,9	93308·15	17·672
		XXIII	·64	−1·44	+ ·11		−1·33	63 44 50·06	5·0012154,6	100280·27	18·992
		XXIV	·64	−1·54	− ·09		−1·63	59 41 21·48	4·9846573,7	96528·90	18·282
			1·91				−5·56	180 0 0·00			
25		XXIII	·65	+1·14	+ ·12		+1·26	59 36 30·78	4·9876363,8	97193·31	18·408
		XXIV	·65	+1·25	− ·10		+1·15	64 29 11·49	5·0072718,6	101688·52	19·259
		XXV	·64	+1·56	− ·02		+1·54	55 54 17·73	4·9699195,9	93308·15	17·672
			1·94				+3·95	180 0 0·00			
26		XXIV	·55	+ ·89	− ·03		+ ·86	53 37 20·37	4·9284610,2	84812·73	16·063
		XXV	·56	+1·43	+ ·03		+1·46	59 3 37·91	4·9559387,1	90352·19	17·112
		XXVI	·56	+ ·47	·00		+ ·47	67 19 1·72	4·9876363,8	97193·31	18·408
			1·67				+2·79	180 0 0·00			
27		XXV	·59	− ·91	− ·01		− ·92	74 42 22·44	5·0288748,6	106874·69	20·241
		XXVI	·59	− ·30	− ·02		− ·32	55 20 42·35	4·9597182,7	91141·93	17·262
		XXVII	·58	− ·67	+ ·03		− ·64	49 56 55·21	4·9284610,2	84812·73	16·063
			1·76				−1·88	180 0 0·00			
28		XXVI	·74	+1·13	− ·01		+1·12	51 57 55·46	4·9816287,7	95858·08	18·155
		XXVII	·74	+1·32	+ ·01		+1·33	66 36 48·60	5·0480724,7	111704·95	21·156
		XXVIII	·74	+1·76	·00		+1·76	61 25 15·94	5·0288748,6	106874·69	20·241
			2·22				+4·21	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
29		XXVII	·62	+1·13	+ ·11		+1·24	59 5 50·17	4·9765173,9	94736·52	17·943
		XXVIII	·63	+ ·86	− ·01		+ ·85	60 39 9·91	4·9833594,6	96240·86	18·227
		XXIX	·62	+1·02	− ·10		+ ·92	60 14 59·92	4·9816287,7	95858·08	18·155
			1·87				+3·01	180 0 0·00			
30		XXVIII	·63	− ·18	+ ·11		− ·07	57 34 5·22	4·9753599,5	94484·36	17·895
		XXIX	·64	− ·22	− ·03		− ·25	64 37 20·37	5·0049315,3	101142·01	19·156
		XXX	·64	− ·12	− ·08		− ·20	57 48 34·41	4·9765173,9	94736·52	17·943
			1·91				− ·52	180 0 0·00			
31		XXIX	·74	− ·06	− ·60		− ·66	70 35 32·13	5·0630679,9	115629·33	21·899
		XXX	·74	− ·04	+ ·58		+ ·54	58 59 27·31	5·0214986,0	105074·81	19·901
		XXXI	·73	− ·08	+ ·02		− ·06	50 25 0·56	4·9753599,5	94484·36	17·895
			2·21				− ·18	180 0 0·00			
32		XXX	·85	+ ·33	+ ·35		+ ·68	57 55 52·00	5·0410910,3	109923·63	20·819
		XXXI	·86	+ ·23	− ·36		− ·13	59 1 10·84	5·0461524,2	111212·20	21·063
		XI	·86	+ ·48	+ ·01		+ ·49	63 2 57·16	5·0630679,9	115629·33	21·899
			2·57				+1·04	180 0 0·00			
33		XXXI	·68	+1·21	− ·18		+1·03	53 17 53·32	4·9723578,3	93833·48	17·771
		XI	·68	+1·10	+ ·10		+1·20	56 46 40·45	4·9908089,8	97905·93	18·543
		X	·68	+ ·64	+ ·08		+ ·72	69 55 26·23	5·0410910,3	109923·63	20·819
			2·04				+2·95	180 0 0·00			

Note.—Stations X and XI appertain to the North-East Longitudinal Series.

February 1878.

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RANGIR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	VII*	Tinsmál	24 7 12·97	79 2 12·45	285 50 40·61	5·1809675,5	106 1 22·39	X
	,,	,,	,,	,,	248 14 20·28	5·0914026,8	68 22 47·71	I
	,,	,,	,,	,,	203 53 44·13	5·1165854,2	23 57 39·96	II
1	X	Rangír	24 0 20·37	79 28 26·43	160 25 38·91	4·9667210,1	340 23 21·86	I
2	I	Kusmár	24 14 44·92	79 22 51·13	140 16 36·97	4·9830825,7	320 12 2·69	II
,,	,,	,,	,,	,,	196 7 50·52	5·1383004,4	16 10 41·72	III
	II	Dálípur	24 26 57·43	79 11 45·87	239 40 45·88	5·0620943,3	59 48 13·95	III
	,,	,,	,,	,,	166 24 6·38	5·1660587,8	346 21 30·36	IV
3	III	Chandla	24 36 33·38	79 29 45·12	122 15 56·60	5·1995153,0	302 5 48·68	IV
,,	,,	,,	,,	,,	171 30 56·77	5·2614378,1	351 28 53·57	V
,,	,,	,,	,,	,,	217 8 2·78	5·2101902,9	37 15 29·07	VI
	IV	Bhoraj	24 50 28·71	79 5 31·72	227 53 42·76	5·1575789,1	48 1 52·66	V
	V	Datiára	25 6 22·21	79 24 52·04	292 16 1·70	5·1302726,4	112 25 36·20	VI
	,,	,,	,,	,,	239 25 39·10	5·1222159,9	59 34 28·37	VII
	,,	,,	,,	,,	174 25 50·97	5·0967571,1	354 24 54·47	VIII

Note.—Stations VII* and X appertain to the Calcutta Longitudinal Series of the South-East Quadrilateral.

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
4	VI	Thanela	24 57 53·79	79 47 29·61	174 56 16·26	5·0756724,3	354 55 27·66	VII
5	VII	Manang	25 17 28·38	79 45 35·16	114 26 34·88	5·1413569,6	294 16 45·56	VIII
,,	,,	,,	,,	,,	174 8 57·05	5·1584221,6	354 7 47·98	IX
	VIII	Nágonáth	25 26 54·19	79 22 39·73	232 10 17·35	5·1482904,9	52 19 1·67	IX
	,,	,,	,,	,,	172 2 4·10	5·0586622,1	352 0 49·11	X
6	IX	Phára	25 41 7·57	79 42 54·66	102 10 40·85	5·1134244,5	282 0 38·23	X
,,	,,	,,	,,	,,	159 48 50·32	5·0290306,8	339 45 54·23	XI
	X	Gokulphára	25 45 37·06	79 19 46·22	230 48 46·75	5·0640036,5	50 55 56·05	XI
	,,	,,	,,	,,	177 40 8·83	5·0502589,8	357 39 46·95	XII
7	XI	Gura	25 57 41·39	79 36 10·40	112 32 55·04	5·0090505,4	292 25 21·40	XII
,,	,,	,,	,,	,,	185 31 40·35	4·9835810,4	5 32 25·15	XIII
	XII	Kanwa	26 4 8·19	79 18 56·14	241 10 53·21	5·0721535,1	61 19 13·87	XIII
	,,	,,	,,	,,	187 30 38·97	5·0308130,0	7 31 47·13	XIV
8	XIII	Nipania	26 13 30·70	79 37 52·27	119 6 54·31	5·0095019,7	298 59 39·40	XIV
,,	,,	,,	,,	,,	181 40 45·12	4·9577536,6	1 40 58·11	XV
	XIV	Husapura	26 21 42·37	79 21 30·43	245 52 11·43	5·0028778,3	65 59 41·28	XV
	,,	,,	,,	,,	188 2 31·20	4·9196119,4	8 3 28·30	XVI
9	XV	Gandaspur	26 28 28·98	79 38 21·53	117 15 52·44	4·9550639,9	297 9 18·01	XVI
,,	,,	,,	,,	,,	178 37 17·16	4·9268274,9	358 37 7·13	XVII
	XVI	Atsu	26 35 17·34	79 23 38·51	240 58 7·13	4·9506117,0	61 4 33·11	XVII
	,,	,,	,,	,,	182 52 17·52	4·9801501,1	2 52 41·33	XVIII
10	XVII	Seontára	26 42 25·60	79 37 59·11	125 31 47·87	4·9537073,7	305 25 43·99	XVIII
,,	,,	,,	,,	,,	190 48 6·54	4·9587495,0	10 49 31·55	XIX
	XVIII	Birona	26 51 2·33	79 24 31·35	247 32 42·82	4·9891121,7	67 40 13·47	XIX
	,,	,,	,,	,,	188 58 45·68	4·9770840,0	9 0 0·02	XX
11	XIX	Kalsán	26 57 10·27	79 41 7·48	126 58 23·68	4·9737187,7	306 52 5·50	XX
,,	,,	,,	,,	,,	181 9 46·62	4·9970493,3	1 9 56·79	XXI
	XX	Bisungarh	27 6 30·27	79 27 15·21	240 57 29·38	4·9456218,4	61 3 59·52	XXI
	,,	,,	,,	,,	183 42 24·28	4·8586873,9	3 42 47·89	XXII
	,,	,,	,,	,,	180 18 54·66	5·0068961,2	0 18 57·50	XXIII
12	XXI	Chandanpur	27 13 33·73	79 41 29·81	112 5 0·68	4·8929037,1	291 58 52·88	XXII
,,	,,	,,	,,	,,	127 36 42·35	4·9846573,7	307 30 13·20	XXIII
,,	,,	,,	,,	,,	184 10 31·44	5·0012154,6	4 11 8·72	XXIV
	XXII	Muhammadabad	27 18 24·05	79 28 6·98	172 4 51·40	4·4743603,3	352 4 30·53	XXIII
	XXIII	Pothári	27 23 16·45	79 27 21·41	243 45 22·50	4·9699195,9	63 52 30·84	XXIV

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXIII	Pothári	27 23 16·45	79 27 21·41	184 8 51·07	5·0072718,6	4 9 28·88	XXV
13	XXIV	Mau	27 30 4·20	79 42 50·90	128 21 42·98	4·9876363,8	308 15 10·51	XXV
,,	,,	,,	,,	,,	181 59 3·90	4·9559387,1	1 59 20·04	XXVI
	XXV	Guri	27 40 0·84	79 28 43·22	249 11 32·04	4·9284610,2	69 18 22·32	XXVI
	,,	,,	,,	,,	174 29 9·01	4·9597182,7	354 28 23·48	XXVII
14	XXVI	Dháka	27 44 58·41	79 43 25·73	124 39 5·26	5·0288748,6	304 31 27·69	XXVII
,,	,,	,,	,,	,,	176 37 1·46	5·0480724,7	356 36 27·03	XXVIII
	XXVII	Saipur	27 54 59·21	79 27 5·58	237 54 38·35	4·9816287,7	58 1 43·71	XXVIII
	,,	,,	,,	,,	178 48 47·56	4·9833594,6	358 48 37·09	XXIX
15	XXVIII	Kasrak	28 3 22·65	79 42 12·15	118 40 54·25	4·9765173,9	298 33 36·55	XXIX
,,	,,	,,	,,	,,	176 15 0·10	5·0049315,3	356 14 25·12	XXX
	XXIX	Janjíri	28 10 52·01	79 26 43·30	233 56 15·54	4·9753599,5	54 3 0·17	XXX
	,,	,,	,,	,,	163 20 42·67	5·0214986,0	343 18 2·59	XXXI
16	XXX	Gajnera	28 20 2·02	79 40 58·11	113 2 28·22	5·0630679,9	292 53 1·30	XXXI
,,	,,	,,	,,	,,	170 58 21·07	5·0461524,2	350 56 47·66	XI
	XXXI	Fatehganj	28 27 28·69	79 21 5·87	180 33 55·60	4·9908089,8	0 34 0·80	X
	,,	,,	,,	,,	233 51 49·60	5·0410910,3	53 59 45·68	XI
	X	Sísgarh	28 43 38·07	79 21 16·72	290 38 33·89	4·9723578,3	110 46 26·81	XI
17	XI	Atária	28 38 9·53	79 37 42·26				

NOTE.—Stations X and XI appertain to the North-East Longitudinal Series.

April 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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RANGIR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. HEIGHTS ABOVE MEAN SEA LEVEL.

The following table gives, first, the usual data of the observed vertical angles and the heights of the signal and instrument &c., in pairs of horizontal lines, the first line of which gives the data for the 1st or the fixed station, and the second line the data for the 2nd or the deduced station. This is followed by the arc contained between the two stations, and then by the terrestrial refraction, and the height of the 2nd station above or below the 1st, as computed from the vertical angles in the usual manner. This difference of height applied to the given height above mean sea level of the fixed station, gives that of the deduced station. Usually there are two or three independent values of the height of the deduced station; the details are so arranged as to show these consecutively and their mean in the columns of "Trigonometrical Results". The mean results thus obtained are however liable to receive corrections for the errors generated in the trigonometrical operations, which are shown up by the spirit leveling operations, whenever a junction between the two has been effected. The spirit leveled determinations are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the leveling operations are adjusted—usually by simple proportion—to accord with the latter. In the table the spirit leveled values are printed thus, **1145·63** &c., or, when not very exactly identified, thus, **1146**, to distinguish them from the adjusted trigonometrical values. The column in which the mean trigonometrical heights are given is barred across where necessary, as after deduction of Stn. VII from Stn. VI, page 39—$_K$ to indicate that one set of adjustment ends and another begins. The trigonometrical heights always refer to the upper mark-stone, or to the upper surface of the pillar on which the theodolite stood; when a spirit leveled height does not refer to either of these surfaces, it is given in combination with a correction, thus $\left\{ \begin{array}{l} \mathbf{501{\cdot}22} \\ + 23{\cdot}1 \end{array} \right.$ and the sum of these two quantities, in this case 524·3, represents the value with which the corresponding trigonometrical mean height 493·0 is comparable. Descriptions follow these tables, exactly indicating the positions of the leveling staff during the determinations of the spirit leveled heights.

When the pillar of the station is perforated, the height given in the last column, is that between the upper surface of pillar and ground level mark-stone in floor of passage; otherwise it is the approximate height of the structure, above the ground at the base of the station.

The heights of the initial stations are taken from the Calcutta Longitudinal Series of the South-East Quadrilateral, page 179—$_B$, Vol. VI, and are as follows:—

VII 2139·2 }
X 1184·2 } feet above Mean Sea Level at Karáchi.

Astronomical Date 1834	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
(1)		VII	D 0 18 4·4	8	1·86	5·20	1219	76	·063	− 326·6	1812·6			
(2)		I	E 0 0 7·8	8	1·86	4·81								
1864												1815·8	1815	7
Ap. 11, 13, 14	3 32	X	E 0 16 3·3	12	2·71	5·25	915	13	·014	+ 634·8	1819·0			
" 9	3 33	I	D 0 31 3·3	4	2·87	5·23								
1834														
June 28	13 30	VII	D 0 23 45·2	4	1·00	5·17	1292	82	·063	− 541·7	1597·5			
July 2	10 0	II	E 0 4 43·5	4	1·00	4·94						1599·9	1599	†
June 23	14 0	I	D 0 14 53·9	4	1·00	4·39	950	46	·049	− 213·4	1602·4			
July 2	10 0	II	E 0 0 20·4	4	1·00	4·94								

(1). The mean of observations taken on 29th June 1834 at 13h 30m and 28th March 1864 at 3h 1m. † Not forthcoming.
(2). Do. Do. 24th " at 14 0 and 8th April 1864 at 3 0.

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Astronomical Date 1834	Astronomical Date: Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
June 25	10 0	I	D 0 10 6·3	8	4·57	4·39	1359	99	·073	− 17·4	1798·4			
" 20	9 0	III	D 0 9 20·0	4	1·00	4·65						1797·5	1796	†
July 2, 3	10·30	II	D 0 2 41·2	8	1·00	4·94	1140	64	·056	+ 196·7	1796·6			
June 16	9 0	III	D 0 14 23·8	6	1·00	4·65								
July 3	10 0	II	D 0 16 5·2	10	1·00	4·94	1448	103	·071	− 240·9	1359·0			
" 5	10 0	IV	D 0 4 46·9	4	1·00	4·82						1360·6	1358	†
June 20	9 0	III	D 0 20 41·5	6	1·00	4·65	1564	112	·072	− 435·4	1362·1			
July 5	10 0	IV	D 0 1 47·4	4	1·00	4·82								
June 20	9 0	III	D 0 25 16·4	4	1·00	4·65	1804	122	·067	− 647·9	1149·6			
July 8	8 30	V	D 0 0 52·6	4	1·00	4·76						1153·3	1151	†
(3)		IV	D 0 14 50·2	8	1·00	4·82	1420	117	·083	− 203·5	1157·1			
(4)		V	D 0 5 6·0	6	1·00	4·76								
June 20	9 0	III	D 0 25 55·4	6	1·00	4·65	1603	131	·082	− 692·3	1105·2			
July 11	9 0	VI	E 0 3 24·0	4	1·00	5·15						1101·4	1098	†
(5)		V	D 0 11 6·6	6	1·00	4·76	1334	91	·069	− 55·8	1097·5			
(6)		VI	D 0 8 14·5	6	2·43	5·15								
(7)		VI	D 0 7 7·8	8	1·00	5·15	1176	78	·067	+ 51·4	1152·8			
(8)		VII	D 0 10 5·4	8	1·00	4·76						1149·4	1145·63	3
(9)		V	D 0 9 36·6	8	1·00	4·76	1309	95	·073	− 7·3	1146·0			
(10)		VII	D 0 9 11·7	8	2·43	4·76								
(11)		V	D 0 13 33·5	6	1·00	4·76	1335	88	·071	− 168·2	982·8			
(12)		VIII	D 0 4 16·1	6	2·43	4·88						984·6	987	†
(13)		VII	D 0 13 36·4	6	1·00	4·76	1368	111	·081	− 159·3	986·3			
(14)		VIII	D 0 5 41·9	6	1·00	4·88								
(15)		VII	D 0 22 36·1	6	1·00	4·76	1423	98	·069	− 514·5	631·1			
(16)		IX	E 0 1 57·2	8	1·00	4·97						631·9	637	†
(17)		VIII	D 0 18 41·5	8	1·00	4·88	1390	95	·068	− 351·8	632·8			
(18)		IX	D 0 1 30·4	8	1·00	4·97								
1836														
Dec. 26	4 33	VIII	D 0 17 4·3	4	1·00	5·03	1131	87	·077	− 299·0	685·6			
" 23	4 28	X	E 0 0 53·3	4	1·00	5·12						691·3	699	12

In some instances, the dates and mean of times of observations taken at two different hours either of the same day or on different days could not be entered in their proper places in columns 1 and 2 from want of space, this information is as follows :—the year of observation being 1834 throughout. (3) 10h 0m and 15h 0m 5th July; (4) 8h 30m 8th July, and 12h 30m 9th July; (5) 8h 30m 8th July, and 12h 30m 9th July; (6) 9h 0m and 14h 0m 11th July; (7) 9h 0m and 14h 0m 11th July; (8) 8h 0m and 14h 0m 16th July; (9) 8h 30m 8th July, and 12h 30m 9th July; (10) 8h 0m and 14h 0m 16th July; (11) 8h 30m 8th July, and 12h 30m 9th July; (12) 8h 0m and 14h 0m 18th July; (13) 8h 0m and 14h 0m 16th July; (14) 8h 0m and 14h 0m 18th July; (15) 8h 0m and 14h 0m 16th July; (16) 8h 0m and 13h 0m 20th July; (17) 8h 0m and 14h 0m 18th July; (18) 8h 0m and 13h 0m 20th July.

† Not forthcoming.

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Astronomical Date 1837		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″			′	″							feet
Jan.	2	5 1	IX	D 0 7 25·6	4	1·00	5·07	1283	99	·077	+ 65·1	697·0			
1836 Dec.	23	4 15	X	D 0 10 52·6	4	1·00	5·12								
1840 April	16	7 43	IX	D 0 10 23·7	10	13·60	4·96	1056	197	·186	− 160·3	471·6			
„	16	7 43	XI	D 0 0 29·8	10	1·88	5·89						466·2	477	33
„	18	7 44	X	D 0 12 39·4	8	13·60	4·96	1145	208	·182	− 230·5	460·8			
„	18	7 44	XI	E 0 0 37·1	8	1·04	5·89								
„	21	9 1	X	D 0 11 1·9	10	11·64	5·89	1109	172	·155	− 157·6	533·7			
„	21	9 1	XII	D 0 1 40·5	10	1·04	4·96						526·6	540	† 28
„	11	9 2	XI	E 0 1 12·0	14	5·08	5·89	1009	471	·467	+ 53·0	519·2			
„	11	9 2	XII	D 0 2 3·1	14	13·60	4·96								
„	8	8 32	XI	D 0 2 34·5	12	5·54	5·89	951	329	·346	− 3·3	462·9			
„	8	8 32	XIII	D 0 2 1·2	12	13·60	4·96						461·1	477	39
„	6	9 26	XII	D 0 1 48·5	12	5·71	5·89	1166	574	·492	− 67·2	459·4			
„	6	9 26	XIII	E 0 2 24·4	12	15·10	4·96								
„	4	8 12	XII	D 0 3 21·8	10	6·17	5·89	1060	439	·414	− 58·1	468·5			
„	4	8 12	XIV	E 0 0 40·3	10	15·10	4·96						481·9	500	34
„	1	7 54	XIII	E 0 0 31·7	12	5·38	5·89	1010	469	·464	+ 34·2	495·3			
„	1	7 54	XIV	D 0 1 28·7	12	13·14	4·96								
Mar.	29	7 49	XIII	D 0 1 22·5	12	5·46	5·89	896	356	·397	+ 4·6	465·7			
„	29	7 49	XV	D 0 1 23·7	12	13·14	4·96						461·4	482	28
„	26	7 47	XIV	D 0 3 44·9	8	5·46	5·89	994	324	·326	− 24·9	457·0			
„	26	7 47	XV	D 0 1 39·4	8	16·06	4·96								
„	24	6 33	XIV	D 0 2 51·0	16	3·81	5·89	821	178	·217	+ 26·9	508·8			
„	24	6 33	XVI	D 0 4 31·9	16	16·06	4·96						503·3	527	‡ 26
„	18	7 48	XV	D 0 0 12·2	8	22·17	5·89	891	313	·351	+ 36·3	497·7			
„	18	7 48	XVI	D 0 3 14·4	8	14·14	4·96								
„	9	8 57	XV	E 0 2 10·9	14	15·89	4·96	834	386	·463	+ 30·1	491·5			
„	9	8 57	XVII	D 0 0 43·8	14	5·50	5·89						492·0	518	* 17
„	7	7 48	XVI	D 0 2 48·1	14	15·89	4·96	881	272	·309	− 10·8	492·5			
„	7	7 48	XVII	D 0 2 25·3	14	5·13	5·89								
„	4	7 32	XVI	D 0 1 11·2	12	14·25	4·96	944	347	·368	+ 15·5	518·8			
„	4	7 32	XVIII	D 0 2 39·7	12	5·13	5·89						513·1	542	† 23
Feb.	29	7 54	XVII	D 0 0 12·5	12	14·25	4·96	888	375	·422	+ 15·3	507·3			
„	29	7 54	XVIII	D 0 1 45·0	12	5·42	5·89								

† Above the terreplein of the fort on which the tower stands. ‡ Above the level of the elevated platform on which the station is placed.
* Above the level of summit of the fort tower on which the station is placed.

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Astronomical Date 1837		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Nov.	19	6 30	XVII	D 0 2 38·4	8	12·32	4·96	898	272	·302	+ 1·0	493·0			
„	19	6 30	XIX	D 0 3 0·3	8	5·58	5·90						493·0	{ 501·22 +23·1	23·1
„	13	7 1	XVIII	D 0 1 34·1	10	12·32	4·96	963	415	·430	− 20·2	492·9			
„	13	7 1	XIX	D 0 0 25·4	10	5·33	5·90								
„	9	6 59	XVIII	D 0 1 47·5	8	12·23	4·92	937	346	·370	− 0·6	541·4			
„	9	6 59	XX	D 0 2 2·2	8	5·33	5·90						534·8	{ 518·88 +23·8	23·8
„	7	7 40	XIX	D 0 0 5·4	14	12·23	4·92	930	435	·468	+ 3·9	528·2			
„	7	7 40	XX	D 0 0 38·1	14	6·03	5·90								
„	28	6 48	XIX	D 0 1 31·4	8	4·92	5·90	981	433	·441	− 15·4	508·9			
„	28	6 48	XXI	D 0 0 10·3	8	12·32	4·96						505·7	508	38
„	4	7 13	XX	D 0 3 21·9	10	5·33	5·90	871	329	·378	− 40·2	502·5			
„	4	7 13	XXI	E 0 0 4·5	10	12·23	4·92								
Octr.	30, 31	7 2	XX	D 0 1 16·5	14	1·54	5·90	1004	380	·378	+ 26·8	569·5			
„	30, 31	7 2	XXIII	D 0 2 41·7	14	12·23	5·06						568·6	574	38
1839 Jan.	8, 10	5 41	XXI	D 0 1 16·1	18	11·89	4·92	953	253	·266	+ 61·9	567·6			
„	8, 10	5 41	XXIII	D 0 5 59·9	18	3·71	5·89								
1842 Jan.	16	4 32	XX	D 0 3 18·7	12	5·13	5·54	713	84	·118	+ 26·2	561·0			
„	16	4 32	XXII	D 0 5 47·2	12	5·38	5·43								
„	12	23 51	XXI	D 0 4 38·1	12	5·13	5·13	772	− 7	·009	+ 43·6	549·3	559·9	565	* 17
„	12	23 51	XXII	D 0 8 29·4	8	5·00	5·43								
„	19	1 28	XXIII	D 0 1 57·7	14	5·12	5·50	294	27	·091	+ 0·8	569·4			
„	19	1 28	XXII	D 0 2 5·4	13	5·46	5·43								
1839 Jan.	27	4 13	XXI	D 0 6 13·8	10	2·00	5·89	990	134	·135	− 2·1	503·6			
„	27	4 13	XXIV	D 0 5 41·9	10	12·31	4·93						508·7	516	38
1838 Dec.	27	20 11	XXIII	D 0 8 50·7	12	2·00	5·89	922	60	·065	− 54·9	513·7			
„	27	20 11	XXIV	D 0 4 23·9	12	11·89	4·96								
1840 Jan.	31	8 3	XXIII	D 0 4 8·1	12	20·00	4·96	1004	323	·322	− 49·3	519·3			
„	31	8 3	XXV	D 0 0 57·2	12	16·50	5·89						522·9	533	38
1837 Dec.	29	3 45	XXIV	D 0 5 44·4	12	9·03	4·96	960	89	·093	+ 17·9	526·6			
„	29	3 45	XXV	D 0 7 16·2	12	2·00	5·44								
1838 April	26	18 34	XXIV	D 0 5 42·0	10	2·00	5·88	892	88	·099	+ 10·8	519·5			
„	26	18 34	XXVI	D 0 6 6·6	10	11·79	4·92						522·3	535	38
„	19	11 12	XXV	D 0 3 20·2	8	4·38	5·89	838	217	·259	+ 2·3	525·2			
„	19	11 12	XXVI	D 0 3 8·4	8	12·89	4·96								

* Above the bastion of the fort on which the tower stands.

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Astronomical Date 1838		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
(1)			XXV	D 0 4 3·9	18	3·79	5·67	900	198	·220	+ 5·3	528·2	524·4	539	38
(2)			XXVII	D 0 4 10·2	18	10·96	4·92								
Jan.	29	4 57	XXVI	D 0 5 35·9	6	2·00	5·44	1056	202	·191	— 1·7	520·6			
„	29	4 57	XXVII	D 0 5 15·0	6	8·90	4·92								
Feb.	26	8 24	XXVI	E 0 2 46·6	10	12·14	4·93	1103	550	·498	+ 83·9	606·2	590·0	608	38
„	26	8 24	XXVIII	D 0 2 38·2	10	5·08	5·92								
„	20	7 46	XXVII	E 0 0 25·9	8	5·17	5·88	947	395	·417	+ 49·5	573·9			
„	20	7 46	XXVIII	D 0 2 49·7	8	12·23	4·93								
„	16	9 7	XXVII	D 0 1 7·7	10	5·63	5·88	951	340	·357	+ 32·1	556·5	563·9	584	38
„	16	9 7	XXIX	D 0 3 9·1	10	12·23	4·96								
Mar.	2	7 43	XXVIII	D 0 2 32·1	8	5·29	5·92	936	358	·383	— 18·8	571·2			
„	2	7 43	XXIX	D 0 0 53·4	8	12·14	5·00								
„	5	7 33	XXVIII	D 0 2 1·4	8	5·25	5·92	999	312	·312	+ 33·0	623·0	608·1	631	38
„	5	7 33	XXX	D 0 4 0·0	8	12·14	4·93								
„	8	7 53	XXIX	E 0 0 4·5	12	5·00	5·92	933	405	·434	+ 31·4	595·3			
„	8	7 53	XXX	D 0 1 56·2	12	11·42	4·92								
„	18	14 29	XXIX	E 0 0 26·6	10	5·08	5·92	1038	518	·499	+ 13·9	577·8	585·0	572·12 +37·9	37·9
„	18	14 29	XXXI	D 0 0 13·4	10	11·42	4·92								
„	23	12 20	XXX	D 0 5 41·3	8	5·39	5·89	1142	259	·227	— 15·9	592·2			
„	23	12 20	XXXI	D 0 4 30·9	8	12·23	4·98								
1839															
Mar.	12	13 26	XXX	D 0 0 44·2	6	4·88	5·89	1098	443	·404	+ 34·2	665·2	659·1	619·32 +37·8	37·8
„	12	13 26	XI	D 0 2 34·7	6	12·23	4·46								
„	19	10 8	XXXI	D 0 4 12·1	10	4·63	5·92	1086	213	·196	+ 42·9	652·9			
„	19	10 8	XI	D 0 6 36·2	10	12·04	4·46								
„	23	4 41	XXXI	D 0 4 30·7	14	2·30	5·92	967	84	·087	+ 64·8	674·8	673·9	670	38
„	23	4 41	X	D 0 8 41·9	14	12·04	5·26								
(3)			XI	D 0 4 3·6	14	5·85	5·37	927	184	·198	+ 15·9	673·0			
(4)			X	D 0 5 7·5	20	8·45	5·30								

In some instances, the dates and mean of times of observations taken at two different hours either of the same day or on different days could not be entered in their proper places in columns 1 and 2 from want of space, this information is as follows:—(1) 4h 28m 11th January, and 8h 3m 16th April 1838; (2) 4h 28m 11th January, and 8h 3m 16th April 1838; (3) 13h 53m 28th March 1839 and 3h 49m 8th April 1851; (4) 13h 53m 28th March 1839 and 3h 47m 17th, 18th, 21st, March 1851.

Note.—Stations X and XI appertain to the North-East Longitudinal Series.

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Descriptions of Spirit-leveled Points.

The spirit-leveled heights given on pages 39—K., 41—K. and 42—K. were determined by the operations either of the G. T. Survey or the Revenue Survey; these connections are hereafter indicated in the former case by the letters (G. T. S.), and in the latter by (R. S.) immediately following the name of each station; the surface on which the leveling staff stood is also described.

VII	or	*Manang Hill Station,*	(R. S.)	; On the upper surface of the circular paka platform.
XIX	„	*Kalsán Tower Station,*	(G. T. S.)	; On the mark-stone imbedded at the level of the ground, over which the perforated masonry column has been built.
XX	„	*Bisungarh Tower Station,*	„	; On the mark-stone imbedded at 1 foot above the level of the ground, over which the perforated masonry column has been built.
XXXI	„	*Fatehganj Tower Station,*	„	; On the mark-stone imbedded at 2 feet above the level of the ground, over which the perforated masonry column has been built.
XI	„	*Atária Tower Station,* (Of the North-East Longitudinal Series).	„	; On the mark-stone imbedded at 2 feet above the level of the ground, over which the perforated masonry pillar has been built.

For further particulars of these stations, see pages 5—K. to 10—K.

May 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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RANGIR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XXII (Muhammadabad)

Lat. N. 27° 18′ 24″·05; Long. E. 79° 28′ 6″·98 = 5h 17m 52s·5; Height above Mean Sea Level, 565 feet.
December 1840; observed by Mr. J. W. Armstrong with Harris and Barrow's 15-inch Theodolite.

Star observed — δ Ursæ Minoris (West and East).
Mean Right Ascension 1840·0 — 18h 23m 56s
Mean North Polar Distance 1840·0 — 3° 24′ 31″·22
Local Mean Times of Elongation, Dec. 26 — Western 5h 56m; Eastern 18 8

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark – Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark – Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark – Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 26	W.	0 1	+ 12 59 40·00	19 18	+ 0 49·00	+ 13 0 29·00	+ 13 0 24·00	8 59	+ 0 10·12	+ 13 0 34·12
		&	59 50·67	17 0	0 38·02	28·69	0 31·00	7 2	0 6·50	37·50
		180 1	60 29·67	0 18	0 0·01	29·68	0 17·00	11 0	0 15·84	32·84
			60 28·67	2 15	0 0·67	29·34	0 15·67	12 45	0 21·29	36·96
„ 26	E.	0 1	+ 5 21 44·67	27 21	− 1 37·76	+ 5 19 66·91	+ 5 20 42·00	18 41	− 0 45·72	+ 5 19 56·28
		&	21 25·00	26 7	1 29·14	55·86	20 37·33	16 50	0 37·06	60·27
		180 1	19 56·33	5 31	0 3·98	52·35	20 0·00	3 26	0 1·56	58·44
			19 56·00	3 35	0 1·68	54·32	20 5·00	5 35	0 4·10	60·90
			20 18·00	13 4	0 22·45	55·55				
			20 26·00	14 21	0 27·10	58·90				
„ 27	W.	10 1	+ 13 0 31·67	6 44	+ 0 5·95	+ 13 0 37·62	+ 12 59 57·00	17 33	+ 0 40·53	+ 13 0 37·53
		&	0 35·33	5 23	0 3·81	39·14	69 2·67	15 57	0 33·46	36·13
		190 1	0 27·33	7 41	0 7·74	35·07	60 36·67	0 38	0 0·05	36·72
			0 24·00	9 1	0 10·67	34·67	60 34·33	2 7	0 0·59	34·92
„ 27	E.	10 1	+ 5 20 38·67	15 58	− 0 33·38	+ 5 19 65·29	+ 5 20 8·67	7 2	− 0 6·48	+ 5 19 62·19
		&	20 31·67	14 7	0 26·11	65·56	20 7·67	5 37	0 4·14	63·53
		190 1	19 59·00	1 45	0 0·40	58·60	20 2·67	0 37	0 0·05	62·62
			20 7·67	6 19	0 5·24	62·43	20 34·00	13 59	0 25·73	68·27
			20 14·00	9 2	0 10·74	63·26	20 36·00	15 8	0 30·15	65·85
„ 28	W.	20 1	+ 12 60 28·33	8 50	+ 0 10·24	+ 13 0 38·57	+ 12 59 54·00	15 51	+ 0 33·03	+ 13 0 27·03
		&	60 29·67	7 7	0 6·66	36·33	60 1·67	14 16	0 26·77	28·44
		200 1	60 31·67	0 29	0 0·03	31·70	60 28·00	2 21	0 0·72	28·72
			59 59·67	16 45	0 36·72	36·39	60 22·00	7 38	0 7·65	29·65
			59 52·67	18 8	0 43·04	35·71	60 18·00	11 23	0 16·98	34·98

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT				FACE RIGHT			
			Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation	Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Dec. 28	E.	20 2	+ 5 20 44·00	16 38	− 0 36·25	+ 5 19 67·75	+ 5 20 7·67	6 49	− 0 6·10	+ 5 19 61·57
		&	20 34·67	15 7	0 29·90	64·77	20 7·00	4 7	0 2·22	64·78
		200 1	20 6·33	2 13	0 0·65	65·68	20 3·33	0 7	0 0·00	63·33
			20 11·00	7 29	0 7·35	63·65	20 38·00	14 1	0 25·80	72·20
			20 14·67	8 44	0 10·02	64·65	20 43·00	16 10	0 34·40	68·60
„ 29	W.	30 1	+ 13 0 17·33	13 4	+ 0 22·46	+ 13 0 39·79	+ 12 60 23·33	5 59	+ 0 4·70	+ 13 0 28·03
		&	0 22·67	11 44	0 18·10	40·77	60 28·33	4 25	0 2·57	30·90
		210 1	0 38·67	2 47	0 1·02	39·69	60 33·00	0 27	0 0·03	33·03
			0 28·33	6 36	0 5·72	34·05	59 58·00	16 44	0 36·66	34·66
			0 24·67	9 21	0 11·45	36·12	59 53·00	18 25	0 44·37	37·37
„ 29	E.	30 1	+ 5 19 59·67	6 23	− 0 5·33	+ 5 19 54·34	+ 5 20 32·67	16 25	− 0 35·32	+ 5 19 57·35
		&	19 56·67	4 50	0 3·07	53·60	20 28·33	14 51	0 28·89	59·44
		210 1	19 58·33	1 23	0 0·25	58·08	20 2·67	3 40	0 1·77	60·90
			20 40·67	17 3	0 38·26	62·41	20 9·00	7 36	0 7·58	61·42
			20 48·00	18 11	0 43·46	64·54	20 10·33	9 6	0 10·88	59·45
„ 30	W.	40 1	+ 13 0 15·33	14 16	+ 0 26·74	+ 13 0 42·07	+ 12 60 27·33	6 41	+ 0 5·88	+ 13 0 33·21
		&	0 19·00	12 51	0 21·73	40·73	60 30·00	5 8	0 3·46	33·46
		220 1	0 38·67	2 26	0 0·78	39·45	60 35·67	0 30	0 0·03	35·70
			0 26·00	7 58	0 8·33	34·33	60 8·00	15 22	0 30·90	38·90
			0 18·00	9 44	0 12·40	30·40	59 59·00	16 53	0 37·30	36·30
„ 30	E.	40 1	+ 5 20 13·33	8 9	− 0 8·73	+ 5 19 64·60	+ 5 20 34·00	16 57	− 0 37·62	+ 5 19 56·38
		&	20 10·33	6 48	0 6·07	64·26	20 31·33	15 38	0 31·98	59·35
		220 1	20 1·00	1 40	0 0·37	60·63	20 7·67	1 33	0 0·32	67·35
			20 36·33	16 17	0 34·86	61·47	20 12·33	7 65	0 8·25	64·08
			20 46·67	18 9	0 43·34	63·33	20 18·67	10 26	0 14·33	64·34
„ 31	W.	50 1	+ 13 0 33·00	6 33	+ 0 5·64	+ 13 0 38·64	+ 12 60 27·00	0 41	+ 0 0·06	+ 13 0 27·06
		&	0 41·67	5 25	0 3·85	45·52	60 32·33	0 9	0 0·00	32·33
		230 1	0 28·67	7 17	0 6·95	35·62	60 29·33	5 14	0 3·59	32·92
			0 18·67	11 0	0 15·86	34·53	59 58·67	16 15	0 34·61	33·28
			0 20·33	12 4	0 19·06	39·39	59 52·00	17 34	0 40·37	32·37
„ 31	E.	50 1	+ 5 20 7·00	5 26	− 0 3·87	+ 5 19 63·13	+ 5 20 27·67	14 22	− 0 27·06	+ 5 19 60·61
		&	20 5·33	4 16	0 2·38	62·95	20 24·00	13 11	0 22·78	61·22
		230 1	20 3·33	2 10	0 0·62	62·71	20 7·67	4 10	0 2·28	65·39
			20 57·00	20 19	0 54·28	62·72	20 18·67	10 43	0 15·10	63·57
			21 10·33	22 13	1 4·96	65·37	20 25·33	12 17	0 19·86	65·47

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Abstract of Astronomical Azimuth observed at XXII (Muhammadabad) 1840.

1. By Eastern Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°
Date	December 26		December 27		December 28		December 29		December 30		December 31	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	66·91	56·28	65·29	62·19	67·75	61·57	54·34	57·35	64·60	56·38	63·13	60·61
	55·86	60·27	65·56	63·53	64·77	64·78	53·60	59·44	64·26	59·35	62·95	61·22
	52·35	58·44	58·60	62·62	65·68	63·33	58·08	60·90	60·63	67·35	62·71	65·39
	54·32	60·90	62·43	68·27	63·65	72·20	62·41	61·42	61·47	64·08	62·72	63·57
	55·55		63·26	65·85	64·65	68·60	64·54	59·45	63·33	64·34	65·37	65·47
	58·90											
Means	57·32	58·98	63·03	64·49	65·30	66·10	58·59	59·71	62·86	62·30	63·38	63·25
	° ′ "		"		"		"		"		"	
Means of both faces	+ 5 19 58·15		63·76		65·70		59·15		62·58		63·32	
Az. of Star fr. S., by W.	183 50 16·63		16·97		17·31		17·76		18·10		18·44	
Az. of Ref. M. „	189 10 14·78		20·73		23·01		16·91		20·68		21·76	

2. By Western Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°
Date	December 26		December 27		December 28		December 29		December 30		December 31	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	29·00	34·12	37·62	37·53	38·57	27·03	39·79	28·03	42·07	35·21	38·64	27·06
	28·69	37·50	39·14	36·13	36·33	28·44	40·77	30·90	40·73	33·46	45·52	32·33
	29·68	32·84	35·07	36·72	31·70	28·72	39·69	33·03	39·45	35·70	35·62	32·92
	29·34	36·96	34·67	34·92	36·39	29·65	34·05	34·66	34·33	38·90	34·53	33·28
					35·71	34·98	36·12	37·37	30·40	36·30	39·39	32·37
Means	29·18	35·36	36·62	36·33	35·74	29·76	38·08	32·80	37·40	35·51	38·74	31·59
	° ′ "		"		"		"		"		"	
Means of both faces	+ 13 0 32·27		36·48		32·75		35·44		36·46		35·17	
Az. of Star fr. S., by W.	176 9 43·48		43·14		42·80		42·35		42·02		41·68	
Az. of Ref. M. „	189 10 15·75		19·62		15·55		17·79		18·48		16·85	

		° ′ "
Astronomical Azimuth of Referring Mark	by Eastern Elongation	189 10 19·64
	by Western „	„ 17·34
	Mean	„ 18·49
Angle Referring Mark and XXI (Chandanpur) *see page* 21—K.	... ...	+102 48 42·06
Astronomical Azimuth of Chandanpur by observation	... ...	291 59 0·55
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see page* 36—K. *ante*	... ...	291 58 52·88
Astronomical—Geodetical Azimuth at XXII (Muhammadabad) ...	... ...	+ 7·67

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In charge of Computing Office.

May 1878.

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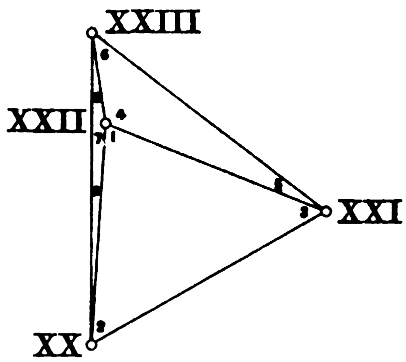
Fig. No. 8



Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

C. DYSON, PHOTO.
Photozincographed at the Office of the Superintendent Great Trigonometrical Survey, Dehra Dún, March 1878.
C. G. OLLENBACH, ZINCO.

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AMUA MERIDIONAL SERIES.

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AMUA MERIDIONAL SERIES—(LONG. 80° 32′).

INTRODUCTION.

The Amua Series is the third in order, reckoning from west to east, of the meridional chains of triangles included in the North-East Quadrilateral. It follows, as closely as the nature of the country traversed would admit of, the meridian of $80\frac{1}{2}$° East Longitude. It was begun contemporaneously with the series immediately to the westward—the Rangír—and was executed throughout its length as a single chain of triangles. It emanates in the Native State of Nagode and the modern district of Jubbulpore, at the side Amua–Lakanpura of the Calcutta Longitudinal Series; and for the first $1\frac{1}{2}$ degrees of its length, it is carried across the hills which, generally speaking, may be said to form the outliers of the Great Vindhya Range—the southern watershed of the Gangetic plain. In this section, the Series traverses the Native States of Panna and Chhatarpur at the south-east extremity of Bundelkhand, the states reckoned under the political control of the Baghelkhand Agency, and the British district of Banda; and the triangulation fixes the important towns of Maihar and Panna, the capitals of the Native States respectively so named. It then descends into the valley of the Jumna; and, passing through the Fatehpur and Cawnpore districts in the Doáb, strikes the right bank of the Ganges in parallel $26\frac{1}{2}$° N. lat.: in this section, it fixes the position of the towns of Banda and Cawnpore. The Series, after crossing the Ganges, is carried through the north-western portion of Oudh, traversing the modern districts of Unao, Lucknow, Hardoi, Sitapur and Kheri, and is now held to terminate at the side Kokra–Dahlelnagar (XXIII–XXV) of the North-East Longitudinal Series; but it also furnished the two triangles north of this side which have been incorporated in the former series. It was brought to a close in the year 1838-39. Its direct length is 282 miles, covering 4 meridional degrees.

The execution of this Series was entrusted to Lieutenant T. Renny of the Bengal Engineers, who had shortly before been appointed to the Great Trigonometrical Survey, on the recommendation of the Surveyor General, Major Everest, by a General Order in the Military Department dated 23rd July 1832. Lieutenant Waugh, of the Bengal Engineers, was also appointed to the Department about the same time. Both officers were then in Calcutta; they were directed to proceed to Central India to acquire an insight into their new duties by sharing in the operations which were then being carried out on the extensive chain of triangles

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known as the Great Arc, under the immediate superintendence of Major Everest. But as in marching from Calcutta to Central India they would have to pass through a region of which it has been said that as little was then known "as of the heart of Africa", Major Everest instructed them to carry a route-survey through this region and draw up a report of it for submission to the Government. Extracts of his instructions—which are interesting for the evidence they furnish of the urgent demand then existing for every sort of information obtainable for immediate geographical requirements—will be found at pages IV—$_K$ and V—$_K$ of the Introduction to the Rangír Meridional Series.

Season 1833-34.

PERSONNEL.

Lieut. T. Renny, Bengal Engineers, 2nd Assistant.
Mr. R. C. Tulloh, 3rd Class Sub-Assistant.
" C. Lane, 3rd " "

With two European Assistants; a native establishment consisting of a nucleus of 24 flagmen, 23 carriers for the large theodolite, 1 native doctor, and 2 harkáras (letter carriers), also 1 havildár, 1 náib, and 12 barkandázes for the protection of the instruments and Government property, and about 130 others for general employment; also with 50 head of baggage cattle, and an elephant for the office tent,—Lieutenant Renny started from Agra on the 30th November 1833. He was furnished with an 18-inch theodolite* (No. 1) by Troughton and Simms for the principal observations, and such other instruments as were needed for the preliminary operations. The party marched to its ground *viá* Gwalior, Datia, Jhánsi and Saugor in company with the party which was proceeding under Lieutenant Waugh to the Rangír Series. The co-operation of the Governor General's Agent in Bundelkhand as well as of the Political Agent for Baghelkhand having been secured, an escort of a duffadár's party of horse and a náik's party of foot was obtained at Saugor. The party reached its first station, Amua (XVII, of the Calcutta Longitudinal Series), on the 13th January 1834.

There Lieutenant Renny commenced operations by taking a series of circumpolar star observations for azimuth; his assistants were detached to select forward stations, and while he remained at Amua, he took observations to such hills in the distance as appeared to be suitable for eventual adoption as principal stations. The selection of stations in the direction of the meridian of Amua proved however to be a very difficult matter, because of an elevated table land in front, which was covered with low forest and jungle and could only be crossed by having towers of considerable height built at the stations of the triangulation and clearing the rays between them, as in the plains. After carefully reconnoitering the ground, Lieutenant Renny decided on giving the Series a bend to the east, avoiding the table land and entering a tract of country which presented fewer difficulties, and had the further advantage of enabling him to place his stations "in a cultivated tract rather than on jungly flats." Sending Mr. Tulloh to the Kaimúr range—where he fixed the station of Patra (II),—and Mr. Lane to the hill of Dharkána (IV), he himself returned to Lakanpura (XIX, of the Calcutta Longitudinal Series) and on 20th February began and completed the measurement of the angle between Amua and Maihar (I). Lieutenant Renny next explored the country to the north-east, and proceeded *viá* Dharkána (IV) to the Vindhyáchal range, selecting Sárang (VI) and Dágri (V) stations near the northern confines of Baghelkhand and bringing the Series

* For the history and description of this instrument, see page 65 of Appendix No. 2 to Vol. II. of the *Account of the Operations of the Great Trigonometrical Survey of India.*

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back to its own meridian. Mr. Tulloh having succeeded in selecting a station in the plains, proceeded to select the stations of Kartár (VII), Marpha (VIII), and Sihonda (IX) which are situated in the Banda district. Lieutenant Renny now considered that his presence was no longer needed on the approximate series, and accordingly returned to resume the final observations, selecting *en route* the station of Potenda (III). He began observations on the 19th March at Maihar (I); and proceeding thence in order to Amua, Lakanpura, Patra (II), Potenda (III), Dharkána (IV), Sárang (VI), Dágri (V), Marpha (VIII), Kartár (VII), Sihonda (IX), and Pavia (X), he was able by 23rd June to complete the first ten triangles of the Series, thereby spanning a *meridional* distance of 100 miles and reaching the extremity of the hill tract through which the Series passes.

Lieutenant Renny had hoped to have a large amount of secondary triangulation executed in connection with the principal operations by one of his assistants. The country passed through possesses many places of considerable interest, prominent among which are the celebrated forts of Ajaigarh and Kalinjar which date back for their origin to the Chandel rule nearly 1000 years ago, and the fancied impregnability of whose walls induced their defenders to defy to some purpose even the British arms in the early portion of the present century; Nagode or Unchehra, a rája of which subsequently proved his loyalty by spontaneous support in the critical times of the Indian Mutiny; Panna, a place of considerable beauty and wealth; Maihar, Kothi and Sohávwal, all the capitals of the Native States or *jagírs* named after them; and Chitarkot, a notable place of pilgrimage and boasting a sanctity the date of whose origin is lost in the mythical ages of Hindu legendary lore. But in these years the supply of instruments was very inadequate for the requirements of the Survey Department. Lieutenant Renny applied more than once to the Mathematical Instrument Office in Calcutta for a small theodolite for the execution of the proposed secondary triangulation, but on each occasion his application could not be complied with; and late in the season, when the 7-inch theodolite which was employed in the preliminary site selection became available for the secondary triangulation, the hot winds were setting in and the atmospheric conditions were such as to make observing impossible, otherwise than to luminous signals, which were only sufficiently numerous to be employed in the principal triangulation. Thus the secondary determinations, this season, were almost wholly restricted to such as could be made from the principal stations.

Towards the end of the season the approximate series passed out of the hill tracts into the plains. The cutting of lines to clear the rays between the stations became necessary. This at first aroused much opposition on the part of the villagers, and retarded the progress of the operations until such time as the District Officers were able to interfere. Further inconvenience was caused by the people of the country in digging up and carrying away the mark-stones, about which they appear to have entertained superstitious misgivings.

Lieutenant Renny continued his operations into the middle of June, when sickness broke out among the natives in his camp from constant exposure to the vicissitudes of the climate, the rainy season having now commenced. Earnestly commending his last four stations to the care of the Collector of Banda, he turned his steps towards the recess quarters at Cawnpore, which he reached on the 1st of July.

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Season 1834-35.

PERSONNEL.

Lieut. T. Renny, Bengal Engineers, 1st Assistant.
Mr. R. C. Tulloh, 3rd Class Sub-Assistant.
„ C. Lane, 3rd „ „

During the recess of 1834, Lieutenant Renny received full instructions from the Surveyor General regarding a new system of selecting stations in the plains by, what was called, ray-tracing, which was to be adopted for laying out the triangulation in advance, and which consisted in running a traverse with a small theodolite and perambulator in the required direction, and as nearly as possible in a straight line, as described at page 41 of Vol. II. The operations of the ensuing field season were solely directed to the selection of stations, and no principal triangulation was attempted, as Lieutenant Renny's services were required elsewhere for the greater portion of the field season, in assisting at the measurement of the Dehra Dún Base-Line. Leaving in the Ordnance depôt at Cawnpore his large theodolite and such of his equipment as was required for the principal observations, Lieutenant Renny took the field with his party on the 13th of October. Happily he had at last succeeded in obtaining a second small theodolite, now indispensably necessary for the ray-tracing and other preliminary operations. After fairly starting the work of the field season, he proceeded by dâk to Dehra Dún, where he remained until the end of April, when the measurement of the base-line was completed; he then marched down country to rejoin his party, which he reached early in June, and found still at work on the Gangetic plains between Cawnpore and Lucknow.

The operations had unfortunately been greatly retarded for want of sufficient authority from the Government to support the surveyors in the necessary operations of cutting down all trees and removing all obstacles on the lines between the principal stations. Hitherto the District Officers had generally been ready to aid the surveyors by giving the requisite instructions to the local native officials to co-operate to such extent as might be necessary, and more particularly to assist the surveyors in ascertaining the owners of the removed trees and other obstacles and in estimating the proper amount of compensation to be paid them. But the Collector of Cawnpore, considering that the aid required of him far exceeded his powers to grant, referred the matter to the Commissioner of the Division, by whom it was forwarded for orders to the Secretary to Government in the Judicial Department. The reply was such as to paralyze, for a time, all vigorous prosecution of survey work. The Vice President in Council ruled that "The Officers in charge of the Trigonometrical Survey are not authorized "to remove trees or other property without the sanction of the owners previously obtained, "and it will rest with those officers to offer such remuneration as will induce the owners to "comply with their wishes." Now in order that the principal triangulation might be advanced at a fairly rapid rate, it was necessary to lay out and complete at least ten new triangles in the course of each field season; the sides of the triangles being of an average length of 14 miles, the clearing of at least twenty perfectly straight 14-mile lines was essentially necessary, and it was generally desirable that this work should be completed during the first half of the field season, so as to allow of the final observations being taken during the remainder of the season. To have raised the tower stations sufficiently high to overlook all intermediate obstacles would—as previous experience had shown—have much retarded, and increased the cost of the operations. Thus line clearing was absolutely necessary; but obviously a number of perfectly straight lines—of an aggregate length of, say, 280 miles—could not be

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cleared without cutting down a considerable number of trees, more or less valuable; and if this might not be done without obtaining the sanction of the owners in every instance, the operations would be liable to be so enormously retarded, that they would have to be abandoned. The Surveyor General pointed out these facts to the Government, and prayed for the immediate issue of such orders as would effectually remove the evil. It was then ruled that "the "*Tehsíldár* or *Peshkár* or other native officials of the district, should invariably accompany "the surveyors, on the grounds that their presence will no doubt, from their superior knowledge "of the inhabitants and of the value of the property, greatly facilitate and expedite agreements "for permission to remove such trees as may interrupt the operations of the survey." This arrangement had the desired effect, by investing the operations of the surveyors with sufficient authority to silence all further opposition.

By the operations of the present season, the Series stood practically laid out to a little beyond the parallel of 27° in N. lat., having been carried through that portion of Oudh which lies south of the river Gumti. Some delay had occurred in obtaining the requisite authority to carry the operations into the Oudh territory; but the most serious obstacle to progress was the action of the Collector of Cawnpore as already described; thus the out-turn of work was less than Lieutenant Renny had expected his two assistants to accomplish in his absence. Stations were selected over a direct meridional distance of 120 miles, involving the execution of over 250 miles of ray-tracing by the route-survey method.

Season 1835-36.

PERSONNEL.

Lieut. T. Renny, Bengal Engineers, 1st Assistant.
Mr. C. Lane, 2nd Class Sub-Assistant.

Before the recess of 1835, Mr. Tulloh resigned his appointment in the Survey Department. No other assistant was available to take his place until towards the close of the following field season. Lieutenant Renny took the field earlier than usual in order to make up as well as he could both for the backwardness in the state of the ray-clearing and for the diminished strength of his party. He took care also to pave the way for an uninterrupted prosecution of the work in prospect by sending copies of the recent orders of Government, on the subject of cutting trees, to the several Civil officials. His progress was accordingly uninterrupted; but the want of a second assistant was much felt, now that all opposition was at an end and the operations could be carried on with vigour. Lieutenant Renny brought several old mud forts into use, by repairing and raising their bastions so as to convert them into principal stations, in doing which he was always careful to fix the lower centre mark in a solid portion of the original structure. Further, as regards the question of the advantages of lofty and expensive towers without line cutting, relatively to low and cheap towers with line cutting—which was still a moot point—Lieutenant Renny found that he could construct towers of earthwork and sundried bricks set in mud, 25 feet high, 16 feet square above and proportionately larger below, with mark-stones at intervals from the basement to the upper surface, at a cost not exceeding Rs. 3 for each foot of height, that is to say for less than Rs. 100 for the highest tower that it was found necessary to erect*. The average cost of clearing the lines between the stations was also found not to exceed Rs. 100, including the

* For details regarding the construction of these towers, see note on page 13 of Part I of Volume VII.

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payment of compensation to the owners of the trees felled on the lines*. Thus the cost of each new tower station and of clearing the two rays leading to it did not exceed Rs. 300; whereas a tower sufficiently high to overlook all obstacles on the lines must have been built of the best masonry, and would probably have cost not less than Rs. 2,000; and the time occupied in its construction would have much exceeded what was required for building the simpler structures designed by Lieutenant Renny, and for clearing the rays between them.

Lieutenant Renny cleared the rays up to the side Barauli–Nimkár (XXV–XXVI), and then proceeded with the selection of the stations remaining to complete the Series up to the northern confines of the Oudh territory. And as permission to enter Nepal was withheld by the Government of India, of whom it had been solicited, the selection of stations was brought to a close at the side Rámuápur–Rámnagar (XXII–XXIV) of the North-East Longitudinal Series. During the latter end of April, the party was strengthened by the arrival of Mr. C. Murphy, 2nd Class Sub-Assistant, transferred from the operations on the northern section of the Great Arc, too late however to be of much help during the present field season. Writing from Cawnpore on 3rd June, Lieutenant Renny reported that he had continued clearing the rays between the stations, as long as the atmosphere was sufficiently clear to enable him to see the blue-lights which were burnt at the forward stations, to indicate their position; these blue-lights, when burnt on lofty poles, were usually visible over all intermediate trees and obstacles at the back stations, more particularly if observed at midnight, when very considerable refraction is generally prevalent; their employment thus frequently enabled the required direction of a ray to be exactly determined, without any other procedure; but as this method of operation was not always to be relied on, and depended for its success very much on the condition of the atmosphere, it was eventually superseded by ray-trace triangulations—described at page 42 of Volume II—which, though sometimes more laborious, were always feasible and certain in their results. Lieutenant Renny's subsequent operations, after finding further ray-clearing impossible, are quoted as follows from his report to the Surveyor General. "I conducted a route-survey for the selection of points for prin-"cipal stations up to the Nepal Hills. At this period, being the middle of last month, fever "and other complaints prevalent in the Tarái broke out in my camp, and before I had "returned to Sitapur both my Sub-Assistants were dangerously ill, and a great portion of my "establishment laid up. As the dimness of the atmosphere at this season would have pre-"vented me doing any more work until the commencement of the rains, and to detain my "establishment in camp would only have been exposing them to relapses, I proceeded here "as soon as my party was sufficiently convalescent to travel, and am happy in being able to "state that my Sub-Assistants are now out of danger, and the Native establishment daily "acquiring strength."

The operations of the season enabled Lieutenant Renny to construct two general maps of the country in which the operations had been carried on, compiled from information acquired in the course of the route-survey ray-traces between the principal stations.

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* The compensation paid for trees felled on sixteen rays in the Oudh territory was under Rs. 70 per ray on the average: the amount of this award was fixed by an official of His Highness the King of Oudh who had been specially deputed to accompany the party.

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Season 1836-37.
PERSONNEL.
Lieut. T. Renny, Bengal Engineers, 1st Assistant.
Mr. C. Murphy, 2nd Class Sub-Assistant.
„ C. Lane, „ „

The party resumed field operations on the 1st October, Lieutenant Renny commencing operations by taking observations at the station of Jájmau (XVIII) which was only 4 miles distant from his recess quarters at Cawnpore, to the three stations, XVI, XVII and XIX, at which towers had already been built. He proceeded thence to Máwa (XVI), where he found it necessary to give an addition of 6 feet to the height of the tower; observing there both by day and night*, he was able by the 17th of the month to complete all the observations, horizontal as well as vertical. The next points visited were the hill stations of Sihonda and Pavia (IX and X) which form the side of continuation of the triangulation completed in the first field season; the single angle remaining to be observed at Sihonda (IX) was completed; at Pavia (X) the angle between Sihonda (IX) and Paprendi (XI) was partially observed, the remaining angle being wholly unobserved because the signal at the tower station at Músapur (XII) was invisible. The observation of the principal angles was then discontinued, as the sides of the triangles were of so great a length for operations in the plains that it appears to have been considered hopeless to attempt to measure them until the season of clear atmosphere which occurs during and shortly after the monsoons.

Having deposited in store at Cawnpore his large theodolite and such other portions of the materiel as he would not need, Lieutenant Renny devoted the remainder of the season to clearing rays, building new towers and raising the old ones wherever necessary. About 270 miles of rays were cleared, carrying this portion of the work up to the extreme northern limit of the Series; the heights of the towers at XXI, XXIV and XXV were increased 15 feet, 30 feet towers were erected at stations XXVI, XXVIII and XXIX, and one of 28—subsequently increased to 35—feet at XXVII.

Season 1837-38.
PERSONNEL.
Lieut. T. Renny, Bengal Engineers, 1st Assistant.
Mr. C. Murphy, 1st Class Sub-Assistant.
„ C. Lane, 1st „ „

The services of Lieutenant Renny were lost to the party until the 1st of March 1838, being required at the measurement of the Sironj Base-Line. Mr. Murphy accordingly took charge at the commencement of the field season, under the general direction of Lieutenant Renny, and proceeded on the 5th October towards Pavia (X) distant about 70 miles from Cawnpore where the recess quarters were established. On his march thither, he ascertained that the mark at Jahánabad station (XV), on the roof of a paka building, had been removed, and that the owners of the building would not allow it to be replaced. This difficulty was however got over with the assistance of the Magistrate of Fatehpur without retarding the progress of the work. Mr. Murphy arrived at Pavia (X) on the 14th October; and by the 20th he was able to complete all observations of horizontal angles which he believed to be necessary; the vertical angles were not observed as the signals were only visible during the night when refracted very considerably and very irregularly, so that the observations would be worthless unless reciprocated by others taken at the same time at the station under observation. The horizontal angles at Paprendi (XI) were then undertaken and completed; afterwards those at Kánákhera

* The night signals used were either vase-lights or blue-lights, the latter having superseded the former, to be in turn superseded a few years afterwards by powerful lamps with parabolic reflectors.

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(XIII) which were all but completed. Mr. Murphy next proceeded to Músapur (XII), where he completed all the horizontal angles in three days, and measured reciprocal verticals with Mr. Lane at Pavia (x), who employed a 7-inch theodolite; these simultaneous verticals were observed on the 4th November to blue-lights, burnt an hour after sunset. Mr. Murphy reached Jáfrabad (XIV) on the 7th November, and by the 11th the three horizontal angles as well as simultaneous verticals on the ray to Músapur (XII) (observed to heliotropes *an hour before sunset*) were measured. The station of Jahánabad (XV) was reached on the 17th: by the 20th the horizontal angles were all disposed of; here simultaneous verticals were observed to lamps on the ray to Jáfrabad (XIV), but though the observations extended over an interval of nearly 2½ hours beginning at an hour after sunset, the results of the means of the measures differed so considerably *inter se* that they were rejected and reserved for future re-measurement. Mr. Murphy remained at Jahánabad while Mr. Lane was marching to Dewarsán (XVII) for simultaneous verticals; they were taken on the 24th at the time of minimum refraction. Mr. Lane proceeded the same day to Jájmau (XVIII), while Mr. Murphy advanced to Dewarsán (XVII), and succeeded on that and the following night in completing the two horizontal angles at this station as well as in taking simultaneous verticals on the ray to Jájmau (XVIII) with Mr. Lane. On the completion of the observations at Dewarsán (XVII) Mr. Murphy fell ill, and had to proceed to Cawnpore for three weeks, at the end of which he returned to find that the favorable season for observing had ended. Crossing the Ganges into Oudh he resumed work on the 21st December at the station of Rau (XX), where he also took observations for fixing Christ's Church Cawnpore, which was then being built. He waited there five days without being able to obtain complete measures of even a single horizontal angle, though he succeeded in taking simultaneous verticals with Mr. Lane on the ray to Jájmau (XVIII). He then recrossed the river and proceeded to Namána (XIX) on the right flank of the Series. The winter rains had now set in, and the conditions of the atmosphere became so unfavorable that though he remained at that station from the 4th to the 28th of January, and worked whenever possible both by day and night, he could only obtain complete observations of two of the three horizontal angles; such few measures as were taken of the third angle were rejected and re-observed later on in the season. Pushing on to Jhalotar (XXI) the horizontal angles occupied him from the 3rd to the 14th of February; and thence returning to Rau (XX)—the observations at which had been left unfinished nearly two months before—he finished the work there by the 19th of February. He then proceeded to Etora (XXIII) where the horizontal observations occupied him from the 24th February to the 3rd March; after this he went to Bakseria (XXII) where by the 8th of the month he had completed the three horizontal angles as well as simultaneous verticals with Mr. Lane on the ray to Rau (XX). At this time Lieutenant Renny returned from the Sironj Base-Line and resumed the direct charge of the operations, examining the work performed by Mr. Murphy, affording him incidental aid in the measurement of the angles at Bakseria (XXII), and accompanying him to his next station Asu (XXIV); there the three horizontal angles as well as the simultaneous verticals on the ray to Bakseria (XXII) were measured between the 10th and 14th of March.

An examination of Mr. Murphy's work brought to light the circumstance that certain of his angles were deficient in respect to the number of zeros on which the measurements

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had been taken. Lieutenant Renny reported that otherwise his arrangements for conducting the details of the work both expeditiously and economically appeared to have been very good. That no loss of time might be incurred in returning to observe such zeros of his angles as were deficient, Mr. Murphy volunteered to undertake the work during the ensuing rains, at a season of the year not usually devoted to field operations. Mr. Lane's share of the work was also favorably commented on by Lieutenant Renny.

On leaving Asu (XXIV), the party proceeded successively to Barauli (XXV) and Fatehnagar (XXVII), and by the end of March the three horizontal angles at each of these stations were disposed of.

Lieutenant Renny had meanwhile been apprized by the Surveyor General that his services would shortly be needed in carrying on the triangulation of the Great Arc to the south of Sironj; he was directed to proceed to Head Quarters as soon as his presence could be dispensed with on the Amua Series. He was anxious before leaving the party to establish some sort of check on the work that had been already executed; and for this purpose he determined to measure an azimuth of verification at the station of Nimkár (XXVI). He arrived there on the 2nd of April; and by the 16th of the month he completed the azimuthal observations and the measurement of two of the three horizontal angles at that station. The reduction of the azimuthal observations, and various necessary arrangements for the future conduct of the work, occupied Lieutenant Renny till the 1st of May, when he proceeded to Dehra Dún, marching *viâ* Bareilly and Hardwár.

Mr. Murphy, now again left to his own resources, resolved to finish at once the insufficiently measured angles to the south in preference to continuing his progress northwards; for he considered that a severe rainy season might possibly set in, and, by forcing him into recess quarters, prevent him from bridging over the gap that then existed in the work. He accordingly retraced his steps to Namána (XIX), where a few months previously he had spent several weeks without the weather admitting of his completing the measures of more than two of the three angles; the third angle was now measured in the course of two days. The party then moved southwards to Pavia (X), where all that remained to be done was the completion of a single angle—between IX and XI—by measures on two zeros: this was effected on the 14th June; and by the 23rd of the same month, the deficiencies in the angles at XI and XIII were also made good. Thus, the Series stood complete up to the side (XXVI)-(XXVII), with the exception of the angle at XXVI (Nimkár) between XXIV and XXV. In addition to the tower-building already indicated, seven new tower stations, each 24 feet high, had been constructed at the northern end of the Series, thereby completing this troublesome portion of the operations.

Season 1838-39.

PERSONNEL.

Lieut. T. Renny, Bengal Engineers, 1st Assistant.
Mr. C. Murphy, 1st Class Sub-Assistant.
„ C. Lane, 1st „ „

During the field season of 1838-39 Lieutenant Renny merely exercised a general supervision over the operations without taking any personal share in them, as he was engaged on the measurement of the principal angles of the section of the Great Arc, to the south of Sironj, between the parallels of 18° and 24°.

The programme for this season's operations was as follows:—to measure the horizontal angles at nine principal stations to complete the Series; to observe an azimuth at Rámuápur,

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the most northerly station on the Amua meridian, which was subsequently allotted to the North-East Longitudinal Series; and lastly, to take simultaneous vertical angles over a distance of nearly 200 miles in the length of the Series, so as to form a continuous chain of relative heights of which only seven links stood supplied by the observations of the previous season. With favorable weather all this might be completed in one field season.

Mr. Murphy moved into camp on the 15th October; and, having crossed the Ganges into Oudh, he proceeded to his first station, Nimkár (XXVI), where the angle between XXIV and XXV was duly observed on the 21st idem. The party proceeded thence in succession to the several northern stations, the horizontal angles at which were all disposed of by the 9th of December. The prescribed azimuth was then undertaken by observations to δ Ursæ Minoris at both elongations. By the end of the month the whole of the programme of work was completed, with the exception of the vertical observations. Mr. Lane had fallen ill at the commencement of the field season, and been unable to render any assistance, in consequence of which Mr. Murphy had engaged the temporary services of Mr. C. D. Campbell, a young candidate for employment in the Survey Department. A collision occurred between the men of the native establishment and a large body of armed men in Oudh—who were said to be desperate freebooters, and inhabited a small fort of their own in a jungle on the banks of the Gumti in the vicinity of the survey operations—which might have been attended with much loss of life had not Mr. Murphy been at hand to interpose and protect his people. But otherwise the operations in Oudh seem to have met with no opposition.

The vertical angles, whose measurement was the one thing remaining to complete the Series, were observed simultaneously at the opposite extremities of the rays, by Mr. Murphy at one end with Troughton and Simms' 18-inch theodolite No. 1—with which the whole of the horizontal angles of this Series were measured—and at the other end by either Mr. Lane or Mr. Campbell with a 7-inch theodolite. These operations were carried, under instruction, over the diagonal sides only of the Series, zigzagging from flank to flank, so as to fix every station in turn, but without giving check determinations on the flank sides as well, as that would have doubled the amount of work to be performed. The field operations were concluded on the 2nd of April. The party then proceeded *viâ* Cawnpore to the Surveyor General's Head Quarters at Dehra Dún.

On the completion of the Simultaneous Reduction of the North-East Quadrilateral, it was found that the errors which had actually been dispersed over the Amua Series, between its origin Amua-Lakanpura and terminus Dahlelnagar-Kokra, were as follows:—

In Logarithm of the latter side		+ 0·000,0043,8 = 0·6 inches per mile nearly.
„ Azimuth	„	− 1″·286
„ Latitude	of Dahlelnagar	+ 0 ·077
„ Longitude	„	− 0 ·173

The trigonometrical heights were checked at several points in subsequent years by connection with the Spirit Leveling Operations in the Trigonometrical and Revenue branches

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of the Survey, see page 38 [of Vol. VII]. The sections into which the Series has thus been divided exhibit the following errors:—in the southern section ending at XVIII, the maximum discordance was found to be + 7 feet; in the next, ending at the side XXVIII–XXIX, it was — 14 feet; and in the last section, it was + 4 feet. The errors were dispersed in the manner indicated at pages 38 and 39 of Part I of Volume VII.

Secondary Triangulation.

It will be seen on reference to the chart of this Series that little secondary triangulation was done in connection with the principal operations, excepting what was accomplished from the hill stations at the southern end of the Series. More could not have been done in the plains excepting by carrying chains of minor triangles for which neither the requisite agency nor instrumental equipment were at the time forthcoming. The positions of Sháhjahánpur and other secondary points, near the northern end of the Series, were fixed in the year 1849-50 by Mr. J. O. N. James, in connection with the operations of the North-East Longitudinal Series; it has been found convenient to exhibit the results with those of this Series; they will therefore be found in the Synoptical Volume for this Series.

Compiled, with Addenda by the Surveyor General, by

C. WOOD.

Surveyor 2nd Grade.

DEHRA DÚN:
November 1881.

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AMUA MERIDIONAL SERIES.

ALPHABETICAL LIST OF STATIONS.

Amúa (of Calcutta Longitudinal Series).	XVII.
Asu	XXIV.
Bakseria	XXII.
Baraoli	XXV.
Bulandpúr	XXXI.
Dágri	V.
Dahlelnagar (of North-East Longitudinal Series).	XXV.
Daráwal	XXVIII.
Dewarsán	XVII.
Dharkána	IV.
Etora	XXIII.
Fatenagar	XXVII.
Jafrábád	XIV.
Jájmáo	XVIII.
Jalhotr	XXI.
Jarúra	XXXII.
Jehánábád	XV.
Kánákhera	XIII.
Kartár	VII.
Kokra (of North-East Longitudinal Series).	XXIII.
Lakanpúra (of Calcutta Longitudinal Series).	XIX.
Maihar	I.
Marfa	VIII.
Máwa	XVI.
Músápúr	XII.
Namána	XIX.
Nimkár	XXVI.
Paprendi	XI.
Parser	XXX.
Patra	II.
Pavia	X.
Potenda	III.
Ráo	XX.
Sárang	VI.
Seonda	IX.
Sirwaia	XXIX.

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AMUA MERIDIONAL SERIES.

NUMERICAL LIST OF STATIONS.

XVII	Amúa. (of Calcutta Longitudinal Series).
XIX	Lakanpúra. (of Calcutta Longitudinal Series).
I	Maihar.
II	Patra.
III	Potenda.
IV	Dharkána.
V	Dágri.
VI	Sárang.
VII	Kartár.
VIII	Marfa.
IX	Seonda.
X	Pavia.
XI	Paprendi.
XII	Músápúr.
XIII	Kánákhera.
XIV	Jafrábád.
XV	Jehánábád.
XVI	Máwa.
XVII	Dewarsán.
XVIII	Jájmáo.
XIX	Namána.
XX	Ráo.
XXI	Jalhotr.
XXII	Bakseria.
XXIII	Etora.
XXIV	Asu.
XXV	Baraoli.
XXVI	Nimkár.
XXVII	Fatenagar.
XXVIII	Daráwal.
XXIX	Sirwaia.
XXX	Parser.
XXXI	Bulandpúr.
XXXII	Jarúra.
XXIII	Kokra. (of North-East Longitudinal Series).
XXV	Dahlelnagar. (of North-East Longitudinal Series).

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AMUA MERIDIONAL SERIES.

DESCRIPTION OF STATIONS.

XVII.—*(Of Calcutta Longitudinal Series).* Amúa Hill Station, lat. 24° 0′, long. 80° 32′, is situated in the Maihar district, and stands on the southernmost extremity of the Kaimúr range, immediately to the E. of the village of Amúa. The encamping ground of Siwaganj, on the high road from Mirzapore to Jubbulpore, is distant about 3 miles to the N.

The station is marked by the centre of a circle engraved on a stone which is fixed on the surface of a platform, and placed perpendicularly over a similar stone at the base. The same point was used on the original as well as revised triangulation of the Calcutta Longitudinal Series.

XIX.—*(Of Calcutta Longitudinal Series).* Lakanpúra Hill Station, lat. 24° 3′, long. 80° 50′, is situated in the Maihar district, and stands on a peak of a small range of hills, at a distance of about 1½ miles to the N. of the small village of Lakna or Lakanpúra.

The station is marked by the centre of a circle engraved on a stone which is fixed on the surface of a platform, 2 feet 4½ inches perpendicularly over the mark which was used on the original triangulation of the Calcutta Longitudinal Series. It was found in good preservation when visited in April, 1865, in the course of the revision of the Calcutta Longitudinal Series.

I. Maihar Hill Station, lat. 24° 17′, long. 80° 46′, is situated in the Maihar district, and stands on the eastern extremity of the Bírapáhár, at a distance of about 1¼ miles to the N.W. of the town of Maihar.

The station is marked by the centre of a circle engraved on a stone which is fixed in the middle of a platform about 2 feet high.

II. Patra Hill Station, lat. 24° 17′, long. 81° 11′, is situated in the Rewah district, and stands on the Kaimúr range, about 2 miles E. of the small village of Patra, and 10 miles S.E. of Amarpatan.

The station is marked by the centre of a circle engraved on a stone which is fixed in the middle of a platform, 2 feet perpendicularly above a similar mark engraved on the rock *in situ*.

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III. Potenda Platform Station, lat. 24° 37′, long. 81° 0′, is situated in the Rewah district, and stands on an open plain, about ¾ of a mile from the village of Potenda, and 6 miles E. of Mádhogarh.

The station is marked by the centre of a circle engraved on a stone which is fixed in the middle of a platform, 2 feet perpendicularly above a similar mark engraved on the rock *in situ*.

IV. Dharkána Hill Station, lat. 24° 28′, long. 80° 36′, is situated in the Nagode district, and stands on a detached hill of that name, about 3 miles S. of the small village of Chúnba, and 8 miles from the station of Nagode.

The station is marked by the centre of a circle engraved on a stone which is fixed in the middle of a platform, 1½ feet perpendicularly above a similar mark engraved on the rock *in situ*.

V. Dágri Hill Station, lat. 24° 51′, long. 80° 44′, is situated in the Nagode district, and stands on the south face of the Bindráchal range, distant about 8 miles to the N. of Koti, and immediately above the small village of Dágri.

The station is marked by the centre of a circle engraved on a stone which is fixed in the middle of a platform, about 6½ feet perpendicularly above a similar stone well imbedded in the ground.

VI. Sárang Hill Station, lat. 24° 46′, long. 80° 24′, is situated in the Panna district, and stands on a peak of that name in the Bindráchal range, distant about 3 miles S.W. of Ethwáñ, and 11 miles E. of Panna.

The station is denoted by the centre of a circle engraved on a stone which is fixed in the middle of a platform, about 3 feet perpendicularly above a similar stone flush with the natural surface of the ground.

VII. Kartár Hill Station, lat. 25° 2′, long. 80° 23′, is situated in the Banda district, and stands on a three-peaked isolated hill, close to the high road from Banda to Ságar.

The station is denoted by a dot engraved in the centre of a hole 1½ inches deep cut in the middle of a large boulder about 9 feet square.

VIII. Marfa Hill Station, lat. 25° 7′, long. 80° 44′, is situated in pargana Badaosa of the Banda district, and stands on an isolated hill of that name, on the north face of the Bindráchal range, at a distance of about 10 miles to the W. of Chitarkoti, a place of Hindoo pilgrimage. The hill was formerly fortified, and pretty considerably inhabited, judging from the several large tanks and ruins of buildings which are to be seen.

The station is on the ruins of an old building, and is denoted by the centre of a circle engraved on a stone which is fixed in the middle of a platform, about 5 feet perpendicularly above a similar mark at the level of the ground.

IX. Seonda Hill Station, lat. 25° 18′, long. 80° 24′, is situated in pargana Seonda of the Banda district, and stands on the eastern extremity of an isolated wedge-shaped hill immediately above the village of that name.

The station is denoted by the centre of a circle engraved on a long stone sunk to within 3 inches of the urface of a slightly elevated platform.

X. Pavia Hill Station, lat. 25° 27′, long. 80° 47′, is situated in pargana Seonda of the

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Banda district, and stands on a low hill immediately S. of the village of that name. A platform in front of a small temple was used for the station.

The station is denoted by the centre of a circle engraved on a stone which was fixed in the middle of the platform and about 6½ feet perpendicularly above a similar stone imbedded below. The station subsequently required an additional elevation, and an earthen platform 11 feet in height was erected.

XI. Paprendi Tower Station, lat. 25° 38′, long. 80° 27′, is situated in pargana Pailáni of the Banda district, and stands on the centre tower on the east face of the mud fort of Paprendi.

The tower was first repaired, and heightened about 10 feet. This station is full 50 feet above the level of the surrounding country.

XII. Músápúr Tower Station, lat. 25° 47′, long. 80° 41′, is situated in pargana Gházípúr of the Fatepúr district, and stands on a mound, elevated about 20 feet above the level of the surrounding country, and lying to the south of the small village of Músápúr.

An earthen platform 23 feet high has been constructed at this station.

XIII. Kánákhera Tower Station, lat. 25° 51′, long. 80° 28′, is situated in pargana Pailáni of the Banda district, and stands on a solid building in the S.E. corner of a fort attached to the village of Kánákhera.

The building was repaired, and heightened about 12 feet, giving it an elevation of full 40 feet above the level of the surrounding country.

XIV. Jafrábád Tower Station, lat. 26° 1′, long. 80° 38′, is situated in pargana Bindki and district Fatepúr, and stands on the N.E. tower of the mud fort adjoining the village of Jafrábád.

The tower was repaired, and heightened 17 feet, and the station is full 40 feet above the level of the surrounding country.

XV. Jehánábád Tower Station, lat. 26° 6′, long. 80° 24′, is situated in pargana Kora and district Fatepúr, and stands on the eastern of two small buildings raised about 9 feet above the roof of a house within a garden, at the S.E. extremity of the town of Jehánábád.

The station is full 40 feet above the level of the surrounding country.

XVI. Máwa Tower Station, lat. 26° 16′, long. 80° 34′, is situated in pargana Sarh Salempúr of the Cawnpore district, and stands on a mound, about 20 feet in height, situated to the N. of the village of Máwa.

An earthen platform 24 feet high has been constructed at this station.

XVII. Dewarsán Tower Station, lat. 26° 16′, long. 80° 21′, is situated in pargana Sarh Salempúr of the Cawnpore district, and stands on the N.W. tower of the inner line of the mud fort attached to the village of Dewarsán.

The tower has an elevation of upwards of 25 feet above the surrounding country, and the station is raised an additional 7 feet.

XVIII. Jájmáo Tower Station, lat. 26° 26′, long. 80° 27′, is situated in pargana Jájmáo

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of the Cawnpore district, and stands on the eastern extremity of the high ground overlooking the Ganges, where formerly stood the fort attached to the village of J.jmáo.

The station is on an earthen platform raised about 8 feet in height.

XIX. Namána Tower Station, lat. 26° 28′, long. 80° 39′, is situated in the Harha district, and stands on a mound, 25 feet high, distant about ⅓ of a mile to the S. of the village of Namána.

The station is on a earthen platform 18 feet in height.

XX. Ráo Tower Station, lat. 26° 39′, long. 80° 30′, is situated in the Rasúlábád district, and stands on a mound, 25 feet high, distant ⅓ of a mile N.W. of the village of Ráo.

The station is on an earthen platform 16½ feet in height.

XXI. Jalhotr Tower Station, lat. 26° 42′, long. 80° 41′, is situated in the Rasúlábád district, and stands on the S.W. tower of the fort attached to the village of Jalhotr.

The tower is about 20 feet high, and an additional elevation of 15 feet was obtained by the erection of an earthen platform.

XXII. Bakseria Tower Station, lat. 26° 51′, long. 80° 32′, is situated in the Lassípúr district, and stands on the ruins of an old fort ¼ of a mile S. of the small village of Bakseria.

An earthen platform 15 feet in height has been erected, which gives an elevation of about 40 feet above the surrounding country.

XXIII. Etora Tower Station, lat. 26° 54′, long. 80° 42′, is situated in the Sandaila district, and stands on a mound, about 15 feet in height, distant ⅓ of a mile W. of the village of Etora.

An earthen platform 18 feet high has been constructed.

XXIV. Asu Tower Station, lat. 27° 5′, long. 80° 31′, is situated in the Sandaila district, and stands on a mound, 25 feet in height, close to the village of Asu, and distant 2 miles N. of the town of Sandaila.

A platform 30 feet high has been constructed.

XXV. Baraoli Tower Station, lat. 27° 8′, long. 80° 43′, is situated in the Sandaila district, and stands on a mound, 20 feet in height, adjoining the village of Baraoli.

A platform of sun-dried bricks and mud cement 30 feet high has been erected.

XXVI. Nimkár Tower Station, lat. 27° 21′, long. 80° 32′, is situated in the Khairábád district, and stands on a mound, 15 feet high, distant ¼ of a mile N.W. of the town of Nimkár, and ½ a mile N. of the Gúmti river.

A platform of paka bricks and mud cement 30 feet high has been erected.

XXVII. Fatenagar Tower Station, lat. 27° 24′, long. 80° 43′, is situated in the Khairábád

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district, and stands on an open plain 2½ miles S.E. of the large town of Macherhata, and ¾ of a mile S.E. of the village of Bulandpúr.

A platform of sun-dried bricks and mud cement 35 feet high has been erected.

XXVIII. Daráwal Tower Station, lat. 27° 34′, long. 80° 31′, is situated in the Khairábád district, and stands on a mound, about 20 feet high, distant ⅛ of a mile N.E. of the village of Daráwal.

A tower of sun-dried bricks and mud cement 30 feet high has been erected.

XXIX. Sirwaia Tower Station, lat. 27° 38′, long. 80° 41′, is situated in the Khairábád district, and stands on the highest point of a mound on which, to the N.E. of the station, extends the village of Sirwaia.

A tower of sun-dried bricks and mud cement 30 feet high has been erected.

XXX. Parser Tower Station, lat. 27° 46′, long. 80° 32′, is situated in the Mahamdi district, and stands on a low mound, close to a large tank, distant about ½ a mile to the S.W. of the village of Parser.

A tower of sun-dried bricks and mud cement 24 feet high has been erected here.

XXXI. Bulandpúr Tower Station, lat. 27° 51′, long. 80° 43′, is situated in the Khairábád district, and stands within a small dilapidated mud fort, lying to the S. of the village of Bulandpúr.

A tower of sun-dried bricks and mud cement 24 feet high has been erected here.

XXXII. Jarúra Tower Station, lat. 28° 0′, long. 80° 31′, is situated in the Mahamdi district, and stands within a small dilapidated mud fort, to the west of, and hard by, the village of Jarúra.

A tower of sun-dried bricks and mud cement 28 feet high has been erected here.

XXIII.—*(Of the North-East Longitudinal Series).* Kokra Tower Station, lat. 28° 12′, long. 80° 31′, is situated in tehsíl Haidarábád of the Mahamdi district, and stands on flat ground on the verge of an extensive jungle. The village of Kokra is distant about 1½ miles to the S.W.

The station was constructed in 1833 for the triangulation of the Amúa Meridional Series, as a tower of sun-dried bricks and mud cement, 25 feet in height, with two mark-stones, one 2 feet below the level of the ground, the other at the surface of the tower. The upper mark was found wanting, and the tower in a dilapidated condition when the station was visited in 1843, in the course of the triangulation of the Pilibhít Terai Series. The old structure was then dismantled to the level of the lower mark, and a new tower 26 feet high constructed, with an isolated central paka pillar which contained mark-stones at distances of 2, 6, 12, 18, 24, 27, and 28 feet, respectively, above the lowest mark-stone. When the station was subsequently visited in 1850, in the course of the North-East Longitudinal Series, the upper portion of the pillar and tower were found to have been destroyed. The structure was again dismantled to within 10 feet of the surface of the ground, and a mark-stone having been found there, it was used as a centre over which a new pillar, with an earthen tower around it, was constructed to the height of 26 feet above the level of the ground, which carried a mark-stone at its surface placed in the normal of the lower mark.

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XXV.—*(Of the North-East Longitudinal Series).* Dahlelnagar Tower Station, lat. 28° 4′, long. 80° 41′, is situated in tehsíl Alíganj of the Mahamdi district, and occupies the highest part of the mound on which the village of Dahlelnagar stands.

A tower of sun-dried bricks and mud cement, 28 feet high, was erected here. It was found in good preservation when the station was visited in 1850, in the course of the triangulation of the North-East Longitudinal Series.

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AMUA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. ADDENDUM TO DESCRIPTION OF STATIONS.

NOTE.—Consequent on modern alterations of district and other boundaries, the sites occupied by the stations are in some instances now included in civil divisions of territory which differ from the district, pargana, or village, recorded in the preceding descriptions of stations: a complete list of all the stations of the Series including a suitably modified statement of the altered sub-divisions in question is accordingly given in the following table, and is derived chiefly from the annual reports, up to 1881, made by the Civil Officials to whose care the stations have been committed. The statement also gives additional information as to position, construction, and present condition of certain of the stations; where no entry regarding present condition is made against a station it is to be assumed that the station when last reported on by the district Official was in good order.

The spelling of names is in accordance with that given in the lists of more important places published under the orders of Government whenever such names occur in the lists.

No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
XVII	Amua	Baghelkhand Agency	Maihar State	Amua	... ...	... ...
XIX	Lakhanpura	Jubbulpore	Thá. Bijerághogarh, Tah. Murwára	Lakhanpura	... ...	... ...
I	Maihar	Baghelkhand Agency	Maihar State	Maihar	... ...	... ...
II	Patra	„	Tál. Amarpátan, Rewah State	...	... ...	... ...
III	Potenda	„	Tál. Mádhogarh, Rewah State	Potenda	... ...	Reported in 1874. "The stones of this station thrown away. A new platform was made on the same spot."
IV	Dharkána	„	Nagode State	Chunaha	... ...	... ...
V	Dágri	„	Kothi State	Dágri	... ...	... ...
VI	Sárang Pahár	Bundelkhand Political Agency	P. Panna	Ahargawa	... ...	... ...
VII	Khairar	Bánda	P. Bánda	Khairar	miles Kartal N.N.E. ½ Khora E. 5½	... ...
VIII	Marpha	„	P. Badausa	Kúlhúan	... ...	Reported in 1867. "The platform fell down last year."

NOTE.—Stations XVII and XIX appertain to the Calcutta Longitudinal Series. P. stands for pargana, Tah. for tahsíl, Thá. for thána, and Tál. for táluka.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
IX	Sihonda	Bánda	P. Sihonda Girwan	Sihonda Girwan	Sihonda Girwan S. 1¾ Bahádarpur W. S. W. 3 Gobindpur N. W. 2¾	... ...
X	Pauia	„	P. Augási	Pauia	... ...	... ...
XI	Piprenda	„	P. Pailáni	Piprenda	... ...	Portions of the tower washed down by the rain in 1867, and the upper mark-stone reported as lost in 1870.
XII	Músapur	Fatehpur	Tah. Gházipur, P. Mutaur	Músapur *alias* Deogaon	Mutaur N. by E. 1¼ Simási E. S. E. ¾ Paigambarpur N. W. by N. 2½	The pillar tumbled down during the heavy rains of 1872-73 as reported in 1874.
XIII	Kánákhera	Bánda	Tah. and P. Pailáni	Kánákhera	Narauli N. E. by E. 1½ Rámpur W. by S. 3	Portions of the tower washed down by the rain in 1867, and the upper mark-stone reported as lost in 1870.
XIV	Jáfrabad	Fatehpur	Tah. Kaliánpur, P. Kutia Gunír	Jáfrabad	Bindki N. N. W. 2 Kadjua N. W. by W. 5	A part of the tower fallen down, and no mark-stone found, as reported in 1872.
XV	Jahánabad	„	Tah. and P. Kora	Jahánabad	Kora N. ½ Sháhjahánpur W. N. W. 1 Sakrabad E. by N. 2	... ...
XVI	Mahowa	Cawnpore	P. Salímpur	Mahowa	Sirsol W. 1 Kharauli N. N. E. 1¼ Domanpur E. S. E. 2	Reported in 1872. "The pillar requires to be rebuilt."
XVII	Deor Sandáh	„	Ditto.	Deor Sandáh	Sárh S. E. 3 Simra E. by N. 1¼ Sultánpur N. W. by W. 1	Ditto.
XVIII	Jájmau	„	P. Jájmau	Jájmau	Cawnpore Railway Station W. by N. 4½ Pokarpur W. 1½	... ...
XIX	Newarna	Unao	Tah. Unao, P. Harha, Thá. Achalganj	Newarna	Newarna Rámsahai N. by E. ½ Pareri Kalán E. 3 Korári Kalán W. by N. 4	Reported in 1873. "Only the foundation exists."

NOTE.—P. stands for pargana, Tah. for tahsíl and Thá. for thána.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
XX	Rau Kirna	Unao	Tah., P. and Thá. Unao	Rau	Makhi N. E. 1½ Thána S. 2¾	Reported in 1873. "Only the foundation exists."
XXI	...	...	...	...	... ...	Reported in 1870. "Demolished with the fort (on which it stood) after the Indian Mutiny, and there is no trace of it."
XXII	Garhi Baksar	Unao	Tah. Mohán, P. Asíwan, Thá. Achalganj, Tál. Tikar	Chak Bíreshar	Haidarabad S. by E. 2½ Ajgain N. E. 3	Reported in 1873. "There is nothing remaining of it except a few marks of its former existence."
XXIII	Etora	Lucknow	Tah., P. and Thá. Malihabad, Tál. Sailamau	Etora	Bakhtiárnagar E. by S. 3½ Mirzaganj E. N. E. 3½ Biárigaon W. S. W. 3¼	Platform washed away by rain as reported in 1875.
XXIV	Asu Sarai	Hardoi	Tah., P. and Thá. Sandíla	Asu Sarai	Sandíla E. by S. 2¼	Reported in 1874 as being 24 feet high.
XXV	Barauli	"	Tah. Sandíla, P. Bálamau, Thá. Kachhona	Barauli	Barwan N. E. 2½ Atrauli N. by W. 2¾	Reported in 1874 as being 22 feet high.
XXVI	...	Sitapur	Tah., P. and Thá. Misrikh, Tál. Aurangabad	Nimkár	Aurangabad E. by S. 4 Beniganj S. W. by S. 4¾	... ...
XXVII	...	"	Tah. Misrikh, P. Machhrehta, Tál. Bariamau, Thá. Sitapur	Bulandapur	Kurauna S. W. by W. 4	... ...
XXVIII	...	"	Tah. Misrikh, Thá. Maholi, Tál. Dundáwal	Dundáwal	Bihat E. by S. 1 Pisáwan W. N. W. 5½	... ...
XXIX	...	"	Tah., P. and Thá. Sitapur, Tál. Halnapur	Sahrohi	Town of Sitapur S. E. by S. 4	... ...
XXX	...	"	Tah. Misrikh, P. and Thá. Maholi, Tál. Baragaon	Parsera	Baragaon S. S. E. 2 Mitauli N. N. W. 3½	... ...
XXXI	Bhulanpur	Kheri	Tah. and Thá. Lakhímpur, P. Basarah, Tál. Raja Oel	...	Basarah N. W. 1½ Oel E. by S. 5	... ...

NOTE.—P. stands for pargana, Tah. for tahsíl, Thá. for tháua and Tál. for táluka.

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No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Villages surrounding the Station	Remarks on the Construction and Condition of the Station
					miles	
XXXII	Jaraura	Kheri	Tah. Muhamdi, P. Haidarabad, Tál. Iláhibaksh Khán, Thá. Gola	...	Alipur S. by W. 2½ Haidarabad N. W. 4½	The station fallen down as reported in 1877.
XXIII	Kokra	„	Tah. Muhamdi, P. Haidarabad	...	Gauri E. by S. 2½ Hardua W. 2 Khamaria S. 1½	The station was constructed in 1833 for the Amua Meridional Series as a tower of sun-dried bricks and mud cement, 25 feet in height, with two mark-stones, one 2 feet below the level of the ground, the other at the surface of the tower. The upper mark-stone was found wanting, and the tower in a dilapidated condition when visited in 1843, in the course of the operations of the Pilibhít Tarái Series. The old structure was then dismantled to the level of the lower mark, and a new tower 26 feet high constructed, with an isolated central paka pillar which contained mark-stones at distances of 2, 6, 12, 18, 24, 27, and 28 feet, respectively, above the lowest mark-stone. When the station was subsequently visited in 1850, in the course of the North-East Longitudinal Series, the upper portion of the pillar and tower were found to have been destroyed. The structure was again dismantled to within 10 feet of the surface of the ground, and a mark-stone having been found there, it was used as a centre over which a new pillar, with an earthen tower around it, was constructed to the height of 26 feet above the level of the ground, which carried a mark-stone at its surface placed in the normal of the lower mark. Pillar partly fallen down as reported in 1871.
XXV	...	Kheri	Tah. Lakhímpur, P. Aliganj	...	Bhúrpur S. W. 1½ Aliganj N. W. 4 Khánpur E. N. E. 1	The central pillar as constructed about the year 1838, was enclosed in a tower of sun-dried bricks and mud cement. It was found in good preservation when visited in 1850 in the course of the operations of the North-East Longitudinal Series. Pillar partly fallen down as reported in 1871.

NOTE.—Stations XXIII and XXV appertain to the North-East Longitudinal Series. P. stands for pargana, Tah. for tahsíl, Thá. for thána, and Tál. for táluka.

August, 1882.

J. B. N. HENNESSEY,
In charge of Computing Office.

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AMUA MERIDIONAL SERIES.

OBSERVED ANGLES.

At XVII

March 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on I												Probabilities and General Means.
	38°	218°	48°	228°	58°	238°	68°	248°	78°	258°	88°	268°	
I & XIX	″ 39·000 2	″ 38·833 2	″ 36·667 2	″ 39·000 2	″ 32·500 2	″ 37·333 2	″ 35·833 2	″ 38·667 2	″ 35·833 2	″ 38·333 2	″ 44·000 2	″ 31·667 2	Probability=0·895 42° 12′ 37″·306

At XIX

February and March 1834, *observed by Lieutenant T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XVII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XVII & I	″ 43·833 2	″ 50·833 2	″ 44·500 2	″ 55·833 2	″ 47·667 2	″ 50·833 2	″ 54·000 2	″ 55·000 2	″ 58·833 2	″ 55·333 2	″ 54·833 2	″ 50·833 2	Probability=1·289 86° 34′ 51″·861

NOTE.—XVII and XIX appertain to Calcutta Longitudinal Series.

At XIX—(Continued.)

February and March* 1834, *observed by Lieutenant T. Renny with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XVII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
I & II	″ 61·833$_2$	″ 46·500$_2$	″ 59·000$_2$	″ 50·167$_2$	″ 58·333$_2$	″ 58·333$_2$	″ 48·500$_2$	″ 50·667$_2$	″ 47·500$_2$	″ 51·000$_2$	″ 44·333$_2$	″ 55·500$_2$	Probability = 1·573 67° 44′ 52″·659

At I

March* 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on IV												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
IV & III	″ 20·833$_2$	″ 25·000$_2$	″ 20·500$_2$	″ 33·833$_2$	″ 14·333$_2$	″ 34·833$_2$	″ 21·333$_2$	″ 32·000$_2$	″ 30·500$_2$	″ 31·833$_2$	″ 24·667$_2$	″ 33·167$_2$	Probability = 1·843 72° 14′ 26″·903
III & II	80·167$_2$	72·833$_2$	81·500$_2$	66·667$_2$	84·000$_2$	59·000$_2$	77·833$_2$	67·333$_2$	71·500$_2$	68·833$_2$	73·833$_2$	67·500$_2$	Probability = 2·016 59° 35′ 12″·583
II & XIX	8·500$_2$	15·667$_2$	6·500$_2$	14·000$_2$	13·667$_2$	21·167$_2$	11·667$_2$	13·667$_2$	8·500$_2$	11·167$_2$	11·333$_2$	8·833$_2$	Probability = 1·099 76° 16′ 12″·056
XIX & XVII	42·333$_2$	37·167$_2$	42·000$_2$	34·500$_2$	35·333$_2$	34·167$_2$	41·833$_2$	40·667$_2$	46·333$_2$	44·833$_2$	47·000$_2$	43·500$_2$	Probability = 1·248 51° 12′ 40″·806

At II

April* 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XIX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	210°	30°	50°	230°	40°	220°	
XIX & I	″ 50·500$_2$	″ 51·000$_2$	″ 48·833$_2$	″ 59·000$_2$	″ 51·167$_2$	″ 58·167$_2$	″ 59·333$_2$	″ 53·500$_2$	″ 58·333$_2$	″ 62·667$_2$	″ 56·167$_2$	″ 57·167$_2$	Probability = 1·205 35° 58′ 55″·486

NOTE.—XVII and XIX appertain to Calcutta Longitudinal Series.

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At II—(Continued.)

April 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XIX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	210°	30°	50°	230°	40°	220°	
	″	″	″	″	″	″	″	″	″	″	″	″	
I & III	$12\cdot167_{2}$	$19\cdot333_{2}$	$18\cdot333_{2}$	$18\cdot333_{2}$	$18\cdot500_{2}$	$22\cdot167_{2}$	$17\cdot167_{2}$	$17\cdot000_{2}$	$24\cdot000_{2}$	$13\cdot000_{2}$	$23\cdot833_{2}$	$3\cdot333_{2}$	Probability = 1·579 61° 58′ 17″·264

At III

April 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on II												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
II & I	$37\cdot111_{2}$	$33\cdot833_{2}$	$34\cdot667_{2}$	$40\cdot667_{2}$	$35\cdot667_{2}$	$43\cdot833_{2}$	$37\cdot667_{2}$	$43\cdot667_{2}$	$37\cdot833_{2}$	$41\cdot333_{2}$	$43\cdot833_{2}$	$44\cdot500_{2}$	Probability = 1·076 58° 26′ 39″·551
I & IV	$21\cdot167_{2}$	$26\cdot833_{2}$	$25\cdot000_{2}$	$26\cdot500_{2}$	$25\cdot667_{2}$	$29\cdot167_{2}$	$27\cdot667_{2}$	$20\cdot667_{2}$	$29\cdot333_{2}$	$24\cdot667_{2}$	$27\cdot500_{2}$	$19\cdot333_{2}$	Probability = 0·914 35° 55′ 25″·292
IV & V	$46\cdot000_{2}$	$38\cdot500_{2}$	$44\cdot833_{2}$	$38\cdot500_{2}$	$36\cdot000_{2}$	$39\cdot167_{2}$	$33\cdot833_{2}$	$40\cdot330_{2}$	$28\cdot000_{2}$	$42\cdot333_{2}$	$31\cdot667_{2}$	$39\cdot500_{2}$	Probability = 1·443 67° 18′ 38″·222

At IV

April 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VI												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & V	$18\cdot500_{2}$	$18\cdot000_{2}$	$14\cdot500_{2}$	$23\cdot667_{2}$	$14\cdot000_{2}$	$22\cdot000_{2}$	$23\cdot667_{2}$	$25\cdot667_{2}$	$20\cdot500_{2}$	$25\cdot167_{2}$	$17\cdot500_{2}$	$25\cdot667_{2}$	Probability = 1·162 50° 0′ 20″·736
V & III	$10\cdot000_{2}$	$18\cdot000_{2}$	$18\cdot167_{2}$	$20\cdot500_{2}$	$20\cdot167_{2}$	$22\cdot333_{2}$	$18\cdot333_{2}$	$14\cdot000_{2}$	$27\cdot167_{2}$	$14\cdot333_{2}$	$27\cdot833_{2}$	$4\cdot833_{2}$	Probability = 1·821 48° 12′ 17″·972

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At IV—(Continued.)

April 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VI												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
III & I	20·333 2	16·500 2	14·167 2	14·667 2	9·833 2	10·333 2	7·833 2	15·667 2	6·167 2	11·667 2	7·167 2	15·333 2	Probability = 1·195 71° 50′ 12″·472

At V

May 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on III												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
III & IV	5·000 2	11·000 2	9·500 2	12·000 2	9·333 2	17·833 2	11·833 2	16·000 2	14·500 2	17·833 2	16·333 2	21·000 2	Probability = 1·253 64° 29′ 13″·514
IV & VI	50·833 2	45·167 2	47·000 2	43·167 2	54·833 2	37·667 2	52·000 2	36·500 2	47·667 2	39·333 2	45·667 2	42·000 2	Probability = 1·584 55° 17′ 45″·153
VI & VII	43·667 2	47·667 2	43·333 2	52·167 2	31·000 2	44·333 2	41·833 2	53·000 2	34·167 2	51·167 2	37·667 2	36·833 2	Probability = 1·980 44° 9′ 43″·070
VII & VIII	19·333 2	13·500 2	21·333 2	20·333 2	27·167 2	23·333 2	23·167 2	15·667 2	32·333 2	11·833 2	26·333 2	18·167 2	Probability = 1·635 63° 6′ 21″·042

At VI

April and May 1834, *observed by Lieutenant T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
VII & V	62·833 2	58·333 2	58·167 2	68·500 2	54·333 2	65·667 2	63·167 2	66·333 2	72·667 2	73·000 2	69·333 2	65·667 2	Probability = 1·601 77° 31′ 4″·833

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At VI—(Continued.)

April and May 1834, *observed by Lieutenant T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
V & IV	″ 70·333 2	″ 61·500 2	″ 68·000 2	″ 60·833 2	″ 69·000 2	″ 63·000 2	″ 63·000 2	″ 63·167 2	″ 55·333 2	″ 54·833 2	″ 55·333 2	″ 66·000 2	Probability = 1·473 74° 42′ 2″·528

At VII

June 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on IX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
IX & VIII	″ 24·333 2	″ 23·667 2	″ 22·667 2	″ 31·667 2	″ 20·167 2	″ 37·667 3	″ 25·667 2	″ 29·667 2	″ 36·167 2	″ 33·500 2	″ 32·833 2	″ 32·833 2	Probability = 1·589 69° 48′ 29″·236
VIII & V	54·667 2	59·167 2	57·833 2	52·667 2	63·833 2	44·222 3	63·000 2	45·167 2	50·167 2	40·667 2	52·833 2	45·000 2	Probability = 2·109 43° 32′ 52″·435
V & VI	21·167 2	10·500 2	13·833 2	24·167 2	9·333 2	22·000 2	9·000 2	24·500 2	10·500 2	22·000 2	16·167 2	15·667 2	Probability = 1·651 58° 19′ 16″·570

At VIII

June 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on V												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
V & VII	″ 43·833 2	″ 49·333 2	″ 49·833 2	″ 56·667 2	″ 33·167 2	″ 54·500 2	″ 50·000 2	″ 54·333 2	″ 54·500 2	″ 60·667 2	″ 51·000 2	″ 51·333 2	Probability = 1·928 73° 20′ 50″·764
VII & IX	30·167 2	32·500 2	26·500 2	20·500 2	38·500 2	24·667 2	35·500 2	18·000 2	32·667 2	15·000 2	26·000 2	29·000 2	Probability = 1·959 46° 31′ 27″·417

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At VIII—(Continued.)

June* 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on V												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40	220°	50	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	
IX & X	$39{\cdot}000_{2}$	$43{\cdot}167_{2}$	$41{\cdot}333_{2}$	$47{\cdot}833_{2}$	$34{\cdot}833_{2}$	$45{\cdot}833_{2}$	$36{\cdot}000_{2}$	$46{\cdot}333_{2}$	$38{\cdot}833_{2}$	$44{\cdot}667_{2}$	$44{\cdot}667_{2}$	$43{\cdot}833_{2}$	Probability = 1·157 64° 32′ 42″·194

At IX

June* 1834, *and November* 1836, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XI												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XI & X	$50{\cdot}167_{2}$	$54{\cdot}333_{2}$	$52{\cdot}917_{2}$	$60{\cdot}583_{2}$	$50{\cdot}000_{2}$	$61{\cdot}833_{2}$	$52{\cdot}500_{2}$	$60{\cdot}583_{2}$	$54{\cdot}167_{2}$	$57{\cdot}417_{2}$	$59{\cdot}667_{2}$	$57{\cdot}500_{2}$	Probability = 1·154 58° 51′ 55″·972
X & VIII	$30{\cdot}667_{2}$	$28{\cdot}833_{2}$	$26{\cdot}500_{2}$	$28{\cdot}500_{2}$	$24{\cdot}333_{2}$	$31{\cdot}000_{2}$	$28{\cdot}667_{2}$	$39{\cdot}167_{2}$	$29{\cdot}333_{2}$	$37{\cdot}167_{2}$	$32{\cdot}667_{2}$	$34{\cdot}333_{2}$	Probability = 1·186 54° 58′ 30″·931
VIII & VII	$71{\cdot}000_{2}$	$75{\cdot}500_{2}$	$81{\cdot}333_{2}$	$70{\cdot}167_{2}$	$76{\cdot}167_{2}$	$69{\cdot}167_{2}$	$79{\cdot}000_{2}$	$58{\cdot}000_{2}$	$77{\cdot}167_{2}$	$67{\cdot}833_{2}$	$69{\cdot}667_{2}$	$69{\cdot}333_{2}$	Probability = 1·730 63° 40′ 12″·028

At X

June* 1834, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on VIII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	
VIII & IX	$40{\cdot}167_{2}$	$44{\cdot}167_{2}$	$43{\cdot}333_{2}$	$47{\cdot}833_{2}$	$39{\cdot}833_{2}$	$54{\cdot}167_{2}$	$47{\cdot}500_{2}$	$53{\cdot}667_{2}$	$47{\cdot}000_{2}$	$53{\cdot}500_{2}$	$50{\cdot}167_{2}$	$51{\cdot}000_{2}$	Probability = 1·391 60° 28′ 47″·695

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At X—(Continued.)

October 1837, *and June* 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on IX												Probabilities and General Means.
	65°	245°	75°	255°	86°	266°	96°	276°	106°	286°	116°	296°	
IX & XI	″ $48{\cdot}167_{2}$	″ $39{\cdot}417_{2}$	″ $40{\cdot}667_{2}$	″ $36{\cdot}167_{2}$	″ $47{\cdot}000_{2}$	″ $29{\cdot}250_{2}$	″ $47{\cdot}667_{2}$	″ $25{\cdot}917_{2}$	″ $31{\cdot}500_{2}$	″ $36{\cdot}667_{2}$	″ $33{\cdot}500_{2}$	″ $41{\cdot}833_{2}$	Probability = 2·027 53° 53′ 38″·146
XI & XII	$39{\cdot}333_{2}$	$61{\cdot}333_{2}$	$43{\cdot}167_{2}$	$48{\cdot}917_{2}$	$40{\cdot}000_{2}$	$56{\cdot}111_{2}$	$46{\cdot}750_{2}$	$53{\cdot}833_{2}$	$47{\cdot}583_{2}$	$54{\cdot}333_{2}$	$52{\cdot}417_{2}$	$52{\cdot}083_{2}$	Probability = 1·837 44° 37′ 49″·655

At XI

October 1837, *and June* 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XIII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XIII & XII	″ $34{\cdot}333_{2}$	″ $45{\cdot}833_{3}$	″ $34{\cdot}459_{4}$	″ $50{\cdot}083_{2}$	″ $32{\cdot}167_{2}$	″ $42{\cdot}917_{2}$	″ $34{\cdot}667_{3}$	″ $49{\cdot}833_{2}$	″ $38{\cdot}267_{5}$	″ $43{\cdot}375_{4}$	″ $37{\cdot}667_{2}$	″ $41{\cdot}000_{2}$	Probability = 1·693 50° 18′ 40″·383
XII & X	$33{\cdot}667_{2}$	$37{\cdot}000_{2}$	$30{\cdot}417_{2}$	$24{\cdot}917_{2}$	$41{\cdot}833_{2}$	$29{\cdot}917_{2}$	$53{\cdot}333_{2}$	$19{\cdot}583_{2}$	$33{\cdot}650_{2}$	$28{\cdot}792_{2}$	$33{\cdot}667_{3}$	$29{\cdot}500_{2}$	Probability = 2·357 64° 53′ 33″·023
X & IX	+60·722 −33·667	56·083 37·000	66·333 30·417	57·944 24·917	63·667 41·833	66·083 29·917	62·667 53·333	59·917 19·583	64·278 33·650	60·008 28·792	62·000 33·667	65·083 29·500	Probability = 2·409
+132° 7′ − 64° 53′	27·055	19·083	35·916	33·027	21·833	36·167	9·333	40·333	30·628	31·208	28·333	35·583	67° 14′ 29″·042

At XII

Novr. 1837, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on X												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
X & XI	″ $35{\cdot}139_{3}$	″ $43{\cdot}083_{2}$	″ $35{\cdot}833_{2}$	″ $44{\cdot}167_{2}$	″ $29{\cdot}500_{2}$	″ $49{\cdot}083_{2}$	″ $36{\cdot}833_{2}$	″ $40{\cdot}833_{2}$	″ $39{\cdot}917_{2}$	″ $41{\cdot}167_{2}$	″ $47{\cdot}083_{2}$	″ $36{\cdot}083_{2}$	Probability = 1·532 70° 28′ 39″·893

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At XII—(Continued.)

Novr. 1837, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on X												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XI & XIII	58·083 (2)	50·083 (2)	60·917 (2)	49·333 (2)	60·417 (2)	46·417 (2)	54·750 (2)	55·333 (2)	51·250 (2)	57·917 (2)	49·917 (2)	55·333 (2)	Probability = 1·301 57° 22′ 54″·146
XIII & XIV	48·583 (2)	54·250 (2)	41·417 (2)	55·833 (2)	36·917 (2)	51·000 (2)	44·750 (2)	51·500 (2)	46·750 (2)	50·583 (2)	51·583 (2)	48·417 (2)	Probability = 1·485 57° 42′ 48″·465

At XIII

October 1837, *and June* 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XV												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XV & XIV	17·833 (2)	30·333 (2)	17·194 (2)	30·000 (2)	16·333 (2)	31·333 (2)	20·333 (2)	22·750 (2)	23·917 (2)	25·000 (2)	29·083 (2)	23·833 (2)	Probability = 1·479 56° 50′ 23″·995
XIV & XII	64·083 (2)	61·833 (2)	66·556 (3)	63·000 (2)	73·917 (2)	57·083 (2)	71·500 (3)	66·417 (2)	66·000 (2)	63·917 (2)	58·333 (2)	64·917 (2)	Probability = 1·317 68° 11′ 4″·796
XII & XI	23·917 (2)	30·583 (2)	23·444 (3)	29·667 (3)	16·667 (2)	30·167 (2)	27·500 (2)	25·417 (2)	32·333 (2)	23·333 (2)	32·667 (2)	20·167 (2)	Probability = 1·387 72° 18′ 26″·322

At XIV

Novr. 1837, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XII												Probabilities and General Means.
	58°	238°	67°	247°	77°	257°	87°	267°	97°	277°	107°	287°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & XIII	61·250 (3)	61·667 (2)	67·583 (2)	71·167 (2)	53·333 (2)	67·417 (2)	69·917 (3)	73·833 (2)	67·695 (3)	64·583 (2)	69·917 (2)	61·083 (3)	Probability = 1·567 54° 6′ 5″·787
XIII & XV	33·000 (2)	38·833 (2)	38·667 (2)	46·583 (2)	27·667 (2)	45·000 (2)	41·917 (2)	41·583 (2)	42·583 (2)	40·500 (2)	40·917 (2)	43·917 (2)	Probability = 1·448 69° 1′ 40″·097

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At XIV—(Continued.)

November* 1837, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XII												Probabilities and General Means.
	58°	238°	67°	247°	77°	257°	87°	267°	97°	277°	107°	287°	
XV & XVI	″ 41·583 2	″ 46·750 2	″ 40·917 2	″ 54·667 2	″ 42·500 2	″ 59·556 3	″ 54·583 2	″ 57·750 2	″ 52·833 2	″ 62·000 2	″ 49·333 2	″ 53·778 3	Probability = 1·970 52° 37′ 51″·354

At XV

November* 1837, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XVII												Probabilities and General Means.
	121°	301°	131°	311°	141°	321°	151°	331°	161°	341°	171°	351°	
XVII & XVI	″ 27·333 2	″ 31·083 2	″ 25·556 3	″ 32·667 3	″ 21·917 2	″ 33·667 2	″ 26·417 2	″ 33·000 2	″ 26·583 2	″ 25·333 2	″ 32·167 2	″ 28·778 3	Probability = 1·039 59° 0′ 28″·708
XVI & XIV	65·583 2	54·833 2	70·833 3	51·750 2	63·250 2	57·250 2	63·167 2	59·500 2	59·306 3	71·833 2	56·667 2	62·305 2	Probability = 1·680 72° 29′ 1″·356
XIV & XIII	54·333 2	65·472 3	38·444 2	70·667 2	52·417 2	63·417 3	48·083 2	56·000 2	63·861 2	51·277 3	59·250 2	47·917 2	Probability = 2·509 54° 7′ 55″·928

At XVI

October* 1836, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XIV												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XIV & XV	″ 62·750 2	″ 77·917 2	″ 65·333 2	″ 73·083 2	″ 54·389 3	″ 73·833 2	″ 65·583 2	″ 74·667 2	″ 67·500 2	″ 76·833 2	″ 69·583 2	″ 63·778 3	Probability = 1·900 54° 53′ 8″·771
XV & XVII	63·667 2	62·222 2	67·917 2	69·000 2	71·500 2	65·583 2	69·500 2	67·917 2	80·000 2	58·667 2	68·042 4	62·833 4	Probability = 1·501 48° 41′ 7″·237

At XVI—(Continued.)

October 1836, *observed by Lieutenant T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XIV												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVII & XVIII	39·167$_{2}$	32·583$_{2}$	33·600$_{5}$	29·083$_{4}$	26·667$_{2}$	36·500$_{2}$	25·667$_{2}$	29·833$_{2}$	21·583$_{2}$	35·917$_{2}$	25·917$_{2}$	35·333$_{2}$	Probability = 1·481 59° 21′ 30″·988
XVIII & XIX	28·250$_{2}$	30·667$_{2}$	30·750$_{4}$	30·708$_{4}$	38·333$_{2}$	31·000$_{2}$	41·250$_{2}$	30·500$_{2}$	38·833$_{2}$	27·833$_{2}$	42·778$_{3}$	30·167$_{2}$	Probability = 1·461 51° 36′ 33″·422

At XVII

November 1837, *observed by Mr. C. Murphy with an* 18-*inch Theodolit eby Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XVIII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVIII & XVI	6·333$_{2}$	17·889$_{3}$	7·167$_{2}$	17·667$_{2}$	5·778$_{3}$	23·667$_{2}$	9·000$_{2}$	19·667$_{2}$	6·167$_{2}$	18·000$_{2}$	16·083$_{2}$	5·583$_{2}$	Probability = 1·837 59° 2′ 12″·750
XVI & XV	26·417$_{2}$	26·750$_{2}$	28·583$_{2}$	19·667$_{3}$	28·000$_{2}$	14·417$_{2}$	20·083$_{2}$	18·167$_{2}$	31·000$_{2}$	24·417$_{2}$	23·750$_{2}$	23·417$_{2}$	Probability = 1·341 72° 18′ 23″·722

At XVIII

November 1837, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XX & XIX	35·500$_{2}$	48·250$_{2}$	39·250$_{2}$	47·833$_{2}$	34·833$_{2}$	46·917$_{2}$	36·333$_{2}$	45·750$_{2}$	42·417$_{2}$	39·917$_{2}$	44·833$_{2}$	41·333$_{2}$	Probability = 1·337 67° 44′ 41″·931

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At XVIII—(Continued.)

October 1836, *observed by Lieutenant T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XIX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIX & XVI	48·389 3	37·500 3	48·167 2	30·167 2	47·833 2	35·333 2	45·667 2	41·056 3	38·833 2	40·583 2	40·000 2	36·444 3	Probability = 1·586 71° 13′ 40″·831
XVI & XVII	4·722 3	20·778 3	8·500 2	19·083 2	12·000 2	19·333 2	18·167 2	9·444 3	16·000 2	15·417 2	15·000 2	13·000 3	Probability = 1·358 61° 36′ 14″·287

At XIX

January and May 1838, *observed Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XVI												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVI & XVIII	43·000 2	51·250 2	44·833 2	56·167 2	38·083 2	54·167 2	41·500 2	57·500 2	43·583 2	50·667 2	48·417 2	40·417 2	Probability = 1·791 57° 9′ 47″·465
XVIII & XX	54·167 2	40·333 2	55·750 2	33·250 2	44·750 2	33·000 2	51·083 2	42·833 2	50·417 2	49·250 2	37·000 2	51·167 2	Probability = 2·195 64° 18′ 45″·250
XX & XXI	14·583 2	31·250 2	14·083 2	31·667 2	15·750 2	28·417 2	17·250 2	26·417 2	16·750 2	25·417 2	18·917 2	18·417 2	Probability = 1·823 44° 33′ 21″·577

At XX

December 1837, *and February* 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXII												Probabilities and General Means.
	116°	296°	126°	306°	136°	316°	146°	326°	156°	336°	166°	346°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXII & XXI	22·417 2	29·917 2	13·583 2	30·333 2	17·750 2	27·417 2	13·500 2	28·167 2	23·500 2	28·333 2	28·917 2	19·083 2	Probability = 1·727 63° 41′ 23″·576

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At XX—(Continued.)

December 1837, *and February* 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXII												Probabilities and General Means.
	116°	296°	126°	306°	136°	316°	146°	326	156°	336°	166°	346	
XXI & XIX	″ 17·833$_{2}$	″ 10·083$_{2}$	″ 25·083$_{2}$	″ 15·000$_{2}$	″ 8·417$_{2}$	″ 20·833$_{2}$	″ 18·333$_{2}$	″ 17·667$_{2}$	″ 18·167$_{2}$	″ 15·778$_{3}$	″ 20·278$_{3}$	″ 9·250$_{2}$	Probability = 1·389 68° 29′ 16″·394
XIX & XVIII	39·750$_{2}$	43·833$_{2}$	27·583$_{2}$	39·750$_{2}$	43·417$_{2}$	34·000$_{2}$	38·833$_{2}$	39·500$_{2}$	37·167$_{2}$	31·389$_{3}$	34·306$_{3}$	40·667$_{2}$	Probability = 1·342 47° 56′ 37″·516

At XXI

February 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XIX												Probabilities and General Means.
	123°	303°	133°	313°	143°	323°	153°	333°	163°	343°	173°	353°	
XIX & XX	″ 11·333$_{2}$	″ 27·083$_{2}$	″ 15·083$_{2}$	″ 29·250$_{2}$	″ 13·250$_{2}$	″ 27·333$_{2}$	″ 22·083$_{2}$	″ 29·000$_{2}$	″ 29·111$_{3}$	″ 25·778$_{3}$	″ 28·250$_{2}$	″ 20·833$_{2}$	Probability = 1·830 66° 57′ 23″·199
XX & XXII	33·583$_{2}$	20·833$_{2}$	33·500$_{2}$	17·833$_{2}$	36·250$_{2}$	22·583$_{2}$	27·333$_{2}$	29·750$_{2}$	19·722$_{3}$	25·583$_{2}$	19·000$_{2}$	26·722$_{3}$	Probability = 1·726 66° 49′ 26″·058
XXII & XXIII	19·000$_{2}$	32·833$_{2}$	14·917$_{2}$	26·333$_{2}$	4·083$_{2}$	24·750$_{2}$	17·000$_{2}$	23·667$_{2}$	20·528$_{2}$	16·250$_{2}$	21·583$_{2}$	20·722$_{3}$	Probability = 1·949 46° 7′ 20″·139

At XXII

March 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXIV												Probabilites and General Means.
	108°	288°	118°	298°	128°	308°	138°	318°	148°	328°	158°	338°	
XXIV & XXIII	″ 25·667$_{2}$	″ 32·917$_{2}$	″ 24·083$_{2}$	″ 41·000$_{2}$	″ 25·833$_{2}$	″ 41·417$_{4}$	″ 23·833$_{2}$	″ 34·917$_{2}$	″ 27·056$_{3}$	″ 37·417$_{2}$	″ 35·389$_{3}$	″ 31·583$_{2}$	Probability = 1·770 71° 59′ 31″·759

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At XXII—(Continued.)

March* 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XXIV												Probabilities and General Means.
	108°	288°	118°	298°	128°	308°	138°	318°	148°	328°	158°	338°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIII & XXI	$69{\cdot}667_{2}$	$55{\cdot}167_{2}$	$80{\cdot}250_{2}$	$62{\cdot}750_{2}$	$68{\cdot}333_{3}$	$54{\cdot}333_{2}$	$64{\cdot}833_{2}$	$63{\cdot}417_{2}$	$63{\cdot}917_{2}$	$66{\cdot}278_{3}$	$63{\cdot}417_{2}$	$69{\cdot}000_{2}$	Probability = 1·872 70° 46′ 5″·114
XXI & XX	$69{\cdot}722_{3}$	$77{\cdot}333_{2}$	$58{\cdot}528_{3}$	$71{\cdot}250_{2}$	$65{\cdot}000_{3}$	$78{\cdot}500_{2}$	$73{\cdot}083_{2}$	$72{\cdot}083_{2}$	$77{\cdot}333_{2}$	$72{\cdot}389_{2}$	$75{\cdot}250_{2}$	$68{\cdot}333_{2}$	Probability = 1·578 49° 29′ 11″·567

At XXIII

February and March* 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XXI												Probabilities and General Means.
	117°	297°	127°	307°	137°	317°	147°	327°	157°	337°	167°	347°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXI & XXII	$28{\cdot}667_{3}$	$40{\cdot}222_{3}$	$25{\cdot}750_{2}$	$34{\cdot}667_{2}$	$31{\cdot}917_{2}$	$42{\cdot}583_{2}$	$26{\cdot}500_{2}$	$36{\cdot}833_{2}$	$34{\cdot}083_{2}$	$34{\cdot}417_{2}$	$40{\cdot}000_{2}$	$31{\cdot}250_{2}$	Probability = 1·494 63° 6′ 33″·907
XXII & XXIV	$67{\cdot}333_{2}$	$52{\cdot}417_{2}$	$71{\cdot}056_{3}$	$51{\cdot}000_{2}$	$64{\cdot}583_{2}$	$50{\cdot}833_{2}$	$57{\cdot}333_{2}$	$51{\cdot}083_{2}$	$55{\cdot}000_{4}$	$55{\cdot}750_{2}$	$48{\cdot}667_{2}$	$59{\cdot}083_{2}$	Probability = 1·992 67° 18′ 57″·012
XXIV & XXV	$41{\cdot}750_{2}$	$52{\cdot}417_{2}$	$37{\cdot}861_{2}$	$54{\cdot}583_{2}$	$45{\cdot}250_{2}$	$51{\cdot}750_{2}$	$49{\cdot}417_{2}$	$61{\cdot}306_{3}$	$51{\cdot}056_{3}$	$57{\cdot}000_{2}$	$55{\cdot}833_{2}$	$45{\cdot}250_{2}$	Probability = 1·867 46° 56′ 50″·289

At XXIV

March* 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XXVI												Probabilities and General Means.
	110°	290°	120°	300°	130°	310°	140°	320°	150°	330°	160°	340°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXVI & XXV	$26{\cdot}500_{2}$	$40{\cdot}500_{2}$	$27{\cdot}000_{2}$	$37{\cdot}000_{2}$	$26{\cdot}833_{2}$	$41{\cdot}083_{2}$	$26{\cdot}250_{2}$	$34{\cdot}083_{2}$	$32{\cdot}944_{3}$	$37{\cdot}111_{3}$	$38{\cdot}917_{2}$	$31{\cdot}500_{2}$	Probability = 1·567 70° 9′ 33″·310

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At XXIV—(Continued.)

March 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXVI												Probabilities and General Means.
	110°	290°	120°	300°	130°	310°	140°	320°	150°	330°	160°	340°	
XXV & XXIII	″ 18·333 2	″ 1·167 2	″ 21·083 2	″ 5·917 2	″ 20·083 2	″ 1·167 2	″ 8·611 3	″ 0·167 2	″ 8·917 2	″ 10·333 2	″ 6·500 3	″ 11·389 3	Probability = 2·002 65° 42′ 9″·472
XXIII & XXII	27·723 3	35·083 2	27·333 2	33·750 2	23·083 3	35·667 2	29·306 2	36·917 2	24·667 2	38·667 2	27·000 2	34·194 2	Probability = 1·453 40° 41′ 31″·116

At XXV

March 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXIII												Probabilities and General Means.
	113°	293°	123°	303°	133°	313°	143°	323°	153°	333°	163°	343°	
XXIII & XXIV	″ 53·167 2	″ 59·917 2	″ 48·417 2	″ 63·833 2	″ 53·000 2	″ 65·417 2	″ 47·833 4	″ 62·900 5	″ 54·583 2	″ 61·417 2	″ 67·500 2	″ 61·583 2	Probability = 1·836 67° 20′ 58″·297
XXIV & XXVI	29·083 2	19·333 2	34·333 2	19·750 2	28·000 2	15·417 2	23·083 2	23·667 2	22·833 2	27·750 2	19·000 3	27·417 2	Probability = 1·479 70° 2′ 24″·139
XXVI & XXVII	24·583 2	32·556 2	21·667 2	30·583 2	25·500 2	30·917 2	29·083 3	28·833 2	26·917 2	24·000 2	27·750 2	24·583 2	Probability = 0·905 37° 59′ 27″·248

At XXVI

April and October 1838, *observed by Lieutenant T. Renny and Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXVIII												Probabilites and General Means.
	105°	285°	115°	295°	125°	305°	135°	315°	145°	325°	155°	335°	
XXVIII & XXVII	″ 15·500 2	″ 21·333 2	″ 11·333 2	″ 19·917 2	″ 12·167 2	″ 23·417 2	″ 13·583 2	″ 22·333 2	″ 12·500 2	″ 21·833 2	″ 20·083 2	″ 21·500 2	Probability = 1·260 75° 18′ 17″·958

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At XXVI—(Continued.)

April and October 1838, *observed by Lieutenant T. Renny and Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXVIII												Probabilities and General Means.
	105°	285°	115°	295°	125°	305°	135°	315°	145°	325°	155°	335°	
XXVII & XXV	″ 56·083 (2)	″ 49·083 (2)	″ 59·333 (2)	″ 47·000 (2)	″ 59·667 (2)	″ 43·583 (2)	″ 55·250 (2)	″ 44·500 (2)	″ 48·917 (2)	″ 51·833 (2)	″ 43·500 (2)	″ 52·750 (2)	Probability = 1·602 66° 46′ 50″·958
XXV & XXIV	49·750 (2)	52·750 (2)	53·417 (2)	66·750 (2)	53·250 (2)	69·500 (2)	63·750 (2)	71·250 (2)	69·917 (2)	63·167 (2)	69·500 (2)	63·000 (2)	Probability = 2·164 39° 48′ 2″·167

At XXVII

March 1838, *observed by Lieut. T. Renny with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXV												Probabilities and General Means.
	105°	285°	115°	295°	125°	305°	135°	315°	145°	325°	155°	335°	
XXV & XXVI	″ 42·083 (4)	″ 46·667 (2)	″ 39·500 (2)	″ 43·083 (2)	″ 34·583 (2)	″ 44·222 (3)	″ 39·583 (2)	″ 51·833 (2)	″ 35·500 (2)	″ 50·000 (2)	″ 47·583 (2)	″ 48·250 (2)	Probability = 1·533 75° 13′ 43″·574
XXVI & XXVIII	37·000 (2)	32·417 (2)	37·889 (3)	29·222 (3)	38·333 (2)	22·667 (2)	35·167 (2)	22·750 (2)	30·250 (2)	26·833 (2)	27·833 (2)	31·278 (3)	Probability = 1·503 58° 38′ 30″·970
XXVIII & XXIX	50·833 (2)	56·750 (2)	54·861 (2)	62·278 (3)	59·250 (2)	66·222 (2)	61·333 (2)	67·083 (2)	64·000 (2)	71·611 (3)	60·250 (2)	66·944 (3)	Probability = 1·621 39° 34′ 1″·785

At XXVIII

October 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXX												Probabilities and General Means.
	120°	300°	130°	310°	140°	320°	150°	330°	160°	340°	170°	350°	
XXX & XXIX	″ 16·167 (2)	″ 12·750 (2)	″ 13·917 (2)	″ 11·917 (2)	″ 16·083 (2)	″ 10·167 (2)	″ 10·750 (2)	″ 16·000 (2)	″ 13·500 (2)	″ 13·750 (2)	″ 14·750 (2)	″ 12·250 (2)	Probability = 0·560 59° 40′ 13″·500

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At XXVIII—(Continued.)

October 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXX												Probabilities and General Means.
	120°	300°	130°	310°	140°	320°	150°	330°	160°	340°	170°	350°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIX & XXVII	28·917 2	27·000 2	26·000 2	17·917 2	27·500 2	23·500 2	21·583 2	28·250 2	27·667 2	28·167 2	29·250 2	24·083 2	Probability = 0·939 68° 45′ 25″·820
XXVII & XXVI	7·333 2	12·000 2	14·667 2	7·000 2	13·417 2	13·750 2	14·083 2	14·333 2	12·583 2	9·167 2	10·250 2	12·417 2	Probability = 0·743 46° 3′ 11″·750

At XXIX

October 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXVII												Probabilities and General Means.
	108°	288°	118°	298°	128°	308°	138°	318°	148°	328°	158°	338°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXVII & XXVIII	36·583 2	29·917 2	28·500 2	31·250 2	31·083 2	26·500 2	28·750 2	24·667 2	27·833 2	29·833 2	31·167 2	32·000 2	Probability = 0·835 71° 40′ 29″·840
XXVIII & XXX	45·750 2	46·083 2	44·833 2	51·417 2	44·917 2	48·417 2	49·833 2	51·667 2	51·333 2	50·417 2	51·667 2	50·833 2	Probability = 0·768 74° 27′ 48″·922
XXX & XXXI	33·833 2	34·250 2	35·417 2	28·333 2	35·333 2	27·500 2	35·750 2	25·833 2	28·917 2	26·917 2	34·750 2	27·917 2	Probability = 1·085 47° 55′ 31″·229

At XXX

October and November 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXXII												Probabilities and General Means.
	113°	293°	123°	302°	132°	312°	142°	322°	152°	332°	162°	342°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXII & XXXI	32·417 2	35·167 2	31·750 2	26·750 2	33·083 2	30·417 2	26·250 2	25·417 2	28·417 2	29·333 2	32·417 2	34·167 2	Probability = 0·892 68° 2′ 30″·465

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At XXX—(Continued.)

October and November 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXXII												Probabilities and General Means.
	113°	293°	123°	302°	132°	312°	142°	322°	152°	332°	162°	342°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXXI & XXIX	19.000_{2}	22.750_{2}	17.083_{2}	18.167_{2}	16.667_{3}	17.833_{2}	21.917_{2}	19.000_{2}	21.250_{2}	22.667_{2}	20.556_{3}	16.417_{2}	Probability = 0·641 77° 4′ 19″·359
XXIX & XXVIII	56.750_{2}	52.250_{2}	62.333_{2}	58.250_{2}	64.389_{3}	58.083_{2}	58.833_{2}	54.500_{2}	55.417_{2}	56.917_{2}	60.750_{2}	57.917_{2}	Probability = 0·923 45° 51′ 58″·032

At XXXI

Novr. 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXIX												Probabilities and General Means.
	125°	305°	135°	315°	145°	325°	155°	335°	165°	345°	175°	355°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXIX & XXX	11.583_{2}	10.000_{3}	8.167_{2}	9.000_{2}	12.417_{2}	6.167_{2}	9.250_{2}	8.000_{2}	2.167_{2}	11.667_{2}	10.000_{2}	10.000_{2}	Probability = 0·768 55° 0′ 9″·035
XXX & XXXII	57.667_{2}	59.167_{3}	66.278_{3}	66.917_{2}	58.003_{2}	62.333_{2}	68.583_{2}	63.500_{2}	67.750_{2}	64.750_{2}	67.417_{2}	66.833_{2}	Probability = 1·091 67° 51′ 4″·100
XXXII & XXV	41.750_{2}	39.110_{3}	30.222_{2}	34.083_{2}	36.917_{2}	37.750_{2}	35.000_{2}	36.000_{2}	29.667_{2}	33.167_{2}	35.139_{2}	30.750_{2}	Probability = 1·015 44° 55′ 34″·963

At XXXII

Novr. 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXIII												Probabilities and General Means.
	115°	295°	125°	305°	135°	315°	145°	325°	155°	335°	165°	345°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXIII & XXV	32.583_{2}	37.750_{2}	35.500_{2}	34.083_{2}	36.500_{2}	33.333_{2}	30.583_{2}	25.000_{2}	36.417_{2}	33.000_{2}	31.833_{2}	32.083_{2}	Probability = 0·934 65° 10′ 33″·222

NOTE.—XXIII and XXV appertain to North-East Longitudinal Series.

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At XXXII—(Continued.)

Novr. 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms*.

Angle between	Means of Circle-readings, telescope being set on XXIII												Probabilities and General Means.
	115°	295°	125°	305°	135°	315°	145°	325°	155°	335°	165°	345°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXV & XXXI	64·500 2	61·833 2	62·583 2	64·833 2	59·750 2	61·750 2	57·417 2	57·750 2	58·583 2	55·417 2	56·583 2	58·917 2	Probability=0·851 64° 22′ 59″·993
XXXI & XXX	31·833 2	21·417 2	32·250 2	29·417 2	28·750 2	20·417 2	31·667 2	24·750 2	24·083 2	26·167 2	21·750 2	18·833 2	Probability=1·321 44° 6′ 25″·945

At XXV

Novr. 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXXI												Probabilities and General Means.
	109°	289°	119°	299°	129°	309°	139°	319°	149°	329°	159°	339°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXI & XXXII	22·917 2	26·583 2	20·333 2	22·083 2	23·833 2	25·167 2	22·333 2	24·000 2	24·667 2	29·583 2	25·583 2	28·833 2	Probability=0·752 70° 41′ 24″·660
XXXII & XXIII	17·083 2	17·500 2	17·000 2	19·917 2	22·500 2	14·833 2	15·583 2	15·250 2	12·917 2	13·667 2	22·750 2	17·750 2	Probability=0·872 64° 55′ 17″·229

At XXIII

Novr. 1838, *observed by Mr. C. Murphy with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XXV												Probabilities and General Means.
	128°	308°	138°	318°	148°	328°	158°	338°	168°	348°	178°	358°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXV & XXXII	8·250 2	3·500 2	10·000 2	14·250 2	16·500 2	8·500 2	12·583 2	14·250 2	10·250 2	14·750 2	5·917 2	4·250 2	Probability=1·157 49° 54′ 10″·250

NOTE.—XXIII and XXV appertain to North-East Longitudinal Series.

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AMUA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
45		XVII	·71	−1·56	− ·11		−1·67	42 12 34·93	4·9453592,1	88177·80	16·700
		XIX	·71	−3·24	+ ·20		−3·04	86 34 48·11	5·1173153,8	131013·31	24·813
		I	·71	−3·05	− ·09		−3·14	51 12 36·96	5·0098779,4	102300·55	19·375
			2·13				−7·85	180 0 0·00			
46		XIX	·94	+1·26	+ ·08		+1·34	67 44 53·04	5·1427169,3	138904·71	26·308
		I	·94	+ ·62	− ·27		+ ·35	76 16 11·47	5·1637365,3	145792·96	27·612
		II	·93	+ ·74	+ ·19		+ ·93	35 58 55·49	4·9453592,1	88177·80	16·700
			2·81				+2·62	180 0 0·00			
47		I	1·36	−2·80	− ·35		−3·15	59 35 8·07	5·1479144,2	140577·06	26·624
		II	1·36	−1·71	+ ·20		−1·51	61 58 14·39	5·1580292,6	143889·56	27·252
		III	1·36	− ·80	+ ·15		− ·65	58 26 37·54	5·1427169,3	138904·71	26·308
			4·08				−5·31	180 0 0·00			
48		I	·96	−1·07	− ·12		−1·19	72 14 24·75	5·1590215,9	144218·70	27·314
		III	·96	− ·26	+ ·18		− ·08	35 55 24·25	4·9486462,9	88847·71	16·827
		IV	·96	− ·45	− ·06		− ·51	71 50 11·00	5·1580292,6	143889·56	27·252
			2·88				−1·78	180 0 0·00			
49		III	1·25	−1·78	+ ·01		−1·77	67 18 35·20	5·1685976,5	147434·00	27·923
		IV	1·25	−2·83	− ·31		−3·14	48 12 13·58	5·0760415,7	119135·61	22·564
		V	1·25	−1·34	+ ·30		−1·04	64 29 11·22	5·1590215,9	144218·70	27·314
			3·75				−5·95	180 0 0·00			

NOTES.—1. The values of the side are given in the same line with the opposite angle.
2. Stations XVII and XIX appertain to the Calcutta Longitudinal Series.

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ' "			
		IV	1·12	−1·13	− ·39		−1·52	50 0 18·10	5·0685557,3	117099·68	22·178
50		V	1·12	−2·11	+ ·33		−1·78	55 17 42·25	5·0991918,1	125658·47	23·799
		VI	1·12	−1·82	+ ·06		−1·76	74 41 59·65	5·1685976,5	147434·00	27·923
			3·36				−5·06	180 0 0·00			
		V	·86	− ·80	+ ·44		− ·36	44 9 41·85	4·9816613,7	95865·28	18·156
51		VI	·87	− ·52	− ·33		− ·85	77 31 3·11	5·1282360,4	134349·49	25·445
		VII	·86	− ·56	− ·11		− ·67	58 19 15·04	5·0685557,3	117099·68	22·178
			2·59				−1·88	180 0 0·00			
		V	·91	− ·37	+ ·11		− ·26	63 6 19·87	5·0971315,1	125063·78	23·686
52		VII	·91	− ·62	− ·35		− ·97	43 32 50·56	4·9850343,7	96612·73	18·298
		VIII	·91	− ·52	+ ·24		− ·28	73 20 49·57	5·1282360,4	134349·49	25·445
			2·73				−1·51	180 0 0·00			
		VII	·94	−1·58	− ·35		−1·93	69 48 26·37	5·1171545,9	130964·80	24·804
53		VIII	·93	−2·42	+ ·27		−2·15	46 31 24·34	5·0054337,7	101259·03	19·178
		IX	·94	−1·88	+ ·08		−1·80	63 40 9·29	5·0971315,1	125063·78	23·686
			2·81				−5·88	180 0 0·00			
		VIII	1·15	+ ·75	+ ·03		+ ·78	64 32 41·82	5·1331945,6	135892·21	25·737
54		IX	1·15	+ ·79	− ·10		+ ·69	54 58 30·47	5·0907764,0	123247·02	23·342
		X	1·15	+1·09	+ ·07		+1·16	60 28 47·71	5·1171545,9	130964·80	24·804
			3·45				+2·63	180 0 0·00			
		IX	1·09	+ ·02	− ·09		− ·07	58 51 54·81	5·1008474,5	126138·44	23·890
55		X	1·09	+ ·04	+ ·13		+ ·17	53 53 37·23	5·0757682,5	119060·64	22·549
		XI	1·10	+ ·06	− ·04		+ ·02	67 14 27·96	5·1331945,6	135892·21	25·737
			3·28				+0·12	180 0 0·00			
		X	·84	− ·01	+ ·09		+ ·08	44 37 48·90	4·9732254,4	94021·12	17·807
56		XI	·85	− ·01	− ·18		− ·19	64 53 31·98	5·0834550,3	121186·72	22·952
		XII	·85	− ·01	+ ·09		+ ·08	70 28 39·12	5·1008474,5	126138·44	23·890
			2·54				−0·03	180 0 0·00			
		XI	·47	+ ·26	− ·05		+ ·21	50 18 40·12	4·8804913,7	75943·63	14·383
57		XII	·48	+ ·15	+ ·07		+ ·22	57 22 53·89	4·9197257,0	83123·87	15·743
		XIII	·48	+ ·17	− ·02		+ ·15	72 18 25·99	4·9732254,4	94021·12	17·807
			1·43				+0·58	180 0 0·00			
		XII	·44	+ ·78	− ·02		+ ·76	57 42 48·79	4·8990307,6	79255·75	15·011
58		XIII	·44	+ ·61	+ ·03		+ ·64	68 11 5·00	4·9397034,5	87036·91	16·484
		XIV	·44	+ ·87	− ·01		+ ·86	54 6 6·21	4·8804913,7	75943·63	14·383
			1·32				+2·26	180 0 0·00			
		XIII	·48	+ ·29	− ·16		+ ·13	56 50 23·65	4·9131469,3	81874·18	15·506
59		XIV	·48	+ ·28	− ·01		+ ·27	69 1 39·89	4·9605784,3	91322·63	17·296
		XV	·48	+ ·84	+ ·17		+1·01	54 7 56·46	4·8990307,6	79255·75	15·011
			1·44				+1·41	180 0 0·00			
		XIV	·49	− ·01	+ ·10		+ ·09	52 37 50·95	4·9006163,8	79545·64	15·065
60		XV	·49	·00	− ·13		− ·13	72 29 0·74	4·9797707,8	95448·87	18·077
		XVI	·49	·00	+ ·03		+ ·03	54 53 8·31	4·9131469,3	81874·18	15·506
			1·47				−0·01	180 0 0·00			
		XV	·34	+ ·29	+ ·02		+ ·31	59 0 28·68	4·8547636,6	71575·38	13·556
61		XVI	·34	+ ·59	·00		+ ·59	48 41 7·49	4·7973572,6	62712·95	11·877
		XVII	·34	+ ·47	− ·02		+ ·45	72 18 23·83	4·9006163,8	79545·64	15·065
			1·02				+1·35	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
62		XVI	·34	+ ·89	− ·04		+ ·85	59 21 31·50	4·8451256,5	70004·44	13·258
		XVII	·34	+1·36	+ ·01		+1·37	59 2 13·78	4·8436724,1	69770·60	13·214
		XVIII	·34	+ ·74	+ ·03		+ ·77	61 36 14·72	4·8547636,6	71575·38	13·556
			1·02				+2·99	180 0 0·00			
63		XVI	·34	− ·19	− ·10		− ·29	51 36 32·79	4·8134820,2	65085·17	12·327
		XVIII	·34	− ·22	+ ·07		− ·15	71 13 40·34	4·8955420,2	78621·62	14·890
		XIX	·34	− ·29	+ ·03		− ·26	57 9 46·87	4·8436724,1	69770·60	13·214
			1·02				−0·70	180 0 0·00			
64		XVIII	·38	− ·76	+ ·02		− ·74	67 44 40·81	4·9091738,1	81128·57	15·365
		XIX	·38	−2·05	− ·07		−2·12	64 18 42·75	4·8976001,3	78995·10	14·961
		XX	·37	− ·76	+ ·05		− ·71	47 56 36·44	4·8134820,2	65085·17	12·327
			1·13				−3·57	180 0 0·00			
65		XIX	·37	− ·02	− ·02		− ·04	44 33 21·17	4·7913808,2	61855·86	11·715
		XX	·37	− ·02	+ ·10		+ ·08	68 29 16·10	4·9139299,3	82021·91	15·534
		XXI	·37	− ·02	− ·08		− ·10	66 57 22·73	4·9091738,1	81128·57	15·365
			1·11				−0·06	180 0 0·00			
66		XX	·33	− ·08	+ ·02		− ·06	63 41 23·19	4·8629282,9	72933·71	13·813
		XXI	·33	− ·08	− ·13		− ·21	66 49 25·52	4·8738794,7	74796·18	14·166
		XXII	·33	− ·06	+ ·11		+ ·05	49 29 11·29	4·7913808,2	61855·86	11·715
			·99				−0·22	180 0 0·00			
67		XXI	·32	+ ·72	− ·10		+ ·62	46 7 20·44	4·7704534,7	58945·89	11·164
		XXII	·33	+ ·67	+ ·20		+ ·87	70 46 5·65	4·8876870,1	77212·39	14·624
		XXIII	·32	+ ·42	− ·10		+ ·32	63 6 33·91	4·8629282,9	72933·71	13·813
			·97				+1·81	180 0 0·00			
68		XXII	·37	+ ·41	+ ·10		+ ·51	71 59 31·90	4·9343982,0	85980·16	16·284
		XXIII	·37	+ ·53	− ·19		+ ·34	67 18 56·98	4·9212455,5	83415·26	15·798
		XXIV	·37	+ ·28	+ ·09		+ ·37	40 41 31·12	4·7704534,7	58945·89	11·164
			1·11				+1·22	180 0 0·00			
69		XXIII	·42	+1·03	− ·12		+ ·91	46 56 50·78	4·8330122,4	68078·85	12·894
		XXIV	·42	+1·18	+ ·28		+1·46	65 42 10·51	4·9289772,2	84913·59	16·082
		XXV	·43	+1·00	− ·16		+ ·84	67 20 58·71	4·9343982,0	85980·16	16·284
			1·27				+3·21	180 0 0·00			
70		XXIV	·51	+ ·50	+ ·09		+ ·59	70 9 33·39	5·0001741,5	100040·10	18·947
		XXV	·51	+ ·45	− ·23		+ ·22	70 2 23·85	4·9998468,2	99964·73	18·933
		XXVI	·50	+ ·95	+ ·14		+1·09	39 48 2·76	4·8330122,4	68078·85	12·894
			1·52				+1·90	180 0 0·00			
71		XXV	·46	− ·05	− ·10		− ·15	37 59 26·64	4·8040218,4	63682·76	12·061
		XXVI	·47	− ·17	+ ·14		− ·03	66 46 50·46	4·9780865,2	95079·42	18·007
		XXVII	·47	− ·16	− ·04		− ·20	75 13 42·90	5·0001741,5	100040·10	18·947
			1·40				−0·38	180 0 0·00			
72		XXVI	·37	+ ·16	+ ·03		+ ·19	75 18 17·78	4·9322553,1	85556·96	16·204
		XXVII	·37	+ ·22	− ·10		+ ·12	58 38 30·72	4·8781216,8	75530·38	14·305
		XXVIII	·37	+ ·05	+ ·07		+ ·12	46 3 11·50	4·8040218,4	63682·76	12·061
			1·11				+0·43	180 0 0·00			
73		XXVII	·36	+2·27	− ·06		+2·21	39 34 3·64	4·7589891,7	57410·22	10·873
		XXVIII	·36	+ ·76	+ ·09		+ ·85	68 45 26·31	4·9242982,2	84003·65	15·910
		XXIX	·37	+ ·61	− ·03		+ ·58	71 40 30·05	4·9322553,1	85556·96	16·204
			1·09				+3·64	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
74		XXVIII	·30	+ ·08	+ ·02		+ ·10	59 40 13·30	4·8391158,7	69042·39	13·076
		XXIX	·30	+ ·15	− ·05		+ ·10	74 27 48·72	4·8868711,4	77067·47	14·596
		XXX	·30	+ ·22	+ ·03		+ ·25	45 51 57·98	4·7589891,7	57410·22	10·873
			·90				+0·45	180 0 0·00			
75		XXIX	·33	+ ·74	− ·02		+ ·72	47 55 31·62	4·7963020,0	62560·76	11·849
		XXX	·34	+ ·26	+ ·07		+ ·33	77 4 19·35	4·9145877,0	82146·25	15·558
		XXXI	·33	+ ·37	− ·05		+ ·32	55 0 9·03	4·8391158,7	69042·39	13·076
			1·00				+1·37	180 0 0·00			
76		XXX	·37	+ ·13	+ ·06		+ ·19	68 2 30·29	4·9209843,9	83365·11	15·789
		XXXI	·37	+ ·19	− ·15		+ ·04	67 51 3·77	4·9203988,2	83252·79	15·768
		XXXII	·37	+ ·27	+ ·09		+ ·36	44 6 25·94	4·7963020,0	62560·76	11·849
			1·11				+0·59	180 0 0·00			
77		XXXI	·38	+ ·68	− ·05		+ ·63	44 55 35·21	4·7950568,1	62381·64	11·815
		XXXII	·38	+ ·48	+ ·10		+ ·58	64 23 0·19	4·9011955,8	79651·80	15·086
		XXV	·39	+ ·38	− ·05		+ ·33	70 41 24·60	4·9209843,9	83365·11	15·789
			1·15				+1·54	180 0 0·00			
78		XXXII	·33	+ ·09	+ ·07		+ ·16	65 10 33·05	4·8693168,3	74014·51	14·018
		XXV	·33	+ ·07	− ·15		− ·08	64 55 16·82	4·8684193,0	73861·69	13·989
		XXIII	·33	+ ·13	+ ·08		+ ·21	49 54 10·13	4·7950568,1	62381·64	11·815
			·99				+0·29	180 0 0·00			

Note.—Stations XXIII and XXV appertain to the North-East Longitudinal Series.

March 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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AMUA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XVII	Amúa	23 59 56·24	80 31 44·44	260 4 20·44	5·0098779,4	80 11 43·06	XIX
	,,	,,	,,	,,	217 51 44·80	5·1173153,8	37 57 40·29	I
23	XIX	Lakanpúra	24 2 49·92	80 49 51·67	166 46 31·88	4·9453592,1	346 45 2·62	I
,,	,,	,,	,,	,,	234 31 25·86	5·1637365,3	54 40 11·17	II
	I	Maihar	24 17 0·34	80 46 13·62	270 28 50·21	5·1427169,3	90 39 7·59	II
	,,	,,	,,	,,	210 53 40·78	5·1580292,6	30 59 12·24	III
	,,	,,	,,	,,	138 39 15·07	4·9486462,9	318 34 52·86	IV
24	II	Patra	24 16 46·74	81 11 14·97	152 37 23·34	5·1479144,2	332 32 33·34	III
25	III	Potenda	24 37 23·04	80 59 34·36	66 54 37·45	5·1590215,9	246 44 40·90	IV
,,	,,	,,	,,	,,	134 13 13·90	5·0760415,7	314 6 45·97	V
	IV	Dharkána	24 28 0·81	80 35 38·29	198 32 26·07	5·1685976,5	18 35 58·44	V
	,,	,,	,,	,,	148 32 6·85	5·0991918,1	328 27 10·43	VI
26	V	Dágri	24 51 5·38	80 44 7·31	73 53 41·81	5·0685557,3	253 45 9·66	VI
,,	,,	,,	,,	,,	118 3 24·52	5·1282360,4	297 54 20·97	VII
,,	,,	,,	,,	,,	181 9 45·30	4·9850343,7	1 9 54·31	VIII

Note.—Stations XVII and XIX appertain to the Calcutta Longitudinal Series of the South-East Quadrilateral.

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	VI	Sárang	24 45 42·20	80 23 46·62	176 14 5·68	4·9816613,7	356 13 36·87	VII
	VII	Kartár	25 1 29·85	80 22 38·18	254 21 29·50	5·0971315,1	74 30 44·79	VIII
	,,	,,	,,	,,	184 33 2·19	5·0054337,7	4 33 39·42	IX
27	VIII	Marfa	25 7 2·29	80 44 28·64	121 2 10·06	5·1171545,9	300 53 29·19	IX
,,	,,	,,	,,	,,	185 34 53·03	5·0907764,0	5 35 48·89	X
	IX	Seonda	25 18 9·78	80 24 5·73	245 54 57·57	5·1331945,6	66 4 37·75	X
	,,	,,	,,	,,	187 3 1·67	5·0757682,5	7 4 10·33	XI
28	X	Pavia	25 27 17·39	80 46 39·44	119 58 16·07	5·1008474,5	299 49 41·27	XI
,,	,,	,,	,,	,,	164 36 5·81	5·0834550,3	344 33 33·61	XII
	XI	Papreudi	25 37 40·25	80 26 45·41	234 56 8·44	4·9732254,4	55 2 13·58	XII
	,,	,,	,,	,,	184 37 27·85	4·9197257,0	4 37 59·71	XIII
29	XII	Músápúr	25 46 34·62	80 40 47·38	112 25 7·95	4·8804913,7	292 19 33·24	XIII
,,	,,	,,	,,	,,	170 7 57·18	4·9397034,5	350 6 45·77	XIV
	XIII	Kánákhera	25 51 20·95	80 27 58·79	224 8 27·80	4·8990307,6	44 12 52·42	XIV
	,,	,,	,,	,,	167 18 3·67	4·9605784,3	347 16 27·20	XV
30	XIV	Jafrábád	26 0 43·97	80 38 3·87	113 14 32·79	4·9131469,3	293 8 30·26	XV
,,	,,	,,	,,	,,	165 52 24·23	4·9797707,8	345 50 31·48	XVI
	XV	Jehánábád	26 6 3·35	80 24 18·54	220 39 29·03	4·9006163,8	40 43 40·28	XVI
	,,	,,	,,	,,	161 39 0·01	4·7973572,6	341 37 24·30	XVII
31	XVI	Máwa	26 16 0·74	80 33 47·94	89 24 48·11	4·8547636,6	269 19 0·13	XVII
,,	,,	,,	,,	,,	148 46 19·95	4·8436724,1	328 43 23·31	XVIII
,,	,,	,,	,,	,,	200 22 53·08	4·8955420,2	20 25 6·92	XIX
	XVII	Dewarsán	26 15 52·89	80 20 41·64	210 16 46·01	4·8451256,5	30 19 38·37	XVIII
	XVIII	Jájmáo	26 25 51·52	80 27 9·98	257 29 42·63	4·8134820,2	77 34 54·13	XIX
	,,	,,	,,	,,	189 45 1·44	4·8976001,3	9 46 7·32	XX
32	XIX	Namána	26 28 10·63	80 38 49·28	141 53 37·26	4·9091738,1	321 49 30·51	XX
,,	,,	,,	,,	,,	186 26 58·80	4·9139299,3	6 27 44·26	XXI
	XX	Ráo	26 38 42·61	80 29 37·44	253 20 14·04	4·7913808,2	73 25 7·36	XXI
	,,	,,	,,	,,	189 38 50·52	4·8738794,7	9 39 52·81	XXII
33	XXI	Jalhotr	26 41 37·85	80 40 30·88	140 14 33·21	4·8629282,9	320 10 41·19	XXII
,,	,,	,,	,,	,,	186 21 53·97	4·8876870,1	6 22 36·61	XXIII
	XXII	Bakseria	26 50 52·91	80 31 55·84	249 24 35·21	4·7704534,7	69 29 10·84	XXIII
	,,	,,	,,	,,	177 25 2·94	4·9212455,5	357 24 44·08	XXIV
34	XXIII	Etora	26 54 17·85	80 42 5·44	136 48 8·19	4·9343982,0	316 43 12·59	XXIV
,,	,,	,,	,,	,,	183 44 59·39	4·9289772,2	3 45 27·32	XXV

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXIV	Asu	27 4 38·20	80 31 14·26	251 1 1·66	4·8330122,4	71 6 26·46	XXV
	„	„	„	„	180 51 27·76	4·9998468,2	0 51 35·35	XXVI
35	XXV	Baraoli	27 8 17·01	80 43 6·92	141 8 50·82	5·0001741,5	321 3 32·09	XXVI
„	„	„	„	„	179 8 17·92	4·9780865,2	359 8 10·65	XXVII
	XXVI	Nimkár	27 21 8·09	80 31 30·85	254 16 41·16	4·8040218,4	74 21 54·02	XXVII
	„	„	„	„	178 58 23·01	4·8781216,8	358 58 16·08	XXVIII
36	XXVII	Fatenagar	27 23 58·52	80 42 51·05	133 0 25·11	4·9322553,1	312 55 4·21	XXVIII
„	„	„	„	„	172 34 29·11	4·9242982,2	352 33 33·34	XXIX
	XXVIII	Daráwal	27 33 35·96	80 31 15·81	244 9 37·54	4·7589891,7	64 14 3·76	XXIX
	„	„	„	„	184 29 23·94	4·8868711,4	4 29 55·13	XXX
37	XXIX	Sirwaia	27 37 43·43	80 40 50·34	138 41 52·78	4·8391158,7	318 37 56·85	XXX
„	„	„	„	„	186 37 24·73	4·9145877,0	6 38 13·87	XXXI
	XXX	Parser	27 46 16·81	80 32 22·98	241 33 37·16	4·7963020,0	61 38 23·23	XXXI
	„	„	„	„	173 31 6·50	4·9203988,2	353 30 17·46	XXXII
38	XXXI	Bulandpúr	27 51 11·46	80 42 35·92	129 29 27·37	4·9209843,9	309 23 51·15	XXXII
„	„	„	„	„	174 25 2·96	4·9011955,8	354 24 22·40	XXV*
	XXXII	Jarúra	27 59 55·94	80 30 38·13	179 50 17·20	4·8684193,0	359 50 16·10	XXIII*
	„	„	„	„	245 0 50·58	4·7950568,1	65 5 47·39	XXV*
	XXIII*	Kokra	28 12 7·34	80 30 35·80	309 56 5·64	4·8693168,3	130 1 4·54	XXV*
39	XXV*	Dahlelnagar	28 4 16·46	80 41 9·41				

NOTE.— Stations XXIII* and XXV* appertain to the North-East Longitudinal Series.

June 1878.

J. B. N. HENNESSEY,
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AMUA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. HEIGHTS ABOVE MEAN SEA LEVEL.

The following table gives, first, the usual data of the observed vertical angles and the heights of the signal and instrument, &c., in pairs of horizontal lines, the first line of which gives the data for the 1st or the fixed station, and the second line the data for the second or the deduced station. This is followed by the arc contained between the two stations, and then by the terrestrial refraction, and the height of the 2nd station above or below the first, as computed from the vertical angles in the usual manner. This difference of height applied to the given height above mean sea level of the fixed station, gives that of the deduced station. Usually there are two or three independent values of the height of the deduced station; the details are so arranged as to show these consecutively and their mean in the columns of "Trigonometrical Results". The mean results thus obtained are however liable to receive corrections for the errors generated in the trigonometrical operations, which are shown up by the spirit leveling operations, whenever a junction between the two has been effected. The spirit leveled determinations are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the leveling operations are adjusted—usually by simple proportion—to accord with the latter. In the table the spirit leveled values are printed thus, **429·42** &c., or, when not very exactly identified, thus **429**, to distinguish them from the adjusted trigonometrical values. The column in which the mean trigonometrical heights are given is barred across where necessary, as after deduction of Stn. XIII from Stn. XII page 36—$_L$ to indicate that one set of adjustment ends and another begins. The trigonometrical heights always refer to the upper mark-stone, or to the upper surface of the pillar on which the theodolite stood; when a spirit leveled height does not refer to either of these surfaces, it is given in combination with a correction, thus $\left\{\begin{array}{l}\mathbf{429 \cdot 42} \\ +16 \cdot 5\end{array}\right.$ and the sum of these two quantities, in this case 445·9, represents the value with which the corresponding trigonometrical mean height 440·3 is comparable. Descriptions follow these tables, exactly indicating the positions of the leveling staff during the determinations of the spirit leveled heights.

When the pillar of the station is perforated, the height given in the last column, is that between the upper surface of pillar and ground level mark-stone in floor of passage; otherwise it is the approximate height of the structure, above the ground at the base of the station.

The heights of the initial stations are taken from the Calcutta Longitudinal Series of the South-East Quadrilateral, page 179—$_B$, Vol. VI, and are as follows:—

XVII 2113·3 }
XIX 1780·1 } feet above Mean Sea Level at Karáchi.

Astronomical Date 1834		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
March	27	9 45	XVII	D 0 12 47·2	4	0·50	4·75	1295	93	·072	− 131·0	1982·3	1981·3	1983	2
„	21	9 45	I	D 0 5 54·9	4	0·50	4·75								
„	30	8 30	XIX	E 0 1 19·6	4	0·50	4·75	871	57	·065	+ 200·2	1980·3			
„	20	8 30	I	D 0 14 17·1	4	0·50	4·75								
„	30	8 15	XIX	E 0 0 45·6	4	0·50	4·75	1440	105	·073	+ 471·3	2251·4	2251·0	2249	2
April	2	8 15	II	D 0 21 27·9	4	0·50	4·75								
March	21	9 15	I	D 0 3 1·6	4	0·50	4·75	1372	111	·081	+ 269·4	2250·7			
April	2	9 15	II	D 0 16 21·7	4	0·50	4·75								

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Astronomical Date 1834		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
March	22	9 0	I	D 0 33 11·1	4	0·50	4·75	1422	153	·107	− 995·1	986·2	993·5	993	2
April	5	9 0	III	E 0 14 22·2	4	0·50	4·75								
„	2	8 0	II	D 0 40 17·2	4	0·50	4·75	1389	118	·085	−1250·3	1000·7			
„	5	8 0	III	E 0 20 52·1	4	0·50	4·75								
March	21	10 0	I	D 0 11 6·9	4	0·50	4·75	878	75	·085	− 126·2	1855·1	1860·3	1860	1·5
April	19	10 0	IV	D 0 1 20·9	4	0·50	4·75								
„	5	8 45	III	E 0 11 33·9	4	0·50	4·75	1425	165	·116	+ 872·0	1865·5			
„	19	8 45	IV	D 0 30 0·6	4	0·50	4·75								
„	5	8 30	III	E 0 9 51·2	4	0·50	4·75	1177	165	·140	+ 590·6	1584·1	1587·4	1588	6·5
May	5	8 30	V	D 0 24 14·0	4	0·50	4·75								
April	24	8 0	IV	D 0 16 57·7	4	0·50	4·75	1457	94	·064	− 269·5	1590·8			
May	5	8 0	V	D 0 4 23·7	4	0·50	4·75								
April	19	9 15	IV	D 0 13 36·5	4	0·50	4·75	1241	84	·068	− 166·2	1694·1	1691·7	1692	3
„	29	9 15	VI	D 0 4 30·6	4	0·50	4·75								
May	5	8 15	V	D 0 5 7·5	4	0·50	4·75	1157	99	·086	+ 101·8	1689·2			
„	1	8 15	VI	D 0 11 6·0	4	0·50	4·75								
„	5	9 45	V	D 0 21 6·5	4	0·50	4·75	1327	116	·087	− 463·7	1123·7	1122·6	1123	0
June	15	9 45	VII	E 0 2 37·7	4	0·50	4·75								
April	30	9 30	VI	D 0 27 25·6	4	0·50	4·75	947	64	·067	− 570·2	1121·5			
June	15	9 30	VII	E 0 13 28·1	4	0·50	4·75								
May	5	9 30	V	D 0 19 4·2	4	0·50	4·75	954	89	·093	− 349·8	1237·6	1238·2	1240	5
June	4	9 30	VIII	E 0 5 49·2	4	0·50	4·75								
„	15	9 15	VII	D 0 5 47·6	4	0·50	4·75	1236	86	·069	+ 116·1	1238·7			
„	4	9 15	VIII	D 0 12 10·6	4	0·50	4·75								
„	15	8 45	VII	D 0 16 42·6	4	0·50	4·75	1000	63	·063	− 273·6	849·0	851·4	849	†
„	18	8 45	IX	E 0 1 52·1	4	0·50	4·75								
„	4	9 0	VIII	D 0 19 30·9	4	0·50	4·75	1294	88	·068	− 384·3	853·9			
„	18	9 0	IX	E 0 0 39·9	4	0·50	4·75								
„	4	8 45	VIII	D 0 30 9·2	4	$10·50	4·75	1218	114	·093	− 769·7	468·5	475·9	481	17·5
„	24	8 45	X	E 0 13 24·2	4	0·50	$6·25								
1836 Novr.	7	3 30	IX	D 0 19 7·1	4	0·50	4·75	1343	90	·067	− 368·2	483·2			
„	10	3 30	X	D 0 0 29·4	4	0·50	4·75								
1839 March	24	*4 36	IX	D 0 20 55·9	10	0·67	4·38	1176	55	·047	− 413·7	437·7	437·7	{427·39 −3}	10‡
„	24	*4 35	XI	E 0 2 57·0	12	0·73	4·88								

* In these instances the chronometer error was not recorded, and hence the times here given have no reference necessarily to the time of day, but are mere chronometer readings. $ These heights are to be combined with negative signs, because the platform at X, Pavia, had an *earthen* platform of 11 feet in height temporarily erected over it so as to overlook a temple in the ray to VIII, Marfa. † Not forthcoming. ‡ Above the tower of the fort on which the station is built.

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Astronomical Date 1837		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Novr.	4	6 8	X	D 0 7 5·6	4	0·00	4·55	1197	325	·271	− 84·6	391·3			
„	4	6 8	XII	D 0 2 18·2	2	0·00	4·86								
1839													408·8	406	23
March	26	5 33	XI	D 0 6 15·9	6	0·71	4·38	929	122	·131	− 11·4	426·3			
„	26	5 34	XII	D 0 5 26·9	8	0·71	4·88								
„	28	5 3	XII	D 0 5 6·0	9	0·79	4·88	750	59	·079	+ 7·7	416·5	416·5	{ 415·62 + 12	12*
„	28	5 3	XIII	D 0 5 46·9	8	0·79	4·50								
1837															
Novr.	10	4 28	XII	D 0 5 12·7	8	0·79	4·23	860	90	·104	+ 15·1	421·1			
„	10	4 31	XIV	D 0 6 26·0	8	0·80	4·86								
1839													423·6	423	17†
March	29	7 17	XIII	D 0 1 59·4	12	1·50	4·67	783	286	·365	− 2·0	426·0			
„	29	7 11	XIV	D 0 1 49·5	12	1·50	4·88								
„	30	7 19	XIV	D 0 1 52·6	12	2·57	4·88	809	268	·332	+ 11·7	435·3	435·3	435	‡
„	30	7 17	XV	D 0 2 53·7	12	1·50	4·67								
1837															
Novr.	24	3 10	XV	D 0 4 53·3	12	0·83	4·43	620	13	·022	+ 4·6	439·9	439·9	439	7†
„	24	3 10	XVII	D 0 5 24·3	12	1·03	4·86								
1839															
March	31	4 40	XV	D 0 6 10·3	8	0·75	4·75	786	22	·028	+ 4·2	439·5			
„	31	4 40	XVI	D 0 6 32·6	12	0·75	4·88						441·1	440	24
April	1	3 37	XVII	D 0 6 22·0	12	0·75	4·67	707	− 26	·036	+ 2·9	442·8			
„	1	3 39	XVI	D 0 6 39·4	13	0·75	4·88								
1837															
Novr.	25	4 0	XVII	D 0 3 42·5	10	0·73	4·28	692	62	·090	+ 24·3	464·2			
„	25	4 0	XVIII	D 0 6 7·6	8	0·73	4·86								
1839													463·0	461·67	8
April	2	3 32	XVI	D 0 4 30·9	8	0·75	4·67	689	24	·035	+ 20·6	461·7			
„	2	3 31	XVIII	D 0 6 33·6	8	0·75	4·88								
Feb.	9	4 17	XVIII	D 0 5 5·4	8	0·75	4·88	643	77	·120	− 15·1	446·6	446·6	449	18
„	9	4 17	XIX	D 0 3 29·1	8	0·58	4·50								
1837															
Dec.	21	6 2	XVIII	D 0 3 30·0	8	0·00	4·63	780	250	·320	− 22·1	439·6			
„	21	5 55	XX	D 0 1 35·1	8	0·00	4·86								
1839													440·3	{ 1429·42 + 16·5	16·5
Feb.	6	6 14	XIX	D 0 2 42·2	8	1·25	4·50	801	261	·326	− 5·7	440·9			
„	6	6 17	XX	D 0 2 14·4	9	1·25	4·88								
„	8	4 53	XX	D 0 4 12·2	8	0·58	4·50	611	96	·157	− 8·8	431·5	431·5	440	15†
„	3	4 54	XXI	D 0 3 14·0	9	0·75	4·88								
1838															
March	6	5 18	XX	D 0 4 0·0	3	0·75	4·79	739	180	·244	− 14·3	426·0			
„	6	5 18	XXII	D 0 2 40·9	4	0·94	4·86								
1839													422·2	430	15
Feb.	2	6 56	XXI	D 0 0 23·7	12	1·25	4·88	720	383	·532	− 12·9	418·6			
„	2	6 56	XXII	E 0 0 49·7	8	1·25	4·67								

* Above the summit of the building on which the station is built. † Above the tower of the fort on which the station is built. ‡ Not forthcoming.

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Astronomical Date 1839		Astronomical Date: Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Jan.	24	4 42	XXII	D 0 2 58·1	8	0·58	4·67	582	153	·262	− 7·3	414·9	414·9	429	18
"	24	4 40	XXIII	D 0 2 7·5	6	0·75	4·88								
1838 March	11	7 7	XXII	E 0 1 31·9	8	0·17	4·46	824	382	·464	+ 53·5	475·7	468·8	480	30
"	11	7 2	XXIV	D 0 2 53·3	10	0·33	4·86								
1839 Jan.	23	4 40	XXIII	D 0 2 50·8	8	0·75	4·88	849	151	·178	+ 46·9	461·8			
"	23	4 44	XXIV	D 0 6 35·6	8	0·58	4·58								
"	22	4 32	XXIV	D 0 5 37·5	8	0·58	4·58	672	61	·091	− 16·6	452·2	452·2	464	30
"	22	4 32	XXV	D 0 3 57·4	11	0·75	4·88								
"	21	7 31	XXV	D 0 1 29·6	12	1·25	4·88	988	368	·372	+ 21·3	473·5	473·5	486	30
"	21	7 26	XXVI	D 0 2 57·2	8	1·25	4·67								
"	17	*5 4	XXVI	D 0 5 28·1	8	0·67	4·67	629	56	·089	− 17·4	456·1	456·1	469	35
"	17	*5 3	XXVII	D 0 3 35·6	8	0·75	4·88								
"	16	*5 33	XXVII	D 0 3 55·8	10	0·75	4·88	845	116	·137	+ 33·5	489·6	489·6	{ 473·28 +30	30
"	16	*5 30	XXVIII	D 0 6 36·6	8	0·67	4·54								
"	10	*4 27	XXVIII	D 0 4 38·4	8	0·67	4·54	567	25	·044	− 1·6	501·7	501·7	{ 47 ·61 +30	30
"	10	*4 29	XXIX	D 0 4 27·5	10	0·75	4·88								
"	9	*4 35	XXIX	D 0 4 52·0	10	0·75	4·88	682	40	·059	+ 7·1	508·8	508·8	{ 484·70 +24	24
"	9	*4 30	XXX	D 0 5 33·7	8	0·58	4·50								
"	8	*3 48	XXX	D 0 5 16·9	8	0·75	4·50	618	14	·022	− 2·9	505·8	505·8	504	24
"	8	*3 52	XXXI	D 0 4 59·4	10	0·75	4·88								
"	7	4 40	XXXI	D 0 1 35·4	10	0·50	4·88	823	246	·299	+ 32·7	538·5	538·5	536	28
"	7	4 36	XXXII	D 0 4 15·9	8	0·50	4·42								
"	6	6 8	XXXII	D 0 1 28·1	8	1·25	4·50	616	305	·495	− 22·5	516·0	516·0	512	28
"	6	6 7	†XXV	E 0 0 59·3	8	1·25	4·88								
"	5	6 0	†XXV	D 0 0 47·9	8	0·25	4·88	731	314	·429	+ 5·9	521·9	521·9	519	26
"	5	6 2	†XXIII	D 0 1 14·1	8	1·25	3·42								

* In these instances the chronometer error was not recorded, and hence the times here given have no reference necessarily to the time of day, but are mere chronometer readings.

NOTE.—Stations †XXIII and †XXV appertain to the North-East Longitudinal Series.

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Descriptions of Spirit-leveled Points.

The spirit-leveled heights given on pages 35—L. to 37—L., were determined by the operations either of the G. T. Survey or the Revenue Survey; these connections are hereafter indicated in the former case by the letters (G. T. S.), and in the latter by (R. S.) immediately following the name of each station; the surface on which the levelling staff stood is also described.

XI	or	*Paprendi Tower Station,*	(R. S.);	On a mark-stone found at 13 feet above the tower of the fort, height = 427·39 feet. From this value, 3 feet (the *approximate* quantity by which the upper mark used in the triangulation is below the mark-stone connected with by spirit-leveling) being subtracted, the height of the *upper* mark-stone of the triangulation is found to be 424 feet.
XIII	„	*Kánákhera Tower Station,*	„ ;	On the lower mark-stone imbedded at summit of the building on which the tower is raised, height=415·62 feet. To this value, 12 feet (the *approximate* height to which the tower was originally carried up) being added, the height of the *upper* mark-stone of the triangulation is found to be 428 feet.
XVIII	„	*Jájmáo Tower Station,*	(G. T. S.);	On the mark-stone let into the upper surface of the platform.
XX	„	*Ráo Tower Station,*	(R. S.);	On the mark-stone imbedded at the level of the ground, over which the platform has been built.
XXVIII	„	*Daráwal Tower Station,*	(G. T. S.);	On the mark-stone imbedded at the level of the ground, over which the tower has been built.
XXIX	„	*Sirwaia Tower Station,*	„	
XXX	„	*Parser Tower Station,*	„	

For further particulars of these stations, see pages 5—L. to 7—L.

July 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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AMUA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XXVI (Nimkár)

Lat. N. 27° 21′ 8″·09; Long. E. 80° 31′ 30″·85 = 5ʰ 22ᵐ 6ˢ·1; Height above Mean Sea Level, 486 feet.
April 1838; observed by Lieutenant T. Renny with Troughton and Simms' 18-inch Theodolite No. 1.

Star observed	*α* Ursæ Minoris (West and East).
Mean Right Ascension 1838·0	1^h 1^m 38^s
Mean North Polar Distance 1838·0	1° 33′ 16″·72
Local Mean Times of Elongation, April 2	Western 6^h 16^m; Eastern 18 20

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark – Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark – Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark – Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Apr. 2	W.	103 28	− 0 31 18·67	14 43	+ 0 12·95	− 0 30 65·72	− 0 31 11·50	1 29	+ 0 0·13	− 0 30 71·37
		&	31 28·33	18 32	0 20·54	67·79	31 10·83	5 32	0 1·83	69·00
		283 28	33 4·67	43 34	1 53·09	71·58	31 54·83	29 10	0 50·80	64·03
			33 17·50	46 5	2 6·44	71·06	32 16·83	34 40	1 11·68	65·15
" 2	E.	103 28	− 3 59 55·50	32 39	− 1 3·60	− 4 0 59·10	− 4 0 39·83	16 53	− 0 17·04	− 4 0 56·87
		&	60 7·50	29 46	0 52·93	60·43	0 45·50	14 41	0 12·90	58·40
		283 28	61 1·00	3 11	0 0·61	61·61	0 47·17	10 41	0 6·85	54·02
			61 5·00	0 36	0 0·02	65·02	0 43·83	12 46	0 9·76	53·59
" 3	W.	113 28	− 0 31 10·50	0 40	+ 0 0·03	− 0 30 70·47	− 0 31 15·83	11 17	+ 0 7·63	− 0 30 68·20
		&	31 7·17	2 43	0 0·44	66·73	31 10·33	8 32	0 4·36	65·97
		293 28	31 31·33	21 17	0 27·08	64·25	31 10·00	10 6	0 6·10	63·90
			31 41 00	23 43	0 33·61	67·39	31 12·67	12 22	0 9·16	63·51
" 4	W.	123 28	− 0 31 36·00	21 32	+ 0 27·81	− 0 30 68·19	− 0 31 13·33	10 47	+ 0 6·97	− 0 30 66·36
		&	31 29·83	18 12	0 19·85	69·98	31 8·67	8 22	0 4·19	64·48
		303 28	31 7·17	2 6	0 0·26	66·91	31 10·00	8 37	0 4·45	65·55
			31 8·83	0 43	0 0·03	68·80	31 13·17	11 1	0 7·26	65·91

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark − Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark − Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Apr. 5	W.	133 29	− 0 31 20·83	14 54	+ 0 13·31	− 0 30 67·52	− 0 31 6·33	6 32	+ 0 2·56	− 0 30 63·77
		&	31 18·83	12 12	0 8·93	69·90	31 5·17	4 33	0 1·24	63·93
		313 28	31 8·83	2 13	0 0·29	68·54	31 13·33	12 21	0 9·12	64·21
			31 10·00	3 52	0 0·89	69·11	31 16·67	14 23	0 12·37	64·30
" 5	E.	133 29	− 4 0 31·50	21 2	− 0 26·44	− 4 0 57·94	− 4 0 44·00	12 22	− 0 9·16	− 4 0 53·16
		&	0 35·83	19 4	0 21·73	57·56	0 46·83	10 42	0 6·85	53·68
		313 28	0 59·67	3 56	0 0·93	60·60	0 52·17	5 51	0 2·05	54·22
			0 59·00	2 10	0 0·28	59·28	0 49·67	8 2	0 3·87	53·54
" 6	W.	153 29	− 0 31 9·33	5 38	+ 0 1·90	− 0 30 67·43	− 0 31 17·67	16 12	+ 0 15·72	− 0 30 61·95
		&	31 6·83	3 44	0 0·84	65·99	31 11·50	14 9	0 12·00	59·50
		333 29	31 19·17	16 6	0 15·52	63·65	31 1·17	4 38	0 1·29	59·88
			31 28·33	18 31	0 20·49	67·84	31 4·50	7 22	0 3·25	61·25
" 6	E.	113 28	− 4 0 59·50	4 39	− 0 1·30	− 4 0 60·80	− 4 0 36·83	17 54	− 0 19·18	− 4 0 56·01
		&	1 0·83	2 52	0 0·49	61·32	0 42·50	15 12	0 13·84	56·34
		293 28	0 50·00	12 38	0 9·56	59·56	0 54·33	4 21	0 1·14	55·47
			0 47·17	14 40	0 12·88	60·05	0 54·67	5 46	0 1·99	56·66
" 7	W.	143 29	− 0 31 7·50	5 9	+ 0 1·58	− 0 30 65·92	− 0 31 16·00	14 43	+ 0 12·99	− 0 30 63·01
		&	31 6·33	3 3	0 0·56	65·77	31 12·00	12 48	0 9·82	62·18
		323 29	31 31·33	19 34	0 22·89	68·44	31 4·33	6 22	0 2·43	61·90
			31 35·83	21 23	0 27·34	68·49	31 6·50	8 41	0 4·51	61·99
" 7	E.	123 29	− 4 0 40·67	16 20	− 0 15·60	− 4 0 56·27	− 4 0 53·83	6 56	− 0 2·88	− 4 0 56·71
		&	0 46·50	14 25	0 12·44	58·94	0 54·33	5 22	0 1·73	56·06
		303 28	0 57·83	2 30	0 0·37	58·20	0 45·17	12 41	0 9·64	54·81
			0 54·83	4 22	0 1·14	55·97	0 40·67	14 34	0 12·71	53·38
" 8	E.	143 29	− 4 0 37·67	17 56	− 0 19·23	− 4 0 56·90	− 4 0 52·50	7 51	− 0 3·68	− 4 0 56·18
		&	0 38·83	15 32	0 14·45	53·28	0 53·83	5 59	0 2·15	55·98
		323 29	0 56·50	1 32	0 0·14	56·64	0 40·00	16 59	0 17·30	57·30
			0 54·50	3 33	0 0·76	55·26				
" 9	E.	153 29	− 4 0 39·50	19 8	− 0 21·91	− 4 0 61·41	− 4 0 50·17	11 19	− 0 7·67	− 4 0 57·84
		&	0 40·17	17 45	0 18·84	59·01	0 51·50	9 52	0 5·83	57·33
		333 29	0 58·00	3 30	0 0·74	58·74	0 57·50	4 21	0 1·14	58·64
			0 58·83	1 55	0 0·22	59·05	0 54·50	6 10	0 2·28	56·78

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Abstract of Astronomical Azimuth observed at XXVI (Nimkár) 1838.

1. By Eastern Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	103°	283°	113°	293°	123°	303°	133°	313°	143°	323°	153°	333°
Date	April 2		April 6		April 7		April 5		April 8		April 9	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	59·10	56·87	60·80	56·01	56·27	56·71	57·94	53·16	56·90	56·18	61·41	57·84
	60·43	58·40	61·32	56·34	58·94	56·06	57·56	53·68	53·28	55·98	59·01	57·33
	61·61	54·02	59·56	55·47	58·20	54·81	60·60	54·22	56·64	57·30	58·74	58·64
	65·02	53·59	60·05	56·66	55·97	53·38	59·28	53·54	55·26		59·05	56·78
Means	61·54	55·72	60·43	56·12	57·35	55·24	58·85	53·65	55·52	56·49	59·55	57·65
	° ′ "		"		"		"		"		"	
Means of both faces	− 4 0 58·63		58·28		56·29		56·25		56·01		58·60	
Az. of Star fr. S., by W.	181 44 54·86		56·14		56·44		55·87		56·77		57·11	
Az. of Ref. M. "	177 43 56·23		57·86		60·15		59·62		60·76		58·51	

2. By Western Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	103°	283°	113°	293°	123°	303°	133°	313°	143°	323°	153°	333°
Date	April 2		April 3		April 4		April 5		April 7		April 6	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	65·72	71·37	70·47	68·20	68·19	66·36	67·52	63·77	65·92	63·01	67·43	61·95
	67·79	69·00	66·73	65·97	69·98	64·48	69·90	63·93	65·77	62·18	65·99	59·50
	71·58	64·03	64·25	63·90	66·91	65·55	68·54	64·21	68·44	61·90	63·65	59·88
	71·06	65·15	67·39	63·51	68·80	65·91	69·11	64·30	68·49	61·99	67·84	61·25
Means	69·04	67·39	67·21	65·40	68·47	65·58	68·77	64·05	67·16	62·27	66·23	60·65
	° ′ "		"		"		"		"		"	
Means of both faces	− 0 30 68·22		66·30		67·02		66·41		64·71		63·44	
Az. of Star fr. S., by W.	178 15 5·31		4·97		4·63		4·30		3·73		3·97	
Az. of Ref. M. "	177 43 57·09		58·67		57·61		57·89		59·02		60·53	

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At XXVI (Nimkár)—(*Continued*).

		° ′ ″
Astronomical Azimuth of Referring Mark	by Eastern Elongation	177 43 58·86
	by Western „	„ 58·47
	Mean	„ 58·67
Angle Referring Mark and XXVIII (Daráwal) *see* below ... ... +		1 14 28·99
Astronomical Azimuth of Daráwal by observation		178 58 27·66
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* page 33—L. *ante*		178 58 23·01
Astronomical—Geodetical Azimuth at XXVI (Nimkár) ... ... +		4·65

At XXVI (Nimkár)

April 1838; *observed by Lieutenant T. Renny with Troughton and Simms'* 18-*inch Theodolite No.* 1.

Angle between	Means of Circle-readings, telescope being set on R. M.												General Mean
	283° 28′	103° 28′	293° 28′	113° 28′	303° 28′	123° 28′	313° 28′	133° 28′	323° 29′	143° 29′	333° 29′	153° 29′	
R.M. & XXVIII	″ 28·42 (2)	″ 30·17 (2)	″ 28·50 (2)	″ 30·58 (2)	″ 29·00 (2)	″ 30·58 (2)	″ 29·50 (2)	″ 27·83 (2)	″ 27·58 (2)	″ 29·50 (2)	″ 27·42 (2)	″ 28·75 (2)	1° 14′ 28″·99

July 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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AMUA MERIDIONAL SERIES.

ALPHABETICAL LIST OF PROPER NAMES.

The major portion of the text of this Series having been printed prior to 1871, the spelling of Indian proper names occurring therein was necessarily in accordance with the rules introduced by Colonel Everest for use in the Survey Department. Subsequently the Government issued a modification of these rules, but as it was not desirable to introduce a change of system in the middle of the publication, Colonel Everest's method was adopted throughout the Series, excepting in the Addendum, beginning with page 9*—L, which, being printed only recently, is in accordance with the Government method. Now that the publication of the Series is finished, it appears desirable to give the proper names in question by both systems of spelling; this is accordingly done in the following table, where the first column of each pair states the spelling adopted and the second column gives the corrected orthography as required by Government rules. Where the methods are identical the second column is left blank.

Orthography		Orthography		Orthography	
By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules	By old or Survey rules	By new or Government rules
Alíganj	Aliganj	Gházípúr	Gházipur	Máwa	
Amarpatan	Amarpátan	Gúmti	Gumti	Mirzapore	Mirzapur
Amúa	Amua	Haidarábád	Haidarabad	Músápúr	Músapur
Asu		Harha		Nagode	
Badaosa	Badausa	Jafrábád	Jáfrabad	Namána	
Bakseria		Jájmáo	Jájmau	Nimkár	
Banda	Bánda	Jalhotr	Jhalotar	Pailáni	
Baraoli	Barauli	Jarúra		Panna	
Bindki		Jehánábád	Jahánabad	Paprendi	
Bindráchal	Vindhyáchal	Jubbulpore		Parser	
Bírapáhár	Bírapahár	Kaimúr		Patra	
Bulandpúr	Bulandpur	Kánákhera		Pavia	
Cawnpore		Kartár		Pilibhít	
Chitarkoti	Chitarkot	Khairábád	Khairabad	Potenda	
Chúnba		Kokra		Ráo	Rau
Dágri		Kora		Rasúlábád	Rasúlabad
Dahlelnagar		Koti	Kothi	Rewah	
Daráwal		Lakanpúra	Lakhanpura	Ságar	Saugor
Dewarsán		Lakna		Sandaila	Sandíla
Dharkána		Lassípúr	Lassípur	Sárang	
Ethwáñ	Ethwán	Macherhata	Machhrehta	Sarh Salempúr	Sárh Salímpur
Etora		Mádhogarh		Seonda	Sihonda
Fatenagar	Fatehnagar	Mahamdi	Muhamdi	Sirwaia	
Fatepúr	Fatehpur	Maihar		Siwaganj	Síwáganj
Ganges		Marfa	Marpha	Terai	Tarái

August, 1882.

J. B. N. HENNESSEY,
In charge of Computing Office.

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KARARA MERIDIONAL SERIES.

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KARARA MERIDIONAL SERIES.

INTRODUCTION.

The Karára Series is the fourth in order—reckoning eastwards from the Northern Section of the Great Arc—of the Meridional chains of triangles included in the North-East Quadrilateral. It emanates at the side Karára-Marwás of the Calcutta Longitudinal Series—in Baghelkhand, south of the river Son, (Soane)—and follows the meridian of Karára, 81° 18′, as closely as the nature of the country permitted. It spans a meridional distance of about 250 miles, and though commenced in the field season of 1837-38 was not brought to a close until 1844-45.

For the first 110 miles of its length, the Series is carried as a double chain of triangles traversing portions of the Districts of Allahabad, Banda and Fatehpur, and of the Native States of Rewah, Soháwal and Panna. The first 90 miles are situated on the Kaimúr range and the high land which, generally speaking, forms the southern watershed of the Gangetic plain between the meridians of 81° and 82°: the remaining 20 miles cross the lower end of the Doáb between the Jumna and the Ganges. The Series is thereafter continued as a chain formed for the most part of single triangles, through portions of the Districts of Rae Bareli, Bara Banki, Sitapur and Partabgarh, in the Province of Oudh, and it terminates at the side Khánpur-Mási of the North-East Longitudinal Series, in the plains at the feet of the Himalayan Mountains.

Season 1837-38.
PERSONNEL.
Lieut. W. Jones, Bengal Engineers, 1st Asst.
Mr. J. Scully, 2nd Class Sub-Assistant.

In January 1838 Lieutenant Jones of the Bengal Engineers, who was then employed on the measurement of the Sironj Base-Line, was directed by the Surveyor General to organize a small native establishment and make all other necessary preparations with a view to commencing the Karára Series before the close of the current field season. Owing to the paucity of officers available only one assistant could be attached to the party.

The party arrived at Karára on the 1st of March, when Lieutenant Jones and Mr. Scully immediately commenced selecting stations for the required triangulation. In those early days of the survey the opinion was generally held that the links composing a chain of principal triangles should be the fewest possible, and therefore that the sides of the triangles should not be less than 20 miles in length. This restriction, coupled with the prescribed

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conditions for securing symmetry, hampered Lieutenant Jones greatly and materially retarded his progress. Thus, writing to the Surveyor General on the 18th May, he reports that "both the result of a minute examination of the ground as far as 60 miles to the north of "Karára and the repeated failures I have met with in my attempts to procure good and "symmetrical triangles compel me to state that I do not expect to succeed in producing such "work as I could wish, and as I feel that you will expect from me". Of one side Kaimúr-Jaliádhar, the shortness of which—seventeen miles—seems to have been a source of considerable concern to him, he says "it was not adopted until I had used every endeavour "during six weeks to get a better one,—until I had myself visited every part of the range "that appeared to offer the remotest chance of success, and cleared much of the heavy jungle "which considerably increases the difficulty of finding two points on this range mutually "visible and yet sufficiently distant". Eventually these difficulties led him to recommend the extension of the "work to the northward by a double series or succession of polygons using short sides"; this was assented to by the Surveyor General as being "very feasible and proper". Five principal stations had been selected by the commencement of June, when the rainy season commenced and sickness broke out in the camp. Lieutenant Jones thereupon proceeded to recess quarters at Allahabad.

Season 1838-39.

PERSONNEL.

Lieut. W. Jones, Bengal Engineers, 1st Asst.
Mr. J. Scully, 1st Class Sub-Assistant.

Lieutenant Jones marched out of Allahabad on the 1st October; but before he had fairly resumed work, the whole camp was seized with jungle fever which compelled him to return to Allahabad. Mr. Scully fell a victim to the disease, and died on the 18th November: Lieutenant Jones himself and the entire native establishment were reduced to such a state of prostration as to leave the Surveyor General no alternative but to suspend the operations, and direct Lieutenant Jones to proceed when sufficiently recovered to join him at Kaliána, where he might be suitably employed in learning the use of the Great Astronomical Circles which were employed on the Great Arc in obtaining determinations of latitude for geodetic requirements; one of these instruments was then being employed there, simultaneously with another at Kaliánpur, in determining the differential latitude, or arc of amplitude between the two stations.

At the commencement of the field season of 1839-40 Lieutenant Jones again proceeded to resume the Karára Series, with the aid of two assistants, Messrs. C. Lane and J. W. Rossenrode; but on the third march from the Head Quarters in Dehra Dún he was taken so seriously ill with jungle fever, that he had to abandon the undertaking, take sick leave, and eventually resign his appointment in the Survey Department.

Season 1841-42.

PERSONNEL.

Captain R. Shortrede, 2nd Bombay European Regiment, 1st Assistant.
Babu Ramdial De, 3rd Class Sub-Assistant.
Mr. D. Kirwan, do. do.

During the recess of 1841 Captain R. Shortrede—of the Bombay Army—was appointed to conduct the Series, and to organize an establishment for the resumption of the work from the point where it had been left by Lieutenant Jones three years previously. The party left the Head Quarters in Dehra Dún early in October; but, owing to various delays and mishaps, it did not reach the first station of operation, Jaliádhar, until the 8th of February, when

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the most favorable season of the year for observing had already gone by, and the opportunity was thus lost for pushing the work across a malarious tract of country in which an outbreak of sickness might at any time compel the party to leave the field. The remainder of the month was spent in clearing hill summits of forest. The next month was for the most part spent at the station of Marwás, where Captain Shortrede hoped to commence the observations of the principal angles; but the haziness of the atmosphere rendered all the signals—both lamps and heliotropes—to be wholly invisible. Captain Shortrede therefore moved on to Karára, where the atmosphere proved to be even worse than at Marwás, so that no terrestrial angles could be observed. "On some days", wrote Captain Shortrede, "I could scarcely see the hill at about two miles distance on which I had the referring-mark". On one day the Marwás heliotrope was seen, but it was flaring and unsteady to such a degree that not a single satisfactory measure of the angle between it and the referring-mark could be got. A complete set of angles between a referring-mark and a circumpolar star was however measured here, in order to obtain a direct astronomical determination of the azimuth at Karára, to be employed as the fundamental azimuth of the Series in lieu of the value of azimuth which had been brought up from Sironj through the Calcutta Longitudinal Series. It consisted of two measures of the angle between the mark and the star on each of 12 'zeros', or settings of the horizontal circle of the principal theodolite, Troughton and Simms' 18-inch No. 1.* Complete sets of observations were taken at both elongations of the star, and very satisfactorily; but they form the sum total of the work of final observing which was accomplished during this season. They were concluded on the 8th of April, when Captain Shortrede proceeded to recess quarters at Allahabad, reporting that in the existing state of the weather and with a sick list continually increasing (he had already lost 7 men of his establishment, and had 20 others sick in hospital) he felt that it would be an unwarrantable exposure of human life to remain longer in the field, and that it was his duty to move for the recess season into Allahabad, where the sick might have a better chance of recovery.

Season 1842-43.

PERSONNEL.

Captain R. Shortrede, 2nd Bombay European Regiment, 1st Assistant.
Mr. J. W. Armstrong, 1st Class Sub-Assistant.
Babu Ramdial De, 3rd do.
Mr. D. Kirwan, do. do.

In the following field season the party, strengthened by Mr. J. W. Armstrong—who had acquired considerable experience in the principal triangulation, having been employed for some time on the Rangír Series—left Allahabad on the 15th of November 1842, and made such good progress that by the end of the field season all the stations south of the Jumna had been selected, and the principal observations had been completed for a distance of about 65 miles from the side of origin.

But the general design of the triangulation as laid out by Captain Shortrede differed materially from what had originally been intended by Colonel Everest, in that it consisted of a continuous net-work of triangles in which mutual observations were taken between all stations—however far apart—that happened to be mutually visible, instead of forming a succession of simple polygonal figures in which the mutual observations were restricted to the

* For a description of this instrument see pages 61 to 64 of the Appendices to Vol. II, and for an account of its peculiarities see page 96, and Appendix No. 4 of the same volume.

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stations lying contiguous to each other. Theoretically of course the net-work is the best, as it ties the triangulation together more thoroughly; but practically it is far the most troublesome and tedious, to execute originally, and to treat eventually in the course of the general reduction of the triangulation; it is moreover very variable in its influence, tending to strengthen some portions of the net-work much more than other portions. For these reasons it had been deliberately rejected by Colonel Everest in favour of the simpler system of successive independent geometrical figures, which had been introduced on all the other chains of triangles executed up to that time, and has since been uniformly adopted.

On the termination of the field season the party retired to recess quarters at Allahabad where it arrived on the 2nd of June.

Season 1843-44.

PERSONNEL.

Captain R. Shortrede, 2nd Bombay European Regiment, 1st Assistant.
Mr. J. W. Armstrong, 1st Class Sub-Assistant.
„ D. Kirwan, 2nd „ „
Babu Ramdial De, 3rd „ „

Field operations were resumed on the 1st November, Captain Shortrede having meanwhile suggested that the triangulation should be extended over the plains to the north as a chain of single triangles, thus departing not only from his original net-work which had become quite impracticable, but from the simple polygonal form which might have been adopted. Captain Waugh, who had then succeeded Colonel Everest as Surveyor General, directed that the polygonal system should be adhered to as far as practicable; but that if much progress had already been made in laying out the Series as a chain of single triangles, it would not be right to incur the expense and delay which the abandonment of work already performed would occasion; otherwise, as there was no special difficulty in carrying the polygonal system over the country in which the operations were being conducted, he particularly wished that that system should not be departed from.

The selection of stations for a principal triangulation over a perfectly level plain—more particularly when richly cultivated and covered with towns, villages and trees—is, however, an undertaking which requires considerable practical experience, so that surveyors who have been operating for years with great success in a hilly country, may find themselves completely baffled and unable to advance, when they enter on an extensive plain covered with obstacles to distant vision and wholly devoid of commanding eminences. Thus in the early days of this Survey some years elapsed before the most appropriate method of operating in such plains was fully elaborated, as will be seen on reference to Section 3 of Chapter II of Volume II which gives a historical sketch of the successive methods adopted for the selection of stations. Captain Shortrede and his assistants had not as yet become sufficiently acquainted with the proper methods of procedure, and thus the selection of stations and the clearing of the lines between them proceeded very slowly; thus, during this season only five new stations were selected and prepared, by the construction of a tower* at each, as points of observation, and of these stations two were afterwards rejected; the measurement of the principal angles was correspondingly retarded, observations being taken at three stations only, *viz.*, Lálapur, Bagála and Pabhosa.

* NOTE.—The average height of these five towers was 32 feet; the average time occupied in their construction was a month and twenty days; and their average cost 440 Rupees.

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Captain Waugh, having called for copies of the angle books containing the observations of the last two seasons, found that Captain Shortrede had departed from the system of observing which had been introduced by Colonel Everest and was then generally practised in this Survey,* and of which it was a leading feature that two or more observations of every angle should be made at each zero-setting of the azimuthal circle, and the mean taken, the whole being recorded separately from the observations at the other zero-settings. Captain Shortrede took only one observation of an angle at each zero-setting, and he combined the pairs of single observations which were taken at 180° apart—with reversed faces—into one, as if both had been taken on a single zero. By this means his observations escaped criticism, as they were never repeated on the same divisions of the circle, and they became to all appearances much more accordant, having been combined together in a way that—as it so happened†—concealed a large portion of the instrumental error, which was obviously objectionable.

Captain Waugh moreover found that the reduction of the net-work of triangulation, which has already been mentioned, would require the simultaneous solution of about 200 equations of condition, the labour of which would be quite out of proportion to the value of the results; he therefore directed the exclusion of certain stations and the omission of all observations which were redundant, thereby reducing the principal triangulation of the Series to the form in which it now appears; all redundant stations were treated as secondaries.

Season 1844-45.

PERSONNEL.

Southern Section:
- Captain R. Shortrede, 2nd Bombay European Regiment, 1st Assistant.
- Mr. J. W. Armstrong, 3rd Principal Sub-Assistant.
- Mr. D. Kirwan, 2nd Class Sub-Assistant.
- „ J. B. N. Hennessey, 3rd Class Sub-Assistant.

Northern Section:
- Captain J.S. Du'Vernet, 2nd Madras European Regiment, 1st Assistant.
- Mr. J. Mulheran, 1st Class Sub-Assistant.
- „ W. Glynn, 2nd „ „

In order to expedite the completion of the Series, Captain Waugh deputed a second party, under Captain J. S. Du'Vernet, to operate at the northern end during the field season of 1844-45, commencing at a side of 'the North Connecting Series'—now known as the North-East Longitudinal Series—which had been established during the previous field season, in close proximity to the Karára meridian. He also directed the abandonment of polygonal figures and the adoption of single triangles, in both sections of the Series, "whereby the operations will be greatly accelerated, although this object will be only obtained at the sacrifice of some degree of precision"; he enjoined however that the single triangles were to be laid out "with every attention to symmetry and elegance".

The direct distance between the parallel up to which the triangulation had been completed, and the side of the 'North Connecting Series' on which it was intended to close, was about 160 miles. In this distance about 25 miles had been already prepared in the southern section by the construction of tower stations, and opening the lines between them, during the previous field season. In the northern section however no preparations had been made; nevertheless Captain Du'Vernet succeeded in carrying his triangulation down to the side Sora-Janai, thus completing a chain of 15 triangles which extended over a

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* For full particulars of this system see Section 2 of Chapter II, Volume II, and for a brief outline see Section 1 of Chapter II of Volume VII.

† For an explanation of this see page 96 and Appendix 4 of Volume II.

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direct distance of about 90 miles in a single field season, and executing much more than half the amount of work which remained to be accomplished.

In the southern section matters did not at first progress equally satisfactorily. When the better part of the field season was over, Captain Shortrede's services were placed at the disposal of the Bombay Government for other duties, and the charge of the party was made over to Mr. J. W. Armstrong. He set to work with great vigour to complete this section by carrying it up to the side to which the northern section was being brought down by Captain Du'Vernet; and by dint of great perseverance, and continuing to operate in the field until the middle of July, long after the hot weather had set in, he succeeded not only in accomplishing the task which he had undertaken, but in revising some angles of which the previous measures were discordant and unsatisfactory, and in improving a group of single unsymmetrical triangles by converting it into a tetragon. He also observed an azimuth of verification at Pabhosa.

The 18-inch Theodolite by Troughton and Simms which had hitherto been used by Captain Shortrede, was replaced at the commencement of this season by an 18-inch Theodolite by Cary, which had originally been obtained from the Madras Observatory and is described at page 68 of the Appendices to Volume II. But this instrument being also deemed unsatisfactory was replaced, in the month of April, by Harris and Barrow's 15-inch Theodolite, which had given very satisfactory results in Mr. Armstrong's hands on the Rangír Series, and is described at page 72 of the Appendices to Volume II.

The measurement of the principal angles in the northern section was executed by Captain Du'Vernet, with Saiyad Mir Mohsin's 18-inch Theodolite, described at page 67 of the Appendices to Volume II.

By the completion of the Karára Series the circuit of triangles which is formed by the Northern Section of the Great Arc and the Karára Series, and the sections of the two longitudinal chains at their extremities by which the two meridional chains are connected together, was also completed. The values of the closing errors as derived from the calculations of that time—which however were only approximate and preliminary to the final reductions—were small in latitude and longitude, but so large in side and azimuth that Captain Waugh proceeded in person to the station of Sora, at the side of junction between the two sections of the series, and determined an azimuth of verification there, by astronomical observations with the theodolite used by Captain Du'Vernet. The results led him to the conclusion that the southern portion of the Karára Series was the more defective of the two. Still however he was of opinion that the closing errors were "evidently of an accu- "mulative character, arising in fact from a want of minute precision in the instrumental "means employed, and therefore only to be remedied by a revision of the work with superior "means". The errors however were insignificant from a geographical point of view, and would exercise no effect on the Indian Atlas; they were also too minute to influence local topographical and revenue survey operations. Thus the Surveyor General, though distressed by their magnitude, concluded that he would not be "justified in recommending a revision "of the work, because an urgent necessity exists for extending the trigonometrical opera-

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"tions over other parts of the country remaining to be triangulated".

On the completion of the Simultaneous Reduction of the North-East Quadrilateral, it was found that the errors which had actually been dispersed over the Karára Series, between the origin Karára-Marwás and terminus Khánpur-Mási, were as follows:—

In side	Logarithm	+ 0·000,0508,7
	giving a ratio of about $7\frac{1}{8}$ inches per mile.	
„	Latitude	+ 0″·826
„	Longitude	+ 0 ·047
„	Azimuth	− 7 ·833

The trigonometrical determinations of the heights of the stations of this Series above the mean sea level, have been corrected by connecting the stations, wherever possible, with the lines of spirit levels which have been executed of late years in the course of operations in the Trigonometrical and the Revenue branches of the Survey Department. A list of the stations which have been so connected will be found on page 55—M; a statement of the several sections into which the Series is divided, as well as the method of adjustment employed is detailed on page 39 of Part I of Volume VII. It will here suffice to state that the spirit levels show that occasional errors of a magnitude which reaches a maximum of 7·7 feet have been made in the trigonometrical determinations of differences of level between contiguous stations; but in the long run these errors have a tendency to cancel each other, the total error generated between the sides of origin and terminus being less than the maximum single error.

Secondary Triangulation.

In the southern portion of the Series the principal stations are all situated on hills, and here therefore the secondary triangulation consists of the measurement of angles at those stations to fix all the most prominent and important points visible from them, such as the temples in Rewah. The angles were measured with the 18-inch theodolite which was employed for the principal triangulation. Usually two angles only of each triangle were measured, the point itself being unvisited; but in a few instances the points are stations of the net-work of triangulation which was primarily designed by Captain Shortrede and afterwards converted into a chain of simple consecutive figures by the elimination of superfluous stations; in these instances the third angle also was measured with the 18-inch theodolite.

On entering the plains it became necessary to fix points in and around the important city of Allahabad, lying about 20 miles to the east of the Series. Observations were taken from the stations of Bagála (XII) and Singraur (XV), with the 18-inch theodolite, which fixed a station in the Fort and the steeple of the Church, and thus furnished a base around which a minor triangulation was executed—probably with a 12-inch theodolite—by Mr. Mulheran when residing in Allahabad during the recess of 1845. In the following field season a chain of secondary triangles was carried up the Ganges from Mirzapore to Allahabad—

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as a part of the operations of the Gurwáni Series—and extended to Singraur (XV), by Mr. Glynn; a branch chain was carried by Mr. Mulheran from Allahabad to Bagála (XII), passing through and connecting with his triangulation of the preceding year; both chains were executed with 12-inch theodolites. These triangulations have been adjusted to fit between the finally determined position-values of the principal stations of the two series on which they rest; the portion including and lying to the west of Allahabad is now published as appertaining to the Karára Series, while that to the east has been allotted to the Gurwáni Series.

A few secondary points were fixed in the vicinity of the side Karra (XVI) to Pariáon (XVIII) by a ray-trace triangulation executed by Mr. Mulheran in 1845. In the same year a point in the town of Rae Bareli, and a few other secondary points, were fixed by ray-trace triangulations depending on the sides Sora (XXIV) to Janai (XXV), Thána (XXXVII) to Imlia (XXXVI), and the terminal side Khánpur to Mási, in connection with Captain Du'Vernet's operations.

In 1845 Mr. Glynn was deputed by Captain Du'Vernet to carry a series of triangles with a 12-inch theodolite, from the side Pesar (XXX) to Utiámau (XXXII) up to the city of Lucknow, in order to fix points of importance in and around that city. It was supplemented and extended a few months subsequently by Mr. Mulheran. The stations of the triangulation not having been permanently marked are not now forthcoming; consequently the usual data of the triangles are not given, but merely the latitudes and longitudes of the domes, buildings and other permanent marks of which the positions were determined*.

In season 1852-53 a chain of secondary triangles was carried up the Gogra River, in connection with the operations of the Huriláong Meridional Series; it crosses the terminal side of the Karára Series, and connects with the station of Mási, at the eastern extremity of that side. The details appertaining to stations No. 164 to 217 of this river triangulation are now published as a portion of the Karára Series. The angles were measured with a 12-inch theodolite by Mr. Belletty. This triangulation has been adjusted to fit exactly between the finally determined position-values of the station Mási and the station Orejhár, the latter being No. XXIV of the Gurwáni Series.

C. WOOD,

Surveyor 2nd Grade.

MUSSOOREE:
May 1881.

* One of these was the site of the transit telescope in the Royal Observatory, the astronomically determined position of which—as deduced by Lieut-Colonel Wilcox—was as follows:—

Latitude 26° 51′ 17″·8, by observations with the mural circle in 1842.
Longitude 80 59 11 ·4, by observations on moon culminating stars in 1841.

The corresponding trigonometrically deduced values are { Lat. 26° 51′ 12″·9 / Long. 80 58 57 ·6

Thus the astronomical determination of latitude exceeds the trigonometrical by 4″·9, which shows that—assuming both to be exact—the proximate local attractions to the south are more influential on the direction of the plumb line in Lucknow than the attraction of the distant Himalayan ranges to the north. The astronomical determination of longitude differs from the trigonometrical by less than 14″; the latter rests on an astronomical determination at Madras which was made within a few years of the one at Lucknow—see Chapter XI of Vol. II—and is now known to be about 2′ 30″ in excess of the true longitude from Greenwich; thus it seems probable that the astronomical longitudes of Madras and Lucknow were both affected in a nearly equal degree by the errors of the then existing Lunar Tables.

J. T. W.

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ALPHABETICAL LIST OF STATIONS.

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NUMERICAL LIST OF STATIONS.

XXIII	Karára. (of Calcutta Longitudinal Series).
XXVI	Marwás. (of Calcutta Longitudinal Series).
I	Kaimúr.
II	Jalíádhar.
III	Dádar.
IV	Náru.
V	Burwa.
VI	Kotar Kaimári.
VII	Doñri.
VIII	Sirmaol.
IX	Kachár.
X	Mhao.
XI	Lálápúr.
XII	Bagála.
XIII	Pabhosa.
XIV	Nagdílpúr.
XV	Singraor.
XVI	Karra.
XVII	Majilgáoñ.
XVIII	Pariáoñ.
XIX	Horesa.
XX	Sálaon.
XXI	Tángan.
XXII	Khára.
XXIII	Munai.
XXIV	Sora.
XXV	Janai.
XXVI	Taoli.
XXVII	Tikiri.
XXVIII	Parewa.
XXIX	Basantpúr.
XXX	Pesar.
XXXI	Turkani.
XXXII	Utíámáo.
XXXIII	Amoli.
XXXIV	Samnadío.
XXXV	Ragaopúr.
XXXVI	Imlía.
XXXVII	Thána.
XXXVIII	Asrafpúr.
XXXIV	Khânpúr. (of North-East Longitudinal Series).
XXXV	Mási. (of North-East Longitudinal Series).

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KARARA MERIDIONAL SERIES.

DESCRIPTION OF PRINCIPAL STATIONS.

Of the 38 Principal Stations composing this Series, the 13 southernmost, as also the 2 initial stations, are on hills, and consist generally of low solid platforms, each carrying a mark at its upper surface and having a corresponding mark below; in a few instances the station is denoted by a pile of stones, on which the usual mark of a circle and dot is fixed, or in the absence of any platform this mark is engraved on the rock *in sitû*. When the Series entered on the plains, suitable artificial elevations had to be constructed, as usual, to admit of overlooking the curvature of the globe. At the first 10 stations, each of these structures consists of a basement 28 to 32 feet in diameter and 3 to 6 feet high, with a mark-stone fixed in its upper surface; this surface carries a masonry pillar, which in some instances is solid and includes at least one mark-stone and in others is perforated throughout its length: the pillar is either square or circular at base and 7 to 8 feet in width, terminating at top in a circle 4 feet in diameter; it is enclosed in a tower of unburnt bricks varying in diameter from 20 to 27 feet at base and from 16 to 21 feet at top: the tower is commonly faced with burnt brick as a protection against rain. At each of the remaining 15 stations of the Series as well as at the 2 terminal stations, the internal masonry pillar is without exception of the solid kind, while the external diameter of the tower varies from 17 to 22 feet at base and from 11 to 14 feet at top: the structure at one of these terminal stations, *viz.* Mási, underwent considerable alteration when revisited in course of the operations of the North-East Longitudinal Series.

The following descriptions have been compiled from those given in the original MS. General Report and other original records of this Series, supplemented in respect to the neighboring villages by information obtained from the Revenue and Topographical Survey maps of the country traversed. The information as to the local sub-divisions in which the several stations occur has been derived from the latest Annual Reports received from the District officers to whose charge the stations have been committed.

XXIII.—(*Of the Calcutta Longitudinal Series*). Karára Hill Station, lat. 24° 5′, long. 81° 18′—observed at in 1827, 1842 and 1865—is situated on the highest point of a small range of hills running north-east and south-west, and is distant about 3 miles E.N.E. of the village of Karára; pargana Mádhogarh of the

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Rewah territories.

The pillar is solid and contains two marks, the upper 3·0 feet above the lower, which is engraved on the rock *in sitû*, having been placed there in 1827. The station was revisited in 1842 for the purpose of originating the Karára Meridional Series, but no alteration in its construction appears to have been made. On again visiting it in 1865, the upper mark was found displaced, and a new pillar carrying a mark-stone at summit in the normal of the old lower mark was then built to the same height as before. The distances and bearings of surrounding villages are:—Dal 1·6 miles W. by N.; Harai 1·8 miles E. by S.; and Mer 1·4 miles S.W.

XXVI.—(*Of the Calcutta Longitudinal Series*). Marwás Hill Station, lat. 24° 5′, long. 81° 49′—observed at in 1827, 1828, 1842 and 1865—is situated on a range of hills running east and west about 2 miles S.S.W. of the town of Marwás; pargana Marwás of the Rewah territories.

The pillar is solid and contains two marks, the upper 3·6 feet above the lower which is engraved on the rock *in sitû*, having been placed there in 1827. The station was revisited in 1842 for the purpose of originating the Karára Meridional Series, but no alteration appears to have been made in its construction. On again visiting it in 1865, the upper mark-stone was found undisturbed, and a new pillar was then built to the same height as before. The distances and bearings of neighboring villages are:—Amarha 0·9 mile N.W. by N.; and Sondia 2·2 miles N.E. by E.

I. Kaimúr Hill Station, lat. 24° 17′, long. 81° 12′—observed at in 1843—is situated on the flat top of a hill so called, and is distant about half a mile S.W. of a tank; pargana Gurha of the Rewah territories.

The station consists of a pile of stones 6 feet high, and is marked as usual with a circle and dot. The distances and bearings of surrounding villages are:—Bagdhari 1·8 miles S.W. by S.; Chanin 2·2 miles N.W.; Bhitarri 2·2 miles E.S.E.; and the hamlet of Hasthar 0·9 mile E. by N.

II. Jaliádhar (*Jaliádhar*) Hill Station, lat. 24° 22′, long. 81° 27′—observed at in 1843— is situated on the summit of a long hill so called which is the highest in that part of the range; pargana Gurha of the Rewah territories.

No description of the construction of the station is forthcoming in the original records, but it may be assumed that it is marked by a structure somewhat similar either to that at Kaimúr or at Dádar. The distances and bearings of surrounding villages are:—Katra 2·7 miles W.N.W.; Mau 2·2 miles S.E.; and Bírpur 1·9 miles S. by E.

III. Dádar Hill Station, lat. 24° 36′, long. 81° 15′—observed at in 1843—is situated on the summit of a small detached hill about 1¾ miles S. by W. of the village of Dádar; pargana Rewah of the Rewah territories.

The station consists of a platform which has a mark-stone at its upper surface. The distances and bearings of surrounding villages are:—Bankunia 0·2 mile E.S.E.; Sakarwar 1·4 miles W.; Murárpur or Marha 1·5 miles N.W.; and Banjára about 1½ miles E.N.E.

IV. Náru Hill Station, lat. 24° 30′, long. 81° 0′—observed at in 1843—is situated at the north-eastern extremity of a large flat-topped hill called Nárugarh on which there are some tanks and several springs of water, and whose summit is enclosed by a stone wall from 5 to 7 feet in height and 4 feet in thickness: in the Soháwal state.

No description of the construction of the station is forthcoming in the original records, but it may be assumed that it is marked by a structure somewhat similar either to that at Kaimúr or at Dádar. The distances and bearings of surrounding villages are:—Gurhuru 1·1 miles E.; Richari 1·6 miles N.; Kaitha 2·8 miles S.W.; and Beharra 2·2 miles S.S.E.

V. Burwa Hill Station, lat. 24° 33′, long. 81° 31′—observed at in 1843—is situated on a detached hill about half a mile E. of Burwa: pargana Raipur of the Rewah territories.

The station consists of a pile of stones—the remains of a small Hindu temple—and is marked as usual with a circle and dot. The distances and bearings of surrounding villages are:—Buradi 0·8 mile S.S.W.; Barhái 1·1 miles N.; Gurgaon 2·2 miles E.; and the town of Raipur 2·6 miles N.W.

VI. Kotar Kaimári Hill Station, lat. 24° 43′, long. 81° 3′—observed at in 1843—is situated on a block named Dongi at the western and highest part of the hill called Kaimári, and is distant somewhat more than 2 miles N.E. of the large village of Kotar: the block itself is held in much veneration in the neighbor-

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hood, for tradition affirms that it is the spot from which the father of Rámchandra shot an arrow across a distance of 15 or 16 miles. Pargana Simurria of the Rewah territories.

The station is marked on a large block of laterite being the southern and lower of two blocks which project conspicuously. The distances and bearings of surrounding places are:—Kotar Kaimári hill fort 0·8 mile E. by N.; Bhamaun 1 mile N.; Umri 1 mile W.; and Abair 1·4 miles S.S.E.

VII. Donri (*Doñri*) Hill Station, lat. 24° 54′, long. 81° 14′—observed at in 1843—is situated on the summit of a hill 1·3 miles N.N.E. of Donri village, and stands on the boundary between the Rewah and Panna territories; pargana Simurria of the Rewah territories.

The station consists of a square platform about 1 foot high, and is marked as usual with a circle and dot. The distances and bearings of surrounding villages are:—Kataik 2·5 miles S.W.; Majnaha 2·3 miles N. by W.; and Barua 1 mile N.N.E.

VIII. Sirmaul (*Sirmaol*) Hill Station, lat. 24° 53′, long. 81° 26′—observed at in 1843—is situated on the highest part of the hill, and is distant about 3¼ miles N. by E. of the village of Sirmaul: pargana Sirmaul of the Rewah territories.

The station consists of a square platform about 2 feet high which has a mark-stone at its upper surface. The distances and bearings of surrounding villages are:—Itma 1·2 miles W.N.W.; Pathera 2·1 miles N. by E.; Luk 2·6 miles N.E.; and Bagha 2 miles S.

IX. Kachár Hill Station, lat. 24° 57′, long. 81° 5′—observed at in 1843—is situated on the highest part of a hill so called, and is distant about 3 miles from Amua the residence of the Raja of Chaurasi. A stream in a rocky dell is about a mile to the S.E., and at 2 or 3 miles distance there is a waterfall which was formerly used as a place of Hindu pilgrimage: in the Panna state.

The station consists of a square platform about 1 foot high, and is marked as usual with a circle and dot. The distances and bearings of neighboring villages are:—Amama 3·4 miles S. by W.; Chutairi 3·5 miles S.W.; and Kulkaria 4·1 miles S.E.

X. Mau (*Mhao*) Hill Station, lat. 25° 1′, long. 81° 18′—observed at in 1843—is situated on the highest part of the north-eastern knob of a hill, and is distant about 2 miles N.E. of Mau village: tahsíl Mau, pargana Chhíbu, district Banda.

The station consists of a square platform, and is marked as usual with a circle and dot. The distances and bearings of surrounding villages are:—Gurdari 1·4 miles N.W. by N.; and Uba 2·6 miles S.E.

XI. Lálapur (*Lálápúr*) Hill Station, lat. 25° 14′, long. 81° 8′—observed at in 1844—is situated on the top of Valmík's *math* (a low temple) on an isolated hill, and is named after the village of Lálapur which lies close to its north-eastern foot: tahsíl Karwi, pargana Tarhawan, district Banda.

The station mark is engraved at 3 inches to the west of the intersection of lines joining the corners of the walls—15 inches high—of the terrace the internal dimensions of which are 8 feet by 7 feet. The distances and bearings of surrounding villages are:—Bagrahi (on the left bank of the Ohan nadi) nearly 0·5 mile W.; Ajaura 0·4 mile N. by E.; Kairi Kutnassa 1 mile E. by N.; and Urwara 1 mile S.S.W.

XII. Bagála Hill Station, lat. 25° 14′, long. 81° 39′—observed at in 1844—is situated on the highest part of a hill, and is named after the village of Bagála which lies at three quarters of a mile to the N.E.: thána, tahsíl and pargana Bárah, district Allahabad.

The station is marked on the rock *in sitû*. The distances and bearings of surrounding villages are:—Unturi 1·1 miles E.S.E.; Londh Kalán 1·4 miles E.N.E.; Burgarh 2·3 miles W.; and Baisa and Shiurájpur 1·2 and 2·3 miles, respectively, S. by E.

XIII. Pabhosa Hill Station, lat. 25° 21′, long. 81° 22′—observed at in 1844—is situated on the ruins of an old temple at the highest part of a hill, elevated about 300 feet above the level of the Jumna (which flows at ¼ mile to the south) and remarkable from the circumstance of its being the only hill in the Doab; it is named after the village of Pabhosa which is distant 0·4 mile E.S.E.: thána Pachchhim Saríra, tahsíl Manjhanpur, pargana Atharban, district Allahabad.

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The station is marked on a long block of stone imbedded in the mound. The distances and bearings of surrounding villages are:—Barehri 1 mile W.; Amind 1·6 miles N. by E.; and Singwal 2·3 miles E. by N.

XIV. Nagdílpur (*Nagdílpúr*) Tower Station, lat. 25° 34′, long. 81° 12′—observed at in 1845—is situated close to the west of the small village of Nagdílpur: tahsíl Khakhreru, pargana Ekdala, district Fatehpur.

The station consists of a tower of unburnt bricks 33 feet high—with diameters at top and bottom, respectively, of 17 and 23 feet—enclosing a central hollow pillar of masonry 7 feet in diameter at bottom and 4 feet at top; the whole standing on a basement 31 feet in diameter and 6 feet high, having the central portion (diameter 8 feet) of masonry and carrying a mark-stone at its upper surface. The distances and bearings of surrounding villages are:—Kabra 0·4 mile W. by S.; Ratanpur 0·6 mile N.W.; and Bírsinghpur 1 mile E.S.E.

XV. Singraur (*Singraor*) Tower Station, lat. 25° 35′, long. 81° 41′—observed at in 1844—stands on the left bank of the Ganges, and is distant 0·6 mile S.S.W. of the village of Singraur: thána and pargana Nawábganj, tahsíl Soraon, district Allahabad.

The station consists of a tower of unburnt bricks 32 feet high—with diameters at top and bottom, respectively, of 16 and 23 feet—enclosing a central hollow core of masonry 7 feet in diameter at bottom and 4 feet at top; the whole standing on a basement 32 feet in diameter and 6 feet high, having the central portion (diameter 8 feet) of masonry and carrying a mark-stone at its upper surface. The distances and bearings of surrounding villages are:—Jhaupurwa 0·9 mile S.W.; Patna 1·2 miles N.W.; Mansúrabad 1·7 miles E. by N.; and Rámnagar 1·3 miles S.E.

XVI. Karra Tower Station, lat. 25° 42′, long. 81° 25′—observed at in 1844 and 1845—is situated on the highest part of the old fort of Karra not far from the right bank of the Ganges which is depressed about 135 feet below it: tahsíl Siráthu, thána and pargana Karra, district Allahabad.

The station consists of a tower of burnt bricks 27 feet high—with diameters at top and bottom, respectively, of 21 and 27 feet—enclosing a central hollow pillar of masonry 7 feet in diameter at bottom and 4 feet at top; the whole standing on a basement 28 feet in diameter and 4½ feet high, which carries a mark-stone at its upper surface. The distances and bearings of surrounding villages are:—Karra 0·3 mile N.E.; Kamálpur 0·9 mile N.W.; Sultánpur 0·7 mile S.W.; and Akbarpur 1·5 miles E.S.E.

XVII. Majilgaon (*Majilgáoñ*) Tower Station, lat. 25° 45′, long. 81° 13′—observed at in 1845—is situated on a mound adjoining the western side of the village of Majilgaon and distant about half a mile N. of the Grand Trunk Road: tahsíl Khága, pargana Hathgaon, district Fatehpur.

The station consists of a tower of unburnt bricks 25 feet high—with diameters at top and bottom, respectively, of 16 and 20 feet, and faced with burnt brick—enclosing a central solid pillar of masonry 8 feet square at base and 4 feet diameter at top; the whole standing on a basement 29 feet in diameter and 3 feet high, having at its upper surface a mark-stone in the normal of which other mark-stones have been fixed in the solid pillar at distances from it of 5, 10, 15, 20 and 25 feet. The distances and bearings of surrounding villages are:—Kathogan 1·9 miles W. by S.; Búdwán 1 mile N. by W.; Kurhaha 1·1 miles E.S.E.; and Purain 2·1 miles S. by E.

XVIII. Pariáon (*Pariáoñ*) Tower Station, lat. 25° 50′, long. 81° 25′—observed at in 1845—is situated on a mound adjoining the village of Pariáon: thána and tahsíl Kunda, pargana Mánikpur, district Partabgarh.

The station consists of a tower of unburnt bricks 25 feet high—with diameters at top and bottom, respectively, of 16 and 20 feet, and faced with burnt brick—enclosing a central solid pillar of masonry 8 feet square at base and 4 feet diameter at top; the whole standing on a basement 29 feet in diameter and 3 feet high, having at its upper surface a mark-stone in the normal of which other mark-stones have been fixed in the solid pillar at distances from it of 5, 10, 15, 20 and 25 feet. The distances and bearings of surrounding villages are:— Murussapur 1·2 miles S.S.W.; Gauri 0·8 mile N.W.; Kiraudi 1 mile N. by E.; and Sayyid Yasímpur 1·4 miles S.E.

XIX. Horesa Tower Station, lat. 25° 55′, long. 81° 17′—observed at in 1845—is situated on a mound adjoining the western side of the village of Horesa, and is distant about 1¾ miles E. of the left bank of the Ganges: thána Jagatpur Tánghan, tahsíl, pargana and district Salon.

The station consists of a tower of unburnt bricks 25 feet high—with diameters at top and bottom, respectively, of 16 and 20 feet, and faced with burnt brick—enclosing a central hollow pillar of masonry 8 feet square at base and 4 feet diameter at top; the whole standing on a basement 29 feet in diameter and 3 feet high, having at its upper surface a mark-stone to which access was had by means of a small arched passage. The distances and bearings of surrounding villages are:—Madáripur 0·3 mile S.W. by S.; Puchkura 1·1 miles N.N.E.; and Gangauli 0·6 mile S.E. by S.

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XX. Sálon (*Sálaon*) Tower Station, lat. 26° 2′, long. 81° 30′—observed at in 1845—is situated near a temple standing on the highest part of the mound on which the town of Salon is built: thána, tahsíl, pargana and district Salon.

The station consists of a tower of unburnt bricks 25 feet high—with diameters at top and bottom, respectively, of 16 and 20 feet, and faced with burnt brick—enclosing a central solid pillar of masonry 8 feet square at base and 4 feet diameter at top; the whole standing on a basement 29 feet in diameter and 3 feet high, having at its upper surface a mark-stone in the normal of which a second mark-stone has been fixed on the summit of the solid pillar. The distances and bearings of surrounding villages are:—Saindhia 1 mile S.W.; Rájapur 1·1 miles N.W. by W.; Sanda Saidun 1·3 miles N.E.; and Aunasudra 1·1 miles E.

XXI. Tánghan (*Tángan*) Tower Station, lat. 26° 3′, long. 81° 19′—observed at in 1845—is situated on a mound adjoining the village of Tánghan: thána Jagatpur Tánghan, tahsíl Lalganj, pargana Dalmau, district Rae Bareli.

The station consists of a tower of unburnt bricks 25 feet high—with diameters at top and bottom, respectively, of 16 and 20 feet, and faced with burnt brick—enclosing a central solid pillar of masonry 8 feet square at base and 4 feet diameter at top; the whole standing on a basement 29 feet in diameter and 3 feet high, having at its upper surface a mark-stone in the normal of which other mark-stones have been fixed in the solid pillar at distances from it of 5, 10, 15, 20 and 25 feet. The distances and bearings of surrounding villages are:—Jingna 0·8 mile S.W.; Jagatpur 0·4 mile N.W.; Pura Bijai Kalán 0·8 mile E.; and Bairihar 0·8 mile S.S.E.

XXII. Khára Tower Station, lat. 26° 8′, long. 81° 13′—observed at in 1845—is situated on a mound about 350 yards N.N.W. of the large village of Khára or Bela Khára: thána Jagatpur Tánghan, tahsíl, pargana and district Rae Bareli.

The station consists of a tower of unburnt bricks 25 feet high—with diameters at top and bottom, respectively, of 16 and 20 feet, and faced with burnt brick—enclosing a central solid pillar of masonry 8 feet square at base and 4 feet diameter at top; the whole standing on a basement 29 feet in diameter and 3 feet high, having at its upper surface a mark-stone in the normal of which another mark-stone has been fixed in the summit of the solid pillar, others being fixed intermediately. The distances and bearings of surrounding villages are:—Jalálpur 0·4 mile N.W.; Habíb-ka-purwa 1 mile N.E. by E.; and Gaura Umarní 0·9 mile S.W.

XXIII. Munai Tower Station, lat. 26° 11′, long. 81° 23′—observed at in 1845—is situated on a small mound about 300 yards S. by W. of the village of Munai: thána Mau, tahsíl, pargana and district Rae Bareli.

The station consists of a tower of unburnt bricks 25 feet high—with diameters at top and bottom, respectively, of 16 and 20 feet, and faced with burnt brick—enclosing a central solid pillar of masonry 8 feet square at base and 4 feet diameter at top; the whole standing on a basement 29 feet in diameter and 3 feet high, having at its upper surface a mark-stone in the normal of which other mark-stones have been fixed in the solid pillar at distances from it of 5, 10, 15, 20 and 25 feet. The distances and bearings of surrounding villages are:—Goyindwára 0·6 mile W. by S.; Nathuapur 1 mile E.N.E.; Banihapurwa 1·2 miles S.E.; and Sehi-ka-purwa 0·7 mile S.S.W.

XXIV. Sora Tower Station, lat. 26° 17′, long. 81° 15′—observed at in 1845—is situated on an elevated mound distant about 500 yards S.S.W. of the village of Sora: thána, tahsíl, pargana and district Rae Bareli.

The station consists of a tower of unburnt bricks 24 feet high—with diameters at top and bottom, respectively, of 14 and 19 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 8, 16 and 24 feet respectively above it. The distances and bearings of surrounding villages are:—Tandu 0·5 mile S.E.; Majhgawan Ráo 1·3 miles W. by N.; Katkan-ka-purwa 0·8 mile N.; and Suranwán 1·4 miles E. by S.

XXV. Janai Tower Station, lat. 26° 22′, long. 81° 24′—observed at in 1845—is situated on a mound distant 600 yards N.W. by N. of the village of Janai: thána and tahsíl Digbijaiganj, pargana Simrauta, district Rae Bareli.

The station consists of a tower of unburnt bricks 24 feet high—with diameters at top and bottom, respectively, of 14 and 20 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 8, 14, 20 and 24 feet respectively above it. The distances and bearings of surrounding villages are:—Chandapur 1·5 miles W.; Domapur 0·3 mile N.; Maharájpur 1·4 miles E. by S.; and Balipur 1·1 miles S.S.W.

XXVI. Tauli (*Taoli*) Tower Station, lat. 26° 27′, long. 81° 15′—observed at in 1845—is situated on

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high ground distant about half a mile N.W. of the village of Tauli: thána and tahsíl Digbijaiganj, pargana Inhauna, district Rae Bareli.

The station consists of a tower of unburnt bricks 30 feet high—with diameters at top and bottom, respectively, of 14 and 19 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 9, 17, 24 and 30 feet respectively above it. The distances and bearings of surrounding villages are:—Pahnasa 1·3 miles W.S.W.; Unchauri 0·6 mile N. by W.; Puráuaganj 1·1 miles E.; and Ghorauna 1·2 miles S.

XXVII. Tikiri Tower Station, lat. 26° 33′, long. 81° 25′—observed at in 1845—is situated about 350 yards S.S.E. of the ruined village of Tikiri: tháná Mohanganj, tahsíl Digbijaiganj, pargana Inhauna, district Rae Bareli.

The station consists of a tower of unburnt bricks 30 feet high—with diameters at top and bottom, respectively, of 12 and 20 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 8, 14, 20, 26 and 30 feet respectively above it. The distances and bearings of surrounding villages are:—Rámpur 1·3 miles W.; Sewapur 1·2 miles N.; Jaitpur 1·4 miles E.; and Kadupur 0·8 mile S.S.E.

XXVIII. Parewa Tower Station, lat. 26° 38′, long. 81° 15′—observed at in 1845—is situated on low ground and is distant nearly 1 mile E. of the village of Parewa: district Bara Banki.

The station consists of a tower of unburnt bricks 30 feet high—with diameters at top and bottom, respectively, of 14 and 19 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 10, 20 and 30 feet respectively above it. The distances and bearings of surrounding villages are:—Dahírapur 0·2 mile N.W.; Khaira Kunku 1·2 miles E. by S.; Sonbaba 0·8 mile S.S.E.; and Khajuria 0·6 mile S.W.

XXIX. Basantpur (*Basantpúr*) Tower Station, lat. 26° 43′, long. 81° 25′—observed at in 1845—is situated on slightly elevated ground within a couple of hundred yards S.S.W. of the village of Basantpur: tháná Zaidpur, tahsíl Haidargarh, pargana Siddhaur, district Bara Banki.

The station consists of a tower of unburnt bricks 24 feet high—with diameters at top and bottom, respectively, of 14 and 19 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 8, 14, 20 and 24 feet respectively above it. The distances and bearings of surrounding villages are:—Dandiya 0·8 mile W.; Simrawan 0·7 mile N.E. by N.; Díh Rámpur 0·7 mile E.S.E.; and Janipur 1 mile S.S.W.

XXX. Pesar Tower Station, lat. 26° 49′, long. 81° 15′—observed at in 1845—is situated on elevated ground adjoining the village of Pesar, and is distant a few yards from the left bank of the Reth river: tháná and tahsíl Nawabganj, pargana Satrikh, district Bara Banki.

The station consists of a tower of unburnt bricks 25 feet high—with diameters at top and bottom, respectively, of 14 and 19 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 8, 16 and 25 feet respectively above it. The distances and bearings of surrounding villages are:—Nagraura 1 mile W.; Gaiaspur 0·5 mile N.N.E.; Sarai Parsanda 0·6 mile S.E.; and Tehri 0·9 mile S.W. by S.

XXXI. Turkani Tower Station, lat. 26° 55′, long. 81° 25′—observed at in 1845—is situated on high ground immediately west of the village of Turkani, and is distant 0·4 mile from the left bank of the Kalyáni river: tháná Nawabganj, tahsíl Rám Sanehi Ghat, pargana Daryabad, district Bara Banki.

The station consists of a tower of unburnt bricks 24 feet high—with diameters at top and bottom, respectively, of 14 and 20 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 8, 16, 20 and 24 feet respectively above it. The distances and bearings of surrounding villages are:—Khidrapur 0·7 mile S.E.; Safdarganj 1·6 miles W.; and Auliapur 1 mile N.

XXXII. Utiámau (*Utíámáo*) Tower Station, lat. 27° 0′, long. 81° 15′—observed at in 1845—is situated on the ruins of the village of Utiámau, and is considerably elevated above the level of the surrounding plain: tháná and tahsíl Nawabganj, pargana Dewa, district Bara Banki.

The station consists of a tower of unburnt bricks 24 feet high—with diameters at top and bottom, respectively, of 14 and 19 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 8 and 24 feet respectively above it. The distances and bearings of surrounding villages are:—Shaikhpur 0·5 mile W.; Jíwanpur 0·6 mile N.; Ugeli 0·7 mile E.; and Kumurkha 0·5 mile S.E.

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XXXIII. Amoli Tower Station, lat. 27° 6′, long. 81° 24′—observed at in 1845—is situated in low ground, and is distant 0·7 mile S.W. of the village of Amoli Kalán: thána and pargana Rámnagar, tahsíl Fatehpur, district Bara Banki.

The station consists of a tower of unburnt bricks 30 feet high—with diameters at top and bottom, respectively, of 14 and 20 feet—enclosing a central solid pillar of masonry having a mark-stone at its base, and others at 8, 14, 20, 26 and 30 feet respectively above it. The distances and bearings of surrounding villages are:—Khilaura 0·6 mile W.; Manaura 1·3 miles N. by W.; Biknapur 0·9 mile E.S.E.; and Thal Khurd 0·5 mile S.

XXXIV. Samnadio (*Samnadío*) Tower Station, lat. 27° 10′, long. 81° 14′—observed at in 1845—is situated on ground slightly elevated above the level of the surrounding country, and is at a short distance S.S.E. from the village of Samnadio or Samnadíh: thána, tahsíl and pargana Fatehpur, district Bara Banki.

The station consists of a tower of unburnt bricks 24 feet high—with diameters at top and bottom, respectively, of 14 and 19 feet—enclosing a central solid pillar of masonry having a mark-stone at base, and others at 8 and 24 feet respectively above it. The distances and bearings of surrounding villages are:—Kiratpur 0·2 mile S.W.; Rasúlpur 0·7 mile N.; Dasrathpur 0·7 mile S.E.; and the town of Fatehpur 0·9 mile E. by N.

XXXV. Ragaupur (*Ragaopúr*) Tower Station, lat. 27° 18′, long. 81° 23′—observed at in 1845—is situated in the low-lying lands between the Chauka and Sarju rivers, and is distant about half a mile S.W. of the village of Ragaupur: thána and tahsíl Bári, pargana Kundri, district Sitapur.

The station consists of a tower of unburnt bricks 30 feet high—with diameters at top and bottom, respectively, of 12 and 22 feet—enclosing a central solid pillar of masonry having a mark-stone at base, and others at 8, 24 and 30 feet respectively above it. The distances and bearings of surrounding villages are:—Uchlapur 0·8 mile W.; Burwi Burwa 0·4 mile N.; Majhgawán 0·7 mile E.; and Pura Shiughulám Singh 0·2 mile S.E. by S.

XXXVI. Imlia (*Imlía*) Tower Station, lat. 27° 19′, long. 81° 10′—observed at in 1845—is situated at the S.W. angle of an old fort in the village of Imlia: tahsíl Bári, thána and pargana Mahmudabad, district Sitapur.

The station consists of a tower of unburnt bricks 24 feet high—with diameters at top and bottom, respectively, of 14 and 20 feet—enclosing a central solid pillar of masonry having a mark-stone at base, and others at 8 and 24 feet respectively above it. The distances and bearings of surrounding villages are:—Ináyatpur 0·7 mile W.; Gobindpur 0·5 mile N.; Khwábipur 0·3 mile E.N.E.; and the town of Mahmudabad 2 miles S. by W.

XXXVII. Thána Tower Station, lat. 27° 28′, long. 81° 17′—observed at in 1845—is situated on the S.W. bastion of the fort in the village of Thána, and is distant nearly a mile from the right bank of the Gogra river; thána Thánagaon, tahsíl Biswán, pargana Kundri, district Sitapur.

The station consists of a tower of unburnt bricks 24 feet high—with diameters at top and bottom, respectively, of 12 and 20 feet—enclosing a central solid pillar of masonry having a mark-stone at base, and others at 8 and 24 feet respectively above it. The distances and bearings of surrounding villages are:—Chainpur 1·5 miles S.W. by S.; Wain 1·1 miles N. by W.; Thaura 1·4 miles N.E. by E.; and Dewaria 1·3 miles S.E.

XXXVIII. Ashrafpur (*Asrafpúr*) Tower Station, lat. 27° 29′, long. 81° 4′—observed at in 1845—is situated on high ground adjoining the southern side of the village of Ashrafpur: thána, tahsíl and pargana Biswán, district Sitapur.

The station consists of a tower of unburnt bricks 24 feet high—with diameters at top and bottom, respectively, of 14 and 20 feet—enclosing a central solid pillar of masonry having a mark-stone at base, and others at 8 and 24 feet respectively above it. The distances and bearings of surrounding villages are:—Pura Ashrafpur 0·4 mile W.; Ukbapur Khurd 1·3 miles E.N.E.; and Ramanbhari 0·2 mile S.E.

XXXIV.—(*Of the North-East Longitudinal Series*). Khánpur (*Khánpúr*) Tower Station, lat. 27° 39′, long. 81° 12′—observed at in 1844, 1845 and 1850—is situated in the centre on an old fortress within the village of Khánpur, and its site is elevated about 40 feet above the level of the surrounding country: thána Thánagaon, tahsíl Biswán, pargana Kundri, district Sitapur.

The station consists of an earthen tower 12 feet high—with diameters at top and bottom, respectively, of 13 and 17

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feet—enclosing a central solid pillar of masonry having mark-stones at 6 and 12 feet respectively above the base. The station of 1844 was revisited in 1845 at the conclusion of the Karára Meridional Series, and was then apparently found in good preservation. It was again visited in 1850 in the course of the operations of the North-East Longitudinal Series; the mark-stone and pillar having been found intact, it was only necessary to repair the earthen tower. The distances and bearings of surrounding villages are:—Bidaura 1·4 miles S.W.; Máupur 0·9 mile N.W.; Kunkari 1·5 miles E.; and Maururia Kalán 0·9 mile S. by W.

XXXV.—(*Of the North-East Longitudinal Series*). Mási Tower Station, lat. 27° 38′, long. 81° 26′—observed at in 1844, 1845 and 1849—is situated in an old fort that stands in the centre of the village of Mási, and its site is elevated about 8 feet above the level of the annual inundation: thána and tahsíl Kurásar, pargana Fakhrpur, district Bahraich.

The station consists of an earthen tower 24 feet high—with diameters at top and bottom, respectively, of 18 and 40 feet—enclosing a central solid pillar of masonry having mark-stones at 3, 8 and 24 feet respectively above the base. The station of 1844—which had the surrounding tower with diameters at top and bottom, respectively, of 11 and 18 feet—was revisited in 1845 at the conclusion of the Karára Meridional Series, and was then apparently found in good preservation. It was again visited in 1849 in the course of the operations of the North-East Longitudinal Series; the mark-stone at summit and the upper 4 or 5 feet of the central pillar which were then found removed were replaced and the surrounding tower extended to its present dimensions. The distances and bearings of surrounding villages are:—Shukulwa 0·9 mile S.W. by S.; Nasírpur 1·1 miles N.W.; Mansa, across the Sarju river, 1 mile E. by N.; and Bishanpur 0·9 mile S.S.E.

NOTE.—In a few instances, the names of principal stations, occurring in the foregoing descriptions, are given by two methods of spelling, distinguished from one another by the use of Roman and Italic type; as in XV. Singraur (*Singraor*): the latter spelling is taken from the Alphabetical and Numerical lists, which precede the descriptions and which were printed in 1869: the spelling in Roman type, is in accordance with the method authorized by the Government and illustrated in lists of Indian proper names published in 1874 and subsequently. It will be seen that the two methods differ but slightly; notwithstanding, where differences exist, both renderings are given, so as to remove all possible doubt as to the identity of a station. The method of spelling authorized by the Government, is hereafter exclusively adopted in the publication of this Series.

J. B. N. HENNESSEY,

In charge of Computing Office.

July 1877.

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KARARA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. ADDENDUM TO DESCRIPTION OF STATIONS.

Note.—Consequent on modern alterations of district and other boundaries, the sites occupied by the stations are in some instances now included in civil divisions of territory which differ from the district, pargana, or village, recorded in the preceding descriptions of stations: a complete list of all the stations of the Series including a suitably modified statement of the altered sub-divisions in question is accordingly given in the following table, and is derived chiefly from the annual reports, up to 1881, made by the Civil Officials to whose care the stations have been committed. The statement also gives present condition of certain of the stations; where no entry regarding present condition is made against a station it is to be assumed that the station when last reported on by the district Official was in good order.

The spelling of names is in accordance with that given in the lists of more important places published under the orders of Government whenever such names occur in the lists.

No. of Station	Local name	District	Pargana, &c.	Village in which the Station lies	Remarks on the Condition of the Station
XXIII	...	Baghelkhand Agency	P. Mádhogarh	Devardah	... ...
XXVI	...	„	Marwás, Rewah State	Marwás	... ...
I	...	„	P. Gurha, Rewah State	Satar	The platform partly washed down, and 3 feet high, as reported in 1873.
II	...	„	Ditto.	Tikar	... ...
III	...	„	Rewah State	Bankari	... ...
IV	...	„	Sohâwal State	Durjanpur	... ...
V	...	„	P. Raepur	Raepur	... ...
VI	Kotar	„	P. Semaria	Kotar	... ...
VII	...	„	Ditto.	Donri	... ...
VIII	Sirmaur	„	P. Sirmaur	Sirmaur	... ...
IX	...	...	... ...	...	*No report received.*
X	Garda-ka-Pahár	Bánda	P. Chhíbu	Sesa Sub Karra	... ...

Note.—Stations XXIII and XXVI appertain to the Calcutta Longitudinal Series of the South-East Quadrilateral. P. stands for pargana.

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KARARA MERIDIONAL SERIES.

OBSERVED ANGLES.

At XXIII

January 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on I												Probabilities and General Means.
	347°	352°	357°	2°	7°	12°	17°	22°	27°	32°	37°	42°	
	"	"	"	"	"	"	"	"	"	"	"	"	
I & II	29·55 2	24·02 2	28·12 2	28·31 2	31·76 2	26·30 2	29·47 2	28·35 2	28·88 2	33·88 2	29·54 2	28·85 2	Probability = 0·7 49° 8′ 28″·92
II & XXVI	40·50 2	44·53 2	41·50 2	45·59 2	41·63 2	39·92 2	41·38 2	42·95 2	41·67 2	39·37 2	40·08 2	41·41 2	Probability = 0·5 65° 38′ 41″·71

At XXVI

January 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on I												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	"	"	"	"	"	"	"	"	"	"	"	"	
XXIII & II	63·82 2	67·40 2	68·32 2	68·42 2	69·38 2	68·08 2	68·13 2	68·07 2	70·70 2	70·77 2	68·18 2	65·95 2	Probability = 0·5 40° 57′ 8″·10

NOTE.—XXIII and XXVI appertain to Calcutta Longitudinal Series.

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At XXVI—(Continued).

January 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on I												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
XXIII & I	″ $39{\cdot}87_{2}$	″ $44{\cdot}12_{2}$	″ $39{\cdot}98_{2}$	″ $42{\cdot}03_{2}$	″ $37{\cdot}68_{2}$	″ $40{\cdot}23_{2}$	″ $44{\cdot}42_{2}$	″ $42{\cdot}72_{2}$	″ $44{\cdot}12_{2}$	″ $44{\cdot}63_{2}$	″ $42{\cdot}23_{2}$	″ $43{\cdot}35_{2}$	Probability = 0·6 20° 2′ 42″·12
I & II	+63·82 −39·87	67·40 44·12	68·32 39·98	68·42 42·03	69·38 37·68	68·08 40·23	68·13 44·42	68·07 42·72	70·70 44·12	70·77 44·63	68·18 42·23	65·95 43·35	Probability = 0·7
+40° 56′ −20° 2′	23·95	23·28	28·34	26·39	31·70	27·85	23·71	25·35	26·58	26·14	25·95	22·60	20° 54′ 25″·99

At I

February and March 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on IV												Probabilities and General Means.
	53°	58°	63°	68°	73°	78°	83°	88°	93°	98°	103°	108°	
IV & III	″ $33{\cdot}48_{4}$	″ $35{\cdot}19_{4}$	″ $36{\cdot}48_{4}$	″ $39{\cdot}57_{4}$	″ $39{\cdot}47_{4}$	″ $34{\cdot}52_{4}$	″ $36{\cdot}55_{4}$	″ $40{\cdot}53_{2}$	″ $41{\cdot}45_{2}$	″ $41{\cdot}02_{2}$	″ $42{\cdot}83_{2}$	″ $40{\cdot}13_{2}$	Probability = 0·8 48° 42′ 38″·43
III & II	$43{\cdot}08_{2}$	$46{\cdot}78_{2}$	$47{\cdot}30_{2}$	$45{\cdot}46_{2}$	$44{\cdot}17_{2}$	$48{\cdot}28_{2}$	$45{\cdot}88_{2}$	$44{\cdot}53_{2}$	$43{\cdot}18_{2}$	$40{\cdot}78_{2}$	$43{\cdot}62_{2}$	$38{\cdot}37_{2}$	Probability = 0·8 60° 27′ 44″·29
II & XXVI	$49{\cdot}72_{2}$	$43{\cdot}52_{2}$	$39{\cdot}23_{2}$	$37{\cdot}74_{2}$	$39{\cdot}58_{2}$	$37{\cdot}97_{2}$	$36{\cdot}77_{2}$	$41{\cdot}42_{2}$	$39{\cdot}24_{2}$	$42{\cdot}05_{2}$	$45{\cdot}46_{2}$	$42{\cdot}40_{2}$	Probability = 1·0 40° 51′ 41″·26
XXVI & XXIII	$4{\cdot}18_{2}$	$5{\cdot}55_{2}$	$9{\cdot}87_{2}$	$6{\cdot}02_{2}$	$5{\cdot}42_{2}$	$5{\cdot}47_{2}$	$8{\cdot}35_{2}$	$2{\cdot}35_{2}$	$2{\cdot}90_{2}$	$3{\cdot}02_{2}$	$1{\cdot}45_{2}$	$4{\cdot}03_{2}$	Probability = 0·7 45° 10′ 4″·88

NOTE.—XXIII and XXVI appertain to Calcutta Longitudinal Series.

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At II

February 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on I												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXVI & XXIII	5·25 $_2$	5·60 $_2$	9·63 $_2$	6·26 $_2$	4·33 $_2$	10·15 $_2$	15·76 $_2$	16·90 $_2$	13·45 $_2$	12·12 $_2$	11·72 $_2$	11·63 $_2$	Probability = 1·2 73° 24′ 10″·23
XXIII & I	51·02 $_2$	51·43 $_2$	48·77 $_2$	48·92 $_2$	52·80 $_2$	50·15 $_2$	45·12 $_2$	45·13 $_2$	45·22 $_2$	46·13 $_2$	46·28 $_2$	48·52 $_2$	Probability = 0·8 44° 49′ 48″·29
I & III	63·83 $_2$	64·60 $_2$	66·68 $_2$	66·72 $_3$	63·92 $_2$	61·15 $_2$	64·00 $_2$	64·92 $_2$	67·58 $_2$	64·05 $_2$	62·70 $_2$	61·67 $_2$	Probability = 0·5 73° 9′ 4″·32
I & V	15·05 $_2$	13·87 $_2$	8·25 $_2$	10·61 $_3$	8·52 $_2$	8·37 $_2$	13·80 $_2$	17·50 $_2$	18·10 $_2$	13·55 $_2$	14·17 $_2$	10·52 $_2$	132° 32′ 12″·69
III & V	+15·05 −63·83	13·87 64·60	8·25 66·68	10·61 66·72	8·52 63·92	8·37 61·15	13·80 64·00	17·50 64·92	18·10 67·58	13·55 64·05	14·17 62·70	10·52 61·67	Probability = 0·9
+132° 32′ − 73° 8′	11·22	9·27	1·57	3·89	4·60	7·22	9·80	12·58	10·52	9·50	11·47	8·85	59° 23′ 8″·37

At III

April 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VIII												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
VIII & V	60·77 $_2$	69·50 $_2$	67·40 $_2$	63·00 $_2$	61·62 $_2$	60·75 $_2$	61·18 $_2$	60·02 $_2$	59·40 $_2$	59·70 $_2$	58·47 $_2$	61·43 $_2$	Probability = 0·9 69° 37′ 1″·94
V & II	13·96 $_2$	15·37 $_2$	10·63 $_2$	11·80 $_2$	10·16 $_2$	14·73 $_2$	12·25 $_2$	18·13 $_2$	11·63 $_2$	11·28 $_2$	14·81 $_2$	17·72 $_2$	Probability = 0·7 40° 29′ 13″·54
II & I	9·55 $_2$	12·33 $_2$	13·49 $_2$	19·02 $_2$	17·60 $_2$	17·65 $_2$	20·25 $_2$	15·48 $_2$	21·10 $_2$	21·18 $_2$	15·37 $_2$	16·55 $_2$	Probability = 1·0 46° 23′ 16″·63

NOTE.—XXIII and XXVI appertain to Calcutta Longitudinal Series.

At III—(Continued).

April 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VIII												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
I & IV	$55''{\cdot}50_{2}$	$50''{\cdot}70_{2}$	$54''{\cdot}05_{2}$	$51''{\cdot}38_{2}$	$52''{\cdot}75_{2}$	$50''{\cdot}42_{2}$	$47''{\cdot}92_{2}$	$49''{\cdot}99_{2}$	$46''{\cdot}69_{2}$	$46''{\cdot}64_{2}$	$51''{\cdot}43_{2}$	$49''{\cdot}55_{2}$	Probability = 0·8 56° 5′ 50″·59
IV & VI	$36{\cdot}07_{2}$	$37{\cdot}20_{2}$	$33{\cdot}53_{2}$	$32{\cdot}48_{2}$	$35{\cdot}62_{2}$	$32{\cdot}40_{2}$	$36{\cdot}45_{2}$	$33{\cdot}36_{2}$	$37{\cdot}28_{2}$	$34{\cdot}76_{2}$	$35{\cdot}39_{2}$	$33{\cdot}82_{2}$	Probability = 0·5 59° 4′ 34″·86
VI & VII	$6{\cdot}85_{2}$	$2{\cdot}87_{2}$	$1{\cdot}44_{2}$	$4{\cdot}91_{2}$	$1{\cdot}98_{2}$	$2{\cdot}93_{2}$	$3{\cdot}87_{2}$	$8{\cdot}07_{2}$	$5{\cdot}65_{2}$	$6{\cdot}62_{2}$	$5{\cdot}60_{2}$	$7{\cdot}75_{2}$	Probability = 0·6 53° 50′ 4″·88
VII & VIII	$57{\cdot}30_{2}$	$52{\cdot}03_{2}$	$59{\cdot}46_{2}$	$57{\cdot}41_{2}$	$60{\cdot}27_{2}$	$61{\cdot}12_{2}$	$58{\cdot}08_{2}$	$54{\cdot}95_{2}$	$58{\cdot}25_{2}$	$59{\cdot}82_{2}$	$58{\cdot}93_{2}$	$53{\cdot}18_{2}$	Probability = 0·8 34° 29′ 57″·57

At IV

April 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VI												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
VI & III	$23''{\cdot}95_{2}$	$22''{\cdot}75_{2}$	$25''{\cdot}03_{2}$	$23''{\cdot}65_{2}$	$22''{\cdot}08_{2}$	$25''{\cdot}83_{2}$	$26''{\cdot}67_{2}$	$19''{\cdot}55_{2}$	$19''{\cdot}40_{2}$	$12''{\cdot}80_{2}$	$14''{\cdot}50_{2}$	$14''{\cdot}91_{2}$	Probability = 1·3 53° 2′ 20″·93
III & I	$32{\cdot}78_{2}$	$32{\cdot}93_{2}$	$31{\cdot}56_{2}$	$33{\cdot}47_{2}$	$31{\cdot}42_{2}$	$33{\cdot}39_{2}$	$25{\cdot}53_{2}$	$30{\cdot}70_{2}$	$33{\cdot}80_{2}$	$44{\cdot}15_{2}$	$43{\cdot}80_{2}$	$39{\cdot}62_{2}$	Probability = 1·5 75° 11′ 34″·43

At V

February 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VIII												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
II & III	$37''{\cdot}80_{2}$	$37''{\cdot}33_{2}$	$36''{\cdot}22_{2}$	$35''{\cdot}85_{2}$	$39''{\cdot}05_{2}$	$39''{\cdot}55_{2}$	$37''{\cdot}97_{2}$	$34''{\cdot}16_{2}$	$33''{\cdot}69_{2}$	$33''{\cdot}42_{2}$	$38''{\cdot}01_{2}$	$43''{\cdot}08_{2}$	Probability = 0·8 80° 7′ 37″·18

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At V—(Continued).

March 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VIII												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	"	"	"	"	"	"	"	"	"	"	"	"	
III & VIII	$35{\cdot}18_{2}$	$36{\cdot}10_{2}$	$38{\cdot}58_{2}$	$39{\cdot}88_{2}$	$37{\cdot}90_{2}$	$37{\cdot}68_{2}$	$39{\cdot}40_{2}$	$44{\cdot}37_{2}$	$45{\cdot}03_{2}$	$46{\cdot}20_{2}$	$42{\cdot}02_{2}$	$42{\cdot}00_{2}$	Probability = 1·0 65° 26′ 40″·36

At VI

April 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on IX												Probabilities and General Means.
	27°	32°	37°	42°	47°	52°	57°	62°	67°	72°	77°	82°	
	"	"	"	"	"	"	"	"	"	"	"	"	
IX & VII	$36{\cdot}20_{2}$	$36{\cdot}68_{2}$	$37{\cdot}65_{2}$	$44{\cdot}85_{2}$	$38{\cdot}67_{2}$	$39{\cdot}66_{2}$	$38{\cdot}10_{2}$	$33{\cdot}90_{2}$	$35{\cdot}05_{2}$	$38{\cdot}15_{2}$	$37{\cdot}95_{2}$	$39{\cdot}45_{2}$	Probability = 0·8 33° 39′ 38″·03
VII & III	$67{\cdot}23_{2}$	$66{\cdot}50_{2}$	$66{\cdot}12_{2}$	$60{\cdot}89_{2}$	$71{\cdot}86_{2}$	$62{\cdot}54_{2}$	$64{\cdot}77_{2}$	$71{\cdot}53_{2}$	$73{\cdot}75_{2}$	$58{\cdot}13_{2}$	$65{\cdot}07_{2}$	$64{\cdot}65_{2}$	Probability = 1·3 80° 1′ 6″·09
III & IV	$62{\cdot}90_{2}$	$69{\cdot}60_{2}$	$73{\cdot}47_{2}$	$75{\cdot}46_{2}$	$66{\cdot}35_{2}$	$68{\cdot}38_{2}$	$66{\cdot}80_{2}$	$65{\cdot}10_{2}$	$57{\cdot}37_{2}$	$67{\cdot}03_{2}$	$68{\cdot}40_{2}$	$70{\cdot}25_{2}$	Probability = 1·3 67° 53′ 7″·59

At VII

April 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on X												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	"	"	"	"	"	"	"	"	"	"	"	"	
X & VIII	$32{\cdot}27_{2}$	$37{\cdot}63_{2}$	$39{\cdot}42_{2}$	$34{\cdot}48_{2}$	$36{\cdot}07_{2}$	$36{\cdot}52_{2}$	$38{\cdot}47_{2}$	$34{\cdot}87_{2}$	$41{\cdot}04_{2}$	$40{\cdot}52_{2}$	$40{\cdot}87_{2}$	$39{\cdot}40_{2}$	Probability = 0·8 63° 21′ 37″·63
VIII & III	$12{\cdot}21_{2}$	$8{\cdot}72_{2}$	$4{\cdot}15_{2}$	$11{\cdot}77_{2}$	$5{\cdot}96_{2}$	$7{\cdot}66_{2}$	$13{\cdot}25_{2}$	$10{\cdot}11_{2}$	$12{\cdot}26_{2}$	$11{\cdot}38_{2}$	$12{\cdot}40_{2}$	$12{\cdot}28_{2}$	Probability = 0·8 82° 50′ 10″·18
III & VI	$46{\cdot}57_{2}$	$54{\cdot}20_{2}$	$60{\cdot}75_{2}$	$54{\cdot}98_{2}$	$55{\cdot}55_{2}$	$53{\cdot}87_{2}$	$51{\cdot}61_{2}$	$53{\cdot}64_{2}$	$54{\cdot}45_{2}$	$57{\cdot}43_{2}$	$53{\cdot}28_{2}$	$55{\cdot}52_{2}$	Probability = 0·9 46° 8′ 54″·32

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At VII—(Continued).

April 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on X												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & IX	39.98_{2}	36.05_{2}	31.65_{2}	38.49_{2}	29.54_{2}	33.57_{2}	27.60_{2}	45.41_{2}	32.40_{2}	25.75_{2}	34.65_{2}	25.15_{2}	Probability = 1·7 66° 43′ 33″·35
IX & X	48.97_{2}	43.40_{2}	44.03_{2}	40.28_{2}	52.88_{2}	48.38_{2}	49.07_{2}	35.97_{2}	39.85_{2}	44.92_{2}	38.80_{2}	47.65_{2}	Probability = 1·4 100° 55′ 44″·52

At VIII

March 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XII												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
V & III	23.25_{2}	24.10_{2}	26.34_{2}	21.87_{2}	31.42_{2}	24.50_{2}	24.89_{2}	17.94_{2}	19.99_{2}	18.80_{2}	18.18_{2}	24.17_{2}	Probability = 1·1 44° 56′ 22″·95
III & VII	53.34_{2}	53.18_{2}	53.60_{2}	59.36_{2}	49.52_{2}	51.82_{2}	50.45_{2}	52.88_{2}	55.73_{2}	52.35_{2}	54.30_{2}	51.25_{2}	Probability = 0·7 62° 39′ 53″·15
VII & X	13.01_{2}	14.79_{2}	15.08_{2}	13.09_{2}	17.43_{2}	15.00_{2}	15.06_{2}	18.62_{2}	13.52_{2}	19.83_{2}	16.52_{2}	13.55_{2}	Probability = 0·6 42° 17′ 15″·46
X & XII	3.52_{2}	4.03_{2}	0.50_{2}	1.73_{2}	2.65_{2}	8.85_{2}	7.52_{2}	6.88_{2}	8.08_{2}	1.55_{2}	8.33_{2}	8.93_{2}	Probability = 0·9 72° 57′ 5″·21

At IX

May 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on X												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XI & X	44.78_{2}	43.07_{2}	41.93_{2}	43.63_{2}	45.70_{2}	42.90_{2}	43.98_{2}	43.88_{2}	44.13_{2}	45.25_{2}	46.80_{2}	43.32_{2}	Probability = 0·4 62° 1′ 44″·11

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At IX—(Continued).

May 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on X												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
X & VII	$52{\cdot}87_{2}$	$54{\cdot}12_{2}$	$52{\cdot}72_{2}$	$52{\cdot}32_{2}$	$50{\cdot}07_{2}$	$50{\cdot}60_{2}$	$52{\cdot}07_{2}$	$54{\cdot}38_{2}$	$51{\cdot}48_{2}$	$53{\cdot}08_{2}$	$45{\cdot}55_{2}$	$49{\cdot}38_{2}$	Probability = 0·7 38° 40′ 51″·55
VII & VI	$45{\cdot}63_{2}$	$44{\cdot}38_{2}$	$41{\cdot}76_{2}$	$40{\cdot}15_{2}$	$42{\cdot}07_{2}$	$44{\cdot}98_{2}$	$44{\cdot}23_{2}$	$44{\cdot}95_{2}$	$48{\cdot}04_{2}$	$44{\cdot}54_{2}$	$46{\cdot}18_{2}$	$46{\cdot}07_{2}$	Probability = 0·6 79° 36′ 44″·41

At X

May 1843, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XIII												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIII & XII	$48{\cdot}80_{2}$	$55{\cdot}63_{2}$	$55{\cdot}93_{2}$	$54{\cdot}57_{2}$	$49{\cdot}45_{2}$	$47{\cdot}53_{2}$	$49{\cdot}53_{2}$	$53{\cdot}07_{2}$	$49{\cdot}58_{2}$	$46{\cdot}96_{2}$	$49{\cdot}23_{2}$	$44{\cdot}83_{2}$	Probability = 1·0 46° 21′ 50″·43
XII & VIII	$38{\cdot}48_{2}$	$34{\cdot}05_{2}$	$31{\cdot}65_{2}$	$32{\cdot}26_{2}$	$36{\cdot}02_{2}$	$36{\cdot}15_{2}$	$35{\cdot}89_{2}$	$31{\cdot}18_{2}$	$36{\cdot}05_{2}$	$39{\cdot}09_{2}$	$40{\cdot}43_{2}$	$41{\cdot}50_{2}$	Probability = 0·9 81° 36′ 36″·06
VIII & VII	$10{\cdot}22_{2}$	$4{\cdot}57_{2}$	$3{\cdot}07_{2}$	$6{\cdot}72_{2}$	$5{\cdot}10_{2}$	$7{\cdot}27_{2}$	$10{\cdot}56_{2}$	$8{\cdot}03_{2}$	$7{\cdot}15_{2}$	$1{\cdot}50_{2}$	$1{\cdot}59_{2}$	$3{\cdot}39_{2}$	Probability = 0·9 74° 21′ 5″·76
VII & IX	$17{\cdot}15_{2}$	$25{\cdot}18_{2}$	$24{\cdot}50_{2}$	$24{\cdot}85_{2}$	$27{\cdot}83_{2}$	$22{\cdot}95_{2}$	$20{\cdot}79_{2}$	$21{\cdot}09_{2}$	$20{\cdot}98_{2}$	$23{\cdot}48_{2}$	$23{\cdot}07_{2}$	$21{\cdot}06_{2}$	Probability = 0·8 40° 23′ 22″·74
IX & XI	$60{\cdot}63_{2}$	$57{\cdot}54_{2}$	$57{\cdot}48_{2}$	$51{\cdot}57_{2}$	$54{\cdot}00_{2}$	$54{\cdot}60_{2}$	$56{\cdot}93_{2}$	$59{\cdot}68_{2}$	$60{\cdot}57_{2}$	$60{\cdot}87_{2}$	$60{\cdot}30_{2}$	$62{\cdot}05_{2}$	Probability = 0·9 75° 18′ 58″·02
XI & XIII	$4{\cdot}72_{2}$	$3{\cdot}03_{2}$	$7{\cdot}37_{2}$	$10{\cdot}03_{2}$	$7{\cdot}60_{2}$	$11{\cdot}50_{2}$	$6{\cdot}30_{2}$	$6{\cdot}95_{2}$	$5{\cdot}67_{2}$	$8{\cdot}10_{2}$	$5{\cdot}38_{2}$	$7{\cdot}17_{2}$	Probability = 0·6 41° 58′ 6″·98

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At XI

Feby. 1844, *observed by Capt. R. Shortrede with an* 18-*inch Theodolite by Troughton & Simms.*

Angle between	Means of Circle-readings, telescope being set on XIV												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIV & XIII	7·62$_2$	14·38$_2$	13·38$_2$	11·10$_2$	6·50$_2$	3·07$_2$	11·50$_2$	12·88$_2$	8·85$_2$	3·40$_2$	3·45$_2$	14·27$_2$	Probability = 1·2 50° 30′ 9″·20
XIII & X	19·81$_2$	20·05$_2$	21·89$_2$	22·77$_2$	21·63$_2$	19·85$_2$	19·80$_2$	23·15$_2$	23·23$_2$	27·63$_2$	30·50$_2$	25·93$_2$	Probability = 0·9 86° 59′ 23″·02
X & IX	26·92$_2$	23·77$_2$	19·65$_2$	21·57$_2$	24·47$_2$	23·88$_2$	22·68$_2$	18·64$_2$	16·15$_2$	17·70$_2$	17·35$_2$	19·93$_2$	Probability = 0·9 42° 39′ 21″·06

At XII

* *March and* † *October* 1844, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on VIII												Probabilities and General Means.
	18°	23°	28°	33°	38°	43°	48°	53°	58°	63°	68°	73°	
	″	″	″	″	″	″	″	″	″	″	″	″	
* VIII & X	20·42$_2$	14·52$_2$	25·95$_2$	22·73$_2$	22·60$_2$	18·13$_2$	19·93$_2$	19·35$_2$	20·63$_2$	22·09$_2$	19·56$_2$	16·70$_2$	Probability = 0·8 25° 26′ 20″·22
* X & XIII	4·28$_2$	10·25$_2$	2·05$_2$	9·28$_2$	4·81$_2$	10·62$_2$	10·13$_2$	14·15$_2$	11·70$_2$	10·81$_2$	10·92$_2$	10·64$_2$	Probability = 1·0 59° 2′ 9″·14
	Means of Circle-readings, telescope being set on XIII												
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
† XIII & XV	57·40$_2$	57·15$_2$	54·97$_2$	51·62$_2$			55·42$_2$	53·17$_2$	48·33$_2$	49·03$_2$	60·63$_2$	51·57$_2$	Probability = 1·2 70° 46′ 53″·93

At XIII

March and April 1844, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.*

Angle between	Means of Circle-readings, telescope being set on XII												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & X	11·35$_2$	12·48$_2$	14·17$_2$	7·59$_2$	7·78$_2$	3·13$_2$	6·80$_2$	4·95$_2$	4·90$_2$	7·17$_2$	3·15$_2$	6·20$_2$	Probability = 1·0 74° 36′ 7″·47

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At XIII—(Continued.)

March and April* 1844, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Troughton and Simms.

Angle between	Means of Circle-readings, telescope being set on XII												Probabilities and General Means.
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	
	″	″	″	″	″	″	″	″	″	″	″	″	
X & XI	26·98$_2$	26·69$_2$	22·98$_2$	28·19$_2$	28·87$_2$	30·67$_2$	29·08$_2$	31·05$_2$	31·00$_2$	31·31$_2$	36·62$_2$	32·15$_2$	Probability = 0·9 51° 2′ 29″·63
XI & XIV	11·70$_2$	10·53$_2$	12·03$_2$	8·09$_2$	11·12$_2$	9·48$_2$	9·77$_2$	11·68$_2$	8·07$_2$	5·69$_2$	8·45$_2$	5·73$_2$	Probability = 0·6 86° 19′ 9″·36
XII & XIV	50·03$_2$	49·70$_2$	49·18$_2$	43·87$_2$	47·77$_2$	43·28$_2$	45·65$_2$	47·68$_2$	43·97$_2$	44·17$_2$	48·22$_2$	44·08$_2$	211° 57′ 46″·47
XII & XVI	41·72$_2$	44·72$_2$	45·38$_2$	40·12$_2$	38·30$_2$	37·12$_2$	39·93$_2$	39·72$_2$	35·77$_2$	35·43$_2$	38·52$_2$	38·60$_2$	253° 41′ 39″·61
XIV & XVI	+41·72 −50·03	44·72 49·70	45·38 49·18	40·12 43·87	38·30 47·77	37·12 43·28	39·93 45·65	39·72 47·68	35·77 43·97	35·43 44·17	38·52 48·22	38·60 44·08	Probability = 0·6
+253° 41′ −211° 57′	51·69	55·02	56·20	56·25	50·53	53·84	54·28	52·04	51·80	51·26	50·30	54·52	41° 43′ 53″·14
XVI & XV	54·78$_2$	52·68$_2$	53·92$_2$	53·38$_2$	56·71$_2$	56·70$_2$	54·87$_2$	51·53$_2$	55·55$_2$	58·79$_2$	57·98$_2$	55·72$_2$	Probability = 0·6 44° 31′ 55″·22
XV & XII	23·50$_2$	22·60$_2$	20·70$_2$	26·50$_2$	24·99$_2$	26·18$_2$	25·20$_2$	28·75$_2$	28·68$_2$	25·78$_2$	23·50$_2$	25·68$_2$	Probability = 0·7 61° 46′ 25″·17

At XIV

July 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.
†February 1845, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Cary.*

Angle between	Means of Circle-readings, telescope being set on XVII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
*XVII & XVI	39·82$_2$	49·96$_2$	38·73$_2$	48·85$_2$	37·70$_2$	43·80$_2$	39·57$_2$	48·02$_2$	45·63$_2$	51·65$_2$	46·18$_2$	42·45$_2$	Probability = 1·3 49° 48′ 44″·36
†XVI & XIII	52·88$_2$	48·29$_2$	41·47$_2$	51·33$_2$	44·20$_2$	43·87$_2$	48·52$_2$	47·03$_2$	44·00$_2$	45·67$_2$	52·30$_2$	45·93$_2$	Probability = 1·0 89° 24′ 47″·12
†XIII & XI	48·72$_2$	43·61$_2$	53·95$_2$	45·95$_3$	47·75$_2$	46·43$_2$	43·33$_2$	47·70$_2$	41·57$_2$	48·90$_2$	44·25$_2$	43·55$_2$	Probability = 0·9 43° 10′ 46″·31

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At XV

December* 1844, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Cary.

Angle between	Means of Circle-readings, telescope being set on XII												Probabilities and General Means.
	63°	243°	73°	253°	83°	263°	93°	273°	103°	283°	113°	293°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & XIII	50·77 2	42·22 2	52·25 2	47·82 2	49·63 2	49·72 2	42·12 2	45·60 2	49·30 2	46·18 2	50·23 2	49·70 2	Probability = 0·9 47° 25′ 47″·96
XIII & XVI	53·25 2	73·05 2	61·23 2	60·77 2	58·08 2	69·80 2	67·72 2	66·52 2	56·92 2	66·27 2	60·12 2	62·90 2	Probability = 1·6 62° 26′ 3″·05

At XVI

****December* 1844, *observed by Captain R. Shortrede with an* 18-*inch Theodolite by Cary.***

†*July* 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.*

Angle between	Means of Circle-readings, telescope being set on XV												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
* XV & XIII	1·00 2	15·58 2	4·90 2	1·90 2	13·13 2	9·88 2	2·83 2	10·85 2	4·08 2	6·77 2	7·07 2	7·97 2	Probability = 1·3 73° 2′ 7″·16
* XIII & XIV	20·65 2	12·55 2	19·57 2	16·02 2	18·28 2	16·43 2	10·58 2	19·75 2	20·88 2	14·90 2	22·98 2	17·70 2	Probability = 1·0 48° 51′ 17″·52
† XIV & XVII	63·42 2	71·41 2	54·10 2	58·27 2	58·57 2	59·33 2	58·98 2	60·19 2	61·11 2	56·05 2	62·85 2	51·23 2	Probability = 1·4 51° 20′ 59″·63
† XVII & XVIII	69·06 2	58·15 2	68·32 2	63·21 2	68·95 2	61·62 2	73·56 2	67·70 2	67·77 2	69·08 2	64·78 2	69·97 2	Probability = 1·2 72° 37′ 6″·85

At XVII

July* 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.

Angle between	Means of Circle-readings, telescope being set on XIX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIX & XVIII	10·50 2	18·97 2	8·00 2	15·05 2	10·83 2	14·08 2	10·55 2	16·52 2	12·18 2	19·10 2	16·37 2	14·17 2	Probability = 1·0 45° 17′ 13″·86

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At XVII—(Continued.)

July* 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.

Angle between	Means of Circle-readings, telescope being set on XIX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVIII & XVI	$53{\cdot}88_2$	$55{\cdot}13_2$	$54{\cdot}33_2$	$52{\cdot}33_2$	$54{\cdot}93_2$	$54{\cdot}52_2$	$53{\cdot}62_2$	$49{\cdot}02_2$	$51{\cdot}67_2$	$47{\cdot}95_2$	$47{\cdot}77_2$	$49{\cdot}25_2$	Probability = 0·8 42° 52′ 52″·03
XVI & XIV	$15{\cdot}67_2$	$15{\cdot}12_2$	$15{\cdot}55_2$	$18{\cdot}45_2$	$16{\cdot}22_2$	$14{\cdot}63_2$	$14{\cdot}35_2$	$16{\cdot}48_2$	$14{\cdot}28_2$	$18{\cdot}38_2$	$16{\cdot}23_2$	$14{\cdot}53_2$	Probability = 0·4 78° 50′ 15″·82

At XVIII

March and April* 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.

Angle between	Means of Circle-readings, telescope being set on XVI												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVI & XVII	$63{\cdot}13_2$	$65{\cdot}23_2$	$58{\cdot}52_2$	$59{\cdot}48_2$	$62{\cdot}28_2$	$60{\cdot}70_2$	$59{\cdot}85_2$	$59{\cdot}08_2$	$57{\cdot}28_2$	$60{\cdot}78_2$	$61{\cdot}50_2$	$62{\cdot}50_2$	Probability = 0·6 64° 30′ 0″·86
XVII & XIX	$45{\cdot}58_2$	$50{\cdot}13_2$	$52{\cdot}28_2$	$54{\cdot}26_2$	$44{\cdot}73_2$	$45{\cdot}06_2$	$48{\cdot}13_2$	$52{\cdot}77_2$	$44{\cdot}71_2$	$51{\cdot}73_2$	$44{\cdot}18_2$	$42{\cdot}07_2$	Probability = 1·1 63° 16′ 47″·97
XIX & XX	$34{\cdot}01_2$	$35{\cdot}67_2$	$36{\cdot}88_2$	$35{\cdot}49_2$	$36{\cdot}45_2$	$37{\cdot}41_2$	$37{\cdot}23_2$	$33{\cdot}48_2$	$33{\cdot}62_2$	$37{\cdot}47_2$	$39{\cdot}10_2$	$38{\cdot}85_2$	Probability = 0·5 72° 58′ 36″·31

At XIX

April* 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.

Angle between	Means of Circle-readings, telescope being set on XXII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXII & XXI	$24{\cdot}98_2$	$23{\cdot}32_2$	$20{\cdot}75_2$	$17{\cdot}20_2$	$17{\cdot}85_2$	$17{\cdot}18_2$	$17{\cdot}83_2$	$17{\cdot}58_2$	$21{\cdot}78_2$	$20{\cdot}13_2$	$18{\cdot}48_2$	$19{\cdot}42_2$	Probability = 0·7 29° 36′ 19″·71
XXI & XX	$55{\cdot}47_2$	$54{\cdot}08_2$	$53{\cdot}90_2$	$56{\cdot}32_2$	$55{\cdot}73_2$	$59{\cdot}25_2$	$55{\cdot}18_2$	$56{\cdot}82_2$	$52{\cdot}80_2$	$63{\cdot}15_2$	$55{\cdot}85_2$	$62{\cdot}05_2$	Probability = 0·9 47° 45′ 56″·72

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At XIX—(Continued.)

April 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.*

Angle between	Means of Circle-readings, telescope being set on XXII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XX & XVIII	6·75 2	3·68 2	2·62 2	4·95 2	6·45 2	5·63 2	13·03 2	9·88 2	12·00 2	2·83 2	12·19 2	9·83 2	Probability = 1·0 67° 41′ 7″·49
XVIII & XVII	54·18 2	57·65 2	58·22 2	55·18 2	58·45 2	55·03 2	58·82 2	54·97 2	52·20 2	54·32 2	54·62 2	53·15 2	Probability = 0·6 71° 25′ 55″·57

At XX

April and May 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.*

Angle between	Means of Circle-readings, telescope being set on XVIII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVIII & XIX	17·18 2	20·43 2	18·78 2	20·14 2	25·10 2	25·37 2	16·80 2	21·10 2	17·35 2	17·80 2	14·73 2	22·90 2	Probability = 0·9 39° 20′ 19″·81
XIX & XXI	7·80 2	4·65 2	6·73 2	10·33 2	8·22 2	8·67 2	6·20 2	2·40 2	11·55 2	3·67 2	9·08 2	4·28 2	Probability = 0·8 36° 16′ 6″·97
XXI & XXIII	22·20 2	21·30 2	24·13 2	17·62 2	26·05 2	20·40 2	21·23 2	22·75 2	21·45 2	25·70 2	21·02 2	25·15 2	Probability = 0·7 49° 54′ 22″·42

At XXI

May 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.*

Angle between	Means of Circle-readings, telescope being set on XIX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIX & XXII	3·90 2	4·57 2	2·18 2	5·95 2	3·50 2	3·98 2	8·77 2	8·54 2	10·15 2	9·45 2	7·18 2	11·43 2	Probability = 0·8 118° 42′ 6″·63
XXII & XXIII	40·17 2	44·62 2	34·17 2	38·08 2	35·06 2	38·02 2	37·88 2	39·55 2	40·93 2	33·15 2	40·75 2	29·10 2	Probability = 1·2 72° 35′ 37″·62

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At XXI—(Continued).

May 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.*

Angle between	Means of Circle-readings, telescope being set on XIX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXIII & XX	″ 16.75_{2}	″ 10.12_{2}	″ 22.53_{2}	″ 17.98_{2}	″ 22.80_{2}	″ 21.38_{2}	″ 18.20_{2}	″ 23.17_{2}	″ 12.55_{2}	″ 20.40_{2}	″ 17.32_{2}	″ 18.92_{2}	Probability = 1·1 72° 44′ 18″·51
XX & XIX	59.18_{2}	60.70_{2}	61.12_{2}	57.98_{2}	58.63_{2}	56.62_{2}	55.15_{2}	48.75_{2}	56.37_{4}	57.00_{2}	54.75_{2}	60.55_{2}	Probability = 0·9 95° 57′ 57″·23

At XXII

May 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.*

Angle between	Means of Circle-readings, telescope being set on XXIV												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXIV & XXIII	″ 11.71_{2}	″ 17.20_{2}	″ 8.45_{2}	″ 17.62_{2}	″ 9.30_{2}	″ 18.20_{2}	″ 8.62_{2}	″ 17.13_{2}	″ 20.00_{2}	″ 20.58_{2}	″ 16.67_{2}	″ 17.12_{2}	Probability = 1·2 61° 32′ 15″·22
XXIII & XXI	64.42_{2}	64.18_{2}	67.60_{2}	64.27_{2}	69.75_{2}	61.60_{2}	68.83_{2}	67.90_{2}	57.30_{2}	60.92_{2}	57.73_{2}	60.93_{2}	Probability = 1·2 61° 3′ 3″·79
XXI & XIX	31.95_{2}	38.00_{2}	36.42_{2}	31.26_{2}	32.85_{2}	35.63_{2}	35.33_{2}	35.73_{2}	40.45_{2}	36.57_{2}	35.95_{2}	33.33_{2}	Probability = 0·7 31° 41′ 35″·29

At XXIII

May 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.*

Angle between	Means of Circle-readings, telescope being set on XX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XX & XXI	″ 18.40_{2}	″ 23.55_{2}	″ 13.61_{3}	″ 21.02_{2}	″ 16.17_{2}	″ 17.23_{2}	″ 18.05_{4}	″ 17.91_{4}	″ 17.75_{2}	″ 21.38_{3}	″ 19.88_{2}	″ 17.42_{2}	Probability = 0·7 57° 21′ 18″·53
XXI & XXII	16.18_{2}	17.55_{2}	22.60_{2}	21.59_{2}	24.25_{2}	22.88_{2}	24.02_{2}	29.30_{2}	24.50_{2}	19.55_{2}	19.13_{2}	23.34_{2}	Probability = 1·0 46° 21′ 22″·07

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At XXIII—(Continued.)

May* 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.

Angle between	Means of Circle-readings, telescope being set on XX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	Probability = 0·9
XXII & XXIV	$11{\cdot}67_{2}$	$18{\cdot}05_{2}$	$10{\cdot}67_{2}$	$15{\cdot}15_{2}$	$13{\cdot}39_{3}$	$9{\cdot}90_{2}$	$9{\cdot}52_{2}$	$13{\cdot}43_{2}$	$7{\cdot}52_{2}$	$12{\cdot}35_{2}$	$10{\cdot}67_{2}$	$6{\cdot}23_{2}$	60° 27′ 11″·55
XXIV & XXV	$32{\cdot}36_{2}$	$39{\cdot}45_{2}$	$28{\cdot}60_{2}$	$32{\cdot}23_{2}$	$26{\cdot}95_{2}$	$32{\cdot}33_{2}$	$27{\cdot}88_{2}$	$37{\cdot}87_{2}$	$29{\cdot}99_{2}$	$34{\cdot}98_{2}$	$35{\cdot}03_{2}$	$30{\cdot}73_{2}$	Probability = 1·1 53° 0′ 32″·37

At XXIV

****May* 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.***

†***May* 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.***

Angle between	Means of Circle-readings, telescope being set on XXV												Probabilities and General Means.
	330°	150°	340°	160°	350°	170°	0°	180°	10°	190°	20°	200°	
*	"	"	"	"	"	"	"	"	"	"	"	"	Probability = 1·4
XXVI & XXV	$57{\cdot}33_{2}$	$55{\cdot}34_{2}$	$51{\cdot}00_{2}$	$55{\cdot}17_{2}$	$56{\cdot}89_{3}$	$53{\cdot}84_{2}$	$60{\cdot}89_{2}$	$64{\cdot}39_{3}$	$59{\cdot}94_{3}$	$69{\cdot}84_{2}$	$63{\cdot}34_{2}$	$62{\cdot}67_{2}$	57° 2′ 59″·22
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
†XXV & XXIII	$35{\cdot}70_{2}$	$48{\cdot}09_{2}$	$36{\cdot}03_{2}$	$44{\cdot}17_{2}$	$41{\cdot}39_{2}$	$45{\cdot}16_{2}$	$42{\cdot}07_{2}$	$42{\cdot}88_{2}$	$44{\cdot}27_{2}$	$44{\cdot}07_{2}$	$42{\cdot}47_{2}$	$37{\cdot}30_{2}$	Probability = 1·1 71° 7′ 41″·97
†XXIII & XXII	$37{\cdot}35_{2}$	$32{\cdot}37_{2}$	$33{\cdot}00_{2}$	$28{\cdot}17_{2}$	$28{\cdot}93_{2}$	$30{\cdot}70_{2}$	$31{\cdot}42_{2}$	$28{\cdot}84_{2}$	$28{\cdot}08_{2}$	$29{\cdot}85_{2}$	$29{\cdot}83_{2}$	$29{\cdot}34_{2}$	Probability = 0·7 58° 0′ 30″·66

At XXV

May* 1845, *observed by Mr. J. W. Armstrong with a* 15-*inch Theodolite by Harris.

Angle between	Means of Circle-readings, telescope being set on XXIII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	"	"	"	"	"	"	"	"	"	"	"	"	Probability = 1·1
XXIII & XXIV	$44{\cdot}18_{2}$	$50{\cdot}65_{2}$	$41{\cdot}20_{2}$	$49{\cdot}63_{2}$	$40{\cdot}47_{2}$	$49{\cdot}72_{2}$	$41{\cdot}63_{2}$	$52{\cdot}05_{2}$	$45{\cdot}02_{2}$	$44{\cdot}68_{2}$	$44{\cdot}22_{2}$	$47{\cdot}83_{2}$	55° 51′ 45″·94

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At XXV—(Continued.)

April 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.*

Angle between	Means of Circle-readings, telescope being set on XXVII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIV & XXVI	$59{\cdot}26_{2}$	$50{\cdot}42_{2}$	$59{\cdot}34_{2}$	$57{\cdot}33_{2}$	$56{\cdot}67_{2}$	$57{\cdot}42_{2}$	$59{\cdot}00_{2}$	$51{\cdot}00_{2}$	$61{\cdot}00_{2}$	$57{\cdot}25_{2}$	$53{\cdot}00_{2}$	$52{\cdot}00_{2}$	Probability = 1·0 64° 2′ 56″·14
XXVI & XXVII	$43{\cdot}34_{2}$	$51{\cdot}67_{2}$	$45{\cdot}67_{2}$	$53{\cdot}34_{2}$	$45{\cdot}75_{2}$	$52{\cdot}17_{2}$	$41{\cdot}25_{2}$	$50{\cdot}00_{2}$	$47{\cdot}09_{2}$	$58{\cdot}84_{2}$	$55{\cdot}50_{2}$	$58{\cdot}67_{2}$	Probability = 1·6 61° 16′ 50″·27

At XXVI

April 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.*

Angle between	Means of Circle-readings, telescope being set on XXVIII												Probabilities and General Means.
	303°	123°	313°	133°	323°	143°	333°	153°	343°	163°	353°	173°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXVIII & XXVII	$5{\cdot}83_{2}$	$10{\cdot}50_{2}$	$6{\cdot}01_{2}$	$13{\cdot}75_{2}$	$9{\cdot}83_{2}$	$9{\cdot}84_{2}$	$9{\cdot}17_{2}$	$12{\cdot}58_{2}$	$4{\cdot}39_{3}$	$5{\cdot}67_{2}$	$11{\cdot}84_{2}$	$7{\cdot}42_{2}$	Probability = 0·8 61° 33′ 8″·90
XXVII & XXV	$40{\cdot}17_{2}$	$35{\cdot}42_{2}$	$36{\cdot}92_{2}$	$38{\cdot}17_{2}$	$37{\cdot}59_{2}$	$27{\cdot}09_{2}$	$35{\cdot}25_{2}$	$36{\cdot}51_{2}$	$30{\cdot}84_{4}$	$35{\cdot}84_{2}$	$26{\cdot}84_{2}$	$31{\cdot}41_{2}$	Probability = 1·2 65° 38′ 34″·34
XXV & XXIV	$59{\cdot}84_{2}$	$66{\cdot}75_{2}$	$60{\cdot}58_{2}$	$58{\cdot}17_{2}$	$57{\cdot}08_{2}$	$66{\cdot}58_{2}$	$62{\cdot}84_{2}$	$65{\cdot}67_{2}$	$69{\cdot}92_{2}$	$64{\cdot}92_{2}$	$76{\cdot}00_{2}$	$70{\cdot}59_{2}$	Probability = 1·5 58° 54′ 4″·91

At XXVII

April 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.*

Angle between	Means of Circle-readings, telescope being set on XXIX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXV & XXVI	$40{\cdot}09_{2}$	$44{\cdot}58_{2}$	$37{\cdot}83_{2}$	$38{\cdot}50_{2}$	$34{\cdot}33_{2}$	$40{\cdot}50_{2}$	$29{\cdot}75_{2}$	$41{\cdot}25_{2}$	$30{\cdot}67_{2}$	$38{\cdot}84_{2}$	$33{\cdot}59_{2}$	$30{\cdot}09_{2}$	Probability = 1·3 53° 4′ 36″·67

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At XXVII—(Continued).

April* 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXIX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXVI & XXVIII	″ 48·61 3	″ 45·09 2	″ 52·50 2	″ 49·67 2	″ 54·00 2	″ 53·75 2	″ 56·04 4	″ 50·75 2	″ 54·00 2	″ 46·67 2	″ 50·66 2	″ 56·75 2	Probability = 1·0 61° 40′ 51″·54
XXVI & XXIX	14·84 3	13·59 2	16·75 2	19·92 2	22·42 2	19·50 2	19·00 2	23·33 2	32·00 2	24·17 2	18·34 2	28·66 2	121° 25′ 21″·04
XXVIII & XXIX	+14·84 −48·61	13·59 45·09	16·75 52·50	19·92 49·67	22·42 54·00	19·50 53·75	19·00 56·04	23·33 50·75	32·00 54·00	24·17 46·67	18·34 50·66	28·66 56·75	Probability = 1·3
+ 121° 25′ − 61° 40′	26·23	28·50	24·25	30·25	28·42	25·75	22·96	32·58	38·00	37·50	27·68	31·91	59° 44′ 29″·50

At XXVIII

April* 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXX												Probabilities and General Means.
	319°	139°	329°	149°	339°	159°	349°	169°	359°	179°	9°	189°	
XXX & XXIX	″ 29·25 2	″ 29·67 2	″ 24·50 2	″ 33·00 2	″ 24·34 2	″ 36·67 2	″ 25·25 2	″ 29·50 2	″ 33·09 2	″ 25·00 2	″ 33·67 2	29·71 4	Probability = 1·1 59° 1′ 29″·47
XXIX & XXVII	22·25 2	21·17 2	19·42 4	16·67 2	24·92 2	16·08 2	23·92 2	14·59 2	14·75 2	12·00 2	13·25 2	19·33 2	Probability = 1·2 60° 4′ 18″·20
XXVII & XXVI	54·39 3	58·50 2	57·08 4	59·75 2	51·17 2	65·33 2	62·17 2	65·33 2	70·42 2	71·17 2	69·42 2	57·76 2	Probability = 1·8 56° 46′ 1″·87

At XXIX

April* 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXVII & XXVIII	″ 21·04 2	″ 8·32 2	″ 18·59 2	″ 9·75 2	″ 21·50 4	″ 16·75 2	″ 21·33 2	″ 13·08 2	″ 23·08 2	″ 11·25 2	″ 15·25 2	″ 12·67 2	Probability = 1·4 60° 11′ 16″·05

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At XXIX—(Continued).

Apl. 1845, *observed by Capt. J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.*

Angle between	Means of Circle-readings, telescope being set on XXX												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXVIII & XXX	$''$ 24·75$_{2}$	$''$ 29·75$_{2}$	$''$ 24·75$_{2}$	$''$ 28·34$_{2}$	$''$ 30·50$_{2}$	$''$ 33·08$_{2}$	$''$ 26·75$_{2}$	$''$ 35·00$_{2}$	$''$ 31·25$_{2}$	$''$ 36·34$_{2}$	$''$ 25·17$_{2}$	$''$ 33·25$_{2}$	Probability = 1·1 60° 33′ 29″·91
XXX & XXXI	64·42$_{2}$	59·59$_{2}$	68·50$_{2}$	60·33$_{2}$	63·92$_{2}$	63·33$_{3}$	70·00$_{4}$	57·50$_{2}$	63·42$_{2}$	57·84$_{2}$	61·26$_{2}$	64·61$_{3}$	Probability = 1·1 61° 27′ 2″·89

At XXX

Apl. 1845, *observed by Capt. J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.*

Angle between	Means of Circle-readings, telescope being set on XXXII												Probabilities and General Means.
	76°	256°	86°	266°	96°	276°	106°	286°	116°	296°	126°	306°	
XXXII & XXXI	$''$ 55·00$_{2}$	$''$ 56·09$_{2}$	$''$ 57·75$_{2}$	$''$ 61·42$_{2}$	$''$ 50·62$_{2}$	$''$ 61·71$_{2}$	$''$ 57·83$_{2}$	$''$ 65·54$_{4}$	$''$ 64·55$_{2}$	$''$ 62·42$_{2}$	$''$ 62·50$_{4}$	$''$ 61·22$_{2}$	Probability = 1·2 57° 44′ 59″·72
XXXI & XXIX	67·92$_{2}$	64·84$_{2}$	62·51$_{2}$	51·34$_{2}$	68·67$_{2}$	58·75$_{3}$	65·34$_{2}$	63·08$_{2}$	60·54$_{2}$	68·59$_{2}$	56·45$_{2}$	62·54$_{2}$	Probability = 1·4 62° 45′ 2″·55
XXIX & XXVIII	60·17$_{2}$	60·75$_{2}$	63·08$_{2}$	57·30$_{2}$	63·59$_{2}$	61·50$_{2}$	62·67$_{2}$	65·09$_{2}$	67·63$_{4}$	62·97$_{2}$	66·25$_{2}$	65·94$_{3}$	Probability = 0·8 60° 25′ 3″·08

At XXXI

Apl. 1845, *observed by Capt. J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.*

Angle between	Means of Circle-readings, telescope being set on XXXII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXIX & XXX	$''$ 56·67$_{2}$	$''$ 55·17$_{2}$	$''$ 60·16$_{2}$	$''$ 53·17$_{2}$	$''$ 51·59$_{2}$	$''$ 50·25$_{2}$	$''$ 51·67$_{2}$	$''$ 51·35$_{2}$	$''$ 49·74$_{4}$	$''$ 47·99$_{2}$	$''$ 49·67$_{2}$	$''$ 59·50$_{2}$	Probability = 1·1 55° 47′ 53″·08

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At XXXI—(Continued).

Apl.* 1845, *observed by Capt. J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXX & XXXII	39·84$_{2}$	37·50$_{2}$	35·60$_{2}$	40·67$_{2}$	35·99$_{2}$	40·33$_{2}$	35·59$_{2}$	43·50$_{2}$	26·33$_{2}$	40·17$_{2}$	33·76$_{2}$	41·34$_{2}$	Probability = 1·3 60° 48′ 37″·55
XXXII & XXXIII	19·00$_{2}$	20·34$_{2}$	22·34$_{2}$	17·25$_{2}$	27·20$_{2}$	26·20$_{2}$	31·00$_{2}$	22·84$_{2}$	31·84$_{2}$	24·58$_{2}$	31·33$_{2}$	20·92$_{2}$	Probability = 1·4 54° 22′ 24″·57

At XXXII

Apl.* 1845, *observed by Capt. J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXIII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXIV & XXXIII	43·01$_{2}$	43·92$_{2}$	38·34$_{2}$	51·50$_{2}$	48·00$_{2}$	45·75$_{2}$	42·51$_{2}$	46·00$_{2}$	39·37$_{2}$	46·91$_{2}$	40·17$_{2}$	42·50$_{2}$	Probability = 1·1 58° 20′ 44″·00
	Means of Circle-readings, telescope being set on XXXIV												
	255°	75°	265°	85°	275°	95°	285°	105°	295°	115°	305°	125°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXIII & XXXI	33·84$_{2}$	45·26$_{2}$	37·08$_{2}$	41·92$_{2}$	42·17$_{2}$	55·80$_{3}$	42·58$_{2}$	48·34$_{2}$	47·58$_{2}$	41·25$_{2}$	48·45$_{2}$	43·30$_{2}$	Probability = 1·6 63° 33′ 43″·96
XXXI & XXX	37·84$_{2}$	31·75$_{2}$	35·67$_{2}$	31·00$_{2}$	31·17$_{2}$	20·55$_{3}$	25·41$_{2}$	21·68$_{2}$	19·42$_{2}$	32·50$_{2}$	17·98$_{2}$	27·62$_{2}$	Probability = 1·8 61° 26′ 27″·72

At XXXIII

Apl.* 1845, *observed by Capt. J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXI												Probabilities and General Means.
	301°	121°	311°	131°	321°	141°	331°	151°	341°	161°	351°	171°	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXI & XXXII	47·33$_{2}$	51·75$_{2}$	41·84$_{2}$	50·67$_{2}$	44·50$_{2}$	49·75$_{2}$	43·22$_{3}$	58·58$_{2}$	53·59$_{2}$	49·00$_{2}$	58·09$_{2}$	48·67$_{2}$	Probability = 1·5 62° 3′ 49″·75

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At XXXIII—(Continued).

Apl.* 1845, *observed by Capt. J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXI												Probabilities and General Means.
	301°	121°	311°	131°	321°	141°	331°	151°	341°	161°	351°	171°	
XXXII & XXXIV	$67''{\cdot}42_{2}$	$64''{\cdot}91_{2}$	$69''{\cdot}67_{2}$	$62''{\cdot}33_{2}$	$71''{\cdot}25_{2}$	$65''{\cdot}84_{2}$	$70''{\cdot}50_{2}$	$57''{\cdot}42_{2}$	$64''{\cdot}08_{2}$	$60''{\cdot}67_{2}$	$58''{\cdot}09_{2}$	$67''{\cdot}34_{2}$	Probability = 1·3 62° 6′ 4″·96
XXXIV & XXXV	$52{\cdot}92_{2}$	$57{\cdot}84_{2}$	$53{\cdot}40_{3}$	$55{\cdot}00_{2}$	$47{\cdot}75_{2}$	$54{\cdot}17_{2}$	$45{\cdot}00_{2}$	$58{\cdot}84_{2}$	$58{\cdot}17_{2}$	$56{\cdot}00_{2}$	$67{\cdot}66_{3}$	$56{\cdot}92_{2}$	Probability = 1·6 60° 4′ 55″·31

At XXXIV

Apl.* 1845, *observed by Capt. J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXVI												Probabilities and General Means.
	57°	237°	67°	247°	77°	257°	87°	267°	97°	277°	107°	287°	
XXXVI & XXXV	$17''{\cdot}78_{3}$	$20''{\cdot}84_{2}$	$19''{\cdot}25_{2}$	$21''{\cdot}79_{2}$	$15''{\cdot}00_{2}$	$20''{\cdot}67_{2}$	$12''{\cdot}84_{2}$	$19''{\cdot}00_{3}$	$24''{\cdot}28_{3}$	$29''{\cdot}59_{2}$	$23''{\cdot}50_{3}$	$22''{\cdot}28_{3}$	Probability = 1·2 67° 49′ 20″·57
XXV & XXXIII	$20{\cdot}00_{2}$	$16{\cdot}92_{2}$	$22{\cdot}42_{2}$	$22{\cdot}88_{2}$	$25{\cdot}25_{2}$	$14{\cdot}25_{2}$	$27{\cdot}17_{2}$	$17{\cdot}00_{3}$	$17{\cdot}05_{3}$	$13{\cdot}75_{2}$	$17{\cdot}50_{3}$	$22{\cdot}34_{3}$	Probability = 1·1 70° 5′ 19″·71
XXXIII & XXXII	$9{\cdot}42_{2}$	$19{\cdot}33_{2}$	$13{\cdot}26_{2}$	$15{\cdot}17_{2}$	$10{\cdot}17_{2}$	$18{\cdot}58_{2}$	$15{\cdot}50_{3}$	$19{\cdot}44_{3}$	$20{\cdot}08_{2}$	$13{\cdot}42_{2}$	$9{\cdot}09_{2}$	$2{\cdot}83_{2}$	Probability = 1·5 59° 33′ 13″·86

At XXXV

Mar.* 1845, *observed by Capt. J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXIII												Probabilities and General Means.
	6°	186°	16°	196°	26°	206°	36°	216°	46°	226°	56°	236°	
XXXIII & XXXIV	$57''{\cdot}58_{2}$	$51''{\cdot}85_{2}$	$54''{\cdot}25_{2}$	$48''{\cdot}94_{3}$	$48''{\cdot}25_{2}$	$47''{\cdot}34_{2}$	$51''{\cdot}76_{2}$	$42''{\cdot}41_{2}$	$46''{\cdot}44_{3}$	$42''{\cdot}42_{2}$	$45''{\cdot}30_{2}$	$44''{\cdot}37_{4}$	Probability = 1·3 49° 49′ 48″·41
	Means of Circle-readings, telescope being set on XXXIV												
	350°	170°	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	
XXXIV & XXXVI	$23''{\cdot}31_{3}$	$30''{\cdot}38_{2}$	$26''{\cdot}46_{4}$	$16''{\cdot}17_{3}$	$20''{\cdot}83_{2}$	$21''{\cdot}58_{2}$	$18''{\cdot}75_{2}$	$17''{\cdot}50_{2}$	$23''{\cdot}42_{2}$	$28''{\cdot}25_{2}$	$23''{\cdot}13_{2}$	$15''{\cdot}99_{2}$	Probability = 1·3 50° 53′ 22″·15

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At XXXV—(Continued).

March 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.*

Angle between	Means of Circle-readings, telescope being set on XXXIII												Probabilities and General Means.
	6°	186°	16°	196°	26°	206°	36°	216°	46°	226°	56°	236°	
XXXVI & XXXVII	$42''{\cdot}17_{2}$	$43''{\cdot}17_{2}$	$49''{\cdot}22_{2}$	$44''{\cdot}50_{2}$	$54''{\cdot}17_{4}$	$43''{\cdot}59_{2}$	$49''{\cdot}92_{2}$	$51''{\cdot}33_{4}$	$51''{\cdot}00_{2}$	$46''{\cdot}17_{2}$	$49''{\cdot}39_{3}$	$49''{\cdot}67_{2}$	Probability = 1·1 55° 37′ 47″·86

At XXXVI

March 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.*

Angle between	Means of Circle-readings, telescope being set on XXXVIII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXXVIII & XXXVII	$71''{\cdot}29_{2}$	$58''{\cdot}17_{2}$	$64''{\cdot}08_{2}$	$58''{\cdot}79_{2}$	$54''{\cdot}33_{2}$	$55''{\cdot}50_{2}$	$60''{\cdot}28_{3}$	$54''{\cdot}58_{2}$	$50''{\cdot}83_{2}$	$51''{\cdot}33_{2}$	$53''{\cdot}02_{2}$	$50''{\cdot}00_{2}$	Probability = 1·7 62° 10′ 56″·85
XXXVII & XXXV	$20{\cdot}96_{2}$	$29{\cdot}92_{2}$	$24{\cdot}09_{2}$	$27{\cdot}25_{2}$	$28{\cdot}67_{2}$	$28{\cdot}50_{2}$	$25{\cdot}09_{2}$	$34{\cdot}33_{2}$	$31{\cdot}42_{2}$	$35{\cdot}67_{2}$	$31{\cdot}58_{2}$	$33{\cdot}42_{2}$	Probability = 1·3 62° 58′ 29″·24
XXXV & XXXIV	$16{\cdot}15_{2}$	$10{\cdot}58_{2}$	$17{\cdot}33_{2}$	$12{\cdot}92_{2}$	$23{\cdot}08_{2}$	$15{\cdot}34_{2}$	$24{\cdot}75_{2}$	$10{\cdot}00_{2}$	$18{\cdot}67_{2}$	$11{\cdot}50_{2}$	$19{\cdot}00_{2}$	$18{\cdot}59_{2}$	Probability = 1·3 61° 17′ 16″·49

At XXXVII

March 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.*

Angle between	Means of Circle-readings, telescope being set on XXXVIII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXXV & XXXVI	$37''{\cdot}34_{2}$	$32''{\cdot}42_{2}$	$46''{\cdot}59_{2}$	$39''{\cdot}67_{2}$	$41''{\cdot}25_{2}$	$36''{\cdot}67_{2}$	$44''{\cdot}76_{2}$	$29''{\cdot}98_{2}$	$49''{\cdot}08_{2}$	$37''{\cdot}92_{2}$	$46''{\cdot}34_{2}$	$45''{\cdot}34_{2}$	Probability = 1·7 61° 23′ 40″·61

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At XXXVII—(Continued).

March* 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXVIII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXXVI & XXXVIII	″ 16.92_2	″ 29.17_2	″ 17.42_3	″ 25.02_2	″ 22.59_2	″ 26.17_2	″ 24.55_3	″ 26.08_2	″ 24.00_2	″ 29.34_2	″ 17.83_2	″ 24.00_2	Probability = 1·2 60° 29′ 23″·59
XXXVIII & XXXIV	54.67_2	52.55_3	54.86_3	47.24_2	53.08_2	49.00_2	53.56_3	52.08_2	51.59_2	54.75_2	58.75_2	52.00_2	Probability = 0·8 60° 53′ 52″·85
XXXIV & XXXV	40.50_2	44.92_3	43.42_2	53.59_2	47.67_2	44.16_2	41.42_2	51.68_2	48.90_2	49.84_2	49.17_2	46.42_2	Probability = 1·1 60° 51′ 46″·81

A XXXVIII

February* 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXVII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
XXXIV & XXXVII	″ 33.92_2	″ 35.84_2	″ 33.00_2	″ 38.92_2	″ 29.00_2	″ 35.84_2	″ 25.25_2	″ 41.25_2	″ 32.54_4	″ 35.75_2	″ 33.84_2	″ 36.25_2	Probability = 1·2 59° 31′ 34″·28
XXXVII & XXXVI	46.25_2	40.50_2	40.25_2	39.09_2	43.08_2	39.75_2	46.67_2	34.83_2	39.92_4	33.58_2	40.75_2	36.34_2	Probability = 1·1 57° 19′ 40″·08

NOTE.—XXXIV and XXXV appertain to North-East Longitudinal Series.

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At XXXIV

February* 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXVII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	Probability = 1·1
XXXV & XXXVII	13.50_{2}	19.59_{2}	19.67_{2}	23.58_{2}	19.42_{2}	23.94_{3}	16.59_{3}	24.92_{2}	22.17_{2}	25.34_{2}	15.17_{2}	21.17_{2}	63° 22′ 20″·43
XXXVII & XXXVIII	38.83_{2}	31.67_{2}	38.58_{2}	32.50_{2}	35.09_{2}	32.00_{2}	35.00_{2}	28.50_{2}	34.50_{2}	29.34_{2}	33.33_{2}	28.17_{2}	Probability = 1·0 59° 34′ 33″·13

At XXXV

March* 1845, *observed by Captain J. S. Du' Vernet with an* 18-*inch Theodolite by Syud Meer Mohsin.

Angle between	Means of Circle-readings, telescope being set on XXXVII												Probabilities and General Means.
	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°	
	″	″	″	″	″	″	″	″	″	″	″	″	Probability = 1·5
XXXVII & XXXIV	63.17_{2}	55.67_{2}	59.76_{2}	49.00_{2}	49.42_{2}	50.33_{2}	52.89_{3}	48.42_{4}	48.94_{4}	44.34_{4}	56.73_{4}	46.62_{4}	55° 45′ 52″·11

Note.—XXXIV and XXXV appertain to North-East Longitudinal Series.

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KARARA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

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Figure No. 9.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	73	24	10·23	1·44
2	20	54	25·99	·49
3	20	2	42·12	·36
4	65	38	41·71	·25
5	49	8	28·92	·49
6	45	10	4·88	·49
7	40	51	41·26	1·00
8	44	49	48·29	·64

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = -4{\cdot}27,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = -5{\cdot}42,$	λ_2
$x_1 + x_2 + x_7 + x_8 = e_3 = +2{\cdot}76,$	λ_3
$\left.\begin{array}{l} -{\cdot}84x_1 + {\cdot}91x_4 + {\cdot}46x_5 \\ +{\cdot}99x_6 - 1{\cdot}156x_7 - {\cdot}54x_8 \end{array}\right\} = e_4 = -4{\cdot}389,$	λ_4

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	−4·27	+2·54	+0·61	+1·93	−0·982
2	−5·42		+1·59		+0·938
3	+2·76		*	+3·57	−2·711
4	−4·389				+3·330

Values of the Factors

$\lambda_1 = -3{\cdot}093$

$\lambda_2 = -3{\cdot}281$

$\lambda_3 = +3{\cdot}808$

$\lambda_4 = +1{\cdot}794$

Angular errors in seconds

$x_1 = -1{\cdot}14$	$x_5 = -1{\cdot}20$
$x_2 = +0{\cdot}35$	$x_6 = -0{\cdot}74$
$x_3 = -2{\cdot}29$	$x_7 = +1{\cdot}73$
$x_4 = -1{\cdot}19$	$x_8 = +1{\cdot}82$

$[wx^2] = 33{\cdot}62$

* In the tables of the equations between the factors the co-efficients of the terms below the diagonal are omitted for convenience, the co-efficient of the *pth* term in the *qth* line being always the same as the co-efficient of the *qth* term in the *pth* line.

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Figure No. 10.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²	No.	Value °	′	″	Reciprocal Weight = (Probability)²	No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	46	23	16·63	1·00	19	56	5	50·59	·64	37	41	58	6·98	·36
2	60	27	44·29	·64	20	75	11	34·43	2·25	38	51	2	29·63	·81
3	73	9	4·32	·25	21	48	42	38·43	·64	39	86	59	23·02	·81
4	40	29	13·54	·49	22	63	21	37·63	·64	40	75	18	58·02	·81
5	59	23	8·37	·81	23	42	17	15·46	·36	41	42	39	21·06	·81
6	80	7	37·18	·64	24	74	21	5·76	·81	42	62	1	44·11	·16
7	69	37	1·94	·81	25	100	55	44·52	1·96	43	61	46	25·17	·49
8	65	26	40·36	1·00	26	40	23	22·74	·64	44	70	46	53·93	1·44
9	44	56	22·95	1·21	27	38	40	51·55	·49	45	47	26	47·96	·81
10	34	29	57·57	·64	28	66	43	33·35	2·89	46	44	31	55·22	·36
11	62	39	53·15	·49	29	79	36	44·42	·36	47	62	26	3·05	2·56
12	82	50	10·18	·64	30	33	39	38·03	·64	48	73	2	7·16	1·69
13	53	50	4·88	·36	31	81	36	36·06	·81	49	41	43	53·14	·36
14	46	8	54·32	·81	32	72	57	5·21	·81	50	48	51	17·52	1·00
15	80	1	6·09	1·69	33	25	26	20·22	·64	51	89	24	47·12	1·00
16	59	4	34·86	·25	34	46	21	50·43	1·00	52	86	19	9·36	·36
17	67	53	7·59	1·69	35	59	2	9·14	1·00	53	43	10	46·31	·81
18	53	2	20·93	1·69	36	74	36	7·47	1·00	54	50	30	9·20	1·44

Equations to be satisfied — **Factor**

Equation		Factor
$x_1 + x_2 + x_3$	$= e_1 = +3{\cdot}10,$	λ_1
$x_4 + x_5 + x_6$	$= e_2 = -2{\cdot}44,$	λ_2
$x_7 + x_8 + x_9$	$= e_3 = +2{\cdot}77,$	λ_3
$x_{10} + x_{11} + x_{12}$	$= e_4 = -0{\cdot}83,$	λ_4
$x_{13} + x_{14} + x_{15}$	$= e_5 = +3{\cdot}67,$	λ_5
$x_{16} + x_{17} + x_{18}$	$= e_6 = +1{\cdot}92,$	λ_6
$x_{19} + x_{20} + x_{21}$	$= e_7 = +1{\cdot}35,$	λ_7
$x_{22} + x_{23} + x_{24}$	$= e_8 = -1{\cdot}84,$	λ_8
$x_{25} + x_{26} + x_{27}$	$= e_9 = -1{\cdot}74,$	λ_9
$x_{28} + x_{29} + x_{30}$	$= e_{10} = -5{\cdot}14,$	λ_{10}
$x_{31} + x_{32} + x_{33}$	$= e_{11} = -0{\cdot}62,$	λ_{11}
$x_{34} + x_{35} + x_{36}$	$= e_{12} = +3{\cdot}99,$	λ_{12}
$x_{37} + x_{38} + x_{39}$	$= e_{13} = -2{\cdot}32,$	λ_{13}
$x_{40} + x_{41} + x_{42}$	$= e_{14} = +1{\cdot}50,$	λ_{14}
$x_{43} + x_{44} + x_{45}$	$= e_{15} = +4{\cdot}04,$	λ_{15}
$x_{46} + x_{47} + x_{48}$	$= e_{16} = +2{\cdot}57,$	λ_{16}
$x_{49} + x_{50} + x_{51}$	$= e_{17} = -4{\cdot}11,$	λ_{17}
$x_{52} + x_{53} + x_{54}$	$= e_{18} = +2{\cdot}98,$	λ_{18}
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} + x_{19}$	$= e_{19} = +0{\cdot}01,$	λ_{19}
$x_{12} + x_{14} + x_{22} + x_{25} + x_{28}$	$= e_{20} = 0{\cdot}00,$	λ_{20}
$x_{24} + x_{26} + x_{31} + x_{34} + x_{37} + x_{40}$	$= e_{21} = -0{\cdot}01,$	λ_{21}
$x_{36} + x_{38} + x_{43} + x_{46} + x_{49} + x_{52}$	$= e_{22} = -0{\cdot}01,$	λ_{22}
$\cdot30x_3 - \cdot57x_2 + \cdot17x_6 - \cdot59x_5 + 1{\cdot}002x_9 - \cdot46x_8 + \cdot13x_{12}$ $- \cdot52x_{11} + \cdot18x_{15} - \cdot96x_{14} + \cdot75x_{18} - \cdot41x_{17} + \cdot88x_{21} - \cdot26x_{20}$	$= e_{23} = -7{\cdot}291,$	λ_{23}
$\cdot52x_{11} - 1{\cdot}455x_{10} + \cdot73x_{13} - \cdot18x_{15} + \cdot28x_{24}$ $- 1{\cdot}099x_{23} + 1{\cdot}249x_{27} - 1{\cdot}175x_{26} + 1{\cdot}502x_{30} - \cdot18x_{29}$	$= e_{24} = +3{\cdot}187,$	λ_{24}
$1{\cdot}099x_{23} - \cdot50x_{22} - \cdot19x_{25} - 1{\cdot}249x_{27} + 2{\cdot}102x_{33} - \cdot31x_{32}$ $+ \cdot28x_{36} - \cdot60x_{35} + \cdot05x_{39} - \cdot81x_{38} + \cdot53x_{42} - 1{\cdot}085x_{41}$	$= e_{25} = -4{\cdot}788,$	λ_{25}
$\cdot60x_{35} - \cdot95x_{34} + 1{\cdot}112x_{37} - \cdot05x_{39} + \cdot92x_{45} - \cdot35x_{44}$ $+ \cdot31x_{48} - \cdot52x_{47} + \cdot01x_{51} - \cdot87x_{50} + \cdot82x_{54} - 1{\cdot}066x_{53}$	$= e_{26} = +2{\cdot}817,$	λ_{26}

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Figure No. 10—(Continued).

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	λ_8	λ_9	λ_{10}	λ_{11}	λ_{12}	λ_{13}
1	+3·10	+1·89												
2	−2·44		+1·94											
3	+2·77			+3·02										
4	−0·83				+1·77									
5	+3·67					+2·86								
6	+1·92						+3·63							
7	+1·35							+3·53						
8	−1·84								+1·81					
9	−1·74									+3·09				
10	−5·14					*					+3·89			
11	−0·62											+2·26		
12	+3·99												+3·00	
13	−2·32													+1·98
14	+1·50													
15	+4·04													
16	+2·57													
17	−4·11													
18	+2·98													
19	+0·01													
20	0·00													
21	−0·01													
22	−0·01													
23	−7·291													
24	+3·187													
25	−4·788													
26	+2·817													

Equations between the factors—(Continued).

No. of e	Co-efficients of λ_{14}	λ_{15}	λ_{16}	λ_{17}	λ_{18}	λ_{19}	λ_{20}	λ_{21}	λ_{22}	λ_{23}	λ_{24}	λ_{25}	λ_{26}
1						+1·00				−0·290			
2						+0·49				−0·369			
3						+0·81				+0·752			
4						+0·64	+0·64			−0·172	−0·676		
5						+0·36	+0·81			−0·473	−0·041		
6						+0·25				+0·575			
7						+0·64				−0·022			
8							+0·64	+0·81			−0·169	+0·076	
9							+1·96	+0·64			−0·140	−0·984	
10							+2·89				+0·897		
11								+0·81				+1·094	
12								+1·00	+1·00			−0·320	−0·350
13								+0·36	+0·81			−0·616	+0·360
14	+1·78							+0·81				−0·794	
15		+2·74							+0·49				+0·241
16			+4·61						+0·36				−0·807
17				+2·36					+0·36				−0·860
18					+2·61				+0·36				+0·317
19						+4·19					−0·668		
20							+6·94			−0·694		−0·692	
21								+4·43			−0·525		−0·550
22									+3·38			−0·376	
23										+4·784	−0·187		
24											+5·336	−1·199	
25												+6·306	−0·362
26													+6·072

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Figure No. 10—(Continued).

Values of the Factors	Values of the Factors	Values of the Factors
$\lambda_1 = +1.642$	$\lambda_{10} = -2.577$	$\lambda_{19} = -0.460$
$\lambda_2 = -1.442$	$\lambda_{11} = -0.071$	$\lambda_{20} = +1.506$
$\lambda_3 = +1.433$	$\lambda_{12} = +1.251$	$\lambda_{21} = +0.480$
$\lambda_4 = -0.772$	$\lambda_{13} = -1.417$	$\lambda_{22} = -0.364$
$\lambda_5 = +0.662$	$\lambda_{14} = +0.278$	$\lambda_{23} = -1.577$
$\lambda_6 = +0.810$	$\lambda_{15} = +1.508$	$\lambda_{24} = +0.596$
$\lambda_7 = +0.456$	$\lambda_{16} = +0.650$	$\lambda_{25} = -0.776$
$\lambda_8 = -1.676$	$\lambda_{17} = -1.553$	$\lambda_{26} = +0.364$
$\lambda_9 = -1.838$	$\lambda_{18} = +1.148$	

Angular errors in seconds

$x_1 = +1.18$	$x_{15} = +.47$	$x_{29} = -.96$	$x_{43} = +.56$
$x_2 = +1.64$	$x_{16} = +.09$	$x_{30} = -1.08$	$x_{44} = +1.98$
$x_3 = +.28$	$x_{17} = +2.47$	$x_{31} = +.33$	$x_{45} = +1.50$
$x_4 = -.93$	$x_{18} = -.64$	$x_{32} = +.14$	$x_{46} = +.10$
$x_5 = -.42$	$x_{19} = .00$	$x_{33} = -1.09$	$x_{47} = +1.17$
$x_6 = -1.09$	$x_{20} = +1.95$	$x_{34} = +1.39$	$x_{48} = +1.30$
$x_7 = +.79$	$x_{21} = -.60$	$x_{35} = +1.93$	$x_{49} = -.69$
$x_8 = +2.16$	$x_{22} = +.14$	$x_{36} = +.67$	$x_{50} = -1.87$
$x_9 = -.18$	$x_{23} = -1.14$	$x_{37} = -.19$	$x_{51} = -1.55$
$x_{10} = -1.34$	$x_{24} = -.84$	$x_{38} = -.93$	$x_{52} = +.28$
$x_{11} = +.17$	$x_{25} = -.36$	$x_{39} = -1.20$	$x_{53} = +.61$
$x_{12} = +.34$	$x_{26} = -1.31$	$x_{40} = +.61$	$x_{54} = +2.09$
$x_{13} = +.22$	$x_{27} = -.07$	$x_{41} = +.92$	
$x_{14} = +2.98$	$x_{28} = -3.10$	$x_{42} = -.03$	

$$[wx^2] = 81.78$$

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Figure No. 11.

Observed Angles

No.	Value °	′	″	Reciprocal Weight = (Probability)²
1	95	57	57·23	·81
2	47	45	56·72	·81
3	36	16	6·97	·64
4	72	44	18·51	1·21
5	49	54	22·42	·49
6	57	21	18·53	·49
7	72	35	37·62	1·44
8	46	21	22·07	1·00
9	61	3	3·79	1·44
10	118	42	6·63	·64
11	31	41	35·29	·49
12	29	36	19·71	·49

Equations to be satisfied

Equations					Factor
x_1	$+x_2$	$+x_3$		$= e_1 = +0·29,$	λ_1
x_4	$+x_5$	$+x_6$		$= e_2 = -1·23,$	λ_2
x_7	$+x_8$	$+x_9$		$= e_3 = +2·96,$	λ_3
x_{10}	$+x_{11}$	$+x_{12}$		$= e_4 = +1·21,$	λ_4
x_1	$+x_4$	$+x_7$	$+x_{10}$	$= e_5 = -0·01,$	λ_5
$1·36x_3$	$-·91x_2$	$+·64x_6$	$-·84x_5$		
$+·55x_9$	$-·95x_8$	$+1·76x_{12}$	$-1·62x_{11}$	$= e_6 = +1·35,$	λ_6

Equations between the factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4	λ_5	λ_6
1	+ 0·29	+2·26				+0·81	+ 0·133
2	− 1·23		+2·19			+1·21	− 0·098
3	+ 2·96			+3·88		+1·44	− 0·158
4	+ 1·21				+1·62	+0·64	+ 0·068
5	− 0·01					+4·10	
6	+ 1·35						+ 6·543

Values of the Factors

$\lambda_1 = +0·271$

$\lambda_2 = -0·314$

$\lambda_3 = +0·932$

$\lambda_4 = +0·909$

$\lambda_5 = -0·432$

$\lambda_6 = +0·209$

Angular errors in seconds

$x_1 = -·13$	$x_5 = -·24$	$x_9 = +1·51$
$x_2 = +·06$	$x_6 = -·09$	$x_{10} = +·30$
$x_3 = +·36$	$x_7 = +·72$	$x_{11} = +·28$
$x_4 = -·90$	$x_8 = +·73$	$x_{12} = +·63$

$[wx^2] = 4·61$

January 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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KARARA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ' "			
		XXIII	1·44	+1·19	+ ·81		+2·00	65 38 42·27	5·2116206,1	162787·34	30·831
93		XXVI	1·44	+1·94	−1·03		+ ·91	40 57 7·58	5·0686231,9	117117·87	22·181
		II	1·44	+1·14	+ ·22		+1·36	73 24 10·15	5·2336163,3	171244·38	32·433
			4·32				+4·27	180 0 0·00			
		XXIII	·58	+1·20	− ·24		+ ·96	49 8 29·30	4·9483767,2	88792·60	16·817
94		II	·58	−1·82	− ·28		−2·10	44 49 45·61	4·9178545,2	82766·48	15·676
		I	·58	− ·99	+ ·52		− ·47	86 1 45·09	5·0686231,9	117117·87	22·181
			1·74				−1·61	180 0 0·00			
		XXIII	1·02	+2·39		+ ·57	+2·96	114 47 12·57	5·3408875,8	219223·73	41·520
	580	XXVI	1·01	+2·29		− ·58	+1·71	20 2 42·82	4·9178545,1	82766·48	15·675
		I	1·02	+ ·74		+ ·01	+ ·75	45 10 4·61	5·2336163,3	171244·38	32·433
			3·05				+5·42	180 0 0·00			
		I	·71	−1·64	− ·43		−2·07	60 27 41·51	5·0281551,9	106697·74	20·208
95		II	·72	− ·28	− ·75		−1·03	73 9 2·57	5·0695674,2	117372·79	22·230
		III	·71	−1·18	+1·18		·00	46 23 15·92	4·9483767,2	88792·60	16·817
			2·14				−3·10	180 0 0·00			
		II	·51	+ ·42	− ·77		− ·35	59 23 7·51	4·9694424,3	93205·69	17·653
96		III	·51	+ ·93	+ ·60		+1·53	40 29 14·56	4·8470672,2	70318·12	13·318
		V	·51	+1·09	+ ·17		+1·26	80 7 37·93	5·0281551,9	106697·74	20·208
			1·53				+2·44	180 0 0·00			

NOTES.—1. The values of the side are given in the same line with the opposite angle.
2. Stations XXIII and XXVI appertain to the Calcutta Longitudinal Series.

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
97		III	·83	− ·79	+ ·31		− ·48	69 37 0·63	5·0923326,3	123689·44	23·426
		V	·83	−2·16	− ·95		−3·11	65 26 36·42	5·0792422,5	120016·86	22·730
		VIII	·82	+ ·18	+ ·64		+ ·82	44 56 22·95	4·9694424,3	93205·69	17·653
			2·48				−2·77	180 0 0·00			
98		III	·57	+1·34	− ·85		+ ·49	34 29 57·49	4·8357661,7	68511·93	12·976
		VIII	·58	− ·17	+ ·09		− ·08	62 39 52·49	5·0312218,9	107453·83	20·351
		VII	·58	− ·34	+ ·76		+ ·42	82 50 10·02	5·0792422,5	120016·86	22·730
			1·73				+ ·83	180 0 0·00			
99		VII	·23	− ·14	− ·23		− ·37	63 21 37·03	4·8034300,7	63596·04	12·045
		VIII	·23	+1·14	− ·29		+ ·85	42 17 16·08	4·6800900,2	47872·94	9·067
		X	·23	+ ·84	+ ·52		+1·36	74 21 6·89	4·8357661,7	68511·93	12·976
			·69				+1·84	180 0 0·00			
100		VIII	·70	− ·14	−1·17		−1·31	72 57 3·20	5·1508909,0	141543·81	26·808
		X	·71	− ·33	− ·40		− ·73	81 36 34·62	5·1657351,7	146465·44	27·740
		XII	·70	+1·09	+1·57		+2·66	25 26 22·18	4·8034300,7	63596·04	12·045
			2·11				+ ·62	180 0 0·00			
101		X	1·01	−1·39	− ·51		−1·90	46 21 47·52	5·0263430,7	106253·46	20·124
		XII	1·02	−1·93	+ ·01		−1·92	59 2 6·20	5·0999923,9	125890·34	23·843
		XIII	1·02	− ·67	+ ·50		− ·17	74 36 6·28	5·1508909,0	141543·81	26·808
			3·05				−3·99	180 0 0·00			
102		XII	1·01	−1·98	− ·60		−2·58	70 46 50·34	5·1341806,5	136201·11	25·796
		XIII	1·01	− ·56	− ·07		− ·63	61 46 23·53	5·1041030,9	127087·57	24·070
		XV	1·00	−1·50	+ ·67		− ·83	47 26 46·13	5·0263430,7	106253·46	20·124
			3·02				−4·04	180 0 0·00			
103		XIII	·95	− ·10	+ ·20		+ ·10	44 31 54·37	4·9994105,3	99864·36	18·914
		XV	·95	−1·17	− ·51		−1·68	62 26 0·42	5·1011697,8	126232·09	23·908
		XVI	·96	−1·30	+ ·31		− ·99	73 2 5·21	5·1341806,5	136201·11	25·796
			2·86				−2·57	180 0 0·00			
104		XIII	·63	+ ·69	− ·72		− ·03	41 43 52·48	4·9244302,9	84029·21	15·915
		XVI	·63	+1·87	+ ·37		+2·24	48 51 19·13	4·9780165,9	95064·11	18·005
		XIV	·63	+1·55	+ ·35		+1·90	89 24 48·39	5·1011697,8	126232·09	23·908
			1·89				+4·11	180 0 0·00			
	581	I	·70	+ ·60		− ·44	+ ·16	48 42 37·89	4·9600983,3	91221·74	17·277
		III	·70	·00		− ·16	− ·16	56 5 49·73	5·0033056,5	100764·05	19·084
		IV	·70	−1·95		+ ·60	−1·35	75 11 32·38	5·0695674,2	117372·79	22·230
			2·10				−1·35	180 0 0·00			
	582	III	·49	− ·09		− ·25	− ·34	59 4 34·03	4·9266980,1	84469·12	15·998
		IV	·48	+ ·64		− ·41	+ ·23	53 2 20·68	4·8958579,6	78678·85	14·901
		VI	·49	−2·47		+ ·66	−1·81	67 53 5·29	4·9600983,3	91221·74	17·277
			1·46				−1·92	180 0 0·00			
	583	III	·54	− ·22		− ·83	−1·05	53 50 3·29	4·9448882,2	88082·21	16·682
		VI	·54	− ·47		+ ·24	− ·23	80 1 5·32	5·0312218,8	107453·83	20·351
		VII	·54	−2·98		+ ·59	−2·39	46 8 51·39	4·8958579,6	78678·85	14·901
			1·62				−3·67	180 0 0·00			
	584	VI	·31	+1·08		− ·65	+ ·43	33 39 38·15	4·6957877,1	49634·97	9·401
		VII	·31	+3·10		·00	+3·10	66 43 36·14	4·9152055,7	82263·20	15·580
		IX	·32	+ ·96		+ ·65	+1·61	79 36 45·71	4·9448882,2	88082·21	16·682
			·94				+5·14	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
	585	VII	·19	+ ·36		−1·12	− ·76	100 55 43·57	4·8762714,5	75209·28	14·244
		IX	·18	+ ·07		+ ·54	+ ·61	38 40 51·98	4·6800900,3	47872·94	9·067
		X	·18	+1·31		+ ·58	+1·89	40 23 24·45	4·6957877,1	49634·97	9·401
			·55				+1·74	180 0 0·00			
	586	IX	·56	+ ·03		−1·66	−1·63	62 1 41·92	4·9913511,6	98028·24	18·566
		X	·57	− ·61		+ ·07	− ·54	75 18 56·91	5·0308803,1	107369·34	20·335
		XI	·56	− ·92		+1·59	+ ·67	42 39 21·17	4·8762714,5	75209·28	14·244
			1·69				−1·50	180 0 0·00			
	587	X	·65	+ ·19		− ·26	− ·07	41 58 6·26	4·9258368,6	84301·80	15·966
		XI	·65	+1·20		− ·36	+ ·84	86 59 23·21	5·0999923,8	125890·34	23·843
		XIII	·65	+ ·93		+ ·62	+1·55	51 2 30·53	4·9913511,6	98028·24	18·566
			1·95				+2·32	180 0 0·00			
	588	XI	·63	−2·09		− ·28	−2·37	50 30 6·20	4·9780165,8	95064·10	18·005
		XIII	·63	− ·28		− ·53	− ·81	86 19 7·92	5·0897028,2	122942·73	23·285
		XIV	·63	− ·61		+ ·81	+ ·20	43 10 45·88	4·9258368,6	84301·80	15·966
			1·89				−2·98	180 0 0·00			
105		XIV	·34	+ ·54	− ·18		+ ·36	49 48 44·38	4·8157810,1	65430·61	12·392
		XVI	·34	+ ·62	+ ·06		+ ·68	51 20 59·97	4·8253621,1	66890·14	12·669
		XVII	·34	+ ·05	+ ·12		+ ·17	78 50 15·65	4·9244302,9	84029·21	15·915
			1·02				+1·21	180 0 0·00			
106		XVI	·24	+ ·58	− ·15		+ ·43	72 37 7·04	4·8399937,6	69182·10	13·103
		XVII	·24	+ ·26	− ·06		+ ·20	42 52 51·99	4·6931066,2	49329·49	9·343
		XVIII	·24	+ ·14	+ ·21		+ ·35	64 30 0·97	4·8157810,1	65430·61	12·392
			·72				+ ·98	180 0 0·00			
107		XVII	·25	+1·30	− ·39		+ ·91	45 17 14·52	4·7148617,3	51863·49	9·823
		XVIII	·25	+1·58	+ ·15		+1·73	63 16 49·45	4·8141667,4	65187·86	12·346
		XIX	·25	+ ·47	+ ·24		+ ·71	71 25 56·03	4·8399937,6	69182·10	13·103
			·75				+3·35	180 0 0·00			
108		XVIII	·30	− ·33	− ·18		− ·51	72 58 35·50	4·8933818,8	78231·54	14·817
		XIX	·29	−1·33	− ·16		−1·49	67 41 5·71	4·8790332,5	75689·08	14·335
		XX	·29	−1·07	+ ·34		− ·73	39 20 18·79	4·7148617,3	51863·49	9·823
			·88				−2·73	180 0 0·00			
109		XIX	·21	− ·06	− ·22		− ·28	47 45 56·23	4·7652078,6	58238·18	11·030
		XX	·21	− ·36	+ ·18		− ·18	36 16 6·58	4·6677467,0	46531·46	8·813
		XXI	·21	+ ·13	+ ·04		+ ·17	95 57 57·19	4·8933818,8	78231·54	14·817
			·63				− ·29	180 0 0·00			
110		XX	·23	+ ·24	− ·24		·00	49 54 22·19	4·7235360,3	52909·78	10·021
		XXI	·23	+ ·90	− ·06		+ ·84	72 44 19·12	4·8198655,7	66048·90	12·509
		XXIII	·23	+ ·09	+ ·30		+ ·39	57 21 18·69	4·7652078,6	58238·18	11·030
			·69				+1·23	180 0 0·00			
111		XXI	·18	− ·72	− ·18		− ·90	72 35 36·54	4·7611465,8	57696·12	10·927
		XXIII	·17	− ·73	+ ·08		− ·65	46 21 21·25	4·6410274,0	43754·97	8·287
		XXII	·17	−1·51	+ ·10		−1·41	61 3 2·21	4·7235360,3	52909·78	10·021
			·52				−2·96	180 0 0·00			
	589	XIX	·14	− ·63		− ·33	− ·96	29 36 18·61	4·6410274,2	43754·97	8·287
		XXI	·14	− ·30		+ ·20	− ·10	118 42 6·39	4·8903472,3	77686·79	14·713
		XXII	·14	− ·28		+ ·13	− ·15	31 41 35·00	4·6677467,0	46531·46	8·813
			·42				−1·21	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
112		XXII	·24	+1·72	− ·32		+1·40	61 32 16·38	4·7767393,1	59805·25	11·327
		XXIII	·24	+ ·97	+ ·12		+1·09	60 27 12·40	4·7721819,3	59180·95	11·209
		XXIV	·23	+ ·59	+ ·20		+ ·79	58 0 31·22	4·7611465,8	57696·12	10·927
			·71				+3·28	180 0 0·00			
113		XXIII	·25	+ ·16	− ·51		− ·35	53 0 31·77	4·7612665,9	57712·06	10·930
		XXIV	·26	+ ·17	− ·28		− ·11	71 7 41·60	4·8348710,8	68370·87	12·949
		XXV	·26	+ ·16	+ ·79		+ ·95	55 51 46·63	4·7767393,1	59805·25	11·327
			·77				+ ·49	180 0 0·00			
114		XXIV	·23	+ ·16	− ·60		− ·44	57 2 58·55	4·7524861,1	56556·96	10·712
		XXV	·23	+ ·08	+ ·31		+ ·39	64 2 56·30	4·7824918,2	60602·68	11·478
		XXVI	·23	+ ·18	+ ·29		+ ·47	58 54 5·15	4·7612665,9	57712·06	10·930
			·69				+ ·42	180 0 0·00			
115		XXV	·25	− ·24	− ·31		− ·55	61 16 49·47	4·7926892,1	62042·49	11·750
		XXVI	·25	− ·13	− ·44		− ·57	65 38 33·52	4·8092126,1	64448·47	12·206
		XXVII	·25	− ·16	+ ·75		+ ·59	53 4 37·01	4·7524861,1	56556·96	10·712
			·75				− ·53	180 0 0·00			
116		XXVI	·28	− ·19	− ·37		− ·56	61 33 8·06	4·8143636,9	65217·43	12·352
		XXVII	·28	− ·30	+ ·20		− ·10	61 40 51·16	4·8148905,1	65296·59	12·367
		XXVIII	·28	− ·98	+ ·17		− ·81	56 46 0·78	4·7926892,1	62042·49	11·750
			·84				−1·47	180 0 0·00			
117		XXVII	·28	− ·96	− ·78		−1·74	59 44 27·48	4·8124048,5	64923·93	12·296
		XXVIII	·29	− ·82	−1·12		−1·94	60 4 15·97	4·8138550,9	65141·10	12·337
		XXIX	·29	−1·11	+1·90		+ ·79	60 11 16·55	4·8143636,9	65217·43	12·352
			·86				−2·89	180 0 0·00			
118		XXVIII	·28	− ·63	− ·91		−1·54	59 1 27·65	4·8062389,2	64008·69	12·123
		XXIX	·29	− ·64	+ ·39		− ·25	60 33 29·37	4·8130083,8	65014·22	12·313
		XXX	·28	− ·34	+ ·52		+ ·18	60 25 2·98	4·8124048,5	64923·93	12·296
			·85				−1·61	180 0 0·00			
119		XXIX	·30	+ ·66	− ·31		+ ·35	61 27 2·94	4·8323946,6	67982·12	12·875
		XXX	·31	+1·07	− ·91		+ ·16	62 45 2·40	4·8376114,7	68803·65	13·031
		XXXI	·30	+ ·66	+1·22		+1·88	55 47 54·66	4·8062389,2	64008·69	12·123
			·91				+2·39	180 0 0·00			
120		XXX	·30	− ·92	−1·27		−2·19	57 44 57·23	4·8159681,5	65458·81	12·398
		XXXI	·30	−1·08	+ ·74		− ·34	60 48 36·91	4·8297601,2	67570·97	12·798
		XXXII	·31	−2·08	+ ·53		−1·55	61 26 25·86	4·8323946,6	67982·12	12·875
			·91				−4·08	180 0 0·00			
121		XXXI	·27	+ ·74	− ·23		+ ·51	54 22 24·81	4·7797748,5	60224·73	11·406
		XXXII	·28	+ ·96	−1·29		− ·33	63 33 43·35	4·8217993,8	66343·65	12·565
		XXXIII	·28	+ ·85	+1·52		+2·37	62 3 51·84	4·8159681,5	65458·81	12·398
			·83				+2·55	180 0 0·00			
122		XXXII	·24	− ·49	− ·69		−1·18	58 20 42·58	4·7742597,1	59464·77	11·262
		XXXIII	·25	− ·68	+ ·40		− ·28	62 6 4·43	4·7905574,3	61738·69	11·693
		XXXIV	·25	− ·91	+ ·29		− ·62	59 33 12·99	4·7797748,5	60224·73	11·406
			·74				−2·08	180 0 0·00			
123		XXXIII	·30	−1·19	+ ·09		−1·10	60 4 53·91	4·8289774,8	67449·30	12·774
		XXXIV	·30	− ·56	− ·77		−1·33	70 5 18·08	4·8643191,5	73167·66	13·858
		XXXV	·29	− ·79	+ ·68		− ·11	49 49 48·01	4·7742597,1	59464·77	11·262
			·89				−2·54	180 0 0·00			

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No. of triangle		Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
124		XXXIV	·30	+ ·50	− ·07		+ ·43	67 49 20·70	4·8525749,9	71215·57	13·488
		XXXV	·29	+ ·58	+ ·15		+ ·73	50 53 22·59	4·7757791,3	59673·17	11·302
		XXXVI	·29	+ ·59	− ·08		+ ·51	61 17 16·71	4·8289774,8	67449·30	12·774
			·88				+1·67	180 0 0·00			
125		XXXV	·33	+ ·69	+ ·38		+1·07	55 37 48·60	4·8257794,7	66954·46	12·681
		XXXVI	·34	+ ·96	− ·68		+ ·28	62 58 29·18	4·8588927,3	72259·14	13·685
		XXXVII	·34	+1·65	+ ·30		+1·95	61 23 42·22	4·8525749,9	71215·57	13·488
			1·01				+3·30	180 0 0·00			
126		XXXVI	·33	+ ·23	+ ·11		+ ·34	62 10 56·86	4·8472529,7	70348·19	13·324
		XXXVII	·32	+ ·12	+ ·36		+ ·48	60 29 23·75	4·8402391,2	69221·20	13·110
		XXXVIII	·32	+ ·10	− ·47		− ·37	57 19 39·39	4·8257794,7	66954·46	12·681
			·97				+ ·45	180 0 0·00			
127		XXXVII	·35	+ ·16	+ ·47		+ ·63	60 53 53·13	4·8529845,3	71282·76	13·501
		XXXVIII	·34	+ ·36	− ·51		− ·15	59 31 33·79	4·8470310,2	70312·25	13·317
		XXXIV*	·34	+ ·25	+ ·04		+ ·29	59 34 33·08	4·8472529,7	70348·19	13·324
			1·03				+ ·77	180 0 0·00			
128		XXXVII	·37	+ ·45	− ·09		+ ·36	60 51 46·80	4·8709064,5	74285·91	14·069
		XXXIV*	·37	+ ·46	− ·77		− ·31	63 22 19·75	4·8809710,4	76027·55	14·399
		XXXV*	·37	+ ·85	+ ·86		+1·71	55 45 53·45	4·8470310,2	70312·25	13·317
			1·11				+1·76	180 0 0·00			

Note.—Stations XXXIV* and XXXV* appertain to the North-East Longitudinal Series.

January 1878.

J. B. N. HENNESSEY,

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KARARA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXIII	Karára	24 4 42·01	81 18 14·47	269 18 36·73	5·2336163,3	89 31 10·76	XXVI
	"	"	"	"	154 31 23·14	4·9178545,2	334 28 45·51	I
	"	"	"	"	203 39 53·02	5·0686231,9	23 43 21·67	II
47	XXVI	Marwás	24 4 59·33	81 49 2·46	109 33 54·59	5·3408875,8	289 18 39·88	I
"	"	"	"	"	130 28 19·78	5·2116206,1	310 19 10·08	II
	I	Kaimúr	24 17 2·15	81 11 49·65	248 26 59·84	4·9483767,2	68 33 7·86	II
	"	"	"	"	187 59 17·62	5·0695674,2	8 0 30·76	III
	"	"	"	"	139 16 39·03	5·0033056,5	319 11 45·12	IV
48	II	Jaliádhar	24 22 24·55	81 26 42·96	141 42 11·15	5·0281551,9	321 37 14·13	III
"	"	"	"	"	201 5 19·17	4·8470672,2	21 7 12·66	V
	III	Dádar	24 36 13·68	81 14 46·40	64 6 21·19	4·9500983,3	244 0 12·04	IV
	"	"	"	"	281 7 59·06	4·9694424,3	101 14 51·10	V
	"	"	"	"	123 10 55·71	4·8958579,6	303 5 57·67	VI
	"	"	"	"	177 0 59·54	5·0312218,9	357 0 34·10	VII
	"	"	"	"	211 30 57·60	5·0792422,5	31 35 42·81	VIII

NOTE.—Stations XXIII and XXVI appertain to the Calcutta Longitudinal Series of the South-East Quadrilateral.

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	IV	Náru	24 29 38·28	80 59 57·90	190 57 50·88	4·9266980,1	10 59 3·45	VI
49	V	Burwa	24 33 14·48	81 31 17·03	166 41 28·35	5·0923326,3	346 39 19·04	VIII
	VI	Kotar Kaimári	24 43 19·82	81 2 52·16	223 4 51·81	4·9448882,2	43 9 26·03	VII
	"	"	"	"	189 25 13·35	4·9152055,7	9 26 14·79	IX
	VII	Donri	24 53 56·77	81 13 45·65	274 10 23·50	4·8357661,7	94 15 35·88	VIII
	"	"	"	"	109 53 2·48	4·6957877,1	289 49 28·76	IX
	"	"	"	"	210 48 46·24	4·6800900,2	30 50 38·73	X
50	VIII	Sirmaul	24 53 6·86	81 26 7·78	136 32 52·19	4·8034300,7	316 29 31·61	X
"	"	"	"	"	209 29 56·09	5·1657351,7	29 35 28·82	XII
	IX	Kachár	24 56 43·77	81 5 18·46	251 8 36·60	4·8762714,5	71 14 3·36	X
	"	"	"	"	189 6 54·12	5·0308803,1	9 8 12·68	XI
	X	Mau	25 0 44·01	81 18 12·26	146 33 0·84	4·9913511,6	326 28 50·95	XI
	"	"	"	"	234 52 56·28	5·1508909,0	55 1 51·70	XII
	"	"	"	"	188 31 7·75	5·0999923,9	8 32 34·27	XIII
	XI	Lálapur	25 14 13·95	81 8 23·73	239 29 27·09	4·9258368,6	59 35 5·45	XIII
	"	"	"	"	188 59 20·26	5·0897028,2	9 0 50·26	XIV
51	XII	Bagála	25 14 9·15	81 39 13·31	114 3 58·92	5·0263430,7	293 56 26·97	XIII
"	"	"	"	"	184 50 50·27	5·1041030,9	4 51 40·60	XV
	XIII	Pabhosa	25 21 17·32	81 21 35·58	145 54 14·00	4·9780165,9	325 50 3·75	XIV
	"	"	"	"	232 10 2·43	5·1341806,5	52 18 27·73	XV
	"	"	"	"	187 38 7·11	5·1011697,8	7 39 26·14	XVI
	XIV	Nagdílpur	25 34 16·82	81 11 53·53	236 25 14·73	4·9244302,9	56 30 45·90	XVI
	"	"	"	"	186 36 30·01	4·8253621,1	6 37 6·48	XVII
52	XV	Singraur	25 35 3·56	81 41 10·61	114 44 29·10	4·9994105,3	294 37 19·97	XVI
53	XVI	Karra	25 41 56·64	81 24 38·96	107 51 46·21	4·8157810,1	287 46 50·49	XVII
"	"	"	"	"	180 28 53·49	4·6931066,2	0 28 55·46	XVIII
	XVII	Majilgaon	25 45 15·01	81 13 17·73	244 53 58·26	4·8399937,6	64 58 56·67	XVIII
	"	"	"	"	199 36 43·49	4·8141667,4	19 38 27·95	XIX
54	XVIII	Pariáon	25 50 5·26	81 24 43·49	128 15 46·37	4·7148617,3	308 12 31·67	XIX
"	"	"	"	"	201 14 22·17	4·8790332,5	21 16 33·64	XX
	XIX	Horesa	25 55 23·20	81 17 17·41	240 31 25·67	4·8933818,8	60 36 52·72	XX
	"	"	"	"	192 45 29·23	4·6677467,0	12 46 18·61	XXI
	"	"	"	"	163 9 10·48	4·8903472,3	343 7 22·08	XXII
55	XX	Salon	26 1 43·97	81 29 44·13	96 52 59·51	4·7652078,6	276 48 21·21	XXI
"	"	"	"	"	146 47 21·93	4·8198655,7	326 44 27·18	XXIII

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXI	Tánghan	26 2 52·72	81 19 10·10	131 28 25·14	4·6410274,0	311 25 46·94	XXII
	,,	,,	,,	,,	204 4 1·86	4·7235360,3	24 5 46·10	XXIII
	XXII	Khára	26 7 39·62	81 13 10·35	250 22 44·56	4·7611465,8	70 27 7·52	XXIII
	,,	,,	,,	,,	188 50 27·94	4·7721819,3	8 51 12·08	XXIV
56	XXIII	Munai	26 10 51·18	81 23 6·97	130 54 20·16	4·7767393,1	310 50 40·63	XXIV
,,	,,	,,	,,	,,	183 54 52·18	4·8348710,8	3 55 14·90	XXV
	XXIV	Sora	26 17 18·83	81 14 50·30	239 42 58·77	4·7612665,9	59 47 1·79	XXV
	,,	,,	,,	,,	182 39 59·99	4·7824918,2	2 40 13·77	XXVI
57	XXV	Janai	26 22 6·80	81 23 58·30	123 49 58·32	4·7524861,1	303 46 8·39	XXVI
,,	,,	,,	,,	,,	185 6 48·04	4·8092126,1	5 7 16·22	XXVII
	XXVI	Tauli	26 27 18·43	81 15 21·33	238 7 34·62	4·7926892,1	58 11 53·48	XXVII
	,,	,,	,,	,,	176 34 26·28	4·8148905,1	356 34 7·06	XXVIII
58	XXVII	Tikiri	26 32 42·59	81 25 1·56	119 52 44·92	4·8143636,9	299 48 6·00	XXVIII
,,	,,	,,	,,	,,	179 37 12·68	4·8138550,9	359 37 10·54	XXIX
	XXVIII	Parewa	26 38 4·00	81 14 38·32	239 43 49·74	4·8124048,5	59 48 27·38	XXIX
	,,	,,	,,	,,	180 42 21·81	4·8130083,8	0 42 25·79	XXX
59	XXIX	Basantpur	26 43 27·75	81 24 56·79	120 21 57·04	4·8062389,2	300 17 22·53	XXX
,,	,,	,,	,,	,,	181 49 0·28	4·8376114,7	1 49 11·16	XXXI
	XXX	Pesar	26 48 47·87	81 14 47·16	237 32 19·82	4·8323946,6	57 37 6·12	XXXI
	,,	,,	,,	,,	179 47 22·29	4·8297601,2	359 47 21·05	XXXII
60	XXXI	Turkani	26 54 48·85	81 25 20·89	118 25 43·33	4·8159681,5	298 20 54·88	XXXII
,,	,,	,,	,,	,,	172 48 8·41	4·8217993,8	352 47 26·64	XXXIII
	XXXII	Utiámau	26 59 57·08	81 14 44·42	234 47 11·25	4·7797748,5	54 51 18·76	XXXIII
	,,	,,	,,	,,	176 26 28·43	4·7905574,3	356 26 9·11	XXXIV
61	XXXIII	Amoli	27 5 40·72	81 23 48·91	116 57 23·44	4·7742597,1	296 52 55·87	XXXIV
,,	,,	,,	,,	,,	177 2 17·65	4·8643191,5	357 1 58·50	XXXV
	XXXIV	Samnadio	27 10 7·34	81 14 1·98	226 47 37·49	4·8289774,8	46 51 46·80	XXXV
	,,	,,	,,	,,	158 58 16·49	4·7757791,3	338 56 27·79	XXXVI
62	XXXV	Ragaupur	27 17 44·37	81 23 7·00	97 45 9·68	4·8525749,9	277 39 10·79	XXXVI
,,	,,	,,	,,	,,	153 22 58·61	4·8588927,3	333 20 13·27	XXXVII
	XXXVI	Imlia	27 19 18·90	81 10 4·55	214 40 41·27	4·8257794,7	34 43 55·83	XXXVII
	,,	,,	,,	,,	152 29 44·08	4·8402391,2	332 27 0·67	XXXVIII
63	XXXVII	Thána (Thánagaon)	27 28 24·00	81 17 7·53	95 13 19·90	4·8472529,7	275 7 20·96	XXXVIII
,,	,,	,,	,,	,,	156 7 13·38	4·8470310,2	336 4 46·98	XXXIV*
,,	,,	,,	,,	,,	216 59 0·55	4·8809710,4	37 2 55·85	XXXV*

Note.—Stations XXXIV* and XXXV* appertain to the North-East Longitudinal Series.

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Station A					Side AB			Station B
Circuit No.	Series No.	Name	Latitude	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Series No.
			° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXXVIII	Ashrafpur	27 29 26·81	81 4 9·54	215 35 46·83	4·8529845,3	35 39 20·40	XXXIV*
	XXXIV*	Khánpur	27 39 0·60	81 11 50·98	272 42 26·86	4·8709064,5	92 48 49·67	XXXV*
64	XXXV*	Mási	27 38 25·17	81 25 36·15				

NOTE.—Stations XXXIV* and XXXV* appertain to the North-East Longitudinal Series.

October 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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KARARA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. HEIGHTS ABOVE MEAN SEA LEVEL.

The following table gives, first, the usual data of the observed vertical angles and the heights of the signal and instrument, &c., in pairs of horizontal lines, the first line of which gives the data for the 1st or the fixed station, and the second line the data for the 2nd or the deduced station. This is followed by the arc contained between the two stations, and then by the terrestrial refraction, and the height of the 2nd station above or below the 1st, as computed from the vertical angles in the usual manner. This difference of height applied to the given height above mean sea level of the fixed station, gives that of the deduced station. Usually there are two or three independent values of the height of the deduced station; the details are so arranged as to show these consecutively and their mean in the columns of "Trigonometrical Results". The mean results thus obtained are however liable to receive corrections for the errors generated in the trigonometrical operations, which are shown up by the spirit leveling operations, whenever a junction between the two has been effected. The spirit leveled determinations are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the leveling operations are adjusted—usually by simple proportion—to accord with the latter. In the table the spirit leveled values are printed thus, **382·80**, &c., to distinguish them from the adjusted trigonometrical values. The column in which the mean trigonometrical heights are given is barred across where necessary, as after deduction of Stn. XVI from Stn. XV, page 51—*M.*, to indicate that one set of adjustment ends and another begins. The trigonometrical heights always refer to the upper mark-stone, or to the upper surface of the pillar on which the theodolite stood; when a spirit leveled height does not refer to either of these surfaces, it is given in combination with a correction, thus $\left\{\begin{array}{l}\mathbf{382{\cdot}80}\\+27\end{array}\right.$ and the sum of these two quantities, in this case 409·8, represents the value with which the corresponding trigonometrical mean height 399·7 is comparable. Descriptions follow these tables, exactly indicating the positions of the leveling staff during the determinations of the spirit leveled heights.

When the pillar of the station is perforated, the height given in the last column, is that between the upper surface of pillar and ground level mark-stone in floor of passage; otherwise it is the approximate height of the structure, above the ground at the base of the station.

The heights of the initial stations are taken from the Calcutta Longitudinal Series of the South-East Quadrilateral, page 179—*B.*, Vol. VI, and are as follows:—

XXIII	1966·2	feet above Mean Sea Level at Karáchi.
XXVI	1776·3	

Astronomical Date 1843		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Jan.	30	3 9	XXIII	E 0 6 23·0	4	4·10	4·80	818	51	·062	+ 298·1	2264·3			
Feb.	9	3 3	I	D 0 18 21·6	4	4·10	4·40								
Jan.	24	2 53	XXVI	D 0 8 8·6	4	4·10	4·70	2166	141	·065	+ 482·0	2258·3	2262·3	2263	6
Feb.	9	3 6	I	D 0 23 14·9	4	4·60	4·40								

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Astronomical Date		Station	Observed Vertical Angle	Number of observations	Height in feet		Contained Arc	Terrestrial Refraction		Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level			Height of Pillar or Tower
1843	Mean of Times of observation				Signal	Instrument		In seconds	Decimals of Contained Arc		Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	
	h. m.		° ′ ″				″							feet
Feb. 21	3 11	II	D 0 3 6·0	4	4·10	4·80	877	54	·062	+ 86·1	2264·3			
„ 9	3 0	I	D 0 9 45·0	4	4·20	4·40								
Jan. 30	3 10	XXIII	D 0 2 9·6	4	4·20	4·80	1157	73	·063	+ 214·3	2180·5			
Feb. 21	3 10	II	D 0 14 44·6	4	4·10	4·80								
Jan. 24	2 56	XXVI	D 0 3 17·2	4	4·20	4·70	1608	101	·063	+ 399·6	2175·9	2177·2	2178	†
Feb. 21	3 7	II	D 0 20 9·5	4	4·60	4·80								
„ 9	3 0	I	D 0 9 45·0	4	4·20	4·40	877	54	·062	− 86·1	2175·2			
„ 21	3 11	II	D 0 3 6·0	4	4·10	4·80								
„ 9, Mar. 30	3 35	I	D 0 42 59·7	8	4·60	4·40	1160	68	·059	−1177·2	1085·1			
Apr. 4	3 34	III	E 0 25 55·5	4	4·10	4·90								
Feb. 21	3 17	II	D 0 42 55·1	4	4·60	4·80	1054	61	·058	−1091·0	1086·2	1085·7	1088	†
Apr. 4	3 31	III	E 0 27 21·6	4	4·10	4·90								
Feb. 9	2 55	I	D 0 17 17·0	4	3·60	4·40	996	57	·057	− 290·3	1972·0			
Apr. 11,13	4 3	IV	E 0 2 29·9	4	4·10	5·60						1972·0	1974	†
„ 4	3 37	III	E 0 26 47·1	4	3·60	4·90	901	57	·063	+ 886·3	1972·0			
„ 11,13	3 55	IV	D 0 39 59·9	4	4·60	5·60								
Feb. 21	3 2	II	D 0 48 10·9	4	3·70	4·80	695	40	·057	− 879·6	1297·6			
Mar. 25	3 56	V	E 0 37 49·0	2	4·10	5·20						1298·0	1300	†
Apr. 4	3 29	III	E 0 0 58·2	4	3·70	4·90	921	50	·055	+ 212·8	1298·5			
Mar. 25	4 12	V	D 0 14 42·2	2	4·60	5·20								
Apr. 4	3 39	III	E 0 9 23·4	4	3·20	4·90	777	37	·047	+ 350·8	1436·5			
„ 22	3 24	VI	D 0 21 10·4	4	4·60	4·20						1437·1	1440	†
„ 11,13	3 53	IV	D 0 28 3·1	4	3·20	5·60	834	45	·054	− 534·3	1437·7			
„ 22	3 25	VI	E 0 15 30·7	4	3·60	4·20								
„ 4	3 42	III	E 0 2 33·4	4	3·60	4·90	1062	59	·056	+ 327·1	1412·8			
May 1	4 11	VII	D 0 18 20·3	4	4·60	4·80						1411·7	1415	1
Apr. 22	3 21	VI	D 0 7 32·7	4	3·60	4·20	870	46	·053	− 26·5	1410·6			
May 1	4 13	VII	D 0 5 31·1	4	3·20	4·80								
Apr. 4	3 28	III	D 0 8 28·9	4	3·60	4·90	1186	43	·036	+ 25·2	1110·9			
Mar. 16	4 10	VIII	D 0 9 54·3	4	4·60	5·20								
„ 25	3 55	V	D 0 14 18·5	2	3·60	5·20	1222	64	·052	− 185·1	1112·9	1111·8	1115	2
„ 16	4 8	VIII	D 0 4 0·9	4	3·70	5·20								
May 1	4 9	VII	D 0 20 8·4	4	3·60	4·80	677	37	·054	− 300·0	1111·7			
Mar. 16	4 15	VIII	E 0 9 56·8	4	3·60	5·20								

† Not forthcoming.

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Astronomical Date 1843	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station – 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
Apr. 22	3 17	VI	D 0 5 2·1	4	5·10	4·20	813	39	·048	+ 25·2	1462·3			
May 8,9	4 6	IX	D 0 7 15·8	4	3·20	5·20						1463·3	1467	1
,, 1	4 18	VII	D 0 0 13·9	4	5·10	4·80	490	11	·023	+ 52·6	1464·3			
,, 8,9	4 4	IX	D 0 7 39·0	4	3·60	5·20								
,, 1	4 7	VII	D 0 6 4·8	4	4·10	4·80	473	19	·041	− 33·6	1378·1			
,, 26	2 57	X	D 0 1 19·3	4	3·60	5·20								
Mar. 16	4 16	VIII	E 0 9 28·5	4	4·10	5·20	628	32	·050	+ 263·5	1375·3	1377·0	1381	†
May 26	2 56	X	D 0 19 2·4	4	3·60	5·20								
,, 8,9	4 2	IX	D 0 9 34·3	4	4·10	5·20	743	35	·048	− 85·7	1377·6			
,, 26	3 1	X	D 0 1 42·8	4	4·60	5·20								
,, 8,9	4 21	IX	D 0 30 6·2	4	4·00	5·20	1061	62	·059	− 695·3	768·0			
1844 Feb. 29	3 23	XI	E 0 14 25·0	4	4·00	5·20						769·7	775	†
1843 May 26	3 3	X	D 0 28 24·9	4	4·00	5·20	968	56	·058	− 605·7	771·3			
1844 Feb. 29	3 22	XI	E 0 14 3·9	4	4·00	5·20								
1843 Mar. 16	4 3	VIII	D 0 22 13·2	4	4·60	5·20	1447	92	·063	− 497·4	614·4			
1844 ,, 16	2 58	XII	E 0 1 7·6	4	4·50	5·20						612·9	617	o
1843 May 26	2 52	X	D 0 28 43·5	4	4·60	5·20	1398	92	·066	− 765·5	611·5			
1844 Mar. 16	3 0	XII	E 0 8 26·4	4	4·00	5·20								
1843 May 26	2 50	X	D 0 31 36·0	4	4·00	5·20	1244	74	·060	− 821·6	555·4			
1844 Apr. 1	4 20	XIII	E 0 13 16·1	4	4·00	5·20								
Feb. 29	3 21	XI	D 0 14 56·3	4	4·00	5·20	833	53	·064	− 216·7	553·0	554·9	565	o
Apr. 1	4 24	XIII	E 0 2 43·9	4	4·00	5·20								
(1) 1844	3 28	XII	D 0 9 29·6	8	4·00	5·20	1050	67	·064	− 56·5	556·4			
,, 1,27	3 49	XIII	D 0 5 50·5	8	4·00	5·20								
Feb. 29	3 20	XI	D 0 18 27·5	4	4·50	5·20	1215	105	·087	− 360·2	409·5			
1845 ,, 25	3 17	XIV	E 0 1 40·3	4	4·00	5·20						400·2	404	33
1844 Apr. 1,27	4 6	XIII	D 0 12 54·5	8	4·50	5·20	939	52	·056	− 163·9	391·0			
Feb. 25	3 16	XIV	D 0 1 4·4	4	4·00	5·20								
1845 Oct. 21	3 55	XII	D 0 15 24·3	4	9·00	5·20	1256	76	·061	− 233·5	379·4			
1844 Dec. 6	2 28	XV	D 0 2 54·5	4	4·00	5·20						369·5	379	32
Apr. 27	3 21	XIII	D 0 15 10·9	4	9·00	5·20	1346	52	·039	− 195·4	359·5			
Dec. 6	2 33	XV	D 0 5 26·6	4	4·00	5·20								
Apr. 27	2 59	XIII	D 0 13 50·7	2	4·50	5·20	1247	55	·044	− 160·0	394·9			
Dec. 12	2 36	XVI	D 0 5 8·7	4	4·00	5·20								

† Not forthcoming. (1) The mean of observations taken on 16th March 1844 and 21st October 1845.

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Astronomical Date 1845		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Feb.	25	3 15	XIV	D o 6 10·7	4	4·50	5·20	830	27	·033	+ 7·6	407·8	399·7	{ 382·80 +27	27
Dec. 1844	12	2 39	XVI	D o 6 48·1	4	4·50	5·20								
"	6	2 37	XV	D o 6 38·7	4	4·50	5·20	987	41	·041	+ 26·9	396·4			
"	12	2 33	XVI	D o 8 20·4	4	9·00	5·20								
1845 Feb.	25	3 14	XIV	D o 5 26·6	4	4·00	5·20	661	25	·038	− 5·7	394·5			
Mar.	11	4 0	XVII	D o 4 50·1	6	4·50	5·20						392·9	395·53	25
"	16	4 57	XVI	D o 5 9·5	4	4·50	5·20	646	42	·065	− 8·4	391·3			
"	11	3 57	XVII	D o 4 16·7	6	4·50	5·20								
"	16	4 58	XVI	D o 5 5·3	4	4·00	5·20	487	23	·048	− 19·1	390·7	390·7	389	25
Apr.	1	4 18	XVIII	D o 2 23·4	4	4·50	5·20								
Mar.	19	10 19	XVII	E o 0 33·6	8	4·00	5·20	683	270	·395	+ 36·5	‡432·0			
"	24	9 53	XVIII	D o 3 2·6	4	4·50	5·20								
"	11	3 55	XVII	D o 5 12·0	6	4·50	5·20	644	11	·017	+ 0·3	395·8			
Apr.	24	3 55	XIX	D o 5 14·2	4	4·50	5·20						397·4	{ 367·84 +25·8	25·8
"	1	4 20	XVIII	D o 3 37·6	4	4·50	5·20	512	8	·016	+ 8·3	399·0			
"	24	3 57	XIX	D o 4 45·8	4	4·00	5·20								
"	1	4 22	XVIII	D o 5 2·3	4	4·00	5·20	748	21	·029	+ 19·6	410·3			
"	30	5 33	XX	D o 6 49·3	4	4·00	5·20						411·5	410·15	25
"	24	5 15	XIX	D o 5 17·2	4	4·00	5·20	773	32	·041	+ 15·4	412·8			
"	30	5 51	XX	D o 6 29·1	4	7·50	5·20								
"	24	4 0	XIX	D o 2 31·0	4	4·50	5·20	460	11	·024	+ 16·0	409·6			
May	8	5 0	XXI	D o 4 39·9	4	7·50	5·20						408·6	409	25
Apr.	30	5 42	XX	D o 4 37·8	4	4·50	5·20	575	21	·037	− 2·5	407·7			
May	8	5 6	XXI	D o 4 21·7	4	4·00	5·20								
Apr.	26	5 22	XIX	D o 4 54·4	4	10·50	5·20	767	38	·050	+ 14·0	407·6			
May	5	5 2	XXII	D o 6 8·7	4	10·50	5·20								
"	8	5 2	XXI	D o 3 44·5	4	4·50	5·20	432	22	·050	− 5·7	402·9	404·9	405	25
"	4	4 58	XXII	D o 2 50·8	4	4·50	5·20								
"	11	4 33	XXIII	D o 3 52·3	4	4·50	5·20	570	27	·047	+ 8·0	404·2			
"	4	4 56	XXII	D o 4 49·2	4	4·50	5·20								
"	2	5 3	XX	D o 5 45·8	4	4·50	5·20	652	20	·030	− 11·9	398·3			
"	10	4 20	XXIII	D o 4 31·6	4	4·50	5·20								
"	8	5 4	XXI	D o 5 0·9	4	4·50	5·20	523	19	·037	− 14·4	394·2	396·6	397·56	25·5
"	10	4 21	XXIII	D o 3 8·6	4	4·50	5·20								

‡ Rejected.

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Astronomical Date 1845	Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
	h. m.		° ′ ″				″							feet
May 4	4 56	XXII	D 0 4 49·2	4	4·50	5·20	570	27	·047	− 8·0	397·3			
„ 11	4 33	XXIII	D 0 3 52·3	4	4·50	5·20								
„ 4	4 55	XXII	D 0 4 10·2	4	4·50	5·20	585	36	·062	+ 2·4	407·4			
„ 12	3 51	XXIV	D 0 4 27·0	4	4·50	5·20						408·8	409	24
„ 11,19	4 4	XXIII	D 0 4 0·3	8	4·50	5·20	591	14	·024	+ 12·6	410·2			
„ 12	3 43	XXIV	D 0 5 27·2	4	4·50	5·20								
„ 19	4 35	XXIII	D 0 4 19·1	4	4·50	5·20	675	19	·028	+ 20·4	418·0			
„ 17	4 35	XXV	D 0 6 22·3	4	4·50	5·20						415·5	417	24
„ 2,12	4 6	XXIV	D 0 4 7·3	4	5·38	5·39	570	22	·039	+ 4·3	413·1			
Apr. 28, May 17	4 28	XXV	D 0 4 36·8	4	5·71	5·39								
May 2	5 9	XXIV	D 0 4 10·0	4	4·25	5·58	599	49	·082	+ 1·3	410·1			
Apr. 26	5 17	XXVI	D 0 4 9·1	4	7·17	5·58						411·1	{ 406·88 +6	30
„ 28	5 0	XXV	D 0 4 21·9	4	4·33	5·58	559	35	·062	− 3·5	412·0			
„ 26	4 57	XXVI	D 0 3 50·0	4	6·00	5·58								
„ 26	4 38	XXVI	D 0 4 50·0	4	6·08	5·58	645	32	·049	− 0·2	412·7	412·7	405·62	30
„ 21	4 37	XXVIII	D 0 4 44·9	4	7·33	5·58								
„ 21	5 54	XXVIII	D 0 3 38·5	4	5·00	5·58	642	116	·181	− 3·7	409·0	409·0	{ 382·36 +25	25
„ 10	5 54	XXX	D 0 3 7·2	4	7·42	5·58								
„ 11	7 30	XXX	D 0 0 29·2	4	5·58	5·58	671	255	·380	+ 16·9	425·9	425·9	{ 390·22 +24	24
„ 9	7 7	XXXI	D 0 1 56·4	4	10·75	5·58								
„ 28	5 14	XXV	D 0 4 15·1	4	6·33	5·58	637	63	·099	− 0·7	416·3			
„ 24	5 20	XXVII	D 0 4 11·6	4	6·08	5·58								
„ 26	5 3	XXVI	D 0 4 40·9	4	6·42	5·58	613	41	·066	− 5·4	407·5			
„ 24	5 7	XXVII	D 0 4 2·1	4	7·33	5·58						407·6	408	30
„ 21	4 44	XXVIII	D 0 4 53·1	4	10·75	5·58	644	23	·035	− 3·2	402·4			
„ 25	4 58	XXVII	D 0 4 34·7	4	10·25	5·58								
„ 14	4 30	XXIX	D 0 4 18·2	4	6·17	5·58	643	26	·041	+ 11·1	404·3			
„ 25	4 43	XXVII	D 0 5 27·7	4	6·50	5·58								
„ 25	4 43	XXVII	D 0 5 27·7	4	6·50	5·58	643	26	·041	− 11·1	397·6			
„ 14	4 30	XXIX	D 0 4 18·2	4	6·17	5·58								
„ 20	5 1	XXVIII	D 0 5 18·0	4	6·75	5·58	641	59	·092	− 19·0	386·6			
„ 14	5 2	XXIX	D 0 3 15·9	4	7·25	5·58						394·3	394	24
„ 10	5 40	XXX	D 0 4 20·4	4	5·75	5·58	632	84	·132	− 8·8	399·1			
„ 14	5 38	XXIX	D 0 3 25·5	4	5·08	5·58								

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Astronomical Date 1845		Mean of Times of observation	Station	Observed Vertical Angle	Number of observations	Height in feet: Signal	Height in feet: Instrument	Contained Arc	Terrestrial Refraction: In seconds	Terrestrial Refraction: Decimals of Contained Arc	Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level: Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	Height of Pillar or Tower
		h. m.		° ′ ″				″							feet
Apr.	9	5 15	XXXI	D 0 5 49·1	4	5·50	5·58	680	52	·077	− 20·4	393·8			
”	14	5 10	XXIX	D 0 3 45·0	4	6·08	5·58								
”	12	5 15	XXX	D 0 2 58·4	4	10·75	5·58	667	69	·104	+ 23·0	430·9			
”	8	5 23	XXXII	D 0 5 19·0	4	10·67	5·58						429·4	{404·66 + 24}	24
”	9	4 41	XXXI	D 0 4 24·9	4	5·00	5·58	647	17	·026	+ 13·7	427·9			
”	8	4 38	XXXII	D 0 5 48·9	4	5·75	5·58								
”	9	5 6	XXXI	D 0 4 30·5	4	5·83	5·58	655	35	·053	+ 7·0	421·2			
”	5	5 10	XXXIII	D 0 5 14·7	4	5·58	5·58						420·0	420	30
”	8	4 58	XXXII	D 0 4 41·9	4	5·83	5·58	595	49	·082	− 9·9	418·8			
”	5	5 4	XXXIII	D 0 3 35·5	4	5·42	5·58								
”	8	4 29	XXXII	D 0 4 58·2	4	5·33	5·58	610	− 2	·003	+ 2·8	431·5			
”	4	4 25	XXXIV	D 0 5 10·2	4	7·25	5·58						431·1	431	24
”	5	4 27	XXXIII	D 0 4 20·6	6	5·33	5·58	587	− 3	·006	+ 10·7	430·7			
”	4	4 12	XXXIV	D 0 5 30·6	4	6·58	5·58								
”	5	4 32	XXXIII	D 0 7 4·3	12	5·67	5·58	723	37	·052	− 35·7	384·3			
Mar.	28	3 55	XXXV	D 0 3 42·6	4	6·08	5·83						389·0	389	30
Apr.	4	5 34	XXXIV	D 0 5 28·3	4	10·67	5·58	666	104	·156	− 37·4	393·7			
Mar.	28	5 10	XXXV	D 0 1 49·1	4	7·83	5·83								
Apr.	2	4 6	XXXIV	D 0 3 24·0	6	5·25	5·58	589	28	·048	+ 18·5	449·6			
Mar.	16	4 10	XXXVI	D 0 5 42·1	4	2·50	5·82						450·2	451	24
”	21	4 0	XXXV	D 0 2 16·5	4	3·17	5·83	703	44	·062	+ 61·8	450·8			
”	16	4 0	XXXVI	D 0 8 4·0	4	6·83	5·82								
”	26	3 30	XXXV	D 0 2 59·7	6	7·00	5·83	714	93	·130	+ 28·5	417·5			
”	8	3 30	XXXVII	D 0 5 50·1	4	4·00	5·58						420·6	421	24†
”	16	3 45	XXXVI	D 0 6 29·6	4	2·50	5·82	661	33	·050	− 26·5	423·7			
”	8	3 0	XXXVII	D 0 3 45·5	4	2·50	5·58								
”	16	3 37	XXXVI	D 0 5 16·8	6	2·17	5·82	684	42	·061	− 1·9	448·3			
Feb.	20	3 30	XXXVIII	D 0 5 7·7	4	1·25	5·60						449·7	450	24
Mar.	8	(1)	XXXVII	D 0 3 34·2	4	1·63	5·58	695	55	·080	+ 30·5	451·1			
Feb.	20	3 45	XXXVIII	D 0 6 34·4	4	1·25	5·60								
Mar.	8	3 45	XXXVII	D 0 4 2·9	6	3·92	5·58	695	46	·066	+ 21·6	442·2			
Feb.	24	3 30	XXXIV*	D 0 6 16·6	4	1·33	5·35						440·2	439	12
”	20	4 0	XXXVIII	D 0 5 43·9	4	1·75	5·60	704	53	·075	− 11·5	438·2			
”	24	3 30	XXXIV*	D 0 4 35·3	4	2·25	5·35								

(1). Not forthcoming, but it would appear from the evidence at hand to have been taken about 4 o'clock. † Above the bastion of the fort on which the station is built.

NOTE.—Station XXXIV* appertains to the North-East Longitudinal Series.

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Astronomical Date		Station	Observed Vertical Angle	Number of observations	Height in feet		Contained Arc	Terrestrial Refraction		Height of 2nd Station − 1st Station in feet	Height in feet of 2nd Station above Mean Sea Level			Height of Pillar or Tower
1845	Mean of Times of observation				Signal	Instrument		In seconds	Decimals of Contained Arc		Trigonometrical Results: By each deduction	Trigonometrical Results: Mean	Final Result	
	h. m.		° ′ ″				″							feet
March 8	4 0	XXXVII	D 0 5 13·6	4	4·50	5·58	751	65	·086	+ 0·1	420·7	423·6	425·89	24
„ 4	3 45	XXXV*	D 0 5 18·4	4	2·92	5·60								
1850 Jan. 20,21	3 3	XXXIV*	D 0 6 16·2	8	5·60	5·08	734	28	·037	− 13·7	426·5			
1849 Dec. 26,27,28,30	3 21	XXXV*	D 0 5 0·7	16	5·30	5·07								

Note.—Stations XXXIV* and XXXV* appertain to the North-East Longitudinal Series.

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Descriptions of Spirit-leveled Points.

The spirit-leveled heights given on pages 51—M. to 54—M., were determined by the operations either of the G. T. Survey or the Revenue Survey; these connections are hereafter indicated in the former case by the letters (G. T. S.), and in the latter by (R. S.) immediately following the name of each station; the surface on which the leveling staff stood is also described.

XVI	or	*Karra Tower Station,*	(*G. T. S.*);	On the mark-stone let into the upper surface of the basement on which the tower has been built.
XVII	"	*Majilgaon Tower Station,*	" ;	On the mark-stone let into the upper surface of the pillar.
XIX	"	*Horesa Tower Station,*	(*R. S.*) ;	On the mark-stone let into the upper surface of the basement on which the tower has been built.
XX	"	*Salon Tower Station,*	" ;	On the mark-stone let into the upper surface of the pillar.
XXIII	"	*Munai Tower Station,*	" ;	On the upper surface of the pillar.
XXVI	"	*Tauli Tower Station,*	" ;	On the mark-stone at 24 feet above the ground, *i. e.* at 6 feet below the one at the original upper surface of the pillar.
XXVIII	"	*Parewa Tower Station,*	" ;	On the mark-stone let into the upper surface of the pillar.
XXX	"	*Pesar Tower Station,*	(*G. T. S.*);	On the mark-stone let into the base of the tower.
XXXI	"	*Turkani Tower Station,*	" ;	On the mark-stone let into the base of the tower.
XXXII	"	*Utiámau Tower Station,*	" ;	On the mark-stone let into the base of the tower.
XXXV	"	*Mási Tower Station,* (Of the North-East Longitudinal Series).	(*R. S.*) ;	On the upper surface of the pillar.

For further particulars of these Stations, see pages 6—M. *to* 10—M.

October 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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KARARA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XIII (Pabhosa)

Lat. N. 25° 21′ 17″·32; Long. E. 81° 21′ 35″·58 = 5h 25m 26s·4; Height above Mean Sea Level, 565 feet.
June and July 1845; observed by Mr. J. W. Armstrong with Harris and Barrow's 15-inch Theodolite.

Star observed	*a* Ursæ Minoris (East).
Mean Right Ascension 1845·0	1h 3m 35s
Mean North Polar Distance 1845·0	1° 31′ 1″·41
Local Mean Time of Elongation, June 12	Eastern 13h 43m

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT				FACE RIGHT			
			Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation	Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
June 12	E.	0 2	+ 0 15 55·46	13 8	− 0 9·91	+ 0 15 45·55	+ 0 15 21·74	2 57	− 0 0·50	+ 0 15 21·24
		&	15 50·30	10 58	0 6·91	43·39	15 23·60	0 42	0 0·03	23·57
		180 2	16 2·53	15 51	0 14·46	48·07	15 24·83	6 3	0 2·10	22·73
			16 8·76	18 1	0 18·69	50·07	15 29·23	8 0	0 3·68	25·55
„ 13	E.	10 2	+ 0 16 1·53	17 10	− 0 16·96	+ 0 15 44·57	+ 0 15 37·27	8 47	− 0 4·45	+ 0 15 32·82
		&	15 57·73	14 58	0 12·90	44·83	15 39·57	6 35	0 2·50	37·07
		190 1	15 51·60	13 3	0 9·80	41·80	15 36·13	4 2	0 0·93	35·20
			15 53·87	14 52	0 12·73	41·14	15 36·40	6 36	0 2·51	33·89
„ 16	E.	20 2	+ 0 15 58·77	18 23	− 0 19·44	+ 0 15 39·33	+ 0 15 39·50	8 10	− 0 3·84	+ 0 15 35·66
		&	15 54·40	16 25	0 15·53	38·87	15 39·57	6 1	0 2·09	37·48
		200 2	15 49·03	11 30	0 7·61	41·42	15 33·67	1 25	0 0·12	33·55
			15 56·13	13 58	0 11·23	44·90	15 38·20	4 15	0 1·04	37·16
„ 18	E.	30 3	+ 0 16 2·43	18 27	− 0 19·55	+ 0 15 42·88	+ 0 15 32·97	9 31	− 0 5·22	+ 0 15 27·75
		&	15 58·24	16 33	0 15·73	42·51	15 36·76	6 51	0 2·71	34·05
		210 3	15 49·17	7 35	0 3·31	45·86	15 30·80	0 59	0 0·06	30·74
			15 50·80	10 9	0 5·93	44·87	15 34·20	2 57	0 0·50	33·70
„ 28	E.	40 4	+ 0 16 1·67	18 51	− 0 20·43	+ 0 15 41·24	+ 0 15 45·67	7 24	− 0 3·15	+ 0 15 42·52
		&	15 55·16	16 8	0 14·95	40·21	15 42·80	5 33	0 1·77	41·03
		220 3	16 56·66	37 58	1 23·01	33·65	15 40·17	0 2	0 0·00	40·17
			17 7·33	39 38	1 30·45	36·88	16 33·60	29 44	0 50·94	42·66

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT				FACE RIGHT			
			Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation	Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	Interval in Time from Elongation	Reduction in Arc to Time of Elongation	Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
July 5	E.	50 3	+ 0 16 0·90	20 47	− 0 24·81	+ 0 15 36·09	+ 0 15 50·80	12 47	− 0 9·39	+ 0 15 41·41
		&	16 0·26	18 50	0 20·38	39·88	15 51·40	10 28	0 6·29	45·11
		230 3	15 37·73	6 32	0 2·45	35·28	15 45·20	2 38	0 0·40	44·80
			15 40·00	9 4	0 4·73	35·27	15 46·17	0 19	0 0·01	46·16
			15 50·10	16 24	0 15·48	34·62	16 12·13	23 27	0 31·67	40·46
			15 57·17	17 51	0 18·35	38·82	16 15·17	24 37	0 34·89	40·28
„ 6	E.	20 2	+ 0 15 58·10	16 35	− 0 15·80	+ 0 15 42·30	+ 0 15 44·67	7 46	− 0 3·47	+ 0 15 41·20
		&	15 52·36	14 6	0 11·42	40·94	15 43·50	4 13	0 1·02	42·48
		200 2	15 51·36	11 54	0 8·15	43·21	15 40·03	3 1	0 0·52	39·51
			15 54·90	14 18	0 11·77	43·13	15 42·77	5 40	0 1·84	40·93

Abstract of Astronomical Azimuth observed at XIII (Pabhosa) 1845.

By Eastern Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°
Date	June 12		June 13		June 16		June 18		June 28		July 5	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	45·55	21·24	44·57	32·82	39·33	35·66	42·88	27·75	41·24	42·52	36·09	41·41
	43·39	23·57	44·83	37·07	38·87	37·48	42·51	34·05	40·21	41·03	39·88	45·11
	48·07	22·73	41·80	35·20	41·42	33·55	45·86	30·74	33·65	40·17	35·28	44·80
	50·07	25·55	41·14	33·89	44·90	37·16	44·87	33·70	36·88	42·66	35·27	46·16
					*41·97	*40·87					34·62	40·46
					*40·61	*42·15					38·82	40·28
					*42·88	*39·18						
					*42·80	*40·60						
Means	46·77	23·27	43·09	34·75	41·60	38·33	44·03	31·56	38·00	41·60	36·66	43·04
	° ′ ″		″		″		″		″		″	
Means of both faces	+ 0 15 35·02		38·92		39·97		37·80		39·80		39·85	
Az. of Star fr. S., by W.	181 40 50·86		50·92		51·08		51·14		51·19		50·81	
Az. of Ref. M. „	181 56 25·88		29·84		31·05		28·94		30·99		30·66	

		°	′	″
Astronomical Azimuth of Referring Mark by Eastern Elongation		181	56	29·56
Angle Referring Mark and XVI (Karra) *see* following page	+	5	41	34·28
Astronomical Azimuth of Karra by observation		187	38	3·84
Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* page 45—M. *ante*		187	38	7·11
Astronomical—Geodetical Azimuth at XIII (Pabhosa)	−			3·27

NOTE.—Where observations occurred on the same pair of zeros on different nights they are reduced in this abstract to one date—the most convenient—by allowing for star's change of place. The date so adopted appears at the head of the column, and the reduced observation is preceded by an asterisk.

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At XIII

June 1845; *observed by Mr. J. W. Armstrong with Harris and Barrow's* 15-*inch Theodolite.*

Angle between	Means of Circle-readings, telescope being set on R. M. 0° 1′	180° 1′	10° 2′	190° 2′	20° 2′	200° 2′	30° 4′	210° 3′	40° 4′	220° 3′	50° 1′	230° 1′	General Mean
	″	″	″	″	″	″	″	″	″	″	″	″	
R. M. & XVI	$33\cdot00_{2}$	$36\cdot03_{2}$	$33\cdot22_{2}$	$31\cdot98_{2}$	$36\cdot30_{2}$	$32\cdot63_{2}$	$36\cdot15_{2}$	$37\cdot70_{2}$	$33\cdot75_{2}$	$33\cdot95_{2}$	$32\cdot58_{2}$	$34\cdot05_{2}$	5° 41′ 34″·28

At XXIV (Sora)

Lat. N. 26° 17′ 18″·83; Long. E. 81° 14′ 50″·30 = 5ʰ 24ᵐ 59ˢ·4; Height above Mean Sea Level, 409 feet.
October 1845; observed by Captain A. S. Waugh with Syud Meer Mohsin's 18-inch Theodolite.

Star observed	α Ursæ Minoris (East and West).
Mean Right Ascension 1845·0	$1^h\ 3^m\ 35^s$
Mean North Polar Distance 1845·0	1° 31′ 1″·41
Local Mean Times of Elongation, Oct. 3	Eastern $6^h\ 20^m$; Western 18 12

Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Oct. 3	E.	0 8	+ 1 5 6·06	13 0	− 0 9·76	+ 1 4 56·30	+ 1 5 12·10	2 44	− 0 0·43	+ 1 5 11·67
		&	4 59·83	9 30	0 5·21	54·62	5 9·90	5 10	0 1·54	8·36
		180 8	5 42·70	26 44	0 41·29	61·41	5 21·13	13 54	0 11·17	9·96
			5 53·40	30 18	0 53·07	60·33	5 24·70	16 46	0 16·24	8·46
„ 3	W.	0 8	+ 4 26 37·20	32 12	+ 0 59·88	+ 4 27 37·08	+ 4 27 35·87	3 53	+ 0 0·87	+ 4 27 36·74
		&	26 46·50	28 37	0 47·33	33·83	27 31·50	10 0	0 5·78	37·28
		180 8								
„ 4	E.	10 10	+ 1 5 14·67	11 52	− 0 8·13	+ 1 5 6·54	+ 1 5 49·24	26 45	− 0 41·24	+ 1 5 8·00
		&	5 8·97	7 55	0 3·61	5·36	5 36·77	23 17	0 31·24	5·53
		190 9	5 5·76	1 1	0 0·06	5·70	5 16·17	13 48	0 11·01	5·16
			5 4·10	4 45	0 1·30	2·80	5 20·97	17 0	0 16·69	4·28
„ 4	W.	10 9	+ 4 27 18·90	16 35	+ 0 15·89	+ 4 27 34·79	+ 4 26 49·03	29 15	+ 0 49·42	+ 4 27 38·45
		&	27 22·84	13 20	0 10·26	33·10	26 59·70	26 14	0 39·79	39·49
		190 10	27 34·53	4 11	0 1·01	35·54				
			27 30·03	7 15	0 3·04	33·07				
„ 5	E.	20 11	+ 1 5 50·36	27 0	− 0 42·00	+ 1 5 8·36	+ 1 5 23·40	15 13	− 0 13·37	+ 1 5 10·03
		&	5 40·83	24 4	0 33·36	7·47	5 17·40	12 41	0 9·29	8·11
		200 10	5 23·26	13 36	0 10·70	12·56	5 10·17	2 15	0 0·29	9·88
			5 26·56	16 27	0 15·64	10·92	5 6·70	0 47	0 0·03	6·67

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark − Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark − Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark − Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Oct. 5	W.	20 10	+ 4 27 27·33	9 13	+ 0 4·90	+ 4 27 32·23	+ 4 27 6·53	21 50	+ 0 27·57	+ 4 27 34·10
		&	27 31·50	6 24	0 2·37	33·87	27 15·36	18 27	0 19·67	35·03
		200 10	27 35·27	6 37	0 2·52	37·79	27 7·83	23 14	0 31·10	38·93
			27 28·56	9 56	0 5·70	34·26				
„ 6	E.	30 5	+ 1 5 7·23	4 44	− 0 1·29	+ 1 5 5·94	+ 1 5 36·63	21 19	− 0 26·20	+ 1 5 10·43
		&	5 3·13	1 37	0 0·15	2·98	5 18·03	14 10	0 11·58	6·45
		210 5	5 8·50	7 51	0 3·56	4·94	5 38·23	22 31	0 29·31	8·92
			5 9·70	10 42	0 6·62	3·08	5 47·46	25 13	0 36·77	10·69
„ 6	W.	30 5	+ 4 27 12·04	18 16	+ 0 19·29	+ 4 27 31·33	+ 4 27 31·46	5 58	+ 0 2·05	+ 4 27 33·51
		&	27 18·00	14 44	0 12·54	30·54	27 33·80	3 15	0 0·61	34·41
		210 5	27 23·63	9 19	0 5·00	28·63				
			27 21·10	12 19	0 8·75	29·85				
„ 7	E.	40 11	+ 1 5 41·37	23 0	− 0 30·51	+ 1 5 10·86	+ 1 5 9·70	8 12	− 0 3·88	+ 1 5 5·82
		&	5 26·53	19 4	0 20·96	5·57	5 6·27	5 14	0 1·58	4·69
		220 11	5 25·40	17 20	0 17·37	8·03	5 6·83	4 35	0 1·21	5·62
			5 32·46	19 57	0 22·99	9·47	5 7·53	7 39	0 3·38	4·15
„ 7	W.	40 11	+ 4 27 33·50	6 47	+ 0 2·66	+ 4 27 36·16	+ 4 27 9·07	18 22	+ 0 19·49	+ 4 27 28·56
		&	27 35·33	2 6	0 0·25	35·58	27 15·40	15 24	0 13·72	29·12
		220 11	27 31·66	7 36	0 3·33	34·99	27 8·40	19 18	0 21·49	29·89
			27 29·93	10 10	0 5·97	35·90	27 0·57	23 13	0 31·06	31·63
„ 8	E.	50 7	+ 1 5 34·30	21 56	− 0 27·75	+ 1 5 6·55	+ 1 5 11·03	8 13	− 0 3·90	+ 1 5 7·13
		&	5 23·33	18 47	0 20·34	2·99	5 8·47	5 27	0 1·71	6·76
		230 7	5 28·93	19 12	0 21·32	7·61	5 5·17	6 31	0 2·45	2·72
			5 28·90	21 30	0 26·71	2·19	5 8·70	8 59	0 4·66	4·04
„ 8	W.	50 7	+ 4 27 29·70	1 2	+ 0 0·06	+ 4 27 29·76	+ 4 27 12·20	14 56	+ 0 12·88	+ 4 27 25·08
		&	27 26·70	1 41	0 0·16	26·86	27 17·14	11 29	0 7·63	24·77
		230 7	27 23·44	9 16	0 4·95	28·39	27 1·83	21 39	0 27·04	28·87
			27 20·00	11 41	0 7·88	27·88	26 48·20	24 56	0 35·82	24·02
„ 9	E.	0 8	+ 1 4 59·83	0 10	− 0 0·00	+ 1 4 59·83	+ 1 5 26·94	16 31	− 0 15·73	+ 1 5 11·21
		&	5 4·30	3 33	0 0·73	63·57	5 19·33	13 13	0 10·09	9·24
		180 8	5 21·03	15 15	0 13·43	67·60	6 4·07	30 49	0 54·85	9·22
			5 27·10	18 27	0 19·68	67·42	6 14·87	32 55	1 2·61	12·26
„ 9	W.	0 8	+ 4 27 29·70	4 50	+ 0 1·35	+ 4 27 31·05	+ 4 27 10·90	18 29	+ 0 19·75	+ 4 27 30·65
		&	27 29·60	1 40	0 0·16	29·76	27 22·63	14 19	0 11·83	34·46
		180 8	27 23·24	8 22	0 4·04	27·28	27 6·40	21 55	0 27·71	34·11
			27 21·40	11 3	0 7·05	28·45	26 54·20	25 55	0 38·70	32·90
„ 10	E.	10 9	+ 1 5 37·40	20 22	− 0 23·91	+ 1 5 13·49	+ 1 5 13·90	6 33	− 0 2·48	+ 1 5 11·42
		&	5 25·03	16 38	0 15·97	9·06	5 10·63	3 40	0 0·77	9·86
		190 9	5 43·14	23 29	0 31·88	11·26	5 14·96	9 29	0 5·20	9·76
			5 52·20	26 40	0 41·07	11·13	5 20·07	12 14	0 8·64	11·43
„ 10	W.	10 9	+ 4 27 31·40	4 5	+ 0 0·96	+ 4 27 32·36	+ 4 27 16·86	17 14	+ 0 17·15	+ 4 27 34·01
		&	27 34·54	1 18	0 0·10	34·64	27 20·87	13 54	0 11·17	32·04
		190 9	27 30·86	7 5	0 2·89	33·75	26 56·27	25 7	0 36·37	32·64
			27 25·37	10 8	0 5·93	31·30	26 46·36	27 51	0 44·66	31·02

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Astronomical Date	Elongation	Zeros (Circle Readings of Referring Mark)	FACE LEFT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE LEFT: Interval in Time from Elongation	FACE LEFT: Reduction in Arc to Time of Elongation	FACE LEFT: Reduced Observation Ref. Mark—Star at Elongation	FACE RIGHT: Observed Horizontal Angle: Diff. of Readings Ref. Mark—Star	FACE RIGHT: Interval in Time from Elongation	FACE RIGHT: Reduction in Arc to Time of Elongation	FACE RIGHT: Reduced Observation Ref. Mark—Star at Elongation
		° ′	° ′ ″	m s	′ ″	° ′ ″	° ′ ″	m s	′ ″	° ′ ″
Oct. 11	E.	20 10	+ 1 5 29·87	20 37	− 0 24·52	+ 1 5 5·35	+ 1 5 7·70	2 30	− 0 0·36	+ 1 5 7·34
		&	5 19·10	16 53	0 16·44	2·66	5 7·87	1 17	0 0·09	7·78
		200 10	5 58·34	27 44	0 44·46	13·88	5 20·10	13 14	0 10·13	9·97
			6 5·54	30 53	0 55·10	10·44	5 30·60	18 13	0 19·18	11·42
„ 11	W.	20 10	+ 4 27 17·47	16 34	+ 0 15·87	+ 4 27 33·34	+ 4 27 29·10	2 40	+ 0 0·41	+ 4 27 29·51
		&	27 23·46	13 40	0 10·79	34·25	27 29·37	0 36	0 0·02	29·39
		200 10	26 55·23	26 21	0 39·99	35·22	27 20·47	11 31	0 7·65	28·12
			26 47·97	29 24	0 49·78	37·75	27 15·20	14 31	0 12·16	27·36
„ 12	E.	30 4	+ 1 5 29·80	20 53	− 0 25·14	+ 1 4 64·66	+ 1 5 18·50	6 13	− 0 2·23	+ 1 5 16·27
		&	5 23·56	16 51	0 16·39	67·17	5 18·67	3 22	0 0·66	18·01
		210 4	5 18·27	17 23	0 17·48	60·79	5 12·40	5 12	0 1·56	10·84
			5 22·43	19 45	0 22·54	59·89	5 14·50	7 58	0 3·67	10·83
„ 12	W.	30 4	+ 4 27 28·60	3 40	+ 0 0·78	+ 4 27 29·38	+ 4 27 15·74	17 21	+ 0 17·40	+ 4 27 33·14
		&	27 29·80	0 39	0 0·02	29·82	27 20·03	13 59	0 11·29	31·32
		210 4	27 25·16	9 19	0 5·00	30·16	27 1·40	23 15	0 31·14	32·54
			27 18·46	12 38	0 9·21	27·67	26 47·63	28 5	0 45·44	33·07

Abstract of Astronomical Azimuth observed at XXIV (Sora) 1845.

1. By Eastern Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°
Date	October 9		October 10		October 11		October 12		October 7		October 8	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	*58·87	*74·24	*69·11	*70·57	*70·87	*72·54	*68·45	*72·94	70·86	65·82	66·55	67·13
	*57·19	*70·93	*67·93	*68·10	*69·98	*70·62	*65·49	*68·96	65·57	64·69	62·99	66·76
	*63·98	*72·53	*68·27	*67·73	*75·07	*72·39	*67·45	*71·43	68·03	65·62	67·61	62·72
	*62·90	*71·03	*65·37	*66·85	*73·43	*69·18	*65·59	*73·20	69·47	64·15	62·19	64·04
	59·83	71·21	73·49	71·42	65·35	67·34	64·66	76·27				
	63·57	69·24	69·06	69·86	62·66	67·78	67·17	78·01				
	67·60	69·22	71·26	69·76	73·88	69·97	60·79	70·84				
	67·42	72·26	71·13	71·43	70·44	71·42	59·89	70·83				
Means	62·67	71·33	69·45	69·47	70·21	70·16	64·94	72·81	68·48	65·07	64·84	65·16
	° ′ ″		″		″		″		″		″	
Means of both faces	+ 1 4 67·00		69·46		70·18		68·88		66·78		65·00	
Az. of Star fr. S., by W.	181 41 10·68		10·23		9·84		9·45		11·57		11·13	
Az. of Ref. M. „	182 46 17·68		19·69		20·02		18·33		18·35		16·13	

NOTE.—Where observations occurred on the same pair of zeros on different nights they are reduced in this abstract to one date—the most convenient—by allowing for star's change of place. The date so adopted appears at the head of the column, and the reduced observation is preceded by an asterisk.

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Abstract of Astronomical Azimuth observed at XXIV (Sora) 1845—(*Continued*).

2. By Western Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	0°	180°	10°	190°	20°	200°	30°	210°	40°	220°	50°	230°
Date	October 9		October 10		October 11		October 12		October 7		October 8	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	*34·52	*34·18	*32·22	*35·88	*29·78	*31·65	*28·76	*30·94	36·16	28·56	29·76	25·08
	*31·27	*34·72	*30·53	*36·92	*31·42	*32·58	*27·97	*31·84	35·58	29·12	26·86	24·77
	31·05	30·65	*32·97	34·01	*35·34	*36·48	*26·06	33·14	34·99	29·89	28·39	28·87
	29·76	34·46	*30·50	32·04	*31·81	29·51	*27·28	31·32	35·90	31·63	27·88	24·02
	27·28	34·11	32·36	32·64	33·34	29·39	29·38	32·54				
	28·45	32·90	34·64	31·02	34·25	28·12	29·82	33·07				
			33·75		35·22	27·36	30·16					
			31·30		37·75		27·67					
Means	30·39	33·50	32·28	33·75	33·61	30·73	28·39	32·14	35·66	29·80	28·22	25·69
	° ′ ″		″		″		″		″		″	
Means of both faces	+ 4 27 31·95		33·02		32·17		30·27		32·73		26·95	
Az. of Star fr. S., by W.	178 18 49·54		49·99		50·32		50·77		48·65		49·10	
Az. of Ref. M. „	182 46 21·49		23·01		22·49		21·04		21·38		16·05	

			° ′ ″
Astronomical Azimuth of Referring Mark	by Eastern Elongation	... ...	182 46 18·37
	by Western „	... ...	„ 20·91
	Mean	... ...	„ 19·64

Angle Referring Mark and XXV (Janai) *see* below ... ... + 56 56 43·63

Astronomical Azimuth of Janai by observation ... ... +239 42 63·27

Geodetical Azimuth of „ by calculation from that adopted (*Vol.* II, page 141) at Kaliánpur, *see* page 46—M. *ante* ... ... 239 42 58·77

Astronomical—Geodetical Azimuth at XXIV (Sora) ... ... + 4·50

NOTE.—Where observations occurred on the same pair of zeros on different nights they are reduced in this abstract to one date—the most convenient—by allowing for star's change of place. The date so adopted appears at the head of the column, and the reduced observation is preceded by an asterisk.

At XXIV

October 1845; *observed by Captain A. S. Waugh with Syud Meer Mohsin's* 18-*inch Theodolite.*

Angle between	Means of Circle-readings, telescope being set on R. M.												General Mean
	0° 8′	180° 8′	10° 10′	190° 10′	20° 10′	200° 10′	30° 5′	210° 5′	40° 11′	220° 11′	50° 7′	230° 7′	
	″	″	″	″	″	″	″	″	″	″	″	″	
R. M. & XXV	51·24$_{2}$	39·20$_{2}$	44·49$_{2}$	39·40$_{2}$	43·13$_{2}$	41·59$_{2}$	51·48$_{4}$	43·96$_{2}$	42·00$_{2}$	35·75$_{4}$	45·25$_{4}$	46·07$_{2}$	56° 56′ 43″·63

October 1878.

J. B. N. HENNESSEY,
In charge of Computing Office.

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PRINCIPAL TRIANGULATION—KARARA MERIDIONAL SERIES.

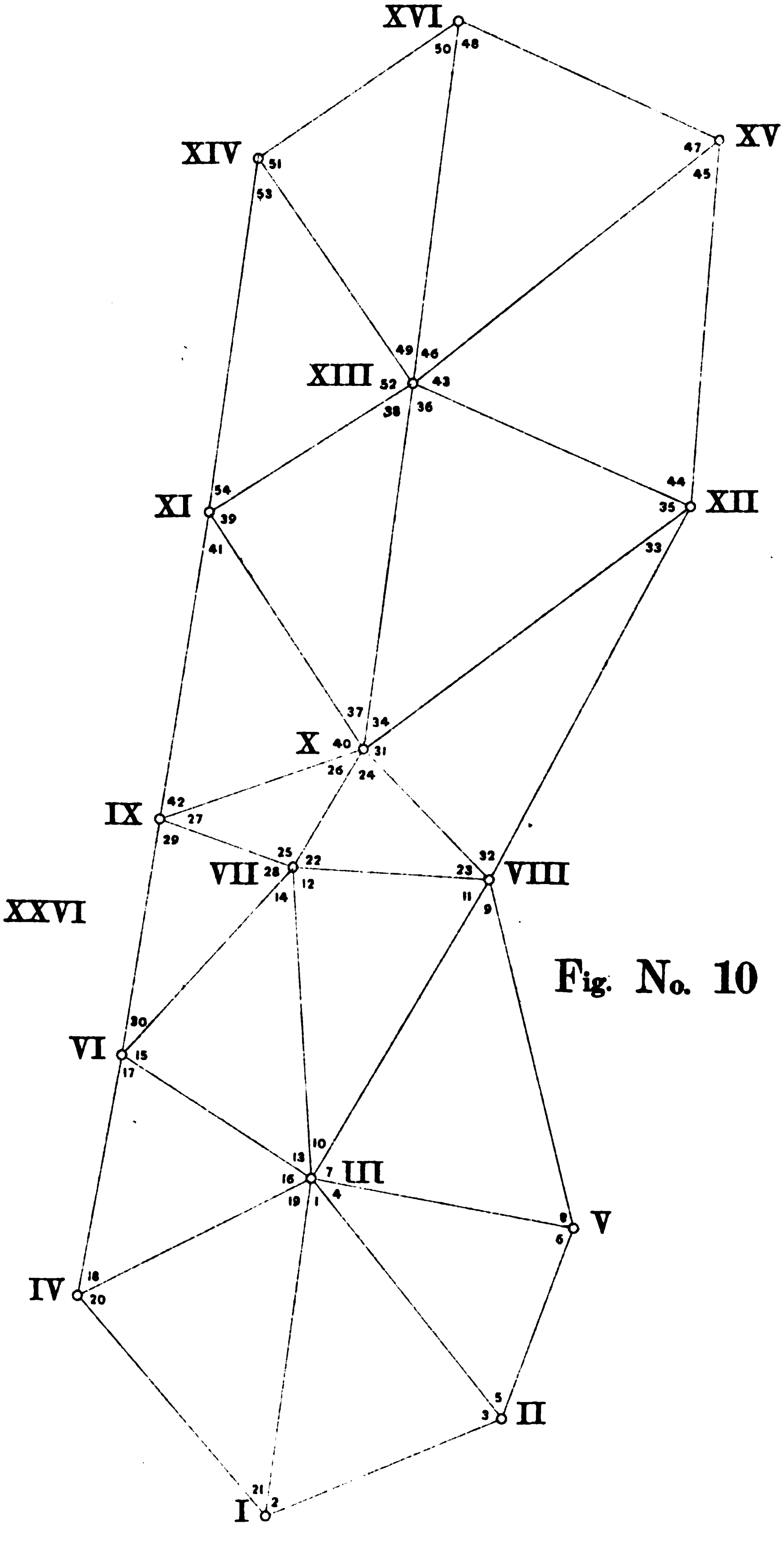

Fig. No. 10

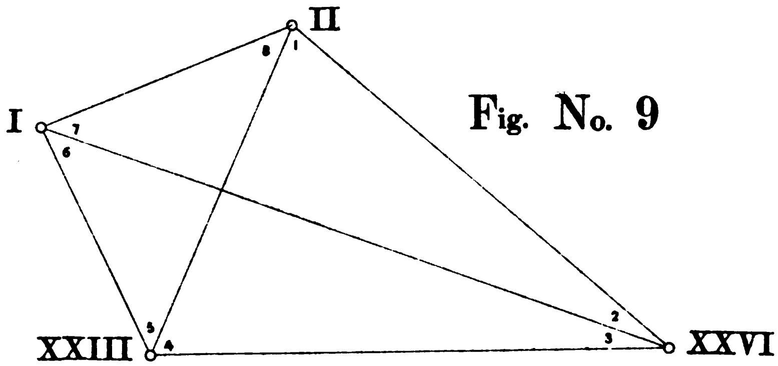

Fig. No. 9

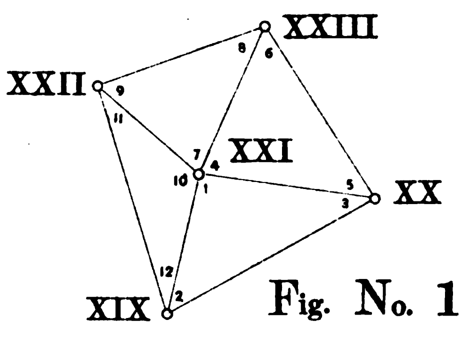

Fig. No. 11

Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

C. DYSON, PHOTO.

Photozincographed at the Office of the Superintendent Great Trigonometrical Survey, Dehra Dún, June 1878.

C. G. OLLENBACH.

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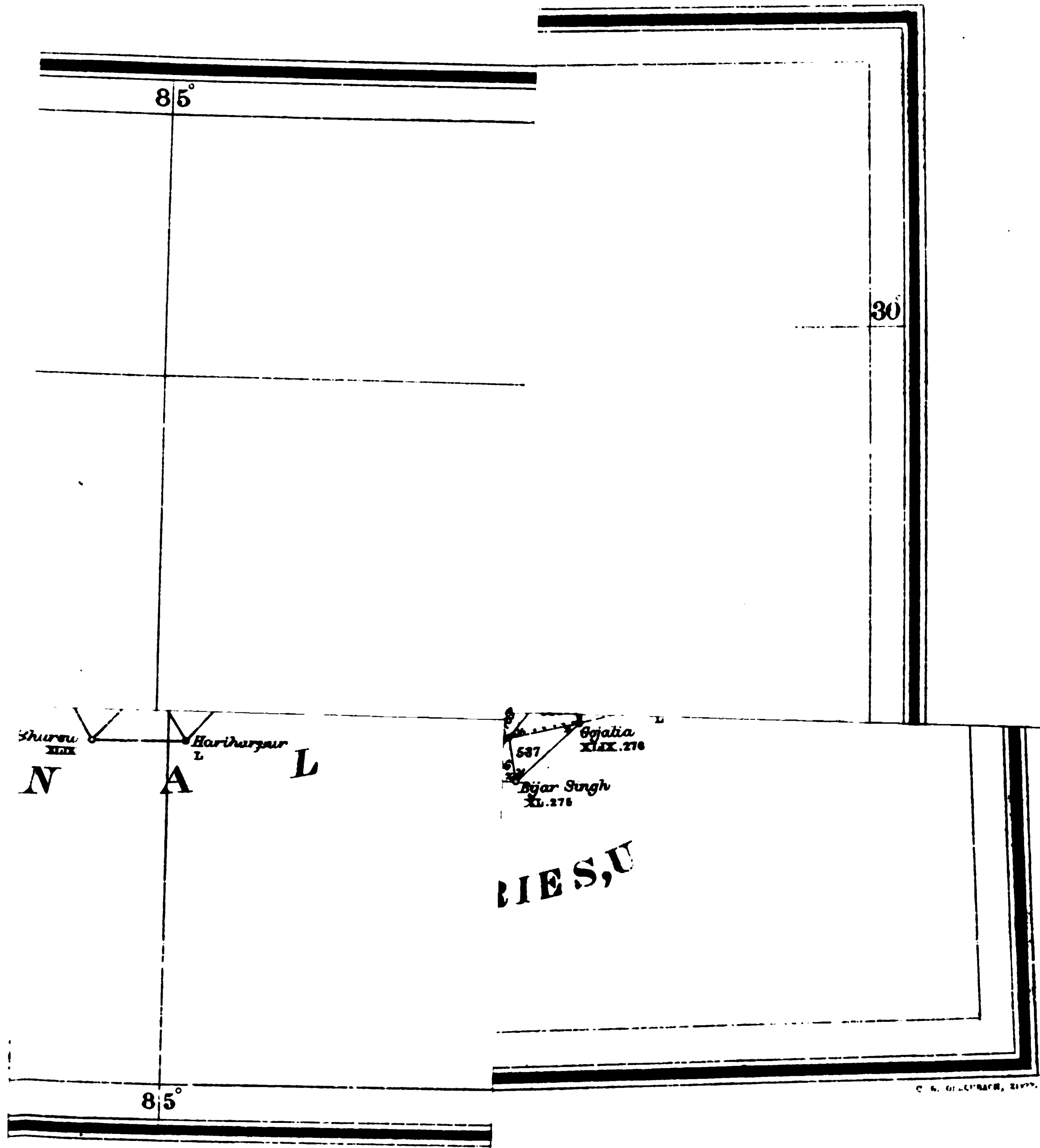
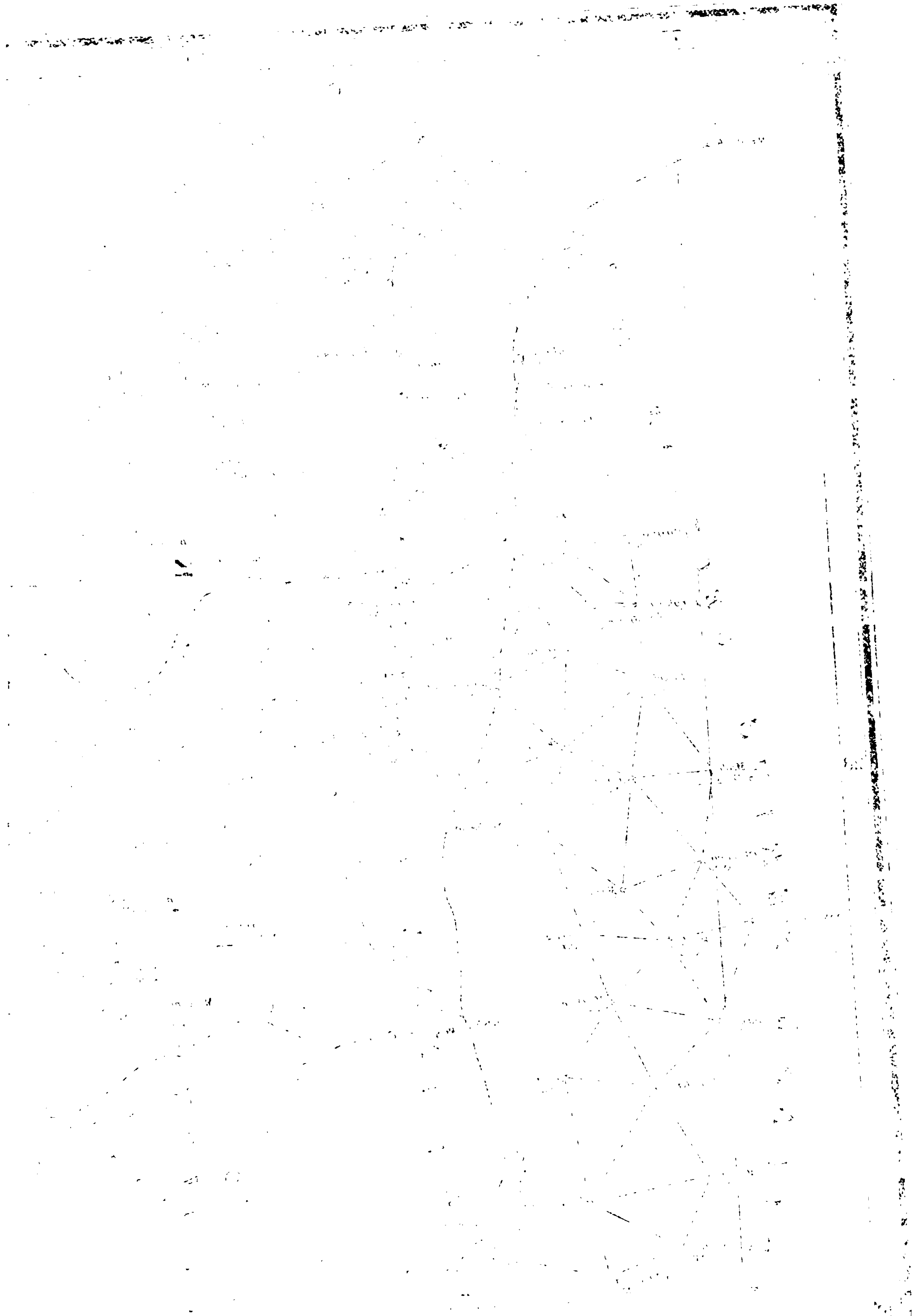


rical Branch, Survey of India, Dehra Dun December 1880

REDUCTION CHART
OF THE
PRINCIPAL TRIANGULATION
OF
THE NORTH-EAST QUADRILATERAL
OF THE
GREAT TRIGONOMETRICAL SURVEY
OF
INDIA.
Sironj Base-Line Figure
COMPRISING THE FOLLOWING SERIES
I. NORTH-EAST LONGITUDINAL
J. BUDHON MERIDIONAL
K. RANGIR MERIDIONAL
L. AMUA MERIDIONAL
M. KARARA MERIDIONAL
N. GURWANI MERIDIONAL
O. GORA MERIDIONAL
P. HURILAONG MERIDIONAL
Q. CHENDWAR MERIDIONAL
R. NORTH PARASNATH MERIDIONAL
S. NORTH MALUNCHA MERIDIONAL
T. CALCUTTA MERIDIONAL
U. EAST CALCUTTA LONGITUDINAL
V. BRAHMAPUTRA
W. EASTERN FRONTIER 23° TO 26°
X. ASSAM LONGITUDINAL
GREAT ARC MERIDIONAL SERIES SECTION 24° TO 30°
CALCUTTA LONGITUDINAL SERIES
EAST CALCUTTA LONGITUDINAL SERIES, U
NORTH-EAST LONGITUDINAL SERIES, I.
ASSAM LONGITUDINAL SERIES, X
EASTERN FRONTIER SERIES, W SECTION 23° TO 26°
BRAHMAPUTRA SERIES, V
CALCUTTA MERIDIONAL SERIES, T
UMBALLA
MEERUT
DELHI
ALIGARH
AGRA
GWALIOR
BAREILLY
LUCKNOW
CAWNPORE
ALLAHABAD
BENARES
PATNA
BHAGALPUR
CALCUTTA



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List of Published Works of the Great Trigonometrical Survey of India.

An Account of the Measurement of an Arc of the meridian between the parallels of 18° 3′ and 24° 7′, being a continuation of the Grand Meridional Arc of India as detailed by the late Lieutenant-Colonel Lambton in the Volumes of the Asiatic Society of Calcutta. By Captain George Everest, of the Bengal Artillery, F.R.S., &c. London, 1830.

An Account of the Measurement of two Sections of the Meridional Arc of India, bounded by the parallels of 18° 3′ 5″; 24° 7′ 11″; and 29° 30′ 18″. By Lieutenant-Colonel Everest, F.R.S., &c., late Surveyor General of India, and his Assistants. London, 1847.

Account of the Operations of the Great Trigonometrical Survey of India.

Volume I. The Standards of Measure and the Base-Lines, also an Introductory Account of the early Operations of the Survey, during the period of 1800-1830. By Colonel J. T. Walker, R.E., F.R.S., &c., &c., Superintendent of the Survey. Dehra Dún, 1870.

Do. II. History and General Description of the Principal Triangulation and of its Reduction. By Colonel J. T. Walker, C.B., R.E., F.R.S., &c., &c., Surveyor General of India and Superintendent of the Survey, and his Assistants. Dehra Dún, 1879.

Do. III. The Principal Triangulation, the Base-Line Figures, the Karáchi Longitudinal, N.W. Himalaya, and Great Indus Series of the North-West Quadrilateral. By Colonel J. T. Walker, R.E., F.R.S., &c., &c., Superintendent of the Survey, and his Assistants. Dehra Dún, 1879.

Do. IV. The Principal Triangulation, the Great Arc (Section 24°-30°), Rahún, Gurhágarh and Jogí-Tíla Meridional Series, and the Sutlej Series of the North-West Quadrilateral. By Colonel J. T. Walker, R.E., F.R.S., &c., &c., Superintendent of the Survey, and his Assistants. Dehra Dún, 1879.

Do. V. Details of the Pendulum Operations by Captains J. P. Basevi, R.E., and W. J. Heaviside, R.E., and of their Reduction. Prepared under the directions of Major-General J. T. Walker, C.B., R.E., F.R.S., &c., &c., Surveyor General of India and Superintendent of the Trigonometrical Survey. Dehra Dún and Calcutta, 1879.

Do. VI. The Principal Triangulation of the South-East Quadrilateral including the Great Arc—Section 18° to 24°, the East Coast Series, the Calcutta and the Bider Longitudinal Series, the Jabalpur and the Biláspur Meridional Series, and the details of their Simultaneous Reduction. Prepared under the directions of Major-General J. T. Walker, C.B., R.E., F.R.S., &c., &c., Surveyor General of India and Superintendent of the Trigonometrical Survey. Dehra Dún, 1880.

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List of Published Works of the Great Trigonometrical Survey of India—(Continued).

Synopses of the Results of the Great Trigonometrical Survey of India, comprising Descriptions, Co-ordinates, &c., of the Principal and Secondary Stations and other Fixed Points, of the Several Series of Triangles, as follows;—

Volume I. The Great Indus Series, or Series *D* of the North-West Quadrilateral. By Colonel J. T. Walker, R.E., F.R.S., &c., &c., Superintendent of the Survey, and his Assistants. Dehra Dún, 1874.

Do. II. The Great Arc—Section 24° to 30°, or Series *A* of the North-West Quadrilateral. By Colonel J. T. Walker, R.E., F.R.S., &c., &c., Superintendent of the Survey, and his Assistants. Dehra Dún, 1874.

Do. III. The Karáchi Longitudinal Series, or Series *B* of the North-West Quadrilateral. By Colonel J. T. Walker, R.E., F.R.S., &c., &c., Superintendent of the Survey, and his Assistants. Dehra Dún, 1874.

Do. IV. The Gurhágarh Meridional Series, or Series *F* of the North-West Quadrilateral. By Colonel J. T. Walker, R.E., F.R.S., &c., &c., Superintendent of the Survey, and his Assistants. Dehra Dún, 1875.

Do. V. The Rahún Meridional Series, or Series *E* of the North-West Quadrilateral. By Colonel J. T. Walker, R.E., F.R.S., &c., &c., Superintendent of the Survey, and his Assistants. Dehra Dún, 1875.

Do. VI. The Jogí-Tíla Meridional Series, or Series *G*, and the Sutlej Series, or Series *H* of the North-West Quadrilateral. By Colonel J. T. Walker, R.E., F.R.S., &c., &c., Superintendent of the Survey, and his Assistants. Dehra Dún, 1875.

Do. VII. The North-West Himalaya Series, or Series *C* of the North-West Quadrilateral, and the Triangulation of the Kashmir Survey. By Major-General J. T. Walker, C.B., R.E., F.R.S., &c., &c., Surveyor General of India and Superintendent of the Survey, and his Assistants. Dehra Dún, 1879.

Do. VIII. The Great Arc—Section 18° to 24°, or Series *A* of the South-East Quadrilateral. By Colonel J. T. Walker, C.B., R.E., F.R.S., &c., &c., Superintendent of the Survey, and his Assistants. Dehra Dún, 1878.

Do. IX. The Jabalpur Meridional Series, or Series *E* of the South-East Quadrilateral. By Colonel J. T. Walker, C.B., R.E., F.R.S., &c., &c., Surveyor General of India and Superintendent of the Survey, and his Assistants. Dehra Dún, 1878.

Do. X. The Bider Longitudinal Series, or Series *D* of the South-East Quadrilateral. By Major-General J. T. Walker, C.B., R.E., F.R.S., &c., &c., Surveyor General of India and Superintendent of the Survey, and his Assistants. Dehra Dún, 1880.

Do. XI. The Biláspur Meridional Series, or Series *F* of the South-East Quadrilateral. By Major-General J. T. Walker, C.B., R.E., F.R.S., &c., &c., Surveyor General of India and Superintendent of the Survey, and his Assistants. Dehra Dún, 1880.

Do. XII. The Calcutta Longitudinal Series, or Series *B* of the South-East Quadrilateral. By Major-General J. T. Walker, C.B., R.E., F.R.S., &c., &c., Surveyor General of India and Superintendent of the Survey, and his Assistants. Dehra Dún, 1880.

Do. XIII. The East Coast Series, or Series *C* of the South-East Quadrilateral. By Major-General J. T. Walker, C.B., R.E., F.R.S., &c., &c., Surveyor General of India and Superintendent of the Survey, and his Assistants. Dehra Dún, 1880.

August, 1882.

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