ACCOUNT OF THE OPERATIONS OF

THE GREAT TRIGONOMETRICAL SURVEY OF INDIA

VOLUME XIV.

GENERAL DESCRIPTION

OF THE

PRINCIPAL TRIANGULATION

OF

THE SOUTH-WEST QUADRILATERAL

INCLUDING

THE SIMULTANEOUS REDUCTION

AND

THE DETAILS OF ITS COMPONENT SERIES.

PREPARED UNDER THE DIRECTIONS OF

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PREFACE.

The present volume forms one of that series of publications, known as the "*Account 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 arrived at after the 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 with which the measurements were made, 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 with the exception of two chains, *viz.*, the Jodhpore and Eastern Sind Meridional Series, which were afterwards executed, 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. The details of the reduction of the two chains afterwards added to this Quadrilateral are published in a supplementary Volume numbered IV A.

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

Volume VI treats 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 to obviate the necessity for frequent reference to Vol. 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 lastly, the resulting values of the lengths and azimuths of the sides, and of the latitudes and longitudes of the stations of the triangulation.

In like manner Volumes VII and VIII treat of the triangulation appertaining to the North-East Quadrilateral, the third of the five great sections before alluded to, and contain full details of the observations, reductions and final results of the sixteen chains or series of triangles embraced within its limits.

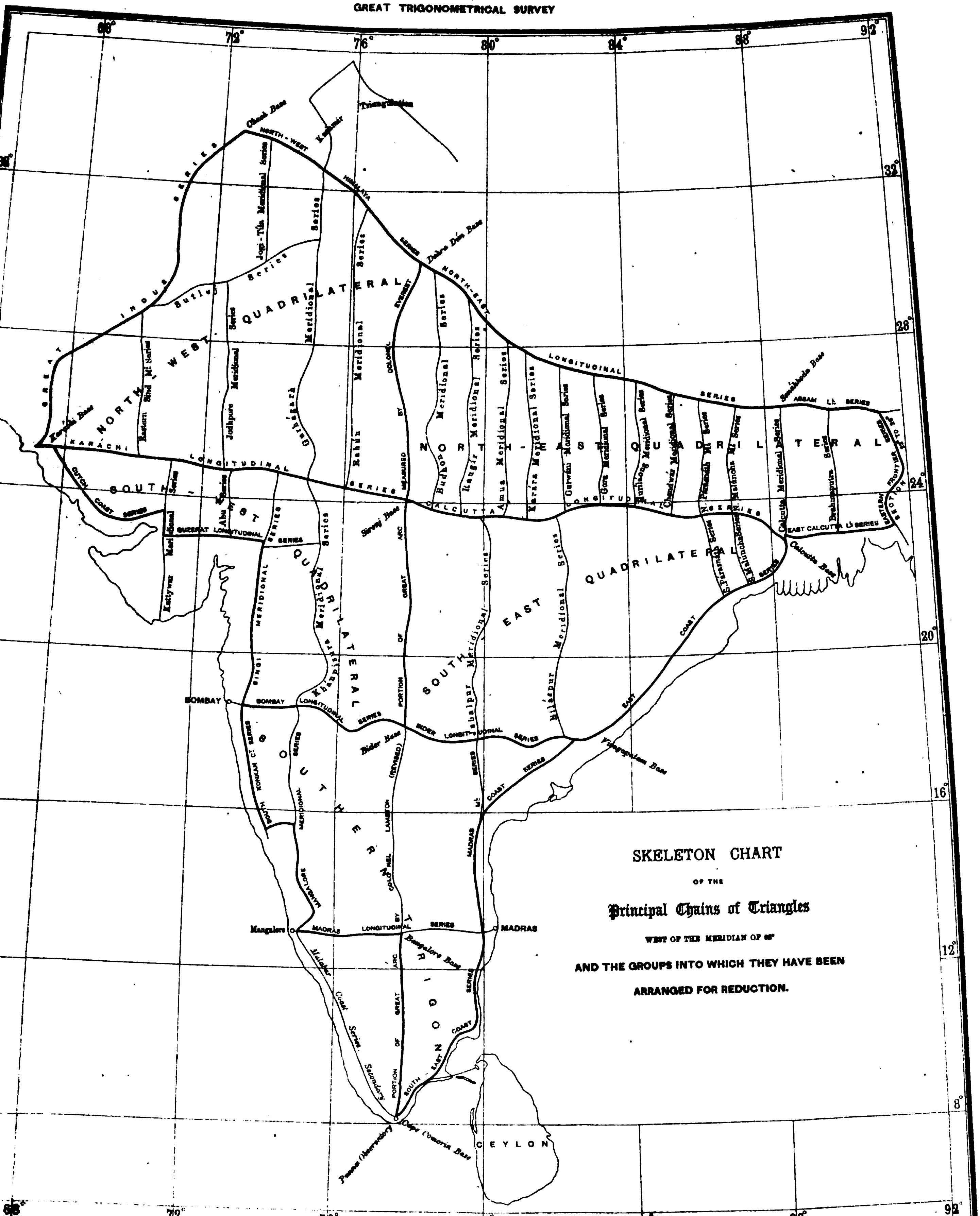
Volumes IX and X are devoted to the Electro-Telegraphic Longitude Operations which have been carried out by the Survey of India Department; but as these operations are not yet complete, the time has not arrived for solving the equations of condition, presented by the several arcs of longitudes already measured, and no combination of the results with those of the triangulation is at present possible; and therefore the subjects of Vols. IX and X, like that of Vol. V, may be considered as distinct from that of the other volumes.

Volume XI, is also a subject by itself, *viz.*, the Astronomical Observations for Latitude which have been carried out by the Great Trigonometrical Survey at intervals from the commencement of the present century.

Volumes XII and XIII are devoted to the Southern Trigon, the fourth of the five great sections into which the principal triangulation has been divided for reduction, and contain details similar to those in Vols III, IV, VI, VII and VIII.

The present volume, No. XIV, is devoted to the South-West Quadrilateral, the last of the five great sections above alluded to. With this the reduction of the whole of the triangulation of India proper is complete.

In order that the reader may obtain a clear conception of the triangulation of India as a whole, and the position of the Section now under consideration relatively to the other Sections, a Skeleton Chart of the Principal Triangulation of India is given facing this 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 Himayala 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 northwards 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 them 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



Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, November 1890.

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, 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 in practice, the Simultaneous Reductions were taken in hand in the following order, *first* the North-West Quadrilateral, *secondly* the South-East and *thirdly* the North-East Quadrilateral; after which the two additional series of the North-West Quadrilateral were reduced, *fourthly* the Southern Trigon and *fifthly* the South-West Quadrilateral. Volume XIV contains full details of the observations, reductions and final results of the whole of the triangulation which is contained within the limits of the South-West 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 each 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 is 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 each 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 of all the chains of triangles.

The chains are:—

G. The Khánpisura Meridional Series.
I. The Abu Meridional Series.
K. The Guzerat Longitudinal Series.
H. The Singi Meridional Series.
J. The Kattywar Meridional Series.
L. The Cutch Coast Series.

For their linear and geodetic elements the whole of the above chains of triangles are dependent on the final elements of the Karáchi Longitudinal and Bombay Longitudinal Series, as derived from the North-West Quadrilateral and the Southern Trigon.

The present volume is divided into two parts. Part I is devoted to the Simultaneous Reduction of the Quadrilateral. Part II is devoted to the details of the six chains of triangles comprising the Quadrilateral.

PART I.

Chapter I gives a general account of the several chains of triangles, indicates the dependency of the Quadrilateral on the North-West Quadrilateral and Southern Trigon 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 the Quadrilateral.

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

First. Some preliminary remarks on the character of the triangulation.

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, 24 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 24 equations of condition.

Seventh. The numerical values of the Fixed Data on which the 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.

Eleventh. The numerical values of the μs and ϕs, the geodetic summations—exhibited in the table at page 36—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, $\mathfrak{b}$ and $\mathfrak{c}$, 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, $\mathfrak{B}$ and $\mathfrak{C}$, 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, secondly with the application of certain equalizing factors and thirdly 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 circuit triangle, resulting from the Simultaneous Reduction and the subsequent apportionments of residual error.

Seventeenth. The final results of the Simultaneous Reduction.

Chapter IV gives the Reduction of Non-Circuit Triangles—*viz.*, the triangles excluded from the Simultaneous Reduction—which was needed for the final adjustment of their angles to satisfy the geometrical conditions of the polygonal figures to which they appertain. This is followed by a Note on some of the details of the Simultaneous Reduction.

Part II.

This portion of the present volume gives full details of the six 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 allotted 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, the numbering of the pages commences afresh for each series, following the order of succession, which has already been indicated at page xi; it is particularised for each series by the addition, as a subscript to the number of the page, of the letter—G to L—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 for each series, the first Series in order—the Khánpisura Meridional—may be taken as typical.

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 north to south in meridional chains, and from east to west in longitudinal and coast chains, the first number of each Series being unity.

4. 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 districts and the sub-divisions in which the stations are situated from the latest Annual Reports furnished by the District Officers to whose charge the stations were committed. For information as to the general form and structure of the stations, reference should be made to Section 4 of Chapter I.

5. In the pages which are allotted to the observations of the angle, 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—commonly called the "zero 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.

The 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.

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.

The right-hand column of the Abstract of Angles contains the following additional information;—*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 of Chapter VII of Volume II, to the example at page 342 of the same volume, and to Section 2 of Chapter II of the present volume.

6 and 7. The 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.

8. 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. 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, 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. 4, and to the reduction of that figure on page $48—_G$ of Part II of this Volume, x_3 is the error of angle 3 at Station XIII between Stations XII and XIV. 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 page 17 of Part I of this Volume; *thirdly* the equations between the 'indeterminate factors',—*fourthly* the values of the indeterminate factors; *fifthly* the values of the angular errors,—and *sixthly* the summation of the product of the square of each error by its weight—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 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.

9. 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 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 173, 172 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.

10. 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.

11. 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 mean-sea level, are given. Several of the absolute determinations have been derived from the Spirit-levelling Operations of this Survey. The errors generated trigonometrically between any two obligatory stations fixed by the spirit-levelling, have been duly dispersed 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-levelled values sometimes refer to the upper surface and sometimes to the basement of the pillar, whichever the levelling-staff was set upon; a description of the exact point referred to is given in each instance.

12. 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. 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-foot 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 20 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 the Madras Observatory 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″.

The Orthography of proper names and of Indian words is based on the official lists for Bombay, the Nizam's dominions and the Central India Agency, published under the orders of the Government of India. It may here be mentioned that as two lists were published, *viz.*, in 1875 and 1879, of names in the Bombay Presidency and Sind, and the printing of the volume was begun prior to the year 1879, that the major portion of the orthography is based on the earlier of these two lists. As a general rule the pronunciations of the vowels are as follows:—*a* has a sound as in wom*a*n, rur*a*l; *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. Final vowels and those in well-known terminals are unaccented. When the popular spelling of a name has been accepted by Government, its correct orthography is given in parenthesis where the name occurs for the first time.

The Simultaneous Reduction of the South-West Quadrilateral was carried out in the same manner as previous reductions. The Introductions to the several series are due to Captain S. G. Burrard, R.E. The members of the office who took a share in the work are Mr. Wood and Mr. Peychers—the latter officer, besides compiling all the descriptions of stations, and performing other duties, had the general supervision of the proofs of the tabular and other professional matter of this volume as it passed through the press, it being due to his care and accuracy that there are so few errata—while the actual calculations were made by Babus Cally Mohun Ghose, Senior Computer, Kally Coomar Chatterji, Amba Prasad, Shoshee Bhooshan Shome, Shiv Nath Saha, Mizaji Lal, Tarapodo Mukerji, Umbica Churn Shome, Madho Narain and others. The binding was done in Calcutta and is the only part of the volume which was not executed in the office at Dehra.

DEHRA DUN,
November, 1890.

W. H. COLE, M.A.,
Offg. Deputy Surveyor General,
In charge Trigonometrical Surveys.

ERRATA ET ADDENDA.

Page			
116 line 4 from bottom		*for* 3rd place	*read* 2nd place
13—*H.*	col. 3 of 1st angle at VII	„ *C* 64° 5′ 37″·44	„ *C* 64° 58′ 37″·44
42—*H.*	line 8 from bottom	„ XXVIII	„ XXXVIII
55—*H.*	col. 10 of 3rd triangle from top, last places of log. feet	„ 7, 4 and 6	„ 8, 5 and 7
55—*H.*	col. 8 of 3rd triangle from bottom	*omit* — ·52	
VI—*I.*	last line	*for* 71½	„ 72½
VII—*I.*	lines 30 to 32 from top	*omit* in April, however, . . .	work of the Abu Series.
VIII—*I.*	in last col. of table	*for* 2·3	*read* — 2·3
10—*I.*	line 2 from top	„ 1852	„ 1851
15—*I.*	*in some copies,* in foot note 1	„ to reduce position	„ to reduce to position
XIX—*J.*	line 2 from top	*after* compound	*insert* figure
4—*K.*	to description of station XIII	*add* There is a rejected station of this name on a hill to the west.	
5—*K.*	line 3 from bottom	*for* indicated	*read* is indicated
9—*L.*	line 7 from top	„ 10 feet	„ 10·13 feet

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

Orthography employed.	Correct Orthography.	Meaning.
Bandar ...	... Bandar ...	... A harbour.
Bheel, Bhíl, Bhil ...	... Bhíl ...	... A tribe of aborigines inhabiting parts of Central India.
Bhír ...	... Bhír ...	... Pasture land.
Brahmin ...	... Bráhman ...	... The highest of the four castes of Hindus.
Chauki ...	... Chaukí ...	... A small police station.
Chota ...	... Chhota ...	... Small.
Dâk Chauki	... Dák Chaukí	... A posting stage.
Dakshin ...	... Dakshin ...	... South, southern country.
Dargáh ...	... Dargáh ...	... A Muhammadan shrine.
Dharmshála	... Dharmshála	... A rest-house.
Fakir ...	... Fakír ...	... A Muhammadan saint or holy person.
Gáikwár, Gaekwar	... Gáikwár ...	... A title specially applied to the ruler of Baroda.
Ghát ...	... Ghát ...	... A hill pass.
Mahádev ...	... Mahádev ...	... One of the three principal Hindu deities, same as Shiva.
Máta ...	... Mátá ...	... A Hindu goddess, meaning mother.
Nizam ...	... Nizám ...	... A title specially applied to the ruler of Hyderabad, Deccan.
Pareshrám	... Pareshrám	... A Hindu god.
Pargana ...	... Pargana ...	... A sub-division of a district.
Patel ...	... Patel ...	... Headman of a village.
Ráj ...	... Ráj ...	... Kingdom.
Rája ...	... Rájá ...	... A king or ruler.
Ran ...	... Ran ...	... A salt marsh.
Rána ...	... Ráná ...	... A title specially applied to the chief of Oodeypore.
Ráo, Rao ...	... Ráo ...	... A chief.
Rŏza ...	... Rauzah ...	... A mausoleum.
Siva ...	... Shiva ...	... One of the three principal Hindu deities, same as Mahádev.
Tahsíl ...	... Tahsíl ...	... Portion of a district subject to a revenue collector.
Taluk, Taluka, Táluka ...	... Taälluk, Taälluka	... A sub-division of a district.
Tappa ...	... Tappá ...	... A posting stage.
Tháne ...	... Tháná ...	... A small police sub-division.
Tindal ...	... Tindal ...	... An overseer.
Vádi ...	... Vádi ...	... A garden.
Wiloda ...	... Viloda ...	... A Hindu deity.
Zilla ...	... Zilla ...	... A district.

PART I.

INTRODUCTORY ACCOUNT

OF

THE TRIANGULATION EMBRACED

BY

THE SOUTH-WEST QUADRILATERAL

WITH THE DETAILS OF ITS

SIMULTANEOUS REDUCTION.

CHAPTER I.

ACCOUNT OF THE TRIANGULATION OF THE SOUTH-WEST QUADRILATERAL.

1.

The Several Chains of Triangles which are contained in the South-West Quadrilateral.

The South-West Quadrilateral is the fifth and last in order of the great sections into which the Principal Triangulation of India was divided for final reduction, consecutively, for reasons which are set forth in Section 7 of Chapter I of Volume II of the *Account of the Operations of the Great Trigonometrical Survey of India.* It falls between the North-West Quadrilateral and Southern Trigon—of these full details, from the measurement of the angles to the determination of the final results, will be found, the former in Volumes II, III and IV and IVA and the latter in Volumes XII and XIII—it depends on these for the whole of its fixed data. It embraces the triangulation between the parallels of 18° and 25° and between the meridian of 78° and the Arabian Sea, and comprises the following Series:—

The Khánpisura Meridional,	hereafter symbolized by		G,
The Singi Meridional,	„	„	H,
The Abu Meridional,	„	„	I,
The Kattywar Meridional,	„	„	J,
The Guzerat Longitudinal,	„	„	K,
The Cutch Coast	„	„	L.

The triangulations contained in the above Series had to be brought into harmony with each other, with the Karáchi Longitudinal Series of the North-West Quadrilateral and the Bombay Longitudinal Series of the Southern Trigon.

It is necessary to repeat in this place, what has already been set forth in Vol. II, that the general character of the triangulation has governed the order in which the several sections have been finally reduced; thus the execution of the North-West and South-East Quadrilaterals was so much superior to that of both the North-East and South-West sections, that there was no alternative but to commence the final reductions with the two former, in order to make the earlier and least accurate triangulations rest on the modern which were more highly finished and exact. For similar reasons, it was decided that the reduction of the Southern Trigon, of which the triangulation had been completed by the time the third section had been finally reduced, should be undertaken before that of the South-West Quadrilateral.

2.

The Observers and Instruments employed on the several Series of Triangles contained in the South-West Quadrilateral.

The principal triangulation of the South-West Quadrilateral was executed entirely by three Officers, Lieut. H. Rivers, Lieut. D. J. Nasmyth and Lieut. C. T. Haig, all of the Bombay Engineers, who took it up in succession. It was commenced by Lieut. Rivers, in 1842, with the execution of the large compound figure at the southern end of the Singi Series. He next, in 1845, took up the triangulation of the Khánpisura Series, from the south and carried it to the north of the parallel of 24°, the northern extension being afterwards absorbed into the Karáchi Longitudinal Series and the Gurhágarh Meridional Series. The instrument that he had employed up to this time was Dollond's 15-inch theodolite*; but it gave such unsatisfactory results that it became necessary to provide him with another, and Troughton and Simms' 18-inch Theodolite No. 2 was sent to him. With this, in 1850, he commenced the Abu Meridional Series from the Karáchi Longitudinal Series and carried it down to the parallel of 23° and then triangulated westwards along that parallel to the meridian of 71°, down which meridian he carried, with Nasmyth's assistance, a chain to the south coast of Kattywar.

In 1853 Rivers retired from the Survey and Nasmyth, who succeeded to the charge of the party, having completed the southern section of the Kattywar Meridional Series in 1855, first commenced the Cutch Coast Series on which he was employed till December, he then extended the Kattywar Meridional Series northward towards the Karáchi Longitudinal Series.

In 1858-59 he extended the Guzerat Longitudinal Series for a distance of 54 miles eastwards from the sides Palri–Wastrál and Wastrál–Mirzápur. Here it was taken up by Haig in 1860 who carried it to the Singi Meridian, then worked south on the Singi Meridional Series till he connected with the side Tarbhán–Dopári of Rivers' work: the next season he

* For the history and description of this instrument see Appendix 2 of Vol. II of the *Account of the Operations of the Great Trigonometrical Survey of India*, page 73.

closed the Guzerat Longitudinal Series on the Khánpisura Meridional Series and also finished the northernmost section of the Singi Series. Troughton and Simms' 18-inch Theodolite No. 2 continued to be used throughout the triangulation.

The series are here arranged in the chronological order of their commencement. The lengths recorded are of the chains as they now stand.

The Singi Meridional Series.

This chain of triangles extending along the meridian of 73½° unites the Bombay Longitudinal and the Karáchi Longitudinal Series. It was commenced under the name of the North Konkan Coast Series by Lieut. H. Rivers, of the Bombay Engineers, in the field season of 1842-43, on the side Karanja–Singi of the Bombay Longitudinal Series, and carried north as a chain of single triangles as far as Párnera. Attempts were made during the next field season to extend the approximate work, but they were frustrated, first by the extreme unhealthiness of the country and afterwards by the density of the atmosphere from smoke and dust. In 1844-45 Rivers made another attempt to extend the series but was driven back by sickness. After completing his observations at Parnera commenced the season before and remeasuring some of his former angles he proceeded to widen the chain by executing a series of triangles along the eastern flank commencing from the side Singi–Párner of the Bombay Longitudinal Series. He carried this chain as far as Pilwa–Sáler by the end of the season and also observed at Tarbhán but did not complete the angles. During 1846, while engaged on the Khánpisura Series, he managed to visit Dopári and thus completed the large compound figure, 150 miles in length, which lies between the Bombay Longitudinal Series and the side Tarbhán–Dopári. In the final reduction of the triangulation the ray Karanja–Kámandrug was thrown out, and the Singi Series therefore originates, as it now stands, from the side Singi–Párner. The instrument employed by Lieut. Rivers was Dollond's 15-inch Theodolite.

The work on the series was now dropped for several years owing to the extreme unhealthiness of the tract of country to the north. In 1860-61 Lieut. C. T. Haig of the Bombay Engineers, when engaged on the Guzerat Longitudinal Series, carried it westwards to the meridian of Singi and then completed the meridional chain southwards as far as the side where Rivers' triangulation had terminated. The remaining portion of the series was executed by Haig during the next season, and it closed on the side Lakarwás–Tána of the Karáchi Longitudinal Series. The chain is 390 miles long and has four azimuths of verification. The instrument used by Haig was Troughton and Simms' 18-inch Theodolite No. 2.

The Khanpisura Meridional Series.

The Khánpisura Meridional Series, also connecting the Bombay Longitudinal and Karáchi Longitudinal Series, was commenced by Lieut. H. Rivers in season 1845-46, and was advanced during that season as far as the side Sátmála–Sirsála and during the next season to Harnása–Indráwan. During the next two seasons he carried the chain beyond the parallel of 24°, the Karáchi Longitudinal Series not having then been executed. In 1850 the latter series was brought up from the east to the Khánpisura meridian and a junction effected by Captain A. Strange of the Madras Cavalry. The chain now consists of a series of quadrilaterals and polygons except at one part where there are only two single triangles. In 1862-63 Captain C. T. Haig strengthened this weak link by adding the station of Áhirmal and the two triangles connecting it with the series. The series is 360 miles long and has two azimuths of verification. The instrument employed by Rivers was Dollond's 15-inch Theodolite and by Haig Barrow's 24-inch Theodolite No. 2.

The Abu Meridional Series.

The Abu Meridional Series was commenced by Lieut. H. Rivers from the side Jeráj–Márd of the Karáchi Longitudinal Series during the field season of 1850-51, and was carried down the meridian of 72¾°, during that and the following season, to the parallel of 23° where it closes on the side Sanoda–Mirzápur of the Guzerat Longitudinal Series. The chain consists of three hexagons and a single triangle, and extends a direct distance of 95 miles. It was executed with Troughton and Simms' 18-inch Theodolite No. 2. No azimuths of verification were observed on the series itself.

The Guzerat Longitudinal Series.

This series was commenced at the southern extremity of the Abu Meridional Series by Lieut. H. Rivers during field season 1851-52, and was carried westwards by him during the next season along the parallel of 23° up to the meridian of 71°, where it unites with the Kattywar Meridional Series, a direct distance of nearly 100 miles. This portion of the chain consisted of single triangles. In 1858-59, Captain D. J. Nasmyth of the Bombay Engineers took up the triangulation on the sides Pálri–Wastrál and Wastrál–Mirzápur and having first, by the addition of the station Jhinjhar, constructed a pentagon round Wastrál; he then carried the series eastwards a distance of about 54 miles. In 1860-61 Captain C. T. Haig of the Bombay Engineers extended the chain further eastward to the Singi Series. The next season Haig completed the Guzerat Longitudinal Series, closing it on the Khánpisura Meridional Series at the side Indráwan–Karsod. The total length of the series is about 260 miles. The instrument employed throughout was Troughton and Simms' 18-inch Theodolite No. 2. Two azimuths of verification were observed.

The Kattywar Meridional Series.

This series was originated by Lieut. H. Rivers from the western extremity of the Guzerat Longitudinal Series during the field season of 1852-53, and carried southwards by him, assisted by Lieut. Nasmyth, along the meridian of 71° to the extreme south of the Kattywar peninsula, terminating at the Island of Diu. The series was afterwards extended northwards by Lieut. Nasmyth to the Karáchi Longitudinal Series principally during the seasons 1855-57. The length of the series is about 275 miles and it has two azimuths of verification. The instrument employed was Troughton and Simms' 18-inch Theodolite No. 2.

The Cutch Coast Series.

The Cutch Coast Series emanates from the Kattywar Meridional Series and trends first in a south-westerly and afterwards in a north-westerly direction till it meets the Karáchi Longitudinal Series. It was commenced by Lieut. Nasmyth in season 1855-56, and the portion of the chain which lies between the meridians of 69° and 70° was executed by him. He then had to return to the Kattywar Meridional Series which was in course of triangulation. In 1856-57 he connected his former triangulation with the Kattywar Meridional Series and extended the chain westward to about longitude 68° 30′. The next season he commenced work from the Karáchi Longitudinal Series and worked south-westwards until he completed the connection with his former season's work. The length of the chain is about 235 miles and it has one azimuth of verification. The instrument employed was Troughton and Simms' 18-inch Theodolite No. 2.

3.

The Dependency of the South-West Quadrilateral on the North-West Quadrilateral and Southern Trigon for the Fixed Data.

The South-West Quadrilateral lies between two chains of triangles which, having entered previous reductions, had been finally adjusted, *viz.*, the Karáchi Longitudinal Series, or Series B, of the North-West Quadrilateral and the Bombay Longitudinal Series, or Series B of the Southern Trigon. These chains form the northern and the southern boundaries of the South-West Quadrilateral, and furnish the whole of the fixed data on which this Quadrilateral rests. From the Karáchi Longitudinal Series depend four meridional chains and one coast series; two of the former unite with the Bombay Longitudinal Series and all are tied together by the Cutch Coast Series and a longitudinal chain called the Guzerat Longitudinal Series. The southern portion of the Kattywar Meridional Series forms a pendant which does not enter the simultaneous reduction, because no circuit being complete no equations could be formed.

It will be seen that the South-West Quadrilateral owing to its situation between two other large sections of the triangulation of India which had already been reduced, and with which it has to be brought into accord, is very much constrained by them. There might have been reason to regret this had the triangulation been of a superior character; but the whole of the Khánpisura and part of the Singi Series were executed with Dollond's 15-inch Theodolite, an instrument very inferior to those employed on the North-West Quadrilateral and on almost the whole of the Southern Trigon. And the remainder of the triangulation was executed with Troughton and Simms' 18-inch Theodolite No. 2, an instrument very much superior to Dollond's 15-inch, but also much inferior to the 24-inch and 36-inch theodolites elsewhere employed.

4.

The Construction of the Principal Stations.

The earliest constructions were on the southern portion of the Singi and on the Khánpisura Meridional Series. They were built under the direction of Lieut. H. Rivers before he had had the opportunity of learning anything about the forms of stations found most suitable in the Great Trigonometrical Survey. Lieut. Rivers' stations were situated on hills and high ground and in general consisted of solid masonry pillars, containing one or more marks sunk in the ground with their upper surfaces flush with the ground level. Above these pillars, solid structures of loose stone masonry were erected from 1 to 14 feet in height with a mark laid loosely in the surface. On the completion of the Khánpisura Series Lieut. Rivers was in the neighbourhood of the party under Captain Renny employed on the Karáchi Longitudinal Series, and by order of the Surveyor General the two parties were united for a time in order that Lieut. Rivers might learn the procedure of the G. T. Survey. When Lieut. Rivers commenced the Abu Meridional Series he adopted new forms of stations; those on hills consisted of solid, circular, isolated pillars of masonry, from 3 to 10 feet in height, having marks at the ground level and one or more other marks in the normal of the former. Around the pillars and level with their surfaces, platforms of loose stone masonry or sundried bricks were constructed for the observatory tent. Stations in the plains were solid structures either circular or square of sundried bricks and mud and faced with kiln burnt bricks, 18 to 32 feet high, having central solid pillars of masonry with marks at top and bottom and intermediately. The stations of the Guzerat Longitudinal Series between the Abu and Kattywar Meridional Series were of similar construction, as also those of the Kattywar Meridional Series itself and a portion of the Cutch Coast Series. Afterwards perforated pillars were employed both for hill and plain stations, with apertures through the surrounding construction to admit of access to the lower mark.

CHAPTER II.

THE MEASUREMENT OF THE ANGLES AND THE GENERAL PRINCIPLES FOLLOWED IN THE REDUCTION OF THE TRIANGULATION OF THE SOUTH-WEST 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, which have been in practice since the year 1823, of observing both the horizontal and the vertical angles. It will not be necessary here therefore to do more 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 centered over the station mark, 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. With the telescope directed to this station the index was made to read 0° 0′, and the instrument having been re-examined for centering and levelled, the remaining stations were 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 usually 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, the Surveyor General, decided that half the arc between the microscopes should be added to each shift.

With the exception of the southern portion of the Singi Meridional Series and the whole of the Khánpisura Meridional Series, which were executed with Dollond's 15-inch Theodolite, all the triangulation of the South-West Quadrilateral was carried out with Troughton and Simms' 18-inch Theodolite No. 2. Both instruments possessed only 3 microscopes.

The system of zeros adopted on the southern portion of the Singi Meridional Series was

$$\frac{0^\circ}{180^\circ},\ \frac{20^\circ}{200^\circ} \text{ and } \frac{40^\circ}{220^\circ},$$

or some modification of this system; by which it is meant that the zero settings were not always the same, but the shifts were invariably through 20°.* Five angles were, however, observed on six pairs of zeros with shifts of 10°.

On the Khánpisura Meridional Series the system was principally

$$\frac{0^\circ}{180^\circ},\ \frac{10^\circ}{190^\circ},\ \frac{20^\circ}{200^\circ},\ \frac{30^\circ}{210^\circ},\ \frac{40^\circ}{220^\circ} \text{ and } \frac{50^\circ}{230^\circ},$$

or some modification of this as before. At 1 station, however, three pairs of zeros were employed as on the southern portion of the Singi Series and at 9 stations four pairs with shifts of 15°.

On the Abu Meridional, Kattywar Meridional, Cutch Coast, on the western and central sections of the Guzerat Longitudinal Series and on a portion of the northern section of the Singi Series the following method of changing zero, which had been devised by Lieutenant Rivers, was employed:—

$$\frac{0^\circ\ 1'}{180^\circ\ 1'},\ \frac{10^\circ\ 12'}{190^\circ\ 12'},\ \frac{20^\circ\ 20'}{200^\circ\ 20'},\ \frac{30^\circ\ 29'}{210^\circ\ 29'},\ \frac{40^\circ\ 38'}{220^\circ\ 38'} \text{ and } \frac{50^\circ\ 50'}{230^\circ\ 50'}.$$

Rivers claimed the advantage for his system that "it brought the zero of the micro-"meter over every 10 minutes of the degree and so shifted the reading as to cancel error of "run." Each change of zero was in fact made to fulfil the following conditions. (1). In the degrees each zero was 10 degrees in excess of the preceding one. (2). At each zero a different

* In the printed abstract of angles of this and the other series the most left-hand station observed to has been made to appear as the 'zero station' although it was not actually so employed during the observations. This was done for the sake of convenience in printing and in no way affects the results.

10 minute division in the degree was intersected. (3). At each zero, in order to bring a different part of the micrometer thread into play, a different number of odd minutes was read, the zero of the microscope being in two cases to the right and two to the left of the intersected division, so that error of run might be cancelled.

In conformity with Colonel Waugh's rule of 1860 that half the distance between the microscopes should be added to each change of zero, the following modification of Rivers's system was adopted on the eastern section of the Guzerat Longitudinal and on the northern portion of the Singi Meridional Series,

$$\frac{0^\circ\ 1'}{180^\circ\ 1'},\ \frac{70^\circ\ 11'}{250^\circ\ 11'},\ \frac{140^\circ\ 22'}{320^\circ\ 22'},\ \frac{210^\circ\ 28'}{30^\circ\ 28'},\ \frac{280^\circ\ 29'}{100^\circ\ 29'}\text{ and }\frac{350^\circ\ 50'}{170^\circ\ 50'}.$$

The minimum number of rounds of observation on each zero was two. When larger differences shewed themselves in successive measures of an angle than it was considered the instrument ought to give, more observations were taken. For full particulars of each instrument and any modifications it may have undergone, see Appendix No. 2 of Volume II.

The several measures of each angle, with the name of the observer and instrument employed and the date of the observations, are given for each series included in the Quadrilateral. Against each single measure is a letter in italics shewing whether the signal observed to was *l*, a lamp, or *h*, a heliotrope; sometimes a direct measurement of an angle was not obtained owing to the temporary invisibility of one of the signals, but the value of the angle was deduced from the measure of the double angle given by the omission of the signal in the round, and from a direct measure of the other angle; in this case the measure is preceded by the letter *d*.

Below the individual measures are their means from which *M*, the general mean, is obtained. The several measures and zero means are then treated as described in the following Section and give *C*, the *Concluded Angle*, together with *w*, its weight relative to other angles measured under similar circumstances, and $\frac{1}{w}$, the reciprocal of the weight.

The Abstracts of the Observed Angles of each series in the Quadrilateral will be found respectively at pages $9\_{G.}$, $9\_{H.}$, $7\_{I.}$, $9\_{J.}$, $9\_{K.}$ and $10\_{L.}$ of the different series in Part II of this volume.

2.

The Deduction of an Angle from its several Measures, and its Weight.

It has been stated that the number of measures of an angle on the same zero is not always constant, but is occasionally increased when considered necessary as already stated.

Of old the custom was to take the arithmetical mean of all the zero-means as the most probable value of the angle resulting from the several measures; but, for reasons which are explained in Chapter VII of Vol. II, this practice has been departed from, and the following procedure has been followed in deducing the value and the weight of each angle in the present volume.

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 all which is N, and D_1, D_2, D_3, &c., the algebraical excess of the successive zero means, Z in number, over the arithmetical mean, M, of all the zeros.

Now put

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

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

and let

$$w_1 = \frac{1}{g^2 + \frac{o^2}{n_1}}, \quad w_2 = \frac{1}{g^2 + \frac{o^2}{n_2}}, \quad w_3 = \frac{1}{g^2 + \frac{o^2}{n_3}}, \quad \text{\&c.};$$

then the resulting angle C, usually called the '*Concluded Angle*',

$$= M + \frac{w_1 D_1 + w_2 D_2 + w_3 D_3 + \ldots}{w_1 + w_2 + w_3 + \ldots}$$

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, $w_1, w_2, \ldots$, 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.

Let w be the weight of the angle thus deduced; then we may put,

$$w = w_1 + w_2 + w_3 + \ldots;$$

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 shown in Vol. II that there is reason to doubt whether the values

* 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, it has been retained as more appropriate than $N-Z$ under existing circumstances.

of the *e.m.s.* thus obtained immediately from the observations are true for angles measured with different instruments, or even for angles with the same instrument but under different circumstances. These values are therefore regarded as preliminary, applicable only in any combination of angles 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 measured with different instruments or under different circumstances. The value of the *modulus* for each group of angles measured under common conditions is 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 the same 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 we have

First, for the average *e. m. s.* of n angles of which the preliminary weights are $w_1, w_2, \ldots w_n$,

$$e_1^2 = \frac{n}{w_1 + w_2 + \ldots + w_n}.$$

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

$$e_2^2 = \frac{\text{sum of squares of } \frac{n}{3} \text{ triangular errors.}}{n}$$

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 the 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 $x_1, x_2, \ldots$ 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

$$e_3^2 = \frac{\text{sum of } (U \div w)}{\text{sum of } m}$$

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 determined, corresponding values of the modulus ρ', 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

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

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.

The record of the measures of the angles is followed by a list of the "Sums of "Squares of Apparent Errors of Single Observations and of Apparent Errors of Single Zeros", which furnishes the requisite data for the investigation—by which it is 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 the 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 Reduction 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 networks. Each triangle is subject to the geometrical condition that the three angles are equal to 180° *plus* the spherical excess, and each group of triangles to additional geometrical conditions, such as that the angles at any 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 this volume is

$$\epsilon = ab \sin C \times \frac{\operatorname{cosec} 1''}{2r^2} \text{*},$$

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 curvature for the oblique section of which the azimuth is 45°, that is, $r = \frac{2\rho\nu}{\rho + \nu}$, ρ being the radius of curvature to the meridian and ν the normal on the axis minor for the mean latitude of the triangle.

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 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

$$N - 2S + 4$$

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

The formula is derived as follows:—A side having been taken as base, the minimum number of angles required to fix each new station is 2; but if all three angles of a triangle are observed they furnish a triangular equation. Suppose now that S stations are fixed, but that in the case of only P of these have the 3 angles been observed; then there are $2(S-2) + P$ angles giving P equations. Every new angle not fixing a fresh station gives an additional equation, either *side* or *angular*. Let there be N angles in all; then there are $N - 2(S-2) - P$ additional equations: hence the total number of equations is $N - 2(S-2)$.

---

* The factor $\frac{\operatorname{cosec} 1''}{2r^2}$ has been tabulated for every degree from 0° to 40° in the *Auxiliary Tables to facilitate the Calculations of the Survey of India*, 3rd Edition, 1887.

This may be extended:—For suppose a net of triangles rests on Q fixed stations and the positions of $(S-Q)$ new stations are determined by observing the necessary angles and that in P instances all 3 angles are observed, then there are $2\,(S-Q)+P$ angles affording P *triangular* equations. Every additional angle now affords a new equation; hence if there are N angles in all, there are $N-2\,(S-Q)-P$ new equations. Therefore there are in all $N-2\,(S-Q)$ equations of condition.

In order to express the equations, denote the observed angles by $X_1, X_2, X_3, \ldots$ the corresponding angular error 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

$$x_1 + x_2 + \ldots = e.$$

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

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

M being the modulus of common logarithms. An alternative form of this equation has been frequently used, which is as follows:—

$$a_1 x_1 - a_2 x_2 + a_3 x_3 - a_4 x_4 + \ldots = \log . \frac{\sin X_1 . \sin X_3 \ldots}{\sin X_2 . \sin X_4 \ldots} = e$$

where a stands for the tabular difference (*t.d.*) of log. sin X for $1''$. The latter form is derivable from the former, because M cot X sin $1'' = t.d.$ log. sin X for $1''$.

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 it requires that the following expression shall be made a minimum,

$$U = \frac{x_1^2}{u_1} + \frac{x_2^2}{u_2} + \ldots + \frac{x_t^2}{u_t}$$

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

$$
\begin{array}{l}
a_1 x_1 + a_2 x_2 + \quad . \; . \; . \quad + a_t x_t = e_a \\
b_1 x_1 + b_2 x_2 + \quad . \; . \; . \quad + b_t x_t = e_b \\
. \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \\
n_1 x_1 + n_2 x_2 + \quad . \; . \; . \quad + n_t x_t = e_n
\end{array}
$$

The equations between the indeterminate factors are

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

in which the brackets [ ] indicate summations, thus

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

The resulting values of the angular errors are

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

and the value of the minimum, U, is

$$\lambda_a e_a + \lambda_b e_b + \; . \; . \; . \; + \lambda_n e_n.$$

In the case of a single triangle—one which does not enter with other triangles into the formation of a polygonal figure—there is only one geometrical equation of condition which is simply

$$x_1 + x_2 + x_3 = e$$

and there is only one indeterminate factor, λ, which is

$$\lambda = \frac{e}{u_1 + u_2 + u_3}$$

and

$$x_1 = u_1\,\lambda, \qquad x_2 = u_2\,\lambda, \qquad x_3 = u_3\,\lambda.$$

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 length 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.

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, North-East, South-East Quadrilaterals and the Southern Trigon 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 some of the Series of the South-West Quadrilateral are based on sides of the Karáchi Longitudinal Series of the North-West Quadrilateral and the Bombay Longitudinal Series of the Southern Trigon, the elements of those sides have been adopted as the fixed elements of the South-West Quadrilateral.

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

$$\Delta\lambda = \begin{cases} -\dfrac{c}{\rho}\cos A \operatorname{cosec} 1'' \\ -\dfrac{1}{1.2}\dfrac{c^2}{\rho.\nu}\sin^2 A \tan\lambda \operatorname{cosec} 1'' \\ -\dfrac{3}{4}\dfrac{c^2}{\rho.\nu}\dfrac{e^2}{1-e^2}\cos^2 A \sin 2\lambda \operatorname{cosec} 1'' \\ +\dfrac{1}{1.2.3}\dfrac{c^3}{\rho.\nu^2}\sin^2 A \cos A\,(1+3\tan^2\lambda)\operatorname{cosec} 1''; \end{cases}$$

$$\Delta L = \begin{cases} -\dfrac{c}{\nu}\dfrac{\sin A}{\cos\lambda}\operatorname{cosec} 1'' \\ +\dfrac{1}{1.2}\dfrac{c^2}{\nu^2}\dfrac{\sin 2A \tan\lambda}{\cos\lambda}\operatorname{cosec} 1'' \\ -\dfrac{1}{1.2.3}\dfrac{c^3}{\nu^3}\dfrac{(1+3\tan^2\lambda)\sin 2A\cos A}{\cos\lambda}\operatorname{cosec} 1'' \\ +\dfrac{1}{1.2.3}\dfrac{c^3}{\nu^3}\dfrac{2\sin^3 A\tan^2\lambda}{\cos\lambda}\operatorname{cosec} 1''; \end{cases}$$

and

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

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 of India*, 3rd Edition, 1887.

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 $= 7{\cdot}320\ 6225\ 4$,

Semi-axis minor, $b = 20,853,375$ feet, „ $= 7{\cdot}319\ 1763\ 4$,

Ellipticity, $c = \dfrac{a-b}{a} = \dfrac{1}{300{\cdot}80}$, „ $= \bar{3}{\cdot}521\ 7196\ 8$,

$e^2 = \dfrac{a^2-b^2}{a^2} = 0{\cdot}0066378$, „ $= \bar{3}{\cdot}822\ 0271\ 8$,

$1 - e^2 = 0{\cdot}9933622$, „ $= \bar{1}{\cdot}997\ 1076\ 1$,

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

6.

Reduction of the Vertical Angles for the Determination of Differences of Height and the 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 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

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

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

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

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

For r, the radius of curvature, the same formula is employed as in the calculation of spherical excess, see page 15, ρ and ν being here taken for the mean latitude of the stations.

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 modern operations are generally measured between the hours of 1 and 3 P.M., when the amount of refraction is usually a minimum.

The heights on the whole of the Khánpisura Meridional Series and on the lower portion of the Singi Meridional Series as originally executed, were very deficient in observations on certain rays and of a generally weak character, hence it ultimately became necessary to revise them completely. This was done during the seasons 1882-5. The heights on the Cutch Coast Series westward of the meridian of 70° have also proved very unsatisfactory from another cause, *viz.*, the abnormal refraction along the coast. This defect has now been overcome by carrying a line of levels, in season 1889-90, from the Bench-mark at Mundra along the Series to Tatta and connecting it with several of the Survey stations.

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

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

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

$$C'' = \frac{c}{r} \operatorname{cosec} 1''$$

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 obtained from the reciprocal vertical angles with determinations by Spirit-Levelling Operations wherever available, with a direct determination of Sea Level or with heights already finally fixed, and then dispersing the differences which exhibited themselves in the intermediate sections.

The mean sea level was determined in 1855 by Mr. J. DaCosta, by observations extending through half a lunation, at two points on the south coast of the Káthiáwár peninsula, *viz.*, Miáni and Diu. The latter was connected with the Principal Triangulation and has been used in obtaining final heights of Principal Stations; the former has only been connected with the Secondary Triangulation. More extended observations were made during 1874 and 1875 by Lieutenant A. W. Baird, R.E., at Okha, Navánár and Hanstal, of which the results at Okha—where observations continued for $16\frac{1}{2}$ months—have alone been made use of in reducing the trigonometrical heights to mean sea level.

The following lines of level have been executed within the area embraced in the South-West Quadrilateral. Two lines originate on either side of the Gulf of Cutch, one at Okha at the entrance on the south and the other at Navánár a little way up the gulf on the north; they pass round the gulf and meet near Wándia station of the Kattywar Meridional Series; from there the northern border of the Little Ran is followed to the eastern extremity and then to Viramgám where it meets the B. B. and C. I. Railway which it follows *viá* Ahmedabad, Baroda, Broach and Surat to Bombay Tidal Station. A loop line from Jodiya *viá* Rájkot and Wadhwán connects the line on the south coast of the Gulf of Cutch with Viramgám. Several short branch lines were also executed and connections made with trigonometrical stations. Another line commencing from Bombay follows the G. I. P. Railway as far as Nándgaon, thence it proceeds to Málegaon and along the Bombay-Agra road *viá* Dhulia, Mhow and Indore to Dewás, thence *viá* Sehore to Bhopal and along the Gwalior road to the Sironj Base-line. From Nándgaon a line is continued along the G. I. P. Railway to Shirsoli. Another line *viá* Ahmednagar connects Dhond Railway Station on the Poona Branch of the G. I. P. Railway with Manmád on the main line of that railway. Short branch lines were also executed and connections made with trigonometrical stations. All the above lines have been connected with Principal Stations in the Series of the South-West Quadrilateral. Another line of levels originating from Mundra, near Navánár on the Gulf of Cutch, was carried through the chain of triangles called the Cutch Coast Series towards Karáchi and connected with several stations of the Series: this line closed on Chilia Bench-mark of the line Manora Harbor to Kashmor executed about the year 1858. Furthermore, the heights of all the stations of the Karáchi Longitudinal Series had been fixed in the course of the reduction of the North-West Quadrilateral and of the Bombay Longitudinal Series in that of the Southern Trigon. Thus sufficient data existed for the final reduction of the heights of the stations. A list of the stations at which the heights were determined by Spirit Levelling is given below:—

Spirit Levelled Points in the South-West Quadrilateral.

Series		Station		
Khánpisura Meridional	... ...	XV	or	Singárchori
		XVII	„	Thíkri
		XXIII	„	Valvádi
		XXIV	„	Dhanvár
		XXV	„	Anakvádi
		XXIV	„	Ágargaon
		Of the Bombay Longitudinal Series of the Southern Trigon.		

Spirit Levelled Points in the South-West Quadrilateral—(Continued).

Series		Station		
Singi Meridional	... ...	XXIII	or	Sidpur
		XXXIII	„	Párnera
		XXXV	„	Ankai
		XXXVII	„	Sinnar
Kattywar Meridional	... ...	VIII	„	Pata-i-Sháh
		X	„	Khánmír
		XII	„	Monába
		XIV	„	Wándia
		XVI	„	Mália
		XXV	„	Tarkia
		XXVI	„	Kakána
Guzerat Longitudinal	... ...	XI	„	Poera
		XVII	„	Jhinjhar
		XVIII	„	Wastrál
		XXI	„	Sola
		XXII	„	Sánand
		XXIV	„	Khoraj
		XXVI	„	Hasalpur
		XXX	„	Ingrori
Cutch Coast	... ...	I	„	Bhacháo
		VI	„	Sakpur
		VIII	„	Charakra
		XVI	„	Háthria
		XXV	„	Lakhpat
		XXVI	„	Sugandia
		XXVII	„	Said Ali
		XXVIII	„	Guni
		XXXI	„	Mod
		XXXVII	„	Mugalbhin
		XXXIX	„	Gada
		XLIII	„	Vikia
		XLIV	„	Dománi

The usual method of dispersing discrepancies between spirit levelled and trigonometrical heights, is to divide them in proportion to the number of intermediate stations and to correct each height according to its number of removes from the point determined by spirit levelling. 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

* 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 levelled 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 levelling. The solution of these equations by minimum squares is performed in the usual manner and needs no illustration.

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 South-West 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 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
	Khánpisura Meridional Series.			
1	Búda* and Bálágara*	Singárchori and Thíkri	− 2·5 & − 2·0	Simple proportion.
2	Indráwan, Mograba and Thíkri	Dhanvár, Valvádi and Anakvádi	+13·5 +14·3 & +13·1	Ditto.
3	Valvádi, Dhanvár and Anakvádi	Ágargaon†	− 5·9	Ditto.
	Singi Meridional Series.			
1	Tána* and Lakarwás*	Játhrábhor and Patángri	+ 9·8 & +10·0	Simple proportion. The heights of Játhrábhor and Patángri were determined in group 1 of the Guzerat Longitudinal Series.
2	... ...	... ...	...	The heights of Kágarol, Wardhari, Ghoráráo, Rencha and Bhor were determined in group 1 of the Guzerat Longitudinal Series.
3	Bhor and Rencha	Sidpur	+ 4·2	Simple proportion.
4	Karáli and Sidpur	Párnera	− 0·4	Ditto.
5	Dopári, Pilwa and Párnera	Ankai and Sinnar	− 2·4 & − 4·3	Ditto.
6	Bhorgarh, Gambírgarh, Sinnar and Ankai	Párner† and Singi†	− 3·1 & − 6·8	Ditto.

* Of the Karáchi Longitudinal Series of the North-West Quadrilateral.
† Of the Bombay Longitudinal Series of the Southern Trigon.

Group	Commencing at Stations	Ending at Stations	Errors in feet	Method of Dispersion, and Remarks
		Abu Meridional Series.		
1	Márd* and Jeráj*	Mirzápur and Sanoda of the Guzerat Longitudinal Series	− 0.3 & − 0.5	Simple proportion. The heights of Mirzápur and Sanoda were determined in groups 2 and 3 of the Guzerat Longitudinal Series.
		Kattywar Meridional Series.		
1	Akoria,* Bhilgaon* and Jhund*	Pata-i-Sháh	− 2·4	Simple proportion.
2	Dájka and Pata-i-Sháh	Kákraji	...	The heights in this group were determined by taking the arithmetical means of two or more values in the following order:—Chitror from Pata-i-Sháh, Khánmír, Monába and Wándia; Kanduka from Dájka, Pata-i-Sháh, Khánmír and Chitror; Gángta from Bela, Dájka and Kanduka; Kesmára from Khánmír, Monába and Kákraji and Kákraji from Kesmára, Monába and Mália.
3	Kákraji and Mália	Tarkia and Kakána	+ 1·7 & − 0·8	Simple proportion.
4	Kakána and Tarkia	Diu Level Datum Tower	− 1·6	Ditto.
		Guzerat Longitudinal Series.		
1	Karsod† and Indráwan†	Poera	+ 3·2	Simple proportion.
2	Jhiria and Poera	Jhinjhar and Wastrál	+ 1·5 & + 2·6	Ditto.
3	Mirzápur, Wastrál and Jhinjhar	Ingrori	...	The heights in this group were determined by taking the arithmetical means of two or more values in the following order:—Sanoda from Mirzápur and Wastrál; Pálri from Jhinjhar, Wastrál, Sola and Sánand; Hájipur from Sola, Sánand, and Khoraj; Wádrora from Hájipur, Khoraj and Hasalpur; Thuleta from Khoraj, Hasalpur and Kárigángar; Kárigángar from Hasalpur, Ingrori and Thuleta; and Por from Hasalpur, Kárigángar and Ingrori.

* Of the Karáchi Longitudinal Series of the North-West Quadrilateral.
† Of the Khánpisura Meridional Series.

Group	Commencing at Stations	Ending at Stations	Errors in feet	Method of Dispersion, and Remarks
		Guzerat Longitudinal Series—(Continued).		
4	Por and Ingrori	Sápakra and Chalarwa	− 3·0 & − 2·8	Simple proportion. The heights of Sápakra and Chalarwa were determined in group 3 of the Kattywar Meridional Series.
		Cutch Coast Series.		
1	Gángta, Chitror, Wándia and Bhacháo	Sakpur and Charakra	...	The heights in this group were determined by taking the arithmetical means of two or more values in the following order:—Nara from Gángta, Chitror, Wándia and Bhacháo; Kakarwa from Gángta, Bhacháo and Nara; Ran from Gángta and Kakarwa; Ráhida from Bhacháo, Kakarwa and Sakpur; and Karárho from Bhacháo, Sakpur and Charakra.
2	Ráhida, Sakpur and Charakra	Háthria	+ 1·9	Simple proportion.
3	Roha, Dinoda and Háthria	Lakhpat	+ 2·4	Ditto.
4	Suri Muri, Bábia and Lakhpat	Patha-ki-beri	...	The heights in this group were determined by taking the arithmetical means of two or more values in the following order:—Jamanwála from Suri Muri and Bábia; Pinjor Pir from Bábia, Jamanwála, Lakhpat, and Sugandia; Hakra from Said Ali, Guni and Mod; and Patha-ki-beri from Guni and Mod.
5	Patha-ki-beri and Mod	Mugalbhin	+ 0·8	Simple proportion.
6	Patha-ki-beri, Jim and Mugalbhin	Gada	− 1·8	Ditto.
7	Abanshāh and Gada	Vikia	− 1·4	Ditto.
8	Bíbi Mariam and Dománi	N. End and S. End of Karáchi Base-line, N. W. Quadrilateral	− 1·2 & − 0·2	Ditto.

Abstracts of the calculations of the trigonometrical differences of height for the several Series embraced in the South-West Quadrilateral, and which also contain the final values of the heights adopted for the stations, will be found in the details of each Series.

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 mean 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.

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 Determinations of Azimuths by Astronomical Observations.

In the course of the operations of this Survey it has been the custom to determine an azimuth at certain of the stations by astronomical observations taken at the time when the stations are visited in the execution of the triangulation. These independent observations of azimuth will be useful hereafter, in investigations of the Figure of the Earth and of local attraction. But for reasons which have already been explained at page 142 of Vol. II, it would not, as a rule, be proper to employ them in the general reduction of the triangulation. It happens, however, that the observations have been reduced each year *pari passû* with the preliminary reductions of the triangulation—figure by figure, or series by series—which precede the final simultaneous reductions. The observations and their reductions are therefore given in the volumes which treat of the triangulation; as they have more in common with it than with the astronomical observations for the determinations of latitude and differential longitudes.

The observations for azimuth consist of measures of the angle between a circumpolar star, when near either elongation, and some 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 larger 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, δA, of the momentary azimuth from the value at elongation, is subsequently calculated and applied to the observed angle between the referring mark and the star. 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 star at elongation, a determination of the azimuth of the referring mark may be deduced.

The formula employed for the calculation has been

$$\delta A^* = \frac{2 \sin^2 \frac{1}{2} \delta P \operatorname{cosec} 1'' \tan A \cos^2 \text{N.P.D.}}{1 - 2 \sin^2 \text{N.P.D.} \sin^2 \frac{1}{2} \delta P \pm \cot P . \sin \delta P}$$

in which A is the azimuth of the star at elongation, P the corresponding hour angle, N.P.D. 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 is observed, and a referring mark has been employed, the angle between the referring mark and one of the contiguous stations of the triangulation is also observed, just as any other horizontal angle: the several measures will generally be found in the Abstract of the Observed Angles at the observing station; but when not there given they follow the abstract of the azimuthal observations.

Abstracts of the azimuthal observations will be found at the end of the details of each series, where 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 results, *viz.*, the difference between the Astronomical and Geodetical Azimuths. Sometimes the whole of the observations on a pair of zeros could not be completed on one night; in such cases the remainder were taken on a subsequent night, and the change of the 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

* Table XXV of the Auxiliary Tables, 3rd Edition, 1887, has been constructed to facilitate the calculation of this formula.

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 purposes 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.

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 this 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:—

$$\log b = \log a + \log\sin Y_1 - \log\sin Z_1 + \log\sin Y_2 - \log\sin Z_2$$
$$+ \ldots + \log\sin Y_m - \log\sin Z_m.$$

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

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

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

$$d \log b = \beta_1 y_1 - \gamma_1 z_1 + \beta_2 y_2 - \gamma_2 z_2 + \ldots + \beta_n y_n - \gamma_n z_n.$$

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

$$E = \sum_1^n [\beta y - \gamma z].$$

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

$$[\beta y - \gamma z] = \log b \textit{ computed} - \log b \textit{ measured};$$

and at junctions of chains we have

$$[\beta y - \gamma z]_r - [\beta y - \gamma z]_l = \log b_r - \log b_l;$$

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 and the Southern Trigon, 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, longitude and reverse azimuths have already been quoted, see pages 19 and 20. In dealing with these we now confine our attention to the first terms only. Expressing them logarithmically we have

$$\log \Delta\lambda = - \log \rho \sin 1'' + \log c + \log \cos A,$$

$$\log \Delta L = - \log \nu \cos \lambda \sin 1'' + \log c + \log \sin A,$$

$$\log \Delta A = \log (B - \pi - A) = - \log \nu \cot \lambda \sin 1'' + \log c + \log \sin A;$$

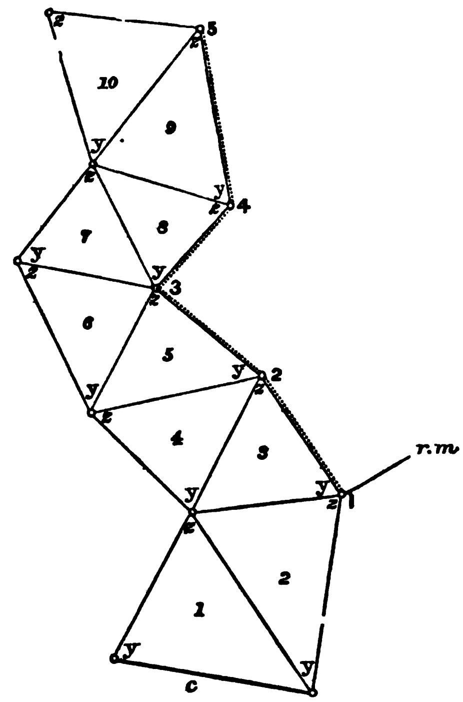
* To save time this is done in course of the preliminary calculation of the triangles, the tabular differences being then noted on the triangle sheets, from which they are afterwards taken when wanted. Provision is also made in the triangle sheets for again employing the same tabular differences, as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

in which A and c are both functions of the observed angles. Differentiating, treating ρ, ν and λ as constants, and expressing the differentials as tabular differences of logarithms

$$\text{t.d.log}\,\Delta\lambda\;\; d\Delta\lambda = \text{t.d.log}\,c\;dc + \text{t.d.log}\cos A\;\,dA,$$

$$\text{t.d.log}\,\Delta L\;\, d\Delta L = \text{t.d.log}\,c\;dc + \text{t.d.log}\sin A\;\,dA,$$

$$\text{t.d.log}\,\Delta A\;(dB - dA) = \text{t.d.log}\,c\;dc + \text{t.d.log}\sin A\;\,dA.$$



From these equations we have

$$d\Delta\lambda = \frac{\text{t.d.log}\;c\;dc}{\text{t.d.log}\,\Delta\lambda} + \frac{\text{t.d.log}\cos A}{\text{t.d.log}\,\Delta\lambda}\,dA,$$

$$d\Delta L = \frac{\text{t.d.log}\;c\;dc}{\text{t.d.log}\,\Delta L} + \frac{\text{t.d.log}\sin A}{\text{t.d.log}\,\Delta L}\,dA,$$

$$dB = \frac{\text{t.d.log}\;c\;dc}{\text{t.d.log}\,\Delta A} + \left\{1 + \frac{\text{t.d.log}\sin A}{\text{t.d.log}\,\Delta A}\right\}dA.$$

The diagram in the margin, which is taken from page 172 of Vol. II, represents the commencement of a chain of triangles in which station 1 is assumed to be the origin of geodetic co-ordinates, and 2, 3, . . . stations on the most direct route—indicated by the dotted line running parallel to the sides on one flank of the chain—which connects 1 with any station in advance. The side c is assumed to be a measured base-line, and the astronomical azimuth of a referring mark at 1 to be the fundamental azimuth. The symbols of the equations just given are made applicable by the employment of subscripts, as follows:—

For the side 1 to 2; $\Delta\lambda_1, \Delta L_1, \Delta A_1, c_1, A_1,$ and B_1,

. . . .

" n to $n+1$; $\Delta\lambda_n, \Delta L_n, \Delta A_n, c_n, A_n$ and B_n,

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

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

δc_2 " " c_1 and c_2,

and so on; and if

δA_1 be the azimuthal error generated between the referring mark and c_1,

δA_2 " " c_1 and c_2,

and so on. Then

$$\text{t.d.log}\,c_1 dc_1 = \text{t.d.log}\,c_1\delta c_1,$$
$$\text{t.d.log}\,c_2 dc_2 = \text{t.d.log}\,c_1\delta c_1 + \text{t.d.log}\,c_2\,\delta c_2,$$

. . . .

and

$$dA_1 = \delta A_1,$$
$$dA_2 = dB_1 + \delta A_2,$$
$$dA_3 = dB_2 + \delta A_3,$$
$$\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot$$

Returning to the expressions for $d\Delta\lambda$, $d\Delta L$ and dB, and treating the last first, because it is independent of the others, and omitting all terms in which higher powers of $\sin 1''$ occur or are latent, as in products of $\sin 1''$ by $\frac{dc}{c}$, expressions for $dB_1, dB_2, dB_3, \ldots$ may be obtained in succession. That for the $(n+1)$th station will be

$$dB_n = \sum_1^n \left[\frac{1}{\text{t.d.log } \Delta A}\right] \text{t.d.log } c_1 \, \delta c_1 + \sum_2^n \left[\frac{1}{\text{t.d.log } \Delta A}\right] \text{t.d.log } c_2 \, \delta c_2 + \ldots + \frac{1}{\text{t.d.log } \Delta A_n} \text{t.d.log } c_n \, \delta c_n$$
$$+ \left\{1 + \sum_1^n \left[\frac{\text{t.d.log sin } A}{\text{t.d.log } \Delta A}\right]\right\} \delta A_1 + \left\{1 + \sum_2^n \left[\frac{\text{t.d.log sin } A}{\text{t.d.log } \Delta A}\right]\right\} \delta A_2 + \ldots + \left\{1 + \frac{\text{t.d.log sin} A_n}{\text{t.d.log } \Delta A_n}\right\} \delta A_n.$$

This is the expression for the error in the azimuth at the $(n+1)$th station of station n, due to the errors of the angles of the triangles which form the chain.

The errors in latitude and longitude at the same station, the $(n+1)$th, are the sums of the respective errors generated between the successive stations of the traverse. Calling these sums $d\lambda_{n+1}$, and dL_{n+1}, then

$$d\lambda_{n+1} = \sum_1^n [d\Delta\lambda]; \quad dL_{n+1} = \sum_1^n [d\Delta L].$$

Expressing $d\Delta\lambda$ and $d\Delta L$ for each side in terms of δc and δA and substituting for the right-hand members of the last equations, we shall have

$$d\lambda_{n+1} = \sum_1^n \left[\frac{1}{\text{t.d.log } \Delta\lambda}\right] \text{t.d.log } c_1 \, \delta c_1 + \sum_2^n \left[\frac{1}{\text{t.d.log } \Delta\lambda}\right] \text{t.d.log } c_2 \, \delta c_2 + \ldots + \frac{1}{\text{t.d.log } \Delta\lambda_n} \text{t.d.log } c_n \, \delta c_n$$
$$+ \sum_1^n \left[\frac{\text{t.d.log cos } A}{\text{t.d.log } \Delta\lambda}\right] \delta A_1 + \sum_2^n \left[\frac{\text{t.d.log cos } A}{\text{t.d.log } \Delta\lambda}\right] \delta A_2 + \ldots + \frac{\text{t.d.log cos } A_n}{\text{t.d.log } \Delta\lambda_n} \delta A_n,$$

and

$$dL_{n+1} = \sum_1^n \left[\frac{1}{\text{t.d.log } \Delta L}\right] \text{t.d.log } c_1 \, \delta c_1 + \sum_2^n \left[\frac{1}{\text{t.d.log } \Delta L}\right] \text{t.d.log } c_2 \, \delta c_2 + \ldots + \frac{1}{\text{t.d.log } \Delta L_n} \text{t.d.log } c_n \, \delta c_n$$
$$+ \sum_1^n \left[\frac{\text{t.d.log sin } A}{\text{t.d.log } \Delta L}\right] \delta A_1 + \sum_2^n \left[\frac{\text{t.d.log sin } A}{\text{t.d.log } \Delta L}\right] \delta A_2 + \ldots + \frac{\text{t.d.log sin } A_n}{\text{t.d.log } \Delta L_n} \delta A_n.$$

In these expressions for the errors in latitude, longitude and azimuth at the $(n+1)$th station we have now to substitute for t.d.log $c_1\delta c_1$, t.d.log $c_2\delta c_2$, . . . and for δA_2, δA_3, . . . in terms of the errors of the angles in each triangle. Turning to the diagram it will be seen that

$$\delta A_2 = z_3 + x_4 + y_5,$$
$$\delta A_3 = z_5 + x_6 + x_7 + y_8,$$
$$\cdots\cdots\cdots$$

and writing

α for t.d.log sin X,
β ,, t.d.log sin Y,
γ ,, t.d.log sin Z,

it can be easily demonstrated that

$$\text{t.d.log}\ c_1\ \delta c_1 = \beta_1 y_1 - \gamma_1 z_1 + \beta_2 y_2 - \gamma_2 z_2 + \alpha_3 x_3 - \gamma_3 z_3,$$
$$\text{t.d.log}\ c_2\ \delta c_2 = \beta_3 y_3 - \alpha_3 x_3 + \beta_4 y_4 - \gamma_4 z_4 + \alpha_5 x_5 - \gamma_5 z_5,$$
$$\text{t.d.log}\ c_3\ \delta c_3 = \beta_5 y_5 - \alpha_5 x_5 + \beta_6 y_6 - \gamma_6 z_6 + \beta_7 y_7 - \gamma_7 z_7 + \alpha_8 x_8 - \gamma_8 z_8,$$
$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$

Eliminating x from these equations by help of the trianglar equation

$$x + y + z = 0,$$

and substituting in the expressions from $d\lambda_{n+1}$, dL_{n+1} and dB_n while making use of the following symbols

E for the left-hand member,
μ_1 ,, the co-efficient of t.d.log $c_1\ \delta c_1$,
μ_2 ,, ,, t.d.log $c_2\ \delta c_2$,
. . . .
ϕ_1 ,, ,, δA_1,
ϕ_2 ,, ,, δA_2,
. . . .

we shall have the following general expression for an error either in latitude, longitude or azimuth

$$\begin{aligned} E = \phi_1\ \delta A_1 &+ \mu_1 \{\beta_1 y_1 - \gamma_1 z_1 + \beta_2 y_2 - \gamma_2 z_2\} \\ &+ \{(\mu_2 - \mu_1)\,\alpha_3 + \mu_2\,\beta_3\}\, y_3 + \{(\mu_2 - \mu_1)\,\alpha_3 - \mu_1\,\gamma_3 + \phi_2\}\, z_3 \\ &+ (\mu_2\,\beta_4 - \phi_2)\, y_4 \qquad + (-\mu_2\,\gamma_4 - \phi_2)\, z_4 \\ &+ \{(\mu_3 - \mu_2)\,\alpha_5 + \mu_3\,\beta_5 + \phi_2\}\, y_5 + \{(\mu_3 - \mu_2)\,\alpha_5 - \mu_2\,\gamma_5 + \phi_3\}\, z_5 \\ &+ \ \cdots \end{aligned}$$

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 m,

$$(\mu_m \beta_p - \phi_m)\, y_p + (-\mu_m \gamma_p - \phi_m)\, z_p.$$

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

$$\{(\mu_{n+1} - \mu_n)\, \alpha_q + \mu_{n+1}\, \beta_q + \phi_n\}\, y_q + \{(\mu_{n+1} - \mu_n)\, \alpha_q - \mu_n \gamma_q + \phi_{n+1}\}\, z_q.$$

Exceptions will appear to 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_m enters the coefficients of all the errors of the angles at station m, and μ_m enters the coefficients of the errors of the other angles of the same triangles, with a *plus* sign if looking from station m the angle is the left-hand one of the triangle and a *minus* sign if the right-hand.

The substitutions for μ and ϕ to render the general equation applicable to either latitude, longitude or azimuth are given in the following table.

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	$+\frac{\text{t.d.log}\cos A_n}{\text{t.d.log}\,\Delta\lambda_n}$	$+\frac{\text{t.d.log}\sin A_n}{\text{t.d.log}\,\Delta L_n}$	$1+\frac{\text{t.d.log}\sin A_n}{\text{t.d.log}\,\Delta A_n}$

Thus 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: and 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.

It is easy to shew that the coefficients of the unknown quantities in the typical equation on page 35 are identical with the corresponding coefficients of equation (121) page 176 of Vol. II. In the former, however, the errors of the base-line and initial azimuth are omitted, as they do not enter the actual equations for solution and are only required for investigations of theoretical error.

III. *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 each branch; and, if the subscripts r and l denote the values obtained by the right and left-hand branches,

$$_{\lambda}E = \lambda_r - \lambda_l,$$
$$_{L}E = L_r - L_l,$$
$$_{A}E = B_r - B_l.$$

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

$$_1\mathfrak{b}_1 y_1 + {}_1\mathfrak{c}_1 z_1 + \dots + {}_1\mathfrak{b}_t y_t + {}_1\mathfrak{c}_t z_t = {}_1E,$$
$$_2\mathfrak{b}_1 y_1 + {}_2\mathfrak{c}_1 z_1 + \dots + {}_2\mathfrak{b}_t y_t + {}_2\mathfrak{c}_t z_t = {}_2E,$$
$$\cdots\cdots\cdots\cdots\cdots$$
$$_n\mathfrak{b}_1 y_1 + {}_n\mathfrak{c}_1 z_1 + \dots + {}_n\mathfrak{b}_t y_t + {}_n\mathfrak{c}_t z_t = {}_nE;$$

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

$$U = \frac{(y_1 + z_1)^2 + y_1^2 + z_1^2}{u_1} + \cdot \cdot \cdot + \frac{(y_t + z_t)^2 + y_t^2 + z_t^2}{u_t}.$$

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

$$\sum_1^t\left[{}_1\mathfrak{b}\,{}_1\mathfrak{B} + {}_1\mathfrak{c}\,{}_1\mathfrak{C}\right]{}_1\Lambda + \sum_1^t\left[{}_1\mathfrak{b}\,{}_2\mathfrak{B} + {}_1\mathfrak{c}\,{}_2\mathfrak{C}\right]{}_2\Lambda + \cdot \cdot \cdot + \sum_1^t\left[{}_1\mathfrak{b}\,{}_n\mathfrak{B} + {}_1\mathfrak{c}\,{}_n\mathfrak{C}\right]{}_n\Lambda = {}_1E;$$

$$\sum_1^t\left[{}_2\mathfrak{b}\,{}_1\mathfrak{B} + {}_2\mathfrak{c}\,{}_1\mathfrak{C}\right]{}_1\Lambda + \sum_1^t\left[{}_2\mathfrak{b}\,{}_2\mathfrak{B} + {}_2\mathfrak{c}\,{}_2\mathfrak{C}\right]{}_2\Lambda + \cdot \cdot \cdot + \sum_1^t\left[{}_2\mathfrak{b}\,{}_n\mathfrak{B} + {}_2\mathfrak{c}\,{}_n\mathfrak{C}\right]{}_n\Lambda = {}_2E;$$

. . . .

$$\sum_1^t\left[{}_n\mathfrak{b}\,{}_1\mathfrak{B} + {}_n\mathfrak{c}\,{}_1\mathfrak{C}\right]{}_1\Lambda + \sum_1^t\left[{}_n\mathfrak{b}\,{}_2\mathfrak{B} + {}_n\mathfrak{c}\,{}_2\mathfrak{C}\right]{}_2\Lambda + \cdot \cdot \cdot + \sum_1^t\left[{}_n\mathfrak{b}\,{}_n\mathfrak{B} + {}_n\mathfrak{c}\,{}_n\mathfrak{C}\right]{}_n\Lambda = {}_nE;$$

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

$$y_p = {}_1\mathfrak{B}_p\,{}_1\Lambda + {}_2\mathfrak{B}_p\,{}_2\Lambda + \cdot \cdot \cdot + {}_n\mathfrak{B}_p\,{}_n\Lambda,$$

$$z_p = {}_1\mathfrak{C}_p\,{}_1\Lambda + {}_2\mathfrak{C}_p\,{}_2\Lambda + \cdot \cdot \cdot + {}_n\mathfrak{C}_p\,{}_n\Lambda,$$

$$x_p = -(y_p + z_p).$$

---

* 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 have always been made use of as a check on the calculations except in the case of the North-East Quadrilateral; the diagonal coefficients were obtained also by the formula

$$\frac{2}{3}\sum_1^t\left[u\,(\mathfrak{b}^2 - \mathfrak{b}\mathfrak{c} + \mathfrak{c}^2)\right].$$

CHAPTER III.

THE DETAILS OF THE SIMULTANEOUS REDUCTION.

1.

Preliminary.

The triangulation of the South-West Quadrilateral does not stand on a par with the greater part of the rest of the triangulation of India inasmuch as it was executed with less refined instruments. It was commenced with Dollond's 15-inch theodolite, an instrument designed by Captain Kater and constructed to the order of Lieut. R. Shortrede, from whom it was purchased for Government by Colonel Everest in 1837. With this instrument a portion of the Singi Meridional Series and the whole of the Khánpisura Meridional Series were executed. It was towards the completion of the latter series that the then Surveyor General, Colonel Waugh, had his attention drawn to the discordances in the readings of the microscopes after successive intersections of the same object, and he learnt then that the instrument had for some time past been giving wild readings and was thoroughly out of repair. He therefore replaced it by one of the two 18-inch theodolites by Troughton and Simms, which had been constructed in 1829-30 and formed part of the equipment imported by Colonel Everest in 1830. With this instrument all the rest of the triangulation was executed. The fact of the triangulation having been performed with instruments not of the highest class, has no influence on the rest of the triangulation of India; for the South-West Quadrilateral lies between two series appertaining to sections of the triangulation which were previously reduced to final terms. With these series the South-West Quadrilateral has been brought into accordance, and they furnish the whole of the fixed data on which it is based. The triangulation forms 6 circuits giving 24 equations in latitude longitude, azimuth and side. The triangulation in Kattywar forms no circuit and therefore does not enter the Simultaneous Reduction, but is treated as a pendent to the main triangulation.

2.

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

The South-West 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	Quadrilaterals	Polygons of 1 and 2 centres		Compound Figures	No. of Angles in each Series
			1	2		
Khánpisura Meridional	...	4	2	2	1	139
Singi "	18	2	1	...	2	153
Abu "	1	...	3	...	...	57
Kattywar "	7	3	2	...	3	159
Guzerat Longitudinal	31	...	2	...	...	122
Cutch Coast	...	5	6	1	1	183
	57	14	16	3	7	813

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 280 triangular, 32 central and 57 side equations, or 369† equations in all.

There are certain peculiarities in some of the figural reductions which may be here noticed:—Fig. No. 10 of the Singi Meridional Series and No. 26 of the Guzerat Longitudinal each have one angle at the central station unobserved and consequently central equations are wanting. Fig. No. 14 of the Singi Meridional Series originally possessed

* 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.

† This number includes two equations in figure 18 derived from its connection with the Karáchi Longitudinal Series to which it is united by two sides.

another triangle formed by the ray Kámandrug–Karanja. Had this ray been retained there would have been three additional equations of condition, one triangular, one central, and the other a side equation, forcing the figure to maintain the ratio of the sides Karanja–Singi to Singi–Párner; while the central equation would have maintained the angle Karanja–Singi–Párner at the value derived from the Bombay Longitudinal Series. Had the triangulation of the latter Series in this neighbourhood been very superior to that of the Singi Series, it would doubtless have been right to have maintained the connection; but this portion of the Bombay Longitudinal Series was executed with the same instrument, Dollond's 15-inch theodolite, as was employed on the triangulation of Fig. 14, and was in no way superior; hence the ray in question was discarded and the figure was left unhampered. In the case of Fig. No. 18 of the Kattywar Meridional Series, which depends on two sides of triangles of the Karáchi Longitudinal Series, the treatment was exactly the reverse, for the Karáchi Series triangulation is in every way far superior to that of the Kattywar Meridional Series. It will be seen on reference to the reduction chart that Figures 20 and 29 have a common station Gángta which causes them, together with the intermediate Figures, 21, 22 and 28, to form one figure, and they might all have been reduced simultaneously. The reduction would, however, have been very laborious and it was decided to reduce them separately, Fig. 29 being reduced last under conditions which maintained the position of Gángta as previously found.

3.

Description of the Reduction Chart.

The Reduction Chart at the end of this volume exhibits the whole of the Principal Triangulation of the South-West Quadrilateral, as it was originally executed. 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 afforded by the Karáchi Longitudinal and the Bombay Longitudinal Series. These 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 South-West 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.

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 six chains G to L form six so-called circuits, the term hitherto used being retained for convenience, though in no case is a complete circuit formed. For example

Circuit *I* is constituted by Series G alone, which originates from a fixed side to the north and closes on a fixed side to the south. Circuit *III* is similarly constituted by Series H. Circuit *II* is formed by the northern portions of Series G and H in combination with a portion of Series K; it originates from a fixed side of the Karáchi Longitudinal Series and closes on another fixed side of the same series. This circuit might equally well have been made to originate from a fixed side of the Bombay Longitudinal Series and to close on another side of the same series, but it would then have contained several more triangles and entailed a good deal more labour in the subsequent calculations. Circuits *IV*, *V* and *VI* resemble Circuit *II*.

Where, in the formation of circuits, the chains have to be divided into sections, they are denoted thus:—

G by G_1 and G_2,
H „ H_1 „ H_2,
J „ J_1 „ J_2,
K „ K_1, K_2 and K_3,

the sections being numbered from north to south or from east to west.

Thus the Circuits are composed as follows:—

Circuit *I* of G_1 and G_2,
„ *II* „ G_1, K_1 and H_1,
„ *III* „ H_1 and H_2,
„ *IV* „ H_1, K_2 and I,
„ *V* „ I, K_3, J_1 and J_2
„ *VI* „ J_1 and L.

Along the flank, on the right-hand side, looking south or west, of every chain of triangles, a dotted line runs parallel to the sides of the triangles; this is the *line of traverse*.

The line of traverse for each circuit is usually divided into two parts, known as the right-hand and left-hand branches; but Circuits *I*, *III* and *VI* have each only one branch, which originates from and closes on sides already fixed in length and position. 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 north to south in meridional and from east to west in longitudinal series.

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; they are the traverse numbers and commence from the initial station of Circuit *I*, *viz.*, Bálágara of the Karáchi Longitudinal Series, which is numbered **1**, and terminate at Vikia, **80**, near the north-western extremity of the Cutch Coast Series.

The circuit triangles are numbered from 1 to 172; commencing from the initial side of Circuit *I*, Bálágara–Búda of the Karáchi Longitudinal Series, they follow the same course as the traverse, and terminate at the north-western extremity of the Cutch Coast 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 of 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; here smaller numerals are used on the Chart for distinction. The numbering commences with 173 and terminates with 280.

Polygonal figures and net-works occur in all the series and are distinguished by numbers carried consecutively through the several chains in the order in which they are lettered. 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 South-West Quadrilateral, and the connections which have been effected with many of the principal stations, are also shewn on the Chart. The lines of levels have already been indicated in Section 7 of Chapter II.

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 at the side Bálágara–Búda of the Karáchi Longitudinal Series, and carried down Series G until they closed on the side Ágargaon–Chincholi of the Bombay Longitudinal Series. They were taken up again at the side Karsod–Indráwan on the western flank of Series G, and carried westward along Series K to the side

Patángri–Bhor of Series H. The calculations were commenced again at Lakarwás–Tána of the Karáchi Longitudinal Series, and carried down Series H, to close on the side Singi–Párner of the Bombay Longitudinal Series; and then again taken up from the side Játhrábhor–Kágarol on the west flank of Series H and carried along Series K westward to the side Mirzápur–Wastrál of the same series. A commencement was again made from the Karáchi Longitudinal Series on the side Jeráj–Márd and the calculations were carried down Series I and westward along Series K, and then north-westward along Series J to the side Monába–Wándia. They were once more commenced from the side Bhilgaon–Akoria of the Karáchi Longitudinal Series and carried down Series J, and then westward and north-westward along Series L to close again on the side Károthol–Sáhiji of the Karáchi Longitudinal Series.

The calculations of the geodetic latitudes, longitudes and azimuths were carried in all cases along the right-hand 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, first where these have fixed values as in the case of Circuits *I* and *III* and next as exhibited by the calculations through the right and left-hand chains of each circuit.

We may employ the formulæ in pages 15 and 16 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 network consistent *inter se*; but they take no cognisance of the connection of chains into circuits, and the conditions required for such connection. The general formula is however equally applicable to both simple figures and to larger sections of the triangulation forming circuits.

The data are as follows:—N (the number of angles) $= 813$, S (the number of stations) $= 225$, and Q (the number of stations of which the positions stand previously fixed by former reductions) $= 15$, or

$$N - 2\,(S - Q) = 393.$$

Now of these 393 equations it has been shewn that 369 have already been employed. Therefore there remain 24 equations of condition to which the triangulation has not been subjected.

Let the symbols G, H, I, . . . L, 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, page 32, and of the geodetic equations, page 35, 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 the equations, page 37.

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

Circuit I.

$$
\begin{aligned}
{}_cG_1 + {}_cG_2 \quad . \; . \; . \; . \; . \; . \; . \quad &= {}_1E; \\
{}_\lambda G_1 + {}_\lambda G_2 \quad . \; . \; . \; . \; . \; . \; . \quad &= {}_2E; \\
{}_L G_1 + {}_L G_2 \quad . \; . \; . \; . \; . \; . \; . \quad &= {}_3E; \\
{}_A G_1 + {}_A G_2 \quad . \; . \; . \; . \; . \; . \; . \quad &= {}_4E.
\end{aligned}
$$

Circuit II.

$$
\begin{aligned}
{}_cH_1 - {}_cG_1 - {}_cK_1 \quad . \; . \; . \; . \; . \quad &= {}_5E; \\
{}_\lambda H_1 - {}_\lambda G_1 - {}_\lambda K_1 \quad . \; . \; . \; . \; . \quad &= {}_6E; \\
{}_L H_1 - {}_L G_1 - {}_L K_1 \quad . \; . \; . \; . \; . \quad &= {}_7E; \\
{}_A H_1 - {}_A G_1 - {}_A K_1 \quad . \; . \; . \; . \; . \quad &= {}_8E.
\end{aligned}
$$

Circuit III.

$$
\begin{aligned}
{}_cH_1 + {}_cH_2 \quad . \; . \; . \; . \; . \; . \; . \quad &= {}_9E; \\
{}_\lambda H_1 + {}_\lambda H_2 \quad . \; . \; . \; . \; . \; . \; . \quad &= {}_{10}E; \\
{}_L H_1 + {}_L H_2 \quad . \; . \; . \; . \; . \; . \; . \quad &= {}_{11}E; \\
{}_A H_1 + {}_A H_2 \quad . \; . \; . \; . \; . \; . \; . \quad &= {}_{12}E.
\end{aligned}
$$

Circuit IV.

$$
\begin{aligned}
{}_cI - {}_cH_1 - {}_cK_2 \quad . \; . \; . \; . \; . \quad &= {}_{13}E; \\
{}_\lambda I - {}_\lambda H_1 - {}_\lambda K_2 \quad . \; . \; . \; . \; . \quad &= {}_{14}E; \\
{}_L I - {}_L H_1 - {}_L K_2 \quad . \; . \; . \; . \; . \quad &= {}_{15}E; \\
{}_A I - {}_A H_1 - {}_A K_2 \quad . \; . \; . \; . \; . \quad &= {}_{16}E.
\end{aligned}
$$

Circuit V.

$$
\begin{aligned}
{}_cJ_1 - {}_cI - {}_cK_3 - {}_cJ_2 \quad . \quad &= {}_{17}E; \\
{}_\lambda J_1 - {}_\lambda I - {}_\lambda K_3 - {}_\lambda J_2 \quad . \quad &= {}_{18}E; \\
{}_L J_1 - {}_L I - {}_L K_3 - {}_L J_2 \quad . \quad &= {}_{19}E; \\
{}_A J_1 - {}_A I - {}_A K_3 - {}_A J_2 \quad . \quad &= {}_{20}E.
\end{aligned}
$$

Circuit VI.

$$
\begin{aligned}
{}_cJ_1 + {}_cL \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad &= {}_{21}E; \\
{}_\lambda J_1 + {}_\lambda L \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad &= {}_{22}E; \\
{}_L J_1 + {}_L L \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad &= {}_{23}E; \\
{}_A J_1 + {}_A L \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad &= {}_{24}E.
\end{aligned}
$$

5.

Formation of the Coefficients of the Unknown Quantities.

On page 37 the equations of condition are represented by a form of which the following may be taken as a general illustration

$$
{}_m\mathfrak{b}_1\, y_1 + {}_m\mathfrak{c}_1\, z_1 + {}_m\mathfrak{b}_2\, y_2 + {}_m\mathfrak{c}_2\, z_2 + \quad . \; . \; . \quad = {}_mE,
$$

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 page 32,

$$\mathfrak{b}_p = \pm \beta_p = \pm \text{ t.d. log sin } Y_p \text{ for } 1'';$$
$$\mathfrak{c}_p = \mp \gamma_p = \mp \text{ t.d. log sin } Z_p \quad ,,$$

For the *Geodetic* Equations we shall have, see page 35,

$$\mathfrak{b}_p = \pm (\mu_l \beta_p - \phi_l);$$
$$\mathfrak{c}_p = \mp (\mu_l \gamma_p + \phi_l);$$

$$\mathfrak{b}_p = \pm \{(\mu_{l+1} - \mu_l) \alpha_p + \mu_{l+1} \beta_p + \phi_l\};$$
$$\mathfrak{c}_p = \pm \{(\mu_{l+1} - \mu_l) \alpha_p - \mu_l \gamma_p + \phi_{l+1}\}.$$

the former being applicable to any, the pth triangle, when it has only the angle X in the traverse at the station l, and the latter when it has the side opposite X in the traverse and lying between the stations l and $l + 1$, the lower signs being employed in left-hand branches of circuits and the upper signs in all other cases.

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

Circuit I. Equations 1 to 4.

Equation 1 has no exceptional coefficients.

In Equations 2, 3 and 4

$$\mathfrak{b}_{29} = -\mu_{14} \alpha_{29} + \phi_{14}; \qquad \mathfrak{c}_{29} = -\mu_{14} (\alpha_{29} + \gamma_{29});$$

with the exception of $\mathfrak{c}_{29}$ in Equation 4, in Azimuth, which needs the addition of unity to carry the calculations as far as the side Ágargaon–Mathuri, and the same equation has two extra coefficients

$$\mathfrak{b}_{30} = -1 \text{ and } \mathfrak{c}_{30} = -1,$$

to carry the calculations to the closing side Ágargaon–Chincholi.

Circuit II. Equations 5 to 8.

In Equation 5

$$\mathfrak{b}_{11} = +\alpha_{11}; \qquad \mathfrak{c}_{11} = +(\alpha_{11} + \gamma_{11});$$
$$\mathfrak{b}_{55} = -\alpha_{55}; \qquad \mathfrak{c}_{55} = -(\alpha_{55} + \gamma_{55}).$$

In Equations 6, 7 and 8

$$\mathfrak{b}_{11} = + \mu_5 \, a_{11} - \phi_5 \, ; \qquad \mathfrak{c}_{11} = + \mu_5 \, (a_{11} + \gamma_{11}) \, ;$$
$$\mathfrak{b}_{39} = + \mu_{18} \, a_{39} - \phi_{18} \, ; \qquad \mathfrak{c}_{39} = + \mu_{18} \, (a_{39} + \gamma_{39}) \, ;$$

except that in Equation 8, in Azimuth, $\mathfrak{c}_{39}$ needs the addition of -1, and there are additional coefficients in this equation which do not occur in the other two

$$\mathfrak{b}_{40} = +1 \, ; \qquad \mathfrak{c}_{40} = +1 \, ;$$
$$\mathfrak{b}_{54} = +1 \, ; \qquad \mathfrak{c}_{54} = +1 \, ;$$
$$\mathfrak{b}_{55} = -1 \, ; \qquad \mathfrak{c}_{55} = 0.$$

Circuit III. Equations 9 to 12.

Equation 9 has no exceptional coefficients.

In Equations 10, 11 and 12

$$\mathfrak{b}_{74} = - \mu_{35} \, a_{74} + \phi_{35} \, ; \qquad \mathfrak{c}_{74} = - \mu_{35} \, (a_{74} + \gamma_{74}) \, ;$$

except that in Equation 12, in Azimuth, $\mathfrak{c}_{74}$ needs the addition of unity, and this equation has also additional coefficients

$$\mathfrak{b}_{75} = -1 \, ; \qquad \mathfrak{c}_{75} = -1.$$

Circuit IV. Equations 13 to 16.

In Equation 13

$$\mathfrak{b}_{54} = + a_{54} \, ; \qquad \mathfrak{c}_{54} = + (a_{54} + \gamma_{54}) \, ;$$
$$\mathfrak{b}_{100} = - a_{100} \, ; \qquad \mathfrak{c}_{100} = - (a_{100} + \gamma_{100}).$$

In Equations 14, 15 and 16

$$\mathfrak{b}_{54} = + \mu_{25} \, a_{54} - \phi_{25} \, ; \qquad \mathfrak{c}_{54} = + \mu_{25} \, (a_{54} + \gamma_{54}) \, ;$$
$$\mathfrak{b}_{84} = + \mu_{39} \, a_{84} - \phi_{39} \, ; \qquad \mathfrak{c}_{84} = + \mu_{39} \, (a_{84} + \gamma_{84}) \, ;$$

except that in Equation 16, in Azimuth, $\mathfrak{c}_{84}$ needs the addition of -1, and this equation has also additional coefficients

$$\mathfrak{b}_{85} = +1 \, ; \qquad \mathfrak{c}_{85} = +1 \, ;$$
$$\mathfrak{b}_{86} = +1 \, ; \qquad \mathfrak{c}_{86} = +1 \, ;$$
$$\mathfrak{b}_{100} = -1 \, ; \qquad \mathfrak{c}_{100} = 0.$$

Circuit V. Equations 17 to 20.

In Equation 17

$$\mathfrak{b}_{135} = -\alpha_{135}; \qquad \mathfrak{c}_{135} = -(\alpha_{135} + \gamma_{135}).$$

In Equations 18, 19 and 20

$$\mathfrak{b}_{123} = +\mu_{56}\,\alpha_{123} - \phi_{56}; \qquad \mathfrak{c}_{123} = +\mu_{56}\,(\alpha_{123} + \gamma_{123});$$

except that in Equation 20, in Azimuth, $\mathfrak{c}_{123}$ needs the addition of -1, and this equation has also additional coefficients

$$\mathfrak{b}_{124} = +1; \qquad \mathfrak{c}_{124} = +1;$$
$$\mathfrak{b}_{135} = -1; \qquad \mathfrak{c}_{135} = 0.$$

Circuit VI. Equations 21 to 24.

Equation 21 has no exceptional coefficients.

In Equations 22, 23 and 24

$$\mathfrak{b}_{171} = -\mu_{80}\,\alpha_{171} + \phi_{80}; \qquad \mathfrak{c}_{171} = -\mu_{80}\,(\alpha_{171} + \gamma_{171});$$

except that in Equation 24, in Azimuth, $\mathfrak{c}_{171}$ needs the addition of unity, and this equation has also additional coefficients

$$\mathfrak{b}_{172} = -1; \qquad \mathfrak{c}_{172} = -1.$$

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 ${}_m\mathrm{k}\int_p^q$ 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 is ${}_m\mathrm{k}_q$: 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.* $${}_{1}k\Big|_{1}^{30} \;.\;.\; = {}_{1}E.$$

(2). *Latitude.* $${}_{2}k\Big|_{1}^{29} \;.\;.\; = {}_{2}E.$$

(3). *Longitude.* $${}_{3}k\Big|_{1}^{29} \;.\;.\; = {}_{3}E.$$

(4). *Azimuth.* $${}_{4}k\Big|_{1}^{30} \;.\;.\; = {}_{4}E.$$

Circuit II.

(5). *Linear.* $${}_{5}k\Big|_{41}^{55} + {}_{5}k\Big|_{1}^{11} + {}_{5}k\Big|_{31}^{40} = {}_{5}E.$$

(6). *Latitude.* $${}_{6}k\Big|_{41}^{53} + {}_{6}k\Big|_{1}^{11} + {}_{6}k\Big|_{31}^{39} = {}_{6}E.$$

(7). *Longitude.* $${}_{7}k\Big|_{41}^{53} + {}_{7}k\Big|_{1}^{11} + {}_{7}k\Big|_{31}^{39} = {}_{7}E.$$

(8). *Azimuth.* $${}_{8}k\Big|_{41}^{55} + {}_{8}k\Big|_{1}^{11} + {}_{8}k\Big|_{31}^{40} = {}_{8}E.$$

Circuit III.

(9). *Linear.* $${}_{9}k\Big|_{41}^{75} \;.\;.\; = {}_{9}E.$$

(10). *Latitude.* $${}_{10}k\Big|_{41}^{74} \;.\;.\; = {}_{10}E.$$

(11). *Longitude.* $${}_{11}k\Big|_{41}^{74} \;.\;.\; = {}_{11}E.$$

(12). *Azimuth.* $${}_{12}k\Big|_{41}^{75} \;.\;.\; = {}_{12}E.$$

Circuit IV.

(13). *Linear.* $${}_{13}k\Big|_{87}^{100} + {}_{13}k\Big|_{41}^{54} + {}_{13}k\Big|_{76}^{86} = {}_{13}E.$$

(14). *Latitude.* $${}_{14}k\Big|_{87}^{99} + {}_{14}k\Big|_{41}^{54} + {}_{14}k\Big|_{76}^{84} = {}_{14}E.$$

(15). *Longitude.* $${}_{15}k\Big|_{87}^{99} + {}_{15}k\Big|_{41}^{54} + {}_{15}k\Big|_{76}^{84} = {}_{15}E.$$

(16). *Azimuth.* $${}_{16}k\Big|_{87}^{100} + {}_{16}k\Big|_{41}^{54} + {}_{16}k\Big|_{76}^{86} = {}_{16}E.$$

Circuit V.

(17). *Linear.* $${}_{17}k\Big|_{125}^{135} + {}_{17}k\Big|_{87}^{124} = {}_{17}E.$$

(18). *Latitude.* $${}_{18}k\Big|_{125}^{134} + {}_{18}k\Big|_{87}^{123} = {}_{18}E.$$

(19). *Longitude.* $${}_{19}k\Big|_{125}^{134} + {}_{19}k\Big|_{87}^{123} = {}_{19}E.$$

(20). *Azimuth.* $${}_{20}k\Big|_{125}^{135} + {}_{20}k\Big|_{87}^{124} = {}_{20}E.$$

Circuit VI.

(21). *Linear.* $${}_{21}k\Big|_{125}^{172} \;.\;.\;.\;.\;.\;.\; = {}_{21}E.$$

(22). *Latitude.* $${}_{22}k\Big|_{125}^{171} \;.\;.\;.\;.\;.\;.\; = {}_{22}E.$$

(23). *Longitude.* $${}_{23}k\Big|_{125}^{171} \;.\;.\;.\;.\;.\;.\; = {}_{23}E.$$

(24). *Azimuth.* $${}_{24}k\Big|_{125}^{172} \;.\;.\;.\;.\;.\;.\; = {}_{24}E.$$

7.

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

It has been stated in Section 3 of Chapter I, that the South-West Quadrilateral rests on two chains of triangles, which having been already finally adjusted, furnish the whole of the data on which the Quadrilateral is based. The two series are the Karáchi and Bombay Longitudinal Series, the former, Series B of the North-West Quadrilateral and the latter, Series B of the Southern Trigon. The fixed data have been taken from Volumes III and XII of the *Account of the Operations of the Great Trigonometrical Survey of India* containing the details of the North-West Quadrilateral and Southern Trigon; but for the geodetic elements a third place of decimals of seconds has been obtained by reference to the manuscript calculations of those sections. The data are as follows:—

Volume III, pages $46_{b.}$ to $51_{b.}$:—

Khanpisura Meridional Series.

Station of origin Bálágara or XXIV; side of origin Bálágara or XXIV to Búda or XXI.

At Bálágara

Latitude North	24°	10′	21″·904,	
Longitude East of Greenwich	75	0	15·836,	
Azimuth of Búda	248	10	32·619,	
Distance "	Log Feet 4·7960898,2.			

Singi Meridional Series.

Station of origin Lakarwás or XXXII; side of origin Lakarwás or XXXII to Tána or XXIX.

At Lakarwás

Latitude North	24°	31′	47″·991,	
Longitude East of Greenwich	73	52	10·410,	
Azimuth of Tána	240	10	36·368,	
Distance "	Log Feet 5·1383141,5.			

Abu Meridional Series.

Station of origin Jeráj or XLIII; side of origin Jeráj or XLIII to Márd or XL.

At Jeráj

Latitude North	24°	24′	59″·768,	
Longitude East of Greenwich	72	32	29·857,	
Azimuth of Márd	271	50	2·185,	
Distance "	Log Feet 5·1803796,3.			

Kattywar Meridional Series.

Station of origin Bhilgaon or LXIV; side of origin Bhilgaon or LXIV to Akoria or LXI.

At Bhilgaon

Latitude North	24°	41′	34″·187,
Longitude East of Greenwich	71	7	10·998,
Azimuth of Akoria	274	27	27·598,
Distance "	Log Feet 4·8160424,8.		

Cutch Coast Series.

Closing station of *Circuit VI*, Károthol or CIV; closing side Károthol or CIV to Sáhiji or CVII.

At Károthol

Latitude North	24°	53′	46″·692,
Longitude East of Greenwich	67	55	59·651,
Azimuth of Sáhiji	80	16	15·052,
Distance "	Log Feet 4·9930496,1.		

Volume XII, pages 56—$_{B.}$ and 57—$_{B.}$:—

Khanpisura Meridional Series.

Closing station of *Circuit I*, Ágargaon or XXIV; closing side Ágargaon or XXIV to Chincholi or XXIII.

At Ágargaon

Latitude North	19°	10′	40″·523,
Longitude East of Greenwich	74	54	32·979,
Azimuth of Chincholi	303	32	19·356,
Distance "	Log Feet 5·2222227,3.		

Singi Meridional Series.

Closing station of *Circuit III*, Singi or XXX; closing side Singi or XXX to Párner or XXVI.

At Singi

Latitude North	18°	56′	45″·894,
Longitude East of Greenwich	73	42	10·304,
Azimuth of Párner	262	5	23·758,
Distance "	Log Feet 5·4143939,5.		

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 Karáchi 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 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 vlaues 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 Guzerat Longitudinal Series, &c.

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

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

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	XXIV*	1	80 17 44·88	·59	5·1011219,9		y	G XIV		61 49 19·39	1·99	5·2784898,6
1	x	XXI*		70 28 25·23	·59	5·0816570,0	15	x	XVIII	8	38 51 2·53	1·99	5·1307454,1
	z	G II	2	29 13 49·89	·58	4·7960898,2		z	XVII		79 19 38·08	1·99	5·3256962,6
		XXI*		39 23 52·13	·61	4·9036948,2			XVII		85 13 40·22	1·85	5·3383383,0
2	”	G II	2	50 50 6·73	·62	4·9906136,3	16	”	XVIII	8	34 30 59·67	1·85	5·0931572,1
		I		89 46 1·14	·62	5·1011219,9			XIX		60 15 20·11	1·85	5·2784898,6
		I		64 39 57·17	·58	4·9949224,9			XVIII	8	50 26 42·67	1·93	5·2257725,2
3	”	II	2	68 13 50·03	·58	5·0067045,5	17	”	XIX		41 55 22·14	1·93	5·1635695,2
		III		47 6 12·80	·58	4·9036948,2			XX	9	87 37 55·19	1·93	5·3383383,0
		II	2	72 37 31·24	·84	5·1002639,5			XX	9	77 18 57·94	1·43	5·2545474,5
4	”	III		58 53 11·51	·84	5·0530936,7	18	”	XIX		36 45 12·24	1·42	5·0422486,5
		VI	3	48 29 17·25	·84	4·9949224,9			XXII	10	65 55 49·82	1·43	5·2257725,2
		III		77 26 24·81	1·20	5·1927354,9			XIX		60 31 43·22	1·73	5·2172251,9
5	”	VI	3	50 28 44·71	1·19	5·0905299,9	19	”	XXII	10	47 53 53·18	1·73	5·1477822,7
		V		52 4 50·48	1·19	5·1002639,5			XXI		71 34 23·60	1·74	5·2545474,5
		VI	3	46 17 19·23	1·10	5·0560617,0			XXII	10	76 8 32·92	2·70	5·3739113,9
6	”	V		51 45 3·93	1·10	5·0920766,2	20	”	XXI		61 15 37·27	2·70	5·3296467,3
		VII	4	81 57 36·84	1·10	5·1927354,9			XXIII	11	42 35 49·81	2·70	5·2172251,9
		V		61 51 12·34	·44	5·0015101,7			XXI		38 51 17·92	1·82	5·1792177,6
7	”	VII	4	29 24 46·76	·44	4·7473388,1	21	”	XXIII	11	40 19 17·38	1·82	5·1926621,2
		VIII		88 44 0·90	·45	5·0560617,0			XXIV		100 49 24·70	1·83	5·3739113,9
		VII	4	48 53 17·45	·49	4·8895642,3			XXIV		58 39 52·69	1·45	5·1586565,6
8	”	VIII		53 57 36·93	·50	4·9202612,2	22	”	XXIII	11	57 45 22·92	1·45	5·1543896,2
		IX	5	77 9 5·62	·50	5·0015101,7			XXVI		63 34 44·39	1·46	5·1792177,6
		VIII		82 4 29·36	·40	4·9755652,7			XXIII	11	60 44 52·23	1·47	5·1698183,7
9	”	IX	5	43 34 58·26	·40	4·8182061,3	23	”	XXVI		61 0 12·64	1·47	5·1708980,9
		X		54 20 32·38	·40	4·8895642,3			XXVII	12	58 14 55·13	1·47	5·1586565,6
		X		56 8 23·56	·92	5·0930693,4			XXVI		60 41 43·79	1·71	5·2054131,4
10	”	IX	5	84 32 50·36	·92	5·1718122,3	24	”	XXVII	12	65 50 51·16	1·71	5·2250951,3
		XII		39 18 46·08	·92	4·9755652,7			XXVIII		53 27 25·05	1·71	5·1698183,7
		IX	5	57 2 0·79	1·12	5·0969789,8			XXVII	12	43 16 33·66	1·14	5·0451041,7
11	”	XII		66 42 58·93	1·13	5·1363297,9	25	”	XXVIII		54 10 1·72	1·14	5·1179633,3
		XIII	6	56 15 0·28	1·12	5·0930693,4			XXX	13	82 33 24·62	1·14	5·2054131,4
		XII		66 0 1·52	1·53	5·2162556,7			XXVIII		104 36 39·96	1·25	5·3125753,9
12	”	XIII	6	70 2 23·49	1·53	5·2286197,9	26	”	XXX	13	43 52 31·54	1·25	5·1676438,6
		XIV		43 57 34·99	1·52	5·0969789,8			XXXI		31 30 48·50	1·24	5·0451041,7
		XIII	6	67 9 37·74	1·60	5·2224471,4			XXX	13	50 56 31·60	2·15	5·2169735,3
13	”	XIV		47 32 1·46	1·59	5·1257717,4	27	”	XXXI		53 39 21·24	2·15	5·2328772,7
		XVI	7	65 18 20·80	1·60	5·2162556,7			XXXIV	14	75 24 7·16	2·16	5·3125753,9
		XVI	7	65 59 27·52	2·58	5·3256962,6			XXXI		50 46 59·23	1·92	5·1878634,9
14	”	XIV		67 56 18·13	2·59	5·3319733,6	28	”	XXXIV	14	73 16 30·35	1·92	5·2799256,5
		XVIII	8	46 4 14·35	2·58	5·2224471,4			XXXIII		55 56 30·42	1·92	5·2169735,3

* These stations appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
29	y	G XXXIV	14	82 51 22·90	2·04	5·3306540,0
	x	XXXIII		51 33 54·88	2·04	5·2279756,3
	z	XXIV*		45 34 42·22	2·04	5·1878634,9
30	,,	G XXXIII		50 49 41·29	1·56	5·2222417,1
		XXIV*		33 29 3·27	1·55	5·0745062,5
		XXIII*		95 41 15·44	1·56	5·3306540,0
31	,,	G IX	5	56 39 45·34	·79	5·0609040,5
		XIII	6	39 39 56·92	·79	4·9440149,7
		K I	15	83 40 17·74	·80	5·1363297,9
32	,,	G XIII	6	77 9 5·42	1·03	5·1579194,8
		K I	15	51 36 29·03	1·02	5·0631266,6
		II		51 14 25·55	1·02	5·0609040,5
33	,,	I	15	40 39 20·61	1·26	5·0487999,0
		II		82 27 20·15	1·26	5·2311013,9
		III	16	56 53 19·24	1·26	5·1579194,8
34	,,	II		44 19 27·02	·48	4·8933862,4
		III	16	43 36 2·55	·47	4·8877000,1
		IV		92 4 30·43	·48	5·0487999,0
35	,,	III	16	53 48 39·13	·40	4·8559211,8
		IV		64 34 20·82	·40	4·9047584,0
		VII	17	61 37 0·05	·40	4·8933862,4
36	,,	IV		92 6 3·64	·65	5·1365191,9
		VII	17	56 18 57·61	·65	5·0569915,0
		VI		31 34 58·75	·64	4·8559211,8
37	,,	VII	17	64 54 6·89	·98	5·1170851,1
		VI		43 49 50·87	·98	5·0005960,3
		VIII	18	71 16 2·24	·98	5·1365191,9
38	,,	VI		56 6 42·57	·81	5·0442882,4
		VIII	18	44 53 29·76	·80	4·9738053,4
		IX		78 59 47·67	·81	5·1170851,1
39	,,	VIII	18	76 11 52·94	·83	5·1100974,8
		IX		47 13 48·51	·82	4·9885694,9
		H XIII		56 34 18·55	·83	5·0442882,4
40	,,	K IX		38 1 58·16	·71	4·9055646,8
		H XIII		61 18 57·26	·72	5·0590424,4
		XVII		80 39 4·58	·72	5·1100974,8

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
41	y	XXIX†		54 37 35·04	1·54	5·1657338,2
	x	XXXII†	19	75 25 17·91	1·54	5·2401535,2
	z	H I		49 57 7·05	1·53	5·1383141,5
42	,,	XXXII†	19	61 23 18·57	1·25	5·1436250,9
		H I		51 7 59·47	1·25	5·0915047,6
		II	20	67 28 41·96	1·26	5·1657338,2
43	,,	I		70 33 45·32	1·18	5·1692739,9
		II	20	46 41 55·99	1·18	5·0567476,1
		III		62 44 18·69	1·18	5·1436250,9
44	,,	II	20	49 33 55·05	1·22	5·0787689,2
		III		60 47 53·88	1·22	5·1382694,9
		IV	21	69 38 11·07	1·22	5·1692739,9
45	,,	IV	21	47 3 31·95	·74	4·9611736,0
		III		59 15 40·52	·74	5·0308797,2
		V	22	73 40 47·53	·75	5·0787689,2
46	,,	III		51 18 54·05	·45	4·8771589,5
		V	22	57 23 15·03	·46	4·9102185,0
		VI		71 17 50·92	·46	4·9611736,0
47	,,	VI		73 40 50·62	·49	4·9838115,1
		V	22	57 39 54·06	·48	4·9284946,2
		VII		48 39 15·32	·48	4·8771589,5
48	,,	V	22	77 4 3·41	·59	5·0427796,5
		VII		44 37 25·38	·59	4·9005517,4
		VIII	23	58 18 31·21	·59	4·9838115,1
49	,,	VII		64 58 36·36	·64	5·0250443,5
		VIII	23	44 18 17·94	·64	4·9120032,6
		IX		70 43 5·70	·65	5·0427796,5
50	,,	VIII	23	60 3 53·16	·63	4·9902801,5
		IX		50 4 57·00	·62	4·9372443,6
		X	24	69 51 9·84	·63	5·0250443,5
51	,,	IX		51 1 15·34	·63	4·9424678,8
		X	24	68 46 10·70	·63	5·0213143,6
		XI		60 12 33·96	·63	4·9902801,5
52	,,	X	24	76 34 5·25	·72	5·0847370,6
		XI		58 55 43·49	·72	5·0295225,7
		XII	25	44 30 11·26	·72	4·9424678,8
53	,,	XI		50 20 26·48	·61	4·9717119,6
		XII	25	42 35 12·29	·60	4·9157040,1
		XIII		87 4 21·23	·61	5·0847370,6
54	,,	XII	25	59 3 3·77	·33	4·9054020,5
		XIII		33 23 1·96	·32	4·7126610,0
		XIV	26	87 33 54·27	·33	4·9717119,6

* These stations appertain to the Bombay Longitudinal Series of the Southern Trigon.
† ,, ,, Karáchi Longitudinal Series of the North-West Quadrilateral.

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	H XIII		78 2 9·47	·50	5·0055427,8		y	H XXIX		64 54 33·27	2·08	5·2758931,6
55	x	XIV	26	50 59 36·70	·50	4·9055434,3	69	x	XXXI	33	45 36 18·93	2·07	5·1729635,4
	z	XVII		50 58 13·83	·50	4·9054020,5		z	XXXII		69 29 7·80	2·08	5·2904854,3
		XIV	26	44 10 25·76	·39	4·8491092,4			XXXI	33	66 35 43·17	3·10	5·3612700,8
56	,,	XVII		43 15 44·65	·38	4·8418842,4	70	,,	XXXII		64 28 19·97	3·10	5·3539466,0
		XVIII	27	92 33 49·59	·39	5·0055427,8			XXXIV	34	48 55 56·86	3·09	5·2758931,6
		XVII		95 42 4·78	·39	5·0181156,5			XXXII		59 28 42·40	4·08	5·3893565,6
57	,,	XVIII	27	41 54 1·64	·38	4·8449407,5	71	,,	XXXIV	34	66 40 12·20	4·08	5·4170884,6
		XIX		42 23 53·58	·39	4·8491092,4			XXXV		53 51 5·40	4·08	5·3612700,8
		XVIII	27	56 43 46·34	·64	4·9741295,2			XXXIV	34	98 52 40·78	3·60	5·5202811,7
58	,,	XIX		55 34 14·65	·64	4·9682380,5	72	,,	XXXV		34 9 45·14	3·60	5·2748984,3
		XX	28	67 41 59·01	·64	5·0181156,5			XXXIX	35	46 57 34·08	3·60	5·3893565,6
		XIX		60 53 11·11	·41	4·9244594,7			XXXV		33 44 38·24	3·90	5·2652831,3
59	,,	XX	28	40 43 50·95	·40	4·7977031,2	73	,,	XXXIX	35	54 1 2·82	3·90	5·4286664,9
		XXI		78 22 57·94	·41	4·9741295,2			XXXVIII		92 14 18·94	3·90	5·5202811,7
		XX	28	55 6 36·64	·78	5·0683157,4			XXXIX	35	80 2 9·09	3·41	5·4389500,8
60	,,	XXI		88 48 21·59	·78	5·1542733,4	74	,,	XXXVIII		58 38 32·71	3·41	5·3769762,0
		XXIII	29	36 5 1·77	·77	4·9244594,7			XXX*		41 19 18·20	3·41	5·2652831,3
		XXI		84 4 53·82	·66	5·1165215,4			H XXXVIII		66 44 32·94	3·37	5·4143966,9
61	,,	XXIII	29	33 1 25·41	·65	4·8552281,4	75	,,	XXX*		36 48 16·39	3·37	5·2286944,3
		XXII		62 53 40·77	·66	5·0683157,4			XXVI*		76 27 10·67	3·38	5·4389500,8
		XXII		81 11 20·85	1·43	5·2458036,6							
62	,,	XXIII	29	51 36 25·68	1·42	5·1451481,6							
		XXIV		47 12 13·47	1·42	5·1165215,4							
		XXIII	29	69 37 54·58	1·52	5·2410660,3			H XII	25	100 43 59·29	·30	4·9881459,1
63	,,	XXIV		38 58 12·08	1·52	5·0676971,3	76	,,	XIV	26	47 51 59·49	·29	4·8659713,6
		XXV	30	71 23 53·34	1·53	5·2458036,6			XV	36	31 24 1·22	·29	4·7126610,0
		XXIV		58 29 8·46	1·05	5·1717936,3			XIV	26	53 22 47·70	·61	4·9462013,7
64	,,	XXV	30	30 51 37·95	1·04	4·9511695,6	77	,,	XV	36	64 29 32·52	·62	4·9971582,7
		XXVI		90 39 13·59	1·05	5·2410660,3			XVI		62 7 39·78	·61	4·9881459,1
		XXV	30	83 38 4·43	1·79	5·3035329,8			XV	36	43 8 43·17	·34	4·7848800,3
65	,,	XXVI		49 9 35·70	1·78	5·1850492,5	78	,,	XVI		54 20 25·08	·35	4·8597384,6
		XXVIII	31	47 12 19·87	1·78	5·1717936,3			K X	37	82 30 51·75	·35	4·9462013,7
		XXVI		62 21 0·48	2·52	5·2963160,0			H XVI		39 33 22·51	·16	4·5924731,4
66	,,	XXVIII	31	53 24 25·71	2·52	5·2536373,1	79	,,	K X	37	57 46 33·27	·16	4·7158003,1
		XXIX		64 14 33·81	2·52	5·3035329,8			XI		82 40 4·22	·16	4·7848800,3
		XXVIII	31	82 56 8·06	2·20	5·3595888,8			X	37	58 34 13·75	·12	4·6231577,8
67	,,	XXIX		37 59 13·25	2·20	5·1521143,5	80	,,	XI		68 46 1·79	·12	4·6615351,3
		XXX	32	59 4 38·69	2·20	5·2963160,0			XII	38	52 39 44·46	·12	4·5924731,4
		XXX	32	56 5 21·00	2·59	5·2904854,3			XI		62 51 14·82	·14	4·6749712,6
68	,,	XXIX		47 14 39·31	2·59	5·2373027,2	81	,,	XII	38	64 58 53·73	·15	4·6828661,9
		XXXI	33	76 39 59·69	2·59	5·3595888,8			XIII		52 9 51·45	·14	4·6231577,8

* These stations appertain to the Bombay Longitudinal Series of the Southern Trigon.

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	K XII	38	63 38 18·87	·16	4·7000955,5
82	x	XIII		58 37 12·45	·16	4·6791047,7
	z	XIV	39	57 44 28·68	·16	4·6749712,6
		XIII		52 58 48·59	·17	4·6785930,4
83	„	XIV	39	69 59 24·30	·18	4·7493162,4
		XV		57 1 47·11	·18	4·7000955,5
		XIV	39	51 50 21·94	·15	4·6361407,4
84	„	XV		68 2 45·64	·15	4·7078688,5
		XVI		60 6 52·42	·15	4·6785930,4
		XV		57 36 31·56	·14	4·6532705,6
85	„	XVI		68 7 25·50	·15	4·6942608,8
		XVII		54 16 2·94	·14	4·6361407,4
		XVII		73 19 25·92	·17	4·7492347,9
86	„	XVI		56 29 57·57	·17	4·6889987,4
		XVIII		50 10 36·51	·16	4·6532705,6
		XLIII*	40	38 58 9·66	1·04	4·9893064,0
87	„	XL*		63 29 6·24	1·04	5·1424564,2
		I I	41	77 32 44·10	1·05	5·1803796,3
		XL*		51 34 27·10	·67	4·9629513,7
88	„	I I	41	72 4 37·04	·68	5·0473557,3
		II		56 20 55·86	·67	4·9893064,0
		II		80 23 41·92	·73	5·0977595,0
89	„	I	41	53 18 46·86	·73	5·0080171,1
		IV		46 17 31·22	·72	4·9629513,7
		I	41	46 7 15·86	·59	4·9560411,6
90	„	IV		41 13 58·79	·59	4·9171890,4
		V	42	92 38 45·35	·59	5·0977595,0
		V	42	59 48 29·81	·85	5·0831444,8
91	„	IV		80 1 23·61	·85	5·1398385,5
		VI	43	40 10 6·58	·85	4·9560411,6
		IV		53 30 1·63	·70	4·9970450,3
92	„	VI	43	47 56 32·37	·70	4·9625431,8
		VII		78 33 26·00	·71	5·0831444,8
		VII		52 15 33·76	·50	4·9100150,9
93	„	VI	43	52 40 4·73	·51	4·9123947,4
		IX		75 4 21·51	·51	4·9970450,3
		VI	43	59 24 49·83	·32	4·8573399,4
94	„	IX		44 12 25·91	·32	4·7657965,7
		X	44	76 22 44·26	·33	4·9100150,9

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	I IX		72 41 59·94	·33	4·8995099,7
95	x	X	44	47 15 20·42	·33	4·7855420,1
	z	XI		60 2 39·64	·33	4·8573399,4
		X	44	60 50 10·56	·32	4·8585905,1
96	„	XI		45 31 27·83	·32	4·7708852,8
		XIII	45	73 38 21·61	·33	4·8995099,7
		XIII	45	64 39 16·47	·29	4·8465554,0
97	„	XI		47 2 40·43	·29	4·7549524,5
		K XIX	46	68 18 3·10	·30	4·8585905,1
		I XI		48 45 10·81	·27	4·7491345,7
98	„	K XIX	46	61 2 7·63	·27	4·8149574,0
		I XIV		70 12 41·56	·28	4·8465554,0
		XIV		62 31 48·13	·18	4·7312439,5
99	„	K XIX	46	49 52 1·03	·18	4·6666023,6
		XVI		67 36 10·84	·19	4·7491345,7
		XVI		63 32 20·68	·22	4·7629968,2
100	„	XIX	46	60 8 37·69	·21	4·7492162,0
		XVIII		56 19 1·63	·21	4·7312439,5
		XIX	46	46 44 0·62	·28	4·7816519,1
101	„	XVIII		89 2 6·52	·28	4·9193553,3
		XXI	47	44 13 52·86	·27	4·7629968,2
		XVIII		70 19 44·74	·27	4·8365013,3
102	„	XXI	47	53 34 49·40	·26	4·7682446,5
		XX		56 5 25·86	·26	4·7816519,1
		XX		56 33 5·72	·28	4·7936629,0
103	„	XXI	47	56 23 35·43	·28	4·7928673,6
		XXII		67 3 18·85	·28	4·8365013,3
		XXI	47	64 7 33·62	·22	4·7823167,8
104	„	XXII		48 25 11·89	·22	4·7021107,5
		XXIII	48	67 27 14·49	·23	4·7936629,0
		XXII		78 20 45·31	·23	4·8386437,5
105	„	XXIII	48	42 18 32·45	·22	4·6757885,3
		XXIV		59 20 42·24	·22	4·7823167,8
		XXIII	48	49 56 19·01	·27	4·7518267,3
106	„	XXIV		60 52 44·07	·27	4·8092727,9
		XXV	49	69 10 56·92	·27	4·8386437,5
		XXV	49	60 50 12·34	·22	4·7563931,5
107	„	XXIV		59 22 58·75	·22	4·7500587,4
		XXVI	50	59 46 48·91	·22	4·7518267,3
		XXIV		55 48 17·39	·20	4·7209171,8
108	„	XXVI	50	60 21 35·95	·21	4·7424391,3
		XXVII		63 50 6·66	·21	4·7563931,5

* These stations appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

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		70 25 36·27	·18	4·7532954,0		y	J XV	56	60 36 22·34	·34	4·8664295,9
109	x	XXVI	50	48 35 4·81	·17	4·6541690,2	123	x	XVI		73 56 43·38	·34	4·9090011,1
	z	XXVIII		60 59 18·92	·18	4·7209171,8		z	XII		45 26 54·28	·33	4·7791358,4
		XXVI	50	64 8 13·67	·28	4·8343349,1			XVI		54 55 43·20	·34	4·8289327,9
110	”	XXVIII		67 33 37·88	·29	4·8459744,3	124	”	XII		61 54 54·40	·35	4·8615395,7
		XXIX	51	48 18 8·45	·28	4·7532954,0			XIV		63 9 22·40	·35	4·8664295,9
		XXVIII		63 52 40·56	·27	4·8204254,8							
111	”	XXIX	51	48 8 16·78	·26	4·7392308,0							
		XXX		67 59 2·66	·27	4·8343349,1							
		XXIX	51	61 5 38·81	·33	4·8498536,7			LXI*		64 34 53·03	·52	5·0061419,8
112	”	XXX		64 0 52·99	·34	4·8613543,7	125	”	LXIV*	57	79 45 19·65	·52	5·0433805,1
		XXXI	52	54 53 28·20	·33	4·8204254,8			J I		35 39 47·32	·51	4·8160424,8
		XXX		53 26 1·00	·33	4·8122582,9			LXIV*	57	44 56 51·15	·94	5·0759474,8
113	”	XXXI	52	65 25 38·85	·33	4·8662242,6	126	”	J I		98 4 13·77	·95	5·2225378,3
		XXXII		61 8 20·15	·33	4·8498536,7			III	58	36 58 55·08	·94	5·0061419,8
		XXXI	52	49 38 44·12	·26	4·7422663,1			I		76 16 29·83	1·82	5·3138675,7
114	”	XXXII		66 48 18·08	·26	4·8236764,6	127	”	III	58	69 33 7·74	1·81	5·2981843,4
		XXXIII	53	63 32 57·80	·26	4·8122582,9			IV		34 10 22·43	1·81	5·0759474,8
		XXXII		55 15 36·72	·27	4·8023670,3			III	58	35 3 27·27	1·47	5·0750492,3
115	”	XXXIII	53	79 3 6·30	·27	4·8796507,7	128	”	IV		49 29 32·50	1·47	5·1968314,2
		XXXIV		45 41 16·98	·27	4·7422663,1			V	59	95 27 0·23	1·47	5·3138675,7
		XXXIII	53	54 14 57·65	·25	4·7564951,5			V	59	66 59 18·64	·69	5·0586698,9
116	”	XXXIV		61 19 52·39	·25	4·7903720,0	129	”	IV		40 6 34·33	·69	4·9037358,4
		XXXV	54	64 25 9·96	·25	4·8023670,3			VI	60	72 54 7·03	·69	5·0750492,3
		XXXIV		63 34 39·58	·18	4·7397917,2			IV		29 56 11·66	·56	4·8001154,3
117	”	XXXV	54	47 53 8·03	·18	4·6579984,0	130	”	VI	60	85 13 41·94	·57	5·1004713,8
		J XXI		68 32 12·39	·19	4·7564951,5			VIII		64 50 6·40	·57	5·0586698,9
		K XXXV	54	57 2 46·69	·30	4·8434494,7			VI	60	82 30 7·30	·33	4·9319811,2
118	”	J XXI		81 34 55·83	·30	4·9149262,2	131	”	VIII		50 27 31·30	·33	4·8228583,4
		XVIII	55	41 22 17·48	·30	4·7397917,2			IX	61	47 2 21·40	·32	4·8001154,3
		XXI		42 54 32·89	·32	4·7690502,3			VIII		69 35 43·09	·40	4·9364520,7
119	”	XVIII	55	83 11 3·11	·32	4·9329265,0	132	”	IX	61	42 19 57·52	·39	4·7928899,1
		XX		53 54 24·00	·32	4·8434494,7			X		68 4 19·39	·39	4·9319811,2
		XX		57 37 33·95	·20	4·7289630,0			IX	61	48 36 5·17	·31	4·8123999,0
120	”	XVIII	55	54 31 3·75	·20	4·7131080,9	133	”	X		44 54 9·01	·31	4·7860094,1
		XVII		67 51 22·30	·21	4·7690502,3			XI	62	86 29 45·82	·32	4·9364520,7
		XVIII	55	60 25 11·47	·23	4·7712018,0			X		61 37 47·48	·22	4·7780237,2
121	”	XVII		67 28 54·38	·23	4·7974074,4	134	”	XI	62	46 7 27·09	·22	4·6914334,2
		XV	56	52 5 54·15	·23	4·7289630,0			XII		72 14 45·43	·22	4·8123999,0
		XVII		47 47 35·42	·28	4·7791358,4			XII		53 53 9·21	·25	4·7643087,1
122	”	XV	56	85 32 42·15	·28	4·9081650,6	135	”	XI	62	69 37 36·48	·26	4·8289265,7
		XVI		46 39 42·43	·28	4·7712018,0			XIV		56 29 14·31	·26	4·7780237,2

* These stations appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	J XI	62	88 2 24·65	·22	4·8695441,1
136	x	XIV		40 17 56·84	·22	4·6805535,4
	z	L II	63	51 39 38·51	·22	4·7643087,1
		J XIV		61 12 49·06	·47	4·9339982,2
137	„	L II	63	69 42 48·96	·47	4·9634749,2
		I		49 4 21·98	·47	4·8695441,1
		II	63	58 10 55·08	·31	4·8668023,1
138	„	I		39 6 28·87	·31	4·7374039,7
		III	64	82 42 36·05	·32	4·9339982,2
		III	64	68 55 46·79	·45	4·9492625,8
139	„	I		60 33 26·88	·45	4·9192588,1
		IV	65	50 30 46·33	·45	4·8668023,1
		I		49 54 14·45	·33	4·8337419,1
140	„	IV	65	43 39 6·75	·33	4·7891215,5
		VI		86 26 38·80	·33	4·9492625,8
		IV	65	58 38 36·86	·31	4·8282076,5
141	„	VI		61 29 7·16	·32	4·8406149,1
		IX	66	59 52 15·98	·32	4·8337419,1
		VI		64 30 41·66	·36	4·8814768,1
142	„	IX	66	62 30 13·59	·36	4·8738906,0
		VIII		52 59 4·75	·36	4·8282076,5
		VIII		78 31 47·64	·38	4·9507697,4
143	„	IX	66	44 48 8·26	·37	4·8075122,3
		X		56 40 4·10	·38	4·8814768,1
		IX	66	48 42 24·12	·31	4·8266868,7
144	„	X		40 11 39·16	·30	4·7606654,4
		XI	67	91 5 56·72	·31	4·9507697,4
		XI	67	82 4 17·17	·45	5·0026927,8
145	„	X		56 35 46·94	·44	4·9284534,5
		XIII	68	41 19 55·89	·44	4·8266868,7
		X		39 27 7·04	·49	4·8255036,3
146	„	XIII	68	67 41 36·88	·49	4·9886554,3
		XII		72 51 16·08	·49	5·0026927,8
		XII		93 50 51·43	·43	5·0369707,2
147	„	XIII	68	48 20 10·23	·43	4·9113050,5
		XIV		37 48 58·34	·43	4·8255036,3
		XIII	68	57 8 31·09	·60	4·9761791,1
148	„	XIV		47 47 27·01	·60	4·9215315,0
		XV	69	75 4 1·90	·60	5·0369707,2
		XIV		53 42 15·26	·72	4·9967898,7
149	„	XV	69	76 3 57·67	·72	5·0774984,8
		XVI		50 13 47·07	·72	4·9761791,1

Triangle Number	Symbolic Error	Station Numbers: Serial	Station Numbers: Traverse	Corrected Plane Angle	Spherical Excess	Logarithm of side-length in Feet
				° ′ ″	″	
	y	L XV	69	43 14 8·58	·49	4·8510725,7
150	x	XVI		63 24 35·17	·50	4·9668305,8
	z	XVIII	70	73 21 16·25	·50	4·9967898,7
		XVIII	70	76 7 45·33	·39	4·9402037,7
151	„	XVI		51 37 8·50	·38	4·8473170,0
		XXI	71	52 15 6·17	·38	4·8510725,7
		XVI		45 1 59·05	·51	4·8785851,4
152	„	XXI	71	80 20 35·06	·52	5·0226515,5
		XX		54 37 25·89	·51	4·9402037,7
		XX		47 57 57·77	·24	4·7507867,0
153	„	XXI	71	46 33 57·28	·24	4·7409809,0
		XXII		85 28 4·95	·25	4·8785851,4
		XXI	71	35 36 38·48	·19	4·6391690,3
154	„	XXII		95 32 45·07	·20	4·8720035,3
		XXV	72	48 50 36·45	·19	4·7507867,0
		XXII		93 15 55·00	·25	4·9370626,2
155	„	XXV	72	56 32 55·97	·25	4·8591197,8
		XXIV		30 11 9·03	·24	4·6391690,3
		XXV	72	75 41 28·84	·38	4·9602895,6
156	„	XXIV		37 35 54·40	·38	4·7593933,4
		XXVII	73	66 42 36·76	·38	4·9370626,2
		XXIV		43 53 25·78	·31	4·8019353,3
157	„	XXVII	73	42 46 31·77	·31	4·7929764,8
		XXVI		93 20 2·45	·31	4·9602895,6
		XXVII	73	62 59 53·94	·24	4·7885094,6
158	„	XXVI		50 13 33·83	·23	4·7243211,3
		XXVIII	74	66 46 32·23	·24	4·8019353,3
		XXVI		46 43 13·78	·27	4·7507580,1
159	„	XXVIII	74	80 42 21·59	·27	4·8828769,3
		XXX		52 34 24·63	·27	4·7885094,6
		XXVIII	74	71 39 36·38	·25	4·8304282,1
160	„	XXX		56 8 36·93	·25	4·7723738,4
		XXXI	75	52 11 46·69	·25	4·7507580,1
		XXX		63 18 4·40	·29	4·8278291,9
161	„	XXXI	75	52 42 19·40	·28	4·7774493,3
		XXXII		63 59 36·20	·29	4·8304282,1
		XXXI	75	58 17 24·29	·24	4·7783562,0
162	„	XXXII		49 16 36·04	·24	4·7281635,9
		XXXIV	76	72 25 59·67	·24	4·8278291,9
		XXXIV	76	53 50 45·51	·21	4·7171653,9
163	„	XXXII		57 46 51·23	·21	4·7374366,7
		XXXVII	77	68 22 23·26	·21	4·7783562,0

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 XXXII		57 3 12·54	·20	4·7280670,7		y	L XL	79	97 5 56·34	·22	4·9014700,9
164	x	XXXVII	77	68 1 26·38	·21	4·7714519,7	169	x	XLII		46 42 16·68	·22	4·7668410,2
	z	XXXV		54 55 21·08	·20	4·7171653,9		z	XLIII	80	36 11 46·98	·21	4·6760723,0
		XXXVII	77	76 55 2·84	·20	4·7961825,0			XLII		60 10 7·58	·25	4·8413141,3
165	,,	XXXV		46 42 37·45	·19	4·6696735,8	170	,,	XLIII	80	34 42 41·60	·25	4·6584994,3
		XXXIX	78	56 22 19·71	·19	4·7280670,7			XLIV		85 7 10·82	·25	4·9014700,9
		XXXV		67 28 24·28	·32	4·8658550,4			XLIII	80	62 39 28·27	·44	4·9323756,3
166	,,	XXXIX	78	60 38 23·92	·32	4·8406186,2	171	,,	XLIV		71 15 58·83	·45	4·9601859,1
		XXXVIII		51 53 11·80	·31	4·7961825,0			CIV*		46 4 32·90	·44	4·8413141,3
		XXXIX	78	56 50 15·70	·30	4·8122540,9			XLIV		59 27 43·72	·63	4·9930753,2
167	,,	XXXVIII		51 53 2·11	·29	4·7853073,9	172	,,	CIV*		72 2 18·75	·64	5·0362252,1
		XL	79	71 16 42·19	·30	4·8658550,4			CVII*		48 29 57·53	·63	4·9323756,3
		XXXVIII		41 22 33·69	·23	4·6760723,0							
168	,,	XL	79	73 52 31·56	·24	4·8384419,8							
		XLII		64 44 54·75	·23	4·8122540,9							

* These stations appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

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 of Section 5 of the preceding chapter—first to the fixed elements of the several stations of origin of the chains G to L, 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 **12** is 5·1179633,3, which occurs in triangle 25, on the same line as the angle for the Serial station G XXVIII, entering between the flank stations **12** and **13**; and the forward azimuth of this side is equal to the back azimuth of **11** at **12** + the sum of the spherical angles at **12**, which occur in triangles 23, 24 and 25, the respective values of which are 188° 16′ 20″·219 and 167° 22′ 24″·27, together amounting to 355° 38′ 44″·489.

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.

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	328 28 18·089	2	23 53 22·262	75 11 35·907	148 32 55·038	27	21 4 56·918	28	22 27 44·263	73 33 28·286	201 2 40·025
2	9 28 15·548	3	23 34 57·824	75 8 15·998	189 26 55·079	28	4 35 8·445	29	22 4 15·108	73 31 27·020	184 34 22·495
3	334 42 19·399	4	23 16 30·111	75 17 42·527	154 46 4·658	29	14 55 14·295	30	21 45 35·857	73 26 7·758	194 53 15·134
4	315 1 47·738	5	23 6 46·319	75 28 12·667	135 5 55·916	30	20 46 55·214	31	21 21 56·711	73 16 32·875	200 43 23·930
5	37 24 53·886	6	22 48 48·349	75 13 23·679	217 19 7·055	31	24 16 24·070	32	21 0 33·932	73 6 16·930	204 12 41·452
6	50 46 12·815	7	22 34 50·074	74 54 59·383	230 39 6·712	32	319 22 45·932	33	20 38 53·478	73 26 0·979	139 29 46·956
7	1 56 59·212	8	21 59 22·935	74 53 41·732	181 56 29·765	33	328 21 56·506	34	20 7 5·650	73 46 44·509	148 29 9·630
8	351 49 37·335	9	21 35 33·227	74 57 21·293	171 50 58·842	34	2 58 10·240	35	19 36 1·364	73 45 2·456	182 57 35·571
9	336 47 55·332	10	21 18 49·036	75 5 0·578	156 50 43·311	35	3 58 32·471	XXX*	18 56 45·459	73 42 10·369	183 57 35·669
10	346 49 5·091	11	20 44 27·297	75 13 33·887	166 52 9·275	XXX*	262 5 17·039	XXVI*			
11	8 17 39·055	12	20 20 13·492	75 9 49·184	188 16 20·219						
12	355 38 44·489	13	19 58 36·634	75 11 33·638	175 39 20·483	25	107 54 35·921	36	23 5 32·735	73 30 12·748	287 49 42·680
13	353 1 52·783	14	19 30 34·471	75 15 10·483	173 3 6·035	36	66 52 0·840	37	23 0 50·439	73 18 20·000	246 47 21·738
14	44 35 12·565	XXIV*	19 10 39·886	74 54 32·408	224 28 22·470	37	85 39 1·138	38	23 0 15·755	73 10 10·387	265 35 49·759
XXIV*	303 32 11·550	XXIII*				38	86 52 47·249	39	22 59 49·764	73 1 39·873	266 49 27·769
						39	86 23 43·179	XVI	22 59 17·708	72 52 34·708	266 20 10·230
5	94 4 40·016	15	23 7 47·483	75 12 33·187	273 58 31·101	XVI	91 4 26·190	XVIII			
15	89 54 41·561	16	23 7 41·948	74 42 8·998	269 42 45·008						
16	64 0 48·058	17	23 1 52·746	74 29 16·096	243 55 45·070	40	310 48 12·885	41	24 9 59·829	72 51 24·659	130 55 59·723
17	66 45 51·650	18	22 55 20·430	74 12 51·704	246 39 27·383	41	19 59 26·633	42	23 57 10·302	72 46 20·064	199 57 22·453
18	79 0 54·933	XIII	22 52 15·603	73 55 49·156	258 54 17·089	42	352 24 39·053	43	23 34 35·047	72 49 35·976	172 25 58·002
XIII	16 47 34·449	XVII				43	12 37 33·892	44	23 25 11·169	72 47 19·098	192 36 39·316
						44	17 4 55·536	45	23 15 52·274	72 44 13·207	197 3 41·882
19	16 59 15·638	20	24 12 18·115	73 45 40·776	196 56 34·879	45	335 21 20·582	46	23 7 19·947	72 48 27·316	155 23 0·659
20	0 41 11·539	21	23 49 35·991	73 45 23·032	180 41 4·317	46	334 35 13·169	XVI	22 59 17·859	72 52 34·695	154 36 50·047
21	297 22 49·297	22	23 41 25·793	74 2 28·878	117 29 42·595	XVI	91 4 29·147	XVIII			
22	23 17 44·905	23	23 29 21·886	73 56 50·958	203 15 29·673						
23	5 56 13·843	24	23 15 8·929	73 55 14·953	185 55 35·759	46	81 27 51·969	47	23 5 17·118	72 33 47·570	261 22 6·739
24	41 7 3·529	25	23 1 49·417	73 42 41·351	221 2 7·361	47	119 41 59·079	48	23 9 24·178	72 25 58·749	299 38 54·974
25	308 7 32·231	XIII	22 52 15·671	73 55 49·563	128 12 39·586	48	99 21 1·644	49	23 11 7·540	72 14 37·013	279 16 33·396
XIII	16 47 27·336	XVII				49	49 17 43·146	50	23 5 3·910	72 7 0·344	229 14 43·722
						50	102 6 27·942	51	23 7 29·218	71 54 45·557	282 1 39·603
25	7 10 36·331	26	22 53 22·093	73 41 32·401	187 10 9·434	51	79 33 44·513	52	23 5 18·248	71 42 0·052	259 28 44·096
26	9 54 7·384	27	22 42 3·795	73 39 24·778	189 53 17·938	52	69 26 36·186	53	23 1 26·021	71 30 52·114	249 22 14·599

* These stations appertain to the Bombay Longitudinal Series of the Southern Trigon.

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
	° ′ ″		° ′ ″	° ′ ″	° ′ ″		° ′ ″		° ′ ″	° ′ ″	° ′ ″
53	86 13 17·129	54	23 0 45·341	71 19 52·904	266 8 59·362	65	55 43 6·691	66	23 21 37·613	70 1 27·482	235 39 2·537
54	75 30 4·772	55	22 57 20·756	71 5 41·206	255 24 32·203	66	91 32 5·847	67	23 21 52·570	69 51 9·120	271 28 0·637
55	134 54 9·063	56	23 4 39·276	70 57 45·394	314 51 3·021	67	84 38 15·287	68	23 20 33·305	69 36 2·949	264 32 16·076
56	153 6 2·511	XII	23 16 35·770	70 51 11·850	333 3 27·622	68	119 2 32·126	69	23 27 14·267	69 22 59·162	298 57 20·868
XII	80 25 16·982	XIV				69	133 19 30·828	70	23 37 43·664	69 10 54·318	313 14 41·317
						70	102 43 43·787	71	23 40 16·780	68 58 35·989	282 38 47·606
57	39 9 39·858	58	24 20 10·659	70 48 11·058	219 1 46·866	71	137 25 5·926	72	23 49 19·841	68 49 33·238	317 21 27·363
58	0 37 21·176	59	23 54 11·902	70 47 52·634	180 37 13·647	72	138 26 29·443	73	23 56 25·721	68 42 42·285	318 23 43·071
59	343 3 34·677	60	23 41 32·462	70 52 3·821	163 5 16·034	73	130 52 46·471	74	24 2 9·262	68 35 29·923	310 49 50·695
60	43 43 13·894	61	23 33 36·001	70 43 49·741	223 39 55·882	74	169 58 21·655	75	24 11 46·896	68 33 38·567	349 57 36·156
61	1 38 20·992	62	23 23 30·883	70 43 30·979	181 38 13·518	75	153 9 7·306	76	24 19 39·543	68 29 17·421	333 7 19·998
62	314 15 26·968	XII	23 16 35·909	70 51 11·778	134 18 29·488	76	99 24 5·628	77	24 21 7·646	68 19 34·528	279 20 5·389
XII	80 25 20·028	XIV				77	132 38 58·489	78	24 26 21·243	68 13 22·491	312 36 24·824
						78	126 27 24·964	79	24 32 20·075	68 4 31·126	306 23 44·703
62	111 55 28·578	63	23 26 27·987	70 35 33·524	291 52 18·831	79	188 38 55·553	80	24 41 52·623	68 6 6·457	8 39 35·266
63	111 25 42·381	64	23 29 45·468	70 26 27·191	291 22 4·806	80	142 13 33·016	CIV*	24 53 46·752	67 55 59·395	322 9 18·410
64	83 0 28·416	65	23 28 4·614	70 11 41·897	262 54 35·661	CIV*	80 16 11·140	CVII*			

* These stations appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

10.

Numerical Values of the Absolute Terms in the Primary Equations of Condition.

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 at the junctions with the Bombay Longitudinal Series of the S. Trigon and 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. 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.

The Absolute Terms will now be particularized.

Circuit I. Equations 1 to 4.

Equation 1, *Linear*. Between the sides Bálágara–Búda and Ágargaon–Chincholi.

Log. computed length Ágargaon–Chincholi by Triangle No. 30	5·2222417,1
Log. final value from Bombay Longitudinal Series, see page 51, ...	5·2222227,3
$_1E = + 189{\cdot}8$ Logarithmic Error +	0·0000189,8

Equations 2 to 4, *Geodetic*. Terminal Station, Ágargaon. Terminal Side, Ágargaon–Chincholi.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	19 10 39·886	74 54 32·408	303 32 11·550
Final values from Bombay Longitudinal Series,—see page 51,	19 10 40·523	74 54 32·979	303 32 19·356
Errors	$_2E = -0{\cdot}637$	$_3E = -0{\cdot}571$	$_4E = -7{\cdot}806$

Circuit II. Equations 5 to 8.

Equation 5, *Linear*. Junction, Patángri–Bhor.

Log. computed length by right-hand chain, Triangle No. 55	4·9055434,3
" left-hand " No. 40	4·9055646,8
$_5E = - 212{\cdot}5$ Logarithmic Error −	0·0000212,5

Equations 6 to 8, *Geodetic*. Terminal Station, Patángri. Terminal Side, Patángri–Bhor.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	22 52 15·671	73 55 49·563	16 47 27·336
Left-hand	22 52 15·603	73 55 49·156	16 47 34·449
Errors	$_6E = +0{\cdot}068$	$_7E = +0{\cdot}407$	$_8E = -7{\cdot}113$

Circuit III. Equations 9 to 12.

Equation 9, *Linear.* Between the sides Lakarwás–Tána and Singi–Párner.

Log. computed length Singi–Párner by Triangle No. 75	5·4143966,9
Log. final value from Bombay Longitudinal Series, see page 51, ...	5·4143939,5
$_{9}E = +27{\cdot}4$ Logarithmic Error +	0·0000027,4

Equations 10 to 12, *Geodetic.* Terminal Station, Singi. Terminal Side, Singi–Párner.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	18 56 45·459	73 42 10·369	262 5 17·039
Final values from Bombay Longitudinal Series,—see page 51,	18 56 45·894	73 42 10·304	262 5 23·758
Errors	$_{10}E = -0{\cdot}435$	$_{11}E = +0{\cdot}065$	$_{12}E = -6{\cdot}719$

Circuit IV. Equations 13 to 16.

Equation 13, *Linear.* Junction, Mirzápur–Wastrál.

Log. computed length by right-hand chain, Triangle No. 100	4·7492162,0
„ left-hand „ No. 86	4·7492347,9
$_{13}E = -185{\cdot}9$ Logarithmic Error −	0·0000185,9

Equations 14 to 16, *Geodetic.* Terminal Station, Mirzápur. Terminal Side, Mirzápur–Wastrál.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	22 59 17·859	72 52 34·695	91 4 29·147
Left-hand	22 59 17·708	72 52 34·708	91 4 26·190
Errors	$_{14}E = +0{\cdot}151$	$_{15}E = -0{\cdot}013$	$_{16}E = +2{\cdot}957$

Circuit V. Equations 17 to 20.

Equation 17, *Linear.* Junction, Monába–Wándia.

Log. computed length by right-hand chain, Triangle No. 135	. . . .	4·8289265,7
„ left-hand „ No. 124	. . . .	4·8289327,9
$_{17}E = -62 \cdot 2$	Logarithmic Error −	0·0000062,2

Equations 18 to 20, *Geodetic.* Terminal Station, Monába. Terminal Side, Monába–Wándia.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	23 16 35·909	70 51 11·778	80 25 20·028
Left-hand	23 16 35·770	70 51 11·850	80 25 16·982
Errors	$_{18}E = +0 \cdot 139$	$_{19}E = -0 \cdot 072$	$_{20}E = +3 \cdot 046$

Circuit VI. Equations 21 to 24.

Equation 21, *Linear.* Between the sides Bhilgaon–Akoria and Károthol–Sáhiji.

Log. computed length Károthol–Sáhiji by Triangle No. 172	. . . .	4·9930753,2
Log. final value from Karáchi Longitudinal Series, see page 51	. . . . .	4·9930496,1
$_{21}E = +257 \cdot 1$	Logarithmic Error +	0·0000257,1

Equations 22 to 24, *Geodetic.* Terminal Station, Károthol. Terminal Side, Károthol–Sáhiji.

Branch of Circuit.	*Latitude.*	*Longitude.*	*Azimuth.*
	° ′ ″	° ′ ″	° ′ ″
Right-hand	24 53 46·752	67 55 59·395	80 16 11·140
Final values from Karáchi Longitudinal Series,—see page 51,	24 53 46·692	67 55 59·651	80 16 15·052
Errors	$_{22}E = +0 \cdot 060$	$_{23}E = -0 \cdot 256$	$_{24}E = -3 \cdot 912$

11.

Numerical Values of the μs and ϕs.

The table of substitutions at page 36 shews 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 at the closing of the chain.*

On reference to the equation on page 35 it will be observed that the μs are factors of the tab. log. differences of sine, α, β or γ. In the side equations it has been found convenient to multiply α, β and γ by 10^7, or in other words to treat the 7th place of decimals as unity. It is convenient to do the same in the geodetic equations and to divide the μs by 10^7, because the latter are large integral quantities containing more significant figures than are required: after division the last two places of decimals can be omitted. In the following tables $\mu \times \frac{1}{10^7}$ is accordingly given.

No. of Station in Traverse	Latitude		Longitude		Azimuth	
	${}_\lambda\mu \times \frac{1}{10^7}$	${}_\lambda\phi$	${}_L\mu \times \frac{1}{10^7}$	${}_L\phi$	${}_A\mu \times \frac{1}{10^7}$	${}_A\phi$
			CIRCUIT *I.* Direct.			
1	− ·00414	+ ·0016	− ·00008	− ·0937	− ·00002	+ 0·9651
2	391	47	23	882	09	·9674
3	365	39	19	824	07	·9697
4	340	65	32	765	12	·9721
5	326	93	46	734	18	·9733
6	301	54	26	677	09	·9755
7	282	04	01	634	+ 01	·9772
8	233	− 01	+ 01	522	01	·9815
9	200	+ 09	− 04	447	− 01	·9842
10	177	29	15	395	05	·9862
11	130	53	26	288	09	·9900
12	096	43	21	213	07	·9927
13	066	46	24	146	08	·9950
14	028	58	29	060	10	·9980
			CIRCUIT *II.* Right-hand Branch.			
19	− ·00137	− ·0012	+ ·00005	− ·0315	+ ·00002	+ 0·9873
20	110	31	14	253	6	·9899
21	079	31	15	181	6	·9928

* The values of the tabular log. differences of the first terms of $\Delta\lambda$, ΔL and ΔA, in the expressions for them, on pages 19 and 20, were employed for t.d. log. $\Delta\lambda$, t.d. log. ΔL and t.d. log. ΔA.

No. of Station in Traverse	Latitude		Longitude		Azimuth	
	$_\lambda\mu \times \frac{1}{10^7}$	$_\lambda\phi$	$_L\mu \times \frac{1}{10^7}$	$_L\phi$	$_A\mu \times \frac{1}{10^7}$	$_A\phi$
	CIRCUIT *II*. Right-hand Branch—(*Continued*).					
22	− ·00068	+ ·0016	− ·00009	− ·0157	− ·00004	+ 0·9937
23	51	01	01	119	1	·9953
24	31	− 03	+ 01	074	0	·9971
25	13	36	18	031	+ 7	·9988
	CIRCUIT *II*. Left-hand Branch.					
1	− ·00108	+ ·0172	− ·00089	− ·0250	− ·00034	+ 0·9900
2	084	203	104	196	41	·9922
3	059	195	100	137	39	·9946
4	034	220	113	078	44	·9969
5	020	249	128	047	50	·9981
15	021	207	106	047	41	·9981
16	021	124	064	047	25	·9981
17	013	090	046	030	18	·9988
18	004	046	024	009	09	·9996
	CIRCUIT *III*. Direct.					
19	− ·00463	+ ·0027	− ·00014	− ·1049	− ·00006	+ 0·9609
20	436	08	05	·0987	03	·9634
21	404	08	05	·0915	03	·9664
22	393	55	28	·0891	12	·9673
23	376	40	20	·0853	09	·9688
24	357	36	18	·0808	08	·9706
25	338	03	01	·0765	01	·9724
26	327	− 01	+ 01	·0738	01	·9734
27	311	07	04	·0703	+ 01	·9748
28	292	23	12	·0658	04	·9765
29	259	26	15	·0584	05	·9794
30	233	41	22	·0526	08	·9816
31	201	67	35	·0451	13	·9843
32	171	97	50	·0385	18	·9867
33	141	43	22	·0320	08	·9890
34	097	+ 10	− 06	·0216	− 02	·9927
35	054	05	04	·0121	01	·9960

No. of Station in Traverse	Latitude		Longitude		Azimuth	
	$_{\lambda}\mu \times \frac{1}{10^7}$	$_{\lambda}\phi$	$_{L}\mu \times \frac{1}{10^7}$	$_{L}\phi$	$_{A}\mu \times \frac{1}{10^7}$	$_{A}\phi$
CIRCUIT *IV*. Right-hand Branch.						
40	− ·00118	− ·0050	+ ·00028	− ·0271	+ ·00012	+ 0·9890
41	098	00	02	223	01	·9910
42	080	14	09	183	04	·9926
43	049	07	04	112	02	·9956
44	036	14	07	082	03	·9967
45	023	22	12	053	05	·9979
46	011	11	06	025	02	·9990
CIRCUIT *IV*. Left-hand Branch.						
19	− ·00128	+ ·0159	− ·00082	− ·0293	− ·00032	+ 0·9882
20	101	140	73	230	29	0·9908
21	069	140	73	158	29	0·9937
22	058	187	96	135	38	0·9946
23	041	172	89	096	35	0·9962
24	022	168	86	051	34	0·9980
25	003	135	69	008	27	0·9997
36	009	102	52	020	20	0·9992
37	002	069	36	007	14	0·9997
38	001	047	24	004	10	0·9999
39	001	024	13	001	05	1·0000
CIRCUIT *V*. Right-hand Branch.						
57	− ·00117	+ ·0047	− ·00022	− ·0267	− ·00010	+ 0·9891
58	087	− 06	+ 04	201	+ 02	·9919
59	052	10	05	118	02	·9953
60	034	+ 02	− 01	078	− 01	·9969
61	023	− 20	+ 10	053	+ 04	·9979
62	010	21	11	021	04	·9992
CIRCUIT *V*. Left-hand Branch.						
40	− ·00094	+ ·0277	− ·00140	− ·0217	− ·00054	+ 0·9911
41	73	327	166	170	65	0·9931
42	56	313	159	130	62	0·9947
43	25	319	163	058	64	0·9977
44	12	313	160	029	63	0·9988
45	+ 02	305	156	+ 001	61	1·0000
46	13	316	162	028	64	1·0011
47	16	276	142	034	56	1·0013

No. of Station in Traverse	Latitude		Longitude		Azimuth	
	$_\lambda\mu \times \frac{1}{10^7}$	$_\lambda\phi$	$_L\mu \times \frac{1}{10^7}$	$_L\phi$	$_A\mu \times \frac{1}{10^7}$	$_A\phi$
	CIRCUIT *V*. Left-hand Branch—(*Continued*).					
48	+ ·00010	+ ·0255	− ·00131	+ ·0023	− ·00052	+ 1·0009
49	08	225	115	18	45	1·0007
50	16	205	105	38	41	1·0015
51	13	172	088	29	35	1·0011
52	16	138	070	36	28	1·0014
53	21	108	055	49	22	1·0019
54	22	078	040	50	16	1·0020
55	27	040	020	60	08	1·0023
56	17	018	009	37	04	1·0015
	CIRCUIT *VI*. Direct.					
57	+ ·00017	+ ·0514	− ·00264	+ ·0038	− ·00107	+ 1·0015
58	047	461	238	103	096	1·0043
59	083	458	237	186	095	1·0077
60	100	470	243	226	098	1·0093
61	111	448	232	251	093	1·0103
62	125	446	231	283	093	1·0116
63	121	425	220	274	088	1·0112
64	116	400	208	265	083	1·0109
65	119	360	187	269	075	1·0110
66	127	333	173	289	070	1·0118
67	127	305	159	288	064	1·0118
68	129	265	138	294	056	1·0120
69	120	230	120	274	049	1·0112
70	105	198	103	241	042	1·0099
71	102	165	086	234	035	1·0096
72	089	141	074	205	030	1·0085
73	079	123	064	183	027	1·0076
74	071	104	054	165	023	1·0069
75	058	100	052	135	022	1·0056
76	047	088	046	110	019	1·0046
77	045	062	032	104	014	1·0044
78	038	045	024	087	010	1·0036
79	030	022	012	068	005	1·0028
80	016	026	014	038	006	1·0016

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 each 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 46-48, 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 46.

Examples.

(1). To find the values of $\mathfrak{b}_6$ and $\mathfrak{c}_6$ in equation 1 of Circuit *I*.

This is a linear equation, and the forms of the coefficients are normal,

$$_1\mathfrak{b}_6 = +\text{ t. d. log sin } 46^\circ\ 17'\ 19'' = +\ 20;$$

$$_1\mathfrak{c}_6 = -\text{ t. d. log sin } 81\ \ 57\ \ 36\ = -\ \ 3.$$

(2). To find the values of $\mathfrak{b}_{17}$ and $\mathfrak{c}_{17}$ in equation 2 of Circuit *I*.

The equation is latitudinal, and the forms of the coefficients are normal,

$$\begin{aligned} _2\mathfrak{b}_{17} &= +\left\{({}_\lambda\mu_9 - {}_\lambda\mu_8)\,a_{17} + {}_\lambda\mu_9\,\beta_{17} + {}_\lambda\phi_8\right\} \\ &= +\ {\cdot}00033 \times 24 - {\cdot}00200 \times 17 - {\cdot}0001 \\ &= +\ {\cdot}0079 - {\cdot}0340 - {\cdot}0001 \\ &= -\ {\cdot}0262; \end{aligned}$$

$$\begin{aligned} _2\mathfrak{c}_{17} &= +\left\{({}_\lambda\mu_9 - {}_\lambda\mu_8)\,a_{17} - {}_\lambda\mu_8\,\gamma_{17} + {}_\lambda\phi_9\right\} \\ &= +\ {\cdot}00033 \times 24 + {\cdot}00233 \times 1 + {\cdot}0009 \\ &= +\ {\cdot}0079 + {\cdot}0023 + {\cdot}0009 \\ &= +\ {\cdot}0111. \end{aligned}$$

(3). To find the values of $\mathfrak{b}_{29}$ and $\mathfrak{c}_{29}$ in equation 4 of Circuit *I*.

The equation is azimuthal, and the forms of the coefficients are exceptional, see page 46,

$$\begin{aligned} _4\mathfrak{b}_{29} &= -\ {}_A\mu_{14}\,a_{29} + {}_A\phi_{14} \\ &= +\ {\cdot}00010 \times 17 + {\cdot}9980 \\ &= +\ {\cdot}0017 + {\cdot}9980 \\ &= +\ {\cdot}9997; \end{aligned}$$

$$\begin{aligned} _4\mathfrak{c}_{29} &= 1 - {}_A\mu_{14}\,(a_{29} + \gamma_{29}) \\ &= 1 + {\cdot}00010 \times (17 + 21) \\ &= 1 + {\cdot}0038 \\ &= 1{\cdot}0038. \end{aligned}$$

No. of Circuit Triangle	Coefficients of *y* and *z*	
	b	c
1st Equation. Linear.		
Direct		
1	+ 4	− 38
2	25	0
3	10	20
4	6	19
5	5	16
6	20	3
7	11	0
8	18	4
9	3	15
10	14	26
11	13	14
12	9	22
13	9	10
14	10	20
15	11	4
16	2	12
17	17	1
18	5	9
19	12	7
20	5	23
21	26	+ 4
22	12	− 11
23	12	13
24	12	16
25	23	3
26	− 6	34
27	+ 17	5
28	17	15

No. of Circuit Triangle	Coefficients of *y* and *z*	
	b	c
1st Equation—(Continued).		
29	+ 3	− 21
30	18	2
2nd Equation. Latitude.		
Direct		
1	−0·0123	+ 0·1637
2	·1025	− ·0047
3	·0438	+ ·0735
4	·0139	·0815
5	·0222	·0545
6	·0597	·0219
7	·0439	− ·0065
8	·0501	+ ·0250
9	·0191	·0396
10	·0549	·0755
11	·0275	·0533
12	·0325	·0608
13	·0164	·0341
14	·0185	·0607
15	·0255	·0094
16	·0046	·0281
17	·0262	·0111
18	·0016	·0273
19	·0241	·0095
20	+ ·0017	·0513
21	− ·0391	− ·0105
22	·0209	+ ·0090
23	·0026	·0248
24	·0158	·0111
25	·0064	·0120

No. of Circuit Triangle	Coefficients of *y* and *z*	
	b	c
2nd Equation—(Continued).		
26	−0·0006	+ 0·0178
27	+ ·0057	·0150
28	− ·0106	− ·0016
29	+ ·0106	+ ·0106
3rd Equation. Longitude.		
Direct		
1	−0·0957	− 0·0863
2	+ ·0824	+ ·0882
3	·0859	·0928
4	− ·0886	− ·0773
5	+ ·0814	+ ·0854
6	− ·0910	− ·0781
7	+ ·0730	+ ·0765
8	− ·0871	− ·0744
9	+ ·0720	+ ·0803
10	·0670	·0854
11	− ·0750	− ·0595
12	+ ·0654	+ ·0734
13	− ·0630	− ·0560
14	·0631	·0518
15	+ ·0523	+ ·0522
16	·0522	·0521
17	− ·0541	− ·0459
18	·0486	·0422
19	+ ·0377	+ ·0406
20	− ·0421	− ·0266
21	+ ·0220	+ ·0278
22	·0257	·0317
23	− ·0307	− ·0173

No. of Circuit Triangle	Coefficients of *y* and *z*	
	b	c
3rd Equation—(Continued).		
24	+0·0188	+ 0·0247
25	− ·0271	− ·0143
26	+ ·0160	+ ·0228
27	− ·0203	− ·0056
28	+ ·0011	+ ·0104
29	− ·0011	·0110
4th Equation. Azimuth.		
Direct		
1	+0·9642	+ 0·9677
2	− ·9697	− ·9674
3	·9683	·9656
4	+ ·9673	+ ·9717
5	− ·9701	− ·9686
6	+ ·9664	+ ·9714
7	− ·9734	− ·9721
8	+ ·9680	+ ·9729
9	− ·9738	− ·9706
10	·9758	·9686
11	+ ·9728	+ ·9787
12	− ·9763	− ·9735
13	+ ·9775	+ ·9800
14	·9774	·9814
15	− ·9814	− ·9815
16	·9815	·9816
17	+ ·9808	+ ·9837
18	·9828	·9852
19	− ·9868	− ·9858
20	+ ·9853	+ ·9908
21	− ·9923	− ·9904

No. of Circuit Triangle	Coefficients of y and z	
	b	c
4th Equation—(Continued).		
22	−0·9911	−0·9890
23	+ ·9894	+ ·9941
24	− ·9935	− ·9916
25	+ ·9907	+ ·9950
26	− ·9945	− ·9923
27	+ ·9930	+ ·9981
28	− ·9997	− ·9965
29	+ ·9997	+ 1·0038
30	−1·0000	− 1·0000
5th Equation. Linear.		
Right-hand Branch		
41	+ 15	− 17
42	11	9
43	8	11
44	18	8
45	20	6
46	17	7
47	6	19
48	5	13
49	10	8
50	12	7
51	17	12
52	5	21
53	17	1
54	12	1
55	− 17	34
Left-hand Branch		
1	− 4	+ 38
2	25	0
5th Equation—(Continued).		
3	− 10	+ 20
4	6	19
5	5	16
6	20	3
7	11	0
8	18	4
9	3	15
10	14	26
11	+ 9	23
31	− 14	3
32	4	17
33	24	14
34	21	0
35	15	11
36	+ 1	35
37	− 10	7
38	14	4
39	6	13
40	27	4
6th Equation. Latitude.		
Right-hand Branch		
41	−0·0194	+ 0·0245
42	·0087	·0138
43	·0057	·0152
44	·0136	·0094
45	·0154	·0076
46	·0132	·0032
47	·0057	·0113
48	+ ·0026	·0125
6th Equation—(Continued).		
49	−0·0052	+ 0·0040
50	·0000	·0069
51	·0050	·0040
52	+ ·0013	·0052
53	·0014	·0037
Left-hand Branch		
1	−0·0155	− 0·0630
2	+ ·0413	+ ·0203
3	·0287	·0035
4	− ·0201	− ·0388
5	+ ·0225	+ ·0101
6	− ·0171	− ·0282
7	+ ·0257	+ ·0220
8	− ·0205	− ·0284
9	+ ·0255	+ ·0219
10	·0277	·0197
11	− ·0267	− ·0046
31	·0217	·0210
32	+ ·0215	+ ·0171
33	− ·0157	− ·0153
34	+ ·0168	+ ·0124
35	− ·0112	− ·0121
36	+ ·0089	+ ·0044
37	− ·0106	− ·0075
38	+ ·0052	+ ·0044
39	− ·0054	− ·0013
7th Equation. Longitude.		
Right-hand Branch		
41	+0·0323	+ 0·0306
7th Equation—(Continued).		
42	−0·0285	− 0·0243
43	+ ·0264	+ ·0238
44	− ·0226	− ·0192
45	·0228	·0195
46	+ ·0142	+ ·0163
47	·0152	·0174
48	− ·0141	− ·0090
49	+ ·0118	+ ·0120
50	− ·0114	− ·0069
51	+ ·0076	+ ·0073
52	− ·0043	− ·0011
53	+ ·0062	+ ·0029
Left-hand Branch		
1	+0·0303	− 0·0131
2	·0064	·0196
3	− ·0092	·0404
4	+ ·0249	·0068
5	− ·0087	·0297
6	+ ·0385	+ ·0070
7	·0046	− ·0078
8	·0331	+ ·0025
9	− ·0009	− ·0239
10	+ ·0132	·0380
11	− ·0068	·0294
31	+ ·0140	·0046
32	− ·0005	·0227
33	+ ·0188	·0114
34	·0087	·0047
35	·0098	·0058

7th Equation—(Continued).

No. of Circuit Triangle	Coefficients of *y* and *z*	
	b	c
36	−0·0035	−0·0191
37	+ ·0003	·0074
38	·0025	·0019
39	− ·0037	·0077

8th Equation. Azimuth.

Right-hand Branch

No. of Circuit Triangle	b	c
41	−0·9870	−0·9876
42	+ ·9887	+ ·9904
43	− ·9894	− ·9906
44	+ ·9910	+ ·9923
45	·9908	·9921
46	− ·9944	− ·9934
47	·9939	·9929
48	+ ·9942	+ ·9964
49	− ·9954	− ·9952
50	+ ·9955	+ ·9974
51	− ·9971	− ·9971
52	+ ·9984	+ ·9997
53	− ·9976	− ·9989
54	+1·0000	+ 1·0000
55	−1·0000	0·0000

Left-hand Branch

No. of Circuit Triangle	b	c
1	−0·9879	− 1·0046
2	+1·0025	+ 0·9922
3	0·9963	·9840
4	− ·9902	− 1·0027
5	+ ·9966	+ 0·9884
6	− ·9849	− ·9972
7	+1·0017	+ ·9969

8th Equation—(Continued).

No. of Circuit Triangle	Coefficients of *y* and *z*	
	b	c
8	−0·9870	− 0·9990
9	+ ·9996	+ ·9906
10	1·0051	·9851
11	−1·0026	− ·0115
31	0·9947	1·0019
32	+ ·9997	+ 0·9911
33	− ·9926	− 1·0043
34	+1·0034	+ 0·9981
35	−0·9961	− 1·0023
36	+ ·9986	+ 0·9925
37	− ·9999	− 1·0029
38	+1·0009	+ 0·9992
39	−1·0013	− 1·0029
40	+1·0000	+ 1·0000

9th Equation. Linear.

Direct

No. of Circuit Triangle	b	c
41	+ 15	− 17
42	11	9
43	8	11
44	18	8
45	20	6
46	17	7
47	6	19
48	5	13
49	10	8
50	12	7
51	17	12
52	5	21
53	17	1

9th Equation—(Continued).

No. of Circuit Triangle	Coefficients of *y* and *z*	
	b	c
54	+ 12	− 1
55	5	17
56	21	+ 1
57	− 2	− 23
58	+ 14	9
59	12	4
60	14	29
61	3	11
62	3	20
63	7	7
64	13	0
65	2	20
66	11	10
67	2	12
68	14	5
69	10	8
70	9	19
71	12	15
72	− 3	20
73	+ 32	+ 1
74	3	− 24
75	9	5

10th Equation. Latitude.

Direct

No. of Circuit Triangle	b	c
41	−0·0722	+ 0·0760
42	·0407	·0471
43	·0357	·0472
44	·0682	·0394
45	·0765	·0310

10th Equation—(Continued).

No. of Circuit Triangle	Coefficients of *y* and *z*	
	b	c
46	−0·0723	+ 0·0220
47	·0291	·0692
48	·0097	·0587
49	·0416	·0261
50	·0352	·0335
51	·0643	·0392
52	·0110	·0776
53	·0578	·0031
54	·0351	·0071
55	·0163	·0557
56	·0617	− ·0003
57	+ ·0069	+ ·0722
58	− ·0388	·0285
59	·0327	·0140
60	·0386	·0821
61	·0052	·0311
62	·0052	·0544
63	·0121	·0208
64	·0262	·0041
65	·0022	·0458
66	·0154	·0268
67	·0020	·0225
68	·0237	·0100
69	·0098	·0156
70	·0086	·0322
71	·0126	·0136
72	+ ·0159	·0332
73	− ·0178	− ·0010
74	+ ·0070	+ ·0194

No. of Circuit Triangle	Coefficients of *y* and *z* b	c
11th Equation. Longitude.		
Direct		
41	+0·1028	+ 0·1073
42	− ·1040	− ·0959
43	+ ·0983	+ ·0993
44	− ·0996	− ·0911
45	·1000	·0917
46	+ ·0843	+ ·0911
47	·0874	·0944
48	− ·0884	− ·0800
49	+ ·0833	+ ·0869
50	− ·0871	− ·0790
51	+ ·0777	+ ·0830
52	− ·0787	− ·0705
53	+ ·0763	+ ·0765
54	− ·0758	− ·0732
55	+ ·0739	+ ·0736
56	− ·0723	− ·0696
57	+ ·0702	+ ·0694
58	− ·0675	− ·0651
59	+ ·0672	+ ·0653
60	− ·0637	− ·0619
61	+ ·0589	+ ·0567
62	·0589	·0554
63	− ·0551	− ·0519
64	+ ·0555	+ ·0526
65	− ·0496	− ·0472
66	+ ·0490	+ ·0416
67	− ·0403	− ·0389
68	·0405	·0396
***11th Equation*—(Continued).**		
69	+0·0342	+ 0·0302
70	− ·0354	− ·0287
71	+ ·0209	+ ·0225
72	− ·0209	− ·0103
73	+ ·0108	+ ·0121
74	− ·0116	·0014
12th Equation. Azimuth.		
Direct		
41	−0·9618	− 0·9599
42	+ ·9613	+ ·9646
43	− ·9636	− ·9631
44	+ ·9629	+ ·9666
45	·9628	·9663
46	− ·9693	− ·9665
47	.9680	·9650
48	+ ·9674	+ ·9710
49	− ·9697	− ·9681
50	+ ·9680	+ ·9714
51	− ·9720	− ·9696
52	+ ·9714	+ ·9750
53	− ·9726	− ·9724
54	+ ·9726	+ ·9737
55	− ·9735	− ·9732
56	+ ·9738	+ ·9750
57	− ·9748	− ·9750
58	+ ·9758	+ ·9768
59	− ·9760	− ·9767
60	+ ·9772	+ ·9782
61	− ·9792	− ·9800
***12th Equation*—(Continued).**		
62	−0·9792	− 0·9804
63	+ ·9808	+ ·9820
64	− ·9806	− ·9816
65	+ ·9828	+ ·9836
66	− ·9829	− ·9856
67	+ ·9861	+ ·9865
68	·9859	·9862
69	− ·9882	− ·9896
70	+ ·9878	+ ·9902
71	− ·9929	− ·9924
72	+ ·9930	+ ·9967
73	− ·9963	− ·9960
74	+ ·9961	+ 1·0004
75	−1·0000	− 1·0000
13th Equation. Linear.		
Right-hand Branch		
87	+ 26	− 5
88	17	14
89	4	20
90	20	+ 1
91	12	− 25
92	15	5
93	16	5
94	13	5
95	7	13
96	12	7
97	10	8
98	18	7
99	11	9
***13th Equation*—(Continued).**		
100	− 12	− 26
Left-hand Branch		
41	− 15	+ 17
42	11	9
43	8	11
44	18	8
45	20	6
46	17	7
47	6	19
48	5	13
49	10	8
50	12	7
51	17	12
52	5	21
53	17	1
54	+ 32	33
76	4	35
77	− 16	11
78	23	3
79	25	3
80	13	16
81	11	16
82	10	13
83	16	14
84	17	12
85	13	15
86	6	18

No. of Circuit Triangle	Coefficients of y and z	
	b	c
14th Equation. Latitude.		
Right-hand Branch		
87	−0·0284	+ 0·0080
88	·0167	·0137
89	·0039	·0196
90	·0117	·0019
91	·0061	·0205
92	·0067	·0032
93	·0071	·0032
94	·0027	·0038
95	·0011	·0061
96	·0015	·0030
97	·0010	·0030
98	·0009	·0019
99	·0001	·0021
Left-hand Branch		
41	+0·0351	− 0·0059
42	− ·0094	·0301
43	+ ·0221	+ ·0029
44	− ·0053	− ·0258
45	·0037	·0241
46	+ ·0286	+ ·0146
47	·0222	·0077
48	− ·0202	− ·0283
49	+ ·0213	+ ·0139
50	− ·0182	− ·0233
51	+ ·0205	+ ·0142
52	− ·0189	− ·0204
53	+ ·0140	+ ·0135
54	− ·0145	− ·0010
***14th Equation*—(Continued).**		
76	−0·0129	− 0·0103
77	+ ·0116	+ ·0092
78	− ·0108	− ·0083
79	+ ·0074	+ ·0068
80	− ·0069	− ·0051
81	+ ·0048	+ ·0045
82	− ·0047	− ·0026
83	+ ·0026	+ ·0023
84	− ·0025	− ·0002
15th Equation. Longitude.		
Right-hand Branch		
87	−0·0292	− 0·0263
88	+ ·0226	+ ·0220
89	·0224	·0219
90	− ·0188	− ·0166
91	·0180	·0137
92	+ ·0118	+ ·0110
93	·0118	·0110
94	− ·0097	− ·0078
95	+ ·0087	+ ·0073
96	− ·0060	− ·0050
97	·0058	·0046
98	+ ·0036	+ ·0021
99	·0032	·0020
Left-hand Branch		
41	−0·0170	− 0·0432
42	+ ·0358	+ ·0141
43	− ·0172	− ·0310
44	+ ·0361	+ ·0100
***15th Equation*—(Continued).**		
45	+0·0379	+ 0·0120
46	·0028	− ·0202
47	− ·0077	·0317
48	+ ·0163	·0046
49	− ·0067	·0167
50	+ ·0195	·0015
51	·0095	·0154
52	·0064	·0195
53	·0109	·0015
54	− ·0213	·0228
76	·0045	·0254
77	+ ·0063	·0077
78	·0079	·0033
79	·0083	·0018
80	·0029	·0063
81	·0022	·0042
82	·0001	·0046
83	·0020	·0019
84	− ·0009	·0026
16th Equation. Azimuth.		
Right-hand Branch		
87	+0·9882	+ 0·9893
88	− ·9908	− ·9911
89	·9910	·9912
90	+ ·9925	+ ·9933
91	·9927	·9945
92	− ·9953	− ·9957
93	·9953	·9957
94	+ ·9962	+ ·9968
***16th Equation*—(Continued).**		
95	−0·9965	− 0·9971
96	+ ·9977	+ ·9981
97	·9977	·9982
98	− ·9986	− ·9991
99	·9988	·9992
100	1·0000	·0000
Left-hand Branch		
41	+0·9930	+ 0·9828
42	− ·9857	− ·9944
43	+ ·9931	+ ·9876
44	− ·9856	− ·9960
45	·9849	·9951
46	+1·0011	+ ·9919
47	0·9969	·9874
48	− ·9934	− 1·0017
49	+ ·9997	+ 0·9934
50	− ·9923	− 1·0007
51	+1·0038	+ 0·9939
52	−0·9975	− 1·0077
53	+1·0043	+ 0·9994
54	−1·0083	− ·0089
76	1·0018	1·0100
77	+1·0024	+ 0·9970
78	−0·9971	− 1·0014
79	+1·0032	+ 0·9993
80	−0·9987	− 1·0024
81	+1·0010	+ 0·9983
82	−1·0001	− 1·0020
83	+1·0008	+ 0·9993

No. of Circuit Triangle	Coefficients of y and z	
	b	c
16th Equation—(Continued).		
84	−1·0004	−1·0010
85	+1·0000	+1·0000
86	1·0000	1·0000
17th Equation. Linear.		
Right-hand Branch		
125	+ 10	− 29
126	21	28
127	5	31
128	30	+ 2
129	9	− 6
130	37	10
131	3	20
132	7	8
133	18	1
134	12	6
135	− 8	22
Left-hand Branch		
87	− 26	+ 5
88	17	14
89	4	20
90	20	− 1
91	12	+ 25
92	15	5
93	16	5
94	13	5
95	7	13
96	12	7
97	10	8
98	18	7

No. of Circuit Triangle	Coefficients of y and z	
	b	c
17th Equation—(Continued).		
99	− 11	+ 9
100	11	14
101	19	22
102	7	14
103	13	9
104	10	9
105	5	12
106	18	8
107	12	12
108	15	10
109	8	12
110	10	19
111	10	9
112	11	15
113	16	12
114	18	10
115	15	20
116	15	10
117	10	8
118	13	24
119	22	15
120	13	9
121	12	17
122	19	20
123	12	20
124	15	10
18th Equation. Latitude.		
Right-hand Branch		
125	−0·0164	+0·0292

No. of Circuit Triangle	Coefficients of y and z	
	b	c
18th Equation—(Continued).		
126	−0·0145	+0·0313
127	·0038	·0276
128	·0097	·0038
129	+ ·0002	·0076
130	− ·0128	·0032
131	+ ·0014	·0067
132	·0004	·0038
133	− ·0009	·0010
134	+ ·0009	·0027
Left-hand Branch		
87	−0·0108	−0·0395
88	+ ·0451	+ ·0225
89	·0356	·0181
90	− ·0258	− ·0349
91	·0295	·0471
92	+ ·0357	+ ·0306
93	·0359	·0306
94	− ·0330	− ·0353
95	+ ·0321	+ ·0297
96	− ·0342	− ·0340
97	·0341	·0337
98	+ ·0293	+ ·0325
99	·0302	·0328
100	·0302	·0334
101	− ·0346	− ·0247
102	+ ·0265	+ ·0298
103	·0255	·0290
104	− ·0275	− ·0230
105	+ ·0250	+ ·0267

No. of Circuit Triangle	Coefficients of y and z	
	b	c
18th Equation—(Continued).		
106	−0·0267	−0·0215
107	·0254	·0205
108	+ ·0181	+ ·0221
109	·0192	·0224
110	− ·0215	− ·0139
111	+ ·0159	+ ·0184
112	− ·0193	− ·0121
113	+ ·0112	+ ·0157
114	− ·0181	− ·0097
115	+ ·0076	+ ·0150
116	− ·0142	− ·0058
117	+ ·0056	+ ·0096
118	− ·0115	·0011
119	·0019	·0081
120	+ ·0005	·0064
121	− ·0052	·0036
122	·0014	·0052
123	·0008	·0044
19th Equation. Longitude.		
Right-hand Branch		
125	+0·0245	+0·0331
126	− ·0267	− ·0147
127	+ ·0203	+ ·0189
128	− ·0186	− ·0117
129	·0134	·0096
130	+ ·0074	+ ·0079
131	− ·0056	− ·0032
132	+ ·0060	+ ·0045
133	− ·0033	− ·0022

No. of Circuit Triangle	Coefficients of y and z	
	b	c
19th Equation—(Continued).		
134	+0·0034	+ 0·0014
Left-hand Branch		
87	+0·0675	+ 0·0126
88	·0112	− ·0402
89	− ·0104	·0502
90	+ ·0471	+ ·0130
91	·0328	− ·0338
92	·0187	·0140
93	·0203	·0140
94	·0260	·0059
95	·0083	·0237
96	·0208	·0121
97	·0172	·0142
98	·0320	·0085
99	·0206	·0118
100	·0206	·0199
101	·0242	·0390
102	·0133	·0165
103	·0219	·0094
104	·0076	·0172
105	·0089	·0134
106	·0165	·0142
107	·0095	·0189
108	·0196	·0067
109	·0122	·0088
110	·0035	·0244
111	·0117	·0050
112	·0030	·0186
113	·0148	·0048

No. of Circuit Triangle	Coefficients of y and z	
	b	c
19th Equation—(Continued).		
114	+0·0049	− 0·0133
115	·0132	·0061
116	− ·0006	·0122
117	+ ·0090	+ ·0018
118	− ·0030	− ·0162
119	+ ·0104	+ ·0030
120	·0086	·0042
121	− ·0058	− ·0080
122	+ ·0054	+ ·0019
123	− ·0042	− ·0023
20th Equation. Azimuth.		
Right-hand Branch		
125	−0·9901	− 0·9862
126	+ ·9892	+ ·9944
127	− ·9918	− ·9925
128	+ ·9925	+ ·9953
129	·9947	·9963
130	− ·9973	− ·9968
131	+ ·9979	+ ·9990
132	− ·9976	− ·9982
133	+ ·9986	+ ·9992
134	− ·9987	− ·9994
135	1·0000	·0000
Left-hand Branch		
87	−0·9731	− 0·9947
88	+1·0042	+ ·9840
89	0·9957	·9801
90	− ·9814	− ·9947
91	·9869	1·0131

No. of Circuit Triangle	Coefficients of y and z	
	b	c
20th Equation—(Continued).		
92	+1·0073	+ 0·9945
93	1·0079	·9945
94	−0·9897	− 1·0022
95	+1·0032	+ 0·9906
96	−0·9919	− 1·0048
97	·9932	1·0056
98	+1·0126	+ 0·9966
99	1·0081	·9953
100	1·0081	·9921
101	−0·9905	− 1·0154
102	+1·0052	+ 0·9935
103	1·0086	·9963
104	−0·9969	− 1·0067
105	+1·0035	+ 0·9947
106	−0·9935	− 1·0056
107	·9963	1·0074
108	+1·0077	+ 0·9974
109	1·0048	·9966
110	−0·9986	− 1·0095
111	+1·0046	+ 0·9979
112	−0·9987	− 1·0074
113	+1·0059	+ 0·9980
114	−0·9979	− 1·0052
115	+1·0052	+ 0·9975
116	−1·0002	− 1·0049
117	+1·0036	+ 1·0007
118	−1·0012	− 1·0063
119	+1·0041	+ 1·0011
120	1·0033	1·0016

No. of Circuit Triangle	Coefficients of y and z	
	b	c
20th Equation—(Continued).		
121	−1·0021	− 1·0032
122	+1·0023	+ 1·0007
123	−1·0017	− 1·0010
124	+1·0000	+ 1·0000
21st Equation. Linear.		
Direct		
125	+ 10	− 29
126	21	28
127	5	31
128	30	+ 2
129	9	− 6
130	37	10
131	3	20
132	7	8
133	18	1
134	12	6
135	15	14
136	1	17
137	12	18
138	13	2
139	8	17
140	18	1
141	13	12
142	10	16
143	4	13
144	19	0
145	3	24
146	25	6
147	− 2	27

21st Equation—(Continued).

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
148	+ 14	− 6
149	15	18
150	22	7
151	5	16
152	21	15
153	19	1
154	29	19
155	− 2	36
156	+ 6	10
157	22	+ 1
158	10	− 9
159	20	16
160	7	17
161	10	11
162	13	7
163	16	9
164	13	15
165	5	14
166	8	16
167	14	7
168	24	10
169	− 2	29
170	+ 12	2
171	11	20
172	13	18

22nd Equation. Latitude.

Direct

No. of Circuit Triangle	b	c
125	−0·0497	− 0·0563
126	+ ·0604	+ ·0404

22nd Equation—(Continued).

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
127	−0·0437	− 0·0607
128	+ ·0775	+ ·0532
129	·0591	·0463
130	− ·0100	− ·0570
131	+ ·0522	+ ·0267
132	− ·0370	− ·0537
133	+ ·0702	+ ·0464
134	− ·0296	− ·0521
135	·0258	·0621
136	+ ·0448	+ ·0202
137	− ·0280	− ·0643
138	+ ·0563	+ ·0363
139	·0497	·0165
140	− ·0146	− ·0372
141	+ ·0535	+ ·0200
142	− ·0206	− ·0536
143	·0282	·0498
144	+ ·0574	+ ·0305
145	·0347	− ·0037
146	·0058	·0342
147	− ·0291	·0613
148	+ ·0416	+ ·0136
149	− ·0050	− ·0446
150	+ ·0444	+ ·0097
151	·0243	− ·0009
152	·0049	·0318
152	·0029	·0175
154	·0426	·0050
155	− ·0159	·0461

22nd Equation—(Continued).

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
156	+0·0161	+ 0·0007
157	·0051	− ·0115
158	·0180	+ ·0019
159	·0038	− ·0218
160	·0127	·0039
161	− ·0042	·0164
162	+ ·0141	+ ·0027
163	·0157	·0017
164	− ·0003	− ·0130
165	+ ·0067	·0032
166	− ·0015	·0106
167	+ ·0074	·0018
168	·0050	·0052
169	− ·0007	·0087
170	·0007	·0029
171	+ ·0015	·0043

23rd Equation. Longitude.

Direct

No. of Circuit Triangle	b	c
125	−0·0302	+ 0·0728
126	·0470	·0834
127	·0222	·0635
128	·0608	·0138
129	·0048	·0353
130	·1125	·0017
131	+ ·0175	·0756
132	− ·0413	− ·0065
133	·0165	+ ·0306
134	·0560	− ·0144
135	·0630	+ ·0040

23rd Equation—(Continued).

No. of Circuit Triangle	Coefficients of *y* and *z*: b	c
136	+0·0289	+ 0·0695
137	− ·0538	·0122
138	+ ·0038	·0343
139	·0139	·0647
140	− ·0606	− ·0250
141	+ ·0059	+ ·0528
142	− ·0462	− ·0012
143	·0358	·0064
144	+ ·0022	+ ·0323
145	·0276	·0705
146	− ·0639	− ·0211
147	·0266	+ ·0079
148	+ ·0160	·0391
149	− ·0454	− ·0058
150	+ ·0066	+ ·0344
151	·0225	·0426
152	− ·0415	− ·0105
153	·0397	·0225
154	+ ·0016	+ ·0365
155	− ·0190	·0061
156	+ ·0191	·0281
157	− ·0324	− ·0189
158	+ ·0146	+ ·0240
159	− ·0273	− ·0079
160	+ ·0133	+ ·0231
161	− ·0187	− ·0078
162	+ ·0086	+ ·0157
163	·0076	·0162
164	− ·0146	− ·0065

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
23rd Equation—(Continued).			*24th Equation*—(Continued).			*24th Equation*—(Continued).			*24th Equation*—(Continued).		
165	+0·0110	+ 0·0150	131	+1·0074	+ 1·0308	146	−1·0260	− 1·0086	161	−1·0078	− 1·0032
166	− ·0106	— ·0049	132	−1·0168	− 1·0029	147	1·0109	0·9969	162	+1·0036	+ 1·0066
167	+ ·0089	+ ·0104	133	+0·9936	+ 1·0125	148	+1·0064	+ 1·0159	163	1·0032	1·0069
168	− ·0097	− ·0056	134	−1·0228	− 1·0060	149	−1·0186	− 1·0024	164	−1·0062	− 1·0023
169	+ ·0067	+ ·0069	135	1·0256	0·9986	150	+1·0028	+ 1·0141	165	+1·0047	+ 1·0064
170	− ·0055	− ·0035	136	+1·0117	+ 1·0280	151	1·0092	1·0174	166	−1·0044	− 1·0020
171	+ ·0048	+ ·0038	137	−1·0218	− 0·9954	152	−1·0170	− 1·0043	167	+1·0037	+ 1·0043
24th Equation.		*Azimuth.*	138	+1·0017	+ 1·0140	153	1·0163	1·0092	168	−1·0040	− 1·0023
Direct			139	1·0059	1·0261	154	+1·0008	+ 1·0151	169	+1·0027	+ 1·0029
125	−1·0122	− 0·9705	140	−1·0245	− 1·0102	155	−1·0079	− 0·9977	170	−1·0023	− 1·0015
126	+0·9810	+ 1·0340	141	+1·0026	+ 1·0215	156	+1·0080	+ 1·0117	171	+1·0020	+ 1·0016
127	−1·0091	− 0·9745	142	−1·0188	− 1·0006	157	−1·0135	− 1·0079	172	−1·0000	− 1·0000
128	+0·9758	+ 1·0058	143	1·0146	1·0027	158	+1·0060	+ 1·0100			
129	·9984	1·0145	144	+1·0011	+ 1·0133	159	−1·0115	− 1·0032			
130	−1·0456	− 0·9995	145	1·0112	1·0285	160	+1·0055	+ 1·0096			

13.

The Weights of the Angles.

The last Section has furnished us with the coefficients of the unknown quantities, 344 in number, which enter the 24 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 page 38—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. 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 13, that the trigonometrical figures which are ordinarily 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 South-West Quadrilateral have been collected into 8 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, n for the number of geometrical equations of condition presented by the figure and $\frac{1}{w} = u$, we have

$$e_1^2 = \frac{[u]}{t} = u_o; \qquad e_3^2 = \left[\frac{x^2}{u}\right]\frac{u_o}{n} \text{ or } \frac{[wx^2]}{n} \times u_o;$$

$$e_2^2 = \frac{\text{sum of squares of triangular errors}}{\text{number of triangles} \times 3}.$$

Then, when we accept e_3 as the most probable value of the *e. m. s.*, we have

$$\rho'^2 = \begin{cases} \dfrac{n}{[wx^2]} & \text{for a single polygonal figure,} \\[2ex] \dfrac{[n]}{[[wx^2]]} & \text{for a group of figures.} \end{cases}$$

The value of the quantity $[wx^2]$ 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 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.

Data for the Calculation of ρ'.

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 Reciprocal Weights $[u]$	Number of Triangles	Sum of Squares of Triangular Errors	Number of Geometrical Equations n	Average of Preliminary Reciprocal Weights u_o	$[wx^2]$	$[wx^2] \times u_o$	
I	G Fig. 1	H	8	13·54	3	31·12	4	1·69	5·94	10·04	± 1·58
	„ 2	„	15	23·70	5	4·14	7	1·58	4·42	6·98	1·00
	„ 3	„	27	36·62	9	51·01	13	1·36	17·89	24·33	1·37
	„ 4	„	18	22·68	6	46·01	8	1·26	14·24	17·94	1·50
	„ 5	„	8	15·06	3	6·82	4	1·88	9·01	16·94	2·06
	„ 6	„	8	11·81	3	0·19	4	1·48	0·24	0·36	0·30
	„ 7	„	20	26·51	7	60·70	10	1·33	16·64	22·13	1·49
	Totals		104	149·92	36	199·99	50			98·72	
II	G Fig. 8	H	27	45·33	9	34·58	13	1·68	7·53	12·65	± 0·99
III	G Fig. 9	H	8	17·93	3	16·90	4	2·24	7·28	16·31	± 2·02
	H „ 14	„	53	140·20	18	166·25	29	2·65	46·71	123·78	2·07
	Totals		61	158·13	21	183·15	33			140·09	

***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 Reciprocal Weights $[u]$	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 Reciprocal Weights u_0	Data for e_3: $[wx^2]$	Data for e_3: $[wx^2] \times u_0$	Approximate Single Values of e_3
	H										
IV	Triangles 41—53	H	39	29·94	13	30·23					
	Fig. 10	„	19	19·48	6	11·58	9	1·03	5·01	5·16	± 0·76
	„ 11	„	8	6·54	3	0·97	4	0·82	0·36	0·30	·27
	„ 12	„	11	9·62	3	0·71	5	0·87	1·84	1·60	·57
	Triangles 62—63	„	6	5·01	2	0·48					
	Fig. 13	„	8	8·95	3	4·41	4	1·12	0·83	0·93	·48
	Triangles 65—67	„	9	9·64	3	4·54					
	K										
	Triangles 31—33	„	9	7·56	3	1·99					
	Fig. 26	„	14	9·80	4	7·61	6	0·70	4·97	3·48	·76
	Triangles 37—40	„	12	7·94	4	5·40					
		Totals	135	114·48	44	67·92	28			11·47	
V	I Fig. 15	H	18	16·09	6	6·50	8	0·89	10·90	9·70	± 1·10
	„ 16	H & P	18	20·36	6	9·03	8	1·13	7·63	8·62	1·04
	„ 17	„	18	19·87	6	4·71	8	1·10	3·00	3·30	0·64
	Tri. 99	P	3	1·85	1	1·44					
		Totals	57	58·17	19	21·68	24			21·62	
VI	J Fig. 18	H	14	11·17	5	8·28	8	0·80	4·02	3·22	± 0·63
	„ 19	„	8	5·91	3	6·19	4	·74	6·60	4·88	1·10
	„ 20	H & P	15	14·58	5	3·80	7	·97	1·44	1·40	0·45
	„ 21	„	8	5·58	3	14·80	4	·70	5·16	3·61	0·95
	„ 22	„	18	11·24	6	43·50	8	·62	30·01	18·61	1·53
	„ 23	„	32	16·97	11	29·26	16	·53	31·59	16·74	1·02
		Totals	95	65·45	33	105·83	47			48·46	

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 Reciprocal Weights $[u]$	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 Reciprocal Weights u_0	Data for e_3: $[wx^2]$	Data for e_3: $[wx^2]\times u_0$	Approximate Single Values of e_3
VII	K Triangles 78—85	H & P	24	18·49	8	4·30					
	Fig. 27	„	15	13·40	5	11·80	7	0·89	7·59	6·76	± 0·98
	Triangles 103—118	„	48	39·44	16	57·39					
	Totals		87	71·33	29	73·49	7			6·76	
VIII	L Fig. 28	H	8	7·77	3	13·07	4	0·97	4·33	4·20	± 1·02
	„ 29	„	15	12·42	5	16·15	9	·83	24·89	20·66	1·52
	„ 30	„	15	11·92	5	8·94	7	·79	10·25	8·10	1·08
	„ 31	„	8	7·18	3	19·35	4	·90	7·69	6·92	1·32
	„ 32	„	8	6·63	3	3·87	4	·83	1·16	0·96	0·49
	„ 33	„	8	5·77	3	4·66	4	·72	1·90	1·37	0·59
	„ 34	„	23	18·25	8	36·01	11	·79	13·54	10·70	0·99
	„ 35	H & P	15	9·59	5	47·05	7	·64	35·26	22·57	1·80
	„ 36	„	8	6·38	3	3·08	4	·80	7·51	6·01	1·23
	„ 37	P	15	11·32	5	6·35	7	·75	8·85	6·64	0·97
	„ 38	H & P	30	21·03	10	17·46	14	·70	14·24	9·97	0·84
	„ 39	„	15	11·83	5	11·08	7	·79	6·52	5·15	0·86
	„ 40	„	15	13·13	5	6·03	7	·88	2·16	1·99	0·53
	Totals		183	143·22	63	193·10	89			105·24	

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
					° ′							
G	I	H	104	Dollond's 15-inch	10 0	2	24	± 1·20	± 1·36	± 1·40	1·4	0·7
G	II	„	21	„ „	15 0	3	24	1·30	1·13	0·99	1·0	1·0
			6	Barrow's 24-inch	7 12	2	20					
G	III	„	6	Dollond's 15-inch	15 0	3	24					
H			52		20 0	3	18	1·61	1·71	2·06	2·1	0·6
H			3		10 0	2	24					
H K	IV	„	135	Troughton and Simms' 18-inch No. 2	10 0	2	24	0·92	0·72	0·63	0·62	2·2
I	V	H,P	57	„ „ „	10 0	2	24	1·01	0·62	0·96	0·96	1·1
J	VI	„	95	„ „ „	10 0	2	24	0·83	1·03	1·08	1·1	0·6
K	VII	„	87	„ „ „	10 0	2	24	0·91	0·92	0·94	0·92	1·0
L	VIII	„	183	„ „ „	10 0	2	24	0·88	1·01	1·10	1·1	0·6

A few details of the preceding table require to be explained:—

Group I comprises 7 figures of which the angles were measured with the same instrument and under the same circumstances: therefore ρ' is taken $= \frac{e_1}{e_3}$.

Group II comprises 1 polygon of which the angles were measured partly by one instrument and partly by another. Prior to the reduction of the figure the weights of the angles were made absolute by the application of factors; $\frac{e_1}{e_3}$ should therefore be sensibly $=1$ and may be assumed $=1$.

Group III comprises a quadrilateral at the southern extremity of the Khánpisura Series and a large compound figure at the south extremity of the Singi Series. The same instrument was used but the measures were not made on the same number of zeros. It was thought advisable to combine the two figures to form one group as the quadrilateral could not stand alone and ρ' was taken $= \frac{e_1}{e_3}$.

Group IV embraces 25 single triangles and 5 figures including 22 triangles. The data therefore for determining e_2 are considerably in excess of those for e_3, but as there are sufficient data for a fair determination of e_3, ρ' is taken $= \frac{e_1}{e_3}$.

Group V includes 3 polygonal figures and 1 triangle. There is no apparent reason for departing from the rule, therefore ρ' is taken $= \frac{e_1}{e_3}$.

Group VI embraces 6 polygonal figures of which the angles were measured under the same circumstances, except that there were two observers. Here $\rho' = \frac{e_1}{e_3}$.

Group VII comprises 24 triangles and only 1 polygonal figure. In this case ρ' is taken $= \frac{e_1}{e_2}$.

Group VIII is entirely composed of polygonal figures, and $\rho' = \frac{e_1}{e_3}$.

The Weights employed in the Simultaneous Reduction of the South-West Quadrilateral.

On dividing the several Preliminary Reciprocal Weights of the angles in each group by the corresponding value of the Factor ρ'^2, as now set forth, we acquire the best values of the Final or Absolute Reciprocal 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 reciprocal weights to be employed would have been the absolute reciprocal 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 reciprocal 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 reciprocal weight of all the angles appertaining to any single triangle, polygonal figure, or net-work, by the factor $(t - n) \div t$—in which t is the number of observed angles and n the number of geometrical conditions for the figure—see Section 5 of Chapter XV, Volume II. 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 u_o for the average value of the Preliminary Reciprocal Weights of the Observed Angles of a single triangle, or those of a polygonal figure, as formerly; also

u_c for the average value of the Absolute Reciprocal Weights of the Corrected Angles of the same triangle or figure, we have

$$u_c = \frac{u_o}{\rho'^2} \times \frac{t-n}{t}.$$

It will be evident that u_c corresponds to the u of the formulæ for the normal equations from which the values of the Indeterminate Factors are determined for the Simultaneous Reduction; see Section 11 of Chapter II.

The following table gives the average values of u_c for the angles of every circuit triangle and also the corresponding value of $\frac{u_c}{3}$ employed in the calculations. The subscripts to the ρ's denote the group to which each appertains.

The Absolute Reciprocal Weights of the Figurally Corrected Angles with the data for their determination.

All Angles in Triangles	Figure	u_o	ρ'^2	$\frac{t-n}{t}$	$u_c = u_o \cdot \frac{t-n}{\rho'^2 t}$	$\frac{u_c}{3}$	All Angles in Triangles	Figure	u_o	ρ'^2	$\frac{t-n}{t}$	$u_c = u_o \cdot \frac{t-n}{\rho'^2 t}$	$\frac{u_c}{3}$
1,2	1	1·69	ρ'^2_1, 0·7	4 ÷ 8, 0·5	1·21	0·4	43		0·75	ρ'^2_4, 2·2	2 ÷ 3, 0·7	0·24	0·1
3—5	2	1·58	"	8 15, 0·5	1·13	0·4	44		0·64	"	2 3, 0·7	0·20	0·1
6—11	3	1·36	"	14 27, 0·5	0·97	0·3	45		0·95	"	2 3, 0·7	0·30	0·1
12—15	4	1·26	"	10 18, 0·6	1·08	0·4	46		0·81	"	2 3, 0·7	0·26	0·1
16,17	5	1·88	"	4 8, 0·5	1·34	0·5	47		0·83	"	2 3, 0·7	0·26	0·1
18,19	6	1·48	"	4 8, 0·5	1·06	0·4	48		0·63	"	2 3, 0·7	0·20	0·1
20—23	7	1·33	"	10 20, 0·5	0·95	0·3	49		0·74	"	2 3, 0·7	0·24	0·1
24—28	8	1·68	ρ'^2_2, 1·0	14 27, 0·5	0·84	0·3	50		0·76	"	2 3, 0·7	0·24	0·1
29,30	9	2·24	ρ'^2_3, 0·6	4 8, 0·5	1·87	0·6	51		0·72	"	2 3, 0·7	0·23	0·1
31		0·89	ρ'^2_4, 2·2	2 3, 0·7	0·28	0·1	52		1·00	"	2 3, 0·7	0·32	0·1
32		0·94	"	2 3, 0·7	0·30	0·1	53		0·88	"	2 3, 0·7	0·28	0·1
33		0·69	"	2 3, 0·7	0·22	0·1	54—56	10	1·03	"	10 19, 0·5	0·23	0·1
34—36	26	0·70	"	8 14, 0·6	0·19	0·1	57,58	11	0·82	"	4 8, 0·5	0·19	0·1
37		0·76	"	2 3, 0·7	0·24	0·1	59—61	12	0·87	"	6 11, 0·5	0·20	0·1
38		0·66	"	2 3, 0·7	0·21	0·1	62		0·87	"	2 3, 0·7	0·28	0·1
39		0·49	"	2 3, 0·7	0·16	0·1	63		0·80	"	2 3, 0·7	0·25	0·1
40		0·73	"	2 3, 0·7	0·23	0·1	64	13	1·12	"	4 8, 0·5	0·25	0·1
41		0·63	"	2 3, 0·7	0·20	0·1	65		1·15	"	2 3, 0·7	0·37	0·1
42		0·66	"	2 3, 0·7	0·21	0·1	66		1·24	"	2 3, 0·7	0·39	0·1

The Absolute Reciprocal Weights of the Figurally Corrected Angles with the data for their determination—(Continued).

All Angles in Triangles	Figure	u_o	ρ'^2	$\frac{t-n}{t}$	$u_c = u_o.\frac{t-n}{\rho'^2 t}$	$\frac{u_c}{3}$	All Angles in Triangles	Figure	u_o	ρ'^2	$\frac{t-n}{t}$	$u_c = u_o.\frac{t-n}{\rho'^2 t}$	$\frac{u_c}{3}$
67		0·82	ρ'^2_4, 2·2	2 ÷ 3,0·7	0·26	0·1	113		0·85	ρ'^2_7, 1·0	2 + 3,0·7	0·60	0·2
68—75	14	2·65	ρ'^2_3, 0·6	24 53,0·5	2·21	0·7	114		0·83	„	2 3,0·7	0·58	0·2
76,77	10	1·03	ρ'^2_4, 2·2	10 19,0·5	0·23	0·1	115		0·93	„	2 3,0·7	0·65	0·2
78		1·06	ρ'^2_7, 1·0	2 3,0·7	0·74	0·3	116		0·68	„	2 3,0·7	0·48	0·2
79		0·89	„	2 3,0·7	0·62	0·2	117		0·97	„	2 3,0·7	0·68	0·2
80		0·92	„	2 3,0·7	0·64	0·2	118		1·01	„	2 3,0·7	0·71	0·2
81		0·63	„	2 3,0·7	0·44	0·2	119—122	23	0·53	ρ'^2_6, 0·6	16 32,0·5	0·44	0·2
82		0·57	„	2 3,0·7	0·40	0·1	123,124	22	0·62	„	10 18,0·6	0·62	0·2
83		0·73	„	2 3,0·7	0·51	0·2	125,126	18	0·80	„	6 14,0·4	0·53	0·2
84		0·62	„	2 3,0·7	0·43	0·1	127,128	19	0·74	„	4 8,0·5	0·62	0·2
85		0·73	„	2 3,0·7	0·51	0·2	129—131	20	0·97	„	8 15,0·5	0·81	0·3
86	27	0·89	„	8 15,0·5	0·45	0·2	132,133	21	0·70	„	4 8,0·5	0·58	0·2
87—90	15	0·89	ρ'^2_5, 1·1	10 18,0·6	0·49	0·2	134,135	22	0·62	„	10 18,0·6	0·62	0·2
91—94	16	1·13	„	10 18,0·6	0·62	0·2	136,137	28	0·97	ρ'^2_8, 0·6	4 8,0·5	0·81	0·3
95—98	17	1·10	„	10 18,0·6	0·60	0·2	138,139	29	0·83	„	6 15,0·4	0·55	0·2
99		0·62	„	2 3,0·7	0·39	0·1	140—142	30	0·79	„	8 15,0·5	0·66	0·2
100—102	27	0·89	ρ'^2_7, 1·0	8 15,0·5	0·45	0·2	143,144	31	0·90	„	4 8,0·5	0·75	0·3
103		0·59	„	2 3,0·7	0·41	0·1	145,146	32	0·83	„	4 8,0·5	0·69	0·2
104		0·63	„	2 3,0·7	0·44	0·2	147,148	33	0·72	„	4 8,0·5	0·60	0·2
105		0·62	„	2 3,0·7	0·43	0·1	149—152	34	0·79	„	12 23,0·5	0·66	0·2
106		0·67	„	2 3,0·7	0·47	0·2	153—155	35	0·64	„	8 15,0·5	0·53	0·2
107		0·90	„	2 3,0·7	0·63	0·2	156,157	36	0·80	„	4 8,0·5	0·67	0·2
108		0·70	„	2 3,0·7	0·49	0·2	158—160	37	0·75	„	8 15,0·5	0·63	0·2
109		0·68	„	2 3,0·7	0·48	0·2	161—166	38	0·70	„	16 30,0·5	0·58	0·2
110		1·14	„	2 3,0·7	0·80	0·3	167—169	39	0·79	„	8 15,0·5	0·66	0·2
111		0·85	„	2 3,0·7	0·60	0·2	170—172	40	0·88	„	8 15,0·5	0·73	0·2
112		1·09	„	2 3,0·7	0·76	0·3							

14.

The Coefficients of the Indeterminate Factors in the Values of the Unknown Quantities.

On reference to page 17 it will be seen that the general expression for the error x_p of any angle X_p appertaining to a trigonometrical figure, is

$$x_p = u_p\,(a_p\,\lambda_a + b_p\,\lambda_b + \ldots + n_p\,\lambda_n);$$

so that the coefficients of $\lambda_a, \lambda_b, \ldots \lambda_n$, 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 South-West Quadrilateral, the coefficients of the indeterminate factors take a more complex form, which is given on page 38. The expressions are

$$y_p = {}_1\mathfrak{B}_p\,{}_1\Lambda + {}_2\mathfrak{B}_p\,{}_2\Lambda + \ldots + {}_n\mathfrak{B}_p\,{}_n\Lambda;$$
$$z_p = {}_1\mathfrak{C}_p\,{}_1\Lambda + {}_2\mathfrak{C}_p\,{}_2\Lambda + \ldots + {}_n\mathfrak{C}_p\,{}_n\Lambda;$$

where

$${}_1\mathfrak{B}_p = \frac{u_p}{3}\,(2\,{}_1\mathfrak{b}_p - {}_1\mathfrak{c}_p); \qquad {}_2\mathfrak{B}_p = \frac{u_p}{3}\,(2\,{}_2\mathfrak{b}_p - {}_2\mathfrak{c}_p); \quad \&c.;$$

$${}_1\mathfrak{C}_p = \frac{u_p}{3}\,(2\,{}_1\mathfrak{c}_p - {}_1\mathfrak{b}_p); \qquad {}_2\mathfrak{C}_p = \frac{u_p}{3}\,(2\,{}_2\mathfrak{c}_p - {}_2\mathfrak{b}_p); \quad \&c.;$$

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.

The coefficients $\mathfrak{b}_p$ and $\mathfrak{c}_p$ of y_p and z_p, in each equation into which these unknown quantities enter, 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 86 and 87. From these data $\mathfrak{B}_p$ and $\mathfrak{C}_p$ were obtained and entered in the following table.

Examples.

$${}_9\mathfrak{B}_{63} = \frac{u_{63}}{3}\,(2 \times {}_9\mathfrak{b}_{63} - {}_9\mathfrak{c}_{63})$$
$$= \cdot 1\,(2 \times 7 + 7) = + 2\cdot 1;$$

$${}_{11}\mathfrak{C}_{73} = \frac{u_{73}}{3}\,(2 \times {}_{11}\mathfrak{c}_{73} - {}_{11}\mathfrak{b}_{73})$$
$$= \cdot 7\,(2 \times \cdot 0121 - \cdot 0108) = + \cdot 0094.$$

1st Equation. Linear.

Direct

No. of Circuit Triangle	𝔅	ℭ
1	+ 18·4	− 32·0
2	20·0	10·0
3	16·0	20·0
4	12·4	17·6
5	10·4	14·8
6	12·9	7·8
7	6·6	3·3
8	12·0	7·8
9	6·3	9·9
10	16·2	19·8
11	12·0	12·3
12	16·0	21·2
13	11·2	11·6
14	16·0	20·0
15	10·4	7·6
16	8·0	13·0
17	17·5	9·5
18	7·6	9·2
19	12·4	10·4
20	9·9	15·3
21	14·4	5·4
22	10·5	10·2
23	11·1	11·4
24	12·0	13·2
25	14·7	8·7
26	6·6	18·6
27	11·7	8·1
28	14·7	14·1

1st Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
29	+ 16·2	− 27·0
30	22·8	13·2

2nd Equation. Latitude.

Direct

No. of Circuit Triangle	𝔅	ℭ
1	−0·0753	+ 0·1359
2	·0801	·0372
3	·0644	·0763
4	·0437	·0708
5	·0396	·0525
6	·0424	·0311
7	·0244	·0093
8	·0376	·0300
9	·0233	·0295
10	·0556	·0618
11	·0325	·0402
12	·0503	·0616
13	·0268	·0338
14	·0391	·0560
15	·0242	·0177
16	·0187	·0304
17	·0318	·0242
18	·0122	·0225
19	·0231	·0172
20	·0144	·0303
21	·0203	·0054
22	·0152	·0117
23	·0090	·0157
24	·0128	·0114
25	·0074	·0091

2nd Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
26	−0·0057	+ 0·0109
27	·0011	·0073
28	·0059	·0022
29	+ ·0064	·0064

3rd Equation. Longitude.

Direct

No. of Circuit Triangle	𝔅	ℭ
1	−0·0420	− 0·0308
2	+ ·0306	+ ·0376
3	·0316	·0399
4	− ·0400	− ·0264
5	+ ·0310	+ ·0358
6	− ·0312	− ·0196
7	+ ·0209	+ ·0240
8	− ·0299	− ·0185
9	+ ·0191	+ ·0266
10	·0146	·0311
11	− ·0272	− ·0132
12	+ ·0230	+ ·0326
13	− ·0280	− ·0196
14	·0298	·0162
15	+ ·0210	+ ·0208
16	·0262	·0260
17	− ·0312	− ·0189
18	·0220	·0143
19	+ ·0139	+ ·0174
20	− ·0173	− ·0033
21	+ ·0049	+ ·0101
22	·0059	·0113
23	− ·0132	− ·0012

3rd Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
24	+0·0039	+ 0·0092
25	− ·0120	− ·0005
26	+ ·0028	+ ·0089
27	− ·0105	·0027
28	·0025	·0059
29	·0079	·0139

4th Equation. Azimuth.

Direct

No. of Circuit Triangle	𝔅	ℭ
1	+0·3843	+ 0·3885
2	− ·3888	− ·3860
3	·3884	·3852
4	+ ·3852	+ ·3904
5	− ·3886	− ·3868
6	+ ·2884	+ ·2929
7	− ·2924	− ·2912
8	+ ·2889	+ ·2933
9	− ·2931	− ·2902
10	·2949	·2884
11	+ ·2901	+ ·2954
12	− ·3916	− ·3883
13	+ ·3900	+ ·3930
14	·3894	·3942
15	− ·3925	− ·3926
16	·4907	·4909
17	+ ·4890	+ ·4933
18	·3922	·3950
19	− ·3951	− ·3939
20	+ ·2939	+ ·2989
21	− ·2983	− ·2966

No. of Circuit Triangle	B	C
4th Equation—(Continued).		
22	−0·2980	− 0·2961
23	+ ·2954	+ ·2996
24	− ·2986	− ·2969
25	+ ·2959	+ ·2998
26	− ·2990	− ·2970
27.	+ ·2964	+ ·3010
28	− ·3009	− ·2980
29	+ ·5974	+ ·6047
30	− ·6000	− ·6000
5th Equation. Linear.		
Right-hand Branch		
41	+ 4·7	− 4·9
42	3·1	2·9
43	2·7	3·0
44	4·4	3·4
45	4·6	3·2
46	4·1	3·1
47	3·1	4·4
48	2·3	3·1
49	2·8	2·6
50	3·1	2·6
51	4·6	4·1
52	3·1	4·7
53	3·5	1·9
54	2·5	1·4
55	0·0	5·1
Left-hand Branch		
1	− 18·4	+ 32·0
2	20·0	10·0

No. of Circuit Triangle	B	C
5th Equation—(Continued).		
3	− 16·0	+ 20·0
4	12·4	17·6
5	10·4	14·8
6	12·9	7·8
7	6·6	3·3
8	12·0	7·8
9	6·3	9·9
10	16·2	19·8
11	1·5	11·1
31	3·1	2·0
32	2·5	3·8
33	6·2	5·2
34	4·2	2·1
35	4·1	3·7
36	3·3	6·9
37	2·7	2·4
38	3·2	2·2
39	2·5	3·2
40	5·8	3·5
6th Equation. Latitude.		
Right-hand Branch		
41	−0·0063	+ 0·0068
42	·0031	·0036
43	·0027	·0036
44	·0037	·0032
45	·0038	·0031
46	·0030	·0020
47	·0023	·0028
48	·0007	·0022

No. of Circuit Triangle	B	C
6th Equation—(Continued).		
49	−0·0014	+ 0·0013
50	·0007	·0014
51	·0014	·0013
52	·0003	·0009
53	·0001	·0006
Left-hand Branch		
1	+0·0128	− 0·0442
2	·0249	·0003
3	·0216	·0087
4	− ·0006	·0230
5	+ ·0140	·0009
6	− ·0018	·0118
7	+ ·0088	+ ·0055
8	− ·0038	− ·0109
9	+ ·0087	+ ·0055
10	·0107	·0035
11	− ·0146	·0053
31	·0022	− ·0020
32	+ ·0026	+ ·0013
33	− ·0016	− ·0015
34	+ ·0021	+ ·0008
35	− ·0010	− ·0013
36	+ ·0013	·0000
37	− ·0014	·0004
38	+ ·0006	+ ·0004
39	− ·0010	·0003
7th Equation. Longitude.		
Right-hand Branch		
41	+0·0034	+ 0·0029

No. of Circuit Triangle	B	C
7th Equation—(Continued).		
42	−0·0033	− 0·0020
43	+ ·0029	+ ·0021
44	− ·0026	− ·0016
45	·0026	·0016
46	+ ·0012	+ ·0018
47	·0013	·0020
48	− ·0019	− ·0004
49	+ ·0012	+ ·0012
50	− ·0016	− ·0002
51	+ ·0008	+ ·0007
52	− ·0008	·0002
53	+ ·0010	·0000
Left-hand Branch		
1	+0·0295	− 0·0226
2	·0130	·0182
3	·0088	·0286
4	·0226	·0154
5	·0049	·0203
6	·0210	·0074
7	·0051	·0061
8	·0191	·0084
9	·0066	·0141
10	·0193	·0268
11	·0047	·0156
31	·0033	·0023
32	·0022	·0045
33	·0049	·0042
34	·0022	·0018
35	·0025	·0021

No. of Circuit Triangle	𝔅	ℭ
7th Equation—(Continued).		
36	+0·0012	− 0·0035
37	·0008	·0015
38	·0007	·0006
39	·0000	·0012
8th Equation. *Azimuth.*		
Right-hand Branch		
41	−0·0986	− 0·0988
42	+ ·0987	+ ·0992
43	− ·0988	− ·0992
44	+ ·0990	+ ·0994
45	·0990	·0993
46	− ·0995	− ·0992
47	·0995	·0992
48	+ ·0992	+ ·0999
49	− ·0996	− ·0995
50	+ ·0994	+ ·0999
51	− ·0997	− ·0997
52	+ ·0997	+ ·1001
53	− ·0996	− ·1000
54	+ ·1000	+ ·1000
55	− ·2000	·1000
Left-hand Branch		
1	−0·3885	− 0·4085
2	+ ·4051	+ ·3928
3	·4034	·3887
4	− ·3911	− ·4061
5	+ ·4019	+ ·3921
6	− ·2918	− ·3029
7	+ ·3020	+ ·2976

No. of Circuit Triangle	𝔅	ℭ
8th Equation—(Continued).		
8	−0·2925	− 0·3033
9	+ ·3026	+ ·2945
10	·3075	·2895
11	− ·5981	·2939
31	·0988	− ·1009
32	+ ·1008	+ ·0983
33	− ·0981	− ·1016
34	+ ·1009	+ ·0993
35	− ·0990	− ·1009
36	+ ·1005	+ ·0986
37	− ·0997	− ·1006
38	+ ·1003	+ ·0998
39	− ·1000	− ·1005
40	+ ·1000	+ ·1000
9th Equation. *Linear.*		
Direct		
41	+ 4·7	− 4·9
42	3·1	2·9
43	2·7	3·0
44	4·4	3·4
45	4·6	3·2
46	4·1	3·1
47	3·1	4·4
48	2·3	3·1
49	2·8	2·6
50	3·1	2·6
51	4·6	4·1
52	3·1	4·7
53	3·5	1·9

No. of Circuit Triangle	𝔅	ℭ
9th Equation—(Continued).		
54	+ 2·5	− 1·4
55	2·7	3·9
56	4·1	1·9
57	1·9	4·4
58	3·7	3·2
59	2·8	2·0
60	5·7	7·2
61	1·7	2·5
62	2·6	4·3
63	2·1	2·1
64	2·6	1·3
65	2·4	4·2
66	3·2	3·1
67	1·6	2·6
68	23·1	16·8
69	19·6	18·2
70	25·9	32·9
71	27·3	29·4
72	9·8	25·9
73	44·1	21·0
74	21·0	35·7
75	16·1	13·3
10th Equation. *Latitude.*		
Direct		
41	−0·0220	+ 0·0224
42	·0129	·0135
43	·0119	·0130
44	·0176	·0147
45	·0184	·0139

No. of Circuit Triangle	𝔅	ℭ
10th Equation—(Continued).		
46	−0·0167	+ 0·0116
47	·0127	·0168
48	·0078	·0127
49	·0109	·0094
50	·0104	·0102
51	·0168	·0143
52	·0100	·0166
53	·0119	·0064
54	·0077	·0049
55	·0088	·0128
56	·0123	·0061
57	·0058	·0138
58	·0106	·0096
59	·0079	·0061
60	·0159	·0203
61	·0042	·0067
62	·0065	·0114
63	·0045	·0054
64	·0057	·0034
65	·0050	·0094
66	·0058	·0069
67	·0027	·0047
68	·0402	·0306
69	·0246	·0287
70	·0346	·0511
71	·0272	·0279
72	·0010	·0354
73	·0242	·0111
74	·0038	·0223

11th Equation. Longitude.

Direct

No. of Circuit Triangle	𝔅	ℭ
41	+0·0098	+ 0·0112
42	− ·0112	− ·0088
43	+ ·0097	+ ·0100
44	− ·0108	− ·0083
45	·0108	·0083
46	+ ·0078	+ ·0098
47	·0080	·0101
48	− ·0097	− ·0072
49	+ ·0080	+ ·0091
50	− ·0095	− ·0071
51	+ ·0072	+ ·0088
52	− ·0087	− ·0062
53	+ ·0076	+ ·0077
54	− ·0078	− ·0071
55	+ ·0074	+ ·0073
56	− ·0075	− ·0067
57	+ ·0071	+ ·0069
58	− ·0070	− ·0063
59	+ ·0069	+ ·0063
60	− ·0066	− ·0060
61	+ ·0061	+ ·0055
62	·0062	·0052
63	− ·0058	− ·0049
64	+ ·0058	+ ·0050
65	− ·0052	− ·0045
66	+ ·0056	+ ·0034
67	− ·0042	− ·0038
68	·0290	·0271

11th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
69	+0·0267	+ 0·0183
70	− ·0295	− ·0154
71	+ ·0135	+ ·0169
72	− ·0221	·0002
73	+ ·0067	·0094
74	− ·0172	·0101

12th Equation. Azimuth.

Direct

No. of Circuit Triangle	𝔅	ℭ
41	−0·0964	− 0·0958
42	+ ·0958	+ ·0968
43	− ·0964	− ·0963
44	+ ·0959	+ ·0970
45	·0959	·0970
46	− ·0972	− ·0964
47	·0971	·0962
48	+ ·0964	+ ·0975
49	− ·0971	− ·0967
50	+ ·0965	+ ·0975
51	− ·0974	− ·0967
52	+ ·0968	+ ·0979
53	− ·0973	− ·0972
54	+ ·0972	+ ·0975
55	− ·0974	− ·0973
56	+ ·0973	+ ·0976
57	− ·0975	− ·0975
58	+ ·0975	+ ·0978
59	− ·0975	− ·0977
60	+ ·0976	+ ·0979
61	− ·0978	− ·0981

12th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
62	−0·0978	− 0·0982
63	+ ·0980	+ ·0983
64	− ·0980	− ·0983
65	+ ·0982	+ ·0984
66	− ·0980	− ·0988
67	+ ·0986	+ ·0987
68	·6899	·6906
69	− ·6908	− ·6937
70	+ ·6898	+ ·6948
71	− ·6954	− ·6943
72	+ ·6925	+ ·7003
73	− ·6976	− ·6970
74	+ ·6943	+ ·7033
75	− ·7000	− ·7000

13th Equation. Linear.

Right-hand Branch

No. of Circuit Triangle	𝔅	ℭ
87	+ 11·4	− 7·2
88	9·6	9·0
89	5·6	8·8
90	7·8	3·6
91	9·8	12·4
92	7·0	5·0
93	7·4	5·2
94	6·2	4·6
95	5·4	6·6
96	6·2	5·2
97	5·6	5·2
98	8·6	6·4
99	3·1	2·9

13th Equation—(Continued).

No. of Circuit Triangle	𝔅	ℭ
100	+ 0·4	− 8·0

Left-hand Branch

No. of Circuit Triangle	𝔅	ℭ
41	− 4·7	+ 4·9
42	3·1	2·9
43	2·7	3·0
44	4·4	3·4
45	4·6	3·2
46	4·1	3·1
47	3·1	4·4
48	2·3	3·1
49	2·8	2·6
50	3·1	2·6
51	4·6	4·1
52	3·1	4·7
53	3·5	1·9
54	+ 3·1	3·4
76	− 2·7	6·6
77	4·3	3·8
78	14·7	8·7
79	10·6	6·2
80	8·4	9·0
81	7·6	8·6
82	3·3	3·6
83	9·2	8·8
84	4·6	4·1
85	8·2	8·6
86	6·0	8·4

No. of Circuit Triangle	B	C
14th Equation. Latitude.		
Right-hand Branch		
87	−0·0130	+ 0·0089
88	·0094	·0088
89	·0055	·0086
90	·0051	·0031
91	·0065	·0094
92	·0033	·0026
93	·0035	·0027
94	·0018	·0021
95	·0017	·0027
96	·0012	·0015
97	·0010	·0014
98	·0007	·0009
99	·0002	·0004
Left-hand Branch		
41	+0·0076	− 0·0047
42	·0011	·0051
43	·0041	·0016
44	·0015	·0046
45	·0017	·0045
46	·0043	+ ·0001
47	·0037	− ·0007
48	− ·0012	·0036
49	+ ·0029	+ ·0007
50	− ·0013	− ·0028
51	+ ·0027	+ ·0008
52	− ·0017	− ·0022
53	+ ·0015	+ ·0013
54	− ·0028	·0013

No. of Circuit Triangle	B	C
14th Equation—(Continued).		
76	−0·0016	− 0·0008
77	+ ·0014	+ ·0007
78	− ·0040	− ·0017
79	+ ·0016	+ ·0012
80	− ·0017	− ·0007
81	+ ·0010	+ ·0008
82	− ·0007	− ·0001
83	+ ·0006	+ ·0004
84	− ·0005	·0002
15th Equation. Longitude.		
Right-hand Branch		
87	−0·0064	− 0·0047
88	+ ·0046	+ ·0043
89	·0046	·0043
90	− ·0042	− ·0029
91	·0045	·0019
92	+ ·0025	+ ·0020
93	·0025	·0020
94	− ·0023	− ·0012
95	+ ·0020	+ ·0012
96	− ·0014	− ·0008
97	·0014	·0007
98	+ ·0010	+ ·0001
99	·0004	·0001
Left-hand Branch		
41	+0·0009	− 0·0069
42	·0058	·0008
43	− ·0003	·0045
44	+ ·0062	·0016

No. of Circuit Triangle	B	C
15th Equation—(Continued).		
45	+0·0064	− 0·0014
46	·0026	·0043
47	·0016	·0056
48	·0037	·0026
49	·0015	·0033
50	·0041	·0023
51	·0034	·0040
52	·0032	·0045
53	·0023	·0014
54	− ·0020	·0024
76	+ ·0016	·0046
77	·0020	·0022
78	·0057	·0044
79	·0037	·0024
80	·0024	·0031
81	·0017	·0021
82	·0005	·0009
83	·0012	·0012
84	·0001	·0004
16th Equation. Azimuth.		
Right-hand Branch		
87	+0·1974	+ 0·1981
88	− ·1981	− ·1983
89	·1982	·1983
90	+ ·1983	+ ·1988
91	·1982	·1993
92	− ·1990	− ·1992
93	·1990	·1992
94	+ ·1991	+ ·1995

No. of Circuit Triangle	B	C
16th Equation—(Continued).		
95	−0·1992	− 0·1995
96	+ ·1995	+ ·1997
97	·1994	·1997
98	− ·1996	− ·1999
99	·0998	·1000
100	·4000	+ ·2000
Left-hand Branch		
41	+0·1003	+ 0·0973
42	− ·0977	− ·1003
43	+ ·0999	+ ·0982
44	− ·0975	− ·1006
45	·0975	·1005
46	+ ·1010	+ ·0983
47	·1006	·0978
48	− ·0985	− ·1010
49	+ ·1006	+ ·0987
50	− ·0984	− ·1009
51	+ ·1014	+ ·0984
52	− ·0987	− ·1018
53	+ ·1009	+ ·0995
54	− ·2008	·0991
76	·0994	− ·1018
77	+ ·1008	+ ·0992
78	− ·2978	− ·3017
79	+ ·2014	+ ·1991
80	− ·1990	− ·2012
81	+ ·2007	+ ·1991
82	− ·0998	− ·1004
83	+ ·2005	+ ·1996

16th Equation—(Continued).

No. of Circuit Triangle	B	C
84	−0·1000	−0·1002
85	+·2000	+·2000
86	·2000	·2000

17th Equation. Linear.

Right-hand Branch

No. of Circuit Triangle	B	C
125	+9·8	−13·6
126	14·0	15·4
127	8·2	13·4
128	11·6	5·2
129	7·2	6·3
130	25·2	17·1
131	7·8	12·9
132	4·4	4·6
133	7·4	4·0
134	6·0	4·8
135	1·2	7·2

Left-hand Branch

No. of Circuit Triangle	B	C
87	−11·4	+7·2
88	9·6	9·0
89	5·6	8·8
90	7·8	3·6
91	9·8	12·4
92	7·0	5·0
93	7·4	5·2
94	6·2	4·6
95	5·4	6·6
96	6·2	5·2
97	5·6	5·2
98	8·6	6·4

17th Equation—(Continued).

No. of Circuit Triangle	B	C
99	−3·1	+2·9
100	7·2	7·8
101	12·0	12·6
102	5·6	7·0
103	3·5	3·1
104	5·8	5·6
105	2·2	2·9
106	8·8	6·8
107	7·2	7·2
108	8·0	7·0
109	5·6	6·4
110	11·7	14·4
111	5·8	5·6
112	11·1	12·3
113	8·8	8·0
114	9·2	7·6
115	10·0	11·0
116	8·0	7·0
117	5·6	5·2
118	10·0	12·2
119	11·8	10·4
120	7·0	6·2
121	8·2	9·2
122	11·6	11·8
123	8·8	10·4
124	8·0	7·0

18th Equation. Latitude.

Right-hand Branch

No. of Circuit Triangle	B	C
125	−0·0124	+0·0150

18th Equation—(Continued).

No. of Circuit Triangle	B	C
126	−0·0121	+0·0154
127	·0070	·0118
128	·0046	·0035
129	·0022	·0045
130	·0086	·0058
131	·0012	·0036
132	·0006	·0014
133	·0006	·0006
134	·0002	·0009

Left-hand Branch

No. of Circuit Triangle	B	C
87	+0·0036	−0·0136
88	·0135	·0000
89	·0106	+·0001
90	−·0033	−·0088
91	·0024	·0129
92	+·0082	+·0051
93	·0082	·0051
94	−·0061	−·0075
95	+·0069	+·0055
96	−·0069	−·0068
97	·0069	·0067
98	+·0052	+·0071
99	·0028	·0035
100	·0054	·0073
101	−·0089	−·0030
102	+·0046	+·0066
103	·0022	·0033
104	−·0064	−·0037
105	+·0023	+·0028

18th Equation—(Continued).

No. of Circuit Triangle	B	C
106	−0·0064	−0·0033
107	·0061	·0031
108	+·0028	+·0052
109	·0032	·0051
110	−·0087	−·0019
111	+·0027	+·0042
112	−·0080	−·0015
113	+·0013	+·0040
114	−·0053	−·0003
115	·0000	+·0045
116	·0045	·0005
117	+·0003	·0027
118	−·0048	·0027
119	·0024	·0036
120	·0011	·0025
121	·0028	·0025
122	·0016	·0024
123	·0012	·0019

19th Equation. Longitude.

Right-hand Branch

No. of Circuit Triangle	B	C
125	+0·0032	+0·0083
126	−·0077	−·0005
127	+·0043	+·0035
128	−·0051	−·0010
129	·0052	·0017
130	+·0021	+·0025
131	−·0024	−·0002
132	+·0015	+·0006
133	−·0009	−·0002

No. of Circuit Triangle	𝔅	ℭ
19th Equation—(Continued).		
134	+0·0011	−0·0001
Left-hand Branch		
87	+0·0245	−0·0085
88	·0125	·0183
89	·0059	·0180
90	·0162	·0042
91	·0199	·0201
92	·0103	·0093
93	·0109	·0097
94	·0116	·0076
95	·0081	·0111
96	·0107	·0090
97	·0097	·0091
98	·0145	·0098
99	·0053	·0044
100	·0122	·0121
101	·0175	·0204
102	·0086	·0093
103	·0053	·0041
104	·0065	·0084
105	·0031	·0036
106	·0094	·0090
107	·0076	·0095
108	·0092	·0066
109	·0066	·0060
110	·0094	·0157
111	·0057	·0043
112	·0074	·0121
113	·0069	·0049

No. of Circuit Triangle	𝔅	ℭ
19th Equation—(Continued).		
114	+0·0046	−0·0063
115	·0065	·0051
116	·0022	·0048
117	·0032	·0011
118	·0020	·0059
119	·0036	·0009
120	·0026	·0000
121	− ·0007	·0020
122	+ ·0018	·0003
123	− ·0012	·0001
20th Equation. *Azimuth.*		
Right-hand Branch		
125	−0·1988	−0·1965
126	+ ·1968	+ ·1999
127	− ·1982	− ·1986
128	+ ·1979	+ ·1996
129	·2979	·2994
130	− ·2993	− ·2989
131	+ ·2990	+ ·3000
132	− ·1994	− ·1998
133	+ ·1996	+ ·2000
134	− ·1996	− ·2000
135	·4000	+ ·2000
Left-hand Branch		
87	−0·1903	−0·2033
88	+ ·2049	+ ·1928
89	·2023	·1929
90	− ·1936	− ·2016
91	·1921	·2079

No. of Circuit Triangle	𝔅	ℭ
20th Equation—(Continued).		
92	+0·2040	+0·1963
93	·2043	·1962
94	− ·1954	− ·2029
95	+ ·2032	+ ·1956
96	− ·1958	− ·2035
97	·1962	·2036
98	+ ·2057	+ ·1961
99	·1021	·0983
100	·2048	·1952
101	− ·1931	− ·2081
102	+ ·2034	+ ·1964
103	·1021	·0984
104	− ·1974	− ·2033
105	+ ·1012	+ ·0986
106	− ·1963	− ·2035
107	·1970	·2037
108	+ ·2036	+ ·1974
109	·2026	·1977
110	− ·2963	− ·3061
111	+ ·2023	+ ·1982
112	− ·2970	− ·3048
113	+ ·2028	+ ·1980
114	− ·1981	− ·2025
115	+ ·2026	+ ·1980
116	− ·1991	− ·2019
117	+ ·2013	+ ·1996
118	− ·1992	− ·2023
119	+ ·2014	+ ·1996
120	·2010	·2000

No. of Circuit Triangle	𝔅	ℭ
20th Equation—(Continued).		
121	−0·2002	−0·2009
122	+ ·2008	+ ·1998
123	− ·2005	− ·2001
124	+ ·2000	+ ·2000
21st Equation. *Linear.*		
Direct		
125	+ 9·8	− 13·6
126	14·0	15·4
127	8·2	13·4
128	11·6	5·2
129	7·2	6·3
130	25·2	17·1
131	7·8	12·9
132	4·4	4·6
133	7·4	4·0
134	6·0	4·8
135	8·8	8·6
136	5·7	10·5
137	12·6	14·4
138	5·6	3·4
139	6·6	8·4
140	7·4	4·0
141	7·6	7·4
142	7·2	8·4
143	6·3	9·0
144	11·4	5·7
145	6·0	10·2
146	11·2	7·4
147	4·6	10·4

21st *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
148	+ 6·8	− 5·2
149	9·6	10·2
150	10·2	7·2
151	5·2	7·4
152	11·4	10·2
153	7·8	4·2
154	15·4	13·4
155	6·4	14·0
156	4·4	5·2
157	8·6	4·0
158	5·8	5·6
159	11·2	10·4
160	6·2	8·2
161	6·2	6·4
162	6·6	5·4
163	8·2	6·8
164	8·2	8·6
165	4·8	6·6
166	6·4	8·0
167	7·0	5·6
168	11·6	8·8
169	5·0	11·2
170	5·2	3·2
171	8·4	10·2
172	8·8	9·8

22nd *Equation*. *Latitude*.

Direct

No. of Circuit Triangle	𝔅	ℭ
125	−0·0086	− 0·0126
126	+ ·0161	+ ·0041

22nd *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
127	−0·0053	− 0·0155
128	+ ·0204	+ ·0058
129	·0216	·0101
130	·0111	− ·0312
131	·0233	+ ·0004
132	− ·0041	− ·0141
133	+ ·0188	+ ·0045
134	− ·0014	− ·0149
135	+ ·0021	·0197
136	·0208	·0013
137	·0025	·0302
138	·0153	+ ·0033
139	·0166	− ·0033
140	·0016	·0120
141	·0174	·0027
142	·0025	·0173
143	− ·0020	·0214
144	+ ·0253	+ ·0011
145	·0146	− ·0084
146	·0092	·0148
147	·0006	·0187
148	·0139	·0029
149	·0069	·0168
150	·0158	·0050
151	·0099	·0052
152	·0083	·0137
153	·0047	·0076
154	·0180	·0105
155	·0029	·0153

22nd *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
156	+0·0063	− 0·0029
157	·0043	·0056
158	·0068	·0028
159	·0059	·0095
160	·0059	·0041
161	·0016	·0057
162	·0051	·0017
163	·0059	·0025
164	·0025	·0051
165	·0033	·0026
166	·0015	·0039
167	·0033	·0022
168	·0030	·0031
169	·0015	·0033
170	·0003	·0010
171	·0015	·0020

23rd *Equation*. *Longitude*.

Direct

No. of Circuit Triangle	𝔅	ℭ
125	−0·0266	+ 0·0352
126	·0355	·0428
127	·0216	·0298
128	·0271	·0177
129	·0135	·0226
130	·0680	·0348
131	·0122	·0401
132	·0152	·0057
133	·0127	·0155
134	·0195	·0054
135	·0260	·0142

23rd *Equation*—(Continued).

No. of Circuit Triangle	𝔅	ℭ
136	−0·0035	+ 0·0330
137	·0359	·0235
138	·0053	·0130
139	·0074	·0231
140	·0192	·0021
141	·0082	·0199
142	·0182	·0088
143	·0196	·0069
144	·0084	·0187
145	·0031	·0227
146	·0213	·0043
147	·0122	·0085
148	·0014	·0124
149	·0170	·0068
150	·0042	·0124
151	+ ·0005	·0125
152	− ·0145	·0041
153	·0114	− ·0011
154	·0067	+ ·0143
155	·0088	·0062
156	+ ·0020	·0074
157	− ·0092	− ·0011
158	+ ·0010	+ ·0067
159	− ·0093	·0023
160	+ ·0007	·0066
161	− ·0059	·0006
162	+ ·0003	·0046
163	− ·0002	·0050
164	·0047	·0007

No. of Circuit Triangle	B	C
***23rd Equation*—(Continued).**		
165	+0·0014	+0·0038
166	− ·0033	·0002
167	+ ·0015	·0024
168	− ·0028	− ·0003
169	+ ·0013	+ ·0014
170	− ·0015	− ·0003
171	+ ·0012	+ ·0006
24th Equation. Azimuth.		
Direct		
125	−0·2108	−0·1858
126	+ ·1856	+ ·2174
127	− ·2087	− ·1880
128	+ ·1892	+ ·2072
129	·2947	·3092
130	− ·3275	− ·2860

No. of Circuit Triangle	B	C
***24th Equation*—(Continued).**		
131	+0·2952	+0·3163
132	− ·2061	− ·1978
133	+ ·1949	+ ·2063
134	− ·2079	− ·1978
135	·2105	·1943
136	+ ·2986	+ ·3133
137	− ·3145	− ·2907
138	+ ·1979	+ ·2053
139	·1971	·2093
140	− ·2078	− ·1992
141	+ ·1967	+ ·2081
142	− ·2074	− ·1965
143	·3080	·2972
144	+ ·2967	+ ·3077
145	·1988	·2092

No. of Circuit Triangle	B	C
***24th Equation*—(Continued).**		
146	−0·2087	−0·1982
147	·2050	·1966
148	+ ·1994	+ ·2051
149	− ·2070	− ·1972
150	+ ·1983	+ ·2051
151	·2002	·2051
152	− ·2059	− ·1983
153	·2047	·2004
154	+ ·1973	+ ·2059
155	− ·2036	− ·1975
156	+ ·2009	+ ·2031
157	− ·2038	− ·2005
158	+ ·2004	+ ·2028
159	− ·2040	− ·1990
160	+ ·2003	+ ·2027

No. of Circuit Triangle	B	C
***24th Equation*—(Continued).**		
161	−0·2025	−0·1997
162	+ ·2001	+ ·2019
163	·1999	·2021
164	− ·2020	− ·1997
165	+ ·2006	+ ·2016
166	− ·2014	− ·1999
167	+ ·2006	+ ·2010
168	− ·2011	− ·2001
169	+ ·2005	+ ·2006
170	− ·2006	− ·2001
171	+ ·2005	+ ·2002
172	− ·2000	− ·2000

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 the equations on page 38. The coefficient of the mth Λ in the lth equation is equal to that of the lth Λ in the mth equation, and may therefore be expressed either as

$$\sum_1^t \left[{}_m\mathfrak{b}_p\, {}_l\mathfrak{B}_p + {}_m\mathfrak{c}_p\, {}_l\mathfrak{C}_p\right], \text{ or as } \sum_1^t \left[{}_l\mathfrak{b}_p\, {}_m\mathfrak{B}_p + {}_l\mathfrak{c}_p\, {}_m\mathfrak{C}_p\right],$$

in which expressions the summations are taken 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 equations, as the case may be.

The coefficients of the Indeterminate Factors, and the Absolute Terms, in each of the 24 equations presented for simultaneous solution, are here given in a tabular form. It will be observed that the coefficients of the factors appertaining to the linear equations are unduly large, and those of the latitude and longitude equations are unduly small, when the equations are compared *inter se*. This does not produce any effect on the final results if sufficient decimal places are kept; but a great saving of labour is effected if the coefficients are brought more nearly on a par, as the number of decimal places in the subsequent calculations need not be so large. The equalizing of the coefficients might have been effected at an earlier stage by multiplying the coefficients $\mathfrak{b}$ and $\mathfrak{c}$ of each equation by a suitable factor, and this was done in the reduction of the North-East Quadrilateral, the factors there chosen being 1 for azimuth equations, 15 for latitude and longitude equations, and ·03 for linear equations. But the same result may be arrived at with less labour by treating the equations between the Indeterminate Factors; and as the advantages derived from employing equalizing factors are confined to these equations, this affords an additional reason for introducing them here. The manner in which they should be introduced will appear from the following considerations:—

If we multiply the equations of condition on page 17 by the equalizing factors f_a, $f_b, \ldots f_n$ and put $\lambda'_a, \lambda'_b, \ldots \lambda'_n$, for the Indeterminate Factors corresponding to the equalized equations, we eventually obtain the following groups of equations between the Indeterminate Factors:—

$$f_a f_a\,[aa\,.\,u]\,\lambda'_a + f_a f_b\,[ab\,.\,u]\,\lambda'_b + \ldots + f_a f_n\,[an\,.\,u]\,\lambda'_n = f_a\, e_a,$$

$$f_a f_b\,[ab\,.\,u]\,\lambda'_a + f_b f_b\,[bb\,.\,u]\,\lambda'_b + \ldots + f_b f_n\,[bn\,.\,u]\,\lambda'_n = f_b\, e_b,$$

$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$

$$f_a f_n\,[an\,.\,u]\,\lambda'_a + f_b f_n\,[bn\,.\,u]\,\lambda'_b + \ldots + f_n f_n\,[nn\,.\,u]\,\lambda'_n = f_n\, e_n.$$

It will be seen that in these equations the introduction of equalizing factors has not affected the identity of the coefficients which are situated symmetrically on opposite sides of the diagonal, which is so valuable an aid in solving the equations. It will also be seen that the resulting values of the factors must be

$$\lambda'_a = \frac{\lambda_a}{f_a}; \ \lambda'_b = \frac{\lambda_b}{f_b}; \quad . \quad . \quad . \quad \lambda'_n = \frac{\lambda_n}{f_n}.$$

In the solution of the equations appertaining to the South-West Quadrilateral, the factors chosen are not strictly equalizing, because this was not necessary, and the desired result was sufficiently nearly approached by employing 10^{-1} for linear equations, 10 for latitude and longitude equations and 1 for azimuth equations, while these factors were more easily introduced than others, the equations so modified are shewn in the second table in this section.

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 substitutions backwards from the last to the first.

The Equations between the Indeterminate Factors expressed in

No. of Equation	THE INDETERMINATE FACTORS												
	${}_{1}\Lambda$	${}_{2}\Lambda$	${}_{3}\Lambda$	${}_{4}\Lambda$	${}_{5}\Lambda$	${}_{6}\Lambda$	${}_{7}\Lambda$	${}_{8}\Lambda$	${}_{9}\Lambda$	${}_{10}\Lambda$	${}_{11}\Lambda$	${}_{12}\Lambda$	${}_{13}\Lambda$
1	+11578·2	−27·1017	−3·2545	−14·4637	−4732·3	+3·0718	+5·0921	− 2·8150	......	......	......	......	......
2	− 27·1017	+ 0·0883	−0·0022	+ 0·1740	+ 17·8177	−0·0140	−0·0181	− 0·0641	......	......	......	......	......
3	− 3·2545	− 0·0022	+0·0751	− 1·0643	+ 0·0696	+0·0147	−0·0090	+ 0·6046	......	......	......	......	......
4	− 14·4637	+ 0·1740	−1·0643	+21·4210	+ 16·8466	−0·1805	+0·0806	− 7·0440	......	......	......	......	......
5	− 4732·3	+17·8177	+0·0696	+16·8466	+7241·6	−4·1169	−5·8376	− 6·0794	+1256·9	− 4·8871	−0·7445	+ 5·1077	−1105·0
6	+ 3·0718	− 0·0140	+0·0147	− 0·1805	− 4·1169	+0·0087	+0·0009	+ 0·2136	− 0·7952	+ 0·0034	+0·0001	+ 0·0009	+ 0·7952
7	+ 5·0921	− 0·0181	−0·0090	+ 0·0806	− 5·8376	+0·0009	+0·0087	− 0·1412	− 0·1216	+ 0·0003	+0·0039	− 0·0393	+ 0·1216
8	− 2·8150	− 0·0641	+0·6046	− 7·0440	− 6·0794	+0·2136	−0·1412	+12·4861	− 2·4515	+ 0·0198	−0·2523	+ 2·7915	+ 7·3515
9	......	......	......	......	+1256·9	−0·7952	−0·1216	− 2·4515	+7607·2	−12·6860	−0·8305	−54·3239	−1105·0
10	......	......	......	......	− 4·8871	+0·0034	+0·0003	+ 0·0198	− 12·6860	+ 0·0329	+0·0012	+ 0·0675	+ 4·4206
11	......	......	......	......	− 0·7445	+0·0001	+0·0039	− 0·2523	− 0·8305	+ 0·0012	+0·0381	− 0·6072	− 0·2018
12	......	......	......	......	+ 5·1077	+0·0009	−0·0393	+ 2·7915	− 54·3239	+ 0·0675	−0·6072	+16·1641	+ 7·2496
13	......	......	......	......	−1105·0	+0·7952	+0·1216	+ 7·3515	−1105·0	+ 4·4206	−0·2018	+ 7·2496	+6276·6
14	......	......	......	......	+ 0·6652	−0·0007	+0·0007	− 0·0465	+ 0·6652	− 0·0030	+0·0039	− 0·0454	− 2·2751
15	......	......	......	......	+ 1·0945	−0·0008	−0·0009	+ 0·0294	+ 1·0945	− 0·0042	−0·0033	+ 0·0285	− 2·1587
16	......	......	......	......	− 1·2662	−0·0012	+0·0404	− 2·6719	− 1·2662	− 0·0075	+0·2380	− 2·6008	+ 1·0491
17	......	......	......	......	......	......	......	......	......	......	......	......	−2486·2
18	......	......	......	......	......	......	......	......	......	......	......	......	+ 0·5261
19	......	......	......	......	......	......	......	......	......	......	......	......	+ 4·3634
20	......	......	......	......	......	......	......	......	......	......	......	......	− 11·8827
21	......	......	......	......	......	......	......	......	......	......	......	......	......
22	......	......	......	......	......	......	......	......	......	......	......	......	......
23	......	......	......	......	......	......	......	......	......	......	......	......	......
24	......	......	......	......	......	......	......	......	......	......	......	......	......

Natural Numbers, before the application of the Equalizing Factors.

AND THEIR COEFFICIENTS												
14A	15A	16A	17A	18A	19A	20A	21A	22A	23A	24A	The Absolute Terms	No. of Equation
......	......	......	......	......	......	......	......	......	......	......	+ 189·8	1
......	......	......	......	......	......	......	......	......	......	......	− 0·637	2
......	......	......	......	......	......	......	......	......	......	......	− 0·571	3
......	......	......	......	......	......	......	......	......	......	......	− 7·806	4
+0·6652	+1·0945	− 1·2662	......	......	......	......	......	......	......	......	− 212·5	5
−0·0007	−0·0008	− 0·0012	......	......	......	......	......	......	......	......	+ 0·068	6
+0·0007	−0·0009	+ 0·0404	......	......	......	......	......	......	......	......	+ 0·407	7
−0·0465	+0·0294	− 2·6719	......	......	......	......	......	......	......	......	− 7·113	8
+0·6652	+1·0945	− 1·2662	......	......	......	......	......	......	......	......	+ 27·4	9
−0·0030	−0·0042	− 0·0075	......	......	......	......	......	......	......	......	− 0·435	10
+0·0039	−0·0033	+ 0·2380	......	......	......	......	......	......	......	......	+ 0·065	11
−0·0454	+0·0285	− 2·6008	......	......	......	......	......	......	......	......	− 6·719	12
−2·2751	−2·1587	+ 1·0491	− 2486·2	+0·5261	+4·3634	−11·8827	......	......	......	......	− 185·9	13
+0·0029	+0·0003	+ 0·0627	+ 1·5563	−0·0008	−0·0028	+ 0·0036	......	......	......	......	+ 0·151	14
+0·0003	+0·0033	− 0·0911	+ 0·2511	+0·0020	−0·0012	+ 0·0636	......	......	......	......	− 0·013	15
+0·0627	−0·0911	+11·9266	+ 1·2995	−0·1648	+0·0347	− 5·1602	......	......	......	......	+ 2·957	16
+1·5563	+0·2511	+ 1·2995	+12220·4	−1·7543	−8·8653	− 0·4273	+ 3923·4	+ 3·4055	− 9·7657	+ 6·1556	− 62·2	17
−0·0008	+0·0020	− 0·1648	− 1·7543	+0·0112	+0·0004	+ 0·3075	− 2·3093	− 0·0012	+ 0·0060	+ 0·0034	+ 0·139	18
−0·0028	−0·0012	+ 0·0347	− 8·8653	+0·0004	+0·0137	− 0·0474	− 0·5825	− 0·0028	+ 0·0008	− 0·0517	− 0·072	19
+0·0036	+0·0636	− 5·1602	− 0·4273	+0·3075	−0·0474	+19·9588	− 4·9564	+ 0·2183	+ 0·1043	+ 4·8223	+ 3·046	20
......	......	......	+ 3923·4	−2·3093	−0·5825	− 4·9564	+12685·2	+11·0570	−18·0321	− 9·4053	+ 257·1	21
......	......	......	+ 3·4055	−0·0012	−0·0028	+ 0·2183	+ 11·0570	+ 0·0314	− 0·0046	+ 0·5308	+ 0·060	22
......	......	......	− 9·7657	+0·0060	+0·0008	+ 0·1043	− 18·0321	− 0·0046	+ 0·0474	+ 0·4336	− 0·256	23
......	......	......	+ 6·1556	+0·0034	−0·0517	+ 4·8223	− 9·4053	+ 0·5308	+ 0·4336	+20·9492	− 3·912	24

The Equations between the Indeterminate Factors expressed in

No of Equation	The Indeterminate Factors												
	$_{1}A$	$_{2}A$	$_{3}A$	$_{4}A$	$_{5}A$	$_{6}A$	$_{7}A$	$_{8}A$	$_{9}A$	$_{10}A$	$_{11}A$	$_{12}A$	$_{13}A$
1	+115.782	−27.1017	− 3.2545	− 1.4464	−47.323	+3.0718	+5.0921	− 0.2815	......	......	......	......	......
2	− 27.1017	+ 8.832	− 0.219	+ 1.7403	+17.8177	−1.400	−1.807	− 0.6413	......	......	......	......	......
3	− 3.2545	− 0.219	+ 7.506	−10.6432	+ 0.0696	+1.470	−0.900	+ 6.0462	......	......	......	......	......
4	− 1.4464	+ 1.7403	−10.6432	+21.4210	+ 1.6847	−1.8053	+0.8055	− 7.0440	......	......	......	......	......
5	− 47.323	+17.8177	+ 0.0696	+ 1.6847	+72.416	−4.1169	−5.8376	− 0.6079	+12.569	− 4.8871	−0.7445	+ 0.5108	−11.050
6	+ 3.0718	− 1.400	+ 1.470	− 1.8053	− 4.1169	+0.871	+0.085	+ 2.1356	− 0.7952	+ 0.336	+0.014	+ 0.0091	+ 0.7952
7	+ 5.0921	− 1.807	− 0.900	+ 0.8055	− 5.8376	+0.085	+0.870	− 1.4122	− 0.1216	+ 0.031	+0.387	− 0.3934	+ 0.1216
8	− 0.2815	− 0.6413	+ 6.0462	− 7.0440	− 0.6079	+2.1356	−1.4122	+12.4861	− 0.2451	+ 0.1978	−2.5226	+ 2.7915	+ 0.7351
9	......	......	......	......	+12.569	−0.7952	−0.1216	− 0.2451	+76.072	−12.6860	−0.8305	− 5.4324	−11.050
10	......	......	......	......	− 4.8871	+0.336	+0.031	+ 0.1978	−12.6860	+ 3.292	+0.124	+ 0.6754	+ 4.4206
11	......	......	......	......	− 0.7445	+0.014	+0.387	− 2.5226	− 0.8305	+ 0.124	+3.808	− 6.0719	− 0.2018
12	......	......	......	......	+ 0.5108	+0.0091	−0.3934	+ 2.7915	− 5.4324	+ 0.6754	−6.0719	+16.1641	+ 0.7250
13	......	......	......	......	−11.050	+0.7952	+0.1216	+ 0.7351	−11.050	+ 4.4206	−0.2018	+ 0.7250	+62.766
14	......	......	......	......	+ 0.6652	−0.070	+0.066	− 0.4652	+ 0.6652	− 0.304	+0.395	− 0.4535	− 2.2751
15	......	......	......	......	+ 1.0945	−0.075	−0.088	+ 0.2940	+ 1.0945	− 0.421	−0.327	+ 0.2852	− 2.1587
16	......	......	......	......	− 0.1266	−0.0116	+0.4042	− 2.6719	− 0.1266	− 0.0752	+2.3800	− 2.6008	+ 0.1049
17	......	......	......	......	......	......	......	......	......	......	......	......	−24.862
18	......	......	......	......	......	......	......	......	......	......	......	......	+ 0.5261
19	......	......	......	......	......	......	......	......	......	......	......	......	+ 4.3634
20	......	......	......	......	......	......	......	......	......	......	......	......	− 1.1883
21	......	......	......	......	......	......	......	......	......	......	......	......	......
22	......	......	......	......	......	......	......	......	......	......	......	......	......
23	......	......	......	......	......	......	......	......	......	......	......	......	......
24	......	......	......	......	......	......	......	......	......	......	......	......	......

Natural Numbers, after the application of the Equalizing Factors.

AND THEIR COEFFICIENTS											The Absolute Terms	No. of Equation
14A	15A	16A	17A	18A	19A	20A	21A	22A	23A	24A		
......	......	......	......	......	......	......	......	......	......	......	+ 18·98	1
......	......	......	......	......	......	......	......	......	......	......	− 6·37	2
......	......	......	......	......	......	......	......	......	......	......	− 5·71	3
......	......	......	......	......	......	......	......	......	......	......	− 7·806	4
+0·6652	+1·0945	− 0·1266	......	......	......	......	......	......	......	......	− 21·25	5
−0·070	−0·075	− 0·0116	......	......	......	......	......	......	......	......	+ 0·68	6
+0·066	−0·088	+ 0·4042	......	......	......	......	......	......	......	......	+ 4·07	7
−0·4652	+0·2940	− 2·6719	......	......	......	......	......	......	......	......	− 7·113	8
+0·6652	+1·0945	− 0·1266	......	......	......	......	......	......	......	......	+ 2·74	9
−0·304	−0·421	− 0·0752	......	......	......	......	......	......	......	......	− 4·35	10
+0·395	−0·327	+ 2·3800	......	......	......	......	......	......	......	......	+ 0·65	11
−0·4535	+0·2852	− 2·6008	......	......	......	......	......	......	......	......	− 6·719	12
−2·2751	−2·1587	+ 0·1049	− 24·862	+0·5261	+4·3634	− 1·1883	......	......	......	......	− 18·59	13
+0·292	+0·033	+ 0·6265	+ 1·5563	−0·078	−0·280	+ 0·0360	......	......	......	......	+ 1·51	14
+0·033	+0·328	− 0·9110	+ 0·2511	+0·196	−0·121	+ 0·6360	......	......	......	......	− 0·13	15
+0·6265	−0·9110	+11·9266	+ 0·1300	−1·6484	+0·3469	− 5·1602	......	......	......	......	+ 2·957	16
+1·5563	+0·2511	+ 0·1300	+122·204	−1·7543	−8·8653	− 0·0427	+ 39·234	+ 3·4055	− 9·7657	+ 0·6156	− 6·22	17
−0·078	+0·196	− 1·6484	− 1·7543	+1·116	+0·035	+ 3·0752	− 2·3093	− 0·115	+ 0·599	+ 0·0338	+ 1·39	18
−0·280	−0·121	+ 0·3469	− 8·8653	+0·035	+1·365	− 0·4741	− 0·5825	− 0·284	+ 0·080	− 0·5166	− 0·72	19
+0·0360	+0·6360	− 5·1602	− 0·0427	+3·0752	−0·4741	+19·9588	− 0·4956	+ 2·1834	+ 1·0426	+ 4·8223	+ 3·046	20
......	......	......	+ 39·234	−2·3093	−0·5825	− 0·4956	+126·852	+11·0570	−18·0321	− 0·9405	+ 25·71	21
......	......	......	+ 3·4055	−0·115	−0·284	+ 2·1834	+ 11·0570	+ 3·135	− 0·456	+ 5·3082	+ 0·60	22
......	......	......	− 9·7657	+0·599	+0·080	+ 1·0426	− 18·0321	− 0·456	+ 4·739	+ 4·3363	− 2·56	23
......	......	......	+ 0·6156	+0·0338	−0·5166	+ 4·8223	− 0·9405	+ 5·3082	+ 4·3363	+20·9492	− 3·912	24

The Equations between the Indeterminate

No. of Equation	THE INDETERMINATE FACTORS, AND THEIR COEF-												
	${}_1\Lambda$	${}_2\Lambda$	${}_3\Lambda$	${}_4\Lambda$	${}_5\Lambda$	${}_6\Lambda$	${}_7\Lambda$	${}_8\Lambda$	${}_9\Lambda$	${}_{10}\Lambda$	${}_{11}\Lambda$	${}_{12}\Lambda$	${}_{13}\Lambda$
1	+115·782	−27·1017	−3·2545	− 1·4464	−47·323	+3·0718	+5·0921	−0·2815	......	......	......	......	......
2		+ 2·4882	−0·9808	+ 1·4017	+ 6·7406	−0·6810	−0·6151	−0·7072	......	......	......	......	......
3			+7·0279	−10·1314	+ 1·3964	+1·2879	−0·9994	+5·7595	......	......	......	......	......
4				+ 6·0079	− 0·6907	+0·4733	−0·2251	+1·6538	......	......	......	......	......
5					+34·4565	−1·2181	−1·9173	+0·2385	+12·569	− 4·8871	−0·7445	+0·5108	−11·050
6						+0·2867	−0·0854	+0·7721	− 0·3509	+ 0·1632	−0·0123	+0·0272	+ 0·4046
7							+0·2113	−0·4503	+ 0·4733	− 0·1923	+0·3419	−0·3569	− 0·3728
8								+4·0686	+ 1·6215	− 0·6177	−1·7557	+1·9541	− 1·0725
9									+69·3512	−10·0267	−0·6401	−5·5648	− 5·2615
10										+ 0·7875	−0·0225	−0·1004	+ 1·3602
11											+2·4741	−4·6933	− 0·2925
12												+5·2502	− 0·0679
13													+54·9268
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													

Factors after the Successive Eliminations.

FICIENTS, AFTER THE SUCCESSIVE ELIMINATIONS												
$_{14}\Lambda$	$_{15}\Lambda$	$_{16}\Lambda$	$_{17}\Lambda$	$_{18}\Lambda$	$_{19}\Lambda$	$_{20}\Lambda$	$_{21}\Lambda$	$_{22}\Lambda$	$_{23}\Lambda$	$_{24}\Lambda$	THE ABSOLUTE TERMS	No. of Equation
......	......	......	......	......	......	......	......	......	......	......	+ 18·98	1
......	......	......	......	......	......	......	......	......	......	......	− 1·9273	2
......	......	......	......	......	......	......	......	......	......	......	− 5·9362	3
......	......	......	......	......	......	......	......	......	......	......	− 15·0408	4
+0·6652	+1·0945	−0·1266	......	......	......	......	......	......	......	......	− 8·8211	5
−0·0465	−0·0363	−0·0161	......	......	......	......	......	......	......	......	+ 1·6099	6
+0·0891	−0·0379	+0·3924	......	......	......	......	......	......	......	......	+ 1·3398	7
−0·1547	+0·3034	−1·7914	......	......	......	......	......	......	......	......	− 0·0286	8
+0·2277	+0·6148	−0·2652	......	......	......	......	......	......	......	......	+ 4·9384	9
−0·0927	−0·1446	−0·0372	......	......	......	......	......	......	......	......	− 4·5885	10
+0·1959	−0·1112	+0·9652	......	......	......	......	......	......	......	......	− 1·7374	11
+0·1439	−0·1173	+0·7308	......	......	......	......	......	......	......	......	− 7·9486	12
−1·6773	−1·4616	+0·4749	− 24·862	+0·5261	+4·3634	− 1·1883	......	......	......	......	− 13·3425	13
+0·1460	−0·0181	+0·3073	+ 0·7971	−0·0619	−0·1468	− 0·0003	......	......	......	......	+ 0·7670	14
	+0·1784	−0·5990	− 0·3117	+0·2023	−0·0231	+ 0·6044	......	......	......	......	− 0·8055	15
		+7·2646	− 2·3793	−0·8434	+0·5406	− 3·1200	......	......	......	......	− 2·1029	16
			+105·2748	−1·1010	−5·9521	− 0·5449	+ 39·234	+ 3·4055	− 9·7657	+ 0·6156	− 18·5427	17
				+0·7460	−0·0422	+ 2·0332	− 1·8990	− 0·0794	+ 0·4969	+ 0·0402	+ 2·3183	18
					+0·4887	+ 0·0147	+ 1·5283	− 0·0960	− 0·4440	− 0·4795	+ 0·2461	19
						+11·0009	+ 4·8372	+ 2·4203	− 0·3488	+ 4·7303	− 1·8372	20
							+100·4897	+ 8·8217	−11·5858	− 1·6481	+ 38·5603	21
								+ 1·6905	+ 0·9194	+ 4·3024	− 1·4860	22
									+ 1·2518	+ 1·5511	− 0·4051	23
										+ 5·5401	+ 2·0192	24

The following table gives the values of the factors to four places of decimals as deduced from the solution of the equations, and also as multiplied by the equalizing factors to give the quantities to be employed in obtaining the values of y and z (see page 99).

The Numerical Values of the Indeterminate Factors.

Factors	Value as deduced	Value as employed	Factors	Value as deduced	Value as employed
${}_1\Lambda$	+ 0·0338	+ 0·0034	${}_{13}\Lambda$	− 0·4224	− 0·0422
${}_2\Lambda$	+ 2·4819	+ 24·8190	${}_{14}\Lambda$	+ 6·5184	+ 65·1840
${}_3\Lambda$	− 6·4490	− 64·4900	${}_{15}\Lambda$	− 9·7600	− 97·6000
${}_4\Lambda$	− 3·1401	− 3·1401	${}_{16}\Lambda$	+ 0·1793	+ 0·1793
${}_5\Lambda$	− 0·4027	− 0·0403	${}_{17}\Lambda$	− 0·3915	− 0·0391
${}_6\Lambda$	+11·4203	+ 114·2030	${}_{18}\Lambda$	+ 5·0746	+ 50·7460
${}_7\Lambda$	+ 0·4635	+ 4·6350	${}_{19}\Lambda$	− 1·4278	− 14·2780
${}_8\Lambda$	− 1·0608	− 1·0608	${}_{20}\Lambda$	− 0·2291	− 0·2291
${}_9\Lambda$	− 1·0434	− 0·1043	${}_{21}\Lambda$	+ 0·4219	+ 0·0422
${}_{10}\Lambda$	− 6·5168	− 65·1680	${}_{22}\Lambda$	− 1·3850	− 13·8500
${}_{11}\Lambda$	− 5·4591	− 54·5910	${}_{23}\Lambda$	− 0·7752	− 7·7520
${}_{12}\Lambda$	− 1·9411	− 1·9411	${}_{24}\Lambda$	+ 0·3645	+ 0·3645

16.

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 for this purpose are, as indicated in Section 11 of Chapter II,

$$y_p = {}_1\mathfrak{B}_p\,{}_1\Lambda + {}_2\mathfrak{B}_p\,{}_2\Lambda + \;\ldots\; + {}_{24}\mathfrak{B}_p\,{}_{24}\Lambda,$$

$$z_p = {}_1\mathfrak{C}_p\,{}_1\Lambda + {}_2\mathfrak{C}_p\,{}_2\Lambda + \;\ldots\; + {}_{24}\mathfrak{C}_p\,{}_{24}\Lambda.$$

The error x_p was simply determined by finding the value of its equivalent, $-(y_p + z_p)$.

The numerical values of the angular errors were first computed to four places of decimals, employing the Λs to four places. These values were then inserted in the equations between y and z, symbolized in Section 11, Chapter II. The angular errors were then contracted to three places of decimals and the equations again tested. Finally they were contracted to two places of decimals, the number employed in the linear and geodetic calculations, and were inserted in these, and certain small residual errors in the closing of chains were found to exist: these were eliminated by 'arbitrary corrections.' The residuals which presented themselves prior to the introduction of the arbitrary corrections will be found in a note on the reduction of this quadrilateral at the end of these chapters.

The following table shews:—

(1). The errors as computed and reduced to two places of decimals,

(2). The arbitrary corrections,

(3). The totals of (1) and (2), giving the values of x, y and z which, with changed sign, were introduced into the linear and geodetic calculations.

No. of Circuit Triangle	x			y			z		
	1	2	3	1	2	3	1	2	3
	″	″	″	″	″	″	″	″	″
1	− 0·47	− 0·02	− 0·49	+ 2·45	+ 0·02	+ 2·47	− 1·98	...	− 1·98
2	+ ·65	+ ·02	+ ·67	+ 0·61	...	+ 0·61	− 1·26	− 0·02	− 1·28
3	+ 1·52	...	+ 1·52	+ ·36	...	+ ·36	− 1·88	...	− 1·88
4	− 0·48	− ·02	− 0·50	+ 1·28	+ ·02	+ 1·30	− 0·80	...	− 0·80
5	+ 1·16	...	+ 1·16	− 0·11	...	− 0·11	− 1·05	...	− 1·05
6	− 0·54	− ·02	− 0·56	+ ·82	+ ·02	+ ·84	− 0·28	...	− 0·28
7	+ ·30	+ ·02	+ ·32	− ·04	...	− ·04	− ·26	− ·02	− ·28
8	− ·29	− ·04	− ·33	+ ·58	+ ·02	+ ·60	− ·29	+ ·02	− ·27
9	+ ·16	...	+ ·16	+ ·09	...	+ ·09	− ·25	...	− ·25
10	+ ·16	...	+ ·16	+ ·30	...	+ ·30	− ·46	...	− ·46
11	+ ·22	...	+ ·22	− ·87	...	− ·87	+ ·65	...	+ ·65
12	+ ·88	...	+ ·88	− 1·45	...	− 1·45	+ ·57	...	+ ·57
13	− ·78	...	− ·78	− 0·05	...	− 0·05	+ ·83	...	+ ·83
14	− ·91	...	− ·91	− ·22	...	− ·22	+ 1·13	...	+ 1·13
15	+ ·38	...	+ ·38	− ·69	...	− ·69	+ 0·31	...	+ 0·31
16	+ ·01	...	+ ·01	− ·59	...	− ·59	+ ·58	...	+ ·58
17	+ ·01	+ ·02	+ ·03	− ·25	...	− ·25	+ ·24	− ·02	+ ·22
18	− ·12	− ·01	− ·13	− ·09	...	− ·09	+ ·21	+ ·01	+ ·22
19	− ·32	− ·02	− ·34	− ·19	...	− ·19	+ ·51	+ ·02	+ ·53
20	+ ·16	...	+ ·16	− ·13	− ·02	− ·15	− ·03	+ ·02	− ·01
21	− ·57	+ ·02	− ·55	+ ·17	− ·02	+ ·15	+ ·40	...	+ ·40
22	− ·67	− ·02	− ·69	+ ·21	...	+ ·21	+ ·46	+ ·02	+ ·48
23	+ ·77	...	+ ·77	− ·26	− ·02	− ·28	− ·51	+ ·02	− ·49
24	− ·99	− ·02	− 1·01	+ ·41	...	+ ·41	+ ·58	+ ·02	+ ·60
25	+ 1·00	+ ·04	+ 1·04	− ·29	− ·02	− ·31	− ·71	− ·02	− ·73
26	− 1·21	− ·04	− 1·25	+ ·64	+ ·02	+ ·66	+ ·57	+ ·02	+ ·59
27	+ 1·21	+ ·04	+ 1·25	− ·24	− ·02	− ·26	− ·97	− ·02	− ·99
28	− 1·57	...	− 1·57	+ 1·01	− ·02	+ ·99	+ ·56	+ ·02	+ ·58
29	+ 3·88	...	+ 3·88	− 1·15	− ·02	− 1·17	− 2·73	+ ·02	− 2·71
30	− 3·80	...	− 3·80	+ 1·96	− ·05	+ 1·91	+ 1·84	+ ·05	+ 1·89

No. of Circuit Triangle	x			y			z		
	1	2	3	1	2	3	1	2	3
	"	"	"	"	"	"	"	"	"
31	+ 0·22	+ 0·04	+ 0·26	− 0·01	− 0·02	− 0·03	− 0·21	− 0·02	− 0·23
32	− ·17	− ·02	− ·19	+ ·30	+ ·02	+ ·32	− ·13	...	− ·13
33	+ ·10	+ ·02	+ ·12	+ ·19	...	+ ·19	− ·29	− ·02	− ·31
34	− ·20	− ·04	− ·24	+ ·31	+ ·02	+ ·33	− ·11	+ ·02	− ·09
35	+ ·03	+ ·02	+ ·05	+ ·17	− ·02	+ ·15	− ·20	...	− ·20
36	+ ·22	...	+ ·22	+ ·18	...	+ ·18	− ·40	...	− ·40
37	− ·02	+ ·02	·00	+ ·06	− ·02	+ ·04	− ·04	...	− ·04
38	+ ·06	...	+ ·06	+ ·09	...	+ ·09	− ·15	...	− ·15
39	− ·10	...	− ·10	+ ·09	...	+ ·09	+ ·01	...	+ ·01
40	+ ·12	+ ·01	+ ·13	+ ·13	− ·01	+ ·12	− ·25	...	− ·25
41	− ·33	...	− ·33	+ ·43	...	+ ·43	− ·10	...	− ·10
42	+ ·31	...	+ ·31	− ·04	...	− ·04	− ·27	...	− ·27
43	− ·26	...	− ·26	+ ·28	...	+ ·28	− ·02	...	− ·02
44	+ ·21	...	+ ·21	+ ·04	...	+ ·04	− ·25	...	− ·25
45	+ ·20	...	+ ·20	+ ·05	...	+ ·05	− ·25	...	− ·25
46	− ·24	...	− ·24	+ ·24	...	+ ·24	·00	...	·00
47	− ·15	...	− ·15	+ ·21	...	+ ·21	− ·06	...	− ·06
48	+ ·20	...	+ ·20	− ·04	...	− ·04	− ·16	...	− ·16
49	− ·18	...	− ·18	+ ·19	...	+ ·19	− ·01	...	− ·01
50	+ ·12	...	+ ·12	·00	...	·00	− ·12	...	− ·12
51	− ·14	...	− ·14	+ ·23	...	+ ·23	− ·09	...	− ·09
52	+ ·14	...	+ ·14	+ ·04	...	+ ·04	− ·18	...	− ·18
53	− ·14	...	− ·14	+ ·18	...	+ ·18	− ·04	...	− ·04
54	− ·29	...	− ·29	+ ·12	...	+ ·12	+ ·17	...	+ ·17
55	+ ·25	...	+ ·25	+ ·29	...	+ ·29	− ·54	...	− ·54
56	− ·57	...	− ·57	+ ·59	...	+ ·59	− ·02	...	− ·02
57	+ ·65	...	+ ·65	− ·02	...	− ·02	− ·63	...	− ·63
58	− ·36	...	− ·36	+ ·50	...	+ ·50	− ·14	...	− ·14
59	+ ·30	...	+ ·30	+ ·04	...	+ ·04	− ·34	...	− ·34
60	− ·18	...	− ·18	+ ·61	...	+ ·61	− ·43	...	− ·43

No. of Circuit Triangle	x			y			z		
	1	2	3	1	2	3	1	2	3
	″	″	″	″	″	″	″	″	″
61	+ 0·34	...	+ 0·34	− 0·05	...	− 0·05	− 0·29	...	− 0·29
62	+ ·39	...	+ ·39	·00	...	·00	− ·39	...	− ·39
63	− ·14	...	− ·14	+ ·20	...	+ ·20	− ·06	...	− ·06
64	+ ·20	...	+ ·20	− ·03	...	− ·03	− ·17	...	− ·17
65	− ·05	...	− ·05	+ ·17	...	+ ·17	− ·12	...	− ·12
66	+ ·19	...	+ ·19	− ·07	...	− ·07	− ·12	...	− ·12
67	− ·03	...	− ·03	+ ·05	...	+ ·05	− ·02	...	− ·02
68	− ·35	...	− ·35	+ ·45	...	+ ·45	− ·10	...	− ·10
69	+ ·18	...	+ ·18	− ·56	...	− ·56	+ ·38	...	+ ·38
70	+ ·59	...	+ ·59	− ·18	...	− ·18	− ·41	...	− ·41
71	− 1·21	...	− 1·21	− ·46	...	− ·46	+ 1·67	...	+ 1·67
72	+ 2·07	...	+ 2·07	− 1·10	...	− 1·10	− 0·97	...	− 0·97
73	− 0·27	− 0·01	− 0·28	− 2·04	+ 0·01	− 2·03	+ 2·31	...	+ 2·31
74	+ 1·99	+ ·02	+ 2·01	− 2·35	...	− 2·35	+ 0·36	− 0·02	+ 0·34
75	− 2·43	...	− 2·43	− 0·32	...	− 0·32	+ 2·75	...	+ 2·75
76	+ 0·06	...	+ 0·06	− ·16	...	− ·16	+ 0·10	...	+ 0·10
77	− ·22	...	− ·22	+ ·10	...	+ ·10	+ ·12	...	+ ·12
78	+ ·35	...	+ ·35	− ·25	...	− ·25	− ·10	...	− ·10
79	− ·32	...	− ·32	+ ·23	...	+ ·23	+ ·09	...	+ ·09
80	+ ·19	...	+ ·19	− ·03	...	− ·03	− ·16	...	− ·16
81	− ·19	...	− ·19	+ ·26	...	+ ·26	− ·07	...	− ·07
82	+ ·06	...	+ ·06	+ ·03	...	+ ·03	− ·09	...	− ·09
83	− ·16	...	− ·16	+ ·35	...	+ ·35	− ·19	...	− ·19
84	+ ·01	...	+ ·01	+ ·13	...	+ ·13	− ·14	...	− ·14
85	− ·05	...	− ·05	+ ·38	+ ·01	+ ·39	− ·33	− ·01	− ·34
86	+ ·03	+ ·02	+ ·05	+ ·29	...	+ ·29	− ·32	− ·02	− ·34
87	− ·22	...	− ·22	− ·35	...	− ·35	+ ·57	...	+ ·57
88	+ ·31	...	+ ·31	− ·67	...	− ·67	+ ·36	...	+ ·36
89	+ ·10	...	+ ·10	− ·45	...	− ·45	+ ·35	...	+ ·35
90	+ ·08	...	+ ·08	− ·27	...	− ·27	+ ·19	...	+ ·19

No. of Circuit Triangle	x			y			z		
	1	2	3	1	2	3	1	2	3
	"	"	"	"	"	"	"	"	"
91	− 0·21	...	− 0·21	− 0·34	...	− 0·34	+ 0·55	...	+ 0·55
92	− ·01	...	− ·01	− ·29	...	− ·29	+ ·30	...	+ ·30
93	+ ·01	...	+ ·01	− ·32	...	− ·32	+ ·31	...	+ ·31
94	+ ·23	...	+ ·23	− ·31	...	− ·31	+ ·08	...	+ ·08
95	− ·27	...	− ·27	− ·17	...	− ·17	+ ·44	...	+ ·44
96	+ ·32	...	+ ·32	− ·38	...	− ·38	+ ·06	...	+ ·06
97	+ ·30	...	+ ·30	− ·35	...	− ·35	+ ·05	...	+ ·05
98	− ·29	...	− ·29	− ·20	...	− ·20	+ ·49	...	+ ·49
99	− ·19	...	− ·19	− ·04	...	− ·04	+ ·23	...	+ ·23
100	− ·82	...	− ·82	+ ·25	...	+ ·25	+ ·57	...	+ ·57
101	+ ·50	...	+ ·50	− ·19	...	− ·19	− ·31	...	− ·31
102	− ·43	...	− ·43	+ ·28	...	+ ·28	+ ·15	...	+ ·15
103	− ·23	...	− ·23	+ ·15	...	+ ·15	+ ·08	...	+ ·08
104	+ ·39	...	+ ·39	− ·15	...	− ·15	− ·24	...	− ·24
105	− ·20	...	− ·20	+ ·14	...	+ ·14	+ ·06	...	+ ·06
106	+ ·33	...	+ ·33	− ·07	...	− ·07	− ·26	...	− ·26
107	+ ·35	...	+ ·35	− ·09	...	− ·09	− ·26	...	− ·26
108	− ·32	...	− ·32	+ ·28	...	+ ·28	+ ·04	...	+ ·04
109	− ·29	...	− ·29	+ ·24	...	+ ·24	+ ·05	...	+ ·05
110	+ ·42	...	+ ·42	− ·05	...	− ·05	− ·37	...	− ·37
111	− ·25	...	− ·25	+ ·24	...	+ ·24	+ ·01	...	+ ·01
112	+ ·33	...	+ ·33	− ·01	...	− ·01	− ·32	...	− ·32
113	− ·18	...	− ·18	+ ·27	...	+ ·27	− ·09	...	− ·09
114	+ ·11	...	+ ·11	+ ·07	...	+ ·07	− ·18	...	− ·18
115	− ·08	...	− ·08	+ ·25	...	+ ·25	− ·17	...	− ·17
116	+ ·03	...	+ ·03	+ ·10	...	+ ·10	− ·13	...	− ·13
117	− ·04	...	− ·04	+ ·14	...	+ ·14	− ·10	...	− ·10
118	+ ·05	...	+ ·05	+ ·16	...	+ ·16	− ·21	...	− ·21
119	+ ·02	...	+ ·02	+ ·24	...	+ ·24	− ·26	...	− ·26
120	+ ·02	+ 0·01	+ ·03	+ ·14	− 0·01	+ ·13	− ·16	...	− ·16

No. of Circuit Triangle	x			y			z		
	1	2	3	1	2	3	1	2	3
	"	"	"	"	"	"	"	"	"
121	− 0·07	− 0·01	− 0·08	+ 0·23	...	+ 0·23	− 0·16	+ 0·01	− 0·15
122	+ ·08	+ ·01	+ ·09	+ ·30	− 0·01	+ ·29	− ·38	...	− ·38
123	− ·09	− ·01	− ·10	+ ·35	...	+ ·35	− ·26	+ ·01	− ·25
124	+ ·05	+ ·02	+ ·07	+ ·27	− ·01	+ ·26	− ·32	− ·01	− ·33
125	− ·13	...	− ·13	− ·35	...	− ·35	+ ·48	...	+ ·48
126	·00	...	·00	− ·39	...	− ·39	+ ·39	...	+ ·39
127	− ·29	...	− ·29	− ·18	...	− ·18	+ ·47	...	+ ·47
128	+ ·18	...	+ ·18	− ·17	...	− ·17	− ·01	...	− ·01
129	+ ·21	...	+ ·21	− ·17	...	− ·17	− ·04	...	− ·04
130	− ·26	...	− ·26	− ·07	...	− ·07	+ ·33	...	+ ·33
131	+ ·31	...	+ ·31	− ·19	...	− ·19	− ·12	...	− ·12
132	− ·28	...	− ·28	+ ·11	...	+ ·11	+ ·17	...	+ ·17
133	+ ·26	...	+ ·26	− ·13	...	− ·13	− ·13	...	− ·13
134	− ·30	...	− ·30	+ ·13	...	+ ·13	+ ·17	...	+ ·17
135	− ·48	...	− ·48	+ ·51	...	+ ·51	− ·03	...	− ·03
136	+ ·48	+ ·02	+ ·50	+ ·09	− ·01	+ ·08	− ·57	− ·01	− ·58
137	− ·18	− ·02	− ·20	+ ·66	+ ·01	+ ·67	− ·48	+ ·01	− ·47
138	+ ·08	...	+ ·08	+ ·14	...	+ ·14	− ·22	...	− ·22
139	+ ·23	+ ·01	+ ·24	+ ·18	...	+ ·18	− ·41	− ·01	− ·42
140	− ·27	− ·01	− ·28	+ ·36	+ ·01	+ ·37	− ·09	...	− ·09
141	+ ·14	+ ·01	+ ·15	+ ·21	...	+ ·21	− ·35	− ·01	− ·36
142	− ·08	− ·01	− ·09	+ ·33	+ ·01	+ ·34	− ·25	...	− ·25
143	− ·08	...	− ·08	+ ·33	...	+ ·33	− ·25	...	− ·25
144	− ·01	...	− ·01	+ ·30	+ ·01	+ ·31	− ·29	− ·01	− ·30
145	+ ·26	+ ·01	+ ·27	+ ·15	...	+ ·15	− ·41	− ·01	− ·42
146	− ·22	− ·02	− ·24	+ ·43	+ ·01	+ ·44	− ·21	+ ·01	− ·20
147	+ ·11	+ ·01	+ ·12	+ ·21	...	+ ·21	− ·32	− ·01	− ·33
148	+ ·02	...	+ ·02	+ ·18	...	+ ·18	− ·20	...	− ·20
149	− ·05	− ·01	− ·06	+ ·37	+ ·01	+ ·38	− ·32	...	− ·32
150	− ·06	...	− ·06	+ ·32	...	+ ·32	− ·26	...	− ·26

No. of Circuit Triangle	x			y			z		
	1	2	3	1	2	3	1	2	3
	″	″	″	″	″	″	″	″	″
151	+ 0·11	...	+ 0·11	+ 0·15	...	+ 0·15	− 0·26	...	− 0·26
152	− ·06	...	− ·06	+ ·40	...	+ ·40	− ·34	...	− ·34
153	− ·14	...	− ·14	+ ·28	...	+ ·28	− ·14	...	− ·14
154	− ·06	− 0·01	− ·07	+ ·52	...	+ ·52	− ·46	+ 0·01	− ·45
155	+ ·28	− ·01	+ ·27	+ ·22	...	+ ·22	− ·50	+ ·01	− ·49
156	·00	...	·00	+ ·16	...	+ ·16	− ·16	...	− ·16
157	− ·14	+ ·01	− ·13	+ ·30	− 0·01	+ ·29	− ·16	...	− ·16
158	− ·04	...	− ·04	+ ·22	...	+ ·22	− ·18	...	− ·18
159	+ ·01	+ ·01	+ ·02	+ ·39	− ·01	+ ·38	− ·40	...	− ·40
160	+ ·02	− ·01	+ ·01	+ ·25	...	+ ·25	− ·27	+ ·01	− ·26
161	+ ·06	...	+ ·06	+ ·21	...	+ ·21	− ·27	...	− ·27
162	− ·11	...	− ·11	+ ·28	...	+ ·28	− ·17	...	− ·17
163	− ·12	...	− ·12	+ ·34	...	+ ·34	− ·22	...	− ·22
164	+ ·10	...	+ ·10	+ ·27	...	+ ·27	− ·37	...	− ·37
165	− ·02	...	− ·02	+ ·22	...	+ ·22	− ·20	...	− ·20
166	+ ·16	...	+ ·16	+ ·20	...	+ ·20	− ·36	...	− ·36
167	− ·16	...	− ·16	+ ·31	...	+ ·31	− ·15	...	− ·15
168	·00	+ ·01	+ ·01	+ ·40	− ·01	+ ·39	− ·40	...	− ·40
169	+ ·11	− ·01	+ ·10	+ ·25	...	+ ·25	− ·36	+ ·01	− ·35
170	+ ·04	+ ·01	+ ·05	+ ·15	− ·01	+ ·14	− ·19	...	− ·19
171	− ·07	− ·01	− ·08	+ ·40	...	+ ·40	− ·33	+ ·01	− ·32
172	+ ·19	+ ·01	+ ·20	+ ·30	− ·01	+ ·29	− ·49	...	− ·49

17.

The Final Results of the Simultaneous Reduction.

The values of the Angular Errors, given in Section 16, are—except in so far as they have been altered as shewn in that section—the results of the general solution of the problem that was presented by the South-West Quadrilateral. The errors were severally applied, with changed signs, to the values of the figurally corrected angles which are given in Section 8, and corresponding corrections were obtained to the logarithmic lengths of the sides of the circuit triangles which are given in that section. The corrections to the sides and angles were then introduced into the several geodetic calculations, from which the values of Latitude, Longitude and Azimuth, for the stations on the line of traverse, had been obtained, as given in Section 9.

After all the corrections had been applied, the residual differences between the computed and fixed values and between the linear and the geodetic values deduced for the circuits—at the junctions of their right and left-hand branches respectively—were found to be very small. Thus the difference between the two logarithmic values of length, for any side of circuit-junction, in no case exceeds ·000,000,05 and in one instance is *nil* to the 8th place of decimals, notwithstanding that logarithm tables to 7 places only had been used in the calculations; and the difference in latitude, longitude and azimuth, at the closing station of any circuit, never exceeds 0″·005.

As regards the magnitudes of the angular errors which are given in Section 16, it will be seen that they are generally small. Their total number is 516 of which 103 are between 0″·0 and 0″·1; 115 between 0″·1 and 0″·2; 109 between 0″·2 and 0″·3; 78 between 0″·3 and 0″·4; 31 between 0″·4 and 0″·5; 23 between 0″·5 and 0″·6; 13 between 0″·6 and 0″·7; 3 between 0″·7 and 0″·8; 6 between 0″·8 and 0″·9; 4 between 0″·9 and 1″·0; 20 between 1″·0 and 2″·0; 9 between 2″·0 and 3″·0; and 2 between 3″·0 and 4″·0.

The final values of the lengths and azimuths of the sides, and of the latitudes and longitudes of the stations at the junctions of the circuits,—as computed after all the angles had been given corrections corresponding to the errors tabulated in Section 16—are shewn below, in contrast with the two primary values which had been respectively given by the right and left-hand branches of the uncorrected circuits. It will be seen that in six cases the final value is intermediate between the two primary values, while in six cases it falls outside both of them.

Linear and Geodetic Values at the Sides and Stations of the Circuit-Junctions.

	Logarithmic Length.	*Azimuth.*	*Latitude.*	*Longitude.*
Circuit *II.*	*Side Patángri-Bhor or XIII–XVII.*		*Station Patángri or XIII.*	
		° ′ ″	° ′ ″	° ′ ″
Right branch	4·905,5434,3	16 47 27·336	22 52 15·671	73 55 49·563
Left "	646,8	34·449	15·603	49·156
Final	378,8	29·94	15·70	49·52
Circuit *IV.*	*Side Mirzápur-Wastrál or XVI–XVIII.*		*Station Mirzápur or XVI.*	
Right branch	4·749,2162,0	91 4 29·147	22 59 17·859	72 52 34·695
Left "	347,9	26·190	17·708	34·708
Final	281,3	30·25	17·79	34·70
Circuit *V.*	*Side Monába-Wándia or XII–XIV.*		*Station Monába or XII.*	
Right branch	4·828,9265,7	80 25 20·028	23 16 35·909	70 51 11·778
Left "	327,9	16·982	35·770	11·850
Final	333,4	22·75	35·86	11·75

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 42) 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 adopted side of junction in azimuth is Karsod–Indráwan for G_1, G_2 and K_1, and Chalarwa–Sápakra for J_2 and K_3. The arc-length of each chain in latitude and longitude is also given, Karsod being adopted as the station of junction of chains G_1, G_2 and K_1, and Chalarwa as that of chains J_2 and K_3.

Apportionment of Error.

Chain of Triangles	Linear		Azimuthal		Arc-length in		Errors in	
	No. of included Triangles	Error in millionth parts of side-length	No. of Circuit Triangles	Error	Latitude	Longitude	Latitude	Longitude
				″	° ′ ″	° ′ ″	″	″
G_1	11	+51·3	11	+ 4·989	1 3 35·43	0 27 56·86	−0·158	−0·030
G_2	20	− 7·5	20	−12·797	3 56 5·96	0 33 39·72	− ·477	− ·536
H_1	15	+12·8	15	− 2·602	1 39 32·29	0 3 39·11	− ·033	+ ·045
H_2	21	− 6·5	21	− 4·115	3 55 29·81	0 13 39·22	− ·404	+ ·021
I	14	−27·4	14	− 1·093	1 25 41·98	0 20 4·84	+ ·070	− ·004
J_1	11	−15·6	11	− 2·719	1 24 58·33	0 15 59·25	+ ·054	+ ·030
J_2	6	−10·8	6	− 0·378	0 19 15·04	0 14 29·33	+ ·029	+ ·030
K_1	10	+10·4	10	− 0·479	0 14 30·78	1 32 23·18	+ ·061	− ·331
K_2	18	+ 2·6	13	− 1·453	0 7 2·09	1 3 14·82	− ·050	− ·037
K_3	19	+15·4	19	− 5·048	0 1 56·98	1 46 53·62	− ·125	+ ·133
L	38	+74·8	38	− 1·191	1 37 10·84	2 55 12·10	+ ·004	− ·283

CHAPTER IV.

THE NON-CIRCUIT TRIANGLES.

The final Figural Adjustments of the Non-Circuit Triangles.

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 30—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 chapter. 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, to furnish the necessary equations of condition for reducing the angles.

The number of equations in each group ranges from 2 to 13. When only two presented themselves 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 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.

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* Among the non-circuit triangles have been reckoned the following, *viz.*, Nos. 230 to 251, which form a pendent to the South-West Quadrilateral and after the final reduction only experienced small linear changes, due to changes of side on which they depended. No angular changes were required and they do not therefore appear in this chapter.

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	6	7	8	10	12	13	Groups	Triangles
	Number of Groups										
Khánpisura Meridional	5	...	3	...	1	1	...	...	...	10	18
Singi "	5	1	...	...	...	...	1	1	...	8	17
Abu "	...	...	3	...	...	...	...	...	...	3	6
Kattywar "	2	...	2	...	1	...	...	...	1	6	16
Guzerat Longitudinal	1	...	1	...	...	...	...	...	...	2	3
Cutch Coast	5	...	5	1	1	1	...	...	...	13	26
Totals ...	18	1	14	1	3	2	1	1	1	42	86

The 42 groups involve 258 angles, or nearly one-third of the whole of the angles contained in the South-West Quadrilateral; the magnitudes of the final corrections and the number of the corrections of each magnitude are as follows:—less than 0″·1, 44; between 0″·1 and 0″·2, 33; between 0″·2 and 0″·3, 29; between 0″·3 and 0″·4, 26; between 0″·4 and 0″·5, 25; between 0″·5 and 0″·6, 17; between 0″·6 and 0″·7, 6; between 0″·7 and 0″·8, 14; between 0″·8 and 0″·9, 10; between 0″·9 and 1″·0, 2; between 1″·0 and 2″·0, 35; between 2″·0 and 3″·0, 10; and 7 in excess of 3″·0.

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 53 to 59, and in the same terms 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 the 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 3rd 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 2, a pentagon (see Reduction Chart and Khánpisura Meridional Series, Plate 1) of which the three triangles 3, 4 and 5 were fixed by the Circuit chains; triangles 174 and 175 have now to be adjusted. The constants known are, sides I to III and III to V and the angle contained between them as given on page 119; hence the equations to be satisfied are, 2 triangular, 1 central and 1 side. Stated symbolically they are:—

Triangular $\left\{ \begin{array}{l} x_{13} + x_{14} + x_{15} = e_1 \\ x_{10} + x_{11} + x_{12} = e_2 \end{array} \right.$

Central . . . $x_{13} + x_{10} = e_3$

Side . . . . t.d. log. sin 15 $\times x_{15}$ — t.d. log. sin 14 $\times x_{14}$ + t.d. log. sin 12 $\times x_{12}$ — t.d. log. sin 11 $\times x_{11} = e_4$

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 174 and 175) are each = 0;

$$e_3 = \left\{ \begin{array}{r} 176^\circ\ 34'\ 8''\cdot26 \\ -\ 176\ \ 34\ \ 5\ \cdot77 \end{array} \right\} \begin{array}{l} \text{. . . Angles 13 + 10 of Triangles 174 and 175, p. 118,} \\ \text{. . . } 360^\circ - \text{Angles 1 + 4 + 7 of Triangles 3, 4 and 5, pp. 55—}a \text{ and 56—}a, \end{array}$$

$= +\ 2''\cdot49$;

$$e_4 = 10{,}000{,}000 \left\{ \begin{array}{l} \{\text{log. [III to V]} - \text{log. [I to III]}\} \\ -\{\text{log. [III to V]} - \text{log. [I to III]}\} \end{array} \right\} \begin{array}{l} \text{. . Triangles 174 and 175, p. 118,} \\ \text{. . " 8 and 5, pp. 55—}a \text{ and 56—}a, \end{array}$$

$= 10{,}000{,}000 \left\{ (5\cdot0905299{,}6 - 5\cdot0067045{,}5) - (5\cdot0905099{,}5 - 5\cdot0066897{,}4) \right\}$

$= +\ 52\cdot0.$

Example 2.—Figure 3 is a double polygon (see Reduction Chart and Khánpisura Meridional Series, Plate 1). Triangles 6 to 11 were fixed by the Circuit chains; triangles 176 to 178 have now to be adjusted. The constants known and the symbolical expressions of the equations are given in full on pages 119 and 120, and need not be repeated here. Stated generally, the equations to be satisfied are, 3 triangular, 2 central and 2 side. The absolute terms are found as follows, the *variables* in all cases being taken from this Chapter and the *constants* from the final results of the Simultaneous Reduction.

Triangular . . . e_1, e_2 and e_3 (the errors of triangles 176 to 178) are each = 0;

Central

$$e_4 = \left\{ \begin{array}{r} 199^\circ\ 44'\ 16''\cdot92 \\ -\ 199\ \ 44\ \ 17\ \cdot56 \end{array} \right\} \begin{array}{l} \text{. . . Angles 4 + 7 of Triangles 176 and 177, p. 118,} \\ \text{. . . } 360^\circ - \text{Angles 1 + 13 + 10 of Triangles 6 to 8, p. 56—}a, \end{array}$$

$= -\ 0''\cdot64$;

$$e_5 = \left\{ \begin{array}{r} 97^\circ\ 41'\ 2''\cdot03 \\ -\ 97\ \ 41\ \ 1\ \cdot21 \end{array} \right\} \begin{array}{l} \text{. . . Angles 9 + 16 of Triangles 177 and 178, p. 118,} \\ \text{. . . } 360^\circ - \text{Angles 11 + 25 + 22 + 19 of Triangles 8 to 11, p. 56—}a, \end{array}$$

$= +\ 0''\cdot82$;

Side

$$e_6 = 10{,}000{,}000 \left\{ \begin{array}{l} \{\text{log. [VII to IX]} - \text{log. [VI to VII]}\} \\ -\{\text{log. [VII to IX]} - \text{log. [VI to VII]}\} \end{array} \right\} \begin{array}{l} \text{Triangles 176 and 177, p. 118,} \\ \text{" 6 and 8, p. 56—}a, \end{array}$$

$= 10{,}000{,}000 \left\{ (4\cdot9202612{,}2 - 5\cdot0920766{,}2) - (4\cdot9202418{,}1 - 5\cdot0920594{,}6) \right\}$

$= +\ 22\cdot5$;

$$e_7 = 10{,}000{,}000 \left\{ \begin{array}{l} \{\text{log. [IX to XIII]} - \text{log. [VII to IX]}\} \\ -\{\text{log. [IX to XIII]} - \text{log. [VII to IX]}\} \end{array} \right\} \begin{array}{l} \text{Triangles 177 and 178, p. 118,} \\ \text{" 8 and 11, p. 56—}a, \end{array}$$

$= 10{,}000{,}000 \left\{ (5\cdot1363297{,}7 - 4\cdot9202612{,}2) - (5\cdot1363074{,}8 - 4\cdot9202418{,}1) \right\}$

$= +\ 28\cdot8.$

Thus the whole of the principal triangulation of the South-West 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 $55_{—G}$, $53_{—H}$, $27_{—I}$, $64_{—J}$, $49_{—K}$ and $71_{—L}$.

Khánpisura 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	173	3	XXIV*	43 51 11·40	·45	4·9906136,0	6	182	3	G XX	36 51 4·56	1·85	5·1477822,3
		4+5	XXI*	109 52 18·10	·46	5·1233363,5			4+5	XIX	97 16 56·76	1·85	5·3663018,3
		6	G I	26 16 30·50	·45	4·7960898,2			6	XXI	45 51 58·68	1·85	5·2257725,2
2	174	15	I	49 49 10·24	1·01	5·1007820,3	7	183	3	XXII	38 35 8·94	1·99	5·1926620,9
		13	III	92 12 47·37	1·01	5·2173556,6			2+20	XXI	100 6 57·71	2·00	5·3908915,4
		14	*IV*	37 58 2·39	1·01	5·0067045,5			19	XXIV	41 17 53·35	2·00	5·2172251,9
"	175	12	*IV*	47 4 33·89	1·22	5·0905299,6	"	184	6	XXII	44 52 42·41	2·68	5·2257966,1
		10	III	84 21 18·66	1·22	5·2237543,7			5	XXIII	71 27 24·31	2·69	5·3540817,0
		11	V	48 34 7·45	1·22	5·1007820,3			7	*XXV*	63 39 53·28	2·69	5·3296467,3
3	176	5	VI	16 59 22·51	·47	4·7786289,6	"	185	9	*XXV*	42 38 37·79	1·96	5·1708981,0
		4	VII	126 2 38·48	·48	5·2206668,7			8	XXIII	87 7 1·25	1·97	5·3394780,1
		6	*XI*	36 57 59·01	·47	5·0920766,2			10	XXVII	50 14 20·96	1·96	5·2257966,1
"	177	7	VII	73 41 37·58	·38	4·9440159,0	8	186	15	XXVI	41 43 26·27	1·72	5·1203606,8
		8	*XI*	65 19 28·67	·38	4·9202612,2			13	XXVIII	80 23 0·73	1·73	5·2910388,5
		9	IX	40 58 53·75	·38	4·7786289,5			14	*XXIX*	57 53 33·00	1·72	5·2250951,3
"	178	17	*XI*	83 38 7·60	·80	5·1363297,7	"	187	10	XXVIII	67 22 45·29	1·42	5·1911689,0
		16	IX	56 42 7·11	·79	5·0611308,0			12	*XXIX*	60 58 26·39	1·41	5·1676438,1
		18	XIII	39 39 45·29	·79	4·9440159,0			11	XXXI	51 38 48·32	1·41	5·1203606,8
4	179	18	XII	44 16 32·03	1·34	5·0806303,0	"	188	27	*XXIX*	47 39 9·89	1·80	5·1719015,9
		16	XIV	56 44 49·09	1·34	5·1590462,7			25	XXXI	81 45 32·58	1·81	5·2987047,7
		17	*XV*	78 58 38·88	1·35	5·2286197,9			26	*XXXII*	50 35 17·53	1·80	5·1911689,0
"	180	15	*XV*	52 47 42·84	1·27	5·1307454,5	"	189	24	*XXXII*	51 39 23·75	2·23	5·2799257,8
		13	XIV	81 59 46·64	1·27	5·2253196,0			22	XXXI	90 38 19·36	2·24	5·3854129,0
		14	XVII	45 12 30·52	1·27	5·0806303,0			23	XXXIII	37 42 16·89	2·23	5·1719015,9
5	181	4	XVII	39 20 40·22	2·17	5·1635695,7	9	190	3	XXXIV	32 50 44·68	1·41	5·0745062,5
		2+3	XVIII	84 57 43·94	2·18	5·3598118,9			4+5	XXXIII	102 23 38·36	1·41	5·3299621,3
		1	XX	55 41 35·84	2·17	5·2784898,6			6	XXIII†	44 45 36·96	1·41	5·1878634,9

* These stations appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.
† This station appertains to the Bombay Longitudinal Series of the Southern Trigon.

Khánpisura Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 1.

Triangle 173.

Constants (from page 55—$_G$).

Sides.						Angle.
XXIV	to	XXI	Log. feet	4·7960898,2	4+5	109° 52′ 18″·44
XXI	„	I	„	4·9906041,7		

Equations to be satisfied.	Adopted Errors.
$x_3 + x_6 = -\cdot 12$	$x_3 = +1''\cdot 38$
$22\,x_3 - 42\,x_6 = +94\cdot 3$	$x_6 = -1\cdot 50$

Figure 2.

Triangles 174 and 175.

Constants (from pages 55—$_G$ and 56—$_G$).

Sides.						Angle.
I	to	III	Log. feet	5·0066897,4	13+10	176° 34′ 5″·77
III	„	V	„	5·0905099,5		

Equations to be satisfied.

						Factors.
x_{13}	$+\ x_{14}$	$+\ x_{15}$	...	$= e_1$	$= \cdot 00,$	λ_1
x_{10}	$+\ x_{11}$	$+\ x_{12}$	...	$= e_2$	$= \cdot 00,$	λ_2
x_{13}	$+\ x_{10}$	...	...	$= e_3$	$= +\ 2\cdot 49,$	λ_3
$18\,x_{15}$	$-27\,x_{14}$	$+19\,x_{12}$	$-19\,x_{11}$	$= e_4$	$= +52\cdot 0,$	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	·00	+3	...	+1	−9	$\lambda_1 = -\ \cdot 5227$	$x_{10} = +1''\cdot 21$	$x_{13} = +1''\cdot 28$
2	·00		+3	+1	0	$\lambda_2 = -\ \cdot 6025$	$x_{11} = -1\cdot 12$	$x_{14} = -1\cdot 24$
3	+ 2·49			+2	...	$\lambda_3 = +\ 1\cdot 8076$	$x_{12} = -\ \cdot 09$	$x_{15} = -\ \cdot 04$
4	+52·0		*		+1775	$\lambda_4 = +\ \cdot 0266$		

Figure 3.

Triangles 176 to 178.

Constants (from page 56—$_G$).

Sides.						Angles.
VI	to	VII	Log. feet	5·0920594,6	4+7	199° 44′ 17″·56
VII	„	IX	„	4·9202418,1	9+16	97 41 1·21
IX	„	XIII	„	5·1363074,8		

* 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.

Khánpisura Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 3—(Continued).

Equations to be satisfied.

								Factors.
x_4	$+ x_5$	$+ x_6$	...	...	...	$= e_1 =$	$\cdot 00$,	λ_1
x_7	$+ x_8$	$+ x_9$	...	...	...	$= e_2 =$	$\cdot 00$,	λ_2
x_{16}	$+ x_{17}$	$+ x_{18}$	...	...	...	$= e_3 =$	$\cdot 00$,	λ_3
x_4	$+ x_7$	...	...	...	...	$= e_4 =$	$- \cdot 64$,	λ_4
x_9	$+ x_{16}$	...	...	...	...	$= e_5 =$	$+ \cdot 82$,	λ_5
$68 x_5$	$- 28 x_6$	$+ 10 x_8$	$- 24 x_9$	...	...	$= e_6 =$	$+ 22 \cdot 5$,	λ_6
$6 x_7$	$- 10 x_8$	$+ 2 x_{17}$	$- 26 x_{18}$	...	...	$= e_7 =$	$+ 28 \cdot 8$,	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	·00	+3	...	...	+1	...	+ 40	...	$\lambda_1 = + \cdot 1775$		
2	·00		+3	...	+1	+1	− 14	− 4	$\lambda_2 = + \cdot 2910$	$x_4 = -'' \cdot 54$	$x_9 = +'' \cdot 30$
3	·00			+3	...	+1	...	− 24	$\lambda_3 = + \cdot 3910$	$x_5 = + \cdot 49$	$x_{16} = + \cdot 52$
4	− ·64				+2	...	...	+ 6	$\lambda_4 = - \cdot 7164$	$x_6 = + \cdot 05$	$x_{17} = + \cdot 50$
5	+ ·82			*		+2	− 24	...	$\lambda_5 = + \cdot 1242$	$x_7 = - \cdot 10$	$x_{18} = -1 \cdot 02$
6	+22·5						+6084	−100	$\lambda_6 = + \cdot 0046$	$x_8 = - \cdot 20$	
7	+28·8							+816	$\lambda_7 = + \cdot 0541$		

Figure 4.

Triangles 179 and 180.

Constants (from page 57—G).

Sides.						Angle.
XII	to	XIV	Log. feet	5·2285994,3	16+13	138° 44′ 36″·53
XIV	„	XVII	„	5·1307296,3		

Equations to be satisfied.

						Factors.
x_{16}	$+ x_{17}$	$+ x_{18}$	...	$= e_1 =$	$\cdot 00$,	λ_1
x_{13}	$+ x_{14}$	$+ x_{15}$	...	$= e_2 =$	$\cdot 00$,	λ_2
x_{16}	$+ x_{13}$	...	...	$= e_3 =$	$+ 1 \cdot 81$,	λ_3
$21 x_{18}$	$- 4 x_{17}$	$+ 16 x_{15}$	$- 21 x_{14}$	$= e_4 =$	$- 45 \cdot 4$,	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	$\lambda_1 = - \cdot 1958$	$x_{13} = +'' \cdot 76$	$x_{16} = + 1'' \cdot 05$
2	·00		+3	+1	− 5	$\lambda_2 = - \cdot 4782$	$x_{14} = + \cdot 33$	$x_{17} = - \cdot 05$
3	+ 1·81			+2	...	$\lambda_3 = + 1 \cdot 2420$	$x_{15} = - 1 \cdot 09$	$x_{18} = - 1 \cdot 00$
4	−45·4		*		+1154	$\lambda_4 = - \cdot 0385$		

Khánpisura Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 5.

Triangle 181.

Constants (from page 57—G).

Sides.						Angle.
XVII	to	XVIII	Log. feet	5·2784758,4	2+3	84° 57′ 46″·36
XVIII	„	XX	„	5·1635562,2		

Equations to be satisfied.					Adopted Errors.		
x_1	+ x_4	=	+ ·24		x_1	=	+ ″·32
$26\,x_4$	− $15\,x_1$	=	− 6·7		x_4	=	− ·08

Figure 6.

Triangle 182.

Constants (from page 57—G).

Sides.						Angle.
XX	to	XIX	Log. feet	5·2257597,2	4+5	97° 16′ 58″·93
XIX	„	XXI	„	5·1477707,3		

Equations to be satisfied.					Adopted Errors.		
x_3	+ x_6	=	+ ·32		x_3	=	− ″·14
$28\,x_3$	− $20\,x_6$	=	− 13·0		x_6	=	+ ·46

Figure 7.

Triangle 183.

Constants (from pages 57—G and 58—G).

Sides.						Angle.
XXII	to	XXI	Log. feet	5·2172132,3	2+20	100° 6′ 59″·40
XXI	„	XXIV	„	5·1926514,3		

Equations to be satisfied.					Adopted Errors.		
x_3	+ x_{19}	=	− ·31		x_3	=	− ″·40
$26\,x_3$	− $24\,x_{19}$	=	− 13·0		x_{19}	=	+ ·09

Figure 7—(Continued).

Triangles 184 and 185.

Constants (from page 58—G).

Sides.						Angle.
XXII	to	XXIII	Log. feet	5·3296345,6	5+8	158° 34′ 28″·69
XXIII	„	XXVII	„	5·1708844,0		

Khánpisura Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 7—(Continued).

Equations to be satisfied.

					Factors.
x_5	$+ x_6$	$+ x_7$	...	$= e_1 = \cdot 00,$	λ_1
x_8	$+ x_9$	$+ x_{10}$	...	$= e_2 = \cdot 00,$	λ_2
x_5	$+ x_8$	...	...	$= e_3 = + 1 \cdot 53,$	λ_3
$21 x_6$	$- 10 x_7$	$+ 23 x_9$	$- 18 x_{10}$	$= e_4 = + 15 \cdot 3,$	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	·00	+ 3	...	+ 1	+ 11	$\lambda_1 = - \cdot 4635$	$x_5 = + {}'' \cdot 75$; $x_8 = + {}'' \cdot 78$
2	·00		+ 3	+ 1	+ 5	$\lambda_2 = - \cdot 4311$	$x_6 = - \cdot 12$; $x_9 = - \cdot 05$
3	+ 1·53			+ 2	...	$\lambda_3 = + 1 \cdot 2123$	$x_7 = - \cdot 63$; $x_{10} = - \cdot 73$
4	+ 15·3		*		+ 1394	$\lambda_4 = + \cdot 0162$	

Figure 8.

Triangles 186 to 189.

Constants (from pages $58_{—G}$ and $59_{—G}$).

Sides.						Angles.
XXVI	to	XXVIII	Log. feet	5·2250844,7	13 + 10	147° 45′ 51″·47
XXVIII	„	XXXI	„	5·1676370,0	11 + 25 + 22	224 2 48 ·55
XXXI	„	XXXIII	„	5·2799183,0		

Equations to be satisfied.

							Factors.
x_{13}	$+ x_{14}$	$+ x_{15}$	...	...	...	$= e_1 = \cdot 00,$	λ_1
x_{10}	$+ x_{11}$	$+ x_{12}$	...	...	...	$= e_2 = \cdot 00,$	λ_2
x_{25}	$+ x_{26}$	$+ x_{27}$	...	...	...	$= e_3 = \cdot 00,$	λ_3
x_{22}	$+ x_{23}$	$+ x_{24}$	...	...	...	$= e_4 = \cdot 00,$	λ_4
x_{13}	$+ x_{10}$	...	...	...	...	$= e_5 = - 2 \cdot 30,$	λ_5
x_{11}	$+ x_{25}$	$+ x_{22}$	...	...	...	$= e_6 = - 2 \cdot 83,$	λ_6
$24 x_{15}$	$- 13 x_{14}$	$+ 12 x_{12}$	$- 17 x_{11}$	...	...	$= e_7 = - 38 \cdot 5,$	λ_7
$9 x_{10}$	$- 12 x_{12}$	$+ 19 x_{27}$	$- 17 x_{26}$	$+ 17 x_{24}$	$- 28 x_{23}$	$= e_8 = + 6 \cdot 7,$	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	·00	+ 3	...	...	...	+ 1	...	+ 11	...	$\lambda_1 = + 1 \cdot 1047$	$x_{10} = - {}'' \cdot 85$; $x_{22} = - 1'' \cdot 54$
2	·00		+ 3	...	...	+ 1	+ 1	− 5	− 3	$\lambda_2 = + 1 \cdot 5538$	$x_{11} = + \cdot 32$; $x_{23} = + \cdot 40$
3	·00			+ 3	...	...	+ 1	...	+ 2	$\lambda_3 = + \cdot 7900$	$x_{12} = + \cdot 53$; $x_{24} = + 1 \cdot 14$
4	·00				+ 3	...	+ 1	...	− 11	$\lambda_4 = + \cdot 8619$	$x_{13} = - 1 \cdot 45$; $x_{25} = - 1 \cdot 61$
5	− 2·30					+ 2	...	...	+ 9	$\lambda_5 = - 2 \cdot 5540$	$x_{14} = + 1 \cdot 98$; $x_{26} = + \cdot 49$
6	− 2·83			*			+ 3	− 17	...	$\lambda_6 = - 2 \cdot 4032$	$x_{15} = - \cdot 53$; $x_{27} = + 1 \cdot 12$
7	−38·5							+ 1178	− 144	$\lambda_7 = - \cdot 0691$	
8	+ 6·7								+ 1948	$\lambda_8 = + \cdot 0166$	

Khánpisura Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 9.

Triangle 190.

Constants (from page 59—$_G$).

Sides.						Angle.
XXXIV	to	XXXIII	Log. feet	5·1878534,6	4+5	102° 23′ 33″·98
XXXIII	„	XXIII	„	5·0745026,5		

Equations to be satisfied. Adopted Errors.

$$x_3 + x_6 = -5{\cdot}79 \qquad x_3 = -3''{\cdot}49$$
$$32\,x_3 - 21\,x_6 = -64{\cdot}3 \qquad x_6 = -2{\cdot}30$$

Singi 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
				° ′ ″	″						° ′ ″	″	
10	191	15 13+14 12	H XIII XIV XVIII	38 36 2·27 95 10 2·91 46 13 54·82	·44 ·44 ·44	4·8418842,1 5·0450087,3 4·9054020,5	14	200	19 20 21	H XXXIV *XXXVI* XXXIX	81 16 28·48 41 46 46·63 56 56 44·89	3·48 3·48 3·48	5·4461945,1 5·2748985,2 5·3745744,2
„	192	11 9 10	XVIII XIV XVI	64 44 31·79 76 1 13·43 39 14 14·78	·53 ·53 ·53	4·9971582,7 5·0277419,0 4·8418842,1	„	201	41 40 42	*XXXVI* XXXIX *XL*	61 39 30·20 52 58 30·42 65 21 59·38	4·76 4·76 4·77	5·4321824,5 5·3898406,6 5·4461945,1
11	193	5 6+7 8	XVII XIX XX	48 19 59·44 97 58 8·74 33 41 51·82	·51 ·52 ·51	4·9741294,7 5·0965810,1 4·8449407,5	„	202	44 43 45	*XL* XXXIX XXX	50 11 58·19 69 3 34·80 60 44 27·01	4·75 4·75 4·75	5·3769762,8 5·4617829,8 5·4321824,5
12	194	11 *a* 10	XIX XXI XXII	38 20 58·94 108 43 44·46 32 55 16·60	·34 ·34 ·33	4·8552281,4 5·0388864,8 4·7977031,2	„	203	27 25 26	XXXV XXXIV *XXXVII*	29 44 3·29 48 14 8·67 102 1 48·04	1·79 1·79 1·80	5·0944628,2 5·2716763,5 5·3893565,6
13	195	2 7 1+8	XXV XXVI *XXVII*	34 4 22·68 26 32 56·93 119 22 40·39	·50 ·50 ·51	4·9799550,1 4·8818483,1 5·1717936,3	„	204	22 24 23	XXXIV *XXXVII* XXXIX	50 38 32·49 88 5 0·80 41 16 26·71	1·43 1·43 1·43	5·1634348,5 5·2748985,2 5·0944628,2
„	196	8 6+7 5	*XXVII* XXVI XXIV	30 14 24·09 117 12 11·47 32 33 24·44	·60 ·60 ·60	4·9511695,6 5·1981562,2 4·9799549,9	„	205	33+34 31 35	XXXIX *XXXVII* XXXVIII	59 42 14·43 71 38 38·71 48 39 6·86	1·83 1·83 1·83	5·2241902,8 5·2652832,2 5·1634348,5
14	197	5 4 6	XXX XXXI *XXXIII*	53 50 31·08 62 45 55·68 63 23 33·24	1·89 1·89 1·89	5·1930033,0 5·2348889,6 5·2373027,2	„	206	36 37 38+39	*XXXVII* XXXVIII XXXV	98 14 24·94 43 35 11·70 38 10 23·36	2·45 2·45 2·44	5·4286665,3 5·2716763,5 5·2241902,8
„	198	8 7 9	*XXXIII* XXXI *XXXVI*	92 25 48·85 48 19 0·94 39 15 10·21	2·27 2·26 2·26	5·3913846,8 5·2649999,6 5·1930033,0	„	207	47 48+51 52	XXXIX XXX* XXVI*	53 58 23·50 78 7 36·59 47 53 59·91	4·78 4·78 4·78	5·4143966,0 5·4971942,9 5·3769762,8
„	199	10 11 12	XXXI *XXXVI* XXXIV	60 2 45·88 55 42 50·50 64 14 23·62	3·80 3·80 3·81	5·3745744,2 5·3539466,1 5·3913846,8							

NOTE.—In the column "Figural Number of Angle" the distinguishing symbol *a* is employed for angles which have not been measured and therefore had no number in the original figural reduction. * These stations appertain to the Bombay Longitudinal Series of the Southern Trigon.

Singi Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 10.

Triangle 191.

Constants (from page 54—$_H$).

Sides.						Angle.
XIII	to	XIV	log. feet	4·9053978,4	13+14	95° 10′ 2″·51
XIV	„	XVIII	„	4·8418802,4		

Equations to be satisfied.	Adopted Errors.
$x_{12} + x_{15} = -\ \cdot 84$	$x_{12} = -\ {}''\cdot 42$
$26\,x_{15} - 20\,x_{12} = -\ 2\cdot 4$	$x_{15} = -\ \cdot 42$

Figure 10—(Continued).

Triangle 192.

Constants (from pages 54—$_H$ and 55—$_H$).

Sides.						Angle.
XVIII	to	XIV	log. feet	4·8418802,4	9	76° 1′ 15″·13
XIV	„	XVI	„	4·9971557,7		

Equations to be satisfied.	Adopted Errors.
$x_{10} + x_{11} = +\ 1\cdot 17$	$x_{10} = +\ {}''\cdot 73$
$10\,x_{11} - 26\,x_{10} = -\ 14\cdot 7$	$x_{11} = +\ \cdot 44$

Figure 11.

Triangle 193.

Constants (from page 55—$_H$).

Sides.						Angle.
XVII	to	XIX	log. feet	4·8449312,2	6+7	97° 58′ 10″·25
XIX	„	XX	„	4·9741207,3		

Equations to be satisfied.	Adopted Errors.
$x_5 + x_8 = +\ \cdot 99$	$x_5 = +\ {}''\cdot 46$
$19\,x_5 - 32\,x_8 = -\ 7\cdot 9$	$x_8 = +\ \cdot 53$

Figure 12.

Triangle 194.

Constants (from page 55—$_H$).

Sides.						Angle.
XIX	to	XXI	log. feet	4·7976934,8	10	108° 43′ 44″·23
XXI	„	XXII	„	4·8552156,3		

Equations to be satisfied.	Adopted Errors.
$x_{11} + x_{12} = -\ \cdot 57$	$x_{11} = -\ {}''\cdot 74$
$27\,x_{12} - 32\,x_{11} = +\ 28\cdot 7$	$x_{12} = +\ \cdot 17$

Singi Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 13.

Triangles 195 and 196.

Constants (from page $56_{—H}$).

Sides.					Angle.
XXV to XXVI	Log. feet	5·1717813,3		6	90° 39′ 14″·81
XXVI „ XXIV	„	4·9511565,2			

Equations to be satisfied.

						Factors.
x_1	$+ x_2$	$+ x_7$	$+ x_8$	$= e_1$	$=$ ·00,	λ_1
x_5	$+ x_7$	$+ x_8$	...	$= e_2$	$= +$ ·17,	λ_2
$31 x_2$	$+ 12 (x_1 + x_8)$	$+ 36 x_8$	$- 33 x_5$	$= e_3$	$= +$ 7·6,	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	·00	+ 4	+ 2	+ 91	$\lambda_1 = -$ ·2001	$x_1 = -$ ″·14 $x_7 = -$ ″·03
2	+ ·17		+ 3	+ 15	$\lambda_2 = +$ ·1641	$x_2 = -$ ·04 $x_8 = +$ ·21
3	+ 7·6		*	+ 4498	$\lambda_3 = +$ ·0052	$x_5 = -$ ·01

Figure 14.

Triangles 197 to 202.

Constants (from pages $56_{—H}$ and $57_{—H}$).

Sides.				Angles.
XXX to XXXI	Log. feet	5·2372906,9	4 + 7 + 10	171° 7′ 50″·35
XXXI „ XXXIV	„	5·3539327,9	12 + 19	145 30 56 ·67
XXXIV „ XXXIX	„	5·2748801,2	21 + 40 + 43	178 58 59 ·50
XXXIX „ XXX†	„	5·3769684,1		

Equations to be satisfied.

								Factors.
x_4	$+ x_5$	$+ x_6$	...	...	...	$= e_1$	$=$ ·00,	λ_1
x_7	$+ x_8$	$+ x_9$	...	...	...	$= e_2$	$=$ ·00,	λ_2
x_{10}	$+ x_{11}$	$+ x_{12}$	...	...	...	$= e_3$	$=$ ·00,	λ_3
x_{19}	$+ x_{20}$	$+ x_{21}$	...	...	...	$= e_4$	$=$ ·00,	λ_4
x_{40}	$+ x_{41}$	$+ x_{42}$	...	...	...	$= e_5$	$=$ ·00,	λ_5
x_{43}	$+ x_{44}$	$+ x_{45}$	...	...	...	$= e_6$	$=$ ·00,	λ_6
x_4	$+ x_7$	$+ x_{10}$	...	...	...	$= e_7$	$= +$ ·10,	λ_7
x_{12}	$+ x_{19}$	...	...	...	...	$= e_8$	$= +$ 2·72,	λ_8
x_{21}	$+ x_{40}$	$+ x_{43}$	...	...	...	$= e_9$	$= +$ 3·60,	λ_9
$15 x_5$	$- 10 x_6$	$- x_8$	$- 25 x_9$	$+ 15 x_{11}$	$- 10 x_{12}$	$= e_{10}$	$= +$ 17·9,	λ_{10}
$12 x_{10}$	$- 15 x_{11}$	$+ 23 x_{20}$	$- 14 x_{21}$	...	...	$= e_{11}$	$= +$ 45·8,	λ_{11}
$3 x_{19}$	$- 23 x_{20}$	$+ 11 x_{41}$	$- 10 x_{42}$	$+ 18 x_{44}$	$- 12 x_{45}$	$= e_{12}$	$= -$ 105·3,	λ_{12}

† This station appertains to the Bombay Longitudinal Series of the Southern Trigon.

Singi Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 14—(Continued).

Equations between the Factors														Values of 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	...	...	+ 5	...	...	λ_1 = − ·1953
2	·00		+ 3	...	...	...	...	+ 1	...	...	− 26	...	...	λ_2 = + ·6655
3	·00			+ 3	...	...	...	+ 1	+ 1	...	+ 5	− 3	...	λ_3 = − 1·6822
4	·00				+ 3	...	...	...	+ 1	+ 1	...	+ 9	− 20	λ_4 = − 3·7178
5	·00					+ 3	...	...	...	+ 1	...	...	+ 1	λ_5 = − 1·0969
6	·00						+ 3	...	...	+ 1	...	...	+ 6	λ_6 = − ·8908
7	+ ·10							+ 3	...	...	...	+ 12	...	λ_7 = + ·1693
8	+ 2·72					*			+ 2	...	− 10	...	+ 3	λ_8 = + 4·6619
9	+ 3·60									+ 3	...	− 14	...	λ_9 = + 3·4145
10	+ 17·9										+ 1276	− 225	...	λ_{10} = + ·0833
11	+ 45·8											+ 1094	− 529	λ_{11} = + ·0670
12	− 105·3												+ 1227	λ_{12} = − ·1237

Adopted Errors

x_4 = − ″·02	x_9 = − 1″·41	x_{20} = + ″·71	x_{43} = + 2″·52
x_5 = + 1 ·05	x_{10} = − ·71	x_{21} = − 1 ·23	x_{44} = − 3 ·12
x_6 = − 1 ·03	x_{11} = − 1 ·49	x_{40} = + 2 ·31	x_{46} = + ·60
x_7 = + ·83	x_{12} = + 2 ·20	x_{41} = − 2 ·45	
x_8 = + ·58	x_{19} = + ·52	x_{42} = + ·14	

Figure 14—(Continued).

Triangles 203 to 206.

Constants (from page 56_{-H}).

Sides.						Angles.
XXXV	to	XXXIV	Log. feet	5·3893465,9	22 + 25	98° 52′ 45″·48
XXXIV	„	XXXIX	„	5·2748801,2	23 + 33	46 57 38 ·65
XXXIX	„	XXXVIII	„	5·2652770,6	35 + 37	92 14 20 ·53
					27 + 39	34 9 46 ·67

Equations to be satisfied.						Factors.
x_{25}	$+ x_{26}$	$+ x_{27}$	...	$= e_1$	= ·00,	λ_1
x_{32}	$+ x_{23}$	$+ x_{24}$	...	$= e_2$	= ·00,	λ_2
x_{31}	$+ x_{33}$	$+ x_{35}$	...	$= e_3$	= + ·28,	λ_3
x_{36}	$+ x_{37}$	$+ x_{39}$	...	$= e_4$	= + 2·03,	λ_4
x_{22}	$+ x_{25}$	...	...	$= e_5$	= − 1·10,	λ_5
x_{23}	$+ x_{33}$	...	...	$= e_6$	= − ·97,	λ_6
x_{35}	$+ x_{37}$	...	...	$= e_7$	= + 2·31,	λ_7
x_{27}	$+ x_{39}$	...	...	$= e_8$	= + 2·07,	λ_8
$36 x_{27}$	$+ 5 x_{26}$	$+ 0 x_{24}$	$- 24 x_{23}$	$= e_9$	= + 84·3,	λ_9
$17 x_{22}$	$- 0 x_{24}$	$+ 7 x_{31}$	$- 19 x_{35}$	$= e_{10}$	= − 122·4,	λ_{10}

Singi Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 14—(Continued).

Equations between the Factors												Values of 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	·00	+ 3	...	...	...	+ 1	...	...	+ 1	+ 41	...	λ_1 = − 3·1837
2	·00		+ 3	...	...	+ 1	+ 1	...	...	− 24	+ 17	λ_2 = + 2·8268
3	+ ·28			+ 3	...	...	+ 1	+ 1	...	...	− 12	λ_3 = − ·5730
4	+ 2·03				+ 3	...	...	+ 1	+ 1	...	...	λ_4 = + 3·1015
5	− 1·10					+ 2	...	...	...	...	+ 17	λ_5 = + 3·5623
6	− ·97						+ 2	...	...	− 24	...	λ_6 = + ·9514
7	+ 2·31				*			+ 2	...	...	− 19	λ_7 = − 4·5059
8	+ 2·07								+ 2	+ 36	...	λ_8 = − 2·7687
9	+ 84·3									+1897	...	λ_9 = + ·2136
10	− 122·4										+ 699	λ_{10} = − ·4628

Adopted Errors

x_{22} = − 1″·56	x_{25} = + ″·46	x_{31} = − 3″·73	x_{36} = + 3″·02
x_{23} = − 1 ·27	x_{26} = − 2 ·12	x_{33} = + ·30	x_{37} = − 1 ·40
x_{24} = + 2 ·83	x_{27} = + 1 ·66	x_{35} = + 3 ·71	x_{39} = + ·41

Figure 14—(Continued).

Triangle 207.

Constants (from page 57_{-H}).

Sides.

XXXIX	to	XXX	Log. feet	5·3769684,1
XXX	„	XXVI	„	5·4143939,5

Angle.

48 + 51 78° 7′ 43″·46

Equations to be satisfied.

x_{47} + x_{52} = + 2·09

$15x_{47}$ − $19x_{52}$ = − 52·2

Adopted Errors.

x_{47} = − ″·37

x_{52} = + 2 ·46

Abu 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	208	5	XLIII*	42 41 37·95	·83	4·9761895,0	16	211	8	I *VIII*	37 44 46·21	·39	4·7657966,7
		4	I I	53 23 16·99	·83	5·0494573,9			7	VI	68 8 5·32	·39	4·9465058,9
		6	*III*	83 55 5·06	·84	5·1424564,2			9	X	74 7 8·47	·39	4·9620278,8
„	209	8	*III*	54 11 0·22	·52	4·9171892,1	17	212	18	IX	40 36 20·12	·24	4·6955768,9
		7	I	57 33 14·75	·52	4·9345151,3			16	XI	86 12 6·50	·24	4·8811421,5
		9	V	68 15 45·03	·52	4·9761895,0			17	*XII*	53 11 33·38	·24	4·7855420,1
16	210	5	V	33 4 10·84	·99	4·9620278,8	„	213	15	*XII*	64 20 56·81	·24	4·8149573,7
		4	VI	91 40 17·40	1·00	5·2249220,7			13	XI	72 25 53·09	·25	4·8392717,2
		6	*VIII*	55 15 31·76	1·00	5·1398385,5			14	XIV	43 13 10·10	·24	4·6955768,9

* This station appertains to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Abu Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 15.

Triangles 208 and 209.

Constants (from page 27_{-I}).

Sides.					Angle.	
XLIII	to	I	Log. feet	5·1424568,8	4+7	110° 56′ 33″·80
I	„	V	„	4·9171924,5		

Equations to be satisfied. Factors.

x_4	$+ x_5$	$+ x_6$	...	$= e_1 =$	·00,	λ_1
x_7	$+ x_8$	$+ x_9$	...	$= e_2 =$	·00,	λ_2
x_4	$+ x_7$	...	...	$= e_3 =$	− ·71,	λ_3
$23 x_5$	$- 2 x_6$	$+ 15 x_8$	$- 8 x_9$	$= e_4 =$	− 27·8,	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	+ 21	$\lambda_1 = +$ ·6927	$x_4 = -$ ″·23 $x_7 = -$ ″·48
2	·00		+ 3	+ 1	+ 7	$\lambda_2 = +$ ·4351	$x_5 = -$ ·57 $x_8 = -$ ·39
3	− ·71			+ 2	...	$\lambda_3 = -$ ·9189	$x_6 = +$ ·80 $x_9 = +$ ·87
4	− 27·8		*		+ 822	$\lambda_4 = -$ ·0552	

Abu Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 16.

Triangles 210 and 211.

Constants (from page 28—I).

Sides.						Angle.
V	to	VI	Log. feet	5·1398441,8	4+7	159° 48′ 24″·35
VI	„	X	„	4·7658033,1		

Equations to be satisfied. Factors.

x_4	+	x_5	+	x_6	...	= e_1	=		·00,	λ_1
x_7	+	x_8	+	x_9	...	= e_2	=		·00,	λ_2
x_4	+	x_7		...	...	= e_3	=	−	·24,	λ_3
$33\,x_5$	−	$15\,x_6$	+	$27\,x_8$	$-\ 6\,x_9$	= e_4	=	−	10·1,	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	+ 18	$\lambda_1 = +$ ·1275	$x_4 = -$ ″·12	$x_7 = -$ ″·12
2	·00		+ 3	+ 1	+ 21	$\lambda_2 = +$ ·1348	$x_5 = -$ ·11	$x_8 = -$ ·07
3	− ·24			+ 2	...	$\lambda_3 = -$ ·2512	$x_6 = +$ ·23	$x_9 = +$ ·19
4	− 10·1		*		+ 2079	$\lambda_4 = -$ ·0073		

Figure 17.

Triangles 212 and 213.

Constants (from page 28—I).

Sides.						Angle.
IX	to	XI	Log. feet	4·7855507,0	16+13	158° 38′ 0″·94
XI	„	XIV	„	4·8149672,5		

Equations to be satisfied. Factors.

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	=	−	·86,	λ_3
$24\,x_{18}$	−	$16\,x_{17}$	+	$10\,x_{15}$	$-\ 23\,x_{14}$	= e_4	=	−	11·9,	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	+ 8	$\lambda_1 = +$ ·2326	$x_{13} = -$ ″·46	$x_{16} = -$ ″·40
2	·00		+ 3	+ 1	− 13	$\lambda_2 = +$ ·1780	$x_{14} = +$ ·36	$x_{17} = +$ ·36
3	− ·86			+ 2	...	$\lambda_3 = -$ ·6353	$x_{15} = +$ ·10	$x_{18} = +$ ·04
4	− 11·9		*		+ 1461	$\lambda_4 = -$ ·0078		

Kattywar 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	214	14	LXVI*	77 57 51·08	·40	5·0212157,9	22	222	15	J *XIII*	64 5 10·99	·41	4·9089950,1
		12	LXIV*	74 19 48·87	·40	5·0144207,8			13	XII	63 43 47·85	·41	4·9076718,7
		13	J *II*	27 42 20·05	·39	4·6982549,6			14	XV	52 11 1·16	·41	4·8526321,8
,,	215	4+8	LXIV*	71 7 37·36	·80	5·0795304,4	23	223	4+5	XVI	92 8 31·92	·24	4·9007013,6
		11	J *II*	53 2 46·12	·79	5·0061419,8			8	XV	38 48 16·14	·23	4·6980402,1
		5	I	55 49 36·52	·79	5·0212158,2			6	*XIX*	49 3 11·94	·24	4·7791358,4
,,	216	10	*II*	68 15 59·18	·76	5·0759473,6	,,	224	2	XV	46 44 25·79	·27	4·7643059,9
		6	I	42 14 36·65	·76	4·9355231,0			7	*XIX*	47 43 26·44	·27	4·7712018,5
		7+9	III	69 29 24·17	·76	5·0795304,4			1+8	XVII	85 32 7·77	·27	4·9007013,6
19	217	5	I	32 28 49·52	1·85	5·0750493,1	,,	225	10	*XIX*	57 14 31·45	·30	4·8228865,1
		6+7	IV	83 39 56·35	1·86	5·3424063,0			9	XVII	75 27 49·09	·30	4·8839792,7
		8	V	63 51 14·13	·1·85	5·2981842,2			11	*XXII*	47 17 39·46	·29	4·7643059,9
20	218	5	V	71 40 9·91	·64	5·0447410,2	,,	226	12	XVII	63 39 45·21	·24	4·8033711,5
		4	VI	65 0 34·02	·64	5·0246660,0			13	*XXII*	46 43 12·93	·24	4·7131082,8
		6	*VII*	43 19 16·07	·63	4·9037358,4			14	XX	69 37 1·86	·25	4·8228865,1
,,	219	8	*VII*	36 51 24·82	·47	4·8228584,0	,,	227	22	*XXII*	70 37 42·18	·32	4·8802931,8
		7	VI	54 21 27·01	·47	4·9547522,2			21	XX	57 9 43·76	·32	4·8299904,1
		9	IX	88 47 8·17	·48	5·0447410,2			23	*XXIV*	52 12 34·06	·32	4·8033711,5
21	220	4	VIII	35 13 49·94	·41	4·7860095,0	,,	228	25	*XXIV*	56 24 51·25	·38	4·8569997,5
		2+3	IX	90 56 2·97	·42	5·0248754,8			24	XX	62 4 7·02	·38	4·8825352,2
		1	XI	53 50 7·09	·41	4·9319811,2			26	*XXIII*	61 31 1·73	·38	4·8802931,8
22	221	18	X	75 21 5·54	·25	4·8526321,8	,,	229	28	*XXIII*	68 50 38·26	·42	4·9329266,9
		16	XII	62 46 27·02	·25	4·8159875,8			27	XX	59 37 7·52	·42	4·8990801,6
		17	*XIII*	41 52 27·44	·24	4·6914334,2			29	XXI	51 32 14·22	·42	4·8569997,5

* These stations appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.
NOTE.—Figures Nos. 24 and 25 form pendents and for reasons given in the footnote to page 115 are omitted.

Kattywar Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 18.

Triangles 214 to 216.

Constants (from page 64—J).

Sides.					Angles.	
LXVI	to	LXIV	Log. feet	4·6982549,6	12+8+4	145° 27′ 27″·30
LXIV	,,	I	,,	5·0061437,4	5+6	98 4 14·72
I	,,	III	,,	5·0759511,1		

Figure 18—(Continued).

Kattywar Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Equations to be satisfied.

							Factors
x_{12}	$+ x_{13}$	$+ x_{14}$	...	...	...	$= e_1 = \quad \cdot 00,$	λ_1
x_5	$+ x_8$	$+ x_{11}$	...	...	...	$= e_2 = + \cdot 39,$	λ_2
x_6	$+ x_9$	$+ x_{10}$	...	...	...	$= e_3 = - \cdot 39,$	λ_3
x_8	$+ x_{12}$	...	...	...	...	$= e_4 = + \cdot 52,$	λ_4
x_5	$+ x_6$	...	...	...	...	$= e_5 = \quad \cdot 00,$	λ_5
$4 x_{14}$	$- 40 x_{13}$	$+ 16 x_{11}$	$- 14 x_5$	...	...	$= e_6 = - 17 \cdot 9,$	λ_6
$7 x_8$	$- 16 x_{11}$	$+ 9 x_{10}$	$- 8 x_9$	...	...	$= e_7 = - 14 \cdot 1,$	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	·00	+ 3	...	...	+ 1	...	− 36	...	$\lambda_1 = - \cdot 7325$	
2	+ ·39		+ 3	...	+ 1	+ 1	+ 2	− 9	$\lambda_2 = - \cdot 4913$	$x_5 = +''\cdot 03$ $x_{11} = +''\cdot 24$
3	− ·39			+ 3	...	+ 1	...	+ 1	$\lambda_3 = - \cdot 1415$	$x_6 = - \cdot 03$ $x_{12} = + \cdot 40$
4	+ ·52				+ 2	...	...	+ 7	$\lambda_4 = + 1 \cdot 1355$	$x_8 = + \cdot 12$ $x_{13} = + \cdot 45$
5	·00			*		+ 2	− 14	...	$\lambda_5 = + \cdot 1098$	$x_9 = + \cdot 46$ $x_{14} = - \cdot 85$
6	− 17·9						+ 2068	− 256	$\lambda_6 = - \cdot 0295$	$x_{10} = - \cdot 82$
7	− 14·1							+ 450	$\lambda_7 = - \cdot 0753$	

Figure 19.

Triangle 217.

Constants (from page 65—$_J$).

Sides.						Angle.
I to IV	Log. feet	5·2981896,5			6+7	83° 39′ 57″·56
IV " V	"	5·0750549,1				

Equations to be satisfied.				Adopted Errors.
x_5	$+ x_8$	$=$	$- \cdot 65$	$x_5 = -''\cdot 19$
$33 x_5$	$- 10 x_8$	$=$	$- 1 \cdot 7$	$x_8 = - \cdot 46$

Figure 20.

Triangles 218 and 219.

Constants (from page 65—$_J$).

Sides.				Angle.
V to VI	Log. feet	4·9037409,7	4+7	119° 22′ 1″·65
VI " IX	"	4·8228639,7		

Kattywar Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 20—(Continued).

Equations to be satisfied.											Factors.
x_4	+	x_5	+	x_6	...	...	=	e_1	=	·00,	λ_1
x_7	+	x_8	+	x_9	...	...	=	e_2	=	·00,	λ_2
x_4	+	x_7	...		...	...	=	e_3	=	+ ·49,	λ_3
$7x_5$	−	$23x_6$	+	$28x_8$	− x_9	...	=	e_4	=	− 4·4,	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	− 16	λ_1 = − ·1358	x_4 = + ″·22	x_7 = + ″·27
2	·00		+ 3	+ 1	+ 27	λ_2 = − ·0928	x_5 = − ·15	x_8 = − ·18
3	+ ·49			+ 2	...	λ_3 = + ·3593	x_6 = − ·07	x_9 = − ·09
4	− 4·4		*		+ 1363	λ_4 = − ·0030		

Figure 21.

Triangle 220.

Constants (from page 65—$_J$).

Sides.						Angle.
VIII	to	IX	Log. feet	4·9319873,4	2+3	90° 56′ 3″·80
IX	„	XI	„	4·7860151,3		

Equations to be satisfied.					Adopted Errors.		
x_1	+	x_4	=	+ ·41	x_1	=	+ ″·14
$30x_4$	−	$15x_1$	=	+ 5·9	x_4	=	+ ·27

Figure 22.

Triangles 221 and 222.

Constants (from pages 65—$_J$ and 66—$_J$).

Sides.						Angle.
X	to	XII	Log. feet	4·6914406,1	13+16	126° 30′ 16″·03
XII	„	XV	„	4·9090028,6		

Equations to be satisfied.											Factors.
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	=	− ·50,	λ_3
$6x_{18}$	−	$24x_{17}$	+	$11x_{15}$	− $16x_{14}$	...	=	e_4	=	− 6·6,	λ_4

Kattywar Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 22—(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	− 5	λ_1 = + ·1092	x_{13} = − ″·24 x_{16} = − ″·26
2	·00		+ 3	+ 1	− 18	λ_2 = + ·0902	x_{14} = + ·18 x_{17} = + ·19
3	− ·50			+ 2	...	λ_3 = − ·3497	x_{15} = + ·06 x_{18} = + ·07
4	− 6·5		*		+ 989	λ_4 = − ·0044	

Figure 23.

Triangles 223 to 229.

Constants (from page 66—J).

Sides.

XVI	to	XV	Log. feet	4·7791380,3
XV	„	XVII	„	4·7712053,0
XVII	„	XX	„	4·7131122,3
XX	„	XXI	„	4·9329313,6

Angles.

2+3	85° 32′ 42″·34
8+9+12	176 52 7 ·23
14+21+24+27	248 28 1 ·40

Equations to be satisfied.

										Factors.
x_3	+ x_5	+ x_6	...	...	...	...	...	= e_1	= + ·38,	λ_1
x_2	+ x_7	+ x_8	...	...	...	...	...	= e_2	= − ·29,	λ_2
x_9	+ x_{10}	+ x_{11}	...	...	...	...	...	= e_3	= ·00,	λ_3
x_{12}	+ x_{13}	+ x_{14}	...	...	...	...	...	= e_4	= ·00,	λ_4
x_{21}	+ x_{22}	+ x_{23}	...	...	...	...	...	= e_5	= ·00,	λ_5
x_{24}	+ x_{25}	+ x_{26}	...	...	...	...	...	= e_6	= ·00,	λ_6
x_{27}	+ x_{28}	+ x_{29}	...	...	...	...	...	= e_7	= ·00,	λ_7
x_2	+ x_3	...	...	...	...	...	...	= e_8	= + ·09,	λ_8
x_8	+ x_9	+ x_{12}	...	...	...	...	...	= e_9	= − ·05,	λ_9
x_{14}	+ x_{21}	+ x_{24}	+ x_{27}	...	...	...	...	= e_{10}	= + ·13,	λ_{10}
− x_5	− 19 x_6	+ 19 x_7	− 2 x_8	...	...	...	...	= e_{11}	= − 12·4,	λ_{11}
20 x_2	− 19 x_7	+ 13 x_{10}	− 19 x_{11}	+ 20 x_{13}	− 8 x_{14}	...	...	= e_{12}	= − 5·0,	λ_{12}
11 x_{12}	− 20 x_{13}	+ 7 x_{22}	− 17 x_{23}	+ 14 x_{25}	− 12 x_{26}	+ 8 x_{28}	− 17 x_{29}	= e_{13}	= − 7·2,	λ_{13}

Equations between the Factors															Values of 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	+ ·38	+ 3	...	...	...	...	...	...	+ 1	...	...	− 20	...	...	λ_1 = − ·1409
2	− ·29		+ 3	...	...	...	...	...	+ 1	+ 1	...	+ 17	+ 1	...	λ_2 = − ·0331
3	·00			+ 3	...	...	...	...	...	+ 1	...	...	− 6	...	λ_3 = − ·0309
4	·00				+ 3	...	...	...	...	+ 1	+ 1	...	+ 12	− 9	λ_4 = + ·0189
5	·00					+ 3	...	...	...	...	+ 1	...	...	− 10	λ_5 = − ·0340
6	·00						+ 3	...	...	...	+ 1	...	...	+ 2	λ_6 = ·0000
7	·00							+ 3	...	...	+ 1	...	...	− 9	λ_7 = − ·0312
8	+ ·09				*				+ 2	...	...	...	+ 20	...	λ_8 = + ·2668
9	− ·05									+ 3	...	− 2	...	+ 11	λ_9 = + ·0116
10	+ ·13										+ 4	...	− 8	...	λ_{10} = + ·0171
11	− 12·4											+ 727	− 361	...	λ_{11} = − ·0268
12	− 5·0												+ 1755	− 400	λ_{12} = − ·0135
13	− 7·2													+ 1552	λ_{13} = − ·0085

Kattywar Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 23—(Continued).

Adopted Errors

$x_2 = -\ ''\cdot 03$	$x_9 = -\ ''\cdot 02$	$x_{21} = -\ ''\cdot 02$	$x_{27} = -\ ''\cdot 01$
$x_3 = +\ \cdot 12$	$x_{10} = -\ \cdot 21$	$x_{22} = -\ \cdot 09$	$x_{28} = -\ \cdot 11$
$x_5 = -\ \cdot 11$	$x_{11} = +\ \cdot 23$	$x_{23} = +\ \cdot 11$	$x_{29} = +\ \cdot 12$
$x_6 = +\ \cdot 37$	$x_{12} = -\ \cdot 06$	$x_{24} = +\ \cdot 02$	
$x_7 = -\ \cdot 29$	$x_{13} = -\ \cdot 08$	$x_{25} = -\ \cdot 12$	
$x_8 = +\ \cdot 03$	$x_{14} = +\ \cdot 14$	$x_{26} = +\ \cdot 10$	

Guzerat 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
				° ′ ″	″						° ′ ″	″	
		14	K II	82 39 37·12	·39	4·9707015,8			15	K XVII	47 46 4·65	·23	4·7682632,5
26	252	12	IV	42 19 41·69	·38	4·8025330,3	27	254	13	XVIII	94 8 29·45	·23	4·8976443,6
		13	V	55 0 41·19	·38	4·8877000,1			14	XX	38 5 25·90	·22	4·6889987,4
		11	V	63 44 56·22	·78	5·0569914,9							
,,	253	a	IV	68 55 20·72	·79	5·0741901,5							
		10	VI	47 19 43·06	·78	4·9707015,8							

NOTE.—In the column "Figural Number of Angle" the distinguishing symbol *a* is employed for angles which have not been measured and therefore had no number in the original figural reduction.

Guzerat Longitudinal Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 26.

Triangles 252 and 253.

Constants (from pages 49_{-K} and 50_{-K}).

Sides.						Angle.
II	to	IV	Log. feet	4·8876769,7	12+a	111° 15′ 3″·72
IV	,,	VI	,,	5·0569650,9		

Equations to be satisfied. Factors.

x_{12}	$+\ x_{13}$	$+\ x_{14}$	...	...	$= e_1$	$=$	$\cdot 00,$	λ_1
x_a	$+\ x_{10}$	$+\ x_{11}$	...	...	$= e_2$	$=$	$\cdot 00,$	λ_2
x_{12}	$+\ x_a$	...	...	...	$= e_3$	$=$	$-\ \cdot 14,$	λ_3
$3x_{14}$	$-\ 14x_{13}$	$+\ 10x_{11}$	$-\ 19x_{10}$	...	$= e_4$	$=$	$+\ 33\cdot 6,$	λ_4

Guzerat Longitudinal Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 26—(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	− 11	$\lambda_1 = + \cdot 3587$	$x_9 = -\ ''\cdot 09$ $x_{12} = -\ ''\cdot 05$
2	·00		+ 3	+ 1	− 9	$\lambda_2 = + \cdot 3183$	$x_{10} = -\ \cdot 82$ $x_{13} = -\ \cdot 48$
3	− ·14			+ 2	...	$\lambda_3 = - \cdot 4085$	$x_{11} = +\ \cdot 91$ $x_{14} = +\ \cdot 53$
4	+ 33·6		*		+ 666	$\lambda_4 = + \cdot 0607$	

Figure 27.

Triangle 254.

Constants (from pages 51_{-K} and 52_{-K}).

Sides.						Angle.
XVII	to	XVIII	Log. feet	4·6889921,8	18	94° 8′ 30″·69
XVIII	„	XX	„	4·7682559,1		

Equations to be satisfied.

$$x_{14} + x_{15} = + 1\cdot 01$$
$$19\,x_{15} - 27\,x_{14} = + 7\cdot 8$$

Adopted Errors.

$$x_{14} = + ''\cdot 25$$
$$x_{15} = + \cdot 76$$

Cutch Coast 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
				° ′ ″	″						° ′ ″	″	
28	255	3	J XI	49 40 27·16	·41	4·9634748,5	30	259	15	L I	47 41 14·65	·36	4·8722255,7
		4+5	XIV	101 30 46·17	·42	5·0724778,9			13	VI	94 40 22·23	·36	5·0018513,8
		6	L I	28 48 46·67	·41	4·7643087,1			14	*VII*	37 38 23·12	·36	4·7891215,5
29	256	5	II	59 7 55·89	·40	4·9679249,1	„	260	12	*VII*	63 46 40·88	·35	4·8738906,9
		4	III	90 32 51·88	·40	5·0342390,4			10	VI	52 53 8·43	·35	4·8227495,0
		6	J *VII*	30 19 12·23	·40	4·7374039,7			11	VIII	63 20 10·69	·35	4·8722255,7
„	257	8	*VII*	39 37 35·32	·41	4·7890780,3	31	261	4	VIII	35 50 22·04	·34	4·7606657,8
		7	L III	66 3 33·05	·41	4·9453367,8			2+3	IX	93 30 32·71	·35	4·9923119,2
		9	*V*	74 18 51·63	·42	4·9679249,1			1	XI	50 39 5·25	·35	4·8814768,1
„	258	11	*V*	81 10 25·29	·32	4·9192585,6	32	262	3	XI	51 23 31·41	·51	4·9886555,1
		10	III	51 45 10·33	·32	4·8194943,0			4+5	X	96 2 54·39	·52	5·0933388,3
		12	IV	47 4 24·38	·31	4·7890780,3			6	XII	32 33 34·20	·51	4·8266868,7

Cutch Coast 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
33	263	5 6+7 8	L XII XIV XV	51 47 55·10 85 36 25·77 42 35 39·13	·61 ·61 ·60	4·9761791,1 5·0795660,3 4·9113050,5
34	264	23 21 22	XIV XVI XVII	46 47 54·43 82 11 24·62 51 0 40·95	1·04 1·05 1·05	5·0496239,2 5·1828789,5 5·0774984,8
„	265	20 18 19	XVII XVI XIX	56 41 16·57 37 43 3·58 85 35 39·85	·51 ·51 ·51	4·9729551,5 4·8374978,7 5·0496239,2
„	266	16+17 14 15	XIX XVI XX	87 13 23·68 29 47 57·96 62 58 38·36	·39 ·38 ·39	5·0226516,6 4·7194880,4 4·9729551,5
„	267	17 10+14 11	XIX XVI XXI	49 45 47·85 74 49 57·27 55 24 14·88	·62 ·63 ·62	4·9402038,6 5·0420634,9 4·9729551,5
35	268	15 13 14	XX XXII XXIII	87 39 57·41 43 5 5·69 49 14 56·90	·22 ·21 ·22	4·8612061,3 4·6960391,1 4·7409809,0
„	269	12 10 11	XXIII XXII XXIV	68 19 46·34 42 38 8·10 69 2 5·56	·28 ·28 ·28	4·8591196,9 4·7217552,1 4·8612061,3
36	270	3 4+5 6	XXV XXIV XXVI	38 27 9·95 81 29 20·45 60 3 29·60	·42 ·42 ·42	4·7929765,7 4·9944683,4 4·9370626,2
37	271	5 4 6	XXVII XXVIII XXIX	56 43 12·50 71 5 35·68 52 11 11·82	·22 ·23 ·22	4·7488939,2 4·8026003,0 4·7243211,3

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
37	272	8 7 9	L XXIX XXVIII XXXI	57 20 15·62 69 45 52·88 52 53 51·50	·25 ·25 ·24	4·7723738,9 4·8194635,2 4·7488939,2
38	273	18 16 17	XXX XXXII XXXIII	48 28 10·58 61 9 58·13 70 21 51·29	·19 ·20 ·20	4·6777207,3 4·7459834,9 4·7774493,3
„	274	13 15 14	XXXII XXXIII XXXV	70 43 44·51 63 14 52·76 46 1 22·73	·21 ·21 ·21	4·7955758,8 4·7714520,1 4·6777207,3
„	275	30 28 29	XXXIII XXXV XXXVI	44 34 2·19 82 28 48·44 52 57 9·37	·26 ·27 ·27	4·7396782,9 4·8897469,2 4·7955758,8
„	276	27 25 26	XXXVI XXXV XXXVIII	69 37 18·69 62 23 24·56 47 59 16·75	·27 ·27 ·26	4·8406187,1 4·8161813,8 4·7396782,9
39	277	5 4 6	XXXIX XL XLI	50 23 18·55 62 34 33·27 67 2 8·18	·21 ·22 ·22	4·7078747,2 4·7693948,3 4·7853073,9
„	278	8 7 9	XLI XL XLIII	69 48 23·92 55 10 15·47 55 1 20·61	·20 ·19 ·19	4·7668409,4 4·7086604,1 4·7078747,2
40	279	15 13 14	XLII XLIV XLV	70 45 3·68 67 33 55·19 41 41 1·13	·22 ·21 ·21	4·8106822,0 4·8014866,7 4·6584994,3
„	280	12 10 11	XLV XLIV CVII*	69 32 20·25 76 35 9·36 33 52 30·39	·54 ·54 ·54	5·0362252,5 5·0525147,3 4·8106822,0

* This station appertains to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Cutch Coast Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 28.

Triangle 255.

Constants (from page 71_{-L}).

Sides.

XI to XIV Log. feet 4·7643143,2

XIV „ I „ 4·9634788,3

Angle.

4+5 101° 30′ 45″·42

Equations to be satisfied.

$$x_3 + x_6 = -1·17$$
$$18x_3 - 38x_6 = +16·3$$

Adopted Errors.

$$x_3 = -''·50$$
$$x_6 = -·67$$

Cutch Coast Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 29.

Triangles 256 to 258.

Constants (from page 71_{-L}).

Sides.						Angles.
VII	to	II	Log. feet	5·0342438,9†	5	59° 7′ 53″·78
II	„	III	„	4·7374067,5	4+7+10	208 21 36 ·35
III	„	IV	„	4·9192606,2		

Equations to be satisfied.

							Factors.
x_4	$+ x_6$	...	...	...	$= e_1$	$= - 2{\cdot}51,$	λ_1
x_7	$+ x_8$	$+ x_9$	...	...	$= e_2$	$= \cdot 00,$	λ_2
x_{10}	$+ x_{11}$	$+ x_{12}$	...	...	$= e_3$	$= \cdot 00,$	λ_3
x_4	$+ x_7$	$+ x_{10}$	...	...	$= e_4$	$= + \cdot 04,$	λ_4
$36 x_6$	$- 0 x_4$	...	...	...	$= e_5$	$= + 20{\cdot}7,$	λ_5
$- 36 x_6$	$+ 25 x_8$	$- 6 x_9$	$+ 3 x_{11}$	$- 20 x_{12}$	$= e_6$	$= - 22{\cdot}9,$	λ_6

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			
1	− 2·51	+ 2	...	...	+ 1	+ 36	− 36	$\lambda_1 = - 5{\cdot}4293$		
2	·00		+ 3	...	+ 1	...	+ 19	$\lambda_2 = - \cdot 7768$	$x_4 = - 3''{\cdot}11$	$x_9 = - ''{\cdot}77$
3	·00			+ 3	+ 1	...	− 17	$\lambda_3 = - \cdot 7852$	$x_6 = + \cdot 60$	$x_{10} = + 1{\cdot}56$
4	+ ·04				+ 3	...	...	$\lambda_4 = + 2{\cdot}3437$	$x_7 = + 1{\cdot}59$	$x_{11} = - \cdot 79$
5	+ 20·7		*			+ 1296	− 1296	$\lambda_5 = + \cdot 1661$	$x_8 = - \cdot 82$	$x_{12} = - \cdot 77$
6	− 22·9						+ 2366	$\lambda_6 = - \cdot 0007$		

Figure 30.

Triangles 259 and 260.

Constants (from page 72_{-L}).

Sides.						Angle.
I	to	VI	Log. feet	4·7891241,2	13+10	147° 33′ 31″·77
VI	„	VIII	„	4·8738908,8		

Equations to be satisfied.

						Factors.
x_{13}	$+ x_{14}$	$+ x_{15}$	...	$= e_1$	$= \cdot 00,$	λ_1
x_{10}	$+ x_{11}$	$+ x_{12}$	...	$= e_2$	$= \cdot 00,$	λ_2
x_{13}	$+ x_{10}$	...	...	$= e_3$	$= - \cdot 40,$	λ_3
$19 x_{15}$	$- 27 x_{14}$	$+ 10 x_{12}$	$- 11 x_{11}$	$= e_4$	$= + 23{\cdot}8,$	λ_4

† Deduced side.

Cutch Coast Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 30—(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	− 8	$\lambda_1 = + \cdot 1659$	$x_{10} = -''\cdot 22$ $x_{13} = -''\cdot 18$
2	·00		+ 3	+ 1	− 1	$\lambda_2 = + \cdot 1209$	$x_{11} = - \cdot 09$ $x_{14} = - \cdot 35$
3	− ·40			+ 2	...	$\lambda_3 = - \cdot 3434$	$x_{12} = + \cdot 31$ $x_{15} = + \cdot 53$
4	+ 23·8		*		+ 1311	$\lambda_4 = + \cdot 0193$	

Figure 31.

Triangle 261.

Constants (from page 72—$_{L}$).

Sides.

VIII	to	IX	Log. feet	4·8814766,5	2+3	Angle. 93° 30′ 32″·83
IX	„	XI	„	4·7600648,4		

Equations to be satisfied.

$$x_1 + x_4 = - \cdot 23$$
$$29\,x_4 - 18\,x_1 = + 7\cdot 8$$

Adopted Errors.

$$x_1 = -''\cdot 31$$
$$x_4 = + \cdot 08$$

Figure 32.

Triangle 262.

Constants (from pages 72—$_{L}$ and 73—$_{L}$).

Sides.

XI	to	X	Log feet.	4·8266856,7	4+5	Angle. 96° 2′ 54″·20
X	„	XII	„	4·9886532,8		

Equations to be satisfied.

$$x_3 + x_6 = - \cdot 71$$
$$17\,x_3 - 33\,x_6 = + 10\cdot 3$$

Adopted Errors.

$$x_3 = -''\cdot 26$$
$$x_6 = - \cdot 45$$

Figure 33.

Triangle 263.

Constants (from page 73—$_{L}$).

Sides.

XII	to	XIV	Log. feet	4·9113004,3	6+7	Angle. 85° 36′ 26″·69
XIV	„	XV	„	4·9761744,1		

Equations to be satisfied.

$$x_5 + x_8 = + \cdot 31$$
$$16\,x_5 - 23\,x_8 = + \cdot 8$$

Adopted Errors.

$$x_5 = +''\cdot 20$$
$$x_8 = + \cdot 11$$

Cutch Coast Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 34.

Triangles 264 to 267.

Constants (from page 73—L).

Sides.					Angles.	
XIV	to	XVI	Log. feet	5·0774932,5	21+18+14	149° 42′ 28″·23
XVI	„	XX	„	5·0226438,4	10	45 1 59 ·16
XVI	„	XXI	„	4·9401965,3		

Equations to be satisfied. Factors.

									Factors.
x_{21}	$+ x_{22}$	$+ x_{23}$	...	...	...	$= e_1$	$=$	$\cdot 00,$	λ_1
x_{18}	$+ x_{19}$	$+ x_{20}$	...	...	...	$= e_2$	$=$	$\cdot 00,$	λ_2
x_{14}	$+ x_{15}$	$+ x_{16}$	$+ x_{17}$	...	...	$= e_3$	$=$	$\cdot 00,$	λ_3
x_{11}	$+ x_{14}$	$+ x_{17}$	...	...	...	$= e_4$	$=$	$- \cdot 40,$	λ_4
x_{21}	$+ x_{18}$	$+ x_{14}$	...	...	...	$= e_5$	$=$	$- \cdot 13,$	λ_5
$20 x_{23}$	$- 17 x_{22}$	$+ 14 x_{20}$	$- 2 x_{19}$	$+ (x_{16} + x_{17})$	$- 10 x_{15}$	$= e_6$	$=$	$+ 25 \cdot 9,$	λ_6
$10 x_{15}$	$- (x_{16} + x_{17})$	$+ 18 x_{17}$	$- 15 x_{11}$	...	...	$= e_7$	$=$	$- 4 \cdot 9,$	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	·00	+ 3	...	...	...	+ 1	+ 3	...	$\lambda_1 = - \cdot 0353$	$x_{11} = -'' \cdot 10$	$x_{19} = -'' \cdot 18$
2	·00		+ 3	...	...	+ 1	+ 12	...	$\lambda_2 = - \cdot 1238$	$x_{14} = - \cdot 01$	$x_{20} = + \cdot 29$
3	·00			+ 4	+ 2	+ 1	− 8	+ 26	$\lambda_3 = + \cdot 3454$	$x_{15} = - \cdot 09$	$x_{21} = - \cdot 01$
4	− ·40				+ 3	+ 1	+ 1	+ 2	$\lambda_4 = - \cdot 3683$	$x_{16} = + \cdot 39$	$x_{22} = - \cdot 54$
5	− ·13					+ 3	...	...	$\lambda_5 = + \cdot 0174$	$x_{17} = - \cdot 29$	$x_{23} = + \cdot 55$
6	+ 25·9			*			+ 991	− 84	$\lambda_6 = + \cdot 0295$	$x_{18} = - \cdot 11$	
7	− 4·9							+ 651	$\lambda_7 = - \cdot 0164$		

Figure 35.

Triangles 268 and 269.

Constants (from page 74—L).

Sides.					Angle.	
XX	to	XXII	Log. feet	4·7409725,8	18+10	85° 43′ 14″·29
XXII	„	XXIV	„	4·8591061,5		

Equations to be satisfied.

							Factors.
x_{13}	$+ x_{14}$	$+ x_{15}$	...	$= e_1$	$=$	$\cdot 00,$	λ_1
x_{10}	$+ x_{11}$	$+ x_{12}$	...	$= e_2$	$=$	$\cdot 00,$	λ_2
x_{13}	$+ x_{10}$	...	...	$= e_3$	$=$	$- \cdot 01,$	λ_3
x_{15}	$- 19 x_{14}$	$+ 9 x_{12}$	$- 8 x_{11}$	$= e_4$	$=$	$+ 52 \cdot 2,$	λ_4

Cutch Coast Series. 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	·00	+ 3	...	+ 1	− 18	$\lambda_1 = +\ 1·0371$	$x_{10} = -\ ''·45$ $x_{13} = +\ ''·44$
2	·00		+ 3	+ 1	+ 1	$\lambda_2 = +\ ·1536$	$x_{11} = -1\ ·04$ $x_{14} = -1\ ·69$
3	− ·01			+ 2	...	$\lambda_3 = -\ ·6004$	$x_{12} = +1\ ·49$ $x_{15} = +1\ ·25$
4	+ 52·2		*		+ 507	$\lambda_4 = +\ ·1395$	

Figure 36.

Triangle 270.

Constants (from page 74—L).

Sides.

XXV	to	XXIV	Log. feet	4·9370493,9
XXIV	„	XXVI	„	4·7929633,1

Angle.

4+5 81° 29′ 20″·58

Equations to be satisfied.

$$x_3 + x_6 = -·29$$
$$27x_3 - 12x_6 = +·3$$

Adopted Errors.

$$x_3 = -\ ''·08$$
$$x_6 = -\ ·21$$

Figure 37.

Triangles 271 and 272.

Constants (from page 74—L).

Sides.

XXVII	to	XXVIII	Log. feet	4·7243069,3
XXVIII	„	XXXI	„	4·7723575,0

Angle.

4+7 140° 51′ 29″·13

Equations to be satisfied.

							Factors.
x_4	$+\ x_5$	$+\ x_6$	...	$= e_1$	=	·00,	λ_1
x_7	$+\ x_8$	$+\ x_9$	...	$= e_2$	=	·00,	λ_2
x_4	$+\ x_7$	...	...	$= e_3$	=	− ·09,	λ_3
$\cdot 14x_5$	$-\ 16x_6$	$+\ 14x_8$	$-\ 16x_9$	$= e_4$	=	+ 21·9,	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	$\lambda_1 = +\ ·0469$	$x_4 = -\ ''·05$ $x_7 = -\ ''·04$
2	·00		+ 3	+ 1	− 2	$\lambda_2 = +\ ·0469$	$x_5 = +\ ·40$ $x_8 = +\ ·38$
3	− ·09			+ 2	...	$\lambda_3 = -\ ·0919$	$x_6 = -\ ·35$ $x_9 = -\ ·34$
4	+ 21·9		*		+ 904	$\lambda_4 = +\ ·0244$	

Cutch Coast Meridional Series. Final Figural Adjustments of the Non-Circuit Triangles.

Figure 38.

Triangles 273 to 276.

Constants (from page 75_{-L}).

Sides.					Angles.	
XXX	to	XXXII	Log. feet	4·7774324,2	16+13	131° 53′ 42″·82
XXXII	„	XXXV	„	4·7714330,8	14+28+25	190 53 36 ·29
XXXV	„	XXXVIII	„	4·8405982,9		

Equations to be satisfied. Factors.

x_{16}	$+ x_{17}$	$+ x_{18}$	...	...	...	$= e_1 =$	·00,	λ_1
x_{13}	$+ x_{14}$	$+ x_{15}$	...	...	...	$= e_2 =$	·00,	λ_2
x_{28}	$+ x_{29}$	$+ x_{30}$	...	...	...	$= e_3 =$	·00,	λ_3
x_{25}	$+ x_{26}$	$+ x_{27}$	...	...	...	$= e_4 =$	·00,	λ_4
x_{16}	$+ x_{13}$	...	...	...	...	$= e_5 =$	+ ·23,	λ_5
x_{14}	$+ x_{28}$	$+ x_{25}$	...	...	...	$= e_6 =$	+ ·19,	λ_6
$19 x_{18}$	$- 7 x_{17}$	$+ 11 x_{15}$	$- 20 x_{14}$	...	...	$= e_7 =$	+ 20·2,	λ_7
$8 x_{13}$	$- 11 x_{15}$	$+ 21 x_{30}$	$- 16 x_{29}$	$+ 8 x_{27}$	$- 19 x_{26}$	$= e_8 =$	+ 14·9,	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	·00	+ 3	...	...	...	+ 1	...	+ 12	...	$\lambda_1 = -$ ·2048		
2	·00		+ 3	...	...	+ 1	+ 1	− 9	− 3	$\lambda_2 = -$ ·0883	$x_{13} = +$ ″·22	$x_{25} = +$ ″·31
3	·00			+ 3	...	...	+ 1	...	+ 5	$\lambda_3 = -$ ·1538	$x_{14} = -$ ·36	$x_{26} = -$ ·33
4	·00				+ 3	...	+ 1	...	− 11	$\lambda_4 = -$ ·0850	$x_{15} = +$ ·14	$x_{27} = +$ ·02
5	+ ·23					+ 2	...	...	+ 8	$\lambda_5 = +$ ·2099	$x_{16} = +$ ·01	$x_{28} = +$ ·24
6	+ ·19			*			+ 3	− 20	...	$\lambda_6 = +$ ·3970	$x_{17} = -$ ·45	$x_{29} = -$ ·36
7	+ 20·2							+ 931	− 121	$\lambda_7 = +$ ·0337	$x_{18} = +$ ·44	$x_{30} = +$ ·12
8	+ 14·9								+ 1307	$\lambda_8 = +$ ·0129		

Figure 39.

Triangles 277 and 278.

Constants (from page 76_{-L}).

Sides.					Angle.	
XXXIX	to	XL	Log. feet	4·7852872,3	4+7	117° 44′ 49″·26
XL	„	XLIII	„	4·7668176,2		

Equations to be satisfied. Factors.

x_4	$+ x_5$	$+ x_6$	...	$= e_1 =$	·00,	λ_1
x_7	$+ x_8$	$+ x_9$	...	$= e_2 =$	·00,	λ_2
x_4	$+ x_7$	...	...	$= e_3 =$	− ·11,	λ_3
$18 x_5$	$- 9 x_6$	$+ 7 x_8$	$- 15 x_9$	$= e_4 =$	+ 31·6,	λ_4

Cutch Coast Series. 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		
1	·00	+ 3	...	+ 1	+ 9	$\lambda_1 = -$ ·1270	$x_4 = -$ ″·19 $x_7 = +$ ″·08
2	·00		+ 3	+ 1	− 8	$\lambda_2 = +$ ·1569	$x_5 = +$ ·78 $x_8 = +$ ·52
3	− ·11			+ 2	...	$\lambda_3 = -$ ·0700	$x_6 = -$ ·59 $x_9 = -$ ·60
4	+ 31·6		*		+ 679	$\lambda_4 = +$ ·0501	

Figure 40.

Triangles 279 and 280.

Constants (from page 76_{-L}).

Sides.						Angle.
XLII	to	XLIV	Log. feet	4·6584760,9	18+10	144° 9′ 5″·32
XLIV	„	CVII	„	5·0361997,2		

Equations to be satisfied.   Factors.

$$x_{18} + x_{14} + x_{15} \;\ldots\;\ldots = e_1 = \cdot 00, \quad \lambda_1$$
$$x_{10} + x_{11} + x_{12} \;\ldots\;\ldots = e_2 = \cdot 00, \quad \lambda_2$$
$$x_{13} + x_{10} \;\ldots\;\ldots\;\ldots = e_3 = -\cdot 02, \quad \lambda_3$$
$$7x_{15} - 24x_{14} + 8x_{12} - 32x_{11} \;\ldots = e_4 = +21\cdot 9, \quad \lambda_4$$

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	·00	+ 3	...	+ 1	− 17	$\lambda_1 = +$ ·1612	$x_{10} = +$ ″·01 $x_{13} = -$ ″·03
2	·00		+ 3	+ 1	− 24	$\lambda_2 = +$ ·2014	$x_{11} = -$ ·35 $x_{14} = -$ ·25
3	− ·02			+ 2	...	$\lambda_3 = -$ ·1913	$x_{12} = +$ ·34 $x_{15} = +$ ·28
4	+ 21·9		*		+ 1713	$\lambda_4 = +$ ·0172	

October, 1890.

W. H. COLE,

In charge of Computing Office.

NOTE ON THE SIMULTANEOUS REDUCTION OF THE SOUTH-WEST QUADRILATERAL.

On the Degree of Numerical Accuracy maintained in the Calculations.

In printing the details of the solution of the problem presented by the South-West Quadrilateral, 4 places of decimals have been generally retained, except in the μ, ϕ tables of Section 11 of Chapter III, where the former are integral quantities divided, for convenience, by 10^7 and the latter are, in the case of latitude and longitude equations, generally preceded by one or more cyphers. But this uniformity could not be maintained in the actual reduction. When the scheme for the reduction of the triangulation of India had been worked out and that of the North-West Quadrilateral was taken in hand, Mr. Hennessey, who was then in charge of the Computing Office, investigated with great care the number of decimal places which should be retained at each stage of the calculations, in order to produce accuracy in the final results up to certain designated limits. In the second reduction that was undertaken, *viz.*, the South-East Quadrilateral, the conclusions arrived at by Mr. Hennessey were generally accepted by Mr. Cole, under whom the calculations were made, except where the employment of tabular log. differences in place of differentials rendered his rules inapplicable; and although the accuracy he sought in the final results may be considered by some as unnecessarily minute, it is attended with the advantage that, assuming the absence of arithmetical mistakes, angular corrections will be arrived at which fully satisfy the problem without any resort to arbitrary adjustment. In the next operation, *viz.*, the reduction of the North-East Quadrilateral under Major Herschel, this officer decided to considerably reduce the number of decimal places employed, with the result that residual errors remained after the solution was complete, which entailed nearly as much labour in their dispersion as the original reduction. In the fourth reduction, *viz.*, that of the Southern Trigon under Mr. Hennessey, fewer decimal places were employed than in the South-East Quadrilateral, and judging from the magnitude of the arbitrary corrections necessary to eliminate residual errors from the linear and geodetic calculations, the number seems to have been too few in some of the stages of the reduction. In the fifth reduction, *viz.*, that of the South-West Quadrilateral under Mr. Cole, less refinement was required, as the instruments employed in the observation of the angles were not of so high a class as those used in the Southern Trigon or North-West and South-East Quadrilaterals, and the final values of the angles were only required to 2 places of decimals.

μ, ϕ.

The calculation of the μs and ϕs was made in the North-West Quadrilateral from differentials, but in all subsequent calculations from tabular log. differences. The latter method is far more expeditious and the quantities would have been the same, but that the μs of the North-West Quadrilateral were made to include the factor sin $1''$, which comes from the differentiation of the sines of the angles. In subsequent calculations this factor is included in the tabular log. differences of the sines of the angles and the μs are consequently large integral numbers. As, however, it is convenient to treat the tabular log. differences of sines in the side equations as integral numbers, in other words to multiply them by 10^7, and the μs are factors of these differences, they have been divided by 10^7, which has had the further advantage that the last figure of the μs could be dropped. The ϕs were calculated to 6 places of decimals in the North-West and South-East Quadrilaterals, but to only 5 places in the Southern Trigon and South-West Quadrilateral: in the latter case they were only employed to 4 places in the subsequent calculations.

$\mathfrak{b}$, $\mathfrak{c}$.

In the linear equations of the North-West Quadrilateral, the co-efficients $\mathfrak{b}$ and $\mathfrak{c}$ were the natural cotangents of the corresponding angles; these were employed to 5 places of decimals. In subsequent reductions the tabular log. differences for $1''$ of the sines of the corresponding angles have been employed, and these never exceeded 2 figures. A certain inconvenience has arisen from these being differences of 7 place logs., while the linear calculations have been extended to an 8th place by interpolation.

In the geodetic equations the different methods of calculating the co-efficients $\mathfrak{b}$ and $\mathfrak{c}$ employed in the North-West Quadrilateral and subsequent reductions make no difference in the actual values arrived at; but in lieu of 6 places of decimals in the North-West Quadrilateral, 5 places were kept in the South-East Quadrilateral. In the Southern Trigon a further reduction was made to 4 places, which seems, from the magnitude of the arbitrary corrections afterwards required to the deduced values of x, y and z, which were required to 3 places, to have been too great a reduction. 5 places of decimals, no doubt, ought to have been kept, seeing that the first place is frequently a cypher and sometimes the second also. In the South-West Quadrilateral, x, y and z were only required to 2 places, therefore taking $\mathfrak{b}$ and $\mathfrak{c}$ to 4 places was sufficient.

The Circuit Errors or Absolute Terms of the Equations.

The circuit errors are linear and geodetic. In the North-West Quadrilateral the former were obtained by multiplying the logarithmic discrepancy of the value of each closing side by cosec $1'' \div$ modulus, and the products were retained to 5 places of decimals. In the South-East Quadrilateral and subsequent calculations the logarithmic discrepancies alone formed the circuit errors, the 7th place of decimals of logs. being taken as unity. The geodetic errors in all quadrilaterals only presented themselves to 3 places of decimals.

$\frac{1}{3w}$ or $\frac{u}{3}$.

The factor $\frac{1}{3w}$ was calculated and employed to 2 places of decimals in the first two reductions; in the third reduction, *viz.*, that of the North-East Quadrilateral, the assumption was made that, if the adopted value of any weight did not differ by more than a tenth part from its computed value, it was sufficiently accurate, and $\frac{u}{3}$ varied from 1 to 3 places of decimals. But it came to be considered afterwards that unnecessary labour had been expended on the calculation of weights, and in the Southern Trigon and South-West Quadrilateral one significant figure only in the decimal places was retained.

𝔅, ℭ.

The 𝔅s and ℭs, which are functions of 𝔟 and 𝔠 and $\frac{u}{3}$, divide themselves into two groups, *viz.*, those appertaining to the linear equations and those belonging to the geodetic equations. The former were in the North-West Quadrilateral obtained to from 3 to 6 decimal places and the latter to from 5 to 7. In the South-East Quadrilateral the corresponding numbers were from 2 to 3 and 7. In the Southern Trigon the former were to 2 places and the latter to 4: in the South-West Quadrilateral they were respectively to 1 and 4 places.

𝔅𝔟, ℭ𝔠.

The 𝔅𝔟s and ℭ𝔠s divide themselves into three groups:—(1) those which spring from linear equations only; (2) those which are obtained by combining linear equations with geodetic equations, and (3) those which are formed from geodetic equations only. The number of decimal places adopted in the North-West Quadrilateral were for (1) 6 places and for (2) and (3) 8 places. In the South-East Quadrilateral they were for (1) 3 and 4 places, for (2) 7 places and for (3) 8 places. In the Southern Trigon and South-West Quadrilateral they were for (1) respectively 2 places and 1, and for (2) and (3) 5 places. In the Southern Trigon (3) should doubtless have been retained to more places, owing to the number of cyphers preceding the significant figures.

Co-efficients in the Equations between the Indeterminate Factors.

As the co-efficients of the Indeterminate Factors are merely summations of 𝔅𝔟 and ℭ𝔠, the number of places in each co-efficient depends on the number of places in its components. In the North-West and South-East Quadrilaterals all the decimal places were made use of; but in the Southern Trigon only 4 places were kept: the introduction of equalizing factors before the solution of the equations did not affect the limit of 4 places, and the solution was carried out with a limit of 4 places. In the South-West Quadrilateral 5 places were employed before the introduction of the equalizing factors and 4 places afterwards.

Indeterminate Factors.

The values of the Indeterminate Factors were in the North-West and South-East Quadrilaterals employed to 5 places, but in the Southern Trigon and South-West Quadrilateral to only 4 places.

y, z.

The angular errors, y and z, were in both the North-West and South-East Quadrilaterals calculated to 5 places of decimals and afterwards contracted to 3 places. In the Southern Trigon and South-West Quadrilateral they were calculated to only 4 places and then reduced to 3 in the former and 2 in the latter.

The Checks on the Calculations.

In the following table are exhibited the checks to which the calculations were subjected in the course of their execution. Column (1) shews the chains and parts of chains involved in each equation of condition; column (2) exhibits the errors in the chains or circuits; these form the absolute terms, both for the equations of condition and for the equations between the indeterminate factors. When the values of these factors were obtained they were multiplied by their co-efficients in the equations connecting them, and the terms being then summed gave the values in column (3). The differences between columns (2) and (3), which are given in column (4), thus shew the accuracy with which the equations between the indeterminate factors have been solved. The factors being known, the values of y and z were next obtained to 4 places of decimals; and these being substituted in the equations of condition and the terms summed, there resulted the quantities in column (5). Thus the differences between the values given in columns (2) and (5), which are exhibited in column (6), shew the accuracy with which the solution of the equations of condition has been performed. As only 2 places of decimals of seconds were to be retained for the angular errors, these had to be contracted; and when this had been done and the contracted values had been employed with opposite signs to correct the calculations of the Triangles, Latitudes, Longitudes and Azimuths, the errors yet remaining in the chains or circuits are shewn in the last column.

Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Values of E					
					By Substitution of y and z		
No. of Equation of Condition	Chains of Triangulation involved (see page 45)	As given in Equation of Condition	By Substitution of the As	Residuals from Columns (2) − (3)	As computed to 4 decimals	Residuals from Columns (2) − (5)	Residuals from Final Computations of Triangles, Latitudes, Longitudes and Azimuths
1 in *c*	$G_1 + G_2$	+ 189·8	+189·80	0·00	+189·66	+0·14	− 0·5
2 „ λ	Do.	− 0·637	− 0·6370	·0000	− 0·6368	− ·0002	− ·002
3 „ *L*	Do.	− 0·571	− 0·5710	·0000	− 0·5701	− ·0009	− ·005
4 „ *A*	Do.	− 7·806	− 7·8058	− ·0002	− 7·7574	− ·0486	+ ·002
5 „ *c*	$H_1 - (G_1 + K_1)$	− 212·5	−212·49	− ·01	−211·58	+ ·08	+ ·1
6 „ λ	Do.	+ 0·068	+ 0·0681	− ·0001	+ 0·0620	+ ·0060	+ ·004
7 „ *L*	Do.	+ 0·407	+ 0·4071	− ·0001	+ 0·4047	+ ·0023	+ ·001
8 „ *A*	Do.	− 7·113	− 7·1122	− ·0008	− 7·1337	+ ·0207	− ·001
9 „ *c*	$H_1 + H_2$	+ 27·4	+ 27·40	·00	+ 28·14	− ·74	·0
10 „ λ	Do.	− 0·435	− 0·4349	− ·0001	− 0·4357	+ ·0007	+ ·002
11 „ *L*	Do.	+ 0·065	+ 0·0650	·0000	+ 0·0679	− ·0029	− ·001
12 „ *A*	Do.	− 6·719	− 6·7199	+ ·0009	− 6·7140	− ·0050	− ·002
13 „ *c*	$I - (H_1 + K_2)$	− 185·9	−185·91	+ ·01	−186·23	+ ·33	− ·1
14 „ λ	Do.	+ 0·151	+ 0·1509	+ ·0001	+ 0·1531	− ·0021	− ·002
15 „ *L*	Do.	− 0·013	− 0·0131	+ ·0001	− 0·0147	+ ·0017	− ·001
16 „ *A*	Do.	+ 2·957	+ 2·9587	− ·0017	+ 2·9858	− ·0288	− ·005
17 „ *c*	$J_1 - (I + K_3 + J_2)$	− 62·2	− 62·20	·00	− 62·52	+ ·32	+ ·1
18 „ λ	Do.	+ 0·139	+ 0·1389	+ ·0001	+ 0·1413	− ·0023	+ ·001
19 „ *L*	Do.	− 0·072	− 0·0720	·0000	− 0·0727	+ ·0007	− ·003
20 „ *A*	Do.	+ 3·046	+ 3·0466	− ·0006	+ 3·0326	+ ·0134	+ ·002
21 „ *c*	$J_1 + L$	+ 257·1	+257·10	·00	+257·14	− ·04	− ·2
22 „ λ	Do.	+ 0·060	+ 0·0600	·0000	+ 0·0601	− ·0001	+ ·002
23 „ *L*	Do.	− 0·256	− 0·2560	·0000	− 0·2556	− ·0004	− ·003
24 „ *A*	Do.	− 3·912	− 3·9116	− ·0004	− 3·9309	+ ·0189	− ·002

Note.—The units of this table are, in side the seventh place of logarithms and in latitude, longitude and azimuth a second of arc.

November, 1890.

W. H. C.

KHANPISURA MERIDIONAL SERIES.

KHANPISURA MERIDIONAL SERIES.

INTRODUCTION.

The Khánpisura Meridional Series of the South-West Quadrilateral is the great chain of principal triangles that follows the meridian of 75½° from the parallel of 19° to that of 24¼°. Its southern extremity is in the dominions of the Nizam, and it passes through Khándesh and Central India. It consists of one compound figure, two double and two single polygons, and four quadrilaterals, and extends over a meridional distance of 360 miles. Its name is derived from the station of Khánpisura of the Bombay Longitudinal Series.

The series lies between the side Búda (XXI)—Bálágara (XXIV) of the Karáchi Longitudinal Series and the side Chincholi (XXIII)—Ágargaon (XXIV) of the Bombay Longitudinal Series. In the simultaneous reduction of the South-West Quadrilateral, it had therefore to be fitted in between a finally fixed side of the North-West Quadrilateral and another of the Southern Trigon: on the completion of this reduction it was found that the errors which had actually been dispersed between the two fixed terminals were as follows:—

	In Latitude of Ágargaon (XXIV)	$-$ 0″·635
	„ Longitude of „ „	$-$ 0·566
	„ Azimuth of Ágargaon (XXIV)—Chincholi (XXIII) ...	$-$ 7·808
In side	Logarithm of feet	+ 0·000,0190,3
	giving a ratio of about 2·78 inches per mile.	

Observations for the direct determination of azimuth have been taken at two stations of the Khánpisura Meridional Series, *viz.*, Valvádi and Indrawán.

In 1845 when the North Konkan or Singi Series had been carried as far north as the parallel of 21° 45′, it was found necessary to temporarily abandon it, as the health of the party had suffered so terribly in its execution. Lieutenant Harry Rivers of the Bombay Engineers, the Officer in charge, was accordingly directed in October, 1845, to start a new series of triangulation from a side of the Bombay Longitudinal Series and carry it due north along the meridian of 75°.

Season 1845-46.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 2nd Assistant G. T. Survey.
Mr. J. Fraser, Sub-Assistant 1st Class.
„ T. Sanger, „ „
„ J. DaCosta, „ 2nd Class.

The sides of the old Bombay Longitudinal Series that Rivers adopted as bases for the new chain were Párner–Khánpisura and Khánpisura–Sautára*, and the first stations he selected were those of Ágargaon and Chincholi. By the end of December 1845 he had completed the triangulation up to the side Dhaigaon–Mathuri, and by the middle of January he had by means of two new single triangles reached Yerúl–Jámkhed. On this latter side he constructed a pentagon round Pophla as a centre which advanced the triangulation as far north as Sátmála–Sirsála. He then proceeded to Surat to take some observations at stations of the Singi Meridional Series, which he had had to relinquish the previous year, and he was occupied with these till the close of the field season.

In the Introduction to the Singi Meridional Series an account is given of the great difficulties that Lieutenant Rivers encountered in the execution of that Series, and of his repeated failures to extend it through the Dáng jungles; he had in fact been unable to carry it north of the parallel 21° 45′, and at this point it was now standing in abeyance.

In the summer of 1846 Rivers proposed to Sir Andrew Waugh to connect the Singi and Khánpisura Series in latitude 20° 30′ by means of three single triangles, one on the side of the Khánpisura Series, Sirsála–Sátmála, one on the side of the Singi Series, Ankai–Sáler, and one between, and to convert the two present Meridional Series from this point northwards into one on the meridian of 74° 45′: this new series he explained would run through Khándesh and Malwa (Málwa), where there were a succession of hills, which they had not the benefit of in the plains of Gujarát, and which moreover did not extend sufficiently to the east to allow of being utilised for the Khánpisura Series: the atmosphere too would be more favorable for trigonometrical work, being higher and further from the haze of the coast. Sir Andrew Waugh, who still believed in the feasibility of extending the Singi Series, refused to sanction Rivers' proposal on the grounds that it was not in keeping with the system of the Indian triangulation, and directed that both Meridional Series should be kept distinct and unconnected. The party passed the recess season of 1846 at Poona.

Season 1846-47.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 2nd Assistant G. T. Survey.
Mr. J. Fraser, Sub-Assistant 1st Class.
„ T. Sanger, „ „
„ J. DaCosta, „ 2nd Class.

On October 9th, 1846, Rivers began observing an astronomical azimuth at Khánpisura, which was not completed till October 21st, owing to cloudy and boisterous weather. He then re-observed the angle at Párner between Khánpisura and Ágargaon and also that at Khánpisura between Párner and Ágargaon, as they had been taken before on but three pairs of zeros†. The next stations he visited were Sirsála and Sátmála,

* The three northern triangles of the Khánpisura Heptagon appertained originally to the Khánpisura Meridional Series: the whole Heptagon is now included in the Bombay Longitudinal Series, and consequently belongs to the Southern Trigon.
† These measures were not utilized in the calculation.

which are situated on the northern edge of the Ajanta range of ghâts and from which a clear view to the north can be obtained all the way to the Sátpuda range. From these stations, at each of which two angles remained to be observed, a further extension of the Khánpisura Series was commenced. After leaving Valvádi, where he had observed an astronomical azimuth, the country became very desolate; there were no villages and no roads, and dense jungle lay in every direction.

At Thíkri a letter arrived from Mr. Sanger, who was in charge of the approximate work, reporting that he had great difficulty in selecting a strong and suitable figure immediately to the north of the parallel of 22°, owing to the country in the Malwa Districts being a perfect plain. Leaving the theodolite and the greater part of his camp at Thíkri, Rivers pushed on in advance to help his assistant; after three weeks hard work he succeeded in laying down an excellent figure, the Mograba Hexagon, and returned to Thíkri to resume the observations of the principal angles. By the middle of April, 1847, he had carried the Khánpisura Series as far north as the side Harnása–Indrawán, and at the latter station had observed an astronomical azimuth. He arrived at Mhow (Mau) shortly before May 1st, where he established his recess quarters.

Season 1847-48.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 2nd Assistant G. T. Survey.
Mr. J. Fraser, Sub-Assistant 1st Class.
" T. Sanger, " "
" J. DaCosta, " 2nd Class.

As Rivers' series was now approaching the parallel of Kaliánpur and Sironj the selection of his stations became a matter of more than ordinary difficulty: preparations were already being made for extending the Great Longitudinal Series along this parallel westwards to Karáchi, but the exact latitude in which it would strike the Khánpisura Meridian could not be foreseen. Rivers was told to so select his figures, between the parallels of 24° and 25°, that any one of them if necessary should admit of being adopted in the new Longitudinal Series. On taking the field in October, 1847, Rivers himself commenced the approximate work, which he found a most difficult task: all his triangles had to admit of satisfactory extensions not only to the north, but also to the east and west, and as there were no commanding hills it was often necessary to make a minor triangulation simply to obtain the direction of the points already determined. Under these circumstances Rivers thought it his best plan to undertake himself the approximate work of the new Longitudinal Series and carry it on simultaneously with that of his own chain. He therefore decided to select the stations on the Khánpisura Meridian as far north as the parallel of 24° and to then work along that parallel to Sironj. He had just completed the selection of the stations for the Aramlia Polygon, and was about to proceed to Sironj, when he received orders to carry the Khánpisura Series due north to Ajmere (Ajmer) and to leave the longitudinal connection with Sironj to be taken up by another officer. He carried the approximate work up to the parallel of 25° and then commenced the final observations working southwards from the northernmost stations. The Great Longitudinal Series eventually struck the Series under review in the latitude of Aramlia, but Rivers' polygon around that station proved unsuitable and another had to be selected. The former, however, together with Rivers' work to the north of it, was included in the Aramlia (now the Gurhágarh) Meridional Series, whilst the side connecting the stations of Bálágara and Búda, which was common to both was made the northern boundary of the Khánpisura Meridional Series. By the end of March, 1848, Rivers had carried the principal work southwards as far as the stations of Dhamnár and Sítamau, and in April he completed the observations at Lohári and Dudhála: at Nigrun, however, though he halted a week, he could not see the Deo Dongri signal, which had been easily visible in November. At Deo Dongri too he was unable to observe Nigrun. At Gurla he met with no better success, though, owing to the shortness of the rays, all the surrounding heliotropes were visible, and at Karsod the Indrawán station could not be made out though large fires were lighted at night, and though the signal had been seen by Mr. Sanger in October. Finding it thus impossible to complete the connection with the side Harnása–Indrawán of his former season's work, he closed the field season at Karsod on May 5th. He had dismantled and packed the instrument, and it was ready to be moved, when during the night one of the boxes was broken open and the telescope and vertical circle were carried off by thieves. They were found next morning in a ditch 300 yards from camp; they were both uninjured but the eye-piece was missing. Rivers arrived at Mhow where he had established his recess quarters on May 15th.

Season 1848-49.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 2nd Assistant G. T. Survey.
Mr. J. Fraser, Sub-Assistant 1st Class.
" T. Sanger, " "
" J. DaCosta " 2nd Class.

Rivers re-commenced operations the following winter: the first station visited was Indrawán which he reached on November 17th, and from thence he went to Karsod. By the end of the year 1848 he had completed the connection between the northern and southern sections, and the Principal Triangulation of the Khánpisura Meridional Series was finished. Rivers then proceeded towards Neemuch (Nimach) and took up the work of the Gurhágarh Series. The instrument employed by Lieutenant Rivers on the Khánpisura Series was the same 15-inch Theodolite by Dollond that was used on the southern section of the Singi Series.

Season 1862-63.

PERSONNEL.

Captain C. T. Haig, R.E., 1st Assistant.
Mr. DaCosta, Assistant.
" J. McGill, Civil 2nd Assistant.
" G. Anding, Sub-Assistant.
" J. E. Donohoe, 3rd Class Sub-Assistant.

The Khánpisura Series as left by Rivers, though otherwise double throughout, was weakened near its southern extremity by the existence of two single triangles, *viz.*, Mathuri, Dhaigaon, Jámkhed and Yerúl, Dhaigaon, Jámkhed. In November 1862, Captain Haig, R.E., who was in charge of the Bombay Party and who was about to undertake the Triangulation of the Mangalore Meridional Series, set out from Poona (Puna) with the object of strengthening the single portion of the Khánpisura Series. This object he obtained by the adoption of but one new station that of Áhirmal, which with Mathuri Jámkhed and Rájur gave two new triangles and thus completed a double polygon round Jámkhed and Pophla. Mathuri, the first station visited was reached on November 10th, 1862 and all the observations necessary at the four stations were completed on December 7th. The instrument he used was that known in the Survey Department as Barrow's 24-inch Theodolite No. 2.

In consequence of the great deficiency of observations on certain rays and of the weak character of the heights in general, the re-measurement of all the vertical angles of Rivers' section of the Khánpisura Series was found necessary. In 1882-83, Mr. A. Christie, Surveyor 4th grade, began this revision from the side Bálágara–Búda of the Karáchi Longitudinal Series, and worked southwards as far as Jalálabad and Bábákuvar. In November 1883, Mr. H. E. T. Keelan, Surveyor 3rd grade, was directed to commence at the southern extremity of the Series, Ágargaon and Chincholi, and to work northwards so as to close on Mr. Christie's work of the previous year. Unfortunately at Ágargaon Mr. Keelan was attacked with severe inflammation of the right eye, which obliged him to return to Ahmednagar (Ahmadnagar) for medical aid; he was compelled to take privilege leave till January 15th, and consequently lost two months in the best part of the season. This interruption made it impossible to complete the revision of the heights in the field season of 1883-84, and Mr. Keelan had to resume work on it the following year, when the remeasurement of all the vertical angles was finished.

In 1868-69, Lieutenant W. J. Heaviside, R.E., visited the stations of Deo Dongri and Harnása, and in the following year those of Valvádi and Dhaigaon, and at each of the four observed an astronomical latitude.

Secondary Triangulation.

On the southern part of the Khánpisura Meridional Series, as far north as the River Tápti, an unusually large number of secondary points were fixed by Rivers: the majority of these were intersected pagodas, forts and trees, but there were several secondary stations too, that were visited and observed at: the positions of the towns of Ahmednagar, Dhulia (Dhula) and Aurungabad were determined. The principal station of Ankai of the Singi Series was observed both from Sátmála and Yerúl.

Between the Tápti and Narbada there were no prominent pagodas to observe and no important towns to be fixed and consequently the secondary work was very scanty, consisting of only some ten intersected points in all.

Between the Narbada and the northern terminus of the Series the country was a desolate desert, and but few opportunities offered of executing secondary work: the town of Dhár was the only place of importance that the Series passed over. From the side Harnása–Singárchori a small secondary series was run to the eastwards, which fixed numerous points in the cities of Indore (Indor) and Mhow and which ended at the town of Dewás.

S. G. BURRARD.

April, 1889.

KHANPISURA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. ALPHABETICAL LIST OF STATIONS.

Ágargaon	XXIV. (Of the Bombay Longitudinal Series).	Indráwan	XIII.
Áhirmal	XXXII.	Jalálabad	XIX.
Ajnád	XXII.	Jalálkheri	X.
Anakvádi	XXV.	Jámkhed	XXXI.
Árgaon	XXI.	Karsod	IX.
Bábákuvar	XX.	Kaula-ka-Máta	XI.
Bálágara	XXIV. (Of the Karáchi Longitudinal Series).	Lohári	VI.
Báwangaz	XVIII.	Mathuri	XXXIII.
Búda	XXI. (Of the Karáchi Longitudinal Series).	Mograba	XIV.
Chincholi	XXIII. (Of the Bombay Longitudinal Series).	Nigrun	III.
Deo Dongri	V.	Pophla	XXVIII.
Dhaigaon	XXXIV.	Rájur	XXIX.
Dhamnár	II.	Sátmála	XXVII.
Dhanora	VII.	Singárchori	XV.
Dhanvár	XXIV.	Sirsála	XXVI.
Dudhála	IV.	Sítamau	I.
Gumánpur	XVI.	Thíkri	XVII.
Gurla	VIII.	Valvádi	XXIII.
Harnása	XII.	Yerúl	XXX.

KHANPISURA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. NUMERICAL LIST OF STATIONS.

XXI (Of the Karáchi Longitudinal Series).	Búda.
XXIV (Of the Karáchi Longitudinal Series).	Bálágara.
I	Sítamau.
II	Dhamnár.
III	Nigrun.
IV	Dudhála.
V	Deo Dongri.
VI	Lohári.
VII	Dhanora.
VIII	Gurla.
IX	Karsod.
X	Jalálkheri.
XI	Kaula-ka-Máta.
XII	Harnása.
XIII	Indráwan.
XIV	Mograba.
XV	Singárchori.
XVI	Gumánpur.
XVII	Thíkri.
XVIII	Báwangaz.
XIX	Jalálabad.
XX	Bábákuvar.
XXI	Árgaon.
XXII	Ajnád.
XXIII	Valvádi.
XXIV	Dhanvár.
XXV	Anakvádi.
XXVI	Sirsála.
XXVII	Sátmála.
XXVIII	Pophla.
XXIX	Rájur.
XXX	Yerúl.
XXXI	Jámkhed.
XXXII	Áhirmal.
XXXIII	Mathuri.
XXXIV	Dhaigaon.
XXIII (Of the Bombay Longitudinal Series).	Chincholi.
XXIV (Of the Bombay Longitudinal Series).	Ágargaon.

KHANPISURA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. DESCRIPTION OF STATIONS.

The Principal Stations of this Series are all situated either on hills or rising ground, and those constructed under the direction of Lieutenant Rivers consisted in general of solid masonry pillars, with one or more marks, sunk in the ground and having their upper surfaces flush with the ground level. Above these pillars, solid structures of loose stone masonry, varying in height from 1 to 14 feet, were erected, with another mark laid loosely at the surface. The stations were all visited again during the field Seasons of 1882-85 for the purpose of revising the observations for height, which were originally very defective. In the course of this revision, which was made under the superintendence of the Officer in charge of the Tidal and Levelling Party, the stations were repaired, some reconstructed, and all protected by mounds of earth and boulders. In the years 1868 to 1870, solid, rectangular masonry pillars, bearing sufficiently accurate marks for Topographical and Revenue Survey purposes—as shewn at page 74 of Volume II of the *Account of the Operations, &c.*,—were built for the protection of the upper mark-stones at stations numbered XIV, XVII, XXIII and XXXIV.

The following descriptions have been compiled from those given by the Officers who executed the Series; by Lieutenant Heaviside, who visited several of the stations during Seasons 1868-69 and 1869-70; and by the Officer in charge of the Tidal and Levelling Operations, under whose superintendence the vertical angles of the whole Series were revised; supplemented as regards adjacent villages from the Topographical Survey Maps of the country traversed, and corrected, so far as the local sub-divisions in which the several stations are situated, from the latest Annual Reports furnished by the District Officers to whose charge the stations were committed.

XXI.—(*Of the Karáchi Longitudinal Series*). Búda Station, lat. 24° 14′, long. 75° 11′—observed at in 1848 and 1850—is situated on a swell of ground about 50 yards W. of the cart road from Badpura to Búda, and about 7¾ miles N.W. of the town of Náhargarh. The station is in the lands of the village of Búda, pargana Náráyangarh, Holkar's territory.

The station as originally built in 1848 consisted of a square platform of loose stones, enclosing a central, solid pillar of masonry having a mark at the top and another 4·15 feet below engraved on the rock *in situ*. When visited in 1850, in the course of the Karáchi Longitudinal Series operations, the old pillar was removed and a new solid pillar of masonry was constructed, 5·2 feet in height, in which three mark-stones were placed in the normal of and at distances of 1·23, 2·75, and 5·2 feet respectively above the original mark on the rock. When again visited in 1882, the upper mark-stone was wanting which necessitated reference to the central mark of 1850. The pillar was then rebuilt, 3¾ feet in diameter, and another mark-stone placed in its upper surface at 2·58 feet above the central mark or 5·33 feet above the mark on the rock. The height of the pillar above the ground level is 4 feet. A stone and earth platform 16 feet square surrounds the pillar. The directions and distances of the circumjacent villages are:—Limbawás W.N.W., miles 1½; Bánskheri W. by S., miles 1¾; Dhorwára S. by W., miles 1½; and Taláo Piplia S.E., miles 1½.

XXIV.—(*Of the Karáchi Longitudinal Series*). Bálágara (*Bálagarra*) Hill Station, lat. 24° 10′, long. 75° 0′—observed at in 1848 and 1850—is situated on the north-eastern of a group of small, isolated hills, about a mile N.E. of the village of Bálágara, and 3 miles W. of the high road from Neemuch to Indore. The hill, on which the station is, rises about 120 feet above the general level of the country, and is a mile in circumference at base. The station is in the lands of the village of Bálágara, pargana Mandsaur, Gwalior territory.

The station as originally built in 1848 consisted of a platform of loose stone masonry, having a mark-stone at the top and another 3·19 feet below engraved on the rock *in sitú*. When visited in 1850 in the course of the Karáchi Longitudinal Series operations, it does not appear that any alteration in the construction of the station was made. In 1868-69, the mark on the rock was found and the platform, 3 feet in height, consisted of loose stone masonry. In the visit of 1882, the station was found unaltered and in good preservation; the surrounding platform being of stones and earth 18 feet square. The directions and distances of the circumjacent villages are:—Bái E., miles 1¾; Dungloda S. by E., miles 1½; Narona N. by E., miles 2; Khera N.E., mile 1; and Kánkri N.W., miles 1¾.

I. Sítamau Hill Station, lat. 24° 2′, long. 75° 22′—observed at in 1848—is situated 1½ miles N.W. of the town of Sítamau, near the centre of a small, flat-topped hill rising some 50 feet above the level of the country, and somewhat conspicuous as being the only wooded hill in the neighbourhood; it is about 20 feet higher than the ridges and spurs with which it is connected. The station is in the lands of the village of Murkhera, Sítamau State, Western Malwa Agency.

The station consisted of a platform of loose stone masonry and contained three marks, the upper two being 5·35 and 8·89 feet respectively above one engraved on the rock at the ground level. It was visited by Lieutenant Heaviside in 1868-69, who stated that "The pillar had apparently not been disturbed." When again visited in 1882, the station was found to consist of an isolated pillar of stone and earth 12·84 feet high, without a mark on its summit, surrounded by a platform of loose stones 18 feet square. A mark-stone was inserted and both the pillar and platform raised by 2·58 feet, making the entire height of the pillar 15·42 feet. The directions and estimated distances of the circumjacent villages are:—Suriakheri N., mile 1; Murkhera W. by S., mile ¾; Chikla E.N.E., miles 3½; and Sítamau (town) S.E., miles 1½.

II. Dhamnár Hill Station, lat. 23° 53′, long. 75° 12—observed at in 1848—is situated on the highest part of a low, flat-topped, isolated hill rising some 40 feet above the level of the surrounding country. The station is 616 feet N.E. of a high solitary tree, and 5 miles S.E. of the Railway Station of Dalauda: pargana Mandsaur, Gwalior territory.

The station consisted of a solid pillar of masonry which carried a mark at its surface level with the ground and another, fixed in the rock with mortar, 2 feet below. It was visited in season 1868-69 by Mr. J. Wood, who remarks "There is no platform built here, and the lower mark is 2½ feet below the surface of the ground." When again visited in 1882, the station was found to consist of a platform of earth and stones 1 foot high with a mark-stone in its upper surface. The directions and estimated distances of the circumjacent villages are:—Jámúnia E., miles 1½; Atunia E.N.E., miles 1½; and Yusufkhera W., mile ¾.

III. Nigrun Station, lat. 23° 46′, long. 75° 27′—observed at in 1848—is situated on the rising ground about 1½ miles S.E. of the village from which it is named, and 3½ miles N. of the town and post office of Tál: The station is in the lands of the village of Nigrun, pargana Tál, Jaora State, Western Malwa Agency.

The station consists of a solid pillar of masonry, about 5 feet in height, having marks at top and bottom 5·15 feet apart. The platform is built of loose stone masonry and carried to a height of 5·27 feet above the top of the solid pillar, the whole structure being 10·27 feet high. When visited in 1882, the platform and a mark-stone in its upper surface were found in good preservation. The directions and distances of the circumjacent villages are:—Pipalia N.E., miles 4; Naráni E.N.E., miles 5¼; Bagunia E. by S., miles 3¼; and Kachalia S.E., miles 4.

IV. Dudhála Hill Station, lat. 23° 51′, long. 75° 49′—observed at in 1848—is situated about 30 feet from the southern extremity of a laterite hill rising 100 feet above the level of the country. The top of the hill is flat, running off into wide spurs to N.W. and N.E. of the station, the southern face being rather precipitous. The town of Baraud lies 4½ miles to S. by E. of the station. The station is in the lands of the village of Dudhála, pargana Jhálra Pátan, Jhallawar State.

The station consists of a platform of loose stone masonry containing two marks, one at the surface 5·23 feet above the other. It was visited by Lieutenant Heaviside in season 1868-69, who remarks "The pillar had apparently not been disturbed". When again visited in 1882, the station and its upper mark-stone were found in good preservation. The directions and distances of the circumjacent villages are:—Atipura N.E. by E., miles 1½; Kasankot E.S.E., miles 1¼; Khandwás S., mile 1; and Ratanpur W.S.W., mile ¾.

V. Deo Dongri Hill Station, lat. 23° 27′, long. 75° 35′—observed at in 1848—is at the junction of three walls on the southern side of the roof (11¾ feet above ground) of the large temple on a low hill at the northern extremity of the village of Deo Dongri. The village is near the centre of a small, isolated hill, about

800 feet in length at top, and rising about 70 feet above the general level of the surrounding country: pargana Unel, Gwalior territory.

The station consists of a solid pillar of masonry, about 2 feet high, containing a mark in the surface 2·92 feet above one imbedded in the masonry of the wall. The mark is 1·33 feet from the E. side and 1·25 feet from the S. side of the pillar. In March 1869 a protecting pillar of stone masonry, 2 feet square, was built over the mark-stone. When again visited in 1882, the station was found marked by a square pillar of stone masonry rising 2·7 feet above the stone roof of the temple. The azimuths and perambulated distances of the circumjacent villages are:—Mattra 326°, miles 1·2; Mo 356°, miles 1·6; Rattra 48°, mile 0·8; Medpur (the largest and most conspicuous temple) 250°, miles 7½ by estimation.

VI. Lohári Hill Station, lat. 23° 35′, long. 75° 8′—observed at in 1848—is situated on a low, flat-topped hill rising about 70 feet above the plain, appertaining to the villages of Lohári, Nagdi and Wairala. It lies about a mile E. of the railway line, and of the high road from Jaora to Rutlam. The station is in the lands of the village of Lohári, Jaora State, Western Malwa Agency.

The station consisted of a platform of loose stones, about 6 feet in height, enclosing a central, solid pillar of masonry which had a mark in its surface and another 5·21 feet below. It was visited in 1869 by Lieutenant Heaviside, when no mark-stones were found and a heap of loose stones alone denoted the site of the station. When again visited in 1883, the station was found to consist of a platform of earth and stones 5½ feet high with a mark-stone in its upper surface, but as this proved too low for observations to Deo Dongri Station, the platform was raised with an isolated pillar of earth and stones in the centre to a height of 13·4 feet above the ground level. The estimated directions and distances of the following villages are:—Lohári N., miles 1½; Waraila S., mile 1; Sadakheri E.S.E., miles 2; and Nagdi E.N.E., miles 1½.

VII. Dhanora Hill Station, lat. 23° 17′, long. 75° 18′—observed at in 1848—is situated on a table-land rising about 80 to 100 feet above the surrounding country, 1 mile N. of Láptia village, and 6 miles E. of the Railway Station of Naugauvan. It is in the lands of the village of Dhanora, Sailána State, Western Malwa Agency.

The station consisted of a platform of loose stone masonry, 12 feet in height, which had a mark-stone at top and another at the ground level. When visited in 1883, no mark-stones were found, on removing the central portion of the heap of stones an excavation, a few inches deep, like the foundation of a pillar, was met with at the ground level: in this a mark-stone was fixed and the platform rebuilt to a height of 9·3 feet, and over which an isolated pillar of earth and stones 1·4 feet high was built, carrying a mark-stone in its upper surface; but this height proving insufficient the pillar was raised by 7·3 feet during the same season. The estimated directions and distances of the following villages are:—Sandla S.W. by W., mile 1; Bamori N. by W., miles 2; and Kamer E., miles 2.

VIII. Gurla Hill Station, lat. 23° 18′, long. 75° 36′—observed at in 1848—is situated on a northern spur of a low, flat-topped range of hills, which stretches in a S.S.E. direction from the station for some 4 or 5 miles, and is about 60 feet above the level of the country to the west. The station is in the lands of the village of Gurla, pargana Unel, Gwalior territory.

The station consists of a platform of loose stone masonry containing two marks, the upper 7·23 feet above the lower. It was visited by Lieutenant Heaviside in season 1868-69, who stated that "The mark-stone was not uncovered, but the pillar was apparently undisturbed". When again visited in 1883, the station was found to consist of a platform of earth and stones 6·7 feet above the ground level having a mark-stone in its upper surface. The directions and estimated distances of the circumjacent villages are:—Unel N. by E., miles 3; Gurla W., mile 1; Nawáda N.W., miles 3½; and Norela S.S.E., miles 4.

IX. Karsod Hill Station, lat. 23° 7′, long. 75° 28′—observed at in 1848 and 1862—is situated on a small hill about 5½ miles N.E. of the town and railway station of Barnagar. It is towards the S. extremity of the hill, and 119 (ft.?) 8 (in.?) S. of the southern wall of a temple. It is in the lands of the village of Chota Karsod, pargana Barnagar, Gwalior territory.

The station consists of a platform (most probably constructed in a manner similar to those at the adjacent stations) and contains two marks, the upper 4·27 feet above the lower. When visited in 1862, in the course of the Guzerat Longitudinal Series operations, the station was found to be about 5 feet in height. When again visited in 1883, the station was found in good order and to consist of a platform of earth and stones enclosing a perforated pillar of masonry 5 feet high with two mark-stones, one in its upper surface and the other below; an aperture on the S. side gives access to the lower mark-stone. The estimated directions and distances of the circumjacent villages are:—Rasulabad S., mile ¾; Chota Karsod N.E. by N., miles 1½; and Palwás N., miles 2¾.

X. Jalálkheri Hill Station, lat. 23° 11′, long. 75° 45′—observed at in 1848—is situated on a detached hill about a mile S. of a table-land. The station is on the northern of two eminences rising 20 feet above the hill top, and some 100 feet above the level of the country and lies 3⅓ miles west of the railway station near the town of Ujjain: pargana and district Ujjain, Gwalior territory.

The station consists of a platform of loose stones about 10 feet square and 6 feet high, the central portion from 2 to 3 feet square is of solid masonry in which three mark-stones are inserted, the two upper being 2·75 and 6·08 feet respectively above one imbedded in the foundation, the second mark-stone is about the ground level. In 1869 Lieutenant Heaviside found the upper mark-stone in position. When visited in 1883, the station was found to consist of a platform of earth and stones 16 feet square and 3·8 feet high with a mark-stone in its upper surface. The directions and estimated distances of the circumjacent villages are:—Jalálkheri W.N.W., mile 1; Mendpura E.N.E., miles 1½; and Chaudukheri S.W. by S., miles 1½.

XI. Kaula-ka-Máta Hill Station, lat. 23° 8′, long. 75° 13′—observed at in 1848—is on an isolated and symmetrically shaped hill rising about 500 feet above the plain. The station is at the N.E. corner of the flat roof of the porch and E. of the spire of the large temple of Kaula-ka-Máta from which the hill derives its name. The station is in the lands of the village of Barmaval, Sailána State, Western Malwa Agency.

The station is denoted by two marks, the upper 0·75 of a foot above the lower. It was visited in 1869, when "the mark was found in good preservation". When again visited in 1883, the station was found to consist of a square pillar of masonry 6 inches high with a mark-stone in its upper surface, the height of which above the top of the hill is 18½ feet. The directions and estimated distances of the circumjacent villages are:—Amleti N.E., mile 1; Barmaval W., miles 3; and Lochitara (on the high road to Mhow) E., miles 2.

Another principal station, about 20 yards S. of the temple, was established in 1862 in the course of the operations of the Guzerat Longitudinal Series, in which Series its full description will be found under the name of Station "I. Kaula-ka-Máta".

XII. Harnása Tower Station, lat. 22° 47′, long. 75° 36′—observed at in 1847 and 1848—is situated on the highest part of the country, the watershed of the Gambhír and Chambal rivers, and 4 miles S. by E. of the town of Depálpur on the road from Neemuch to Indore: pargana Depálpur, Holkar's territory.

The station as originally built in 1846 consisted of a solid pillar of masonry sunk to a depth of about 9 feet, having its upper surface flush with the ground level. It contained two marks, one at the surface about 9 feet above the other. Over the pillar a loose stone platform was constructed with a mark in its upper surface. The height of the platform above the top of the pillar appears to have been originally 7·35 feet; but this not proving sufficient it was increased to 10·31 feet in April 1847. The station was revisited in 1869 by Mr. J. Wood, Assistant Surveyor, who removed the pile of stones and found a mark-stone about 3 feet below the ground level. He built up the pillar to the ground level and placed a mark-stone there. At this level astronomical observations for latitude were taken in 1869-70. Immediately afterwards a perforated masonry pillar was built over the mark-stone at the ground level and carried up to a height of 10·31 feet, the height of the station as given in the original description. The pillar is surrounded by a platform, and an arched passage runs nearly north and south through the platform and pillar giving access to the mark-stone. When again visited in 1883, the upper 4 feet of the pillar was found pulled down, it was rebuilt to a height of 10·2 feet above the ground level mark. The directions and distances of the circumjacent villages are:—Jaloda N.E. by N., miles 1¾; Harnása S. by E., mile ¾; Suklundi S. by W., miles 1¾; Básoda W. by N., mile ¾; and Girora N. by W., miles 2.

XIII. Indráwan Tower Station, lat. 22° 49′, long. 75° 13′—observed at in 1847, 1848 and 1862—is situated on rising ground, about 1 mile N.W. of the village from which the station obtains its name, and 8 miles N.N.E. of Desi. The station is in the lands of the village of Barawál, pargana Badnáwar, Dhár State, Bhopáwar Agency.

The station as originally built in April 1847 consisted of a solid pillar of masonry sunk to a depth of 6·3 feet, containing two marks, the upper in the surface of the pillar being at the ground level; over this a platform of loose stones, 7·46 feet in height, with a mark at the top was constructed. In November 1848 an addition of 2·17 feet was made to the height of the platform. It was again visited in February 1862 in the course of the operations of the Guzerat Longitudinal Series: in the records of that Series it is simply stated that it is built 4·75 feet high. In 1869 the loose stone platform was removed, and over the original mark at the ground level, a perforated and isolated pillar of masonry 7·46 feet in height and 3½ feet in diameter was built with a mark-stone in its upper surface, and surrounded by a platform of earth and stones of the same height as the pillar. An arched passage from E. to W. gives access to the ground level mark. It thus appears that the station as last constructed is 2·17 feet lower than that of November 1848. When again visited in 1883, the pillar and its upper mark-stone were found in good order. The directions and distances of the circumjacent villages are:—Borjhiri W., mile 1; Burwai E., miles 2¼; and Gundikheri S.E., miles 1¼.

XIV. Mograba Hill Station, lat. 22° 23′, long. 75° 22′—observed at in 1847—is situated on the summit of the highest, flat-topped hill 5½ miles to N.W. of the old, ruined city of Mándo or Mándogarh: the small Bheel village of Mograba lies to the N.E. at about ¾ of a mile in direct distance from the station: pargana Nálchha, Dhár State, Bhopáwar Agency.

The station consists of a platform having its upper surface flush with the ground, which contains two marks, the lower, on a large stone set in the muram (a kind of gravel), is 0·40 of a foot below the one in the surface of the platform. It was visited in 1869, when the upper mark-stone was found firmly imbedded. When again visited in 1883, the station was found in good order and covered over by a protecting masonry pillar 3 feet, 8 inches high, but as the upper diameter was too small to admit of the theodolite, the upper 6 inches of the pillar were removed. The directions and estimated distances of the circumjacent villages are:—Talwára N. by E., miles 8; Múrkhál S., miles 2½; and Mandauda S.S.W., miles 3.

XV. Singárchori Hill Station, lat. 22° 25′, long. 75° 43′—observed at in 1847—is situated on the highest part of a range of hills so called, lying about 3½ miles E.S.E. of the village of Mánpur on the high road from

Bombay to Agra, and 11¾ miles S.S.W. of the cantonment of Mhow. The hill is about 1000 feet in height: Mánpur State, Bhopáwar Agency.

The station was denoted by two marks, the upper 1·79 feet above the lower. When visited in 1883, a masonry pillar 2 feet in diameter and 3 feet above ground level surrounded by earthwork about 2 feet high was found; there being no mark-stone on the pillar its upper portion was removed and a mark-stone embedded in its centre 1·75 feet above the ground level. The directions and estimated distances of the following villages are:—Bargaon N.W. by N., miles 1¼; Mograpura E.S.E., miles 1¼; and Nayapura E. by N., miles 1½.

XVI. Gumánpur Tower Station, lat. 22° 35′, long. 74° 55′—observed at in 1847—is situated on rising ground about ¾ of a mile S. of the village of that name and about 200 yards N. of the edge of the Ghát, and 5½ miles N. by E. of the large village of Tanda. It is in the lands of the village of Gumánpur, Amjhera State, Bhopáwar Agency.

The station of 1847 consisted of a loose stone platform with a mark-stone at top 7·48 feet above one let into masonry at the ground level. In 1869 the platform was removed and a perforated and isolated pillar of masonry, 7·48 feet in height, built above the original mark at the ground level, and surrounded by a platform of stones: a passage from N. to S. gives access to the ground level mark. When again visited in 1883, the station was found to consist of a pillar of masonry 5·3 feet high and 3 feet in diameter with a mark-stone in its upper surface, and surrounded by a platform of loose stones. The directions and distances of the circumjacent villages are:—Ratanpura N.E. by N., miles 2; Ringnod E.N.E., miles 4; Nawapura E. by S., miles 1½; and Urai W.N.W., mile ½.

XVII. Thíkri Hill Station, lat. 22° 1′, long. 75° 27′—observed at in 1847—is situated on a knoll, 40 yards long, 20 yards wide, and 20 feet high, at the S. extremity of a table-land which rises about 300 feet above the general level of the surrounding country. It is about 3½ miles S. by E. of the Police Station of Thíkri on the high road from Bombay to Agra: pargana Dharampuri, Dhár State, Bhopáwar Agency.

The station consists of a platform of loose stones enclosing a solid circular pillar of masonry which contains two marks, one at the surface 1·25 feet above the other which is engraved on the rock. When visited in 1869, the upper mark-stone was found firmly fixed; it was again visited in 1883, when the station was found protected by a rectangular capping pillar 3¼ feet high built over the circular pillar level with the surface of the knoll. The directions and distances of the circumjacent villages are:—Rarkot S. by E., mile 1; Rupkhera S.W. by W., miles 1½; Khurrampur (on the high road) W., miles 4½; and Nader N.N.E., miles 2.

XVIII. Báwangaz Hill Station, lat. 21° 59′, long. 74° 54′—observed at in 1847—is on the terraced roof of a temple which is built of fine slabs of granite, on the highest part—a peak—of a remarkable hill called Báwangaz, about 5 miles S. of the Nerbudda river. The temple is dedicated to a god whose colossal figure is cut on the rock in bold relief, about 600 feet below, on the southern face or scarp of the hill. The station is almost in the centre of the flat portion of the roof E. of the dome, 13·42 feet from the nearest part of the circumference of the dome, 11·42 feet from the outside of the N. wall, and 12·75 feet from the outside of the S. wall; the roof of the temple is 10 feet above the ground. The station is in the lands of the village of Barwáni, Barwáni State, Bhopáwar Agency.

The station consists of a solid circular pillar of masonry which contains two marks, the upper 0·44 of a foot above the one engraved on a slab of granite of the roof. When visited in 1869 and 1883 the station and its upper mark-stone were found in good preservation. The directions and distances of the circumjacent places are:—Barwáni town N.E., miles 4½; Chilkalda town N. by E., miles 7; Bhomia village N., miles 2½; Mangarpati and Kachkor (on the Goi stream) W.N.W., miles 3½; and Wadgaon E.N.E., miles 4.

XIX. Jalálabad Hill Station, lat. 21° 41′, long. 75° 27′—observed at in 1847—is situated on the highest peak of the same range of hills as that on which the old, ruined fort of Bijagarh stands and from which it lies 3½ miles in a direction E. by S. The station is in the lands of the village of Náráyangarh, pargana Khargon, Holkar's territory.

The station consists of a platform of loose stone masonry containing two marks, one at the surface and the other 0·44 of a foot below. It was visited by Lieutenant Heaviside in 1869, when the upper mark-stone was found in position, and about 2½ feet above the ground level. In 1883 and 1884, the station was found in good preservation and the upper mark-stone in position. The directions and distances of the circumjacent villages are:—Sángvi N.N.W., miles 4; Bhadwáli N., miles 4½; Sirwil Chauki (police station) and temple S.E. by S., miles 4½; and Dhaura S.W. by S., miles 2½.

XX. Bábákuvar (*Bábákuwar*) Hill Station, lat. 21° 36′, long. 74° 57′—observed at in 1847—is situated on the main ridge of the Sátpura hills, about 9½ miles N.W. by W. of the Dák Bungalow at Palásner on the high road from Bombay to Agra, and 550 feet E. of an idol at the W. extremity of the hill. The station is in the lands of the village of Boradi, taluka Shirpur, district Khándesh.

The station consists of a platform of loose stone masonry containing two marks, one at the surface and the other 1·67 feet below. When visited in 1883 and 1884, the station was found in good preservation and the upper mark-stone in position. The height of the platform is about 1 foot from the ground level. The directions and distances of the circumjacent villages are:—Chaparkhera N.E., miles 4½; Rájmali E., miles 4½; Vakvar S.E. by E., miles 5; and Khera S.E. by S., miles 6½.

XXI. Árgaon Hill Station, lat. 21° 18′, long. 75° 34′—observed at in 1847—is situated on a high peak of the Sátpuda range, rising some 2500 feet above the plains of Khándesh. The peak which is known by the name of Mondhiámal, is about 1¾ miles W. of the ruins of Gauligarh, and 5½ miles N.N.W. of Árgaon village. A small conical peak is 50 yards to S.E. The station is in the lands of the village of Bhadgaon, taluka Chopda, district Khándesh.

The station consists of a platform of loose stone masonry containing two marks, one at the surface and the other 0·81 of a foot below engraved on the rock. In 1869 Lieutenant Heaviside found the upper mark-stone in position and nearly on the same level as the highest part of the peak. When again visited in 1884, the upper mark-stone and platform were found in good preservation. The azimuths and estimated distances of the circumjacent villages are:—Dhánora 4°, miles 6¾; Ádávad 42°, miles 8; Birgaon 6°, miles 6; and Mahorad 356°, miles 4½.

XXII. Ajnád Hill Station, lat. 21° 19′ long. 75° 5′—observed at in 1847—is situated on a long, high ridge running nearly in a direction W.N.W. and E.S.E. and parallel to road to south from Shirpur to Tanda on the Aner river, about 2 miles N. of Ajnád village. The station is in the lands of the village of Ajnád, taluka Shirpur, district Khándesh.

The station consists of a platform of loose stone masonry containing two marks, one at the surface and the other 0·67 of a foot below engraved on the rock. When visited in 1884, the upper mark-stone and platform were found in good preservation. The azimuths and distances of the circumjacent villages are:—Bábla 340°, miles 2½; Tárli 321°, miles 3½; and Bhátpur 28°, miles 3.

XXIII. Valvádi (*Walwári*) Hill Station, lat. 20° 44′, long. 75° 14′—observed at in 1846—is situated near the N.W. extremity of a group or range of low hills about 90 feet in height. The station is about 20 yards from the W. edge of a flat, rocky hill, whose summit is 150 yards long and 30 yards wide. The station is in the lands of the village of Valvádi, taluka Páchora, district Khándesh.

The station consisted of a platform of loose stone masonry having a mark at its surface and another 2·00 feet below it engraved on the rock *in sitú*. A heap of stones, apparently the station platform of some former survey, was found here: the centre of this heap was made the site. It was visited in 1870 by Lieutenant Heaviside, when the upper mark-stone was not found, the platform was partly dug up and a solid circular pillar of masonry was built up from the level of the lower mark to a height of 2 feet and a mark-stone inserted in its upper surface. When again visited in 1884, the station was found protected by a rectangular pillar 2·8 feet high built over the circular masonry pillar. The directions and estimated distances of the circumjacent villages are:—Mándla S.W. by S., miles 4; Títi W. by N., miles 2½; Chorvár N., miles 2; and Valvádi S.E. by S., miles 1½.

XXIV. Dhanvár (*Dhanwár*) Hill Station, lat. 20° 53′, long. 75° 38′—observed at in 1846—is on the southern of a group of low, flat-topped hills which rises some 70 feet above the low range from which it springs, and is some 200 feet above the level of the country. The top of the hill is pear shaped, the station being about 20 yards from the narrow end and 60 yards from the broader. The station is in the lands of the village of Dhanvár, taluka Jalgaon, district Khándesh.

The station consists of a platform having the usual mark at its surface and another 0·98 of a foot below. In 1869 the upper mark-stone was in position and about 2 feet above the hill top. When visited in 1884, the upper mark-stone was found in the centre and upper surface of a platform 2 feet high. The azimuths and estimated distances of the circumjacent villages are:—Dhánora 186°, miles 2; Karmar 300°, miles 2; Dehori 240° miles 1½; and Paláskhera 350°, miles 4.

XXV. Anakvádi (*Anakwári*) Hill Station (locally known as Silla Dongar) lat. 20° 47′, long. 74° 44′—observed at in 1846 and 1847—is on the summit of a conical hill about 1000 feet above the plain and some 700 feet above the lower range from which it rises with precipitous sides. The station mark is 20 feet S.E. of a small heap of stones forming a shrine: it is in the lands of Anakvádi village, taluka Dhulia, district Khándesh.

The station consists of a platform having two marks, one in its upper surface and the other 2·5 feet below it. It was visited by Lieutenant Heaviside in season 1868-69, who stated that "A mark-stone is in position and on a level with the surface of the ground." When again visited in 1884, the upper mark-stone was found protruding 6 inches above the surface of the three large stones on which the theodolite stand rested; this upper mark is 3·2 feet above and in the normal of the lower one engraved on the rock *in sitú*. The directions and estimated distances of the circumjacent villages are:—Anakvádi S. by W., miles 1½; Sargaon N.W. by W., miles 3; Dhulia N.E. by N., miles 10; Laling (fort) E.N.E., miles 4; and Arvi (Dâk Bungalow) S.S.E., miles 2½.

XXVI. Sirsála Hill Station, also called Shekh Máru Pír, lat. 20° 30′, long. 75° 34′—observed at in 1846—is on a hill about 200 feet high close to the N. edge of the table-land which rises gradually from the Godávari

river and here terminates in a northerly direction by a descent of some 1200 feet into the plains of Khándesh. About 1½ miles W. of the station and built in a gorge above a precipice of the table-land, is an uninhabited fort which contains a temple dedicated to Mahádev. The station is in the lands of the village of Sirsála, taluka Nánded, district Aurangabad.

The station consists of a platform of stones having a mark at its surface and another 0·83 of a foot below engraved on the rock *in sitú*. In 1869 Lieutenant Heaviside found the upper mark-stone in position and about 2 feet above the hill top. When again visited in 1884, the platform and lower mark were found in good preservation, the upper mark-stone was replaced (having been picked up from the hill side) at 0·83 of a foot above and in the normal of the lower mark. The azimuths and estimated distances of the circumjacent villages are:—Kelgaon 37°, miles 2¼; Borkhera 173°, miles 3; Sirsála 313°, miles 1¼; Shekhpur 345°, miles 3; and Pipalgaon 354°, miles 3.

XXVII. Sátmála Hill Station, lat. 20° 20′, long. 75° 10′—observed at in 1846—is on a hill so called, about 2 miles W. of a chauki (police station) on the Ganthála Ghát, and 5 miles N. of the taluk town of Kanad. The line of Ghâts extends about 15 miles further west, and its descent to the plains to north is considerable. The station is in the lands of the village of Ganthála, taluka Kanad, district Aurangabad.

The station originally consisted of a platform about 5 feet high, having a mark-stone at its surface and another 5·00 feet below. In season 1846-47, the platform was raised 4·04 feet. When visited in 1884, the platform was found 9 feet high, built of loose boulders, having a mark-stone on its summit not firmly fixed, as the structure was too shaky for observation the upper portion was removed till the mark-stone said to be 5 feet above the ground level was disclosed wedged in between three large stones used for the theodolite stand to rest on. As this part was firm and adapted for observations, the platform was built up to the level of this mark. No masonry pillar appears to have been built here, nor could one be erected now as both water and labour were difficult to obtain. The azimuths and estimated distances of the following places are:—Bámni 345°, miles 5½; and Hevadgaon 350°, miles 4½.

XXVIII. Pophla Hill Station, lat. 20° 2′, long. 75° 31′—observed at in 1846—is on the highest part of a hill, 1½ miles N. E. of that village, a vádi (garden) of which is close below the station. It is 7·25 feet (20° N. of W.) from the centre of a tomb. The station is in the lands of the village of Pophla, taluka Phúlamri, district Aurangabad.

The station consisted of a platform having a mark-stone at its surface and another 1·08 feet below. When visited in 1884, no mark-stones were found, the platform, with an excavation in the centre, remained to mark the site of the station. A mark-stone was built into the centre of the platform—7·25 feet from, 20° N. of W. of the centre of the tomb (above mentioned), and on a level with the upper surface of the platform which is 1·25 feet above the surface of the hill. The azimuths and estimated distances of the following villages are:—Kámkhera 3°, miles 3; Modhai 56°, miles 2; Chincholi 91°, miles 1½; Bámangaon 212°, miles 2; and Vághul 266°, miles 2.

XXIX. Rájur Hill Station, lat. 20° 4′, long. 75° 54′—observed at in 1846 and 1862—is on a small conical hill about 200 yards W. of the village, and N. W. of a large temple, about 50 feet high, built of most elaborately carved stone, having two tiers of pillars above its base which is 13½ feet high. The horizontal distance of the station to the N. W. pillar of the first tier is 68·8 feet, and that to the N. W. corner of the base, 66 feet. The station is in the lands of the village of Rájur, taluka Jaffrabad, district Aurangabad.

The station first consisted of a platform 14 feet high with two mark-stones, a large one, about 3 feet square and 2 feet thick, at the top and another 13·75 feet below about the ground level. It was visited in 1862 and then rebuilt to a height of about 20 feet. When again visited in 1884, the surrounding platform was found to have fallen away leaving the upper 12 feet of the circular masonry pillar exposed, this was rebuilt with stones. The upper mark-stone was in position, 20·25 feet above and in the normal of the mark at the ground level. The azimuths and estimated distances of the following villages are:—Chanaigaon 32°, miles 2; Táplichandai 112°, miles 1¼; Kámkhera 212°, miles 1¼; Lon 283°, miles 2; and Tápon 327°, miles 1¼.

XXX. Yerúl Hill Station, lat. 19° 59′, long. 75° 12′—observed at in 1846—is on the high table-land, about 2½ miles S. of the celebrated cave temples. The station is 418 feet W. of a conspicuous Bar tree, 1949 feet E.N.E. of an old station of the Bombay Trigonometrical Survey, and 60 feet from the southern and 525 feet from the northern edge of the hill. It is in the lands of the village of Súribhanjan, taluka Rŏza, district Aurangabad.

The station consisted of a platform with two mark-stones, one at the ground level and the other 2·13 feet below. In 1870 the upper mark-stone was not found, but the lower one was probably in position. A pile of stones about 3 feet in height was then erected over the platform. When again visited in 1884, no mark-stones were found and only a heap of boulders marking the site of the platform. The platform was rebuilt to a height of 1 foot, taking the centre of the heap of boulders as a guide and a mark was placed in the centre and on a level with its upper surface. The position of this mark was tested by observing the horizontal angles between the four adjacent stations with a 14-inch theodolite which showed no appreciable difference with the angles measured in 1846. The estimated directions and distances of the following places are:—Daulatabad (minaret) S.E., miles 4¾; Chumar Tekri (centre of hill fort) S.E. by S., miles 8 or 9; and Daulatabad (Rŏza, mausoleum) N.E., miles 3½.

XXXI. Jámkhed Hill Station, lat. 19° 41′, long. 75° 42′—observed at in 1845, 1846 and 1862—is situated on a square, flat-topped knoll rising about 20 feet above the surface of the irregular plateau like range trending east and west and terminating about 150 feet to the east of the station in an abrupt fall to the plain below, and lies about 2 miles N. of the town of Jámkhed. The station is in the lands of the village of Rhailgarh, taluka Ambad, district Aurangabad.

The station of 1846 consisted of a platform containing two mark-stones, the lower 1·63 feet below the one at the surface of the ground. When visited in 1862, the mark at the ground level of the old station was found and over this a circular perforated and isolated pillar of masonry 3½ feet in diameter was built, carrying a mark in its upper surface 3·00 feet above the one at the ground level, access to which was obtained by a passage constructed for the purpose. When again visited in 1884, the circular masonry pillar and the rectangular aperture for plumbing over the mark at the ground level were found in good preservation, but no upper mark. The height of the upper surface of the pillar above the one at the ground level is 3 feet. The azimuths and estimated distances of the following villages are:—Jámkhed 4°, miles 2¼; Rhailgarh 180°, miles 2; Kingaon 271°, miles 2; and Vitalvádi 336°, miles 1½.

XXXII. Áhirmal Hill Station, lat. 19° 33′, long. 76° 7′—observed at in 1862—is situated on an isolated hill of that name, about 1½ miles N.E. by N. of the village of Dhákephal. The platform of the station is built contiguous to a Muhammadan mosque. It is in the lands of the village of Dhákephal, taluka Ambad, district Aurangabad.

The station consists of a platform of loose rubble, enclosing a central, isolated and perforated pillar of masonry 5 feet in height. Access to the lower mark is obtained through a passage specially constructed for the purpose. When visited in 1884, the circular masonry pillar and the mark in its upper surface were found in good preservation. The azimuths and estimated distances of the circumjacent villages are:—Dhárgaon 5°, miles 3¼; Hadgaon 115°, miles 1½; Jaula 169°, mile 1; and Jhirgaon 260°, miles 2¼.

XXXIII. Mathuri Hill Station, lat. 19° 11′, long. 75° 32′—observed at in 1845 and 1862—is on the N.W. corner of the temple built on the conical hill 1½ miles E. of Mathuri village, over the junction of the walls of the smaller shrine: it is in the lands of the village of Mathuri, taluka Bíd, Nizam's territory.

The station of 1845 contained two marks, the one imbedded in the stone masonry of the wall 1·38 feet below the upper which was fixed at the level of the roof which is 10 feet above the ground. When visited in 1862, the mark on a level with roof of the temple was found in position, over which a solid, circular pillar of masonry was built carrying a mark in its upper surface 1·17 feet above the one level with the roof. When again visited in 1884, the upper portion of the circular masonry pillar was found broken and the upper mark-stone removed; but the mark of 1845 on a level with the roof of the temple was found in position. The pillar was rebuilt to a height of 1·17 feet above the roof of the temple, carrying a mark in its upper surface. The directions and distances of the circumjacent villages are:—Bhorgaon S. by W., miles 2¾; Hukarda S.W., miles 4¼; Mirsángvi W.S.W., miles 4½; Titurvani E. by S., miles 1½; and Malegaon W. by N., miles 3¾.

XXXIV. Dhaigaon Station, lat. 19° 31′, long. 75° 15′—observed at in 1845—is situated on the high ground, about 1½ miles S. of the Vagji stream which joins the Godávari river at 2¼ miles to N.E. of the station. It is in the lands of the village of Dhaigaon, taluka Nevása, district Ahmednagar.

"The soil was excavated to a depth of about 4·75 feet and 2½ feet below the muram (a kind of gravel), a large stone, about 4 feet long and 1 foot square, with the usual mark on its upper surface, was imbedded in the muram. From the surface of the muram a pillar of stone masonry about 4 feet in diameter has been built up and raised about 2 feet above the ground. A platform of loose stones has been built around the pillar and a stone with the usual mark placed at its surface at the height of 20¼ (?) above the mark on the large stone". When visited in 1884, the pillar and the mark were found in good preservation. The azimuths and perambulated distances of the following are:—Dhaigaon (large pipal tree S. of village) 76°, miles 1·95; Gheori (temple) 306°, miles 2·06; and Devlána (temple on right bank of the Godávari) 219° miles 2·29.

XXIII. (*Of the Bombay Longitudinal Series*). Chincholi Hill Station, lat. 18° 55′, long. 75° 19′—observed at in 1845—is situated on a short narrow ridge about 300 feet long trending east and west nearly, and 30 feet higher than the level of the surrounding plateau. The station is on the western end of the ridge while a large bar tree marks the eastern extremity. The large village of Ashti on the high road from Ahmednagar to Jámkhed lies about 10 miles to S.W. by S. and that of Ámalner 4 miles to E. by N. of the station. It is in the lands of the village of Chincholi, taluka Ashti, Nizam's territory.

The station consists of a solid platform and contains two marks, the one at its surface is 0·83 of a foot above one fixed in 1834. When visited in 1884, the station was found to consist of a circular masonry pillar 2·8 feet in diameter at top with a mark-stone embedded flush with its upper surface: the pillar is surrounded by a large irregular shaped platform of loose boulders from which it is not isolated. Judging from the appearance the pillar does not appear to be very ancient. The height of the upper mark above the ground level is 10·6 feet. The azimuths and distances of the circumjacent villages are:—Chikhli 13°, miles 2; Chincholi 34°, mile ¾; and Gangarvádi 67°, miles 2¾.

XXIV. (*Of the Bombay Longitudinal Series*). Ágargaon Hill Station, lat. 19° 11′, long. 74° 55′—**observed at in 1845**—is situated on a low part of an extensive and irregularly shaped table-land, about 1 mile N. of that village, and 6½ miles E. by N. of Shendi which is ½ a mile E. of the high road from Ahmednagar to Aurangabad. It is in the lands of the village of Ágargaon, taluka Nagar, district Ahmednagar.

The station as originally built consisted of a platform of loose stone masonry and contained three mark-stones, one at the ground level and the other two 7·13 and 13·54 feet respectively above it. When visited in 1882, the station was found to consist of a mound of loose boulders about 10 feet high and 30 feet in diameter, having a post—erected by a Survey Party about 2 or 3 years ago—rising 3½ feet above it, the mound was raised 16·43 feet above a bench-mark on the ground level and a mark-stone inserted at that height. When again visited in 1883, the upper mark-stone was found in position and protected by the usual rectangular pillar of masonry. The directions and distances of the following places are:—Ahmednagar S.W., miles 9; Ranjani S.E. by E., miles 2¾; Kalhar N.E. by N., miles 2¼; Pimpalgaon Uzáni W. by S., miles 3¾; and Deogaon S.W., miles 3.

NOTE.—In some instances the names of Principal Stations, occurring in the foregoing descriptions, are given by two methods of spelling distinguished from each other by the use of Roman and Italic type, as Station XXV Anakvádi (*Anakwári*): the latter spelling is in keeping with that adopted in the pages containing the observed angles printed in March 1879, which was based on a list of names of places for the Bombay Presidency published under the orders of the Government in September 1875: the spelling in Roman type is in accordance with that in a revised edition of the same published in 1880, and with the list of names for the Dominions of His Highness the Nizam, published in February 1883. It will be seen that the two methods differ but slightly, notwithstanding where differences occur, both renderings are given so as to remove all possible doubt as to the identity of a station. The method of spelling in Roman type is hereafter exclusively adopted in the publication of this Series.

February, 1888.

M. W. ROGERS,

In charge of Computing Office.

KHANPISURA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. OBSERVED ANGLES.

At XXI (Búda)

March 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on I												M = Mean of Groups w = Relative Weight C = Concluded Angle
	118° 41′	298° 41′	128° 41′	308° 41′	138° 41′	318° 41′	148° 42′	328° 41′	158° 41′	338° 42′	168° 41′	348° 42′	
I & II	″ *h* 57·33 *h* 57·67	″ *h* 62·00 *h* 52·67	″ *h* 52·67 *h* 52·00 *h* 50·34	″ *h* 51·67 *h* 48·33	″ *h* 49·67 *d* 48·84	″ *h* 50·67 *h* 56·67	″ *d* 46·04 *d* 50·38	″ *d* 56·68 *d* 56·01	″ *d* 46·87 *d* 46·20	″ *h* 57·33 *d* 60·37	″ *h* 55·67 *h* 52·66 *h* 62·66	″ *h* 52·33 *h* 52·33	$M = 53''\cdot 23$ $w = 0\cdot 60$ $\frac{1}{w} = 1\cdot 67$
	57·50	57·34	51·67	50·00	49·25	53·67	48·21	56·35	46·53	58·85	57·00	52·33	$C = 39^\circ\, 23'\, 53''\cdot 23$
II & XXIV	*d* 12·92 *d* 7·92	*h* 16·33 *h* 23·67	*d* 20·16 *d* 26·16 *d* 25·12	*h* 29·33 *h* 35·00	*h* 30·33 *h* 29·33 *d* 27·33	*h* 23·67 *h* 29·33	*h* 32·00 *h* 30·67	*h* 18·67 *h* 24·34 *d* 19·33	*h* 30·33 *d* 33·08	*h* 29·67 *h* 21·67 *d* 24·97	*d* 25·38 *d* 20·71 *d* 27·71	*h* 20·67 *h* 22·67	$M = 24''\cdot 79$ $w = 0\cdot 24$ $\frac{1}{w} = 4\cdot 17$
	10·42	20·00	23·81	32·17	29·00	26·50	31·33	20·78	31·71	25·44	24·60	21·67	$C = 70^\circ\, 28'\, 24''\cdot 79$

Note.—Stations XXI and XXIV appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At XXIV (Bálagarra)

March 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	106° 13′	286° 13′	116° 12′	296° 12′	126° 13′	306° 12′	136° 12′	316° 12′	146° 12′	326° 12′	156° 13′	336° 12′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXI & I	h 77·33 h 74·34	h 67·66 h 68·00	h 72·34 h 78·00	h 68·00 h 70·67	h 76·00 h 73·00 h 79·33	h 72·34 h 75·67	h 67·67 h 65·00	h 72·00 h 73·00 d 71·28	h 68·00 d 59·83 d 62·83	h 70·67 d 70·17	h 65·33 d 67·33	h 72·66 h 75·00 d 76·50	M = 70″·98 w = 0·60 1/w = 1·67 C = 43° 51′ 10″·98
	75·84	67·83	75·17	69·33	76·11	74·01	66·33	72·09	63·55	70·42	66·33	74·72	
I & II	h 24·00 h 27·66	h 36·34 h 36·33	h 29·33 h 28·00	h 37·67 h 35·33	h 29·00 h 29·67 h 29·67	h 34·00 h 32·33	h 29·67 h 33·34	h 35·33 d 34·83	h 34·33 d 36·12	d 33·92 d 32·58	d 29·34 d 31·00	h 34·67 h 35·00	M = 32″·50 w = 0·96 1/w = 1·04 C = 36° 26′ 32″·50
	25·83	36·34	28·66	36·50	29·45	33·17	31·50	35·08	35·23	33·25	30·17	34·83	

At I (Sítamau)

March 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on IV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	182° 2′	2° 1′	192° 1′	12° 1′	202° 2′	22° 2′	212° 2′	32° 2′	222° 2′	42° 2′	232° 2′	52° 2′	
	″	″	″	″	″	″	″	″	″	″	″	″	
IV & III	d 12·17 d 9·51	h 20·66 h 15·67 h 15·00	h 12·34 d 10·00	h 7·00 h 11·00 d 9·99	d 13·67 d 14·33 d 13·00	d 5·50 d 6·83	d 16·83 d 17·83	h 6·33 d 4·67 d 7·34	h 17·33 d 19·56 d 18·55 d 17·89	d 5·01 d 7·34	h 19·66 d 19·45	h 11·67 d 6·89 d 9·23	M = 12″·09 w = 0·48 1/w = 2·08 C = 49° 49′ 12″·09
	10·84	17·11	11·17	9·33	13·67	6·17	17·33	6·11	18·33	6·17	19·56	9·26	
III & II	h 53·66 d 60·66	h 49·67 h 53·00 h 54·33	h 56·66 d 61·23	d 61·83 d 60·50	h 55·67 h 54·67 d 53·67	h 63·66 d 64·49	d 54·83 d 52·50	h 63·00 d 61·33 d 63·33	h 50·34 d 49·83 d 50·84	d 63·16 d 60·83	h 50·67 d 50·22 d 52·22	h 60·00 h 59·00	M = 57″·29 w = 0·48 1/w = 2·08 C = 64° 39′ 57″·29
	57·16	52·33	58·95	61·16	54·67	64·08	53·66	62·55	50·34	62·00	51·04	59·50	
II & XXIV	h 29·67 h 25·67	h 30·33 h 28·00 h 30·00	h 29·00 h 28·66 h 30·67	h 26·34 h 28·00	h 31·66 h 33·33 h 34·00	h 31·34 h 28·34	h 37·33 h 37·67	h 27·67 h 25·67 d 26·00	h 33·33 h 35·66	h 24·67 h 27·66	h 35·00 h 33·00	h 26·00 h 24·66 h 27·66	M = 30″·11 w = 0·84 1/w = 1·19 C = 63° 29′ 30″·11
	27·67	29·44	29·44	27·17	33·00	29·84	37·50	26·45	34·50	26·16	34·00	26·11	

NOTE.—Stations XXI and XXIV appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At I (Sítamau)—(*Continued*).

Angle between	Circle readings, telescope being set on IV 182° 2′	2° 1′	192° 1′	12° 1′	202° 2′	22° 2′	212° 2′	32° 2′	222° 2′	42° 2′	232° 2′	52° 2′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIV & XXI	″ h 36·67 h 40·00 h 33·33 h 35·00 h 38·34	″ h 34·34 h 35·00 h 33·00	″ h 34·34 h 39·67 h 36·00	″ h 28·33 h 31·67 h 27·67	″ h 36·67 h 32·67 h 34·00	″ h 27·66 h 34·33 h 29·67	″ l 32·67 l 31·00	″ l 31·33 l 31·67	″ l 34·00 l 33·66	″ l 32·33 l 33·67 l 35·34	″ l 23·34 l 26·33 l 19·67 h 20·00	″ l 36·33 l 28·00 h 31·67	$M = 32''\cdot25$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$ $C = 26^\circ 16' 32''\cdot25$
	36·67	34·11	36·67	29·22	34·45	30·55	31·84	31·50	33·83	33·78	22·33	32·00	

At II (Dhámnár)

March 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXIV 139° 5′	319° 5′	149° 5′	329° 5′	159° 5′	339° 6′	169° 5′	349° 5′	179° 5′	359° 5′	189° 5′	9° 5′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIV & XXI	″ h 53·00 d 53·83 d 55·50	″ h 49·67 h 52·00 h 52·00	″ h 44·67 h 46·00	″ h 50·00 h 47·67	″ h 46·00 h 46·67	″ h 53·00 h 50·66	″ h 46·33 h 45·00	″ h 47·34 h 51·33 h 50·33	″ h 46·00 d 46·50	″ h 49·33 h 53·67	″ h 48·66 h 47·34	″ h 50·00 h 52·67 h 51·00	$M = 49''\cdot16$ $w = 1\cdot36$ $\frac{1}{w} = 0\cdot74$ $C = 29^\circ 13' 49''\cdot23$
	54·11	51·22	45·34	48·83	46·34	51·83	45·66	49·67	46·25	51·50	48·00	51·22	
XXI & I	h 58·67 d 56·55 d 58·83	h 70·67 h 70·66 d 71·66	h 66·33 h 67·00	h 73·33 h 72·66	h 65·33 h 64·33	h 64·00 h 67·67	h 67·33 h 69·00	h 67·00 h 64·67 h 60·00	h 69·66 h 68·00	h 63·67 h 61·66	h 71·67 h 74·00	h 67·33 h 64·00 h 66·67	$M = 66''\cdot81$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$ $C = 50^\circ 50' 6''\cdot81$
	58·02	71·00	66·67	72·99	64·83	65·84	68·16	63·89	68·83	62·67	72·83	66·00	
I & III	h 58·33 h 52·67 h 59·33	h 48·33 h 50·34 d 50·33	h 51·00 h 52·67	h 47·00 h 50·34	h 52·00 h 51·00	h 52·67 h 47·67	h 46·00 h 50·66 h 51·00 d 46·78	h 51·33 h 50·00 d 53·33	h 45·67 d 44·50 d 44·17	h 55·00 h 55·67	h 45·00 h 45·33	h 56·67 h 53·67 h 53·66	$M = 50''\cdot73$ $w = 0\cdot84$ $\frac{1}{w} = 1\cdot19$ $C = 68^\circ 13' 50''\cdot73$
	56·78	49·67	51·84	48·67	51·50	50·17	48·61	51·55	44·78	55·33	45·17	54·67	
III & VI	h 30·67 h 33·67 h 27·67	h 29·67 h 30·33 d 31·00	h 32·33 h 31·00	h 32·00 h 30·66	h 35·00 h 34·67 h 38·00	h 26·00 h 30·33	h 35·67 h 36·00 h 37·00 d 33·78	h 36·00 h 31·33 d 36·33	h 36·33 h 34·67 d 34·17	h 27·00 h 25·33	h 34·33 h 33·67	h 29·66 h 30·66 h 28·34	$M = 31''\cdot92$ $w = 1\cdot15$ $\frac{1}{w} = 0\cdot87$ $C = 72^\circ 37' 31''\cdot99$
	30·67	30·33	31·67	31·33	35·89	28·16	35·61	34·55	35·06	26·17	34·00	29·55	

Note.—Stations XXI and XXIV appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At III (Nigrun)

**April and* †*December* 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on VI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	301° 7′	121° 8′	311° 6′	131° 7′	321° 7	141° 7′	331° 7′	151° 7′	341° 7′	161° 7′	351° 7′	171° 8′	
* VI & II	″ l 15·00 l 12·33 h 12·66 h 13·33	″ h 12·34 h 11·00	″ l 9·00 h 15·33 h 12·66 h 12·33	″ h 7·34 h 10·67	″ h 10·67 h 16·00 h 13·33 h 14·67	″ h 9·33 h 8·33	″ h 17·67 h 19·00 h 18·67	″ h 6·33 h 10·33 h 5·67	″ l 10·67 l 14·67 l 15·00	″ l 12·00 l 5·66 h 8·34	″ h 15·66 h 14·00	″ h 9·33 h 9·34	$M = 11''\cdot 75$ $w = 1\cdot 08$ $\frac{1}{w} = 0\cdot 93$ $C = 58^\circ\ 53'\ 11''\cdot 75$
	13·33	11·67	12·33	9·01	13·67	8·83	18·45	7·44	13·45	8·67	14·83	9·33	
* II & I	l 17·67 l 15·00 l 11·66 h 14·67	l 10·34 l 4·33 l 8·00 h 11·00	l 7·33 l 13·00 l 7·66 h 13·34 h 10·67	h 15·66 h 14·67	l 5·33 h 10·33 h 5·00	l 17·00 l 14·66 l 8·34 l 12·00 h 13·34	l 10·66 l 9·33 h 8·00	l 14·34 l 13·67 h 13·00 h 16·00	l 6·67 l 8·00 l 15·00 l 11·33 h 9·67	l 22·00 l 20·00 l 18·33 l 23·00	h 8·00 h 8·00	h 14·34 h 17·33	$M = 12''\cdot 26$ $w = 0\cdot 67$ $\frac{1}{w} = 1\cdot 49$ $C = 47^\circ\ 6'\ 12''\cdot 35$
	14·75	8·42	10·40	15·17	6·89	13·07	9·33	14·25	10·13	20·83	8·00	15·83	
* I & IV	h 46·33 d 47·92	h 51·33 d 52·91	d 55·26 d 54·93	d 47·67 d 48·66	d 54·11 d 57·11	h 48·33 d 46·59	d 45·67 d 47·00 d 48·33	d 40·75 d 43·42	h 45·00 d 41·87	d 36·17 d 39·50 d 38·17	h 46·00 h 48·00	h 47·00 h 40·00	$M = 47''\cdot 21$ $w = 0\cdot 48$ $\frac{1}{w} = 2\cdot 08$ $C = 92^\circ\ 12'\ 47''\cdot 21$
	47·13	52·12	55·09	48·17	55·61	47·46	47·00	42·08	43·44	37·95	47·00	43·50	
	Circle readings, telescope being set on IV												
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
† IV & V	″ h 17·00 l 17·66 l 21·50 l 15·83	″ l 20·34 l 18·00	″ l 16·00 l 16·33 l 18·34	″ l 26·67 l 27·00 l 26·83	″ h 16·66 h 15·50 l 19·50 l 17·17 d 20·66	″ h 23·67 h 22·33 h 19·66 h 18·83 l 16·34 d 22·36	″ l 17·00 l 14·33	″ l 17·66 l 22·67 l 23·66 d 20·55	″ h 17·00 h 16·00 l 18·00	″ h 15·00 h 14·50	″ l 16·66 l 22·33 h 16·33	″ h 29·67 h 23·67	$M = 19''\cdot 42$ $w = 0\cdot 72$ $\frac{1}{w} = 1\cdot 39$ $C = 84^\circ\ 21'\ 19''\cdot 42$
	18·00	19·17	16·89	26·83	17·90	20·53	15·67	21·13	17·00	14·75	18·44	26·67	
† V & VI	l 26·67 l 26·16 l 31·67	l 17·33 l 19·33	l 27·00 l 22·00 l 22·33	l 19·00 l 17·66 l 19·17	l 17·84 l 20·83 d 22·79	h 17·67 h 22·67 l 28·33 d 25·08	l 32·00 d 33·49	l 25·67 l 21·00 l 26·67 d 23·67	l 28·00 d 27·33	d 38·42 d 38·92	l 28·00 l 25·67 h 28·67	h 20·00 h 25·00	$M = 25''\cdot 51$ $w = 0\cdot 36$ $\frac{1}{w} = 2\cdot 78$ $C = 77^\circ\ 26'\ 25''\cdot 51$
	28·17	18·33	23·78	18·61	20·49	23·44	32·75	24·25	27·66	38·67	27·45	22·50	

At IV (Dudhála)

April 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on V												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0 1′	180° 1′	10° 0′	190° 1′	20° 0′	200° 0′	30° 1′	210° 0′	40° 1′	220° 0′	50° 1′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
V & III	h 40·00 h 37·33 h 39·00 d 41·84	h 36·33 h 34·00 h 33·34 h 34·66	h 32·33 h 35·33 h 36·00 d 34·99	h 32·33 h 32·67 h 36·00	h 35·00 h 34·00 h 34·66	h 35·67 h 35·67 h 38·00 d 39·34	h 27·67 h 28·00 h 29·67	h 41·00 h 39·33 h 42·00 d 43·89	h 36·67 h 38·00 d 34·18	h 47·67 h 44·00	h 31·67 h 31·33	h 39·33 h 38·33	$M = 36''·39$ $w = 0·57$ $\frac{1}{w} = 1·75$
	39·54	34·58	34·66	33·67	34·55	37·17	28·45	41·56	36·28	45·83	31·50	38·83	$C = 47° 4' 36''·27$
III & I	h 58·00 d 59·84 d 62·51 d 60·84	h 68·00 d 70·09	h 64·34 h 59·67 d 62·45	h 65·00 d 65·33	h 66·34 d 66·45	h 63·33 d 67·00 d 67·00 d 64·67	h 65·66 d 67·88	h 58·67 d 61·56 d 63·23 d 60·56	h 59·33 d 55·00 d 57·33	d 52·89 d 56·56	h 66·33 h 67·00	h 56·34 h 55·33	$M = 62''·57$ $w = 0·48$ $\frac{1}{w} = 2·08$
	60·30	69·05	62·15	65·16	66·40	65·50	66·77	61.00	57·22	54·73	66·66	55·84	$C = 37° 58' 2''·57$

At V (Deo Dongri)

December 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on VIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
VIII & VII	h 17·67 h 16·67	h 17·67 h 12·66 h 15·00	h 10·00 h 12·00	h 18·33 h 15·67 h 16·33	h 16·00 h 14·00 h 13·34	h 11·33 h 13·66 h 12·34	h 7·00 h 6·33	h 15·67 h 14·34	h 7·33 h 7·67 d 6·17	h 13·00 h 17·00 h 14·17 d 15·01 d 14·68	h 9·67 h 11·67	h 17·00 h 12·66 h 17·67	$M = 13''·08$ $w = 1·89$ $\frac{1}{w} = 0·53$ $C = 61° 51' 13''·31$
	17·17	15·11	11·00	16·78	14·45	12·44	6·67	15·00	7·06	14·77	10·67	15·78	
VII & VI	h 61·00 h 65·33	h 64·00 d 63·89	h 65·67 d 66·67 d 66·00	d 68·72 d 66·55	h 66·00 h 70·33 h 70·33	h 63·34 d 64·90 d 66·56	h 71·67 h 73·34	d 64·33 d 63·99	h 69·67 h 71·33 d 69·17	h 61·66 h 59·66 d 60·95 d 60·62	h 71·66 h 67·66	h 62·00 h 67·00 h 63·00	$M = 66''·32$ $w = 1·38$ $\frac{1}{w} = 0·72$
	63·17	63·94	66·11	67·64	68·89	64·93	72·50	64·16	70·06	60·72	69·66	64·00	$C = 51° 45' 5''·34$
VI & III	d 52·66 d 54·99	d 49·00 d 47·83	h 54·66 d 55·61 d 56·28 d 57·61	d 45·91 d 47·91	h 45·34 h 44·00 d 46·17	h 54·66 h 52·67	d 44·49 d 45·50	h 53·00 h 52·66 d 56·83	d 49·11 d 49·77	d 58·41 d 58·74 d 59·42 d 57·42	d 48·78 d 50·78	d 54·61 d 53·95 d 52·94	$M = 51''·23$ $w = 0·85$ $\frac{1}{w} = 1·18$
	53·83	48·41	56·04	46·91	45·17	53·67	44·99	54·16	49·44	58·50	49·78	53·83	$C = 52° 4' 52''·56$

At V (Deo Dongri)—(*Continued*).

Angle between	Circle readings, telescope being set on VIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
III & IV	h 4·00 d 9·17 d 6·84	d 13·89 d 15·06	d 0·13 d 1·46	d 9·84 d 11·00	h 7·00 h 11·33 d 10·67	d 5·33 d 2·83 d 3·16	d 11·51 d 10·50	d 2·67 d 0·01	d 10·11 d 9·45	d 1·25 d 3·08	d 10·89 d 11·89	d 8·39 d 5·39 d 5·39	M = 7″·32 w = 0·85 1/w = 1·18
	6·67	14·48	0·79	10·42	9·67	3·77	11·01	1·34	9·78	2·16	11·39	6·39	C = 48° 34′ 8″·65

At VI (Lohári)

April* 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.

Angle between	Circle readings, telescope being set on II												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 1′	210° 0′	40° 1′	220° 1′	50° 1′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
II & III	l 28·34 l 24·00 h 22·33 h 25·00 h 27·00 l 21·67 l 25·00	h 17·67 h 16·66 l 22·00 l 19·67	h 16·33 h 18·66	h 17·33 l 18·00	l 15·33 l 13·67 h 16·33	l 20·67 l 24·00 l 18·00	l 13·34 l 12·67 h 11·00	l 18·67 l 20·00	h 15·33 h 19·00 h 16·67	l 25·33 h 22·00 h 27·00 h 24·34	l 12·66 l 15·33 l 15·67 d 13·23	l 22·00 l 20·66 d 15·67	M = 18″·49 w = 0·81 1/w = 1·23 C = 48° 29′ 18″·50
	24·76	19·00	17·50	17·66	15·11	20·89	12·34	19·34	17·00	24·67	14·22	19·44	
III & V	l 44·00 l 42·00 d 37·24	l 46·67 l 50·33 d 52·67	h 49·67 h 50·00	h 49·34 d 49·66 d 47·16	h 48·00 d 46·22	d 43·45 d 46·44	h 47·00 d 44·00	d 42·34 d 43·01 d 45·91 d 44·58	h 50·67 h 50·34	h 40·66 d 44·66 d 42·00	l 55·00 l 45·34 l 50·00 d 48·79	l 39·33 l 43·67 d 35·84	M = 46″·12 w = 0·72 1/w = 1·39
	41·08	49·89	49·84	48·72	47·11	44·94	45·50	43·96	50·51	42·44	49·78	39·61	C = 50° 28′ 46″·12
V & VII	d 25·78 d 25·11 d 24·78 d 29·11	d 19·23 d 19·89 d 18·89 d 18·89	h 20·33 h 20·00	h 16·33 h 16·00	d 23·50 d 21·84	d 25·33 d 22·34	d 27·40 d 29·06	h 14·66 h 24·00 h 19·34 d 16·67	h 18·00 d 17·32	d 19·67 d 21·66 d 18·33	l 21·33 l 22·33 d 21·33	l 26·33 l 24·67 d 19·84	M = 21″·50 w = 0·84 1/w = 1·19
	26·20	19·22	20·17	16·16	22·67	23·84	28·23	18·67	17·66	19·89	21·66	23·61	C = 46° 17′ 21″·50
VII & XI	h 26·66 h 21·33	h 21·00 h 21·00	h 23·34 h 21·34	h 21·33 h 21·67	d 18·50 d 19·83	d 15·67 d 13·66	h 18·34 d 16·93	h 31·34 h 20·66 h 24·00 d 22·67	h 23·67 d 23·83	h 22·67 h 26·34	h 21·33 d 20·22	h 24·66 d 23·56	M = 21″·51 w = 1·08 1/w = 0·93
	24·00	21·00	22·34	21·50	19·16	14·67	17·63	24·67	23·75	24·51	20·77	24·11	C = 16° 59′ 21″·51

At VII (Dhanora)

November 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on V												*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	29° 59′	209° 59′	39° 59′	219° 59′	50° 0′	230° 0′	
V & VIII	″ *h* 49·66 *h* 51·33	″ *h* 45·34 *h* 45·00	″ *h* 43·67 *h* 47·67	″ *h* 48·00 *h* 51·33	″ *h* 48·34 *h* 49·33	″ *h* 49·00 *h* 51·34	″ *h* 45·66 *h* 44·33	″ *h* 48·67 *h* 49·34	″ *l* 45·66 *l* 43·33	″ *l* 48·66 *l* 46·34	″ *h* 45·67 *h* 48·00	″ *h* 52·67 *d* 52·67	*M* = 47″·96 *w* = 1·68 1/*w* = 0·60
	50·50	45·17	45·67	49·66	48·84	50·17	44·99	49·01	44·49	47·50	46·84	52·67	*C* = 29° 24′ 47″·96
VIII & IX	*h* 13·34 *h* 17·67	*h* 22·66 *h* 20·34	*h* 14·66 *h* 13·00	*h* 19·00 *d* 21·00	*h* 16·33 *d* 16·67	*h* 19·00 *d* 21·66	*h* 16·00 *d* 14·00	*h* 19·66 *h* 19·66	*l* 15·67 *l* 20·00	*l* 11·00 *l* 12·00	*h* 16·00 *h* 18·00	*h* 12·67 *d* 12·67 *d* 9·67	*M* = 16″·69 *w* = 0·97 1/*w* = 1·03
	15·51	21·50	13·83	20·00	16·50	20·33	15·00	19·66	17·83	11·50	17·00	11·67	*C* = 48° 53′ 16″·64
IX & XI	*h* 40·00 *h* 38·33	*h* 34·00 *h* 38·33	*h* 44·00 *h* 40·33	*h* 33·34 *d* 35·34	*h* 35·66 *d* 36·00	*h* 36·00 *d* 38·66	*h* 38·34 *d* 36·34	*h* 33·67 *h* 36·67	*d* 40·00 *d* 40·67	*d* 46·17 *d* 44·84	*h* 38·67 *d* 38·16	*h* 42·33 *d* 39·33	*M* = 38″·55 *w* = 1·08 1/*w* = 0·93
	39·17	36·16	42·17	34·34	35·83	37·33	37·34	35·17	40·33	45·51	38·41	40·83	*C* = 73° 41′ 38″·55
XI & VI	*d* 37·66 *d* 38·50	*d* 43·67 *d* 39·34	*h* 42·67 *h* 40·67	*d* 30·34 *d* 34·33	*d* 38·33 *d* 41·66	*d* 35·33 *d* 36·67	*d* 44·00 *d* 41·33	*d* 40·34 *d* 40·67	*h* 43·67 *h* 41·00	*h* 34·00 *h* 36·00	*h* 35·34 *h* 37·67	*d* 39·00 *d* 40·67	*M* = 38″·87 *w* = 1·08 1/*w* = 0·93
	38·08	41·51	41·67	32·33	40·00	36·00	42·66	40·51	42·33	35·00	36·51	39·83	*C* = 126° 2′ 38″·87
VI & V	*h* 34·67 *h* 33·83	*h* 39·00 *h* 40·67	*h* 40·00 *h* 41·00	*h* 44·33 *h* 40·34	*h* 43·33 *h* 40·00	*h* 41·67 *h* 40·33	*h* 38·00 *h* 40·67	*h* 35·33 *h* 35·00	*h* 37·33 *h* 39·33	*h* 39·66 *h* 40·00	*h* 40·00 *h* 40·00	*h* 34·00 *h* 32·33	*M* = 38″·78 *w* = 1·32 1/*w* = 0·76
	34·25	39·84	40·50	42·33	41·67	41·00	39·33	35·17	38·33	39·83	40·00	33·16	*C* = 81° 57′ 38″·78

At VIII (Gurla)

December 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on X												*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	135° 14′	315° 14′	145° 14′	325° 14′	155° 15′	335° 14′	165° 15′	345° 14′	175° 14′	355° 14′	185° 14′	5° 14′	
X & IX	″ *h* 23·33 *d* 25·83 *d* 24·50	″ *h* 32·67 *h* 36·00	″ *h* 21·66 *d* 24·00 *d* 24·00	″ *h* 32·33 *h* 32·33	″ *d* 27·67 *d* 29·00	″ *h* 31·33 *d* 31·83 *d* 32·16	″ *d* 26·66 *d* 27·67	″ *h* 31·66 *d* 32·49 *d* 32·50	″ *d* 33·94 *d* 33·60	″ *d* 35·66 *d* 36·00	″ *h* 39·67 *h* 37·33	″ *d* 30·08 *d* 28·42	*M* = 30″·94 *w* = 0·60 1/*w* = 1·67
	24·55	34·34	23·22	32·33	28·33	31·77	27·17	32·22	33·77	35·83	38·50	29·25	*C* = 82° 4′ 30″·94

At VIII (Gurla)—(*Continued*).

Angle between	Circle readings, telescope being set on X 135° 14′	315° 14′	145° 14′	325° 14′	155° 15′	335° 14′	165° 15′	345° 14′	175° 14′	355° 14′	185° 14′	5° 14′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
IX & VII	*h* 38·67 *h* 37·33	*h* 29·67 *h* 30·67	*h* 41·67 *d* 38·55 *d* 39·89	*h* 33·00 *h* 33·33	*h* 36·33 *d* 36·25	*d* 33·83 *d* 34·16	*d* 35·34 *d* 34·00	*d* 35·83 *d* 36·17	*h* 31·00 *d* 32·50	*h* 37·00 *d* 37·33	*h* 34·33 *h* 34·00	*h* 43·33 *d* 45·16	$M = 35''\cdot81$ $w = 0\cdot84$ $\frac{1}{w} = 1\cdot19$
	38·00	30·17	40·04	33·17	36·29	33·99	34·67	36·00	31·75	37·17	34·16	44·25	$C = 53° 57' 35''\cdot81$
VII & V	*h* 60·33 *h* 60·67	*h* 66·33 *h* 62·33 *h* 61·00	*l* 60·33 *l* 62·33 *h* 60·67	*h* 63·33 *h* 61·00	*l* 60·00 *l* 65·67 *l* 64·00 *h* 61·34	*l* 64·67 *l* 65·00	*l* 64·66 *l* 66·00	*l* 61·00 *l* 59·33	*l* 65·00 *l* 61·50 *l* 62·16 *h* 65·34	*l* 61·33 *l* 62·34 *h* 61·34	*h* 61·00 *h* 61·00	*l* 54·67 *l* 57·34 *h* 55·50	$M = 61''\cdot84$ $w = 1\cdot74$ $\frac{1}{w} = 0\cdot57$
	60·50	63·22	61·11	62·17	62·75	64·83	65·33	60·17	63·50	61·67	61·00	55·84	$C = 88° 44' 1''\cdot82$

At IX (Karsod)

November 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on VIII 0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 1′	220° 0′	50° 1′	230° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
VIII & X	*h* 66·67 *h* 65·67	*h* 60·34 *h* 61·50	*h* 61·00 *h* 61·66	*h* 61·33 *h* 59·33	*h* 54·00 *h* 57·33 *h* 52·66	*h* 59·67 *h* 62·33	*h* 58·33 *h* 57·33	*h* 59·00 *h* 60·00	*l* 58·00 *h* 56·00 *h* 55·67	*h* 59·66 *h* 57·33 *h* 59·67	*h* 55·00 *h* 54·67	*h* 61·00 *h* 61·00 *h* 61·34	$M = 59''\cdot43$ $w = 1\cdot08$ $\frac{1}{w} = 0\cdot93$
	66·17	60·92	61·33	60·33	54·66	61·00	57·83	59·50	56·56	58·89	54·84	61·11	$C = 43° 34' 59''\cdot43$
X & XII	*h* 47·00 *h* 49·33	*h* 52·33 *h* 47·16	*h* 51·66 *h* 54·67	*h* 51·33 *h* 54·00	*h* 57·33 *h* 54·33	*h* 48·66 *h* 45·67	*h* 57·33 *h* 54·33	*h* 50·00 *h* 50·00	*d* 49·51 *d* 48·84	*h* 50·00 *h* 49·67 *h* 49·00	*h* 49·66 *h* 51·67	*h* 46·67 *h* 49·67 *h* 48·33	$M = 50''\cdot85$ $w = 1\cdot32$ $\frac{1}{w} = 0\cdot76$
	48·17	49·74	53·17	52·66	55·83	47·17	55·83	50·00	49·17	49·56	50·67	48·22	$C = 84° 32' 50''\cdot85$
XII & XIII	*d* 57·99 *d* 56·99	*d* 62·67 *d* 63·34	*h* 64·00 *h* 60·33	*h* 62·67 *d* 66·68	*d* 57·01 *d* 56·68	*d* 63·49 *d* 62·83	*d* 59·00 *d* 63·00 *d* 57·50	*d* 69·67 *d* 68·67	*h* 60·66 *h* 61·66	*h* 66·67 *d* 65·90	*d* 56·17 *d* 56·84	*d* 60·33 *d* 61·33 *d* 63·33 *d* 64·91	$M = 61''\cdot90$ $w = 0\cdot74$ $\frac{1}{w} = 1\cdot35$
	57·49	63·01	62·16	64·68	56·84	63·16	59·83	69·17	61·16	66·29	56·50	62·48	$C = 57° 2' 1''\cdot88$
XIII & XI	*d* 66·33 *d* 64·32	*d* 64·33 *d* 63·66	*h* 65·34 *h* 68·67	*h* 65·66 *h* 65·66	*d* 75·50 *d* 74·84	*d* 75·01 *d* 75·67	*d* 73·33 *d* 69·67 *d* 68·00	*d* 57·66 *d* 60·66	*h* 72·34 *h* 66·34	*h* 63·33 *d* 59·50	*d* 74·00 *d* 70·67	*d* 71·34 *d* 70·17 *d* 74·01	$M = 68''\cdot08$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$
	65·33	63·99	67·01	65·66	75·17	75·34	70·33	59·16	69·34	61·41	72·34	71·84	$C = 56° 42' 8''\cdot08$

At IX (Karsod)—(*Continued*).

Angle between	Circle readings, telescope being set on VIII 0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 1′	220° 0′	50° 1′	230° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XI & VII	″ h 59·33 h 60·00	″ h 62·34 h 56·33	″ h 54·33 d 52·33	″ h 50·00 d 49·33	″ h 54·33 h 52·33	″ h 53·67 h 48·00	″ h 50·67 d 53·16	″ h 59·67 h 57·34	″ h 52·66 h 55·66	″ h 65·00 h 61·00	″ h 50·50 h 52·67	″ h 57·00 h 58·17	$M = 55''\cdot24$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$
	59·67	59·33	53·33	49·67	53·33	50·83	51·92	58·50	54·16	63·00	51·59	57·58	$C = 40° 58' 55''\cdot24$
VII & VIII	h 59·00 h 60·34	h 63·66 h 64·67	h 62·00 d 60·00	h 66·67 d 66·00	h 65·67 h 66·67	h 66·00 h 66·00	h 67·34 h 65·00	h 65·33 h 64·66	h 68·00 h 69·67	h 58·00 h 63·00 h 60·33	h 69·50 h 70·66	h 61·66 h 61·66	$M = 64''\cdot63$ $w = 1\cdot08$ $\frac{1}{w} = 0\cdot93$
	59·67	64·17	61·00	66·33	66·17	66·00	66·17	65·00	68·83	60·44	70·08	61·66	$C = 77° 9' 4''\cdot63$

At X (Jalálkheri)

December 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XII 249° 31′	69° 31′	259° 31′	79° 32′	269° 31′	89° 32′	279° 31′	99° 31′	289° 31′	109° 32′	299° 31′	119° 32′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XII & IX	″ d 16·72 d 16·72 d 16·72	″ d 16·73 d 16·73	″ l 18·66 l 24·67 l 21·67	″ l 21·67 h 27·33	″ d 18·75 d 19·25	″ d 33·34 d 31·67	″ h 19·66 d 19·44	″ h 28·33 d 24·55	″ d 19·66 d 18·00	″ d 26·67 d 27·66	″ d 24·33 d 23·50	″ d 28·34 d 29·84	$M = 23''\cdot01$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$
	16·72	16·73	21·67	24·50	19·00	32·51	19·55	26·44	18·83	27·16	23·92	29·09	$C = 56° 8' 23''\cdot01$
IX & VIII	l 32·00 l 34·33 l 34·50	h 36·16 h 35·67 h 36·00	l 37·34 l 35·16 l 36·00	l 31·67 l 34·66 h 26·67 h 29·00	l 38·00 l 37·50	l 34·33 l 29·66 l 28·33 h 33·00	l 38·67 l 39·67 h 34·34	l 34·67 h 27·00 h 28·66	h 35·33 h 36·67	h 30·33 h 29·34	h 32·67 h 33·50	h 31·00 h 29·50	$M = 33''\cdot51$ $w = 1\cdot10$ $\frac{1}{w} = 0\cdot91$
	33·61	35·94	36·17	30·50	37·75	31·33	37·56	30·11	36·00	29·84	33·08	30·25	$C = 54° 20' 33''\cdot46$

At XI (Kaula-ka-Máta)

November 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on VI 323° 2′	143° 2′	333° 2′	153° 2′	343° 2′	163° 3′	353° 3′	173° 3′	3° 2′	183° 2′	13° 2′	193° 2′	M = Mean of Groups w = Relative Weight C = Concluded Angle
VI & VII	″ h 54·00 h 56·67 h 57·00	″ h 50·00 h 51·33	″ h 62·67 h 63·67	″ h 53·34 h 55·67	″ h 62·00 h 61·33 h 61·33	″ h 63·67 h 64·00	″ h 63·33 h 62·34	″ h 60·33 h 58·66	″ h 59·34 h 61·67	″ h 57·67 h 59·00	″ h 64·33 h 61·00 h 59·00	″ h 60·34 h 59·67	$M = 59''\cdot35$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$
	55·89	50·67	63·17	54·50	61·55	63·84	62·83	59·50	60·50	58·34	61·44	60·00	$C = 36° 57' 59''\cdot35$

At XI (Kaula-ka-Máta)—(*Continued*).

Angle between	Circle readings, telescope being set on VI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	323° 2′	143° 2′	333° 2′	153° 2′	343° 2′	163° 3′	353° 3′	173° 3′	3° 2′	183° 2′	13° 2′	193° 2′	
VII & IX	″ h 30·67 l 32·34 l 32·17 l 31·33	″ l 30·00 l 29·00	″ l 26·00 l 27·34	″ l 26·67 l 29·67	″ l 18·66 l 21·66	″ l 29·67 l 37·00 l 34·33 d 32·45	″ h 24·67 h 23·00 d 22·83	″ h 35·00 d 36·49	″ h 31·00 h 29·67	″ h 36·00 h 33·50	″ l 21·66 l 25·00 l 26·00	″ l 30·34 l 30·67 h 29·00 d 32·50	$M = 29''\cdot06$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$
	31·63	29·50	26·67	28·17	20·16	33·36	23·50	35·75	30·33	34·75	24·22	30·63	$C = 65° 19' 29''\cdot06$
IX & XIII	l 67·67 d 69·37	d 66·50 d 67·34	l 74·33 d 75·83	l 68·33 l 69·66	l 75·67 l 71·84	l 66·66 l 65·00 l 58·00 d 62·00	h 72·66 h 68·67 d 69·66	h 62·34 d 63·83	d 64·00 d 64·32	d 61·11 d 63·61	l 69·00 l 69·00	l 75·33 h 73·66 d 77·00	$M = 68''\cdot37$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$
	68·52	66·92	75·08	69·00	73·75	62·92	70·33	63·08	64·16	62·36	69·00	75·33	$C = 83° 38' 8''\cdot37$

At XII (Harnása)

******April* 1847; *and* †*December* 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 0′	190° 0′	20° 1′	200° 1′	30° 0′	210° 0′	40° 1′	220° 1′	50° 0′	230° 1′	
* XV & XIV	″ h 36·33 h 35·00 h 35·00	″ h 33·33 h 34·00	″ h 32·66 h 36·67 h 32·00	″ h 32·33 h 34·00	″ h 31·66 h 31·00	″ h 33·67 h 36·34 h 32·33	″ h 28·33 h 31·00 h 30·67	″ h 37·00 h 40·66	″ h 34·34 h 29·66 h 30·67	″ h 33·34 h 32·00	″ h 29·00 h 30·67 d 31·49	″ h 33·66 h 36·33 h 38·00	$M = 33''\cdot41$ $w = 1\cdot68$ $\frac{1}{w} = 0\cdot60$
	35·44	33·67	33·78	33·16	31·33	34·11	30·00	38·83	31·56	32·67	30·39	36·00	$C = 44° 16' 33''\cdot41$
* XIV & XIII	d 60·56 d 61·56	d 64·33 d 65·00 d 63·99	h 62·34 h 61·33	h 64·00 h 60·00	h 63·67 h 63·33	h 60·67 h 59·33	d 69·66 d 66·33 d 68·00	d 60·17 d 59·51 d 63·17	h 63·33 h 63·34 h 61·33	h 64·33 h 64·00	h 62·33 h 62·00 d 63·82	h 57·34 h 55·34	$M = 62''\cdot31$ $w = 1\cdot44$ $\frac{1}{w} = 0\cdot69$
	61·06	64·44	61·84	62·00	63·50	60·00	68·00	60·95	62·67	64·16	62·72	56·34	$C = 66° 0' 2''\cdot31$
	Circle readings, telescope being set on XIII												
	293° 18′	113° 18′	303° 17′	123° 17′	313° 17′	133° 17′	323° 17′	143° 17′	333° 17′	153° 17′	343° 17′	163° 17′	
† XIII & IX	″ l 58·34 l 57·67 l 57·66	″ l 53·66 l 54·67	″ l 62·16 l 62·00	″ h 57·00 l 56·33 l 60·66 l 55·34	″ l 63·00 l 63·67	″ l 54·33 l 56·67 l 53·00	″ h 69·00 h 66·16	″ l 55·33 l 55·67 h 59·34	″ h 62·33 h 59·33 h 64·34	″ d 65·00 d 63·67 d 64·00	″ l 65·34 l 59·33 l 64·00	″ l 54·00 l 55·00	$M = 59''\cdot79$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$
	57·89	54·17	62·08	57·33	63·33	54·67	67·58	56·78	62·00	64·22	62·89	54·50	$C = 66° 42' 59''\cdot79$

At XII (Harnása)—(*Continued*).

Angle between	Circle readings, telescope being set on XIII: 293° 18′	113° 18′	303° 17′	123° 17′	313° 17′	133° 17′	323° 17′	143° 17′	333° 17′	153° 17′	343° 17′	163° 17′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
† IX & X	″ l 54·34 l 55·34	″ l 48·00 l 46·67	″ l 45·33 l 43·33	″ h 42·34 h 38·66 l 44·66	″ l 40·67 l 40·00	″ l 52·00 l 48·33 l 49·66	″ h 40·66 h 41·67	″ l 52·67 l 49·67 l 47·00 h 54·00	″ h 44·67 h 45·34 h 43·34 h 43·00 l 44·00	″ h 46·67 h 48·00 h 47·67	″ l 42·33 l 38·00 l 35·33	″ l 48·00 l 48·00	$M = 45''\cdot73$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$
	54·84	47·34	44·33	41·89	40·33	50·00	41·17	50·83	44·07	47·45	38·55	48·00	$C = 39° 18' 45''\cdot73$

At XIII (Indráwan)

* *March and April* 1847; *and* † *November* 1848; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XI: 320° 21′	140° 20′	330° 21′	150° 20′	340° 21′	160° 20′	350° 20′	170° 20′	0° 20′	180° 20′	10° 20′	190° 19′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
† XI & IX	″ l 40·67 l 41·67	″ l 40·00 l 44·00 l 44·00	″ l 50·00 l 51·00	″ l 34·50 l 38·16 l 42·83	″ l 46·00 l 47·84	″ l 45·00 l 41·00 l 41·00	″ l 53·00 l 49·16	″ l 41·00 l 40·67	″ l 54·34 l 51·00	″ l 55·34 l 54·34	″ l 45·84 l 46·00	″ l 42·33 l 42·50	$M = 45''\cdot82$ $w = 0\cdot36$ $\frac{1}{w} = 2\cdot78$
	41·17	42·67	50·50	38·50	46·92	42·33	51·08	40·84	52·67	54·84	45·92	42·41	$C = 39° 39' 45''\cdot82$
† IX & XII	h 62·00 h 64·00 h 63·17	h 62·33 h 62·00 h 59·67	h 60·33 l 59·00 l 60·33	l 68·17 l 67·00 l 63·67	l 57·50 l 58·83	l 68·00 l 69·83 l 68·84	h 51·00 h 51·33	l 68·66 h 66·50	h 56·00 l 55·66 l 55·67	l 57·33 l 58·33	l 55·50 l 56·66	l 68·67 l 66·34	$M = 61''\cdot13$ $w = 0\cdot36$ $\frac{1}{w} = 2\cdot78$
	63·06	61·33	59·89	66·28	58·17	68·89	51·16	67·58	55·78	57·83	56·08	67·51	$C = 56° 15' 1''\cdot13$

Angle between	Circle readings, telescope being set on R. M.: 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 29·00 l 27·00 l 27·33	″ l 25·00 l 24·33	″ l 25·34 l 24·33	″ l 27·67 l 33·00 l 28·33	″ l 18·34 l 22·66 l 22·67 l 19·33	″ l 26·33 l 23·33 l 23·66	″ l 22·34 l 23·67	″ l 25·66 l 25·33	″ l 22·34 l 26·67 l 20·33 l 22·33	″ l 20·67 l 20·33	″ l 16·33 l 18·33 l 21·67	″ l 22·34 l 23·66 l 26·67	$M = 23''\cdot92$ $w = 1\cdot15$ $\frac{1}{w} = 0\cdot87$
	27·78	24·67	24·83	29·67	20·75	24·44	23·01	25·49	22·92	20·50	18·78	24·22	$C = 93° 59' 23''\cdot93$
* XII & XIV	d 23·17 d 25·17 d 24·84	d 28·27 d 28·94	d 22·49 d 23·49	d 17·33 d 21·00 d 21·00 d 18·11 d 15·77	d 23·92 d 26·25 d 25·25	d 19·56 d 20·89	d 23·16 d 21·83	d 28·17 d 28·50	d 21·44 d 17·11 d 23·45 d 21·45	d 28·33 d 28·67	d 24·11 d 22·11 d 18·77	d 30·12 d 30·45 d 28·78 d 28·44 d 29·45	$M = 24''\cdot27$ $w = 0\cdot84$ $\frac{1}{w} = 1\cdot19$
	24·39	28·61	22·99	18·64	25·14	20·22	22·50	28·33	20·86	28·50	21·66	29·45	$C = 70° 2' 24''\cdot27$

NOTE.—R. M. denotes Referring Mark.

At XIII (Indráwan)—(*Continued*).

Angle between	Circle readings, telescope being set on R.M.												M = Mean of Groups w = Relative Weight C = Concluded Angle
	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 & XVI	h 32·33 h 36·00 h 39·00	h 44·33 h 37·00 h 40·33 h 39·67 d 36·73	h 39·67 h 38·33	h 40·33 h 36·00 h 34·33	h 51·33 h 39·67 h 43·67	h 42·66 h 39·00	h 40·00 h 41·66 h 42·00 h 42·67	h 42·67 h 40·33 h 39·33 h 42·67	h 51·33 h 44·00 h 43·00	h 40·00 h 43·66 d 40·33	h 47·67 h 43·67 h 44·67	h 33·67 h 36·67 h 37·33 d 36·33 d 31·66	$M = 40''\cdot65$ $w = 0\cdot82$ $\frac{1}{w} = 1\cdot22$ $C = 67^\circ\ 9'\ 40''\cdot67$
	35·78	39·61	39·00	36·89	44·89	40·83	41·58	41·25	46·11	41·33	45·34	35·13	

At XIV (Mograba)

March* 1847; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.

Angle between	Circle readings, telescope being set on XII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	179° 59′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & XV	h 42·00 h 46·33	h 45·66 h 42·00	h 48·67 h 45·33 h 47·00 h 45·66	h 52·66 h 51·67 h 50·00 d 51·67	h 46·00 h 42·00	h 54·33 h 53·33	h 45·33 h 46·00	h 54·00 h 58·00	h 46·66 h 53·00 h 44·66	h 56·33 h 55·00	h 50·33 h 47·33 h 47·00 d 47·67	h 56·00 h 53·34	$M = 49''\cdot35$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$ $C = 56^\circ\ 44'\ 49''\cdot35$
	44·17	43·83	46·66	51·50	44·00	53·83	45·67	56·00	48·11	55·66	48·08	54·67	
XV & XVII	h 53·67 h 48·34	h 48·00 h 55·00	h 54·66 h 52·33	h 42·67 d 43·23 d 42·56	h 48·34 h 49·34	h 41·33 h 41·67	h 51·00 h 50·33	h 43·67 h 46·00 h 41·00	h 48·67 h 44·00 h 46·67	h 42·00 h 42·67	h 41·33 h 44·66 d 42·45	h 46·33 d 46·00	$M = 46''\cdot76$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$ $C = 81^\circ\ 59'\ 46''\cdot76$
	51·01	51·50	53·49	42·82	48·84	41·50	50·67	43·56	46·45	42·33	42·81	46·17	
XVII & XVIII	h 17·66 h 20·66 h 21·00	h 23·34 d 23·67	h 16·34 h 16·67	h 28·67 h 25·66	h 20·34 h 20·00	h 28·67 h 26·33	h 18·67 d 20·67	h 26·66 h 24·33 h 27·00	h 19·67 h 14·67	h 23·34 d 25·66	h 26·67 h 28·00	h 21·33 d 21·00	$M = 22''\cdot54$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$ $C = 61^\circ\ 49'\ 22''\cdot54$
	19·77	23·51	16·50	27·17	20·17	27·50	19·67	26·00	17·17	24·50	27·33	21·17	
XVIII & XVI	h 22·34 h 23·67 h 24·34	h 14·67 d 15·00	h 29·33 h 28·00	h 17·67 d 19·84	d 24·66 d 29·16	h 14·67 d 16·00	h 18·00 d 20·00	h 16·34 d 11·11	d 26·50 d 26·84	h 14·67 d 16·99	h 14·67 d 19·33	d 19·66 d 19·33	$M = 19''\cdot97$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$ $C = 67^\circ\ 56'\ 19''\cdot97$
	23·45	14·84	28·66	18·76	26·91	15·33	19·00	13·73	26·67	15·83	17·00	19·49	

At XIV (Mograba)—(*Continued*).

Circle readings, telescope being set on XII

Angle between	0° 0′	179° 59′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XVI & XIII	″ h 61·33 d 64·99	″ h 65·00 h 60·00	″ h 56·34 h 59·00 h 55·33	″ h 69·00 h 68·66	″ h 61·00 h 60·00	″ h 66·66 h 67·67	″ d 66·99 d 66·66	″ h 69·33 d 73·78	″ h 66·00 h 65·66	″ d 62·33 d 63·67	″ h 65·67 d 68·55 d 70·33	″ h 63·34 h 63·67	M = 64″·83 w = 0·72 1/w = 1·39
	63·16	62·50	56·89	68·83	60·50	67·17	66·82	71·56	65·83	63·00	68·18	63·50	C = 47° 32′ 4″·83
XIII & XII	h 38·34 h 35·34 h 34·34	h 30·00 h 35·33	h 40·00 h 41·00 h 35·67	h 29·00 h 31·34 h 33·33	h 39·33 h 39·00	h 33·34 h 32·33	h 37·34 h 37·67	h 31·67 h 33·67 h 31·33	h 36·34 h 36·33 h 42·34 h 37·67	h 39·00 h 37·66	h 35·67 h 39·00 h 37·67	h 35·00 h 36·33	M = 35″·84 w = 1·26 1/w = 0·79
	36·01	32·67	38·89	31·22	39·16	32·84	37·50	32·22	38·17	38·33	37·45	35·67	C = 43° 57′ 35″·83

At XV (Singárchori)

March 1847; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Circle readings, telescope being set on XVII

Angle between	228° 14′	48° 14′	238° 14′	58° 14′	248° 14′	68° 14′	258° 14′	78° 14′	268° 14′	88° 14′	278° 14′	98° 14′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XVII & XIV	″ h 52·00 h 52·34	″ h 42·67 h 41·67	″ h 45·66 h 46·67	″ h 43·00 h 44·00	″ h 39·00 h 37·34 h 39·67	″ h 43·67 h 44·67	″ h 38·33 h 39·33	″ h 41·66 h 41·00	″ h 37·33 h 41·00	″ d 50·83 d 49·83	″ h 38·33 h 39·33 d 37·33	″ h 50·33 h 46·67	M = 43″·61 w = 0·48 1/w = 2·08
	52·17	42·17	46·17	43·50	38·67	44·17	38·83	41·33	39·16	50·33	38·33	48·50	C = 52° 47′ 43″·61
XIV & XII	h 33·33 h 35·00 h 35·66	h 36·67 h 37·33	h 36·34 h 36·33	h 43·33 h 42·00	h 44·34 h 48·00 h 44·67	h 43·00 h 41·33	h 42·67 h 44·00	h 37·00 h 36·67	h 40·34 h 39·66	h 35·67 h 36·67	h 46·67 h 44·00 d 43·84	h 33·33 h 33·33	M = 39″·42 w = 0·72 1/w = 1·39
	34·66	37·00	36·34	42·66	45·67	42·17	43·33	36·84	40·00	36·17	44·84	33·33	C = 78° 58′ 39″·42

At XVI (Gumánpur)

March 1847; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Circle readings, telescope being set on XIII

Angle between	294° 41′	114° 42′	304° 41′	124° 42′	314° 41′	134° 42′	324° 41′	144° 41′	334° 41′	154° 42′	344° 42′	164° 42′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XIII & XIV	″ h 19·00 h 20·66	″ h 20·67 h 23·00	″ h 21·67 h 22·00	″ h 25·33 h 27·00	″ h 26·00 h 26·66	″ h 21·00 h 22·67	″ h 30·34 h 27·00	″ h 20·67 h 23·33	″ h 30·33 h 28·00 h 29·00	″ h 26·33 h 28·00	″ h 23·34 h 23·33	″ h 21·34 h 17·66	M = 23″·97 w = 0·97 1/w = 1·03
	19·83	21·84	21·83	26·17	26·33	21·83	28·67	22·00	29·11	27·17	23·33	19·50	C = 65° 18′ 24″·02

At XVI (Gumánpur)—(*Continued*).

Angle between	Circle readings, telescope being set on XIII 294° 41′	114° 42′	304° 41′	124° 42′	314° 41′	134° 42′	324° 41′	144° 41′	334° 41′	154° 42′	344° 42′	164° 42′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XIV & XVIII	″ h 27·66 h 32·00 h 29·66	″ h 29·00 h 26·66	″ h 32·00 h 32·66	″ h 35·33 h 31·00 h 37·00	″ h 29·34 h 29·00	″ h 29·66 h 31·00	″ h 19·34 h 24·66 h 22·00 h 22·66 h 23·00	″ h 34·00 h 36·34 h 33·33	″ h 27·66 h 24·34 h 23·00	″ h 29·67 h 32·00	″ h 23·67 h 21·00	″ h 33·67 h 28·33 h 32·66	$M = 29''\cdot21$ $w = 0\cdot66$ $\frac{1}{w} = 1\cdot52$ $C = 65°\ 59'\ 29''\cdot25$
	29·77	27·83	32·33	34·44	29·17	30·33	22·33	34·56	25·00	30·84	22·33	31·55	

At XVII (Thíkri)

February and March* 1847 ; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.

Angle between	Circle readings, telescope being set on XIX 150° 15′	330° 14′	160° 15′	340° 15′	170° 14′	350° 15′	180° 14′	0° 14′	190° 14′	10° 14′	200° 14′	20° 14′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XIX & XX	″ d 47·83 d 51·17	″ d 62·44 d 60·11	″ h 50·00 d 49·11	″ d 63·00 d 63·33	″ h 64·34 d 57·88 d 59·89	″ d 62·44 d 63·11	″ d 54·16 d 54·83	″ d 66·00 d 66·67	″ h 56·67 h 55·67	″ h 58·66 d 55·49	″ d 58·49 d 59·83	″ h 56·33 h 57·33	$M = 58''\cdot09$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$ $C = 45°\ 52'\ 58''\cdot09$
	49·50	61·28	49·55	63·17	60·70	62·77	54·50	66·33	56·17	57·08	59·16	56·83	
XX & XVIII	h 44·00 h 43·00	h 41·33 h 42·67	h 49·67 h 47·33	h 39·00 h 40·67	h 39·00 d 40·34 d 41·01 d 41·00	h 39·33 d 41·00	d 47·78 d 46·11	h 47·00 d 45·23 d 46·56	h 44·33 h 55·33	h 48·00 d 46·17	d 43·18 d 41·84	h 43·33 h 39·33	$M = 44''\cdot03$ $w = 0\cdot85$ $\frac{1}{w} = 1\cdot18$ $C = 39°\ 20'\ 43''\cdot99$
	43·50	42·00	48·50	39·84	40·34	40·16	46·95	46·26	49·83	47·08	42·51	41·33	
XVIII & XIV	h 43·67 d 45·89 d 43·22	d 41·23 d 42·22	d 45·17 d 46·84 d 43·66	h 43·00 d 44·66 d 43·66	h 41·00 h 44·34 d 44·22	d 43·33 d 41·33 d 43·00	h 37·00 h 40·67 h 39·00	d 36·11 d 35·44	h 41·67 h 32·34 d 32·34	h 40·67 h 39·67	h 37·00 h 42·00	h 41·00 h 41·67	$M = 40''\cdot99$ $w = 1\cdot08$ $\frac{1}{w} = 0\cdot93$ $C = 79°\ 19'\ 40''\cdot99$
	44·26	41·73	45·22	43·77	43·19	42·55	38·89	35·77	35·45	40·17	39·50	41·34	
XIV & XV	h 33·00 h 32·00 h 28·34	h 27·33 h 24·67 h 29·33	h 24·67 h 26·33	h 27·67 h 27·67	h 35·33 h 32·00 h 31·00	h 27·67 h 29·67 h 28·00	h 34·00 h 35·67 h 32·33	h 26·66 h 27·33	h 35·66 h 37·00 d 31·66	h 27·66 h 31·00	h 37·66 h 34·00 h 34·66	h 32·67 h 34·33	$M = 30''\cdot56$ $w = 0\cdot96$ $\frac{1}{w} = 1\cdot04$ $C = 45°\ 12'\ 30''\cdot56$
	31·11	27·11	25·50	27·67	32·78	28·45	34·00	27·00	34·77	29·33	35·44	33·50	

At XVIII (Báwangaz)

February 1847; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XVI												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	313° 56′	133° 56′	323° 56′	143° 56′	333° 56′	153° 56′	343° 56′	163° 56′	353° 56′	173° 56′	3° 56′	183° 56′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVI & XIV	*h* 15·66	*h* 16·34	*h* 16·67	*h* 12·34	*h* 17·33	*h* 16·33	*h* 18·00	*h* 11·33	*h* 18·34	*h* 17·67	*h* 20·00	*h* 16·66	M = 17″·08
	h 18·33	*h* 14·34	*h* 17·67	*h* 12·33	*h* 19·66	*h* 13·00	*h* 19·66	*h* 13·67	*h* 23·67	*h* 17·67	*h* 21·00	*h* 16·67	w = 1·32
	h 18·33				*h* 21·67	*h* 15·67	*h* 19·66		*h* 23·00		*h* 20·34		1/w = 0·76
	17·44	15·34	17·17	12·34	19·55	15·00	19·11	12·50	21·67	17·67	20·45	16·66	C = 46° 4′ 17″·08
XIV & XVII	*h* 67·67	*h* 64·66	*h* 67·33	*h* 67·66	*h* 63·67	*h* 61·00	*h* 58·67	*h* 65·33	*h* 62·66	*h* 65·67	*h* 61·34	*h* 70·00	M = 64″·70
	h 67·67	*h* 64·33	*h* 67·00	*h* 67·00	*h* 61·67	*h* 61·00	*h* 64·34	*h* 64·33	*h* 61·33	*h* 67·00	*h* 60·67	*h* 69·66	w = 1·20
	h 66·67	*d* 69·16					*h* 59·67						1/w = 0·83
	67·34	66·05	67·17	67·33	62·67	61·00	60·89	64·83	61·99	66·34	61·00	69·83	C = 38° 51′ 4″·70
XVII & XIX	*h* 57·33	*h* 60·00	*h* 59·00	*h* 67·00	*h* 58·33	*h* 67·67	*h* 64·67	*h* 63·00	*h* 56·67	*h* 58·66	*d* 57·83	*h* 56·00	M = 60″·98
	h 56·00	*h* 63·67	*h* 60·33	*h* 68·00	*h* 59·33	*h* 66·34	*h* 60·00	*h* 66·34	*h* 57·00	*h* 58·33	*d* 58·50	*h* 55·34	w = 0·64
	h 57·33	*d* 66·50					*d* 67·50				*d* 59·83		1/w = 1·56
	56·89	63·39	59·67	67·50	58·83	67·00	64·06	64·67	56·84	58·49	58·72	55·67	C = 34° 31′ 0″·97
XIX & XX	*h* 48·00	*h* 49·67	*h* 49·34	*h* 39·67	*h* 51·33	*h* 41·00	*h* 42·00	*h* 38·34	*h* 51·67	*h* 44·67	*h* 51·34	*h* 45·34	M = 46″·13
	h 47·33	*h* 47·66	*h* 49·00	*h* 40·67	*h* 51·00	*h* 42·00	*h* 43·66	*h* 37·33	*h* 50·34	*h* 44·67	*h* 51·00	*h* 46·33	w = 0·60
	h 48·00						*d* 47·99						1/w = 1·67
	47·78	48·67	49·17	40·17	51·16	41·50	44·55	37·84	51·00	44·67	51·17	45·84	C = 50° 26′ 46″·13

At XIX (Jalálabad)

February 1847; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXI												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	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	*h* 47·00	*h* 43·33	*h* 42·67	*h* 48·33	*h* 48·66	*h* 49·00	*h* 41·00	*h* 54·67	*h* 41·00	*h* 44·00	*h* 38·00	*h* 44·00	M = 44″·89
	h 48·00	*h* 47·67	*h* 42·33	*h* 47·33	*h* 45·33	*h* 49·67	*h* 40·33	*h* 53·00	*h* 39·34	*h* 43·67	*h* 41·00	*h* 43·66	w = 0·60
			d 40·32		*h* 45·34						*h* 37·67		1/w = 1·67
											h 35·00		
	47·50	45·50	41·77	47·83	46·44	49·34	40·66	53·84	40·17	43·83	37·92	43·83	C = 60° 31′ 44″·89

At XIX (Jalálabad)—(*Continued*).

Angle between	Circle readings, telescope being set on XXI 0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXII & XX	h 15·33	h 22·00	h 10·33	h 14·67	h 3·34	h 9·67	h 16·00	h 11·33	h 13·00	h 6·66	h 24·33	h 10·34	$M = 13''\cdot39$
	h 14·67	d 19·50	h 13·34	h 17·34	h 6·00	h 6·66	h 14·34	h 12·00	h 16·66	h 9·00	h 25·66	d 12·17	$w = 0\cdot36$
			d 9·66								d 22·33	d 11·63	$\frac{1}{w} = 2\cdot78$
	15·00	20·75	11·11	16·01	4·67	8·16	15·17	11·67	14·83	7·83	24·11	11·38	$C = 36^\circ 45' 13''\cdot39$
XX & XVIII	d 18·50	h 17·00	h 34·67	h 18·00	d 33·17	h 18·66	h 20·66	h 18·33	h 20·33	h 25·67	h 13·34	h 21·33	$M = 21''\cdot18$
	d 19·17	h 16·67	h 29·00	h 18·00	d 33·84	h 21·00	d 22·49	h 17·66	h 18·00	h 25·66	d 11·34	d 19·58	$w = 0\cdot36$
			d 29·66				d 23·82				d 10·01	d 17·08	$\frac{1}{w} = 2\cdot78$
	18·84	16·83	31·11	18·00	33·51	19·83	22·32	17·99	19·17	25·66	11·56	19·33	$C = 41^\circ 55' 21''\cdot18$
XVIII & XVII	h 20·00	h 22·00	h 15·00	h 25·33	d 11·16	h 26·67	h 25·67	h 26·34	h 21·00	h 23·00	h 27·34	h 25·33	$M = 22''\cdot41$
	d 19·83	h 24·00	h 14·66	h 24·66	d 10·83	h 27·34	h 21·34	h 28·00	h 22·67	h 21·00	h 27·67	h 26·33	$w = 0\cdot48$
	d 19·16		h 17·00		d 9·49						h 28·66		$\frac{1}{w} = 2\cdot08$
	19·66	23·00	15·55	25·00	10·49	27·00	23·51	27·17	21·83	22·00	27·89	25·83	$C = 60^\circ 15' 22''\cdot41$

At XX (Bábákuwar)

January 1847; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XVIII 0° 0′	180° 1′	10° 0′	190° 0′	20° 0′	200° 1′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XVIII & XVII	h 34·67	h 39·00	h 35·00	h 37·00	h 38·33	h 36·33	h 34·33	h 46·00	h 34·00	h 46·33	h 32·00	h 46·00	$M = 37''\cdot93$
	h 36·33	h 37·33	h 36·33	h 35·33	h 39·00	h 37·67	h 34·33	h 49·34	h 35·34	h 44·34	h 33·00	h 40·00	$w = 0\cdot60$
	h 38·67		d 34·83		d 34·82	d 33·83		h 48·00		d 41·49		h 41·00	$\frac{1}{w} = 1\cdot67$
	h 36·33												
	36·50	38·17	35·39	36·16	37·38	35·94	34·33	47·78	34·67	44·05	32·50	42·33	$C = 55^\circ 41' 37''\cdot93$
XVII & XIX	h 24·33	h 26·00	h 19·34	h 30·33	h 19·33	h 24·00	h 20·67	h 18·33	h 20·00	h 10·67	h 21·67	h 15·67	$M = 20''\cdot47$
	h 17·67	d 22·00	h 21·00	h 29·67	h 18·00	h 25·00	h 19·67	h 16·00	h 18·33	h 14·33	h 21·33	d 20·00	$w = 0\cdot49$
	h 25·33	d 24·49	d 19·33		d 14·82	d 21·33		d 18·83		d 8·65			$\frac{1}{w} = 2\cdot04$
	h 25·33												
	23·17	24·16	19·89	30·00	17·38	23·44	20·17	17·72	19·16	11·22	21·50	17·84	$C = 31^\circ 56' 20''\cdot53$
XIX & XXI	h 59·34	h 61·00	h 68·33	h 62·67	h 73·67	h 65·34	h 71·33	h 62·00	h 73·00	h 72·00	h 66·33	h 65·67	$M = 66''\cdot72$
	h 64·00	d 57·00	h 66·67	h 64·00	h 70·00	h 68·00	h 68·66	h 65·00	h 73·33	h 68·67	h 67·67	h 65·00	$w = 0\cdot73$
	d 69·00	d 59·49			d 67·99	d 63·50		d 65·16		d 66·49			$\frac{1}{w} = 1\cdot37$
	d 71·00												
	65·84	59·16	67·50	63·33	70·55	65·61	70·00	64·05	73·16	69·05	67·00	65·34	$C = 36^\circ 51' 6''\cdot71$

At XX (Bábákuwar)—(*Continued*).

Angle between	Circle readings, telescope being set on XVIII 0° 0′	180° 1′	10° 0′	190° 0′	20° 0′	200° 1′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXI & XXII	″ h 59·00 h 54·34 d 64·00 d 66·00	″ h 60·00 h 56·00	″ h 56·00 h 55·33	″ h 49·33 h 50·33	″ h 49·33 h 51·67	″ h 47·33 h 47·00 h 49·67	″ h 49·34 h 50·67	″ h 54·00 h 57·00 h 53·34	″ h 45·34 h 47·34	″ h 55·67 h 53·66 d 50·82	″ h 52·00 h 53·33	″ h 53·67 h 56·66	$M = 52''\cdot93$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$
	60·84	58·00	55·66	49·83	50·50	48·00	50·01	54·78	46·34	53·38	52·66	55·17	$C = 40°\ 27'\ 52''\cdot93$

At XXI (Árgaon)

January 1847 ; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXIV 0° 0′	180° 0′	10° 0′	190° 0′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	50° 0′	230° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIV & XXIII	″ h 24·00 h 25·00 h 24·33	″ h 24·00 h 21·34 h 24·33	″ h 18·00 h 22·00 d 22·50	″ h 19·33 h 17·67 d 20·67	″ h 15·33 h 17·00 h 18·34	″ h 19·34 h 17·33	″ h 15·00 h 15·67 h 16·67	″ h 17·34 h 17·00	″ h 16·33 h 16·67	″ h 18·00 h 20·00	″ h 14·67 h 15·00 h 14·67	″ h 27·67 h 24·33 h 25·66	$M = 19''\cdot34$ $w = 0\cdot96$ $\frac{1}{w} = 1\cdot04$
	24·44	23·22	20·83	19·22	16·89	18·34	15·78	17·17	16·50	19·00	14·78	25·89	$C = 38°\ 51'\ 19''\cdot34$
XXIII & XXII	d 35·14 d 34·14 d 34·81	d 42·78 d 40·44 d 41·44 d 42·89	h 34·67 h 35·00 d 37·34	h 43·00 h 44·00 d 45·67	h 40·33 d 38·45	h 40·66 d 43·00 d 42·99	h 44·66 d 45·56 d 43·89	d 46·16 d 46·50 d 41·66	h 38·33 h 38·00	h 38·67 h 39·00	h 44·66 d 45·89	d 33·11 d 34·11	$M = 40''\cdot29$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$
	34·70	41·89	35·67	44·22	39·39	42·22	44·70	44·77	38·17	38·83	45·28	33·61	$C = 61°\ 15'\ 40''\cdot29$
XXII & XX	h 24·66 h 24·33 h 24·34 h 28·00 h 23·00	h 22·34 h 23·34 h 20·00	h 32·33 h 26·00 h 25·00	h 21·00 h 21·66 d 23·50	h 30·34 h 30·00	h 22·67 h 24·66	h 26·33 h 25·67	h 25·67 h 23·67	h 28·34 h 27·67	h 25·33 h 24·00	h 20·34 h 19·33	h 26·34 h 25·67	$M = 24''\cdot97$ $w = 1\cdot32$ $\frac{1}{w} = 0\cdot76$
	24·87	21·89	27·78	22·05	30·17	23·67	26·00	24·67	28·00	24·67	19·83	26·01	$C = 25°\ 42'\ 24''\cdot97$
XX & XIX	h 61·67 d 63·34	h 62·67 h 59·67	h 59·33 h 63·33	h 63·67 h 60·67 d 64·34	h 53·33 h 53·66	h 61·67 h 59·00	h 57·00 h 58·33	h 60·00 h 65·00	h 53·33 h 54·00	h 63·00 h 62·34	h 60·33 h 60·33	h 65·66 h 63·33	$M = 60''\cdot25$ $w = 0\cdot85$ $\frac{1}{w} = 1\cdot18$
	62·51	61·17	61·33	62·89	53·49	60·34	57·66	62·50	53·67	62·67	60·33	64·49	$C = 45°\ 52'\ 0''\cdot28$

At XXII (Ajnád)

January 1847; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	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 51·00 h 47·33 h 52·33 d 49·33	h 55·00 h 52·33 h 53·34	h 49·00 h 48·33	h 51·00 h 55·00 h 55·00	h 51·00 h 50·33 d 48·51	h 57·67 h 57·66	h 45·33 h 47·00 d 47·50 d 46·17	h 57·67 h 56·67	h 47·00 h 44·33 h 48·00	h 53·00 h 53·00	h 44·33 h 47·00 h 48·34	h 56·34 h 53·00	M = 51″·49 w = 0·72 1/w = 1·39
	50·00	53·56	48·67	53·67	49·95	57·66	46·50	57·17	46·44	53·00	46·56	54·67	C = 65° 55′ 51″·49
XIX & XXI	h 58·00 h 55·00 h 55·00 d 55·11	h 50·33 h 54·34	h 56·00 h 56·67	h 58·67 h 53·00	h 53·33 d 50·84 d 51·51	h 50·33 h 49·00	h 58·67 h 60·00 d 60·84 d 59·17	h 52·33 h 53·66	h 60·34 h 60·00	h 51·00 h 52·34	h 57·33 h 58·66 h 56·66	h 51·33 d 53·66 d 53·83	M = 54″·74 w = 1·01 1/w = 0·99
	55·78	52·34	56·33	55·84	51·89	49·66	59·67	53·00	60·17	51·67	57·55	52·94	C = 47° 53′ 54″·78
XXI & XXIV	h 13·00 d 10·00 d 10·00 d 8·33	h 10·67 h 9·00	h 16·34 h 14·66	h 11·33 h 12·00	h 15·00 h 11·34	d 11·67 d 10·34 d 7·83	h 5·33 h 7·00 h 4·33 d 7·49	d 7·67 d 7·34	d 1·50 d 0·16	h 11·34 h 11·66	h 11·00 h 7·34 d 10·33	h 14·34 h 13·67	M = 9″·99 w = 0·72 1/w = 1·39
	10·33	9·84	15·50	11·66	13·17	9·95	6·04	7·51	0·83	11·50	9·56	14·00	C = 38° 35′ 9″·99
XXIV & XXIII	h 21·67 h 23·34 d 18·67	h 22·33 h 23·66	h 20·66 h 24·00	h 25·34 h 26·67	d 19·33 d 19·32	d 24·99 d 25·66 d 22·16	h 24·34 h 23·33 d 25·78	d 28·00 d 27·33	d 28·83 d 27·82	h 27·00 h 24·67	h 24·34 h 26·33 d 26·50	h 23·00 h 21·33	M = 24″·20 w = 1·56 1/w = 0·64
	21·23	23·00	22·33	26·00	19·33	24·27	24·48	27·66	28·33	25·83	25·72	22·17	C = 37° 33′ 24″·20
XXIII & XXV	d 46·11 d 49·17	d 52·83 d 53·51	d 42·50 d 40·84	d 42·66 d 42·33	h 50·66 h 48·67	h 45·33 h 45·00	h 55·00 d 55·44	h 42·00 h 43·33	h 52·67 d 51·16	h 48·00 d 47·66	h 49·00 h 45·33	h 44·33 h 50·33	M = 47″·66 w = 0·60 1/w = 1·67
	47·64	53·17	41·67	42·50	49·66	45·17	55·22	42·66	51·92	47·83	47·16	47·33	C = 44° 52′ 47″·66

At XXIII (Walwári)

December 1846; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on R.M.												M = Mean of Groups w = Relative Weight C = Concluded Angle
	140° 1′	230° 0′	150° 0′	330° 0′	160° 0′	340° 0′	170° 0′	350° 0′	180° 0′	0° 0′	190° 0′	10° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
R.M. & XXI	h 65·00 h 66·33	h 62·00 h 66·33 h 65·34	h 57·00 h 60·66 h 61·34	h 65·66 h 66·33	h 60·67 h 59·34	h 67·00 h 66·66	h 61·67 h 64·34 h 64·67 d 67·50	h 66·33 h 67·33	h 62·33 h 60·33 h 64·00	h 68·00 h 68·67	h 65·33 h 63·67	h 69·00 h 70·00	M = 64″·89 w = 1·20 1/w = 0·83
	65·67	64·56	59·67	65·99	60·01	66·83	64·54	66·83	62·22	68·34	64·50	69·50	C = 27° 52′ 4″·89

NOTE.—R. M. denotes Referring Mark.

At XXIII (Walwári)—(*Continued*).

Angle between	Circle readings, telescope being set on R. M.												M = Mean of Groups w = Relative Weight C = Concluded Angle
	140° 1′	320° 0′	150° 0′	330° 0′	160° 0′	340° 0′	170° 0′	350° 0′	180° 0′	0° 0′	190° 0′	10° 0′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXI & XXIV	h 14·33 h 14·34	d 24·33 d 20·00 d 20·99	d 21·00 d 17·34 d 16·66	d 24·34 d 23·67	d 18·99 d 20·32	d 20·33 d 20·67	h 17·33 h 17·00 d 21·11	d 15·83 d 16·50	h 19·00 d 20·34 d 22·34 d 18·67	d 19·00 d 18·33	h 21·00 d 23·17	h 13·67 d 16·00	$M = 19''·08$ $w = 1·32$ $\frac{1}{w} = 0·76$
	14·34	21·77	18·33	24·00	19·66	20·50	18·48	16·16	20·09	18·67	22·08	14·84	$C = 40° 19' 19''·08$
XXIV & XXVI	h 31·34 h 27·00	h 26·67 h 20·67 h 19·67	h 32·00 h 32·33	h 19·00 h 22·00	h 24·66 h 22·33	h 23·34 h 22·34	h 27·00 h 26·33	h 24·00 h 28·33	h 27·67 h 25·67	h 22·66 h 15·66	h 18·33 h 18·33	h 26·33 d 24·66	$M = 24''·42$ $w = 0·61$ $\frac{1}{w} = 1·64$
	29·17	22·34	32·17	20·50	23·49	22·84	26·67	26·16	26·67	19·16	18·33	25·50	$C = 57° 45' 24''·39$
XXVI & XXVII	h 51·33 d 48·33	h 56·00 h 57·00 h 57·33	h 47·00 h 45·00	h 58·34 h 55·34	h 51·00 d 58·17	h 55·00 h 54·00	d 50·00 d 50·67	h 53·00 d 53·00	h 51·00 d 54·67	d 57·45 d 57·79	h 54·00 h 58·34	h 51·67 d 50·00	$M = 53''·28$ $w = 0·85$ $\frac{1}{w} = 1·18$
	49·83	56·78	46·00	56·84	54·59	54·50	50·33	53·00	52·84	57·62	56·17	50·83	$C = 60° 44' 53''·32$
XXVII & XXV	h 66·33 d 63·33	h 55·66 h 59·33 h 57·33	h 64·66 h 64·67	d 56·33 d 59·33	h 63·00 h 63·34	h 63·33 h 65·33	h 66·00 d 64·65	d 65·67 d 66·66	h 66·66 h 64·00	d 70·22 d 68·88	h 64·66 h 64·33	d 66·66 d 67·50 d 68·50	$M = 64''·22$ $w = 0·96$ $\frac{1}{w} = 1·04$
	64·83	57·44	64·67	57·83	63·17	64·33	65·32	66·17	65·33	69·55	64·49	67·55	$C = 87° 7' 4''·22$
XXV & XXII	d 29·33 d 31·66	d 23·83 d 29·50	d 28·67 d 30·34	h 26·67 h 25·33	h 31·66 h 34·33 h 28·00	h 26·00 h 28·33	h 29·00 d 28·78	h 23·66 h 22·67	h 28·00 h 32·00 h 27·67	h 24·67 h 26·00	h 27·00 h 26·00 h 28·67	h 26·67 d 25·83 d 24·83	$M = 27''·56$ $w = 1·84$ $\frac{1}{w} = 0·54$
	30·50	26·66	29·51	26·00	31·33	27·16	28·89	23·17	29·22	25·33	27·22	25·78	$C = 71° 27' 27''·58$
XXII & R.M.	h 47·00 h 44·67	h 47·33 h 47·00	h 50·00 h 48·33	h 45·66 h 47·67	h 45·34 h 41·00 h 45·00 h 50·66 h 43·33	h 42·34 h 44·00	h 44·33 h 48·67 h 45·66	h 42·34 h 45·00 h 47·33 h 46·66	h 41·67 h 44·33	h 47·00 h 44·66 h 44·67	h 48·33 h 44·33	h 45·34 h 47·00	$M = 45''·80$ $w = 2·93$ $\frac{1}{w} = 0·34$
	45·84	47·16	49·17	46·66	45·07	43·17	46·22	45·33	43·00	45·44	46·33	46·17	$C = 14° 43' 45''·78$

At XXIV (Dhanwár)

November and December 1846; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXVI 200° 31′	20° 31′	210° 31′	30° 31′	220° 31′	40° 31′	230° 31′	50° 31′	240° 31′	60° 31′	250° 31′	70° 31′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVI & XXIII	″ h 55·67 h 54·33	″ h 53·67 h 52·34 h 50·33	″ h 61·00 h 58·34	″ h 49·67 h 49·66	″ h 60·33 h 61·33 h 56·33 h 59·33	″ h 51·66 h 48·00 h 49·67	″ h 58·34 h 56·00	″ h 51·67 h 50·67 h 51·67	″ h 55·33 h 56·00	″ h 56·34 h 54·34	″ h 48·66 h 48·66	″ h 57·00 h 52·67 d 55·67	M = 54″·07 w = 0·84 1/w = 1·19
	55·00	52·11	59·67	49·67	59·33	49·78	57·17	51·34	55·66	55·34	48·66	55·11	C = 58° 39′ 54″·07
XXIII & XXII	d 27·58 d 27·25	d 29·80 d 28·80 d 29·80	d 25·17 d 25·49	d 36·33 d 35·67	h 15·00 h 22·67 h 29·00 h 31·33 d 24·75	h 39·66 h 33·00 d 33·50	d 25·00 d 25·67	d 30·11 d 31·12	h 29·67 h 27·00	h 32·00 h 33·00	h 33·67 h 35·00	h 29·34 h 32·33 d 31·67	M = 30″·03 w = 0·61 1/w = 1·64
	27·42	29·47	25·33	36·00	24·55	35·39	25·33	30·62	28·33	32·50	34·34	31·11	C = 59° 31′ 29″·94
XXII & XXI	h 58·67 h 56·67 h 53·33 h 54·33	h 54·34 h 50·00 h 54·33 h 56·66 h 55·66	h 57·66 h 57·34	h 50·00 h 52·00 h 49·00	h 67·00 h 61·66 h 59·34 h 61·00 d 62·50	h 50·67 h 55·66 d 50·34	h 60·33 h 63·67 h 60·00	h 52·67 h 51·66	h 61·33 h 64·66	h 54·00 h 55·00	h 60·00 h 58·00	h 59·33 h 57·00 d 59·00	M = 56″·73 w = 0·60 1/w = 1·67
	55·75	54·20	57·50	50·33	62·30	52·22	61·33	52·17	62·99	54·50	59·00	58·44	C = 41° 17′ 56″·73

At XXV (Anakwári)

* *December* 1846; *and* † *January* 1847; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXII 296° 21′	116° 20′	306° 20′	126° 20′	316° 20′	136° 21′	326° 19′	146° 19′	336° 20′	156° 20′	346° 21′	166° 21′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† XXII & XXIII	″ h 55·67 h 56·00	″ h 55·33 h 55·66	″ h 54·67 h 54·67	″ h 56·34 h 53·67	″ h 57·34 h 54·67	″ h 56·66 h 56·00	″ h 65·33 h 65·00	″ h 57·00 h 55·67	″ h 67·67 h 67·67	″ h 58·00 h 54·67 h 59·00	″ h 65·67 h 63·66	″ h 51·33 h 55·00 h 53·00	M = 58″·13 w = 0·48 1/w = 2·08
	55·84	55·49	54·67	55·01	56·00	56·33	65·17	56·33	67·67	57·22	64·67	53·11	C = 63° 39′ 58″·13
	Circle readings, telescope being set on XXIII 317° 21′	137° 21′	327° 22′	147° 22′	337° 22′	157° 22′	347° 22′	167° 22′	357° 22′	177° 21′	7° 22′	187° 22′	
* XXIII & XXVII	″ h 38·00 h 40·00 h 37·66	″ h 40·33 h 39·67	″ h 42·00 h 39·33	″ h 39·00 h 35·66 h 35·67 h 35·00	″ h 39·00 h 40·67	″ h 40·33 h 40·67	″ h 42·33 h 41·33	″ h 38·66 h 37·34	″ h 48·34 h 46·33	″ h 39·67 h 41·33	″ h 43·33 h 41·67	″ h 41·00 h 43·00 h 42·00	M = 40″·67 w = 1·56 1/w = 0·64
	38·55	40·00	40·67	36·33	39·83	40·50	41·83	38·00	47·34	40·50	42·50	42·00	C = 42° 38′ 40″·67

At XXVI (Sirsála)

‡ *January;* and § *November* 1846; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXIX								M = Mean of Groups w = Relative Weight C = Concluded Angle
	333° 17′	153° 17′	348° 17′	168° 17′	3° 17′	183° 17′	18° 16′	198° 16′	
‡. XXIX & XXVIII	″ h 30·34 h 29·66 h 33·00 h 31·66	″ h 28·66 h 21·67 h 21·66 h 18·66	″ h 32·33 h 31·00	″ h 25·00 h 24·66 h 24·33	″ h 28·34 h 31·00	″ h 29·34 h 28·66	″ h 22·66 h 25·66 h 27·34	″ h 25·67 h 28·67 h 28·34	$M = 27''\cdot70$ $w = 0\cdot66$ $\frac{1}{w} = 1\cdot52$ $C = 41^\circ 43' 27''\cdot68$
	31·17	22·66	31·66	24·66	29·67	29·00	25·22	27·56	
‡ XXVIII & XXVII	h 40·00 h 41·33 h 44·00 h 41·34	h 48·33 h 50·00 h 49·34	h 39·67 h 39·33	h 52·00 h 45·67 h 52·00	h 40·34 h 48·00 h 44·67 h 45·00	h 51·00 h 49·67 h 56·00 h 50·34	h 47·67 h 45·00 h 44·00	h 44·67 h 45·00	$M = 45''\cdot87$ $w = 0\cdot40$ $\frac{1}{w} = 2\cdot50$ $C = 60^\circ 41' 45''\cdot87$
	41·67	49·22	39·50	49·89	44·50	51·75	45·56	44·84	

Angle between	Circle readings, telescope being set on XXVII												
	59° 0′	238° 59′	69° 0′	249° 0′	79° 0′	259° 0′	89° 0′	269° 0′	99° 0′	278° 59′	109° 0′	288° 59′	
§ XXVII & XXIII	″ h 13·67 h 14·33 h 20·66	″ h 17·33 h 21·33 h 16·00 h 20·34	″ h 23·33 h 13·33 h 16·66 h 16·67	″ h 6·66 h 10·67 h 9·34	″ h 15·66 h 14·34	″ h 10·00 h 10·00 h 8·00	″ h 16·66 h 18·67 h 19·67	″ h 12·33 h 7·67 h 7·67	″ h 19·67 h 14·00 h 14·67	″ h 9·34 h 8·67	″ h 18·00 h 13·66 h 14·67	″ h 6·33 h 7·34 h 10·33 h 8·66	$M = 13''\cdot50$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$ $C = 61^\circ 0' 13''\cdot50$
	16·22	18·75	17·50	8·89	15·00	9·33	18·33	9·22	16·11	9·01	15·44	8·16	
§ XXIII & XXIV	h 46·33 h 41·67 h 53·00 h 45·67 h 47·34	h 50·67 h 41·67 h 49·67 h 48·66	h 46·00 h 41·34 h 46·00 h 48·00 h 47·67 h 46·33	h 55·34 h 55·00	h 43·67 h 47·33 h 46·34	h 56·00 h 52·00 h 53·66	h 42·00 h 46·00 h 44·66	h 51·33 h 53·33 h 52·66	h 37·67 h 37·00	h 46·33 h 47·33	h 37·00 h 38·34	h 50·34 h 46·00 h 44·00 h 48·34	$M = 46''\cdot74$ $w = 0\cdot36$ $\frac{1}{w} = 2\cdot78$ $C = 63^\circ 34' 46''\cdot74$
	46·80	47·67	45·89	55·17	45·78	53·89	44·22	52·44	37·34	46·83	37·67	47·17	

At XXVII (Sátmála)

‖ *February;* and ¶ *December* 1846; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 1′	190° 1′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	49° 59′	230° 0′	
¶ XXV & XXIII	″ h 21·67 h 21·00 h 24·33	″ h 26·67 h 25·33 h 23·67 h 23·00 h 21·34	″ h 19·34 h 20·00	″ h 25·33 h 23·33 h 22·67	″ h 18·67 h 21·00 h 18·33	″ h 25·00 h 25·00	″ h 25·00 h 22·34	″ h 29·00 h 30·34 d 27·50	″ h 19·67 h 18·67 h 19·00	″ h 28·67 h 29·33	″ h 21·67 h 22·00	″ h 30·00 h 30·34	$M = 23''\cdot90$ $w = 0\cdot84$ $\frac{1}{w} = 1\cdot19$ $C = 50^\circ 14' 23''\cdot90$
	22·33	24·00	19·67	23·78	19·33	25·00	23·67	28·95	19·11	29·00	21·84	30·17	

At XXVII (Sátmála)—(*Continued*).

Angle between	Circle readings, telescope being set on XXV 0° 0′	180° 0′	10° 1′	190° 1′	20° 0′	200° 0′	30° 0′	210° 0′	40° 0′	220° 0′	49° 59′	230° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
¶ XXIII & XXVI	″ *h* 56·33 *d* 61·01 *d* 58·00	″ *h* 63·00 *h* 63·00 *d* 58·66 *d* 65·67	″ *h* 60·00 *h* 59·00	″ *h* 54·67 *h* 58·00 *h* 60·33	″ *h* 60·33 *h* 57·66 *h* 57·67	″ *h* 51·67 *h* 54·00	″ *h* 55·67 *h* 56·33	″ *h* 57·33 *h* 54·33 *d* 53·66	″ *h* 62·00 *h* 59·33 *h* 61·34	″ *h* 51·67 *h* 52·00	″ *h* 55·33 *h* 56·67	″ *h* 50·66 *h* 49·66	$M = 56''\cdot63$ $w = 0\cdot84$ $\frac{1}{w} = 1\cdot19$ $C = 58^\circ\ 14'\ 56''\cdot63$
	58·45	62·58	59·50	57·67	58·55	52·84	56·00	55·11	60·89	51·83	56·00	50·16	

Angle between	Circle readings, telescope being set on XXVI 10° 53′	190° 53′	25° 52′	205° 52′	40° 52′	220° 52′	55° 52′	235° 52′	
‖ XXVI & XXVIII	″ *h* 53·00 *h* 50·00 *h* 50·66	″ *h* 56·33 *h* 56·67	″ *h* 47·00 *h* 51·33 *h* 50·67	″ *h* 57·66 *h* 58·67	″ *h* 50·66 *h* 51·33 *d* 48·66	″ *h* 58·00 *h* 57·67 *h* 56·00	″ *h* 53·67 *h* 51·66 *h* 53·67	″ *h* 54·00 *h* 52·33	$M = 53''\cdot65$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$ $C = 65^\circ\ 50'\ 53''\cdot65$
	51·22	56·50	49·67	58·17	50·22	57·22	53·00	53·16	
‖ XXVIII & XXX	*h* 30·67 *h* 31·33 *h* 31·34	*h* 30·33 *h* 30·33	*h* 38·00 *h* 39·00 *h* 35·33	*h* 28·34 *h* 28·66	*h* 38·00 *h* 40·67 *d* 37·00	*h* 25·66 *h* 30·00 *h* 28·34	*h* 36·33 *h* 34·00 *h* 37·33	*h* 36·34 *h* 36·00	$M = 33''\cdot25$ $w = 0\cdot40$ $\frac{1}{w} = 2\cdot50$ $C = 43^\circ\ 16'\ 33''\cdot25$
	31·11	30·33	37·44	28·50	38·56	28·00	35·89	36·17	

At XXVIII (Pophla)

January 1846; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXVII 0° 0′	180° 0′	15° 0′	195° 1′	30° 0′	210° 0′	45° 0′	225° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVII & XXVI	″ *h* 29·00 *h* 27·34 *h* 27·66	″ *h* 22·33 *h* 25·67	″ *h* 26·34 *h* 21·66	″ *h* 27·67 *h* 26·00	″ *h* 27·33 *h* 25·00 *h* 26·00	″ *h* 31·67 *h* 32·66	″ *h* 27·34 *h* 26·00	″ *h* 28·67 *h* 28·00 *h* 28·67 *d* 29·49 *d* 30·16	$M = 27''\cdot10$ $w = 1\cdot04$ $\frac{1}{w} = 0\cdot96$ $C = 53^\circ\ 27'\ 27''\cdot10$
	28·00	24·00	24·00	26·84	26·11	32·16	26·67	29·00	
XXVI & XXIX	*h* 64·67 *h* 64·00 *h* 59·34	*h* 62·67 *h* 62·33 *h* 61·00	*h* 65·33 *h* 65·00	*h* 60·00 *d* 56·33	*h* 64·00 *h* 64·67	*d* 60·66 *d* 59·67	*h* 59·66 *d* 62·33 *d* 60·99	*h* 55·67 *h* 58·66 *d* 58·21 *d* 58·88	$M = 61''\cdot42$ $w = 1\cdot04$ $\frac{1}{w} = 0\cdot96$ $C = 80^\circ\ 23'\ 1''\cdot42$
	62·67	62·00	65·17	58·16	64·34	60·16	60·99	57·86	

At XXVIII (Pophla)—(*Continued*).

Angle between	Circle readings, telescope being set on XXVII 0° 0′	180° 0′	15° 0′	195° 1′	30° 0′	210° 0′	45° 0′	225° 0′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XXIX & XXXI	″ *h* 43·00 *h* 50·66 *h* 48·67	″ *h* 48·33 *h* 50·33	″ *h* 41·66 *h* 43·00	″ *h* 55·33 *d* 51·66	″ *h* 43·33 *h* 42·33 *h* 42·00	″ *h* 48·00 *h* 50·00	″ *h* 47·00 *h* 50·00	″ *h* 46·33 *h* 47·33 *h* 48·67 *h* 50·00	$M = 47''\cdot59$ $w = 0\cdot56$ $\frac{1}{w} = 1\cdot79$
	47·44	49·33	42·33	53·50	42·55	49·00	48·50	48·08	$C = 67° 22' 47''\cdot59$
XXXI & XXX	*h* 38·66 *h* 36·34 *h* 38·00	*h* 38·67 *h* 36·67	*h* 41·34 *h* 43·67 *h* 43·67	*d* 42·67 *d* 42·66	*h* 39·67 *h* 41·00	*h* 44·34 *h* 44·67	*h* 39·00 *h* 37·33	*h* 45·33 *h* 46·34 *h* 45·66	$M = 41''\cdot21$ $w = 0\cdot75$ $\frac{1}{w} = 1\cdot33$
	37·67	37·67	42·89	42·67	40·33	44·51	38·16	45·78	$C = 104° 36' 41''\cdot25$
XXX & XXVII	*h* 64·33 *h* 66·66 *h* 66·00	*h* 63·33 *h* 63·00 *h* 66·33	*h* 66·00 *h* 61·66 *h* 59·33	*h* 56·33 *h* 56·34	*h* 65·67 *h* 66·00	*h* 56·33 *h* 54·66	*h* 64·67 *h* 63·00 *h* 65·34	*h* 58·34 *h* 59·00 *h* 55·34	$M = 61''\cdot47$ $w = 0\cdot40$ $\frac{1}{w} = 2\cdot50$
	65·66	64·22	62·33	56·34	65·83	55·50	64·34	57·56	$C = 54° 10' 1''\cdot47$

At XXIX (Rájur)

**November* 1862; *observed by Captain C. T. Haig, R.E., with Barrow's* 24-*inch Theodolite No.* 2.
†*January* 1846; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXII 0° 0′	180° 1′	43° 13′	223° 13′	86° 24′	266° 24′	129° 37′	309° 37′	172° 48′	352° 48′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
* XXXII & XXXI	″ *l* 13·34 *l* 13·68	″ *l* 10·14 *l* 11·02	″ *l* 11·68 *l* 11·54	″ *l* 12·34 *l* 13·02	″ *l* 12·52 *l* 12·08	″ *l* 14·00 *l* 12·88	″ *l* 11·52 *l* 12·64	″ *l* 13·44 *l* 11·68	″ *l* 9·50 *l* 7·98	″ *l* 10·10 *l* 11·30	$M = 11''\cdot82$ $w = 4\cdot30$ $\frac{1}{w} = 0\cdot23$
	13·51	10·58	11·61	12·68	12·30	13·44	12·08	12·56	8·74	10·70	$C = 47° 39' 11''\cdot82$

Angle between	Circle readings, telescope being set on XXXI 286° 8′	106° 8′	301° 8′	121° 9′	316° 8′	136° 8′	331° 7′	151° 8′	
† XXXI & XXVIII	″ *h* 22·34 *h* 23·00	″ *h* 29·66	″ *h* 26·67 *h* 28·34	″ *h* 32·33 *h* 31·33 *h* 28·66	″ *h* 35·33 *d* 33·44 *d* 35·11	″ *h* 27·33 *h* 27·00 *d* 29·58	″ *h* 32·33 *h* 33·67 *h* 35·33 *h* 35·00	″ *h* 22·34 *h* 25·00 *h* 24·67	$M = 28''\cdot91$ $w = 0\cdot40$ $\frac{1}{w} = 2\cdot50$
	22·67	29·66	27·51	30·77	34·63	27·97	34·08	24·00	$C = 60° 58' 28''\cdot91$

At XXIX (Rájur)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXI: 286° 8′	106° 8′	301° 8′	121° 9′	316° 8′	136° 8′	331° 7′	151° 8′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† XXVIII & XXVI	″ h 38·33 h 38·34	″ h 30·67 h 30·66	″ h 33·66 h 33·33	″ h 30·67 h 32·33	″ h 30·67 h 30·66 h 29·34	″ h 34·67 h 33·33 h 38·33 h 35·34	″ h 31·00 h 26·66 h 30·33	″ h 41·00 h 40·00 h 40·66	$M = 33''\cdot69$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$ $C = 57^\circ 53' 33''\cdot69$
	38·34	30·66	33·50	31·50	30·22	35·42	29·33	40·55	

At XXX (Yerúl)

January 1846; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXVII: 277° 27′	97° 26′	292° 26′	112° 26′	307° 26′	127° 26′	322° 26′	142° 26′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVII & XXVIII	″ h 25·67 h 20·33 h 22·34	″ h 18·33 h 25·67 h 27·34	″ h 21·00 h 25·66 h 23·67	″ h 22·00 h 22·00 h 25·33	″ h 31·00 h 37·34 h 32·33	″ h 26·67 h 22·67 h 19·00 h 24·67	″ h 25·66 h 29·00	″ h 23·66 h 19·67 h 21·00 h 18·67	$M = 24''\cdot75$ $w = 0\cdot47$ $\frac{1}{w} = 2\cdot13$ $C = 82^\circ 33' 24''\cdot70$
	22·78	23·78	23·44	23·11	33·56	23·25	27·33	20·75	
XXVIII & XXXI	h 26·67 h 27·67 d 28·34	h 31·67 h 24·34 h 25·33 d 26·34 d 28·67	h 36·00 h 31·00 h 34·34 d 31·83	h 35·67 h 35·00 d 37·00	h 31·33 h 37·66 h 37·66 h 32·67	h 35·33 h 42·00 h 38·00 h 43·00 d 39·91	h 30·66 h 30·33 h 33·34 h 29·33	h 33·00 h 34·33	$M = 32''\cdot88$ $w = 0\cdot40$ $\frac{1}{w} = 2\cdot50$ $C = 43^\circ 52' 32''\cdot88$
	27·56	27·27	33·29	35·89	34·83	39·65	30·92	33·66	
XXXI & XXXIV	h 39·33 d 41·16 d 39·83	h 43·33 h 41·00 d 38·00 d 45·33 d 44·34	h 32·33 h 34·67 d 31·55	h 35·66 h 34·33 d 36·66	h 27·67 h 32·00 h 28·34 h 32·00	h 30·67 h 28·66 h 27·00 h 28·67 d 29·08	h 42·67 h 41·00 h 36·00 h 42·33	h 31·34 h 29·00	$M = 35''\cdot05$ $w = 0\cdot24$ $\frac{1}{w} = 4\cdot17$ $C = 50^\circ 56' 35''\cdot05$
	40·11	42·40	32·85	35·55	30·00	28·82	40·50	30·17	

At XXXI (Jámkhed)

**December 1845 and January 1846; observed by Lieutenant H. Rivers with Dollond's 15-inch Theodolite.*
†November 1862; observed by Captain C. T. Haig, R.E., with Barrow's 24-inch Theodolite No. 2.

Angle between	Circle readings, telescope being set on XXXIII 255° 34′	75° 34′	270° 34′	90° 34′	285° 34′	105° 34′	300° 33′	120° 34′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XXXIII & XXXIV	″ h 58·00 h 55·33	″ h 58·33 h 59·67 d 59·83	″ h 55·00 h 55·67 h 57·66 h 54·66	″ h 63·00 h 64·33	″ h 55·34 d 56·16	″ h 62·33 h 60·00 h 60·34 d 63·55	″ h 54·34 h 58·67	″ h 57·00 h 59·66 h 59·66 d 59·88	$M = 58''\cdot53$ $w = 0\cdot88$ $\frac{1}{w} = 1\cdot14$
	56·67	59·28	55·75	63·66	55·75	61·56	56·50	59·05	$C = 50° 46' 58''\cdot53$
* XXXIV & XXX	h 21·67 h 23·00	h 22·67 h 22·33 d 23·33	h 22·34 h 23·67 h 19·67 h 24·34 h 20·67	h 17·33 h 19·34	h 26·00 h 25·67	h 18·67 h 19·33 h 18·33 d 21·44	h 26·00 h 24·33	h 22·34 h 19·67 h 20·34 d 21·89	$M = 22''\cdot14$ $w = 1\cdot13$ $\frac{1}{w} = 0\cdot88$
	22·34	22·78	22·14	18·33	25·84	19·44	25·16	21·06	$C = 53° 39' 22''\cdot14$
* XXX & XXVIII	h 51·00 h 50·34	h 45·00 h 43·67 h 45·00	h 52·66 h 53·66	h 44·00 h 43·66	h 43·67 h 44·33 h 43·67	h 44·34 h 47·00 h 53·34 h 47·00 h 47·00	h 48·00 h 46·67 h 49·67	h 52·33 h 53·67 h 49·00 h 47·00	$M = 47''\cdot81$ $w = 0\cdot58$ $\frac{1}{w} = 1\cdot72$
	50·67	44·56	53·16	43·83	43·89	47·74	48·11	50·50	$C = 31° 30' 47''\cdot86$
* XXVIII & XXIX	h 44·33 h 45·33 h 45·33	h 57·33 h 58·00	d 40·17 d 41·18	d 57·78 d 58·12	d 48·44 d 47·78 d 48·44	d 52·93 d 52·27	d 40·22 d 40·22	d 37·50 d 40·17	$M = 47''\cdot65$ $w = 0\cdot16$ $\frac{1}{w} = 6\cdot25$
	45·00	57·67	40·67	57·95	48·22	52·60	40·22	38·84	$C = 51° 38' 47''\cdot65$

Angle between	Circle readings, telescope being set on XXIX 187° 36′	7° 37′	230° 49′	50° 49′	274° 0′	94° 1′	317° 12′	137° 12′	0° 24′	180° 24′	
† XXIX & XXXII	″ l 37·34 l 35·36	″ l 32·32 l 32·84	″ l 34·12 l 33·90	″ h 30·84 h 32·30	″ l 33·06 l 32·04	″ l 33·20 l 34·22	″ l 32·54 l 32·74	″ l 36·44 l 35·06	″ l 34·26 l 34·16	″ l 37·96 l 37·04	$M = 34''\cdot09$ $w = 2\cdot60$ $\frac{1}{w} = 0\cdot38$
	36·35	32·58	34·01	31·57	32·55	33·71	32·64	35·75	34·21	37·50	$C = 81° 45' 34''\cdot09$
† XXXII & XXXIII	h 21·74 h 21·22	h 21·62 h 22·40	h 20·14 l 21·22	h 21·56 h 21·40	l 19·94 l 19·74	l 19·98 l 19·34	l 21·54 l 22·24	l 22·90 l 21·40	l 22·28 l 23·08	l 22·20 l 22·22	$M = 21''\cdot41$ $w = 8\cdot80$ $\frac{1}{w} = 0\cdot11$
	21·48	22·01	20·68	21·48	19·84	19·66	21·89	22·15	22·68	22·21	$C = 90° 38' 21''\cdot41$

At XXXII (Áhirmal)

December 1862; *observed by Captain C. T. Haig, R.E., with Barrow's* 24-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXIII 0° 0′	180° 0′	43° 13′	223° 13′	86° 24′	266° 24′	129° 36′	309° 36′	172° 48′	352° 48′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXIII & XXXI	″ h 24·18 h 24·66	″ h 24·80 h 25·60	″ l 26·72 l 26·62	″ h 25·56 h 26·28	″ l 28·06 l 28·28	″ l 29·54 l 28·36	″ l 27·34 l 27·58	″ l 26·62 l 25·62	″ h 24·24 h 25·10	″ h 25·40 h 23·96	M = 26″·23 w = 3 ·90 $\frac{1}{w}$ = 0 ·26 C = 51° 39′ 26″·23
	24·42	25·20	26·67	25·92	28·17	28·95	27·46	26·12	24·67	24·68	
XXXI & XXIX	h 18·40 h 18·36	h 19·68 h 19·80	l 16·88 l 16·68	h 20·00 h 19·76	l 20·62 l 18·68	l 15·90 l 16·94	l 18·20 l 18·18	l 19·86 l 21·40	h 21·54 h 21·42	h 22·80 h 22·64	M = 19″·39 w = 2 ·50 $\frac{1}{w}$ = 0 ·40 C = 50° 35′ 19″·39
	18·38	19·74	16·78	19·88	19·65	16·42	18·19	20·63	21·48	22·72	

At XXXIII (Mathuri)

December 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXIII 309° 11′	129° 11′	324° 11′	144° 11′	339° 10′	159° 11′	354° 11′	174° 11′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIII & XXIV	″ h 44·33 h 47·33 h 43·33	″ h 45·66 h 45·34 h 43·67 h 44·00	″ h 40·00 h 41·33 h 41·00	″ h 36·66 h 33·66 h 34·33	″ h 46·33 h 46·00	″ h 34·33 h 38·67 h 36·67	″ h 49 67 h 48·66 h 44·34 h 45·67	″ h 43·33 h 44·34	M = 42″·37 w = 0 ·40 $\frac{1}{w}$ = 2 ·50 C = 50° 49′ 42″·37
	45·00	44·67	40·78	34·88	46·17	36·56	47·08	43·84	
XXIV & XXXIV	h 62·00 h 59·67 h 61·67	h 52·67 h 52·00 h 57·00 h 54·00	h 58·66 h 58·34 d 60·00 d 58·01	h 59·00 h 63·00 h 62·00	h 56·67 h 56·33	h 66·33 h 60·33 h 62·00	h 53·33 h 55·67 h 53·66	h 62·00 h 61·66	M = 58″·82 w = 0 ·62 $\frac{1}{w}$ = 1 ·61 C = 51° 33′ 58″·81
	61·11	53·92	58·75	61·33	56·50	62·89	54·22	61·83	
XXXIV & XXXI	h 29·00 h 29·00 h 29·00	h 38·67 h 36·66 h 37 33 h 37·33	h 30·67 h 32·66 d 32·01 d 32·33	h 34·00 h 37·00 h 37·00	h 34·00 h 34·34	h 30·67 h 32·00 h 31·33	h 35·33 h 34·00 h 36·34	h 26·67 h 26·00	M = 32″·69 w = 0 ·56 $\frac{1}{w}$ = 1 ·79 C = 55° 56′ 32″·69
	29·00	37·50	31·92	36·00	34·17	31·33	35·22	26·34	

Note.—Stations XXIII and XXIV appertain to the Bombay Longitudinal Series.

At XXXIII (Mathuri)—(*Continued*).

November 1862; *observed by Captain C. T. Haig, R.E., with Barrow's* 24-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXI										M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 1′	43° 13′	223° 13′	86° 24′	266° 24′	129° 37′	309° 37′	172° 48′	352° 48′	
XXXI & XXXII	″ h 16·90 h 18·32	″ h 18·96 h 17·52	″ h 18·58 h 19·82	″ h 21·62 h 21·04	″ h 19·12 h 19·46	″ h 18·92 h 19·62	″ l 21·10 l 21·04	″ l 19·62 l 19·82	″ l 19·34 l 19·30	″ l 17·44 l 18·30	$M = 19''\cdot29$ $w = 6\cdot30$ $\frac{1}{w} = 0\cdot16$
	17·61	18·24	19·20	21·33	19·29	19·27	21·07	19·72	19·32	17·87	$C = 37° 42' 19''\cdot29$

At XXXIV (Dhaigaon).

December 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXX								M = Mean of Groups w = Relative Weight C = Concluded Angle
	128° 28′	308° 28′	143° 28′	323° 28′	158° 28′	338° 28′	173° 28′	353° 28′	
XXX & XXXI	″ h 10·00 h 13·66 h 5·67	″ h 13·66 h 17·33 h 15·66	″ h 9·00 h 3·34 h 4·00 d 4·55	″ h 11·34 h 13·34	″ h 10·00 h 7·67	″ h 14·66 h 11·33 h 15·33	″ h 10·00 d 12·49 d 9·83	″ h 12·33 h 11·67 d 9·33 d 11·00	$M = 10''\cdot92$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$
	9·78	15·55	5·22	12·34	8·84	13·77	10·77	11·08	$C = 75° 24' 10''\cdot92$
XXXI & XXXIII	h 36·33 h 34·00 h 38·33 d 34·77	h 30·34 h 28·00 h 28·34	h 39·66 h 39·33 h 34·67 d 36·99	h 32·00 h 29·66	h 28·33 h 28·66	h 26·67 h 30·33 h 28·67	h 34·66 h 35·67	h 33·34 h 35·00 d 31·50 d 33·17	$M = 32''\cdot34$ $w = 0\cdot56$ $\frac{1}{w} = 1\cdot79$
	35·86	28·89	37·66	30·83	28·50	28·56	35·16	33·25	$C = 73° 16' 32''\cdot34$
XXXIII & XXIII	h 36·67 h 39·34 h 39·00 d 36·89	h 48·00 h 45·67 h 47·33	h 42·34 h 46·00 h 46·67 d 44·10	h 50·66 h 50·67	h 50·67 h 51·34	h 52·33 h 52·00 h 51·66	h 41·67 h 39·66	h 47·66 h 44·00 d 43·16 d 44·83	$M = 46''\cdot13$ $w = 0\cdot32$ $\frac{1}{w} = 3\cdot13$
	37·98	47·00	44·78	50·66	51·01	52·00	40·66	44·91	$C = 32° 50' 46''\cdot13$
XXIII & XXIV	h 43·33 h 40·33 h 41·00 d 40·10	h 36·00 h 41·00 h 40·00	h 41·66 h 41·00 h 41·00 d 40·32	h 29·34 h 31·67	h 42·33 h 41·66	h 35·67 h 33·34 h 33·67	h 45·67 h 43·00 h 43·67 h 44·67	h 43·33 h 43·33 h 39·00 h 39·67 h 41·33	$M = 39''\cdot19$ $w = 0\cdot40$ $\frac{1}{w} = 2\cdot50$
	41·19	39·00	41·00	30·50	42·00	34·23	44·25	41·33	$C = 50° 0' 39''\cdot19$

NOTE.—Stations XXIII and XXIV appertain to the Bombay Longitudinal Series.

At XXIII (Chincholi)

November 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXIV: 120° 0′	300° 0′	140° 0′	320° 0′	160° 0′	340° 0′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	
XXIV & XXXIV	h 37·67 h 41·00 h 39·66 h 41·33	h 38·00 h 38·34 d 37·17	h 34·67 h 32·33	h 39·67 h 39·33 h 36·33	h 31·00 h 35·00 h 34·00	h 37·67 h 39·33 h 38·00	$M = 36''\cdot89$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$ $C = 50^\circ 55' 36''\cdot89$
	39·92	37·84	33·50	38·44	33·33	38·33	
XXXIV & XXXIII	h 35·67 d 37·42	h 42·00 h 43·00	h 41·33 h 42·33	h 37·33 h 37·33 h 38·00	h 44·00 h 44·00 h 42·00	h 36·66 h 33·67 h 38·67	$M = 39''\cdot68$ $w = 0\cdot54$ $\frac{1}{w} = 1\cdot85$ $C = 44^\circ 45' 39''\cdot68$
	36·55	42·50	41·83	37·55	43·33	36·33	

At XXIV (Ágargaon)

November 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXIV: 263° 13′	83° 13′	278° 12′	98° 12′	293° 12′	113° 12′	308° 12′	128° 12′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	
XXXIV & XXXIII	h 38·00 h 35·34 h 39·00	h 42·34 h 44·67 h 39·67 h 44·33	h 36·00 h 36·00 h 36·00	h 50·67 h 49·67	h 40·67 h 38·00 h 45·00 d 45·45 d 40·45	h 49·33 h 46·67 h 47·00 d 47·39 d 47·45	h 36·00 h 40·00 h 37·33	h 41·33 h 41·66	$M = 41''\cdot89$ $w = 0\cdot32$ $\frac{1}{w} = 3\cdot13$ $C = 45^\circ 34' 41''\cdot89$
	37·45	42·75	36·00	50·17	41·91	47·57	37·78	41·50	
XXXIII & XXIII	h 64·00 h 62·66 h 65·00 h 66·34 h 64·34	h 58·66 h 67·33 h 67·66 h 63·00 h 64·67 h 65·00	h 63·00 h 61·00 h 61·34	h 62·67 h 59·33	h 65·67 h 68·00 h 65·00 d 70·45 d 65·45	h 60·00 h 64·00 h 59·67 d 60·95 d 61·00	h 73·33 h 71·33 h 72·00	h 65·00 h 64·67 h 64·34	$M = 64''\cdot57$ $w = 0\cdot55$ $\frac{1}{w} = 1\cdot82$ $C = 33^\circ 29' 4''\cdot63$
	64·47	64·39	61·78	61·00	66·91	61·12	72·22	64·67	

NOTE.—Stations XXIII and XXIV appertain to the Bombay Longitudinal Series.

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In charge of Computing Office.

KHANPISURA MERIDIONAL SERIES.

Sums of Squares of Apparent Errors of Single Observations, and of Apparent Errors of Single Zeros.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXI	I & II	26	137·55	12	190·43	Dollond's 15-inch.
„	II & XXIV	29	180·39	12	422·43	
XXIV	XXI & I	28	98·56	12	203·29	
„	I & II	25	22·83	12	126·27	
I	IV & III	31	56·89	12	273·80	
„	III & II	29	60·66	12	250·59	
„	II & XXIV	29	38·33	12	157·92	
„	XXIV & XXI	36	156·13	12	163·49	
II	XXIV & XXI	28	37·02	12	90·57	
„	XXI & I	28	50·76	12	206·36	
„	I & III	31	81·70	12	152·24	
„	III & VI	32	64·73	12	107·81	
III	VI & II	34	93·87	12	113·78	
„	II & I	43	205·56	12	183·79	
„	I & IV	26	53·19	12	297·87	
„	IV & V	39	147·34	12	165·10	
„	V & VI	33	148·15	12	383·35	
IV	V & III	38	70·07	12	236·34	

NOTE.—Stations XXI and XXIV appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	REMARKS.
IV	III & I	32	64·08	12	249·49	
V	VIII & VII	33	53·12	12	138·14	
"	VII & VI	31	58·00	12	130·64	
"	VI & III	31	31·35	12	211·61	
"	III & IV	28	42·69	12	221·54	
VI	II & III	40	128·12	12	156·50	
"	III & V	33	151·53	12	156·22	
"	V & VII	33	98·07	12	139·55	
"	VII & XI	26	93·16	12	105·83	
VII	V & VIII	24	27·50	12	73·61	
"	VIII & IX	25	38·94	12	122·18	
"	IX & XI	24	35·37	12	115·51	
"	XI & VI	24	39·47	12	118·21	
"	VI & V	24	23·76	12	98·18	
VIII	X & IX	28	18·77	12	229·20	
"	IX & VII	25	10·30	12	158·63	
"	VII & V	32	58·34	12	68·58	
IX	VIII & X	28	26·44	12	112·26	
"	X & XII	26	44·93	12	92·36	
"	XII & XIII	27	46·04	12	162·12	
"	XIII & XI	26	66·25	12	297·27	Dollond's 15-inch.
"	XI & VII	24	59·97	12	195·96	
"	VII & VIII	25	21·70	12	121·36	
X	XII & IX	26	46·10	12	285·57	
"	IX & VIII	33	116·21	12	103·22	
XI	VI & VII	27	30·10	12	169·68	
"	VII & IX	32	64·60	12	246·54	
"	IX & XIII	28	73·04	12	240·68	
XII	XV & XIV	31	60·90	12	70·02	
"	XIV & XIII	29	30·28	12	86·77	
"	XIII & IX	32	72·13	12	217·05	
"	IX & X	33	88·36	12	258·90	
XIII	XI & IX	27	72·47	12	312·80	
"	IX & XII	30	27·22	12	347·51	
"	R.M. & XII	33	87·37	12	102·17	
"	XII & XIV	35	67·97	12	152·12	
"	XIV & XVI	40	250·72	12	143·63	
XIV	XII & XV	31	92·70	12	246·88	
"	XV & XVII	28	72·00	12	194·54	
"	XVII & XVIII	26	36·58	12	174·46	
"	XVIII & XVI	25	45·74	12	296·06	

NOTE.—R.M. denotes Referring Mark.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks.
XIV	XVI & XIII	26	49·49	12	178·08	Dollond's 15-inch.
„	XIII & XII	31	82·93	12	90·85	
XV	XVII & XIV	26	21·61	12	251·41	
„	XIV & XII	27	20·35	12	194·45	
XVI	XIII & XIV	25	27·21	12	124·27	
„	XIV & XVIII	32	86·45	12	189·68	
XVII	XIX & XX	25	38·23	12	299·65	
„	XX & XVIII	27	83·81	12	136·58	
„	XVIII & XIV	31	98·74	12	109·49	
„	XIV & XV	31	72·73	12	131·71	
XVIII	XVI & XIV	30	44·84	12	94·13	
„	XIV & XVII	27	38·40	12	104·20	
„	XVII & XIX	28	61·86	12	187·39	
„	XIX & XX	26	24·51	12	223·22	
XIX	XXI & XXII	28	42·46	12	218·84	
„	XXII & XX	27	41·09	12	330·28	
„	XX & XVIII	28	45·21	12	418·51	
„	XVIII & XVII	28	23·22	12	290·95	
XX	XVIII & XVII	32	69·47	12	222·84	
„	XVII & XIX	32	101·56	12	233·35	
„	XIX & XXI	31	145·99	12	152·69	
„	XXI & XXII	29	125·70	12	196·20	
XXI	XXIV & XXIII	32	38·37	12	139·55	
„	XXIII & XXII	32	35·23	12	190·78	
„	XXII & XX	30	60·85	12	92·58	
„	XX & XIX	25	41·73	12	138·73	
XXII	XX & XIX	33	56·18	12	178·99	
„	XIX & XXI	31	45·70	12	121·88	
„	XXI & XXIV	30	43·98	12	167·60	
„	XXIV & XXIII	28	36·22	12	78·92	
„	XXIII & XXV	24	35·33	12	203·76	
XXIII	R.M. & XXI	29	49·68	12	101·06	
„	XXI & XXIV	29	46·67	12	93·90	
„	XXIV & XXVI	25	83·38	12	184·76	
„	XXVI & XXVII	25	56·02	12	135·19	
„	XXVII & XXV	26	25·40	12	134·29	
„	XXV & XXII	28	62·37	12	62·11	
„	XXII & R.M.	31	99·74	12	30·19	
XXIV	XXVI & XXIII	30	46·27	12	153·04	
„	XXIII & XXII	30	199·69	12	174·79	
„	XXII & XXI	36	118·58	12	194·45	

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks.
XXV	XXII & XXIII	26	27·48	12	254·30	
,,	XXIII & XXVII	28	26·39	12	82·64	
XXVI	XXIX & XXVIII	23	82·08	8	74·10	
,,	XXVIII & XXVII	25	98·66	8	123·21	
,,	XXVII & XXIII	37	171·11	12	192·75	
,,	XXIII & XXIV	39	195·18	12	334·33	
XXVII	XXV & XXIII	32	40·00	12	160·51	
,,	XXIII & XXVI	31	73·84	12	152·24	Dollond's 15-inch.
,,	XXVI & XXVIII	21	26·68	8	75·45	
,,	XXVIII & XXX	21	30·22	8	124·49	
XXVIII	XXVII & XXVI	21	26·43	8	50·47	
,,	XXVI & XXIX	21	36·11	8	49·56	
,,	XXIX & XXXI	20	56·35	8	94·11	
,,	XXXI & XXX	19	11·35	8	71·85	
,,	XXX & XXVII	21	44·52	8	130·36	
XXIX	XXXII & XXXI	20	5·44	10	19·39	Barrow's 24-inch No. 2.
,,	XXXI & XXVIII	21	24·74	8	129·36	
,,	XXVIII & XXVI	21	27·44	8	116·74	
XXX	XXVII & XXVIII	25	152·88	8	111·76	
,,	XXVIII & XXXI	30	134·64	8	123·08	
,,	XXXI & XXXIV	29	98·65	8	202·53	Dollond's 15-inch.
XXXI	XXXIII & XXXIV	23	35·04	8	59·37	
,,	XXXIV & XXX	24	30·97	8	46·24	
,,	XXX & XXVIII	24	79·22	8	85·90	
,,	XXVIII & XXIX	17	5·55	8	419·87	
,,	XXIX & XXXII	20	5·62	10	32·76	
,,	XXXII & XXXIII	20	2·94	10	9·44	
XXXII	XXXIII & XXXI	20	3·34	10	22·14	Barrow's 24-inch No. 2.
,,	XXXI & XXIX	20	3·66	10	35·52	
XXXIII	XXIII & XXIV	24	46·18	8	143·38	
,,	XXIV & XXXIV	24	51·37	8	87·71	Dollond's 15-inch.
,,	XXXIV & XXXI	24	14·36	8	99·07	
,,	XXXI & XXXII	20	3·64	10	13·46	Barrow's 24-inch No. 2.
XXXIV	XXX & XXXI	24	81·80	8	69·75	
,,	XXXI & XXXIII	24	46·50	8	92·69	
,,	XXXIII & XXIII	24	34·19	8	179·20	
,,	XXIII & XXIV	27	47·86	8	145·52	
XXIII	XXIV & XXXIV	18	28·73	6	38·71	Dollond's 15-inch.
,,	XXXIV & XXXIII	15	18·17	6	51·45	
XXIV	XXXIV & XXXIII	27	77·17	8	173·00	
,,	XXXIII & XXIII	32	104·72	8	96·47	

NOTE.—Stations XXIII and XXIV appertain to the Bombay Longitudinal Series.

From the preceding data of the sums of the squares of the apparent errors, in the measurement of each angle, we may ascertain the *e.m.s.* (error of mean square) *of observation* of a single measure of an angle, and the *e.m.s. of graduation and observation* of the mean of the measures on a single zero, for each group of angles measured with the same instrument, by the same observer, and under similar circumstances.

The instruments employed were as follows :—

1st.—A theodolite by Dollond, having an azimuthal circle 15 inches in diameter, furnished with 8 microscopes; observations were taken on 6, 4 or 3 pairs of zeros (*face right* and *face left*), giving circle readings at 10°, 15° or 20° apart.

2nd.—Barrow's 24-inch Theodolite No. 2, having 5 microscopes; observations were taken on 5 pairs of zeros, giving circle readings at 7° 12′ apart.

The *e.m.s. of observation* of a single measure of an angle $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of observations.}}{\text{No. of observations} - \text{No. of angles} \times \text{No. of changes of zero.}}}$

The *e.m.s. of graduation and observation* of the mean of the measures on a single zero $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of zero.}}{\text{No. of angles} \times (\text{No. of changes of zero} - 1).}}$

Group	Instrument and Observer	Position of stations	Intervals between microscope readings of circle	Number of: Measures on each zero (average)	Angles	Single measures	Single zeros	*e. m. s.* of observation of a single measure	*e. m. s.* of graduation and observation of a single zero
			° ′					″	″
I	Dollond's 15-inch Theodolite; Lieutenant H. Rivers.	Hills,	10 0	2·46	106	3134	1272	$\left\{\frac{7337\cdot37}{3134-1272}\right\}^{\frac{1}{2}} = \pm 1\cdot985$	$\left\{\frac{18981\cdot09}{1272-106}\right\}^{\frac{1}{2}} = \pm 4\cdot035$
II	Ditto.	,,	15 0	2·94	27	636	216	$\left\{\frac{1505\cdot68}{636-216}\right\}^{\frac{1}{2}} = \pm 1\cdot893$	$\left\{\frac{3175\cdot24}{216-27}\right\}^{\frac{1}{2}} = \pm 4\cdot099$
III	Ditto.	,,	20 0	2·75	2	33	12	$\left\{\frac{46\cdot90}{33-12}\right\}^{\frac{1}{2}} = \pm 1\cdot494$	$\left\{\frac{90\cdot16}{12-2}\right\}^{\frac{1}{2}} = \pm 3\cdot003$
IV	Barrow's 24-inch Theodolite No. 2; Captain C. T. Haig, R.E.	,,	7 12	2·00	6	120	60	$\left\{\frac{24\cdot64}{120-60}\right\}^{\frac{1}{2}} = \pm 0\cdot641$	$\left\{\frac{132\cdot71}{60-6}\right\}^{\frac{1}{2}} = \pm 1\cdot568$

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KHANPISURA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

KHANPISURA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

Figure No. 1.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	29	13	49·23	0·74
2	36	26	32·50	1·04
3	43	51	10·98	1·67
4	70	28	24·79	4·17
5	39	23	53·23	1·67
6	26	16	32·25	1·39
7	63	29	30·11	1·19
8	50	50	6·81	1·67

Equations to be satisfied — **Factor**

$x_1 + x_2 + x_3 + x_4 = e_1 = -4{\cdot}26$, λ_1

$x_3 + x_4 + x_5 + x_6 = e_2 = -0{\cdot}11$, λ_2

$x_1 + x_2 + x_7 + x_8 = e_3 = -3{\cdot}60$, λ_3

$\left.\begin{matrix} -1{\cdot}184\,x_2 + {\cdot}17\,x_3 - {\cdot}35\,x_4 \\ +1{\cdot}218\,x_5 - {\cdot}00\,x_6 + {\cdot}50\,x_7 \end{matrix}\right\} = e_4 = +1{\cdot}781$, λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 4·26	+7·62	+5·84	+1·78	−2·41
2	− 0·11		+8·90	...	+0·86
3	− 3·60		*	+4·64	−0·64
4	+ 1·781				+4·79

Values of the Factors

$\lambda_1 = -1{\cdot}3635$

$\lambda_2 = +0{\cdot}9328$

$\lambda_3 = -0{\cdot}3246$

$\lambda_4 = -0{\cdot}5234$

Angular errors in seconds

$x_1 = -1{\cdot}24$	$x_5 = +{\cdot}49$
$x_2 = -1{\cdot}12$	$x_6 = +1{\cdot}30$
$x_3 = -{\cdot}87$	$x_7 = -{\cdot}70$
$x_4 = -1{\cdot}03$	$x_8 = -{\cdot}54$

$[wx^2] = 5{\cdot}94$

* 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.

Figure No. 2.

Observed Angles

No.	Value	Reciprocal Weight
	° ′ ″	
1	47 6 12·35	1·49
2	64 39 57·29	2·08
3	68 13 50·73	1·19
4	58 53 11·75	0·93
5	72 37 31·99	0·87
6	48 29 18·50	1·23
7	77 26 25·51	2·78
8	50 28 46·12	1·39
9	52 4 52·56	1·18
10	84 21 19·42	1·39
11	48 34 8·65	1·18
12	47 4 36·27	1·75
13	92 12 47·21	2·08
14	37 58 2·57	2·08
15	49 49 12·09	2·08

Equations to be satisfied — Factor

$x_1 + x_2 + x_3 = e_1 = -1·37$, λ_1

$x_4 + x_5 + x_6 = e_2 = -0·28$, λ_2

$x_7 + x_8 + x_9 = e_3 = +0·61$, λ_3

$x_{10} + x_{11} + x_{12} = e_4 = +0·68$, λ_4

$x_{13} + x_{14} + x_{15} = e_5 = -1·16$, λ_5

$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = -3·76$, λ_6

$$\left.\begin{array}{l} +·40x_3 - ·47x_2 + ·89x_6 - ·31x_5 + ·78x_9 \\ -·82x_8 + ·93x_{12} - ·88x_{11} + ·84x_{15} - 1·28x_{14} \end{array}\right\} = e_7 = +4·06, \quad \lambda_7$$

Equations between the Factors

No. of e	Value of e	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7
1	− 1·37	+4·76					+1·49	− 0·502
2	− 0·28		+3·03				+0·93	+ 0·825
3	+ 0·61			+5·35			+2·78	− 0·220
4	+ 0·68				+4·32		+1·39	+ 0·590
5	− 1·16					+6·24	+2·08	− 0·915
6	− 3·76						+8·67	...
7	+ 4·06							+10·664

(Co-efficients of λ_1 … λ_7)

Values of the Factors

$\lambda_1 = -\ 0·046$

$\lambda_2 = +\ 0·003$

$\lambda_3 = +\ 0·465$

$\lambda_4 = +\ 0·314$

$\lambda_5 = +\ 0·085$

$\lambda_6 = -\ 0·646$

$\lambda_7 = +\ 0·378$

Angular errors in seconds

$x_1 = -1·03$	$x_6 = +·41$	$x_{11} = -·02$
$x_2 = -·46$	$x_7 = -·50$	$x_{12} = +1·16$
$x_3 = +·12$	$x_8 = +·22$	$x_{13} = -1·17$
$x_4 = -·60$	$x_9 = +·89$	$x_{14} = -·83$
$x_5 = -·09$	$x_{10} = -·46$	$x_{15} = +·84$

$[wx^2] = 4·42$

Figure No. 8.

Observed Angles

No.	Value °	′	″	Reciprocal Weight	No.	Value °	′	″	Reciprocal Weight	No.	Value °	′	″	Reciprocal Weight
1	81	57	38·78	0·76	10	48	53	16·64	1·03	19	57	2	1·88	1·35
2	51	45	5·34	0·72	11	77	9	4·63	0·93	20	56	15	1·13	2·78
3	46	17	21·50	1·19	12	53	57	35·81	1·19	21	66	42	59·79	1·67
4	126	2	38·87	0·93	13	29	24	47·96	0·60	22	84	32	50·85	0·76
5	16	59	21·51	0·93	14	88	44	1·82	0·57	23	39	18	45·73	2·08
6	36	57	59·35	1·39	15	61	51	13·31	0·53	24	56	8	23·01	2·08
7	73	41	38·55	0·93	16	56	42	8·08	2·08	25	43	34	59·43	0·93
8	65	19	29·06	2·08	17	83	38	8·37	2·08	26	54	20	33·46	0·91
9	40	58	55·24	1·67	18	39	39	45·82	2·78	27	82	4	30·94	1·67

Equations to be satisfied — **Factor**

Equations to be satisfied	Factor
$x_1 + x_2 + x_3 \;\ldots\;\ldots\;\ldots\;\ldots = e_1 = +\,2{\cdot}32,$	λ_1
$x_4 + x_5 + x_6 \;\ldots\;\ldots\;\ldots\;\ldots = e_2 = -\,1{\cdot}69,$	λ_2
$x_7 + x_8 + x_9 \;\ldots\;\ldots\;\ldots\;\ldots = e_3 = +\,1{\cdot}71,$	λ_3
$x_{10} + x_{11} + x_{12} \;\ldots\;\ldots\;\ldots\;\ldots = e_4 = -\,4{\cdot}41,$	λ_4
$x_{13} + x_{14} + x_{15} \;\ldots\;\ldots\;\ldots\;\ldots = e_5 = +\,1{\cdot}76,$	λ_5
$x_{16} + x_{17} + x_{18} \;\ldots\;\ldots\;\ldots\;\ldots = e_6 = -\,0{\cdot}11,$	λ_6
$x_{19} + x_{20} + x_{21} \;\ldots\;\ldots\;\ldots\;\ldots = e_7 = -\,0{\cdot}57,$	λ_7
$x_{22} + x_{23} + x_{24} \;\ldots\;\ldots\;\ldots\;\ldots = e_8 = -\,3{\cdot}17,$	λ_8
$x_{25} + x_{26} + x_{27} \;\ldots\;\ldots\;\ldots\;\ldots = e_9 = +\,2{\cdot}63,$	λ_9
$x_1 + x_4 + x_7 + x_{10} + x_{13} \;\ldots\;\ldots = e_{10} = +\,0{\cdot}80,$	λ_{10}
$x_9 + x_{11} + x_{16} + x_{19} + x_{22} + x_{25} \;\ldots = e_{11} = +\,0{\cdot}11,$	λ_{11}
$\left.\begin{array}{l} {\cdot}96\,x_3 - {\cdot}79\,x_2 + 1{\cdot}329\,x_6 - 3{\cdot}2731\,x_5 + 1{\cdot}151\,x_9 \\ -\,{\cdot}46\,x_8 + {\cdot}73\,x_{12} - {\cdot}23\,x_{11} + {\cdot}53\,x_{15} - {\cdot}02\,x_{14} \end{array}\right\} \ldots\;\ldots = e_{12} = +\,6{\cdot}161,$	λ_{12}
$\left.\begin{array}{l} {\cdot}46\,x_8 - {\cdot}29\,x_7 + {\cdot}87\,x_{10} - {\cdot}73\,x_{12} + 1{\cdot}206\,x_{18} - {\cdot}11\,x_{17} \\ +\,{\cdot}43\,x_{21} - {\cdot}67\,x_{20} + {\cdot}67\,x_{24} - 1{\cdot}221\,x_{23} + {\cdot}14\,x_{27} - {\cdot}72\,x_{26} \end{array}\right\} \ldots = e_{13} = -\,0{\cdot}133,$	λ_{13}

Figure No. 8—(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	+ 2·32	+2·67									+0·76		+ 0·57	
2	− 1·69		+3·25								+0·93		− 1·20	
3	+ 1·71			+4·68							+0·93	+1·67	+ 0·97	+ 0·69
4	− 4·41				+3·15						+1·03	+0·93	+ 0·65	+ 0·03
5	+ 1·76					+1·70					+0·60		+ 0·27	
6	− 0·11						+6·94					+2·08		+ 3·12
7	− 0·57							+5·80				+1·35		− 1·14
8	− 3·17								+4·92			+0·76		− 1·15
9	+ 2·63									+3·51		+0·93		− 0·42
10	+ 0·80										+4·25			+ 0·63
11	+ 0·11											+7·72	+ 1·71	
12	+ 6·161												+17·45	− 1·07
13	− 0·133													+12·10

Values of the Factors

λ_1	= + 0·6779
λ_2	= − 0·5258
λ_3	= + 0·1824
λ_4	= − 1·6397
λ_5	= + 0·8328
λ_6	= − 0·0237
λ_7	= − 0·1358
λ_8	= − 0·6751
λ_9	= + 0·7126
λ_{10}	= + 0·4305
λ_{11}	= + 0·1126
λ_{12}	= + 0·3188
λ_{13}	= − 0·0575

Angular errors in seconds

x_1	= + ·84	x_{10}	= − 1·30	x_{19}	= − ·03
x_2	= + ·31	x_{11}	= − 1·49	x_{20}	= − ·27
x_3	= + 1·17	x_{12}	= − 1·62	x_{21}	= − ·27
x_4	= − ·09	x_{13}	= + ·76	x_{22}	= − ·43
x_5	= − 1·47	x_{14}	= + ·47	x_{23}	= − 1·27
x_6	= − ·13	x_{15}	= + ·53	x_{24}	= − 1·47
x_7	= + ·59	x_{16}	= + ·18	x_{25}	= + ·77
x_8	= + ·01	x_{17}	= − ·03	x_{26}	= + ·68
x_9	= + 1·11	x_{18}	= − ·26	x_{27}	= + 1·18

$[wx^2] = 17·89$

Figure No. 4.

Observed Angles

No.	°	′	″	Reciprocal Weight
1	43	57	35·83	0·79
2	66	0	2·31	0·69
3	70	2	24·27	1·19
4	47	32	4·83	1·39
5	67	9	40·67	1·22
6	65	18	24·02	1·03
7	67	56	19·97	2·08
8	65	59	29·25	1·52
9	46	4	17·08	0·76
10	61	49	22·54	1·39
11	38	51	4·70	0·83
12	79	19	40·99	0·93
13	81	59	46·76	1·67
14	45	12	30·56	1·04
15	52	47	43·61	2·08
16	56	44	49·35	2·08
17	78	58	39·42	1·39
18	44	16	33·41	0·60

Equations to be satisfied — **Factor**

$$x_1 + x_2 + x_3 = e_1 = -2.17, \quad \lambda_1$$
$$x_4 + x_5 + x_6 = e_2 = +4.73, \quad \lambda_2$$
$$x_7 + x_8 + x_9 = e_3 = -1.45, \quad \lambda_3$$
$$x_{10} + x_{11} + x_{12} = e_4 = +2.26, \quad \lambda_4$$
$$x_{13} + x_{14} + x_{15} = e_5 = -2.88, \quad \lambda_5$$
$$x_{16} + x_{17} + x_{18} = e_6 = -1.85, \quad \lambda_6$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = -0.72, \quad \lambda_7$$
$$\left.\begin{array}{lll} +.36\,x_3 & -.45\,x_2 & +.46\,x_6 \\ -.42\,x_5 & +.96\,x_9 & -.45\,x_8 \\ +.19\,x_{13} & -1.24\,x_{11} & +.76\,x_{15} \\ -.99\,x_{14} & +1.03\,x_{18} & -.19\,x_{17} \end{array}\right\} = e_8 = +1.78, \quad \lambda_8$$

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	− 2·17	+2·67						+0·79	+ 0·117
2	+ 4·73		+3·64					+1·39	− 0·038
3	− 1·45			+4·36				+2·08	+ 0·046
4	+ 2·26				+3·15			+1·39	− 0·852
5	− 2·88			*		+4·79		+1·67	+ 0·551
6	− 1·85						+4·07	+2·08	+ 0·354
7	− 0·72							+9·40	...
8	+ 1·78								+ 5·955

Values of the Factors

$\lambda_1 = -0.8243$

$\lambda_2 = +1.3206$

$\lambda_3 = -0.3188$

$\lambda_4 = +0.8816$

$\lambda_5 = -0.6492$

$\lambda_6 = -0.4807$

$\lambda_7 = -0.0407$

$\lambda_8 = +0.5402$

Angular errors in seconds

$x_1 = -.68$	$x_7 = -.75$	$x_{13} = -1.15$
$x_2 = -.74$	$x_8 = -.85$	$x_{14} = -1.23$
$x_3 = -.75$	$x_9 = +.15$	$x_{15} = -.50$
$x_4 = +1.78$	$x_{10} = +1.16$	$x_{16} = -1.08$
$x_5 = +1.33$	$x_{11} = +.18$	$x_{17} = -.81$
$x_6 = +1.62$	$x_{12} = +.92$	$x_{18} = +.04$

$[wx^2] = 14.24$

Figure No. 5.

Observed Angles

No.	Value			Reciprocal Weight
	°	′	″	
1	55	41	37·93	1·67
2	50	26	46·13	1·67
3	34	31	0·97	1·56
4	39	20	43·99	1·18
5	45	52	58·09	2·08
6	60	15	22·41	2·08
7	41	55	21·18	2·78
8	31	56	20·53	2·04

Equations to be satisfied — Factor

$x_1 + x_2 + x_7 + x_8 = e_1 = -0·02,$ λ_1

$x_3 + x_4 + x_5 + x_6 = e_2 = -0·09,$ λ_2

$x_5 + x_6 + x_7 + x_8 = e_3 = -2·61,$ λ_3

$\left.\begin{array}{l} -·74\,x_2 + ·09\,x_3 - 1·220\,x_4 \\ +·97\,x_5 + ·22\,x_6 + 1·334\,x_7 \end{array}\right\} = e_4 = -8·408,$ λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 0·02	+ 8·16	...	+ 4·82	+ 2·47
2	− 0·09		+ 6·90	+ 4·16	+ 1·18
3	− 2·61		*	+ 8·98	+ 6·18
4	− 8·408				+ 9·69

Values of the Factors

$\lambda_1 = -0·0433$

$\lambda_2 = -0·2349$

$\lambda_3 = +0·7347$

$\lambda_4 = -1·2972$

Angular errors in seconds

$x_1 = -·08$	$x_5 = -1·59$
$x_2 = +1·53$	$x_6 = +·45$
$x_3 = -·55$	$x_7 = -2·89$
$x_4 = +1·60$	$x_8 = +1·42$

$[wx^2] = 9·01$

Figure No. 6.

Observed Angles

No.	Value			Reciprocal Weight
	°	′	″	
1	65	55	51·49	1·39
2	40	27	52·93	1·67
3	36	51	6·71	1·37
4	36	45	13·39	2·78
5	60	31	44·89	1·67
6	45	52	0·28	1·18
7	25	42	24·97	0·76
8	47	53	54·78	0·99

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = +0{\cdot}24,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = -0{\cdot}28,$	λ_2
$x_1 + x_2 + x_7 + x_8 = e_3 = +0{\cdot}24,$	λ_3
$\left.\begin{matrix} {\cdot}44\,x_1 + 1{\cdot}172\,x_2 - 1{\cdot}334\,x_3 \\ -{\cdot}13\,x_4 - {\cdot}70\,x_5 + 1{\cdot}34\,x_8 \end{matrix}\right\} = e_4 = -0{\cdot}437,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	+ 0·24	+ 7·21	+ 4·15	+ 3·06	+ 0·38
2	− 0·28		+ 7·00	...	− 3·36
3	+ 0·24		*	+ 4·81	+ 3·90
4	− 0·437				+ 7·64

Values of the Factors

$\lambda_1 = +\ 0{\cdot}0803$

$\lambda_2 = -\ 0{\cdot}2138$

$\lambda_3 = +\ 0{\cdot}2120$

$\lambda_4 = -\ 0{\cdot}2630$

Angular errors in seconds

$x_1 = +\ {\cdot}24$	$x_5 = -\ {\cdot}06$
$x_2 = -\ {\cdot}03$	$x_6 = -\ {\cdot}25$
$x_3 = +\ {\cdot}30$	$x_7 = +\ {\cdot}16$
$x_4 = -\ {\cdot}27$	$x_8 = -\ {\cdot}13$

$[wx^2] = 0{\cdot}24$

Figure No. 7.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	42	35	50·67	1·17
2	61	15	40·29	1·39
3	38	35	9·99	1·39
4	37	33	24·20	0·64
5	71	27	27·58	0·54
6	44	52	47·66	1·67
7	63	39	58·13	2·08
8	87	7	4·22	1·04
9	42	38	40·67	0·64
10	50	14	23·90	1·19
11	60	44	53·32	1·18
12	58	14	56·63	1·19
13	61	0	13·50	1·67
14	57	45	24·39	1·64
15	63	34	46·74	2·78
16	58	39	54·07	1·19
17	40	19	19·08	0·76
18	59	31	29·94	1·64
19	41	17	56·73	1·67
20	38	51	19·34	1·04

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = -2·95$,	λ_1
$x_5 + x_6 + x_7 = e_2 = +5·31$,	λ_2
$x_8 + x_9 + x_{10} = e_3 = +2·90$,	λ_3
$x_{11} + x_{12} + x_{13} = e_4 = -0·96$,	λ_4
$x_{14} + x_{15} + x_{16} = e_5 = +0·84$,	λ_5
$x_{17} + x_{18} + x_{19} + x_{20} = e_6 = -0·38$,	λ_6
$x_1 + x_4 + x_{17} + x_{18} = e_7 = -3·69$,	λ_7
$x_1 + x_5 + x_8 + x_{11} + x_{14} + x_{17} = e_8 = -0·74$,	λ_8
$1·301\,x_4 - 1·004\,x_6 + ·49\,x_7 - 1·086\,x_9 + ·83\,x_{10} - ·62\,x_{12} + ·55\,x_{13} - ·50\,x_{15} + ·61\,x_{16} - ·59\,x_{18} = e_9 = -2·527$,	λ_9
$-·968\,x_1 + ·18\,x_2 + ·25\,x_3 - 1·051\,x_4 + ·12\,x_{17} + ·19\,x_{18} + 1·328\,x_{19} + 1·421\,x_{20} = e_{10} = +3·140$,	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	− 2·95	+4·59						+1·81	+1·17	+0·83	+1·21
2	+ 5·31		+4·29						+0·54	−0·66	
3	+ 2·90			+2·87					+1·04	+0·29	
4	− 0·96				+4·04				+1·18	+0·18	
5	+ 0·84					+5·61			+1·64	−0·66	
6	− 0·38						+5·11	+2·40	+0·76	−0·97	+4·10
7	− 3·69							+4·21	+1·93	−0·14	−1·40
8	− 0·74								+6·33		−1·04
9	− 2·527									+7·51	−1·06
10	+ 3·140										+7·05

Values of the Factors

$\lambda_1 = -2·4931$
$\lambda_2 = +1·2032$
$\lambda_3 = +1·0942$
$\lambda_4 = -0·1827$
$\lambda_5 = +0·1497$
$\lambda_6 = +17·6023$
$\lambda_7 = +16·1422$
$\lambda_8 = -0·1363$
$\lambda_9 = -0·3371$
$\lambda_{10} = -12·6414$

Angular errors in seconds

$x_1 = -1·84$	$x_8 = +1·00$	$x_{15} = +·89$
$x_2 = +·32$	$x_9 = +·92$	$x_{16} = -·07$
$x_3 = -·94$	$x_{10} = +·98$	$x_{17} = -·12$
$x_4 = -·49$	$x_{11} = -·38$	$x_{18} = -1·24$
$x_5 = +·58$	$x_{12} = +·03$	$x_{19} = +1·38$
$x_6 = +2·57$	$x_{13} = -·61$	$x_{20} = -·40$
$x_7 = +2·16$	$x_{14} = +·02$	

$[wx^2] = 16·64$

Figure No. 8.

Observed Angles

No.	Value °	′	″	Reciprocal Weight	No.	Value °	′	″	Reciprocal Weight	No.	Value °	′	″	Reciprocal Weight
1	53	27	27·10	4·37	10	67	22	47·59	4·37	19	50	46	58·53	4·37
2	60	41	45·87	4·37	11	51	38	47·65	4·37	20	73	16	32·34	4·37
3	65	50	53·65	4·37	12	60	58	28·91	4·37	21	55	56	32·69	4·37
4	54	10	1·47	4·37	13	80	23	1·42	4·37	22	90	38	21·41	0·63
5	43	16	33·25	4·37	14	57	53	33·69	4·37	23	37	42	19·29	0·63
6	82	33	24·70	4·37	15	41	43	27·68	4·37	24	51	39	26·23	0·63
7	104	36	41·25	4·37	16	53	39	22·14	4·37	25	81	45	34·09	0·63
8	43	52	32·88	4·37	17	50	56	35·05	4·37	26	50	35	19·39	0·63
9	31	30	47·86	4·37	18	75	24	10·92	4·37	27	47	39	11·82	0·63

Equations to be satisfied

								Factor
x_1	$+x_2$	$+x_3$	...	...	...	...	$= e_1 = +1{\cdot}49,$	λ_1
x_4	$+x_5$	$+x_6$	...	...	...	...	$= e_2 = -4{\cdot}00,$	λ_2
x_7	$+x_8$	$+x_9$	...	...	...	...	$= e_3 = -1{\cdot}75,$	λ_3
x_{10}	$+x_{11}$	$+x_{12}$	...	...	...	...	$= e_4 = -0{\cdot}09,$	λ_4
x_{13}	$+x_{14}$	$+x_{15}$	...	...	...	...	$= e_5 = -2{\cdot}38,$	λ_5
x_{16}	$+x_{17}$	$+x_{18}$	...	...	...	...	$= e_6 = +1{\cdot}65,$	λ_6
x_{19}	$+x_{20}$	$+x_{21}$	...	...	...	...	$= e_7 = -2{\cdot}20,$	λ_7
x_{22}	$+x_{23}$	$+x_{24}$	...	...	...	...	$= e_8 = +0{\cdot}23,$	λ_8
x_{25}	$+x_{26}$	$+x_{27}$	...	...	...	...	$= e_9 = -0{\cdot}11,$	λ_9
x_1	$+x_4$	$+x_7$	$+x_{10}$	$+x_{13}$	...	...	$= e_{10} = -1{\cdot}17,$	λ_{10}
x_9	$+x_{16}$	$+x_{19}$	$+x_{22}$	$+x_{25}$	$+x_{11}$	...	$= e_{11} = -8{\cdot}32,$	λ_{11}
$9x_3$ $-22x_8$	$-12x_2$ $+11x_{12}$	$+3x_6$ $-17x_{11}$	$-22x_5$ $+24x_{15}$	$+34x_9$ $-13x_{14}$ }	...	...	$= e_{12} = +20{\cdot}9,$	λ_{12}
$22x_8$ $+17x_{24}$	$+5x_7$ $-27x_{23}$	$+6x_{18}$ $+19x_{27}$	$-17x_{17}$ $-17x_{26}$	$+15x_{21}$ $+9x_{10}$	$-7x_{20}$ $-11x_{12}$ }	...	$= e_{13} = -8{\cdot}5,$	λ_{13}

NOTE.—The reciprocal weights here given are not the *preliminary* reciprocal weights, as in the reduction of other figures, but *final* or *absolute* weights.

Figure No. 8—(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	+ 1·49	+ 13·11									+ 4·37		− 13·11	
2	− 4·00		+ 13·11								+ 4·37		− 83·03	
3	− 1·75			+ 13·11							+ 4·37	+ 4·37	+ 52·44	+ 117·99
4	− 0·09				+ 13·11						+ 4·37	+ 4·37	− 26·22	− 8·74
5	− 2·38					+ 13·11					+ 4·37		+ 48·07	
6	+ 1·65						+ 13·11					+ 4·37		− 48·07
7	− 2·20							+ 13·11				+ 4·37		+ 34·96
8	+ 0·23								+ 1·89			+ 0·63		− 6·30
9	− 0·11									+ 1·89		+ 0·63		+ 1·26
10	− 1·17										+ 21·85			+ 61·18
11	− 8·32											+ 18·74	+ 74·29	
12	+ 20·9												+ 15351·81	− 2643·85
13	− 8·5													+ 6775·54

Values of the Factors

λ_1	=	+ 0·1384
λ_2	=	− 0·2566
λ_3	=	+ 0·0541
λ_4	=	+ 0·2362
λ_5	=	− 0·1776
λ_6	=	+ 0·3487
λ_7	=	+ 0·0362
λ_8	=	+ 0·3435
λ_9	=	+ 0·1517
λ_{10}	=	− 0·0608
λ_{11}	=	− 0·6357
λ_{12}	=	+ 0·0045
λ_{13}	=	+ 0·0030

Angular errors in seconds

x_1 =	+ ·34	x_{10} =	+ ·88	x_{19} =	− 2·62
x_2 =	+ ·37	x_{11} =	− 2·08	x_{20} =	+ ·07
x_3 =	+ ·78	x_{12} =	+ 1·11	x_{21} =	+ ·35
x_4 =	− 1·39	x_{13} =	− 1·04	x_{22} =	− ·19
x_5 =	− 1·55	x_{14} =	− 1·03	x_{23} =	+ ·17
x_6 =	− 1·06	x_{15} =	− ·31	x_{24} =	+ ·25
x_7 =	+ ·04	x_{16} =	− 1·25	x_{25} =	− ·30
x_8 =	+ ·09	x_{17} =	+ 1·30	x_{26} =	+ ·06
x_9 =	− 1·88	x_{18} =	+ 1·60	x_{27} =	+ ·13

$[wx^2] = 7·53$

Figure No. 9.

Observed Angles

No.	Value			Reciprocal Weight
	°	′	″	
1	45	34	41·89	3·13
2	50	0	39·19	2·50
3	32	50	46·13	3·13
4	51	33	58·81	1·61
5	50	49	42·37	2·50
6	44	45	39·68	1·85
7	50	55	36·89	1·39
8	33	29	4·63	1·82

Equations to be satisfied — **Factor**

$x_1 + x_2 + x_3 + x_4 = e_1 = -0·10,$ λ_1

$x_5 + x_6 + x_7 + x_8 = e_2 = -1·10,$ λ_2

$x_1 + x_2 + x_7 + x_8 = e_3 = -3·96,$ λ_3

$\left.\begin{array}{l} -·71\,x_2 + ·13\,x_3 - ·79\,x_4 \\ +·81\,x_5 + ·10\,x_6 + ·91\,x_7 \end{array}\right\} = e_4 = -3·572,$ λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 0·10	+ 10·37	...	+ 5·63	− 2·64
2	− 1·10		+ 7·56	+ 3·21	+ 3·47
3	− 3·96		*	+ 8·84	− 0·51
4	− 3·572				+ 5·13

Values of the Factors

$\lambda_1 = +0·1769$

$\lambda_2 = +0·8320$

$\lambda_3 = -0·9356$

$\lambda_4 = -1·2624$

Angular errors in seconds

$x_1 = -2·37$	$x_5 = -·48$
$x_2 = +·34$	$x_6 = +1·31$
$x_3 = +·04$	$x_7 = -1·74$
$x_4 = +1·89$	$x_8 = -·19$

$[wx^2] = 7·28$

May 1879.

J. B. N. HENNESSEY,
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KHANPISURA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of Station	Spherical Excess	Corrections to Observed Angle: Figure	Circuit	Non-circuit	Total	Corrected Plane Angle	Distance: Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
1		XXIV (Bálágara)	·59	+1·99	−2·47		− ·48	80 17 42·41	5·1011136,7	126215·78	23·905
		XXI (Búda)	·59	+1·03	+ ·49		+1·52	70 28 25·72	5·0816499,1	120684·06	22·857
		II (Dhamnár)	·58	+1·24	+1·98		+3·22	29 13 51·87	4·7960898,2	62530·20	11·843
			1·76				+4·26	180 0 0·00			
2		XXI (Búda)	·61	− ·49	− ·61		−1·10	39 23 51·52	4·9036849,2	80109·67	15·172
		II (Dhamnár)	·62	+ ·54	− ·67		− ·13	50 50 6·06	4·9906041,7	97859·77	18·534
		I (Sítamau)	·62	− ·60	+1·28		+ ·68	89 46 2·42	5·1011136,7	126215·78	23·905
			1·85				− ·55	180 0 0·00			
	173	XXI (Búda)	·46	+ ·54		− ·12	+ ·42	109 52 17·98	5·1233300,4	132840·35	25·159
		XXIV (Bálágara)	·45	+ ·87		−1·38	− ·51	43 51 10·02	4·9906041,6	97859·77	18·534
		I (Sítamau)	·45	−1·30		+1·50	+ ·20	26 16 32·00	4·7960898,2	62530·20	11·843
			1·36				+ ·11	180 0 0·00			
3		I (Sítamau)	·58	+ ·46	− ·36		+ ·10	64 39 56·81	4·9949085,4	98834·49	18·719
		II (Dhamnár)	·58	− ·12	−1·52		−1·64	68 13 48·51	5·0066897,4	101552·30	19·233
		III (Nigrun)	·58	+1·03	+1·88		+2·91	47 6 14·68	4·9036849,2	80109·67	15·172
			1·74				+1·37	180 0 0·00			
	174	I (Sítamau)	1·01	− ·84		+ ·04	− ·80	49 49 10·28	5·1007639,4	126114·19	23·885
		III (Nigrun)	1·01	+1·17		−1·28	− ·11	92 12 46·09	5·2173375,4	164944·39	31·239
		IV (Dudhála)	1·01	+ ·83		+1·24	+2·07	37 58 3·63	5·0066897,4	101552·30	19·233
			3·03				+1·16	180 0 0·00			

NOTES.—1. The values of the sides are given in the same lines with the opposite angles.
2. Stations XXI (Búda) and XXIV (Bálágara) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of 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
			″	″	″	″	″	° ′ ″			
		IV (Dudhála)	1·22	−1·16		+ ·09	−1·07	47 4 33·98	5·0905099,7	123171·44	23·328
	175	III (Nigrun)	1·22	+ ·46		−1·21	− ·75	84 21 17·45	5·2237339,0	167391·69	31·703
		V (Deo Dongri)	1·22	+ ·02		+1·12	+1·14	48 34 8·57	5·1007639,4	126114·19	23·885
			3·66				− ·68	180 0 0·00			
		II (Dhamnár)	·84	+ ·09	−1·30		−1·21	72 37 29·94	5·1002476,1	125964·33	23·857
4		III (Nigrun)	·84	+ ·60	+ ·50		+1·10	58 53 12·01	5·0530788,6	113000·12	21·402
		VI (Lohári)	·84	− ·41	+ ·80		+ ·39	48 29 18·05	4·9949085,4	98834·49	18·719
			2·52				+ ·28	180 0 0·00			
		III (Nigrun)	1·20	+ ·50	+ ·11		+ ·61	77 26 24·92	5·1927174,7	155853·82	29·518
5		VI (Lohári)	1·19	− ·22	−1·16		−1·38	50 28 43·55	5·0905099,5	123171·43	23·328
		V (Deo Dongri)	1·19	− ·89	+1·05		+ ·16	52 4 51·53	5·1002476,1	125964·33	23·857
			3·58				− ·61	180 0 0·00			
		VI (Lohári)	1·10	−1·17	− ·84		−2·01	46 17 18·39	5·0560418,5	113773·69	21·548
6		V Deo Dongri)	1·10	− ·31	+ ·56		+ ·25	51 45 4·49	5·0920594,6	123611·67	23·411
		VII (Dhanora)	1·10	− ·84	+ ·28		− ·56	81 57 37·12	5·1927174,7	155853·82	29·518
			3·30				−2·32	180 0 0·00			
		V (Deo Dongri)	·44	− ·53	+ ·04		− ·49	61 51 12·38	5·0014903,5	100343·75	19·005
7		VII (Dhanora)	·44	− ·76	− ·32		−1·08	29 24 46·44	4·7473177,6	55887·89	10·585
		VIII (Gurla)	·45	− ·47	+ ·28		− ·19	88 44 1·18	5·0560418,5	113773·69	21·548
			1·33				−1·76	180 0 0·00			
		VII (Dhanora)	·49	+1·30	− ·60		+ ·70	48 53 16·85	4·8895432,2	77543·11	14·686
8		VIII (Gurla)	·50	+1·62	+ ·33		+1·95	53 57 37·26	4·9202418,1	83222·70	15·762
		IX (Karsod)	·50	+1·49	+ ·27		+1·76	77 9 5·89	5·0014903,5	100343·75	19·005
			1·49				+4·41	180 0 0·00			
		VI (Lohári)	·47	+1·47		− ·49	+ ·98	16 59 22·02	4·7786086,1	60063·22	11·376
	176	VII (Dhanora)	·48	+ ·09		+ ·54	+ ·63	126 2 39·02	5·2206490,4	166206·91	31·479
		XI (Kaula-ka-Máta)	·47	+ ·13		− ·05	+ ·08	36 57 58·96	5·0920594,6	123611·67	23·411
			1·42				+1·69	180 0 0·00			
		VII (Dhanora)	·38	− ·59		+ ·10	− ·49	73 41 37·68	4·9439963,4	87901·51	16·648
	177	IX (Karsod)	·38	−1·11		− ·30	−1·41	40 58 53·45	4·7786086,1	60063·22	11·376
		XI (Kaula-ka-Máta)	·38	− ·01		+ ·20	+ ·19	65 19 28·87	4·9202418,0	83222·70	15·762
			1·14				−1·71	180 0 0·00			
		VIII (Gurla)	·40	−1·18	− ·09		−1·27	82 4 29·27	4·9755438,6	94524·38	17·902
9		IX (Karsod)	·40	− ·77	− ·16		− ·93	43 34 58·10	4·8181844,0	65793·71	12·461
		X (Jalálkheri)	·40	− ·68	+ ·25		− ·43	54 20 32·63	4·8895432,2	77543·11	14·686
			1·20				−2·63	180 0 0·00			
		X (Jalálkheri)	·92	+1·47	− ·30		+1·17	56 8 23·26	5·0930463,2	123892·86	23·465
10		IX (Karsod)	·92	+ ·43	− ·16		+ ·27	84 32 50·20	5·1717896,0	148521·60	28·129
		XII (Harnása)	·92	+1·27	+ ·46		+1·73	39 18 46·54	4·9755438,6	94524·38	17·902
			2·76				+3·17	180 0 0·00			
		XI (Kaula-ka-Máta)	·80	+ ·03		− ·50	− ·47	83 38 7·10	5·1363074,8	136869·74	25·922
	178	IX (Karsod)	·79	− ·18		− ·52	− ·70	56 42 6·59	5·0611078,9	115108·62	21·801
		XIII (Indráwan)	·79	+ ·26		+1·02	+1·28	39 39 46·31	4·9439963,4	87901·51	16·648
			2·38				+ ·11	180 0 0·00			
		IX (Karsod)	1·12	+ ·03	+ ·87		+ ·90	57 2 1·66	5·0969580,6	125013·82	23·677
11		XII (Harnása)	1·13	+ ·27	− ·22		+ ·05	66 42 58·71	5·1363074,8	136869·74	25·922
		XIII (Indráwan)	1·12	+ ·27	− ·65		− ·38	56 14 59·63	5·0930463,2	123892·86	23·465
			3·37				+ ·57	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
		XII (Harnása)	1·53	+ ·74	+1·45		+2·19	66 0 2·97	5·2162374,1	164527·09	31·160
12		XIII (Indráwan)	1·53	+ ·75	− ·88		− ·13	70 2 22·61	5·2285994,3	169277·56	32·060
		XIV (Mograba)	1·52	+ ·68	− ·57		+ ·11	43 57 34·42	5·0969580,6	125013·82	23·677
			4·58				+2·17	180 0 0·00			
		XII (Harnása)	1·34	− ·04		+1·00	+ ·96	44 16 33·03	5·0806120,3	120395·99	22·802
	179	XIV (Mograba)	1·34	+1·08		−1·05	+ ·03	56 44 48·04	5·1590244,2	144219·64	27·314
		XV (Singárchori)	1·35	+ ·81		+ ·05	+ ·86	78 58 38·93	5·2285994,3	169277·56	32·060
			4·03				+1·85	180 0 0·00			
		XV (Singárchori)	1·27	+ ·50		+1·09	+1·59	52 47 43·93	5·1307296,2	135123·11	25·591
	180	XIV (Mograba)	1·27	+1·15		− ·76	+ ·39	81 59 45·88	5·2253017,9	167997·10	31·818
		XVII (Thíkri)	1·27	+1·23		− ·33	+ ·90	45 12 30·19	5·0806120,3	120395·99	22·802
			3·81				+2·88	180 0 0·00			
		XIII (Indráwan)	1·60	−1·33	+ ·05		−1·28	67 9 37·79	5·2224297,5	166889·79	31·608
13		XIV (Mograba)	1·59	−1·78	+ ·78		−1·00	47 32 2·24	5·1257558,2	133584·44	25·300
		XVI (Gumánpur)	1·60	−1·62	− ·83		−2·45	65 18 19·97	5·2162374,1	164527·09	31·160
			4·79				−4·73	180 0 0·00			
		XVI (Gumánpur)	2·58	+ ·85	+ ·22		+1·07	65 59 27·74	5·3256813,5	211680·76	40·091
14		XIV (Mograba)	2·59	+ ·75	+ ·91		+1·66	67 56 19·04	5·3319590,4	214762·79	40·675
		XVIII (Báwangaz)	2·58	− ·15	−1·13		−1·28	46 4 13·22	5·2224297,5	166889·79	31·608
			7·75				+1·45	180 0 0·00			
		XIV (Mograba)	1·99	−1·16	+ ·69		− ·47	61 49 20·08	5·2784758,4	189878·53	35·962
15		XVIII (Báwangaz)	1·99	− ·18	− ·38		− ·56	38 51 2·15	5·1307296,3	135123·11	25·591
		XVII (Thíkri)	1·99	− ·92	− ·31		−1·23	79 19 37·77	5·3256813,5	211680·76	40·091
			5·97				−2·26	180 0 0·00			
		XVII (Thíkri)	1·85	− ·01	+ ·59		+ ·58	85 13 40·81	5·3383250,6	217934·05	41·275
16		XVIII (Báwangaz)	1·85	+ ·55	− ·01		+ ·54	34 30 59·66	5·0931438,5	123920·70	23·470
		XIX (Jalálabad)	1·85	− ·45	− ·58		−1·03	60 15 19·53	5·2784758,4	189878·53	35·962
			5·55				+ ·09	180 0 0·00			
		XVIII (Báwangaz)	1·93	−1·53	+ ·25		−1·28	50 26 42·92	5·2257597,2	168174·35	31·851
17		XIX (Jalálabad)	1·93	+2·89	− ·03		+2·86	41 55 22·11	5·1635562,2	145732·42	27·601
		XX (Bábákuvar)	1·93	−1·34	− ·22		−1·56	87 37 54·97	5·3383250,6	217934·05	41·275
			5·79				+ ·02	180 0 0·00			
		XVIII (Báwangaz)	2·18	− ·98		+ ·24	− ·74	84 57 44·18	5·3597984,0	228980·42	43·368
	181	XVII (Thíkri)	2·17	−1·60		+ ·08	−1·52	39 20 40·30	5·1635562,4	145732·42	27·601
		XX (Bábákuvar)	2·17	+ ·08		− ·32	− ·24	55 41 35·52	5·2784758,4	189878·53	35·962
			6·52				−2·50	180 0 0·00			
		XX (Bábákuvar)	1·43	− ·27	+ ·09		− ·18	77 18 58·03	5·2545348,9	179694·54	34·033
18		XIX (Jalálabad)	1·42	+ ·27	+ ·13		+ ·40	36 45 12·37	5·0422364,2	110213·91	20·874
		XXII (Ajnád)	1·43	− ·24	− ·22		− ·46	65 55 49·60	5·2257597,2	168174·35	31·851
			4·28				− ·24	180 0 0·00			
		XIX (Jalálabad)	1·73	+ ·06	+ ·19		+ ·25	60 31 43·41	5·2172132,3	164897·17	31·231
19		XXII (Ajnád)	1·73	+ ·13	+ ·34		+ ·47	47 53 53·52	5·1477707,3	140530·56	26·616
		XXI (Árgaon)	1·74	+ ·09	− ·53		− ·44	71 34 23·07	5·2545348,9	179694·54	34·033
			5·20				+ ·28	180 0 0·00			
		XX (Bábákuvar)	1·85	− ·30		+ ·14	− ·16	36 51 4·70	5·1477707,4	140530·56	26·616
	182	XIX (Jalálabad)	1·85	+ ·33		+ ·32	+ ·65	97 16 57·08	5·3662898,6	232428·75	44·021
		XXI (Árgaon)	1·85	+ ·25		− ·46	− ·21	45 51 58·22	5·2257597,2	168174·35	31·851
			5·55				+ ·28	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ' "			
		XXII (Ajnád)	2·70	+1·43	+ ·15		+1·58	76 8 33·07	5·3738994,8	236537·22	44·799
20		XXI (Árgaon)	2·70	− ·32	− ·16		− ·48	61 15 37·11	5·3296345,6	213616·38	40·458
		XXIII (Valvádi)	2·70	+1·84	+ ·01		+1·85	42 35 49·82	5·2172132,3	164897·17	31·231
			8·10				+2·95	180 0 0·00			
		XXI (Árgaon)	1·82	+ ·40	− ·15		+ ·25	38 51 17·77	5·1792053,0	151079·41	28·614
21		XXIII (Valvádi)	1·82	+ ·12	+ ·55		+ ·67	40 19 17·93	5·1926514,3	155830·12	29·513
		XXIV (Dhanvár)	1·83	− ·14	− ·40		− ·54	100 49 24·30	5·3738994,8	236537·22	44·799
			5·47				+ ·38	180 0 0·00			
		XXII (Ajnád)	1·99	+ ·94		+ ·40	+1·34	38 35 9·34	5·1926514,3	155830·12	29·513
	183	XXI (Árgaon)	2·00	+ ·08		− ·31	− ·23	100 6 57·40	5·3908798,9	245968·74	46·585
		XXIV (Dhanvár)	2·00	−1·38		− ·09	−1·47	41 17 53·26	5·2172132,3	164897·17	31·231
			5·99				− ·36	180 0 0·00			
		XXIV (Dhanvár)	1·45	+ ·07	− ·21		− ·14	58 39 52·48	5·1586443,7	144093·50	27·290
22		XXIII (Valvádi)	1·45	− ·02	+ ·69		+ ·67	57 45 23·61	5·1543785,8	142685·09	27·024
		XXVI (Sirsála)	1·46	− ·89	− ·48		−1·37	63 34 43·91	5·1792053,0	151079·41	28·614
			4·36				− ·84	180 0 0·00			
		XXII (Ajnád)	2·68	−2·57		+ ·12	−2·45	44 52 42·53	5·2257840,6	168183·77	31·853
	184	XXIII (Valvádi)	2·69	− ·58		− ·75	−1·33	71 27 23·56	5·3540683,4	225979·14	42·799
		XXV (Anakvádi)	2·69	−2·16		+ ·63	−1·53	63 39 53·91	5·3296345,6	213616·38	40·458
			8·06				−5·31	180 0 0·00			
		XXV (Anakvádi)	1·96	− ·92		+ ·05	− ·87	42 38 37·84	5·1708844,2	148212·36	28·071
	185	XXIII (Valvádi)	1·97	−1·00		− ·78	−1·78	87 7 0·47	5·3394640,8	218506·37	41·384
		XXVII (Sátmála)	1·96	− ·98		+ ·73	− ·25	50 14 21·69	5·2257840,6	168183·77	31·853
			5·89				−2·90	180 0 0·00			
		XXIII (Valvádi)	1·47	+ ·38	+ ·28		+ ·66	60 44 52·51	5·1698058,7	147844·73	28·001
23		XXVI (Sirsála)	1·47	+ ·61	− ·77		− ·16	61 0 11·87	5·1708844,0	148212·36	28·071
		XXVII (Sátmála)	1·47	− ·03	+ ·49		+ ·46	58 14 55·62	5·1586443,7	144093·50	27·290
			4·41				+ ·96	180 0 0·00			
		XXVI (Sirsála)	1·71	− ·37	− ·41		− ·78	60 41 43·38	5·2054010,6	160472·65	30·393
24		XXVII (Sátmála)	1·71	− ·78	+1·01		+ ·23	65 50 52·17	5·2250844,7	167913·05	31·802
		XXVIII (Pophla)	1·71	− ·34	− ·60		− ·94	53 27 24·45	5·1698058,7	147844·73	28·001
			5·13				−1·49	180 0 0·00			
		XXVI (Sirsála)	1·72	+ ·31		+ ·53	+ ·84	41 43 26·80	5·1203539,6	131933·15	24·987
	186	XXVIII (Pophla)	1·73	+1·04		+1·45	+2·49	80 23 2·18	5·2910314,1	195448·07	37·017
		XXIX (Rájur)	1·72	+1·03		−1·98	− ·95	57 53 31·02	5·2250844,7	167913·05	31·802
			5·17				+2·38	180 0 0·00			
		XXVIII (Pophla)	1·42	− ·88		+ ·85	− ·03	67 22 46·14	5·1911634,9	155297·14	29·412
	187	XXIX (Rájur)	1·41	−1·11		− ·53	−1·64	60 58 25·86	5·1676369,9	147108·24	27·861
		XXXI (Jámkhed)	1·41	+2·08		− ·32	+1·76	51 38 48·00	5·1203539,6	131933·15	24·987
			4·24				+ ·09	180 0 0·00			
		XXVII (Sátmála)	1·14	+1·55	+ ·31		+1·86	43 16 33·97	5·0450926,2	110941·13	21·012
25		XXVIII (Pophla)	1·14	+1·39	−1·04		+ ·35	54 10 0·68	5·1179495,1	131204·75	24·849
		XXX (Yerúl)	1·14	+1·06	+ ·73		+1·79	82 33 25·35	5·2054010,6	160472·65	30·393
			3·42				+4·00	180 0 0·00			
		XXVIII (Pophla)	1·25	− ·04	− ·66		− ·70	104 36 39·30	5·3125662,6	205383·85	38·898
26		XXX (Yerúl)	1·25	− ·09	+1·25		+1·16	43 52 32·79	5·1676370,0	147108·24	27·861
		XXXI (Jámkhed)	1·24	+1·88	− ·59		+1·29	31 30 47·91	5·0450926,2	110941·13	21·012
			3·74				+1·75	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
	188	XXIX (Rájur)	1·80	− ·13		−1·12	−1·25	47 39 8·77	5·1718948,8	148557·60	28·136
		XXXI (Jámkhed)	1·81	+ ·30		+1·61	+1·91	81 45 34·19	5·2987006,8	198930·17	37·676
		XXXII (Áhirmal)	1·80	− ·06		− ·49	− ·55	50 35 17·04	5·1911634,9	155297·14	29·412
			5·41				+ ·11	180 0 0·00			
	189	XXXII (Áhirmal)	2·23	− ·25		−1·14	−1·39	51 39 22·61	5·2799182,9	190510·22	36·081
		XXXI (Jámkhed)	2·24	+ ·19		+1·54	+1·73	90 38 20·90	5·3854073,1	242888·71	46·002
		XXXIII (Mathuri)	2·23	− ·17		− ·40	− ·57	37 42 16·49	5·1718948,8	148557·60	28·136
			6·70				− ·23	180 0 0·00			
27		XXX (Yerúl)	2·15	−1·30	+ ·26		−1·04	50 56 31·86	5·2169643,3	164802·70	31·213
		XXXI (Jámkhed)	2·15	+1·25	−1·25		·00	53 39 19·99	5·2328656,6	170948·65	32·377
		XXXIV (Dhaigaon)	2·16	−1·60	+ ·99		− ·61	75 24 8·15	5·3125662,6	205383·85	38·898
			6·46				−1·65	180 0 0·00			
28		XXXI (Jámkhed)	1·92	+2·62	− ·99		+1·63	50 46 58·24	5·1878534,6	154118·04	29·189
		XXXIV (Dhaigaon)	1·92	− ·07	+1·57		+1·50	73 16 31·92	5·2799183,0	190510·22	36·081
		XXXIII (Mathuri)	1·92	− ·35	− ·58		− ·93	55 56 29·84	5·2169643,3	164802·70	31·213
			5·76				+2·20	180 0 0·00			
29		XXXIV (Dhaigaon)	2·04	− ·38	+1·17		+ ·79	82 51 24·07	5·3306386,2	214110·80	40·551
		XXXIII (Mathuri)	2·04	−1·89	−3·88		−5·77	51 33 51·00	5·2279535,0	169025·99	32·013
		XXIV (Ágargaon)	2·04	+2·37	+2·71		+5·08	45 34 44·93	5·1878534,6	154118·04	29·189
			6·12				+ ·10	180 0 0·00			
30		XXXIII (Mathuri)	1·56	+ ·48	−1·91		−1·43	50 49 39·38	5·2222226,8	166810·22	31·593
		XXIV (Ágargaon)	1·55	+ ·19	+3·80		+3·99	33 29 7·07	5·0745026,5	118714·19	22·484
		XXIII (Chincholi)	1·56	+ ·43	−1·89		−1·46	95 41 13·55	5·3306386,2	214110·80	40·551
			4·67				+1·10	180 0 0·00			
	190	XXXIV (Dhaigaon)	1·41	− ·04		+3·49	+3·45	32 50 48·17	5·0745026,7	118714·19	22·484
		XXXIII (Mathuri)	1·41	−1·41		−5·79	−7·20	102 23 32·57	5·3299498,8	213771·52	40·487
		XXIII (Chincholi)	1·41	−1·31		+2·30	+ ·99	44 45 39·26	5·1878534,6	154118·04	29·189
			4·23				−2·76	180 0 0·00			

NOTE.—Stations XXIII (Chincholi) and XXIV (Ágargaon) appertain to the Bombay Longitudinal Series of the Southern Trigon.

February, 1890.

W. H. COLE,

In charge of Computing Office.

KHANPISURA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXI (Búda)	24 14 11·86	75 10 43·06	68 14 49·77	4·7960898,2	248 10 32·62	XXIV (Bálágara)
	„ „	„	„	318 22 31·33	4·9906041,7	138 27 18·09	I (Sítamau)
	„ „	„	„	357 46 23·46	5·1011136,7	177 46 45·02	II (Dhamnár)
1	XXIV (Bálágara)	24 10 21·90	75 0 15·84	292 1 43·09	5·1233300,4	112 10 45·64	I (Sítamau)
„	„ „	„	„	328 28 15·62	5·0816499,1	148 32 52·57	II (Dhamnár)
	I (Sítamau)	24 2 6·65	75 22 24·33	48 41 15·05	4·9036849,2	228 36 51·70	„ „
	„ „	„	„	344 1 17·66	5·0066897,4	164 3 19·59	III (Nigrun)
	„ „	„	„	294 12 6·37	5·2173375,4	114 23 4·08	IV (Dudhála)
2	II (Dhamnár)	23 53 22·29	75 11 35·91	296 50 40·79	4·9949085,4	116 57 4·33	III (Nigrun)
„	„ „	„	„	9 28 11·57	5·0530788,6	189 26 51·11	VI (Lohári)
	III (Nigrun)	23 45 59·27	75 27 25·29	256 16 6·69	5·1007639,4	76 24 59·44	IV (Dudhála)
	„ „	„	„	340 37 25·36	5·0905099,5	160 40 21·11	V (Deo Dongri)
	„ „	„	„	58 3 51·48	5·1002476,1	237 56 10·00	VI (Lohári)
	IV (Dudhála)	23 50 54·31	75 49 25·06	29 20 24·24	5·2237339,0	209 14 30·90	V (Deo Dongri)
	V (Deo Dongri)	23 26 47·79	75 34 44·17	108 35 28·39	5·1927174,7	288 24 54·74	VI (Lohári)
	„ „	„	„	56 50 22·80	5·0560418,5	236 43 37·71	VII (Dhanora)
	„ „	„	„	354 59 9·98	4·7473177,6	174 59 30·77	VIII (Gurla)
3	VI (Lohári)	23 34 57·88	75 8 16·03	334 42 14·23	5·0920594,6	154 45 59·49	VII (Dhanora)
„	„ „	„	„	351 41 36·72	5·2206490,4	171 43 18·72	XI (Kaula-ka-Máta)
4	VII (Dhanora)	23 16 30·23	75 17 42·57	266 8 24·59	5·0014903,5	86 15 29·14	VIII (Gurla)

NOTE.—Stations XXI (Búda) and XXIV (Bálágara) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
4	VII (Dhanora)	23 16 30·23	75 17 42·57	315 1 41·93	4·9202418,1	135 5 50·11	IX (Karsod)
„	„ „	„	„	28 43 19·99	4·7786086,1	208 41 18·15	XI (Kaula-ka-Máta)
	VIII (Gurla)	23 17 36·14	75 35 36·57	32 17 51·38	4·8895432,2	212 14 56·50	IX (Karsod)
	„ „	„	„	310 13 21·71	4·8181844,0	130 16 54·13	X (Jalálkheri)
5	IX (Karsod)	23 6 46·48	75 28 12·70	255 49 55·00	4·9755438,6	75 56 21·10	„ „
„	„ „	„	„	94 6 56·28	4·9439963,4	274 0 47·40	XI (Kaula-ka-Máta)
„	„ „	„	„	340 22 46·12	5·0930463,2	160 25 39·51	XII (Harnása)
„	„ „	„	„	37 24 48·90	5·1363074,8	217 19 2·10	XIII (Indráwan)
	X (Jalálkheri)	23 10 34·89	75 44 35·01	19 47 56·92	5·1717896,0	199 44 26·97	XII (Harnása)
	XI (Kaula-ka-Máta)	23 7 48·21	75 12 33·30	357 38 55·30	5·0611078,9	177 39 15·00	XIII (Indráwan)
	XII (Harnása)	22 47 29·91	75 35 37·33	93 42 39·67	5·0969580,6	273 34 2·85	„ „
	„ „	„	„	27 42 35·17	5·2285994,3	207 37 13·03	XIV (Mograba)
	„ „	„	„	343 26 0·80	5·1590244,2	163 28 49·24	XV (Singárchori)
6	XIII (Indráwan)	22 48 48·54	75 13 23·78	343 36 26·99	5·2162374,1	163 39 37·09	XIV (Mograba)
„	„ „	„	„	50 46 6·38	5·1257558,2	230 39 0·30	XVI (Gumánpur)
	XIV (Mograba)	22 22 44·21	75 21 38·57	264 22 2·41	5·0806120,3	84 30 8·96	XV (Singárchori)
	„ „	„	„	116 7 33·26	5·2224297,5	295 57 21·87	XVI (Gumánpur)
	„ „	„	„	346 21 49·56	5·1307296,3	166 23 57·49	XVII (Thíkri)
	„ „	„	„	48 11 11·63	5·3256813,5	228 0 38·57	XVIII (Báwangaz)
	XV (Singárchori)	22 24 39·91	75 42 55·62	31 42 23·76	5·2253017,9	211 36 28·95	XVII (Thíkri)
7	XVI (Gumánpur)	22 34 50·27	74 54 59·56	1 56 52·19	5·3319590,4	181 56 22·77	XVIII (Báwangaz)
	XVII (Thíkri)	22 1 2·77	75 27 17·16	87 4 17·73	5·2784758,4	266 51 42·71	„ „
	„ „	„	„	1 50 35·07	5·0931438,5	181 50 19·33	XIX (Jalálabad)
	„ „	„	„	47 43 35·26	5·3597984,0	227 32 28·29	XX (Bábákuvar)
8	XVIII (Báwangaz)	21 59 23·20	74 53 41·99	301 22 44·22	5·3383250,6	121 34 57·95	XIX (Jalálabad)
„	„ „	„	„	351 49 29·07	5·1635562,2	171 50 50·60	XX (Bábákuvar)
	XIX (Jalálabad)	21 40 35·29	75 26 34·90	79 39 33·91	5·2257597,2	259 28 47·50	„ „
	„ „	„	„	342 22 34·98	5·1477707,3	162 25 19·85	XXI (Árgaon)
	„ „	„	„	42 54 20·12	5·2545348,9	222 46 25·98	XXII (Ajnád)
9	XX (Bábákuvar)	21 35 33·54	74 57 21·60	296 19 54·05	5·3662898,6	116 33 19·78	XXI (Árgaon)
„	„ „	„	„	336 47 46·96	5·0422364,2	156 50 34·95	XXII (Ajnád)
	XXI (Árgaon)	21 18 27·70	75 34 4·92	90 50 55·04	5·2172132,3	270 40 21·23	„ „
	„ „	„	„	29 35 15·23	5·3738994,8	209 27 53·73	XXIII (Valvádi)
	„ „	„	„	350 43 55·64	5·1926514,3	170 45 30·91	XXIV (Dhanvár)
10	XXII (Ajnád)	21 18 49·40	75 5 0·92	346 48 57·00	5·3296345,6	166 52 1·21	XXIII (Valvádi)
„	„ „	„	„	309 15 32·56	5·3908798,9	129 27 35·65	XXIV (Dhanvár)
„	„ „	„	„	31 41 42·21	5·3540683,4	211 34 12·76	XXV (Anakvádi)
11	XXIII (Valvádi)	20 44 27·73	75 13 34·30	249 47 13·48	5·1792053,0	69 56 4·78	XXIV (Dhanvár)
„	„ „	„	„	95 24 34·96	5·2257840,6	275 14 9·36	XXV (Anakvádi)
„	„ „	„	„	307 32 38·54	5·1586443,7	127 39 41·83	XXVI (Sirsála)

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
11	XXIII (Valvádi)	20 44 27·73	75 13 34·30	8 17 32·52	5·1708844,0	188 16 13·70	XXVII (Sátmála)
	XXIV (Dhanvár)	20 53 3·31	75 38 29·61	11 16 10·85	5·1543785,8	191 14 27·20	XXVI (Sirsála)
	XXV (Anakvádi)	20 47 2·38	74 44 9·52	317 52 49·16	5·3394640,8	138 1 50·05	XXVII (Sátmála)
	XXVI (Sirsála)	20 29 56·24	75 33 36·25	66 39 28·49	5·1698058,7	246 31 10·79	„ „
	„ „	„	„	5 57 43·40	5·2250844,7	185 56 40·03	XXVIII (Pophla)
	„ „	„	„	324 14 14·88	5·2910314,1	144 21 10·24	XXIX (Rájur)
12	XXVII (Sátmála)	20 20 13·97	75 9 49·65	312 22 4·67	5·2054010,6	132 29 13·87	XXVIII (Pophla)
„	„ „	„	„	355 38 39·78	5·1179495,1	175 39 15·79	XXX (Yerúl)
	XXVIII (Pophla)	20 2 20·80	75 30 33·31	266 19 43·94	5·1203539,6	86 27 37·50	XXIX (Rájur)
	„ „	„	„	78 19 12·05	5·0450926,2	258 12 42·28	XXX (Yerúl)
	„ „	„	„	333 42 31·50	5·1676370,0	153 46 23·14	XXXI (Jámkhed)
	XXIX (Rájur)	20 3 43·04	75 53 34·58	25 29 10·23	5·1911634,9	205 25 12·55	„ „
	„ „	„	„	337 49 59·66	5·2987006,8	157 54 25·66	XXXII (Áhirmal)
13	XXX (Yerúl)	19 58 37·15	75 11 34·13	302 5 16·32	5·3125662,6	122 15 33·99	XXXI (Jámkhed)
„	„ „	„	„	353 1 50·33	5·2328656,6	173 3 3·58	XXXIV (Dhaigaon)
	XXXI (Jámkhed)	19 40 33·04	75 41 55·24	287 10 48·55	5·1718948,8	107 19 6·82	XXXII (Áhirmal)
	„ „	„	„	17 49 11·69	5·2799183,0	197 45 49·38	XXXIII (Mathuri)
	„ „	„	„	68 36 11·85	5·2169643,3	248 27 13·89	XXXIV (Dhaigaon)
	XXXII (Áhirmal)	19 33 16·35	76 6 39·51	55 39 41·98	5·3854073,1	235 28 8·10	XXXIII (Mathuri)
	XXXIII (Mathuri)	19 10 34·78	75 31 46·95	141 49 17·62	5·1878534,6	321 43 47·73	XXXIV (Dhaigaon)
	„ „	„	„	39 25 43·64	5·0745026,5	219 21 27·27	XXIII (Chincholi)
	„ „	„	„	90 15 24·58	5·3306386,2	270 3 10·74	XXIV (Ágargaon)
14	XXXIV (Dhaigaon)	19 30 35·04	75 15 10·99	354 34 37·31	5·3299498,8	174 35 46·60	XXIII (Chincholi)
„	„ „	„	„	44 35 13·84	5·2279535,0	224 28 23·77	XXIV (Ágargaon)
	XXIII (Chincholi)	18 55 25·27	75 18 41·47	123 40 12·16	5·2222226,8	303 32 19·36	„ „
	XXIV (Ágargaon)	19 10 40·52	74 54 32·97				

NOTE.—Stations XXIII (Chincholi) and XXIV (Ágargaon) appertain to the Bombay Longitudinal Series of the Southern Trigon.

February, 1890.

W. H. COLE,
In charge of Computing Office.

KHANPISURA 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 levelling operations, wherever a junction between the two has been effected. The spirit levelled determinations are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the levelling operations are adjusted by simple proportion to accord with the latter. In the table the spirit levelled values are printed thus, 2891'10, &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. XVII from Stn. XIV, page 67—G., to indicate that one set of adjustments ends and another begins. The trigonometrical heights always refer to the upper mark or to the upper surface of the pillar or structure on which the theodolite stood; when a spirit levelled height does not refer to either of these surfaces, it is given in combination with a correction, thus $\begin{cases} 854\cdot65 \\ -3\cdot5 \end{cases}$, and the sum of these two quantities, in this case 851·15, represents the value with which the corresponding trigonometrical mean height 849·2 is comparable. Descriptions follow these tables, exactly indicating the surfaces on which the levelling staff stood during the determinations of the spirit levelled 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 the ground level mark-stone in the floor of the 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 above Mean Sea Level are taken from the Karáchi Longitudinal Series of the North-West Quadrilateral and are as follows:—

XXI (Búda) 1525·5 feet; XXIV (Bálágara) 1804·1 feet.

Astronomical Date 1882-83	Mean of Times of observation	Number and Name of 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
Dec. 1	1 28	XXI (Búda)	D 0 4 15·8	4	1·7	4·8	640	− 5	·008	+ 24·7	1550·2	1548·2	1548	1·5
" 2	1 33	*Digau	D 0 6 53·1	4	1·7	4·8								
" 21	1 31	XXIV (Bálágara)	D 0 17 1·3	8	1·8	4·8	804	42	·052	−257·9	1546·2			
" 2	1 24	*Digau	E 0 4 43·5	4	0·9	4·8								

Note.—Stations XXI (Búda) and XXIV (Bálágara) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.
* This is an auxiliary station for the determination of height only, and its data are not published in this Volume.

Astronomical Date 1882-83	Mean of Times of observation	Number and Name of 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. 25	1 33	XXIV (Bálágara)	D 0 14 42·5	4	*0·9	4·8	1313	79	·060	−190·2	1613·9			
Dec. 6	2 0	I (Sítamau)	D 0 4 47·9	6	1·7	4·8								
„ 2, Jan. 2	1 33	† Digau	E 0 0 7·8	8	1·1	4·8	526	17	·032	+ 69·1	1617·3	1615·8	1616	15·4
„ 6, „ 3	1 41	I (Sítamau)	D 0 8 44·9	8	1·8	4·8								
„ 20, „ 1	1 41	II (Dhamnár)	D 0 8 42·8	8	3·7	4·8	791	34	·043	− 61·6	1616·2			
„ 6, „ 3	1 34	I (Sítamau)	D 0 3 30·3	10	2·0	4·8								
Jan. 20	2 53	XXI (Búda)	D 0 5 45·3	6	1·8	4·8	1247	25	·020	+158·1	‡ 1683·6			
„ 1	1 24	II (Dhamnár)	D 0 14 16·8	4	5·0	4·8								
Nov. 27,29, Dec. 21	2 11	XXIV (Bálágara)	D 0 12 37·3	12	1·8	4·8	1193	62	·052	−127·1	1677·0			
Dec. 20	2 15	II (Dhamnár)	D 0 5 20·5	6	3·1	4·8								
„ 2, Jan. 2	1 35	† Digau	E 0 1 57·9	14	2·3	4·8	624	12	·019	+130·3	1678·5	1677·6	1678	1
„ 20, „ 1	1 47	II (Dhamnár)	D 0 12 15·9	10	1·8	4·8								
„ 6, „ 3	1 34	I (Sítamau)	D 0 3 30·3	10	2·0	4·8	791	34	·043	+ 61·6	1677·2			
„ 20, „ 1	1 41	II (Dhamnár)	D 0 8 42·8	8	3·7	4·8								
„ 6	1 43	I (Sítamau)	D 0 8 50·9	4	1·8	4·8	1003	36	·036	− 28·8	1587·0			
„ 16	1 50	III (Nigrun)	D 0 6 48·5	6	4·3	4·8						1586·1	1587	10
„ 20	2 9	II (Dhamnár)	D 0 10 50·0	6	2·9	4·8	977	36	·037	− 92·4	1585·2			
„ 16, Jan. 6	1 31	III (Nigrun)	D 0 4 26·2	8	2·2	4·8								
„ 6	1 46	I (Sítamau)	D 0 9 44·4	4	2·5	4·8	959	52	·054	− 71·3	1544·5			
„ 7,18	2 4	† Tarauli	D 0 4 37·5	10	4·3	4·8						1545·3	1546	3·3
„ 15,16	2 6	III (Nigrun)	D 0 7 38·5	8	2·0	4·8	749	33	·044	− 40·0	1546·1			
„ 7,18	2 7	† Tarauli	D 0 4 1·5	8	1·8	4·8								
„ 15	2 11	III (Nigrun)	D 0 6 58·9	6	1·7	4·8	1246	63	·051	+ 89·3	1675·4			
„ 8	2 24	IV (Dudhála)	D 0 11 50·4	4	1·8	4·8						1674·5	1675	5
„ 7, Jan. 4	2 4	† Tarauli	E 0 1 14·2	10	2·1	4·8	679	38	·056	+128·2	1673·5			
„ 8	2 32	IV (Dudhála)	D 0 11 32·4	4	2·9	4·8								
„ 15, Jan. 6	2 27	III (Nigrun)	D 0 2 31·7	8	1·7	4·8	472	5	·011	+ 21·5	1607·6			
„ 14	2 52	† Pátan	D 0 5 33·8	4	1·8	4·1						1605·4	1606	6·5
„ 18, Jan. 4	2 2	† Tarauli	D 0 2 36·6	8	3·0	4·8	695	28	·040	+ 57·9	1603·2			
„ 14	2 21	† Pátan	D 0 8 17·7	4	1·6	4·1								
Jan. 6	1 30	III (Nigrun)	D 0 4 44·1	4	2·9	4·8	994	29	·029	+ 91·8	1677·9	1677·9	1678	5
„ 8	1 19	† Parnakhera	D 0 11 1·8	4	2·2	4·8								
Dec. 8	2 41	IV (Dudhála)	D 0 11 16·9	6	1·8	4·8	1654	91	·055	+ 51·1	1725·6			
„ 13	2 29	V (Deo Dongri)	D 0 13 22·9	4	1·8	4·8								
„ 14	2 34	† Pátan	D 0 3 14·0	6	4·3	4·1	962	32	·033	+120·2	1725·6	1726·6	1727	§
„ 13	1 34	V (Deo Dongri)	D 0 11 50·8	4	1·6	4·8								

NOTE.—Stations XXI (Búda) and XXIV (Bálágara) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.
* This height is to be combined with negative sign because the pillar at I (Sítamau) had a subsequent permanent addition made to it of 2·6 feet.
† These are auxiliary stations for the determination of height only, and their data are not published in this Volume. ‡ Rejected.
§ See description of this station, pages 4—G. and 5—G.

Astronomical Date 1882-83	Mean of Times of observation	Number and Name of 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. 8	1 36	* Parnakhera	D 0 4 49·2	4	1·8	4·8	886	44	·050	+ 50·7	1728·6			
„ 16	1 18	V (Deo Dongri)	D 0 8 42·7	4	1·7	4·8								
„ 1	2 20	II (Dhamnár)	D 0 7 0·7	6	0·9	4·8	1117	40	·036	+ 57·6	1735·2			
„ 18	1 55	VI (Lohári)	D 0 10 29·0	6	1·8	4·8								
„ 6	1 37	III (Nigrun)	D 0 5 36·7	4	1·8	4·8	1245	50	·040	+147·4	1733·5	1735·3	1736	13·4
„ 18	1 27	VI (Lohári)	D 0 13 39·4	4	1·8	4·8								
„ 8	1 33	* Parnakhera	D 0 2 0·5	4	1·8	4·8	655	33	·050	+ 59·2	1737·1			
„ 18	1 28	VI (Lohári)	D 0 8 7·8	4	2·1	4·8								
„ 16	1 16	V (Deo Dongri)	D 0 4 6·9	4	†4·9	4·8	1124	53	·047	+154·5	1881·1			
„ 11,12	1 49	VII (Dhanora)	D 0 13 1·9	10	1·8	†2·4								
„ 18	1 48	VI (Lohári)	D 0 5 16·5	6	1·8	4·8	1221	54	·044	+147·0	1882·3	1881·7	1883	18·0
Feb. 14	1 26	VII (Dhanora)	D 0 13 26·9	6	1·8	4·7								
Dec. 13, Jan. 16	1 45	V (Deo Dongri)	D 0 5 4·2	8	2·2	4·8	553	26	·047	− 12·0	1714·6			
Jan. 13	1 37	VIII (Gurla)	D 0 3 36·8	8	1·9	4·8								
„ 11,12	1 47	VII (Dhanora)	D 0 13 10·5	8	2·2	†2·4	992	37	·037	−165·9	1715·8	1715·2	1716	6·7
„ 13	1 44	VIII (Gurla)	D 0 2 17·6	6	†4·7	4·8								
„ 11,12, Feb. 14	1 36	VII (Dhanora)	D 0 10 19·4	12	1·6	1·2	822	36	·044	− 99·0	1782·7			
„ 26, „ 9	1 41	IX (Karsod)	D 0 2 26·5	8	†2·1	4·8								
„ 18	1 41	VIII (Gurla)	D 0 3 19·9	6	1·7	4·8	766	30	·039	+ 60·4	1775·6	1779·4	1781	5
„ 26,29	1 40	IX (Karsod)	D 0 8 39·2	8	2·4	4·8								
„ 23	1 32	XI (Kaula-ka-Máta)	D 0 13 2·0	4	1·7	4·8	869	53	·061	−167·5	1780·0			
„ 26,29	2 0	IX (Karsod)	E 0 0 2·9	8	1·4	4·8								
„ 18	2 41	VI (Lohári)	D 0 7 55·7	6	2·5	4·8	1642	85	·052	+211·9	1947·2			
„ 23	2 13	XI (Kaula-ka-Máta)	D 0 16 42·5	4	1·8	4·8								
„ 11,12	1 40	VII (Dhanora)	D 0 0 48·5	8	2·5	†2·4	594	5	·008	+ 66·0	1947·7	1947·2	1948	0·5
„ 23	1 34	XI (Kaula-ka-Máta)	D 0 8 48·5	4	1·8	4·8								
„ 26,29	2 0	IX (Karsod)	E 0 0 2·9	8	1·4	4·8	869	53	·061	+167·5	1946·7			
„ 23	1 32	XI (Kaula-ka-Máta)	D 0 13 2·0	4	1·7	4·8								
„ 13	1 37	VIII (Gurla)	D 0 3 33·8	6	2·2	4·8	650	25	·038	+ 30·0	1745·2			
„ 30,31	1 20	X (Jalálkheri)	D 0 6 41·2	8	2·4	4·8								
„ 26,29	1 33	IX (Karsod)	D 0 8 13·0	8	2·2	4·8	934	44	·047	− 29·2	1750·2	1747·7	1749	3·8
„ 30,31	1 23	X (Jalálkheri)	D 0 6 7·3	8	1·5	4·8								
„ 25,26	2 9	IX (Karsod)	D 0 7 42·7	8	2·0	4·8	651	22	·034	− 48·0	1731·4			
Feb. 8	1 55	* Kwála	D 0 2 42·5	6	1·5	4·5								
Jan. 23, Feb. 15	1 49	XI (Kaula-ka-Máta)	D 0 14 58·8	10	2·1	4·8	1046	35	·033	−208·4	1738·8	1734·4	1736	4·5
Feb. 8	1 52	* Kwála	D 0 1 27·3	6	1·7	4·5								

* These are auxiliary stations for the determination of height only, and their data are not published in this Volume.
† These heights are to be combined with negative signs because the pillar at VII (Dhanora) had a subsequent permanent addition made to it, *vide* page 5—G.

Astronomical Date 1883	Mean of Times of observation	Number and Name of 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. 16	1 27	* Baloda	D 0 5 35·4	4	1·4	4·6	453	−14	·031	− 17·8	1733·0			
„ 19	2 5	* Kwála	D 0 2 42·8	4	4·0	4·5								
Jan.29,Feb.9	1 44	IX (Karsod)	D 0 6 44·2	8	1·5	4·8	643	18	·028	− 28·7	1750·7			
Feb. 10,12	1 26	* Baloda	D 0 3 42·7	8	1·3	4·6								
„ 16	1 23	XI (Kaula-ka-Máta)	D 0 15 41·9	6	4·1	4·8	613	21	·034	−196·3	1750·9	1751·5	1753	·2
„ 10,12	1 13	* Baloda	E 0 5 57·5	8	1·7	4·6								
Mar. 19	2 5	* Kwála	D 0 2 42·8	4	4·0	4·5	453	−14	·031	+ 17·8	1752·9			
„ 16	1 27	* Baloda	D 0 5 35·4	4	1·4	4·6								
„ 17	1 30	XI (Kaula-ka-Máta)	D 0 13 39·5	6	4·3	4·8	849	23	·027	−173·4	1773·8			
„ 15	1 50	* Samalia	E 0 0 9·0	4	3·0	4·9								
Feb. 12	2 25	* Baloda	D 0 2 51·3	6	†3·2	4·6	365	−51	·140	+ 19·2	1770·7	1772·3	1774	5
„ 21	2 24	* Samalia	D 0 5 17·2	6	4·1	†0·2								
„ 15,16	1 37	XI (Kaula-ka-Máta)	D 0 11 43·5	8	‡5·5	4·8	740	37	·050	−124·2	1823·0			
„ 17	1 46	* Jalodia	E 0 0 29·0	4	4·3	‡3·0								
„ 12	1 57	* Baloda	D 0 0 40·8	8	‡5·5	4·6	511	−29	·057	+ 71·3	1822·8	1822·9	1825	8·8
„ 17	1 55	* Jalodia	D 0 9 0·1	4	4·1	‡3·0								
„ 10,12	1 24	* Baloda	D 0 3 57·9	8	2·5	4·6	646	− 9	·014	+ 32·2	1783·7			
„ 23	1 54	* Nagora	D 0 7 16·6	4	4·1	4·8								
„ 22	2 15	* Samalia	D 0 3 11·0	6	1·4	†0·2	446	−16	·036	+ 9·0	1781·3	1782·5	1784	5·8
„ 23	1 25	* Nagora	D 0 5 14·9	4	†2·8	4·8								
„ 9	1 36	IX (Karsod)	D 0 8 33·8	4	2·3	4·8	1225	39	·032	+ 39·0	1818·4			
„ 27	2 8	XII (Harnása)	D 0 10 42·9	6	2·3	4·5								
„ 8	1 55	* Kwála	D 0 2 8·5	6	2·3	4·5	718	11	·015	+ 79·2	1813·6	1815·9	1818	10·2
„ 27	2 12	XII (Harnása)	D 0 9 38·8	6	2·1	4·5								
„ 23	2 22	* Nagora	D 0 4 18·4	4	2·3	4·8	705	6	·009	+ 33·1	1815·6			
„ 27	2 7	XII (Harnása)	D 0 7 24·1	4	3·9	4·5								
„ 21,22	2 37	* Samalia	E 0 2 8·8	8	1·9	†0·2	372	−21	·056	+ 59·3	1831·6			
Mar. 9,10	1 50	XIII (Indráwan)	D 0 9 3·5	8	2·5	4·5								
„ 13	1 50	* Jalodia	D 0 2 39·4	4	11·3	4·6	414	−26	·063	+ 8·2	1831·1	1832·0	1834	7·5
„ 9,10	2 29	XIII (Indráwan)	D 0 4 32·2	8	4·6	4·5								
Feb. 23	2 10	* Nagora	D 0 1 46·4	4	1·9	4·8	540	−18	·033	+ 50·7	1833·2			
Mar. 9	1 55	XIII (Indráwan)	D 0 8 7·2	4	2·2	4·5								
Feb. 27	1 46	XII (Harnása)	E 0 0 34·3	4	4·5	4·5	1673	83	·050	+647·3	2463·2			
Mar. 6,7	1 52	XIV (Mograba)	D 0 25 44·1	8	3·6	4·6								
„ 9	2 36	XIII (Indráwan)	E 0 0 40·1	4	9·0	4·5	1626	60	·037	+627·8	2459·8	2461·5	2464	0
„ 6,7	1 53	XIV (Mograba)	D 0 25 41·5	8	3·0	4·6								

* These are auxiliary stations for the determination of height only, and their data are not published in this Volume.

† These heights are to be combined with negative signs because the pillar at Samalia had a subsequent permanent addition made to it of 5 feet.

‡ Ditto ditto Jalodia ditto ditto 7·8 „

Astronomical Date 1883		Mean of Times of observation	Number and Name of 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.	27	2 7	XII (Harnása)	E 0 14 49·2	4	2·8	4·5	1425	70	·049	+1073·2	2889·1			
Mar.	2	2 5	XV (Singárchori)	D 0 36 17·8	8	4·3	4·5						2888·6	2891·10	1·8
”	5,6,7	2 0	XIV (Mograba)	E 0 3 15·5	10	1·9	4·6	1190	64	·054	+ 426·6	2888·1			
”	2	1 32	XV (Singárchori)	D 0 21 1·3	4	4·5	4·5								
”	28	2 18	XIV (Mograba)	D 0 50 49·1	4	4·7	4·6	1335	79	·059	−1612·3	849·2	849·2	854·65	0
Apr.	3,4	2 11	XVII (Thíkri)	E 0 31 11·2	8	4·3	4·9							−3·5	
Mar.	20	3 1	XIII (Indráwan)	D 0 11 17·2	4	11·8	4·5	1320	−17	·013	− 7·1	1826·8			
”	28	2 51	XVI (Gumánpur)	D 0 10 57·0	4	10·7	4·5						1828·2	1825	5·3
”	5,6,7	1 57	XIV (Mograba)	D 0 25 25·9	16	2·5	4·6	1649	85	·052	− 634·0	1829·6			
”	23	1 49	XVI (Gumánpur)	E 0 0 43·6	4	4·6	4·5								
”	24	2 14	XVI (Gumánpur)	D 0 11 0·6	4	4·2	4·5	2123	124	·058	+ 289·9	2118·1			
Apr.	7	2 31	XVIII (Báwangaz)	D 0 20 20·0	6	1·7	4·8						2117·9	2112	†
Mar.	7,28	2 1	XIV (Mograba)	D 0 20 54·5	10	4·2	4·6	2092	128	·061	− 346·0	2117·6			
Apr.	7	2 5	XVIII (Báwangaz)	D 0 9 40·5	4	4·2	4·8								
”	3,4	1 43	XVII (Thíkri)	E 0 8 40·2	8	4·2	4·9	1876	96	·051	+1255·0	2106·2*			
”	7	1 25	XVIII (Báwangaz)	D 0 36 46·0	4	4·2	4·8								
”	4	1 52	XVII (Thíkri)	E 0 39 55·6	6	3·0	4·9	1225	70	·057	+1767·6	2618·8			
”	12	1 15	XIX (Jalálabad)	D 0 58 5·2	4	4·2	4·5								
”	7	1 41	XVIII (Báwangaz)	D 0 7 55·2	4	3·0	4·8	2154	125	·058	+ 505·7	2623·6	2621·3	2613	2·5
”	12,13	2 40	XIX (Jalálabad)	D 0 23 50·7	8	4·2	4·5								
(1)		2 11	XX (Bábákuvar)	D 0 13 11·1	10	1·9	4·8	1662	99	·060	− 45·1	2621·4			
(2)		2 10	XIX (Jalálabad)	D 0 11 21·3	10	1·3	4·8								
Apr.	3,4	1 49	XVII (Thíkri)	E 0 10 19·8	8	1·9	4·9	2263	121	·053	+1814·1	2665·3			
”	24	1 34	XX (Bábákuvar)	D 0 44 4·3	6	5·4	4·5								
”	7	1 24	XVIII (Báwangaz)	E 0 2 8·3	4	1·9	4·8	1440	74	·051	+ 549·8	2667·7	2666·4	2658	1·0
”	20	2 0	XX (Bábákuvar)	D 0 23 44·3	6	4·2	4·5								
(2)		2 10	XIX (Jalálabad)	D 0 11 21·3	10	1·3	4·8	1662	99	·060	+ 45·1	2666·3			
(1)		2 11	XX (Bábákuvar)	D 0 13 11·1	10	1·9	4·8								
1884															
Dec.	9	2 11	XIX (Jalálabad)	E 0 2 18·7	8	2·0	5·1	1389	80	·058	+ 516·1	3137·4			
Nov.	21	1 56	XXI (Árgaon)	D 0 22 56·2	8	2·0	5·1								
Dec.	3	2 21	XX (Bábákuvar)	D 0 9 33·6	6	2·0	5·1	2297	156	·068	+ 475·3	3141·7	3139·6	3129	0·8
Nov.	19	2 11	XXI (Árgaon)	D 0 23 37·5	6	1·7	5·1								
”	25	2 11	XXII (Ajnád)	E 0 19 6·1	4	2·0	5·1	1630	104	·064	+1487·4	3139·7			
”	19	2 6	XXI (Árgaon)	D 0 42 55·4	6	1·7	5·1								
Dec.	9	2 31	XIX (Jalálabad)	D 0 31 36·2	8	1·8	5·1	1776	109	·061	− 969·9	1651·4			
Nov.	28	2 27	XXII (Ajnád)	E 0 5 30·4	6	1·8	5·1								

(1) The mean of observations taken on 20th and 21st April, 1883, and 4th December, 1884. (2) The mean of observations taken on 14th April, 1883, and 9th December, 1884. * Rejected. † See description of this station, page 7—G.

Astronomical Date 1884		Mean of Times of observation	Number and Name of 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
Dec.	3	2 29	XX (Bábákuvar)	D 0 39 46·3	4	1·4	5·1	1089	62	·057	−1013·3	1653·1	1652·2	1641	0·7
Nov.	28	2 4	XXII (Ajnád)	E 0 23 27·0	4	1·7	5·1								
”	19	2 6	XXI (Árgaon)	D 0 42 55·4	6	1·7	5·1	1630	104	·064	−1487·4	1652·2			
”	25	2 11	XXII (Ajnád)	E 0 19 6·1	4	2·0	5·1								
”	19,21	1 49	XXI (Árgaon)	D 0 54 34·9	6	3·5	5·1	1540	94	·061	−1962·0	1177·6			
Apr.	17	1 35	XXIV (Dhanvár)	E 0 31 56·4	4	1·7	5·1								
Nov.	25,28	2 14	XXII (Ajnád)	D 0 24 25·3	8	3·5	5·1	2431	149	·061	− 473·3	1178·9	1178·3	1164·81	2·0
Apr.	17	2 20	XXIV (Dhanvár)	D 0 11 12·6	8	2·1	5·1								
”	22	1 44	XXIII (Valvádi)	D 0 10 24·2	6	2·3	4·4	1493	72	·048	+ 39·2	1178·3			
”	17	1 44	XXIV (Dhanvár)	D 0 12 10·7	6	3·3	5·1								
Nov.	19	2 20	XXI (Árgaon)	D 0 46 12·6	6	4·1	5·1	2338	142	·061	−2000·6	1139·0			
Apr.	26	1 52	XXIII (Valvádi)	E 0 11 54·6	6	1·7	4·4								
Nov.	25,28	2 8	XXII (Ajnád)	D 0 23 48·4	6	4·1	5·1	2111	124	·059	− 513·0	1139·2	1139·1	1127·57 −2·8	2·0
Apr.	22	1 34	XXIII (Valvádi)	D 0 7 19·2	4	1·8	4·4								
”	17	1 44	XXIV (Dhanvár)	D 0 12 10·7	6	3·3	5·1	1493	72	·048	− 39·2	1139·1			
”	22	1 44	XXIII (Valvádi)	D 0 10 24·2	6	2·3	4·4								
Nov.	25,28	2 17	XXII (Ajnád)	D 0 7 15·4	6	1·3	5·1	2233	132	·059	+ 605·6	2257·8			
May	2	1 56	XXV (Anakvádi)	D 0 25 40·1	4	1·8	4·8								
Apr.	23	1 38	XXIII (Valvádi)	E 0 10 26·9	4	2·0	4·4	1662	91	·055	+1116·6	2255·7	2256·8	2243·74	3·2
May	2	1 40	XXV (Anakvádi)	D 0 35 8·5	4	5·0	4·8								
Apr.	22	2 9	XXIII (Valvádi)	E 0 29 1·3	4	1·7	4·4	1424	76	·053	+1663·3	2788·1			
”	8	2 16	XXVI (Sirsála)	D 0 50 18·3	4	3·3	5·0								
”	17	2 5	XXIV (Dhanvár)	E 0 28 33·5	6	1·7	5·1	1410	77	·055	+1623·9	2788·7	2789·6	2790	0·8
”	10	1 53	XXVI (Sirsála)	D 0 49 40·2	6	1·8	5·0								
”	2	1 51	XXVII (Sátmála)	D 0 17 59·1	4	3·8	5·3	1461	74	·051	− 301·3	2792·1			
”	8,9	1 55	XXVI (Sirsála)	D 0 3 58·7	6	3·3	5·0								
”	23	2 0	XXIII (Valvádi)	E 0 34 50·8	4	1·8	4·4	1456	81	·056	+1958·4	3083·2	3083·2	3084	0·0
”	3	2 6	*A	D 0 56 30·1	4	4·1	5·3								
”	3	2 23	*A	E 0 34 12·6	2	5·3	5·3	9	0	·000	+ 8·8	3092·0			
”	3	1 47	XXVII (Sátmála)	D 0 34 21·6	2	5·3	5·3								
May	2	1 25	XXV (Anakvádi)	D 0 2 31·4	4	4·6	4·8	2159	126	·058	+ 851·1	3094·8	3092·2	3093	5·0
Apr.	3	1 22	XXVII (Sátmála)	D 0 29 21·2	4	1·8	5·3								
”	8,9	1 55	XXVI (Sirsála)	D 0 3 58·7	6	3·3	5·0	1461	74	·051	+ 301·3	3089·7			
”	2	1 51	XXVII (Sátmála)	D 0 17 59·1	4	3·8	5·3								
”	8	1 57	XXVI (Sirsála)	D 0 12 2·8	6	1·9	5·0	1660	82	·049	+ 23·5	2813·1			
Mar.	11,14	1 44	XXVIII (Pophla)	D 0 12 58·3	6	3·8	5·1						2816·3	2818	1·3

* This is an auxiliary station for the determination of height only, and its data are not published in this Volume.

Astronomical Date 1884		Mean of Times of observation	Number and Name of 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.	2	1 29	XXVII (Sátmála)	D 0 17 54·5	6	1·9	5·3	1586	73	·046	− 272·7	2819·5			
Mar.	14	1 28	XXVIII (Pophla)	D 0 6 4·8	6	8·5	5·1								
Apr.	9	1 29	XXVI (Sirsála)	D 0 26 25·4	6	1·3	5·0	1932	92	·048	− 670·4	2119·2			
Mar.	8	1 31	XXIX (Rájur)	D 0 2 48·7	6	3·0	5·1						2122·7	2125	20·3
„	11	1 28	XXVIII (Pophla)	D 0 27 47·9	6	1·7	5·1	1304	68	·052	− 690·1	2126·2			
„	6	1 24	XXIX (Rájur)	E 0 8 13·9	4	4·3	5·1								
Apr.	2	1 15	XXVII (Sátmála)	D 0 13 31·0	4	2·5	5·3	1297	48	·037	− 130·8	2961·4			
Mar.	25	1 21	XXX (Yerúl)	D 0 6 34·2	4	5·8	5·1						2957·3	2959	1·0
„	11	2 21	XXVIII (Pophla)	D 0 4 5·8	6	1·7	5·1	1096	54	·049	+ 136·9	2953·2			
„	25,29	2 7	XXX (Yerúl)	D 0 12 34·3	6	1·8	5·1								
„	11	1 58	XXVIII (Pophla)	D 0 26 9·0	4	2·5	5·1	1454	71	·049	− 648·6	2167·7			
Feb.	21	1 59	XXXI (Jámkhed)	E 0 4 12·2	6	4·3	5·1						2171·2	2174	3·0
Mar.	29	1 43	XXX (Yerúl)	D 0 28 15·7	4	3·3	5·1	2030	107	·053	− 782·5	2174·8			
Feb.	23	1 42	XXXI (Jámkhed)	D 0 2 5·9	6	1·6	5·1								
Mar.	6	2 15	XXIX (Rájur)	D 0 3 20·0	6	3·0	5·1	477	12	·025	+ 8·4	2131·1			
„	4	2 8	* Chaura Dongar	D 0 4 37·7	4	1·6	5·0						2135·0	2138	0·5
Feb.	25	1 35	XXXI (Jámkhed)	D 0 9 12·7	6	2·1	5·1	1061	46	·043	− 32·3	2138·9			
Mar.	4	1 34	* Chaura Dongar	D 0 7 7·2	4	2·5	5·0								
„	6	1 39	XXIX (Rájur)	D 0 16 44·4	6	1·8	5·1	1966	92	·047	− 106·7	2016·0			
„	1	1 37	XXXII (Áhirmal)	D 0 13 3·1	6	1·8	5·0								
Feb.	20	1 33	XXXI (Jámkhed)	D 0 14 16·1	4	2·0	5·1	1469	87	·059	− 147·2	2024·0	2020·5	2024	5·0
„	27	1 32	XXXII (Áhirmal)	D 0 7 27·1	4	2·0	5·0								
Mar.	4	1 59	* Chaura Dongar	D 0 14 36·6	6	3·5	5·0	1649	91	·055	− 113·6	2021·4			
Feb.	28	1 48	XXXII (Áhirmal)	D 0 9 57·7	6	1·8	5·0								
„	17	2 12	XXXI (Jámkhed)	D 0 13 43·0	4	2·3	5·1	1883	112	·059	+ 9·2	2180·4			
„	5,6,9	2 23	XXXIII (Mathuri)	D 0 14 0·8	10	4·2	5·0								
„	29	2 47	XXXII (Áhirmal)	D 0 15 19·4	6	2·0	5·0	2401	148	·062	+ 161·2	2181·7	2183·1	2188	†
„	9	2 48	XXXIII (Mathuri)	D 0 19 53·4	6	1·8	5·0								
„	12	2 24	XXXIV (Dhaigaon)	E 0 2 31·4	4	2·3	5·0	1523	65	·043	+ 636·3	2187·2			
„	4,5	2 2	XXXIII (Mathuri)	D 0 25 45·1	6	7·3	5·0								
Mar.	27,29	2 15	XXX (Yerúl)	D 0 41 4·5	6	5·3	5·1	1690	80	·047	−1409·3	1548·0			
Feb.	14	2 14	XXXIV (Dhaigaon)	E 0 15 35·0	6	4·3	5·0								
„	17	1 27	XXXI (Jámkhed)	D 0 25 20·2	4	5·1	5·1	1629	68	·042	− 617·5	1553·7	1548·8	1553	2·0
„	14	1 33	XXXIV (Dhaigaon)	E 0 0 22·0	6	2·2	5·0								
„	4,5	2 2	XXXIII (Mathuri)	D 0 25 45·1	6	7·3	5·0	1523	65	·043	− 636·3	1544·8			
„	12	2 24	XXXIV (Dhaigaon)	E 0 2 31·4	4	2·3	5·0								

* This is an auxiliary station for the determination of height only, and its data are not published in this Volume. † See description of this station, page 85—G.

Astronomical Date 1884		Mean of Times of observation	Number and Name of 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.	2	2 11	XXXIII (Mathuri)	E 0 4 29·2	4	1·8	5·0	962	61	·063	+ 328·2	2511·3			
Jan.	27	1 55	*Tarkha	D 0 18 36·8	4	4·3	5·0						2511·1	2516	0·0
Feb.	12	1 50	XXXIV (Dhaigaon)	E 0 11 39.0	4	1·8	5·0	1451	78	·054	+ 962·1	2510·9			
Jan.	31	1 59	*Tarkha	D 0 33 16·8	6	7·3	5·0								
Feb.	2	1 52	XXXIII (Mathuri)	E 0 12 43·3	4	4·1	5·0	1173	67	·057	+ 739·5	2922·6			
Jan.	23,25	2 12	XXIII (Chincholi)	D 0 30 5·7	6	4·3	5·0								
"	27	2 16	*Tarkha	E 0 15 16·8	6	4·1	5·0	678	24	·035	+ 410·2	2921·3	2922·7	2928	10·6
"	25	2 6	XXIII (Chincholi)	D 0 25 49·7	4	4·2	5·0								
1883-84															
Nov.	17	2 28	XXIV (Ágargaon)	D 0 16 59·7	4	4·4	9·5	1649	89	·054	− 224·7	2924·1			
Jan.	25	2 25	XXIII (Chincholi)	D 0 7 33·3	4	8·7	5·0								
Feb.	4	2 15	XXXIII (Mathuri)	D 0 0 0·1	4	8·7	5·0	2116	125	·059	+ 964·7	3147·8			
Nov.	17	2 23	XXIV (Ágargaon)	D 0 31 7·2	4	4·1	9·5								
Feb.	12	2 7	XXXIV (Dhaigaon)	E 0 20 12·9	4	8·7	5·0	1671	91	·054	+1600·9	3149·7	3148·1	3153·95	†12·0
Nov.	17	2 18	XXIV (Ágargaon)	D 0 45 0·1	4	7·7	9·5								
Jan.	25	2 25	XXIII Chincholi)	D 0 7 33·3	4	8·7	5·0	1649	89	·054	+ 224·7	3146·7			
Nov.	17	2 28	XXIV (Ágargaon)	D 0 16 59·7	4	4·4	9·5								

NOTE.—Stations XXIII (Chincholi) and XXIV (Ágargaon) appertain to the Bombay Longitudinal Series of the Southern Trigon.

* This is an auxiliary station for the determination of height only, and its data are not published in this Volume.

† When the vertical angles were measured the height of the upper mark was 16·43 feet above the bench-mark mentioned in the description of the station. Since then the height has been reduced to 12 feet as given in the last column.

Description of Spirit-levelled Points.

When determining the Spirit-levelled heights, given on pages 67—G. to 70—G., the levelling staff stood on the surfaces hereafter described.

XV (Singárchori)	On the upper mark-stone.
XVII (Thíkri)	On a rock at the foot of the rectangular protecting pillar, height = 851·77 feet. To this value, 2·88 feet (the height of the upper surface of the rectangular protecting pillar above this rock) being added, the height of the upper surface of the protecting pillar was found to be 854·65 feet.
XXIII (Valvádi)	On a stone at the side of the circular pillar, height = 1124·56 feet. To this value, 3·01 feet (the height of the upper surface of the rectangular protecting pillar above this stone) being added, the height of the upper surface of the protecting pillar was found to be 1127·57 feet.
XXIV (Dhanvár) **XXV** (Anakvádi)	} On the upper mark-stone.
XXIV (Ágargaon)	On a bench-mark (⊙) at the foot of the station, height = 3141·95 feet. To this value, 12·0 feet (the height of the upper mark-stone above this B. M.) being added, the height of the upper mark-stone was found to be 3153·95 feet.

For further particulars of these stations, see pages 6—G. to 8c—G.

NOTE.—Station XXIV (Ágargaon) appertains to the Bombay Longitudinal Series.

W. H. COLE,

March, 1890.

In charge of Computing Office.

KHANPISURA MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XIII (Indráwan)

Lat. N. 22° 48′ 48″·54; Long. E. 75° 13′ 23″·78 = 5^h 0^m 53^s·6; Height above Mean Sea Level, 1834 feet.
March and April 1847; observed by Lieutenant H. Rivers with Dollond's 15-inch Theodolite.

Star observed	α Ursæ Minoris (West and East).
Mean Right Ascension 1847·0	1^h 4^m 9^s
Mean North Polar Distance 1847·0	1° 30′ 22″·85
Local Mean Times of Elongation, March 29	Western 6^h 36^m Eastern 18 39

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	′ ″	° ′ ″
Mar. 29	W.	0 0	+ 1 12 24·66	15 14	+ 0 12·97	+ 1 12 37·63	+ 1 12 29·33	6 5	+ 0 2·07	+ 1 12 31·40
		&	12 25·33	13 49	0 10·67	36·00	12 30·66	4 20	0 1·05	31·71
		180 0	12 31·00	9 2	0 4·56	35·56	12 32·67	1 3	0 0·06	32·73
			12 33·00	10 51	0 6·58	39·58	12 31·67	2 21	0 0·31	31·98
„ 29	E.	0 0	− 2 3 4·33	16 25	− 0 15·06	− 2 3 19·39	− 2 2 31·67	31 20	− 0 54·74	− 2 3 26·41
		&	3 5·67	14 55	0 12·44	18·11	2 35·33	29 38	0 48·98	24·31
		180 0					2 49·67	24 6	0 32·42	22·09
							2 52·00	22 32	0 28·35	20·35
„ 30	W.	10 0	+ 1 12 37·33	5 38	+ 0 1·78	+ 1 12 39·11	+ 1 12 24·00	14 3	+ 0 11·05	+ 1 12 35·05
		&	12 38·34	3 57	0 0·88	39·22	12 25·33	12 19	0 8·49	33·82
		190 0	12 37·67	1 11	0 0·08	37·75	12 27·00	10 13	0 5·82	32·82
			12 39·00	2 51	0 0·45	39·45	12 22·33	11 47	0 7·75	30·08
							12 21·67	12 56	0 9·33	31·00
„ 30	E.	10 0	− 2 0 45·33	53 0	− 2 36·02	− 2 3 21·35	− 2 1 45·66	41 3	− 1 33·75	− 2 3 19·41
		&	0 55·00	51 3	2 24·81	19·81	1 56·00	38 54	1 24·22	20·22
		190 0	3 3·00	18 16	0 18·62	21·62	2 33·66	28 25	0 45·01	18·67
			3 3·00	16 14	0 14·71	17·71	2 38·33	26 36	0 39·45	17·78
			3 4·67	14 56	0 12·45	17·12				

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	′ ″	° ′ ″
Mar. 31	W.	20 0	+ 1 12 39·33	0 47	+ 0 0·03	+ 1 12 39·36	+ 1 12 33·00	8 48	+ 0 4·34	+ 1 12 37·34
		&	12 38·66	2 19	0 0·30	38·96	12 28·66	7 13	0 2·92	31·58
		200 0	12 33·67	8 51	0 4·37	38·04	12 13·33	19 13	0 20·60	33·93
			12 31·33	10 46	0 6·47	37·80	12 10·00	21 14	0 25·15	35·15
			12 30·67	12 3	0 8·10	38·77				
„ 31	E.	20 0	− 2 0 54·34	50 45	− 2 23·13	− 2 3 17·47	− 2 2 33·34	29 56	− 0 50·00	− 2 3 23·34
		&	1 0·66	48 54	2 12·94	13·60	2 51·66	22 36	0 28·49	20·15
		200 0	2 59·67	15 56	0 14·17	13·84	2 56·00	21 5	0 24·80	20·80
			3 5·00	13 51	0 10·71	15·71	3 21·66	6 14	0 2·17	23·83
							3 24·00	4 27	0 1·10	25·10
Apr. 1	W.	30 0	+ 1 12 32·66	4 51	+ 0 1·31	+ 1 12 33·97	+ 1 12 25·00	13 14	+ 0 9·80	+ 1 12 34·80
		&	12 36·67	6 32	0 2·38	39·05	12 24·66	11 33	0 7·47	32·13
		210 0	12 32·33	12 55	0 9·31	41·64	12 11·00	21 33	0 25·91	36·91
			12 29·33	14 35	0 11·87	41·20	12 1·33	23 48	0 31·59	32·92
„ 1	E.	30 0	− 2 1 29·67	43 45	− 1 46·53	− 2 3 16·20	− 2 0 39·66	54 25	− 2 44·43	− 2 3 24·09
		&	1 38·00	41 45	1 37·05	15·05	0 48·66	52 40	2 34·08	22·74
		210 0	2 58·34	16 43	0 15·60	13·94	3 20·00	5 22	0 1·61	21·61
			3 4·33	14 19	0 11·44	15·77	3 20·33	0 0	0 0·00	20·33
„ 2	W.	40 0	+ 1 12 35·66	5 50	+ 0 1·90	+ 1 12 37·56	+ 1 12 29·00	13 20	+ 0 9·92	+ 1 12 38·92
		&	12 38·34	7 10	0 2·87	41·21	12 25·00	14 34	0 11·84	36·84
		220 0	12 5·33	26 1	0 37·74	43·07	12 12·00	18 40	0 19·45	31·45
			11 58·34	27 26	0 41·96	40·30	12 10·67	20 3	0 22·43	33·10
„ 2	E.	40 0	− 2 3 2·00	16 44	− 0 15·64	− 2 3 17·64	− 2 3 25·67	2 41	− 0 0·40	− 2 3 26·07
		&	3 10·67	7 9	0 2·86	13·53	3 26·00	1 28	0 0·12	26·12
		220 0					3 27·00	4 54	0 1·34	28·34
							3 21·66	8 7	0 3·69	25·35
„ 3	W.	50 0	+ 1 12 39·67	0 8	+ 0 0·00	+ 1 12 39·67	+ 1 12 35·34	7 41	+ 0 3·30	+ 1 12 38·64
		&	12 38·67	0 52	0 0·04	38·71	12 32·33	8 52	0 4·40	36·73
		230 0	12 5·33	23 38	0 31·18	36·51	12 27·33	13 10	0 9·69	37·02
			12 4·00	25 15	0 35·58	39·58	12 24·33	14 41	0 12·05	36·38
			12 2·33	26 11	0 38·26	40·59				
„ 4	E.	50 0	− 2 3 12·00	8 17	− 0 3·84	− 2 3 15·84	− 2 1 47·00	41 49	− 1 37·36	− 2 3 24·36
		&	3 10·67	6 42	0 2·52	13·19	1 51·00	39 31	1 26·98	17·98
		230 0	3 15·00	0 35	0 0·02	15·02	3 22·00	9 39	0 5·22	27·22
			3 16·67	1 16	0 0·09	16·76	3 21·67	11 28	0 7·37	29·04
							3 18·33	12 45	0 9·11	27·44
„ 5	E.	40 0	− 2 3 17·00	1 26	− 0 0·12	− 2 3 17·12	− 2 3 12·67	12 18	− 0 8·46	− 2 3 21·13
		&	3 17·00	0 6	0 0·00	17·00	3 24·33	7 3	0 2·78	27·11
		220 0	3 16·67	4 56	0 1·36	18·03				
			3 15·67	6 39	0 2·47	18·14				

Abstract of Astronomical Azimuth observed at XIII (Indráwan) 1847.

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	March 29		March 30		March 31		April 1		April 2		April 4	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	19·39	26·41	21·35	19·41	17·47	23·34	16·20	24·09	17·64	26·07	15·84	24·36
	18·11	24·31	19·81	20·22	13·60	20·15	15·05	22·74	13·53	26·12	13·19	17·98
		22·09	21·62	18·67	13·84	20·80	13·94	21·61	*16·06	28·34	15·02	27·22
		20·35	17·71	17·78	15·71	23·83	15·77	20·33	*15·94	25·35	16·76	29·04
			17·12			25·10			*16·97	*20·07		27·44
									*17·08	*26·05		
Means	18·75	23·29	19·52	19·02	15·16	22·64	15·24	22·19	16·20	25·33	15·20	25·21
	° ′ ″		″		″		″		″		″	
Means of both faces	− 2 3 21·02		19·27		18·90		18·72		20·76		20·21	
Az. of Star fr. S., by W.	181 37 56·33		56·63		56·93		57·23		57·56		58·27	
Az. of Ref. M. „	179 34 35·31		37·36		38·03		38·51		36·80		38·06	

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	March 29		March 30		March 31		April 1		April 2		April 3	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	37·63	31·40	39·11	35·05	39·36	37·34	33·97	34·80	37·56	38·92	39·67	38·64
	36·00	31·71	39·22	33·82	38·96	31·58	39·05	32·13	41·21	36·84	38·71	36·73
	35·56	32·73	37·75	32·82	38·04	33·93	41·64	36·91	43·07	31·45	36·51	37·02
	39·58	31·98	39·45	30·08	37·80	35·15	41·20	32·92	40·30	33·10	39·58	36·38
				31·00	38·77						40·59	
Means	37·19	31·96	38·88	32·55	38·59	34·50	38·97	34·19	40·54	35·08	39·01	37·19
	° ′ ″		″		″		″		″		″	
Means of both faces	+ 1 12 34·57		35·72		36·54		36·58		37·81		38·10	
Az. of Star fr. S., by W.	178 22 3·82		3·52		3·22		2·92		2·62		2·27	
Az. of Ref. M. „	179 34 38·39		39·24		39·76		39·50		40·43		40·37	

		°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation	179	34	37·34
	by Western „		„	39·62
	Mean		„	38·48
Angle Referring Mark and XII (Harnása) *see page* 19—G. *ante*	... ...	+ 93	59	23·93
Astronomical Azimuth of Harnása by observation	... ...	273	34	2·41
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur, *see page* 61—G. *ante*	... ...	273	34	2·85
Astronomical − Geodetical Azimuth at XIII (Indráwan)	... ...	−		0·44

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 XXIII (Valvádi)

Lat. N. 20° 44′ 27″·73; Long. E. 75° 13′ 34″·30 = 5h 0m 54s·3; Height above Mean Sea Level, 1125 feet.
December 1846; observed by Lieutenant H. Rivers with Dollond's 15-inch Theodolite.

Star observed — ε Ursæ Minoris (East and West).
Mean Right Ascension 1846·0 — 17h 1m 56s
Mean North Polar Distance 1846·0 — 7° 43′ 7″·70
Local Mean Times of Elongation, December 6 — Eastern 18h 12m; Western 5 50

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. 6	E.	140 0	− 6 39 10·00	8 55	− 0 22·22	− 6 39 32·22	− 6 38 15·00	16 45	− 1 18·20	− 6 39 33·20
		&	39 12·00	7 39	0 16·36	28·36	38 27·66	15 11	1 4·29	31·95
		320 0	39 32·33	2 53	0 2·33	34·66	39 26·33	5 22	0 8·05	34·38
			39 34·33	1 42	0 0·81	35·14	39 15·34	7 2	0 13·84	29·18
„ 7	W.	140 0	+ 9 50 42·67	11 47	+ 0 38·99	+ 9 51 21·66	+ 9 51 16·33	2 24	+ 0 1·62	+ 9 51 17·95
		&	50 53·67	10 16	0 29·59	23·26	51 18·34	1 21	0 0·52	18·86
		320 0	50 25·67	13 35	0 51·51	17·18	51 6·00	5 54	0 9·75	15·75
			50 18·00	15 1	1 2·92	20·92	51 0·00	7 11	0 14·44	14·44
„ 7	E.	150 0	− 6 38 22·33	15 9	− 1 3·96	− 6 39 26·29	− 6 39 26·67	5 4	− 0 7·17	− 6 39 33·84
		&	38 31·67	13 55	0 53·98	25·65	39 32·00	2 27	0 1·68	33·68
		330 0								
„ 8	W.	150 0	+ 9 51 6·00	6 12	+ 0 10·77	+ 9 51 16·77	+ 9 51 5·00	2 49	+ 0 2·21	+ 9 51 7·21
		&	51 15·67	4 57	0 6·87	22·54	51 7·67	4 8	0 4·77	12·44
		330 0	49 22·34	20 12	1 53·51	15·85	50 22·00	13 37	0 51·67	13·67
			49 8·34	21 26	2 7·76	16·10				
„ 8	E.	160 0	− 6 39 9·67	8 5	− 0 18·24	− 6 39 27·91	− 6 38 21·67	15 44	− 1 8·96	− 6 39 30·63
		&	39 16·34	6 54	0 13·29	29·63	38 32·00	14 35	0 59·27	31·27
		340 0	39 27·34	1 42	0 0·81	28·15	39 30·00	4 41	0 6·14	36·14
			39 25·33	0 37	0 0·11	25·44	39 20·33	5 53	0 9·70	30·03
							39 14·67	7 4	0 13·99	28·66
„ 9	W.	160 0	+ 9 50 24·33	13 54	+ 0 54·22	+ 9 51 18·55	+ 9 51 4·34	4 40	+ 0 6·11	+ 9 51 10·45
		&	50 32·00	12 40	0 45·02	17·02	51 8·00	3 31	0 3·47	11·47
		340 0	50 41·67	10 20	0 29·77	11·44	51 14·00	1 39	0 0·76	14·76
			50 39·00	11 19	0 35·70	14·70	51 15·33	2 52	0 2·29	17·62
			50 32·00	12 26	0 43·08	15·08	51 14·67	3 39	0 3·72	18·39
„ 9	E.	170 0	− 6 39 18·66	5 37	− 0 8·82	− 6 39 27·48	− 6 39 24·33	5 33	− 0 8·62	− 6 39 32·95
		&	38 44·33	11 33	0 37·38	21·71	39 26·67	4 34	0 5·84	32·51
		350 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. 10	W.	170 0	+ 9 51 14·33	2 33	+ 0 1·81	+ 9 51 16·14	+ 9 50 37·67	10 40	+ 0 31·87	+ 9 51 9·54
		&	51 18·67	0 55	0 0·23	18·90	50 46·66	9 15	0 23·96	10·62
		350 0	51 11·66	4 40	0 6·10	17·76	50 11·34	14 24	0 57·82	9·16
			51 10·00	5 51	0 9·57	19·57	49 59·67	15 46	1 9·29	8·96
			51 4·00	6 41	0 12·49	16·49				
„ 10	E.	180 0	− 6 37 14·00	22 17	− 2 18·17	− 6 39 32·17	− 6 39 20·67	7 42	− 0 16·58	− 6 39 37·25
		&	37 39·33	20 17	1 54·56	33·89	39 20·66	5 59	0 10·02	30·68
		0 0	39 3·33	9 14	0 23·86	27·19	39 36·00	0 23	0 0·04	36·04
			38 46·33	12 20	0 42·61	28·94	39 31·33	1 55	0 1·02	32·35
„ 11	W.	180 0	+ 9 51 11·00	3 19	+ 0 3·06	+ 9 51 14·06	+ 9 51 6·33	4 8	+ 0 4·80	+ 9 51 11·13
		&	51 10·34	4 32	0 5·73	16·07	51 6·67	2 53	0 2·34	9·01
		0 0	50 50·67	9 11	0 23·50	14·17	49 53·67	16 38	1 17·16	10·83
			50 41·00	10 39	0 31·61	12·61	49 37·34	18 1	1 30·49	7·83
							49 24·34	19 33	1 46·49	10·83
„ 11	E.	190 0	− 6 39 28·67	0 57	− 0 0·25	− 6 39 28·92	− 6 38 7·33	17 33	− 1 25·72	− 6 39 33·05
		&	39 23·33	5 5	0 7·25	30·58	38 29·00	15 19	1 5·33	34·33
		10 0	39 21·00	6 0	0 10·10	31·10	38 40·67	13 56	0 54·07	34·74
			39 16·66	7 23	0 15·30	31·96	38 15·33	16 51	1 19·74	35·07
			39 12·00	8 32	0 20·43	32·43	38 2·67	18 6	1 32·03	34·70
							37 46·67	19 21	1 45·19	31·86
„ 12	W.	190 0	+ 9 51 22·66	0 9	+ 0 0·01	+ 9 51 22·67	+ 9 50 43·33	9 16	+ 0 23·94	+ 9 51 7·27
		&	51 21·33	1 4	0 0·31	21·64	50 32·67	10 18	0 29·57	2·24
		10 0	51 21·00	2 1	0 1·13	22·13	50 29·00	11 11	0 34·86	3·86
			49 29·67	19 18	1 43·63	13·30	50 23·00	12 1	0 40·24	3·24
			49 21·00	20 31	1 57·07	18·07				
„ 13	E.	170 1	− 6 38 36·33	13 49	− 0 53·21	− 6 39 29·54	− 6 39 28·00	4 32	− 0 5·74	− 6 39 33·74
		&	38 42·33	12 25	0 42·99	25·32	39 30·00	3 18	0 3·04	33·04
		350 1	39 9·34	7 43	0 16·69	26·03	39 34·67	1 25	0 0·56	35·23
„ 14	E.	150 0	− 6 38 48·33	12 9	− 0 41·16	− 6 39 29·49	− 6 39 31·33	1 29	− 0 0·62	− 6 39 31·95
		&	38 54·66	10 57	0 33·44	28·10	37 23·33	21 32	2 10·25	33·58
		330 0								

Abstract of Astronomical Azimuth observed at XXIII (Valvádi) 1846.

1. By Eastern Elongation of ε Ursæ Minoris.

Face		L	R	L	R	L	R	L	R	L	R	L	R
Zero		140°	320°	150°	330°	160°	340°	170°	350°	180°	0°	190°	10°
Date		December 6		December 7		December 8		December 13		December 10		December 11	
		"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation		32·22 28·36 34·66 35·14	33·20 31·95 34·38 29·18	26·29 25·65 *26·87 *25·48	33·84 33·68 *29·33 *30·96	27·91 29·63 28·15 25·44	30·63 31·27 36·14 30·03 28·66	*28·97 *23·20 29·54 25·32 26·03	*34·44 *34·00 33·74 33·04 35·23	32·17 33·89 27·19 28·94	37·25 30·68 36·04 32·35	28·92 30·58 31·10 31·96 32·43	33·05 34·33 34·74 35·07 34·70 31·86
Means		32·60	32·18	26·07	31·95	27·78	31·35	26·61	34·09	30·55	34·08	31·00	33·96
		° ′ "		"		"		"		"		"	
Means of both faces	—	6 39 32·39		29·01		29·57		30·35		32·31		32·48	
Az. of Star fr. S., by W.		188 15 22·93		23·31		23·68		25·55		24·43		24·80	
Az. of Ref. M. „		181 35 50·54		54·30		54·11		55·20		52·12		52·32	

2. By Western Elongation of ε Ursæ Minoris.

Face		L	R	L	R	L	R	L	R	L	R	L	R
Zero		140°	320°	150°	330°	160°	340°	170°	350°	180°	0°	190°	10°
Date		December 7		December 8		December 9		December 10		December 11		December 12	
		"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation		21·66 23·26 17·18 20·92	17·95 18·86 15·75 14·44	16·77 22·54 15·85 16·10	7·21 12·44 13·67	18·55 17·02 11·44 14·70 15·08	10·45 11·47 14·76 17·62 18·39	16·14 18·90 17·76 19·57 16·49	9·54 10·62 9·16 8·96	14·06 16·07 14·17 12·61	11·13 9·01 10·83 7·83 10·83	22·67 21·64 22·13 13·30 18·07	7·27 2·24 3·86 3·24
Means		20·76	16·75	17·82	11·11	15·36	14·54	17·77	9·57	14·23	9·93	19·56	4·15
		° ′ "		"		"		"		"		"	
Means of both faces	+	9 51 18·75		14·46		14·95		13·67		12·08		11·86	
Az. of Star fr. S., by W.		171 44 36·88		36·51		36·13		35·76		35·39		35·01	
Az. of Ref. M. „		181 35 55·63		50·97		51·08		49·43		47·47		46·87	

			°	′	"
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation		181	35	53·10
	by Western „		„		50·24
	Mean		„		51·67
Angle Referring Mark and XXII (Ajnád) *see page* 27—G. *ante*		—	14	43	45·78
Astronomical Azimuth of Ajnád by observation			166	52	5·89
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur, *see page* 61—G. *ante*			166	52	1·21
Astronomical—Geodetical Azimuth at XXIII (Valvádi)		+			4·68

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.

March, 1890.

W. H. COLE,

In charge of Computing Office.

PLATE 1.

PRINCIPAL TRIANGULATION—KHANPISURA MERIDIONAL SERIES.

Fig. No. 1

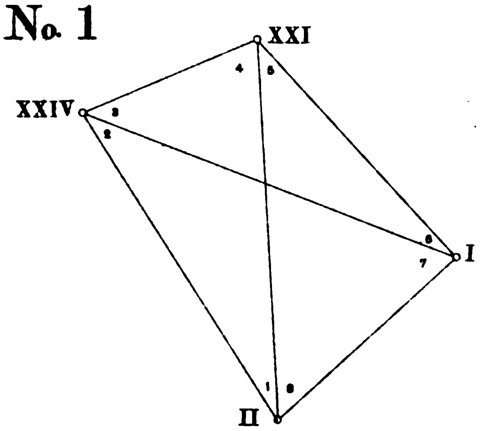


Fig. No. 2

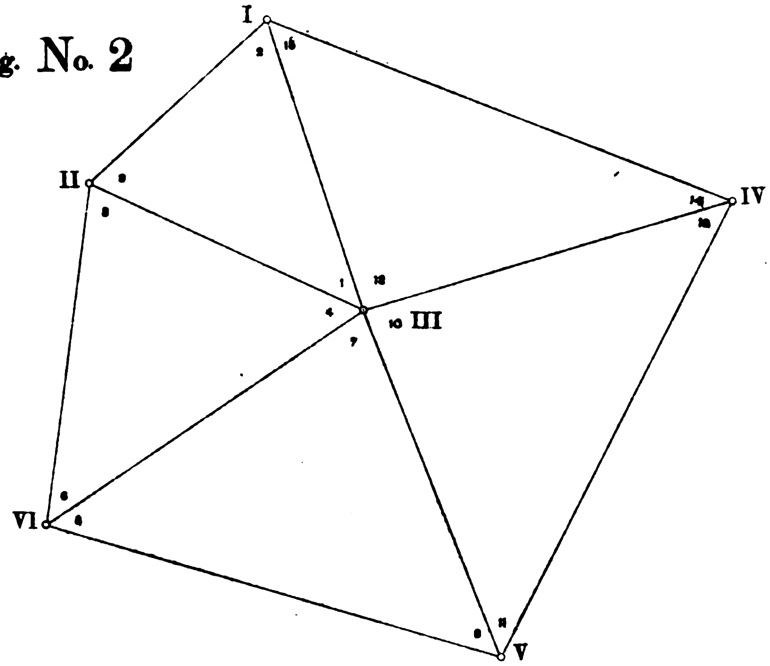


Fig. No. 3

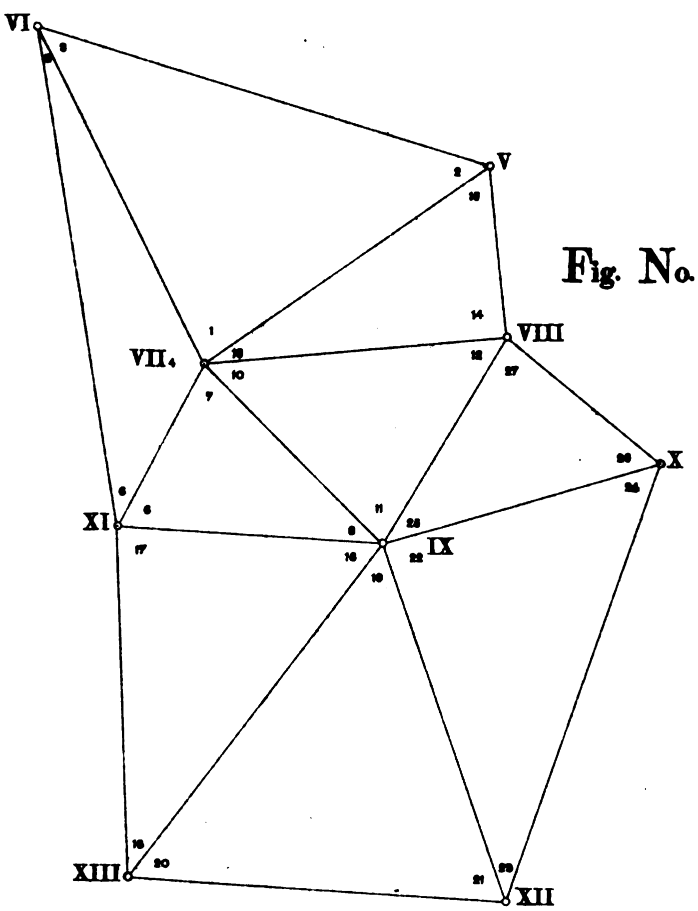
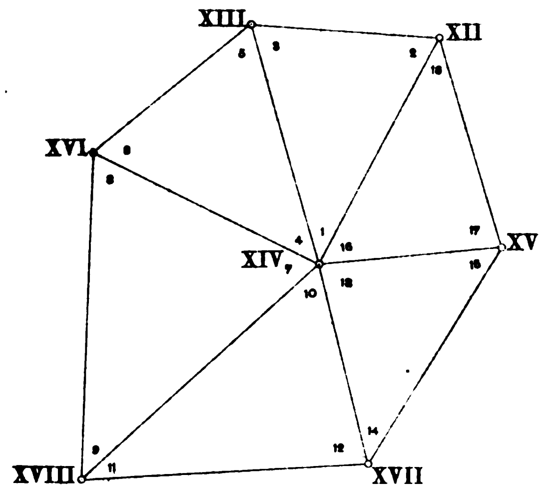


Fig. No. 4



Scale 1 Inch = 24 Miles or $\frac{1}{1520640}$

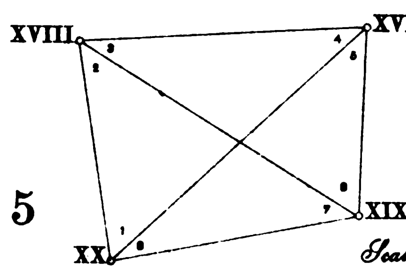


Fig. No. 5

Scale 1 Inch = 24 Miles or $\frac{1}{1520640}$

Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún January 1889

PRINCIPAL TRIANGULATION — KHANPISURA MERIDIONAL SERIES.

Fig. No. 6

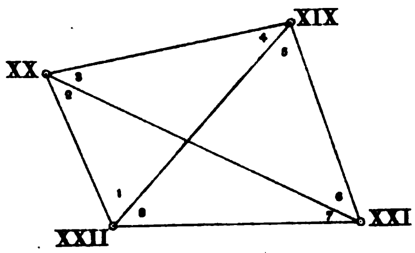


Fig. No. 7

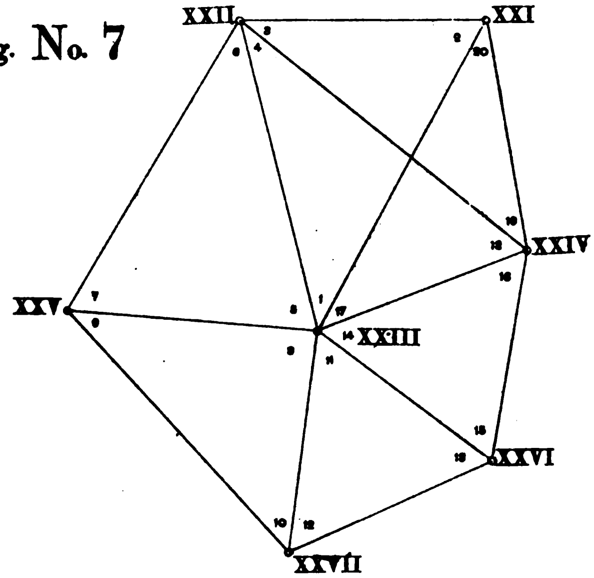


Fig. No. 8

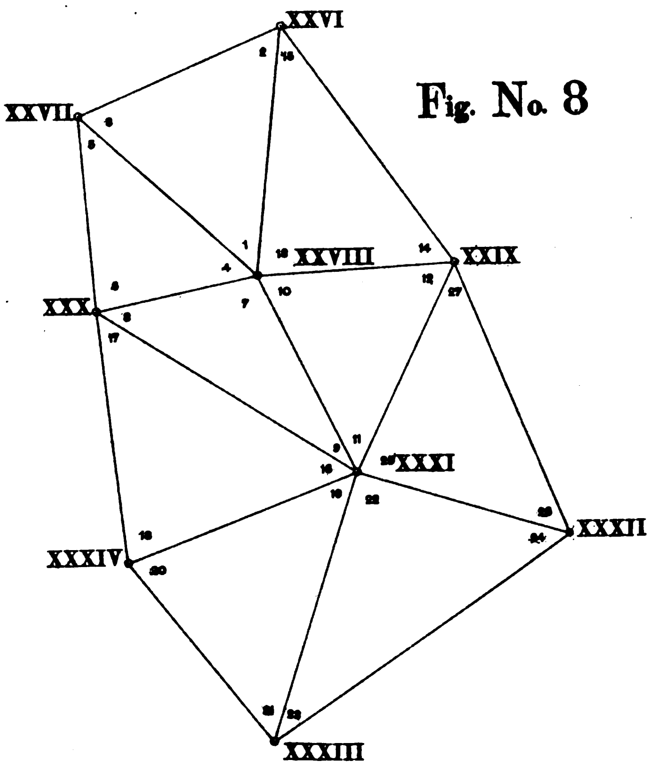
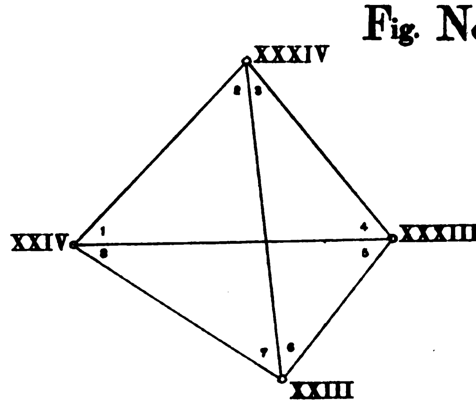


Fig. No. 9



Scale 1 Inch = 24 Miles or $\frac{1}{1520640}$

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, January 1889

SINGI MERIDIONAL SERIES.

SINGI MERIDIONAL SERIES.

INTRODUCTION.

The Singi Meridional Series of the South-West Quadrilateral is the great chain of principal triangles that follows the meridian of 73° 30′ from the parallel of 19° to that of 24½°. It traverses the British districts of Ahmednagar (Ahmadnagar), Thána, Násik, and Surat, and several of the Native States subject to the Rewa Kántha (Revákántha) and Meywar (Mewár) Political Agencies: it consists of one tetragon, two quadrilaterals, two compound figures, and eighteen single triangles, and extends over a meridional distance of 390 miles.

Its side of origin is Lakarwás (XXXII)—Tána (XXIX) of the Karáchi Longitudinal Series, and it closes on the side Singi (XXX)—Párner (XXVI) of the Bombay Longitudinal Series: from this it will be seen that in the simultaneous reduction of the South-West Quadrilateral, the Series under review had to be fitted in between a finally fixed side of the North-West Quadrilateral and one similarly determined of the Southern Trigon: on the completion of this reduction it was found that the errors which had actually been dispersed between the two fixed terminals were as follows:—

In	Latitude of Singi (XXX)	— 0″·435
„	Longitude of „	+ 0 ·065
„	Azimuth Singi (XXX)—Párner (XXVI)...	— 6 ·719
In side	Logarithm of feet	+ 0·000,00274
	giving a ratio of about 0·40 inches per mile.	

The great compound figure, covering a length of 150 miles, that forms the southern portion of this triangulation, was originally termed the North Konkan Coast Series: when its extension to the northward in 1860 was undertaken, it was re-named after the station of Singi of the Bombay Longitudinal Series: the "Singi Series" however only included the present chain of triangles as far north as the parallel of 23°, where it is cut by the Guzerat

(Gujarát) Longitudinal Series at right angles, and the northern portion that lies between the Karáchi and Guzerat Longitudinal Series was for years known as the Oodeypore (Udepur) Meridional Series. But when the simultaneous reduction of the South-West Quadrilateral was undertaken in 1884, the Oodeypore and Singi were merged into one great Meridional Series, and called after the latter.

In the latter part of 1827, Captain J. Jopp, the Deputy Surveyor General of Bombay, who was then employed in compiling maps of different portions of that Presidency, proposed to the Surveyor General, Colonel J. A. Hodgson, to carry a Trigonometrical Survey over such portions of Bombay territories as had not yet been triangulated; his object being to correct and unite the independent detailed surveys of portions of the country which were already in his hands, as well as any others which might be subsequently made. This proposal having been, after certain explanations, assented to and recommended by the Surveyor General, met with the sanction of the Government of India; and on the 15th March 1828, Lieutenant R. Shortrede, of the 14th Bombay European Regiment, an Officer of considerable talent and mathematical knowledge, who had already been employed in the Deccan (Dakshin) Survey, was appointed to superintend the execution.

Immediately on hearing of the newly proposed survey of Bombay, Captain Everest asked the Government of India to place it under his orders; his request was however refused owing to the objections of the Local Government. The latter had for some time previous felt the want of a good map of their Presidency and had started the new survey for the sole purpose of supplying one: their unwillingness to surrender the control of it can thus be easily understood: Everest had the reputation of subordinating the requirements of geography to those of geodesy, and the revenue officials of Bombay felt that if once they handed over the management of their survey to him the geographical wants of their province would be sacrificed to science and their establishment carried off to measure some distant "arc of meridian". Having failed to obtain the control of the Bombay Survey, Everest next urged that at any rate it should be made to emanate from a side of his own triangulation, a series of which had been carried westward from the Great Arc along the parallel of Bombay to within 150 miles of Poona (Puna); and he pointed out that unless this was done much confusion must ensue when the future junction was effected. The Bombay Surveyors again objected, and Shortrede was directed to make his triangulation depend on a base-line of his own which he was to measure with a steel chain by Cary that had never been compared against any recognised standard of length.

Lieutenant Shortrede selected a site for his base on the Kárla plain about 40 miles east of Bombay, and occupied himself during the rains of 1828 in preparing the requisite apparatus: in the month of November he proceeded to the spot, and, with the assistance of Captains Jopp and Grafton, commenced the measurement on the 12th of December, 1828, and finished it on the 16th of January, 1829. The base was 4·065 miles in length, and had the defect of a break in the measurement, caused by the river Indráyani, whose abrupt banks and uneven rocky bed prevented the measurement from being carried directly across:

Shortrede determined the length of this portion by measuring a small supplementary base along one bank of the river perpendicular to the main alignment and by then observing the horizontal angle at the outer extremity of this auxiliary line between the ramrods of his two guns one of which he had stuck in the ground on either side of the river. The remainder of the season after the completion of the Kárla Base-line and the next three years were occupied in extending a network of triangles over the whole country from Latitude 18° to 21°, and from Longitude 73° to 75°.

After the Government of India had refused to sanction the transfer of the Bombay survey to the control of Captain Everest, the latter had laid the case before the Court of Directors themselves, and in 1831 the Governor General received orders from England to unite all the Trigonometrical Surveys in India under one head. Everest's first act on taking over his new charge was to call for a report on Shortrede's Base-line. On discovering what had been done he immediately wrote to Shortrede pointing out the absurdity of having a break in the middle of a base and suggested the advisability of at once selecting a new site and making an entirely new measurement; this letter was not received by Shortrede till three months after it had been written; he had been proud of his performances and was extremely hurt: he answered that he considered his base as accurate as any of the G. T. Survey, and that as far as the "break" was concerned he had Colonel Lambton's G. T. Base-line at Bangalore (Bĕngalúr) as a precedent. Six months afterwards he learnt from Colonel Everest for the first time, that the base-line at Bangalore which he had so faithfully imitated had been commenced on an open, unbroken plain, and that the break in its length was solely caused by the action of the natives, who, in the course of the measurement, had set to work and deliberately excavated a series of large tanks in the actual alignment: to his intense mortification he discovered too from the sarcastic letter of his chief that Lambton himself had rejected this very Bangalore measurement shortly after its execution on account of the break in its continuity.

Shortrede's triangulation supplied ample food for another prolonged and bitter controversy between the two Surveyors. Everest could hardly allude to it with temper: a suggestion made by the Surveyor General to incorporate it with the G. T. Survey he received with horror and dismissed with scorn. Every detail of the work was found fault with, and numberless changes were introduced: but in these days the postal arrangements were so defective that three months would often elapse between the despatch of a letter from Bengal and its arrival at Bombay, and as may be expected under such conditions of correspondence no great improvements were possible. In October, 1831, Everest wrote to Shortrede that it was useless to continue work until they had had a personal interview, and pressed him to come round to Calcutta where one of the great Base-lines was about to be measured. Shortrede, conscious now of his deficiencies, was only too anxious to go. Unfortunately it was necessary for him, although he was under the orders of the Superintendent of the G. T. Survey, to ask permission of the Government of Bombay; fearing that an application by letter would be answered and refused by some irresponsible Under-Secretary, he asked and obtained a personal interview with Lord Clare, the Governor: the reasons he advanced in favor of his proposed journey were numerous and weighty; his experience he said of trigonometrical work had hitherto been confined to petty triangulation executed for military purposes in which no great accuracy was necessary, whilst of the methods in vogue with the G. T. Survey which had taken 30 years to develope he was entirely ignorant: he wished now to learn the innermost details of scientific surveying from the only man in India who could teach him: if too he were to go at once, he would be able to assist at the measurement of the Calcutta Base-line and become acquainted with the use of the compensation bars: and what was more important still he would be able to take his chain with him and compare it with Everest's standard. Lord Clare replied that such grounds appeared quite insufficient to warrant the Bombay Government in sending one of their officers to another Presidency, and that until he received a direct order from Lord William Bentinck he should refuse his consent. In 1834 when Shortrede resigned his appointment, all his work was discarded, and, except as a guide in the selection of stations for the later triangulation, it has never been made any use of.

In November, 1841, when the Bombay Longitudinal Series was approaching completion, Colonel Everest decided to run a Meridional Series northwards from Bombay towards Surat: the triangulation party employed in this Presidency was under Lieutenant W. S. Jacob of the Bombay Engineers, and to him the execution of the new project was to be entrusted. By the aid of charts of Shortrede's triangulation, the angles of which were regarded as true to within ten seconds of arc, Jacob was enabled at Bider, where the great Base-line was being measured, to select an approximate series for the North Konkan without going into the field. His design was submitted to Everest for approval in January, 1842, and received final sanction in the following summer. Arrangements were accordingly made to break ground after the recess season, but towards the close of the hot weather Lieutenant Jacob's health entirely gave way: since 1834 when he was first appointed to the Survey in succession to Lieutenant Shortrede, he had been almost continuously employed in peculiarly pestilential tracts of country and had now become a perfect wreck from malaria: he proceeded to England on medical certificate, and his connection with the Survey Department terminated: he was succeeded on December 14th, 1842, by Lieutenant Harry Rivers of the Bombay Engineers, an officer of great mathematical ability who had been appointed to the Trigonometrical Survey only three months previously.

Season 1842-43.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 2nd Assistant, G. T. Survey.
Mr. J. Fraser, Sub-Assistant, 1st Class.
" T. Sanger, " "
" J. DaCosta, " 2nd "

Shortly before Christmas Rivers took the field: from Karanja–Singi* as his side of origin he commenced carrying a narrow series of single triangles due northwards along the Coast and having observed a set of circumpolar star observations to δ Ursæ Minoris and 51 Cephei for azimuth at Kalsubai reached Párnera in February without difficulty or interruption. Smoke now began to rise from all the neighbouring jungles, and several days passed without a heliotrope being visible. Finding that the smoke became daily

* Owing to the complexity of the figure at the southern end of the Singi Meridional Series, it was considered desirable to reject the observations on the ray Karanja–Kámandrug, so that the Series now terminates on the single side Singi–Párner of the Bombay Longitudinal Series.

denser and that the haze and fog from the sea seemed to be gradually increasing, Rivers quitted Párnera after a halt of three weeks without finishing his observations. As the season was now well advanced he thought it better to waste no more time in the low lands on the coast, but to proceed to the stations on the line of the ghâts which he hoped were at too high an altitude to be affected by the atmospheric density of the plains: he therefore entered the hills, and commenced observing from mountain tops: but the work even now was most unsatisfactory for not only was the heliotrope at Surat completely obscured by the smoke and haze on the plains, but even the few hill stations, that were mutually visible, were so foggy and indistinct, that all the observations taken were of but little value. At his last Hill Station of Raura all the heliotropes were visible except the one at Párnera, which lay very low and in the thickest part of the smoke. It was useless to continue working under such circumstances, as the smoke and haze were known to gradually increase without intermission till the commencement of the rainy season, and so towards the end of March Rivers set out for Poona: the movements of the party were greatly hampered by the large percentage of sick: two out of the three sub-assistants, the hospital-assistant, and 20 men were all down with fever at Párnera, and at Raura Rivers himself succumbed. During the recess season the observations taken in the latter half of February and in March were found to yield such poor results that the stations of Raura and Rupgarh had to be cut out from the principal series and incorporated as secondary points.

In November, 1843, Lieutenant Rivers was deputed to take up the triangulation of the South Konkan Coast Series, and consequently no observations were taken during the winter of 1843-44 upon the Series under review. Mr. DaCosta was, however, despatched in December to Surat and instructed to carry on the approximate work northward: it is fatal, we have now learnt, to enter the jungles of this neighbourhood before the end of February, and every party that has ever attempted to work here in the winter months has failed. Mr. DaCosta and his men were no more successful than others, and they had not been in the Surat districts three weeks before they were all without exception severely attacked by fever. Mr. DaCosta strove hard to carry out the work that had been entrusted to him, and it was long before he would retreat from the jungles, but he eventually became so crippled with illness that he had to move into Surat: by March he had sufficiently recovered to take the field again, and the jungles had now become fairly healthy, but the season of haze and smoke had re-commenced and nothing in the way of approximate work was feasible. Lieut. Rivers himself had reached Poona from the Southern Konkan on March 5th, and left it for Surat on March 14th; his intentions were to visit the unfinished stations of the former season and to complete the observations of those few angles, that had only been partially observed: he seems to have thought that the haze and smoke of the preceding year had been of abnormal density and were not likely to be met with again to such an extent. He had no sooner arrived at Párnera than he found out his mistake: the density of the atmosphere was just the same as when he was here before; he remained now three weeks but never succeeded once in obtaining a glimpse of a single heliotrope: on April 9th he set out for Mahábaleshvar, where he had established his recess quarters.

In October, 1844, Messrs. Fraser and Sanger were again despatched to Párner in the hopes that with their greatly increased experience of the country they would now succeed in carrying the approximate series northward through the Gáikwár's dominions: fresh obstacles however arose, which had not been foreseen. The inhabitants threw every impediment in the way of the surveyors: the *patels* (headmen) of the villages refused to supply them with food or forage: the owners of the land forbade the erection of signals, and the guards of the forts, which were generally situated on natural prominences, refused admittance to any one connected with the Survey party: in many instances bodies of signalmen were beaten and otherwise maltreated. The British Resident at the Court of the Gáikwár was appealed to in vain for assistance; he apparently possessed no influence and was unwilling to move in the matter. His Highness himself was convinced that the two Englishmen were not traversing his dominions for the sole purpose of looking through a small telescope, and his inability to discover their ulterior designs greatly irritated him. His repeated refusals to help them, are clear evidence that he approved if he did not encourge the malevolence of his subjects: when at last at the request of the Bombay Government he did put forth his authority, all vexatious hindrances ceased and the progress of the survey was nowhere impeded. A month's work however had been lost.

Season 1844-45.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 2nd Assistant, G. T. Survey.
Mr. J. Fraser, Sub-Assistant, 1st Class.
" T. Sanger, " "
" J. DaCosta, " 2nd "

Rivers left Poona at the same time as his assistants and proceeded to Mirya a principal station of the South Konkan Coast Series, where he took a complete set of astronomical observations for the direct determination of azimuth: he then set out for Párnera, which he reached on November 7th. The atmosphere was now clear and all the heliotropes were visible, but it was the malarious season: Mr. Fraser's party had been attacked with fever almost as soon as they had arrived, and the percentage of their sick had steadily increased week by week. Though Mr. Fraser himself had been among the first to succumb, and was labouring under severe illness for the greater part of the time, he succeeded before Christmas in selecting two good quadrilaterals to the northward. By the first of January to such an extent had the ravages of the disease spread that not a single man of his detachment remained unscathed. Lieutenant Rivers's contingent fared no better; within six weeks of their arrival nine-tenths of their number were in hospital, and before the year 1845 had fairly commenced the whole party were crippled. Rivers completed the observations of the two angles at Párnera, and then proceeded southwards to the Gambírgarh and Kalsubai stations at which five angles had to be remeasured owing to the poor results of the former season having been rejected: so much was he delayed by illness and hampered by the number of sick that the measurement of these six angles was all he succeeded in doing throughout November and December. What was worse he had but slight prospects of improving upon this rate of progress in the future: the fever as yet had shewn no signs of abating, the natives he had newly enrolled to replace those disabled by sickness had almost to a man succumbed to the disease, and several deaths had occurred in his party. Every day too brought the smoky season nearer, and he had learnt full well by this time that any work to be done must be done before then. In this dilemma Rivers took a step on his own responsibility, that was severely censured afterwards by Sir Andrew Waugh: he decided that no triangulation to the north of Surat could possibly be carried out, and so determined to abandon all idea of it and to make no further attempt: in its stead he commenced widening his short chain of single triangles that stood completed between Singi and Párnera by adding on another similar chain along its eastern flank: his work thus lost the character of a meridional series and assumed that of a network. During January he observed at Párner and Hewargaon; during February he completed the observations at Hewargaon and at Kalsubai, Sinnar, and Bhorgarh, and during March at Ankai and Sáler: at the last-named station observations were taken to Polaris for the direct determination of azimuth. Pilwa was completed and Tarbhán was reached before the end of the season, but the work at the latter could not be completed: the haze had set in and hills but 15 miles distant were invisible: the heliotrope at Dopári was obscured and nothing was seen of the huge fire that was lighted there nightly which, it was hoped, would serve as a signal. Upon the return of the party to their recess quarters in Poona, Mr. Fraser was for some days the only man sufficiently free from fever to be able to attend office, whilst the condition of the signalmen and menials seems to have been lamentable. Towards the end of the recess season Lieutenant Rivers asked to be allowed to again attack the Singi Series, but permission was refused. Sir Andrew Waugh was unwilling to expose his assistant for two consecutive years to such a pestilential climate as that of the Surat districts, and insisted on giving him a turn in some more healthy tract. Rivers and his party were accordingly directed to discontinue work on the Singi meridian and to take up instead the triangulation of the neighbouring series, known as the Khánpisura Meridional.

In October, 1845, when marching from Poona to the scene of his new work, he visited Singi *en route*, and observed there the angles between Párner and Hewargaon and between Hewargaon and Kalsubai, both of which had been omitted in the previous season, when the doubling of the original Singi chain was undertaken: he was occupied by this four days and then left for Khánpisura. Towards the end of February, 1846, Rivers took advantage of an opportunity that occurred to visit Dopári where three angles had to be observed: the measurement of these formed the last occasion that he was employed on the Singi Meridional Series. The great compound figure, the largest by far in the whole triangulation of India, now stood completed with the exception of the one angle at Tarbhán between Dopári and Pilwa.

The instrument employed by Lieutenant Rivers on the Singi Meridional Series was the same 15-inch Theodolite by Dollond* that was used in the observations of the Bombay Longitudinal and South Konkan Coast Series. It was constructed on a design and under the direction of Captain Kater, and possessed, like all Dollond's instruments, a very fine telescope: but the horizontal circle was one of the first that had ever been engine-divided and

* For a full description of the instrument and its performances see Appendix No. 2 of Volume II of the *Account of the Operations of the Great Trigonometrical Survey of India.*

proved of an inferior order, giving angles differing to the extent of 13″ on different parts of the limb. The microscopes too were not adjustable for "run", and corrections varying with the temperature had therefore to be applied to the recorded readings of the angles. The method of changing zero pursued by Lieutenant Rivers gave readings at every 20° of the limb instead of at every 10° according to the recognised system in force in the G. T. Survey, a deviation from established practice which resulted in a much larger triangular error than that which obtained with the same instrument on the Bombay Longitudinal Series.

The triangulation of the Singi Meridional Series, after Lieutenant Rivers gave it up in 1845, remained in abeyance for upwards of 15 years when work was resumed on it by Lieutenant (now Major-General) C. T. Haig of the Bombay Engineers, the present Deputy Surveyor General in charge of Trigonometrical Surveys.

Lieutenant Haig first arrived in India in July, 1856, and served with the Bombay Sappers and Miners in the Persian War of 1856-57, and with the Rajputana (Rájputána) Field Force during the mutiny as Staff Officer of Engineers. He was appointed a Second Assistant in the Great Trigonometrical Survey in September, 1859, and joined the Bombay Triangulation Party at Rájkot a few weeks later. This Party had been employed for some years under Captain Nasmyth of the Bombay Engineers on the Káthiáwár (Káthiávád) triangulation, their recess quarters being at Rájkot. On arrival there Lieutenant Haig found orders awaiting him to join the Okhámandal Field Force with which Captain Nasmyth was also serving, and for the next two months both officers were employed as military engineers at the siege of Dwárka. On the fall of that place in December, 1859, they rejoined the Bombay Survey Party in Káthiáwár, where they remained for the rest of the winter. On March 10th, 1860, Captain Nasmyth proceeded on furlough and Lieutenant Haig assumed charge of the Party: work was continued in Káthiáwár till April 25th, when the field season was brought to a close: the Party marched to their recess quarters at Rájkot, where they remained during the summer under Mr. DaCosta, whilst Lieutenant Haig joined Major J. T. Walker's Party at Murree (Marri). The programme of work laid down for the Bombay Party during the field season of 1860-61 was to take up the Guzerat Longitudinal Series at the side Wardhari–Ghorárāo, carry it eastward until it met the Khánpisura Meridional Series, and then to return and work southwards from a side of this new work down the meridian of 73½° to meet Rivers's portion of the so-called North Konkan Series*.

Season 1860-61.

PERSONNEL.

Lieutenant C. T. Haig, Bombay Engineers, 2nd Assistant.
Mr. J. DaCosta, Civil 2nd Assistant.
„ J. Mc Gill, Senior Sub-Assistant.
„ G. A. Anding, 3rd Class Sub-Assistant.

The head-quarters of the Party quitted Rájkot on November 15th, 1860, and reached Wardhari on the 30th. Mr. Mc Gill had taken the field about a month previously to lay out the approximate work: the stations of Játhrábhor, Kágarol and Rencha, which are situated at the junction of the Singi and Guzerat Series had been selected several years previously. Up to the end of December, 1860, Mr. DaCosta was employed on the Káthiáwár triangulation: he then left for the Deccan to take up the approximate

* The Instrument to be used was the Theodolite known in this Department as Troughton and Simms' 18-inch No. 2. For a description of it, see Appendix No. 2 of Volume II of the *Account of the Operations of the Great Trigonometrical Survey of India.*

work of the Mangalore (Mangalúr) Meridional Series, on which he remained employed till the close of the field season. At the beginning of the season the progress of the Party met with some serious checks: in the approximate chart furnished to Lieutenant Haig the ray between Játhrábhor and Ghoráráo was laid down, but after several days had been spent in felling trees it was found to be impracticable. Another delay was caused by a mistake of the mason; instead of repairing the old Rencha station, he built a new station at another village also called Rencha, and the signalman shewed his heliotrope to Ghoráráo from this latter. Lieutenant Haig himself too went to this new station and did not find out his mistake until he had put up his instrument.

On arriving at Bhor Lieutenant Haig found the ray Bhor–Patángri impossible owing to a large hill intervening: having observed all the other rays he went to Patángri and selected a new station there: whilst the pillar was being built he visited Játhrábhor and Kágarol; and then went back to Ghoráráo and observed there the correct ray to Rencha: Kágarol, Patángri, and Bhor were then revisited and on January 20th, 1861, the Kágarol Hexagon at the junction of the two Principal Series was finished.

In the meanwhile Mr. McGill had been carrying the approximate series southwards on the Singi meridian: his progress was excellent until he reached Kesarwa, when he and all his Party were prostrated with jungle fever: he had to retire to Broach (Bharúch) and was unable to resume his work during the field season. Mr. McGill's absence necessitated a change of programme, as he was the only officer available for the approximate work: he had trusted to be able to select all the stations of the Singi Series and to also get well on with the approximate work of the Guzerat Longitudinal Series to the east of the Singi meridian before Lieutenant Haig had finished the observations of the Kágarol Hexagon*, and this he would have done, if all had gone right. As it was, Lieutenant Haig found no approximate work ready for him on the Guzerat Longitudinal Series; his first idea now was to select his stations himself, as well as observe the angles, and this he began doing: but his progress proved so slow, that towards the end of January he gave it up and returned to Bhor with the object of observing at the stations of the new Meridional Series already selected: the observations at Kandálwa, Páwágarh, and Masábár were taken without difficulty, and Karáli was reached on February 6th: the atmosphere now became hazy and dense, and smoke began to rise from the jungles. The ray Karáli–Kesarwa had to be rejected, as after it had been observed on three pairs of zeros the heliotrope at Kesarwa became invisible. The Sidpur ray from Karáli was very difficult of observation, and detained the Party a week. At Sidpur itself, which is situated in the Rájpipla state in the very heart of the smoky area, there was a further delay of ten days owing to the difficulty of observing the Bábásiráj heliotrope, and the station of Kesarwa was not reached till February 28th: it was here that Mr. McGill had been taken ill and consequently no approximate work existed beyond.

The stations of Bábásiráj, Kesarwa and Páthal had been selected in 1845 by Lieutenant Rivers and had been intended by him to form with Dopári a huge quadrilateral. As

* The Kágarol Hexagon appertained originally to the Guzerat Longitudinal Series, but it was found convenient afterwards to include it in the Singi Meridional Series.

however the rays Dopári–Kesarwa, Dopári–Bábásiráj and Páthal–Bábásiráj were all over fifty miles in length, Lieutenant Haig did not attempt to observe them and abandoned his predecessor's quadrilateral as impracticable. The selection of smaller figures proved a difficult matter owing to the intervention of high hills, on which no points could be discovered that gave suitable triangles: the stations of Ságbára and Álamwári were the best that could be found in spite of the invisibility of the latter from Páthal. By the time that all the stations had been decided on, the smoky season had commenced in good earnest and progress was naturally slow. At Ságbára the Páthal ray alone occupied fifteen days and Álamwári was not reached till April 5th. Three weeks later however all the angles at Páthal and Álamwári as well as those that had been omitted by Lieutenant Rivers at Dopári and Tarbhán* had been observed, and the connection with the old work of 1845 thus stood thoroughly completed. The Singi Series had at last been carried through the difficult and fever-stricken tracts of the Rájpipla state that had so baffled the efforts of the earlier surveyors. Lieutenant Haig's party had by no means got off scot free: at Kesarwa no less than 60 per cent of his men were on the sick-list, and by the close of the season there was hardly a native in the party who had not at one time or another been a sufferer. The jungles in this tract seem absolutely fatal to enter before the middle of February, and Mr. McGill made a great mistake in trying to penetrate them in December: there is a local proverb in these parts to the effect that the Dáng jungles should be feared like a musket ball, a proverb that testifies as much to the martial ardour of the people as it does to the unhealthiness of the forests.

Season 1861-62.

PERSONNEL.

Lieutenant C. T. Haig, Bombay Engineers, 1st Assistant.
Mr. J. DaCosta, Civil 2nd Assistant.
„ J. McGill, Junior Civil 2nd Assistant.
„ G. A. Anding, 3rd Class Sub-Assistant.

The Bombay Party under Lieutenant Haig passed the recess season of 1861 at Poona and in October following again took the field. The first stations visited were Játhrábhor and Patángri of the Singi Meridional Series, and an attempt was made to prolong the Guzerat Longitudinal Series eastwards from the side that joined them. The plan however was found impracticable and the side Patángri–Bhor had to be substituted. At starting Lieutenant Haig himself took up the approximate work of the Guzerat Longitudinal Series and carried it eastwards to the meridian of $74\frac{1}{2}°$: he here left it in charge of Mr. McGill and returned to Patángri to observe δ Ursæ Minoris for azimuth. Shortly after Christmas he commenced the final observations of the angles of the Guzerat Longitudinal Series, and these occupied the Head Quarters of the Party up to the end of February.

Mr. DaCosta in the meantime had selected the stations of the Guzerat Coast Minor Series between Surat and Cambay (Khambhat) as well as of a branch series to Baroda (Vadodra), and had taken up by the first week in January the approximate work of the Oodeypur Meridional Series: (this latter series as has been mentioned before lost its designation of Oodeypur in 1884 and now constitutes the northern section of the Singi Meridional Series). In selecting his stations Mr. DaCosta worked northwards from the side Játhrábhor–Patángri of the Kágarol Hexagon, laying out only a single series of triangles.

* The side that was common to both Rivers' and Haig's work was Tarbhán–Dopári: at Tarbhán the angle Pilwa–Tarbhán–Dopári seems never to have been observed: Haig observed the northern angle Páthal–Tarbhán–Dopári, whilst Rivers observed the whole angle Pilwa–Tarbhán–Páthal: the southern angle Pilwa–Tarbhán–Dopári was deduced from the other two.

By the end of February Mr. McGill had completed his approximate work on the Guzerat Longitudinal Series and was ordered by Lieutenant Haig to assist in selecting stations for the Series on the Oodeypur meridian: he was however not to work with Mr. DaCosta but to start from a side of the Karáchi Longitudinal Series and proceed southwards: the two surveyors were directed to keep each other thoroughly acquainted with their movements, so that they might have no difficulty in effecting a junction between their two approximate series whenever they should happen to meet. Unfortunately the country through which this series runs is inhabited by semi-barbarous races: the thieves, who form a large and recognised portion of the inhabitants of every village, assault a man for the sake of the clothes he has on his back; and if he attempts to escape bring him down with a shower of arrows utterly regardless of his life: on this account communication was attended with great risk and consequently Messrs. DaCosta and McGill were each in ignorance of the other's progress until they actually met: the bend in the Series in latitude 23° 45′ is due to their inability to work in conjunction.

Mr. McGill intended to have commenced on the side Lakarwás–Bonkalore, with which Sísa and Salúmbar were to have formed a quadrilateral, but the Rája of Salúmbar, a very refractory chief, would not permit a station to be built on his hill, although directed to do so by the Political Agent: Mr. McGill had therefore to start the approximate series from the radial side Tána–Lakarwás of the Tána Hexagon.

Having completed the Guzerat Longitudinal Series, Lieutenant Haig marched northwards to Lakarwás, which he reached by the 10th of March: he was here delayed a few days by fog but after this no further interruption occurred, and he completed the final observations of the Oodeypur Meridional Series on April 25th: he had thus visited 15 stations and observed 34 angles in six weeks. A chain of single triangles now connected the Karáchi and Guzerat Longitudinal Series and the triangulation of the Singi Meridional Series stood fully completed. The head-quarters of the Party reached Poona on the 7th of May, 1862.

In consequence of the great deficiency of observations on certain rays, and of the weak character of the heights in general, the re-measurement of all the vertical angles of Rivers's section of the Singi Series was found necessary. Mr. H. E. T. Keelan, Surveyor 3rd Grade, who was then engaged in revising the heights on the Khánpisura Meridional Series, was accordingly directed to re-take the vertical observations on all rays of the Singi Series south of the side Tarbhán–Dopári. Mr. Keelan completed the revision of the Khánpisura heights on December 9th, 1884, at Jalálabad; he was then occupied some weeks in observing the vertical angles on the ray Ágargaon–Párner of the Bombay Longitudinal Series, and on January 8th, 1885, at Párner he commenced observing the Singi vertical angles: much difficulty was at times experienced in obtaining good vision of the heliotropes owing to the dense haze that set in early in February, but in spite of this Dopári was reached on April 13th. The revision of heights was completed at Bhorgarh on May 13th.

Secondary Triangulation.

On the Southern Section of the Series between the side Tarbhán–Dopári and the Bombay Longitudinal Series some hundred secondary points exist, chiefly pagodas and forts. Several of them were stations of Shortrede's Bombay network, but the angles were all re-observed by Rivers. Between the side Tarbhán–Dopári and the Guzerat Longitudinal Series only 20 secondary points were fixed by Lieutenant Haig during the progress of the principal work in 1860-61. In the following year however Mr. DaCosta visited the stations of Páwágarh and Masábár, and managed from them by means of two triangles only to lay down the position of the Baroda Clock Tower.

A few secondary triangles were formed with sides of the Kágarol Hexagon as bases and some 10 points thus fixed. On the Oodeypur Section of the Singi Series between the Guzerat and Karáchi Longitudinal Series the positions of a few trees, temples and huts were determined, but, with the exception perhaps of the Bánswára Palace, no place or town of importance was laid down.

The great feature in the secondary work of the Singi Series is the minor triangulation on the Guzerat Coast, which was first commenced in November, 1861, when Mr. DaCosta took up the approximate work. He started from the side Tarbhán–Páthal of the Singi Series and carried a line of single triangles northwards along the coast until he effected a junction with the Sábarmati Minor Series* at the side Rhoni–Omliála in latitude 22½°. The approximate work was all completed by the end of December, but the final observations had to be postponed till the following year. The country over which the triangulation was to pass was studded with valuable fruit trees, and exorbitant compensation was demanded by the landowners before they would permit even a bough to be lopped off. It unfortunately happened too that Mr. DaCosta could find no natural eminences for his stations, and an immense deal of ray-cutting was necessary to obtain mutual visibility. The Guzerat Coast Series was unquestionably a work of more than ordinary importance, filling up as it did the only gap of unsurveyed coast between the mouth of the Indus and Goa (Gova), but the estimated cost was so enormous, that Lieutenant Haig decided to postpone the work and refer the matter to the consideration of the Superintendent of the Great Trigonometrical Survey. Sanction to spend the necessary money was obtained in the following summer, and in November 1862 the final operations were commenced. Three months were occupied in clearing the rays, and building the stations, and on January 27th the observations of the angles were begun. The instrument used was a 12-inch Theodolite by Troughton and Simms, and the angles were all taken on two pairs of zeros 0°, 180°, 30°, 210°, the three angles of every triangle being observed. The series which comprises twenty-eight main secondary triangles was completed on the 23rd of March. It determines the geographical positions of Surat, Broach and Cambay, of ten minor towns and ports, and of several conspicuous hills and buildings which proved useful in the subsequent topographical survey of the tracts; it crosses the Tápti, Narbada, Mahi, Kím, and Dhádhar rivers.

* This series belongs to the Guzerat Longitudinal Series, from a side of which, Sánand–Pálri, it originates: it follows the course of the Sábarmati river to its mouth.

Early in the season of 1861-62 when Mr. DaCosta was engaged on the approximate work of the Guzerat Coast Series, he selected the stations for a branch series, which was to be carried eastwards from the Guzerat Coast Triangulation to fix Baroda: as much clearing was however necessary on the rays of this branch, and great expense would be incurred, the plan was abandoned, and no observations taken. Baroda was afterwards fixed as has been mentioned above by triangles carried westward from a principal side of the Singi Meridional Series.

January, 1889.

S. G. BURRARD,
In charge Computing Office.

SINGI MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. ALPHABETICAL LIST OF STATIONS.

Station	No.
Álamwári	XXVII.
Ámjio	VII.
Anjini	I.
Ankai	XXXV.
Bábásiráj	XXIV.
Bhor	XVII.
Bhorgarh	XXXIV.
Deokotla	IX.
Dopári	XXIX.
Dúngarpur	IV.
Gambírgarh	XXXVI.
Ghoráráo	XVI.
Hewargaon	XXXVIII.
Játhrábhor	XII.
Kágarol	XIV.
Kalsubai	XXXIX.
Kámandrug	XL.
Kandálwa	XIX.
Karáli	XXII.
Kesarwa	XXV.
Kua	VIII.
Lakarwás	XXXII. (Of the Karáchi Longitudinal Series).
Lohária	VI.
Masábár	XXI.
Párner	XXVI. (Of the Bombay Longitudinal Series).
Párnera	XXXIII.
Patángri	XIII.
Páthal	XXVIII.
Páwágarh	XX.
Pilwa	XXXI.
Rencha	XVIII.
Ságbára	XXVI.
Sagwára	V.
Sáler	XXXII.
Sidpur	XXIII.
Singi	XXX. (Of the Bombay Longitudinal Series).
Sinnar	XXXVII.
Sísa	II.
Tána	XXIX. (Of the Karáchi Longitudinal Series).
Tarbhán	XXX.
Tembla	X.
Tukwása	III.
Uchak	XI.
Wardhari	XV.

SINGI MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. NUMERICAL LIST OF STATIONS.

XXIX (Of the Karáchi Longitudinal Series).	Tána.
XXXII (Of the Karáchi Longitudinal Series).	Lakarwás.
I	Anjini.
II	Sísa.
III	Tukwása.
IV	Dúngarpur.
V	Sagwára.
VI	Lohária.
VII	Ámjio.
VIII	Kua.
IX	Deokotla.
X	Tembla.
XI	Uchak.
XII	Játhrábhor.
XIII	Patángri.
XIV	Kágarol.
XV	Wardhari.
XVI	Ghoráráo.
XVII	Bhor.
XVIII	Rencha.
XIX	Kandálwa.
XX	Páwágarh.

XXI	Masábár.
XXII	Karáli.
XXIII	Sidpur.
XXIV	Bábásiráj.
XXV	Kesarwa.
XXVI	Ságbára.
XXVII	Álamwári.
XXVIII	Páthal.
XXIX	Dopári.
XXX	Tarbhán.
XXXI	Pilwa.
XXXII	Sáler.
XXXIII	Párnera.
XXXIV	Bhorgarh.
XXXV	Ankai.
XXXVI	Gambírgarh.
XXXVII	Sinnar.
XXXVIII	Hewargaon.
XXXIX	Kalsubai.
XL	Kámandrug.
XXVI (Of the Bombay Longitudinal Series).	Párner.
XXX (Of the Bombay Longitudinal Series).	Singi.

SINGI MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. DESCRIPTION OF STATIONS.

All the Principal Stations of this Series are situated on hills or rising ground: those numbered I to XVI and XVIII to XXVII, consist of circular, isolated and perforated pillars of masonry, 2 to 6 feet in height, each of which carries marks (⊙) engraved on stone at top and at ground level. Around these pillars, and level with their summits, platforms of earth and rubble have been constructed for the accommodation of the observatory tent. An aperture through each platform and pillar was specially left for reference to the ground level mark. At Station XVII there is only one mark (⊙) which is engraved on the rock *in sitú*, and for the observatory tent a temporary platform of wood and bamboos was erected. The two stations of the Karáchi Longitudinal Series from which this triangulation emanates, have solid pillars of masonry, surrounded by platforms of stones: the pillars carry marks at top, bottom and intermediately. The remaining stations of this Series together with the two of the Bombay Longitudinal Series on which this triangulation terminates, were constructed under the direction of Lieutenant Rivers, and consist in general of solid, masonry pillars with one or more marks sunk in the ground and having their upper surfaces flush with the ground level. Above these pillars, solid structures of loose stone masonry, about 1 to 4 feet in height, were erected with another mark laid at the surface.

The following descriptions have been compiled from those given by the Officers who executed the Series, supplemented as regards adjacent villages, &c., from the Topographical Survey maps of the country traversed. Some details regarding the heights and the construction of the stations have been gathered from annual reports, contingent bills, and other records of the Series, but in several instances the information required is unavoidably meagre or is even wholly absent, because no record of the facts now wanted for incorporation appears to have been kept by the Executive Officer. The local Sub-divisions in which the several stations are situated, have been derived, when practicable, from the latest Annual Reports furnished by the district officers to whose charge the stations are committed.

XXIX. (*Of the Karáchi Longitudinal Series*). Tána Hill Station, lat. 24° 43′, long. 74° 14′—observed at in 1851 and 1862—is situated on the highest point of a well-known, isolated hill, about a mile W. of the road from Akola to Tána. The station platform is built near and to the south of the site of some ruined buildings upon which there are now a few sacred stones: estate of the Tána Ráj, under the Meywar (Mewár) Residency.

The station of 1851 consists of a platform of the usual construction, 2·53 feet in height, enclosing a solid, isolated pillar of masonry in which are placed three mark-stones, one at top, another at the level of the foundation, and the third 2 feet above the latter. It was visited in 1862 in the course of the Singi Meridional Series operations, but no statement of its condition or of any alteration then made is forthcoming. The directions and distances of the circumjacent villages are:—Tána S.S.E., miles 1¾; Intáli S.W. by W., miles 4½; Daulatpur W., mile 1; Raepuria N.E., miles 2¾; and Kanerkhera E.N.E., mile ¾.

XXXII. (*Of the Karáchi Longitudinal Series*). Lakarwás Hill Station, lat. 24° 32′, long. 73° 52′—observed at in 1851 and 1862—is situated on the range of hills forming the eastern defence of the city of Oodeypore (Udaipur), about 1½ miles S.E. by S. of the large village of Lakarwás on a road from Kánpur to Korábar, which crosses the range to the north, and 2 miles S. of the ruined gate called "Sejah-ka-Darwáza" which is one of the approaches to Oodeypore. The station is in the lands of the village of Lakarwás, zilla Girwa, tahsíl Oodeypore, under the Meywar Residency.

The station of 1851 consists of a platform of the usual construction, 2·80 feet in height, enclosing a solid, isolated pillar of masonry which contains three mark-stones, one at the surface, the second 1 foot below and the third at the level of the foundation. It was visited in 1862 in the course of the Singi Meridional Series operations, but no statement of its condition or of any alteration then made is forthcoming. The directions and distances of the circumjacent villages are:—Karget N.E. by N., miles 2½; Dhámdar S., miles 2; Umra W. by S., miles 2¾; and Maton N.W., miles 3.

I. Anjini Hill Station, lat. 24° 15′, long. 74° 11′—observed at in 1862—is situated on a high hill named Anjini Máta, about ½ a mile S. of the southernmost part of the scattered village of Anjini, and 4 miles E. by N. of Karauli which is 6½ miles N. by E. of the town of Salúmbar. The platform is a few feet E. of the portion of the hill dedicated to the Máta (goddess). The station is in the lands of the village of Anjini belonging to the Salúmbar Ráo.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 3·06 feet in height: an aperture gives access to the lower mark. The directions and distances of the circumjacent villages are:—Birirokhera S.S.E., miles 2½; Kánpur W. by S., miles 2¾; Urwária W. by N., miles 3¾; and Taláo N.W. by N., miles 2½.

II. Sísa Hill Station, lat. 24° 12′, long. 73° 46′—observed at in 1862—is situated on the southern extremity of a hill locally known as Sísa Magra, about a mile N.E. by E. of the Parshád Dâk Bungalow on the high road from Kherwára to Oodeypore. The ascent to the station commences from the western side, and is very steep. The station is in the lands of the village of Parshád, territory of the Rána of Oodeypore.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 4·37 feet in height, with mark-stones at top and bottom: an aperture gives access to the lower mark.

III. Tukwása Hill Station, lat. 23° 56′, long. 74° 6′—observed at in 1862—is situated on a hill locally known as Túnk-ka-Magra having the village of Tukwása at its northern foot, and about 1¾ miles S.W. by W. of the town of Áspur. The station is in the lands of the village of Tukwása, Dúngarpur state.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 4·94 feet in height, with mark-stones at top and bottom: an aperture gives access to the lower mark. The directions and distances of the circumjacent villages are:—Gara (Moriána) E. by S., miles 1½; Wásúndar S.W. by S., mile ¾; Sakáui W., miles 3½; and Amartia N.N.W., miles 2.

IV. Dúngarpur Hill Station, lat. 23° 50′, long. 73° 45′—observed at in 1862—is situated on the northern tower of some old fortifications on a hill locally known as Dún-ka-Magra, close to and immediately south of the palace and town of Dúngarpur. The station is in the lands of the town of Dúngarpur, Dúngarpur state.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 3·58 feet in height, with mark-stones at top and bottom: an aperture gives access to the lower mark.

V. Sagwára Hill Station, lat. 23° 41′, long. 74° 2′—observed at in 1862—locally known as Naia Magra, is situated on a hill about 1¾ miles N.W. of the town of that name. The foot-path leading to the station commences from the south-east. The station is in the lands of the village of Sagwára, Dúngarpur state.

The station consists of a platform of wood, earth and rubble enclosing an isolated and perforated pillar of masonry 4·60 feet in height: an aperture gives access to the lower mark. The directions and distances of the circumjacent villages are:—Gamra N.E., miles 1¼; Madkola S. by E., miles 1¾; Gowári S. by W., miles 2; Udepur S.W. by S., miles 3; and Pádra N. by W., miles 2½.

VI. Lohária Hill Station, lat. 23° 46′, long. 74° 15′—observed at in 1862—is situated on a hill locally called Khanio, about ¾ of a mile W.N.W. of the large village so called, and 2½ miles S.S.E. of the Baneshwar temple on an island at the confluence of the Mahi and Som rivers. The station which is ascended from the east, is in the lands of the village of Lohária, thána Bánswára, territory of the Rája of Bánswára.

The station consists of a platform enclosing an isolated and perforated pillar of masonry 2·75 feet in height above the lower mark which is engraved on a rock imbedded in the hill: an aperture gives access to the lower mark. The directions and distances of the circumjacent villages are:—Káli-ka-Pára N.E., miles 1½; Vichháwára E.N.E., miles 1¾; Pároda W. by S., miles 2¼; Wási W.N.W., mile ¾; and Karáua N. by W., miles 1¼.

VII. Ámjio Hill Station, lat. 23° 32′, long. 74° 16′—observed at in 1862—is situated on a long, flat hill, about 1½ miles E.N.E. of village so called, and 3½ miles N.W. by W. of Bodia which is 2 miles S.S.E. of Partapor town. To the north and east, distant about a mile, are numerous Bhíl huts. The station is nearly on the centre of the hill but not on the highest part which is a little to the east and obstructs the view in that direction. The station is in the lands of the village of Ámjio, thána Bánswára, territory of the Rája of Bánswára.

The station consists of a platform of wood, earth and rubble enclosing an isolated and perforated pillar of masonry 4 feet in height above the lower mark: an aperture gives access to the lower mark. The directions and distances of the circumjacent villages are:—Gamdi W.S.W., miles 2; Vakhatpur W., miles 3; Máudarda W.N.W., miles 2½; and Gara (Sujáji) N.N.W., miles 2.

VIII. Kua Hill Station, lat. 23° 29′, long. 73° 57′—observed at in 1862—is situated on a low hill forming part of a range running N.N.E. and S.S.W., about 2 miles N. of Kua village. The station is in the lands of the village of Kua, Dúngarpur state.

The station consists of a platform of wood, earth and rubble enclosing an isolated and perforated pillar of masonry 4·95 feet in height, with mark-stones at top and bottom: an aperture gives access to the lower mark.

IX. Deokotla Hill Station, lat. 23° 19′, long. 74° 12′—observed at in 1862—is situated on a conspicuous peak at the eastern end of a short range of hills running E. and W., about ⅛ of a mile S.W. of Deokotla village, and 2 miles S. by W. of the large village of Shergarh: territory of the Rája of Bánswára.

The station consists of a platform of wood, earth and rubble enclosing an isolated and perforated pillar of masonry 5 feet in height: an aperture gives access to the lower mark. The directions and distances of the circumjacent villages are:—Tánda N. by E., miles 1½; Tejpur W.S.W., miles 3; and Phalwa (scattered huts) W., miles 4.

X. Tembla Hill Station, lat. 23° 15′, long. 73° 55′—observed at in 1862—is situated on the highest part of a range of low hills running N. and S., about ¾ of a mile W. by N. of Tembla village, and 3¾ miles N. of the town of Sunth. The station is in the lands of the village of Tembla, thána and state Sunth, Rewa Kántha (Revákántha) Political Agency.

The station consists of a platform 5 feet in height (most probably of the same construction as those at the adjacent stations) enclosing an isolated and perforated pillar of masonry, with mark-stones at top and bottom: an aperture gives access to the lower mark. The directions and distances of the circumjacent villages are:—Sagvária S.E. by E., mile 1; Páderim S.S.E., mile 1; Kureta S. by W., mile 1; Kerámul S.W. by S., miles 1½; and Nathukáka (hamlet) W., miles 1¾.

XI. Uchak Hill Station, lat. 23° 3′, long. 74° 4′—observed at in 1862—is situated on a hill locally so called, S. of the village of Moli, and about 2 miles E. of Bánpur: Sanjeli estate, Rewa Kántha Political Agency.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 5·15 feet in height, and has an aperture for access to the lower mark. The nearest villages are Chakisva and Doki.

XII. Játhrábhor Hill Station, lat. 23° 2′, long. 73° 43′—observed at in 1860, 1861 and 1862—is situated on a range of hills, about 1½ miles W. of Játhrábhor village. The station is in the lands of the village of Játhrábhor, thána and state Lúnáváda, Rewa Kántha Political Agency.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 5 feet in height, and has an aperture for access to the lower mark. The directions and distances of the circumjacent villages are:—Sukatimba (hamlet) S. by W., mile ¾; Boria N.W., miles 1¼; and Chari N., miles 1¾.

XIII. Patángri Hill Station, lat. 22° 52′, long. 73° 56′—observed at in 1861-62—is situated on a high, flat-topped hill forming portion of a range, about ½ a mile S.S.E. of village of Patángri, and 5 miles N. by E. of Rebári at the seventeenth mile-stone of the high road from the town and Railway Station of Godhra to Dohad. The station is in the lands of the village of Patángri, thána and state Báriya, Rewa Kántha Political Agency.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 2 feet in height, with mark-stones at top and bottom: an aperture gives access to the lower mark. The directions and distances of the circumjacent villages are:—Pála N., miles 2; Devi E.N.E., miles 1¼; Pasáyata E., miles 1½; Jámodra E.S.E., miles 2¼; Dhabuka S.E., mile ½; Navagám S.W., miles 2¼; and Mátaria Vejma N.W. by W., miles 1¾.

XIV. Kágarol Hill Station, lat. 22° 53′, long. 73° 42′—observed at in 1860-61—is situated on a low isolated hill also known as Pipalia-ni-Dungri, and 8 miles N.N.E. of the town and Railway Station of Godhra. The station is in lands of the village of Pipalia, sub-division Godhra, district Panch Mahâls.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 5 feet in height, and has an aperture for access to the lower mark. The directions and distances of the circumjacent villages are:—Pati (hamlet) N., miles 3; Vijápur N.N.E., miles 1¾; Navagám E.S.E., miles 1¼; Sámpa S.E. by S., miles 2¼; Mitháli S. by W., miles 2; Dokva W.S.W., mile 1; and Shehera N. by W., miles 4½.

XV. Wardhari Hill Station, lat. 23° 6′, long. 73° 30′—observed at in 1860—is situated on a hill, about ⅓ of a mile E. of village so called. The station is in the lands of the village of Wardhari, thána and state Lúnáváda, Rewa Kántha Political Agency.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 5·83 feet in height, and has an aperture for access to the lower mark. The directions and distances of the circumjacent villages are:—Ved N. by W., mile ¾; Jitpur N.E. by E., mile 1; Dhesia E. by S., mile 1; Bhimpur S.S.W., miles 1¾; and Karáchhla W. by S., miles 2½.

XVI. Ghorárâo Hill Station, lat. 22° 52′, long. 73° 24′—observed at in 1859 and 1860—is situated on a ridge of hills, about 1⅓ miles N.N.E. of Kuni village on the right bank of the Mahi river, 6 miles S. by E. of Bálásinor (Vádáshinor) town, and 4⅓ miles N. by E. of Páli Railway Station on the B. B. and C. I. Line. The station is in the lands of the village of Kuni, táluka Thásra, district Kaira (Kheda).

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 5 feet in height, and has an aperture for access to the lower mark. The directions and distances of the circumjacent villages are:—Nadisar E.N.E., miles 2½; Sangol E.S.E., miles 1¼; Sonipur S., miles 2; Rasúlpur Parál W. by S., miles 2¼; Parál W., miles 2; and Menpura N.W. by W., miles 1½.

XVII. Bhor Hill Station, lat. 22° 40′, long. 73° 52′—observed at in 1860-61 and 1862—is situated on the southern of two rocks on the high hill of Bhálápur, and about 6 miles S.W. by W. of the town of Báriya. The station is in the lands of the village of Bhor, thána and state Báriya, Rewa Kántha Political Agency.

As regards the construction of the station the following is all that is forthcoming:—"The platform for the observatory was made of bamboos resting on logs of wood fixed in the crevices of the rocks, and the mark is made on the rock". The directions and distances of the circumjacent villages are:—Gholáv N., miles 3; Kálidungri E.N.E., miles 1¾; Virol E. by S. miles 1¾; Kákalpur S. by W., miles 1½; and Khánpála W.N.W., miles 1¼.

XVIII. Rencha Hill Station, lat. 22° 42′, long. 73° 39′—observed at in 1860-61—is situated on a small isolated hill locally known as Vagh Dungar, and about 3¼ miles E. by N. of the large village of Vejalpur on the high road from Kálol to Godhra. The station is in the lands of the village of Richhia, sub-division Kálol, district Panch Mahâls.

The station consists of a platform of logs of wood covered over with earth, enclosing an isolated and perforated pillar of masonry 5 feet in height, with marks at top and bottom, and has an aperture for access to the lower mark which is cut on the rock. The directions and distances of the circumjacent villages are:—Richhia N., mile ½; Chaláli S.E., miles 2; Arádra S., miles 3½; and Nádarkha W. by N., miles 2.

XIX. Kandálwa Hill Station, lat. 22° 28′, long. 73° 50′—observed at in 1861—is situated on a high range of hills of the same name, which runs E. and W., about 3 miles S.W. of the village of Puneh. The station is in the lands of the village of Kandálva, thána Karáli, Chhota Udepur state, Rewa Kántha Political Agency.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 5 feet in height, with mark-stones at top and bottom, and has an aperture giving access to the lower mark.

XX. Páwágarh Hill Station, lat. 22° 28′, long. 73° 33′—observed at in 1861—is situated on the second highest part of the well-known hill of this name, a few yards S. of a temple dedicated to the goddess Kálka Máta. The village of Chámpáner (which was once a flourishing town) is to N.E. from which the ascent to the station is by a path about 4 miles in length. The station is in the lands of the village of Chámpáner, sub-division Hálol, district Panch Mahále.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 2 feet in height, with mark-stones at top and bottom, and has an aperture for access to the lower mark.

XXI. Masábár Hill Station, lat. 22° 19′, long. 73° 45′—observed at in 1861—is on a peak of a high and steep hill having the village of Masábár a short distance from its N.E. foot; the hill is locally known as Masábario Dungar and more commonly as Mahábár. The station is in the lands of the village of Masábár, sub-division Jámbughoda, district Panch Mahále.

The station consists of a platform of earth and rubble 3 feet in height, enclosing an isolated and perforated pillar of masonry, and though no mention of any marks is made, it may be assumed that the usual marks must have been inserted in the pillar as at the adjacent stations. The nearest villages are Khudsár, Duma and Pipia.

XXII. Karáli Hill Station, lat. 22° 10′, long. 73° 54′—observed at in 1861—is situated at the western end of a short range of hills running E. and W., about a mile S.S.E. of Karáli village, and 2 miles N. of the village of Timarva Nava on the right bank of the Heran river. The station is in the lands of the village of Karáli, Chhota Udepur state, Rewa Kántha Political Agency.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 5 feet in height, with an upper and lower mark-stone: an aperture gives access to the lower mark. The directions and distances of the circumjacent villages are:—Karsan N.E. by N., miles 1¾; Gamária (hamlet) E. by S., miles 1¼; Rundhi Juni S.S.E., mile 1; Pherkua S.W. by W., miles 2¾; Daulatpura W. by N., miles 1½; and Ghoraj N.W., miles 2.

XXIII. Sidpur Station, lat. 22° 4′, long. 73° 31′—observed at in 1861—is situated on the western bank of the Orsang river, and about a mile S.S.E. of Sidpur village: pargana Dabhoi, Gáikwár territory.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry 4·83 feet in height, with mark-stones at top and bottom: an aperture gives access to the lower mark. When visited in 1876-77 by Captain Baird, R.E., in the course of the levelling operations, he found the station to consist of "a circular pillar 5 feet high over which is a covering pillar 3½ feet high, the upper mark-stone of which was found intact". The directions and distances of the circumjacent villages are:—Kántoli N., mile 1; Bhiloria W., miles 1¼; Ásádara S.E. by S., miles 1¼; Akoti S.S.W., miles 1½; and Chanváda S.W., mile 1.

XXIV. Bábásiráj Hill Station, lat. 21° 47′, long. 73° 57′—observed at in 1861—is situated on the highest hill which has the hamlet of Amba at its eastern foot, about 8 miles S. of the Narbada river, and 2 miles S. by E. of the village of Pipalkota: Mevás state of Káthi, district Khándesh.

No information whatever as regards the construction of this station is given in the records of this Series. The district officer reports that "There is no masonry pillar but only a platform 3½ feet in height".

XXV. Kesarwa Hill Station, lat. 21° 46′, long. 73° 26′—observed at in 1861—is on the summit of a high hill forming one of a range running W. and S., about 2¼ miles S.E. of the village so called. The station is in the lands of the village of Kesváda, thána Nándod of the Rájpipla state, Rewa Kántha Political Agency.

The station consists of a platform of bricks and mud cement enclosing an isolated and perforated pillar of masonry 4 feet in height, with mark-stones at top and bottom, and has an aperture for access to the lower mark. The directions and distances of the circumjacent villages are:—Gared N., miles 1¼; Chatváda N.E., miles 2; Handi Dhochki E. by N., miles 2; and Dabhál W. by N., miles 4½.

XXVI. Ságbára Hill Station, lat. 21° 34′, long. 73° 49′—observed at in 1861—is situated about 8 miles N. of the Tápti river, and some 12 miles N. by E. of a small fort of Vájpur on the right bank of the Tápti: thána Ságbára of the Rájpipla state, Rewa Kántha Political Agency.

No details of the construction of the station platform and pillar are forthcoming.

XXVII. Álamwári Hill Station, lat. 21° 35′, long. 73° 33′—observed at in 1861—is about 8 miles N.W. of Báradev, and 10 miles E.S.E. of Netrang: Rájpipla state, Rewa Kántha Political Agency.

No details of the construction of the station platform and pillar are forthcoming.

XXVIII. Páthal Hill Station, lat. 21° 22′, long. 73° 17′—observed at in 1861—is situated on one of a group of hills called Khumbaria on the western skirts of the Dáng jungles, about 2 miles N.E. of the village so called, and 6 miles N.E. of Areth on the high road and at the seventeenth mile-stone from Kím to Mándvi. The station is in the lands of the village of Kálmoi, táluka Mándvi, district Surat.

The station was originally established in 1846. It was visited and repaired in 1861. When visited in 1863 it was described as follows:—"No pillar was built, a masonry platform 1 foot in height having the usual mark-stones in the foundation and on its surface, indicates the site of the station". The directions and distances of the circumjacent villages are:—Parvat E.N.E., miles 1½; Regáma E. by S., miles 3; Kálmoi S. by W., mile ⅞; and Lindia N.W., mile 1.

XXIX. Dopári Hill Station, lat. 21° 5′, long. 73° 46′—observed at in 1846 and 1861—is situated at the centre of a long ridge, and on the boundary between the Khándesh collectorate and the Songad táluka of Gáikwár's territory. A small village Bhoreh is about 2½ miles to N.E.

The station as originally built in 1846 is described as follows:—"A mark was made on the rock below and a platform built up to the surface with another stone at top". When visited in 1861 it was repaired, but nothing exists to shew the state it was found nor the repairs then effected. When visited in April 1885, the platform was found partly destroyed, but a mark 1 foot below the surface of the existing remains was found undisturbed; this mark is 0·8 of a foot below the surface of the hill. A scattered group of huts within a circle of a mile lie 3 miles to S.W. The nearest centre is called Tarpára, ¼ of a mile further is Leotara, and at another ¼ of a mile lies Dhabda. About 6 miles S.W. by W. is the site called Mendha, and 7 miles S.W. is the Gáikwár tháua station of Saudervail.

XXX. Tarbhán Station, lat. 21° 1′, long. 73° 6′—observed at in 1845 and 1861—is situated on rising ground, about 3¼ miles S.S.W. of Sarbhon, and 1¼ miles S.E. of Párdi Vágha, both on the road from Navsári to the town of Bárdoli. The station is in the lands of the village of Sarbhon, táluka Bárdoli, district Surat.

The station as originally built in 1845 consisted of a platform enclosing a circular, isolated pillar of brick masonry "with three stones for the feet of the instrument and a central one for the mark. A second stone is at the surface of the ground "2·67 feet below this". When visited in 1861 it was repaired. It was again visited in April 1885 and found to be in good preservation. The directions and distances of the circumjacent villages are:—Tarbhán N., mile ⅜; Varoli N.E. by N., miles 1⅜; Kavita E.S.E., miles 1½; and Kharad S. by E., mile 1.

XXXI. Pilwa Hill Station, lat. 20° 39′, long. 73° 26′—observed at in 1845—is situated on a hill so called, about 20 yards S. of a conspicuous tree. There are no villages near the station, a few scattered huts called Chauronia where a market is held every Sunday lie about a mile to S.W., and a similar collection called Mankonia 2 miles to N.W.: Bánsda (Vánsda) state, Surat Agency.

The station was originally established by the Bombay Trigonometrical Survey. "A platform has been built over the "old mark and another station stone at its surface plumbed over the former at the height of 2·25 feet". When visited in March 1885, it was found to consist of a platform of loose stones 1 foot high, enclosing three large flat stones placed triangularly for the theodolite stand; between these stones, and at a depth of 2 inches, is a circle and dot on a stone apparently undisturbed.

XXXII. Sáler Hill Station, lat. 20° 43′, long. 73° 59′—observed at in 1845—is in the fort of Sáler at the western end of a remarkable, narrow ridge about ½ a mile in length, and having along its southern face an almost perpendicular drop of about 1000 feet: the eastern end is rather higher, and is capped with rock, but the space being extremely confined and occupied by symbols dedicated to the worship of Pareshrám, the station could not be established here on account of the strong objections of the people: táluka Báglán, district Násik.

The station is denoted by two marks, one at the surface of the ground and the other 1·96 feet below firmly fixed in the muram (a kind of gravel). When visited in April 1885, three dressed stones, triangularly imbedded for the theodolite stand, were found around the mark-stone of the station which was undisturbed and on a level with the surface of the hill: there is no platform. The directions and distances of the circumjacent villages are:—Chichli N.W. by W., miles 2½; Bhilpára S.W., mile 1; Mahardar S.S.E., miles 1½; Vagamba N.E., miles 2½; and Sáler S., mile ½.

XXXIII. Párnera Hill Station, lat. 20° 33′, long. 72° 59′—observed at in 1844—is situated on the raised mound running along the middle length of the fort which is on a small isolated hill. It is about 1¼ miles E. of the B. B. and C. I. Railway line level crossing, and 2⅓ miles N. of the town of Párdi. The station is in the lands of the village of Párnera, táluka Bulsár (Valsád), district Surat.

No pillar was built. The station of 1844 was denoted by two mark-stones, "one at the surface level and the other below". It was visited in 1876-77 by Captain Baird, R.E., who stated that "a mark ⊙ is cut on the rock *in sitû*". When again visited in March 1885, three large flat stones placed triangularly for the theodolite stand were found around the mark-stone which was apparently undisturbed: there is no platform. The directions and distances of the circumjacent villages are:—Párnera N., mile ½; scattered huts (no name) S., mile ½; and Chichváda (scattered huts) W. by N., mile ½.

XXXIV. Bhorgarh Hill Station, lat. 20° 7′, long. 73° 47′—observed at in 1845—locally known as Bhorgad, is situated on a table-land, 179 feet S.W. of a conspicuous tree, and about 2 miles W. by N. of the hill fort of Rámsej immediately E. of the road to Násik. The station is in the lands of the village of Rámsej, táluka Dindori, district Násik.

The station consists of a platform and has two marks, the one at the surface is 2·40 feet above the lower which was established by the Bombay Trigonometrical Survey. When visited in May 1885, the platform was fouud in good repair, and the upper mark, 2·40 feet above the rocky surface of the hill, apparently undisturbed. The directions and distances of the circumjacent villages are:—Tongaldara E.S.E., miles 1½; Rávalgaon W.N.W., miles 2¾; Rásegaon N. by E., miles 2¾; and Goalvádi S.S.E., miles 2.

XXXV. Ankai Hill Station, lat. 20° 11′, long. 74° 29′—observed at in 1845—locally known as Chándkha Bovas Dúngar, is situated on a conical knoll, in the centre of the fort of Ankai which is about ¾ of a mile E. of the road from Sawargaon to the Railway Station of Manmád on the G. I. P. Railway, this road is skirted by the Dhond and Manmád Railway. The station is in the lands of the village of Ankai, táluka Yeola (Yevla), district Násik.

In 1845 the station consisted of a platform, and had two marks, the one at the surface was 3·67 feet above the lower cut on the rock which agreed in position with some appearance of a mark found on the rock on which a pole had been erected in 1832. When visited in 1881 by the Levelling Party, no upper mark was found; a bench-mark, with the inscription B. ○ M., was cut on a stone of the platform. When again visited in April 1885, a platform of dressed stones, 10 feet square and 22 inches high, was found but no upper mark. A search was made for the lower mark, but none having been found, the central portion of the platform was rebuilt and the bench-mark stone fixed in the centre of and level with the upper surface of the platform, the outer and upper edges of which were in perfect preservation having been built with dressed stones set in good mortar. The directions and distances of the circumjacent villages are:—Anakvádi (on the road to the Manmád Railway Station) N. by W., miles 1½; Visápur W., miles 3¼; Dhanakvádi S.S.W., miles 3; Vánjarvádi N.E. by N., miles 2¾; Chándgohán E.S.E., miles 2; and Kasúr S.E. by S., miles 3¼.

XXXVI. Gambírgarh Hill Station, lat. 20° 3′, long. 73° 6′—observed at in 1843 and 1844—is named after the old and now entirely destroyed fort of Gambírgarh, and is situated on the highest part of the hill (S.E. extremity) which is crowned with immense, perpendicular masses of basaltic rock, rising 100 feet and more in some places. It is in a thinly populated and very wild part of the Thána district. The station is in the lands of the village of Váyaloli, táluka Dáhánu, district Thána.

The station of 1843 and 1844, was described as follows:—"The stone at the surface has been plumbed over the lower which is 2·23 feet below it". When visited in March 1885, a slight trace of a platform about 6 or 8 inches above the surface of the hill with three large flat stones planted triangularly were found. Between these stones and at the bottom of a triangular well, 1·71 feet deep, a mark with circle and dot was found engraved on the rock apparently *in sitú.*

XXXVII. Sinnar Hill Station, lat. 19° 53′, long. 74° 3′—observed at in 1845—locally known as Dhagya Dúngar, is situated on the centre of three knolls on a range of hills, about 3 miles N. of the town of Sinnar, and ¾ of a mile N. of a two-domed temple on the southern knoll. The station is in the lands of the village of Máparvádi, táluka Sinnar, district Násik.

The station consists of a stone platform having two marks, one at its surface and the other 1·35 feet below it which is engraved on the rock. When visited in 1885 the platform was found newly repaired, the upper mark-stone undisturbed and apparently in position: the platform which is on a level with the upper mark-stone, is 1·5 feet above the surface of the hill. The directions and distances of the circumjacent villages are:—Máparvádi S.S.W., miles 1¼; Málegaon W.S.W., miles 2¼; Deshvandi N. by W., miles 2½; and Vadagaon Pimpri E.N.E., miles 3¾.

XXXVIII. Hewargaon Hill Station, lat. 19° 29′, long. 74° 16′—observed at in 1845—is situated on a small knoll on a table-land, and is about 400 feet higher than the ridge which in a manner connects it with the Báleshvar hill on the west "and runs eastward for a distance of some 20 miles," about 6 miles S. by E. of the town of Sangamner at the junction of the Pravara river with the Malungi stream: táluka Sangamner, district Ahmednagar (Ahmadnagar).

The station consists of a stone platform and has two marks, the one at the surface is 1·67 feet above the other. When visited in January 1885, the station was found in good preservation and the upper mark undisturbed. The directions and distances of the circumjacent villages are:—Hewargaon N.N.W., miles 2¼; Nimgaon N. by E., miles 2½; Jámgaon N.E. by E., miles 4¼; Ambhor W., miles 3½; Modalvádi S., miles 1½; Chándnapur W.N.W., miles 2½; and Jhola N.W., miles 3.

XXXIX. Kalsubai Hill Station, lat. 19° 36′, long. 73° 45′—observed at in 1842, 1844 and 1845—is situated on a hill so called which rises abruptly on its western side, and is on the boundary between the Násik and Ahmednagar districts. It is about 10 miles E. of the general line of the Western Gháts, and 12 miles S.E. of the Igatpuri (Vigatpuri) Dâk Bungalow on the G.I.P. Railway Line from Bombay to Jubbulpore (Jabalpur). A temple lies to the N. by E., the S.W. and S.E. angles of which are 15·44 feet and 22·89 feet respectively. The station is in the lands of the village of Bári, táluka Akola, district Ahmednagar.

The station was originally denoted by a circle and dot engraved on the rock: no pillar was built. When visited in February 1885, the station was found in good repair and to consist of a platform, 4 feet 3 inches above the lower mark cut on the rock *in sitú*, surrounding a perforated masonry pillar 3 feet in diameter. The directions and distances of the circumjacent villages are:—Indor N., miles 2¼; Vásádi N.N.E., miles 3¼; Varanguz E., miles 4; Pánjra S. by E., miles 2½; and Ambavádi W.N.W., miles 2¾.

XL. Kámandrug Hill Station, lat. 19° 23′, long. 73° 0′—observed at in 1843—is situated on the eastern and lower point of a double peaked hill connected by a curving narrow ridge which leads on to a high plateau to the north; this plateau in 1885 was being prepared for a sanitarium for the Railway employés of the district. The station is in the lands of the village of Káman, táluka Bassein (Vasai), district Thána.

Of the station built in 1843, no description is forthcoming except that two mark-stones were left, one at the surface of the ground and the other 2·21 feet below it. When visited in 1885, no platform or pillar was found but only three large flat stones imbedded flush with the hill top, between which and at the depth of 2·25 feet below their upper surface a mark, circle and cross-lines, was found at the bottom of a well.

XXVI. (*Of the Bombay Longitudinal Series*). Párner Hill Station, lat. 19° 3′, long. 74° 27′—observed at in 1838, 1845 and 1846—is situated on a knoll of a flat-topped hill which rises about 450 feet above the plains to the south: it is ascended by a fair path from the village of Kumbarvádi (at the E. foot of the hill) immediately to the W. of the road from Párner to Tákle Dhokeshvar, and about 3½ miles N.W. of the town of Párner. The hill commands a fair view all round except towards the N.E., where it is intercepted by a Muhammadan dargáh surrounded by trees, distant 40 feet from the station. The station is in the lands of the village of Párner, táluka Párner, district Ahmednagar.

The station of 1838 is described as "marked by a cross on a large stone at the depth of 3·31 feet and again at the level of the ground by the usual circle and centre". No change appears to have been made in 1845 and 1846. When visited in 1881, the station was found to consist of a perforated pillar of masonry 3 feet in diameter and 3·17 feet above the ground level, surrounded by a platform of earth and stones 10 feet in diameter; "there was no mark-stone at top, but there may be one at the bottom of the perforation which is 19½ inches deep"; a mark was let into the upper surface of the pillar and covered over by a cairn of stones. When again visited in 1885, the station was found in good condition and the upper mark apparently undisturbed. *Note.*—In September 1868 the district officer reported as follows:—"No sign to be found except a hole in the ground in which there has apparently been a stone": from this it appears that the station as found in 1881 was most probably built by a Survey Party, about the years 1877-78. The directions and distances of the circumjacent villages are:—Karandi N.E. by N., miles 1⅜; Háthálkhindi W. by N., miles 1⅝; Viroli N.W., miles 2¼; and Puna (hamlet) S.S.W., mile 1.

XXX. (*Of the Bombay Longitudinal Series*). Singi Hill Station, lat. 18° 57′, long. 73° 42′—observed at in 1839, 1842 and 1845—is situated on a sharp peak of the narrow ridge of hills, about 1¼ miles N. by E. of the village of Argaon above which it rises about 2000 feet. The ascent is steep on all sides and towards the S. it is almost precipitous. The upper part of the hill is composed of porous basalt, and the lower, in some parts, is amygdaloidal rock with occasional small masses of zeolite. The station is in the lands of the village of Argaon, táluka Khed, district Poona (Puna).

The station of 1839 was denoted by a mark-stone: in 1842 an upper mark-stone was placed, but this having been disturbed another upper mark-stone was placed in 1845 at 3·08 feet above and in the normal of the mark of 1839. When visited in 1885, "the mark was found in position and apparently undisturbed. It is flush with the surface of the hill top; a ring of stones about 10 feet in diameter defining a kind of platform was found which had to be filled up and levelled for the observations. No masonry pillar exists at the station." The azimuths, directions and distances of the circumjacent villages are:—Argaon 9°, miles 1⅓; Kura Buzurg 156°, miles 1⅝; Kura Khurd 196°, miles 1½; Audar E. by N., miles 2; and Aunda W. by N., miles 2¼.

December, 1890.

J. ECCLES,

In charge of Computing Office.

SINGI MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. OBSERVED ANGLES.

At XXIX (Tána)

March 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on I												M = Mean of Groups w = Relative Weight C = Concluded Angle
	305° 23′	125° 23′	15° 34′	195° 34′	85° 45′	265° 45′	155° 50′	335° 51′	226° 1′	46° 2′	296° 12′	116° 12′	
I & XXXII	″ h 37·06 h 36·64	″ h 36·00 h 36·03	″ h 39·37 h 38·46	″ h 34·97 h 34·23	″ h 36·54 h 36·36	″ h 41·23 h 41·84	″ h 32·63 h 33·34	″ h 32·40 h 33·20	″ h 33·63 h 33·63	″ h 35·97 h 35·57	″ l 32·57 l 32·67	″ l 34·37 l 34·27	$M = 35''·54$ $w = 1·67$ $\frac{1}{w} = 0·60$
	36·85	36·02	38·91	34·60	36·45	41·54	32·98	32·80	33·63	35·77	32·62	34·32	$C = 54° 37′ 35''·54$

At XXXII (Lakarwás)

March 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 11′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
XXIX & I	″ h 18·40 h 18·53	″ h 16·50 h 17·56	″ l 14·76 l 14·24	″ l 16·67 l 16·87	″ h 18·97 h 18·27	″ h 15·36 h 14·47	″ h 19·67 h 19·50	″ h 18·07 h 18·76	″ h 23·50 h 23·94	″ h 22·63 h 22·17	″ l 19·57 l 19·40	″ l 16·20 l 16·60	$M = 18''·36$ $w = 1·58$ $\frac{1}{w} = 0·63$
	18·47	17·03	14·50	16·77	18·62	14·91	19·59	18·41	23·72	22·40	19·49	16·40	$C = 75° 25′ 18''·36$

NOTE.—Stations XXIX and XXXII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At XXXII (Lakarwás)—(*Continued*).

Angle between	Circle readings, telescope being set on XXIX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 11′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
I & II	h 21·04	h 22·30	l 25·27	l 18·86	h 18·83	h 18·07	h 18·43	h 21·33	h 14·74	h 18·33	l 21·26	l 24·64	$M = 20''\cdot 25$
	h 20·67	h 22·20	l 24·80	l 18·37	h 19·97	h 19·00	h 19·17	h 20·64	h 14·20	h 19·30	l 21·26	l 23·36	$w = 1\cdot 51$ $\frac{1}{w} = 0\cdot 66$
	20·86	22·25	25·03	18·62	19·40	18·53	18·80	20·99	14·47	18·81	21·26	24·00	$C = 61^\circ\, 23'\, 20''\cdot 25$

At I (Anjini)

***March* 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on III												M = Mean of Groups w = Relative Weight C = Concluded Angle
	188° 22′	8° 22′	258° 32′	78° 33′	328° 43′	148° 44′	38° 49′	218° 49′	109° 0′	289° 0′	179° 11′	359° 11′	
	″	″	″	″	″	″	″	″	″	″	″	″	
III & II	h 46·50	h 51·84	h 42·10	h 42·74	l 40·73	l 46·20	l 51·00	l 47·30	h 51·93	h 53·80	h 48·06	h 49·80	$M = 47''\cdot 88$
	h 47·50	h 51·57	h 41·10	h 42·37	l 42·46	l 47·47	l 50·74	l 47·30	h 52·90	h 52·50	h 50·27	h 50·90	$w = 0\cdot 69$ $\frac{1}{w} = 1\cdot 45$
	47·00	51·71	41·60	42·55	41·60	46·83	50·87	47·30	52·42	53·15	49·16	50·35	$C = 70^\circ\, 33'\, 47''\cdot 88$
II & XXXII	h 64·00	h 57·10	h 61·70	h 67·03	l 62·07	l 62·10	l 59·50	l 64·67	h 58·77	h 57·90	h 61·04	h 59·23	$M = 61''\cdot 16$
	h 64·23	h 57·83	h 63·00	h 66·53	l 60·34	l 60·37	l 60·73	l 63·97	h 58·76	h 58·00	h 60·60	h 58·40	$w = 1\cdot 47$ $\frac{1}{w} = 0\cdot 68$
	64·12	57·46	62·35	66·78	61·21	61·23	60·12	64·32	58·76	57·95	60·82	58·82	$C = 51^\circ\, 8'\, 1''\cdot 16$
XXXII & XXIX	h 6·53	h 9·86	h 9·90	h 5·13	h 12·57	l 11·16	l 8·43	l 2·96	h 4·97	h 5·87	h 8·66	h 6·50	$M = 7''\cdot 45$
	h 6·90	h 8·90	h 8·83	h 4·50	l 11·27	l 12·30	l 7·17	l 3·50	h 3·74	h 5·83	h 7·23	h 6·07	$w = 1\cdot 53$ $\frac{1}{w} = 0\cdot 65$
	6·72	9·38	9·36	4·82	11·92	11·73	7·80	3·23	4·35	5·85	7·95	6·28	$C = 49^\circ\, 57'\, 7''\cdot 45$

At II (Sísa)

***March* 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XXXII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXII & I	h 41·10	h 42·17	l 43·44	l 44·34	l 46·00	l 38·00	l 47·66	l 45·87	h 43·80	h 42·24	h 42·80	h 47·60	$M = 43''\cdot 64$
	h 41·83	h 41·87	l 43·16	l 43·80	l 45·50	l 37·16	l 48·46	l 45·40	h 43·20	h 42·07	h 43·87	h 45·94	$w = 1\cdot 55$ $\frac{1}{w} = 0\cdot 65$
	41·47	42·02	43·30	44·07	45·75	37·58	48·06	45·63	43·50	42·16	43·33	46·77	$C = 67^\circ\, 28'\, 43''\cdot 64$

Note.—Stations XXIX and XXXII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At II (Sísa)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXII 0°1′	180°1′	70°11′	250°12′	140°22′	320°22′	210°28′	30°28′	280°39′	100°39′	350°50′	170°50′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
I & III	h 59·23	h 56·74	l 59·10	l 57·36	l 58·87	l 60·87	l 60·04	l 54·33	h 56·64	h 56·76	h 54·30	h 54·43	$M = 57''\cdot56$
	l 59·30	h 56·74	l 58·94	l 57·80	l 60·10	l 62·10	l 58·17	l 54·00	h 56·70	h 57·83	h 55·16	h 56·03	$w = 2\cdot43$
	59·27	56·74	59·02	57·58	59·48	61·49	59·10	54·17	56·67	57·29	54·73	55·23	$\frac{1}{w} = 0\cdot41$; $C = 46°\,41'\,57''\cdot56$
III & IV	h 56·63	h 56·63	l 60·30	l 55·80	l 56·53	l 51·13	l 50·83	l 60·03	h 62·13	h 57·27	h 56·60	h 56·67	$M = 56''\cdot65$
	l 55·30	h 56·06	l 59·50	l 55·87	l 56·76	l 52·37	l 51·60	l 60·83	h 63·00	h 56·84	h 55·10	h 55·90	$w = 1\cdot13$
	55·97	56·34	59·90	55·84	56·64	51·75	51·22	60·43	62·56	57·06	55·85	56·28	$\frac{1}{w} = 0\cdot88$; $C = 49°\,33'\,56''\cdot65$

At III (Tukwása)

March 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VI 125°54′	305°54′	196°4′	16°5′	266°16′	86°16′	336°21′	156°21′	46°32′	226°32′	116°43′	296°43′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & V	h 55·54	h 53·83	h 53·86	h 56·17	l 58·73	l 53·73	l 48·67	l 54·87	h 51·80	h 57·10	l 53·07	l 51·94	$M = 54''\cdot27$
	h 54·94	h 54·14	l 54·54	h 55·60	l 58·47	l 53·73	l 49·96	l 55·36	h 53·00	h 57·17	l 52·93	l 53·37	$w = 2\cdot04$
	55·24	53·99	54·20	55·88	58·60	53·73	49·32	55·11	52·40	57·14	53·00	52·65	$\frac{1}{w} = 0\cdot49$; $C = 51°\,18'\,54''\cdot27$
V & IV	h 41·46	h 39·27	h 41·27	h 40·43	l 36·94	l 44·37	l 44·13	l 40·57	h 39·73	h 42·33	l 41·96	l 41·46	$M = 41''\cdot19$
	h 41·83	h 40·76	l 42·43	h 39·76	l 36·77	l 44·17	l 43·57	l 41·97	h 38·13	l 42·10	l 42·54	l 40·56	$w = 2\cdot80$
	41·65	40·01	41·85	40·10	36·85	44·27	43·85	41·27	38·93	42·22	42·25	41·01	$\frac{1}{w} = 0\cdot36$; $C = 59°\,15'\,41''\cdot19$
IV & II	h 56·17	h 55·86	h 52·77	h 54·83	l 58·00	l 52·70	l 53·03	l 58·03	h 61·50	h 54·74	l 54·44	l 54·40	$M = 55''\cdot34$
	h 55·10	h 53·87	l 52·60	h 55·27	l 57·16	l 53·33	l 52·43	l 57·10	h 61·70	l 55·23	l 54·20	l 53·60	$w = 1\cdot81$
	55·64	54·86	52·69	55·05	57·58	53·01	52·73	57·57	61·60	54·98	54·32	54·00	$\frac{1}{w} = 0\cdot55$; $C = 60°\,47'\,55''\cdot34$
II & I	h 20·70	h 20·37	h 21·36	h 21·80	l 16·93	l 24·20	l 19·20	l 16·13	h 19·40	h 19·63	l 21·90	l 22·87	$M = 20''\cdot23$
	h 20·07	h 20·77	l 20·50	h 20·53	l 18·37	l 23·37	l 19·54	l 15·87	h 19·23	h 18·73	l 21·80	l 22·27	$w = 2\cdot62$
	20·39	20·57	20·93	21·16	17·65	23·79	19·37	16·00	19·31	19·18	21·85	22·57	$\frac{1}{w} = 0\cdot38$; $C = 62°\,44'\,20''\cdot23$

At IV (Dúngarpur)

March 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	Circle readings, telescope being set on II												
II & III	″ h 11·04 h 10·93	″ h 12·64 h 11·64	″ h 9·94 h 11·34	″ h 13·87 h 14·50	″ h 12·50 h 12·87	″ h 9·14 h 8·44	″ h 10·90 h 11·73	″ h 9·46 h 9·87	″ h 16·20 h 16·14	″ h 12·67 h 12·80	″ h 15·50 h 14·13	″ h 16·23 h 15·50	$M = 12''\cdot50$ $w = 2\cdot10$ $\frac{1}{w} = 0\cdot48$
	10·99	12·14	10·64	14·18	12·69	8·79	11·31	9·67	16·17	12·73	14·82	15·86	$C = 69^\circ 38' 12''\cdot50$
III & V	h 30·76 h 31·47	h 32·96 h 32·83	h 34·20 h 33·73	h 28·36 h 27·30	h 36·77 h 36·13	h 36·30 h 37·40	h 37·06 h 37·73	h 36·07 h 36·17	h 26·93 h 27·10	h 34·70 h 34·00	h 28·60 h 28·73	h 25·87 h 26·94	$M = 32''\cdot42$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$
	31·12	32·89	33·97	27·83	36·45	36·85	37·39	36·12	27·02	34·35	28·66	26·41	$C = 47^\circ 3' 32''\cdot42$

At V (Sagwára)

April 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 1′	180° 1′	70° 11′	250° 11′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	Circle readings, telescope being set on IV												
IV & III	″ l 49·80 l 49·03	″ l 48·40 l 48·37	″ l 44·60 l 45·87	″ l 51·93 l 50·63	″ l 46·33 l 46·87	″ l 40·67 l 39·90	″ h 47·67 h 46·80	″ h 45·66 h 47·34	″ l 54·16 l 54·84	″ l 51·24 l 51·80	″ l 49·84 l 48·66	″ l 45·56 l 47·36	$M = 48''\cdot06$ $w = 0\cdot91$ $\frac{1}{w} = 1\cdot10$
	49·42	48·38	45·24	51·28	46·60	40·28	47·24	46·50	54·50	51·52	49·25	46·46	$C = 73^\circ 40' 48''\cdot06$
III & VI	l 11·07 l 11·80	l 13·66 l 14·70	l 22·26 l 22·86	l 11·87 l 11·87	l 14·40 l 14·46	l 19·27 l 19·70	h 13·50 h 14·60	h 15·27 h 14·86	l 10·60 l 10·26	l 15·96 l 17·27	l 14·06 l 13·67	l 16·74 l 16·30	$M = 15''\cdot04$ $w = 1\cdot02$ $\frac{1}{w} = 0\cdot98$
	11·44	14·18	22·56	11·87	14·43	19·48	14·05	15·07	10·43	16·61	13·87	16 52	$C = 57^\circ 23' 15''\cdot04$
VI & VII	l 54·07 l 53·03	l 53·84 l 52·10	l 50·00 l 48·40	l 59·93 l 60·80	l 56·07 l 56·74	l 59·06 l 58·23	h 54·20 h 52·84	h 57·03 h 55·34	l 54·07 l 53·50	l 50·50 l 50·07	l 54·10 l 55·60	l 58·66 l 57·80	$M = 54''\cdot83$ $w = 1\cdot07$ $\frac{1}{w} = 0\cdot94$
	53·55	52·97	49·20	60·37	56·40	58·65	53·52	56·18	53·79	50·28	54·85	58·23	$C = 57^\circ 39' 54''\cdot83$
VII & VIII	l 64·33 l 64·20	l 63·33 l 65·06	l 66·87 l 66·44	l 56·83 l 57·16	l 62·90 l 62·40	l 61·20 l 61·60	h 68·57 h 69·40	h 64·44 h 65·56	l 68·73 l 68·50	l 69·84 l 68·20	l 66·34 l 65·47	l 61·37 l 62·40	$M = 64''\cdot63$ $w = 0\cdot93$ $\frac{1}{w} = 1\cdot07$
	64·27	64·19	66·66	56·99	62·65	61·40	68·99	65·00	68·61	69·02	65·91	61·88	$C = 77^\circ 4' 4''\cdot63$

At VI (Lohária)

April 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VII 215° 2′	35° 2′	285° 13′	105° 13′	355° 24′	175° 24′	65° 29′	245° 29′	135° 40′	315° 40′	205° 51′	25° 51′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
VII & V	″ *h* 50·70 *h* 50·00	″ *h* 51·74 *h* 51·13	″ *l* 56·87 *l* 56·43	″ *h* 56·57 *h* 56·03	″ *l* 50·74 *l* 50·37	″ *l* 53·27 *l* 53·44	″ *l* 48·37 *l* 49·20	″ *l* 55·16 *l* 54·50	″ *l* 49·37 *l* 48·67	″ *l* 46·40 *l* 47·30	″ *l* 47·73 *l* 47·30	″ *l* 50·50 *l* 51·53	$M = 51''\cdot39$ $w = 1\cdot12$ $\frac{1}{w} = 0\cdot89$
	50·35	51·44	56·65	56·30	50·55	53·36	48·78	54·83	49·02	46·85	47·52	51·01	$C = 73°\ 40'\ 51''\cdot39$
V & III	*h* 53·80 *h* 54·86	*h* 55·66 *h* 55·80	*l* 48·50 *l* 49·67	*h* 50·40 *h* 49·67	*l* 47·10 *l* 47·36	*l* 55·56 *l* 54·70	*l* 50·33 *l* 49·67	*l* 44·04 *l* 44·63	*l* 51·33 *l* 51·43	*l* 48·60 *l* 49·13	*l* 52·87 *l* 52·76	*l* 52·03 *l* 52·63	$M = 50''\cdot94$ $w = 1\cdot06$ $\frac{1}{w} = 0\cdot95$
	54·33	55·73	49·09	50·03	47·23	55·13	50·00	44·34	51·38	48·86	52·82	52·33	$C = 71°\ 17'\ 50''\cdot94$

At VII (Ámjio)

April 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX 201° 45′	21° 45′	271° 51′	91° 51′	342° 7′	162° 7′	52° 18′	232° 18′	122° 24′	302° 24′	192° 35′	12° 34′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
IX & VIII	″ *h* 32·10 *h* 34·07	″ *h* 38·97 *h* 38·94	″ *h* 38·86 *h* 37·60	″ *h* 35·70 *h* 37·40	″ *l* 37·33 *l* 36·30	″ *l* 34·73 *l* 35·57	″ *l* 41·30 *l* 41·27	″ *l* 38·30 *l* 39·06	″ *l* 38·87 *l* 38·50	″ *l* 34·40 *l* 34·04	″ *h* 37·87 *h* 37·33	″ *h* 39·20 *h* 40·90	$M = 37''\cdot44$ $w = 2\cdot03$ $\frac{1}{w} = 0\cdot49$
	33·09	38·95	38·23	36·55	36·82	35·15	41·28	38·68	38·69	34·22	37·60	40·05	$C = 64°\ 5'\ 37''\cdot44$
VIII & V	*h* 29·84 *h* 29·00	*h* 26·37 *h* 26·46	*h* 22·30 *h* 22·30	*h* 32·03 *h* 30·43	*l* 25·20 *l* 25·66	*l* 27·87 *l* 28·30	*l* 25·53 *l* 26·00	*l* 23·87 *l* 22·40	*l* 26·23 *l* 25·70	*l* 25·73 *l* 27·03	*h* 25·80 *h* 27·57	*h* 24·76 *h* 24·20	$M = 26''\cdot27$ $w = 1\cdot91$ $\frac{1}{w} = 0\cdot52$
	29·42	26·42	22·30	31·23	25·43	28·08	25·77	23·13	25·97	26·38	26·68	24·48	$C = 44°\ 37'\ 26''\cdot27$
V & VI	*h* 16·43 *h* 15·26	*h* 15·06 *h* 14·57	*h* 20·14 *h* 19·67	*h* 13·53 *h* 13·73	*l* 19·20 *l* 19·87	*l* 21·06 *l* 20·63	*l* 11·34 *l* 12·00	*l* 14·40 *l* 15·37	*l* 14·40 *l* 13·70	*l* 15·27 *l* 14·20	*h* 17·83 *h* 15·87	*h* 16·14 *h* 14·23	$M = 16''\cdot00$ $w = 1\cdot52$ $\frac{1}{w} = 0\cdot66$
	15·85	14·81	19·91	13·63	19·53	20·85	11·67	14·88	14·05	14·74	16·85	15·18	$C = 48°\ 39'\ 16''\cdot00$

At VIII (Kua)

April 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on V												M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	197° 20′	17° 20′	267° 31′	87° 31′	337° 41′	157° 41′	47° 47′	227° 47′	117° 58′	297° 58′	188° 9′	8° 9′	
	″	″	″	″	″	″	″	″	″	″	″	″	
V & VII	h 30·47	h 30·47	h 34·06	h 31·27	h 29·27	l 33·14	l 28·80	l 34·84	l 32·24	l 33·26	l 33·96	l 30·94	M = 31″·97
	h 30·33	h 30·96	h 33·50	h 31·90	h 29·60	l 32·93	l 29·40	l 34·43	l 32·63	l 34·26	l 33·47	l 31·24	w = 3·48
													$\frac{1}{w}$ = 0·29
	30·40	30·72	33·78	31·58	29·44	33·03	29·10	34·64	32·43	33·76	33·72	31·09	C = 58° 18′ 31″·97
VII & IX	h 22·93	h 22·37	h 16·27	h 17·73	h 25·53	l 19·63	l 25·73	l 17·83	l 15·96	l 14·64	l 17·27	l 19·16	M = 19″·53
	h 22·20	h 20·87	h 17·23	h 16·94	h 25·80	l 19·87	l 24·86	l 17·57	l 16·70	l 14·77	l 16·80	l 20·16	w = 0·94
													$\frac{1}{w}$ = 1·07
	22·57	21·62	16·75	17·33	25·67	19·75	25·29	17·70	16·33	14·71	17·03	19·66	C = 44° 18′ 19″·53
IX & X	h 52·97	h 53·76	h 55·93	h 56·27	h 49·87	l 58·67	l 50·57	l 53·33	l 54·97	l 52·90	l 56·53	l 55·24	M = 54″·10
	h 53·30	h 54·83	h 55·23	h 54·90	l 48·56	l 58·67	l 52·00	l 52·90	l 54·70	l 51·90	l 56·30	l 54·14	w = 1·90
													$\frac{1}{w}$ = 0·53
	53·14	54·29	55·58	55·59	49·21	58·67	51·29	53·11	54·84	52·40	56·41	54·69	C = 60° 3′ 54″·10

At IX (Deokotla)

April 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XI												M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	188° 11′	8° 11′	258° 22′	78° 22′	328° 33′	148° 33′	38° 39′	218° 39′	108° 50′	288° 50′	179° 0′	359° 1′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XI & X	h 20·14	h 17·87	l 18·26	h 11·03	l 11·63	l 19·04	l 16·67	l 14·70	h 18·63	h 17·00	h 15·20	h 13·06	M = 16″·19
	h 20·44	h 17·57	l 17·67	h 10·97	l 10·63	l 19·43	l 18·63	l 15·50	h 18·50	h 16·20	h 16·47	h 13·34	w = 1·28
													$\frac{1}{w}$ = 0·78
	20·29	17·72	17·97	11·00	11·13	19·23	17·65	15·10	18·57	16·60	15·83	13·20	C = 51° 1′ 16″·19
X & VIII	h 55·03	h 52·57	l 58·94	h 58·80	l 61·74	l 57·46	l 59·40	l 66·07	h 59·47	h 55·47	h 57·57	h 56·20	M = 58″·18
	h 55·73	h 52·20	l 58·86	h 59·30	l 62·60	l 56·64	l 59·17	l 65·13	h 58·90	h 56·43	h 57·50	h 55·03	w = 1·02
													$\frac{1}{w}$ = 0·98
	55·38	52·39	58·90	59·05	62·17	57·05	59·28	65·60	59·19	55·95	57·53	55·62	C = 50° 4′ 58″·18
VIII & VII	h 68·33	h 70·06	l 64·76	l 67·70	l 67·26	l 69·20	l 64·60	l 59·53	h 68·70	h 68·73	h 67·23	h 68·17	M = 66″·94
	h 67·37	h 70·63	l 65·54	l 66·53	l 65·67	l 69·86	l 64·06	l 60·27	h 66·84	h 68·63	h 67·50	h 69·37	w = 1·51
													$\frac{1}{w}$ = 0·66
	67·85	70·35	65·15	67·11	66·47	69·53	64·33	59·90	67·77	68·68	67·36	68·77	C = 70° 43′ 6″·94

At X (Tembla)

April 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Circle readings, telescope being set on VIII

M = Mean of Groups; *w* = Relative Weight; *C* = Concluded Angle

Angle between	0°1′	180°1′	70°11′	250°11′	140°22′	320°22′	210°28′	30°28′	280°39′	100°39′	350°50′	170°50′	M, w, C
	″	″	″	″	″	″	″	″	″	″	″	″	
VIII & IX	h 11·73	h 9·00	l 11·47	l 12·97	l 6·43	l 3·36	h 13·00	h 11·13	h 13·40	h 10·53	h 10·83	h 13·80	M = 10″·91
	h 10·44	h 10·40	l 10·83	l 12·20	l 7·87	l 4·27	h 14·70	h 12·37	h 14·97	h 12·13	h 10·13	h 13·90	w = 1·32
	11·09	9·70	11·15	12·58	7·15	3·82	13·85	11·75	14·18	11·33	10·48	13·85	1/w = 0·76; C = 69° 51′ 10″·91
IX & XI	d 7·34	d 17·70	d 13·00	l 8·10	d 15·58	d 10·72	h 10·14	h 9·50	h 10·33	h 14·50	h 9·70	h 11·06	M = 11″·57
	d 8·04	d 18·24	d 13·63	l 8·70	d 16·65	d 10·75	h 9·13	h 9·40	h 9·23	h 13·37	h 10·34	h 12·57	w = 1·19
	7·69	17·97	13·32	8·40	16·11	10·74	9·63	9·45	9·78	13·94	10·02	11·81	1/w = 0·84; C = 68° 46′ 11″·57
XI & XII	h 67·74	h 56·87	l 61·40	l 65·70	l 68·97	l 67·43	h 67·56	h 69·47	h 66·64	h 67·24	h 70·04	h 64·70	M = 65″·91
	h 67·04	h 56·33	l 60·77	l 65·03	l 67·90	l 67·40	h 67·70	h 67·90	h 66·84	h 68·00	h 69·60	h 63·46	w = 0·87
	67·39	56·60	61·09	65·36	68·44	67·41	67·63	68·69	66·74	67·62	69·82	64·08	1/w = 1·15; C = 76° 34′ 5″·91

At XI (Uchak)

April 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Circle readings, telescope being set on XIII

M = Mean of Groups; *w* = Relative Weight; *C* = Concluded Angle

Angle between	190°32′	10°32′	260°43′	80°43′	330°53′	150°54′	40°59′	220°59′	111°10′	291°10′	181°21′	1°21′	M, w, C
	″	″	″	″	″	″	″	″	″	″	″	″	
XIII & XII	h 26·46	h 30·80	l 30·53	h 22·64	l 24·70	l 32·97	l 27·40	l 28·10	h 26·16	h 26·53	h 28·20	h 28·67	M = 27″·53
	h 25·20	h 31·10	l 29·20	l 22·34	l 26·04	l 32·77	l 26·47	l 26·60	h 27·40	h 25·17	h 28·34	h 26·93	w = 1·56
	25·83	30·95	29·87	22·49	25·37	32·87	26·93	27·35	26·78	25·85	28·27	27·80	1/w = 0·64; C = 50° 20′ 27″·53
XII & X	h 47·90	h 40·36	l 41·60	h 46·10	l 49·77	l 38·27	l 44·57	l 44·46	h 48·27	h 43·07	h 43·60	h 41·57	M = 44″·16
	h 47·53	h 40·00	l 43·20	l 45·70	l 49·23	l 38·26	l 46·33	l 44·04	h 46·60	h 44·57	h 42·40	h 42·50	w = 1·12
	47·72	40·18	42·40	45·90	49·50	38·26	45·45	44·25	47·44	43·82	43·00	42·03	1/w = 0·89; C = 58° 55′ 44″·16
X & IX	h 35·97	h 36·24	l 34·83	h 31·60	l 32·66	l 40·20	l 30·70	l 33·44	h 34·17	h 35·37	h 35·33	h 36·40	M = 34″·74
	h 35·00	h 36·64	l 34·13	l 33·03	l 31·97	l 41·10	l 30·84	l 33·86	h 33·74	h 34·53	h 35·73	h 36·17	w = 1·84
	35·49	36·44	34·48	32·31	32·32	40·65	30·77	33·65	33·95	34·95	35·53	36·29	1/w = 0·54; C = 60° 12′ 34″·74

At XII (Játhrábhor)

**December* 1860; †*January* 1861; *and* ‡*April* 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on X												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	272° 55′	92° 55′	343° 6′	163° 6′	53° 17′	233° 17′	123° 22′	303° 23′	193° 34′	13° 34′	263° 44′	83° 44′	
X & XI ‡	″	″	″	″	″	″	″	″	″	″	″	″	$M = 11''\cdot93$
	h 15·07	*h* 14·20	*h* 9·74	*h* 14·60	*h* 8·24	*h* 5·20	*h* 11·84	*h* 9·36	*l* 14·77	*l* 14·87	*l* 15·00	*l* 8·54	$w = 1\cdot05$
	h 15·80	*h* 14·37	*h* 9·56	*h* 14·76	*h* 7·70	*h* 6·17	*h* 11·94	*h* 9·50	*l* 13·93	*l* 15·30	*l* 15·70	*l* 10·13	$\frac{1}{w} = 0\cdot96$
	15·44	14·28	9·65	14·68	7·97	5·69	11·89	9·43	14·35	15·08	15·35	9·34	$C = 44° 30' 11''\cdot93$
XI & XIII ‡	*h* 13·43	*h* 15·66	*h* 17·66	*h* 14·90	*h* 17·73	*h* 20·34	*h* 14·16	*h* 12·90	*l* 8·53	*l* 8·06	*l* 10·80	*l* 11·33	$M = 13''\cdot76$
	h 12·80	*h* 16·73	*h* 17·00	*h* 15·74	*h* 19·27	*h* 19·50	*h* 13·96	*h* 12·77	*l* 7·47	*l* 7·83	*l* 10·90	*l* 10·87	$w = 0\cdot79$
	13·12	16·19	17·33	15·32	18·50	19·92	14·06	12·84	8·00	7·94	10·85	11·10	$\frac{1}{w} = 1\cdot26$; $C = 42° 35' 13''\cdot76$
	Circle readings, telescope being set on XIII												
	0° 0′	180° 0′	10° 12′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
XIII & XIV †	″	″	″	″	″	″	″	″	″	″	″	″	$M = 4''\cdot03$
	h 6·33	*h* 4·46	*h* 3·20	*h* 3·93	*h* 4·46	*h* 2·04	*h* 6·23	*h* 5·76	*h* 5·30	*h* 3·83	*l* 1·73	*l* 0·63	$w = 3\cdot11$
	h 6·37	*h* 4·73	*h* 3·10	*h* 4·27	*h* 5·67	*h* 1·63	*h* 6·27	*h* 6·24	*h* 5·63	*h* 3·33	*l* 0·94	*l* 0·66	$\frac{1}{w} = 0\cdot32$
	6·35	4·60	3·15	4·10	5·06	1·84	6·25	6·00	5·46	3·58	1·34	0·64	$C = 59° 3' 4''\cdot03$
	Circle readings, telescope being set on XIV												
	0° 1′	180° 1′	10° 12′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
XIV & XV *	″	″	″	″	″	″	″	″	″	″	″	″	$M = 59''\cdot54$
	h 54·77	*h* 53·93	*l* 58·63	*h* 57·54	*l* 63·43	*l* 59·33	*l* 63·96	*l* 60·70	*l* 60·66	*l* 67·10	*h* 55·94	*h* 58·47	$w = 0\cdot76$
	h 54·76	*h* 53·70	*l* 59·07	*l* 56·63	*l* 62·86	*l* 59·30	*l* 65·17	*l* 61·20	*l* 61·13	*l* 66·76	*h* 56·00	*h* 57·86	$\frac{1}{w} = 1\cdot32$
	54·77	53·81	58·85	57·09	63·14	59·32	64·56	60·95	60·90	66·93	55·97	58·16	$C = 100° 43' 59''\cdot54$

At XIII (Patángri)

January 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVII												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	0° 0′	180° 0′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
XVII & XVIII	″	″	″	″	″	″	″	″	″	″	″	″	$M = 7''\cdot75$
	h 3·20	*h* 3·53	*l* 6·33	*l* 4·20	*l* 12·00	*l* 8·36	*l* 15·34	*l* 11·77	*l* 14·37	*l* 6·54	*h* 5·37	*h* 3·10	$w = 0\cdot60$
	h 2·10	*h* 2·13	*l* 5·63	*l* 4·93	*l* 11·27	*l* 7·30	*l* 15·20	*l* 12·70	*l* 14·06	*l* 7·03	*h* 5·23	*h* 4·27	$\frac{1}{w} = 1\cdot68$
	2·65	2·83	5·98	4·57	11·63	7·83	15·27	12·24	14·21	6·79	5·30	3·68	$C = 39° 26' 7''\cdot75$

At XIII (Patángri)—(*Continued*).

§ *January* 1861; *and* ¶ *April* 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

M = Mean of Groups; w = Relative Weight; C = Concluded Angle

Circle readings, telescope being set on XVII

Angle between	0° 0′	180° 0′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M, w, C
§ XVIII & XIV	″ h 67·30	″ h 65·37	″ l 62·94	″ l 61·87	″ l 56·90	″ l 55·80	″ l 56·60	″ l 60·06	″ l 60·40	″ l 66·23	″ h 66·43	″ h 66·20	M = 62″·35
	h 69·30	h 66·33	l 63·07	l 61·53	l 57·43	l 57·23	l 56·50	l 59·20	l 60·00	l 65·97	h 67·74	h 65·97	w = 0·64
	68·30	65·85	63·01	61·70	57·16	56·52	56·55	59·63	60·20	66·10	67·08	66·09	$\frac{1}{w}$ = 1·57; C = 38° 36′ 2″·35
§ XIV & XII	h 57·97	h 59·40	l 63·66	l 64·40	l 64·74	l 66·77	l 63·66	l 66·34	l 60·73	l 56·93	h 57·50	h 59·57	M = 61″·77
	h 57·80	h 59·54	l 63·70	l 64·80	l 63·37	l 67·07	l 64·00	l 67·33	l 59·14	l 56·77	h 57·06	h 60·10	w = 0·90
	57·89	59·47	63·68	64·60	64·05	66·92	63·83	66·84	59·93	56·85	57·28	59·84	$\frac{1}{w}$ = 1·11; C = 33° 23′ 1″·77

Circle readings, telescope being set on XII

Angle between	272° 56′	92° 56′	343° 7′	163° 7′	53° 18′	233° 18′	123° 24′	303° 24′	193° 35′	13° 35′	263° 45′	83° 46′	M, w, C
¶ XII & XI	″ h 23·17	″ h 28·33	″ h 22·83	″ h 24·47	″ h 23·77	″ h 24·74	″ h 22·23	″ h 19·27	″ h 18·00	″ h 20·70	″ h 23·56	″ h 18·67	M = 22″·35
	h 23·27	h 27·80	h 23·50	h 24·70	h 23·60	h 24·36	h 21·44	h 19·94	h 17·64	h 19·73	h 22·66	h 17·90	w = 1·37
	23·22	28·07	23·16	24·59	23·68	24·55	21·84	19·60	17·82	20·22	23·11	18·28	$\frac{1}{w}$ = 0·73; C = 87° 4′ 22″·35

At XIV (Kágarol)

** *December* 1860; *and* ‖ *January* 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

M = Mean of Groups; w = Relative Weight; C = Concluded Angle

Circle readings, telescope being set on XIII

Angle between	71° 52′	251° 52′	82° 3′	262° 3′	92° 14′	272° 14′	102° 20′	282° 20′	112° 30′	292° 30′	122° 41′	302° 41′	M, w, C
‖ XIII & XVIII	″ h 62·67	″ h 57·90	″ h 59·16	″ h 62·90	″ h 66·90	″ h 63·33	″ h 67·66	″ h 65·40	″ l 64·70	″ l 61·53	″ l 62·53	″ l 56·17	M = 62″·45
	h 61·33	h 59·23	h 57·44	h 63·27	h 66·16	h 62·33	h 67·70	h 65·10	l 64·50	l 62·33	l 63·67	l 54·90	w = 0·95
	62·00	58·57	58·30	63·08	66·53	62·83	67·68	65·25	64·60	61·93	63·10	55·54	$\frac{1}{w}$ = 1·06; C = 95° 10′ 2″·45

Circle readings, telescope being set on XVII

Angle between	122° 52′	302° 52′	133° 2′	313° 2′	143° 13′	323° 13′	153° 19′	333° 19′	163° 30′	343° 30′	173° 41′	353° 41′	M, w, C
** XVII & XVIII	″ h 19·17	″ h 22·63	″ h 26·34	″ h 24·50	″ h 27·87	″ h 21·33	″ h 32·76	″ h 29·87	″ h 31·13	″ h 27·07	″ h 25·37	″ h 21·50	M = 25″·60
	h 20·30	h 20·74	h 25·60	h 23·83	h 27·63	h 21·40	h 31·43	h 28·54	h 31·60	h 27·14	h 24·46	h 22·06	w = 0·73
	19·74	21·68	25·97	24·17	27·75	21·36	32·10	29·20	31·37	27·10	24·92	21·78	$\frac{1}{w}$ = 1·38; C = 44° 10′ 25″·60

At XIV (Kágarol)—(*Continued*).

Angle between	Circle readings, telescope being set on XVII: 122° 52′	302° 52′	133° 2′	313° 2′	143° 13′	323° 13′	153° 19′	333° 19′	163° 30′	343° 30′	173° 41′	353° 41′	*M* = Mean of Groups, *w* = Relative Weight, *C* = Concluded Angle
**	″	″	″	″	″	″	″	″	″	″	″	″	
XVIII & XVI	*h* 20·40	*h* 16·54	*h* 12·23	*h* 12·03	*h* 9·00	*h* 17·27	*h* 9·14	*h* 9·50	*h* 9·23	*h* 12·83	*h* 12·16	*h* 17·80	*M* = 13″·37
	h 19·57	*h* 18·30	*h* 13·17	*h* 12·13	*h* 9·77	*h* 16·60	*h* 9·10	*h* 10·30	*h* 9·64	*h* 12·93	*h* 13·30	*h* 18·00	*w* = 0·83
													$\frac{1}{w}$ = 1·20
	19·99	17·42	12·70	12·08	9·38	16·94	9·12	9·90	9·43	12·88	12·73	17·90	*C* = 76° 1′ 13″·37
**													
XVI & XV	*h* 47·86	*h* 48·60	*h* 51·37	*h* 49·00	*h* 56·53	*h* 46·80	*h* 51·30	*h* 51·46	*h* 50·34	*h* 49·13	*h* 47·37	*h* 43·37	*M* = 49″·33
	h 48·26	*h* 48·26	*h* 50·70	*h* 47·87	*h* 55·13	*h* 48·67	*h* 51·90	*h* 51·90	*h* 50·23	*h* 47·97	*h* 46·84	*h* 43·14	*w* = 1·24
													$\frac{1}{w}$ = 0·80
	48·06	48·43	51·04	48·43	55·83	47·74	51·60	51·68	50·28	48·55	47·11	43·25	*C* = 53° 22′ 49″·33
**													
XV & XII	*h* 59·40	*h* 57·43	*h* 58·86	*h* 59·00	*h* 55·53	*h* 61·00	*h* 58·70	*h* 63·17	*h* 56·70	*h* 64·47	*h* 59·93	*h* 65·50	*M* = 59″·93
	h 59·67	*h* 56·84	*h* 59·03	*h* 60·30	*h* 56·44	*h* 59·83	*h* 58·73	*h* 62·36	*h* 57·93	*h* 63·90	*h* 60·00	*h* 63·56	*w* = 1·61
													$\frac{1}{w}$ = 0·62
	59·54	57·13	58·95	59·65	55·98	60·42	58·71	62·77	57·31	64·19	59·96	64·53	*C* = 47° 51′ 59″·93
**													
XII & R.M.	*h* 10·80	*h* 15·80	*h* 12·97	*h* 13·60	*h* 10·70	*h* 12·53	*h* 8·23	*h* 6·57	*h* 13·03	*h* 9·77	*h* 13·50	*h* 14·53	*M* = 11″·76
	h 11·90	*h* 16·06	*h* 11·90	*h* 12·70	*h* 10·10	*h* 12·90	*h* 7·34	*h* 6·84	*h* 12·34	*h* 10·50	*h* 12·66	*h* 14·97	*w* = 1·68
													$\frac{1}{w}$ = 0·60
	11·35	15·93	12·44	13·15	10·40	12·71	7·79	6·70	12·69	10·13	13·08	14·75	*C* = 15° 42′ 11″·76

At XV (Wardhari)

***November and December* 1860; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XII: 328° 37′	148° 37′	338° 37′	158° 37′	348° 58′	168° 58′	359° 4′	179° 4′	9° 15′	189° 15′	19° 26′	199° 26′	*M* = Mean of Groups, *w* = Relative Weight, *C* = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & XIV	*h* 65·10	*h* 63·67	*l* 64·27	*l* 67·44	*l* 64·13	*l* 65·37	*h* 57·74	*h* 56·20	*h* 59·20	*h* 58·13	*h* 58·30	*h* 61·30	*M* = 61″·64
	h 64·24	*h* 62·24	*l* 63·70	*l* 65·97	*l* 63·67	*l* 66·20	*h* 57·54	*h* 57·24	*h* 60·13	*h* 58·77	*h* 59·50	*h* 59·37	*w* = 1·02
													$\frac{1}{w}$ = 0·98
	64·67	62·96	63·98	66·71	63·90	65·78	57·64	56·72	59·67	58·45	58·90	60·33	*C* = 31° 24′ 1″·64
XIV & XVI	*h* 33·63	*h* 28·96	*l* 34·36	*l* 31·20	*l* 34·00	*l* 28·67	*h* 33·46	*h* 33·66	*h* 35·73	*h* 36·87	*h* 37·67	*h* 32·97	*M* = 33″·73
	h 33·86	*h* 30·23	*l* 34·47	*l* 31·96	*l* 33·83	*l* 29·23	*h* 32·56	*h* 34·40	*h* 36·97	*h* 38·06	*h* 38·03	*h* 34·83	*w* = 1·56
													$\frac{1}{w}$ = 0·64
	33·75	29·59	34·42	31·58	33·91	28·95	33·01	34·03	36·35	37·47	37·85	33·90	*C* = 64° 29′ 33″·73

NOTE.—R.M. denotes Referring Mark.

At XVI (Ghorárâo)

December 1860; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XV 0° 1′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XV & XIV	″ *h* 39·84 *h* 40·20	″ *h* 39·87 *h* 41·07	″ *h* 42·66 *h* 42·40	″ *h* 42·24 *h* 41·60	″ *h* 44·96 *h* 43·94	″ *l* 35·97 *l* 36·13	″ *l* 39·54 *l* 38·13	″ *l* 44·34 *l* 43·54	″ *h* 41·00 *h* 40·40	″ *h* 39·23 *h* 39·53	″ *h* 41·66 *h* 41·70	″ *h* 39·30 *h* 41·27	$M = 40''\cdot86$ $w = 2\cdot25$ $\frac{1}{w} = 0\cdot45$ $C = 62° 7' 40''\cdot86$
	40·02	40·47	42·53	41·92	44·45	36·05	38·84	43·94	40·70	39·38	41·68	40·28	
XIV & XVIII	*h* 10·97 *h* 10·43	*h* 13·54 *h* 12·16	*h* 14·83 *h* 14·00	*h* 10·73 *h* 11·03	*h* 17·87 *h* 19·00	*h* 15·93 *h* 16·10	*h* 18·67 *h* 18·33	*h* 17·73 *h* 18·77	*l* 17·66 *l* 17·00	*l* 15·13 *l* 13·60	*l* 10·83 *l* 12·60	*l* 11·57 *l* 11·73	$M = 14''\cdot59$ $w = 1\cdot28$ $\frac{1}{w} = 0\cdot78$ $C = 39° 14' 14''\cdot59$
	10·70	12·85	14·42	10·88	18·43	16·02	18·50	18·25	17·33	14·36	11·72	11·65	

At XVII (Bhor)

**December* 1860; *and* †*January* 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIX 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 29′	220° 29′	50° 50′	230° 50′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
* XIX & XX	″ *h* 56·27 *h* 57·93	″ *h* 58·74 *h* 57·60	″ *h* 59·50 *h* 61·10	″ *h* 57·60 *h* 56·93	″ *l* 61·80 *l* 61·10	″ *l* 55·40 *l* 55·70	″ *l* 62·63 *l* 63·34	″ *l* 61·93 *l* 63·07	″ *h* 64·63 *h* 64·30	″ *h* 56·86 *h* 57·67	″ *h* 60·90 *h* 61·60	″ *h* 59·40 *h* 59·33	$M = 59''\cdot81$ $w = 1\cdot52$ $\frac{1}{w} = 0\cdot66$ $C = 48° 19' 59''\cdot81$
	57·10	58·17	60·30	57·27	61·45	55·55	62·98	62·50	64·47	57·26	61·25	59·37	
* XX & XVIII	*d* 63·57 *d* 61·91	*d* 61·74 *d* 62·88	*h* 64·86 *d* 64·26	*d* 64·66 *d* 64·03	*l* 64·53 *l* 64·40	*l* 59·17 *l* 61·04	*l* 62·57 *l* 62·73	*l* 68·30 *l* 67·27	*h* 67·97 *h* 66·90	*h* 70·70 *h* 71·20	*h* 65·47 *h* 65·63	*h* 66·44 *h* 68·00	$M = 65''\cdot01$ $w = 1\cdot34$ $\frac{1}{w} = 0\cdot75$ $C = 47° 22' 5''\cdot01$
	62·74	62·31	64·56	64·35	64·46	60·11	62·65	67·78	67·44	70·95	65·55	67·22	
* XVIII & XIV	*h* 45·87 *h* 46·56	*h* 50·47 *h* 50·73	*h* 44·54 *h* 45·57	*h* 45·70 *h* 46·94	*l* 42·03 *l* 43·57	*l* 47·23 *l* 46·93	*l* 44·00 *l* 43·10	*l* 40·70 *l* 42·13	*h* 43·97 *h* 43·80	*h* 44·14 *h* 43·70	*h* 44·00 *h* 45·20	*h* 45·90 *h* 43·80	$M = 45''\cdot02$ $w = 2\cdot10$ $\frac{1}{w} = 0\cdot48$ $C = 43° 15' 45''\cdot02$
	46·22	50·60	45·05	46·32	42·80	47·08	43·55	41·42	43·88	43·92	44·60	44·85	

Angle between	Circle readings, telescope being set on XIV 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
† XIV & XIII	″ *h* 8·00 *h* 8·34	″ *h* 14·00 *h* 13·80	″ *h* 12·70 *h* 13·94	″ *h* 15·87 *h* 16·14	″ *h* 15·60 *h* 15·50	″ *h* 12·94 *h* 13·26	″ *h* 23·24 *h* 21·80	″ *h* 16·40 *h* 16·80	″ *h* 14·57 *h* 14·60	″ *h* 14·97 *h* 15·80	″ *h* 13·43 *h* 12·14	″ *h* 14·84 *h* 13·23	$M = 14''\cdot66$ $w = 1\cdot09$ $\frac{1}{w} = 0\cdot91$ $C = 50° 58' 14''\cdot66$
	8·17	13·90	13·32	16·01	15·55	13·10	22·52	16·60	14·58	15·39	12·78	14·04	

At XVIII (Rencha)

**December* 1860; *and †January* 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVI 295° 16′	115° 16′	305° 27′	125° 27′	315° 38′	135° 38′	325° 44′	145° 44′	335° 54′	155° 54′	346° 5′	166° 5′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XVI & XIV	″ h 36·60 h 35·43	″ h 32·13 h 32·40	″ h 27·47 h 27·60	″ h 35·70 h 34·13	″ l 26·37 l 27·97 l 24·77 l 27·23	″ l 34·30 l 34·03	″ l 28·40 l 27·33	″ l 30·60 l 29·23	″ h 32·47 h 32·33	″ h 31·76 h 30·70	″ h 31·13 h 31·80	″ h 35·44 h 36·00	M = 31″·67 w = 1·14
	36·02	32·26	27·54	34·91	26·59	34·16	27·87	29·91	32·40	31·23	31·47	35·72	$\frac{1}{w}$ = 0·88 C = 64° 44′ 31″·67
* XIV & XVII	h 45·84 h 46·10	h 46·54 h 46·17	h 45·57 h 46·87	h 46·33 h 45·63	h 49·30 h 49·80	h 44·40 h 45·47	l 51·44 l 53·00	l 54·93 l 54·70	l 51·60 l 53·13	l 52·00 l 53·86	l 50·73 l 51·46	l 54·27 l 53·34	M = 49″·69 w = 0·92
	45·97	46·36	46·22	45·98	49·55	44·93	52·22	54·82	52·36	52·93	51·10	53·80	$\frac{1}{w}$ = 1·09 C = 92° 33′ 49″·69
* XVII & XIX	h 68·10 h 66·96	h 63·10 h 64·53	h 64·06 h 63·07	h 66·03 h 66·30	h 60·67 h 58·27	h 60·04 h 59·46	l 61·56 l 60·84	l 56·14 l 55·77	l 61·74 l 60·07	l 62·67 l 60·84	l 65·93 l 65·24	l 57·96 l 58·53	M = 62″·00 w = 0·99
	67·53	63·82	63·56	66·17	59·47	59·75	61·20	55·95	60·91	61·75	65·59	58·24	$\frac{1}{w}$ = 1·01 C = 41° 54′ 2″·00
* XIX & XX	h 45·53 h 47·07	h 45·86 h 45·57	h 53·37 h 53·16	h 41·44 h 41·70	h 47·86 h 49·73	h 46·23 h 46·24	l 47·90 l 47·20	l 48·40 l 49·16	l 49·66 l 49·43	l 43·43 l 44·86	l 45·70 l 44·70	l 45·97 l 46·23	M = 46″·93 w = 1·35
	46·30	45·72	53·26	41·57	48·80	46·23	47·55	48·78	49·55	44·14	45·20	46·10	$\frac{1}{w}$ = 0·74 C = 56° 43′ 46″·93
	Circle readings, telescope being set on XIV 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
† XIV & XIII	″ l 52·17 l 51·70	″ l 51·77 l 51·23	″ l 53·50 l 53·97	″ l 54·97 l 55·36	″ l 55·44 l 55·37	″ h 55·10 h 55·20	″ h 57·66 h 57·66	″ h 55·90 h 57·23	″ h 58·60 h 58·23	″ h 54·83 h 55·50	″ h 56·07 h 56·06	″ h 52·87 h 51·27	M = 54″·90 w = 2·40
	51·94	51·50	53·73	55·17	55·40	55·15	57·66	56·57	58·41	55·17	56·06	52·07	$\frac{1}{w}$ = 0·42 C = 46° 13′ 54″·90

At XIX (Kandálwa)

January 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXII 162° 48′	342° 48′	172° 59′	352° 59′	183° 10′	3° 10′	193° 16′	13° 16′	203° 27′	23° 27′	213° 37′	33° 37′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXII & XXI	″ h 67·90 h 66·70	″ h 60·53 h 59·60	″ h 57·76 h 57·30	″ h 54·46 h 54·67	″ h 58·40 h 58·44	″ h 55·96 h 56·53	″ h 60·47 h 60·60	″ h 59·80 h 58·70	″ l 55·60 l 56·66	″ l 62·64 l 63·14	″ l 64·44 l 64·07	″ l 64·54 l 63·34	M = 60″·09 w = 0·80
	67·30	60·07	57·53	54·56	58·42	56·25	60·53	59·25	56·13	62·89	64·26	63·94	$\frac{1}{w}$ = 1·24 C = 38° 21′ 0″·09

At XIX (Kandálwa)—(*Continued*).

Angle between	Circle readings, telescope being set on XXII: 162° 48′	342° 48′	172° 59′	352° 59′	183° 10′	3° 10′	193° 16′	13° 16′	203° 27′	23° 27′	213° 37′	33° 37′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXI & XX	*h* 7·20 *h* 7·03	*h* 16·23 *h* 16·27	*h* 12·64 *h* 11·26	*h* 10·17 *h* 10·43	*h* 8·50 *h* 8·66	*h* 10·17 *h* 9·63	*h* 9·23 *h* 10·07	*h* 12·40 *h* 12·80	*l* 14·17 *l* 12·64	*l* 10·66 *l* 10·30	*l* 11·96 *l* 13·10	*l* 11·56 *l* 11·56	$M = 11''·19$ $w = 2·05$
	7·12	16·25	11·95	10·30	8·58	9·90	9·65	12·60	13·40	10·48	12·53	11·56	$\frac{1}{w} = 0·49$ $C = 60° 53' 11''·19$
XX & XVIII	*h* 17·43 *h* 17·64	*h* 13·67 *h* 12·53	*h* 18·50 *h* 19·40	*h* 20·93 *h* 19·03	*h* 16·60 *h* 17·00	*h* 16·77 *h* 17·57	*h* 14·50 *h* 12·73	*h* 11·93 *h* 12·20	*l* 10·80 *l* 12·36	*l* 14·94 *l* 15·30	*l* 13·47 *l* 12·83	*l* 14·17 *l* 14·27	$M = 15''·27$ $w = 1·55$
	17·54	13·10	18·95	19·98	16·80	17·17	13·61	12·07	11·58	15·12	13·15	14·22	$\frac{1}{w} = 0·65$ $C = 55° 34' 15''·27$
XVIII & XVII	*h* 52·20 *h* 53·40	*h* 56·87 *h* 57·67	*h* 52·86 *h* 52·74	*h* 55·20 *h* 55·80	*h* 55·23 *h* 54·07	*h* 58·36 *h* 57·63	*h* 53·34 *h* 55·17	*h* 54·30 *h* 54·27	*l* 50·57 *l* 50·64	*l* 49·20 *l* 49·83	*l* 53·40 *l* 52·97	*l* 51·47 *l* 52·63	$M = 53''·74$ $w = 1·92$
	52·80	57·27	52·80	55·50	54·65	58·00	54·25	54·29	50·60	49·52	53·18	52·05	$\frac{1}{w} = 0·52$ $C = 42° 23' 53''·74$

At XX (Páwágarh)

January 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms*' 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVIII: 0° 1′	180° 1′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XVIII & XVII	*h* 2·13 *h* 3·13	*h* 2·60 *h* 3·47	*h* 5·43 *h* 4·10	*h* 2·30 *h* 3·96	*l* 7·26 *l* 7·27	*l* 6 97 *l* 7·34	*l* 10·54 *l* 10·37	*l* 10·70 *l* 9·93	*h* 11·46 *h* 11·67	*h* 10·53 *h* 10·76	*h* 11·13 *h* 10·83	*h* 8·46 *h* 8·13	$M = 7''·52$ $w = 1·04$
	2·63	3·04	4·76	3·13	7·27	7·15	10·46	10·31	11·57	10·64	10·98	8·30	$\frac{1}{w} = 0·96$ $C = 34° 0' 7''·52$
XVII & XIX	*h* 57·87 *h* 57·37	*h* 56·86 *h* 56·43	*h* 55·20 *h* 55·46	*h* 55·33 *h* 55·14	*l* 52·70 *l* 52·33	*l* 47·20 *l* 47·03	*l* 50·10 *l* 49·53	*l* 48·53 *l* 47·97	*h* 45·10 *h* 46·93	*h* 49·23 *h* 49·54	*h* 51·34 *h* 51·60	*h* 53·90 *h* 53·83	$M = 51''·94$ $w = 0·80$
	57·62	56·65	55·33	55·23	52·52	47·11	49·82	48·25	46·01	49·39	51·47	53·86	$\frac{1}{w} = 1·25$ $C = 33° 41' 51''·94$
XIX & XXI	*h* 46·83 *h* 46·40	*h* 47·44 *h* 47·37	*h* 48·34 *h* 48·27	*h* 54·67 *h* 53·53	*l* 54·07 *l* 53·64	*l* 56·83 *l* 57·33	*l* 52·73 *l* 53·04	*l* 59·34 *l* 59·50	*h* 53·00 *h* 52·20	*h* 47·47 *h* 48·80	*h* 46·80 *h* 47·33	*h* 48·70 *h* 49·40	$M = 51''·38$ $w = 0·67$
	46·62	47·40	48·31	54·10	53·85	57·08	52·89	59·42	52·60	48·13	47·07	49·05	$\frac{1}{w} = 1·50$ $C = 40° 43' 51''·38$

At XX (Páwágarh)—(*Continued*).

Angle between	Circle readings, telescope being set on XVIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
XXI & XXIII	″ *h* 38·17 *h* 38·16	″ *h* 37·30 *h* 37·30	″ *h* 35·80 *h* 36·27	″ *h* 36·33 *h* 36·83	″ *l* 34·47 *l* 35·53	″ *l* 32·90 *l* 32·77	″ *l* 39·80 *l* 38·70	″ *l* 33·53 *l* 34·26	″ *h* 41·34 *h* 41·30	″ *h* 40·23 *h* 39·73	″ *h* 40·03 *h* 39·30	″ *h* 35·00 *h* 35·50	$M = 37''\cdot 11$ $w = 1\cdot 72$
	38·17	37·30	36·03	36·58	35·00	32·84	39·25	33·89	41·32	39·98	39·67	35·25	$\frac{1}{w} = 0\cdot 58$ $C = 55^\circ\ 6'\ 37''\cdot 11$

At XXI (Masábár)

February 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXII												M = Mean of groups w = Relative Weight C = Concluded Angle
	108° 44′	288° 44′	118° 55′	298° 55′	129° 6′	309° 6′	139° 12′	319° 12′	149° 23′	329° 22′	159° 33′	339° 33′	
XXII & XXIII	″ *h* 58·10 *h* 58·30	″ *h* 56·40 *h* 58·23	″ *h* 57·47 *h* 58·53	″ *h* 49·70 *h* 48·93	″ *l* 50·70 *l* 51·10	″ *h* 51·24 *h* 49·07	″ *l* 54·16 *l* 54·10	″ *l* 49·10 *l* 48 97	″ *h* 57·90 *h* 58·80	″ *h* 54·30 *h* 54·80	″ *h* 58·83 *h* 59·13	″ *h* 55·87 *h* 57·37	$M = 54''\cdot 63$ $w = 0\cdot 81$
	58·20	57·32	58·00	49·31	50·90	50·16	54·13	49·03	58·35	54·55	58·98	56·62	$\frac{1}{w} = 1\cdot 24$ $C = 84^\circ\ 4'\ 54''\cdot 63$
XXIII & XX	*h* 21·47 *h* 20·90	*h* 20·23 *h* 20·13	*h* 21·07 *h* 20·07	*h* 22·86 *h* 25·03	*l* 26·03 *l* 24·90	*h* 23·93 *h* 25·43	*l* 24·10 *l* 24 77	*l* 24·40 *l* 23 87	*h* 23·13 *h* 22·44	*h* 21·17 *h* 21·20	*h* 17·70 *h* 17·90	*h* 20·00 *h* 19·33	$M = 22''\cdot 17$ $w = 2\cdot 04$
	21·19	20·18	20·57	23·94	25·47	24·68	24·43	24·14	22·78	21·19	17·80	19·66	$\frac{1}{w} = 0\cdot 49$ $C = 88^\circ\ 48'\ 22''\cdot 17$
XX & XIX	*h* 58·70 *h* 58·50	*h* 62·34 *h* 62·44	*h* 58·83 *h* 57·30	*h* 60·24 *h* 58·37	*l* 56·00 *l* 56·70	*h* 60·83 *h* 60·10	*l* 53·90 *l* 54·07	*l* 54·44 *l* 55·43	*h* 51·34 *h* 51·63	*h* 58·36 *h* 58·13	*h* 60·07 *h* 58·87	*h* 60·70 *h* 61·07	$M = 57''\cdot 85$ $w = 1\cdot 20$
	58·60	62·39	58·07	59·30	56·35	60·47	53·98	54·94	51·48	58·25	59·47	60·88	$\frac{1}{w} = 0\cdot 83$ $C = 78^\circ\ 22'\ 57''\cdot 85$

At XXII (Karáli)

February 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	183° 1′	3° 0′	193° 11′	13° 11′	203° 22′	23° 22′	213° 28′	33° 27′	223° 38′	43° 38′	233° 49′	53° 49′	
XXIV & XXIII	″ *d* 20·28 *d* 20·25	″ *d* 26·21 *d* 25·91	″ *d* 18·49 *d* 18·22	″ *d* 20·76 *d* 20·53	″ *d* 17·79 *d* 17·48	″ *d* 19·75 *d* 20·45	″ *h* 25·87 *h* 24·06	″ *h* 28·33 *h* 28·27	″ *h* 25·10 *h* 26·16	″ *l* 25·33 *l* 25·13	″ *h* 20·63 *h* 19·33	″ *d* 22·81 *d* 22·81	$M = 22''\cdot 50$ $w = 1\cdot 00$
	20·27	26·06	18·35	20·65	17·63	20·10	24·97	28·30	25·63	25·23	19·98	22·81	$\frac{1}{w} = 1\cdot 00$ $C = 81^\circ\ 11'\ 22''\cdot 50$

At XXII (Karáli)—(*Continued*).

Angle between	Circle readings, telescope being set on XXIV 183° 1′	3° 0′	193° 11′	13° 11′	203° 22′	23° 22′	213° 28′	33° 27′	223° 38′	43° 38′	233° 49′	53° 49′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIII & XXI	h 45·47	h 39·60	l 43·17	l 41·54	l 40·73	l 44·83	h 41·86	h 40·90	h 39·30	l 40·30	h 38·74	d 43·55	$M = 41''·64$ $w = 2·30$
	h 45·50	h 37·90	l 42·33	l 41·77	l 41·04	l 43·67	h 44·44	h 39·93	h 38·17	l 41·77	h 39·23	d 43·72	$\frac{1}{w} = 0·43$
	45·49	38·75	42·75	41·65	40·89	44·25	43·15	40·41	38·74	41·03	38·99	43·63	$C = 62° 53' 41''·64$
XXI & XIX	h 15·40	h 18·36	l 16·27	l 20·20	l 18·27	l 22·40	h 14·34	h 13·64	h 15·33	h 14·30	h 16·56	l 16·13	$M = 16''·64$ $w = 1·63$
	h 14·43	h 18·97	l 16·90	l 19·03	l 17·73	l 22·83	h 13·10	h 12·83	h 15·87	l 14·53	h 16·24	l 15·77	$\frac{1}{w} = 0·61$
	14·92	18·66	16·59	19·61	18·00	22·62	13·72	13·23	15·60	14·42	16·40	15·95	$C = 32° 55' 16''·64$

At XXIII (Sidpur)

February 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XX 169° 40′	349° 40′	179° 50′	359° 50′	190° 1′	10° 1′	200° 7′	20° 7′	210° 18′	30° 18′	220° 29′	40° 29′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XX & XXI	d 66·14	d 61·15	d 57·14	d 56·89	d 62·25	d 61·53	d 64·75	d 63·48	d 66·78	d 66·93	d 61·15	d 65·13	$M = 62''·82$ $w = 1·11$
	d 66·25	d 62·55	d 57·54	d 57·99	d 61·31	d 61·44	d 64·32	d 63·34	d 67·22	d 66·20	d 60·94	d 65·27	$\frac{1}{w} = 0·90$
	66·20	61·85	57·34	57·44	61·78	61·48	64·54	63·41	67·00	66·56	61·05	65·20	$C = 36° 5' 2''·82$
XXI & XXII	h 26·57	h 32·83	h 30·53	h 28·90	d 26·02	d 28·60	d 20·41	d 22·12	d 22·82	d 22·43	h 25·36	h 20·93	$M = 25''·59$ $w = 0·77$
	h 26·96	h 32·66	h 30·03	h 28·54	d 26·66	d 28·00	d 20·25	d 21·96	d 21·51	d 23·03	h 25·57	h 21·40	$\frac{1}{w} = 1·31$
	26·77	32·74	30·28	28·72	26·34	28·30	20·33	22·04	22·17	22·73	25·46	21·17	$C = 33° 1' 25''·59$
XXII & XXIV	d 24·92	d 21·14	d 29·09	d 26·63	d 33·21	d 25·97	d 33·14	d 28·30	d 23·72	d 28·97	d 25·60	d 27·65	$M = 27''·33$ $w = 0·98$
	d 24·65	d 21·73	d 29·19	d 27·03	d 32·57	d 25·20	d 33·30	d 28·46	d 23·09	d 28·37	d 26·34	d 27·62	$\frac{1}{w} = 1·02$
	24·79	21·43	29·14	26·83	32·89	25·59	33·22	28·38	23·40	28·67	25·97	27·64	$C = 51° 36' 27''·33$
XXIV & XXV	h 56·33	h 61·36	h 53·23	h 57·00	h 50·54	h 58·53	h 49·43	h 54·10	h 57·77	h 56·03	h 58·50	h 60·10	$M = 55''·92$ $w = 0·85$
	h 56·60	h 60·77	h 52·53	h 56·60	h 48·97	h 59·30	h 49·76	h 53·70	h 58·40	h 54·70	h 57·76	h 60·13	$\frac{1}{w} = 1·18$
	56·47	61·06	52·88	56·80	49·76	58·91	49·60	53·90	58·08	55·37	58·13	60·11	$C = 69° 37' 55''·92$

At XXIV (Bábásiráj)

March 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXVI 215° 21′	35° 21′	225° 32′	45° 32′	235° 43′	55° 43′	245° 48′	65° 48′	255° 59′	75° 59′	266° 10′	86° 10′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVI & XXVII	″ l 28·54 l 28·80	″ l 31·07 l 31·57	″ l 27·70 l 27·70	″ l 29·93 l 29·80	″ l 24·57 l 24·37	″ h 25·43 h 24·87	″ h 20·60 h 20·60	″ h 19·93 h 19·50	″ h 22·07 h 21·27	″ h 19·20 h 19·87	″ h 28·70 h 26·83	″ h 22·74 h 22·43	M = 24″·92 w = 0·71 1/w = 1·42
	28·67	31·32	27·70	29·87	24·47	25·15	20·60	19·71	21·67	19·54	27·76	22·59	C = 32° 33′ 24″·92
XXVI & XXV	h 6·27 h 5·17	h 11·37 h 10·83	h 9·53 h 8·74	l 9·00 l 7·90	d 6·97 d 8·04	l 9·66 l 10·44	h 11·13 h 11·20	h 8·74 h 8·17	h 9·73 h 9·00	h 8·40 h 10·17	l 13·93 l 14·76	h 6·60 h 5·83	M = 9″·23 w = 2·16 1/w = 0·46
	5·72	11·10	9·14	8·45	7·50	10·05	11·17	8·45	9·37	9·28	14·35	6·21	C = 58° 29′ 9″·23
XXV & XXIII	h 20·70 h 19·03	h 13·53 h 14·50	h 18·90 l 19·03	l 15·70 l 16·84	h 11·73 h 10·33	l 13·17 l 12·83	h 8·90 h 8·67	h 12·30 h 12·50	h 13·20 h 12·87	h 10·77 h 9·43	h 11·07 l 8·97 l 9·70	h 14·17 h 13·73	M = 13″·44 w = 0·98 1/w = 1·02
	19·87	14·01	18·97	16·27	11·03	13·00	8·78	12·40	13·04	10·10	9·91	13·95	C = 38° 58′ 13″·44
XXIII & XXII	h 15·23 h 14·63	h 18·83 h 17·34	h 11·00 l 9·10 l 8·87	l 16·40 l 16·10	l 16·23 l 15·36	l 19·40 l 18·53	h 13·70 h 14·23	h 15·40 h 14·73	h 11·90 h 11·66	h 16·97 h 17·57	h 14·13 l 12·90	h 14·77 h 15·04	M = 15″·02 w = 1·73 1/w = 0·58
	14·93	18·09	9·66	16·25	15·79	18·97	13·96	15·07	11·78	17·27	13·51	14·91	C = 47° 12′ 15″·02

At XXV (Kesarwa)

February and March 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIII 0° 1′	180° 1′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIII & XXIV	″ h 51·64 h 52·50	″ h 54·77 h 54·20	″ h 57·13 h 57·33	″ h 54·27 h 54·50	″ l 54·67 l 53·77	″ l 55·63 l 55·27	″ h 53·93 h 52·70	″ h 54·67 h 54·13	″ h 56·13 h 55·67	″ h 57·80 h 57·34	″ h 53·40 h 53·66	″ h 55·23 h 55·90	M = 54″·84 w = 4·66 1/w = 0·21
	52·07	54·49	57·23	54·38	54·22	55·45	53·32	54·40	55·90	57·57	53·53	55·56	C = 71° 23′ 54″·84

At XXV (Kesarwa)—(*Continued*).

Angle between	Circle readings, telescope being set on XXIII 0° 1′	180° 1′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIV & XXVI	d 38·86	d 37·40	d 36·52	d 38·97	d 41·34	d 39·12	d 41·58	d 44·80	d 37·00	d 39·07	d 39·92	d 34·39	$M = 39''\cdot05$
	d 38·39	d 37·97	d 36·32	d 38·74	d 40·48	d 39·48	d 41·98	d 44·47	d 37·46	d 39·53	d 39·66	d 33·72	$w = 1\cdot64$ $\frac{1}{w} = 0\cdot61$
	38·63	37·68	36·42	38·86	40·91	39·30	41·78	44·63	37·23	39·30	39·79	34·06	$C = 30^\circ 51' 39''\cdot05$
XXVI & XXVII	d 25·36	d 28·12	d 23·07	d 23·29	d 18·24	d 19·06	d 21·98	d 19·64	d 27·85	d 25·15	d 20·26	d 19·68	$M = 22''\cdot77$
	d 25·07	d 28·85	d 21·77	d 24·13	d 18·64	d 19·53	d 21·14	d 19·70	d 27·55	d 25·61	d 21·55	d 21·28	$w = 1\cdot08$ $\frac{1}{w} = 0\cdot93$
	25·22	28·48	22·42	23·71	18·44	19·30	21·56	19·67	27·70	25·38	20·90	20·48	$C = 34^\circ 4' 22''\cdot77$
XXVI & XXVIII	d 7·11	d 5·97	d 10·52	d 6·16	d 6·51	d 2·08	d 6·58	d 2·46	d 8·54	d 2·97	d 6·42	d 6·80	$M = 6''\cdot06$
	d 7·58	d 6·70	d 9·88	d 6·50	d 6·91	d 2·55	d 6·18	d 2·52	d 8·24	d 3·43	d 6·99	d 5·77	$w = 2\cdot18$ $\frac{1}{w} = 0\cdot46$
	7·35	6·33	10·20	6·33	6·71	2·32	6·38	2·49	8·39	3·20	6·70	6·29	$C = 83^\circ 38' 6''\cdot06$

At XXVI (Ságbára)

March and April 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No*. 2.

Angle between	Circle readings, telescope being set on XXIX 157° 51′	337° 51′	168° 1′	348° 1′	178° 18′	358° 12′	188° 18′	8° 18′	198° 29′	18° 29′	208° 40′	28° 40′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIX & XXVIII	d 66·68	d 56·80	d 66·22	d 61·25	d 63·55	d 64·68	d 63·87	d 63·50	d 61·35	d 66·73	d 59·88	d 57·44	$M = 62''\cdot58$
	d 66·15	d 56·70	d 66·19	d 61·55	d 63·72	d 64·28	d 63·57	d 63·10	d 61·95	d 65·67	d 59·85	d 57·34	$w = 1\cdot11$ $\frac{1}{w} = 0\cdot90$
	66·42	56·75	66·20	61·40	63·64	64·48	63·72	63·30	61·65	66·20	59·86	57·39	$C = 62^\circ 21' 2''\cdot58$
XXVIII & XXV	h 37·47	h 39·46	h 34·40	h 35·40	h 34·73	h 29·43	h 40·43	h 35·20	h 41·40	h 31·30	h 42·27	h 41·57	$M = 37''\cdot01$
	h 38·00	h 39·94	h 34·43	h 36·10	h 34·56	h 29·83	h 39·63	h 35·60	h 40·80	h 32·36	h 42·83	h 41·20	$w = 0\cdot73$ $\frac{1}{w} = 1\cdot38$
	37·74	39·70	34·41	35·75	34·65	29·63	40·03	35·40	41·10	31·83	42·55	41·38	$C = 49^\circ 9' 37''\cdot01$
XXVII & XXV	h 56·54	l 53·83	l 55·14	l 50·73	l 58·00	l 50·23	h 62·53	h 59·43	h 60·36	h 60·16	h 61·30	h 55·63	$M = 56''\cdot89$
	l 57·24	l 55·10	l 54·07	l 51·90	l 56·87	l 50·10	h 61·80	h 59·90	h 59·20	h 58·97	h 60·27	h 55·97	$w = 0\cdot84$ $\frac{1}{w} = 1\cdot18$
	56·89	54·47	54·60	51·32	57·43	50·17	62·16	59·67	59·78	59·56	60·79	55·80	$C = 26^\circ 32' 56''\cdot89$

At XXVI (Ságbára)—(*Continued*).

Angle between	Circle readings, telescope being set on XXIX 157° 51′	337° 51′	168° 1′	348° 1′	178° 13′	358° 12′	188° 18′	8° 18′	198° 29′	18° 29′	208° 40′	28° 40′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXV & XXIV	″ h 15·96 l 16·63	″ l 20·07 l 19·36	″ l 12·16 l 13·83	″ l 19·30 l 17·93	″ l 11·80 l 12·43	″ l 22·80 l 21·93	″ h 6·63 h 7·43	″ h 13·77 h 13·13	″ h 9·90 h 9·60	″ h 13·47 h 15·20	″ h 8·13 h 9·00	″ h 17·30 h 16·30	M = 14″·34 w = 0·55 1/w = 1·81 C = 90° 39′ 14″·34
	16·30	19·71	13·00	18·62	12·11	22·37	7·03	13·45	9·75	14·33	8·57	16·80	

At XXVII (Álamwári)

April 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXV 0° 1′	180° 0′	10° 12′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXV & XXIV	″ h 11·63 h 12·64	″ h 13·70 h 14·13	″ h 14·60 h 15·44	″ h 13·30 h 13·73	″ h 15·23 h 15·00	″ h 12·50 h 13·87	″ h 18·16 h 18·17	″ l 20·26 l 19·70	″ l 16·50 l 17·40	″ l 18·27 l 17·67	″ l 18·00 l 16·64	″ l 18·50 l 19·26	M = 16″·01 w = 1·85 1/w = 0·54 C = 89° 8′ 16″·01
	12·14	13·91	15·02	13·52	15·11	13·19	18·16	19·98	16·95	17·97	17·32	18·88	
XXIV & XXVI	d 26·14 d 25·13	d 26·17 d 25·74	d 23·65 d 24·38	d 27·64 d 27·61	h 24·37 h 25·66	h 29·53 h 28·86	h 23·54 h 23·10	l 21·04 l 21·00	l 24·03 l 23·36	l 20·60 l 22·23	l 23·93 l 24·90	l 20·50 l 20·24	M = 24″·31 w = 1·72 1/w = 0·58 C = 30° 14′ 24″·31
	25·64	25·95	24·02	27·62	25·02	29·19	23·32	21·02	23·70	21·41	24·42	20·37	

At XXVIII (Páthal)

April 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXV 0° 1′	180° 0′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXV & XXVI	″ d 12·56 d 12·33	″ d 13·85 d 14·18	″ d 19·44 d 19·40	″ d 23·34 d 23·20	″ d 23·72 d 23·90	″ d 17·12 d 17·75 d 18·84	″ h 26·83 h 25·67	″ h 25·57 h 26·50	″ l 20·60 h 22·90 h 23·07	″ h 21·56 l 22·97	″ h 23·93 h 23·53	″ h 21·97 h 22·00	M = 21″·11 w = 0·62 1/w = 1·61 C = 47° 12′ 21″·11
	12·45	14·01	19·42	23·27	23·81	17·90	26·25	26·04	22·19	22·26	23·73	21·99	
XXVI & XXIX	d 33·34 d 33·57	d 32·92 d 32·59	d 30·64 d 29·91	d 20·53 d 20·67	d 23·63 d 23·45	d 28·82 d 29·42	d 24·69 d 24·88	d 26·53 d 26·23	h 25·84 h 25·63	d 34·40 d 34·03	h 25·04 h 25·57	h 23·13 h 23·36	M = 27″·45 w = 0·61 1/w = 1·64 C = 53° 24′ 27″·45
	33·46	32·75	30·28	20·60	23·54	29·12	24·78	26·38	25·74	34·21	25·31	23·24	

At XXVIII (Páthal)—(*Continued*).

Angle between	Circle readings, telescope being set on XXV 0° 1′	180° 0′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIX & XXX	″ d 8·93 d 8·70	″ d 6·73 d 6·87	″ d 8·63 d 8·34	″ d 13·73 d 13·80	″ d 16·41 d 16·59	″ h 6·80 h 6·20	″ d 8·52 d 8·33	″ d 7·77 d 8·07	″ d 12·01 d 12·05	″ d 1·24 d 1·41	″ d 17·72 d 17·59	″ d 12·77 d 12·51	$M = 10''\cdot07$ $w = 0\cdot56$ $\frac{1}{w} = 1\cdot77$ $C = 82°\ 56'\ 10''\cdot07$
	8·82	6·80	8·48	13·77	16·50	6·50	8·42	7·92	12·03	1·33	17·65	12·64	

At XXIX (Dopári)

**February* 1846; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

†*April* 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXII 320° 0′	140° 0′	340° 0′	160° 0′	360° 0′	180° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XXXII & XXXI	″ h 41·00 h 42·33 h 36·66 h 36·00 h 37·00 d 39·55	″ h 33·00 h 35·67 h 34·66 h 35·33	″ h 28·34 h 26·33 h 30·33 d 26·17	″ h 27·33 h 25·33 h 24·67 h 28·66 d 26·33 d 24·28	″ h 32·00 h 29·00 h 35·34	″ h 30·67 h 32·34 h 32·00	$M = 31''\cdot85$ $w = 0\cdot30$ $\frac{1}{w} = 3\cdot33$ $C = 64°\ 54'\ 31''\cdot85$
	38·76	34·67	27·79	26·10	32·11	31·67	
* XXXI & XXX	h 35·34 h 36·33 h 46·67 d 40·40 d 38·33	h 44·67 h 41·00 h 43·00 h 41·34	h 39·66 h 40·00 d 37·67 d 38·49	h 45·67 h 51·67 d 48·50 d 50·83 d 46·99	h 43·67 d 42·22 d 41·33 d 45·67	h 47·00 d 43·00 d 48·67	$M = 43''\cdot17$ $w = 0\cdot36$ $\frac{1}{w} = 2\cdot78$ $C = 47°\ 14'\ 43''\cdot17$
	39·41	42·50	38·96	48·73	43·22	46·22	
* XXX & XXVIII	h 18·33 h 21·00 h 10·66 h 16·67 d 15·55	h 13·66 h 19·00 h 20·34 h 17·33	h 14·67 h 15·00 d 14·22	h 6·00 h 9·67 d 10·00 d 6·38	h 20·00 d 17·66 d 22·09	h 14·33 d 10·33	
	16·44	17·58	14·63	8·01	19·92	12·33	$M = 14''\cdot82$ $w = 0\cdot30$

Lesser circle readings	257° 47′	77° 47′	267° 58′	87° 58′	278° 8′	98° 8′	288° 14′	108° 14′	298° 25′	118° 25′	308° 36′	128° 36′	
† XXX & XXVIII	″ h 16·70 h 15·80	″ h 15·40 h 15·70 h 14·20	″ h 15·20 h 14·83	″ h 15·34 h 14·83	″ h 19·50 h 19·40	″ h 16·47 h 16·80	″ h 19·04 h 19·20	″ h 15·80 h 15·93	″ h 11·70 h 11·73	″ h 13·04 h 13·26	″ h 12·63 h 11·83	″ h 15·90 h 16·46	$w = 2\cdot46$ $\frac{1}{w} = 0\cdot41$ $C = 37°\ 59'\ 15''\cdot40$
	16·25	15·10	15·02	15·08	19·45	16·64	19·12	15·86	11·72	13·15	12·23	16·18	$M = 15''\cdot48$ $w = 2\cdot16$

At XXIX (Dopári)—(*Continued*).

Angle between	Circle readings, telescope being set on XXX 257° 47′	77° 47′	267° 58′	87° 58′	278° 8′	98° 8′	288° 14′	108° 14′	298° 25′	118° 25′	308° 36′	128° 36′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
† XXVIII & XXVI	*h* 38·86 *h* 39·54	*h* 41·50 *h* 40·60 *h* 41·23	*h* 35·20 *h* 36·83	*h* 41·10 *h* 40·10	*h* 31·17 *h* 31·03	*h* 38·40 *h* 38·10	*h* 31·00 *h* 30·67	*h* 35·07 *h* 34·67	*h* 34·96 *h* 33·57	*h* 36·83 *l* 36·00	*l* 31·13 *l* 30·24	*l* 35·76 *l* 34·57	$M = 35''\cdot71$ $w = 0\cdot85$ $\frac{1}{w} = 1\cdot18$
	39·20	41·11	36·02	40·60	31·10	38·25	30·83	34·87	34·27	36·41	30·69	35·16	$C = 64^\circ 14' 35''\cdot77$

At XXX (Tarbhán)

‡*April* 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

§*April* 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXVIII 0° 1′	180° 0′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
‡ XXVIII & XXIX	*h* 39·03 *h* 37·87	*h* 42·70 *h* 41·37	*h* 39·97 *h* 40·33	*h* 43·53 *h* 43·34	*h* 43·33 *h* 43·67	*h* 39·24 *h* 37·93	*h* 40·33 *h* 40·20	*h* 42·57 *h* 42·47	*h* 41·34 *h* 40·73	*h* 42·37 *h* 41·57	*h* 39·53 *h* 38·70	*h* 38·93 *h* 39·56	$M = 40''\cdot86$ $w = 3\cdot48$ $\frac{1}{w} = 0\cdot29$
	38·45	42·04	40·15	43·43	43·50	38·59	40·26	42·52	41·04	41·97	39·11	39·25	$C = 59^\circ 4' 40''\cdot86$

Angle between	Circle readings, telescope being set on XXVIII 20° 0′	200° 0′	40° 0′	220° 0′	60° 0′	240° 1′	
	″	″	″	″	″	″	
§ XXVIII & XXXI	*h* 3·33 *h* 4·00 *h* 2·34 *h* 2·00	*h* 4·67 *h* 5·00 *h* 0·33 *h* 0·66 *h* 4·66	*h* 9·00 *h* 9·33	*h* 1·67 *h* 5·33	*h* 1·66 *h* 2·00	*h* 4·66 *h* 8·33 *h* 6·33	$M = 4''\cdot49$ $w = 0\cdot69$ $\frac{1}{w} = 1\cdot45$ $C = 115^\circ 10' 4''\cdot47$
	2·92	3·06	9·17	3·50	1·83	6·44	
§ XXXI & XXXIII	*h* 33·33 *d* 29·75 *d* 30·74	*h* 36·34 *h* 32·00 *h* 33·34	*h* 28·66 *h* 27·67	*h* 41·33 *h* 37·33	*h* 38·00 *h* 36·67	*h* 35·34 *h* 31·00 *h* 31·67	$M = 33''\cdot78$ $w = 0\cdot36$ $\frac{1}{w} = 2\cdot78$
	31·27	33·89	28·17	39·33	37·33	32·67	$C = 53^\circ 50' 33''\cdot78$

At XXXI (Pilwa)

April 1845 ; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXIV: 0° 0′	180° 0′	340° 0′	160° 0′	320° 0′	140° 0′	*M* = Mean of Groups, *w* = Relative Weight, *C* = Concluded Angle
	″	″	″	″	″	″	
XXXIV & XXXVI	*h* 50·66 *h* 51·00 *h* 51·67 *h* 52·33	*h* 48·67 *h* 48·00	*h* 57·67 *h* 58·33 *h* 57·00	*h* 44·66 *h* 44·34 *h* 46·00 *h* 45·00	*h* 51·67 *h* 48·33 *h* 53·00	*h* 45·34 *h* 47·66 *h* 46·67	$M = 50''\cdot00$ $w = 0\cdot30$ $\frac{1}{w} = 3\cdot33$ $C = 60°\ 2'\ 50''\cdot00$
	51·42	48·33	57·67	45·00	51·00	46·56	
XXXVI & XXXIII	*h* 57·33 *h* 59·67	*d* 68·33 *d* 69·00	*h* 55·33 *d* 56·00	*h* 67·33 *h* 68·00	*h* 60·00 *h* 64·00	*h* 66·66 *h* 63·33	$M = 62''\cdot92$ $w = 0\cdot24$ $\frac{1}{w} = 4\cdot17$ $C = 48°\ 19'\ 2''\cdot92$
	58·50	68·67	55·66	67·67	62·00	64·99	
XXXIII & XXX	*h* 63·00 *d* 64·50	*h* 58·00 *h* 56·33	*d* 62·16 *d* 64·16	*h* 51·33 *d* 53·33	*h* 57·00 *h* 61·00	*h* 57·34 *h* 56·33 *h* 56·67	$M = 58''\cdot70$ $w = 0\cdot30$ $\frac{1}{w} = 3\cdot33$ $C = 62°\ 45'\ 58''\cdot70$
	63·75	57·17	63·16	52·33	59·00	56·78	
XXX & XXIX	*d* 64·17 *d* 65·17	*d* 60·68 *d* 59·34	*d* 57·84 *d* 58·17	*d* 67·89 *d* 65·89	*h* 64·33 *d* 61·66	*d* 69·01 *d* 68·33	$M = 63''\cdot54$ $w = 0\cdot36$ $\frac{1}{w} = 2\cdot78$ $C = 76°\ 40'\ 3''\cdot54$
	64·67	60·01	58·01	66·89	62·99	68·67	
XXIX & XXXII	*h* 21·67 *d* 19·50 *d* 19·83	*h* 18·66 *h* 18·34	*h* 24·67 *h* 25·34	*h* 15·33 *h* 13·66 *h* 14·67	*h* 22·34 *h* 21·00	*h* 14·00 *h* 14·00	$M = 19''\cdot01$ $w = 0\cdot32$ $\frac{1}{w} = 3\cdot13$ $C = 45°\ 36'\ 18''\cdot91$
	20·33	18·50	25·01	14·55	21·67	14·00	
XXXII & XXXIV	*h* 42·33 *h* 40·67	*h* 47·00 *h* 48·66	*h* 40·33 *h* 39·33	*h* 54·34 *h* 54·00 *h* 52·33	*h* 46·66 *h* 48·67	*h* 50·66 *h* 51·34	$M = 46''\cdot90$ $w = 0\cdot19$ $\frac{1}{w} = 5\cdot26$ $C = 66°\ 35'\ 47''\cdot25$
	41·50	47·83	39·83	53·56	47·67	51·00	

At XXXII (Sáler)

March and April 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXV 159° 25′	 339° 25′	 179° 24′	 359° 25′	 199° 25′	 19° 25′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XXXV & XXXIV	″ *h* 43·67 *h* 47·00	″ *h* 45·67 *h* 47·33	″ *h* 47·33 *h* 47·00	″ *h* 49·00 *h* 44·67	″ *h* 52·00 *h* 49·34	″ *h* 41·66 *h* 43·66 *d* 43·00	$M = 46''\cdot55$ $w = 0\cdot79$ $\frac{1}{w} = 1\cdot27$ $C = 59^\circ\ 28'\ 46''\cdot50$
	45·34	46·50	47·16	46·84	50·67	42·77	
XXXIV & XXXI	*h* 29·00 *h* 29·00	*h* 18·00 *h* 20·33 *h* 20·00	*h* 21·33 *d* 22·84	*h* 21·00 *h* 19·00 *d* 21·49	*h* 20·00 *h* 22·00	*h* 25·00 *h* 24·00 *d* 24·84	$M = 22''\cdot77$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$ $C = 64^\circ\ 28'\ 22''\cdot77$
	29·00	19·44	22·09	20·50	21·00	24·61	
XXXI & XXIX	*h* 3·33 *d* 6·44	*h* 6·67 *h* 8·00 *h* 8·00	*h* 12·00 *d* 13·51 *d* 14·12	*h* 7·33 *h* 8·66 *d* 9·49	*h* 12·00 *h* 9·66	*h* 8·33 *d* 5·51 *d* 6·51 *d* 7·01 *d* 7·18	$M = 8''\cdot65$ $w = 0\cdot66$ $\frac{1}{w} = 1\cdot52$ $C = 69^\circ\ 29'\ 8''\cdot65$
	4·89	7·56	13·21	8·49	10·83	6·91	
XXIX & R. M.	*h* 61·00 *h* 63·67 *h* 61·00	*h* 63·33 *h* 60·34 *h* 58·67	*h* 59·66 *h* 60·33 *h* 61·67	*h* 62·67 *h* 62·34 *d* 64·00	*h* 57·00 *h* 58·34	*h* 63·66 *h* 62·33 *h* 62·00 *d* 63·00	$M = 61''\cdot11$ $w = 1\cdot42$ $\frac{1}{w} = 0\cdot70$ $C = 27^\circ\ 9'\ 1''\cdot16$
	61·89	60·78	60·55	63·00	57·67	62·75	

At XXXIII (Párnera)

November 1844; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXX 4° 10′	 184° 11′	 24° 11′	 204° 11′	 44° 11′	 224° 11′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XXX & XXXI	″ *d* 38·00 *d* 38·34	″ *d* 31·12 *d* 31·11	″ *h* 35·33 *h* 34·34	″ *h* 41·00 *h* 39·33 *h* 40·00	″ *h* 30·00 *h* 31·67	″ *h* 36·33 *d* 33·56	$M = 35''\cdot00$ $w = 0\cdot42$ $\frac{1}{w} = 2\cdot38$ $C = 63^\circ\ 23'\ 35''\cdot00$
	38·17	31·12	34·83	40·11	30·84	34·94	

NOTE.—R.M. denotes Referring Mark.

At XXXIII (Párnera)—(*Continued*).

Angle between	Circle readings, telescope being set on XXX						M = Mean of Groups w = Relative Weight C = Concluded Angle
	4° 10′	184° 11′	24° 11′	204° 11′	44° 11′	224° 11′	
XXXI & XXXVI	″ h 52·00 h 51·66	″ h 52·66 h 52·67	″ h 52·34 h 54·00	″ h 48·00 h 49·00 h 47·00	″ h 51·33 h 49·67	″ h 48·00 h 49·67 h 49·67	$M = 50''\cdot88$ $w = 1\cdot38$ $\frac{1}{w} = 0\cdot72$ $C = 92^\circ 25' 50''\cdot88$
	51·83	52·67	53·17	48·00	50·50	49·11	

At XXXIV (Bhorgarh)

February 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXVII						M = Mean of Groups w = Relative Weight C = Concluded Angle
	300° 0′	120° 0′	320° 0′	140° 0′	340° 0′	160° 0′	
XXXVII & XXXIX	″ h 30·34 h 33·00 h 35·00	″ h 36·33 h 38·67 h 34·66	″ h 36·67 h 34·67 h 36·33 h 36·67	″ h 28·34 h 27·00 h 29·00	″ h 40·67 h 41·67	″ h 29·00 h 27·67	$M = 33''\cdot84$ $w = 0\cdot24$ $\frac{1}{w} = 4\cdot17$ $C = 50^\circ 38' 33''\cdot84$
	32·78	36·55	36·09	28·11	41·17	28·33	
XXXIX & XXXVI	h 29·00 d 32·22	d 34·12 d 34·45 d 35·67	h 30·34 d 27·91	h 38·67 d 42·55	h 29·33 h 29·00	d 40·33 d 40·66	$M = 34''\cdot13$ $w = 0\cdot18$ $\frac{1}{w} = 5\cdot56$ $C = 81^\circ 16' 34''\cdot13$
	30·61	34·75	29·13	40·61	29·16	40·50	
XXXVI & XXXI	d 32·33 d 31·33	h 19·67 h 21·67	h 31·66 h 33·00	h 13·34 h 17·00	h 26·00 d 29·16	h 18·00 d 22·00	$M = 24''\cdot60$ $w = 0\cdot12$ $\frac{1}{w} = 8\cdot33$ $C = 64^\circ 14' 24''\cdot60$
	31·83	20·67	32·33	15·17	27·58	20·00	
XXXI & XXXII	h 59·67 d 59·78	h 57·33 d 57·24 d 62·21	h 56·00 h 54·33	h 66·00 d 65·22	h 59·33 h 59·34	h 63·34 h 64·00	$M = 60''\cdot41$ $w = 0\cdot42$ $\frac{1}{w} = 2\cdot38$ $C = 48^\circ 56' 0''\cdot41$
	59·73	58·93	55·16	65·61	59·34	63·67	

At XXXIV (Bhorgarh)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVII 300° 0′	120° 0′	320° 0′	140° 0′	340° 0′	160° 0′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
XXXII & XXXV	″	″	″	″	″	″	$M = 16''\cdot 38$
	d 12·58	d 18·45	d 21·77	d 15·89	d 18·34	d 11·83	$w = 0\cdot 36$
	d 11·24	d 19·45	d 21·77	d 17·56	d 19·01	d 11·49	$\frac{1}{w} = 2\cdot 78$
	d 11·58	d 17·12		d 14·56			
	11·80	18·34	21·77	16·00	18·68	11·66	$C = 66° 40' 16''\cdot 38$
XXXV & XXXVII	h 13·67	h 11·00	h 4·00	h 11·66	h 6·00	h 15·00	$M = 10''\cdot 69$
	h 15·66	h 10·00	h 4·00	h 14·33	h 5·33	h 15·34	$w = 0\cdot 24$
	h 13·33	h 12·33		h 15·33			$\frac{1}{w} = 4\cdot 17$
	h 15·00						
	14·42	11·11	4·00	13·77	5·66	15·17	$C = 48° 14' 10''\cdot 69$

At XXXV (Ankai)

March 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXVIII 158° 15′	338° 15′	178° 14′	358° 14′	198° 14′	18° 14′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
XXXVIII & XXXIX	″	″	″	″	″	″	$M = 42''\cdot 10$
	h 35·00	h 41·00	h 41·33	h 46·00	h 38·33	h 47·33	$w = 0\cdot 24$
	h 37·33	d 46·07	h 38·33	h 51·67	h 40·00	h 40·66	$\frac{1}{w} = 4\cdot 17$
		d 44·07		d 51·34		d 44·22	
	36·17	43·71	39·83	49·67	39·16	44·07	$C = 33° 44' 42''\cdot 10$
XXXIX & XXXVII	h 47·00	h 43·00	h 41·33	h 36·00	h 46·67	h 41·00	$M = 43''\cdot 15$
	h 46·33	h 39·66	h 43·33	d 38·83	h 47·00	h 42·67	$w = 0\cdot 42$
		h 43·66		d 38·16		h 41·67	$\frac{1}{w} = 2\cdot 38$
		h 49·33		d 34·83		d 42·00	
						d 43·67	
	46·67	43·91	42·33	36·95	46·84	42·20	$C = 4° 25' 43''\cdot 15$
XXXVII & XXXIV	d 4·00	h 5·00	h 8·67	h 6·00	h 4·66	h 4·00	$M = 5''\cdot 64$
	d 3·34	d 7·44	h 8·34	h 7·67	h 6·67	h 0·00	$w = 1\cdot 26$
		d 6·11		d 7·11	h 5·67	h 2·00	$\frac{1}{w} = 0\cdot 79$
		d 4·44				d 3·89	
		d 7·11				d 4·84	
		d 6·53					
	3·67	6·11	8·50	6·93	5·67	2·95	$C = 29° 44' 5''\cdot 62$

At XXXV (Ankai)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVIII: 158° 15′	338° 15′	178° 14′	358° 14′	198° 14′	18° 14′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
XXXIV & XXXII	″ h 14·33 h 15·67	″ h 11·00 h 8·00 h 7·67	″ h 6·67 h 5·66	″ h 10·66 h 9·67 h 3·33 d 8·16	″ h 9·66 h 9·00	″ h 10·00 h 9·00 d 12·34	$M = 9''\cdot63$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$ $C = 53^\circ 51' 9''\cdot63$
	15·00	8·89	6·17	7·95	9·33	10·45	

At XXXVI (Gambírgarh)

**January* 1843; *and* †*November* 1844; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXIII: 240° 0′	60° 0′	260° 0′	80° 0′	280° 0′	100° 1′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
† XXXIII & XXXI	″ h 15·67 h 16·00 h 16·33	″ h 11·00 h 12·67 h 12·00	″ h 5·34 h 5·67	″ h 12·67 h 10·00 h 10·33 d 12·17	″ h 5·33 h 6·00	″ h 12·67 h 14·00	$M = 10''\cdot62$ $w = 0\cdot36$ $\frac{1}{w} = 2\cdot78$ $C = 39^\circ 15' 10''\cdot62$
	16·00	11·89	5·51	11·29	5·67	13·33	
† XXXI & XXXIV	d 45·44 d 45·11 d 44·78	d 50·77 d 51·78 d 51·94	d 57·99 d 57·66	h 60·33 h 58·00 d 60·34	d 54·78 d 53·45	d 56·67 d 56·33	$M = 54''\cdot10$ $w = 0\cdot24$ $\frac{1}{w} = 4\cdot17$ $C = 55^\circ 42' 54''\cdot10$
	45·11	51·50	57·83	59·56	54·11	56·50	
† XXXIV & XXXIX	d 50·89 d 52·56 d 49·89	h 47·67 h 47·33	h 53·00 h 54·34	h 43·67 h 43·33	h 44·66 h 50·67 h 49·33	h 50·66 h 49·67	$M = 49''\cdot02$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$ $C = 41^\circ 46' 49''\cdot02$
	51·11	47·50	53·67	43·50	48·22	50·11	

Angle between	Circle readings, telescope being set on XXXIII: 359° 59′	179° 59′	10° 0′	190° 0′	20° 2′	200° 2′	30° 0′	210° 1′	40° 0′	220° 0′	50° 0′	230° 1′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
* XXXIX & XL	″ d 35·79 d 34·45	″ d 35·33 d 36·66 d 36·66	″ d 30·34 d 31·00	″ d 46·00 d 43·34	″ h 31·34 h 30·34	″ h 41·00 h 41·34	″ h 33·66 h 30·33	″ h 37·67 h 38·33 d 36·65	″ h 33·34 d 30·56	″ d 34·83 d 33·49	″ h 36·66 d 36·16	″ h 35·34 h 33·66	$M = 35''\cdot44$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$ $C = 61^\circ 39' 35''\cdot44$
	35·12	36·22	30·67	44·67	30·84	41·17	32·00	37·55	31·95	34·16	36·41	34·50	

At XXXVII (Sinnar)

February 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXIV: 60° 0′	240° 1′	80° 0′	260° 0′	100° 0′	280° 1′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXIV & XXXV	″ h 47·67 h 49·33	″ h 45·33 h 47·33	″ h 52·67 h 52·00	″ h 47·66 h 46·00	″ h 51·33 h 48·67	″ h 42·33 h 44·33	$M = 47''\cdot89$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$ $C = 102°\ 1'\ 47''\cdot89$
	48·50	46·33	52·34	46·83	50·00	43·33	
XXXV & XXXVIII	h 29·00 d 31·17	h 27·67 h 27·67	d 29·99 d 30·66	h 25·34 d 28·67	h 29·00 h 26·00	h 26·67 h 29·34	$M = 28''\cdot43$ $w = 2\cdot22$ $\frac{1}{w} = 0\cdot45$ $C = 98°\ 14'\ 28''\cdot43$
	30·09	27·67	30·32	27·01	27·50	28·00	
XXXVIII & XXXIX	h 38·00 d 38·36	h 49·33 h 50·66	h 34·34 h 36·34	h 45·33 d 48·66 d 50·99	h 43·67 d 44·67	h 42·33 d 45·83	$M = 43''\cdot35$ $w = 0\cdot18$ $\frac{1}{w} = 5\cdot56$ $C = 71°\ 38'\ 43''\cdot35$
	38·18	50·00	35·34	48·33	44·17	44·08	
XXXIX & XXXIV	h 63·00 h 59·00 h 62·66	h 58·66 h 57·00	d 63·33 d 61·33	h 57·34 d 63·00	h 59·33 h 57·33	h 64·34 h 65·33	$M = 60''\cdot84$ $w = 0\cdot73$ $\frac{1}{w} = 1\cdot37$ $C = 88°\ 5'\ 0''\cdot85$
	61·55	57·83	62·33	60·17	58·33	64·84	

At XXXVIII (Hewargaon)

January and February 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXVI: 182° 22′	2° 23′	202° 22′	22° 23′	222° 22′	42° 23′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVI & XXX	″ d 39·72 d 40·38	″ h 36·00 d 34·22	″ h 43·00 h 43·00	″ h 37·00 h 42·00 h 41·33 d 41·11	″ h 40·00 h 40·00 h 40·34	″ h 34·00 h 33·00 d 34·33	$M = 38''\cdot74$ $w = 0\cdot48$ $\frac{1}{w} = 2\cdot08$ $C = 66°\ 44'\ 38''\cdot74$
	40·05	35·11	43·00	40·36	40·11	33·78	
XXX & XXXIX	d 33·95 d 32·28 d 32·61	h 39·00 d 39·44 d 40·78	h 32·67 h 33·34	h 38·00 h 36·66 h 39·00 d 38·89	h 36·00 h 36·67 h 36·00 h 31·33	h 38·00 h 39·34 d 39·50	$M = 36''\cdot30$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$ $C = 58°\ 38'\ 36''\cdot30$
	32·95	39·74	33·01	38·14	35·00	38·95	

NOTE.—Stations XXVI and XXX appertain to the Bombay Longitudinal Series.

At XXXVIII (Hewargaon)—(*Continued*).

Angle between	Circle readings, telescope being set on XXVI						M = Mean of Groups w = Relative Weight C = Concluded Angle
	182° 22′	2° 23′	202° 22′	22° 23′	222° 22′	42° 23′	
XXXIX & XXXVII	″ d 65·89 d 67·56 d 67·23	″ d 71·00 d 69·66	″ h 67·00 d 66·83 d 66·50 d 65·82	″ d 62·00 d 59·66 d 61·66	″ d 71·33 d 71·33 d 68·66	″ h 64·33 d 62·27 d 61·27 d 60·93 d 63·60 d 59·61 d 60·88	$M = 66''\cdot19$ $w = 0\cdot36$ $\frac{1}{w} = 2\cdot78$ $C = 48^\circ\,39'\,6''\cdot19$
	66·89	70·33	66·54	61·11	70·44	61·84	
XXXVII & XXXV	h 14·33 h 17·33 h 17·66	h 6·00 h 8·66 h 12·33 h 9·00	h 11·67 h 12·00	h 13·00 h 15·34 h 13·34	h 11·00 h 11·00 h 13·67	h 19·66 h 20·00 h 19·33 h 22·33 h 17·34	$M = 13''\cdot80$ $w = 0\cdot41$ $\frac{1}{w} = 2\cdot44$ $C = 43^\circ\,35'\,13''\cdot85$
	16·44	9·00	11·84	13·89	11·89	19·73	

At XXXIX (Kalsubai)

December 1842; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXX						M = Mean of Groups w = Relative Weight C = Concluded Angle
	83° 59′	264° 0′	103° 57′	283° 58′	123° 57′	303° 57′	
XXX & XL	″ h 41·67 h 37·33	″ h 36·66 h 38·33 h 37·66 d 39·89	″ h 40·67 h 43·33 d 41·49	″ h 36·34 h 35·00 h 35·00	″ h 39·00 h 38·34 d 36·22	″ h 45·00 h 40·34 d 41·12	$M = 39''\cdot15$ $w = 0\cdot83$ $\frac{1}{w} = 1\cdot20$ $C = 69^\circ\,3'\,39''\cdot15$
	39·50	38·14	41 83	35·45	37·85	42·15	
XL & XXXVI	h 30·66 h 37·33 d 33·72	h 36·33 h 36·67 h 40·34 d 40·12	h 33·67 h 30·67 d 31·66 d 29·88	h 36·33 h 36·34 h 37·33	h 37·00 h 39·33 h 34·67 d 34·55	h 31·66 h 35·66 h 33·34 d 32·00	$M = 34''\cdot99$ $w = 0\cdot78$ $\frac{1}{w} = 1\cdot28$ $C = 52^\circ\,58'\,34''\cdot99$
	33·90	38·37	31·47	36·67	36·39	33·16	

NOTE.—Stations XXVI and XXX appertain to the Bombay Longitudinal Series.

At XXXIX (Kalsubai)—(*Continued*).

**December 1844; and †February 1845; observed by Lieutenant H. Rivers with Dollond's 15-inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXVI 200° 0′	20° 0′	220° 0′	40° 0′	240° 0′	60° 0′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
* XXXVI & XXXIV	″ h 50·33 h 50·34 h 49·67	″ h 43·00 h 44·67 h 46·00	″ h 54·34 h 53·33 h 52·33 d 53·66	″ h 44·66 h 44·33 h 44·00 d 43·11	″ h 54·00 h 51·00 h 49·00 d 50·50	″ h 51·34 h 49·00 h 48·33 d 48·99	$M = 48''\cdot78$ $w = 0\cdot42$ $\frac{1}{w} = 2\cdot38$ $C = 56°\,56'\,48''\cdot78$
	50·11	44·56	53·42	44·02	51·13	49·41	
* XXXIV & XXXV	h 35·33 d 35·56	h 41·33 h 37·33 h 37·33	h 31·33 h 33·34 d 32·67	h 43·34 h 40·67 h 44·67 d 41·67	h 37·00 h 36·00 d 35·67	h 41·33 h 46·00 h 46·67 d 44·10	$M = 38''\cdot32$ $w = 0\cdot30$ $\frac{1}{w} = 3\cdot33$ $C = 46°\,57'\,38''\cdot32$
	35·45	38·66	32·45	42·59	36·22	44·52	
	Circle readings, telescope being set on XXXIV 256° 57′	76° 58′	96° 56′	276° 55′	296° 57′	116° 58′	
† XXXIV & XXXVII	″ h 30·33 h 26·33 h 28·33 h 29·33 h 26·33	″ h 26·00 h 30·00 h 28·00 h 25·00 d 23·44 d 29·32	″ h 31·66 h 30·66 h 29·00	″ h 21·66 h 22·67 h 21·00	″ h 26·00 h 26·33	″ h 36·33 h 32·00 h 33·00	$M = 27''\cdot88$ $w = 0\cdot36$ $\frac{1}{w} = 2\cdot78$ $C = 41°\,16'\,27''\cdot88$
	28·13	26·96	30·44	21·78	26·17	33·78	
† XXXVII & XXXV	h 11·67 h 8·33 h 8·00	h 12·00 h 14·00 h 11·67 d 8·75 d 12·33 d 14·58	h 14·00 h 11·67 h 10·00	h 10·34 d 11·89	h 10·33 h 12·00	h 10·00 h 13·33	$M = 11''\cdot23$ $w = 2\cdot97$ $\frac{1}{w} = 0\cdot34$ $C = 5°\,41'\,11''\cdot27$
	9·33	12·22	11·89	11·12	11·16	11·67	
† XXXV & XXXVIII	h 64·00 d 63·67 d 63·34	h 63·67 h 67·66 d 65·44 d 68·42	h 60·34 h 62·67	d 66·16 d 67·49	h 65·00 h 63·67	h 57·33 h 59·33	$M = 63''\cdot50$ $w = 0\cdot55$ $\frac{1}{w} = 1\cdot82$ $C = 54°\,1'\,3''\cdot55$
	63·67	66·30	61·51	66·82	64·34	58·33	

At XXXIX (Kalsubai)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVI 200° 0′	20° 0′	220° 0′	40° 0′	240° 0′	60° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XXXV & XXVI	″ h 57·00 d 55·67	″ d 53·11 d 55·44 d 54·11	″ h 54·34 d 54·66 d 53·13	″ d 46·08 d 48·75 d 46·41	″ h 44·00 h 47·00 h 50·33	″ h 46·67 h 42·34 h 41·00 d 42·77	$M = 50''\cdot33$ $w = 0\cdot23$ $\frac{1}{w} = 4\cdot35$ $C = 80^\circ\ 4'\ 50''\cdot07$
	56·34	54·22	54·04	47·08	47·11	43·19	
* XXVI & XXX	d 24·10 d 23·77 d 24·77	h 25·67 h 30·67 h 28·33	d 32·42 d 29·42 d 29·09	h 28·00 h 32·34	d 28·87 d 24·87 d 27·87	h 26·33 h 28·33 d 26·76	$M = 27''\cdot88$ $w = 1\cdot01$ $\frac{1}{w} = 0\cdot99$ $C = 53^\circ\ 58'\ 27''\cdot86$
	24·21	28·22	30·31	30·17	27·20	27·14	

At XL (Kámandrug)

January 1843; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXXVI 50° 2′	230° 1′	60° 0′	240° 0′	70° 0′	249° 59′	80° 0′	259° 59′	89° 59′	269° 59′	100° 0′	279° 59′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXVI & XXXIX	″ h 58·00 h 56·34 h 53·33	″ h 69·34 h 68·67	″ h 63·66 h 60·33	″ h 63·67 h 64·67	″ h 65·34 h 63·00 h 65·34	″ h 63·33 h 62·67	″ h 70·00 h 69·66	″ h 64·34 h 62·67	″ h 64·66 h 67·66	″ h 55·00 h 58·00	″ h 66·67 h 64·33	″ h 58·00 h 62·00 h 62·67	$M = 63''\cdot42$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot67$ $C = 65^\circ\ 22'\ 3''\cdot42$
	55·89	69·01	61·99	64·17	64·56	63·00	69·83	63·51	66·16	56·50	65·50	60·89	
XXXIX & XXX	h 68·67 d 64·45 d 67·78	d 59·32 d 58·33	d 66·33 d 67·67	d 63·99 d 62·99	h 64·66 h 61·67 h 60·66	h 65·67 h 63·00	d 54·00 d 54·34	d 63·44 d 65·11	d 64·00 d 61·00	h 73·33 h 63·00	d 60·83 d 63·17	d 67·44 d 67·78 d 67·11	$M = 63''\cdot46$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$ $C = 50^\circ\ 12'\ 3''\cdot46$
	66·97	58·83	67·00	63·49	62·33	64·33	54·17	64·28	62·50	68·16	62·00	67·44	

At XXVI (Párner)

January 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XXX 0° 1′	180° 0′	20° 1′	200° 0′	40° 1′	220° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXX & XXXIX	″ h 61·34 h 63·00 h 59·67 d 62·22	″ h 68·66 h 64·33 h 67·66 h 69·67 h 65·33	″ h 60·34 h 61·67 h 62·33 d 62·78	″ h 62·67 h 62·33	″ h 67·66 h 65·67 h 64·00 h 67·00	″ h 73·66 h 73·00	$M = 65''\cdot40$ $w = 0\cdot30$ $\frac{1}{w} = 3\cdot33$ $C = 47^\circ\ 54'\ 5''\cdot40$
	61·56	67·13	61·78	62·50	66·08	73·33	

NOTE.—Stations XXVI and XXX appertain to the Bombay Longitudinal Series.

At XXVI (Párner)—(*Continued*).

Angle between	Circle readings, telescope being set on XXX 0° 1′	180° 0′	20° 1′	200° 0′	40° 1′	220° 0′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXIX & XXXVIII	″ h 13·66 h 10·67 h 11·00 d 12·66	″ h 9·00 h 14·67 h 11·34 h 11·67	″ h 6·33 h 8·33 h 10·00 d 9·55	″ h 18·00 h 18·00	″ h 12·67 h 12·33 h 8·67 h 7·00	″ h 10·00 h 12·33	$M = 11''\cdot93$ $w = 0\cdot52$ $\frac{1}{w} = 1\cdot92$ $C = 28^\circ\ 33'\ 11''\cdot83$
	12·00	11·67	8·55	18·00	10·17	11·17	

At XXX (Singi)

†*December* 1842; *and* ‡*October* 1845; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on XL 2° 3′	182° 4′	22° 3′	202° 4′	42° 3′	222° 4′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† XL & XXXIX	″ h 26·00 h 27·67 h 29·00	″ h 28·00 h 27·33 h 25·66	″ h 35·33 h 34·00 d 30·67 d 31·33	″ h 26·66 h 27·67 h 30·67 d 20·00 d 20·33	″ h 36·34 h 36·00 h 36·00	″ h 32·00 h 29·00 h 28·33 h 27·00	$M = 29''\cdot61$ $w = 0\cdot31$ $\frac{1}{w} = 3\cdot23$ $C = 60^\circ\ 44'\ 29''\cdot46$
	27·56	27·00	32·83	25·07	36·11	29·08	
	Circle readings, telescope being set on XXXIX 40° 1′	220° 1′	60° 0′	239° 59′	79° 59′	259° 59′	
‡ XXXIX & XXXVIII	″ h 24·67 h 23·00 h 21·00	″ h 22·34 h 23·34	″ h 21·66 h 23·33 h 23·00 d 18·66 d 20·66	″ h 25·67 h 26·00 d 27·00	″ h 19·34 h 22·00	″ h 19·00 h 18·34	$M = 22''\cdot13$ $w = 0\cdot85$ $\frac{1}{w} = 1\cdot18$ $C = 41^\circ\ 19'\ 22''\cdot12$
	22·89	22·84	21·46	26·22	20·67	18·67	
‡ XXXVIII & XXVI	h 16·00 h 19·34 h 20·67	h 22·00 d 19·83	h 21·33 h 24·00 d 18·67 d 20·67	h 14·00 h 16·00 d 16·16	h 25·00 h 24·00	h 22·34 h 21·66	$M = 20''\cdot44$ $w = 0\cdot57$ $\frac{1}{w} = 1\cdot75$ $C = 36^\circ\ 48'\ 20''\cdot33$
	18·67	20·92	21·17	15·39	24·50	22·00	

NOTE.—Stations XXVI and XXX appertain to the Bombay Longitudinal Series.

July 1879.

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

SINGI MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. SUMS OF SQUARES OF APPARENT ERRORS.

Sums of Squares of Apparent Errors of Single Observations, and of Apparent Errors of Single Zeros.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXIX	I & XXXII	24	1·63	12	78·80	Troughton and Simms' 18-inch Theodolite No. 2.
XXXII	XXIX & I	24	1·91	12	82·86	
„	I & II	24	3·32	12	86·77	
I	III & II	24	7·81	12	189·23	
„	II & XXXII	24	5·69	12	88·18	
„	XXXII & XXIX	24	5·58	12	84·84	
II	XXXII & I	24	3·55	12	84·41	
„	I & III	24	5·63	12	53·01	
„	III & IV	24	4·63	12	115·44	
III	VI & V	24	3·36	12	63·83	
„	V & IV	24	5·13	12	45·97	
„	IV & II	24	4·32	12	71·81	
„	II & I	24	3·54	12	49·51	
IV	II & III	24	3·63	12	62·11	
„	III & V	24	2·78	12	182·77	
V	IV & III	24	6·88	12	143·45	
„	III & VI	24	2·86	12	128·63	
„	VI & VII	24	8·37	12	121·42	

Note.—Stations XXIX and XXXII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
V	VII & VIII	24	5·08	12	140·62	Troughton and Simms' 18-inch Theodolite No. 2.
VI	VII & V	24	2·59	12	117·44	
„	V & III	24	2·63	12	124·42	
VII	IX & VIII	24	7·06	12	63·29	
„	VIII & V	24	5·72	12	67·87	
„	V & VI	24	6·50	12	85·11	
VIII	V & VII	24	1·56	12	37·58	
„	VII & IX	24	3·52	12	140·20	
„	IX & X	24	4·94	12	68·17	
IX	XI & X	24	4·24	12	102·32	
„	X & VIII	24	2·90	12	129·07	
„	VIII & VII	24	5·99	12	86·24	
X	VIII & IX	24	8·70	12	97·79	
„	IX & XI	24	4·41	12	109·95	
„	XI XII	24	3·77	12	151·33	
XI	XIII & XII	24	7·44	12	83·05	
„	XII & X	24	6·92	12	116·41	
„	X & IX	24	3·08	12	70·84	
XII	X & XI	24	2·89	12	125·66	
„	XI & XIII	24	3·59	12	165·44	
„	XIII & XIV	24	1·52	12	42·11	
„	XIV & XV	24	1·90	12	173·36	
XIII	XVII & XVIII	24	4·21	12	220·44	
„	XVIII & XIV	24	5·04	12	205·52	
„	XIV & XII	24	3·15	12	145·14	
„	XII & XI	24	2·25	12	95·79	
XIV	XIII & XVIII	24	5·95	12	137·91	
„	XVII & XVIII	24	5·40	12	180·29	
„	XVIII & XVI	24	3·91	12	157·78	
„	XVI & XV	24	4·84	12	105·01	
„	XV & XII	24	5·29	12	80·60	
„	XII & R. M.	24	3·26	12	78·26	
XV	XII & XIV	24	6·84	12	127·85	
„	XIV & XVI	24	5·22	12	83·58	
XVI	XV & XIV	24	5·03	12	57·60	
„	XIV & XVIII	24	5·71	12	101·87	
XVII	XIX & XX	24	5·33	12	85·33	
„	XX & XVIII	24	6·62	12	96·98	
„	XVIII & XIV	24	7·25	12	61·28	
„	XIV & XIII	24	4·54	12	119·53	
XVIII	XVI & XIV	26	10·13	12	113·54	

NOTE.—R. M. denotes Referring Mark.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XVIII	XIV & XVII	24	6·71	12	142·64	Troughton and Simms' 18-inch Theodolite No. 2.
„	XVII & XIX	24	9·04	12	130·69	
„	XIX & XX	24	5·12	12	96·77	
„	XIV & XIII	24	2·87	12	54·23	
XIX	XXII & XXI	24	3·50	12	163·28	
„	XXI & XX	24	3·49	12	63·68	
„	XX & XVIII	24	6·34	12	83·76	
„	XVIII & XVII	24	4·82	12	67·70	
XX	XVIII & XVII	24	3·66	12	126·20	
„	XVII & XIX	24	2·45	12	164·10	
„	XIX & XXI	24	2·60	12	196·89	
„	XXI & XXIII	24	2·17	12	76·21	
XXI	XXII & XXIII	24	6·67	12	161·87	
„	XXIII & XX	24	5·63	12	63·52	
„	XX & XIX	24	4·80	12	108·42	
XXII	XXIV & XXIII	24	3·45	12	131·20	
„	XXIII & XXI	24	8·19	12	55·32	
„	XXI & XIX	24	3·15	12	80·18	
XXIII	XX & XXI	24	2·58	12	117·77	
„	XXI & XXII	24	1·87	12	171·92	
„	XXII & XXIV	24	1·48	12	133·71	
„	XXIV & XXV	24	3·56	12	155·05	
XXIV	XXVI & XXVII	24	2·77	12	186·30	
„	XXVI & XXV	24	5·15	12	59·82	
„	XXV & XXIII	25	6·92	12	133·09	
„	XXIII & XXII	25	6·16	12	74·83	
XXV	XXIII & XXIV	24	2·38	12	27·77	
„	XXIV & XXVI	24	1·34	12	79·95	
„	XXVI & XXVII	24	4·31	12	121·31	
„	XXVI & XXVIII	24	1·74	12	60·26	
XXVI	XXIX & XXVIII	24	1·14	12	118·08	
„	XXVIII & XXV	24	1·97	12	181·21	
„	XXVII & XXV	24	5·30	12	154·95	
„	XXV & XXIV	24	6·32	12	236·89	
XXVII	XXV & XXIV	24	3·95	12	70·39	
„	XXIV & XXVI	24	4·10	12	75·92	
XXVIII	XXV & XXVI	26	7·59	12	211·37	
„	XXVI & XXIX	24	0·86	12	216·41	
„	XXIX & XXX	24	0·38	12	234·18	
XXIX	XXXII & XXXI	26	84·96	6	105·34	Dollond's 15-inch Theodolite.
„	XXXI & XXX	25	146·16	6	72·52	

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXIX	XXX & XXVIII	21	115·24	6	88·87	Dollond's 15-inch Theodolite.
"	XXX & XXVIII	25	2·44	12	62·22	Troughton and Simms' 18-inch Theodolite No. 2.
"	XXVIII & XXVI	25	5·09	12	145·63	
XXX	XXVIII & XXIX	24	3·63	12	36·45	
"	XXVIII & XXXI	18	38·22	6	38·26	
"	XXXI & XXXIII	15	37·00	6	82·41	
XXXI	XXXIV & XXXVI	19	18·62	6	101·47	
"	XXXVI & XXXIII	12	16·98	6	133·00	
"	XXXIII & XXX	13	15·04	6	92·09	
"	XXX & XXIX	12	7·27	6	82·16	
"	XXIX & XXXII	14	5·34	6	90·07	
"	XXXII & XXXIV	13	7·83	6	141·76	
XXXII	XXXV & XXXIV	13	21·98	6	33·17	
"	XXXIV & XXXI	15	10·36	6	62·03	
"	XXXI & XXIX	18	17·72	6	43·93	
"	XXIX & R.M.	18	22·06	6	19·12	
XXXIII	XXX & XXXI	13	7·19	6	68·55	
"	XXXI & XXXVI	14	6·67	6	20·90	
XXXIV	XXXVII & XXXIX	17	25·26	6	130·44	
"	XXXIX & XXXVI	13	17·11	6	145·04	
"	XXXVI & XXXI	12	23·10	6	246·42	
"	XXXI & XXXII	13	18·10	6	69·02	
"	XXXII & XXXV	15	8·50	6	81·58	Dollond's 15-inch Theodolite.
"	XXXV & XXXVII	16	13·84	6	113·71	
XXXV	XXXVIII & XXXIX	15	64·20	6	112·72	
"	XXXIX & XXXVII	19	65·14	6	66·60	
"	XXXVII & XXXIV	21	25·86	6	21·18	
"	XXXIV & XXXII	16	45·91	6	44·94	
XXXVI	XXXIII & XXXI	16	8·06	6	88·95	
"	XXXI & XXXIV	15	5·66	6	137·06	
"	XXXIV & XXXIX	14	25·05	6	60·60	
"	XXXIX & XL	26	19·67	12	194·56	
XXXVII	XXXIV & XXXV	12	10·53	6	48·96	
"	XXXV & XXVIII	12	16·21	6	9·97	
"	XXXVIII & XXXIX	13	25·76	6	161·11	
"	XXXIX & XXXIV	13	31·72	6	34·53	
XXXVIII	XXVI & XXX*	16	18·31	6	62·15	
"	XXX* & XXXIX	19	26·64	6	45·97	
"	XXXIX & XXXVII	22	27·74	6	80·54	
"	XXXVII & XXXV	20	47·64	6	72·67	
XXXIX	XXX & XL	18	36·53	6	32·70	

NOTE.—R. M. denotes Referring Mark. Stations XXVI and XXX* appertain to the Bombay Longitudinal Series.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXXIX	XL & XXXVI	22	70·24	6	33·13	Dollond's 15-inch Theodolite.
"	XXXVI & XXXIV	22	26·69	6	69·69	
"	XXXIV & XXXV	19	40·34	6	103·90	
"	XXXIV & XXXVII	22	61·20	6	82·40	
"	XXXVII & XXXV	18	45·61	6	5·23	
"	XXXV & XXXVIII	15	20·72	6	50·29	
"	XXXV & XXVI	18	47·02	6	136·92	
"	XXVI & XXX	17	40·06	6	25·74	
XL	XXXVI & XXXIX	27	47·30	12	199·26	
"	XXXIX & XXX	27	86·31	12	176·28	
XXVI	XXX & XXXIX	21	37·79	6	102·59	
"	XXXIX & XXXVIII	20	56·23	6	52·01	
XXX	XL & XXXIX	22	124·28	6	84·52	
"	XXXIX & XXXVIII	17	26·36	6	32·36	
"	XXXVIII & XXVI	16	32·11	6	48·30	

NOTE.—Stations XXVI and XXX appertain to the Bombay Longitudinal Series.

From the preceding data of the sums of the squares of the apparent errors, in the measurement of each angle, we may ascertain the *e.m.s.* (error of mean square) *of observation* of a single measure of an angle, and the *e.m.s. of graduation and observation* of the mean of the measures on a single zero, for each group of angles measured with the same instrument, by the same observer, and under similar circumstances.

The instruments employed were as follows :—

1st.—Troughton and Simms' 18-inch Theodolite No. 2, having 3 microscopes; observations were taken on 6 pairs of zeros (*face left and face right*), giving circle readings at 10° apart.

2nd.—A theodolite by Dollond, having an azimuthal circle 15 inches in diameter, furnished with 3 microscopes; observations were taken on 6 or 3 pairs of zeros, giving circle readings at 10° or 20° apart.

The *e.m.s. of observation* of a single measure of an angle $= \sqrt{\frac{\text{Sum of squares of apparent errors of observations.}}{\text{No. of observations} - \text{No. of angles} \times \text{No. of changes of zero.}}}$

The *e.m.s. of graduation and observation* of the mean of the measures on a single zero $= \sqrt{\frac{\text{Sum of squares of apparent errors of zero.}}{\text{No. of angles} \times (\text{No. of changes of zero} - 1).}}$

Group	Instrument and Observer	Position of stations	Intervals between microscope readings of circle	Number of: Measures on each zero (average)	Angles	Single measures	Single zeros	*e. m. s.* of observation of a single measure	*e. m. s.* of graduation and observation of a single zero
			° ′					″	″
I	Troughton and Simms' 18-inch Theodolite No. 2; Lieutenant C. T. Haig, R.E.	Hills,	10 0	2·01	101	2432	1212	$\left\{\frac{445\cdot23}{2432-1212}\right\}^{\frac{1}{2}} = \pm\ 0\cdot604$	$\left\{\frac{11317\cdot75}{1212-101}\right\}^{\frac{1}{2}} = \pm\ 3\cdot192$
II	Dollond's 15-inch Theodolite; Lieutenant H. Rivers.	"	10 0	2·22	3	80	36	$\left\{\frac{153\cdot28}{80-36}\right\}^{\frac{1}{2}} = \pm\ 1\cdot866$	$\left\{\frac{570\cdot10}{36-3}\right\}^{\frac{1}{2}} = \pm\ 4\cdot156$
III	Ditto.	"	20 0	2·80	52	875	312	$\left\{\frac{1794\cdot16}{875-312}\right\}^{\frac{1}{2}} = \pm\ 1\cdot785$	$\left\{\frac{3969\cdot59}{312-52}\right\}^{\frac{1}{2}} = \pm\ 3\cdot907$

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

SINGI MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

Figure No. 10.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	33	23	1·77	1·11
2	59	3	4·03	0·32
3	47	51	59·93	0·62
4	100	43	59·54	1·32
5	31	24	1·64	0·98
6	53	22	49·33	0·80
7	64	29	33·73	0·64
8	62	7	40·86	0·45
9	76	1	13·37	1·20
10	39	14	14·59	0·78
11	64	44	31·67	0·88
12	46	13	54·90	0·42
13	44	10	25·60	1·38
14	50	59	36·85	2·43
15	38	36	2·35	1·57
16	39	26	7·75	1·68
17	50	58	14·66	0·91
18	43	15	45·02	0·48
19	46	19	54·79	1·51

Equations to be satisfied

									Factor
x_3	$+x_4$	$+x_5$		...	...	...	...	$= e_1 = +\ 0·23,$	λ_1
x_6	$+x_7$	$+x_8$		...	...	...	...	$= e_2 = +\ 2·08,$	λ_2
x_9	$+x_{10}$	$+x_{11}$		...	...	...	...	$= e_3 = -\ 1·96,$	λ_3
x_{12}	$+x_{13}$	$+x_{18}$	$+x_{19}$	...	...	...	...	$= e_4 = -\ 0·85,$	λ_4
x_{14}	$+x_{15}$	$+x_{16}$	$+x_{17}$	...	...	...	...	$= e_5 = +\ 0·11,$	λ_5
x_{12}	$+x_{13}$	$+x_{14}$	$+x_{15}$	...	...	...	...	$= e_6 = -\ 1·62,$	λ_6
$-x_1$	$-x_2$	$+x_3$	$+x_6$	$+x_9$	$+x_{12}$	$+x_{14}$	...	$= e_7 = +\ 0·26,$	λ_7
$12x_2$ $-10x_7$	$-32x_1$ $+10x_{11}$	$+35x_5$ $-26x_{10}$	$+4x_4$ $+27x_{16}$	$+11x_8$ $-20x_{12}$	...	...	...	$= e_8 = +\ 29·2,$	λ_8
$21x_{12}$	$-22x_{15}$	$+5x_{16}$	$-17x_{17}$	$+23x_{18}$	$+x_{19}$	...	...	$= e_9 = -\ 3·1,$	λ_9

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
1	+ 0·23	+2·92						+0·62	+ 39·58	
2	+ 2·08		+1·89					+0·80	− 1·45	
3	− 1·96			+2·86				+1·20	− 11·48	
4	− 0·85				+3·79		+1·80	+1·38	− 8·40	+ 21·37
5	+ 0·11					+6·59	+4·00	+2·43	+ 42·39	− 41·61
6	− 1·62						+5·80	+3·81	+ 33·99	− 25·72
7	+ 0·26				*			+7·86	+ 31·68	
8	+ 29·2								+4450·60	−1108·98
9	− 3·1									+1505·52

Values of the Factors

$\lambda_1 = -\ 0·0560$

$\lambda_2 = +\ 0·9805$

$\lambda_3 = -\ 0·7869$

$\lambda_4 = +\ 0·0519$

$\lambda_5 = +\ 0·3065$

$\lambda_6 = -\ 0·7446$

$\lambda_7 = +\ 0·2934$

$\lambda_8 = +\ 0·0054$

$\lambda_9 = -\ 0·0031$

Angular errors in seconds

$x_1 = -\ ·51$	$x_8 = +\ ·47$	$x_{15} = -\ ·36$
$x_2 = -\ ·07$	$x_9 = -\ ·59$	$x_{16} = +\ ·49$
$x_3 = +\ ·15$	$x_{10} = -\ ·72$	$x_{17} = +\ ·33$
$x_4 = -\ ·05$	$x_{11} = -\ ·65$	$x_{18} = -\ ·01$
$x_5 = +\ ·13$	$x_{12} = -\ ·36$	$x_{19} = +\ ·07$
$x_6 = +\ 1·02$	$x_{13} = -\ ·55$	
$x_7 = +\ ·59$	$x_{14} = -\ ·35$	

$[wx^2] = 5·01$

* 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.

Figure No. 11.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	34	0	7·52	0·96
2	56	43	46·93	0·74
3	41	54	2·00	1·01
4	47	22	5·01	0·75
5	48	19	59·81	0·66
6	42	23	53·74	0·52
7	55	34	15·27	0·65
8	33	41	51·94	1·25

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = -0{\cdot}08,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = -0{\cdot}60,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = -0{\cdot}78,$	λ_3
$\left.\begin{matrix} -31x_1 - 3x_2 - 27x_3 \\ +26x_6 + 3x_7 + 32x_8 \end{matrix}\right\} = e_4 = -24{\cdot}0,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 0·08	+ 3·46	+ 1·76		− 59·25
2	− 0·60		+ 2·94	+ 1·18	− 13·75
3	− 0·78		*	+ 3·08	+ 55·47
4	− 24·0				+3302·88

Values of the Factors

$\lambda_1 = -0{\cdot}0879$

$\lambda_2 = -0{\cdot}1925$

$\lambda_3 = -0{\cdot}0084$

$\lambda_4 = -0{\cdot}0095$

Angular errors in seconds

$x_1 = +{\cdot}20$	$x_5 = -{\cdot}14$
$x_2 = -{\cdot}05$	$x_6 = -{\cdot}23$
$x_3 = -{\cdot}02$	$x_7 = -{\cdot}02$
$x_4 = -{\cdot}21$	$x_8 = -{\cdot}39$

$[wx^2] = 0{\cdot}36$

Figure No. 12.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	78	22	57·85	0·83
2	60	53	11·19	0·49
3	40	43	51·38	1·50
4	88	48	22·17	0·49
5	55	6	37·11	0·58
6	36	5	2·82	0·90
7	84	4	54·63	1·24
8	33	1	25·59	1·31
9	62	53	41·64	0·43
10	32	55	16·64	0·61
11	38	21	0·09	1·24

Equations to be satisfied — Factor

$x_1 + x_2 + x_3 = e_1 = -0·80,$ λ_1

$x_4 + x_5 + x_6 = e_2 = -0·23,$ λ_2

$x_7 + x_8 + x_9 = e_3 = -0·11,$ λ_3

$x_1 + x_4 + x_7 - x_{10} - x_{11} = e_4 = -1·07,$ λ_4

$\left.\begin{array}{l} 24x_3 - 12x_2 + 29x_6 - 14x_5 \\ +11x_9 - 32x_8 + 26x_{11} - 32x_{10} \end{array}\right\} = e_5 = +65·3,$ 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	− 0·80	+2·82			+0·83	+ 30·12
2	− 0·23		+1·97		+0·49	+ 17·98
3	− 0·11			+2·98	+1·24	− 37·19
4	− 1·07		*		+4·41	− 12·72
5	+ 65·3					+4661·49

Values of the Factors

$\lambda_1 = -0·4505$

$\lambda_2 = -0·2596$

$\lambda_3 = +0·2706$

$\lambda_4 = -0·1483$

$\lambda_5 = +0·0197$

Angular errors in seconds

$x_1 = -·50$	$x_7 = +·15$
$x_2 = -·33$	$x_8 = -·47$
$x_3 = +·03$	$x_9 = +·21$
$x_4 = -·20$	$x_{10} = -·30$
$x_5 = -·31$	$x_{11} = +·82$
$x_6 = +·28$	

$[wx^2] = 1·84$

Figure No. 13.

Observed Angles

No.	Value	Reciprocal Weight
	° ′ ″	
1	89 8 16·01	0·54
2	34 4 22·77	0·93
3	30 51 39·05	0·61
4	25 55 44·31	1·88
5	32 33 24·92	1·42
6	90 39 14·34	1·81
7	26 32 56·89	1·18
8	30 14 24·31	0·58

Equations to be satisfied

Equation	Factor
$x_3 + x_4 + x_5 + x_6 = e_1 = -0{\cdot}52,$	λ_1
$x_5 + x_6 + x_7 + x_8 = e_2 = -1{\cdot}34,$	λ_2
$x_1 + x_2 + x_7 + x_8 = e_3 = -1{\cdot}53,$	λ_3
$\left.\begin{array}{l} 12x_1 + 31x_2 - 35x_3 \\ +13x_4 - 20x_5 + 48x_8 \end{array}\right\} = e_4 = -35{\cdot}0,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 0·52	+5·72	+3·23		− 25·31
2	− 1·34		+4·99	+1·76	− 0·56
3	− 1·53		*	+3·23	+ 63·15
4	− 35·0				+3940·78

Values of the Factors

$\lambda_1 = -0{\cdot}0331$

$\lambda_2 = -0{\cdot}1329$

$\lambda_3 = -0{\cdot}3250$

$\lambda_4 = -0{\cdot}0039$

Angular errors in seconds

$x_1 = -{\cdot}20$	$x_5 = -{\cdot}12$
$x_2 = -{\cdot}41$	$x_6 = -{\cdot}30$
$x_3 = +{\cdot}06$	$x_7 = -{\cdot}54$
$x_4 = -{\cdot}16$	$x_8 = -{\cdot}38$

$[wx^2] = 0{\cdot}83$

Figure No. 14.

Observed Angles

No.	Value	Reciprocal Weight	No.	Value	Reciprocal Weight	No.	Value	Reciprocal Weight	No.	Value	Reciprocal Weight
	° ′ ″			° ′ ″			° ′ ″			° ′ ″	
1	76 40 3·54	2·78	15	64 28 22·77	2·08	29	53 51 9·63	1·67	43	69 3 39·15	1·20
2	47 14 43·17	2·78	16	45 36 18·91	3·13	30	59 28 46·50	1·27	44	50 12 3·46	1·39
3	56 5 23·61	1·74	17	69 29 8·65	1·52	31	71 38 43·35	5·56	45	60 44 29·46	3·23
4	62 45 58·70	3·33	18	64 54 31·85	3·33	32	46 57 38·32	3·33	46	26 3 46·52	6·17
5	53 50 33·78	2·78	19	81 16 34·13	5·56	33	5 41 11·27	0·34	47	53 58 27·86	0·99
6	63 23 35·00	2·38	20	41 46 49·02	2·08	34	54 1 3·55	1·82	48	41 19 22·12	1·18
7	48 19 2·92	4·17	21	56 56 48·78	2·38	35	48 39 6·19	2·78	49	58 38 36·30	1·67
8	92 25 50·88	0·72	22	50 38 33·84	4·17	36	98 14 28·43	0·45	50	66 44 38·74	2·08
9	39 15 10·62	2·78	23	41 16 27·88	2·78	37	43 35 13·85	2·44	51	36 48 20·33	1·75
10	60 2 50·00	3·33	24	88 5 0·85	1·37	38	33 44 42·10	4·17	52	47 54 5·40	3·33
11	55 42 54·10	4·17	25	48 14 10·69	4·17	39	4 25 43·15	2·38	53	28 33 11·83	1·92
12	64 14 24·60	8·33	26	102 1 47·89	1·67	40	52 58 34·99	1·28			
13	66 35 47·25	5·26	27	29 44 5·62	0·79	41	61 39 35·44	1·39			
14	48 56 0·41	2·38	28	66 40 16·38	2·78	42	65 22 3·42	1·67			

Equations to be satisfied — **Factor**

$$x_1 + x_2 + x_3 = e_1 = +2·55, \quad \lambda_1$$
$$x_4 + x_5 + x_6 = e_2 = +1·81, \quad \lambda_2$$
$$x_7 + x_8 + x_9 = e_3 = -2·37, \quad \lambda_3$$
$$x_{10} + x_{11} + x_{12} = e_4 = -2·71, \quad \lambda_4$$
$$x_{13} + x_{14} + x_{15} = e_5 = +1·14, \quad \lambda_5$$
$$x_{16} + x_{17} + x_{18} = e_6 = -6·82, \quad \lambda_6$$
$$x_{19} + x_{20} + x_{21} = e_7 = +1·49, \quad \lambda_7$$
$$x_{22} + x_{23} + x_{24} = e_8 = -1·72, \quad \lambda_8$$
$$x_{25} + x_{26} + x_{27} = e_9 = -1·18, \quad \lambda_9$$
$$x_{28} + x_{29} + x_{30} = e_{10} = +0·27, \quad \lambda_{10}$$
$$x_{31} + x_{33} + x_{34} + x_{35} = e_{11} = -1·13, \quad \lambda_{11}$$
$$x_{36} + x_{37} + x_{38} + x_{39} = e_{12} = +0·19, \quad \lambda_{12}$$
$$x_{34} + x_{35} + x_{37} + x_{38} = e_{13} = -6·01, \quad \lambda_{13}$$
$$x_{40} + x_{41} + x_{42} = e_{14} = -0·44, \quad \lambda_{14}$$
$$x_{43} + x_{44} + x_{45} = e_{15} = -2·18, \quad \lambda_{15}$$
$$x_{46} + x_{47} + x_{48} + x_{49} = e_{16} = +2·57, \quad \lambda_{16}$$
$$x_{50} + x_{51} + x_{52} + x_{53} = e_{17} = +6·18, \quad \lambda_{17}$$
$$x_{47} + x_{48} + x_{51} + x_{52} = e_{18} = +1·37, \quad \lambda_{18}$$
$$x_{32} - x_{23} - x_{33} = e_{19} = -0·83, \quad \lambda_{19}$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_{20} = +1·32, \quad \lambda_{20}$$
$$x_{12} + x_{14} + x_{19} + x_{22} + x_{25} + x_{28} = e_{21} = +0·05, \quad \lambda_{21}$$
$$x_{24} + x_{26} + x_{31} + x_{36} = e_{22} = +0·52, \quad \lambda_{22}$$
$$x_{21} + x_{23} + x_{33} + x_{34} + x_{40} + x_{43} + x_{46} + x_{47} = e_{23} = 0·00, \quad \lambda_{23}$$
$$\left.\begin{aligned} &·672\,x_3 - ·925\,x_2 + ·501\,x_6 - ·731\,x_5 + 1·224\,x_9 + ·042\,x_8 \\ &+ ·483\,x_{12} - ·682\,x_{11} + ·478\,x_{15} - ·871\,x_{14} + ·468\,x_{18} - ·374\,x_{17} \end{aligned}\right\} = e_{24} = -7·030, \quad \lambda_{24}$$
$$\left.\begin{aligned} &·651\,x_{21} - 1·119\,x_{20} + 1·473\,x_{27} + 1·473\,x_{39} - ·934\,x_{32} + ·590\,x_{30} \\ &- ·731\,x_{29} + ·433\,x_{13} - ·478\,x_{15} + ·682\,x_{11} - ·576\,x_{10} \end{aligned}\right\} = e_{25} = +1·021, \quad \lambda_{25}$$
$$\left.\begin{aligned} &·880\,x_{35} - ·584\,x_{33} - ·584\,x_{34} + 1·272\,x_{38} + 1·272\,x_{39} \\ &- 1·051\,x_{37} + ·893\,x_{25} - 1·751\,x_{27} + 1·139\,x_{23} - ·820\,x_{22} \end{aligned}\right\} = e_{26} = -2·717, \quad \lambda_{26}$$
$$\left.\begin{aligned} &1·497\,x_{38} + ·919\,x_{35} + ·039\,x_{37} - ·156\,x_{26} - ·976\,x_{22} \\ &- 1·473\,x_{27} - 1·473\,x_{39} + ·033\,x_{24} - ·332\,x_{31} \end{aligned}\right\} = e_{27} = -3·363, \quad \lambda_{27}$$
$$\left.\begin{aligned} &·459\,x_{42} - ·539\,x_{41} + ·560\,x_{45} - ·833\,x_{44} + ·609\,x_{49} - 1·137\,x_{48} \\ &+ ·332\,x_{31} - ·880\,x_{35} + ·820\,x_{22} - ·033\,x_{24} + 1·119\,x_{20} - ·153\,x_{19} \end{aligned}\right\} = e_{28} = -1·207, \quad \lambda_{28}$$
$$·609\,x_{49} + ·551\,x_{47} - ·176\,x_{46} + ·241\,x_{53} - ·663\,x_{52} - ·430\,x_{50} = e_{29} = -1·473, \quad \lambda_{29}$$

Figure No. 14—(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	+2·55	+7·30	...	...	...	...	...	...	...	...	...	...	...	...	...
2	+1·81		+8·49	...	...	...	...	...	...	...	...	...	...	...	...
3	−2·37			+7·67	...	...	...	...	...	...	...	...	...	...	...
4	−2·71				+15·83	...	...	...	...	...	...	...	...	...	...
5	+1·14					+9·72	...	...	...	...	...	...	...	...	...
6	−6·82						+7·98	...	...	...	...	...	...	...	...
7	+1·49							+10·02	...	...	...	...	...	...	...
8	−1·72								+8·32	...	...	...	...	...	...
9	−1·18									+6·63	...	...	...	...	...
10	+0·27										+5·72	...	...	...	...
11	−1·13											+10·50	...	+ 4·60	...
12	+0·19												+9·44	+ 6·61	...
13	−6·01													+11·21	...
14	−0·44														+4·34
15	−2·18														
16	+2·57														
17	+6·18														
18	+1·37														
19	−0·83														
20	+1·32														
21	+0·05														
22	+0·52														
23	0·00														
24	−7·030														
25	+1·021														
26	−2·717														
27	−3·363														
28	−1·207														
29	−1·473														

Equations between the Factors—(Continued).

No. of e	Co-efficients of λ_{15}	λ_{16}	λ_{17}	λ_{18}	λ_{19}	λ_{20}	λ_{21}	λ_{22}	λ_{23}	λ_{24}	λ_{25}	λ_{26}	λ_{27}	λ_{28}	λ_{29}
1	...	...	...	...	...	+ 2·78	...	...	...	− 1·40					
2	...	...	...	...	...	+ 3·33	...	...	...	− 0·84					
3	...	...	...	...	...	+ 4·17	...	...	...	+ 3·43					
4	...	...	...	...	...	+ 3·33	+ 8·33	...	...	+ 1·18	+ 0·93				
5	...	...	...	...	...	+ 5·26	+ 2·38	...	...	− 1·08	+ 1·28				
6	...	...	...	...	...	+ 3·13	...	...	...	+ 0·99					
7	...	...	...	...	...	...	+ 5·56	...	+ 2·38	...	− 0·78	...	...	+ 1·48	
8	...	...	...	...	− 2·78	...	+ 4·17	+ 1·37	+ 2·78	...	...	− 0·25	− 4·02	+ 3·37	
9	...	...	...	...	...	...	+ 4·17	+ 1·67	...	...	+ 1·16	+ 2·34	− 1·81		
10	...	...	...	...	...	...	+ 2·78	...	...	...	− 0·47				
11	...	...	...	...	− 0·34	...	...	+ 5·56	+ 2·16	...	...	+ 1·18	+ 0·71	− 0·60	
12	...	...	...	...	...	...	...	+ 0·45	...	...	+ 3·51	+ 5·77	+ 2·83		
13	...	...	...	...	...	...	...	...	+ 1·82	...	...	+ 4·12	+ 8·89	− 2·45	
14	...	...	...	...	...	...	...	...	+ 1·28	...	...	...	...	+ 0·02	
15	+5·82	...	...	...	...	...	...	...	+ 1·20	...	...	...	...	+ 0·65	
16		+10·01	...	+ 2·17	...	...	...	...	+ 7·16	...	...	...	...	− 0·32	+ 0·48
17			+ 9·08	+ 5·08	...	...	...	...	...	...	...	...	...	...	− 2·64
18				+ 7·25	...	...	...	...	+ 0·99	...	...	...	...	− 1·34	− 1·66
19					+ 6·45	...	...	...	− 3·12	...	− 3·11	− 2·97			
20						+22·00	...	...	...	...	+ 0·36				
21							+27·39	...	...	+ 1·95	...	+ 0·30	− 4·72	+ 2·57	
22								+ 9·05	...	...	...	...	− 1·80	+ 1·80	
23									+16·96	...	+ 1·55	+ 1·90	...	...	− 0·54
24										+16·52	− 2·41				
25											+19·24	+ 2·42	− 6·88	− 2·61	
26												+28·34	+10·42	− 4·96	
27													+23·26	− 6·20	
28														+13·18	+ 0·62
29															+ 3·07

Figure No. 14.

Observed Angles

No.	Value ° ′ ″	Reciprocal Weight	No.	Value ° ′ ″	Reciprocal Weight	No.	Value ° ′ ″	Reciprocal Weight	No.	Value ° ′ ″	Reciprocal Weight
1	76 40 3·54	2·78	15	64 28 22·77	2·08	29	53 51 9·63	1·67	43	69 3 39·15	1·20
2	47 14 43·17	2·78	16	45 36 18·91	3·13	30	59 28 46·50	1·27	44	50 12 3·46	1·39
3	56 5 23·61	1·74	17	69 29 8·65	1·52	31	71 38 43·35	5·56	45	60 44 29·46	3·23
4	62 45 58·70	3·33	18	64 54 31·85	3·33	32	46 57 38·32	3·33	46	26 3 46·52	6·17
5	53 50 33·78	2·78	19	81 16 34·13	5·56	33	5 41 11·27	0·34	47	53 58 27·86	0·99
6	63 23 35·00	2·38	20	41 46 49·02	2·08	34	54 1 3·55	1·82	48	41 19 22·12	1·18
7	48 19 2·92	4·17	21	56 56 48·78	2·38	35	48 39 6·19	2·78	49	58 38 36·30	1·67
8	92 25 50·88	0·72	22	50 38 33·84	4·17	36	98 14 28·43	0·45	50	66 44 38·74	2·08
9	39 15 10·62	2·78	23	41 16 27·88	2·78	37	43 35 13·85	2·44	51	36 48 20·33	1·75
10	60 2 50·00	3·33	24	88 5 0·85	1·37	38	33 44 42·10	4·17	52	47 54 5·40	3·33
11	55 42 54·10	4·17	25	48 14 10·69	4·17	39	4 25 43·15	2·38	53	28 33 11·83	1·92
12	64 14 24·60	8·33	26	102 1 47·89	1·67	40	52 58 34·99	1·28			
13	66 35 47·25	5·26	27	29 44 5·62	0·79	41	61 39 35·44	1·39			
14	48 56 0·41	2·38	28	66 40 16·38	2·78	42	65 22 3·42	1·67			

Equations to be satisfied — **Factor**

$$x_1 + x_2 + x_3 = e_1 = +2\cdot55, \quad \lambda_1$$
$$x_4 + x_5 + x_6 = e_2 = +1\cdot81, \quad \lambda_2$$
$$x_7 + x_8 + x_9 = e_3 = -2\cdot37, \quad \lambda_3$$
$$x_{10} + x_{11} + x_{12} = e_4 = -2\cdot71, \quad \lambda_4$$
$$x_{13} + x_{14} + x_{15} = e_5 = +1\cdot14, \quad \lambda_5$$
$$x_{16} + x_{17} + x_{18} = e_6 = -6\cdot82, \quad \lambda_6$$
$$x_{19} + x_{20} + x_{21} = e_7 = +1\cdot49, \quad \lambda_7$$
$$x_{22} + x_{23} + x_{24} = e_8 = -1\cdot72, \quad \lambda_8$$
$$x_{25} + x_{26} + x_{27} = e_9 = -1\cdot18, \quad \lambda_9$$
$$x_{28} + x_{29} + x_{30} = e_{10} = +0\cdot27, \quad \lambda_{10}$$
$$x_{31} + x_{33} + x_{34} + x_{35} = e_{11} = -1\cdot13, \quad \lambda_{11}$$
$$x_{36} + x_{37} + x_{38} + x_{39} = e_{12} = +0\cdot19, \quad \lambda_{12}$$
$$x_{34} + x_{35} + x_{37} + x_{38} = e_{13} = -6\cdot01, \quad \lambda_{13}$$
$$x_{40} + x_{41} + x_{42} = e_{14} = -0\cdot44, \quad \lambda_{14}$$
$$x_{43} + x_{44} + x_{45} = e_{15} = -2\cdot18, \quad \lambda_{15}$$
$$x_{46} + x_{47} + x_{48} + x_{49} = e_{16} = +2\cdot57, \quad \lambda_{16}$$
$$x_{50} + x_{51} + x_{52} + x_{53} = e_{17} = +6\cdot18, \quad \lambda_{17}$$
$$x_{47} + x_{48} + x_{51} + x_{52} = e_{18} = +1\cdot37, \quad \lambda_{18}$$
$$x_{32} - x_{23} - x_{33} = e_{19} = -0\cdot83, \quad \lambda_{19}$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_{20} = +1\cdot32, \quad \lambda_{20}$$
$$x_{12} + x_{14} + x_{19} + x_{22} + x_{25} + x_{28} = e_{21} = +0\cdot05, \quad \lambda_{21}$$
$$x_{24} + x_{26} + x_{31} + x_{36} = e_{22} = +0\cdot52, \quad \lambda_{22}$$
$$x_{21} + x_{23} + x_{33} + x_{34} + x_{40} + x_{43} + x_{46} + x_{47} = e_{23} = 0\cdot00, \quad \lambda_{23}$$
$$\left.\begin{array}{l}\cdot672\,x_3 - \cdot925\,x_2 + \cdot501\,x_6 - \cdot731\,x_5 + 1\cdot224\,x_9 + \cdot042\,x_8 \\ + \cdot483\,x_{12} - \cdot682\,x_{11} + \cdot478\,x_{15} - \cdot871\,x_{14} + \cdot468\,x_{18} - \cdot374\,x_{17}\end{array}\right\} = e_{24} = -7\cdot030, \quad \lambda_{24}$$
$$\left.\begin{array}{l}\cdot651\,x_{21} - 1\cdot119\,x_{20} + 1\cdot473\,x_{27} + 1\cdot473\,x_{39} - \cdot934\,x_{32} + \cdot590\,x_{30} \\ - \cdot731\,x_{29} + \cdot433\,x_{13} - \cdot478\,x_{15} + \cdot682\,x_{11} - \cdot576\,x_{10}\end{array}\right\} = e_{25} = +1\cdot021, \quad \lambda_{25}$$
$$\left.\begin{array}{l}\cdot880\,x_{35} - \cdot584\,x_{33} - \cdot584\,x_{34} + 1\cdot272\,x_{38} + 1\cdot272\,x_{39} \\ -1\cdot051\,x_{37} + \cdot893\,x_{25} - 1\cdot751\,x_{27} + 1\cdot139\,x_{23} - \cdot820\,x_{22}\end{array}\right\} = e_{26} = -2\cdot717, \quad \lambda_{26}$$
$$\left.\begin{array}{l}1\cdot497\,x_{38} + \cdot919\,x_{35} + \cdot039\,x_{37} - \cdot156\,x_{26} - \cdot976\,x_{22} \\ -1\cdot473\,x_{27} - 1\cdot473\,x_{39} + \cdot033\,x_{24} - \cdot332\,x_{31}\end{array}\right\} = e_{27} = -3\cdot363, \quad \lambda_{27}$$
$$\left.\begin{array}{l}\cdot459\,x_{42} - \cdot539\,x_{41} + \cdot560\,x_{45} - \cdot833\,x_{44} + \cdot609\,x_{49} - 1\cdot137\,x_{48} \\ + \cdot332\,x_{31} - \cdot880\,x_{35} + \cdot820\,x_{23} - \cdot033\,x_{24} + 1\cdot119\,x_{20} - \cdot153\,x_{19}\end{array}\right\} = e_{28} = -1\cdot207, \quad \lambda_{28}$$
$$\cdot609\,x_{49} + \cdot551\,x_{47} - \cdot176\,x_{46} + \cdot241\,x_{53} - \cdot663\,x_{52} - \cdot430\,x_{50} = e_{29} = -1\cdot473, \quad \lambda_{29}$$

Figure No. 14—(Continued).

Equations between the Factors

No. of e	Value of e	Co-efficients of λ₁	λ₂	λ₃	λ₄	λ₅	λ₆	λ₇	λ₈	λ₉	λ₁₀	λ₁₁	λ₁₂	λ₁₃	λ₁₄
1	+2·55	+7·30	...	...	...	...	...	...	...	...	...	...	...	...	...
2	+1·81		+8·49	...	...	...	...	...	...	...	...	...	...	...	...
3	−2·37			+7·67	...	...	...	...	...	...	...	...	...	...	...
4	−2·71				+15·83	...	...	...	...	...	...	...	...	...	...
5	+1·14					+9·72	...	...	...	...	...	...	...	...	...
6	−6·82						+7·98	...	...	...	...	...	...	...	...
7	+1·49							+10·02	...	...	...	...	...	...	...
8	−1·72								+8·32	...	...	...	...	...	...
9	−1·18									+6·63	...	...	...	...	...
10	+0·27										+5·72	...	...	...	...
11	−1·13											+10·50	...	+ 4·60	...
12	+0·19												+9·44	+ 6·61	...
13	−6·01													+11·21	...
14	−0·44														+4·34
15	−2·18														
16	+2·57														
17	+6·18														
18	+1·37														
19	−0·83														
20	+1·32														
21	+0·05														
22	+0·52														
23	0·00														
24	−7·030														
25	+1·021														
26	−2·717														
27	−3·363														
28	−1·207														
29	−1·473														

Equations between the Factors—(Continued).

No. of e	Co-efficients of λ₁₅	λ₁₆	λ₁₇	λ₁₈	λ₁₉	λ₂₀	λ₂₁	λ₂₂	λ₂₃	λ₂₄	λ₂₅	λ₂₆	λ₂₇	λ₂₈	λ₂₉
1	...	...	...	...	...	+ 2·78	...	...	...	− 1·40					
2	...	...	...	...	...	+ 3·33	...	...	...	− 0·84					
3	...	...	...	...	...	+ 4·17	...	...	...	+ 3·43					
4	...	...	...	...	...	+ 3·33	+ 8·33	...	...	+ 1·18	+ 0·93				
5	...	...	...	...	...	+ 5·26	+ 2·38	...	...	− 1·08	+ 1·28				
6	...	...	...	...	...	+ 3·13	...	...	...	+ 0·99					
7	...	...	...	...	...	...	+ 5·56	...	+ 2·38	...	− 0·78	...	...	+ 1·48	
8	...	...	...	...	− 2·78	...	+ 4·17	+ 1·37	+ 2·78	...	...	− 0·25	− 4·02	+ 3·37	
9	...	...	...	...	...	...	+ 4·17	+ 1·67	...	...	+ 1·16	+ 2·34	− 1·81		
10	...	...	...	...	...	...	+ 2·78	...	...	...	− 0·47				
11	...	...	...	...	− 0·34	...	...	+ 5·56	+ 2·16	...	...	+ 1·18	+ 0·71	− 0·60	
12	...	...	...	...	...	...	...	+ 0·45	...	...	+ 3·51	+ 5·77	+ 2·83		
13	...	...	...	...	...	...	...	...	+ 1·82	...	...	+ 4·12	+ 8·89	− 2·45	
14	...	...	...	...	...	...	...	...	+ 1·28	...	...	...	...	+ 0·02	
15	+ 5·82	...	...	...	...	...	...	...	+ 1·20	...	...	...	...	+ 0·65	
16		+ 10·01	...	+ 2·17	...	...	...	...	+ 7·16	...	...	...	...	− 0·32	+ 0·48
17			+ 9·08	+ 5·08	...	...	...	...	...	...	...	...	...	...	− 2·64
18				+ 7·25	...	...	...	...	+ 0·99	...	...	...	...	− 1·34	− 1·66
19					+ 6·45	...	...	...	− 3·12	...	− 3·11	− 2·97			
20						+ 22·00	...	...	...	...	+ 0·36				
21							+ 27·39	...	...	+ 1·95	...	+ 0·30	− 4·72	+ 2·57	
22								+ 9·05	...	...	...	...	− 1·80	+ 1·80	
23									+ 16·96	...	+ 1·55	+ 1·90	...	...	− 0·54
24										+ 16·52	− 2·41				
25											+ 19·24	+ 2·42	− 6·88	− 2·61	
26												+ 28·34	+ 10·42	− 4·96	
27													+ 23·26	− 6·20	
28														+ 13·18	+ 0·62
29															+ 3·07

Figure No. 14.

Observed Angles

No.	Value	Reciprocal Weight	No.	Value	Reciprocal Weight	No.	Value	Reciprocal Weight	No.	Value	Reciprocal Weight
	° ′ ″			° ′ ″			° ′ ″			° ′ ″	
1	76 40 3·54	2·78	15	64 28 22·77	2·08	29	53 51 9·63	1·67	43	69 3 39·15	1·20
2	47 14 43·17	2·78	16	45 36 18·91	3·13	30	59 28 46·50	1·27	44	50 12 3·46	1·39
3	56 5 23·61	1·74	17	69 29 8·65	1·52	31	71 38 43·35	5·56	45	60 44 29·46	3·23
4	62 45 58·70	3·33	18	64 54 31·85	3·33	32	46 57 38·32	3·33	46	26 3 46·52	6·17
5	53 50 33·78	2·78	19	81 16 34·13	5·56	33	5 41 11·27	0·34	47	53 58 27·86	0·99
6	63 23 35·00	2·38	20	41 46 49·02	2·08	34	54 1 3·55	1·82	48	41 19 22·12	1·18
7	48 19 2·92	4·17	21	56 56 48·78	2·38	35	48 39 6·19	2·78	49	58 38 36·30	1·67
8	92 25 50·88	0·72	22	50 38 33·84	4·17	36	98 14 28·43	0·45	50	66 44 38·74	2·08
9	39 15 10·62	2·78	23	41 16 27·88	2·78	37	43 35 13·85	2·44	51	36 48 20·33	1·75
10	60 2 50·00	3·33	24	88 5 0·85	1·37	38	33 44 42·10	4·17	52	47 54 5·40	3·33
11	55 42 54·10	4·17	25	48 14 10·69	4·17	39	4 25 43·15	2·38	53	28 33 11·83	1·92
12	64 14 24·60	8·33	26	102 1 47·89	1·67	40	52 58 34·99	1·28			
13	66 35 47·25	5·26	27	29 44 5·62	0·79	41	61 39 35·44	1·39			
14	48 56 0·41	2·38	28	66 40 16·38	2·78	42	65 22 3·42	1·67			

Equations to be satisfied — **Factor**

$$x_1 + x_2 + x_3 = e_1 = +2.55, \qquad \lambda_1$$
$$x_4 + x_5 + x_6 = e_2 = +1.81, \qquad \lambda_2$$
$$x_7 + x_8 + x_9 = e_3 = -2.37, \qquad \lambda_3$$
$$x_{10} + x_{11} + x_{12} = e_4 = -2.71, \qquad \lambda_4$$
$$x_{13} + x_{14} + x_{15} = e_5 = +1.14, \qquad \lambda_5$$
$$x_{16} + x_{17} + x_{18} = e_6 = -6.82, \qquad \lambda_6$$
$$x_{19} + x_{20} + x_{21} = e_7 = +1.49, \qquad \lambda_7$$
$$x_{22} + x_{23} + x_{24} = e_8 = -1.72, \qquad \lambda_8$$
$$x_{25} + x_{26} + x_{27} = e_9 = -1.18, \qquad \lambda_9$$
$$x_{28} + x_{29} + x_{30} = e_{10} = +0.27, \qquad \lambda_{10}$$
$$x_{31} + x_{33} + x_{34} + x_{35} = e_{11} = -1.13, \qquad \lambda_{11}$$
$$x_{36} + x_{37} + x_{38} + x_{39} = e_{12} = +0.19, \qquad \lambda_{12}$$
$$x_{34} + x_{35} + x_{37} + x_{38} = e_{13} = -6.01, \qquad \lambda_{13}$$
$$x_{40} + x_{41} + x_{42} = e_{14} = -0.44, \qquad \lambda_{14}$$
$$x_{43} + x_{44} + x_{45} = e_{15} = -2.18, \qquad \lambda_{15}$$
$$x_{46} + x_{47} + x_{48} + x_{49} = e_{16} = +2.57, \qquad \lambda_{16}$$
$$x_{50} + x_{51} + x_{52} + x_{53} = e_{17} = +6.18, \qquad \lambda_{17}$$
$$x_{47} + x_{48} + x_{51} + x_{52} = e_{18} = +1.37, \qquad \lambda_{18}$$
$$x_{32} - x_{23} - x_{33} = e_{19} = -0.83, \qquad \lambda_{19}$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_{20} = +1.32, \qquad \lambda_{20}$$
$$x_{12} + x_{14} + x_{19} + x_{22} + x_{25} + x_{28} = e_{21} = +0.05, \qquad \lambda_{21}$$
$$x_{24} + x_{26} + x_{31} + x_{36} = e_{22} = +0.52, \qquad \lambda_{22}$$
$$x_{21} + x_{23} + x_{33} + x_{34} + x_{40} + x_{43} + x_{46} + x_{47} = e_{23} = 0.00, \qquad \lambda_{23}$$
$$\left.\begin{array}{l} .672\,x_3 - .925\,x_2 + .501\,x_6 - .731\,x_5 + 1.224\,x_9 + .042\,x_8 \\ + .483\,x_{12} - .682\,x_{11} + .478\,x_{15} - .871\,x_{14} + .468\,x_{18} - .374\,x_{17} \end{array}\right\} = e_{24} = -7.030, \qquad \lambda_{24}$$
$$\left.\begin{array}{l} .651\,x_{21} - 1.119\,x_{20} + 1.473\,x_{27} + 1.473\,x_{39} - .934\,x_{32} + .590\,x_{30} \\ - .731\,x_{29} + .433\,x_{13} - .478\,x_{15} + .682\,x_{11} - .576\,x_{10} \end{array}\right\} = e_{25} = +1.021, \qquad \lambda_{25}$$
$$\left.\begin{array}{l} .880\,x_{35} - .584\,x_{33} - .584\,x_{34} + 1.272\,x_{38} + 1.272\,x_{39} \\ -1.051\,x_{37} + .893\,x_{25} - 1.751\,x_{27} + 1.139\,x_{23} - .820\,x_{22} \end{array}\right\} = e_{26} = -2.717, \qquad \lambda_{26}$$
$$\left.\begin{array}{l} 1.497\,x_{38} + .919\,x_{35} + .039\,x_{37} - .156\,x_{25} - .976\,x_{23} \\ -1.473\,x_{27} - 1.473\,x_{39} + .033\,x_{24} - .332\,x_{31} \end{array}\right\} = e_{27} = -3.363, \qquad \lambda_{27}$$
$$\left.\begin{array}{l} .459\,x_{42} - .539\,x_{41} + .560\,x_{45} - .833\,x_{44} + .609\,x_{49} - 1.137\,x_{48} \\ + .332\,x_{31} - .880\,x_{35} + .820\,x_{23} - .033\,x_{24} + 1.119\,x_{20} - .153\,x_{19} \end{array}\right\} = e_{28} = -1.207, \qquad \lambda_{28}$$
$$.609\,x_{49} + .551\,x_{47} - .176\,x_{46} + .241\,x_{53} - .663\,x_{52} - .430\,x_{50} = e_{29} = -1.473, \qquad \lambda_{29}$$

Figure No. 14—(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	+2·55	+7·30	...	...	...	...	...	...	...	...	...	...	...	...	...
2	+1·81		+8·49	...	...	...	...	...	...	...	...	...	...	...	...
3	−2·37			+7·67	...	...	...	...	...	...	...	...	...	...	...
4	−2·71				+15·83	...	...	...	...	...	...	...	...	...	...
5	+1·14					+9·72	...	...	...	...	...	...	...	...	...
6	−6·82						+7·98	...	...	...	...	...	...	...	...
7	+1·49							+10·02	...	...	...	...	...	...	...
8	−1·72								+8·32	...	...	...	...	...	...
9	−1·18									+6·63	...	...	...	...	...
10	+0·27										+5·72	...	...	...	...
11	−1·13											+10·50	...	+ 4·60	...
12	+0·19												+9·44	+ 6·61	...
13	−6·01													+11·21	...
14	−0·44														+4·34
15	−2·18														
16	+2·57														
17	+6·18														
18	+1·37														
19	−0·83														
20	+1·32														
21	+0·05														
22	+0·52														
23	0·00														
24	−7·030														
25	+1·021														
26	−2·717														
27	−3·363														
28	−1·207														
29	−1·473														

Equations between the Factors—(Continued).

No. of e	Co-efficients of														
	λ_{15}	λ_{16}	λ_{17}	λ_{18}	λ_{19}	λ_{20}	λ_{21}	λ_{22}	λ_{23}	λ_{24}	λ_{25}	λ_{26}	λ_{27}	λ_{28}	λ_{29}
1	...	...	...	...	...	+ 2·78	...	...	...	− 1·40					
2	...	...	...	...	...	+ 3·33	...	...	...	− 0·84					
3	...	...	...	...	...	+ 4·17	...	...	...	+ 3·43					
4	...	...	...	...	...	+ 3·33	+ 8·33	...	...	+ 1·18	+ 0·93				
5	...	...	...	...	...	+ 5·26	+ 2·38	...	...	− 1·08	+ 1·28				
6	...	...	...	...	...	+ 3·13	...	...	...	+ 0·99					
7	...	...	...	...	...	...	+ 5·56	...	+ 2·38	...	− 0·78	...	...	+ 1·48	
8	...	...	...	...	− 2·78	...	+ 4·17	+ 1·37	+ 2·78	...	...	− 0·25	− 4·02	+ 3·37	
9	...	...	...	...	...	...	+ 4·17	+ 1·67	...	...	+ 1·16	+ 2·34	− 1·81		
10	...	...	...	...	...	...	+ 2·78	...	...	...	− 0·47				
11	...	...	...	...	− 0·34	...	...	+ 5·56	+ 2·16	...	...	+ 1·18	+ 0·71	− 0·60	
12	...	...	...	...	...	...	...	+ 0·45	...	...	+ 3·51	+ 5·77	+ 2·83		
13	...	...	...	...	...	...	...	...	+ 1·82	...	...	+ 4·12	+ 8·89	− 2·45	
14	...	...	...	...	...	...	...	...	+ 1·28	...	...	...	...	+ 0·02	
15	+5·82	...	...	...	...	...	...	...	+ 1·20	...	...	...	...	+ 0·65	
16		+10·01	...	+ 2·17	...	...	...	...	+ 7·16	...	...	...	...	− 0·32	+ 0·48
17			+ 9·08	+ 5·08	...	...	...	...	...	...	...	...	...	...	− 2·64
18				+ 7·25	...	...	...	...	+ 0·99	...	...	...	...	− 1·34	− 1·66
19					+ 6·45	...	...	...	− 3·12	...	− 3·11	− 2·97			
20						+22·00	...	...	...	...	+ 0·36				
21							+27·39	...	...	+ 1·95	...	+ 0·30	− 4·72	+ 2·57	
22								+ 9·05	...	...	...	...	− 1·80	+ 1·80	
23									+16·96	...	+ 1·55	+ 1·90	...	...	− 0·54
24										+16·52	− 2·41				
25											+19·24	+ 2·42	− 6·88	− 2·61	
26												+28·34	+10·42	− 4·96	
27													+23·26	− 6·20	
28														+13·18	+ 0·62
29															+ 3·07

Figure No. 14.

Observed Angles

No.	Value ° ′ ″	Reciprocal Weight	No.	Value ° ′ ″	Reciprocal Weight	No.	Value ° ′ ″	Reciprocal Weight	No.	Value ° ′ ″	Reciprocal Weight
1	76 40 3·54	2·78	15	64 28 22·77	2·08	29	53 51 9·63	1·67	43	69 3 39·15	1·20
2	47 14 43·17	2·78	16	45 36 18·91	3·13	30	59 28 46·50	1·27	44	50 12 3·46	1·39
3	56 5 23·61	1·74	17	69 29 8·65	1·52	31	71 38 43·35	5·56	45	60 44 29·46	3·23
4	62 45 58·70	3·33	18	64 54 31·85	3·33	32	46 57 38·32	3·33	46	26 3 46·52	6·17
5	53 50 33·78	2·78	19	81 16 34·13	5·56	33	5 41 11·27	0·34	47	53 58 27·86	0·99
6	63 23 35·00	2·38	20	41 46 49·02	2·08	34	54 1 3·55	1·82	48	41 19 22·12	1·18
7	48 19 2·92	4·17	21	56 56 48·78	2·38	35	48 39 6·19	2·78	49	58 38 36·30	1·67
8	92 25 50·88	0·72	22	50 38 33·84	4·17	36	98 14 28·43	0·45	50	66 44 38·74	2·08
9	39 15 10·62	2·78	23	41 16 27·88	2·78	37	43 35 13·85	2·44	51	36 48 20·33	1·75
10	60 2 50·00	3·33	24	88 5 0·85	1·37	38	33 44 42·10	4·17	52	47 54 5·40	3·33
11	55 42 54·10	4·17	25	48 14 10·69	4·17	39	4 25 43·15	2·38	53	28 33 11·83	1·92
12	64 14 24·60	8·33	26	102 1 47·89	1·67	40	52 58 34·99	1·28			
13	66 35 47·25	5·26	27	29 44 5·62	0·79	41	61 39 35·44	1·39			
14	48 56 0·41	2·38	28	66 40 16·38	2·78	42	65 22 3·42	1·67			

Equations to be satisfied — **Factor**

$$x_1 + x_2 + x_3 \cdots = e_1 = +2{\cdot}55, \quad \lambda_1$$
$$x_4 + x_5 + x_6 \cdots = e_2 = +1{\cdot}81, \quad \lambda_2$$
$$x_7 + x_8 + x_9 \cdots = e_3 = -2{\cdot}37, \quad \lambda_3$$
$$x_{10} + x_{11} + x_{12} \cdots = e_4 = -2{\cdot}71, \quad \lambda_4$$
$$x_{13} + x_{14} + x_{15} \cdots = e_5 = +1{\cdot}14, \quad \lambda_5$$
$$x_{16} + x_{17} + x_{18} \cdots = e_6 = -6{\cdot}82, \quad \lambda_6$$
$$x_{19} + x_{20} + x_{21} \cdots = e_7 = +1{\cdot}49, \quad \lambda_7$$
$$x_{22} + x_{23} + x_{24} \cdots = e_8 = -1{\cdot}72, \quad \lambda_8$$
$$x_{25} + x_{26} + x_{27} \cdots = e_9 = -1{\cdot}18, \quad \lambda_9$$
$$x_{28} + x_{29} + x_{30} \cdots = e_{10} = +0{\cdot}27, \quad \lambda_{10}$$
$$x_{31} + x_{33} + x_{34} + x_{35} \cdots = e_{11} = -1{\cdot}13, \quad \lambda_{11}$$
$$x_{36} + x_{37} + x_{38} + x_{39} \cdots = e_{12} = +0{\cdot}19, \quad \lambda_{12}$$
$$x_{34} + x_{35} + x_{37} + x_{38} \cdots = e_{13} = -6{\cdot}01, \quad \lambda_{13}$$
$$x_{40} + x_{41} + x_{42} \cdots = e_{14} = -0{\cdot}44, \quad \lambda_{14}$$
$$x_{43} + x_{44} + x_{45} \cdots = e_{15} = -2{\cdot}18, \quad \lambda_{15}$$
$$x_{46} + x_{47} + x_{48} + x_{49} \cdots = e_{16} = +2{\cdot}57, \quad \lambda_{16}$$
$$x_{50} + x_{51} + x_{52} + x_{53} \cdots = e_{17} = +6{\cdot}18, \quad \lambda_{17}$$
$$x_{47} + x_{48} + x_{51} + x_{52} \cdots = e_{18} = +1{\cdot}37, \quad \lambda_{18}$$
$$x_{32} - x_{23} - x_{33} \cdots = e_{19} = -0{\cdot}83, \quad \lambda_{19}$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} \cdots = e_{20} = +1{\cdot}32, \quad \lambda_{20}$$
$$x_{13} + x_{14} + x_{19} + x_{22} + x_{25} + x_{28} \cdots = e_{21} = +0{\cdot}05, \quad \lambda_{21}$$
$$x_{24} + x_{26} + x_{31} + x_{36} \cdots = e_{22} = +0{\cdot}52, \quad \lambda_{22}$$
$$x_{21} + x_{23} + x_{33} + x_{34} + x_{40} + x_{43} + x_{46} + x_{47} = e_{23} = 0{\cdot}00, \quad \lambda_{23}$$
$$\left.\begin{array}{l} {\cdot}672\,x_3 - {\cdot}925\,x_2 + {\cdot}501\,x_6 - {\cdot}731\,x_5 + 1{\cdot}224\,x_9 + {\cdot}042\,x_8 \\ + {\cdot}483\,x_{12} - {\cdot}682\,x_{11} + {\cdot}478\,x_{15} - {\cdot}871\,x_{14} + {\cdot}468\,x_{18} - {\cdot}374\,x_{17} \end{array}\right\} \cdots = e_{24} = -7{\cdot}030, \quad \lambda_{24}$$
$$\left.\begin{array}{l} {\cdot}651\,x_{21} - 1{\cdot}119\,x_{20} + 1{\cdot}473\,x_{27} + 1{\cdot}473\,x_{39} - {\cdot}934\,x_{32} + {\cdot}590\,x_{30} \\ - {\cdot}731\,x_{29} + {\cdot}433\,x_{13} - {\cdot}478\,x_{15} + {\cdot}682\,x_{11} - {\cdot}576\,x_{10} \end{array}\right\} \cdots = e_{25} = +1{\cdot}021, \quad \lambda_{25}$$
$$\left.\begin{array}{l} {\cdot}880\,x_{35} - {\cdot}584\,x_{33} - {\cdot}584\,x_{34} + 1{\cdot}272\,x_{38} + 1{\cdot}272\,x_{39} \\ - 1{\cdot}051\,x_{37} + {\cdot}893\,x_{25} - 1{\cdot}751\,x_{27} + 1{\cdot}139\,x_{23} - {\cdot}820\,x_{22} \end{array}\right\} \cdots = e_{26} = -2{\cdot}717, \quad \lambda_{26}$$
$$\left.\begin{array}{l} 1{\cdot}497\,x_{38} + {\cdot}919\,x_{35} + {\cdot}039\,x_{37} - {\cdot}156\,x_{26} - {\cdot}976\,x_{22} \\ - 1{\cdot}473\,x_{27} - 1{\cdot}473\,x_{39} + {\cdot}033\,x_{24} - {\cdot}332\,x_{31} \end{array}\right\} \cdots = e_{27} = -3{\cdot}363, \quad \lambda_{27}$$
$$\left.\begin{array}{l} {\cdot}459\,x_{42} - {\cdot}539\,x_{41} + {\cdot}560\,x_{45} - {\cdot}833\,x_{44} + {\cdot}609\,x_{49} - 1{\cdot}137\,x_{48} \\ + {\cdot}332\,x_{31} - {\cdot}880\,x_{35} + {\cdot}820\,x_{22} - {\cdot}033\,x_{24} + 1{\cdot}119\,x_{20} - {\cdot}153\,x_{19} \end{array}\right\} \cdots = e_{28} = -1{\cdot}207, \quad \lambda_{28}$$
$${\cdot}609\,x_{49} + {\cdot}551\,x_{47} - {\cdot}176\,x_{46} + {\cdot}241\,x_{53} - {\cdot}663\,x_{52} - {\cdot}430\,x_{50} \cdots = e_{29} = -1{\cdot}473, \quad \lambda_{29}$$

Figure No. 14—(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	+2·55	+7·30	...	...	...	...	...	...	...	...	...	...	...	...	...
2	+1·81		+8·49	...	...	...	...	...	...	...	...	...	...	...	...
3	−2·37			+7·67	...	...	...	...	...	...	...	...	...	...	...
4	−2·71				+15·83	...	...	...	...	...	...	...	...	...	...
5	+1·14					+9·72	...	...	...	...	...	...	...	...	...
6	−6·82						+7·98	...	...	...	...	...	...	...	...
7	+1·49							+10·02	...	...	...	...	...	...	...
8	−1·72								+8·32	...	...	...	...	...	...
9	−1·18									+6·63	...	...	...	...	...
10	+0·27										+5·72	...	...	...	...
11	−1·13											+10·50	...	+4·60	...
12	+0·19												+9·44	+6·61	...
13	−6·01													+11·21	...
14	−0·44														+4·34
15	−2·18														
16	+2·57														
17	+6·18														
18	+1·37														
19	−0·83														
20	+1·32														
21	+0·05														
22	+0·52														
23	0·00														
24	−7·030														
25	+1·021														
26	−2·717														
27	−3·363														
28	−1·207														
29	−1·473														

Equations between the Factors—(Continued).

No. of e	Co-efficients of λ_{15}	λ_{16}	λ_{17}	λ_{18}	λ_{19}	λ_{20}	λ_{21}	λ_{22}	λ_{23}	λ_{24}	λ_{25}	λ_{26}	λ_{27}	λ_{28}	λ_{29}
1	...	...	...	...	...	+2·78	...	...	...	−1·40					
2	...	...	...	...	...	+3·33	...	...	...	−0·84					
3	...	...	...	...	...	+4·17	...	...	...	+3·43					
4	...	...	...	...	...	+3·33	+8·33	...	...	+1·18	+0·93				
5	...	...	...	...	...	+5·26	+2·38	...	...	−1·08	+1·28				
6	...	...	...	...	...	+3·13	...	...	...	+0·99					
7	...	...	...	...	...	...	+5·56	...	+2·38	...	−0·78	...	...	+1·48	
8	...	...	...	...	−2·78	...	+4·17	+1·37	+2·78	...	...	−0·25	−4·02	+3·37	
9	...	...	...	...	...	...	+4·17	+1·67	...	...	+1·16	+2·34	−1·81		
10	...	...	...	...	...	...	+2·78	...	...	...	−0·47				
11	...	...	...	...	−0·34	...	...	+5·56	+2·16	...	...	+1·18	+0·71	−0·60	
12	...	...	...	...	...	...	...	+0·45	...	...	+3·51	+5·77	+2·83		
13	...	...	...	...	...	...	...	...	+1·82	...	...	+4·12	+8·89	−2·45	
14	...	...	...	...	...	...	...	...	+1·28	...	...	...	...	+0·02	
15	+5·82	...	...	...	...	...	...	...	+1·20	...	...	...	...	+0·65	
16		+10·01	...	+2·17	...	...	...	...	+7·16	...	...	...	...	−0·32	+0·48
17			+9·08	+5·08	...	...	...	...	...	...	...	...	...	...	−2·64
18				+7·25	...	...	...	...	+0·99	...	...	...	...	−1·34	−1·66
19					+6·45	...	...	...	−3·12	...	−3·11	−2·97			
20						+22·00	...	...	...	...	+0·36				
21							+27·39	...	...	+1·95	...	+0·30	−4·72	+2·57	
22								+9·05	...	...	...	...	−1·80	+1·80	
23									+16·96	...	+1·55	+1·90	...	...	−0·54
24										+16·52	−2·41				
25											+19·24	+2·42	−6·88	−2·61	
26												+28·34	+10·42	−4·96	
27													+23·26	−6·20	
28														+13·18	+0·62
29															+3·07

Figure No. 14—(Continued).

Values of the Factors	Values of the Factors	Values of the Factors
$\lambda_1 = +\ 0.1997$	$\lambda_{11} = +\ 4.4356$	$\lambda_{21} = -\ 0.0110$
$\lambda_2 = +\ 0.0862$	$\lambda_{12} = +\ 5.2061$	$\lambda_{22} = -\ 2.8849$
$\lambda_3 = -\ 0.3222$	$\lambda_{13} = -\ 6.9337$	$\lambda_{23} = -\ 0.0736$
$\lambda_4 = -\ 0.1945$	$\lambda_{14} = -\ 0.0761$	$\lambda_{24} = -\ 0.2789$
$\lambda_5 = -\ 0.0395$	$\lambda_{15} = -\ 0.2729$	$\lambda_{25} = -\ 0.0636$
$\lambda_6 = -\ 0.9199$	$\lambda_{16} = +\ 0.4754$	$\lambda_{26} = -\ 1.4421$
$\lambda_7 = +\ 0.2819$	$\lambda_{17} = +\ 1.2416$	$\lambda_{27} = +\ 2.3707$
$\lambda_8 = +\ 1.7626$	$\lambda_{18} = -\ 0.9199$	$\lambda_{28} = -\ 0.7784$
$\lambda_9 = +\ 1.7244$	$\lambda_{19} = +\ 0.1351$	$\lambda_{29} = +\ 0.1600$
$\lambda_{10} = +\ 0.0466$	$\lambda_{20} = +\ 0.2536$	

Angular errors in seconds

$x_1 = +\ 1.26$	$x_{15} = -\ .30$	$x_{29} = +\ .15$	$x_{43} = -\ .40$
$x_2 = +\ 1.27$	$x_{16} = -\ 2.09$	$x_{30} = +\ .02$	$x_{44} = +\ .52$
$x_3 = +\ .02$	$x_{17} = -\ 1.23$	$x_{31} = +\ 2.81$	$x_{45} = -\ 2.30$
$x_4 = +\ 1.13$	$x_{18} = -\ 3.50$	$x_{32} = +\ .64$	$x_{46} = +\ 2.30$
$x_5 = +\ .81$	$x_{19} = +\ 2.17$	$x_{33} = +\ 1.73$	$x_{47} = -\ .42$
$x_6 = -\ .13$	$x_{20} = -\ 1.09$	$x_{34} = -\ 3.17$	$x_{48} = +\ .51$
$x_7 = -\ .28$	$x_{21} = +\ .41$	$x_{35} = -\ 2.50$	$x_{49} = +\ .18$
$x_8 = -\ .24$	$x_{22} = -\ .08$	$x_{36} = +\ 1.04$	$x_{50} = +\ 2.43$
$x_9 = -\ 1.85$	$x_{23} = -\ .26$	$x_{37} = -\ .30$	$x_{51} = +\ .57$
$x_{10} = +\ .32$	$x_{24} = -\ 1.38$	$x_{38} = -\ .04$	$x_{52} = +\ .71$
$x_{11} = -\ .20$	$x_{25} = +\ .23$	$x_{39} = -\ .51$	$x_{53} = +\ 2.47$
$x_{12} = -\ 2.83$	$x_{26} = -\ 1.95$	$x_{40} = -\ .19$	
$x_{13} = +\ .98$	$x_{27} = +\ .54$	$x_{41} = +\ .48$	
$x_{14} = +\ .46$	$x_{28} = +\ .10$	$x_{42} = -\ .73$	

$[wx^2] = 46.71$

July 1879.

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

SINGI MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of Station	Spherical Excess	Corrections to Observed Angle: Figure	Circuit	Non-circuit	Total	Corrected Plane Angle	Distance: Log. feet	Feet	Miles
			"	"	"	"	"	° ' "			
41		XXIX (Tána)	1·54	+1·04	− ·43		+ ·61	54 37 34·61	5·1657330,2	146464·72	27·740
		XXXII (Lakarwás)	1·54	+1·09	+ ·33		+1·42	75 25 18·24	5·2401535,2	173841·53	32·925
		I (Anjini)	1·53	+1·13	+ ·10		+1·23	49 57 7·15	5·1383141,5	137503·62	26·042
			4·61				+3·26	180 0 0·00			
42		XXXII (Lakarwás)	1·25	− ·43	+ ·04		− ·39	61 23 18·61	5·1436240,8	139195·15	26·363
		I (Anjini)	1·25	− ·44	− ·31		− ·75	51 7 59·16	5·0915031,8	123453·43	23·381
		II (Sísa)	1·26	− ·42	+ ·27		− ·15	67 28 42·23	5·1657330,2	146464·72	27·740
			3·76				−1·29	180 0 0·00			
43		I (Anjini)	1·18	−1·38	− ·28		−1·66	70 33 45·04	5·1692727,3	147663·34	27·967
		II (Sísa)	1·18	− ·39	+ ·26		− ·13	46 41 56·25	5·0567470,8	113958·60	21·583
		III (Tukwása)	1·18	− ·36	+ ·02		− ·34	62 44 18·71	5·1436240,8	139195·15	26·363
			3·54				−2·13	180 0 0·00			
44		II (Sísa)	1·22	− ·38	− ·04		− ·42	49 33 55·01	5·0787673,9	119885·70	22·706
		III (Tukwása)	1·22	− ·24	− ·21		− ·45	60 47 53·67	5·1382677,7	137488·95	26·040
		IV (Dúngarpur)	1·22	− ·21	+ ·25		+ ·04	69 38 11·32	5·1692727,3	147663·34	27·967
			3·66				− ·83	180 0 0·00			
45		IV (Dúngarpur)	·74	+ ·27	− ·05		+ ·22	47 3 31·90	4·9611718,2	91447·49	17·320
		III (Tukwása)	·74	+ ·07	− ·20		− ·13	59 15 40·32	5·0308778,0	107368·72	20·335
		V Sagwára)	·75	+ ·22	+ ·25		+ ·47	73 40 47·78	5·0787673,9	119885·70	22·706
			2·23				+ ·56	180 0 0·00			

NOTES—1. The values of the sides are given in the same lines with the opposite angles.
2. Stations XXIX (Tána) and XXXII (Lakarwás) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of 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
			"	"	"	"	"	° ′ "			
46		III (Tukwása)	·45	+ ·23	− ·24		− ·01	51 18 53·81	4·8771567,8	75362·76	14·273
		V (Sagwára)	·46	+ ·45	+ ·24		+ ·69	57 23 15·27	4·9102170,3	81323·68	15·402
		VI (Lohária)	·46	+ ·44	·00		+ ·44	71 17 50·92	4·9611718,2	91447·49	17·320
			1·37				+ 1·12	180 0 0·00			
47		VI (Lohária)	·49	− ·28	− ·21		− ·49	73 40 50·41	4·9838091,1	96340·56	18·246
		V (Sagwára)	·48	− ·29	+ ·15		− ·14	57 39 54·21	4·9284925,5	84818·89	16·064
		VII (Ámjio)	·48	− ·20	+ ·06		− ·14	48 39 15·38	4·8771567,8	75362·76	14·273
			1·45				− ·77	180 0 0·00			
48		V (Sagwára)	·59	− ·63	+ ·04		− ·59	77 4 3·45	5·0427770,6	110351·21	20·900
		VII (Ámjio)	·59	− ·30	− ·20		− ·50	44 37 25·18	4·9005487,1	79533·24	15·063
		VIII (Kua)	·59	− ·17	+ ·16		− ·01	58 18 31·37	4·9838091,1	96340·56	18·246
			1·77				− 1·10	180 0 0·00			
49		VII (Ámjio)	·64	− ·44	− ·19		− ·63	64 58 36·17	5·0250415,6	105935·50	20·064
		VIII (Kua)	·64	− ·95	+ ·18		− ·77	44 18 18·12	4·9120010,4	81658·43	15·466
		IX (Deokotla)	·65	− ·59	+ ·01		− ·58	70 43 5·71	5·0427770,6	110351·21	20·900
			1·93				− 1·98	180 0 0·00			
50		VIII (Kua)	·63	− ·31	·00		− ·31	60 3 53·16	4·9902772,8	97786·13	18·520
		IX (Deokotla)	·62	− ·56	− ·12		− ·68	50 4 56·88	4·9372412,9	86544·86	16·391
		X (Tembla)	·63	− ·44	+ ·12		− ·32	69 51 9·96	5·0250415,6	105935·50	20·064
			1·88				− 1·31	180 0 0·00			
51		IX (Deokotla)	·63	− ·22	− ·23		− ·45	51 1 15·11	4·9424645,0	87592·02	16·589
		X (Tembla)	·63	− ·24	+ ·14		− ·10	68 46 10·84	5·0213114,8	105029·54	19·892
		XI (Uchak)	·63	− ·15	+ ·09		− ·06	60 12 34·05	4·9902772,8	97786·13	18·520
			1·89				− ·61	180 0 0·00			
52		X (Tembla)	·72	+ ·06	− ·04		+ ·02	76 34 5·21	5·0847332,9	121543·94	23·020
		XI (Uchak)	·72	+ ·05	− ·14		− ·09	58 55 43·35	5·0295186,4	107033·24	20·271
		XII (Játhrábhor)	·72	+ ·05	+ ·18		+ ·23	44 30 11·44	4·9424645,0	87592·02	16·589
			2·16				+ ·16	180 0 0·00			
53		XI (Uchak)	·61	− ·44	− ·18		− ·62	50 20 26·30	4·9717078,7	93693·16	17·745
		XII (Játhrábhor)	·60	− ·87	+ ·14		− ·73	42 35 12·43	4·9157005,5	82357·01	15·598
		XIII (Patángri)	·61	− ·51	+ ·04		− ·47	87 4 21·27	5·0847332,9	121543·94	23·020
			1·82				− 1·82	180 0 0·00			
54		XII (Játhrábhor)	·33	+ ·07	− ·12		− ·05	59 3 3·65	4·9053978,4	80426·25	15·232
		XIII (Patángri)	·32	+ ·51	+ ·29		+ ·80	33 23 2·25	4·7126578,6	51600·97	9·773
		XIV (Kágarol)	·33		− ·17			87 33 54·10	4·9717078,7	93693·16	17·745
			·98					180 0 0·00			
55		XIII (Patángri)	·50	− ·13	− ·29		− ·42	78 2 9·18	5·0055375,0	101283·22	19·182
		XIV (Kágarol)	·50	+ ·35	− ·25		+ ·10	50 59 36·45	4·9055378,8	80452·20	15·237
		XVII (Bhor)	·50	− ·33	+ ·54		+ ·21	50 58 14·37	4·9053978,4	80426·25	15·232
			1·50				− ·11	180 0 0·00			
56		XIV (Kágarol)	·39	+ ·55	− ·59		− ·04	44 10 25·17	4·8491027,2	70648·46	13·380
		XVII (Bhor)	·38	+ ·01	+ ·57		+ ·58	43 15 45·22	4·8418802,4	69483·26	13·160
		XVIII (Rencha)	·39	+ ·29	+ ·02		+ ·31	92 33 49·61	5·0055375,0	101283·22	19·182
			1·16				+ ·85	180 0 0·00			
76		XII (Játhrábhor)	·30	+ ·05	+ ·16		+ ·21	100 43 59·45	4·9881430,6	97306·77	18·429
		XIV (Kágarol)	·29	− ·15	− ·06		− ·21	47 51 59·43	4·8659684,6	73446·06	13·910
		XV (Wardhari)	·29	− ·13	− ·10		− ·23	31 24 1·12	4·7126578,6	51600·97	9·773
			·88				− ·23	180 0 0·00			

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of Station	Spherical Excess	Corrections to Observed Angle: Figure	Circuit	Non-circuit	Total	Corrected Plane Angle	Distance: Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
		XIV (Kágarol)	·61	−1·02	−·10		−1·12	53 22 47·60	4·9461984,9	88348·37	16·733
77		XV (Wardhari)	·62	−·59	+·22		−·37	64 29 32·74	4·9971557,7	99347·23	18·816
		XVI (Ghoráráo)	·61	−·47	−·12		−·59	62 7 39·66	4·9881430,6	97306·77	18·429
			1·84				−2·08	180 0 0·00			
		XIII (Patángri)	·44	+·36		+·42	+·78	38 36 2·69	4·8418802,5	69483·27	13·160
	191	XIV (Kágarol)	·44	+·90		−·84	+·06	95 10 2·07	5·0450038,5	110918·46	21·007
		XVIII (Rencha)	·44	+·36		+·42	+·78	46 13 55·24	4·9053978,4	80426·25	15·232
			1·32				+1·62	180 0 0·00			
		XIV (Kágarol)	·53	+·59		+1·17	+1·76	76 1 14·60	5·0277404,7	106595·89	20·189
	192	XVI (Ghoráráo)	·53	+·72		−·73	−·01	39 14 14·05	4·8418802,4	69483·26	13·160
		XVIII (Rencha)	·53	+·65		−·44	+·21	64 44 31·35	4·9971557,6	99347·23	18·816
			1·59				+1·96	180 0 0·00			
		XVII (Bhor)	·39	+·35	+·02		+·37	95 42 4·80	5·0181076,8	104257·59	19·746
57		XVIII (Rencha)	·38	+·02	−·65		−·63	41 54 0·99	4·8449312,2	69973·12	13·252
		XIX (Kandálwa)	·39	+·23	+·63		+·86	42 23 54·21	4·8491027,2	70648·46	13·380
			1·16				+·60	180 0 0·00			
		XVIII (Rencha)	·64	+·05	−·50		−·45	56 43 45·84	4·9741207,3	94215·14	17·844
58		XIX (Kandálwa)	·64	+·02	+·36		+·38	55 34 15·01	4·9682304,7	92945·95	17·603
		XX (Páwágarh)	·64	+·19	+·14		+·33	67 41 59·15	5·0181076,8	104257·59	19·746
			1·92				+·26	180 0 0·00			
		XVII (Bhor)	·51	+·14		−·46	−·32	48 19 58·98	4·9741207,5	94215·14	17·844
	193	XIX (Kandálwa)	·52	+·25		+·99	+1·24	97 58 9·73	5·0965728,7	124903·01	23·656
		XX (Páwágarh)	·51	+·39		−·53	−·14	33 41 51·29	4·8449312,2	69973·12	13·252
			1·54				+·78	180 0 0·00			
		XIX (Kandálwa)	·41	+·33	−·04		+·29	60 53 11·07	4·9244505,0	84033·12	15·915
59		XX (Páwágarh)	·40	−·03	−·30		−·33	40 43 50·65	4·7976934,8	62761·52	11·887
		XXI (Masábár)	·41	+·50	+·34		+·84	78 22 58·28	4·9741207,3	94215·14	17·844
			1·22				+·80	180 0 0·00			
		XX (Páwágarh)	·78	+·31	−·61		−·30	55 6 36·03	5·0683046,6	117032·01	22·165
60		XXI (Masábár)	·78	+·20	+·18		+·38	88 48 21·77	5·1542631,2	142647·15	27·017
		XXIII (Sidpur)	·77	−·28	+·43		+·15	36 5 2·20	4·9244505,0	84033·12	15·915
			2·33				+·23	180 0 0·00			
		XXI (Masábár)	·66	−·15	+·05		−·10	84 4 53·87	5·1165101,6	130770·62	24·767
61		XXIII (Sidpur)	·65	+·47	−·34		+·13	33 1 25·07	4·8552156,3	71649·91	13·570
		XXII (Karáli)	·66	−·21	+·29		+·08	62 53 41·06	5·0683046,6	117032·01	22·165
			1·97				+·11	180 0 0·00			
		XIX (Kandálwa)	·34	−·81		−·17	−·98	38 20 58·77	4·8552156,4	71649·91	13·570
	194	XXI (Masábár)	·34			−·57		108 43 43·89	5·0388748,4	109364·12	20·713
		XXII (Karáli)	·33	+·29		+·74	+1·03	32 55 17·34	4·7976934,8	62761·52	11·887
			1·01				−·52	180 0 0·00			
		XXII (Karáli)	1·43	−·22	·00		−·22	81 11 20·85	5·2457915,0	176113·04	33·355
62		XXIII (Sidpur)	1·42	−·23	−·39		−·62	51 36 25·29	5·1451353,3	139680·36	26·455
		XXIV (Bábásiráj)	1·42	−·13	+·39		+·26	47 12 13·86	5·1165101,6	130770·62	24·767
			4·27				−·58	180 0 0·00			
		XXIII (Sidpur)	1·52	+·18	−·20		−·02	69 37 54·38	5·2410536,9	174202·20	32·993
63		XXIV (Bábásiráj)	1·52	+·16	+·14		+·30	38 58 12·22	5·0676852,9	116865·23	22·134
		XXV (Kesarwa)	1·53	+·03	+·06		+·09	71 23 53·40	5·2457915,0	176113·04	33·355
			4·57				+·37	180 0 0·00			

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of 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
			"	"	"	"	"	° ′ "			
64		XXIV (Bábásiráj)	1·05	+ ·28	+ ·03		+ ·31	58 29 8·49	5·1717813,3	148518·78	28·129
		XXV (Kesarwa)	1·04	− ·06	− ·20		− ·26	30 51 37·75	4·9511565,2	89362·75	16·925
		XXVI (Ságbára)	1·05	+ ·30	+ ·17		+ ·47	90 39 13·76	5·2410536,9	174202·20	32·993
			3·14				+ ·52	180 0 0·00			
	195	XXV (Kesarwa)	·50	+ ·41		+ ·04	+ ·45	34 4 22·72	4·9799427,4	95486·68	18·085
		XXVI (Ságbára)	·50	+ ·54		+ ·03	+ ·57	26 32 56·96	4·8818360,4	76179·13	14·428
		XXVII (Álamwári)	·51	+ ·58		− ·07	+ ·51	119 22 40·32	5·1717813,3	148518·78	28·129
			1·51				+1·53	180 0 0·00			
	196	XXIV (Bábásiráj)	·60	+ ·12		+ ·01	+ ·13	32 33 24·45	4·9799427,4	95486·68	18·085
		XXVI (Ságbára)	·60	+ ·84		+ ·20	+1·04	117 12 11·67	5·1981437,1	157813·35	29·889
		XXVII (Álamwári)	·60	+ ·38		− ·21	+ ·17	30 14 23·88	4·9511565,2	89362·75	16·925
			1·80				+1·34	180 0 0·00			
65		XXV (Kesarwa)	1·79	+ ·16	− ·17		− ·01	83 38 4·26	5·3035204,0	201150·19	38·097
		XXVI (Ságbára)	1·78	+ ·47	+ ·05		+ ·52	49 9 35·75	5·1850368,0	153121·73	29·000
		XXVIII (Páthal)	1·78	+ ·54	+ ·12		+ ·66	47 12 19·99	5·1717813,3	148518·78	28·129
			5·35				+1·17	180 0 0·00			
66		XXVI (Ságbára)	2·52	+ ·42	+ ·07		+ ·49	62 21 0·55	5·2963033,8	197835·11	37·469
		XXVIII (Páthal)	2·52	+ ·78	− ·19		+ ·59	53 24 25·52	5·2536243,0	179318·18	33·962
		XXIX (Dopári)	2·52	+ ·56	+ ·12		+ ·68	64 14 33·93	5·3035204,0	201150·19	38·097
			7·56				+1·76	180 0 0·00			
67		XXVIII (Páthal)	2·20	+ ·19	− ·05		+ ·14	82 56 8·01	5·3595762,3	228863·33	43·345
		XXIX (Dopári)	2·20	+ ·05	+ ·03		+ ·08	37 59 13·28	5·1521017,9	141939·02	26·882
		XXX (Tarbhán)	2·20	+ ·03	+ ·02		+ ·05	59 4 38·71	5·2963033,8	197835·11	37·469
			6·60				+ ·27	180 0 0·00			
68		XXX (Tarbhán)	2·59	− ·02	− ·45		− ·47	56 5 20·55	5·2904721,1	195196·54	36·969
		XXIX (Dopári)	2·59	−1·27	+ ·35		− ·92	47 14 39·66	5·2372906,9	172699·36	32·708
		XXXI (Pilwa)	2·59	−1·26	+ ·10		−1·16	76 39 59·79	5·3595762,3	228863·33	43·345
			7·77				−2·55	180 0 0·00			
69		XXIX (Dopári)	2·08	+3·50	+ ·56		+4·06	64 54 33·83	5·2758807,0	188747·26	35·748
		XXXI (Pilwa)	2·07	+2·09	− ·18		+1·91	45 36 18·75	5·1729501,5	148919·02	28·204
		XXXII (Sáler)	2·08	+1·23	− ·38		+ ·85	69 29 7·42	5·2904721,1	195196·54	36·969
			6·23				+6·82	180 0 0·00			
70		XXXI (Pilwa)	3·10	− ·98	+ ·18		− ·80	66 35 43·35	5·3612570,3	229750·81	43·513
		XXXII (Sáler)	3·10	+ ·30	− ·59		− ·29	64 28 19·38	5·3539327,9	225908·60	42·786
		XXXIV (Bhorgarh)	3·09	− ·46	+ ·41		− ·05	48 55 57·27	5·2758807,0	188747·26	35·748
			9·29				−1·14	180 0 0·00			
71		XXXII (Sáler)	4·08	− ·02	+ ·46		+ ·44	59 28 42·86	5·3893465,9	245101·86	46·421
		XXXIV (Bhorgarh)	4·08	− ·10	+1·21		+1·11	66 40 13·41	5·4170790,3	261263·69	49·482
		XXXV (Ankai)	4·08	− ·15	−1·67		−1·82	53 51 3·73	5·3612570,3	229750·81	43·513
			12·24				− ·27	180 0 0·00			
72		XXXIV (Bhorgarh)	3·60	− ·15	+1·10		+ ·95	98 52 41·88	5·5202689,4	331336·21	62·753
		XXXV (Ankai)	3·60	− ·03	−2·07		−2·10	34 9 43·07	5·2748801,2	188312·92	35·665
		XXXIX (Kalsubai)	3·60	− ·64	+ ·97		+ ·33	46 57 35·05	5·3893465,9	245101·86	46·421
			10·80				− ·82	180 0 0·00			
73		XXXV (Ankai)	3·90	+ ·04	+2·03		+2·07	33 44 40·27	5·2652770,6	184194·69	34·885
		XXXIX (Kalsubai)	3·90	+3·17	+ ·28		+3·45	54 1 3·10	5·4286544,5	268320·90	50·818
		XXXVIII (Hewargaon)	3·90	+2·80	−2·31		+ ·49	92 14 16·63	5·5202689,4	331336·21	62·753
			11·70				+6·01	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
74		XXXIX (Kalsubai)	3·41	−1·88	+2·35		+ ·47	80 2 11·44	5·4389456,8	274755·05	52·037
		XXXVIII (Hewargaon)	3·41	− ·18	−2·01		−2·19	58 38 30·70	5·3769684,1	238214·62	45·116
		XXX (Singi)	3·41	− ·51	− ·34		− ·85	41 19 17·86	5·2652770,6	184194·69	34·885
			10·23				−2·57	180 0 0·00			
75		XXXVIII (Hewargaon)	3·37	−2·43	+ ·32		−2·11	66 44 33·26	5·4143939,5	259653·36	49·177
		XXX (Singi)	3·37	− ·57	+2·43		+1·86	36 48 18·82	5·2286982,2	169316·08	32·067
		XXVI (Párner)	3·38	−3·18	−2·75		−5·93	76 27 7·92	5·4389456,8	274755·05	52·037
			10·12				−6·18	180 0 0·00			
	197	XXX (Tarbhán)	1·89	− ·81		−1·05	−1·86	53 50 30·03	5·1929886,4	155951·17	29·536
		XXXI (Pilwa)	1·89	−1·13		+ ·02	−1·11	62 45 55·70	5·2348758,9	171741·74	32·527
		XXXIII (Párnera)	1·89	+ ·13		+1·03	+1·16	63 23 34·27	5·2372906,9	172699·36	32·708
			5·67				−1·81	180 0 0·00			
	198	XXXIII (Párnera)	2·27	+ ·24		− ·58	− ·34	92 25 48·27	5·3913665,0	246244·49	46·637
		XXXI (Pilwa)	2·26	+ ·28		− ·83	− ·55	48 19 0·11	5·2649801,4	184068·79	34·862
		XXXVI (Gambírgarh)	2·26	+1·85		+1·41	+3·26	39 15 11·62	5·1929886,4	155951·17	29·536
			6·79				+2·37	180 0 0·00			
	199	XXXI (Pilwa)	3·80	− ·32		+ ·71	+ ·39	60 2 46·59	5·3745593,5	236896·88	44·867
		XXXVI (Gambírgarh)	3·80	+ ·20		+1·49	+1·69	55 42 51·99	5·3539327,7	225908·59	42·786
		XXXIV (Bhorgarh)	3·81	+2·83		−2·20	+ ·63	64 14 21·42	5·3913665,0	246244·49	46·637
			11·41				+2·71	180 0 0·00			
	200	XXXVI (Gambírgarh)	3·48	+1·09		− ·71	+ ·38	41 46 45·92	5·2748801,0	188312·91	35·665
		XXXIV (Bhorgarh)	3·48	−2·17		− ·52	−2·69	81 16 27·96	5·4461775,8	279368·58	52·911
		XXXIX (Kalsubai)	3·48	− ·41		+1·23	+ ·82	56 56 46·12	5·3745593,5	236896·88	44·867
			10·44				−1·49	180 0 0·00			
	201	XXXVI (Gambírgarh)	4·76	− ·48		+2·45	+1·97	61 39 32·65	5·4321683,6	270500·66	51·231
		XXXIX (Kalsubai)	4·76	+ ·19		−2·31	−2·12	52 58 28·11	5·3898201,2	245369·22	46·471
		XL (Kámandrug)	4·77	+ ·73		− ·14	+ ·59	65 21 59·24	5·4461775,8	279368·58	52·911
			14·29				+ ·44	180 0 0·00			
	202	XXXIX (Kalsubai)	4·75	+ ·40		−2·52	−2·12	69 3 32·28	5·4617675,9	289579·33	54·845
		XL (Kámandrug)	4·75	− ·52		+3·12	+2·60	50 12 1·31	5·3769684,0	238214·62	45·116
		XXX (Singi)	4·75	+2·30		− ·60	+1·70	60 44 26·41	5·4321683,6	270500·66	51·231
			14·25				+2·18	180 0 0·00			
	203	XXXV (Ankai)	1·79	− ·54		−1·66	−2·20	29 44 1·63	5·0944476,8	124293·29	23·540
		XXXIV (Bhorgarh)	1·79	− ·23		− ·46	− ·69	48 14 8·21	5·2716664,5	186924·59	35·402
		XXXVII (Sinnar)	1·80	+1·95		+2·12	+4·07	102 1 50·16	5·3893465,9	245101·86	46·421
			5·38				+1·18	180 0 0·00			
	204	XXXIV (Bhorgarh)	1·43	+ ·08		+1·56	+1·64	50 38 34·05	5·1634193,2	145686·52	27·592
		XXXVII (Sinnar)	1·43	+1·38		−2·83	−1·45	88 4 57·97	5·2748801,3	188312·93	35·665
		XXXIX (Kalsubai)	1·43	+ ·26		+1·27	+1·53	41 16 27·98	5·0944476,8	124293·29	23·540
			4·29				+1·72	180 0 0·00			
	205	XXXVII (Sinnar)	1·83	−2·81		+3·73	+ ·92	71 38 42·44	5·2652771,6	184194·73	34·885
		XXXIX (Kalsubai)	1·83	+1·44		− ·02	+1·42	59 42 14·41	5·2241815,8	167564·32	31·736
		XXXVIII (Hewargaon)	1·83	+2·50		−3·71	−1·21	48 39 3·15	5·1634193,2	145686·52	27·592
			5·49				+1·13	180 0 0·00			
	206	XXXV (Ankai)	2·44	+ ·55		+1·62	+2·17	38 10 24·98	5·2241816,8	167564·36	31·736
		XXXVII (Sinnar)	2·45	−1·04		−3·02	−4·06	98 14 21·92	5·4286544,5	268320·90	50·818
		XXXVIII (Hewargaon)	2·45	+ ·30		+1·40	+1·70	43 35 13·10	5·2716664,5	186924·59	35·402
			7·34				− ·19	180 0 0·00			

NOTE.—Stations XXVI (Párner) and XXX (Singi) appertain to the Bombay Longitudinal Series of the Southern Trigon.

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
	207	XXXIX (Kalsubai)	4·78	+ ·42		+ ·37	+ ·79	53 58 23·87	5·4143939,6	259653·37	49·177
		XXX (Singi)	4·78	−1·08		+2·09	+1·01	78 7 38·68	5·4971919,9	314189·71	59·506
		XXVI (Párner)	4·78	− ·71		−2·46	−3·17	47 53 57·45	5·3769684,1	238214·62	45·116
			14·34				−1·37	180 0 0·00			

Note.—Stations XXVI (Párner) and XXX (Singi) appertain to the Bombay Longitudinal Series of the Southern Trigon.

March, 1890.

W. H. COLE,
In charge of Computing Office.

SINGÍ MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXIX (Tána)	24 43 3·93	74 13 44·30	60 19 35·48	5·1383141,5	240 10 36·37	XXXII (Lakarwás)
	„ „	„	„	5 41 59·33	5·2401535,2	185 40 42·03	I (Anjini)
19	XXXII (Lakarwás)	24 31 47·99	73 52 10·41	315 35 56·15	5·1657330,2	135 43 33·35	„ „
„	„ „	„	„	16 59 16·01	5·0915031,8	196 56 35·25	II (Sísa)
	I (Anjini)	24 14 30·13	74 10 37·74	84 35 32·94	5·1436240,8	264 25 18·74	„ „
	„ „	„	„	14 1 46·72	5·0567470,8	193 59 45·16	III (Tukwása)
20	II (Sísa)	24 12 18·12	73 45 40·78	311 7 16·17	5·1692727,3	131 15 25·27	„ „
„	„ „	„	„	0 41 12·40	5·1382677,7	180 41 5·17	IV (Dúngarpur)
	III (Tukwása)	23 56 14·66	74 5 39·93	70 27 30·38	5·0787673,9	250 19 17·71	„ „
	„ „	„	„	11 11 49·32	4·9611718,2	191 10 32·18	V (Sagwára)
	„ „	„	„	319 52 55·06	4·9102170,3	139 56 43·19	VI (Lohária)
21	IV (Dúngarpur)	23 49 36·00	73 45 23·03	297 22 50·35	5·0308778,0	117 29 43·65	V (Sagwára)
22	V (Sagwára)	23 41 25·80	74 2 28·86	248 33 47·91	4·8771567,8	68 38 51·81	VI (Lohária)
„	„ „	„	„	306 13 42·60	4·9838091,1	126 19 17·13	VII (Ámjio)
„	„ „	„	„	23 17 46·64	4·9005487,1	203 15 31·41	VIII (Kua)
	VI (Lohária)	23 45 58·19	74 15 4·09	354 58 0·91	4·9284925,5	174 58 32·99	VII (Ámjio)
	VII (Ámjio)	23 32 1·01	74 16 24·06	81 41 51·36	5·0427770,6	261 34 3·37	VIII (Kua)
	„ „	„	„	16 43 14·55	4·9120010,4	196 41 34·33	IX (Deokotla)
23	VIII (Kua)	23 29 21·90	73 56 50·94	305 52 22·13	5·0250415,6	125 58 27·97	„ „
„	„ „	„	„	5 56 15·92	4·9372412,9	185 55 37·83	X (Tembla)

NOTE.—Stations XXIX (Tána) and XXXII (Lakarwás) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	IX (Deokotla)	23 19 6·05	74 12 11·98	75 53 30·47	4·9902772,8	255 46 48·42	X (Tembla)
	" "	"	"	24 52 14·73	5·0213114,8	204 49 8·49	XI (Uchak)
24	X (Tembla)	23 15 8·95	73 55 14·93	324 32 59·89	4·9424645,0	144 36 33·81	" "
"	" "	"	"	41 7 5·82	5·0295186,4	221 2 9·65	XII (Játhrábhor)
	XI (Uchak)	23 3 21·65	74 4 18·96	85 40 49·74	5·0847332,9	265 32 21·81	" "
	" "	"	"	35 20 22·83	4·9157005,5	215 17 4·07	XIII (Patángri)
25	XII (Játhrábhor)	23 1 49·45	73 42 41·32	308 7 34·84	4·9717078,7	128 12 42·19	" "
"	" "	"	"	7 10 38·82	4·7126578,6	187 10 11·92	XIV (Kágarol)
"	" "	"	"	107 54 38·57	4·8659684,6	287 49 45·33	XV (Wardhari)
	XIII (Patángri)	22 52 15·70	73 55 49·52	94 49 39·62	4·9053978,4	274 44 6·35	XIV (Kágarol)
	" "	"	"	16 47 29·94	4·9055378,8	196 45 53·91	XVII (Bhor)
	" "	"	"	56 13 36·49	5·0450038,5	236 7 15·09	XVIII (Rencha)
26	XIV (Kágarol)	22 53 22·13	73 41 32·37	139 18 12·20	4·9881430,6	319 13 46·74	XV (Wardhari)
"	" "	"	"	85 55 23·99	4·9971557,7	265 48 31·98	XVI (Ghoráráo)
"	" "	"	"	325 43 43·30	5·0055375,0	145 47 39·04	XVII (Bhor)
"	" "	"	"	9 54 8·86	4·8418802,4	189 53 19·41	XVIII (Rencha)
36	XV (Wardhari)	23 5 32·78	73 30 12·73	23 43 20·10	4·9461984,9	203 40 51·71	XVI (Ghoráráo)
	XVI (Ghoráráo)	22 52 11·17	73 23 52·63	305 2 46·56	5·0277404,7	125 8 47·53	XVIII (Rencha)
	XVII (Bhor)	22 39 32·41	73 51 41·35	102 31 53·44	4·8491027,2	282 27 9·41	" "
	" "	"	"	6 49 48·25	4·8449312,2	186 49 14·20	XIX (Kandálwa)
	" "	"	"	55 9 47·74	5·0965728,7	235 2 48·36	XX (Páwágarh)
27	XVIII (Rencha)	22 42 3·84	73 39 24·74	324 21 10·78	5·0181076,8	144 25 19·60	XIX (Kandálwa)
"	" "	"	"	21 4 57·26	4·9682304,7	201 2 40·37	XX (Páwágarh)
	XIX (Kandálwa)	22 28 3·92	73 50 12·62	88 51 3·95	4·9741207,3	268 44 40·16	" "
	" "	"	"	27 57 52·47	4·7976934,8	207 55 53·06	XXI (Masábár)
	" "	"	"	349 36 53·36	5·0388748,4	169 38 13·02	XXII (Karáli)
28	XX (Páwágarh)	22 27 44·33	73 33 28·25	309 28 31·21	4·9244505,0	129 32 54·37	XXI (Masábár)
"	" "	"	"	4 35 8·02	5·1542631,2	184 34 22·07	XXIII (Sidpur)
	XXI (Masábár)	22 18 54·50	73 44 59·15	316 39 37·29	4·8552156,3	136 42 55·35	XXII (Karáli)
	" "	"	"	40 44 31·82	5·0683046,6	220 39 25·04	XXIII (Sidpur)
	XXII (Karáli)	22 10 17·84	73 53 42·39	73 49 13·63	5·1165101,6	253 40 50·76	" "
	" "	"	"	352 37 51·35	5·1451353,3	172 39 2·51	XXIV (Bábásiráj)
29	XXIII (Sidpur)	22 4 15·21	73 31 26·99	305 17 17·47	5·2457915,0	125 26 47·23	" "
"	" "	"	"	14 55 13·37	5·0676852,9	194 53 14·22	XXV (Kesarwa)
	XXIV (Bábásiráj)	21 47 24·96	73 56 52·51	86 28 33·49	5·2410536,9	266 17 9·15	" "
	" "	"	"	27 59 23·95	4·9511565,2	207 56 39·77	XXVI (Ságbára)
	" "	"	"	60 32 49·00	5·1981437,1	240 23 51·00	XXVII (Álamwári)
30	XXV (Kesarwa)	21 45 35·98	73 26 7·74	297 8 47·94	5·1717813,3	117 17 24·96	XXVI (Ságbára)
"	" "	"	"	331 13 11·16	4·8818360,4	151 15 34·65	XXVII (Álamwári)
"	" "	"	"	20 46 53·99	5·1850368,0	200 43 22·71	XXVIII (Páthal)

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXVI (Ságbára)	21 34 22·74	73 49 28·11	90 44 27·50	4·9799427,4	270 38 15·48	XXVII (Álamwári)
	" "	"	"	68 7 47·43	5·3035204,0	247 55 44·48	XXVIII (Páthal)
	" "	"	"	5 46 44·36	5·2536243,0	185 45 35·01	XXIX (Dopári)
	XXVII (Álamwári)	21 34 34·13	73 32 36·38				
31	XXVIII (Páthal)	21 21 56·88	73 16 32·89	301 20 12·52	5·2963033,8	121 30 58·56	" "
"	" "	"	"	24 16 22·73	5·1521017,9	204 12 40·13	XXX (Tarbhán)
	XXIX (Dopári)	21 4 54·50	73 46 17·43	83 31 43·08	5·3595762,3	263 17 21·04	" "
	" "	"	"	36 17 0·83	5·2904721,1	216 9 47·57	XXXI (Pilwa)
	" "	"	"	331 22 24·92	5·1729501,5	151 26 53·09	XXXII (Sáler)
32	XXX (Tarbhán)	21 0 34·13	73 6 16·97	319 22 44·18	5·2372906,9	139 29 45·19	XXXI (Pilwa)
"	" "	"	"	13 13 16·10	5·2348758,9	193 10 49·45	XXXIII (Párnera)
33	XXXI (Pilwa)	20 38 53·72	73 26 1·00	261 46 8·39	5·2758807,0	81 57 43·59	XXXII (Sáler)
"	" "	"	"	76 43 47·60	5·1929886,4	256 34 25·61	XXXIII (Párnera)
"	" "	"	"	328 21 54·84	5·3539327,9	148 29 7·96	XXXIV (Bhorgarh)
"	" "	"	"	28 24 45·23	5·3913665,0	208 17 37·80	XXXVI (Gambírgarh)
	XXXII (Sáler)	20 43 18·44	73 58 49·11	17 29 21·11	5·3612570,3	197 25 8·32	XXXIV (Bhorgarh)
	" "	"	"	318 0 34·17	5·4170790,3	138 11 15·50	XXXV (Ankai)
	XXXIII (Párnera)	20 32 56·85	72 59 23·60	349 0 16·15	5·2649801,4	169 2 23·92	XXXVI (Gambírgarh)
34	XXXIV (Bhorgarh)	20 7 5·96	73 46 44·50	264 5 25·81	5·3893465,9	84 20 7·69	XXXV (Ankai)
"	" "	"	"	84 14 42·73	5·3745593,5	264 0 33·59	XXXVI (Gambírgarh)
"	" "	"	"	312 19 35·81	5·0944476,8	132 25 5·21	XXXVII (Sinnar)
"	" "	"	"	2 58 11·29	5·2748801,2	182 57 36·62	XXXIX (Kalsubai)
	XXXV (Ankai)	20 11 10·94	74 29 24·24	54 36 4·27	5·2716664,5	234 26 57·17	XXXVII (Sinnar)
	" "	"	"	16 25 36·85	5·4286544,5	196 21 7·77	XXXVIII (Hewargaon)
	" "	"	"	50 10 21·02	5·5202689,4	229 55 15·27	XXXIX (Kalsubai)
	XXXVI (Gambírgarh)	20 3 5·69	73 5 31·89	305 47 22·99	5·4461775,8	126 0 47·02	" "
	" "	"	"	7 27 0·40	5·3898201,2	187 25 8·28	XL (Kámandrug)
	XXXVII (Sinnar)	19 53 15·61	74 2 47·49	332 41 21·54	5·2241816,3	152 45 52·22	XXXVIII (Hewargaon)
	" "	"	"	44 20 5·81	5·1634193,2	224 14 6·03	XXXIX (Kalsubai)
	XXXVIII (Hewargaon)	19 28 39·20	74 16 11·11	104 6 47·24	5·2652770,6	283 56 22·27	" "
	" "	"	"	338 43 36·50	5·2286982,2	158 47 7·75	XXVI (Párner)
	" "	"	"	45 28 13·13	5·4389456,8	225 17 1·57	XXX (Singi)
35	XXXIX (Kalsubai)	19 36 1·76	73 45 2·44	73 2 14·15	5·4321683,6	252 47 12·29	XL (Kámandrug)
"	" "	"	"	310 0 8·47	5·4971919,9	130 13 58·68	XXVI (Párner)
"	" "	"	"	3 58 37·12	5·3769684,1	183 57 40·30	XXX (Singi)
	XL (Kámandrug)	19 22 53·80	72 59 59·54	302 59 18·35	5·4617675,9	123 13 9·14	" "
	XXVI (Párner)	19 2 34·75	74 26 51·54	82 19 56·45	5·4143939,5	262 5 23·76	" "
	XXX (Singi)	18 56 45·90	73 42 10·30				

NOTE.—Stations XXVI (Párner) and XXX (Singi) appertain to the Bombay Longitudinal Series of the Southern Trigon.

April, 1890.

W. H. COLE,
In charge of Computing Office.

SINGI 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 levelling operations, wherever a junction between the two has been effected. The spirit levelled determinations are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the levelling operations are adjusted by simple proportion to accord with the latter. In the table the spirit levelled values are printed thus, **613·96**, &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. XVII from Stn. XVIII, page 64—*H.*, to indicate that one set of adjustments ends and another begins. The trigonometrical heights always refer to the upper mark or to the upper surface of the pillar or structure on which the theodolite stood; when a spirit levelled height does not refer to either of these surfaces, it is given in combination with a correction, thus $\left\{\begin{matrix} \mathbf{168{\cdot}72} \\ -3{\cdot}5 \end{matrix}\right.$, and the sum of these two quantities, in this case 165·22, represents the value with which the corresponding trigonometrical mean height 169·4 is comparable. Descriptions follow these tables, exactly indicating the surfaces on which the levelling staff stood during the determinations of the spirit levelled 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 the ground level mark-stone in the floor of the passage; otherwise, it is the approximate height of the structure above the ground at the base of the station.

The heights of the fixed stations above Mean Sea Level are as follows:—

XXIX (Tána)	2089·3 feet	From the Karáchi Longitudinal Series of the North-West Quadrilateral.
XXXII (Lakarwás)	2574·4 „	
XXVI (Párner)	3239 feet	From the Bombay Longitudinal Series of the Southern Trigon.
XXX (Singi)	4243 „	
XII (Játhrábhor)	798·1 feet	From the Guzerat Longitudinal Series.
XIII (Patángri)	921·9 „	
XIV (Kágarol)	595 „	
XV (Wardhari)	556 „	
XVI (Ghoráráo)	323 „	
XVII (Bhor)	1037·3 „	
XVIII (Rencha)	541·8 „	

Astronomical Date 1862	Mean of Times of observation	Number and Name of 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. 15	2 35	XXIX (Tána)	D 0 17 1·4	4	2·6	5·1	1722	97	·057	−214·8	1874·5	1876·0	1875	3·1
„ 18,19	2 21	I (Anjini)	D 0 8 31·9	8	2·6	5·2								
„ 12	2 32	XXXII (Lakarwás)	D 0 26 55·7	4	2·6	5·1	1447	93	·064	−697·0	1877·4			
„ 18,19	2 33	I (Anjini)	E 0 5 47·1	8	2·6	5·2								

NOTE.—Stations XXIX (Tána) and XXXII (Lakarwás) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Astronomical Date 1862	Mean of Times of observation	Number and Name of 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. 12	2 41	XXXII (Lakarwás)	D 0 17 14·7	4	2·6	5·1	1223	66	·054	− 290·3	2284·1	2284·0	2282	4·4
„ 22	2 27	II (Sísa)	D 0 1 4·9	4	2·6	5·2								
„ 19	2 45	I (Anjini)	E 0 0 1·6	4	2·6	5·2	1372	87	·063	+ 407·9	2283·9			
„ 22	2 40	II (Sísa)	D 0 20 7·3	4	2·6	5·2								
„ 18,19	2 46	I (Anjini)	D 0 29 18·9	8	2·6	5·2	1129	64	·057	− 693·0	1183·0	1185·8	1184	4·9
„ 29,31	2 17	III (Tukwása)	E 0 12 29·3	8	2·5	5·2								
„ 22	2 53	II (Sísa)	D 0 36 17·4	4	2·7	5·2	1458	85	·058	−1095·4	1188·6			
„ 29,31	2 33	III (Tukwása)	E 0 14 42·4	8	2·6	5·2								
„ 22	3 0	II (Sísa)	D 0 31 54·4	4	2·6	5·2	1362	82	·060	− 873·9	1410·1	1408·8	1406	3·6
„ 25,26,27	2 39	IV (Dúngarpur)	E 0 11 47·5	12	2·6	5·2								
„ 29,31	2 50	III (Tukwása)	D 0 2 28·7	8	2·7	5·2	1182	65	·055	+ 221·6	1407·4			
„ 25,26	2 47	IV (Dúngarpur)	D 0 15 11·4	8	2·6	5·2								
„ 29,31	2 37	III (Tukwása)	D 0 14 38·0	8	2·6	5·2	906	48	·052	− 206·9	978·9	980·1	976	4·6
Apr. 2,4	2 35	V (Sagwára)	E 0 0 55·5	8	2·5	5·1								
Mar. 26,27	2 37	IV (Dúngarpur)	D 0 21 41·5	8	2·6	5·2	1059	54	·051	− 427·5	981·3			
Apr. 2	2 25	V (Sagwára)	E 0 5 41·5	4	2·7	5·1								
Mar. 29	2 48	III (Tukwása)	D 0 20 1·9	4	2·6	5·2	804	47	·059	− 331·5	854·3	855·4	851	2·8
Apr. 8,9	2 25	VI (Lohária)	E 0 7 59·6	8	2·6	5·1								
„ 2,4	2 49	V (Sagwára)	D 0 11 16·4	8	2·7	5·1	743	40	·054	− 123·6	856·5			
„ 9	2 27	VI (Lohária)	D 0 0 0·6	4	2·6	5·1								
„ 2,4	2 35	V (Sagwára)	D 0 7 51·8	8	2·6	5·1	951	54	·057	− 21·0	959·1	958·5	953	4
„ 10,11	2 49	VII (Ámjio)	D 0 6 22·2	8	2·6	5·2								
„ 9	2 33	VI (Lohária)	D 0 2 9·1	4	2·6	5·1	840	48	·057	+ 102·5	957·9			
„ 10,11	2 44	VII (Ámjio)	D 0 10 27·7	8	2·6	5·2								
„ 2	3 4	V (Sagwára)	D 0 14 47·8	4	2·5	5·1	787	35	·045	− 201·6	778·5	777·6	772	5·0
„ 14	3 11	VIII (Kua)	E 0 2 37·9	4	2·6	5·1								
„ 10,11	2 40	VII (Ámjio)	D 0 13 45·5	8	2·6	5·2	1087	63	·058	− 181·9	776·6			
„ 14	2 35	VIII (Kua)	D 0 2 25·5	4	2·6	5·1								
„ 11	2 35	VII (Ámjio)	E 0 6 46·9	4	2·6	5·2	809	44	·054	+ 306·5	1265·0	1265·2	1258	5
„ 17	2 17	IX (Deokotla)	D 0 19 1·6	4	2·6	5·2								
„ 14	3 3	VIII (Kua)	E 0 8 1·0	4	2·6	5·1	1046	59	·056	+ 487·9	1265·5			
„ 17	2 27	IX (Deokotla)	D 0 23 38·9	4	2·6	5·2								
„ 14	2 55	VIII (Kua)	D 0 6 44·0	4	2·5	5·1	858	37	·044	− 2·8	774·8	774·5	767	5
„ 19	2 24	X (Tembla)	D 0 6 31·0	4	2·5	5·1								
„ 17	2 36	IX (Deokotla)	D 0 24 36·0	4	2·6	5·2	964	47	·049	− 490·9	774·3			
„ 19	2 44	X (Tembla)	E 0 9 55·0	4	2·6	5·1								

NOTE.—Station XXXII (Lakarwás) appertains to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Astronomical Date 1862		Mean of Times of observation	Number and Name of 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.	17	2 43	IX (Deokotla)	D 0 8 31·6	4	2·6	5·2	1040	48	·046	− 17·7	1247·5			
„	21,22	2 20	XI (Uchak)	D 0 7 22·1	8	2·6	5·2								
„	19	3 51	X (Tembla)	E 0 11 58·1	4	2·6	5·1	866	47	·054	+471·5	1246·0	1246·8	1238	5·2
„	21,22	3 9	XI (Uchak)	D 0 25 2·7	8	2·6	5·2								
„	19	2 35	X (Tembla)	D 0 6 59·7	4	2·6	5·1	1058	51	·048	+ 32·9	807·4			
„	25	2 50	XII (Játhrábhor)	D 0 9 6·6	4	2·6	5·2								
„	21,22	2 44	XI (Uchak)	D 0 21 28·7	8	2·6	5·2	1198	58	·049	−438·4	808·4	807·9	798	5
„	25	2 39	XII (Játhrábhor)	E 0 3 19·1	4	2·6	5·2								
„	21,22	2 44	XI (Uchak)	D 0 19 27·2	8	3·5	5·2	815	32	·039	−314·5	932·3			
„	23	2 51	XIII (Patángri)	E 0 6 46·0	4	2·6	5·2								
1860-61															
Jan.	15	2 22	XII (Játhrábhor)	D 0 2 18·3	4	2·6	5·1	925	57	·062	+123·7	931·6	931·9	922	2
„	5,6	2 46	XIII (Patángri)	D 0 11 23·3	8	2·6	5·2								
Dec.	19,20	2 30	XII (Játhrábhor)	D 0 17 35·4	8	2·6	5·2	511	27	·052	−204·2	593·9			
„	21,27	2 33	XIV (Kágarol)	E 0 9 37·3	8	2·6	5·1								
Jan.	5,6	2 41	XIII (Patángri)	D 0 20 1·2	8	2·6	5·2	792	41	·052	−327·4	594·5	594·2	595	5
„	2	2 21	XIV (Kágarol)	E 0 7 58·0	4	2·6	5·1								
Dec.	19,20	2 41	XII (Játhrábhor)	D 0 16 47·7	8	2·8	5·2	724	46	·063	−243·8	554·3			
„	1	2 38	XV (Wardhari)	E 0 6 1·1	4	2·6	5·2								
„	21,27	2 35	XIV (Kágarol)	D 0 8 29·8	8	2·8	5·1	962	58	·060	− 38·7	555·5	554·9	556	5·8
Nov. 30, Dec.	1	2 45	XV (Wardhari)	D 0 5 46·2	8	2·7	5·2								
Dec.	21,27,28	2 28	XIV (Kágarol)	D 0 16 42·8	12	2·7	5·1	979	54	·055	−270·9	323·3			
„	3,4	2 20	XVI (Ghoráráo)	E 0 2 2·2	8	2·7	5·1								
„	1	2 12	XV (Wardhari)	D 0 15 39·6	4	2·6	5·2	875	49	·056	−233·5	321·4	322·4	323	5
„	3,4	2 7	XVI (Ghoráráo)	E 0 2 31·2	8	2·8	5·1								
Jan.	5,6	2 39	XIII (Patángri)	D 0 20 2·9	8	2·7	5·2	1095	52	·048	−378·2	543·7			
„	19	2 31	XVIII (Rencha)	E 0 3 23·6	4	2·6	5·1								
„	2	2 36	XIV (Kágarol)	D 0 7 55·1	4	2·7	5·1	688	33	·048	− 52·7	541·5	541·8	542	5
„	19	2 20	XVIII (Rencha)	D 0 2 42·1	4	2·7	5·1								
Dec.	31	2 25	XVI (Ghoráráo)	D 0 0 52·0	4	2·7	5·1	1052	58	·055	+217·7	540·1			
„	12	2 42	XVIII (Rencha)	D 0 14 54·5	4	2·7	5·1								
Jan.	5,6	2 24	XIII (Patángri)	D 0 1 6·5	8	2·7	5·2	797	48	·060	+113·2	1035·1			
„	20	2 25	XVII (Bhor)	D 0 10 47·3	4	2·6	5·1								
Dec.	21,27	2 38	XIV (Kágarol)	E 0 7 31·6	8	2·7	5·1	1002	59	·059	+441·4	1035·6	1036·6	1037	†
„	14,15	2 50	XVII (Bhor)	D 0 22 26·0	8	2·7	5·1								
„	10,11	2 32	XVIII (Rencha)	E 0 19 0·1	8	2·8	5·1	696	44	·063	+497·2	1039·0			
„	14,15	2 41	XVII (Bhor)	D 0 29 23·7	8	2·6	5·1								

† See description of this station, page 5—H.

Astronomical Date 1860-61	Mean of Times of observation	Number and Name of 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
Dec. 14,15	2 18	XVII (Bhor)	E 0 12 43·0	8	2·5	5·1	693	45	·065	+ 363·8	1401·1			
Jan. 22,24	2 38	XIX (Kandálwa)	D 0 23 1·4	8	2·6	5·1								
Dec. 10,11,12	2 53	XVIII (Rencha)	E 0 20 46·0	12	2·5	5·1	1031	63	·061	+ 861·2	1403·0	1403·0	1402	5
Jan. 22,24	2 28	XIX (Kandálwa)	D 0 36 1·0	8	2·7	5·1								
„ 26,28	2 54	XX (Páwágarh)	D 0 54 57·2	8	2·7	5·2	928	58	·062	−1318·2	1404·8			
„ 22,23,24	2 44	XIX (Kandálwa)	E 0 41 13·6	12	2·6	5·1								
Dec. 14,15	2 28	XVII (Bhor)	E 0 37 23·9	8	2·7	5·1	1233	82	·066	+1685·3	2722·6			
Jan. 26,28	2 24	XX (Páwágarh)	D 0 55 21·5	8	2·6	5·2								
Dec. 10,11	3 1	XVIII (Rencha)	E 1 13 55·5	8	2·8	5·1	920	61	·066	+2181·6	2723·4	2722·1	2721	2
Jan. 26,28	2 27	XX (Páwágarh)	D 1 27 24·8	8	2·8	5·2								
„ 22,23,24	2 44	XIX (Kandálwa)	E 0 41 13·6	12	2·6	5·1	928	58	·062	+1318·2	2720·3			
„ 26,28	2 54	XX (Páwágarh)	D 0 54 57·2	8	2·7	5·2								
„ 22,23	2 52	XIX (Kandálwa)	D 0 17 50·8	8	2·7	5·1	621	38	·062	− 240·5	1162·5			
Feb. 2,5	2 5	XXI (Masábár)	E 0 8 30·1	8	2·7	5·1						1162·4	1160	3
Jan. 26,28	2 22	XX (Páwágarh)	D 1 9 54·0	8	2·7	5·2	830	55	·066	−1559·8	1162·3			
Feb. 2,5	2 38	XXI (Masábár)	E 0 57 41·6	8	2·7	5·1								
Jan. 22,23	2 51	XIX (Kandálwa)	D 0 17 36·8	8	2·5	5·1	1084	70	·065	− 307·6	1095·4			
Feb. 6,9	2 39	XXII (Karáli)	E 0 1 43·4	8	2·6	5·1						1095·2	1092	5
„ 2,5	2 15	XXI (Masábár)	D 0 8 27·6	8	2·6	5·1	708	48	·068	− 67·4	1095·0			
„ 6,9	2 41	XXII (Karáli)	D 0 1 59·1	8	2·7	5·1								
„ 2,5	2 28	XXI (Masábár)	D 0 37 45·4	8	2·6	5·1	1157	69	·059	− 993·6	168·8			
„ 14,18,21	2 25	XXIII (Sidpur)	E 0 20 37·1	12	2·7	5·1						169·4	168·72 −3·5	4·8
„ 7,8	2 57	XXII (Karáli)	D 0 33 52·4	8	2·6	5·1	1289	76	·059	− 925·3	169·9			
„ 13,14,18	2 31	XXIII (Sidpur)	E 0 14 46·5	12	2·6	5·1								
„ 9,11	2 33	XXII (Karáli)	E 0 43 29·7	8	2·6	5·1	1384	88	·063	+2179·5	3271·6			
Mar. 14,16	2 16	XXIV (Bábásiráj)	D 1 3 46·0	8	2·6	5·2						3271·9	3272	3·5
Feb. 21,22	2 48	XXIII (Sidpur)	E 0 47 54·9	8	2·6	5·1	1739	109	·063	+3106·9	3272·1			
Mar. 14,16	2 44	XXIV (Bábásiráj)	D 1 13 21·2	8	2·7	5·2								
Feb. 13,14,18,21	2 28	XXIII (Sidpur)	E 0 32 30·2	16	2·6	5·1	1158	71	·061	+1395·6	1560·8			
(1)	2 22	XXV (Kesarwa)	D 0 49 35·4	28	2·8	5·1						1560·6	1561	4
Mar. 14,16	2 43	XXIV (Bábásiráj)	D 0 46 22·1	8	2·6	5·2	1717	106	·061	−1711·6	1560·3			
Feb. 26,27,28	2 15	XXV (Kesarwa)	E 0 21 10·6	12	2·6	5·1								
Mar. 16,19	2 31	XXIV (Bábásiráj)	D 0 57 9·6	8	2·7	5·2	885	45	·050	−1311·4	1960·5			
„ 27,28,29,30,31 and Apr. 2	2 12	XXVI (Ságbára)	E 0 43 42·7	24	2·6	5·2								
Mar. 6,7	2 13	XXV (Kesarwa)	D 0 1 39·3	8	2·7	5·1	1465	81	·056	+ 399·9	1960·5	1960·4	1961	†
„ 27,28,29,30,31 and Apr. 2,5	2 26	XXVI (Ságbára)	D 0 20 9·8	28	2·8	5·2								

(1) The mean of observations taken on 26th, 27th and 28th February, and 1st, 4th, 6th and 7th March, 1861. † Not forthcoming.

Astronomical Date 1861	Mean of Times of observation	Number and Name of 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. 8,9,10	2 41	XXVII (Álamwári)	E 0 32 54·1	12	2·7	5·2	941	48	·051	+1111·9	1960·1			
Mar. 27	2 29	XXVI (Ságbára)	D 0 47 8·9	4	2·7	5·2								
„ 19	3 2	XXIV (Bábásiráj)	D 1 4 18·7	4	3·0	5·2	1557	88	·056	−2421·8	850·1			
Apr. 9,10	2 41	XXVII (Álamwári)	E 0 41 10·4	8	2·6	5·2								
Mar. 10	2 18	XXV (Kesarwa)	D 0 37 59·5	4	2·9	5·1	754	37	·050	− 714·3	846·3	848·3	848	*
Apr. 8,9,10	2 25	XXVII (Álamwári)	E 0 26 27·7	12	2·7	5·2								
Mar. 27	2 29	XXVI (Ságbára)	D 0 47 8·9	4	2·7	5·2	941	48	·051	−1111·9	848·6			
Apr. 8,9,10	2 41	XXVII (Álamwári)	E 0 32 54·1	12	2·7	5·2								
(1)	2 24	XXV (Kesarwa)	D 0 30 32·4	20	3·9	5·1	1516	87	·058	− 861·1	699·5			
Apr. 12,13,16,17	2 28	XXVIII (Páthal)	E 0 8 5·7	16	2·8	5·2						700·6	701	1
„ 2,5	2 30	XXVI (Ságbára)	D 0 36 14·7	8	4·0	5·2	1984	109	·055	−1258·7	701·7			
„ 12,13,16,17	2 52	XXVIII (Páthal)	E 0 6 45·2	16	2·7	5·2								
Mar. 28,29,30	2 37	XXVI (Ságbára)	D 0 16 38·3	12	3·5	5·2	1777	108	·061	− 187·6	1772·8			
Apr. 21	2 14	XXIX (Dopári)	D 0 9 28·7	4	2·7	5·9						1770·8	1771	†
„ 17	2 44	XXVIII (Páthal)	E 0 4 9·5	4	3·3	5·2	1953	114	·058	+1068·1	1768·7			
„ 21	2 26	XXIX (Dopári)	D 0 32 59·0	4	2·6	5·9								
„ 13,16,17	2 42	XXVIII (Páthal)	D 0 24 12·7	10	2·6	5·2	1405	66	·047	− 559·2	141·4			
„ 25	2 24	XXX (Tarbhán)	E 0 2 52·7	4	2·6	5·1						139·5	140	2·7
(2)	2 10	XXIX (Dopári)	D 0 41 13·2	10	2·3	5·8	2262	133	·059	−1633·3	137·5			
(3)	2 16	XXX (Tarbhán)	E 0 7 51·0	10	2·6	5·1								
1885														
Apr. 14	2 13	XXIX (Dopári)	D 0 10 2·1	6	1·8	5·8	1929	108	·056	+ 245·2	2016·0			
Mar. 30	2 14	XXXI (Pilwa)	D 0 18 38·5	6	2·8	5·2						2017·3	2018	0·8
Apr. 4	2 20	XXX (Tarbhán)	E 0 24 49·3	8	1·7	5·1	1707	104	·061	+1879·0	2018·5			
Mar. 27	2 20	XXXI (Pilwa)	D 0 49 57·8	6	2·4	5·2								
Apr. 7	1 53	XXX (Tarbhán)	D 0 3 11·1	6	2·2	5·1	1698	92	·054	+ 474·3	613·8			
Mar. 21	2 13	XXXIII (Párnera)	D 0 22 6·9	12	5·2	5·3						613·6	613·96	0
„ 27	1 46	XXXI (Pilwa)	D 0 42 7·2	6	1·3	5·2	1542	105	·068	−1403·8	613·5			
„ 16	1 48	XXXIII (Párnera)	E 0 19 45·9	6	1·6	5·3								
Apr. 14	1 41	XXIX (Dopári)	E 1 6 48·8	6	1·3	5·8	1472	88	·060	+3367·8	5138·8			
„ 23	1 42	XXXII (Sáler)	D 1 28 34·4	6	2·6	5·1						5139·2	5140	0
Mar. 29	2 1	XXXI (Pilwa)	E 0 43 4·9	8	1·3	5·2	1866	112	·060	+3121·9	5139·5			
Apr. 23	2 19	XXXII (Sáler)	D 1 10 35·6	6	1·8	5·1								
Mar. 30	1 24	XXXI (Pilwa)	E 0 6 57·8	8	1·7	5·2	2233	145	·065	+1526·1	3543·7			
May 13	1 46	XXXIV (Bhorgarh)	D 0 39 27·6	8	2·5	5·1								
Apr. 22	2 23	XXXII (Sáler)	D 0 40 35·3	6	1·7	5·1	2271	138	·061	−1598·2	3541·0	3541·1	3543	2·4
May 8,10	2 49	XXXIV (Bhorgarh)	E 0 7 13·2	6	1·3	5·1								

(1) The mean of observations taken on 26th, 27th and 28th February, and 1st and 10th March, 1861. (2) The mean of observations taken on 21st April, 1861, and 14th April, 1885. (3) The mean of observations taken on 25th April, 1861, and 4th April, 1885. * Not forthcoming. † See description of this station, page 7—H.

Astronomical Date 1885		Mean of Times of observation	Number and Name of 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.	8	1 59	XXXVI (Gambírgarh)	E 0 1 51·9	6	1·7	6·7	2342	165	·070	+1289·3	3538·7			
May	8,10	1 56	XXXIV (Bhorgarh)	D 0 35 30·1	6	3·3	5·1								
Mar.	28	1 54	XXXI (Pilwa)	D 0 14 33·0	6	3·0	5·2	2434	151	·062	+ 232·1	2249·7			
„	10	1 53	XXXVI (Gambírgarh)	D 0 21 4·3	6	1·3	6·7								
„	16	1 52	XXXIII (Párnera)	E 0 17 21·4	8	3·3	5·3	1819	122	·067	+1635·1	2249·1	2250·6	2252	†
„	8	1 46	XXXVI (Gambírgarh)	D 0 43 45·3	6	2·0	6·7								
May	8,10	1 56	XXXIV (Bhorgarh)	D 0 35 30·1	6	3·3	5·1	2342	165	·070	−1289·3	2253·1			
Mar.	8	1 59	XXXVI (Gambírgarh)	E 0 1 51·9	6	1·7	6·7								
Apr.	22	1 49	XXXII (Sáler)	D 0 45 14·4	6	1·3	5·1	2582	150	·058	−1990·0	3149·2			
„	30	1 56	XXXV (Ankai)	E 0 7 6·9	6	1·3	5·1								
May	8,10	2 19	XXXIV (Bhorgarh)	D 0 23 16·8	6	1·2	5·1	2422	143	·059	− 387·0	3154·1	3151·7	3154·11	3·7
Apr.	30	2 20	XXXV (Ankai)	D 0 12 25·0	6	1·7	5·1								
May	8,10	1 42	XXXIV (Bhorgarh)	D 0 29 15·2	6	1·3	5·1	1229	78	·063	− 730·4	2810·7			
Feb.	3	1 41	XXXVII (Sinnar)	E 0 11 9·6	6	1·8	5·0								
Apr.	30	1 32	XXXV (Ankai)	D 0 19 51·4	6	1·7	5·1	1847	112	·061	− 340·3	2811·4	2811·1	2815·44	1·4
Feb.	3,4	1 24	XXXVII (Sinnar)	D 0 7 20·2	10	1·7	5·0								
May	8,10	2 36	XXXIV (Bhorgarh)	E 0 20 11·5	6	1·7	5·1	1862	116	·062	+1854·3	5397·1			
Feb.	9,10	1 47	XXXIX (Kalsubai)	D 0 47 29·4	6	1·7	5·1								
Mar.	6	2 41	XXXVI (Gambírgarh)	E 0 18 39·6	6	1·8	6·7	2761	184	·067	+3142·7	5395·0	5398·3	5400	4·3
Feb.	9,10	1 57	XXXIX (Kalsubai)	D 0 58 39·9	6	3·2	5·1								
„	3	2 9	XXXVII (Sinnar)	E 0 50 27·6	6	2·7	5·0	1440	89	·062	+2587·4	5402·8			
„	8	2 1	XXXIX (Kalsubai)	D 1 11 36·9	4	2·5	5·1								
Apr.	30	1 44	XXXV (Ankai)	D 0 21 15·7	6	1·3	5·1	2652	161	·061	− 139·7	3014·4			
Jan.	27,28	2 10	XXXVIII (Hewargaon)	D 0 17 40·7	8	1·7	5·1								
Feb.	3	1 56	XXXVII (Sinnar)	D 0 8 0·1	6	1·9	5·0	1656	103	·062	+ 202·2	3017·6	3014·6	3017	1·7
Jan.	27	2 5	XXXVIII (Hewargaon)	D 0 16 18·1	6	1·9	5·1								
Feb.	8	1 31	XXXIX (Kalsubai)	D 0 57 51·0	4	1·9	5·1	1821	116	·064	−2386·5	3011·8			
Jan.	26	1 56	XXXVIII (Hewargaon)	E 0 31 12·4	6	1·7	5·1								
Mar.	6	2 19	XXXVI (Gambírgarh)	D 0 19 5·5	6	3·0	6·7	2425	169	·070	− 117·2	2135·1			
Feb.	28	2 32	XL (Kámandrug)	D 0 15 49·4	6	2·5	7·2								
„	9,10	1 48	XXXIX (Kalsubai)	D 1 0 39·5	6	3·0	5·1	2674	186	·070	−3261·6	2136·7	2135·9	2138	†
„	22,24	1 50	XL (Kámandrug)	E 0 22 10·7	8	1·8	7·2								
Jan.	26	1 37	XXXVIII (Hewargaon)	D 0 4 39·8	6	1·5	5·1	2716	164	·060	+1221·6	4236·2			
„	19	1 26	XXX (Singi)	D 0 35 13·2	4	2·0	5·2								
Feb.	8,10	1 57	XXXIX (Kalsubai)	D 0 33 58·1	6	1·5	5·1	2355	149	·063	−1161·9	4236·4	4235·9	4243	o
Jan.	19	1 46	XXX (Singi)	D 0 0 26·3	4	1·8	5·2								

NOTE.—Station XXX (Singi) appertains to the Bombay Longitudinal Series of the Southern Trigon.

† See descriptions of these stations, page 8—H.

Astronomical Date 1885		Mean of Times of observation	Number and Name of 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	2 24	XL (Kámandrug)	E 0 4 9·9	8	1·3	7·2	2863	191	·067	+2099·1	4235·0			
Jan.	20	2 18	XXX (Singi)	D 0 45 37·1	6	3·0	5·2								
„	25	1 42	XXXVIII (Hewargaon)	D 0 7 49·7	6	1·2	5·1	1674	99	·059	+ 223·8	3238·4			
„	8	1 35	XXVI (Párner)	D 0 16 54·0	6	1·8	5·1								
Feb.	8	1 18	XXXIX (Kalsubai)	D 0 46 22·9	4	1·2	5·1	3106	193	·062	−2164·4	3233·9	3236·2	3239	3·2
Jan.	11	1 45	XXVI (Párner)	E 0 0 58·6	6	1·7	5·1								
„	19	1 8	XXX (Singi)	D 0 31 57·3	4	2·8	5·2	2567	162	·063	− 999·6	3236·3			
„	8	1 35	XXVI (Párner)	D 0 5 30·3	6	1·8	5·1								

NOTE.—Stations XXVI (Párner) and XXX (Singi) appertain to the Bombay Longitudinal Series of the Southern Trigon.

Description of Spirit-levelled Points.

When determining the Spirit-levelled heights, given on pages 65—*H.* to 67—*H.*, the levelling staff stood on the surfaces hereafter described.

XXIII (Sidpur) — On a peg at the foot of the station, height=162·88 feet. To this value, 5·84 feet (the height of the upper surface of the rectangular protecting pillar above this peg) being added, the height of the upper surface of the protecting pillar was found to be 168·72 feet.

XXXIII (Párnera) — On a peg below the station, height=565·62 feet. To this value, 48·34 feet (the height of the station mark cut on the rock *in sitú* above this peg) being added, the height of the station mark was found to be 613·96 feet.

XXXV (Ankai), **XXXVII (Sinnar)** — On the upper mark-stone.

For further particulars of these stations, see pages 6—*H.* to 8—*H.*

April, 1890.

W. H. COLE,
In charge of Computing Office.

SINGI MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XIII (Patángri)

Lat. N. 22° 52′ 15″·70; Long. E. 73° 55′ 49″·52 = 4ʰ 55ᵐ 43ˢ·3; Height above Mean Sea Level, 923 feet.
December 1861; observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed	δ Ursæ Minoris (East and West).
Mean Right Ascension 1861·0	18ʰ 17ᵐ 11ˢ
Mean North Polar Distance 1861·0	3° 23′ 51″·55
Local Mean Times of Elongation, December 21	Eastern 18ʰ 20ᵐ Western 6 10

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. 21	E.	179 44	− 3 56 47·13	18 23	− 0 42·49	− 3 57 29·62	− 3 57 21·24	6 54	− 0 6·00	− 3 57 27·24
		&	56 54·87	16 33	0 34·42	29·29	57 26·03	0 57	0 0·11	26·14
		359 44	57 27·20	6 45	0 5·75	32·95				
			57 23·66	8 25	0 8·96	32·62				
„ 22	W.	179 44	+ 3 24 43·70	10 26	+ 0 13·76	+ 3 24 57·46	+ 3 23 49·40	22 48	+ 1 5·69	+ 3 24 55·09
		&	24 46·40	9 12	0 10·69	57·09	23 58·93	20 52	0 55·00	53·93
		359 44	24 40·20	10 51	0 14·82	55·02	24 56·54	1 32	0 0·30	56·84
			24 36·50	12 30	0 19·68	56·18	24 55·60	0 12	0 0·01	55·61
„ 22	E.	249 55	− 3 56 31·30	21 37	− 0 58·78	− 3 57 30·08	− 3 57 19·00	9 0	− 0 10·22	− 3 57 29·22
		&	56 43·10	19 28	0 47·66	30·76	57 21·27	7 9	0 6·45	27·72
		69 55	57 30·90	1 25	0 0·25	31·15	57 11·60	11 20	0 16·20	27·80
			57 29·67	3 6	0 1·22	30·89	57 6·80	12 38	0 20·15	26·95
„ 23	W.	249 55	+ 3 24 49·87	8 24	+ 0 8·89	+ 3 24 58·76	+ 3 24 13·50	18 59	+ 0 45·52	+ 3 24 59·02
		&	24 53·47	7 9	0 6·46	59·93	24 17·40	17 43	0 39·63	57·03
		69 55	24 48·87	7 59	0 8·03	56·90	24 59·07	1 17	0 0·21	59·28
			24 45·33	9 15	0 10·79	56·12	24 57·43	0 9	0 0·00	57·43

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	E.	320 6	− 3 56 6·94	25 32	− 1 21·87	− 3 57 28·81	− 3 57 3·80	14 24	− 0 26·10	− 3 57 29·90
		&	56 19·87	23 17	1 8·17	28·04	57 6·27	12 37	0 20·02	26·29
		140 5	57 30·43	1 43	0 0·37	30·80	57 17·06	9 8	0 10·52	27·58
			57 29·94	0 16	0 0·01	29·95	57 9·67	11 15	0 15·98	25·65
„ 24	W.	320 6	+ 3 24 42·87	10 34	+ 0 14·07	+ 3 24 56·94	+ 3 24 6·60	19 33	+ 0 48·27	+ 3 24 54·87
		&	24 47·06	8 56	0 10·08	57·14	24 12·20	18 16	0 42·12	54·32
		140 6	24 43·87	9 53	0 12·29	56·16	24 56·30	0 20	0 0·01	56·31
			24 39·84	11 18	0 16·07	55·91	24 55·97	1 26	0 0·26	56·23
„ 24	E.	30 12	− 3 56 48·53	17 49	− 0 39·92	− 3 57 28·45	− 3 57 25·06	7 37	− 0 7·32	− 3 57 32·38
		&	56 57·70	15 51	0 31·58	29·28	57 25·07	6 8	0 4·74	29·81
		210 11	57 29·87	1 19	0 0·22	30·09	57 18·50	9 23	0 11·13	29·63
			57 29·60	2 54	0 1·07	30·67	57 13·90	11 17	0 16·06	29·96
„ 25	W.	30 12	+ 3 24 40·36	11 5	+ 0 15·49	+ 3 24 55·85	+ 3 23 56·53	21 19	+ 0 57·41	+ 3 24 53·94
		&	24 43·17	9 37	0 11·69	54·86	24 8·50	19 28	0 47·85	56·35
		210 11	24 45·00	8 51	0 9·85	54·85	24 59·23	0 16	0 0·01	59·24
			24 40·77	10 32	0 13·97	54·74	24 59·74	1 11	0 0·18	59·92
„ 25	E.	100 23	− 3 56 19·83	24 3	− 1 12·64	− 3 57 32·47	− 3 57 13·27	10 15	− 0 13·25	− 3 57 26·52
		&	56 36·40	21 10	0 56·34	32·74	57 18·60	8 22	0 8·82	27·42
		280 22	57 28·84	1 0	0 0·12	28·96	57 7·16	12 45	0 20·54	27·70
			57 30·26	3 5	0 1·19	31·45	57 0·87	14 29	0 26·46	27·33
„ 26	W.	100 23	+ 3 24 43·36	9 0	+ 0 10·22	+ 3 24 53·58	+ 3 24 19·83	17 45	+ 0 39·81	+ 3 24 59·64
		&	24 44·56	7 50	0 7·74	52·30	24 27·64	16 8	0 32·87	60·51
		280 23	24 45·64	8 29	0 9·06	54·70	25 0·43	0 25	0 0·02	60·45
			24 37·74	10 18	0 13·37	51·11	24 59·40	1 46	0 0·39	59·79
„ 26	E.	170 34	− 3 56 15·84	24 56	− 1 18·09	− 3 57 33·93	− 3 57 9·13	13 0	− 0 21·27	− 3 57 30·40
		&	56 26·50	23 2	1 6·64	33·14	57 25·80	4 52	0 2·98	28·78
		350 33	57 33·80	4 0	0 2·01	35·81	56 42·44	19 22	0 47·39	29·83
			57 21·26	10 39	0 14·31	35·57	56 16·96	24 39	1 16·76	33·72
„ 27	W.	170 34	+ 3 24 46·64	7 15	+ 0 6·63	+ 3 24 53·27	+ 3 24 27·63	15 36	+ 0 30·74	+ 3 24 58·37
		&	24 53·17	5 59	0 4·51	57·68	24 32·43	14 2	0 24·86	57·29
		350 33	24 50·16	6 53	0 5·98	56·14	25 0·27	0 44	0 0·07	60·34
			24 47·84	8 9	0 8·36	56·20	24 59·50	0 32	0 0·04	59·54

Abstract of Astronomical Azimuth observed at XIII (Patángri) 1861.

1. By Eastern Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	250°	70°	320°	140°	30°	210°	100°	280°	171°	351°
Date	December 21		December 22		December 23		December 24		December 25		December 26	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	29·62	27·24	30·08	29·22	28·81	29·90	28·45	32·38	32·47	26·52	33·93	30·40
	29·29	26·14	30·76	27·72	28·04	26·29	29·28	29·81	32·74	27·42	33·14	28·78
	32·95		31·15	27·80	30·80	27·58	30·09	29·63	28·96	27·70	35·81	29·83
	32·62		30·89	26·95	29·95	25·65	30·67	29·96	31·45	27·33	35·57	33·72
Means	31·12	26·69	30·72	27·92	29·40	27·36	29·62	30·45	31·41	27·24	34·61	30·68
	° ′ ″		″		″		″		″		″	
Means of both faces	— 3 57 28·91		29·32		28·38		30·03		29·32		32·64	
Az. of Star fr. S., by W.	183 41 13·19		13·52		13·84		14·17		14·60		14·93	
Az. of Ref. M. „	179 43 44·28		44·20		45·46		44·14		45·28		42·29	

2. By Western Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	250°	70°	320°	140°	30°	210°	100°	280°	171°	351°
Date	December 22		December 23		December 24		December 25		December 26		December 27	
	"	"	"	"	"	"	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	57·46	55·09	58·76	59·02	56·94	54·87	55·85	53·94	53·58	59·64	53·27	58·37
	57·09	53·93	59·93	57·03	57·14	54·32	54·86	56·35	52·30	60·51	57·68	57·29
	55·02	56·84	56·90	59·28	56·16	56·31	54·85	59·24	54·70	60·45	56·14	60·34
	56·18	55·61	56·12	57·43	55·91	56·23	54·74	59·92	51·11	59·79	56·20	59·54
Means	56·44	55·37	57·93	58·19	56·54	55·43	55·08	57·36	52·92	60·10	55·82	58·89
	° ′ ″		″		″		″		″		″	
Means of both faces	+ 3 24 55·91		58·06		55·98		56·22		56·51		57·35	
Az. of Star fr. S., by W.	176 18 46·59		46·27		45·94		45·62		45·18		44·86	
Az. of Ref. M. „	179 43 42·50		44·33		41·92		41·84		41·69		42·21	

		°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation	179	43	44·28
	by Western „		„	42·42
	Mean		„	43·35
Angle Referring Mark and XVII (Bhor) *see following page*		—162	56	12·71
Astronomical Azimuth of Bhor by observation		16	47	30·64
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur: *see page* 60—H. *ante*		16	47	29·94
Astronomical — Geodetical Azimuth at XIII (Patángri)		+		0·70

At XIII (Patángri)

December 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on R.M. 359° 44′	179° 45′	69° 55′	249° 55′	140° 6′	320° 6′	210° 11′	30° 12′	280° 23′	100° 23′	350° 34′	170° 34′	*M* = Mean of Groups, *w* = Relative Weight, *C* = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	$M = 12''{\cdot}71$
R.M. and XVII (Bhor)	*l* 11·96	*l* 13·30	*h* 11·60	*h* 10·23	*h* 12·50	*h* 17·07	*h* 15·73	*h* 13·47	*h* 12·04	*h* 10·33	*h* 15·27	*h* 10·30	$w = 2{\cdot}16$
	l 12·16	*l* 13·10	*h* 11·70	*h* 10·20	*h* 10·83	*h* 17·40	*h* 15·20	*h* 14·23	*h* 11·14	*h* 9·53	*h* 15·33	*h* 10·53	$\frac{1}{w} = 0{\cdot}46$
	12·06	13·20	11·65	10·22	11·66	17·24	15·46	13·85	11·59	9·93	15·30	10·42	$C = 162^\circ 56' 12''{\cdot}71$

NOTE.—R. M. denotes Referring Mark.

At XXXII (Sáler)

Lat. N. 20° 43′ 18″·44; Long. E. 73° 58′ 49″·11 = 4

Lat. N. 20° 43′ 18″·44; Long. E. 73° 58′ 49″·11 = $4^h\ 55^m\ 55^s{\cdot}3$; Height above Mean Sea Level, 5140 feet.
March 1845; observed by Lieutenant H. Rivers, with Dollond's 15-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, March 28	Eastern $18^h\ 40^m$; Western 6 38

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. 28	E.	200 0	− 2 53 9·00	94 44	− 8 8·46	− 3 1 17·46	− 2 55 45·33	76 42	− 5 22·13	− 3 1 7·46
		&	53 33·34	92 2	7 41·39	14·73	56 1·00	74 41	5 5·56	6·56
		20 0	54 16·00	88 9	7 3·89	19·89	56 20·66	72 53	4 51·12	11·78
			59 38·66	42 47	1 41·01	19·67	58 27·33	54 27	2 43·19	10·52
			59 44·00	41 0	1 32·78	16·78	58 39·00	52 39	2 32·70	11·70
			59 52·33	39 4	1 24·31	16·64	58 49·66	51 2	2 23·51	13·17
„ 29	W.	200 0	+ 0 13 0·66	5 12	+ 0 1·50	+ 0 12 62·16	+ 0 12 59·33	5 39	+ 0 1·77	+ 0 12 61·10
		&	12 57·33	6 45	0 2·53	59·86	12 59·33	4 31	0 1·13	60·46
		20 0	12 56·33	8 19	0 3·83	60·16	13 3·34	3 33	0 0·70	64·04
			13 0·00	9 49	0 5·34	65·34	13 3·67	2 39	0 0·39	64·06
			12 59·67	11 1	0 6·73	66·40	12 21·00	26 56	0 40·11	61·11
			12 56·67	12 0	0 7·98	64·65	12 21·00	28 24	0 44·60	65·60
„ 30	E.	220 0	− 2 60 27·34	28 6	− 0 43·67	− 3 1 11·01	− 2 58 28·67	53 14	− 2 36·07	− 3 1 4·74
		&	60 28·00	26 57	0 40·17	8·17	58 44·00	51 14	2 24·60	8·60
		40 1	60 36·00	24 41	0 33·73	9·73	58 51·00	49 8	2 13·11	4·11
			60 36·66	23 43	0 31·14	7·80	58 59·67	47 20	2 3·55	3·22
							60 58·00	16 25	0 14·93	12·93
							60 58·67	15 32	0 13·36	12·03

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. 31	W.	240 1	+ 0 12 10·33	31 18	+ 0 54·32	+ 0 12 64·65	+ 0 12 46·34	18 28	+ 0 18·91	+ 0 12 65·25
		&	12 16·66	29 55	0 49·61	66·27	12 49·67	16 54	0 15·83	65·50
		60 0	12 18·00	28 44	0 45·76	63·76	12 56·67	15 46	0 13·77	70·44
			12 20·00	27 53	0 43·09	63·09	12 57·67	14 41	0 11·97	69·64
							12 58·34	13 44	0 10·47	68·81
„ 31	W.	220 0	+ 0 12 48·33	14 28	+ 0 11·61	+ 0 12 59·94	+ 0 13 9·00	0 34	+ 0 0·02	+ 0 12 69·02
		&	12 48·33	16 23	0 14·86	63·19	13 9·00	0 57	0 0·05	69·05
		40 0	12 7·33	31 1	0 53·21	60·54	13 9·00	1 46	0 0·17	69·17
			12 3·00	32 23	0 58·00	61·00	13 9·00	2 42	0 0·40	69·40
							13 9·33	3 34	0 0·70	70·03
							13 9·33	4 22	0 1·06	70·39
„ 31	E.	240 0	− 2 58 32·67	54 54	− 2 45·91	− 3 1 18·58	− 2 60 15·00	31 22	− 0 54·39	− 3 1 9·39
		&	58 45·00	52 41	2 32·91	17·91	60 23·00	29 47	0 49·03	12·03
		60 0	58 57·66	50 17	2 19·34	17·00	60 24·33	28 41	0 45·53	9·86
			59 8·33	48 24	2 9·11	17·44	60 26·00	27 22	0 41·44	7·44
			60 52·00	20 42	0 23·73	15·73	60 33·67	26 7	0 37·74	11·41
			60 52·34	19 1	0 20·02	12·36	60 34·33	24 53	0 34·26	8·59
			60 58·34	17 20	0 16·62	14·96				
			61 1·34	15 39	0 13·58	14·92				

Abstract of Astronomical Azimuth observed at XXXII (Sáler) 1845.

1. By Eastern Elongation of *α* Ursæ Minoris.

Face	L	R	L	R	L	R
Zero	200°	20°	220°	40°	240°	60°
Date	March 28		March 30		March 31	
	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	17·46	7·46	11·01	4·74	18·58	9·39
	14·73	6·56	8·17	8·60	17·91	12·03
	19·89	11·78	9·73	4·11	17·00	9·86
	19·67	10·52	7·80	3·22	17·44	7·44
	16·78	11·70		12·93	15·73	11·41
	16·64	13·17		12·03	12·36	8·59
					14·96	
					14·92	
Means	17·53	10·20	9·18	7·61	16·11	9·79
	° ′ ″		″		″	
Means of both faces	− 3 1 13·87		8·39		12·95	
Az. of Star fr. S., by W.	181 37 7·46		8·10		8·42	
Az. of Ref. M. „	178 35 53·59		59·71		55·47	

Abstract of Astronomical Azimuth observed at XXXII (Sáler) 1845—(*Continued*).

2. By Western Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R
Zero	200°	20°	220°	40°	240°	60°
Date	March 29		March 31		March 31	
	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	62·16 59·86 60·16 65·34 66·40 64·65	61·10 60·46 64·04 64·06 61·11 65·60	59·94 63·19 60·54 61·00	69·02 69·05 69·17 69·40 70·03 70·39	64·65 66·27 63·76 63·09	65·25 65·50 70·44 69·64 68·81
Means	63·10	62·73	61·17	69·51	64·44	67·93
	° ′ ″		″		″	
Means of both faces	+ 0 12 62·91		65·34		66·19	
Az. of Star fr. S., by W.	178 22 52·38		51·74		51·74	
Az. of Ref. M. „	178 35 55·29		57·08		57·93	

			°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation	... ...	178	35	56·26
	by Western „	... ...		„	56·77
	Mean	... ...		„	56·51
Angle Referring Mark and XXIX (Dopári) *see page* 30—H. *ante* ...		... ...	− 27	9	1·16
Astronomical Azimuth of Dopári by observation		... ...	151	26	55·35
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur, *see page* 61—H. *ante*		... ...	151	26	53·09
Astronomical—Geodetical Azimuth at XXXII (Sáler)		... ...	+		2·26

At XXXIII (Párnera)

Lat. N. 20° 32′ 56″·85; Long. E. 72° 59′ 23″·60 = 4h 51m 57s·6; Height above Mean Sea Level, 614 feet.
February 1843; observed by Lieutenant H. Rivers with Dollond's 15-inch Theodolite.

Star observed	Draconis (1135 A. S. C.)* (East and West).
Mean Right Ascension 1843·0	9h 14m 11s
Mean North Polar Distance 1843·0	7° 59′ 21″·08
Local Mean Times of Elongation, February 6	Eastern 6h 22m; Western 17 56

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. 6	E.	355 23	− 4 9 38·33	8 1	− 0 18·52	− 4 9 56·85	− 4 9 31·00	1 18	− 0 0·48	− 4 9 31·48
		&	9 57·34	2 1	0 1·16	58·50	9 31·00	2 22	0 1·61	32·61
		175 22	9 24·66	10 53	0 34·28	58·94	9 30·67	3 25	0 3·36	34·03
			9 11·67	11 59	0 41·58	53·25	9 22·67	4 39	0 6·24	28·91
" 6	W.	355 22	+ 12 53 23·34	16 41	+ 1 20·73	+ 12 54 44·07	+ 12 54 56·67	5 40	+ 0 9·29	+ 12 54 65·96
		&	53 34·34	15 7	1 6·26	40·60	55 1·67	4 3	0 4·74	66·41
		175 22	54 36·66	4 0	0 4·62	41·28	55 0·00	2 47	0 2·24	62·24
			54 35·00	5 25	0 8·49	43·49	55 0·67	1 16	0 0·46	61·13
" 7	E.	15 22	− 4 9 57·33	2 50	− 0 2·34	− 4 9 59·67	− 4 9 24·00	4 40	− 0 6·27	− 4 9 30·27
		&	9 55·00	3 48	0 4·19	59·19	9 34·33	1 31	0 0·66	34·99
		195 22	9 53·34	4 48	0 6·70	60·04	9 4·66	10 42	0 33·23	37·89
			9 50·34	5 42	0 9·43	59·77	8 52·66	12 0	0 41·80	34·46
" 7	W.	15 22	+ 12 53 52·67	13 38	+ 0 53·88	+ 12 54 46·55	+ 12 55 1·66	1 45	+ 0 0·88	+ 12 54 62·54
		&	54 37·00	5 8	0 7·62	44·62	55 1·66	0 20	0 0·04	61·70
		195 22	54 30·66	7 10	0 14·85	45·51	54 59·00	0 40	0 0·13	59·13
			54 22·00	8 23	0 20·31	42·31	54 58·67	1 40	0 0·81	59·48
" 8	E.	35 23	− 4 9 49·66	5 2	− 0 7·31	− 4 9 56·97	− 4 9 33·00	0 29	− 0 0·07	− 4 9 33·07
		&	9 51·33	4 8	0 4·92	56·25	9 32·34	1 36	0 0·75	33·09
		215 23	9 23·67	9 54	0 28·44	52·11	9 32·33	2 24	0 1·68	34·01
			9 13·67	11 4	0 35·53	49·20	9 29·00	3 24	0 3·35	32·35
" 8	W.	35 23	+ 12 54 42·67	1 25	+ 0 0·58	+ 12 54 43·25	+ 12 54 16·67	10 48	+ 0 33·79	+ 12 54 50·46
		&	54 42·00	0 16	0 0·02	42·02	54 42·00	7 54	0 18·06	60·06
		215 22	54 43·66	0 36	0 0·11	43·77	54 43·00	7 29	0 16·18	59·18
			54 44·00	1 34	0 0·72	44·72	54 35·33	8 41	0 21·78	57·11

* The Star is identical with No. 908 of the Greenwich 9-year Catalogue for 1872 from which its elements have been computed.

Abstract of Astronomical Azimuth observed at XXXIII (Párnera) 1843.

1. By Eastern Elongation of Draconis (1135 A.S.C.).

Face	L	R	L	R	L	R
Zero	355°	175°	15°	195°	35°	215°
Date	February 6		February 7		February 8	
	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	56·85 58·50 58·94 53·25	31·48 32·61 34·03 28·91	59·67 59·19 60·04 59·77	30·27 34·99 37·89 34·46	56·97 56·25 52·11 49·20	33·07 33·09 34·01 32·35
Means	56·89	31·76	59·67	34·40	53·63	33·13
	° ′ ″		″		″	
Means of both faces	− 4 9 44·32		47·04		43·38	
Az. of Star fr. S., by W.	188 32 18·04		17·72		17·40	
Az. of Ref. M. „	184 22 33·72		30·68		34·02	

2. By Western Elongation of Draconis (1135 A.S.C.).

Face	L	R	L	R	L	R
Zero	355°	175°	15°	195°	35°	215°
Date	February 6		February 7		February 8	
	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	44·07 40·60 41·28 43·49	65·96 66·41 62·24 61·13	46·55 44·62 45·51 42·31	62·54 61·70 59·13 59·48	43·25 42·02 43·77 44·72	50·46 60·06 59·18 57·11
Means	42·36	63·94	44·75	60·71	43·44	56·70
	° ′ ″		″		″	
Means of both faces	+ 12 54 53·15		52·73		50·07	
Az. of Star fr. S., by W.	171 27 42·07		42·39		42·71	
Az. of Ref. M. „	184 22 35·22		35·12		32·78	

			°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation		184	22	32·81
	by Western „			„	34·37
	Mean...			„	33·59
Angle Referring Mark and XXXVI (Gambírgarh) *see following page*		+	164	37	53·38
Astronomical Azimuth of Gambírgarh by observation			349	0	26·97
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur, *see page* 61—H. *ante*			349	0	16·15
Astronomical—Geodetical Azimuth at XXXIII (Párnera)		+			10·82

At XXXIII (Párnera)

February 1843; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on R.M.						M = Mean of Groups w = Relative Weight C = Concluded Angle
	355° 23′	175° 23′	15° 22′	195° 22′	35° 23′	215° 23′	
	″	″	″	″	″	″	
R.M. and XXXVI (Gambírgarh)	h 65·00 h 56·66 h 58·00 h 55·67	h 51·67 h 48·34 h 49·66 h 54·00	h 50·33 h 50·00	h 57·33 h 57·67	h 44·67 h 44·67	h 65·00 h 54·33 h 55·33	$M = 53''·38$ $w = 0·18$ $\frac{1}{w} = 5·56$
	58·83	50·92	50·17	57·50	44·67	58·22	$C = 164° 37' 53''·38$

NOTE.—R.M. denotes Referring Mark.

At XXXIX (Kalsubai). *By Cephei* 51 (*Hev.*).

Lat. N. 19° 36′ 1″·76; Long. E. 73° 45′ 2″·44 = 4h 55m 0s·2; Height above Mean Sea Level, 5400 feet.
December 1842; observed by Lieutenant H. Rivers with Dollond's 15-inch Theodolite.

Star observed	Cephei 51 (Hev.) (East and West).
Mean Right Ascension 1842·0	6h 24m 27s
Mean North Polar Distance 1842·0	2° 44′ 21″·70
Local Mean Times of Elongation, December 28	Eastern 6h 3m Western 17 53

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	E.	79 33	− 3 22 7·00	1 2	− 0 9·10	− 3 22 7·10	− 3 21 25·00	21 54	− 0 47·75	− 3 22 12·75
		&	22 11·66	2 29	0 0·61	12·27	21 19·34	23 31	0 55·06	14·40
		259 33	21 39·33	17 51	0 31·71	11·04				
			21 37·33	19 4	0 36·19	13·52				
„ 28	W.	79 33	+ 2 26 57·00	0 35	+ 0 0·03	+ 2 26 57·03	+ 2 26 27·66	9 31	+ 0 9·01	+ 2 26 36·67
		&	25 36·34	27 30	1 15·02	51·36	26 28·33	10 37	0 11·21	39·54
		259 33	25 27·67	28 17	1 19·34	47·01	26 29·33	11 45	0 13·73	43·06
„ 29	E.	99 31	− 3 22 1·00	4 49	− 0 2·31	− 3 22 3·31	− 3 22 0·67	12 43	− 0 16·08	− 3 22 16·75
		&	22 4·66	7 1	0 4·90	9·56	22 8·67	11 32	0 13·23	21·90
		279 31	21 53·67	11 38	0 13·47	7·14	22 12·00	10 34	0 11·11	23·11
			21 52·00	12 40	0 15·98	7·98	22 12·66	9 35	0 9·14	21·80
			21 0·33	27 8	1 13·33	13·66				
			20 54·33	28 33	1 21·18	15·51				

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	W.	99 31	+ 2 26 26·67	11 4	+ 0 12·18	+ 2 26 38·85	+ 2 25 40·00	23 4	+ 0 52·97	+ 2 26 32·97
		&	26 30·00	9 47	0 9·52	39·52	26 15·33	13 56	0 19·32	34·65
		279 31	26 32·34	9 30	0 8·99	41·33	26 26·33	13 5	0 17·03	43·36
			26 33·34	10 47	0 11·58	44·92	26 20·67	14 35	0 21·16	41·83
„ 30	E.	119 31	− 3 22 8·66	0 41	− 0 0·05	− 3 22 8·71	− 3 22 1·00	7 51	− 0 6·12	− 3 22 7·12
		&	22 10·33	0 36	0 0·03	10·36	22 2·67	9 19	0 8·63	11·30
		299 31					22 7·67	10 13	0 10·38	18·05
							22 4·67	11 43	0 13·65	18·32
„ 30	W.	119 31	+ 2 25 25·00	28 38	+ 1 21·69	+ 2 26 46·69	+ 2 26 1·33	18 24	+ 0 33·74	+ 2 26 35·07
		&	25 33·33	26 58	1 12·46	45·79	26 7·00	17 7	0 29·20	36·20
		299 31	26 38·33	8 46	0 7·63	45·96	26 30·67	4 49	0 2·31	32·98
			26 14·33	18 21	0 33·43	47·76	26 38·33	3 31	0 1·23	39·56
			26 2·67	20 3	0 39·90	42·57				

Abstract of Astronomical Azimuth observed at XXXIX (Kalsubai) 1842.

1. By Eastern Elongation of Cephei 51 (Hev.).

Face	L	R	L	R	L	R
Zero	80°	260°	100°	280°	120°	300°
Date	December 28		December 29		December 30	
	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	7·10 12·27 11·04 13·52	12·75 14·40	3·31 9·56 7·14 7·98 13·66 15·51	16·75 21·90 23·11 21·80	8·71 10·36	7·12 11·30 18·05 18·32
Means	10·98	13·58	9·53	20·89	9·54	13·70
	° ′ ″		″		″	
Means of both faces	− 3 22 12·28		15·21		11·62	
Az. of Star fr. S., by W.	182 54 30·36		29·98		29·60	
Az. of Ref. M. „	179 32 18·08		14·77		17·98	

Abstract of Astronomical Azimuth observed at XXXIX (Kalsubai) 1842—(*Continued*).

2. By Western Elongation of Cephei 51 (Hev.).

Face	L	R	L	R	L	R
Zero	80°	260°	100°	280°	120°	300°
Date	December 28		December 29		December 30	
	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	57·03 51·36 47·01	36·67 39·54 43·06	38·85 39·52 41·33 44·92	32·97 34·65 43·36 41·83	46·69 45·79 45·96 47·76 42·57	35·07 36·20 32·98 39·56
Means	51·80	39·76	41·16	38·20	45·75	35·95
	° ′ ″		″		″	
Means of both faces +	2 26 45·78		39·68		40·85	
Az. of Star fr. S., by W.	177 5 29·83		30·21		30·59	
Az. of Ref. M. „	179 32 15·61		9·89		11·44	

		°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation	179	32	16·94
	by Western „	„		12·31
	Mean	„		14·63

(*For deduction of Astronomical — Geodetical Azimuth at* XXXIX (Kalsubai), *see page* 81—H.)

At XXXIX (Kalsubai). *By δ Ursæ Minoris.*

December 1842; observed by Lieutenant H. Rivers with Dollond's 15-inch Theodolite.

Star observed	δ Ursæ Minoris (East and West).
Mean Right Ascension 1842·0	$18^h\ 23^m\ 18^s$
Mean North Polar Distance 1842·0	$3^\circ\ 24'\ 27''·07$
Local Mean Times of Elongation, December 28	Eastern $17^h\ 59^m$; Western 5 51

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	E.	79 33	− 4 4 37·34	1 41	− 0 0·35	− 4 4 37·69	− 4 4 29·00	10 27	− 0 13·54	− 4 4 42·54
		&	4 4·33	16 45	0 34·77	39·10	4 29·67	11 28	0 16·30	45·97
		259 33	4 6·00	17 43	0 38·90	44·90	4 29·67	12 22	0 18·95	48·62
„ 29	W.	99 31	+ 3 9 7·67	10 14	+ 0 12·94	+ 3 9 20·61	+ 3 9 5·00	7 14	+ 0 6·48	+ 3 9 11·48
		&	9 2·67	11 15	0 15·63	18·30	9 7·66	5 36	0 3·88	11·54
		279 31	7 30·00	29 50	1 49·63	19·63	9 9·34	6 39	0 5·47	14·81
			7 17·67	31 14	2 0·13	17·80	9 5·00	7 47	0 7·49	12·49
			7 1·00	33 21	2 16·90	17·90				
„ 29	E.	99 31	− 4 4 40·33	10 18	− 0 13·11	− 4 4 53·44	− 4 3 38·66	24 39	− 1 14·92	− 4 4 53·58
		&	4 39·33	9 18	0 10·69	50·02	3 45·67	23 19	1 7·05	52·72
		279 31	4 38·66	8 10	0 8·25	46·91	4 31·33	12 52	0 20·49	51·82
			4 40·00	6 56	0 5·94	45·94	4 29·67	14 10	0 24·84	54·51
„ 30	W.	119 31	+ 3 9 13·00	0 18	+ 0 0·01	+ 3 9 13·01	+ 3 8 43·33	14 40	+ 0 26·55	+ 3 9 9·88
		&	9 12·34	1 52	0 0·43	12·77	8 41·66	15 48	0 30·81	12·47
		299 31	7 0·00	33 30	2 18·10	18·10	7 31·33	28 55	1 42·99	14·32
			6 50·00	34 50	2 29·28	19·28	7 15·33	30 43	1 56·17	11·50
							7 5·67	31 46	2 4·22	9·89
„ 30	E.	119 31	− 4 3 1·00	28 47	− 1 42·03	− 4 4 43·03	− 4 4 8·00	18 5	− 0 40·34	− 4 4 48·34
		&	3 7·67	27 23	1 32·34	40·01	4 13·67	16 54	0 35·23	48·90
		299 31	4 35·67	7 33	0 7·06	42·73	4 23·00	15 55	0 31·26	54·26
			4 33·67	8 39	0 9·27	42·94	4 21·33	15 2	0 27·89	49·22
			4 11·33	17 39	0 38·60	49·93				

Abstract of Astronomical Azimuth observed at XXXIX (Kalsubai) 1842.

1. By Eastern Elongation of δ Ursæ Minoris.

Face	L	R	L	R	L	R
Zero	80°	260°	100°	280°	120°	300°
Date	December 28		December 29		December 30	
	"	"	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	37·69 39·10 44·90	42·54 45·97 48·62	53·44 50·02 46·91 45·94	53·58 52·72 51·82 54·51	43·03 40·01 42·73 42·94 49·93	48·34 48·90 54·26 49·22
Means	40·56	45·71	49·08	53·16	43·73	50·18

	° ′ ″	″	″
Means of both faces	− 4 4 43·14	51·12	46·95
Az. of Star fr. S., by W.	183 37 1·91	2·25	2·59
Az. of Ref. M. „	179 32 18·77	11·13	15·64

2. By Western Elongation of δ Ursæ Minoris.

Face	L	R	L	R
Zero	100°	280°	120°	300°
Date	December 29		December 30	
	"	"	"	"
Observed difference of Circle-Readings, Ref. M.—Star Reduced to Elongation	20·61 18·30 19·63 17·80 17·90	11·48 11·54 14·81 12·49	13·01 12·77 18·10 19·28	9·88 12·47 14·32 11·50 9·89
Means	18·85	12·58	15·79	11·61

	° ′ ″	″
Means of both faces	+ 3 9 15·72	13·70
Az. of Star fr. S., by W.	176 22 57·92	57·58
Az. of Ref. M. „	179 32 13·64	11·28

		°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation	179	32	15·18
	by Western „		„	12·46
	Mean		„	13·82
Concluded by both Stars, *see page* 79—H.			„	14·23
Angle Referring Mark and XL (Kámandrug) *see following page*		− 106	30	0·06
Astronomical Azimuth of Kámandrug by observation		73	2	14·17
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur, *see page* 61—H. *ante* ...		73	2	14·15
Astronomical—Geodetical Azimuth at XXXIX (Kalsubai)		+		0·02

At XXXIX (Kalsubai)

December 1842; *observed by Lieutenant H. Rivers with Dollond's* 15-*inch Theodolite.*

Angle between	Circle readings, telescope being set on R.M.						M = Mean of Groups w = Relative Weight C = Concluded Angle
	79° 34′	259° 33′	99° 31′	279° 30′	119° 31′	299° 31′	
	″	″	″	″	″	″	
R.M. and XL (Kámandrug)	h 64·00 h 61·33 h 59·67	h 58·66 h 64·00 h 61·67	h 58·66 h 61·00 h 61·00	h 61·00 h 58·00 h 56·67	h 58·66 h 62·66 h 55·67	h 59·33 h 60·66 h 58·34	$M = 60''\cdot06$ $w = 8\cdot27$ $\frac{1}{w} = 3\cdot80$
	61·67	61·44	60·22	58·56	59·00	59·44	$C = 106° 30' 0''\cdot06$

NOTE.—R.M. denotes Referring Mark.

April, 1890.

W. H. COLE,
In charge of Computing Office.

PRINCIPAL TRIANGULATION—SINGI MERIDIONAL SERIES.

Fig. No. 10

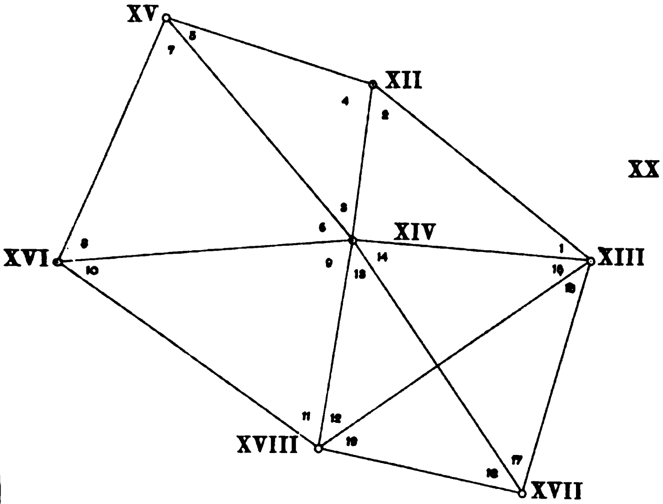
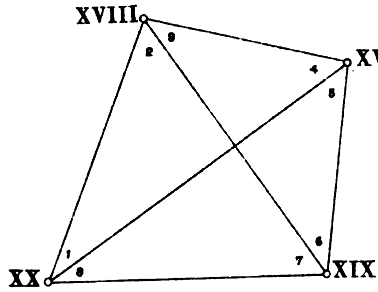


Fig. No. 11



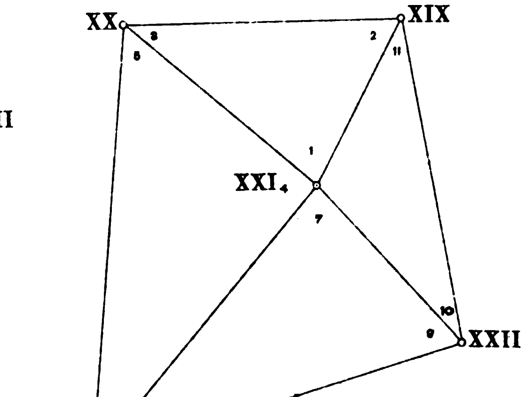
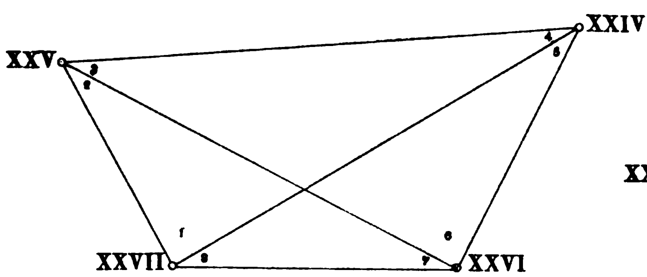


Fig. No. 12

Fig. No. 13



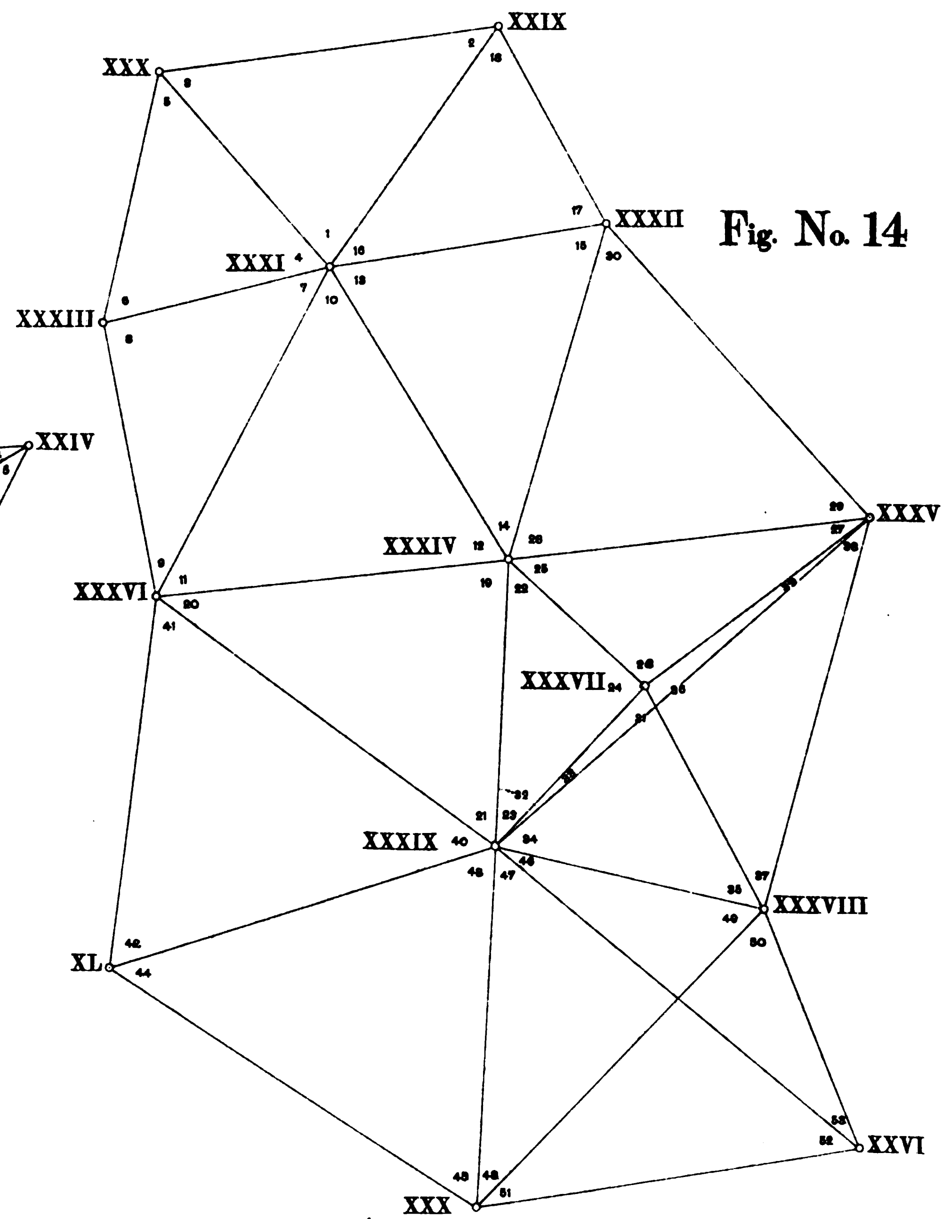


Fig. No. 14

Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, February 1890.

ABU MERIDIONAL SERIES.

ABU MERIDIONAL SERIES.

INTRODUCTION.

The Abu Meridional Series of the South-West Quadrilateral is the small chain of principal triangles that follows the meridian of $72\frac{3}{4}$° from the parallel of $24\frac{1}{2}$° to that of 23°. It starts from Jeráj–Márd, a side of the Karáchi Longitudinal Series, situated immediately south of Mount Abu and it closes near Ahmedabad (Amdávád) on the side Sanoda–Mirzápur of the Guzerat Longitudinal Series: it consists of three hexagons and one single triangle, and extends over a distance of 95 miles.

The Abu Meridional Series was designed in 1850 for two purposes: *firstly*, it was to connect the Karáchi Longitudinal Series with the Gulf of Cambay (Khambhat) and thus furnish an independent check on the heights of the former: and *secondly*, it was to afford a trigonometrical basis for the topographical surveys of Gujarát and the Káthiáwár (Káthiávád) Peninsula, countries not then incorporated in the Indian Atlas. As moreover the accurate delineation of the Coast Line from Cambay southwards was a matter of great importance, it was originally intended to carry the Abu Series not only to the parallel of 23° as has been actually done, but down the Sábarmati river through Kaira (Kheda), and thence along the Coast Line through Cambay and Broach (Bharúch), until it should join a little south of Surat on the side Tarbhán–Dopári* of the Singi Meridional Series.

During the summer of 1850 the Bombay Triangulation Party, then located at Neemuch (Nimach) under Lieutenant Harry Rivers of the Bombay Engineers, received orders to discontinue their work on the Gurhágarh Meridional Series, and to take up instead the triangulation on the meridian of Mount Abu. Captain A. Strange had by this time carried the principal work of the Karáchi Longitudinal Series from Sironj to within a few miles of Mount Abu and the approximate work some 40 miles to the westward beyond, and Lieutenant Rivers had to select a base from the latter.

On receipt of Strange's chart of the approximate work Rivers decided to make his

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* The side Tarbhán–Dopári was in 1850 the northern extremity of the Singi Meridional Series: many unsuccessful efforts had been made to carry the latter further north: it was eventually connected with the Karáchi Longitudinal Series in 1862 by a series running parallel to the Abu Series and 70 miles distant to the east.

new series start from the side Jeráj–Márd of the Gúru Sikkar–Belka Double Pentagon*, both of which stations were on the edge of a range of hills and possessed a commanding view.

Season 1850-51.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 1st Assistant, G. T. Survey.
Mr. J. Fraser, Senior Sub-Assistant.
„ T. Sanger, Sub-Assistant.
„ J. DaCosta Ditto.
„ John McGill, (Probationer).

On the Singi and Khánpisura Series, Rivers had always worked with Dollond's 15-inch Theodolite, but this had now been discarded; its results had of late been very unsatisfactory and it had become from constant use and occasional accidents thoroughly out of repair. In its stead was to be used an 18-inch theodolite† by Troughton and Simms, which had been employed with considerable success on the Amua and Budhon Series, and which arrived at Neemuch from Dehra Dún in September 1850.

In the middle of October the party set out from Neemuch for the field, but owing to very heavy rain that lasted without intermission from the 20th to the 25th, their progress was much delayed. Rivers himself left Neemuch on November 5th and proceeded to Mount Abu where Captain Strange was passing the recess season.

As no approximate work as yet existed on the Abu Meridian south of his side of origin Rivers had himself to undertake the selection of stations. At the outset he met with but few obstacles, and by December 5th he had constructed a polygon round Gori as a centre. The northern portion of the Series was situated in a mountainous district, where the Sábarmati, Banás, and other Gujarát rivers rise. The few inhabitants that there were were Bheels; they were quite lawless and in fact professional robbers. Individuals if travelling singly were not safe and even parties were liable to be robbed and molested. South of the side Kárdo–Kaináth the country became very difficult and unsuitable for triangulation: it was absolutely flat and covered with trees; towers‡ had to be built at all the stations, and many delays were encountered in clearing the rays: if Rivers could have seen the country before commencing work he would have recommended the adoption of a single series instead of a double one, but now that he was on the ground it was too late to get his instructions changed. The advantages of a double series did not, he thought, compensate for its additional expense; for, owing to the great number of towers that had to be built and to the vast quantities of fruit trees that had to be cleared, triangulation in such a country was most costly. Rivers was very averse to adopting Everest's system of ray-tracing; he regarded it as a slow and laborious process, and, in order to avoid its necessity, he endeavoured to so select his stations that large fires at the two extremities of his rays would serve as sufficient guides for the clearance: this method however involved much loss of time in the choice of the stations, and had consequently to

* The principal angles at Jeráj and Márd which form part of the Gúru Sikkar–Belka Double Pentagon and appertain to the Karáchi Longitudinal Series were observed by Mr. C. Lane in February and March 1851 with Troughton and Simms' 36-inch Theodolite.

† Troughton and Simms' 18-inch Theodolite No. 2: for a full description of this instrument and the work performed by it, see Appendix No. 2 of Volume II of the *Account of the Operations of the Great Trigonometrical Survey of India.*

‡ A tower twenty-five feet high had to be built at each extremity of a twelve mile ray in order to ensure mutual visibility of the heliotropes.

be abandoned: he tried in its stead, in order to obtain the line of a ray, the plan of lighting fires at close intervals over the whole distance between the two stations, but this invariably failed also.

Neither Rivers nor his assistants possessed any experience of systematic ray-tracing, a fact that had greatly increased his reluctance to adopt it, but towards the end of December he decided that he had no alternative but to resort to it. He commenced the new system on the Pára Polygon, all the rays of which with the exception of Kárdo–Kaináth had to be cleared, and the whole of December was spent on this work. The ray-traces, however, proved most unsatisfactory; the country was intersected with ravines which caused errors in the perambulator readings, and the angles of the traverses were not observed with sufficient care: the line first cut invariably had to be altered, and immense loss of time, double expense, and great additional injury to the trees of the country were entailed.

By January 1st, the approximate work had only reached Lakwára, but after that, in spite of the lines laid off from the ray-traces at Rakhiál being far from true, better progress was made: on the eastern flank of the third hexagon there was some rising ground and advantage was taken of this, which obviated the necessity of towers. By the end of January the approximate work, with the exception of the tower-building, had been carried down to the stations of Lakwára–Rakhiál–Amalyára, and the final angles had been commenced.

The first station visited was Wantra and then Moráli, and observations were completed at both. Only the northern angles at Rakhiál and Amalyára were observed, as the stations of Sanoda and Bárdoli were not selected till the following year. At Warsora Rivers was delayed by Dhámanwa not being visible and he eventually had to leave without observing it: several trees had been cut on the line, but the ray had proved untrue. At Pára also Dhámanwa was invisible and remained unobserved. Rivers was unable to waste time in waiting for the successful clearance of the rays, as dust-storms and smoke come on with the hot weather, and he wished to make sure of the northern stations during this season, the more especially as they are dangerous to visit immediately after the rains. During March he completed the observations at Kherwa, Kaináth and Márd, and in April he finished those at Gori and Jeráj: he also visited the stations of Kárdo and Siniána, but at each he was troubled with dust-storms and prevented from observing all the angles.

The soil of the country was very sandy and afforded no foundation to such massive structures as the towers. Two of these, the external portion of which consisted of sun-dried mud bricks, fell, and it was found necessary to face them and others with burnt bricks set in lime to a foot in depth.

On the Abu Series, Rivers adopted a slightly different method of changing zero to the one that he had employed before. On the Khánpisura and Gurhágarh Series he had followed the established practice of the Great Trigonometrical Survey in the case of three-microscope instruments and had worked with the ordinary six pairs of zeros,* *viz.*:—

$$\frac{0^\circ\ 0'}{180^\circ\ 0'},\ \frac{10^\circ\ 0'}{190^\circ\ 0'},\ \frac{20^\circ\ 0'}{200^\circ\ 0'},\ \frac{30^\circ\ 0'}{210^\circ\ 0'},\ \frac{40^\circ\ 0'}{220^\circ\ 0'}\ \text{and}\ \frac{50^\circ\ 0'}{230^\circ\ 0'}.$$

In order to bring the zero of the micrometer over every 10 minutes of the degree and to shift the reading so as to cancel error of "run" he employed the following zeros on this Series:—

$$\frac{0^\circ\ 1'}{180^\circ\ 1'},\ \frac{10^\circ\ 12'}{190^\circ\ 12'},\ \frac{20^\circ\ 20'}{200^\circ\ 20'},\ \frac{30^\circ\ 29'}{210^\circ\ 29'},\ \frac{40^\circ\ 38'}{220^\circ\ 38'}\ \text{and}\ \frac{50^\circ\ 50'}{230^\circ\ 50'}.$$

The party closed the field season towards the beginning of May, and proceeded to Ahmedabad where they established their recess-quarters for the summer.

In August, 1851, Mr. Fraser resigned his appointment: he had entered the Bombay Survey Department in 1822 and had been employed from 1828 to 1834 on the Trigonometrical Survey of the Bombay Presidency, which was being carried out by Lieutenant R. Shortrede under the orders of Captain J. Jopp. On the amalgamation of this Survey in 1834 with the Great Trigonometrical Survey of India, he had been transferred to the latter and had worked for the last seventeen years of his service under Lieutenants W. S. Jacob and H. Rivers. He was succeeded by Mr. McGill, who had been working with the party as a probationer during the field season of 1850-51.

In October, 1851, Mr. J. W. Rossenrode was appointed an additional assistant to the Bombay Party: his services were at the time in much request in Bengal and he was ill-able to be spared, he had had great experience of trigonometrical operations in flat and wooded countries, and was sent at the urgent demand of Lieutenant Rivers to instruct the assistants of the Bombay Party in the ray-trace system and to thus prevent a repetition of the failures of the previous season. He left Calcutta in October, but owing to the immense distance that he had to march, he did not join Lieutenant Rivers till the middle of February, when it was too late for him to be of much use.

Season 1851-52.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 1st Assistant, G. T. Survey.
Lieutenant D. J. Nasmyth, Bombay Engineers, 2nd Assistant.
Mr. T. Sanger, Senior Sub-Assistant.
„ J. DaCosta, Sub-Assistant.
„ J. W. Rossenrode, Ditto.
„ J. McGill, Ditto.

The main body of the party were not in a fit state to leave Ahmedabad for the field before November, owing to the native portion having suffered so much from fever towards the end of the rainy season. During October, however, Rivers himself succeeded in selecting a few stations of the Guzerat Longitudinal Series in the neighbourhood of Ahmedabad. In November, he regularly took up the approximate work of this latter series and proceeded westward from the meridian of $71\frac{1}{2}^\circ$ along the parallel of 23°. Messrs.

* This method of changing zero was altered in 1860 by Colonel Waugh for reasons which will be found fully explained at pages xii to xvii of the Introduction to the Great Indus Series, *vide* Volume III of the *Account of the Operations of the Great Trigonometrical Survey of India*. Since that date the zero-settings for theodolites, with three microscopes have always been as follows:—

$$\frac{0^\circ\ 0'}{180^\circ\ 0'},\ \frac{70^\circ\ 1'}{250^\circ\ 1'},\ \frac{140^\circ\ 2'}{320^\circ\ 2'},\ \frac{210^\circ\ 3'}{30^\circ\ 3'},\ \frac{280^\circ\ 4'}{100^\circ\ 4'}\ \text{and}\ \frac{350^\circ\ 5'}{170^\circ\ 5'},$$

the changes in the minutes were introduced with a view to cancelling the effects of any errors in the construction of the threads of the micrometers.

Sanger and DaCosta were left behind on the Abu Series north of Ahmedabad clearing the lines by the ray-trace system. They were the only two assistants with the party available for work, but as the nature of the country was such that every line required a ray-trace survey, and numerous fruit trees of great value had to be cut, Rivers considered it advisable to place them both on this duty. Rivers returned to the Abu Series on December 15th, in the hopes of finding sufficient rays cleared to allow him to commence the observations of the final angles, but he was disappointed, as only a few were ready.

On December 22nd, he went to Sanoda as being the station at which the Meridional Series of Abu and the Longitudinal Series of Guzerat meet, and observed δ Ursæ Minoris for azimuth. He was joined here on December 29th, by Lieutenant Nasmyth, a young Officer of the Bombay Engineers, who had been appointed to the Great Trigonometrical Survey of India a few weeks previously. At the beginning of January, Rivers proceeded to the head of the Gulf of Cambay to make arrangements for connecting the heights of the stations of the Guzerat Series and thence those of the Abu and Karáchi Longitudinal Series with mean sea level: his plan was to erect a tidal station near the mouth of the Sábarmati river and to then connect it by levelling with the nearest principal station of the Guzerat Longitudinal Series: he found however afterwards that such operations would occupy him entirely to the exclusion of trigonometrical work, and as, too, he had much difficulty in obtaining a level capable of such accurate observations as were required, he abandoned the enterprise and substituted for his line of levels a minor series of triangulation, the approximate work of which Mr. DaCosta proceeded to take up*. On his return from Cambay he took up the final angles of the Abū Series: his progress was again much impeded by finding lines not properly cleared and by having to set to work and do it himself: the result was that by the end of January he had been only able to observe at the two stations of Kárdo and Warsora. During February he succeeded in completing the observations at all the stations of the series with the exception of Siniána, notwithstanding that the height of the towers at several had to be increased on his arrival because the effect of refraction on which he depended for the visibility of his stations was less in April than it was in November when they were built. From the 1st of March to the end of the field season he was employed in observing the final angles of the Guzerat Longitudinal Series: in April, however, an opportunity offered, and he visited Siniána and observed the two angles at that station, thus finishing the principal work of the Abu Series. Mr. Rossenrode had joined him in February, but the clearance of the rays, the special work for which he had been sent, had by that time been carried out with much annoyance and trouble in the most difficult parts of the country, and so he was detached on approximate work to the western extremity of the Guzerat Longitudinal Series. The party established their recess quarters for the summer of 1852 at Ahmedabad.

When the results of the past season came to be computed out it was found that the geometrical conditions of the Pára Hexagon could not be satisfied† unless a correction exceeding 3″ in amount was applied to the angle Kárdo–Dhámanwa–Pára.

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* *Vide* Introduction to the Guzerat Longitudinal Series.

† The geometrical conditions of the figures of the triangulation were in these days satisfied by Colonel Everest's method of successive approximations, *vide* page 108, Volume II of the *Account of the Operations, &c.*

On this account Lieutenant Rivers decided to re-visit the station of Dhámanwa, and observe the faulty angle again. He left cantonments accompanied by Nasmyth on November 1st, 1852, and completed the observations on November 4th. The final angle Kárdo–Dhámanwa–Pára as derived from the observations taken on the former occasion was 55° 15′ 29″·59, a value that had been shewn by the computations to be somewhat over 3″ in defect. The result of the second visit to Dhámanwa was to make the angle 55° 15′ 32″·96 which agreed within a quarter of a second of arc with the computed value. Rivers however did not feel justified in rejecting the earlier result *in toto*, and he therefore combined the two. The concluded angle finally adopted was equal to

$$55^\circ\ 15' + \frac{0\cdot 58 \times 29''\cdot 59 + 2\cdot 01 \times 32''\cdot 96}{0\cdot 58 + 2\cdot 01} = 55^\circ\ 15'\ 32''\cdot 23,$$

the quantities 0·58 and 2·01 being the respective weights of the two observed results.

By November 6th the party had returned to Ahmedabad, and were preparing to start for the Káthiáwár Peninsula to commence the triangulation there. As Rivers had applied for furlough, and had every expectation of its being granted, he handed the party over to Nasmyth, and when they left for the field he remained behind: on November 22nd, however, he received official intimation that his furlough had been refused; he left Ahmedabad the same evening for Káthiáwár, and on overtaking Nasmyth some weeks later he again resumed charge of the work.

The closing errors at Mirzápur in latitude, longitude, azimuth and side may be exhibited as follows:—

VALUES.	Latitude.	Longitude.	Azimuth†.	Side in feet†.
When calculated from the side Jeráj–Márd of the Karáchi Longitudinal Series *viâ* the Abu Series.	22° 59′ 17″·859	72° 52′ 34″·694	154° 36′ 50″·047	53857·2
When calculated from the side Tána–Lakarwás of the Karáchi Longitudinal Series *viâ* the northern section of the Singi Series and the central section of the Guzerat Longitudinal Series.	22° 59′ 17″·708	72° 52′ 34″·708	154° 36′ 47″·090	53859·5
Closing errors ...	+ 0″·151*	− 0″·014*	+ 2″·957	2·3

* To determine the error of the geographical position of Mirzápur in feet it should be noted that 1 foot = 0″·01 approximately both on meridian and parallel.

† The side Mirzápur–Sanoda.

On the completion of the Simultaneous Reduction of the South-West Quadrilateral, it was found that the portions of the corrections which had actually fallen to the Abu Meridional Series were:—

	In Latitude of Mirzápur (XVI)	... ...	$-0''\cdot070$
	„ Longitude of „	... ...	$+0\cdot005$
	„ Azimuth of Mirzápur (XVI)—Sanoda (XIX)		$+0\cdot843$
In side	Logarithm of feet	... ...	$+0\cdot000{,}0101{,}5$
	giving a ratio of about 1·48 inches per mile.		

Astronomical observations for azimuth have never been taken at any of the stations of the Abu Meridional Series: Sanoda, where Rivers observed δ Ursæ Minoris, now appertains to the Guzerat Longitudinal Series.

Secondary Triangulation.

So many difficulties were encountered in selecting the stations and clearing the rays for the principal triangulation of the Abu Series, that Rivers had been obliged to employ all his Assistants on that work, and consequently there had never been any one available for secondary operations. The result was that not nearly so many points were laid down trigonometrically as was desirable: this was the more to be regretted as the Topographical Survey of the country had yet to be carried out.

In the Gori Hexagon some half-dozen hill peaks, a few temples, and a dome in Pálanpur were fixed, and the position of a point in the large town of Ídar near the principal station of Kaináth was determined. In the Pára Hexagon the Harsol Residency and four or five trees were laid down: a point in a village two miles from Ahmednagar (Ahmadnagar) was intersected from two principal stations, but neither in this important town nor in the great fort of Bijápur* was any secondary station established: these omissions are probably due to the Rajput chiefs refusing to allow the Surveyors to enter their strongholds. Between the principal side Warsora–Moráli of the Abu Series and the Guzerat Longitudinal Series, though seven principal triangles intervened, no secondary station was established and no intersected point laid down.

* The principal station of Pára was only two miles distant from Bijápur.

June, 1889.

S. G. BURRARD.

ABU MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. ALPHABETICAL LIST OF STATIONS.

Amalyára	XII.	Márd	XL. (Of the Karáchi Longitudinal Series).
Bárdoli	XIV.	Mirzápur	XVI. (Of the Guzerat Longitudinal Series).
Dhámanwa	VIII.	Moráli	IX.
Gorí	I.	Pára	VI.
Jeráj	XLIII. (Of the Karáchi Longitudinal Series).	Rakhiál	XI.
Kaináth	IV.	Sanoda	XIX. (Of the Guzerat Longitudinal Series).
Kárdo	V.	Siniána	III.
Kherwa	II.	Wantra	VII.
Lakwára	XIII.	Warsora	X.

ABU MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. NUMERICAL LIST OF STATIONS.

XL (Of the Karáchi Longitudinal Series).	Márd.	VIII	Dhámanwa.
XLIII (Of the Karáchi Longitudinal Series).	Jeráj.	IX	Moráli.
I	Gori.	X	Warsora.
II	Kherwa.	XI	Rakhiál.
III	Siniána.	XII	Amalyára.
IV	Kaináth.	XIII	Lakwára.
V	Kárdo.	XIV	Bárdoli.
VI	Pára.	XVI (Of the Guzerat Longitudinal Series).	Mirzápur.
VII	Wantra.	XIX (Of the Guzerat Longitudinal Series).	Sanoda.

ABU MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. DESCRIPTION OF STATIONS.

Of the 14 Principal Stations of this Series those numbered I to V and VII, IX and XII, as also XL and XLIII of the Karáchi Longitudinal Series from which this triangulation emanantes, are situated on hills. All these save XLIII consist of solid, circular and isolated pillars of masonry, from 3 to 10 feet in height, having marks engraved either on the rock *in sitú* or on stones imbedded at about the ground level and one or more other marks cut on stones inserted in the normals of the former marks. Around the pillars and level with their surfaces, platforms of loose stone masonry or of sun-dried bricks and mud were constructed for the observatory tent to rest on. At Station XLIII, where the rock rises sufficiently above the surface of the hill, there is no other mark than that on the rock. The remaining stations, together with the two of the Guzerat Longitudinal Series on which this triangulation terminates, being situated in the plains, it was found necessary to construct towers to overlook the curvature of the earth. These are solid structures—either circular or square, built of sun-dried bricks and mud and faced with kiln-burnt bricks—18 to 32 feet in height, enclosing central, solid pillars of masonry which carry marks at top, bottom and intermediately, the upper portion of each pillar being circular and isolated.

The following descriptions have been compiled from those given by the Officers who executed the Series, supplemented as regards adjacent villages from information obtained from other original records of the Series, and corrected in respect to the local sub-divisions in which the several stations are situated from the latest Annual Reports furnished by the District Officers to whose charge the stations have been committed.

XL.—(*Of the Karáchi Longitudinal Series*). Márd, locally known as Mad, Hill Station, lat. 24° 24′, long. 73° 0′—observed at in February and March 1851—is situated on one of a group of high hills forming a portion of the southern face of the Aravalli range, in lands appertaining to the town of Posína from which the ascent to the station is long and tedious: Edar State, Mahi Kánta Agency.

The station as built for the Karáchi Longitudinal Series consists of a platform, 3·75 feet in height, enclosing a solid, isolated pillar of masonry which has a mark-stone at level of the foundation, another at the top and a third 2 feet above the former. When again visited in March 1851 for originating the Abu Meridional Series no alteration appears to have been made in the construction of the station.

XLIII.—(*Of the Karáchi Longitudinal Series*). Jeráj Hill Station, lat. 24° 25′, long. 72° 32′—observed at in 1851—is situated on the summit of a high and extensive hill lying between Mount Abu and Deesa and is on the boundary between the Sirohee and Pálanpur States. The hill is locally known as Jásor but is named Jeráj from a deity said to reside at its foot: sub-division Dántiwara, Pálanpur State.

No pillar and platform could be built and the station is marked by a circle and dot engraved on a large rock crowning the hill.

I. Gori, locally known as Gori Dungri, Hill Station, lat. 24° 10′, long. 72° 51′—observed at in 1851—is on a high peak of a mountain range running S.W. and N.E. The station is in lands appertaining to the village of Kaiwad: Dánta State, Mahi Kánta Agency.

The station consists of a platform enclosing a solid, circular and isolated pillar of masonry, containing two marks, the lower engraved on the rock *in sitú* and the upper (level with the surface of the platform) 2·75 feet above it. The directions and estimated distances of the circumjacent villages are:—Punádra W., miles 1½; Kaiwad W., at foot of hill; and Dánta N.W., miles 6.

II. Kherwa Hill Station, lat. 24° 7′, long. 73° 8′—observed at in 1851—is situated on a small, round hill appertaining to the lands of Kherwa village, and about 9 miles E. of Unchi Dhunal: Edar State, Mahi Kánta Agency.

The station consists of a platform enclosing a solid, isolated pillar of masonry, containing two marks, the lower engraved on the rock *in sitú* and the upper 3 feet above it. The directions and estimated distances of the circumjacent villages are:—Wurtol S., miles 4; Kherwa E., miles 1½; and Bramanchi Kheri S., miles 7.

III. Siniána Hill Station, lat. 24° 7′, long. 72° 35′—observed at in 1851-52—is on a small hill capped with immense masses of rock, in lands appertaining to Siniána village: pargana and State Pálanpur.

The station consists of a platform enclosing a solid, isolated pillar of masonry, 3·93 feet in height, which contains two marks, the lower engraved on the rock *in sitú* and the upper 3·92 feet above it. The directions and estimated distances of the circumjacent villages are:—Siniána N.W., miles 1½; and Gola N., miles 2.

IV. Kaináth, locally known as Kulnáth, Hill Station, lat. 23° 51′, long. 73° 1′—observed at in 1851—is situated on a large, flat-topped hill composed of granite and porphyry, and called Kaináth from its being dedicated to a deity of that name; the station is about 3 miles N.W. of the town of Edar: Edar State, Mahi Kánta Agency.

The station consists of a platform of loose stones and earth enclosing a solid, isolated pillar of masonry, which contains two marks, the lower engraved on the rock *in sitú* and the upper 2·92 feet above it.

V. Kárdo Hill Station, lat. 23° 57′, long. 72° 46′—observed at in 1851 and 1852—is situated on the western extremity of a small, steep hill of that name which is crowned with enormous masses of rock; the hill though detached forms part of the range on which are several temples called Táranga, Ajitnáth, &c., lying about 4 miles to N.E. of the station: sub-division Kherálu, Baroda State.

The station consists of a platform enclosing a solid, isolated pillar of masonry, 3·75 feet in height, which contains two marks, the lower engraved on the rock *in sitú* and the upper 3·75 feet above it. The directions and estimated distances of the circumjacent villages are:—Wauri N.E., miles 4; Kadi S., miles 2; Chotia S.W., miles 4; and Dabhoda W., miles 2.

VI. Pára Tower Station, lat. 23° 35′, long. 72° 50′—observed at in 1851 and 1852—stands on the rising ground about ¾ of a mile W. of the village of Pára, and 2·16 miles E.N.E. of the town of Vijápur: sub-division Kadi, Baroda State.

The station consists of a tower faced with burnt bricks, 20 feet in height, enclosing a solid pillar of masonry of which the upper 4 feet is circular and isolated. The azimuths and perambulated distances of the circumjacent villages are:—Ganeshpur 181° 8′, mile 0·46; and Ranchirpur 5° 8′, mile 0·42.

VII. Wantra Hill Station, lat. 23° 37′, long. 73° 7′—observed at in 1851—is situated towards the western edge of a flat hill detached from the table-land lying to the eastward of it. The station obtains its name from the small village of Wantra which is in one of the valleys on the southern side of the hill: Edar State, Mahi Kánta Agency.

The station consists of a square platform, 4 feet in height, enclosing a solid, isolated pillar of masonry which contains two marks, the lower engraved on the rock *in situ* and the upper 2·92 feet above it. The directions and estimated distances of the circumjacent villages are:—Gamri S.S.W., miles 2; Virawára W., miles 2; and Kamp N., mile 1.

VIII. Dhámanwa Tower Station, lat. 23° 32′, long. 72° 33′—observed at in 1852—stands on a low, sandy ridge about ¾ of a mile S.E. of the village Dhámanwa, and the same distance N.W. of that of Puraria: Baroda State.

The station consists of a tower of sun-dried bricks and mud and faced with burnt bricks, which encloses a solid pillar of masonry 32 feet in height the upper 5 feet of which is isolated; it has a mark-stone at the ground level, another at top 32 feet above it, and five others placed intermediately. Four small pillars with marks thereon are built outside the tower, the intersection of lines joining these marks indicates the exact position of the mark-stone at the summit.

IX. Moráli Hill Station, lat. 23° 25′, long. 73° 0′—observed at in 1851—is situated on a small piece of rising ground composed of iron ore, which appertains to the land of Moráli village: taluka Parántij, district Ahmedabad.

The station consists of a platform of sun-dried bricks enclosing a pillar of masonry, 10 feet in height and with 1·25 feet foundation; the pillar, of which the upper 5 feet is isolated, contains three marks, one at the top and the others at 5·25 and 10·00 feet respectively below it. The directions and estimated distances of the circumjacent villages are:—Gari N., miles 1½; and Moráli N.W., mile 1.

X. Warsora Tower Station, lat. 23° 25′, long. 72° 47′—observed at in 1851-52—stands at the southern extremity of the village of Warsora. The spot is somewhat above the general level, having been the site of a large building of which however no trace remains above ground. The land in the neighbourhood is much cut up with deep ravines which drain into the Sábarmati river, about a mile E. of Warsora: sub-division Saber Kánata, Mahi Kánta Agency.

The station consists of a tower faced with burnt bricks, 25 feet in height, enclosing a solid pillar of masonry of which the upper 4 feet is isolated.

XI. Rakhiál Tower Station, lat. 23° 16′, long. 72° 57′—observed at in 1851-52—stands on the rising ground about 5 furlongs N.W. of the village of Rakhiál: sub-division Báwisi, Mahi Kánta Agency.

The station consists of a tower of sun-dried bricks and mud and faced with burnt bricks, 18 feet square at base and 13 feet at top, which encloses a solid pillar of masonry, 22 feet in height, diminishing from 4½ feet square at base to 3½ feet square near summit; the pillar, of which the upper 4 feet is circular and isolated, has a foundation of 5 feet, and mark-stones are fixed in it at 6, 12, 18 and 22 feet respectively above the one at the ground level. Four small pillars with marks thereon are built at 20 yards from the central pillar, and the intersection of lines connecting them indicates the position of the upper mark. The azimuths and perambulated distances of the circumjacent villages are:—Pipria 92° 31′, mile 0·75; Nawánagar 111° 1′, miles 1·78; and Bhadrunda 196° 1′, mile 0·68.

XII. Amalyára Hill Station, lat. 23° 14′, long. 73° 6′—observed at in 1851-52—is situated on the rising ground about ¾ of a mile N.E. of the village of Amalyára: sub-division Wátrak Kánta, Mahi Kánta Agency.

The station consists of a platform of sun-dried bricks enclosing a circular, solid pillar of masonry, 5 feet in height, which contains two marks, one at the ground level and the other 5 feet above it. The village of Chandrej lies to the N.E. at a distance of about 1 mile.

XIII. Lakwára Tower Station, lat. 23° 16′, long. 72° 44′—observed at in 1852—stands close to the left bank of the Sábarmati river and some 200 yards N.E. of the village from which the station obtains its name: sub-division Degám, Baroda State.

The tower is built like the others of this Series, and is 22 feet high. Four small pillars were built outside the tower and the intersection of the lines engraved on them defined the position of the station mark at the level of the ground. When the tower was finished, the upper mark did not agree with this intersection and it was therefore moved in January 1852, 2·9 inches in a direction forming an angle of + 26° with Warsora Station. The only angle observed in season 1850-51, connected with the old upper mark, was that at Warsora between Rakhiál and Lakwára stations, and a small correction has therefore been applied to this angle to reduce it to the present station mark: should this mark ever be removed it can be recovered by the marks on the outer pillars. The present mark at the level of the ground, is 0·9 of an inch east of the mark used.

XIV. Bárdoli Tower Station, lat. 23° 5′, long. 72° 58′—observed at in 1852—stands on the rising ground about ¾ of a mile W. of the village from which it is named: sub-division Atarsumba, Baroda State.

The station consists of a tower of sun-dried bricks and mud and faced with burnt bricks, enclosing a solid pillar of masonry, 22 feet in height, which contains mark-stones at every 5 feet.

XVI.—(*Of the Guzerat Longitudinal Series*). Mirzápur Tower Station, lat. 22° 59′, long. 72° 53′—observed at in 1852 and 1858—is situated on a sandy hill about a mile W. by S. of the village of Mirzápur, and 4 miles N.N.W. of the large village of Haldarwás on the right bank of the Wátrak river: taluka Daskroi, district Ahmedabad.

The station consists of a tower enclosing a solid pillar of masonry, 18 feet in height, which has a mark-stone at top and others at 3, 8, 13 and 18 feet respectively below it, the lowest being at the ground level. The directions and estimated distances of the circumjacent villages are:—Chándivel Bhátpura W.N.W., mile ¾; Wárod (on the left bank of the Meswo river) W.S.W., miles 2¾; Kaniel S. by E., miles 1½; and Patáwat (on the western bank of the Wátrak) S.E., miles 3. When visited in 1858 in the course of Guzerat Longitudinal Series operations, no alteration appears to have been made in the construction of the station.

XIX.—(*Of the Guzerat Longitudinal Series*). Sanoda Tower Station, lat. 23° 7′, long. 72° 48′—observed at in 1852—stands on the rising ground about ¾ of a mile S.E. of the village from which the station has been named. The whole country in the neighbourhood is much covered with large trees: sub-division Degám, Baroda State.

The station consists of a tower (most probably built in a manner similar to those at the adjacent stations) enclosing a solid pillar of masonry. Four small pillars have been built outside the tower, and the intersection of lines engraved on them will give the position of the upper station mark. Other mark-stones have also been fixed at every 5 feet in the pillar.

February 1880.

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

ABU MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. OBSERVED ANGLES.

At XL (Márd)

March 1851; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on II: 0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
II & I	″ h 18·50 h 19·07	″ h 20·40 h 21·14	″ h 25·00 h 27·40	″ h 24·40 h 24·06	″ h 29·17 h 28·93	″ h 22·83 h 23·96	″ h 32·93 h 33·14	″ h 28·80 h 27·70	″ l 29·70 l 29·10	″ l 27·73 l 27·14	″ l 25·53 l 26·63	″ l 24·10 l 25·00	$M = 25''\cdot93$ $w = 0\cdot78$ $\frac{1}{w} = 1\cdot29$
	18·79	20·77	26·20	24·23	29·05	23·39	33·04	28·25	29·40	27·43	26·08	24·55	$C = 51° 34' 25''\cdot93$
I & XLIII	h 9·26 h 11·63 h 12·67	h 9·76 h 10·20	l 5·54 l 5·60	l 12·46 l 13·04	l 13·16 l 9·00 l 11·20	l 11·23 l 13·20 l 12·23	l 0·07 l 0·53	l 13·17 l 13·10	l 7·87 l 10·14	l 7·47 l 6·04	l 3·60 l 4·74	l 7·73 l 7·50	$M = 8''\cdot65$ $w = 0\cdot77$ $\frac{1}{w} = 1\cdot31$
	11·19	9·98	5·57	12·75	11·12	12·22	0·30	13·14	9·00	6·76	4·17	7·61	$C = 63° 29' 8''\cdot66$

Note.—Stations XL and XLIII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At XLIII (Jeráj)

April 1851; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	Circle readings, telescope being set on XL												
XL & I	″ h 3·60 h 4·57	″ h 4·97 h 6·53	″ h 7·50 h 6·57	″ h 7·87 h 8·23	″ h 14·90 h 15·44	″ h 5·90 h 7·30	″ h 12·84 h 12·76	″ h 12·74 l 13·00	″ h 12·80 h 14·33	″ h 10·77 h 11·64	″ h 6·30 h 8·37	″ h 10·67 h 8·74	$M = 9''·51$ $w = 0·94$ $\frac{1}{w} = 1·07$
	4·09	5·75	7·03	8·05	15·17	6·60	12·80	12·87	13·57	11·20	7·34	9·70	$C = 38° 58′ 9''·51$
I & III	h 43·90 h 43·40	h 40·97 h 40·00	h 37·57 h 36·13	h 42·46 h 40·77	h 33·93 h 33·83	h 37·26 h 36·16	h 37·83 h 36·27	h 40·70 h 39·30	h 38·00 h 37·04	h 39·74 h 41·40	h 42·26 h 40·97	h 39·97 h 40·83	$M = 39''·20$ $w = 1·52$ $\frac{1}{w} = 0·66$
	43·65	40·49	36·85	41·61	33·88	36·71	37·05	40·00	37·52	40·57	41·62	40·40	$C = 42° 41′ 39''·20$

At I (Gori)

April 1851; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	Circle readings, telescope being set on XL												
XL & II	″ l 35·23 l 35·97	″ l 33·93 l 36·56	″ h 39·87 h 41·17	″ h 34·17 h 37·40 h 35·20	″ h 35·50 h 36·00 d 36·17	″ h 33·93 h 30·73 h 32·76	″ h 37·44 h 38·00	″ h 38·00 h 39·17 h 37·67	″ l 39·77 l 38·94	″ h 38·20 h 39·77	″ l 37·94 l 39·33	″ l 42·20 l 42·93 l 41·60	$M = 37''·54$ $w = 1·59$ $\frac{1}{w} = 0·63$
	35·60	35·25	40·52	35·59	35·89	32·47	37·72	38·28	39·35	38·99	38·63	42·24	$C = 72° 4′ 37''·54$
II & IV	l 48·24 l 45·76	l 51·44 l 49·30 l 48·70	h 43·93 h 43·83	h 47·77 h 47·66	h 48·84 h 47·27 d 48·48	h 49·37 h 48·94	h 48·63 h 49·03	h 51·67 h 49·30 h 51·16	l 44·06 l 45·00	h 47·50 h 45·90	l 45·73 l 46·50	l 48·30 l 45·83 l 44·53	$M = 47''·41$ $w = 2·60$ $\frac{1}{w} = 0·38$
	47·00	49·81	43·88	47·72	48·20	49·15	48·83	50·71	44·53	46·70	46·12	46·22	$C = 53° 18′ 47''·42$
IV & V	l 22·10 l 21·07	l 14·80 l 13·26	h 17·37 h 15·43	h 15·27 h 14·60	h 17·23 h 18·63	h 18·66 h 17·70	h 23·40 h 22·70	h 14·00 h 15·96	l 15·60 l 15·66	h 16·90 h 15·17	l 16·83 l 15·14	l 9·60 l 12·04 l 13·33	$M = 16''·70$ $w = 1·17$ $\frac{1}{w} = 0·85$
	21·59	14·03	16·40	14·93	17·93	18·18	23·05	14·98	15·63	16·04	15·98	11·66	$C = 46° 7′ 16''·70$

Note.—Stations XL and XLIII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At I (Gori)—(*Continued*).

Angle between	Circle readings, telescope being set on XL 0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
V & III	*l* 14·90 *l* 16·20 *h* 13·93	*l* 14·56 *l* 16·07	*h* 14·56 *h* 15·67	*h* 19·67 *h* 18·56	*h* 9·44 *h* 14·33 *h* 13·20	*h* 16·60 *h* 14·27	*h* 8·87 *h* 10·50	*h* 19·56 *h* 17·54	*l* 16·14 *l* 17·17	*h* 14·40 *l* 14·37	*l* 15·30 *l* 15·03	*l* 16·13 *l* 15·16	$M = 15''\cdot20$ $w = 1\cdot79$ $\frac{1}{w} = 0\cdot56$ $C = 57^\circ 33' 15''\cdot19$
	15·01	15·32	15·11	19·12	12·32	15·43	9·69	18·55	16·65	14·39	15·16	15·65	
III & XLIII	*l* 10·33 *l* 11·43	*l* 16·60 *h* 17·40	*h* 16·84 *h* 16·57	*h* 13·76 *h* 16·60 *h* 15·74	*h* 22·90 *h* 19·54 *h* 20·40	*h* 17·10 *h* 16·23	*h* 21·30 *h* 20·00	*h* 14·00 *h* 15·20	*l* 20·00 *l* 21·37	*h* 20·00 *l* 21·27	*l* 17·27 *l* 14·83	*l* 18·84 *l* 18·17	$M = 17''\cdot39$ $w = 1\cdot24$ $\frac{1}{w} = 0\cdot81$ $C = 53^\circ 23' 17''\cdot39$
	10·88	17·00	16·71	15·37	20·95	16·66	20·65	14·60	20·69	20·63	16·05	18·51	
XLIII & XL	*l* 52·94 *l* 50·44	*l* 48·67 *l* 49·00	*h* 50·56 *h* 48·13 *h* 48·10	*h* 49·04 *h* 46·97	*h* 43·63 *h* 42·46	*h* 47·50 *h* 49·34	*h* 39·20 *h* 40·23	*h* 42·67 *h* 42·83	*l* 42·56 *l* 41·06	*h* 44·16 *l* 41·90	*l* 46·50 *l* 47·47	*l* 45·50 *l* 46·37	$M = 45''\cdot76$ $w = 0\cdot89$ $\frac{1}{w} = 1\cdot12$ $C = 77^\circ 32' 45''\cdot76$
	51·69	48·84	48·93	48·00	43·05	48·42	39·71	42·75	41·81	43·03	46·99	45·93	

At II (Kherwa)

March 1851; *observed by Lieutenant H. Rivers with Troughton and Simms*' 18-*inch Theodolite No.* 2.

Angle between	Circle readings telescope being set on IV 0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 21′	30° 30′	210° 30′	40° 38′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
IV & I	*h* 41·17 *h* 43·03	*h* 37·67 *l* 40·10 *l* 36·90	*l* 39·73 *l* 39·83	*l* 37·33 *l* 36·60	*l* 46·73 *l* 45·73	*l* 33·93 *l* 35·37	*l* 46·17 *l* 47·64	*l* 43·37 *l* 43·80	*l* 45·30 *l* 43·93	*l* 43·74 *h* 44·46	*h* 42·37 *h* 40·33	*h* 40·93 *h* 42·10	$M = 41''\cdot67$ $w = 0\cdot84$ $\frac{1}{w} = 1\cdot19$ $C = 80^\circ 23' 41''\cdot67$
	42·10	38·22	39·78	36·97	46·23	34·65	46·90	43·59	44·61	44·10	41·35	41·52	
I & XL	*h* 54·43 *h* 58·30 *h* 54·83	*l* 55·00 *l* 56·67	*l* 57·04 *l* 57·87	*l* 56·17 *l* 55·56	*l* 55·10 *l* 55·27	*l* 58·40 *l* 56·00	*l* 54·87 *l* 55·27	*l* 60·10 *l* 56·84 *l* 57·67	*l* 55·14 *l* 54·87	*l* 59·66 *h* 58·94	*h* 57·30 *h* 56·53	*h* 58·47 *h* 55·97 *h* 57·00	$M = 56''\cdot59$ $w = 5\cdot41$ $\frac{1}{w} = 0\cdot18$ $C = 56^\circ 20' 56''\cdot60$
	55·85	55·84	57·45	55·87	55·18	57·20	55·07	58·20	55·01	59·30	56·91	57·15	

NOTE.—Stations XL and XLIII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At III (Siniána)

April 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XLIII 276° 7′	96° 6′	286° 17′	106° 17′	296° 25′	116° 25′	306° 34′	126° 34′	316° 43′	136° 43′	326° 55′	146° 54′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XLIII & I	″ h 6·67 h 7·67	″ l 7·20 l 6·00	″ l 13·87 l 11·27	″ l 7·43 l 6·94	″ l 7·30 l 9·40	″ l 5·60 l 2·60 l 5·00	″ h 1·57 h 1·07	″ h 2·83 h 3·73	″ h 0·20 h 1·17	″ h 2·37 h 1·94	″ h 3·07 h 2·03	″ h 5·90 h 4·24	$M = 5''\cdot 11$ $w = 0\cdot 99$ $\frac{1}{w} = 1\cdot 01$
	7·17	6·60	12·57	7·19	8·35	4·40	1·32	3·28	0·68	2·16	2·55	5·07	$C = 83^\circ 55' 5''\cdot 11$
I & V	h 57·87 h 58·03	h 57·84 l 59·90 l 58·07	l 57·66 l 59·23	l 58·73 l 58·43	l 65·34 l 61·40 l 65·54	l 55·70 l 56·00	h 66·26 h 68·40	h 66·34 h 60·84 h 64·30	h 64·93 h 63·60	h 65·00 h 64·23	h 60·66 h 59·90	h 63·70 h 61·93	$M = 61''\cdot 39$ $w = 0\cdot 92$ $\frac{1}{w} = 1\cdot 09$
	57·95	58·60	58·45	58·58	64·09	55·85	67·33	63·83	64·26	64·62	60·28	62·81	$C = 54^\circ 11' 1''\cdot 39$

At IV (Kaináth)

March 1851; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VII 185° 16′	5° 16′	195° 27′	15° 27′	205° 35′	25° 34′	215° 44′	35° 43′	225° 53′	45° 53′	236° 5′	56° 5′	M = Mean of Groups w = Relative Weight C = Concluded Angle
VII & VI	″ h 60·96 h 61·43	″ h 64·47 h 64·17	″ l 63·53 l 60·44 l 64·17	″ h 60·30 l 62·17	″ l 64·40 l 64·20	″ l 67·33 l 68·00	″ h 60·67 h 60·20	″ h 60·24 h 59·03 h 60·07	″ h 59·87 h 60·60	″ h 64·20 h 59·77 h 60·90	″ l 51·66 l 55·56 l 52·77	″ l 56·73 l 56·73	$M = 61''\cdot 13$ $w = 0\cdot 85$ $\frac{1}{w} = 1\cdot 17$
	61·20	64·32	62·71	61·23	64·30	67·67	60·43	59·78	60·24	61·62	53·33	56·73	$C = 53^\circ 30' 1''\cdot 12$
VI & V	h 24·47 h 24·97	h 19·00 h 18·87	l 25·64 l 26·16	h 22·40 l 18·00 l 17·03	l 27·20 l 23·73 l 24·60	l 17·84 l 18·84	h 21·03 h 23·57	h 24·30 h 27·17 h 25·13	h 28·03 h 30·80 h 27·80	h 26·87 h 31·20 h 31·16	l 27·50 l 23·07 l 27·13	l 26·37 l 24·24	$M = 24''\cdot 16$ $w = 0\cdot 81$ $\frac{1}{w} = 1\cdot 24$
	24·72	18·94	25·90	19·14	25·18	18·34	22·30	25·53	28·88	29·74	25·90	25·30	$C = 80^\circ 1' 24''\cdot 18$
V & I	h 60·93 h 59·80	h 63·66 h 64·66	l 58·40 l 57·60	h 59·36 l 61·56 l 61·57	l 55·63 l 59·90 l 58·30	l 60·83 l 63·50	h 57·23 h 57·90	h 53·36 h 55·83 h 56·30	h 54·03 h 54·64	h 52·20 h 50·37	l 56·60 l 59·20 l 54·40	l 58·53 l 56·27	$M = 58''\cdot 00$ $w = 0\cdot 91$ $\frac{1}{w} = 1\cdot 10$
	60·37	64·16	58·00	60·83	57·94	62·16	57·57	55·16	54·33	51·29	56·73	57·40	$C = 41^\circ 13' 58''\cdot 00$

NOTE.—Station XLIII appertains to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At IV (Kaináth)—(*Continued*).

Angle between	Circle readings, telescope being set on VII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	185° 16′	5° 16′	195° 27′	15° 27′	205° 35′	25° 34′	215° 44′	35° 43′	225° 53′	45° 53′	236° 5′	56° 5′	
I & II	″ h 27·27 h 27·27	″ h 28·07 h 26·27	″ l 33·00 l 31·47	″ h 30·90 l 32·47	″ l 36·00 l 33·30 l 29·96	″ l 29·53 l 31·14	″ h 37·44 h 37·73	″ h 37·34 h 35·04 h 34·34	″ h 33·47 h 31·30	″ h 31·30 h 32·00	″ l 37·50 l 35·57 l 38·93	″ l 33·00 l 34·46	$M = 32''\cdot50$ $w = 1\cdot02$ $\frac{1}{w} = 0\cdot98$ $C = 46° 17' 32''\cdot52$
	27·27	27·17	32·24	31·68	33·09	30·34	37·58	35·57	32·39	31·65	37·33	33·73	

At V (Kárdo)

***March* 1851; *and* †*January* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on III												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	
* III & I	″ h 40·63 h 42·40	″ h 40·13 h 42·73 h 38·17	″ h 47·16 h 44·83	″ h 45·54 h 45·17	″ h 43·06 h 45·37	″ h 39·83 l 39·70	″ l 48·64 l 46·56	″ l 44·97 l 45·87	″ l 44·56 h 47·70	″ l 46·63 l 46·60	″ h 50·70 h 49·93	″ h 44·74 h 46·13	$M = 44''\cdot89$ $w = 1\cdot22$ $\frac{1}{w} = 0\cdot82$ $C = 68° 15' 44''\cdot88$
	41·52	40·34	45·99	45·36	44·21	39·77	47·60	45·42	46·13	46·61	50·32	45·43	
* I & IV	h 46·14 h 47·34	h 42·54 h 39·57 h 40·26	h 45·80 h 45·97	h 41·76 h 43·83	h 48·90 h 47·03	h 47·17 h 46·53 l 49·70	l 50·24 l 47·67	l 50·13 l 49·17	l 51·57 l 50·94 h 52·30	l 46·73 l 45·93	h 40·53 h 43·57 h 41·04	h 42·80 h 41·43	$M = 46''\cdot03$ $w = 0\cdot96$ $\frac{1}{w} = 1\cdot04$ $C = 92° 38' 46''\cdot03$
	46·74	40·79	45·89	42·79	47·97	47·80	48·95	49·65	51·60	46·33	41·71	42·12	
* IV & VI	h 28·80 h 28·73	h 32·74 h 32·03	h 31·60 h 28·97	h 34·40 h 32·14	h 30·67 h 29·53	l 31·40 l 32·33	l 24·73 l 26·00	l 30·50 l 31·43	h 25·16 h 25·47	h 37·40 h 35·47	h 27·27 h 25·13 h 28·20	h 26·43 h 26·84	$M = 29''\cdot86$ $w = 1\cdot01$ $\frac{1}{w} = 0\cdot99$ $C = 59° 48' 29''\cdot86$
	28·77	32·38	30·29	33·27	30·10	31·86	25·37	30·96	25·32	36·43	26·87	26·64	
Lesser circle readings	0° 1′	180° 1′	10° 13′	190° 12′	20° 20′	200° 20′	30° 30′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	
† VI & VIII	h 10·80 h 10·60	h 6·50 h 7·60	h 7·43 h 6·90	h 12·90 h 10·13 h 11·36	h 11·64 h 12·86	h 14·44 h 13·10	h 14·00 h 13·70	h 8·10 h 10·47 h 9·47	h 13·76 h 14·44	h 15·23 h 15·60	h 15·96 h 17·23 h 16·20	h 14·44 h 13·40	$M = 12''\cdot12$ $w = 1\cdot26$ $\frac{1}{w} = 0\cdot80$ $C = 33° 4' 12''\cdot12$
	10·70	7·05	7·17	11·46	12·25	13·77	13·85	9·35	14·10	15·41	16·46	13·92	

At VI (Pára)

***March 1851; and †February 1852; observed by Lieutenant H. Rivers with Troughton and Simms' 18-inch Theodolite No. 2.**

Angle between	0° 2′	180° 2′	10° 13′	190° 13′	20° 20′	200° 20′	30° 30′	210° 30′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† X & VIII	h 67·26 h 67·20	h 66·30 h 65·20	l 70·27 l 69·10	l 62·36 l 63·17	h 67·50 h 68·53	l 55·87 l 56·00	h 63·84 h 65·36	h 65·83 h 64·26	l 64·73 l 68·57 l 69·10	h 66·60 h 67·67	l 67·20 l 69·76	l 70·26 l 67·40 l 68·20	M = 65″·89 w = 0·85 1/w = 1·18 C = 68° 8′ 5″·89
	67·23	65·75	69·69	62·76	68·02	55·93	64·60	65·05	67·47	67·13	68·48	68·62	
† VIII & V	h 11·70 h 12·47	h 13·60 h 11·20	l 16·86 l 17·57	l 16·43 l 16·24	h 17·77 h 17·80	l 25·30 l 22·80	h 21·60 h 20·97	h 19·90 h 20·84	h 26·84 l 25·10	h 20·30 h 19·16	l 12·63 l 12·90	l 15·50 l 15·40	M = 17″·95 w = 0·59 1/w = 1·71 C = 91° 40′ 17″·95
	12·09	12·40	17·21	16·34	17·78	24·05	21·29	20·37	25·97	19·73	12·76	15·45	
* V & IV	h 9·70 h 10·46 h 12·57	h 8·63 h 7·90	l 5·76 l 5·57	l 9·97 l 7·97	l 0·17 l 1·60	l 4·26 h 5·10	h 7·67 h 6·20 h 3·30	h 6·53 h 7·54	l 5·93 l 6·54	h 11·10 h 9·23	l 12·93 l 11·80 h 11·36	h 10·07 h 10·60	M = 7″·58 w = 1·16 1/w = 0·87 C = 40° 10′ 7″·59
	10·91	8·27	5·66	8·97	0·89	4·68	5·72	7·03	6·24	10·16	12·03	10·34	
* IV & VII	h 32·70 h 32·00	h 37·13 h 36·93	l 34·57 l 35·50 l 34·00	l 35·76 l 36·77	l 31·83 l 30·07	l 35·44 h 34·50	h 34·10 h 32·84	h 33·20 h 31·46	l 29·00 l 28·36	h 30·13 h 30·17	l 36·73 l 33·90 h 36·37	l 31·07 l 30·87	M = 33″·13 w = 1·67 1/w = 0·60 C = 47° 56′ 33″·13
	32·35	37·03	34·69	36·27	30·95	34·97	33·47	32·33	28·68	30·15	35·67	30·97	
* VII & IX	h 59·84 h 63·90 h 61·80	h 63·34 h 63·37	l 64·23 l 68·17 l 67·50	l 65·74 l 64·33	l 73·27 l 74·10	l 64·94 l 62·83 h 63·10	h 62·90 h 62·53	h 64·44 h 65·00	l 64·40 l 65·63 l 66·10	h 66·10 h 65·27	l 61·67 l 63·04 h 63·60	l 63·86 l 62·47	M = 64″·88 w = 1·19 1/w = 0·84 C = 52° 40′ 4″·87
	61·85	63·36	66·63	65·03	73·69	63·62	62·71	64·72	65·38	65·69	62·77	63·16	
* IX & X	h 56·50 h 56·90 h 52·94 h 55·07	h 56·10 h 56·00	l 52·24 l 47·83 l 48·23	l 55·76 l 54·47	l 42·87 l 43·83	l 58·70 l 60·73 h 63·37	h 46·60 h 45·83	h 47·83 h 47·44	l 51·43 l 47·24 l 46·60	h 46·67 h 48·30	l 46·97 l 49·56 h 47·63	l 46·04 l 47·93	M = 50″·42 w = 0·43 1/w = 2·30 C = 59° 24′ 50″·43
	55·35	56·05	49·43	55·12	43·35	60·93	46·21	47·64	48·42	47·48	48·05	46·99	

Circle readings, telescope being set on X

At VII (Wantra)

January 1851; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX 0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
IX & VI	″ l 34·34 l 34·63	″ l 33·40 l 35·66 h 29·30	″ l 32·20 l 31·30	″ l 35·26 l 37·36	″ l 36·27 l 35·27	″ l 34·60 l 32·07	″ l 35·20 l 37·90 l 36·90	″ l 32·16 l 35·33 l 35·97 l 32·50	″ l 32·07 l 31·07 l 31·43	″ l 32·74 l 30·33	″ l 31·47 l 35·54 l 32·50	″ l 34·33 l 32·83	M = 33″·74 w = 3·01 1/w = 0·33 C = 52° 15′ 33″·74
	34·49	32·79	31·75	36·31	35·77	33·33	36·67	33·99	31·52	31·54	33·17	33·58	
VI & IV	l 22·73 l 22·64	l 25·60 l 23·34 h 24·77	l 22·57 l 23·47	l 26·40 l 28·06 l 25·60	l 22·83 l 22·63	l 24·33 l 22·36 l 25·00	l 26·00 l 24·10	l 31·04 l 28·13 l 26·10	l 27·13 l 30·10	l 26·86 l 30·00 l 28·07	l 34·76 l 31·76 l 33·73	l 31·04 l 28·00	M = 26″·41 w = 1·03 1/w = 0·97 C = 78° 33′ 26″·42
	22·69	24·57	23·02	26·69	22·73	23·90	25·05	28·42	28·61	28·31	33·42	29·52	

At VIII (Dhámanwa)

‡ *February*; *and* § *November* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on V 304° 46′	124° 45′	314° 57′	184° 57′	325° 5′	145° 4′	335° 15′	155° 14′	345° 22′	165° 22′	355° 35′	175° 35′	M = Mean of Groups w = Relative Weight C = Concluded Angle
§ V & VI	″ l 29·34 l 31·20	″ l 34·46 l 36·57	″ l 34·13 l 33·64	″ l 32·66 l 30·43	″ l 35·80 l 32·13 l 33·93	″ l 38·97 l 37·36 l 39·00	″ l 34·56 l 32·33 l 35·36	″ l 31·24 l 30·13	″ l 31·70 l 29·93	″ l 32·60 l 31·27	″ l 31·63 l 32·64	″ l 31·64 l 32·83	
	30·27	35·52	33·88	31·55	33·95	38·44	34·08	30·68	30·82	31·93	32·14	32·23	M = 32″·96 w = 2·01
Lesser circle readings	267° 1′	87° 1′	277° 12′	97° 12′	287° 20′	107° 20′	297° 29′	117° 29′	307° 38′	127° 38′	317° 50′	137° 50′	
‡ V & VI	h 32·97 h 28·47	h 22·90 h 24·77	h 34·50 h 33·57	h 34·84 h 34·27	h 29·50 h 30·40	h 34·70 h 35·40	h 36·10 h 35·97 h 34·04 h 32·76 h 35·83	h 31·04 h 29·70	h 22·66 h 21·33	h 26·27 h 26·33	h 26·23 h 26·90	h 27·04 h 26·40	w = 2·59 1/w = 0·39 C = 55° 15′ 32″·23
	30·72	23·84	34·03	34·56	29·95	35·05	34·94	30·37	21·99	26·30	26·57	26·72	M = 29″·59 w = 0·58
‡ VI & X	h 52·10 h 52·53	h 55·83 h 53·90	h 47·36 h 46·87	h 45·00 h 45·03	h 51·00 h 49·43 h 46·33	l 46·06 l 44·97	l 43·13 h 42·24 h 40·20 h 41·76	l 41·27 l 41·14	h 48·90 h 49·00	h 48·63 h 48·84	h 46·70 h 46·16	h 47·96 h 47·17	M = 47″·37 w = 0·78 1/w = 1·29 C = 37° 44′ 47″·37
	52·32	54·86	47·12	45·01	48·92	45·52	41·83	41·20	48·95	48·74	46·43	47·56	

At IX (Moráli)

February 1851; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 28′	210° 29′	40° 38′	220° 38′	50° 49′	230° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & XI	l 12·16 l 15·20 l 15·73	l 12·90 l 15·23	l 17·23 l 15·30	l 18·87 h 18·87 h 19·37	h 26·27 h 23·46 h 24·83	h 15·50 h 15·76	l 23·97 l 25·97	l 22·63 l 23·44	l 26·77 l 29·16	l 26·00 l 27·67	h 22·60 h 20·87	h 24·04 h 24·47	$M = 21''·08$ $w = 0·47$ $\frac{1}{w} = 2·12$
	14·36	14·07	16·26	19·04	24·85	15·63	24·97	23·04	27·96	26·84	21·73	24·26	$C = 40° 36' 21''·08$
XI & X	l 64·94 l 65·90 l 63·77	l 62·23 l 60·90	l 64·87 l 64·23	l 62·40 h 61·33 l 62·27	h 59·30 h 60·30	h 58·74 h 59·97	l 53·83 l 54·23	l 65·87 l 63·66	l 53·27 l 53·40	l 62·43 l 61·36	h 58·53 h 57·63	h 58·66 h 58·43	$M = 60''·23$ $w = 0·80$ $\frac{1}{w} = 1·25$
	64·87	61·57	64·55	62·00	59·80	59·35	54·03	64·77	53·33	61·90	58·08	58·54	$C = 72° 42' 0''·23$
X & VI	l 24·06 l 21·00 l 21·80	l 23·57 l 24·30	h 22·23 h 23·06 l 22·20 l 21·80	h 22·36 h 20·57	h 25·33 h 25·60	h 25·16 h 24·93	l 30·67 l 29·20	l 20·10 l 19·00	l 32·80 l 29·74	l 24·60 l 24·24	h 27·84 h 27·27	h 26·84 h 26·30	$M = 24''·99$ $w = 0·99$ $\frac{1}{w} = 1·01$
	22·29	23·94	22·32	21·46	25·47	25·04	29·94	19·55	31·27	24·42	27·55	26·57	$C = 44° 12' 24''·99$
VI & VII	l 23·00 l 26·27 l 26·47	l 24·30 l 24·44	h 26·93 h 24·47	h 25·50 h 25·50	h 17·80 h 19·90	h 23·00 h 21·60	l 15·03 l 15·70	l 22·07 l 25·77 l 24·70	l 14·80 l 15·00	l 18·97 l 18·23	h 17·26 h 17·83	h 17·86 h 19·34	$M = 20''·93$ $w = 0·71$ $\frac{1}{w} = 1·40$
	25·25	24·37	25·70	25·50	18·85	22·30	15·37	24·18	14·90	18·60	17·54	18·60	$C = 75° 4' 20''·94$

At X (Warsora)

January 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	285° 54′	105° 54′	296° 6′	116° 5′	306° 13′	126° 13′	316° 22′	136° 22′	326° 31′	146° 31′	336° 43′	156° 43′	
	″	″	″	″	″	″	″	″	″	″	″	″	
VIII & VI	h 14·30 h 14·54	h 14·30 h 15·46	h 9·50 l 9·90	h 7·20 h 8·96 h 9·40	l 10·17 l 8·83	l 11·80 l 12·40	l 5·57 l 3·40	l 2·07 l 4·94 l 3·76	h 2·63 h 2·67	h 6·00 h 5·30	h 1·00 h 0·77	h 7·23 h 7·03	$M = 7''·79$ $w = 0·57$ $\frac{1}{w} = 1·74$
	14·42	14·88	9·70	8·52	9·50	12·10	4·49	3·59	2·65	5·65	0·88	7·13	$C = 74° 7' 7''·79$

At X (Warsora)—(*Continued*).

March 1851; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	285° 54′	105° 54′	296° 6′	116° 5′	306° 13′	126° 13′	316° 22′	136° 22′	326° 31′	146° 31′	336° 43′	156° 43′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	Circle readings, telescope being set on VIII												
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & IX	h 45·30	h 36·86	h 44·20	h 42·90	l 41·60	l 36·40	l 40·94	l 45·47	h 46·73	l 53·93	h 48·36	h 48·57	M = 44″·23
	h 45·87	h 40·03	h 41·13	h 42·10	l 41·87	l 37·00	h 44·80	l 46·10	l 49·73	l 50·86	h 47·53	h 46·16	w = 0·66
		h 40·07	h 41·93				h 41·83		l 45·67	h 50·60			1/w = 1·53
	45·59	38·99	42·42	42·50	41·73	36·70	42·52	45·79	47·38	51·80	47·94	47·37	C = 76° 22′ 44″·23
IX & XI	h 18·97	h 22·80	h 23·77	h 24·07	l 20·23	l 30·26	l 20·77	l 19·33	h 17·07	l 15·10	h 19·47	h 21·13	M = 21″·09
	h 19·17	h 22·83	h 21·63	h 22·37	l 19·80	l 30·76	h 22·60	l 20·37	l 16·90	l 14·47	h 20·07	h 21·20	w = 0·82
									l 17·80	h 15·43			1/w = 1·22
	19·07	22·82	22·70	23·22	20·01	30·51	21·69	19·85	17·26	15·00	19·77	21·16	C = 47° 15′ 21″·09
XI & XIII	h 12·63	h 9·40	h 9·86	h 10·37	l 16·67	l 5·44	l 8·06	l 13·57	h 11·36	l 10·76	h 12·83	h 10·54	M = 11″·10
	h 12·73	h 8·64	h 9·37	h 12·70	l 17·20	l 5·36	l 9·13	l 11·06	l 9·94	l 10·00	h 14·03	h 9·50	w = 1·47
							l 11·03		l 11·00	l 12·07			1/w = 0·68
							h 11·40			h 13·60			
	12·68	9·02	9·62	11·53	16·94	5·40	9·90	12·32	10·77	11·61	13·43	10·02	C = {60° 50′ 11″·10 *−0·37

At XI (Rakhiál)

February 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	Circle readings, telescope being set on XII												
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & XIV	h 54·73	h 53·37	h 53·46	h 50·50	h 50·37	h 50·26	h 52·17	h 54·23	h 59·37	h 56·83	l 54·94	l 52·43	M = 53″·29
	h 51·87	h 53·43	h 53·67	h 49·53	h 51·40	h 46·87	h 51·83	h 54·36	h 58·97	h 57·13	l 52·90	l 52·16	w = 1·52
						h 51·80							1/w = 0·66
	53·30	53·40	53·57	50·01	50·89	49·64	52·00	54·29	59·17	56·98	53·92	52·30	C = 72° 25′ 53″·28
XIV & XIX	d 4·93	d 7·53	d 12·14	d 12·98	h 17·03	h 19·24	h 8·13	h 10·90	h 7·37	h 7·33	l 9·10	l 10·57	M = 10″·47
	d 3·70	d 7·47	d 11·93	d 13·95	h 15·17	h 17·17	h 10·33	h 8·23	h 7·53	h 8·37	l 11·30	l 8·84	w = 0·82
						h 15·60		h 12·13					1/w = 1·21
	4·32	7·50	12·03	13·47	16·10	17·34	9·23	10·42	7·45	7·85	10·20	9·70	C = 48° 45′ 10″·48

* Correction to reduce to position of present station mark; see description of station XIII.

NOTE.—Station XIX appertains to the Guzerat Longitudinal Series.

At XI (Rakhiál)—(*Continued*).

******February* 1851; *and* †*February* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XII 0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† XIX & XIII	″ h 37·34 h 37·63	″ h 35·93 h 35·30	″ l 35·33 h 38·20	″ h 41·27 h 42·00	″ h 40·50 h 41·43	″ h 36·70 h 40·63	″ h 42·57 h 41·74	″ h 42·17 h 42·63	″ h 44·00 h 42·27	″ h 43·60 h 43·73	″ l 40·00 l 39·43	″ l 38·30 l 36·66	M = 39″·97 w = 1·55 1/w = 0·65
	37·49	35·61	36·77	41·63	40·97	38·66	42·16	42·40	43·13	43·67	39·71	37·48	C = 47° 2′ 39″·97
† XIII & X	h 28·27 h 26·97	h 28·90 h 28·70	h 23·50 h 25·97	h 27·03 h 27·03	h 29·80 h 32·20	h 26·86 h 26·53	h 24·06 h 23·73	h 30·90 h 32·07	h 27·60 h 27·27	h 30·84 h 30·40	l 26·20 l 26·33	l 29·26 l 31·90 l 29·60	M = 27″·99 w = 1·89 1/w = 0·53
	27·62	28·80	24·74	27·03	31·00	26·69	23·90	31·48	27·44	30·62	26·26	30·25	C = 45° 31′ 27″·99
Lesser circle readings	299° 58′	119° 59′	310° 9′	130° 9′	320° 17′	140° 17′	330° 26′	150° 26′	340° 35′	160° 35′	350° 47′	170° 47′	
* X & IX	″ h 43·34 h 42·23 h 41·77	″ l 44·23 l 44·24	″ l 44·50 l 41·83 l 43·54	″ l 44·50 l 45·44	″ h 35·43 h 36·93 h 35·17	″ h 46·63 h 46·80	″ h 43·47 h 38·44 h 40·43	″ h 37·56 h 36·23	″ h 38·27 h 35·67	″ h 36·43 h 40·13 h 36·97	″ l 29·53 l 33·20 l 29·76	″ l 34·90 l 35·04	M = 39″·65 w = 0·51 1/w = 1·97
	42·45	44·24	43·29	44·97	35·84	46·71	40·78	36·90	36·97	37·84	30·83	34·97	C = 60° 2′ 39″·64
* IX & XII	h 60·10 h 63·70 h 62·90	l 60·03 l 59·24	l 69·84 l 67·33 l 65·23	l 64·83 l 63·16	h 66·83 h 63·47 h 64·33	h 58·27 h 59·34	h 64·23 h 67·20 h 68·54	h 67·84 h 67·57	h 66·93 h 68·47	h 72·00 h 70·10 h 68·16	l 77·14 l 73·77 l 76·07	l 71·47 l 71·80	M = 66″·37 w = 0·49 1/w = 2·03
	62·23	59·64	67·47	63·99	64·88	58·81	66·66	67·70	67·70	70·09	75·66	71·64	C = 86° 12′ 6″·38

At XII (Amalyára)

***February* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XIV 295° 40′	115° 40′	305° 51′	125° 51′	315° 59′	135° 59′	326° 9′	146° 8′	336° 18′	156° 17′	346° 29′	166° 29′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XIV & XI	″ h 57·63 h 57·93	″ h 57·80 h 54·00 l 57·13	″ l 55·96 l 56·20	″ l 59·07 l 58·23	″ l 56·10 l 55·20	″ l 60·84 l 61·40	″ l 55·50 l 55·70	″ l 54·77 l 54·40	″ l 54·37 l 55·57	″ l 56·93 l 58·56	″ l 60·93 l 61·86	″ l 55·56 l 59·03 l 54·00	M = 57″·17 w = 2·17 1/w = 0·46
	57·78	56·31	56·08	58·65	55·65	61·12	55·60	54·59	54·97	57·74	61·40	56·20	C = 64° 20′ 57″·17

Note.—Station XIX appertains to the Guzerat Longitudinal Series.

At XII (Amalyára)—(*Continued*).

February* 1851; *observed by Lieutenant H. Rivers with Troughton and Simms' 18-inch Theodolite No. 2.

Angle between	Circle readings, telescope being set on XIV												*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	295° 40′	115° 40′	305° 51′	125° 51′	315° 59′	135° 59′	326° 9′	146° 8′	336° 18′	156° 17′	346° 29′	166° 29′	
XI & IX	″ h 32·03 h 31·47	″ h 31·37 h 31·07	″ l 33·16 l 35·56 l 34·97	″ h 31·10 l 28·50 l 29·97	″ h 33·66 h 34·60 h 33·03	″ h 32·27 h 30·27	″ h 41·56 h 38·60 h 39·46	″ h 33·30 h 34·06	″ l 27·80 l 32·13 l 34·47	″ l 37·23 l 37·33	″ l 31·80 l 33·40	″ l 35·57 l 34·10	*M* = 33″·51 *w* = 1·37 $\frac{1}{w}$ = 0·73 *C* = 53° 11′ 33″·51
	31·75	31·22	34·56	29·86	33·76	31·27	39·87	33·68	31·47	37·28	32·60	34·84	

At XIII (Lakwára)

February* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms' 18-inch Theodolite No. 2.

Angle between	Circle readings, telescope being set on X												*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	221° 44′	41° 44′	231° 55′	51° 55′	242° 3′	62° 3′	252° 11′	72° 12′	262° 21′	82° 21′	272° 32′	92° 32′	
X & XI	″ h 18·33 h 21·86 h 22·43	″ h 20·73 h 20·87 h 20·80	″ h 20·20 l 23·83 l 24·43	″ l 24·46 l 21·66	″ h 20·83 h 18·50	″ h 17·73 h 18·36	″ h 21·80 h 22·13	″ h 20·77 h 20·53	″ h 26·07 l 26·43 l 25·77	″ l 15·56 l 14·47	″ l 28·20 l 25·40 l 25·30	″ l 27·94 l 27·97	*M* = 21″·94 *w* = 0·86 $\frac{1}{w}$ = 1·16 *C* = 73° 38′ 21″·95
	20·87	20·80	22·82	23·06	19·67	18·04	21·97	20·65	26·09	15·01	26·30	27·96	
XI & XIX	h 18·87 h 18·50	h 16·07 h 19·13 h 17·70	h 14·40 l 11·50 l 14·80	l 12·87 l 15·47	h 19·17 h 21·30	h 21·37 h 20·00	h 14·03 h 14·44	h 14·30 h 13·60	h 16·50 l 14·70 l 13·73	l 15·90 l 17·03	l 16·80 l 13·87 l 16·33	l 15·30 l 12·40 l 11·40	*M* = 16″·11 *w* = 1·60 $\frac{1}{w}$ = 0·62 *C* = 64° 39′ 16″·10
	18·69	17·63	13·57	14·17	20·23	20·69	14·23	13·95	14·98	16·47	15·67	13·03	

At XIV (Bárdoli)

February* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms' 18-inch Theodolite No. 2.

Angle between	Circle readings, telescope being set on XVI												*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	227° 17′	47° 16′	237° 28′	57° 28′	247° 36′	67° 36′	257° 45′	77° 45′	267° 54′	87° 54′	278° 6′	98° 6′	
XVI & XIX	″ h 47·50 h 47·93	″ h 43·54 h 40·74 h 43·36	″ h 50·87 h 48·77	″ h 43·46 h 44·33	″ h 48·33 h 48·56	″ l 44·73 l 46·34	″ l 51·80 l 51·50 h 50·93 h 54·34	″ l 47·90 l 44·90 l 44·70	″ h 46·60 h 46·27	″ h 49·93 h 50·67	″ h 51·77 h 50·20	″ h 47·97 h 51·00 h 50·76	*M* = 47″·80 *w* = 1·28 $\frac{1}{w}$ = 0·78 *C* = 62° 31′ 47″·80
	47·72	42·55	49·82	43·89	48·45	45·53	52·14	45·83	46·44	50·30	50·98	49·91	

NOTE.—Stations XVI and XIX appertain to the Guzerat Longitudinal Series.

At XIV (Bárdoli)—(*Continued*).

Angle between	Circle readings, telescope being set on XVI												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	227° 17′	47° 16′	237° 28′	57° 28′	247° 36′	67° 36′	257° 45′	77° 45′	267° 54′	87° 54′	278° 6′	98° 6′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIX & XI	h 47·83	h 46·76	h 38·20	h 42·67	h 40·27	l 48·43	l 38·97	l 39·60	h 39·46	h 35·67	h 40·13	h 44·40	$M = 41''\cdot59$
	h 45·80	h 49·73	h 38·97	h 40·77	h 39·84	l 46·13	h 38·24	l 39·50	h 42·00	h 34·83	h 41·33	h 39·46	$w = 0\cdot73$
		h 48·14					h 36·30					h 43·14	$\frac{1}{w} = 1\cdot38$
							h 37·70						
	46·82	48·21	38·58	41·72	40·06	47·28	37·80	39·55	40·73	35·25	40·73	42·33	$C = 70°\ 12'\ 41''\cdot59$
XI & XII	h 2·90	h 4·07	h 9·70	h 12·50	h 12·90	l 2·77	l 13·13	l 15·50	h 19·00	h 13·63	h 5·10	h 9·06	$M = 10''\cdot03$
	h 4·70	h 3·17	h 10·10	h 9·27	h 13·16	l 2·37	l 16·77	l 16·80	h 16·16	h 14·27	h 7·34	h 5·60	$w = 0\cdot44$
							h 15·36		h 16·00		h 9·97	h 5·80	$\frac{1}{w} = 2\cdot25$
							h 15·27						
	3·80	3·62	9·90	10·89	13·03	2·57	15·13	16·15	17·05	13·95	7·47	6·82	$C = 43°\ 13'\ 10''\cdot04$

At XIX (Sanoda)

February 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIII												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	334° 55′	154° 54′	345° 5′	165° 5′	355° 13′	175° 13′	5° 22′	185° 22′	15° 31′	195° 31′	25° 43′	205° 43′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XIII & R.M.	h 30·67	h 36·93	h 28·44	l 27·44	h 24·73	h 28·53	l 25·73	h 23·47	h 24·33	h 26·97	h 25·77	h 25·90	$M = 27''\cdot70$
	h 29·06	h 37·50	h 29·90	l 30·50	h 23·33	h 28·27	h 23·26	h 25·77	h 24·93	h 27·14	h 25·83	h 27·17	$w = 0\cdot89$
			h 28·07								h 27·67	l 30·44	$\frac{1}{w} = 1\cdot13$
	29·87	37·21	28·80	28·97	24·03	28·40	24·50	24·62	24·63	27·05	26·42	27·84	$C = 25°\ 7'\ 27''\cdot70$
XIII & XI	h 60·74	h 66·73	d 59·06	d 62·37	h 62·36	h 63·77	l 68·43	d 62·76	h 63·90	h 61·64	d 61·49	d 62·01	$M = 62''\cdot95$
	h 60·53	h 68·27	d 61·14	d 65·33	h 61·60	h 62·47	h 65·86	d 65·06	h 63·73	h 61·40	d 61·22	d 59·00	$w = 1\cdot90$
		h 67·54	d 61·13	d 63·91								d 59·50	$\frac{1}{w} = 0\cdot53$
			d 60·33										
	60·64	67·51	60·41	63·87	61·98	63·12	67·15	63·91	63·81	61·52	61·36	60·17	$C = 68°\ 18'\ 2''\cdot95$
XI & XIV	h 9·93	h 10·54	h 10·54	l 6·56	h 4·80	h 8·86	l 8·07	h 4·20	h 4·93	h 9·76	h 6·26	l 9·03	$M = 7''\cdot73$
	h 8·70	h 7·93	h 11·83	h 8·50	h 6·73	h 10·27	h 5·60	h 5·30	h 6·53	h 10·24	l 3·70	l 6·24	$w = 2\cdot40$
							h 7·57						$\frac{1}{w} = 0\cdot42$
	9·32	9·23	11·19	7·53	5·76	9·57	7·08	4·75	5·73	10·00	4·98	7·63	$C = 61°\ 2'\ 7''\cdot73$

NOTE.—Stations XVI and XIX appertain to the Guzerat Longitudinal Series. R.M. denotes Referring Mark.

At XIX (Sanoda)—(*Continued*).

Angle between	Circle readings, telescope being set on XIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	334° 55′	154° 54′	345° 5′	165° 5′	355° 13′	175° 13′	5° 22′	185° 22′	15° 31′	195° 31′	25° 43′	205° 43′	
XIV & XVI	″ h 63·50 h 64·17	″ h 58·70 h 60·47	″ h 55·90 h 57·54	″ l 63·00 l 63·60	″ h 63·40 h 61·34	″ h 63·04 h 60·93	″ l 57·13 h 57·36 h 55·93	″ h 63·00 h 59·86 h 58·60	″ h 60·14 h 59·37	″ h 59·54 h 57·74	″ l 64·27 l 64·74	″ l 60·04 l 63·20 h 62·64	$M = 60''\cdot 83$ $w = 1\cdot 66$ $\frac{1}{w} = 0\cdot 60$
	63·84	59·58	56·72	63·30	62·37	61·99	56·81	60·49	59·75	58·64	64·51	61·96	$C = 49° 52' 0''\cdot 82$

At XVI (Mirzápur)

***February* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XIX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	63° 34′	243° 34′	73° 45′	253° 45′	83° 53′	263° 53′	94° 2′	274° 2′	104° 10′	284° 10′	114° 22′	294° 23′	
XIX & XIV	″ h 11·20 h 11·17	″ h 12·17 h 14·10	″ h 11·27 h 11·34	″ h 14·16 h 14·86	″ h 9·10 h 7·03	″ h 4·17 h 7·93 h 7·27	″ h 9·47 h 10·00	″ h 8·57 h 9·37	″ h 12·20 h 13·04	″ h 9·97 h 9·74	″ l 12·14 l 14·20 l 10·94	″ l 11·93 l 11·43 l 8·54	$M = 10''\cdot 74$ $w = 2\cdot 12$ $\frac{1}{w} = 0\cdot 47$
	11·19	13·13	11·31	14·51	8·06	6·46	9·74	8·97	12·62	9·85	12·43	10·63	$C = 67° 36' 10''\cdot 73$

NOTE.—Stations XVI and XIX appertain to the Guzerat Longitudinal Series.

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ABU MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. SUMS OF SQUARES OF APPARENT ERRORS.

Sums of Squares of Apparent Errors of Single Observations, and of Apparent Errors of Single Zeros.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XL	II & I	24	6·00	12	168·89	Troughton and Simms' 18-inch Theodolite No. 2.
„	I & XLIII	27	21·32	12	168·08	
XLIII	XL & I	24	8·88	12	138·51	
„	I & III	24	8·89	12	84·55	
I	XL & II	29	20·35	12	79·34	
„	II & IV	28	21·21	12	46·92	
„	IV & V	25	17·52	12	108·74	
„	V & III	26	25·19	12	68·31	
„	III & XLIII	26	18·18	12	103·12	
„	XLIII & XL	25	16·77	12	144·39	
II	IV & I	25	14·24	12	153·51	
„	I & XL	27	23·46	12	19·88	
III	XLIII & I	25	14·96	12	130·02	
„	I & V	27	35·54	12	137·28	
IV	VII & VI	28	29·99	12	149·05	
„	VI & V	30	63·55	12	153·79	
„	V & I	28	38·77	12	137·60	
„	I & II	27	37·94	12	122·32	

Note.—Stations XL and XLIII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
V	III & I	25	26·22	12	102·05	Troughton and Simms' 18-inch Theodolite No. 2.
„	I & IV	28	26·32	12	132·06	
„	IV & VI	25	15·53	12	127·86	
„	VI & VIII	27	10·87	12	102·88	
VI	X & VIII	26	24·13	12	150·37	
„	VIII & V	24	9·40	12	223·22	
„	V & IV	27	21·87	12	110·00	
„	IV & VII	26	11·18	12	76·81	
„	VII & IX	29	25·16	12	106·84	
„	IX & X	30	54·63	12	294·98	
VII	IX & VI	30	55·63	12	35·07	
„	VI & IV	30	42·77	12	121·79	
VIII	V & VI	27	24·24	12	60·93	
„	V & VI	27	24·07	12	223·86	
„	VI & X	27	18·95	12	166·11	
IX	XII & XI	27	24·35	12	275·61	
„	XI & X	26	8·80	12	163·00	
„	X & VI	27	14·52	12	131·11	
„	VI & VII	26	22·83	12	180·51	
X	VIII & VI	26	11·36	12	227·63	
„	VI & IX	29	39·91	12	194·72	
„	IX & XI	26	7·28	12	159·51	
„	XI & XIII	29	23·75	12	85·70	
XI	XII & XIV	25	20·12	12	82·16	
„	XIV & XIX	26	24·48	12	155·15	
„	XIX & XIII	24	16·22	12	81·53	
„	XIII & X	25	11·88	12	67·26	
„	X & IX	30	40·77	12	253·81	
„	IX & XII	30	50·48	12	260·20	
XII	XIV & XI	26	25·04	12	55·51	
„	XI & IX	29	40·17	12	89·29	
XIII	X & XI	29	33·48	12	146·97	
„	XI & XIX	29	35·88	12	76·42	
XIV	XVI & XIX	29	29·39	12	97·89	
„	XIX & XI	28	32·59	12	175·72	
„	XI & XII	29	40·36	12	290·27	
XIX	XIII & R.M.	27	28·22	12	143·16	
„	XIII & XI	29	20·82	12	66·00	
„	XI & XIV	25	22·30	12	50·08	
„	XIV & XVI	27	26·80	12	74·40	
XVI	XIX & XIV	27	25·27	12	57·26	

NOTE.—R.M. denotes Referring Mark. Stations XVI and XIX appertain to the Guzerat Longitudinal Series.

From the preceding data of the sums of the squares of the apparent errors, in the measurement of each angle, we may ascertain the *e.m.s.* (error of mean square) *of observation* of a single measure of an angle, and the *e.m.s. of graduation and observation* of the mean of the measures on a single zero, for each group of angles measured with the same instrument, by the same observer, and under similar circumstances.

The instrument employed was Troughton and Simms' 18-inch Theodolite No. 2, having 3 microscopes to read the azimuthal circle; observations were taken on 6 pairs of zeros (*face left* and *face right*) giving circle readings at 10° apart.

The *e.m.s of observation* of a single measure of an angle $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of observations.}}{\text{No. of observations} - \text{No. of angles} \times \text{No. of changes of zero.}}}$

The *e.m.s. of graduation and observation* of the mean of the measures on a single zero $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of zero.}}{\text{No. of angles} \times (\text{No. of changes of zero} - 1).}}$

Group	Instrument and Observer	Position of stations	Intervals between microscope readings of circle	Number of: Measures on each zero (average)	Number of: Angles	Number of: Single measures	Number of: Single zeros	*e. m. s.* of observation of a single measure	*e. m. s.* of graduation and observation of a single zero
			° ′					″	″
I	Troughton and Simms' 18 inch Theodolite No. 2; Lieutenant H. Rivers.	Hills,	10 0	2·24	30	807	360	$\left\{\frac{785\cdot27}{807-360}\right\}^{\frac{1}{2}} = \pm 1\cdot325$	$\left\{\frac{3732\cdot39}{360-30}\right\}^{\frac{1}{2}} = \pm 3\cdot363$
II	Ditto.	Plains,	10 0	2·26	29	786	348	$\left\{\frac{705\cdot53}{786-348}\right\}^{\frac{1}{2}} = \pm 1\cdot269$	$\left\{\frac{4057\cdot61}{348-29}\right\}^{\frac{1}{2}} = \pm 3\cdot566$

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ABU MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

Figure No. 15.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	77	32	45·76	1·12
2	63	29	8·66	1·31
3	38	58	9·51	1·07
4	53	23	17·39	0·81
5	42	41	39·20	0·66
6	83	55	5·11	1·01
7	57	33	15·19	0·56
8	54	11	1·39	1·09
9	68	15	44·88	0·82
10	46	7	16·70	0·85
11	92	38	46·03	1·04
12	41	13	58·00	1·10
13	53	18	47·42	0·38
14	46	17	32·52	0·98
15	80	23	41·67	1·19
16	72	4	37·54	0·63
17	56	20	56·60	0·18
18	51	34	25·93	1·29

Equations to be satisfied — **Factor**

$$x_1 + x_2 + x_3 = e_1 = +\ 0·80, \qquad \lambda_1$$
$$x_4 + x_5 + x_6 = e_2 = -\ 0·80, \qquad \lambda_2$$
$$x_7 + x_8 + x_9 = e_3 = -\ 0·10, \qquad \lambda_3$$
$$x_{10} + x_{11} + x_{12} = e_4 = -\ 1·04, \qquad \lambda_4$$
$$x_{13} + x_{14} + x_{15} = e_5 = -\ 0·57, \qquad \lambda_5$$
$$x_{16} + x_{17} + x_{18} = e_6 = -\ 1·95, \qquad \lambda_6$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = 0·00, \qquad \lambda_7$$
$$\left.\begin{matrix} 26\,x_3 & -\ 11\,x_2 & +\ 2\,x_6 \\ -\ 22\,x_5 & +\ 9\,x_9 & -15\,x_8 \\ +\ 24\,x_{13} & +\ x_{11} & +\ 4\,x_{15} \\ -\ 20\,x_{14} & +\ 17\,x_{18} & -14\,x_{17} \end{matrix}\right\} = e_8 = -\ 153·5, \qquad \lambda_8$$

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	+ 0·80	+3·50						+1·12	+ 13·41
2	− 0·80		+2·48					+0·81	− 12·50
3	− 0·10			+2·47				+0·56	− 8·97
4	− 1·04				+2·99			+0·85	+ 27·44
5	− 0·57			*		+2·55		+0·38	− 14·84
6	− 1·95						+2·10	+0·63	+ 19·41
7	0·00							+4·35	...
8	− 153·5								+2970·75

Values of the Factors

$\lambda_1 = +\ 0·4097$
$\lambda_2 = -\ 0·6619$
$\lambda_3 = -\ 0·2858$
$\lambda_4 = +\ 0·1539$
$\lambda_5 = -\ 0·5866$
$\lambda_6 = -\ 0·4254$
$\lambda_7 = +\ 0·1374$
$\lambda_8 = -\ 0·0587$

Angular errors in seconds

$x_1 = +\ ·61$	$x_7 = -\ ·08$	$x_{13} = -\ ·17$
$x_2 = +\ 1·38$	$x_8 = +\ ·65$	$x_{14} = +\ ·58$
$x_3 = -\ 1·19$	$x_9 = -\ ·67$	$x_{15} = -\ ·98$
$x_4 = -\ ·43$	$x_{10} = +\ ·25$	$x_{16} = -\ ·18$
$x_5 = +\ ·42$	$x_{11} = +\ ·09$	$x_{17} = +\ ·07$
$x_6 = -\ ·79$	$x_{12} = -\ 1·38$	$x_{18} = -\ 1·84$

$[wx^2] = 10·90$

* 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.

Figure No. 16.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	40	10	7·59	0·87
2	80	1	24·18	1·24
3	59	48	29·86	0·99
4	91	40	17·95	1·71
5	33	4	12·12	0·80
6	55	15	32·23	0·39
7	68	8	5·89	1·18
8	37	44	47·37	1·29
9	74	7	7·79	1·74
10	59	24	50·43	2·30
11	76	22	44·23	1·53
12	44	12	24·99	1·01
13	52	40	4·87	0·84
14	75	4	20·94	1·40
15	52	15	33·74	0·33
16	47	56	33·13	0·60
17	78	33	26·42	0·97
18	53	30	1·12	1·17

Equations to be satisfied — Factor

$$x_1 + x_2 + x_3 = e_1 = -0·92, \quad \lambda_1$$
$$x_4 + x_5 + x_6 = e_2 = -0·69, \quad \lambda_2$$
$$x_7 + x_8 + x_9 = e_3 = -0·12, \quad \lambda_3$$
$$x_{10} + x_{11} + x_{12} = e_4 = -1·32, \quad \lambda_4$$
$$x_{13} + x_{14} + x_{15} = e_5 = -1·97, \quad \lambda_5$$
$$x_{16} + x_{17} + x_{18} = e_6 = -1·44, \quad \lambda_6$$
$$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = -0·14, \quad \lambda_7$$
$$\left.\begin{array}{lll} 12x_3 & -4x_2 & +15x_6 \\ -32x_5 & +6x_9 & -27x_8 \\ +22x_{12} & -5x_{11} & +16x_{15} \\ -6x_{14} & +16x_{18} & -4x_{17} \end{array}\right\} = e_8 = -98·5, \quad \lambda_8$$

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	− 0·92	+3·10						+0·87	+ 6·92
2	− 0·69		+2·90					+1·71	− 19·75
3	− 0·12			+4·21				+1·18	− 24·39
4	− 1·32				+4·84			+2·30	+ 14·57
5	− 1·97					+2·57		+0·84	− 3·12
6	− 1·44						+2·74	+0·60	+ 14·84
7	− 0·14							+7·50	...
8	− 98·5								+3049·41

Values of the Factors

$\lambda_1 = -0·3687$

$\lambda_2 = -0·8108$

$\lambda_3 = -0·3954$

$\lambda_4 = -0·4214$

$\lambda_5 = -0·9895$

$\lambda_6 = -0·4477$

$\lambda_7 = +0·5470$

$\lambda_8 = -0·0367$

Angular errors in seconds

$x_1 = +·16$	$x_7 = +·18$	$x_{13} = -·37$
$x_2 = -·28$	$x_8 = +·77$	$x_{14} = -1·08$
$x_3 = -·80$	$x_9 = -1·07$	$x_{15} = -·52$
$x_4 = -·45$	$x_{10} = +·28$	$x_{16} = +·06$
$x_5 = +·29$	$x_{11} = -·36$	$x_{17} = -·29$
$x_6 = -·53$	$x_{12} = -1·24$	$x_{18} = -1·21$

$[wx^2] = 7·63$

Figure No. 17.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	60	2	39·64	1·97
2	72	42	0·23	1.25
3	47	15	21·09	1·22
4	45	31	27·99	0·53
5	60	50	10·73	0·68
6	73	38	21·95	1·16
7	47	2	39·97	0·65
8	64	39	16·10	0·62
9	68	18	2·95	0·53
10	48	45	10·48	1·21
11	61	2	7·73	0·42
12	70	12	41·59	1·38
13	72	25	53·28	0·66
14	43	13	10·04	2·25
15	64	20	57·17	0·46
16	86	12	6·38	2·03
17	53	11	33·51	0·73
18	40	36	21·08	2·12

Equations to be satisfied

Equations to be satisfied	Factor
$x_1 + x_2 + x_3 = e_1 = -\ 0·03,$	λ_1
$x_4 + x_5 + x_6 = e_2 = -\ 0·30,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -\ 1·86,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = -\ 1·02,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = -\ 0·24,$	λ_5
$x_{16} + x_{17} + x_{18} = e_6 = +\ 0·25,$	λ_6
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = -\ 2·26,$	λ_7
$\left.\begin{array}{lll} 19\ x_3 & -\ 7\ x_2 & +\ 7\ x_6 \\ -12\ x_5 & +\ 8\ x_9 & -10\ x_8 \\ +\ 7\ x_{12} & -11\ x_{11} & +10\ x_{15} \\ -22\ x_{14} & +24\ x_{18} & -16\ x_{17} \end{array}\right\} = e_8 = +\ 38·6,$	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	− 0·03	+4·44						+1·97	+ 14·43
2	− 0·30		+2·37					+0·53	− 0·04
3	− 1·86			+1·80				+0·65	− 1·96
4	− 1·02				+3·01			+1·21	+ 5·04
5	− 0·24					+3·37		+0·66	− 44·90
6	+ 0·25						+4·88	+2·03	+ 39·20
7	− 2·26							+7·05	...
8	+ 38·6								+3413·79

Values of the Factors

$\lambda_1 = +\ 0·0519$

$\lambda_2 = -\ 0·0757$

$\lambda_3 = -\ 0·9390$

$\lambda_4 = -\ 0·2683$

$\lambda_5 = +\ 0·1343$

$\lambda_6 = +\ 0·0472$

$\lambda_7 = -\ 0·2229$

$\lambda_8 = +\ 0·0122$

Angular errors in seconds

$x_1 = -\ ·33$	$x_7 = -\ ·75$	$x_{13} = -\ ·06$
$x_2 = -\ ·04$	$x_8 = -\ ·66$	$x_{14} = -\ ·30$
$x_3 = +\ ·34$	$x_9 = -\ ·45$	$x_{15} = +\ ·12$
$x_4 = -\ ·16$	$x_{10} = -\ ·60$	$x_{16} = -\ ·36$
$x_5 = -\ ·15$	$x_{11} = -\ ·17$	$x_{17} = -\ ·11$
$x_6 = +\ ·01$	$x_{12} = -\ ·25$	$x_{18} = +\ ·72$

$[wx^2] = 3·00$

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ABU MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
87		XLIII (Jeráj)	1·04	+1·19	+ ·35		+1·54	38 58 10·01	4·9893075,5	97568·03	18·479
		XL (Márd)	1·04	−1·38	+ ·22		−1·16	63 29 6·46	5·1424568,8	138821·56	26·292
		I (Gori)	1·05	−0·61	− ·57		−1·18	77 32 43·53	5·1803796,3	151488·48	28·691
			3·13				− ·80	180 0 0·00			
88		XL (Márd)	·67	+1·84	+ ·67		+2·51	51 34 27·77	4·9629541,6	91823·57	17·391
		I (Gori)	·68	+ ·18	− ·31		− ·13	72 4 36·73	5·0473571,6	111521·12	21·121
		II (Kherwa)	·67	− ·07	− ·36		− ·43	56 20 55·50	4·9893075,5	97568·03	18·479
			2·02				+1·95	180 0 0·00			
89		II (Kherwa)	·73	+ ·98	+ ·45		+1·43	80 23 42·37	5·0977631,3	125245·79	23·721
		I (Gori)	·73	+ ·17	− ·10		+ ·07	53 18 46·76	5·0080204,4	101863·93	19·292
		IV (Kaináth)	·72	− ·58	− ·35		− ·93	46 17 30·87	4·9629541,6	91823·57	17·391
			2·18				+ ·57	180 0 0·00			
90		I (Gori)	·59	− ·25	+ ·27		+ ·02	46 7 16·13	4·9560453,2	90374·38	17·116
		IV (Kaináth)	·59	+1·38	− ·08		+1·30	41 13 58·71	4·9171924,5	82640·41	15·652
		V (Kárdo)	·59	− ·09	− ·19		− ·28	92 38 45·16	5·0977631,3	125245·79	23·721
			1·77				+1·04	180 0 0·00			
	208	XLIII (Jeráj)	·83	− ·42		+ ·57	+ ·15	42 41 38·52	4·9761913,7	94665·43	17·929
		I (Gori)	·83	+ ·43		+ ·23	+ ·66	53 23 17·22	5·0494583,6	112062·00	21·224
		III (Siniána)	·84	+ ·79		− ·80	− ·01	83 55 4·26	5·1424568,8	138821·56	26·292
			2·50				+ ·80	180 0 0·00			

NOTES.—1. The values of the sides are given in the same lines with the opposite angles.
2. Stations XL (Márd) and XLIII (Jeráj) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
	209	III (Siniána)	·52	− ·65		+ ·39	− ·26	54 11 0·61	4·9171924,5	82640·41	15·652
		I (Gori)	·52	+ ·08		+ ·48	+ ·56	57 33 15·23	4·9345184,3	86003·95	16·289
		V (Kárdo)	·52	+ ·67		− ·87	− ·20	68 15 44·16	4·9761913,7	94665·43	17·929
			1·56				+ ·10	180 0 0·00			
91		V (Kárdo)	·85	+ ·80	+ ·34		+1·14	59 48 30·15	5·0831504,3	121101·76	22·936
		IV (Kaináth)	·85	+ ·28	+ ·21		+ ·49	80 1 23·82	5·1398441,8	137988·91	26·134
		VI (Pára)	·85	− ·16	− ·55		− ·71	40 10 6·03	4·9560453,2	90374·38	17·116
			2·55				+ ·92	180 0 0·00			
92		IV (Kaináth)	·70	+1·21	+ ·29		+1·50	53 30 1·92	4·9970515,3	99323·39	18·811
		VI (Pára)	·70	− ·06	+ ·01		− ·05	47 56 32·38	4·9625492,7	91737·99	17·375
		VII (Wantra)	·71	+ ·29	− ·30		− ·01	78 33 25·70	5·0831504,3	121101·76	22·936
			2·11				+1·44	180 0 0·00			
93		VII (Wantra)	·50	+ ·52	+ ·32		+ ·84	52 15 34·08	4·9100222,7	81287·22	15·395
		VI (Pára)	·51	+ ·37	− ·01		+ ·36	52 40 4·72	4·9124013,8	81733·74	15·480
		IX (Moráli)	·51	+1·08	− ·31		+ ·77	75 4 21·20	4·9970515,3	99323·39	18·811
			1·52				+1·97	180 0 0·00			
94		VI (Pára)	·32	− ·28	+ ·31		+ ·03	59 24 50·14	4·8573475,5	72002·49	13·637
		IX (Moráli)	·32	+1·24	− ·23		+1·01	44 12 25·68	4·7658033,1	58318·09	11·045
		X (Warsora)	·33	+ ·36	− ·08		+ ·28	76 22 44·18	4·9100222,7	81287·22	15·395
			·97				+1·32	180 0 0·00			
	210	V (Kárdo)	0·99	− ·29		+ ·11	− ·18	33 4 10·95	4·9620342,2	91629·28	17·354
		VI (Pára)	1·00	+ ·45		+ ·12	+ ·57	91 40 17·52	5·2249280,3	167852·60	31·790
		VIII (Dhámanwa)	1·00	+ ·53		− ·23	+ ·30	55 15 31·53	5·1398441,8	137988·91	26·134
			2·99				+ ·69	180 0 0·00			
	211	VIII (Dhámanwa)	·39	− ·77		+ ·07	− ·70	37 44 46·28	4·7658033,1	58318·09	11·045
		VI (Pára)	·39	− ·18		+ ·12	− ·06	68 8 5·44	4·9465124,5	88412·26	16·745
		X (Warsora)	·39	+1·07		− ·19	+ ·88	74 7 8·28	4·9620342,2	91629·28	17·354
			1·17				+ ·12	180 0 0·00			
95		IX (Moráli)	·33	+ ·04	+ ·17		+ ·21	72 42 0·11	4·8995182,6	79344·76	15·027
		X (Warsora)	·33	− ·34	+ ·27		− ·07	47 15 20·69	4·7855507,0	61031·03	11·559
		XI (Rakhiál)	·33	+ ·33	− ·44		− ·11	60 2 39·20	4·8573475,5	72002·49	13·637
			·99				+ ·03	180 0 0·00			
96		X (Warsora)	·32	+ ·15	+ ·38		+ ·53	60 50 10·94	4·8585993,1	72210·33	13·676
		XI (Rakhiál)	·32	+ ·16	− ·32		− ·16	45 31 27·51	4·7708929,5	59005·56	11·175
		XIII (Lakwára)	·33	− ·01	− ·06		− ·07	73 38 21·55	4·8995182,6	79344·76	15·027
			·97				+ ·30	180 0 0·00			
97		XIII (Lakwára)	·29	+ ·66	+ ·35		+1·01	64 39 16·82	4·8465645,9	70236·77	13·302
		XI (Rakhiál)	·29	+ ·75	− ·30		+ ·45	47 2 40·13	4·7549607,2	56880·15	10·773
		XIX (Sanoda)	·30	+ ·45	− ·05		+ ·40	68 18 3·05	4·8585993,1	72210·33	13·676
			·88				+1·86	180 0 0·00			
98		XI (Rakhiál)	·27	+ ·60	+ ·20		+ ·80	48 45 11·01	4·7491444,6	56123·46	10·629
		XIX (Sanoda)	·27	+ ·17	+ ·29		+ ·46	61 2 7·92	4·8149672,5	65308·13	12·369
		XIV (Bárdoli)	·28	+ ·25	− ·49		− ·24	70 12 41·07	4·8465645,9	70236·77	13·302
			·82				+1·02	180 0 0·00			
	212	IX (Moráli)	·24	− ·72		− ·04	− ·76	40 36 20·08	4·6955860,6	49611·93	9·396
		XI (Rakhiál)	·24	+ ·36		+ ·40	+ ·76	86 12 6·90	4·8811514,6	76059·15	14·405
		XII (Amalyára)	·24	+ ·11		− ·36	− ·25	53 11 33·02	4·7855507,0	61031·03	11·559
			·72				− ·25	180 0 0·00			

Note.—Station XIX (Sanoda) appertains to the Guzerat Longitudinal Series.

No. of Triangle Circuit	No. of Triangle Non-circuit	Number and Name of Station	Spherical Excess	Corrections to Observed Angle: Figure	Circuit	Non-circuit	Total	Corrected Plane Angle	Distance: Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
	213	XII (Amalyára)	·24	− ·12		− ·10	− ·22	64 20 56·71	4·8149672,4	65308·13	12·369
		XI (Rakhiál)	·25	+ ·06		+ ·46	+ ·52	72 25 53·55	4·8392820,2	69068·81	13·081
		XIV (Bárdoli)	·24	+ ·30		− ·36	− ·06	43 13 9·74	4·6955860,6	49611·93	9·396
			·73				+ ·24	180 0 0·00			
99		XIV (Bárdoli)	·18	+ ·51	+ ·04		+ ·55	62 31 48·17	4·7312541,0	53858·48	10·200
		XIX (Sanoda)	·18	+ ·39	+ ·19		+ ·58	49 51 1·22	4·6666128,1	46410·13	8·790
		XVI (Mirzápur)	·19	+ ·30	− ·23		+ ·07	67 36 10·61	4·7491444,6	56123·46	10·629
			·55				+1·20	180 0 0·00			

NOTE.—Stations XVI (Mirzápur) and XIX (Sanoda) appertain to the Guzerat Longitudinal Series.

July, 1890.

W. H. COLE,

In charge of Computing Office.

ABU MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XL (Márd)	24 24 9·27	72 59 48·01	92 1 19·17	5·1803796,3	271 50 2·18	XLIII (Jeráj)
	" "	"	"	28 32 11·67	4·9893075,5	208 28 44·65	I (Gori)
	" "	"	"	336 57 43·23	5·0473571,6	157 0 56·82	II (Kherwa)
40	XLIII (Jeráj)	24 24 59·77	72 32 29·86	310 48 13·23	5·1424568,8	130 56 0·07	I (Gori)
"	" "	"	"	353 29 52·58	5·0494583,6	173 30 48·87	III (Siniána)
41	I (Gori)	24 9 59·83	72 51 24·66	280 33 22·06	4·9629541,6	100 40 0·65	II (Kherwa)
"	" "	"	"	77 32 42·02	4·9761913,7	257 25 53·97	III (Siniána)
"	" "	"	"	333 52 9·55	5·0977631,3	153 56 11·38	IV (Kaináth)
"	" "	"	"	19 59 26·27	4·9171924,5	199 57 22·09	V (Kárdo)
	II (Kherwa)	24 7 12·30	73 7 39·15	20 16 17·55	5·0080204,4	200 13 42·97	IV (Kaináth)
	III (Siniána)	24 6 36·64	72 34 46·84	311 36 55·10	4·9345184,3	131 41 37·41	V (Kárdo)
	IV (Kaináth)	23 51 25·42	73 1 18·93	112 42 12·08	4·9560453,2	292 36 7·84	" "
	" "	"	"	32 40 47·41	5·0831504,3	212 36 4·67	VI (Pára)
	" "	"	"	339 10 44·79	4·9625492,7	159 13 5·96	VII (Wantra)
42	V (Kárdo)	23 57 10·29	72 46 20·06	352 24 38·84	5·1398441,8	172 25 57·79	VI (Pára)
"	" "	"	"	25 28 50·78	5·2249280,3	205 23 38·30	VIII (Dhámanwa)
43	VI (Pára)	23 34 35·02	72 49 35·98	260 32 37·75	4·9970515,3	80 39 39·55	VII (Wantra)
"	" "	"	"	80 45 39·27	4·9620342,2	260 39 10·83	VIII (Dhámanwa)
"	" "	"	"	313 12 42·98	4·9100222,7	133 16 56·65	IX (Moráli)
"	" "	"	"	12 37 33·44	4·7658033,1	192 36 38·87	X (Warsora)
	VII (Wantra)	23 37 15·71	73 7 9·60	28 24 4·97	4·9124013,8	208 21 18·36	IX (Moráli)
	VIII (Dhámanwa)	23 32 8·41	72 33 24·00	298 23 57·50	4·9465124,5	118 29 30·20	X (Warsora)
	IX (Moráli)	23 25 23·18	73 0 12·14	89 4 30·65	4·8573475,5	268 59 23·38	" "
	" "	"	"	16 22 30·21	4·7855507,0	196 21 17·10	XI (Rakhiál)
	" "	"	"	335 46 9·89	4·8811514,6	155 48 22·43	XII (Amalyára)

NOTE.—Stations XL (Márd) and XLIII (Jeráj) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
44	X (Warsora)	23 25 11·13	72 47 19·10	316 14 44·40	4·8995182,6	136 18 37·57	XI (Rakhiál)
"	" "	"	"	17 4 55·66	4·7708929,5	197 3 42·00	XIII (Lakwára)
	XI (Rakhiál)	23 15 42·94	72 57 7·61	282 33 24·24	4·6955860,6	102 36 49·17	XII (Amalyára)
	" "	"	"	90 47 9·74	4·8585993,1	270 42 3·88	XIII (Lakwára)
	" "	"	"	354 59 18·04	4·8149672,5	174 59 42·09	XIV (Bárdoli)
	" "	"	"	43 44 29·32	4·8465645,9	223 41 4·42	XIX (Sanoda)
	XII (Amalyára)	23 13 55·83	73 5 46·86	38 15 52·22	4·8392820,2	218 12 52·07	XIV (Bárdoli)
45	XIII (Lakwára)	23 15 52·23	72 44 13·21	335 21 20·99	4·7549607,2	155 23 1·07	XIX (Sanoda)
	XIV (Bárdoli)	23 4 58·28	72 58 8·71	42 15 12·39	4·6666128,1	222 13 1·69	XVI (Mirzápur)
	" "	"	"	104 47 0·74	4·7491444,6	284 43 12·61	XIX (Sanoda)
	XVI (Mirzápur)	22 59 17·79	72 52 34·70	154 36 50·89	4·7312541,0	334 35 14·01	XIX (Sanoda)
46	XIX (Sanoda)	23 7 19·89	72 48 27·32				

NOTE.—Stations XVI (Mirzápur) and XIX (Sanoda) appertain to the Guzerat Longitudinal Series.

July, 1890.

W. H. COLE,
In charge of Computing Office.

ABU 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 levelling operations, wherever a junction between the two has been effected, or, which are developed on the completion of a trigonometrical chain forming a circuit or lying between points already fixed. The last mentioned case is the one presented by the present series, which is adjusted between the stations of Márd and Jeráj of the Karáchi Longitudinal Series of the North-West Quadrilateral, and Sanoda and Mirzápur of the Guzerat Longitudinal Series. The trigonometrical heights always refer to the upper mark in the surface of the circular pillar on which the theodolite stood.

The height given in the last column is the approximate height of the structure above the ground at the base of the station.

The heights of the initial stations above Mean Sea Level are taken from the Karáchi Longitudinal Series of the North-West Quadrilateral, and are as follows:—

XL (Márd) 3080·3 feet; XLIII (Jeráj) 3575·2 feet.

Astronomical Date 1851	Mean of Times of observation	Number and Name of 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. 31	2 44	XL (Márd)	D 0 16 28·7	4	3·7	5·3	965	53	·054	−262·6	2817·7	2817·4	2817	2·8
Apr. 5	2 57	I (Gori)	E 0 2 1·6	4	3·7	5·3								
" 18	2 59	XLIII (Jeráj)	D 0 28 54·0	4	3·7	5·5	1371	80	·059	−758·1	2817·1			
" 7	2 40	I (Gori)	E 0 8 36·8	4	2·6	5·3								

Astronomical Date 1851	Mean of Times of observation	Number and Name of 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	Mean	Final Result	Height of Pillar or Tower
	h m		° ′ ″				″							feet
Mar. 31	2 53	XL (Márd)	D 1 10 59·4	4	3·8	5·3	1104	61	·055	−2036·2	1044·1	1044·9	1045	3
„ 28	3 28	II (Kherwa)	E 0 54 31·0	4	3·7	5·3								
Apr. 7	2 53	I (Gori)	D 1 12 59·5	6	3·9	5·3	905	55	·061	−1771·7	1045·7			
Mar. 28	3 20	II (Kherwa)	E 0 59 41·5	4	5·2	5·3								
Apr. 18	3 9	XLIII (Jeráj)	D 1 28 40·2	4	3·8	5·5	1110	61	·055	−2621·3	953·9	953·4	953	3·9
„ 11	3 23	III (Siniána)	E 1 12 4·6	4	2·5	5·3								
„ 7	3 18	I (Gori)	D 1 14 36·2	4	3·6	5·3	933	55	·059	−1864·5	952·9			
„ 10	3 23	III (Siniána)	E 1 0 46·9	4	3·7	5·3								
„ 7	3 6	I (Gori)	D 0 42 8·3	4	3·8	5·3	1240	75	·060	−1202·9	1614·5	1614·5	1615	2·9
Mar. 22	3 59	IV (Kaináth)	E 0 23 52·9	4	3·6	5·3								
„ 28	3 42	II (Kherwa)	E 0 11 48·4	4	3·8	5·3	1009	62	·062	+ 569·8	1614·7			
„ 22	3 26	IV (Kaináth)	D 0 26 39·4	4	3·7	5·3								
„ 18	3 27	V (Kárdo)	E 0 8 36·4	4	3·7	5·3	891	53	·059	+ 399·9	1614·2			
„ 22	3 49	IV (Kaináth)	D 0 21 48·8	4	3·9	5·3								
Apr. 5	3 15	I (Gori)	D 1 12 46·2	4	3·9	5·3	818	49	·060	−1603·8	1213·6	1214·4	1214	3·8
Mar. 18	3 41	V (Kárdo)	E 1 0 37·5	4	3·6	5·3								
Apr. 10	3 35	III (Siniána)	E 0 4 8·3	4	3·9	5·3	849	49	·058	+ 261·6	1215·0			
Mar. 18	3 47	V (Kárdo)	D 0 16 46·5	4	3·9	5·3								
„ 22	3 49	IV (Kaináth)	D 0 21 48·8	4	3·9	5·3	891	53	·059	− 399·9	1214·7			
„ 18	3 27	V (Kárdo)	E 0 8 36·4	4	3·7	5·3								
„ 22	3 41	IV (Kaináth)	D 0 41 40·7	4	3·8	5·3	1198	72	·060	−1157·4	457·1	458·9	459	20
„ 12,13	3 44	VI (Pára)	E 0 24 1·7	8	3·7	5·3								
„ 18	3 35	V (Kárdo)	D 0 28 56·2	4	3·9	5·3	1367	76	·056	− 753·7	460·7			
„ 13	3 34	VI (Pára)	E 0 8 36·8	4	3·9	5·3								
„ 22	3 32	IV (Kaináth)	D 0 37 39·9	4	3·9	5·3	908	53	·058	− 825·2	789·3	788·5	789	2·9
Jan. 29	2 56	VII (Wantra)	E 0 24 10·7	4	3·9	5·3								
Mar. 12	3 22	VI (Pára)	E 0 3 57·8	4	3·9	5·3	979	48	·049	+ 328·7	787·6			
Jan. 29	3 13	VII (Wantra)	D 0 18 47·3	4	3·8	5·3								
1852														
Jan. 23	2 43	V (Kárdo)	D 0 28 14·5	6	3·9	5·5	1661	106	·064	− 787·4	427·0	429·2	429	32
„ 31, Feb. 2	3 24	VIII (Dhámanwa)	E 0 4 0·4	8	3·8	5·4								
Feb. 5	4 53	VI (Pára)	D 0 8 8·3	4	3·8	5·4	903	29	·032	− 27·6	431·3			
„ 2	4 22	VIII (Dhámanwa)	D 0 5 41·7	4	13·8	5·4								
1851														
Mar. 13	3 55	VI (Pára)	D 0 6 37·9	4	3·9	5·3	803	− 7	·008	+ 5·5	464·4	465·8	466	10
Feb. 4	3 0	IX (Moráli)	D 0 7 2·7	4	5·5	5·3								
Jan. 29	3 22	VII (Wantra)	D 0 19 39·1	4	3·8	5·3	809	49	·060	− 324·8	463·7			
Feb. 4	2 49	IX (Moráli)	E 0 7 40·2	4	3·9	5·3								

Note.—Stations XL (Márd) and XLIII (Jeráj) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Astronomical Date 1851		Mean of Times of observation	Number and Name of 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.	4	3 31	X (Warsora)	D 0 2 19·6	4	3·9	5·3	709	21	·029	+ 69·3	469·2			
Feb.	4	3 10	IX (Moráli)	D 0 8 55·3	4	4·3	5·3								
1852															
„	5	3 35	VI (Pára)	D 0 8 21·0	4	4·0	5·4	578	6	·010	− 60·3	398·6			
Jan.	17	2 48	X (Warsora)	D 0 1 15·7	4	3·8	5·5								
„	31, Feb. 2	3 29	VIII (Dhámanwa)	D 0 8 2·3	8	4·0	5·4	872	22	·026	− 28·0	401·2	398·2	398	25
„	16	3 40	X (Warsora)	D 0 5 51·2	6	4·3	5·5								
1851															
Feb.	4	3 10	IX (Moráli)	D 0 8 55·3	4	4·3	5·3	709	21	·029	− 69·3	394·8			
Mar.	4	3 31	X (Warsora)	D 0 2 19·6	4	3·9	5·3								
Feb.	5	3 27	IX (Moráli)	D 0 11 34·5	4	3·7	5·3	604	16	·026	−119·2	346·6			
„	25	2 56	XI (Rakhiál)	E 0 1 52·1	4	3·9	5·2						346·8	347	22
Mar.	4	4 40	X (Warsora)	D 0 8 41·6	6	4·3	5·3	784	7	·008	− 51·3	346·9			
Feb.	26	4 52	XI (Rakhiál)	D 0 4 14·3	4	4·4	5·2								
„	5	3 16	IX (Moráli)	D 0 10 4·8	4	3·8	5·3	753	25	·033	− 91·9	373·9			
„	8	3 30	XII (Amalyára)	D 0 1 46·1	4	3·9	5·3						374·3	375	5
„	25	3 11	XI (Rakhiál)	D 0 2 3·3	6	3·9	5·2	489	11	·022	+ 27·9	374·7			
„	8	3 20	XII (Amalyára)	D 0 5 56·1	4	3·7	5·3								
1852															
Jan.	17	2 58	X (Warsora)	D 0 10 22·8	4	4·2	5·5	584	27	·045	−100·9	297·3			
Feb.	9	3 2	XIII (Lakwára)	E 0 1 21·3	6	3·8	5·4						297·4	298	22
„	11	4 52	XI (Rakhiál)	D 0 8 8·1	6	4·3	5·5	711	12	·017	− 49·4	297·4			
„	9	3 47	XIII (Lakwára)	D 0 3 20·8	4	6·0	5·4								
„	11	3 44	XI (Rakhiál)	D 0 10 27·5	6	4·1	5·5	694	9	·013	− 97·2	249·6			
„	17	4 6	XIX (Sanoda)	D 0 0 57·2	6	3·8	5·4						250·2	250	†
„	9	3 23	XIII (Lakwára)	D 0 7 56·9	4	4·1	5·4	563	−21	·038	− 46·7	250·7			
„	17	3 49	XIX (Sanoda)	D 0 2 18·4	6	3·9	5·4								
„	13	3 39	XI (Rakhiál)	D 0 7 28·9	4	3·8	5·5	647	15	·023	− 42·8	304·0			
„	16	3 23	XIV (Bárdoli)	D 0 2 58·3	4	3·8	5·4						302·5	303	22
„	17	3 8	XIX (Sanoda)	D 0 1 22·4	4	3·8	5·4	553	14	·025	+ 50·7	300·9			
„	16	3 31	XIV (Bárdoli)	D 0 7 33·8	6	4·1	5·4								
„	16	3 38	XIV (Bárdoli)	D 0 8 26·4	4	3·8	5·4	459	18	·038	− 64·7	237·8			
„	23	3 16	XVI (Mirzápur)	E 0 1 8·0	4	3·8	5·5						237·2	238	18
„	17	3 18	XIX (Sanoda)	D 0 5 10·4	4	3·8	5·4	533	14	·027	− 13·7	236·5			
„	23	3 6	XVI (Mirzápur)	D 0 3 26·1	4	3·8	5·5								

Note.—Stations XVI (Mirzápur) and XIX (Sanoda) appertain to the Guzerat Longitudinal Series. † Not forthcoming.

July, 1890.

W. H. COLE,
In charge of Computing Office.

Fig. No. 15

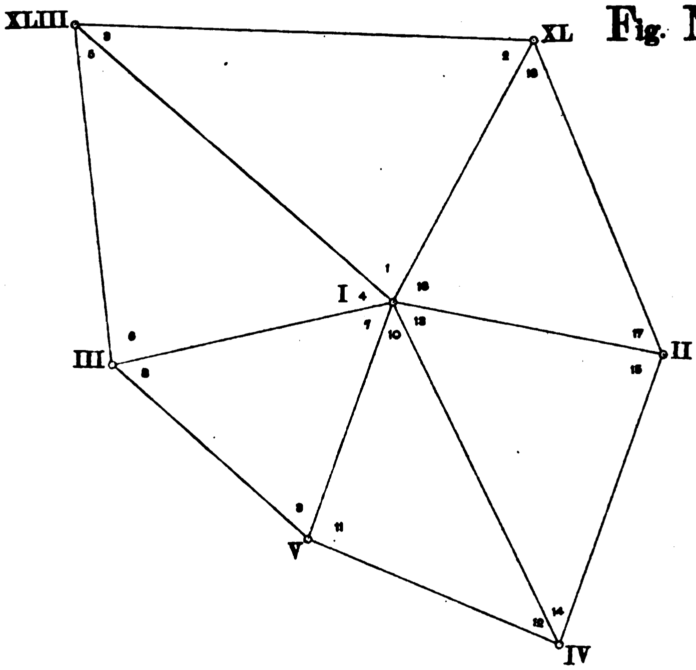


Fig. No. 16

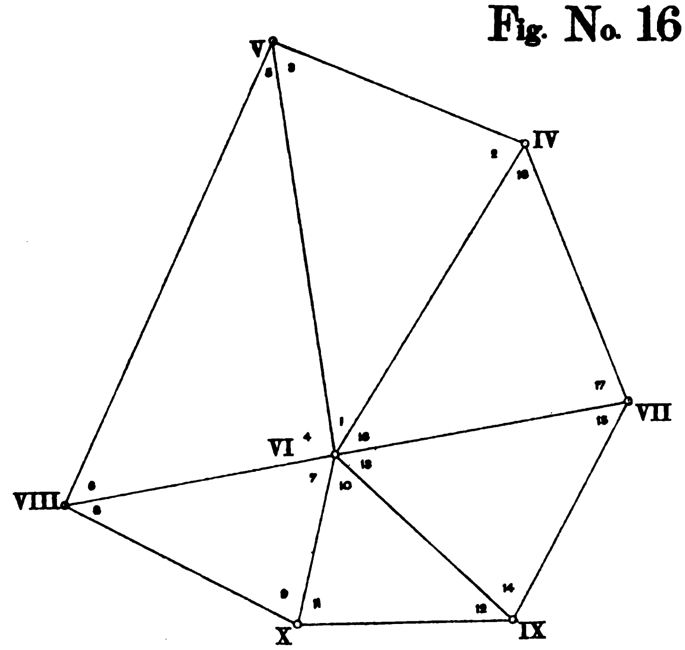
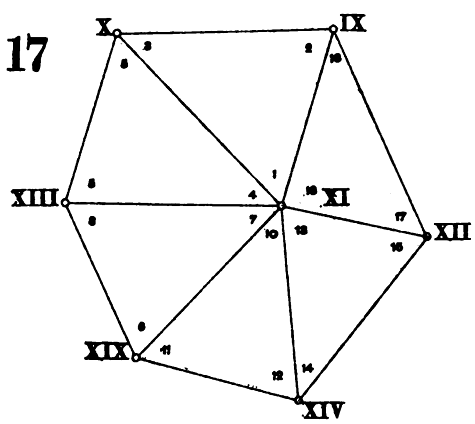


Fig. No. 17



Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, January 1869.

KATTYWAR MERIDIONAL SERIES.

KATTYWAR MERIDIONAL SERIES.

INTRODUCTION.

The Kattywar (Káthiáwár) Meridional Series of the South-West Quadrilateral is the chain of Principal Triangles that follows the meridian of 71° from the parallel of 24° 40′ to that of 20° 40′. It originates in the deserts of Sind, crosses the Ran and eastern districts of Cutch (Kachh), and thence runs straight down the centre of the Kattywar peninsula terminating in the island of Diu (Dív). It emanates from the side Bhilgaon–Akoria of the Karáchi Longitudinal Series: it is joined in latitude 23° 30′ from the west by the Cutch Coast Series at the side Chitror–Wándia, and in latitude 23° from the east by the Guzerat (Gujarát) Longitudinal Series at the side Chalarwa–Sápakra: south of this it has no further connection with any exterior Principal Triangulation. In the simultaneous reduction, therefore, of the South-West Quadrilateral, the portion of the Series under review between Bhilgaon and Wándia entered into the two circuits of triangulation situated one on either side of it, the next portion between Wándia and Sápakra entered into the eastern of these circuits, whilst the southern half from Dúngarpur to Dangarwári did not enter into the reduction at all, being only an exterior pendent of the Quadrilateral without any closing check to shew the errors accumulated in length or direction.

The Kattywar Meridional Series consists of three compound figures, one hexagon, one pentagon, three quadrilaterals and seven single triangles, and extends over a distance of 275 miles. The portion south of latitude 23° was designed in 1850 in conjunction with the Abu Meridional and the western section of the Guzerat Longitudinal Series, for the purpose of affording a trigonometrical basis for the Topographical Survey of Kattywar. The northern portion, that lies between the Guzerat and Karáchi Longitudinal Series, was afterwards added with the double object of checking the triangulation of the former, and of enabling the borders of the Ran to be delineated.

During the winter of 1851-52 the Bombay Triangulation Party, under Lieutenant H. Rivers of the Bombay Engineers, was employed on the final work of the Abu Meridional and Guzerat Longitudinal Series; and by the end of that field season the former series had been finished and all the angles of the latter between the stations of Mirzápur and Ingrori had been observed. In March and April 1852 during the prosecution of the principal work by the main body of the party, Mr. J. W. Rossenrode, the senior assistant, carried the approximate work of the Guzerat Longitudinal Series to its western extremity and also selected the station of Rangpur of the Kattywar Meridional Series and constructed a hexagon round it.

Season 1852-53.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 1st Assistant.
Lieutenant D. J. Nasmyth, Bombay Engineers, 2nd Assistant.
Mr. T. Sanger, Sub-Assistant.
" J. DaCosta, "
" J. McGill, "

In November, 1852 the same party resumed work on the Guzerat Longitudinal Series at the side Ingrori–Degám, with the purpose of completing it to the westward. On arrival at the station of Ingrori it was found that the heights of the towers would have to be considerably increased to render the Degám heliotrope visible. While this was being done, Lieutenant Nasmyth of the Bombay Engineers, who was temporarily in charge of the party, decided to make a reconnoissance of the country to the westward with the object of improving Mr. Rossenrode's approximate series. The hexagon of the Kattywar Meridional Series, that had been constructed around the station of Rangpur was, owing to the smallness of its sides, an eyesore he especially wished to remove; and as the part of the country in which it was situated was comparatively open and favorable for triangulation, there seemed no real necessity to limit the sides to five or six miles in length as Mr. Rossenrode had done. The result of the revision was, that the triangles were made more symmetrical and only seven stations were required to span the same extent of country as had under the original arrangement taken ten. By December 1st, Nasmyth, who had in the meantime been rejoined by Rivers, had in addition selected all the stations of the hexagon round Dúngarpur. The party then returned eastwards to Ingrori to take up the final work of the Guzerat Longitudinal Series.

Mr. DaCosta, who had been detached from the main body of the party, commenced early in the same month to carry the approximate work of the Kattywar Meridional Series southwards from the side Wánkáner–Chatrikhera towards the island of Diu, and by the first of January he had selected sites for stations as far south as Mumaiya; four weeks later he was within a short distance of the sea coast. Here his progress was checked by the Portuguese authorities of Diu who were jealous of a British Officer even landing on their island, and greatly objected to a tower being built and observed from. It was, however, considered a matter of importance that a station should be established on the island, and Rivers, to whom DaCosta had referred the matter, explained to the Governor that his work was being carried on purely in the interests of science, and had no military or political aspects: he also offered, if he were allowed to erect and visit a station at Diu, to give the Portuguese the co-ordinates of their town, a gift however that they do not seem to have valued, as his request was refused. He then wrote for assistance to the Political Agent of Kattywar and to the Chief Secretary to the Bombay Government, through whose representations Mr. DaCosta was at length allowed to build the station of Dangarwári.

Early in January 1853 the principal angles of the western section of the Guzerat Longitudinal Series were completed, and those of the Kattywar Meridional Series commenced: the stations of Chalarwa and Dúngarpur had already been visited during the previous month and the angles at them observed. Observations of δ Ursæ Minoris for azimuth had also been taken at Dúngarpur during the last week in December. By the sixth of February the angles at fourteen more stations had been observed, when the operations were suddenly brought to a stand-still at Mumaiya through the towers at Rangpur (south)* and Konkáwáo which Mr. DaCosta had reported to be indispensable not yet having been built. It seemed from the appearance of the country that no towers were required, and while endeavours were being made to dispense with them, operations with the large theodolite were stopped. As, however, the surrounding stations had not a sufficiently commanding view, it was found impossible to make any new arrangements that did not reject many at which final work had already been completed. It was therefore thought best to continue the building of these stations and, until they should be ready, to proceed with the angles south of the difficult ray. Before starting southwards it was found necessary to substitute the station of Jitori for Piplia, although the latter had been observed from Mumaiya and Chitália. In spite of these delays by the 19th of March all the principal angles had been observed as far south as the sea coast; the party then returned to Rangpur (south)* where, under Mr. J. McGill's directions, a tower 35 feet high had been built as well as one 30 feet high at Konkáwáo, but on setting up the instrument it was evident that all chance of observing to the Konkáwáo signal had vanished with the cold weather. A short-lived glimpse of the heliotrope in the early morning and an unsteady glimmer of the lamp in the evening, faintly struggling over the heated table-land, were all that were seen.

In the meantime Mr. DaCosta had been despatched to the neighbourhood of Mumaiya to start the western branch of a minor longitudinal series across Kattywar. The first step that he found necessary was to change the site of Mumaiya, and having done that he selected a quadrilateral on the side Mumaiya–Konkáwáo; but he subsequently found that by means of a station at Trákura he could construct a somewhat symmetrical hexagon round the new station of Mumaiya, and he consequently abandoned the quadrilateral. At the suggestion of Mr. Sanger who had been conducting the approximate work of the eastern section of the Kattywar Longitudinal Series, the stations of Rangpur (south)* and Mujyásar were then omitted from the principal work; and the large compound figure as it now exists round Mumaiya and Jitori was decided upon: the symmetry of the triangles was thus greatly improved, and no grazing rays had now to be observed. These new arrangements, however, necessitated the revisiting of the stations of Manáwa, Sarkala, Mumaiya, Bháyásar and Chitália, and also final observations at two new stations, Deo-ki-Galol and Trákura, and as the season was well advanced these were serious drawbacks: the observations also to and from Rangpur (south)* and Mujyásar were rendered useless except for secondary work.

In March, Rivers received intimation that furlough had been granted him, and he handed over charge of the work, and his connection with the Great Trigonometrical Survey,

* Now a Secondary Station.

which had lasted for nine years, now terminated. The field records of the triangulation of the South-West Quadrilateral, the greater portion of which are due to him, bear witness to his conspicuous abilities and his great talents as an observer. He eventually rose under the Bombay Government to high office in the Railway Department: he died in England in 1889.

After Rivers' departure Nasmyth was much delayed by cloudy weather, fogs and storms; and at the end of April he found that he had the observations at the two stations of Itria and Sakpur still to finish, ere the hiatus in the southern section of the principal series would be filled. An interval of fine weather enabled him to observe from both; and by the 10th of May the Kattywar Meridional Series had been completed from its junction with the Guzerat Longitudinal Series in latitude 23° to the island of Diu on the southern coast of the Kattywar peninsula. Nasmyth now took up the work of the eastern branch of the Kattywar Longitudinal Series, and closed the field season at Gogha on May 25th. He was here joined by Mr. J. H. Smith, who had been examined a few weeks previously by Lieutenant Rivers at Bombay and had just been appointed to the Department. The party passed the recess season at Rájkot.

The character of the country traversed by the past season's operations was as follows:—The northern portion was flat and a few of the rays about Rangpur and Chalarwa had only been visible with the aid of considerable refraction. In the neighbourhood of Dúngarpur is an extensive and high table-land, much intersected by streams—perhaps more numerous here for the extent of country than anywhere else in India—and to the south of this table-land were numerous peaks rising to 2,000 or 3,000 feet. The southern and south-western portion of the Kattywar peninsula is known as the Gír; it is a wild mountainous and deserted tract and its soil is poor, unproductive and stony: the water is bad, causing dropsy and disease of the spleen. Prior to 1800 the country had been disturbed for centuries and had never been long enough under one Government to derive the advantages even of a bad one, till at last it became deserted except by robbers and outlaws, to whom it secured but too safe a retreat. In 1850 these latter were removed, but even now in 1889 the Gír can boast of no civilisation or productiveness.

Season 1853-54.

PERSONNEL.

Lieutenant D. J. Nasmyth, Bombay Engineers, 2nd Assistant.
Mr. T. Sanger, Sub-Assistant.
„ J. DaCosta, „
„ J. McGill, „
„ J. H. Smith, „

Early in October 1853, the party took the field and marched to Konkáwáo, where Lieutenant Nasmyth wished to observe Polaris at both elongations for azimuth. A dense fog prevailed and protracted the work from six days, the normal number, to ten; and though excessive heat by day and heavy dews by night fostered fever and ague, the observations were successful. The party returned to Rájkot on October 19th.

In November Mr. DaCosta left for Cambay (Khambhat), to complete the approximate work of the Sábarmati Minor Series: a few platforms had to be built, a few rays cleared, and in one or two instances the symmetry of the triangles required improvement. Towards the middle of December he crossed the Gulf to Gogha and took up the approximate work of the Kattywar Coast Minor Series. In the meantime Mr. Sanger had been despatched northwards to the Ran with orders to select stations for a minor longitudinal series through Cutch, to provide for the geography of that province; on completing which he was directed to carry the approximate work of the Kattywar Meridional Series northwards from Rangpur and Kákraji and connect it with a side of the Karáchi Longitudinal Series.

On November 8th, 1853, Nasmyth himself resumed work on the Kattywar Minor Longitudinal Series, and was occupied with it till December 25th. He then took up the final observations of the Sábarmati Minor Series, which employed him till the middle of February. Having completed these he returned to Kattywar, and on February 18th set up his theodolite at Chalarwa, a station of the Kattywar Meridional Series, with the intention of carrying the Principal Triangulation across the Ran into Cutch. He now met with a series of grievous delays: hardly any of the rays were cleared, and on one of them when he had spent much time in cutting down the trees a village appeared in the way and the tower had to be raised. At Kákraji he was overtaken by a violent storm, and after that till the last week of April, when the weather became more suitable, the air was seldom clear. When the storm was over he hurried back to Pangasia and then crossed the Ran to Khánmír. Water had been gradually extending over the Ran, the mud was soft, and quicksands existed in many places, and numerous dead bullocks and carts stuck fast afforded unanswerable proofs of the difficulties of crossing, while camels could only travel with half loads. The water was particularly salt and caused any lacerations on the wayfarers' feet to smart severely. The field season was closed at Chitror in the middle of May, the Kattywar Meridional Series having been completed to Pata-i-Sháh. The party, who had experienced intense heat during April and May, remained in Mándvi on the Cutch Coast till the rains set in: they then moved to Bhúj, where they established their recess quarters; but finding it unhealthy, they returned to Mándvi in September.

Season 1854-55.

During the early part of the field season 1854-55, Lieutenant Nasmyth and Mr. McGill were at Karáchi taking part in the measurement of the Base-line, that was being carried on under Major A. Strange with the Colby apparatus of compensation bars and microscopes, while Mr. Smith had lately quitted the party and joined Lieutenant J. F. Tennant, R.E.; thus Messrs. DaCosta and Sanger were the only two officers available for trigonometrical work in Kattywar.

Mr. Sanger's approximate work of the preceding year had made the Principal Series through Cutch to depend, at its junction with the Kattywar Meridional Series, on one single triangle and one quadrilateral, in the latter of which were two angles of less than 30°; and this was a flaw that Lieutenant Nasmyth wished to remove. He therefore on leaving for Karáchi placed both his remaining assistants on the duty of improving Mr. Sanger's original design. The district of Wagan in which they were to operate is bounded on the one side by the sea and on the other by the Ran, whilst its breadth is too inconsiderable for symmetrical triangles. The proposed triangles that resulted from their joint labours were approved by Nasmyth though they were still wanting in symmetry. On completion of this work Mr.

Sanger took up the approximate work of the Guzerat Longitudinal Series east of Ahmedabad (Amdávád), and Mr. DaCosta continued his observations of the angles of the Kattywar Coast Minor Series, which he had been unable to finish the previous year.

Towards the end of the measurement of the Karáchi Base-line Lieutenant Nasmyth having fallen ill, was detained on this account for some weeks at Karáchi, and when sufficiently recovered to be moved, was taken to Bombay and thence to Mahábaleshvar. No final observations were in consequence made on the Kattywar Meridional Series during the season 1854-55. Mr. DaCosta completed the angles of the Kattywar Coast Minor Series on January 25th, 1855, and then took up the work of connecting the triangulation with mean sea level*. His first tidal station was selected in Miáni Harbour, 35 miles south-east of

* The tide gauge with an Index 2 feet long was erected about one mile up the Vartho River, where there was a depth of water sufficient to indicate the rise and fall of tides, 576 feet from its left bank, and close N.W. of the town of Miáni, Porbandar State: the position was the most sheltered in the neighbourhood, free from the influence of waves, and protected by a bar at the mouth of the river which is remarkably narrow. The box contrivance of the gauge further protected it from the undulations in the water when there happened to prevail high wind during the observations. The rise and fall of tides were satisfactorily registered to ·05 of a foot. The zero of the gauge was tested almost after every registration of the tides, with a 12-inch theodolite duly adjusted for the observations and found constant. A masonry pillar had been built at the distance of 70 feet up the bank in which two stones were imbedded, one at the level of the ground having the numeral 39 engraved thereon and the other 1 foot above it at top having the numeral 40 engraved. This latter was found afterwards by spirit-levelling with Gravatt's level to be 38·0800 feet above the *lowest* water mark, or 35·6550 feet above mean sea level as shewn at the end of this synopsis.

Synopsis of the Tidal Observations taken at Miáni Bandar with a Fixed Scale and Floating Index 2 feet long.

Date		Mean Time of Observation	Reading on the Fixed Gauge	Range of Tide	Mean Level of Water	Temperature Fahrenheit	Remarks
Month	Day						
1855		*h m*	*feet*	*feet*	*feet*	°	
February	8	13 15	5·10	...	...	...	Clear. W. wind.
„	„	19 55	3·30	1·80	4·200	...	„ „
„	9	3 25	6·75	3·45	5·025	...	Very cloudy. Calm.
„	„	11 20	3·19	3·56	4·970	...	High S.W. wind.
„	„	15 55	4·85	1·66	4·020	78	S.W. wind.
„	„	21 5	3·55	1·30	4·200	...	Calm.
„	10	3 5	6·40	2·85	4·975	...	„
„	„	12 40	2·98	3·42	4·690	...	High S.W. wind.
„	„	17 50	4·75	1·77	3·865	68	S.W. Wind.
„	„	22 50	3·90	0·85	4·325	...	N. wind.
„	11	3 50	5·85	1·95	4·875	56	Very foggy. Calm.
„	„	13 55	2·70	3·15	4·275	84	Calm.
„	„	19 45	5·05	2·35	3·875	...	„
„	12	0 35	4·48	0·57	4·765	...	„
„	„	4 55	5·70	1·22	5·090	...	Clear. Calm.
„	„	15 35	2·67†	3·03	4·185	82	Sultry. „
„	„	21 0	5·95	3·28	4·310	69	Very calm.

† Reading of *lowest* water mark.

Dwárka (Dvárka). His tide-gauge, which was self-registering, had been previously prepared at Mándvi under the direction of Lieutenant Nasmyth: it consisted of two boxes in one of which the float rose and fell with the surface of the water, while in the other a counterpoise to the float left cork indices at the highest and lowest points which it had reached. These indices, which were originally of card, slid up and down on a tightly stretched brass wire, and were held by their own friction in the places to which they were carried by the counterpoise: cork had to be substituted for card, as the friction of the latter upon wire was not sufficient to support its own weight. The gauge was supported on a scaffolding of

Synopsis of the Tidal Observations taken at Miáni Bandar—(Continued).

Date		Mean Time of Observation	Reading on the Fixed Gauge	Range of Tide	Mean Level of Water	Temperature Fahrenheit	Remarks
Month	Day						
1855		h m	feet	feet	feet	°	
February	18	2 10	4·64	1·31	5·295	63	Calm.
„	„	6 0	5·73	1·09	5·185	62	N. breeze.
„	„	16 45	2·73	3·00	4·230	...	S.W. wind.
„	„	22 5	6·74	4·01	4·735	64	Calm.
„	14	4 0	4·46	2·28	5·600	65	N. wind.
„	„	7 5	6·05	1·59	5·255	...	Cloudy. High S. wind.
„	„	17 20	2·85	3·20	4·450	...	„ Calm.
„	„	23 10	7·45	4·60	5·150	...	Clear „
„	15	5 20	4·45	3·00	5·950	...	Some clouds about the horizon. Calm.
„	„	8 30	6·67	2·22	5·560	71	Cloudy. Calm. ☾ Perigee $15^{d}\cdot6$
„	„	18 20	3·12	3·55	4·895	73	S.W. breeze.
„	„	23 25	7·78	4·66	5·450	70	N. breeze.
„	16	6 35	4·25	3·53	6·015	...	Calm.
„	„	9 50	7·03	2·78	5·640	...	High S. wind. ● Perigee.
„	„	19 0	3·18	3·85	5·105	70	Calm.
„	„	24 0	8·00	4·82	5·590	60	„
„	17	7 15	4·06	3·94	6·030	...	„
„	„	11 5	7·25	3·19	5·655	...	S.W. wind.
„	„	19 35	3·25	4·00	5·250	70	Calm.
„	18	0 30	8·30	5·05	5·775	68	W. breeze. Spring Tide.
„	„	7 15	4·08	4·22	6·190	70	Very calm.
„	„	11 45	7·43	3·35	5·755	...	N.E. wind.
„	„	20 10	3·42	4·01	5·425	...	Calm.
„	19	0 33	8·28	4·86	5·850	...	S. breeze.
„	„	8 50	3·90	4·38	6·090	...	E. breeze.
„	„	12 28	7·15	3·25	5·525	...	W. wind.
„	„	20 35	3·40	3·75	5·275	...	Calm.

piles, which were forced into the ground by the ordinary plan of lashing boats to them at high-water and thus enabling their weight to exert a downward pull as the tide fell. These piles were securely strutted and cross-bars fixed to them, on which cradles rested at intervals of a foot for the support of the gauge. The tidal observations at Miáni extended from February 8th to 23rd inclusive, and exhibited a rise of 3·2050 feet as the extreme height of the tide above mean sea level. The zero of the gauge was referred to a stone masonry pillar which was connected both trigonometrically and by levelling with the adjoining station of Sarsad Máta of the Longitudinal Series of Kattywar.

Synopsis of the Tidal Observations taken at Miáni Bandar—(Continued).

Date		Mean Time of Observation	Reading on the Fixed Gauge	Range of Tide	Mean Level of Water	Temperature Fahrenheit	Remarks
Month	Day						
		h m	*feet*	*feet*	*feet*		
1855 February	20	0 53	8·12	4·72	5·760	...	Calm.
"	"	9 45	3·67	4·45	5·895	...	"
"	"	13 5	6·80	3·13	5·235	...	S.W. wind.
"	"	21 13	3·40	3·40	5·100	...	Calm.
"	21	1 15	7·86	4·46	5·630	...	"
"	"	10 23	3·45	4·41	5·655	...	"
"	"	14 28	6·35	2·90	4·900	...	Very high W. wind.
"	"	21 13	3·48	2·87	4·915	...	Calm.
"	22	1 45	7·47	3·99	5·475	...	"
"	"	11 13	3·16	4·31	5·315	...	W. wind.
"	"	15 40	5·72	2·56	4·440	...	Very high W. wind.
"	"	21 33	3·65	2·07	4·685	...	Calm.
"	23	2 8	6·73	3·08	5·190	...	"
"	"	11 50	2·86	3·87	4·795	...	W. breeze.

	feet
By observations during a semi-lunation from 8th to 23rd February, being the mean reading on the Gauge of high and low tides	5·0950
Subtract length of Index bar carrying a float at its lower end	2·0000
True height of mean sea level above the zero of the graduated scale of the Gauge	3·0950
Subtract for difference of height between zero of the scale and the *lowest* water mark, as deduced by the Index bar	−0·6700
Height of mean sea level above *lowest* water mark	2·4250
Height of summit of level datum pillar above *lowest* water mark	38·0800
Ditto ditto above mean sea level	35·6550

Similar observations were taken at Diu*, in the creek which separates that island from the mainland; and the means adopted for putting up the gauge and for observing the range of the tide were identical with those followed at Miáni Bandar. As the Portuguese authorities

* The gauge with the floating Index 8 feet long was set up in Diu Creek, 56·5 feet N.E. of the ruined and smallest tower on the westernmost curtain of Diu fort S. W. of Gogla (Portuguese Settlement) where there was a sufficient depth of water for the purpose of making Tidal Observations. The position was further the most sheltered in the locality and free from the influence of waves. The rise and fall of the tides were satisfactorily registered to ·05 of a foot. Upon the tower, on a slab level with the flags, is engraved the numeral 14, that being the height of the tower as obtained by levelling above the mean sea level deduced from the mean of high and low tide observations made uninterruptedly during a semi-lunation from the 3rd to 17th March, 1855.

Synopsis of the Tidal Observations taken at Diu Creek with a Fixed Scale and Floating Index 8 feet long.

Date		Mean Time of Observation	Reading on the Fixed Gauge	Range of Tide	Mean Level of Water	Temperature Fahrenheit	Remarks
Month	Day						
1855		h m	feet	feet	feet		
March	3	0 15	8·69	...	...	...	Calm.
„	„	6 15	4·61	4·08	6·650	...	„
„	„	11 33	7·02	2·41	5·815	...	„
„	„	18 8	3·15	3·87	5·085	...	„
„	4	0 40	8·88	5·73	6·015	...	„ ○ Apogee.
„	„	6 50	4·10	4·78	6·490	...	„
„	„	12 5	7·52	3·42	5·810	...	„
„	„	18 30	3·50	4·02	5·510	...	Very calm.
„	5	1 13	9·12	5·62	6·310	...	Calm. Spring Tides.
„	„	7 20	4·14	4·98	6·630	...	„
„	„	12 50	8·00	3·86	6·070	...	
„	„	19 3	3·69	4·31	5·845	...	Very calm.
„	6	1 30	9·03	5·34	6·360	...	Clear. Very calm.
„	„	7 45	3·69	5·34	6·360	...	Cloudy. Calm.
„	„	13 28	8·04	4·35	5·865	...	S.W. wind.
„	„	19 50	4·04	4·00	6·040	...	Calm.
„	7	1 53	8·88	4·84	6·460	...	Cloudy. Very calm.
„	„	8 15	3·24	5·64	6·060	...	Calm.
„	„	14 5	8·03	4·79	5·635	...	S.W. wind.
„	„	20 10	4·51	3·52	6·270	...	Calm.
„	8	1 48	8·59	4·08	6·550	...	„
„	„	8 50	2·78	5·81	5·685	...	Cloudy. W. wind.
„	„	14 36	7·72	4·94	5·250	...	High S. wind.
„	„	20 46	5·04	2·68	6·380	...	Calm. W. wind.
„	9	2 33	8·20	3·16	6·620	...	W. wind.
„	„	9 20	2·72	5·48	5·460	...	„
„	„	17 20	8·15	5·43	5·435	...	High S.W. wind.
„	„	21 53	5·85	2·30	7·000	...	
„	10	2 15	7·80	1·95	6·825	...	Very rough.
„	„	9 45	3·08	4·72	5·440	...	Very calm.
„	„	18 5	8·13	5·05	5·605	...	„
„	„	22 50	6·68	1·45	7·405	...	„

refused to allow a pillar to be built, the mark to which the zero of the gauge was referred was engraved upon the stone pavement of a martello tower that guarded the ferry, and was con-

Synopsis of the Tidal Observations taken at Diu Creek—(Continued).

Date: Month	Date: Day	Mean Time of Observation	Reading on the Fixed Gauge	Range of Tide	Mean Level of Water	Temperature Fahrenheit	Remarks
1855		*h m*	*feet*	*feet*	*feet*		
March	11	3 0	7·60	0·92	7·140	...	Very calm.
"	"	9 55	3·34	4·26	5·470	...	N.E. wind. Neap Tide.
"	"	19 5	8·25	4·91	5·795	...	Calm.
"	12	0 8	7·36	0·89	7·805	...	"
"	"	3 45	7·53	0·17	7·445	...	"
"	"	10 33	3·75	3·78	5·640	...	N.E. wind.
"	"	20 58	8·68	4·93	6·215	...	Calm.
"	13	2 0	7·43	1·25	8·055	...	"
"	"	4 55	7·20	0·23	7·315		
"	"	11 30	3·34	3·86	5·270		
"	"	21 25	8·78	5·44	6·060	...	"
"	14	3 28	6·63	2·15	7·705	...	Flashes of lightning on the E. Cloudy.
"	"	5 30	6·88	0·25	6·755		[W. breeze.
"	"	13 45	3·34	3·54	5·110	...	S.W. wind.
"	"	22 35	9·15	5·81	6·245	...	"
"	15	4 10	6·10	3·05	7·625	...	Calm.
"	"	7 40	7·00	0·90	6·550	...	"
"	"	15 30	2·90	4·10	4·950	...	High S.W. wind.
"	"	23 30	9·20	6·30	6·050	...	Very rough.
"	16	4 56	4·73	4·47	6·965	...	Calm. ☾ Perigee 15ᵈ·23
"	"	9 35	7·30	2·57	6·015	...	"
"	"	16 40	2·35	4·95	4·825	...	S.W. wind.
"	"	23 45	9·35	7·00	5·850	...	S.W. breeze. Very rough.
"	17	5 25	3·70	5·65	6·525	...	Very calm.
"	"	10 40	8·05	4·35	5·875	...	N.E. wind.
"	"	17 10	2·15*	5·90	5·100	...	Calm.
"	"	24 0	9·67	7·52	5·910	...	"

* Reading of *lowest* water mark.

	feet
By observations during a semi-lunation from 3rd to 17th March, being the mean reading on the Gauge of high and low tides	6·1923
Subtract length of Index bar carrying a float at its lower end	3·0000
True height of mean sea level above the zero of the graduated scale of the Gauge	3·1923
Add for difference of height between zero of the scale and the *lowest* water mark as deduced by the Index bar	+ 0·8500
Height of mean sea level above *lowest* water mark	4·0423
Height of instrument on summit of level datum tower above *lowest* water mark	23·1500
Height of instrument on summit of level datum tower above mean sea level	19·1077
Deduct for height of instrument	4·8300
Height of level datum tower above mean sea level	14·2777

nected with the principal station Dangarwári of the Kattywar Meridional Series. The observations at Diu extended from the 3rd to the 17th March and exhibited a rise of 3·4777 feet as the extreme height of the tide above mean sea level. Mr. DaCosta next moved the apparatus to Bhávnagar, but his scaffolding had hardly been set up when it was knocked over by the waves. Despairing after repeated failures of ever being able to secure a firm foundation for the piles at this place, with the limited means at his disposal, Mr. DaCosta embarked in April for Sikotar Máta at the head of the gulf of Cambay. This station had been connected with the Abu and Guzerat Principal Series by the Sábarmati Minor Series which had been carried out for that special purpose: its site had been fixed upon by Nasmyth himself, after much trouble and consideration, and though no tidal observations had as yet been taken there, great importance had been for several years attached to it as a tidal station both by Rivers and Nasmyth.* It proved, however, to be most unfortunately situated, for observations had hardly been begun when the bore came up the Sábarmati and swept away the scaffolding and gauge, the observer himself having a narrow escape. After this mishap Mr. DaCosta rejoined Lieutenant Nasmyth at Mahábaleshvar where he passed the hot weather of 1855, moving to Poona (Puna) at the commencement of the rains. The following winter he proceeded again to Cambay to search for a suitable site for a tidal station, but all his endeavours to erect the gauge failed: he therefore stored his appurtenances at Vadgám and proceeded to Cutch on trigonometrical work.

Season 1855-56.

PERSONNEL.

Lieutenant D. J. Nasmyth, Bombay Engineers, 1st Assistant.
Mr. J. DaCosta, Sub-Assistant.
„ T. Sanger, „
„ J. McGill, „
„ C. McGill, „

In November, 1855, Lieutenant Nasmyth commenced the final angles of the Cutch Coast Principal Series, and remained employed on them till the end of December. He then took up the work of the northern section of the Kattywar Meridional Series, as he apprehended difficulties later on in the season in observing signals at stations near the Ran. He crossed the Ran into Párker early in January, the distance between the *terra firma* of Vágad and that of Párker being about 40 miles. The party rested for one night at Bela before crossing, and the march was made without difficulty, the road being dry all the way.

The first station visited in Párker was Kálunjhar, situated in a group of granite hills, formerly notorious as the refuge of robbers: the instrument here rested on solid rock, as it did also at both Khársar and Viráwáh. By January 31st, 1856, in spite of unfavorable weather at the desert stations of Jhund, Bhilgaon and Akoria,† the final observation at the six stations north of the Ran had been completed.

On his return to Bela, Nasmyth found the platform had been tampered with, but as the upper station mark seemed undisturbed he set up his instrument and observed the two northern angles. After Iwália, however, had been visited and the quadrilateral Iwália–Bela–

* *Vide* Introduction to the Guzerat Longitudinal Series.
† The Principal angles at Jhund, Bhilgaon, and Akoria which appertain to the Karáchi Longitudinal Series were observed by Captain A. Strange in December, 1851, with Troughton and Simms' 36-inch Theodolite.

Kálunjhar–Viráwáh completed, it became evident that an error had crept into the work; so he revisited Bela, and took observations from the lower station mark, finding differences in both angles between the later and earlier results sufficiently large to prove the necessity of the repetitions. At Pata-i-Sháh a mistake appeared in the approximate work, one of the surrounding stations named Bhújnari, situated to the north-west, not being visible. Ultimately it was found necessary to substitute Dájka for it, a change that entailed the necessity of again visiting Iwália and Bela. In March Nasmyth and many natives of the party were attacked by dysentery, a disease always prevalent on the borders of the Ran, owing to a peculiar property in the water, and an interruption in the work ensued.

From Bela he went to Gángta, which is situated on a small preserve of grass in the midst of the Ran ten miles from the nearest drinking water; and which was formerly a stronghold of marauders by whom the district of Vágad was overrun. The station is at the western angle of the Dájka pentagon, and the angles between Bela and Dájka and Dájka and Kanduka were now observed. This station was, also, afterwards utilized in the principal work of the Cutch Coast Series as one of the stations of the Kakarwa pentagon, and the two angles on either side the Gángta–Kakarwa ray were observed. As the Kattywar Meridional and Cutch Coast Series both consisted of principal triangulation and were of equal value, the employment of Gángta as a principal station in each rendered the figure at their junction one of great complexity. If the figural reduction had been carried out rigorously all the triangles within the periphery Gángta–Bela–Iwália–Pata-i-Sháh–Khánmír–Kesmára–Kákraji Mália–Wándia–Sakpur–Ráhida–Ran–Gángta would have had to be regarded as belonging to one compound geometrical figure: the fact too that the interior angles of the quadrilateral Gángta–Kanduka–Chitror and Nara had not been observed would if anything rather have increased the complication. The reduction was, however, not carried out rigorously: the Dájka pentagon was first reduced independently of any exterior observations, and then in the following order the Kanduka–Khánmír quadrilateral, the Monába hexagon, and the Nara–Wándia quadrilateral were taken in hand. When therefore it came to the turn of the Kakarwa pentagon, three of its angular points, Gángta, Nara and Sakpur had already been fixed: in addition thus to the seven geometrical conditions that have to be satisfied in the case of every complete simple pentagon, two others entered into this figure; the sum of the two angles at Nara had a fixed value, and the side Sakpur–Nara had to bear a fixed ratio in length to the side Nara–Gángta.

Nasmyth was very anxious to carry the northern section of the Kattywar Meridional Series as far as the parallel of 23°, and to also connect it with its southern section before the close of the field season and thus to complete the circuit of the triangulation formed by the sections of the Karáchi and Guzerat Longitudinal Series that lay between the meridians of 71° and 73° with the northern section of the Series under review and the Abu Meridional Series, and test the accuracy of the triangulation. Towards the end of April the weather was very unfavorable: the dry loam of the Ran was raised by the least breeze, the atmosphere clouded by it and signals obscured. The observations both at Wándia and Monába extended over a week. Work had eventually to be brought to a close at Kesmára at the beginning of May, and the junction between the northern and southern sections of the Series postponed till the following year. During the summer of 1856 the party recessed at Bhúj.

Season 1856-57.

PERSONNEL.

Lieutenant D. J. Nasmyth, Bombay Engineers, 1st Assistant.
Mr. J. DaCosta, Sub-Assistant.
" T. Sanger, "
" J. McGill, "
" C. McGill, "

On August 31st, 1856, the party again took the field and was employed on the Cutch Coast Series till the middle of October. Nasmyth then resumed the final observations of the Kattywar Meridional Series; and as the triangle on the north side of the ray Monába–Wándia, which was one of the last completed in the previous season, had exhibited a large error, he observed two of its angles again, on the same parts of the limb as before. The new values, however, came out almost identical with the former but with smaller weights.

At all the stations in Kattywar the platforms were found destroyed, and the mark-stones carried away. At Wánkáner and Dúngarpur the lower mark-stone had to be dug down to and was found intact, but at Rangpur and Chalarwa great difficulty was experienced in recovering the original positions of the marks. Whilst these platforms were being re-built, Nasmyth returned to Cutch and took up the observations at stations north of the Ran. Throughout November the signals were very bad: different hours during the night were tried but the lamps were at all times unsteady. One triangle exhibited an error of 5″, another of 4″, and a third of 3″; but as repetitions of observations did not seem to improve the results, Nasmyth decided that he had no alternative but to push on. He afterwards attributed these errors to an earthquake that occurred in November 1856. On December 21st he completed the observations of the Kattywar Meridional Series at Wánkáner, and again took up those of the Cutch Coast.

All the angles of the Kattywar Meridional Series were observed with Troughton and Simms' 18-inch Theodolite No. 2*, and were taken on six pairs of zeros. The method adopted of changing zero was one that had been invented by Lieutenant Rivers and first employed by him on the Abu Meridional Series; by it each change of zero was made to fulfil the following conditions:—(1) In the degrees each zero was 10° in excess of the preceding; (2) At each zero a different 10′ graduation in the degree was intersected; (3) Each zero was a different number of minutes from the division to be intersected, being in three cases to the right of that division and in three to the left. The method is fully described in the Introduction to the Guzerat Longitudinal Series.

On the completion of the simultaneous reduction of the South-West Quadrilateral, in which the northern half of the Kattywar Meridional Series was included, it was found that the errors that had actually been dispersed between the side of origin Bhilgaon (LXIV)–

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* For a description of this instrument and its performances, see Appendix No. 2 of Volume II of the *Account of the Operations of the Great Trigonometrical Survey of India.*

Akoria (LXI) and the terminus Chalarwa (XVIII)–Sápakra (XXI), a distance of 132 miles, were:—

	In Latitude of Chalarwa (XVIII) ...	... ...	+ 0″·083
	„ Longitude of „	... ...	+ 0 ·060
	„ Azimuth of Chalarwa (XVIII)–Sápakra (XXI)		− 3 ·097
In Side	Logarithm of feet	... ...	− 0 ·000,0114,7
	giving a ratio of about 1·67 inches per mile.		

Astronomical observations for azimuth have been taken at two stations of the Kattywar Meridional Series, *viz.*, Dúngarpur and Konkáwáo.

Kattywar Minor Longitudinal Series.

This Series cuts the Kattywar Meridional at right angles in latitude 22°: the figure at the junction is the great compound figure round the stations of Mumaiya and Jitori which appertains to the meridional chain and forms the connecting link between the eastern and western branches of the longitudinal. The eastern branch starts from the principal side Itria-Sakpur and extends to Gogha on the gulf of Cambay, a distance of 53 miles: it consists of two quadrilaterals and one single triangle. The western branch starts from the principal side Trákura–Deo-ki-Galol and extends to Sarsad Máta on the sea coast, a distance of 84 miles: it consists of three quadrilaterals. The angles of the Longitudinal Series were taken, like those of the Meridional Series, with Troughton and Simms' 18-inch Theodolite No. 2, but on only three pairs of zeros instead of six: in consequence of this change from the orthodox method of observing, the Longitudinal Series has had to be regarded as Secondary.

In February, 1853, Mr. Sanger, on return from sick-leave, joined Lieutenants Rivers and Nasmyth at Mumaiya, and was directed to take up the approximate work of the eastern branch of the Kattywar Longitudinal Series. By April 1st, he had selected five stations which brought him to Gogha on the Coast; he then returned to the centre of the peninsula and commenced the approximate work of the western branch, and before the end of the field season he had constructed three quadrilaterals and reached the terminal station of Sarsad Máta.

By May 10th, 1853, Lieutenant Nasmyth having completed at Itria and Sakpur the observations of the final angles on the southern section of the Kattywar Meridional Series, proceeded to Chamárdi to commence the final work of the Longitudinal Series. He was at first so much delayed by bad weather that he decided to take the angles on but three pairs of zeros instead of six, a change that he considered justifiable owing to the shortness of the branch series, but even then his progress was bad. At Pálitána the station had been selected on a temple, and there was in consequence no isolation for the instrument and the movements of the observer affected the levels. Another spot had to be chosen, but, owing to the lateness of the season and the consequent unfavorableness of the weather, the distant signal of Itria could not be observed. With this exception all the observations on the eastern branch of the Series were completed.

On November 8th, 1853, Lieutenant Nasmyth commenced the final work on the western branch of the Kattywar Longitudinal Series: as this was to be also a short chain he decided to work as before with only three changes of zero. At starting he had much difficulty in procuring bearers for his instrument; there were none to be had in Rájkot; exorbitant wages were demanded by those at Ahmedabad, and he had eventually to send to the Deccan for them. He completed the western branch without meeting with any interruptions, and he then proceeded to Pálitána to observe the one absent ray of the eastern branch, when he found that all the stations near Pálitána had been tampered with and several destroyed. By December 25th, 1853, all the angles of the Kattywar Longitudinal Series from Sarsad Máta to Gogha had been observed.

Kattywar Coast Minor Series.

This Series, which is of great geographical value, starts from Gogha on the Gulf of Cambay in the very east of the peninsula, follows exactly the Coast-line of Kattywar by Diu, Porbandar, Dwárka and Navánagar, and ends at the head of the Gulf of Cutch at its junction with the Ran. It may be compared to a rhombus, one diagonal of which runs north and south, the other east and west, and one side of which—the north-eastern—is missing. At both extremities of its meridional diagonal it is connected with points of the Kattywar Meridional Series, and similarly at both extremities of its longitudinal diagonal with points of the Kattywar Longitudinal Series. Each of its three sections, the south-eastern, the south-western and the north-western, have had their own individual errors dispersed over their respective lengths, and the error accumulated in one has not been carried on into the next.

The Coast Minor Series emanates, at its eastern angle, from the side Gogha–Trimbak of the Kattywar Longitudinal Series, and terminates at its northern corner on the side Mália-Pangasia of the Kattywar Meridional Series. At its southern corner at Diu the two fixed principal stations of the Kattywar Meridional Series, *viz.*, Nántej and Dangarwári, have been utilised also as stations of the Coast Minor Series, and at the western corner the same procedure has been followed with regard to the three stations Patelka, Sarsad Máta and Sátbagar of the Kattywar Longitudinal Series. The Series for the greater part of its length is a simple chain of single triangles with sides from six to eight miles long; at the western corner however it loses this form for a short space and becomes a network, the change having been made with the object of fixing the island of Ajár and the headlands on the rugged coast of the Dwárka Peninsula.

The Coast Minor Series was begun in December, 1853, by Mr. DaCosta who took up its approximate work at Gogha. By March 27th, 1854, he had selected all the stations on the three sides of the rhombus, built the pillars and cleared the rays. He then began to observe the final angles, which he had been instructed to do with a 12-inch theodolite on one pair of zeros. In April the winds were scorching and the heat overpowering; it was rarely that any thing animate except the surveyors was seen stirring during the day; two of the party died of sunstroke and there were fourteen cases of guinea worm. Mr. DaCosta closed work on June 18th, 1854, having finished the observations of the angles from Dwárka to Diu and from Diu to Gogha. The final angles on the north-western section of the Coast Series, a few of which had to be revised in November, 1859, from Dwárka to the Ran of Cutch, were observed by the same officer during November and December, 1854, and January, 1855, his average triangular error being 15″.

The triangulation on the Coast of Kattywar to the north-west of the Gulf of Cambay has not been incorporated in the Kattywar Coast Minor Series: the stations of Gogha and Bhávnagar belong to the Kattywar Longitudinal Series, those of Bharbhír and Haibatpur to the Kattywar Minor Meridional Series No. IV, and the triangles thenceforward as far as the head of the gulf to the Sábarmati Minor Series.

The Kattywar Minor Meridional Series.

There are four Minor Meridional Series traversing the peninsula of Kattywar, numerically designated from west to east No. I, No. II, No. III and No. IV. They follow respectively the meridians of 70°, 70½°, 71½° and 72°, and as the Principal Meridional Series itself runs down the meridian of 71°, they divide the whole of Kattywar into strips half a degree of longitude in breadth. Nos. I and II each start at their southern extremity from a side of the south-western section of the Kattywar Coast Minor Series, and join on to its north-western section each at two sides of the latter: the station Gop Gavar, of the Kattywar Minor Longitudinal Series, has been utilized as a station of No. I Minor Series, and though no stations of the former could be incorporated in No. II Minor Series, yet checks on the work were obtained by signals at Mevása, Osham being intersected from the stations of this series. No. I Minor Series is 60 miles long and contains 12 single triangles and one quadrilateral. No. II Minor Series is 112 miles long and contains 19 single triangles and one quadrilateral.

The Minor Meridional Series No. III starts near Rájula from a side of the south-eastern section of the Kattywar Coast Minor Series and closes on the principal side Nárechána-Charári of the Guzerat Longitudinal Series: two of the stations, Itria and Sakpur of the Kattywar Meridional Series, situated too at the extremities of one ray, were incorporated. It is 125 miles long, and consists of one pentagon, three quadrilaterals and 16 single triangles.

The Minor Meridional Series No. IV starts from the side Bhávnagar–Chamárdi of the Kattywar Longitudinal Series and closes on the principal side Ingrori–Kárigángar of the Guzerat Longitudinal Series. It is 80 miles long, and consists of one compound and 14 single triangles.

The average length of the side in these four minor series is from 10 to 14 miles: all the angles were observed with Troughton and Simms' 18-inch Theodolite No. 2 on two pairs of zeros, the average triangular error being no larger than that on triangulation observed with the full number of zeros.

The approximate work of the Minor Meridional Series No. I was begun in February, 1859, by Mr. DaCosta; the observations of the final angles were made by Lieutenant Nasmyth between April 1st and 28th, 1859. On the completion of this series a check was obtained for the Coast Minor Series executed by Mr. DaCosta five years previously with a 12-inch theodolite: comparisons of the values of common sides shewed an error of 0·60 of an inch per mile generated in the 270 mile circuit by Gop Gavar, Mumaiya, Diu and Bagasra,—an error of 3·04 inches per mile in the 130 mile circuit by Gop Gavar, Bagasra and Sarsad Máta—of 2·43 inches in the 310 mile circuit Gop Gavar, Mumaiya, Diu and Sarsad Máta—and of ·18 of an inch in the 140 mile circuit Gop Gavar, Gurgat and Navánagar.

Whilst Nasmyth was observing the angles of the Minor Meridional Series No. I, Mr. McGill was following him laying down secondary points, and Mr. DaCosta was engaged on the selection of the stations for the Minor Series No. II.

In September, 1859, Lieutenant C. T. Haig of the Bombay Engineers was appointed a Second Assistant in the Great Trigonometrical Survey, and a few weeks later joined the Bombay Triangulation Party at Rájkot. On arrival he found orders attaching him temporarily to the Okhámandal Field Force with which Captain Nasmyth was also serving, and for the next two months both officers were employed as military engineers at the siege of Dwárka. On the fall of that place in December, 1859, they rejoined the Bombay Survey Party and for the next month were employed in completing some minor triangulation on the south coast of Cutch.

In January, 1860, Captain Nasmyth commenced observing the angles of the Minor Series No. II, followed as before by Mr. McGill on secondary work: he completed it on February 29th and then handed over the party to Lieutenant Haig, and on March 10th he left for Bombay prior to proceeding to England on furlough. Mr. DaCosta had in the meantime selected and built all the stations of the Minor Series III. On taking over charge Lieutenant Haig took up the final work of Minor Series No. III, which he completed on April 29th. The party then retired to Rájkot where they had established their recess quarters.

In November, 1860, Mr. DaCosta was detached by Lieutenant Haig to Bhávnagar with orders to connect the eastern extremity of the Kattywar Longitudinal Series with the southern extremity of the Sábarmati Minor Series by means of a small chain of single triangles. The stations of the Kattywar Minor Meridional Series No. IV had been previously selected as far north as Haibatpur by Mr. DaCosta, and the pillars both at Haibatpur and Bharbhír had been built. By January 13th, 1861, he had completed the angles of the connecting chain, and had thus carried the final work of the Minor Series No. IV up to the side Haibatpur–Patna.

Season 1863-64.

PERSONNEL.

Captain C. T. Haig, R.E., 1st Assistant.
Mr. John McGill, Civil 2nd Assistant.
„ G. A. Anding, 2nd Class Sub-Assistant.
„ J. E. Donohoe, 3rd „ „
„ A. D. Christie, 3rd „ „

In April, 1863, an accident happened to the great theodolite on the Mangalore Meridional Series, which put a temporary stop to all Principal Triangulation in the Bombay Presidency: Captain Haig and his assistants were therefore set free the following season to organize the new party, that had been sanctioned and was now to be trained for the purpose of carrying out the topographical survey of Guzerat, Kattywar and Cutch. The party started from Poona for Kattywar early in November, 1863 and arrived at Gogha on November 14th: Captain Nasmyth who was expected from England in the course of the field season, was to have command of the new topographical party, leaving Captain Haig in independent charge of the trigonometrical work.

The Kattywar Peninsula was now intersected, except on the meridian of 72°, at half degrees of longitude by Minor Meridional Series; it was also traversed by a longitudinal chain running east and west, and the whole was included by a Coast Series. On arrival, therefore, Haig himself took up the Minor Meridional Series No. IV, which was regarded as particularly important as it ran along the boundary between our own territory and that of the Chiefs of Kattywar. Commencing from Mr. DaCosta's side, Haibatpur–Patna, Haig proceeded north, selecting the stations and building the pillars, everywhere meeting with great obstruction from the villagers. Having closed the approximate work on the principal side Kárigángar–Ingrori of the Guzerat Longitudinal Series, he began about the middle of February observing the final angles, working southwards. At the southern extremity of the Series he re-observed Mr. DaCosta's angles, finishing the work on May 2nd, 1864.

A few days after, accompanied by Messrs. Christie and Donohoe and five of the native establishment, he left Bhávnagar in a steamer bound for Surat intending to thence proceed by rail to Poona. Before reaching Surat the party experienced considerable danger from the steamer leaking; in fact so critical was their position that the master of the ship, a Parsee, wanted Captain Haig and Mr. Christie to escape stealthily with him in the boat and leave the others to their fate. Captain Haig refused, and took steps to prevent anybody from loosening the boat, the Parsee Captain giving himself up in tears to despair. To lighten the ship the passengers' kit was then thrown overboard and also some articles of Government property. The steamer ultimately stranded at the mouth of the Tápti and all hands were saved. Mr. Donohoe died of cholera on board the steamer on May 4th.

Secondary Triangulation.

At the upper extremity of the Kattywar Meridional Series north of the Ran one or two cupolas of temples and a few hill peaks were intersected from principal stations, and the positions of some marks on the borders of the Ran laid down. On crossing the Ran from Viráwáh to Bela, a platform was built on each of the small islands Nara Bet and Karir, and though none of them were visited, yet signals at all were observed from four principal stations.

The eastern end of Cutch when being traversed by the Principal Meridional Series was covered with secondary stations and intersected points: marks in the towns of Fatiagad, Rahpur, Omia, Sántalpur and Shikárpur were accurately laid down: the positions of the small islets in the Ran were determined, and sufficient points were fixed along the actual edge of the Ran so that its border might be definitely delineated. All the principal triangles were broken up into numerous small ones, and it would be difficult throughout the whole area to find a spot that was not within a mile of some known point.

South of the Ran the secondary work on the Principal Meridional Series was very much more scanty, and below the Kattywar Longitudinal Series hardly any exists at all. The palace of Halvad, the fort of Sara and temples in Morvi, Amreli and Chotila were laid down: the church spire of Rájkot and two other points in that city were fixed. For the rest some hundred trees and a few temples and peaks were the only objects, between the parallels of 21° and 23°, whose positions were determined by secondary work from principal stations of the Meridional Series, the island of Diu was fixed by a principal station itself.

From the Longitudinal Series, the positions of Gogha, Bhávnagar, Pálitána, Umrála, Dámnagar, Jetpur and Miáni were determined. By means of secondary work from the Coast Series the position of every cape, creek and bay was made known and the important sea-ports of Mángrol, Navíbandar and Porbandar, the celebrated town of Dwárka and numerous other villages were fixed. From the four Minor Meridional Series points were intersected in Navánagar, Junágad, Múli, Wadhwán (Vadhván) and Chúda, and immense numbers of trees and natural objects, observed.

During the season 1863-64, when Captain Haig was engaged on the Minor Meridional Series No. 4, Messrs. McGill and Anding remained wholly employed on secondary work in the Kattywar peninsula. McGill commenced by breaking up the large triangles of the Bhávnagar–Pálitána, and Pálitána–Itria Quadrilaterals into a network and then covering the space between the meridians of 71° 30′ and 72° with triangulation: having completed this he threw a network over the space between 71° and 71° 30′. In the meantime Anding had done the same to the untriangulated areas between 70° and 70° 30′ and between 70° 30′ and 71°. By means of these networks the whole of the Kattywar peninsula was covered with secondary stations and intersected points, and all the large triangles of the Meridional and Longitudinal Series were broken up.

The heights of the Principal Stations of the Kattywar Meridional Series depend in the first instance on the values of the stations of Jhund, Bhilgaon and Akoria of the Karáchi

Longitudinal Series, which were finally fixed in the reduction of the North-West Quadrilateral; next, on the heights of the stations of Pata-i-Sháh, Khánmír, Monába, Wándia and Mália, of which the values were determined by spirit-levelling operations in 1874-6; thirdly, on the heights of Tarkia and Kakána, also determined by spirit-levelling during 1875-6; and lastly, on a determination of sea-level at Diu made in 1855. The intermediate heights, of which the values were obtained trigonometrically, shewed in the northern portion of the series a cumulative error of — 2·4 feet and in the middle section an error of + 0·5 of a foot and in the lowest portion of — 1·6 feet. These errors were dispersed by simple proportion according to the number of removes from the origin of each section.

A considerable number of secondary stations were connected with in the spirit-levelling referred to above and their values thus finally fixed, and a further determination of sea-level at Miáni Bandar made in 1855, has also been utilized in obtaining the final heights of secondary stations.

S. G. BURRARD.

September, 1889.

KATTYWAR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. ALPHABETICAL LIST OF STATIONS.

Station	No.
Akoria	LXI. (Of the Karáchi Longitudinal Series).
Bela	V.
Bháyásar	XXVIII.
Bhilgaon	LXIV. (Of the Karáchi Longitudinal Series).
Chalarwa	XVIII.
Chatrikhera	XXIII.
Chitália	XXIX.
Chitror	XI.
Dájka	VI.
Dangarwári	XLII.
Deo-ki-Galol	XXXII.
Dúngarpur	XX.
Gángta	VII.
Itria	XXXV.
Iwália	IV.
Jákia	XL.
Jhund	LXVI. (Of the Karáchi Longitudinal Series).
Jitori	XXXIII.
Kakána	XXVI.
Kákraji	XV.
Kálunjhar	III.
Kanduka	IX.
Kesmára	XIII.
Khánmír	X.
Khársar	II.
Konkáwáo	XXXIV.
Maidhar	XXVII.
Mália	XVI.
Manáwa	XXXVII.
Monába	XII.
Mumaiya	XXX.
Nandivela	XXXIX.
Nántej	XLI.
Pangasia	XIX.
Pata-i-Sháh	VIII.
Rangpur	XVII.
Sakpur	XXXVI.
Sápakra	XXI.
Sarkala	XXXVIII.
Tarkia	XXV.
Trákura	XXXI.
Viráwáh	I.
Virpur	XXII.
Wándia	XIV.
Wánkáner	XXIV.

KATTYWAR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. NUMERICAL LIST OF STATIONS.

LXI (Of the Karáchi Longitudinal Series).	Akoria.
LXIV (Of the Karáchi Longitudinal Series).	Bhilgaon.
LXVI (Of the Karáchi Longitudinal Series).	Jhund.
I	Viráwáh.
II	Khársar.
III	Kálunjhar.
IV	Iwália.
V	Bela.
VI	Dájka.
VII	Gángta.
VIII	Pata-i-Sháh.
IX	Kanduka.
X	Khánmír.
XI	Chitror.
XII	Monába.
XIII	Kesmára.
XIV	Wándia.
XV	Kákraji.
XVI	Mália.
XVII	Rangpur.
XVIII	Chalarwa.
XIX	Pangasia.
XX	Dúngarpur.
XXI	Sápakra.
XXII	Virpur.
XXIII	Chatrikhera.
XXIV	Wánkáner.
XXV	Tarkia.
XXVI	Kakána.
XXVII	Maidhar.
XXVIII	Bháyásar.
XXIX	Chitália.
XXX	Mumaiya.
XXXI	Trákura.
XXXII	Deo-ki-Galol.
XXXIII	Jitori.
XXXIV	Konkáwáo.
XXXV	Itria.
XXXVI	Sakpur.
XXXVII	Manáwa.
XXXVIII	Sarkala.
XXXIX	Nandivela.
XL	Jákia.
XLI	Nántej.
XLII	Dangarwári.

KATTYWAR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. DESCRIPTION OF STATIONS.

The Principal Stations of this Series, with 8 exceptions, are all situated on hills or rising ground. These, save stations III and VI, have solid, circular pillars of masonry 1 to 8 feet in height carrying marks at top and bottom: at stations III and VI, where the rock rises sufficiently above the hill, no pillars were built, and only a mark was engraved on the rock. Around the pillars and level with their surfaces, solid platforms of stones or earth-work were constructed for the observatory tent to rest on. The 8 exceptions are the stations IX, XV to XIX, XXI and XXXIV, at which, they being situated in the plains, it was found necessary to construct towers to overlook the curvature of the earth. These are solid structures of sun-dried bricks or stones set in mud cement, 12 to 36 feet in height, enclosing solid pillars of masonry, which carry marks at top, bottom and intermediately, the upper 5 feet of each pillar being circular and isolated.

The following descriptions have been compiled from those originally supplied by the Officers who executed the Series and from the records of Captain Baird's Levelling Operations in 1874 to 1876, supplemented as regards the position of the adjacent villages from the Topographical maps of the country traversed. Some information regarding the heights and construction of the stations have been gathered from reports, contingent bills and other records of the Series. The information, as to the local sub-divisions in which the several stations are situated, has been derived, where practicable, from the latest Annual Reports received from the Civil Authorities to whose charge the stations have been committed.

LXI.—(*Of the Karáchi Longitudinal Series*). Akoria Station, lat. 24° 41′, long. 71° 19′—observed at in 1851 and 1856—is upon a small mound on the northern border of the Ran of Cutch, and derives its name from a village that formerly stood near this site: pargana Bautra, district Jodhpore.

The station consists of a platform edged with stakes and filled in with sand, enclosing a solid pillar of masonry, 8 feet in height, which has a mark-stone at the level of the foundation, and others at 1, 3, 7 and 8 feet respectively above it: the pillar is isolated by an annular wall of masonry. When again visited in 1856, no statement of any alteration in the construction of the station is forthcoming. The large village of Khijriati is distant about 6 miles.

LXIV.—(*Of the Karáchi Longitudinal Series*). Bhilgaon Hill Station, lat. 24° 42′, long. 71° 7′—observed at in 1851 and 1856—is situated on a sand hill appertaining to the village of Dedrai, in that part of the Thar, or Little-desert, which appertains to Bhuj: thána Halla, taluka Nagar, district Thar and Párkar.

The station consists of a platform enclosing a solid, isolated pillar of masonry, 4 feet in height, which has a mark-stone at bottom, and others at 2, 3 and 4 feet respectively above it. When again visited in 1856, no statement of any alteration in the construction of the station is forthcoming. Sammari village, bearing 16° E. of the ray to Jhund Station, is distant about 2 miles.

LXVI.—(*Of the Karáchi Longitudinal Series*). Jhund Hill Station, lat. 24° 48′, long. 71° 1′—observed at in 1851 and 1856—is situated on a sand hill in that part of the Thar, which appertains to Bhuj: thána Halla, taluka Nagar, district Thar and Párkar.

The station consists of a platform edged with stakes and filled in with sand, enclosing a solid pillar of masonry, 3 feet in height, which has a mark-stone at bottom, and others at 2 and 3 feet respectively above it: the pillar is isolated by an annular wall of masonry. When again visited in 1856, no statement of any alteration in the construction of the station is forthcoming. The village of Jhund is distant about 2 miles, and the villages of Borli, Chucha and Gundi are nearest to the station.

I. Viráwáh Hill Station, lat. 24° 25′, long. 71° 9′—observed at in 1856—is situated on the summit of one of a group of high hills lying about 3 miles W. of the village of Churia; the hills are surrounded on three sides by the Ran which is not fordable to the eastward: taluka Nagar, district Thar and Párkar.

The station consists of a platform which is a few inches in height on one side and 1½ feet on the other, enclosing a small, isolated pillar of masonry built upon a granite rock. The nearest villages to the station are Wandia and Beruna.

II. Khársar Hill Station, lat. 24° 34′, long. 70° 50′—observed at in 1856—is on the highest point of one of a group of hills composed chiefly of hard granite, the rock being very much broken; that on which the station is, has several deep fissures. The hill is in the lands of Khársar village from which there is an ascent to the station: taluka Nagar, district Thar and Párkar.

The station consists of a loose stone platform enclosing an isolated pillar of masonry about 2 feet in height. Khársar village lies E., a little short of a mile; and Viráwáh to S. by W., about 4 miles.

III. Kálunjhar Hill Station, lat. 24° 20′, long. 70° 48′—observed at in 1856—is on a peak called Godar Takia of the Kálunjhar group of hills composed of granite. The hill lies to the south of the village of Nagar from which there is an ascent to the station: taluka Nagar, district Thar and Párkar.

The station mark is engraved on a solid mass of rock which is so hard that it was found impossible to smooth its surface: hollows were cut for the feet of the instrument: a small quantity of rubble work surrounds the rock as a platform for the observatory tent to stand on.

IV. Iwália Hill Station, lat. 23° 52′, long. 71° 9′—observed at in 1856—is situated on the highest part of the hill called after the village of Iwália to which it belongs. The Ran extends on three sides, though on the south it is many miles away: sub-division Sántalpur, Pálanpur State.

The station consists of the usual platform about 5 feet in height, enclosing an isolated pillar of masonry. The directions and estimated distances of the following villages are:—Iwália E., close; and Jakotra S., mile 1.

V. Bela Hill Station, lat. 23° 54′, long. 70° 48′—observed at in 1856—is situated on a hill locally called Nilwa, lying towards the west and north of the village of Bela, at a distance of about 3 miles: it is in the lands appertaining to Bela village, pargana Wágad, Cutch State.

The station consists of a platform about 5 feet in height, enclosing an isolated pillar of masonry.

VI. Dájka Hill Station, lat. 23° 42′, long. 70° 52′—observed at in 1856—is on a hill appertaining to the lands of the village of Fathiagad: pargana Wágad, Cutch State.

The station mark is engraved upon a large stone which on three sides is hewn into the shape of a pillar, on the fourth side, the stone was hewn out as much as its hardness would allow, and the hollow as well as more than 2 feet of the depth on the other three sides was filled with sand. The directions and distances of the following buildings are:—Fathiagad round tower E.N.E., miles 1·44; and Dulka temple S.W., miles 4·89.

VII. Gángta Hill Station, lat. 23° 44′, long. 70° 32′—observed at in 1856—is situated on the highest part of a hill in the Ran. The road from the village of Rau, at the time the station was visited, was dry but the Ran generally around the station was muddy: it is in the lands of Rau village, pargana Wágad, Cutch State. The ruins of a tower and walls are to be seen here, the place having once been the stronghold of freebooters.

The station consists of a platform about 5 feet in height, enclosing an isolated pillar of masonry which is built in a manner similar to those at the adjacent stations. The approximate directions and distances of the following villages are:—Rau S.E., miles 6; and Dauri N., miles 9.

VIII. Pata-i-Sháh Hill Station, lat. 23° 33′, long. 70° 59′—observed at in 1854 and 1856—is situated on an isolated hill rising some 150 feet above the surrounding country: the tomb of a Muhammadan devotee, called Pir Pata-i-Sháh is about 120 links S. of the station: in lands of Bangerah village, pargana Adesir, Cutch State.

The station consists of a platform of stones and earth enclosing a solid, isolated pillar of masonry, about 5 feet in height, which has a mark-stone at top. When again visited in 1856, no statement of any alteration in the construction of the station is forthcoming. The directions and approximate distances of the following villages are:—Lakhgad N.N.W., miles 1½; Bangerah S., mile 1; and the town of Adesir E., miles 3.

IX. Kanduka Hill Station, lat. 23° 34′, long. 70° 44′—observed at in 1856—is situated on a hill appertaining to the village lands of Rahpur: pargana Wágad, Cutch State.

The station consists of a platform of rubble, about 12 feet in height, enclosing a pillar of masonry of which the upper 5 feet is isolated. The directions and distances of the following places are:—Rahpur town W., miles 2½; and Omia fort E.N.E., miles 4¾.

X. Khánmír Hill Station, lat. 23° 24′, long. 70° 55′—observed at in 1854 and 1856—is situated on the highest part of the hill locally called Gur, which rises some 250 feet above the level of the plain, and is one of a range of low hills running N.W. and S.E. and terminating southwards near the Ran: it is in the lands of the village of Khánmír which lies about 1½ miles to N., pargana Wágad, Cutch State.

The station consists of a platform of loose stones enclosing a solid, isolated pillar of masonry, 5 feet in height, which has a mark-stone at top. When again visited in 1856, no statement of any alteration in the construction of the station is forthcoming. The hill fort of Khánmír is to N.W., about 1⅓ miles.

XI. Chitror or Chitrod Hill Station, lat. 23° 24′, long. 70° 44′—observed at in 1854 and 1856—is situated on the highest point of the hill called Dhia which is within a couple of miles of the town of Chitrod: pargana Wágad, Cutch State.

The station consists of a platform enclosing an isolated pillar of masonry, but as it was not sufficiently large for the stand of the instrument, it had to be increased, in effecting which the height of the pillar was increased a little. This addition of about 6 to 7 inches was made after the 30th March 1854. When again visited in 1856, no statement of any alteration in the construction of the station is forthcoming.

XII. Monába Hill Station, lat. 23° 17′, long. 70° 51′—observed at in 1856—is situated on the highest point of the Dhar hill, a conspicuous and elevated pasture ground on the verge of the Ran called Bhír Mandad, about 4 miles E.S.E. of the village of Monába, and N.W. of Bhimdeoka. There are a few huts close to the station which are occupied during the cold season by people who graze cattle along the margin of the Ran: pargana Wágad, Cutch State.

The station consists of a mud platform, about 5 feet in height, enclosing the usual, isolated pillar of masonry. When visited in 1875-76 by Mr. T. H. Rendell in the course of the Levelling Operations, the upper mark-stone was found to have been destroyed, but a portion of the upper surface of the pillar could be traced, and one of the three flat stones (generally placed for the feet of the theodolite stand to rest upon) was found intact.

XIII. Kesmára Hill Station, lat. 23° 17′, long. 71° 4′—observed at in 1856—is situated on the highest point of a hill in the island of Bet in the Ran between Palanswa in Cutch, and Gantila or Tekar in Kattywar; the island is used as a Bhír or pasture land: pargana Wágad, Cutch State.

The station consists of a platform, about 5 feet in height, enclosing the usual, isolated pillar of masonry.

XIV. Wándia Station, lat. 23° 15′, long. 70° 39′—observed at in 1856—is on the middle tower or bastion at the re-entering angle on the western face of the town wall of Wándia: pargana Wágad, Cutch State.

The station consists of a mud platform, about 5 feet in height, built on the centre of the solid bastion, enclosing an isolated pillar of masonry, which has a mark-stone at its upper surface. The village of Janghi is to S.W. by W., about 3½ miles.

XV. Kákraji Tower Station, lat. 23° 5′, long. 70° 58′—observed at in 1854 and 1856—stands on a mound immediately E. of a tank which is close S. of the village of Kákraji. The station tower is built having its northern face abutting against a temple dedicated to Siva: taluka Mália, district Hállár.

The station consists of a solid tower of sun-dried bricks and mud cement, 36 feet in height, enclosing a solid pillar of burnt bricks and mortar, the upper 5 feet as usual being isolated. Four outer marks were made, and the intersection of the lines joining them indicated the position of the upper mark. When revisited in 1856, the upper mark was found displaced 2·44 inches to S.S.E. of the point indicated by the intersection of lines joining the outer marks, the observations were then taken not from the mark but from the point thus indicated. The directions and distances of the circumjacent villages are:—Vejalpur E., miles 2¼; Khambária N.E. by N., miles 3¼; Sultánpur W., miles 3¼; and Aniali S. by W., miles 3¼.

XVI. Mália Tower Station, lat. 23° 5′, long. 70° 47′—observed at in 1854 and 1856—stands on the embankment of a tank about a mile W.S.W. of the large village of Mália, and 1½ miles N.W. by W. of Captain Mackenzie's tomb near the western bank of the Machhu river: taluka Mália, district Hállár.

The station consists of a solid tower, 18 feet in height, enclosing a pillar of stone and mortar, the upper 5 feet of which is isolated. Four outer marks were made, and the intersection of the lines joining them indicated the position of the upper mark. When visited in 1856, no statement of any alteration in the construction of the station is forthcoming, but the outer marks having been destroyed, the position of the upper mark could not be verified. When again visited in 1874-75 in the course of the Levelling Operations, the upper mark-stone was found tolerably perfect, but the circle and dot had disappeared. The directions and distances of the circumjacent villages are:—Náni Barál S.W. by W., miles 3¾; Moti Barál S.S.W., miles 4; and Virwadar S.E. by E., miles 3.

XVII. Rangpur Tower Station, lat. 22° 55′, long. 70° 56′—observed at in 1853, 1854 and 1856—stands on the mound of a tank about half a mile nearly S. of the village of Rangpur, and 1½ miles N.E. by N. of Bela on the left bank of a branch of the Godadhroi river: taluka Morvi, district Hállár.

The station consists of a solid tower 16 feet in height. There are four outer marks on stones deeply embedded in the ground, and the intersection of lines connecting them diagonally indicated the position of the station mark. When again visited in 1856, the upper mark was found displaced by 1·57 inches to N.E. The directions and distances of the circumjacent villages are:—Haripur and Kerála N.W., miles 3; Sanála S.E. by S., miles 2½; and Jiwápur N.N.E., miles 4.

XVIII. Chalarwa or Charádwa Tower Station, lat. 22° 57′, long. 71° 6′—observed at in 1852, 1854 and 1856—stands on the bank of a small dry tank near junction of roads from Kariand, Suswáo and Chalarwa, and about 2¾ miles N.E. of the town of Chalarwa: taluka Dhrángadra, district Jhalawad.

The station consists of a tower of stones set in mud cement, 11 feet square and 16 feet in height, enclosing a pillar of stone and mortar. Four pillars are built outside the tower, and the intersection of the lines engraved on them indicated the position of the upper mark on which the theodolite was centered; the mark at the ground level is 0·65 of an inch to E. of the upper one. When again visited in 1856, the upper mark-stone was found displaced by 0·95 of an inch to N.E., but no statement of any alteration in the construction of the station is forthcoming. The directions and distances of the circumjacent villages are:—Suswáo N.E. by N., miles 3¼; Kariana S.E. by S., miles 2¼.

XIX. Pangasia Tower Station, lat. 22° 57′, long. 70° 46′—observed at in 1854 and 1856—stands on an embankment at the northern side of a tank named Bora, immediately south of road from Náráyan-ka village to that of Pangasia, and about ¾ of a mile E.S.E. of the latter: taluka Morvi, district Hállár.

The station consists of a solid tower of stone and mud cement, 20 feet in height, enclosing a pillar of stone and mortar, the upper 5 feet of which is isolated. When again visited in 1856, no statement of any alteration in the construction of the station is forthcoming. The directions and distances of the circumjacent villages are:—Derála (on the western bank of the Machhu river) N.E., miles 2¼; Náráyan-ka E., miles 2; Khewália S., miles 2¼; and Sarwad N.W., miles 3.

XX. Dúngarpur Hill Station, lat. 22° 48′, long. 71° 2′—observed at in 1852 and 1856—is situated on one of the knolls on the table-land, about ¾ of a mile W.S.W. of the village from which the station is named, and 4¾ miles in the same direction from the village of Mathak: taluka Dhrángadra, district Jhalawad.

The station consists of a platform of loose stones, enclosing a pillar of stone and mortar, which contains a mark 5 feet above the ground and another at top. When again visited in 1856, the upper mark had been destroyed and a new one was placed by reference to the mark 5 feet above the ground. The directions and distances of the circumjacent villages are:—Gidach S.W., miles 2; Ol S.E. by E., miles 2½; and Rátábhe N., miles 3.

XXI. Sápakra Tower Station, lat. 22° 52′, long. 71° 17′—observed at in 1853—stands on the rising ground south of the village of Sápakra: taluka Dhrángadra, district Jhalawad.

The station consists of a tower of loose stones with a broad base, 26 feet in height, enclosing a pillar of stone and lime cement. The directions and distances of the circumjacent villages are:—Bhalgámda N.W., miles 3¼; Digaria W. by S., miles 3; Ratewália E.S.E., miles 2¾; and Chitrori (on the right bank of the Bámbhan river) S. by W., miles 2¼.

XXII. Virpur Station, lat. 22° 45′, long. 70° 51′—observed at in 1853, 1854 and 1856—is situated on the rising ground about a mile E. of the metalled road from Tankára to Morvi, and 1½ miles N.E. of Virpur village; the highest point in the neighbourhood is about 1¾ miles to E.S.E.: taluka Morvi, district Hállár.

The station consists of a platform of loose stones, about 5 feet in height, enclosing a pillar of stone and mortar. When again visited in 1854 and 1856, no statement of any alteration in the construction of the station is forthcoming. The directions and distances of the circumjacent villages are:—Sanála (on the metalled road) N. by W., miles 2¼; Rájpur W.N.W., miles 2¾; and Hamírpur or Nawagám E. by S., miles 3.

XXIII. Chatrikhera Hill Station, lat. 22° 40′, long. 71° 11′—observed at in 1853—is situated on the northern extremity of a small rocky hill, about 1½ miles S.S.E. of the village of Chatrikhera, and 2¾ miles E. of Lunsar: taluka Wánkáner, district Jhalawad.

The station consists of a platform of loose stones, 8 feet in height, enclosing a pillar of stone and mortar; the lower mark is engraved on the rock *in sitú*. The directions and distances of the circumjacent villages are:—Undwi N.E. by N., miles 2¼; Vijalia S.E., miles 1¼; and Mandásar S.S.W., miles 1½.

XXIV. Wánkáner Hill Station, lat. 22° 36′, long. 70° 58′—observed at in 1853 and 1856—is situated on a hill, about ¾ of a mile S.W. of the town of Wánkáner on the Machhu river; a temple which is overhung by a tree is 300 yards E. of the station: taluka Wánkáner, district Jhalawad.

The station consists of a platform of loose stones, about 5 feet in height, enclosing a pillar of stone and mortar which has a mark at top and another at the surface of the ground. When again visited in 1856, the upper mark-stone had been destroyed and a new one was placed by reference to the ground level mark. The directions and distances of the circumjacent villages are:—Deoli or Rátideoli N.N.W., miles 2; Rájáwadla S.E. by S., miles 2; and Panch Dwárka W.S.W., miles 3¼.

XXV. Tarkia Hill Station, lat. 22° 29′, long. 71° 12′—observed at in 1853—is on a small peak of the ridge, about 1½ miles S.E. of the village of Tarkia, and 4½ miles N.N.W. of the town and Dák Bungalow of Chotila on the road from Rájkot to Ahmedabad: taluka Wánkáner, district Jhalawad.

The station consists of the usual platform, about 5 feet in height, enclosing a circular pillar of masonry. The directions and distances of the circumjacent villages are:—Rámparu nearly E., miles 1½; Pájwáli S.S.E., miles 2; Jániwadla S.W. by S., miles 3; and Pándal N.W., miles 3½.

XXVI. Kakána Hill Station, lat. 22° 25′, long. 70° 59′—observed at in 1853—is situated on the rocky table-land, about ¾ of a mile S.S.W. of the village of Kakána, and 4½ miles N. of the large village or town of Kuwárwa on the metalled road from Rájkot to Ahmedabad: taluka Rájkot, district Hállár.

The station consists of a platform of rubble of the usual dimensions, enclosing a circular pillar of masonry. When again visited in 1875-76 by Captain Baird in the course of the Levelling Operations, he found the station to consist of the usual, circular pillar surrounded by a platform of rubble stone, and surmounted by a 3-foot rectangular pillar of the Kattywar Minor Triangulation. The directions and distances of the circumjacent villages are:—Sulia N.W., mile ¾; Jhiána S. by W., miles 1¾; Sáthra (on the Machhu river) E.S.E., miles 2¾; and Sanosara W., miles 3½.

XXVII. Maidhar Hill Station, lat. 22° 17′, long. 71° 14′—observed at in 1853—is situated on a small, conical hill on the eastern edge of the high table-land which divides the drainage of the whole peninsula: the eastern face of the plateau is well defined for a considerable distance to N. and S. of the station: taluka Limri, district Jhalawad.

The station consists of the usual platform about 5 feet in height. The directions and distances of the circumjacent villages are:—Sanosra E.N.E., miles 2½; Kheráua N., miles 2; Chobári S. by E., miles 1¾; and Bhojpára W. by S., miles 2¾.

XXVIII. Bháyásar Hill Station, lat. 22° 10′, long. 70° 56′—observed at in 1853—is situated on a small, conical, rocky hill which rises immediately above the old site of the village of Bháyásar, and 3½ miles N. by E. of Rájpura; the station is about 4 yards S. of a shrine: taluka Sirdhar, district Hállár.

The station consists of a platform about 5 feet in height. The directions and distances of the circumjacent villages are:—Kátrota E., mile 1; Pipláua W.S.W., miles 2¾; Bháyásar S.S.W., mile ½; and Pádásan N.E., miles 2¼.

XXIX. Chitália Hill Station, lat. 22° 3′, long. 71° 12′—observed at in 1853—is situated on a small, isolated hill, about 2½ miles N.N.E. of Adkot on the metalled road from Rájkot to Gogo; a temple was in course of construction close to the S.E. corner of the platform: taluka Jasdán, district Kattywar.

The station consists of a stone platform, about 5 feet in height, enclosing a pillar of stone and mortar. The directions and distances of the circumjacent villages are:—Jasdán (on the right bank of the Bhádar river) E., miles 3; Chitália W., mile ¾; Lákháwár N.N.W., miles 1¼; and Samadiala (on the metalled road) nearly W. by S., miles 3¼.

XXX. Mumaiya or Mumaia Hill Station, lat. 21° 54′, long. 70° 54′—observed at in 1853—is situated on the hilly ground, about 1½ miles S. of the village of Mumaiya, and 5½ miles S.E. by S. of the town of Gondal on the Gondli river: taluka Gondal, district Hállár.

The station consists of the usual platform about 4 feet in height, enclosing an isolated pillar. The directions and distances of the circumjacent villages are:—Bandhia N.E. by E., miles 4¼; Kudla S. by E., miles 3½; and Khokhri S.S.W., miles 4½.

XXXI. Trákura Hill Station, lat. 21° 58′, long. 70° 39′—observed at in 1853—is situated on a hill midway between the villages of Trákura and Harmaria lying 2½ miles respectively to E.S.E. and W.N.W.: taluka Gondal, district Hállár.

The station consists of a platform, about 4 feet in height, enclosing an isolated pillar. The directions and distances of the circumjacent villages are:—Amrali S. by W., miles 2½; Mespur W., miles 4; and Garnára N.E. by E., miles 3½.

XXXII. Deo-ki-Galol Hill Station, lat. 21° 38′, long. 70° 44′—observed at in 1853—is on one of the knolls of a ridge running nearly E.S.E. and W.N.W., about 1½ miles W.N.W. of the village of Deo-ki-Galol on the metalled road from Jetpur to Mánakwára: taluka Jetpur, district Kattywar.

The station consists of the usual platform built to a height of 4 feet to isolate the pillar. The directions and distances of the circumjacent villages are:—Khambhália S., miles 3¼; Mándwa S.W., miles 2¾; Bamangám W., miles 2¼; and Piplia (on the metalled road) N. by W., miles 1½.

XXXIII. Jitori Hill Station, lat. 21° 44′, long. 71° 9′—observed at in 1853—is situated on the eastern extremity, but not on the highest point, of a ridge running E. and W., about a mile N.N.W. of the village of Jitori, and 5¾ miles W. of the large village of Chital: taluka Gondal, district Hállár.

The station consists of the usual platform 5 feet in height. The directions and distances of the circumjacent villages are:—Pipria N.E. by N., miles 2; Sárangpur N.W., miles 2; Máyápádar nearly W., miles 2½; and Lúni S., miles 2½.

XXXIV. Konkáwáo Tower Station, lat. 21° 39′, long. 70° 59′—observed at in 1853—is situated on a table-land, about 3½ miles N.W. by W. of the village of Konkáwáo Moti, and 4½ miles N.E. of that of Tori: pargana Bilkha, district Sorath.

The station consists of a tower 30 feet in height, enclosing a pillar of which the upper 5 feet is isolated. Outer marks have been made by which the position of the upper mark of the station can be determined in case it is lost. The directions and distances of the circumjacent villages are:—Anida N. by W., miles 2; Arjansakh W. by S., miles 2½; and Nájapur S., miles 2¾.

XXXV. Itria Hill Station, lat. 21° 57′, long. 71° 27′—observed at in 1853—is situated on the highest part of a prominent hill, about 2 miles S. by W. of Itria village on the right bank of the Ghela river, and 5 miles N.E. of the large village of Kariana on the Kálubhár river: taluka Itria Ghadala, district Gohelwád.

The station consists of a platform, 1 foot in height, enclosing an isolated pillar. The directions and distances of the circumjacent villages are:—Khambála W.N.W., miles 3½; Iswaria S.W., miles 3½; and Shirwánia S., miles 3.

XXXVI. Sakpur Hill Station, lat. 21° 33′, long. 71° 33′—observed at in 1853—is situated on the centre of the highest of a number of scattered hills, about a mile S.W. of the village from which it takes its name, and 4 miles nearly W.N.W. of the large village of Gáriadhár: taluka Bhaunagar, district Gohelwád.

The station consists of a platform, 1 foot in height, which is built on the solid rock. The directions and distances of the circumjacent villages are:—Kalánpur W. by N., miles 2½; Rájkot N.E., miles 2; and Wauri Náni E. by S., miles 1¾.

XXXVII. Manáwa Hill Station, lat. 21° 22′, long. 71° 8′—observed at in 1853—is situated on the hilly ground S. of the village from which it has been named, and about 5 miles E.N.E. of the village of Dhári on the right bank of the Shetrunji river: taluka Gondal, district Hállár.

The station consists of a stone platform, 5 feet in height, enclosing an isolated pillar of stone and mortar. The directions and distances of the circumjacent villages are:—Manáwa N., mile 1; Jhar E. by S., miles 1½; and Chhatardia S. by E., miles 2.

XXXVIII. Sarkala Hill Station, lat. 21° 12′, long. 70° 53′—observed at in 1853—is situated 50 yards from the highest part of the lofty and conspicuous hill known as Sarkala lying on the northern boundary of the wild country called the Gir, ascent to the summit being difficult. The surrounding country is a waste, the only village is the small one of Dodalia about 3 miles to the N.E.; a few huts, near the ruins of a wall and tower indicating the site of the fort of Sassi, are about 2 miles to E.: taluka Una, district Sorath.

The station consists of the usual platform, 5 feet in height.

XXXIX. Nandivela Hill Station, lat. 21° 2′, long. 71° 9′—observed at in 1853—is situated on the western extremity and on the highest part of one of the largest, isolated hills in the Gir, about 2¾ miles N.E. of Wadli village: taluka Una, district Sorath.

The station consists of a platform, 5 feet in height, which has been built in a manner similar to those at the neighbouring stations. The directions and distances of the circumjacent villages are:—Barwála S.S.W., mile 1; Kantála E.S.E., miles 3; Nitli S.S.W., miles 2¾; and Chíkhal Koba (on the left bank of the Ráwal river) W.S.W., miles 3½.

XL. Jákia Hill Station, lat. 20° 58′, long. 70° 56′—observed at in 1853—is situated on a hill about 1 mile N.E. of Jákia village, and about 200 yards N.W. of a rocky knoll on the same ridge on which there is some object of worship indicated by flags: taluka Una, district Sorath.

The station consists of a stone platform enclosing a circular pillar of masonry, about 5 feet in height, which carries a mark at top. The approximate directions and distances of the circumjacent villages are:—Gadra S., miles 3; Babria N.W., miles 1½; and Farera S., miles 1½.

XLI. Nántej Hill Station, lat. 20° 51′, long. 71° 8′—observed at in 1853—is situated on the rising ground about 300 feet S. of the cart road from Nántej to Sámter: taluka Una, district Sorath.

The station consists of a platform, 8 feet in height, enclosing a solid, circular pillar of masonry which contains two mark-stones. The directions and distances of the circumjacent villages are:—Sámter E., miles 1½; Amodra S., miles 2; Kasári W., miles 2½; Nántej W. by N., mile ½; and the town of Una S.W. by W., miles 3½.

XLII. Dangarwári Hill Station, lat. 20° 43′, long. 70° 59′—observed at in 1853—is situated on a rocky hill almost in the centre of the island of Diu, which belongs to the Portuguese, and about 3½ miles W. of the town. This part of the island is mostly sandy, and throughout the whole length across its centre, occasional patches of lime-stone rock appear. A few huts of the village of Dangarwári are to the west of the platform, and others in the cocoanut gardens at the foot of the hill are on the N. side.

The station consists of the usual platform enclosing a circular pillar of masonry which contains three marks, one flush with the ground, another at top and a third intermediately. The directions and distances of the following places are:—St. Remedio's Church and the Pársi's Cemetery S.E. by E., miles 2; and chief flag of Diu Guard House N., miles 1¾.

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

April 1880.

KATTYWAR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. OBSERVED ANGLES.

At LXI (Akoria)

January 1856; *observed by Lieutenant D.J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on I 295° 26′	115° 26′	305° 36′	125° 36′	315° 47′	135° 47′	325° 53′	145° 53′	336° 4′	156° 4′	346° 14′	166° 14′	M = Mean of Groups w = Relative Weight C = Concluded Angle
I & LXIV	″ l 57·00 l 56·33	″ l 53·90 l 54·00	″ l 52·77 l 52·50	″ l 55·04 l 53·60	″ l 51·66 l 52·40	″ l 59·36 l 59·00	″ l 49·84 l 51·36 l 49·76	″ l 53·46 l 53·26	″ l 51·86 l 51·54	″ l 52·64 l 52·90	″ l 52·90 l 55·23 l 54·40	″ l 55·70 l 57·16 l 55·13	$M = 53''\cdot93$ $w = 2\cdot00$ $\frac{1}{w} = 0\cdot50$
	56·67	53·95	52·63	54·32	52·03	59·18	50·32	53·36	51·70	52·77	54·18	56·00	$C = 64^\circ\ 34'\ 53''\cdot93$

At LXIV (Bhilgaon)

January 1856; *observed by Lieutenant D.J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on LXI 280° 15′	100° 15′	290° 26′	110° 26′	300° 37′	120° 37′	310° 42′	130° 42′	320° 53′	140° 53′	331° 4′	151° 4′	M = Mean of Groups w = Relative Weight C = Concluded Angle
LXI & I	″ h 24·87 h 23·80	″ h 22·60 h 23·33	″ h 23·30 l 20·67 l 22·20	″ h 22·27 h 22·77 l 22·53	″ h 16·80 h 16·40	″ h 24·13 h 25·00	″ h 17·96 h 17·06	″ h 18·13 h 16·73	″ l 15·43 l 14·33	″ l 23·80 l 22·97	″ l 20·90 l 21·97	″ l 23·33 l 23·36	$M = 20''\cdot92$ $w = 1\cdot05$ $\frac{1}{w} = 0\cdot95$
	24·34	22·96	22·06	22·52	16·60	24·57	17·51	17·43	14·88	23·38	21·44	23·34	$C = 79^\circ\ 45'\ 20''\cdot92$

NOTE.—Stations LXI and LXIV appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At LXIV (Bhilgaon)—(*Continued*).

Angle between	Circle readings, telescope being set on LXI 280° 15′	100° 15′	290° 26′	110° 26′	300° 37′	120° 37′	310° 42′	130° 42′	320° 53′	140° 53′	331° 4′	151° 4′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
I & III	h 45·23 h 46·90	h 49·77 h 50·43	h 49·44 l 50·93 l 50·73	h 53·36 h 53·13 h 52·63	h 53·37 h 54·67	h 50·90 h 50·54	h 56·10 h 55·80	h 54·04 h 53·97	l 53·44 l 53·87	l 49·10 l 51·23 l 50·70	l 52·97 l 52·17	l 48·97 l 49·87	$M = 51''\cdot69$ $w = 1\cdot64$ $\frac{1}{w} = 0\cdot61$
	46·07	50·10	50·37	53·04	54·02	50·72	55·95	54·00	53·66	50·34	52·57	49·42	$C = 44^\circ\ 56'\ 51''\cdot69$
III & II	h 53·06 h 51·54 h 52·00	h 47·87 h 46·30	h 51·90 l 50·57 l 52·13	h 43·94 h 42·20 l 42·20 h 42·83	h 41·90 h 41·47	h 43·70 h 43·26	l 47·60 l 46·60	h 46·67 l 45·86	l 47·90 l 47·73	l 48·20 l 47·53	l 47·40 l 47·56	l 50·83 l 50·53	$M = 47''\cdot18$ $w = 1\cdot06$ $\frac{1}{w} = 0\cdot94$
	52·40	47·09	51·53	42·79	41·68	43·48	47·10	46·27	47·81	47·87	47·48	50·68	$C = 26^\circ\ 10'\ 47''\cdot18$
II & LXVI	h 41·70 h 43·03	h 52·56 h 52·87	l 43·30 l 42·00	l 52·30 l 53·47 h 51·77	h 48·70 h 46·70	h 48·24 h 47·07	l 51·04 l 49·77	h 50·10 h 50·50	l 50·76 l 50·94	l 52·03 l 51·47	l 50·70 l 52·24	l 49·80 l 49·44	$M = 49''\cdot17$ $w = 0\cdot97$ $\frac{1}{w} = 1\cdot03$
	42·37	52·71	42·65	52·51	47·70	47·66	50·40	50·30	50·85	51·75	51·47	49·62	$C = 74^\circ\ 19'\ 49''\cdot17$

At LXVI (Jhund)

January 1856; *observed by Lieutenant D.J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on LXIV 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
LXIV & II	h 53·86 h 54·50	h 49·44 h 50·00	h 51·77 h 52·87	h 49·23 h 48·84	l 47·70 l 47·90	h 43·93 l 44·50 h 44·40	l 54·77 l 52·23 l 53·33	l 51·40 l 52·40	h 54·93 h 54·96	h 54·94 h 55·00	h 52·34 h 50·40 h 52·20	h 51·50 h 52·50	$M = 51''\cdot35$ $w = 1\cdot18$ $\frac{1}{w} = 0\cdot85$
	54·18	49·72	52·32	49·04	47·80	44·28	53·44	51·90	54·94	54·97	51·65	52·00	$C = 77^\circ\ 57'\ 51''\cdot35$

At I (Viráwáh)

January and February 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IV 241° 30′	61° 30′	251° 40′	71° 40′	261° 51′	81° 51′	271° 57′	91° 57′	282° 8′	102° 8′	292° 18′	112° 18′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
IV & V	h 47·13 l 48·04	h 48·40 h 48·07	l 46·26 l 48·03	l 47·17 l 46·34	l 50·20 l 49·84	l 49·50 l 49·87	l 53·27 l 54·10	h 51·87 h 54·13 h 53·67	l 56·66 l 57·14	l 52·40 l 52·97	h 58·97 h 57·93	l 49·64 l 50·53	$M = 51''\cdot20$ $w = 0\cdot82$ $\frac{1}{w} = 1\cdot23$
	47·59	48·23	47·15	46·75	50·02	49·69	53·68	53·22	56·90	52·69	58·45	50·08	$C = 32^\circ\ 28'\ 51''\cdot20$

NOTE.—Stations LXI, LXIV and LXVI appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At I (Viráwáh)—(*Continued*).

Angle between	Circle readings, telescope being set on IV 241° 30′	61° 30′	251° 40′	71° 40′	261° 51′	81° 51′	271° 57′	91° 57′	282° 8′	102° 8′	292° 18′	112° 18′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
V & III	″ *h* 44·54 *h* 45·90 *l* 45·30	″ *h* 40·20 *h* 41·30	″ *l* 43·00 *l* 43·17	″ *l* 42·20 *l* 40·93	″ *l* 40·04 *l* 40·60	″ *l* 34·10 *l* 34·13 *h* 36·47	″ *h* 38·64 *h* 39·57	″ *h* 39·47 *h* 40·57	″ *l* 41·74 *l* 42·30	″ *l* 44·73 *l* 43·23	″ *l* 36·73 *h* 36·94 *h* 36·83 *h* 37·77	″ *l* 44·16 *l* 44·20	*M* = 41″·02 *w* = 1·29 $\frac{1}{w}$ = 0·77
	45·25	40·75	43·09	41·56	40·32	34·90	39·11	40·02	42·02	43·98	37·07	44·18	*C* = 43° 47′ 41″·02
III & II	*l* 36·90 *l* 35·37	*h* 39·73 *h* 39·36	*l* 37·77 *l* 36·50	*l* 39·96 *l* 40·47	*l* 41·00 *l* 39·10	*l* 46·44 *l* 45·87 *h* 44·70	*h* 36·60 *h* 35·40	*h* 36·36 *h* 37·03	*l* 32·70 *l* 32·30	*l* 33·40 *l* 33·27	*h* 33·03 *h* 32·03 *h* 33·13	*l* 35·74 *l* 35·53 *h* 35·23	*M* = 37″·13 *w* = 0·83 $\frac{1}{w}$ = 1·20
	36·14	39·54	37·14	40·21	40·05	45·67	36·00	36·70	32·50	33·33	32·73	35·50	*C* = 42° 14′ 37″·13
II & LXIV	*l* 34·93 *l* 35·90	*h* 37·97 *h* 37·40	*l* 37·73 *l* 37·93	*l* 35·17 *l* 36·66	*l* 39·13 *l* 39·46	*l* 33·70 *l* 34·83 *h* 33·23	*h* 40·36 *h* 41·93	*h* 39·77 *h* 39·30	*l* 38·80 *l* 38·16	*l* 34·37 *l* 35·10	*h* 38·46 *h* 39·37 *h* 38·40	*l* 35·50 *l* 34·44	*M* = 37″·31 *w* = 2·29 $\frac{1}{w}$ = 0·44
	35·42	37·68	37·83	35·92	39·29	33·92	41·15	39·53	38·48	34·74	38·74	34·97	*C* = 55° 49′ 37″·31
LXIV & LXI	*l* 47·20 *l* 46·80	*h* 43·76 *h* 43·64	*l* 45·87 *l* 46·34	*l* 45·80 *l* 46·40	*l* 48·07 *l* 48·10	*l* 47·93 *l* 46·37	*h* 49·04 *h* 48·30	*h* 52·43 *h* 51·63	*l* 49·83 *l* 49·14	*l* 53·23 *l* 51·23 *l* 51·57	*l* 46·30 *l* 46·53 *h* 44·57	*l* 53·86 *l* 53·80	*M* = 48″·33 *w* = 1·30 $\frac{1}{w}$ = 0·77
	47·00	43·70	46·11	46·10	48·08	47·15	48·67	52·03	49·49	52·01	45·80	53·83	*C* = 35° 39′ 48″·33

At II (Khársar)

January 1856; *observed by Lieutenant D. J. Nasmyth, R. E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on LXVI 210° 59′	80° 59′	221° 9′	41° 9′	231° 21′	51° 21′	241° 27′	61° 27′	251° 38′	71° 38′	261° 48′	81° 48′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
LXVI & LXIV	″ *l* 24·80 *l* 23·64	″ *l* 24·24 *l* 24·67	″ *l* 24·23 *l* 24·57	″ *l* 26·84 *l* 25·86	″ *l* 18·06 *l* 19·06	″ *l* 22·47 *l* 23·66	″ *h* 17·70 *h* 17·87	″ *h* 16·66 *h* 17·53	″ *h* 16·67 *h* 16·37	″ *h* 17·34 *h* 16·07	″ *h* 20·23 *h* 20·03	″ *h* 15·63 *h* 15·40	*M* = 20″·40 *w* = 0·80 $\frac{1}{w}$ = 1·24
	24·22	24·46	24·40	26·35	18·56	23·06	17·79	17·09	16·52	16·71	20·13	15·51	*C* = 27° 42′ 20″·40

NOTE.—Stations LXI, LXIV and LXVI appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At II (Khársar)—(*Continued*).

Angle between	Circle readings, telescope being set on LXVI 210° 59′	30° 59′	221° 9′	41° 9′	231° 21′	51° 21′	241° 27′	61° 27′	251° 38′	71° 38′	261° 48′	81° 48′	M = Mean of Groups w = Relative Weight C = Concluded Angle
LXIV & I	″ h 42·27 h 42·60	″ h 46·16 h 46·00	″ h 46·97 l 46·60	″ h 45·67 h 44·67	″ l 49·47 l 49·83	″ l 46·33 l 45·64	″ l 52·53 l 50·64 h 51·33	″ l 46·80 l 47·93	″ l 47·90 l 48·13	″ h 46·97 h 45·06	″ h 48·03 h 47·70	″ h 45·30 h 46·50	$M = 46''\cdot 90$ $w = 2\cdot 25$ $\frac{1}{w} = 0\cdot 44$
	42·44	46·08	46·78	45·17	49·65	45·99	51·50	47·36	48·02	46·01	47·87	45·90	$C = 53° \; 2' \; 46''\cdot 90$
I & III	h 62·90 h 62·40	h 60·90 h 61·97	h 59·80 l 58·03	h 62·46 h 62·13	l 58·96 l 58·74	l 61·73 l 63·13	l 52·97 l 52·90 h 52·94	l 60·34 l 59·24	l 60·57 l 59·87	h 62·00 h 63·24	h 61·20 h 61·17	h 64·50 h 64·57	$M = 60''\cdot 66$ $w = 1\cdot 35$ $\frac{1}{w} = 0\cdot 74$
	62·65	61·44	58·91	62·30	58·85	62·43	52·94	59·79	60·22	62·62	61·18	64·54	$C = 68° \; 16' \; 0''\cdot 66$

At III (Kálunjhar)

January 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on II 290° 31′	110° 31′	300° 42′	120° 42′	310° 53′	130° 53′	320° 58′	140° 58′	331° 9′	151° 9′	341° 20′	161° 20′	M = Mean of Groups w = Relative Weight C = Concluded Angle
II & LXIV	″ h 32·97 h 32·40	″ h 27·10 h 28·87	″ h 26·40 h 26·47	″ h 26·80 h 25·46 h 26·46	″ h 26·00 h 25·37	″ h 27·20 h 25·83	″ h 27·26 h 26·50	″ h 30·04 h 29·20	″ h 31·10 l 28·77 l 28·94	″ h 31·67 h 32·70	″ l 31·27 l 30·57	″ l 32·73 l 34·47	$M = 29''\cdot 03$ $w = 1\cdot 50$ $\frac{1}{w} = 0\cdot 67$
	32·69	27·98	26·44	26·24	25·68	26·52	26·88	29·62	29·60	32·18	30·92	33·60	$C = 32° \; 30' \; 29''\cdot 03$
LXIV & I	h 54·30 h 54·87	h 58·60 h 59·53	h 56·24 h 56·70	h 58·43 l 61·00 h 61·14 h 59·97	h 58·30 h 59·57	h 62·67 h 62·50	h 50·84 h 51·43	h 55·83 h 55·37	h 54·17 l 55·26	h 55·30 h 55·10	l 55·10 l 55·73	l 55·80 l 54·96	$M = 56''\cdot 60$ $w = 1\cdot 26$ $\frac{1}{w} = 0\cdot 79$
	54·59	59·06	56·47	60·14	58·93	62·59	51·13	55·60	54·72	55·20	55·41	55·38	$C = 36° \; 58' \; 56''\cdot 60$
I & IV	h 10·40 h 9·80	h 8·76 h 10·13	h 13·90 h 13·33	h 7·10 l 6·57	h 8·90 h 9·20	h 5·97 h 6·14	h 13·03 h 13·03	h 8·23 h 8·03	h 12·76 l 10·97	h 8·23 h 9·30	l 11·13 l 12·57	l 10·74 l 12·94 l 10·87	$M = 10''\cdot 02$ $w = 2\cdot 03$ $\frac{1}{w} = 0\cdot 49$
	10·10	9·45	13·61	6·84	9·05	6·05	13·03	8·13	11·87	8·76	11·85	11·52	$C = 69° \; 33' \; 10''\cdot 02$

NOTE.—Stations LXIV and LXVI appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At III (Kálunjhar)—(*Continued*).

Angle between	Circle readings, telescope being set on II												M = Mean of Groups w = Relative Weight C = Concluded Angle
	290° 31′	110° 31′	300° 42′	120° 42′	310° 53′	130° 53′	320° 58′	140° 58′	331° 9′	151° 9′	341° 20′	161° 20′	
IV & V	″ *h* 25·23 *h* 26·14	″ *h* 26·60 *h* 26·27	″ *h* 26·43 *h* 28·00	″ *h* 28·04 *h* 29·86	″ *h* 27·57 *h* 27·13	″ *h* 31·70 *h* 31·86	″ *h* 26·93 *h* 27·80	″ *h* 32·27 *h* 33·20	″ *h* 25·00 *h* 26·30	″ *h* 31·40 *h* 31·10	″ *l* 26·27 *l* 26·26	″ *l* 28·36 *l* 27·53	$M = 28''\cdot22$ $w = 1\cdot98$ $\frac{1}{w} = 0\cdot51$ $C = 35^\circ\ 3'\ 28''\cdot22$
	25·69	26·43	27·22	28·95	27·35	31·78	27·36	32·74	25·65	31·25	26·26	27·95	

At IV (Iwália)

**February*; *and* †*February and March* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	330° 4′	150° 4′	340° 15′	160° 15′	350° 26′	170° 26′	0° 33′	180° 32′	10° 48′	190° 43′	20° 53′	200° 53′	
† VIII & VI	″ *h* 16·13 *h* 16·97	″ *h* 15·86 *h* 15·66	″ *l* 14·66 *l* 14·60	″ *h* 16·90 *l* 16·47	″ *l* 12·86 *l* 13·57	″ *l* 19·04 *l* 18·20 *l* 16·97 *l* 17·90	″ *h* 8·20 *h* 7·97	″ *l* 6·84 *l* 9·20 *l* 9·07	″ *h* 8·30 *h* 9·60	″ *h* 8·57 *l* 8·40	″ *l* 13·60 *l* 14·63	″ *l* 7·73 *l* 7·10	$M = 12''\cdot52$ $w = 0\cdot75$ $\frac{1}{w} = 1\cdot33$ $C = 29^\circ\ 56'\ 12''\cdot52$
	16·55	15·76	14·63	16·69	13·21	18·03	8·09	8·37	8·95	8·48	14·12	7·41	
† VI & V	*h* 30·70 *h* 32·13	*h* 33·44 *h* 34·20	*l* 32·94 *l* 32·93	*h* 32·63 *h* 34·84 *l* 34·07	*l* 39·34 *l* 37·43	*l* 33·00 *l* 33·17	*h* 38·27 *h* 36·76	*l* 38·43 *l* 38·40	*h* 40·13 *h* 38·43	*h* 33·83 *l* 35·14	*l* 35·20 *l* 35·40	*l* 33·90 *l* 35·67	$M = 35''\cdot27$ $w = 1\cdot80$ $\frac{1}{w} = 0\cdot55$ $C = 40^\circ\ 6'\ 35''\cdot27$
	31·42	33·82	32·93	33·85	38·39	33·08	37·52	38·41	39·28	34·49	35·30	34·78	
	Circle readings, telescope being set on V												
	70° 4′	250° 4′	80° 14′	260° 14′	90° 24′	270° 24′	100° 31′	280° 31′	110° 42′	290° 41′	120° 52′	300° 52′	
* V & III	″ *h* 32·13 *h* 33·03 *h* 34·96 *h* 32·64	″ *h* 34·57 *h* 35·53 *h* 35·23	″ *h* 28·94 *h* 29·43 *h* 29·37 *h* 27·67	″ *l* 33·53 *l* 34·80 *h* 35·03 *h* 35·33	″ *l* 32·86 *l* 31·20 *h* 31·57	″ *l* 38·83 *h* 39·40 *h* 37·53	″ *h* 32·87 *h* 32·50	″ *l* 34·74 *h* 32·70 *h* 32·67	″ *h* 28·37 *h* 29·87	″ *h* 32·23 *h* 32·84 *h* 32·77	″ *h* 31·33 *h* 29·77	″ *h* 30·90 *h* 30·86	$M = 32''\cdot63$ $w = 1\cdot58$ $\frac{1}{w} = 0\cdot63$ $C = 49^\circ\ 29'\ 32''\cdot64$
	33·19	35·11	28·85	34·67	31·88	38·59	32·69	33·37	29·12	32·61	30·55	30·88	
* III & I	*h* 17·47 *h* 16·23 *h* 16·44	*h* 21·23 *h* 19·13 *h* 20·06 *h* 19·33	*h* 18·97 *h* 20·47 *h* 20·53	*h* 21·80 *h* 21·24 *h* 22·10	*h* 22·87 *h* 24·03	*l* 23·14 *l* 23·57 *h* 24·46	*h* 26·33 *h* 26·33	*l* 26·47 *l* 27·70 *h* 26·36	*h* 29·36 *h* 31·37 *h* 30·34	*h* 27·96 *h* 27·33	*h* 28·70 *h* 29·76	*h* 23·23 *h* 23·17	$M = 24''\cdot09$ $w = 0\cdot70$ $\frac{1}{w} = 1\cdot42$ $C = 34^\circ\ 10'\ 24''\cdot09$
	16·71	19·94	19·99	21·71	23·45	23·72	26·33	26·84	30·36	27·65	29·23	23·20	

At V (Bela)

* *February*; *and* † *March* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on III 193° 32′	13° 32′	203° 42′	23° 42′	213° 53′	33° 53′	223° 59′	43° 59′	234° 9′	54° 9′	244° 20′	64° 20′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
* III & I	″ *h* 41·90 *h* 43·07	″ *h* 39·43 *h* 41·47	″ *h* 44·30 *l* 46·37 *l* 45·07 *h* 45·36	″ *l* 45·13 *h* 44·63 *h* 45·23	″ *h* 47·97 *h* 47·34	″ *h* 51·50 *h* 50·37	″ *h* 47·50 *h* 46·97	″ *h* 48·60 *h* 49·40	″ *h* 38·47 *h* 39·84	″ *h* 47·17 *h* 47·40	″ *h* 41·84 *h* 41·23	″ *h* 41·47 *h* 40·70	
	42·49	40·45	45·27	45·00	47·66	50·93	47·24	49·00	39·15	47·29	41·53	41·09	*M* = 44″·76 *w* = 0·84
Lesser circle readings	197° 35′	17° 34′	207° 45′	27° 45′	217° 56′	37° 56′	228° 1′	48° 1′	238° 13′	58° 13′	248° 23′	68° 23′	
† III & I	*h* 42·90 *h* 41·76	*h* 41·77 *h* 42·90	*l* 49·73 *h* 49·10 *h* 49·10	*h* 49·97 *h* 48·33	*l* 47·90 *l* 46·20	*l* 48·43 *l* 49·50	*h* 46·07 *h* 45·44	*l* 50·83 *h* 51·36 *l* 51·57 *h* 50·03	*h* 41·13 *h* 40·67	*h* 43·27 *h* 44·07	*h* 42·14 *h* 43·07	*h* 42·76 *h* 42·53	*w* = 1·82 $\frac{1}{w}$ = 0·55 *C* = 31° 35′ 45″·14
	42·33	42·34	49·31	49·15	47·05	48·96	45·76	50·95	40·90	43·67	42·60	42·65	*M* = 45″·47 *w* = 0·98
Lesser circle readings	225° 7′	45° 7′	235° 18′	55° 18′	245° 28′	65° 28′	255° 35′	75° 35′	265° 45′	85° 45′	275° 56′	95° 56′	
* I & IV	*h* 12·50 *h* 11·40	*h* 17·57 *h* 16·03	*h* 11·03 *l* 11·73	*l* 19·34 *h* 18·80 *h* 17·20	*h* 16·73 *h* 15·90	*h* 15·43 *h* 14·00	*h* 16·23 *h* 16·33	*h* 13·00 *h* 11·84	*h* 13·27 *h* 13·26	*h* 10·93 *h* 11·40	*h* 19·53 *h* 17·93	*h* 16·36 *h* 16·16	
	11·95	16·80	11·38	18·45	16·32	14·71	16·28	12·42	13·27	11·16	18·73	16·26	*M* = 14″·81 *w* = 1·61
Lesser circle readings	229° 10′	49° 10′	239° 21′	59° 21′	249° 32′	69° 32′	259° 37′	79° 37′	269° 48′	89° 48′	279° 59′	99° 59′	
† I & IV	*h* 15·16 *h* 14·77	*h* 18·66 *h* 17·97	*h* 18·80 *h* 16·57 *h* 17·27	*h* 14·13 *h* 13·04	*l* 15·70 *l* 14·30	*l* 14·54 *l* 13·33	*h* 21·37 *h* 20·40	*h* 10·10 *h* 12·40 *h* 11·44	*h* 17·37 *h* 17·06	*l* 12·80 *h* 13·03 *h* 13·13	*h* 16·26 *h* 16·57	*h* 17·27 *h* 18·10	*w* = 3·25 $\frac{1}{w}$ = 0·31 *C* = 63° 51′ 15″·32
	14·97	18·31	17·55	13·59	15·00	13·93	20·89	11·31	17·21	12·99	16·42	17·68	*M* = 15″·82 *w* = 1·64
† IV & VI	*h* 21·03 *h* 19·54 *h* 21·23	*h* 17·20 *h* 18·00	*l* 16·63 *l* 16·86	*l* 22·77 *l* 21·13	*l* 16·80 *l* 17·24	*l* 24·10 *l* 24·47	*l* 14·40 *l* 14·47	*l* 19·94 *l* 19·64	*l* 18·17 *l* 17·13	*l* 21·60 *l* 21·46	*l* 19·67 *l* 18·63	*l* 23·17 *l* 22·07	*M* = 19″·45 *w* = 1·44
	20·60	17·60	16·75	21·95	17·02	24·28	14·44	19·79	17·65	21·53	19·15	22·62	$\frac{1}{w}$ = 0·69 *C* = 66° 59′ 19″·45
† VI & VII	*h* 11·73 *h* 12·90	*h* 10·44 *h* 10·93	*l* 15·90 *l* 14·67	*l* 6·03 *l* 7·27	*l* 9·66 *l* 9·93	*l* 4·97 *l* 4·83	*l* 12·10 *l* 9·70 *l* 9 47	*l* 10·10 *l* 11·53	*l* 13·33 *l* 14·50	*l* 11·50 *l* 11·37	*l* 12·76 *l* 13·36	*l* 10·96 *l* 11·80	*M* = 10″·89 *w* = 1·42
	12·32	10·68	15·29	6·65	9·79	4·90	10·42	10·82	13·91	11·44	13·06	11·38	$\frac{1}{w}$ = 0·71 *C* = 71° 40′ 10″·89

At VI (Dájka)

February 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Circle readings, telescope being set on V. *M* = Mean of Groups; *w* = Relative Weight; *C* = Concluded Angle.

Angle between	0° 1′	180° 1′	10° 10′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M, w, C
	″	″	″	″	″	″	″	″	″	″	″	″	
V & IV	*l* 7·77 *l* 7·24 *l* 8·16	*l* 7·33 *h* 7·63	*h* 12·17 *h* 9·36 *h* 11·00	*l* 4·30 *l* 4·60	*h* 8·03 *h* 7·20	*l* 2·63 *l* 1·83	*l* 7·00 *l* 7·67	*l* 8·43 *l* 8·23	*h* 12·03 *h* 13·23	*h* 10·53 *h* 7·77 *h* 7·40	*l* 9·67 *l* 8·07 *l* 8·90	*l* 7·30 *l* 7·80	*M* = 7″·80 *w* = 1·66 1/*w* = 0·60
	7·72	7·48	10·84	4·45	7·62	2·23	7·33	8·33	12·63	8·57	8·88	7·55	*C* = 72° 54′ 7″·80
IV & VIII	*l* 35·80 *l* 37·14 *h* 36·40	*l* 42·30 *l* 40·67 *h* 43·07	*h* 34·63 *h* 35·14	*l* 40·67 *l* 39·30	*h* 45·64 *h* 44·90	*l* 45·74 *l* 47·00	*l* 46·73 *l* 47·46	*l* 47·87 *l* 47·87	*h* 45·34 *h* 45·63 *l* 45·17	*h* 44·57 *h* 45·10	*l* 41·80 *l* 44·73 *l* 44·90	*l* 42·86 *l* 43·27	*M* = 43″·09 *w* = 0·70 1/*w* = 1·42
	36·45	42·01	34·89	39·98	45·27	46·37	47·10	47·87	45·38	44·83	43·81	43·07	*C* = 85° 13′ 43″·09
VIII & IX	*l* 13·66 *h* 12·33 *h* 12·10	*l* 10·87 *l* 9·27 *h* 8·77	*h* 13·24 *h* 11·33 *h* 12·33	*l* 13·56 *l* 13·06 *h* 12·94	*h* 3·06 *h* 2·23	*l* 10·00 *l* 8·77	*l* 2·53 *l* 4·37	*l* 2·63 *l* 1·80	*l* 1·80 *l* 0·53 *h* 0·47	*h* 5·10 *h* 3·90	*l* 5·13 *l* 6·34	*l* 8·50 *l* 6·84	*M* = 7″·03 *w* = 0·62 1/*w* = 1·62
	12·70	9·64	12·30	13·19	2·65	9·38	3·45	2·22	0·93	4·50	5·73	7·67	*C* = 82° 30′ 7″·03
IX & VII	*l* 25·77 *l* 24·54 *h* 25·16	*l* 29·73 *l* 28·86	*h* 26·86 *h* 27·37	*h* 24·30 *h* 23·67 *h* 25·46	*h* 30·37 *h* 32·00	*l* 22·50 *l* 22·40	*l* 30·47 *l* 29·70	*l* 28·06 *l* 29·83	*h* 28·84 *h* 30·24 *l* 29·80	*h* 27·80 *h* 27·80	*l* 26·64 *l* 25·86	*l* 26·63 *l* 26·53	*M* = 27″·42 *w* = 1·78 1/*w* = 0·56
	25·16	29·30	27·11	24·48	31·19	22·45	30·08	28·95	29·63	27·80	26·25	26·58	*C* = 54° 21′ 27″·42
VII & V	*h* 36·70 *h* 36·03	*l* 32·50 *l* 34·24	*h* 34·04 *h* 33·33	*l* 39·67 *h* 39·14 *h* 38·03	*h* 32·67 *h* 31·90	*l* 39·20 *l* 40·20	*l* 31·00 *l* 30·13	*l* 34·77 *l* 33·54	*h* 33·83 *h* 31·77 *h* 32·20	*h* 35·93 *h* 35·23	*l* 35·06 *l* 34·04	*l* 36·44 *l* 36·30	*M* = 34″·85 *w* = 1·62 1/*w* = 0·62
	36·37	33·37	33·68	38·95	32·29	39·70	30·56	34·16	32·60	35·58	34·55	36·37	*C* = 65° 0′ 34″·85

At VII (Gángta)

March 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Circle readings, telescope being set on V. *M* = Mean of Groups; *w* = Relative Weight; *C* = Concluded Angle.

Angle between	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M, w, C
	″	″	″	″	″	″	″	″	″	″	″	″	
V & VI	*h* 13·10 *h* 11·96	*h* 14·07 *h* 13·17	*l* 13·33 *l* 15·67 *l* 16·43	*h* 17·67 *h* 15·90	*l* 18·47 *l* 19·76	*l* 12·87 *l* 11·56	*l* 20·37 *l* 20·74	*l* 19·37 *l* 19·34	*l* 24·16 *h* 25·43 *h* 24·73	*h* 17·17 *h* 18·06	*l* 19·16 *l* 17·37	*l* 12·77 *l* 14·50 *l* 14·00	*M* = 16″·98 *w* = 0·85 1/*w* = 1·18
	12·53	13·62	15·14	16·79	19·11	12·22	20·55	19·36	24·77	17·61	18·27	13·76	*C* = 43° 19′ 16″·98

At VII (Gángta)—(*Continued*).

Angle between	Circle readings, telescope being set on V 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
VI & IX	″ h 30·80 h 31·57	″ h 26·27 h 26·27	″ l 26·43 l 25·10 l 23·70	″ h 21·77 h 21·43	″ l 22·73 l 22·90	″ l 23·80 l 23·44	″ l 26·40 l 25·30	″ l 24·57 l 23·66	″ l 22·14 h 23·27 h 22·63	″ h 30·13 h 27·97 h 29·20	″ h 22·60 l 23·94	″ l 32·20 l 28·94 l 30·37	$M = 25''\cdot51$ $w = 1\cdot15$ $\frac{1}{w} = 0\cdot87$
	31·19	26·27	25·08	21·60	22·81	23·62	25·85	24·12	22·68	29·10	23·27	30·50	$C = 36^\circ 51' 25''\cdot51$

At VIII (Pata-i-sháh)

***March* 1854; *and* †*February* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms' 18-inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on X 302° 1′	122° 1′	312° 11′	132° 11′	322° 23′	142° 23′	332° 28′	152° 28′	342° 39′	162° 39′	352° 50′	172° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* X & XI	″ l 52·54 l 51·93	″ l 49·43 l 50·30 h 49·14	″ l 53·66 l 52·23	″ l 51·97 l 51·44	″ h 54·54 h 55·26	″ l 58·40 l 59·86	″ l 60·30 l 58·90	″ l 59·24 l 59·20	″ l 55·57 l 56·90	″ l 56·53 l 57·80	″ l 50·76 l 51·80	″ l 55·04 l 56·57	
	52·24	49·62	52·94	51·71	54·90	59·13	59·60	59·22	56·23	57·17	51·28	55·80	$M = 54''\cdot99$ $w = 1\cdot01$
Lesser circle readings	0° 1′	180° 1′	10° 12′	190° 11′	20° 22′	200° 22′	30° 27′	210° 27′	40° 38′	220° 38′	50° 49′	230° 49′	
† X & XI	h 49·76 h 49·60	h 50·03 h 50·07	h 50·43 h 52·07	h 47·90 h 46·43	l 53·00 l 53·47	h 49·43 h 51·34 h 51·10	h 55·13 h 56·24	h 54·14 h 53·93 h 54·47	l 55·57 l 56·60	l 55·00 l 55·47	l 59·06 l 57·27	l 52·30 l 53·27	$w = 2\cdot17$ $\frac{1}{w} = 0\cdot46$ $C = 34^\circ 21' 53''\cdot85$
	49·68	50·05	51·25	47·17	53·23	50·62	55·69	54·18	56·08	55·24	58·16	52·79	$M = 52''\cdot85$ $w = 1\cdot16$
† XI & IX	h 51·10 h 52·94	h 51·63 l 53·36 h 51·06	h 54·83 h 53·43	h 50·70 h 49·47	l 50·80 l 51·03	h 48·70 h 46·90	h 50·50 h 49·63	h 49·20 h 51·40 h 49·67	l 50·33 l 48·33	l 47·23 l 48·43	l 50·67 l 50·13	l 54·67 l 52·13 l 54·00	$M = 50''\cdot69$ $w = 2\cdot82$ $\frac{1}{w} = 0\cdot35$
	52·02	52·02	54·13	50·09	50·91	47·80	50·07	50·09	49·33	47·83	50·40	53·60	$C = 35^\circ 13' 50''\cdot70$
† IX & VI	h 33·47 h 31·96	h 34·40 l 33·24	h 26·04 h 26·77	h 34·64 h 35·37	l 30·60 l 31·73	h 36·53 h 36·16	h 26·83 h 27·03	h 31·93 h 29·90 h 31·93	l 31·50 l 31·44	l 33·47 l 32·14	l 28·47 l 28·30	l 27·47 l 30·46 l 29·93	$M = 31''\cdot30$ $w = 1\cdot22$ $\frac{1}{w} = 0\cdot82$
	32·72	33·82	26·40	35·01	31·16	36·35	26·93	31·25	31·47	32·80	28·39	29·29	$C = 50^\circ 27' 31''\cdot30$
† VI & IV	h 7·47 h 8·20	h 4·14 h 2·83	h 10·80 h 11·06	h 8·70 h 7·04	h 11·40 h 10·67	h 0·90 h 2·80	h 10·34 h 11·44	h 6·53 h 7·56	l 6·07 l 7·00	h 5·64 l 6·90	l 9·73 l 9·93	l 5·60 l 5·40	$M = 7''\cdot42$ $w = 1\cdot35$ $\frac{1}{w} = 0\cdot74$
	7·84	3·48	10·93	7·87	11·04	1·85	10·89	7·04	6·54	6·27	9·83	5·50	$C = 64^\circ 50' 7''\cdot42$

At IX (Kanduka)

March 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VII 271° 12′	91° 12′	281° 24′	101° 24′	291° 35′	111° 35′	301° 41′	121° 41′	311° 52′	131° 52′	322° 8′	142° 8′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
VII & VI	*l* 10·20 *l* 11·50	*l* 14·23 *l* 16·27	*l* 11·16 *h* 11·23 *h* 12·53 *l* 12·07	*h* 10·50 *h* 9·84	*l* 9·44 *l* 9·87	*l* 12·60 *l* 12·50	*h* 3·47 *h* 2·37	*l* 5·73 *l* 5·06	*h* 4·87 *h* 4·56	*l* 6·00 *l* 5·80	*l* 4·03 *l* 2·83	*l* 11·47 *l* 11·10	M = 8″·66 w = 0·74 1/w = 1·35
	10·85	15·25	11·75	10·17	9·66	12·55	2·92	5·39	4·72	5·90	3·43	11·28	C = 88° 47′ 8″·66
VI & VIII	*l* 15·53 *l* 15·40	*l* 15·10 *l* 14·53	*l* 22·00 *h* 22·97 *l* 22·77	*h* 21·93 *h* 21·60	*l* 21·76 *l* 22·80	*l* 18·40 *l* 17·50	*h* 28·96 *h* 28·90	*l* 23·87 *l* 24·80	*h* 27·37 *h* 25·74	*l* 22·80 *l* 23·36	*l* 22·64 *l* 23·30	*l* 18·30 *l* 18·27	M = 21″·58 w = 0·66 1/w = 1·52
	15·47	14·81	22·58	21·77	22·28	17·95	28·93	24·33	26·56	23·08	22·97	18·28	C = 47° 2′ 21″·58
VIII & X	*l* 61·13 *l* 59·20	*h* 62·67 *l* 62·34	*l* 55·37 *l* 56·93	*h* 54·04 *h* 53·56	*l* 57·54 *l* 56·13	*l* 53·17 *l* 54·70	*l* 57·00 *h* 58·46	*l* 59·20 *l* 59·17	*h* 55·83 *h* 55·06	*l* 61·90 *l* 60·00	*l* 59·06 *l* 58·74	*l* 65·06 *l* 63·63	M = 58″·33 w = 1·08 1/w = 0·93
	60·17	62·50	56·15	53·80	56·84	53·93	57·73	*l* 59·19	55·44	60·95	58·90	64·35	C = 42° 19′ 58″·33
X & XI	*h* 67·24 *l* 66·64 *l* 67·50	*h* 65·30 *l* 65·70	*l* 63·97 *l* 64·80 *l* 64·93	*h* 68·90 *h* 67·87	*l* 63·03 *l* 62·87	*l* 67·66 *l* 67·93	*l* 59·26 *h* 58·00	*l* 62·53 *l* 61·63	*h* 68·33 *h* 68·24	*l* 64·13 *l* 66·34 *l* 64·40	*l* 67·00 *l* 67·03	*l* 64·87 *l* 66·03	M = 65″·23 w = 1·42 1/w = 0·71
	67·13	65·50	64·57	68·39	62·95	67·79	58·63	62·08	68·29	64·96	67·01	65·45	C = 48° 36′ 5″·23

At X (Khánmír)

* *March and April* 1856; † *November* 1856; *observed by Lieutenant D. J. Nasmyth, R. E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIII 110° 3′	290° 3′	120° 14′	300° 14′	130° 25′	310° 25′	140° 30′	320° 30′	150° 42′	330° 42′	160° 52′	340° 52′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
* XIII & XII	*h* 7·14 *h* 7·43	*h* 8·90 *h* 7·70	*h* 6·10 *h* 6·37	*h* 6·80 *h* 6·10	*h* 6·90 *l* 7·64	*l* 4·80 *l* 2·76 *l* 2·63	*l* 7·53 *l* 6·33	*l* 2·77 *l* 2·77	*h* 5·34 *h* 6·17	*h* 6·30 *h* 7·63	*h* 9·66 *h* 10·00	*h* 9·07 *h* 8·60	M = 6″·67 w = 2·83 1/w = 0·35
	7·29	8·30	6·23	6·45	7·27	3·40	6·93	2·77	5·76	6·96	9·83	8·84	C = 75° 21′ 6″·67

At X (Khánmír)—(*Continued*).

Angle between	Circle readings, telescope being set on XIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	110° 3′	290° 3′	120° 14′	300° 14′	130° 25′	310° 25′	140° 30′	320° 30′	150° 42′	330° 42′	160° 52′	340° 52′	
* XII & XI	″ h 47·80 h 46·87	″ h 50·56 h 48·94	″ h 47·27 h 46·70	″ h 50·20 h 51·46	″ h 44·20 l 44·16	″ l 48·43 l 48·60	″ l 41·34 l 43·50 l 41·77	″ l 47·13 l 46·50	″ h 43·86 h 44·86	″ h 48·70 h 47·70	″ h 45·54 h 45·13	″ h 47·96 h 46·96	$M = 46''\cdot83$ $w = 1\cdot93$ $\frac{1}{w} = 0\cdot52$
	47·34	49·75	46·98	50·83	44·18	48·52	42·20	46·81	44·36	48·20	45·34	47·46	$C = 61°\ 37'\ 46''\cdot83$
	Circle readings, telescope being set on XI												
	247° 2′	67° 2′	257° 13′	77° 13′	267° 23′	87° 24′	277° 30′	97° 30′	287° 40′	107° 40′	297° 51′	117° 51′	
† XI & IX	″ h 5·90 h 6·46	″ h 8·74 l 6·97 l 7·94	″ l 12·87 l 13·26	″ l 6·40 l 6·24	″ l 11·77 h 13·40	″ l 10·67 l 11·10	″ h 15·87 h 17·84 h 15·83	″ h 8·14 h 7·03	″ l 9·80 l 11·33	″ l 12·83 l 11·60	″ l 5·90 l 6·33	″ l 6·90 l 7·30	$M = 9''\cdot75$ $w = 1\cdot04$ $\frac{1}{w} = 0\cdot97$
	6·18	7·88	13·07	6·32	12·58	10·89	16·51	7·58	10·57	12·21	6·12	7·10	$C = 44°\ 54'\ 9''\cdot75$
† IX & VIII	h 23·86 h 22·54	h 20·06 l 22·90 l 20·20	l 18·50 l 20·40	l 22·73 l 22·53	l 20·76 h 21·50	l 24·43 l 23·77	h 14·80 h 14·33 h 14·10	h 19·83 h 20·30	l 19·90 l 18·10	l 20·37 l 21·47	l 23·10 l 23·50	l 21·90 l 21·80	$M = 20''\cdot93$ $w = 1\cdot74$ $\frac{1}{w} = 0\cdot58$
	23·20	21·05	19·45	22·63	21·13	24·10	14·41	20·07	19·00	20·92	23·30	21·85	$C = 68°\ 4'\ 20''\cdot92$

At XI (Chitror)

‡*May* 1854; §*March* 1856; *and* ¶*November* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	273° 30′	93° 31′	283° 41′	103° 41′	293° 52′	113° 52′	303° 58′	123° 58′	314° 9′	134° 9′	324° 20′	144° 20′	
§ IX & VIII	″ h 70·63 h 70·94	″ h 67·77 h 67·47	″ l 68·17 l 66·80	″ l 66·37 l 66·67	″ h 63·37 h 62·97	″ h 59·67 h 60·77	″ l 66·44 l 67·34	″ l 67·80 l 69·04	″ l 66·34 l 65·90	″ l 69·17 l 69·56	″ h 62·27 h 62·30	″ h 72·80 h 72·30	$M = 66''\cdot79$ $w = 0\cdot96$ $\frac{1}{w} = 1\cdot04$
	70·79	67·62	67·48	66·52	63·17	60·22	66·89	68·42	66·12	69·37	62·28	72·55	$C = 53°\ 50'\ 6''\cdot79$
§ VIII & X	h 40·30 h 41·10	h 42·36 h 42·73	l 38·43 h 37·00	l 44·40 l 42·30 l 42·63	h 40·33 h 41·60	h 46·66 h 44·83	l 35·70 l 34·96	l 34·76 l 33·73	l 34·93 l 33·74	l 35·17 l 34·04	h 38·43 h 37·27	h 35·33 h 35·04	
	40·70	42·55	37·71	43·11	40·97	45·74	35·33	34·25	34·33	34·61	37·85	35·18	$M = 38''\cdot53$ $w = 0\cdot75$

At XI (Chitror)—(*Continued*).

Angle between	Circle readings, telescope being set on VIII 37° 19′	217° 20′	47° 30′	227° 31′	57° 42′	237° 42′	67° 47′	247° 47′	77° 58′	257° 58′	88° 9′	268° 9′	M = Mean of Groups w = Relative Weight C = Concluded Angle
‡ VIII & X	″ l 38·90 l 38·37	″ l 38·24 l 39·57	″ l 43·87 l 46·33 l 46·07	″ l 39·93 l 41·00	″ h 35·80 h 36·87	″ l 37·90 l 38·90	″ h 36·20 h 36·17	″ h 34·93 h 35·83	″ l 36·33 l 37·97	″ l 41·74 l 40·80	″ l 43·24 l 42·64	″ l 43·76 l 45·23 l 43·17	w = 1·85 1/w = 0·54 C = 32° 39′ 39″·17
	38·64	38·90	45·42	40·47	36·33	38·40	36·19	35·38	37·15	41·27	42·94	44·05	M = 39″·60 w = 1·10
Lesser circle readings	0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 50′	
¶ X & XII	h 24·70 h 23·23	h 23·34 h 23·83	h 28·33 h 28·20	h 27·24 h 28·27	h 31·30 h 29·17	l 22·87 l 22·10	h 32·90 h 32·50	l 29·80 h 29·30 h 30·13	l 30·10 l 30·30	h 29·56 l 28·84 l 28·87	l 27·97 l 27·33	l 24·77 l 24·80	M = 27″·54 w = 1·18 1/w = 0·84 C = 46° 7′ 27″·54
	23·97	23·58	28·27	27·75	30·24	22·48	32·70	29·74	30·20	29·09	27·65	24·79	
¶ XII & XIV	h 39·86 h 39·34	h 37·50 h 36·80	h 35·50 h 35·17	h 37·33 h 34·57 h 35·70	h 33·00 h 32·97 l 34·27	l 37·10 l 36·40	h 28·73 h 28·56	h 35·64 h 35·47	l 27·50 l 27·76	h 34·40 l 32·00 l 34·00	l 32·66 l 31·67	l 35·20 l 35·20	M = 34″·23 w = 1·00 1/w = 1·00
	39·60	37·15	35·34	35·87	33·41	36·75	28·64	35·56	27·63	33·47	32·16	35·20	C = 69° 37′ 34″·23

At XII (Monába)

*******March*; *and* ‖*November* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms' 18-inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on X 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
** X & XIII	″ h 27·10 h 27·76	″ l 27·47 l 28·26	″ l 30·20 l 30·50	″ l 25·73 l 27·74	″ l 30·60 l 31·37	″ h 23·17 h 22·43	″ l 28·96 l 29·83 l 27·70	″ l 31·37 l 27·70 l 28·03	″ l 31·34 l 29·70	″ l 29·00 l 28·04	″ l 33·10 l 32·46	″ l 28·17 h 28·70	
	27·43	27·87	30·35	26·73	30·99	22·80	28·83	29·03	30·52	28·52	32·78	28·43	M = 28″·69 w = 1·82
‖ X & XIII	l 26·73 l 26·47	l 26·90 l 26·57	h 28·36 h 27·80	h 25·06 h 25·54	l 32·17 l 32·17	l 20·66 l 21·90	h 28·64 l 27·10	l 25·46 h 27·53 h 27·13 h 26·63	l 29·37 h 29·20	h 25·87 h 26·33	l 30·66 l 29·73	h 26·34 h 26·83	w = 3·44 1/w = 0·29 C = 62° 46′ 28″·01
	26·60	26·74	28·08	25·30	32·17	21·28	27·87	26·69	29·28	26·10	30·20	26·58	M = 27″·24 w = 1·62

At XII (Monába)—(*Continued*).

Angle between	Circle readings, telescope being set on X 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
** XIII & XV	h 46·30 h 49·47 l 50·10	l 50·70 l 49·60	l 47·90 l 45·90 l 45·07	l 50·77 l 49·76	l 44·17 l 44·60	h 48·80 h 51·00 h 51·16	l 47·20 l 44·60 l 46·00	l 49·10 l 48·40	l 47·90 l 48·96	l 53·30 l 52·30	h 45·07 h 46·07	h 53·43 h 53·30	
	48·62	50·15	46·29	50·27	44·38	50·32	45·93	48·75	48·43	52·80	45·57	53·37	M = 48″·74 w = 1 ·44
|| XIII & XV	l 48·17 l 49·43	l 52·20 l 51·86	h 47·74 h 47·17	h 51·27 h 53·06	l 42·13 l 42·40 l 41·90	l 49·17 l 49·00	h 45·96 l 45·80	l 46·70 h 49·07 h 46·14	l 47·30 h 46·70	h 50·33 h 50·37	l 47·04 l 47·90	h 50·13 h 52·74	w = 2 ·85 $\frac{1}{w}$ = 0 ·35 C = 63° 43′ 48″·58
	48·80	52·03	47·46	52·16	42·14	49·09	45·88	47·30	47·00	50·35	47·47	51·43	M = 48″·43 w = 1 ·41
** XV & XVI	h 53·30 h 52·04 l 53·10	l 51·73 l 53·10	l 56·23 l 58·77 l 58·60	l 54·43 l 54·64	l 59·80 l 60·63	h 58·70 h 56·74	l 62·44 l 63·74 l 65·04	l 50·20 l 53·40 l 54·20 l 56·03	l 54·80 l 53·80	l 57·20 l 55·93	h 50·86 h 52·27	h 48·17 h 49·40	
	52·81	52·42	57·87	54·53	60·22	57·72	63·74	53·46	54·30	56·56	51·57	48·78	M = 55″·33 w = 0 ·69
|| XV & XVI	h 52·93 h 50·50	h 51·17 h 52·96	h 57·00 h 55·67	l 52·27 l 54·73 h 54·27	l 60·24 l 56·70 l 59·56	l 58·77 l 59·23	h 63·57 l 62·10 l 63·43	h 53·80 l 54·40	l 57·30 h 56·50	h 53·60 h 53·63	l 53·20 l 53·83	h 53·70 h 51·80	w = 1 ·69 $\frac{1}{w}$ = 0 ·59 C = 45° 26′ 55″·42
	51·72	52·06	56·34	53·76	58·83	59·00	63·03	54·10	56·90	53·61	53·52	52·75	M = 55″·47 w = 1 ·00
** XVI & XIV	h 60·80 h 60·73 l 58·77	l 54·50 l 52·04 l 51·77	l 49·17 l 48·06	l 54·57 l 55·26	l 48·80 h 47·87 h 48·53	h 54·20 h 54·96	l 45·23 l 47·76 l 47·26	l 62·27 l 58·60 l 55·94 l 57·47	l 52·73 l 51·93	l 53·14 l 52·87	h 55·64 h 54·20	h 52·60 h 53·87	
	60·10	52·77	48·62	54·91	48·40	54·58	46·75	58·57	52·33	53·01	54·92	53·23	M = 53″·18 w = 0 ·75
|| XVI & XIV	h 59·00 h 59·24	h 53·13 h 53·36 h 54·00	h 50·66 h 49·13	l 55·07 l 54·90	l 52·30 l 56·67 l 51·97	l 49·86 l 50·83	l 47·60 l 47·43	h 59·10 h 59·86 l 57·70	l 50·26 h 49·96	h 54·93 h 54·27	l 54·43 l 52·76	l 55·13 l 54·50	w = 1 ·69 $\frac{1}{w}$ = 0 ·59 C = 61° 54′ 53″·31
	59·12	53·50	49·90	54·98	53·65	50·35	47·51	58·89	50·11	54·60	53·60	54·81	M = 53″·42 w = 0 ·94
** XIV & XI	h 3·23 h 2·80 l 3·40	l 4·30 l 6·80 l 8·33	l 10·90 l 10·90	l 6·20 l 5·87	l 8·93 h 11·33 h 9·80	h 7·13 h 8·80	l 14·07 l 12·14 l 11·84	l 2·60 l 5·97 l 5·86	l 14·44 l 13·33	l 7·46 l 7·33	l 13·06 l 11·86	l 8·74 h 7·03	
	3·14	6·48	10·90	6·04	10·02	7·96	12·68	4·81	13·89	7·39	12·46	7·89	M = 8″·64 w = 1 ·02

At XII (Monába)—(*Continued*).

Angle between	0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
‖ XIV & XI	″ h 3·93 h 4·43	″ h 8·03 h 5·87 h 6·47	″ h 13·60 h 13·34 h 14·17	″ l 6·34 l 7·73 l 7·40	″ l 6·83 l 7·96 l 9·83	″ l 9·27 l 8·14	″ l 10·50 l 12·90	″ h 8·70 h 6·13	″ h 15·00 h 13·97	″ h 6·94 h 7·57	″ l 9·20 l 10·50	″ l 4·53 l 7·50 l 6·70	$w = 2''\cdot 23$ $\frac{1}{w} = 0\cdot 45$ $C = 53^\circ 53' 8''\cdot 73$
	4·18	6·79	13·70	7·16	8·21	8·71	11·70	7·41	14·49	7·25	9·85	6·24	$M = 8''\cdot 81$ $w = 1\cdot 21$
** XI & X	h 48·93 h 49·27	h 49·20 l 48·76	l 44·93 l 45·27	l 45·16 l 45·60	l 46·00 l 44·63	h 48·77 h 47·83	l 39·43 l 41·06	l 44·83 l 43·83 l 44·47	l 38·56 l 36·67 l 39·96	l 46·90 l 46·13	l 42·67 l 43·64	l 47·93 h 48·17	
	49·10	48·98	45·10	45·38	45·32	48·30	40·24	44·38	38·40	46·52	43·15	48·05	$M = 45''\cdot 24$ $w = 1\cdot 04$
‖ XI & X	h 51·54 h 50·73	h 48·94 h 47·87	h 44·64 h 43·87	l 46·60 l 44·94 l 46·24	l 44·43 l 45·27	l 49·27 l 48·06	l 41·94 l 40·60	h 41·97 h 42·80 h 42·50	h 42·54 h 41·20	h 46·43 h 45·10	l 44·57 l 45·00	l 46·14 l 47·76	$w = 2\cdot 40$ $\frac{1}{w} = 0\cdot 42$ $C = 72^\circ 14' 45''\cdot 40$
	51·14	48·40	44·26	45·93	44·85	48·66	41·27	42·42	41·87	45·77	44·78	46·95	$M = 45''\cdot 53$ $w = 1\cdot 36$

At XIII (Kesmára)

November 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	254° 8′	74° 3′	264° 14′	84° 14′	274° 24′	94° 24′	284° 30′	104° 30′	294° 41′	114° 41′	304° 52′	124° 52′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XV & XII	″ h 12·20 h 13·10	″ h 7·86 h 6·83	″ l 14·17 l 12·16 l 14·07	″ h 6·77 h 6·07	″ l 16·04 l 15·17	″ l 9·26 l 10·27	″ l 12·60 l 14·74 l 11·44	″ l 13·07 l 11·30	″ l 14·63 l 15·77	″ l 14·04 l 14·37	″ h 12·60 h 12·23	″ h 15·57 h 15·50	$M = 12''\cdot 31$ $w = 1\cdot 28$ $\frac{1}{w} = 0\cdot 78$ $C = 64^\circ 5' 12''\cdot 31$
	12·65	7·35	13·47	6·42	15·60	9·77	12·93	12·18	15·20	14·21	12·41	15·54	
XII & X	h 26·63 h 26·67	h 31·04 h 31·67	l 27·70 l 28·94	h 33·53 h 30·66 l 33·16	l 29·43 l 28·93	l 36·77 l 35·10	l 27·10 l 26·16	l 28·13 l 28·77	l 24·80 l 25·40	l 24·13 l 23·77 h 25·17	h 24·83 h 25·77	h 27·03 h 27·50	$M = 28''\cdot 42$ $w = 1\cdot 02$ $\frac{1}{w} = 0\cdot 98$ $C = 41^\circ 52' 28''\cdot 42$
	26·65	31·36	28·32	32·45	29·18	35·93	26·63	28·45	25·10	24·36	25·30	27·27	

At XIV (Wándia)

*March; and †November 1856; observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms' 18-inch Theodolite No. 2.

Angle between	Circle readings, telescope being set on XI 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
* XI & XII	l 8·53 l 8·77	l 14·03 l 10·80 l 13·30	l 12·80 l 15·67 l 15·26	l 10·23 l 9·96	l 15·57 l 16·03	l 8·43 l 8·30	l 19·67 l 20·54	l 15·54 l 15·87	l 15·74 l 14·86	l 13·03 l 12·80	l 12·13 l 13·30	l 12·34 l 11·33	
	8·65	12·71	14·58	10·10	15·80	8·36	20·11	15·70	15·30	12·92	12·71	11·84	M = 13″·23 w = 1 ·05
† XI & XII	l 13·40 l 14·34	l 17·70 l 16·23	h 14·70 h 15·60	l 13·30 h 14·70	h 17·80 h 17·57	l 10·93 l 11·40	l 16·67 l 17·40	l 14·00 l 15·17	l 15·46 l 13·30 h 13·23	h 12·50 h 13·17	l 16·40 l 16·83	h 11·77 h 12·37	w = 3 ·71 $\frac{1}{w}$ = 0 ·27 C = 56° 29′ 14″·26
	13·87	16·97	15·15	14·00	17·68	11·17	17·03	14·59	14·00	12·83	16·62	12·07	M = 14″·67 w = 2 ·66
* XII & XVI	l 25·94 l 26·67	l 21·97 l 24·27 l 23·40	l 21·27 l 20·23	l 23·97 l 25·20	l 18·70 l 16·97	l 26·33 l 25·94	l 16·13 l 14·73	l 17·93 l 17·07	l 21·10 l 20·90	l 22·67 l 23·87	l 23·17 l 21·16	l 22·26 l 23·60	
	26·31	23·21	20·75	24·58	17·84	26·13	15·43	17·50	21·00	23·27	22·17	22·93	M = 21″·76 w = 1 ·01
† XII & XVI	l 23·10 l 22·20	l 19·64 l 20·87	h 21·00 h 22·10	l 19·50 h 21·67 h 21·60	h 16·07 h 16·96	l 23·73 l 23·70	l 18·40 l 18·30	l 19·70 l 19·67	l 18·84 l 19·57	h 26·30 h 25·40	l 23·80 h 23·13	h 22·86 h 23·10	w = 2 ·72 $\frac{1}{w}$ = 0 ·37 C = 63° 9′ 21″·45
	22·65	20·26	21·55	20·92	16·51	23·72	18·35	19·68	19·21	25·85	23·46	22·98	M = 21″·26 w = 1 ·71

At XV (Kákraji)

‡April 1854; and §November 1856; observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms' 18-inch Theodolite No. 2.

Angle between	Circle readings, telescope being set on XVIII 307° 55′	127° 55′	318° 5′	138° 5′	328° 16′	148° 16′	338° 22′	158° 22′	348° 33′	168° 33′	358° 44′	178° 44′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
‡ XVIII & XVII	h 54·93 l 54·30	l 58·04 l 57·96	l 56·13 l 57·37 l 57·56 h 56·90	l 58·26 l 59·83	h 54·87 h 55·87 h 55·43	l 57·93 l 58·73	l 52·20 l 50·93	l 52·93 l 51·00	l 53·50 l 54·07	l 50·36 l 50·10	l 49·50 l 48·80	l 50·60 l 51·34	
	54·62	58·00	56·99	59·04	55·39	58·33	51·57	51·96	53·79	50·23	49·15	50·97	M = 54″·17 w = 1 ·02

At XV (Kákraji)—(*Continued*).

Angle between	Circle readings, telescope being set on XVIII: 307° 55′	127° 55′	318° 5′	138° 5′	328° 16′	148° 16′	338° 22′	158° 22′	348° 33′	168° 33′	358° 44′	178° 44′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
§ XVIII & XVII	h 56·40	l 54·54	l 51·30	h 58·23	l 55·77	h 62·67	l 55·10	l 56·13	h 55·47	l 56·17	h 52·20	h 55·57	w = 2·67
	h 55·93	l 53·50	h 52·50	h 57·73	l 56·77	h 61·96	l 56·20	l 54·60	l 56·83	l 55·30	h 52·30	h 55·37	1/w = 0·37; C = 52° 5′ 55″·16
	56·17	54·02	51·90	57·98	56·27	62·31	55·65	55·37	56·15	55·73	52·25	55·47	M = 55″·77; w = 1·65
‡ XVII & XIX	h 20·77	l 17·63	l 22·90	l 20·24	h 25·67	l 21·30	l 28·60	l 29·20	l 28·13	l 24·97	l 28·30	l 22·77	
	l 22·70	l 18·63	l 20·87	l 21·57	h 25·13	l 21·90	l 27·63	l 28·56	l 28·37	l 25·74	l 27·37	l 23·63	
		l 16·07	l 21·53		h 24·50								
	21·74	17·44	21·77	20·90	25·10	21·60	28·12	28·88	28·25	25·35	27·84	23·20	M = 24″·18; w = 0·90
§ XVII & XIX	h 20·64	l 25·00	l 25·63	h 28·27	l 27·83	h 20·73	l 31·33	l 28·37	l 26·27	l 24·77	h 25·60	h 20·50	w = 2·13
	l 21·90	l 26·93	h 25·10	h 27·90	l 25·96	l 22·60	l 31·33	l 28·60	l 26·64	l 24·93	h 26·50	h 21·66	1/w = 0·47; C = 46° 44′ 25″·02
	21·27	25·97	25·36	28·09	26·89	21·67	31·33	28·48	26·46	24·85	26·05	21·08	M = 25″·63; w = 1·23
‡ XIX & XVI	l 22·00	l 19·97	l 17·67	l 16·03	h 14·43	h 15·43	l 20·30	l 16·00	l 19·67	l 21·60	l 17·77	l 23·90	
	l 20·90	h 20·40	l 17·16	l 15·46	h 15·50	l 15·07	l 19·27	l 16·90	l 19·63	l 22·83	l 19·97	l 23·30	
		h 20·94			h 14·13	l 14·53					h 18·87		
		h 20·27											
	21·45	20·40	17·41	15·75	14·69	15·01	19·78	16·45	19·65	22·22	18·87	23·60	M = 18″·77; w = 1·39
§ XIX & XVI	h 20·63	l 14·76	l 13·80	h 7·60	l 12·23	h 10·33	l 15·03	l 15·93	l 10·07	l 20·13	h 15·77	h 17·37	w = 2·24
	l 19·43	l 14·50	h 13·76	h 7·93	l 12·37	l 11·44	l 16·07	l 14·96	l 10·57	l 19·27	h 15·53	h 18·54	1/w = 0·45; C = 38° 48′ 17″·15
	20·03	14·63	13·78	7·77	12·30	10·88	15·55	15·45	10·32	19·70	15·65	17·95	M = 14″·50; w = 0·85
§ XVI & XII	h 19·40	h 24·50	l 21·10	h 23·66	l 22·10	h 23·37	l 20·00	l 25·04	l 26·33	l 24·20	h 28·33	h 28·26	M = 23″·96
	h 19·90	h 25·20	h 20·87	h 25·27	l 21·43	h 22·74	l 19·56	l 26·74	l 26·20	l 25·20	h 28·73	h 26·96	w = 1·37
	19·65	24·85	20·99	24·46	21·77	23·05	19·78	25·89	26·27	24·70	28·53	27·61	1/w = 0·73; C = 60° 36′ 23″·96
§ XII & XIII	h 65·27	h 60·84	l 67·44	h 63·60	l 63·30	h 62·53	l 58·80	l 56·33	l 60·50	l 58·73	h 57·33	h 60·50	M = 61″·17
	h 64·80	h 61·24	l 66·76	h 62·17	l 64·64	h 62·20	l 60·24	l 55·86	l 58·80	l 57·83	h 57·57	h 60·54	w = 1·13
		h 61·34											1/w = 0·89
	65·04	61·14	67·10	62·88	63·97	62·37	59·52	56·09	59·65	58·28	57·45	60·52	C = 52° 11′ 1″·17

At XVI (Mália)

******April* 1854; *and* †*November* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIV 231° 8′	51° 8′	241° 19′	61° 19′	251° 29′	71° 30′	261° 35′	81° 35′	271° 46′	91° 46′	281° 57′	101° 57′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† XIV & XII	″ *l* 39·63 *l* 39·63	″ *h* 40·50 *l* 41·33	″ *l* 38·00 *l* 38·84	″ *l* 43·60 *l* 43·64	″ *l* 43·06 *l* 42·10	″ *h* 39·34 *l* 42·94 *l* 41·17	″ *h* 46·13 *h* 48·14	″ *h* 37·66 *h* 39·34	″ *h* 44·70 *h* 46·47 *h* 46·87	″ *h* 44·44 *h* 43·57 *h* 42·40	″ *h* 42·24 *l* 44·24	″ *l* 43·60 *l* 42·24	$M = 42''\cdot30$ $w = 1\cdot55$ $\frac{1}{w} = 0\cdot64$ $C = 54^\circ\ 55'\ 42''\cdot30$
	39·63	40·92	38·42	43·62	42·58	41·15	47·13	38·50	46·01	43·47	43·24	42·92	
† XII & XV	*l* 47·24 *l* 47·34	*h* 50·84 *l* 47·60 *l* 49·73	*l* 46·14 *l* 45·86	*l* 43·40 *l* 43·20	*l* 39·80 *l* 42·90 *l* 42·20	*h* 50·60 *l* 49·70	*h* 37·77 *h* 38·46	*h* 41·57 *h* 40·16	*h* 42·03 *h* 40·36 *h* 40·07	*h* 42·20 *h* 44·26 *h* 43·93	*h* 45·50 *l* 44·90	*l* 47·33 *l* 47·33	$M = 44''\cdot46$ $w = 0\cdot85$ $\frac{1}{w} = 1\cdot18$ $C = 73^\circ\ 56'\ 44''\cdot46$
	47·29	49·39	46·00	43·30	41·63	50·15	38·12	40·86	40·82	43·46	45·20	47·33	
* XV & XVII	*l* 35·06 *l* 36·60 *l* 36·13 *l* 37·07	*l* 36·10 *l* 36·60 *l* 36·43	*l* 38·23 *l* 38·76	*l* 39·44 *l* 38·80	*l* 43·20 *l* 41·76	*l* 37·13 *l* 35·94	*l* 46·27 *l* 46·80	*l* 45·36 *l* 45·16	*l* 45·40 *l* 46·50	*l* 44·70 *l* 43·43	*l* 42·80 *l* 41·83	*l* 41·03 *l* 42·20	
	36·22	36·38	38·49	39·12	42·48	36·54	46·53	45·26	45·95	44·07	42·31	41·62	$M = 41''\cdot25$ $w = 0\cdot82$
† XV & XVII	*h* 41·43 *h* 40·77	*h* 41·20 *l* 43·67 *l* 41·07	*l* 46·50 *l* 46·60	*l* 42·36 *l* 45·70 *l* 44·57	*l* 41·90 *l* 43·33 *l* 43·20	*h* 38·20 *l* 37·80	*h* 50·27 *h* 49·64	*h* 46·13 *h* 44·87	*h* 47·27 *h* 49·40 *h* 47·70	*h* 45·16 *h* 44·24 *h* 43·84	*h* 45·16 *l* 45·03 *l* 43·23	*l* 35·80 *l* 38·13 *l* 38·13	$w = 1\cdot66$ $\frac{1}{w} = 0\cdot60$ $C = 46^\circ\ 39'\ 42''\cdot49$
	41·10	41·98	46·55	44·21	42·81	38·00	49·96	45·50	48·12	44·41	44·47	37·35	$M = 43''\cdot71$ $w = 0\cdot84$
* XVII & XIX	*h* 52·33 *h* 51·77 *l* 50·80 *l* 50·40	*l* 49·63 *l* 49·97	*l* 49·37 *l* 49·94	*l* 48·33 *l* 49·17	*l* 49·77 *l* 50·14	*l* 51·67 *l* 50·93	*l* 50·03 *l* 49·13	*l* 53·04 *l* 54·84	*l* 49·67 *l* 50·90	*l* 53·14 *l* 52·93	*l* 52·97 *l* 53·94	*l* 54·97 *l* 54·60	
	51·33	49·80	49·65	48·75	49·96	51·30	49·58	53·94	50·28	53·04	53·45	54·79	$M = 51''\cdot32$ $w = 2\cdot90$
† XVII & XIX	*h* 45·04 *h* 46·23	*h* 49·80 *l* 49·23	*l* 45·10 *l* 44·00	*l* 45·54 *l* 43·03 *l* 42·83	*l* 49·87 *l* 49·23	*h* 46·76 *h* 46·44	*h* 45·36 *h* 46·26	*h* 49·67 *h* 50·07	*h* 43·60 *h* 45·77 *h* 42·76 *h* 44·10	*h* 49·60 *h* 49·96	*h* 42·50 *l* 44·70 *l* 44·87 *l* 45·53	*l* 54·04 *l* 52·74 *l* 54·80	$w = 4\cdot07$ $\frac{1}{w} = 0\cdot25$ $C = 45^\circ\ 28'\ 50''\cdot16$
	45.64	49·51	44·55	43·80	49·55	46·60	45·81	49·87	44·06	49·78	44·40	53·86	$M = 47''\cdot29$ $w = 1\cdot17$

At XVII (Rangpur)

******January* 1853; *observed by Lieutenant H. Rivers*; *and* †*February* 1854; ‡*April* 1854; §*December* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXII												*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	0° 0′	180° 1′	10° 12′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 38′	220° 38′	50° 50′	230° 50′	
‡ XXII & XIX	″ *l* 47·00 *h* 45·83 *h* 45·34	″ *h* 43·57 *l* 43·57 *l* 42·03	″ *l* 48·20 *l* 47·30	″ *l* 46·84 *l* 44·80 *l* 44·50	″ *l* 50·20 *l* 47·97 *l* 48·40	″ *l* 41·40 *l* 42·74 *l* 42·00	″ *l* 49·90 *l* 50·87	″ *l* 52·47 *l* 51·56	″ *h* 55·50 *h* 57·14 *l* 57·27	″ *l* 56·17 *h* 55·36 *h* 56·94	″ *h* 53·76 *h* 54·77 *l* 54·40 *l* 54·77	″ *h* 54·93 *h* 55·13 *l* 54·77 *l* 55·90	
	46·06	43·06	47·75	45·38	48·86	42·05	50·39	52·01	56·64	56·16	54·43	55·18	*M* = 49″·83 *w* = 0·46
§ XXII & XIX	*h* 50·37 *l* 49·13 *l* 49·60	*l* 47·44 *l* 48·63	*l* 49·43 *l* 51·53 *l* 50·16	*l* 48·30 *l* 47·64	*l* 47·63 *l* 49·17	*l* 38·54 *d* 40·41	*h* 47·90 *h* 48·00	*l* 47·20 *l* 47·06	*h* 50·97 *h* 50·66	*l* 49·50 *l* 47·10 *l* 50·50 *h* 50·10	*l* 46·17 *l* 47·44	*h* 48·46 *h* 47·93	*w* = 1·84 $\frac{1}{w}$ = 0·54 *C* = 75° 27′ 48″·35
	49·70	48·04	50·37	47·97	48·40	39·47	47·95	47·13	50·82	49·30	46·80	48·20	*M* = 47″·85 *w* = 1·38
‡ XIX & XVI	*h* 31·87 *l* 32·97	*h* 33·60 *l* 33·96 *l* 33·20	*l* 32·73 *l* 33·13	*l* 34·43 *l* 34·14 *l* 35·64	*l* 33·80 *l* 34·53	*l* 38·64 *l* 37·66 *l* 38·87	*l* 35·60 *l* 34·13	*l* 38·83 *l* 40·00	*h* 27·36 *h* 26·97 *h* 26·83 *l* 26·57	*h* 28·27 *h* 27·83	*h* 28·94 *l* 28·76 *l* 30·57	*l* 25·70 *l* 26·30	
	32·42	33·59	32·93	34·74	34·17	38·39	34·86	39·42	26·93	28·05	29·42	26·00	*M* = 32″·58 *w* = 0·66
§ XIX & XVI	*l* 29·87 *l* 29·43	*l* 29·50 *h* 31·24	*l* 28·03 *l* 29·37 *l* 28·34	*h* 33·53 *l* 28·53 *l* 33·30	*l* 29·00 *l* 29·57	*l* 34·93 *d* 36·80	*h* 29·67 *h* 28·96	*l* 37·74 *l* 36·40	*l* 26·57 *l* 25·73	*l* 28·00 *l* 30·33 *l* 28·63	*l* 27·13 *l* 27·63	*h* 28·70 *h* 27·67	*w* = 1·75 $\frac{1}{w}$ = 0·57 *C* = 37° 44′ 31″·11
	29·65	30·37	28·58	31·79	29·29	35·86	29·32	37·07	26·15	28·99	27·38	28·18	*M* = 30″·22 *w* = 1·09
‡ XVI & XV	*h* 34·13 *l* 35·43 *l* 32·67	*l* 34·36 *l* 34·13	*l* 30·90 *l* 31·96	*l* 32·63 *l* 32·36	*l* 39·03 *l* 37·23	*l* 31·07 *l* 30·36	*l* 36·00 *l* 38·26	*l* 32·54 *l* 33·10	*l* 41·00 *l* 39·33	*l* 30·80 *l* 31·90	*l* 34·04 *l* 33·60	*l* 36·20 *l* 34·23	
	34·08	34·25	31·43	32·49	38·13	30·72	37·13	32·82	40·16	31·35	33·82	35·22	*M* = 34″·30 *w* = 1·37
	Circle readings, telescope being set on XVI												
	312° 13′	132° 13′	322° 24′	142° 24′	332° 34′	152° 34′	342° 40′	162° 40′	352° 51′	172° 51′	3° 2′	183° 2′	
† XVI & XV	″ *h* 39·76 *h* 38·43	″ *h* 39·47 *l* 37·50	″ *h* 36·50 *l* 36·50	″ *h* 41·90 *h* 41·97	″ *l* 40·23 *l* 39·93	″ *l* 42·46 *l* 43·80 *l* 44·33 *l* 42·76	″ *l* 35·63 *l* 34·70	″ *l* 32·70 *l* 31·96	″ *h* 28·60 *l* 28·60 *h* 29·70 *h* 29·90	″ *h* 28·10 *h* 29·63 *h* 30·44	″ *h* 30·53 *h* 31·20	″ *h* 30·80 *h* 28·00 *h* 28·13	*w* = 2·34 $\frac{1}{w}$ = 0·43 *C* = 47° 47′ 35″·13
	39·10	38·48	36·50	41·94	40·08	43·34	35·16	32·33	29·20	29·39	30·87	28·98	*M* = 35″·45 *w* = 0·44

At XVII (Rangpur)—(*Continued*).

Angle between	Circle readings, telescope being set on XXII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 1′	10° 12′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 38′	220° 38′	50° 50′	230° 50′	
§ XVI & XV	″ l 32·37 l 31·33	″ l 35·50 h 34·26	″ l 34·74 l 33·63 l 33·03	″ h 33·50 l 34·57 l 33·03	″ l 42·33 l 39·50 l 38·47	″ l 34·30 l 32·43	″ h 45·50 h 44·20	″ l 30·73 l 29·77	″ l 43·20 l 43·80	″ l 38·04 l 37·47	″ l 40·87 l 41·53	″ h 38·24 h 39·16	
	31·85	34·88	33·80	33·70	40·10	33·37	44·85	30·25	43·50	37·75	41·20	38·70	M = 37″·00 w = 0·53
§ XV & XVIII	l 55·63 l 55·94 l 57·50	l 56·17 l 56·20	l 59·46 l 57·94 l 59·67	l 62·73 l 58·73 h 57·77	l 51·20 l 53·63 l 54·47	l 55·07 l 55·20	h 50·97 h 50·37	l 57·17 l 60·47 l 59·37	h 46·93 h 47·87 l 47·24	l 52·83 l 54·47	l 51·07 l 49·17	h 56·24 h 56·30	
	56·36	56·19	59·02	59·74	53·10	55·13	50·67	59·00	47·35	53·65	50·12	56·27	M = 54″·72 w = 0·78
	Circle readings, telescope being set on XVI												
	312° 13′	132° 13′	322° 24′	142° 24′	332° 34′	152° 34′	342° 40′	162° 40′	352° 51′	172° 51′	3° 2′	183° 2′	$w = 1 \cdot 38$ $\frac{1}{w} = 0 \cdot 72$ $C = 67° 28' 55'' \cdot 62$
† XV & XVIII	″ h 51·63 h 52·60	″ h 51·40 h 51·07	″ l 57·57 l 57·20	″ l 50·46 l 52·77 l 52·36	″ l 54·70 l 54·57	″ l 51·24 l 51·27	″ l 58·30 l 57·33	″ l 62·00 l 63·37	″ h 58·20 h 59·07	″ h 58·90 h 59·70	″ h 63·40 h 61·63	″ h 61·13 h 62·53	
	52·12	51·23	57·39	51·86	54·63	51·26	57·81	62·69	58·63	59·30	62·52	61·83	M = 56″·77 w = 0·60
	Circle readings, telescope being set on XVIII												
	292° 10′	112° 10′	302° 21′	122° 21′	312° 29′	132° 29′	322° 38′	142° 38′	332° 47′	152° 47′	342° 59′	162° 59′	
* XVIII & XX	″ h 24·43 h 25·44	″ h 30·10 h 27·57 h 27·56	″ h 24·40 l 24·73	″ h 25·80 h 23·37 h 23·50	″ l 19·40 l 21·96 l 22·53	″ l 23·17 l 23·33	″ l 19·70 l 19·70	″ l 20·97 l 18·90	″ l 21·83 l 22·66	″ l 22·27 l 25·17 l 26·00 h 23·17	″ h 19·60 h 17·84	″ h 22·40 h 22·36	
	24·94	28·41	24·56	24·22	21·30	23·25	19·70	19·94	22·24	24·15	18·72	22·38	M = 22″·82 w = 1·55
	Circle readings, telescope being set on XXII												
	0° 0′	180° 1′	10° 12′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 38′	220° 38′	50° 50′	230° 50′	$w = 3 \cdot 85$ $\frac{1}{w} = 0 \cdot 26$ $C = 67° 51' 23'' \cdot 24$
§ XVIII & XX	″ l 22·90 l 23·13	″ h 26·54 h 25·77	″ l 22·24 l 25·33 l 25·23	″ l 23·64 l 20·04 l 20·76 l 20·96	″ l 25·90 l 26·07	″ l 23·10 l 23·57	″ h 23·33 h 24·50	″ l 19·30 l 17·76 l 17·63	″ h 23·90 h 23·83	″ l 24·50 l 23·46	″ l 25·30 l 26·43	″ l 22·80 l 21·76	
	23·02	26·15	24·27	21·35	25·99	23·33	23·92	18·23	23·86	23·98	25·87	22·28	M = 23″·52 w = 2·30

At XVII (Rangpur)—(*Continued*).

Angle between	Circle readings, telescope being set on XVIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	292° 10′	112° 10′	302° 21′	122° 21′	312° 29′	132° 29′	322° 38′	142° 38′	332° 47′	152° 47′	342° 59′	162° 59′	
* XX & XXII	″ h 42·14 h 42·46	″ h 40·20 h 39·16	″ h 46·33 h 45·60	″ h 44·57 h 45·56	″ l 55·70 l 50·87 l 54·27	″ l 43·10 l 43·67	″ l 45·26 l 43·93 l 44·43	″ l 46·86 l 44·70	″ l 46·67 l 47·90	″ l 44·10 l 42·03 h 44·63	″ h 49·77 h 50·60	″ h 40·57 h 43·64 h 44·70	
	42·30	39·68	45·97	45·06	53·61	43·39	44·54	45·78	47·28	43·59	50·19	42·97	M = 45″·36 w = 0·84

Angle between	Circle readings, telescope being set on XXII												
	0° 0′	180° 1′	10° 12′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 38′	220° 38′	50° 50′	230° 50′	w = 2·10 $\frac{1}{w}$ = 0·48 C = 63° 39′ 45″·52
§ XX & XXII	″ l 45·70 l 47·06	″ h 43·36 h 43·77	″ l 42·43 l 42·37	″ l 44·53 l 44·80	″ l 41·30 l 42·20	″ l 53·47 l 52·56	″ h 42·17 l 43·33	″ l 48·20 l 48·70 l 46·50	″ h 46·36 h 44·37 h 46·90	″ l 47·40 l 45·04 l 45·73	″ l 47·96 l 46·84	″ l 46·63 l 45·07	
	46·38	43·57	42·40	44·66	41·75	53·02	42·75	47·80	45·88	46·06	47·40	45·85	M = 45″·63 w = 1·26

At XVIII (Chalarwa)

‖*December* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.
¶*February* 1854; (*a*) *November* 1856; *and* (*b*) *December* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	276° 50′	96° 50′	287° 1′	107° 1′	297° 10′	117° 10′	307° 18′	127° 18′	317° 27′	137° 27′	327° 39′	147° 39′	
‖ XXI & XX	″ l 68·47 l 66·47 l 66·84	″ l 64·60 l 63·74	″ h 62·46 h 61·87	″ l 65·20 l 64·14 h 67·24 h 66·56	″ h 58·90 h 58·97	″ h 66·53 h 63·14 h 62·53	″ l 59·83 l 63·70 l 62·20	″ l 58·53 l 59·07 l 60·16	″ l 59·77 l 60·56	″ l 63·90 l 66·46	″ l 62·34 l 61·10	″ l 65·50 l 67·16	M = 63″·08 w = 1·44 $\frac{1}{w}$ = 0·69 C = 83° 11′ 3″·09
	67·26	64·17	62·17	65·78	58·94	64·07	61·91	59·25	60·16	65·18	61·72	66·33	
‖ XX & XVII	l 65·43 l 61·56 l 64·40	l 66·20 l 66·36	h 65·50 h 64·17 h 64·33	h 63·06 h 65·36 h 63·56	h 66·70 h 68·87	h 59·74 h 64·46 h 62·47	l 68·97 l 68·20	l 66·70 l 64·33 l 66·74	h 65·87 h 66·77	l 64·77 l 65·00	l 64·20 l 62·13	l 61·07 l 63·23	
	63·80	66·28	64·67	63·99	67·79	62·22	68·58	65·92	66·32	64·89	63·16	62·15	M = 64″·98 w = 2·52 w = 4·25 $\frac{1}{w}$ = 0·24 C = 54° 31′ 4″·71
(b) XX & XVII	l 61·87 l 61·83	l 65·73 l 66·20	l 68·37 l 68·87	l 65·90 l 64·37	h 64·60 h 64·97	h 59·77 h 61·03	h 68·83 h 69·16	h 63·23 h 63·33	h 65·07 h 64·27	h 63·77 h 63·80	h 63·23 h 62·87	h 61·80 h 61·53	
	61·85	65·97	68·62	65·13	64·79	60·40	68·99	63·28	64·67	63·79	63·05	61·66	M = 64″·35 w = 1·73

At XVIII (Chalarwa)—(*Continued*).

Angle between	Circle readings, telescope being set on XVII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	299° 35′	119° 35′	309° 46′	129° 46′	319° 57′	139° 57′	330° 3′	150° 3′	340° 14′	160° 14′	350° 24′	170° 24′	
	″	″	″	″	″	″	″	″	″	″	″	″	
¶ XVII & XV	h 11·47	h 13·50	l 15·67	h 13·07	l 10·76	l 14·50	l 7·83	l 8·83	l 8·24	l 8·10	l 8·17	l 4·70	
	h 12·90	h 15·74	l 15·83	h 13·34	l 8·96	l 14·73	l 7·13	l 8·63	l 9·67	l 9·80	l 7·64	l 5·30	
	12·19	14·62	15·75	13·20	9·86	14·62	7·48	8·73	8·95	8·95	7·91	5·00	M = 10″·61 w = 1·03
(a) XVII & XV	h 13·23	h 12·60	h 12·60	h 14·40	l 9·93	l 15·57	l 13·90	l 11·80	l 10·47	l 15·23	h 12·33	l 15·47	w = 3·94
	h 11·50	h 12·00	h 11·44	h 15·77	l 8·36	l 15·87	l 12·37	l 10·87	l 10·86	l 14·90	h 13·10	l 14·34	$\frac{1}{w}$ = 0·25
												h 14·40	C = 60° 25′ 12″·27
	12·37	12·30	12·02	15·08	9·15	15·72	13·13	11·34	10·66	15·07	12·71	14·74	M = 12″·86 w = 2·91

At XIX (Pangasia)

***April* 1854; †*November* 1856; *and* ‡*December* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XVI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	
	″	″	″	″	″	″	″	″	″	″	″	″	
* XVI & XV	l 3·16	l 4·33	l 8·30	l 9·10	l 8·13	h 7·57	l 17·07	h 15·60	l 14·20	l 16·03	l 13·43	l 12·83	
	l 3·50	l 5·36	l 6·86	l 7·80	l 10·86	h 6·90	l 17·20	l 16·00	l 15·17	l 16·47	l 15·40	l 12·97	
					h 10·60			l 14·74			l 12·43		
	3·33	4·85	7·58	8·45	9·86	7·23	17·14	15·45	14·68	16·25	13·75	12·90	M = 10″·96 w = 0·54
† XVI & XV	h 8·77	h 11·16	l 15·17	l 12·30	l 12·97	l 11·20	h 18·20	h 13·87	l 13·63	h 12·46	l 12·84	l 12·97	w = 3·39
	h 9·06	h 11·57	l 13·87	l 10·67	l 13·10	h 10·53	h 17·80	h 16·07	l 13·80	l 13·60	l 11·10	l 10·70	$\frac{1}{w}$ = 0·29
				l 11·73			h 20·10	h 14·37				l 11·74	C = 49° 3′ 12″·47
	8·92	11·36	14·52	11·57	13·04	10·86	18·70	14·77	13·72	13·03	11·97	11·80	M = 12″·86 w = 1·91
‡ XVI & XV	h 9·10	h 12·43	h 14·94	l 13·80	l 10·83	l 7·97	l 23·73	l 14·00	l 12·87	l 12·90	l 10·04	l 10·20	
	h 7·50	h 11·60	l 14·80	l 12·90	l 12·74	l 8·00	l 20·27	l 14·46	l 13·00	l 11·80	l 10·33	h 10·30	
					l 13·66		l 20·17					h 9·80	
	8·30	12·02	14·87	13·35	12·41	7·98	21·39	14·23	12·94	12·35	10·18	10·10	M = 12″·51 w = 0·94

At XIX (Pangasia)—(*Continued*).

Angle between	Circle readings, telescope being set on XVI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	
	″	″	″	″	″	″	″	″	″	″	″	″	
* XV & XVII	l 32·87 l 31·00	l 30·57 l 29·44	l 26·23 l 27·37	l 27·87 l 27·90	l 30·57 h 30·07	h 30·33 h 32·00	h 24·03 h 21·80	h 30·63 l 30·76 l 27·57	l 31·04 l 29·67	l 33·17 l 33·13	l 29·40 l 30·50 l 31·13	l 31·87 l 33·13	
	31·94	30·00	26·80	27·89	30·32	31·16	22·92	29·65	30·35	33·15	30·34	32·50	M = 29″·75 w = 1·48
† XV & XVII	h 28·10 h 27·00	h 23·47 h 24·87	l 22·03 l 22·13	l 20·27 l 17·80 l 20·50	l 25·30 l 24·90	l 24·97 l 26·37 h 24·43	h 23·84 h 21·13 h 22·90	h 25·80 h 24·23	l 26·93 l 27·47	h 28·64 l 29·77	l 28·53 l 28·46	l 22·80 l 22·77	w = 3·78 $\frac{1}{w}$ = 0·26 C = 47° 43′ 26″·87
	27·55	24·17	22·08	19·52	25·10	25·26	22·62	25·02	27·20	29·20	28·50	22·78	M = 24″·92 w = 1·41
‡ XV & XVII	h 29·70 h 28·40	h 23·47 h 23·40	l 20·03 l 21·63	l 19·30 l 20·47	l 30·33 l 29·17	l 27·00 l 27·60	l 19·07 l 19·10	l 26·13 l 24·80	l 27·06 l 25·73	l 28·90 l 28·80	l 24·56 l 25·47	l 26·16 l 26·96 h 27·93	
	29·05	23·44	20·83	19·88	29·75	27·30	19·09	25·46	26·40	28·85	25·01	27·02	M = 25″·17 w = 0·89
* XVII & XXII	l 28·80 l 30·33	l 32·80 l 32·93	l 33·87 l 33·03	l 33·07 l 32·40	l 29·13 l 29·40	h 31·84 h 32·20	h 29·73 h 30·23 l 31·24	h 30·14 l 30·60 l 32·13	l 31·50 l 31·93	l 27·23 l 29·87 l 30·37	l 32·43 l 33·50	l 29·83 l 28·96	
	29·57	32·86	33·45	32·74	29·26	32·02	30·40	30·96	31·72	29·16	32·96	29·40	M = 31″·21 w = 4·25
‡ XVII & XXII	h 27·83 h 29·76	h 31·00 h 28·86 h 31·83	l 33·20 l 32·50	h 33·90 h 31·46 h 33·13	l 26·87 l 27·50 l 26·40	l 34·54 l 33·13	l 35·40 l 35·73	l 33·63 l 33·70	l 37·34 l 38·37	l 34·43 l 35·44	l 40·80 l 40·77	l 30·27 h 31·67	w = 5·06 $\frac{1}{w}$ = 0·20 C = 57° 14′ 31″·54
	28·80	30·56	32·85	32·83	26·92	33·83	35·57	33·66	37·86	34·93	40·79	30·97	M = 33″·30 w = 0·81

At XX (Dúngarpur)

§ *December* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

¶ *December* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on R. M.												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 12′	20° 21′	200° 21′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
§ R.M. & XVIII	l 21·77 l 21·24	l 23·06 l 22·70	l 18·46 l 16·87	h 16·80 h 19·97 l 19·53	h 21·14 h 21·57	h 15·70 h 17·57	l 21·80 l 19·60	l 24·40 l 23·73	h 25·36 h 24·97	h 26·60 h 26·97	h 27·10 h 24·47	h 22·14 h 22·06	M = 21″·95 w = 1·14 $\frac{1}{w}$ = 0·88 C = 19° 56′ 21″·95
	21·51	22·88	17·66	18·77	21·36	16·63	20·70	24·07	25·16	26·79	25·78	22·10	

NOTE.—R.M. denotes Referring Mark.

At XX (Dúngarpur)—(*Continued*).

Angle between	0°1′	180°1′	10°12′	190°12′	20°21′	200°21′	30°29′	210°29′	40°38′	220°38′	50°50′	230°50′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
§ XVIII & XXI	h 27·90	h 22·47	l 26·74	h 25·20	h 22·76	h 26·37	l 20·50	l 21·87	h 23·47	h 22·24	h 19·83	h 24·90	M = 23″·68
	h 26·80	h 23·40	l 27·63	h 23·00	h 23·56	h 24·90	l 19·30	l 21·50	h 24·10	h 22·10	h 22·50	h 25·17	w = 2·14
													1/w = 0·47
	27·35	22·94	27·18	24·10	23·16	25·64	19·90	21·68	23·79	22·17	21·16	25·04	C = 53° 54′ 23″·68
§ XXI & XXIII	h 6·03	h 7·46	l 4·46	h 10·77	h 5·70	h 6·76	l 11·60	l 6·13	h 5·97	h 12·06	h 8·24	h 3·73	M = 7″·59
	h 4·80	h 6·93	l 5·27	h 11·83	h 5·47	h 7·66	l 10·90	l 10·10	h 4·30	h 10·80	h 10·63	h 5·70	w = 1·66
	h 6·13							l 5·67					1/w = 0·60
	5·65	7·20	4·86	11·30	5·59	7·21	11·25	7·30	5·13	11·43	9·44	4·71	C = 59° 37′ 7″·59
§ XXIII & XXIV	l 9·90	l 4·87	l 13·57	h 7·23	h 12·14	h 6·07	l 3·24	l 7·74	h 9·56	h 5·17	h 5·50	h 10·37	M = 7″·53
	l 6·14	l 4·66	l 13·53	h 5·57	h 10·90	h 6·17	l 5·74	l 4·87	h 9·57	h 4·43	h 4·17	h 7·40	w = 1·27
	h 11·57						l 4·07	l 6·37					1/w = 0·79
	9·20	4·77	13·55	6·40	11·52	6·12	4·35	6·33	9·56	4·80	4·84	8·88	C = 62° 4′ 7″·53
§ XXIV & XXII	l 39·27	l 48·16	l 39·10	h 47·64	h 39·86	h 45·50	l 47·43	l 44·20	h 43·10	h 45·13	h 45·06	h 43·33	
	l 43·23	l 47·50	l 37·50	l 46·57	h 41·70	h 45·57	l 47·10	l 40·76	h 41·36	h 45·17	l 47·40	h 41·17	
	h 38·06							l 41·76	h 40·93				
	40·19	47·83	38·30	47·11	40·78	45·53	47·27	42·24	41·80	45·15	46·23	42·25	M = 43″·72; w = 1·12
¶ XXIV & XXII	h 42·33	h 46·80	l 38·43	l 48·57	l 40·33	l 47·94	l 41·10	l 43·26	h 43·13	h 44·26	h 42·50	h 40·23	w = 2·27
	h 43·74	h 47·10	l 37·07	l 48·46	l 40·87	l 46·40	h 42·04	l 42·30	h 40·73	h 44·87	h 44·04	h 39·50	1/w = 0·44
									h 41·00				C = 57° 9′ 43″·42
	43·04	46·95	37·75	48·51	40·60	47·17	41·57	42·78	41·62	44·57	43·27	39·86	M = 43″·14; w = 1·15
§ XXII & XVII	h 67·14	h 57·37	l 58·97	h 55·73	h 66·17	h 63·07	l 63·80	l 60·80	h 62·20	h 60·77	h 62·40	h 63·07	
	h 65·67	h 58·13	l 59·27	l 55·20	h 62·87	h 60·63	l 63·96	l 63·57	h 65·20	h 61·43	l 61·26	h 65·20	
					h 61·83				h 66·53				
	66·41	57·75	59·12	55·46	63·62	61·85	63·88	62·19	64·64	61·10	61·83	64·13	M = 61″·83; w = 1·16
¶ XXII & XVII	h 62·20	h 56·43	l 62·60	l 55·07	l 63·20	l 62·40	l 62·97	l 65·14	h 63·40	h 63·17	h 65·77	h 67·84	w = 2·08
	h 62·73	h 55·40	l 64·70	l 56·84	l 63·90	l 62·17	h 63·93	l 64·06	h 64·70	h 63·03	h 63·93	h 69·64	1/w = 0·48
			l 62·70				h 64·90						C = 69° 37′ 2″·23
	62·47	55·91	63·33	55·96	63·55	62·28	63·93	64·60	64·05	63·10	64·85	68·74	M = 62″·73; w = 0·92

Note.—R.M. denotes Referring Mark.

At XX (Dúngarpur)—(*Continued*).

Angle between	Circle readings, telescope being set on R. M. 0° 1′	180° 1′	10° 12′	190° 12′	20° 21′	200° 21′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
§ XVII & XVIII	″ h 30·16 h 29·07	″ h 40·63 h 39·70	″ l 35·63 l 37·27	″ h 33·87 h 31·63 h 30·87	″ h 33·34 h 33·27	″ h 31·33 h 33·50	″ l 33·93 l 32·63	″ l 38·90 l 37·06	″ h 35·47 h 36·10	″ h 35·80 h 36·37	″ h 35·97 h 36·86	″ h 37·24 h 36·13	
	29·62	40·16	36·45	32·12	33·31	32·41	33·28	37·98	35·79	36·08	36·42	36·68	M = 35″·03 w = 1 ·36
¶ XVII & XVIII	h 29·00 h 31·30 h 30·93	h 43·03 h 41·53	h 39·03 h 40·24	h 34·57 h 34·90	l 38·06 l 37·86	l 34·24 l 35·33	h 33·73 h 32·23	h 36·07 h 37·07	h 36·40 h 36·24	h 34·57 h 33·87	h 33·33 h 34·63	h 33·06 h 32·23	w = 2 ·48 $\frac{1}{w}$ = 0 ·40 C = 57° 37′ 35″·26
	30·41	42·28	39·64	34·73	37·96	34·79	32·98	36·57	36·32	34·22	33·98	32·64	M = 35″·54 w = 1 ·12

At XXI (Sápakra)

January 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIII 0° 1′	180° 1′	10° 12′	190° 13′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIII & XX	″ h 13·10 h 15·13	″ h 9·84 h 13·70 h 13·07	″ h 17·06 l 15·83	″ l 10·90 l 9·80	″ l 19·04 l 18·23	″ l 16·04 l 14·54	″ l 21·74 l 19·73	″ l 15·76 l 17·00	″ h 14·50 h 13·63	″ h 16·17 h 19·06 h 16·46	″ h 14·23 h 13·84	″ h 9·77 h 13·47 h 11·36	M = 15″·08 w = 1 ·26 $\frac{1}{w}$ = 0 ·79 C = 51° 32′ 15″·07
	14·12	12·20	16·44	10·35	18·64	15·29	20·73	16·38	14·07	17·23	14·03	11·53	
XX & XVIII	h 30·03 h 30·74	h 32·23 h 27·93 h 29·93	h 27·77 l 26·97	l 32·06 l 37·43 l 32·17	l 32·23 l 34·54	l 29·44 l 29·63	l 24·76 l 27·03	l 37·47 l 35·57	h 33·70 h 34·53	h 36·50 h 35·24 h 36·30	h 32·97 h 33·33	h 36·30 h 36·70	M = 32″·23 w = 0 ·91 $\frac{1}{w}$ = 1 ·10 C = 42° 54′ 32″·23
	30·39	30·03	27·37	33·89	33·38	29·54	25·89	36·52	34·12	36·01	33·15	36·50	

At XXII (Virpur)

* *January* 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.
† *April* 1854; *and* ‡ *December* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIX 312° 43′	132° 43′	322° 54′	142° 54′	333° 4′	153° 4′	343° 10′	163° 10′	353° 21′	173° 21′	3° 31′	183° 31′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† XIX & XVII	″ h 39·90 h 42·40 h 41·44	″ h 41·66 h 42·70	″ l 38·53 l 41·46 l 39·67	″ l 43·14 l 43·13 l 42·13	″ h 45·47 h 46·44	″ l 45·67 l 46·07 h 46·83	″ l 38·34 l 37·70	″ l 39·30 l 39·46	″ l 35·20 l 35·76	″ l 37·40 l 35·20 l 35·47	″ l 33·94 h 31·56 h 32·80	″ h 33·03 h 31·17 h 31·90	
	41·25	42·18	39·89	42·80	45·96	46·19	38·02	39·38	35·48	36·02	32·77	32·03	M = 39″·33 w = 0 ·55

At XXII (Virpur)—(*Continued*).

Angle between	Circle readings, telescope being set on XIX 266° 0′	86° 0′	276° 10′	96° 10′	286° 21′	106° 21′	296° 27′	116° 27′	306° 38′	126° 38′	316° 49′	136° 48′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
‡ XIX & XVII	″ *h* 42·23 *h* 40·80	″ *h* 36·73 *h* 36·90	″ *h* 43·80 *h* 42·23	″ *h* 36·00 *h* 36·17	″ *l* 42·23 *h* 40·20 *h* 40·07	″ *l* 36·17 *l* 36·90	″ *h* 37·80 *h* 38·94	″ *h* 36·07 *h* 35·90	″ *h* 41·97 *l* 41·10	″ *h* 38·46 *h* 38·90	″ *l* 37·43 *l* 38·34	″ *l* 44·40 *l* 41·07 *l* 41·87	$w = 2 \cdot 27$ $\frac{1}{w} = 0 \cdot 44$ $C = 47° 17′ 39″ \cdot 19$
	41·52	36·81	43·02	36·08	40·83	36·54	38·37	35·98	41·54	38·68	37·88	42·45	$M = 39″ \cdot 14$ $w = 1 \cdot 72$
‡ XVII & XX	*h* 14·20 *h* 14·33	*h* 16·23 *h* 17·30	*l* 10·43 *l* 9·44	*l* 17·90 *l* 18·33	*l* 14·87 *h* 16·80 *h* 16·30	*l* 23·23 *l* 22·86 *l* 24·20	*h* 14·23 *h* 12·93	*h* 17·23 *h* 16·07	*h* 10·36 *l* 13·40 *l* 10·46	*h* 16·37 *h* 13·24 *h* 13·60	*l* 15·67 *l* 13·93	*l* 12·73 *l* 11·54	
	14·27	16·76	9·94	18·11	15·99	23·43	13·58	16·65	11·41	14·40	14·80	12·14	$M = 15″ \cdot 12$ $w = 0 \cdot 94$
Lesser circle readings	313° 18′	133° 18′	323° 29′	143° 29′	333° 37′	153° 37′	343° 46′	163° 46′	353° 55′	173° 55′	4° 7′	184° 7′	$w = 1 \cdot 86$
* XVII & XX	*h* 13·50 *h* 12·63	*h* 20·00 *h* 18·34	*h* 13·76 *h* 12·50	*h* 15·90 *h* 16·40	*h* 16·10 *h* 15·80	*h* 17·13 *h* 16·90	*l* 10·63 *l* 12·24	*l* 8·77 *l* 9·77	*l* 8·87 *l* 11·53	*l* 11·54 *l* 13·37	*l* 6·04 *l* 7·57	*l* 11·33 *l* 9·93	$\frac{1}{w} = 0 \cdot 54$ $C = 46° 43′ 14″ \cdot 04$
	13·07	19·17	13·13	16·15	15·95	17·01	11·44	9·27	10·20	12·45	6·81	10·63	$M = 12″ \cdot 94$ $w = 0 \cdot 92$
* XX & XXIV	*h* 44·70 *h* 45·04	*h* 35·87 *h* 37·83 *h* 38·87	*h* 45·27 *h* 46·17	*h* 41·80 *h* 41·10	*h* 37·70 *h* 38·57	*h* 39·90 *h* 40·33	*l* 39·90 *l* 39·03	*l* 45·83 *l* 44·53	*l* 43·40 *l* 41·43	*l* 44·40 *l* 43·73	*l* 45·60 *l* 47·50	*l* 47·84 *l* 48·27	
	44·87	37·52	45·72	41·45	38·14	40·11	39·47	45·18	42·41	44·07	46·55	48·05	$M = 42″ \cdot 80$ $w = 0 \cdot 98$
	Circle readings, telescope being set on XIX 266° 0′	86° 0′	276° 10′	96° 10′	286° 21′	106° 21′	296° 27′	116° 27′	306° 38′	126° 38′	316° 49′	136° 48′	$w = 2 \cdot 18$
‡ XX & XXIV	″ *h* 41·80 *h* 43·30	″ *h* 41·50 *h* 40·30	″ *l* 48·50 *l* 49·36	″ *l* 38·53 *l* 39·57	″ *l* 42·27 *h* 41·60	″ *l* 36·43 *l* 34·84 *l* 34·57	″ *h* 43·43 *h* 43·40	″ *h* 42·07 *h* 40·86	″ *h* 41·04 *l* 43·90 *l* 42·27	″ *h* 41·03 *h* 42·10	″ *l* 40·96 *l* 39·97	″ *l* 39·77 *l* 42·60 *l* 41·33	$\frac{1}{w} = 0 \cdot 46$ $C = 70° 37′ 42″ \cdot 14$
	42·55	40·90	48·93	39·05	41·94	35·28	43·41	41·47	42·40	41·56	40·47	41·23	$M = 41″ \cdot 60$ $w = 1 \cdot 20$

At XXIII (Chatrikhera)

January 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXV 221° 55′	41° 55′	232° 6′	52° 6′	242° 14′	62° 14′	252° 23′	72° 23′	262° 32′	82° 32′	272° 44′	92° 44′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XXV & XXVI	″ *h* 16·53 *h* 17·80	″ *h* 18·34 *h* 16·04	″ *h* 10·87 *h* 11·43	″ *h* 17·40 *h* 16·67	″ *l* 12·63 *l* 14·23	″ *l* 14·50 *l* 12·30	″ *l* 14·24 *l* 14·76	″ *l* 19·00 *l* 17·34	″ *l* 23·83 *l* 20·10 *l* 19·40	″ *l* 12·10 *l* 12·77	″ *h* 21·27 *h* 21·13	″ *h* 21·83 *h* 21·44	$M = 16″ \cdot 54$ $w = 0 \cdot 90$ $\frac{1}{w} = 1 \cdot 11$
	17·17	17·19	11·15	17·03	13·43	13·40	14·50	18·17	21·11	12·44	21·20	21·63	$C = 43° 7′ 16″ \cdot 54$

At XXIII (Chatrikhera)—(*Continued*).

Angle between	Circle readings, telescope being set on XXV 221° 55′	41° 55′	232° 6′	52° 6′	242° 14′	62° 14′	252° 23′	72° 23′	262° 32′	82° 32′	272° 44′	92° 44′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVI & XXIV	″ *h* 57·47 *h* 57·80	″ *h* 53·26 *h* 53·80	″ *l* 60·90 *l* 58·90	″ *h* 55·64 *h* 56·30	″ *l* 59·97 *l* 61·34 *d* 59·30	″ *l* 56·30 *l* 57·37	″ *l* 55·03 *l* 54·60	″ *l* 52·23 *l* 53·43	″ *l* 50·27 *l* 51·80	″ *l* 56·43 *l* 54·77	″ *h* 53·80 *h* 51·17	″ *h* 53·34 *h* 51·43	M = 55″·27 w = 1·31 1/w = 0·76 C = 33° 27′ 55″·27
	57·64	53·53	59·90	55·97	60·20	56·83	54·82	52·83	51·03	55·60	52·49	52·38	
XXIV & XX	*h* 60·07 *h* 59·23	*h* 66·64 *h* 64·76	*h* 70·06 *l* 68·67	*h* 65·53 *h* 67·10	*l* 58·13 *l* 57·86 *d* 56·64	*l* 71·07 *l* 70·13	*l* 59·10 *l* 60·57	*l* 62·54 *l* 61·50	*l* 61·67 *l* 65·10 *l* 61·90	*l* 63·97 *l* 63·13	*h* 64·16 *h* 62·10	*h* 61·66 *h* 64·80 *h* 61·94	M = 63″·62 w = 0·78 1/w = 1·28 C = 61° 31′ 3″·61
	59·65	65·70	69·37	66·31	57·54	70·60	59·84	62·02	62·89	63·55	63·13	62·80	
XX & XXI	*h* 40·36 *h* 42·23	*h* 35·46 *h* 37·47	*h* 42·10 *h* 43·13	*h* 34·87 *h* 36·80	*l* 40·90 *l* 38·70	*l* 27·90 *l* 29·83	*l* 43·70 *l* 40·87 *l* 41·26	*l* 38·20 *l* 36·93	*l* 37·90 *l* 38·70	*l* 36·73 *l* 40·20 *h* 40·26	*h* 41·00 *h* 41·84	*h* 43·57 *h* 43·07 *h* 42·20	M = 38″·84 w = 0·75 1/w = 1·33 C = 68° 50′ 38″·85
	41·30	36·46	42·62	35·83	39·80	28·87	41·94	37·56	38·30	39·06	41·42	42·95	

At XXIV (Wánkáner)

**January* 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

†*December* 1856; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXII 307° 49′	127° 49′	318° 0′	138° 0′	328° 9′	148° 9′	338° 17′	158° 17′	348° 26′	168° 26′	358° 38′	178° 38′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XXII & XX	″ *h* 34·57 *h* 33·03	″ *h* 41·70 *h* 37·46 *h* 38·70	″ *h* 34·50 *h* 33·73	″ *h* 36·40 *l* 35·47	″ *l* 33·66 *l* 33·20	″ *l* 38·10 *l* 36·87	″ *l* 27·90 *l* 28·63	″ *l* 33·20 *l* 31·47	″ *h* 30·77 *h* 32·00	″ *h* 34·37 *h* 31·50 *h* 30·20	″ *h* 30·97 *h* 33·90 *h* 33·43	″ *h* 34·60 *h* 32·84	
	33·80	39·29	34·12	35·93	33·43	37·49	28·26	32·34	31·38	32·02	32·77	33·72	M = 33″·71 w = 1·36
† XXII & XX	*h* 34·77 *h* 35·34	*h* 38·43 *h* 37·00	*h* 33·03 *h* 31·53	*h* 38·47 *h* 36·47	*h* 35·23 *h* 32·87 *h* 34·50	*h* 41·27 *h* 41·53	*h* 32·83 *h* 32·10	*h* 35·96 *h* 35·94	*l* 35·66 *l* 33·36 *l* 32·83	*l* 37·43 *l* 35·47	*l* 28·57 *l* 27·53	*l* 32·04 *l* 34·10	w = 2·39 1/w = 0·42 C = 52° 12′ 34″·20
	35·06	37·71	32·28	37·47	34·20	41·40	32·47	35·95	33·95	36·45	28·05	33·07	M = 34″·84 w = 1·03

At XXIV (Wánkáner)—(*Continued*).

Angle between	Circle readings, telescope being set on XXII 307°49′	127°49′	318°0′	138°0′	328°9′	148°9′	338°17′	158°17′	348°26′	168°26′	358°38′	178°38′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XX & XXIII	″ h 51·56 h 50·76 h 53·34	″ h 52·04 h 50·43	″ h 51·70 h 51·23	″ l 47·20 l 51·46 l 50·96	″ l 53·04 l 55·47	″ l 52·67 l 52·53	″ l 53·46 l 55·23 l 53·70	″ l 52·50 l 55·16 l 52·10	″ h 54·33 h 55·16 h 55·10	″ h 50·16 h 51·03	″ h 50·70 h 49·30	″ h 47·93 h 49·30	M = 51″·90 w = 2·79 1/w = 0·36
	51·89	51·24	51·47	49·87	54·26	52·60	54·13	53·25	54·86	50·59	50·00	48·62	C = 56° 24′ 51″·91
* XXIII & XXV	h 13·34 h 11·74	h 14·10 h 12·60	h 18·37 h 17·04	l 16·40 l 14·50	l 13·90 l 11·66	l 15·40 l 17·40	l 14·54 l 14·80	l 20·63 l 19·90	h 15·70 h 15·93	h 20·70 h 20·23	h 15·13 h 15·20	h 17·77 h 17·70	M = 16″·03 w = 1·68 1/w = 0·60
	12·54	13·35	17·71	15·45	12·78	16·40	14·67	20·26	15·82	20·46	15·17	17·73	C = 47° 32′ 16″·03
* XXV & XXVI	h 57·73 h 57·83	h 57·20 h 59·03	h 54·57 h 55·83	l 61·90 l 62·74	l 63·60 l 65·47	l 53·30 l 54·90	l 58·70 l 58·96	l 55·67 l 55·34	h 63·80 h 63·73	h 57·57 h 58·04	h 60·04 h 60·06 h 61·30	h 57·03 h 58·73	M = 58″·83 w = 1·05 1/w = 0·95
	57·78	58·12	55·20	62·32	64·53	54·10	58·83	55·21	63·76	57·81	60·47	57·88	C = 58° 21′ 58″·83

At XXV (Tarkia)

January 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXVII 0°1′	180°2′	10°13′	190°12′	20°20′	200°20′	30°29′	210°29′	40°38′	220°38′	50°50′	230°50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVII & XXVI	″ h 53·74 h 54·24	″ h 50·73 h 49·54 h 48·17	″ h 48·67 h 46·03 h 44·20	″ h 46·13 h 44·53 h 46·87	″ h 45·83 h 47·67	″ h 41·73 h 41·80	″ h 50·37 h 50·97	″ h 48·84 h 49·16	″ h 51·17 h 51·50	″ h 55·13 h 55·93	″ l 50·73 l 53·33	″ l 51·83 l 51·40	M = 49″·53 w = 0″·79 1/w = 1·27
	53·99	49·48	46·30	45·84	46·75	41·77	50·67	49·00	51·33	55·53	52·03	51·62	C = 83° 33′ 49″·52
XXVI & XXIV	h 31·16 h 31·06	h 36·93 h 36·60	h 32·87 h 32·63	h 34·50 h 37·50 h 36·70	h 38·07 h 36·43	h 38·94 h 36·86 h 36·57	h 30·00 h 32·07	h 34·40 h 35·80	h 32·00 h 33·06	h 31·74 h 32·94	l 39·17 l 36·27 l 35·56	l 32·67 l 32·63	M = 34″·35 w = 1·80 1/w = 0·56
	31·11	36·77	32·75	36·23	37·25	37·46	31·03	35·10	32·53	32·34	37·00	32·65	C = 44° 36′ 34″·36
XXIV & XXIII	h 31·57 h 31·14	h 30·73 h 27·70 h 30·73	h 33·63 h 35·07	h 31·20 h 32·33 h 28·80	h 35·43 h 36·70	h 29·90 h 30·00	h 32·97 h 33·03	h 32·16 h 31·54	h 37·56 h 36·34	h 35·70 h 35·60	l 32·56 l 32·70	l 28·26 l 27·40	M = 32″·51 w = 1·46 1/w = 0·68
	31·36	29·72	34·35	30·78	36·06	29·95	33·00	31·85	36·95	35·65	32·63	27·83	C = 55° 52′ 32″·51

At XXVI (Kakána)

January 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIV 0° 1′	180° 1′	10° 13′	190° 13′	20° 20′	200° 20′	30° 29′	210° 29′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIV & XXIII	″ h 47·03 h 43·10	″ h 46·66 h 45·27	″ h 49·46 h 47·77	″ h 49·36 h 48·73 h 49·30	″ h 50·70 l 55·44 l 53·04	″ l 49·06 l 47·20	″ l 57·26 l 54·84 l 55·90	″ l 52·33 l 53·63	″ l 59·23 l 59·03	″ l 53·17 l 56·80 l 56·93	″ l 50·50 l 50·67	″ l 48·53 l 48·67	$M = 51''\cdot07$ $w = 0\cdot63$ $\frac{1}{w} = 1\cdot60$
	45·07	45·96	48·62	49·13	53·06	48·13	56·00	52·98	59·13	55·63	50·58	48·60	$C = 40^\circ 37' 51''\cdot08$
XXIII & XXV	h 44·70 h 45·97	h 44·74 h 41·97 h 42·56	h 39·40 h 41·00	h 35·40 h 37·90 h 36·47	h 36·90 l 35·90	l 36·90 l 38·20	l 30·80 l 32·90 l 31·17	l 36·27 l 36·97	l 36·03 l 39·83	l 44·37 l 42·96	l 43·27 l 41·83	l 42·77 l 44·07	$M = 39''\cdot58$ $w = 0\cdot70$ $\frac{1}{w} = 1\cdot43$
	45·34	43·09	40·20	36·59	36·40	37·55	31·62	36·62	37·93	43·66	42·55	43·42	$C = 36^\circ 23' 39''\cdot57$
XXV & XXVII	h 14·10 h 13·23 h 16·43	h 17·26 h 17·20	h 13·00 h 11·70	h 20·04 h 18·57 h 19·50	h 14·86 l 13·80	l 18·27 l 18·53	l 14·80 l 17·43 l 19·56	l 16·73 l 16·60	l 11·84 l 11·34	l 12·63 l 12·84	l 9·73 l 13·27 l 10·27	l 17·33 l 18·13	$M = 15''\cdot28$ $w = 1\cdot39$ $\frac{1}{w} = 0\cdot72$
	14·59	17·23	12·35	19·37	14·33	18·40	17·26	16·67	11·59	12·73	11·09	17·73	$C = 45^\circ 21' 15''\cdot28$
XXVII & XXVIII	l 42·53 l 43·60	l 43·70 l 44·83	h 48·94 h 48·90	h 41·76 h 41·27	h 45·64 h 44·70	l 44·97 l 46·34	l 47·74 l 44·33 l 42·60	l 43·13 l 41·96	l 42·70 l 44·50	l 48·33 l 46·53	l 47·20 l 45·76	l 44·27 l 42·10	$M = 44''\cdot73$ $w = 2\cdot36$ $\frac{1}{w} = 0\cdot42$
	43·07	44·26	48·92	41·52	45·17	45·65	44·89	42·55	43·60	47·43	46·48	43·18	$C = 68^\circ 30' 44''\cdot73$

At XXVII (Maidhar)

January and February 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIX 196° 28′	16° 28′	206° 39′	26° 38′	216° 47′	36° 46′	226° 55′	46° 55′	237° 4′	57° 4′	247° 16′	67° 16′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIX & XXVIII	″ h 31·10 h 31·17	″ h 34·10 h 33·50	″ l 28·17 l 26·36	″ h 32·83 l 31·47	″ l 28·26 l 24·76 l 26·07	″ l 28·90 l 27·23	″ l 31·40 l 31·47	″ l 27·20 l 28·90	″ l 27·77 l 25·63	″ l 28·67 l 28·40	″ h 29·67 h 32·43 h 28·54	″ h 28·74 h 29·27 h 28·97	$M = 29''\cdot39$ $w = 2\cdot04$ $\frac{1}{w} = 0\cdot49$
	31·14	33·80	27·26	32·15	26·36	28·07	31·43	28·05	26·70	28·54	30·21	28·99	$C = 57^\circ 53' 29''\cdot38$

At XXVII (Maidhar)—(*Continued*).

Angle between	Circle readings, telescope being set on XXIX 196° 28′	16° 28′	206° 39′	26° 38′	216° 47′	36° 46′	226° 55′	46° 55′	237° 4′	57° 4′	247° 16′	67° 16′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVIII & XXVI	″ h 36·33 h 32·83 h 35·80	″ h 33·33 h 32·97	″ l 39·96 l 39·80	″ h 31·57 l 31·26	″ l 36·47 l 38·54	″ l 34·07 l 34·87	″ l 36·70 l 35·27	″ l 36·70 l 34·40	″ l 37·57 l 37·40	″ l 34·63 l 35·43	″ h 42·33 h 41·07	″ h 36·70 h 37·03	$M = 36''\cdot17$ $w = 1\cdot48$ $\frac{1}{w} = 0\cdot68$
	34·99	33·15	39·88	31·42	37·50	34·47	35·99	35·55	37·48	35·03	41·70	36·87	$C = 54° 35' 36''\cdot17$
XXVI & XXV	h 59·70 h 61·60 h 60·10	h 58·97 h 58·67	h 55·33 h 52·73 h 55·27	h 55·40 h 56·37	l 60·70 l 61·33	l 60·37 l 61·00	l 56·87 l 57·40	l 57·94 l 56·87	l 55·33 l 55·54	l 58·87 l 57·74	h 53·53 h 54·10	h 54·30 h 52·90	$M = 57''\cdot25$ $w = 1\cdot65$ $\frac{1}{w} = 0\cdot61$
	60·47	58·82	54·44	55·89	61·01	60·69	57·13	57·41	55·43	58·31	53·81	53·60	$C = 51° 4' 57''\cdot25$

At XXVIII (Bháyásar)

**January* 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

†*April* 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXVI 0° 2′	180° 2′	10° 12′	190° 13′	20° 20′	200° 21′	30° 29′	210° 30′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XXVI & XXVII	″ h 41·23 h 42·24	″ h 41·00 h 42·00	″ h 42·06 l 42·43	″ h 41·93 h 41·90	″ l 48·17 l 45·87	″ l 39·97 l 40·17	″ l 45·90 l 44·20	″ l 41·90 l 40·46	″ l 42·70 l 42·30	″ l 40·10 l 41·10	″ l 40·83 l 38·36 l 41·04	″ l 38·37 l 39·73	$M = 41''\cdot91$ $w = 2\cdot34$ $\frac{1}{w} = 0\cdot43$
	41·74	41·50	42·24	41·92	47·02	40·07	45·05	41·18	42·50	40·60	40·08	39·05	$C = 56° 53' 41''\cdot91$
* XXVII & XXIX	h 45·30 h 44·60	h 42·84 h 41·70	h 46·20 l 47·50	h 47·34 h 47·46	l 42·10 l 42·67	l 48·20 l 48·76	l 46·34 l 47·00	l 49·60 l 51·64	l 45·80 l 45·60	l 49·90 l 48·27	l 49·53 l 49·07	l 46·73 l 47·90	$M = 46''\cdot75$ $w = 1\cdot74$ $\frac{1}{w} = 0\cdot57$
	44·95	42·27	46·85	47·40	42·39	48·48	46·67	50·62	45·70	49·08	49·30	47·32	$C = 50° 1' 46''\cdot75$
	Circle readings, telescope being set on XXIX 286° 22′	106° 21′	296° 32′	116° 32′	306° 40′	126° 40′	316° 49′	136° 49′	326° 58′	146° 58′	337° 10′	157° 10′	
† XXIX & XXX	″ h 16·30 h 13·53 h 15·37	″ h 16·30 h 16·14	″ h 11·47 h 12·10	″ h 8·86 h 10·67	″ h 12·97 l 12·27	″ l 17·00 l 16·60	″ l 9·14 l 8·43	″ l 10·50 l 10·70	″ l 10·27 l 9·16	″ l 12·40 l 13·90	″ l 11·13 l 9·54	″ l 13·84 l 14·47	$M = 12''\cdot42$ $w = 1\cdot61$ $\frac{1}{w} = 0\cdot62$
	15·07	16·22	11·79	9·76	12·62	16·80	8·79	10·60	9·71	13·15	10·34	14·15	$C = 73° 40' 12''\cdot42$

At XXVIII (Bháyásar)—(*Continued*).

Angle between	Circle readings, telescope being set on XXIX 286° 22′	106° 21′	296° 32′	116° 32′	306° 40′	126° 40′	316° 49′	136° 49′	326° 58′	146° 58′	337° 10′	157° 10′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† XXX & XXXI	″ h 40·60 h 42·33 h 41·26	″ h 41·14 h 40·20	″ h 46·00 h 45·80	″ h 46·24 h 47·86	″ l 47·60 l 46·87	″ l 39·94 l 39·30	″ l 51·16 l 52·00	″ l 52·24 l 51·93	″ l 48·43 l 47·94	″ l 49·26 l 49·37	″ l 49·40 l 49·06	″ l 47·53 l 45·70	$M = 46''\cdot57$ $w = 0\cdot71$ $\frac{1}{w} = 1\cdot40$ $C = 44^\circ\ 8'\ 46''\cdot57$
	41·40	40·67	45·90	47·05	47·24	39·62	51·58	52·08	48·19	49·31	49·23	46·62	

At XXIX (Chitália)

‡*April* 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.
§*February* 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXV 283° 7′	103° 6′	293° 18′	113° 18′	303° 26′	123° 25′	313° 34′	133° 35′	323° 44′	143° 43′	333° 56′	153° 55′	M = Mean of Groups w = Relative Weight C = Concluded Angle
‡ XXXV & XXXIII	″ h 45·70 h 47·74 h 45·87	″ h 49·57 l 50·67	″ l 43·10 l 43·53	″ l 43·00 l 45·30 l 44·34	″ l 40·86 l 42·07	″ l 47·80 l 49·40	″ h 41·10 h 42·50	″ l 41·33 l 41·90	″ h 41·20 h 39·36	″ h 44·23 h 44·40	″ h 44·63 h 45·80	″ h 46·74 h 46·73	$M = 44''\cdot51$ $w = 1\cdot27$ $\frac{1}{w} = 0\cdot79$ $C = 76^\circ\ 54'\ 44''\cdot51$
	46·44	50·12	43·32	44·21	41·46	48·60	41·80	41·62	40·28	44·31	45·22	46·73	
‡ XXXIII & XXX	h 11·50 h 12·50 h 12·40	h 11·80 l 11·06 l 11·23	l 15·63 l 15·30	l 11·53 l 11·33	l 19·17 l 19·33	l 12·53 l 12·50	h 18·50 h 19·67	l 17·87 l 20·13 l 19·33	h 16·10 h 17·14	h 15·57 h 13·50	h 14·27 h 13·60	h 17·40 h 16·80	$M = 15''\cdot21$ $w = 1\cdot30$ $\frac{1}{w} = 0\cdot77$ $C = 54^\circ\ 42'\ 15''\cdot21$
	12·13	11·36	15·47	11·43	19·25	12·51	19·09	19·11	16·62	14·53	13·94	17·10	
‡ XXX & XXVIII	h 61·07 h 60·90	l 61·97 h 63·17 h 62·07	l 67·84 l 66·94	l 66·77 l 66·04	l 65·53 l 65·54	l 66·10 l 65·17	h 58·90 h 59·86	l 66·00 l 64·53	h 64·63 h 63·83	h 66·50 h 66·63	h 62·20 h 63·83	h 64·30 h 63·03	$M = 64''\cdot21$ $w = 2\cdot02$ $\frac{1}{w} = 0\cdot50$ $C = 52^\circ\ 27'\ 4''\cdot21$
	60·99	62·40	67·39	66·40	65·54	65·63	59·38	65·27	64·23	66·56	63·02	63·66	

Angle between	Circle readings, telescope being set on XXVIII 287° 57′	107° 57′	298° 8′	118° 8′	308° 15′	128° 15′	318° 25′	138° 25′	328° 34′	148° 33′	338° 46′	158° 46′	
§ XXVIII & XXVII	″ h 53·67 h 53·66	″ h 52·50 h 51·40	″ h 49·33 h 47·06 h 48·13	″ h 46·20 h 46·50	″ l 49·67 l 47·40	″ l 51·70 l 52·56	″ l 47·30 l 48·00	″ l 46·90 l 46·94	″ l 47·67 l 46·17	″ l 45·90 l 47·33	″ l 48·93 l 48·54	″ l 48·20 l 48·63	$M = 48''\cdot84$ $w = 1\cdot99$ $\frac{1}{w} = 0\cdot50$ $C = 72^\circ\ 4'\ 48''\cdot84$
	53·67	51·95	48·17	46·35	48·53	52·13	47·65	46·92	46·92	46·62	48·73	48·42	

At XXX (Mumaiya)

April 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIX												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 12′	20° 21′	200° 21′	30° 30′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIX & XXXIII	h 39·27	h 40·67	l 39·90	l 36·60	h 44·70	h 35·00	h 38·00	h 42·70	l 43·47	l 40·13	l 41·24	l 41·34	M = 40″·65
	l 42·57	l 42·44	h 42·53	l 36·77	h 44·50	h 35·73	h 38·46	h 42·77	l 42·04	l 42·40	l 42·30	l 41·97	w = 1·60
	l 38·13	l 42·13	h 40·67										$\frac{1}{w}$ = 0·62
	39·99	41·75	41·03	36·69	44·60	35·36	38·23	42·74	42·75	41·27	41·77	41·65	C = 60° 10′ 40″·65
XXXIII & XXXIV	l 58·76	h 59·77	l 61·17	l 67·17	h 63·37	h 63·57	h 68·10	h 67·44	l 65·63	l 68·94	l 61·70	l 61·43	M = 63″·66
	l 61·80	l 58·50	h 58·20	l 66·96	h 60·66	h 65·00	h 67·17	h 67·40	l 64·76	l 68·67	l 62·03	l 61·67	w = 0·94
	h 59·20	l 58·80	h 58·20		h 62·03								$\frac{1}{w}$ = 1·06
	59·92	59·02	59·19	67·07	62·02	64·28	67·64	67·42	65·19	68·81	61·86	61·55	C = 38° 37′ 3″·65
XXXIV & XXXII	h 34·27	h 39·80	l 32·80	l 32·04	h 31·06	h 33·27	h 34·80	h 38·66	l 35·90	l 36·06	l 41·36	l 36·50	M = 35″·65
	h 33·43	h 37·30	h 33·90	l 34·87	h 32·37	h 34·43	h 36·33	h 37·60	l 35·67	l 36·83	l 39·23	l 35·86	w = 1·88
			d 35·13	l 33·47									$\frac{1}{w}$ = 0·53
	33·85	38·55	33·94	33·46	31·72	33·85	35·56	38·13	35·79	36·44	40·30	36·18	C = 47° 54′ 35″·64
XXXII & XXXI	h 68·00	h 60·20	l 72·33	l 66·16	h 65·97	h 65·13	h 61·30	h 59·10	l 57·34	l 59·57	l 54·97	l 61·47	M = 62″·64
	h 65·03	l 62·60	h 70·40	l 64·04	h 66·20	h 65·33	h 63·00	h 60·33	l 59·30	l 59·57	l 55·17	l 60·10	w = 0·58
	h 65·87		d 73·15										$\frac{1}{w}$ = 1·73
	66·30	61·40	71·96	65·10	66·09	65·23	62·15	59·71	58·32	59·57	55·07	60·79	C = 77° 25′ 2″·65
XXXI & XXVIII	l 50·04	h 49·96	l 46·67	l 50·13	h 46·03	h 47·43	h 47·97	h 46·50	l 50·36	l 43·87	l 56·77	l 49·00	M = 48″·56
	l 51·07	l 47·27	l 46·57	l 49·70	h 47·43	h 47·64	h 45·50	h 45·77	l 49·17	l 44·20	l 56·50	l 49·54	w = 1·19
	h 49·47						h 58·20						$\frac{1}{w}$ = 0·84
	50·19	48·62	46·62	49·91	46·73	47·54	47·22	46·13	49·77	44·03	56·64	49·27	C = 81° 59′ 48″·56
XXVIII & XXIX	l 48·23	h 49·87	l 47·36	l 46·00	h 49·14	h 54·74	h 47·46	h 46·30	l 47·20	h 47·60	l 42·70	l 48·86	M = 47″·93
	l 49·30	h 48·24	l 46·83	l 48·36	h 48·07	h 53·40	h 46·97	h 45·90	l 46·76	l 48·96	l 43·63	l 49·16	w = 1·79
	h 49·53	l 49·57								l 45·80			$\frac{1}{w}$ = 0·56
	49·02	49·23	47·10	47·18	48·60	54·07	47·22	46·10	46·98	47·45	43·16	49·01	C = 53° 52′ 47″·93

At XXXI (Trákura)

April 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXVIII 306° 11'	126° 11'	316° 21'	136° 21'	326° 29'	146° 29'	336° 38'	156° 38'	346° 47'	166° 47'	356° 58'	176° 58'	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVIII & XXX	″ *h* 27·84 *h* 28·84	″ *h* 29·00 *h* 29·67	″ *l* 29·00 *l* 27·60	″ *l* 32·23 *l* 32·30	″ *l* 30·30 *l* 29·47	″ *l* 34·13 *l* 34·13	″ *l* 28·50 *l* 29·63	″ *l* 27·36 *l* 29·40	″ *l* 28·97 *l* 28·04	″ *l* 26·74 *l* 25·17	″ *l* 22·60 *l* 22·23	″ *l* 23·63 *l* 23·67	$M = 28''\cdot35$ $w = 1\cdot13$ $\frac{1}{w} = 0\cdot89$ $C = 53^\circ\ 51'\ 28''\cdot35$
	28·34	29·34	28·30	32·26	29·89	34·13	29·06	28·38	28·51	25·95	22·42	23·65	
XXX & XXXII	*h* 58·80 *h* 60·90	*h* 56·70 *h* 58·47	*l* 57·97 *l* 59·34	*l* 55·84 *l* 55·93	*l* 63·97 *l* 64·63	*l* 53·63 *l* 56·40 *l* 53·50	*l* 59·56 *l* 59·40	*l* 62·37 *l* 61·77	*l* 63·63 *l* 63·00	*l* 63·76 *l* 64·90	*l* 64·23 *h* 65·00	*l* 62·40 *l* 62·70	$M = 60''\cdot60$ $w = 0\cdot99$ $\frac{1}{w} = 1\cdot01$ $C = 60^\circ\ 56'\ 0''\cdot60$
	59·85	57·59	58·65	55·89	64·30	54·51	59·48	62·07	63·31	64·33	64·62	62·55	

At XXXII (Deo-ki-Galol)

April 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXI 318° 23'	138° 23'	328° 33'	148° 33'	338° 41'	158° 42'	348° 50'	168° 50'	359° 0'	179° 0'	9° 10'	189° 10'	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXI & XXX	″ *l* 58·30 *l* 59·54	″ *l* 63·07 *l* 63·30	″ *l* 59·70 *l* 60·67	″ *l* 62·00 *l* 61·77	″ *l* 58·47 *l* 59·27	″ *l* 64·80 *l* 65·63	″ *l* 55·04 *l* 55·24	″ *l* 54·66 *l* 54·73	″ *h* 50·50 *h* 51·20	″ *h* 51·27 *h* 51·50	″ *h* 50·87 *h* 50·47	″ *h* 52·23 *h* 52·10	$M = 56''\cdot93$ $w = 0\cdot46$ $\frac{1}{w} = 2\cdot19$ $C = 41^\circ\ 38'\ 56''\cdot93$
	58·92	63·19	60·18	61·89	58·87	65·21	55·14	54·70	50·85	51·38	50·67	52·17	
XXX & XXXIV	*l* 9·76 *l* 11·14	*l* 13·03 *l* 12·80	*l* 10·44 *l* 11·83	*l* 12·30 *l* 12·97	*l* 12·97 *l* 11·90	*l* 9·14 *l* 9·00	*l* 18·46 *l* 15·80 *h* 18·03	*l* 12·84 *l* 13·70	*h* 12·23 *h* 12·00	*h* 11·40 *h* 11·30	*h* 11·46 *h* 11·06	*h* 11·97 *h* 10·50	$M = 12''\cdot11$ $w = 2\cdot77$ $\frac{1}{w} = 0\cdot36$ $C = 55^\circ\ 5'\ 12''\cdot12$
	10·45	12·92	11·13	12·64	12·43	9·07	17·43	13·27	12·12	11·35	11·26	11·23	

At XXXIII (Jitori)

March 1853; *observed by Lieutenants H. Rivers and D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXX 358° 39'	178° 39'	8° 51'	188° 51'	18° 58'	198° 58'	29° 8'	209° 8'	39° 16'	219° 16'	49° 28'	229° 28'	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXX & XXIX	″ *h* 54·40 *h* 55·83	″ *h* 62·80 *h* 59·10 *h* 60·34	″ *h* 64·57 *h* 63·94	″ *h* 62·30 *h* 61·97	″ *h* 70·24 *h* 68·17 *h* 66·26	″ *h* 61·36 *h* 60·43	″ *l* 65·40 *l* 65·30	″ *l* 64·84 *l* 67·80 *h* 64·90	″ *l* 64·33 *l* 65·90	″ *l* 63·60 *l* 61·43	″ *h* 66·53 *h* 64·26	″ *l* 71·00 *l* 69·03	$M = 63''\cdot80$ $w = 0\cdot76$ $\frac{1}{w} = 1\cdot31$ $C = 65^\circ\ 7'\ 3''\cdot80$
	55·12	60·75	64·25	62·14	68·22	60·90	65·35	65·85	65·11	62·52	65·39	70·02	

At XXXIII (Jitori)—(*Continued*).

Angle between	Circle readings, telescope being set on XXX 358° 39′	178° 39′	8° 51′	188° 51′	18° 58′	198° 58′	29° 8′	209° 8′	39° 16′	219° 16′	49° 28′	229° 28′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIX & XXXV	h 43·23 h 39·96 h 40·56	h 42·27 h 44·44	l 47·30 l 44·87 h 44·66 h 42·37	l 44·37 l 45·24 h 45·34 h 45·50	l 45·80 l 45·10	l 47·90 h 46·97	h 49·30 l 49·67	h 51·17 h 53·84 l 54·50	l 51·10 l 50·30	h 53·27 h 49·90	h 44·23 h 46·57	l 50·97 l 51·17	M = 47″·40 w = 0·83 1/w = 1·21 C = 43° 51′ 47″·39
	41·25	43·36	44·80	45·11	45·45	47·43	49·49	53·17	50·70	51·58	45·40	51·07	
XXXV & XXXVI	h 13·47 h 13·64	h 14·37 h 11·13 h 11·53	h 11·64 h 12·80	h 13·03 h 11·80 h 12·34	h 14·30 h 12·53	h 15·70 h 17·60 l 12·64 l 10·23	h 16·83 h 15·53	h 11·83 h 11·33	l 9·63 l 9·30	h 12·13 h 10·67	h 10·07 h 8·67	l 7·03 l 7·00	M = 11″·91 w = 1·81 1/w = 0·55 C = 63° 7′ 11″·92
	13·56	12·34	12·22	12·39	13·41	14·04	16·18	11·58	9·47	11·40	9·37	7·01	
XXXVI & XXXVII	h 45·63 h 45·43	h 46·20 h 48·50	h 39·73 h 42·20	h 40·50 h 43·36 h 45·60	h 38·44 h 36·44 h 36·44	h 34·94 h 37·44 l 42·10 l 40·84	h 33·20 h 34·30	h 41·37 h 40·70	l 39·60 l 39·23	h 37·10 h 36·43	h 40·54 h 41·64	l 36·44 l 41·30 h 34·26	M = 40″·19 w = 0·74 1/w = 1·35 C = 67° 9′ 40″·18
	45·53	47·35	40·97	43·15	37·11	38·83	33·75	41·03	39·42	36·76	41·09	37·33	
XXXVII & XXXVIII	h 52·84 h 53·30 d 52·94 d 54·30	h 56·57 h 57·53 d 55·06 d 52·93	h 55·70 h 55·03 h 55·60 d 53·77 d 55·83 d 53·86	h 52·90 h 54·36	h 58·30 h 57·13 h 56·70	h 56·23 h 53·66 d 54·34	h 56·87 h 58·87 h 57·93 d 56·63	h 57·70 h 56·80	l 62·90 h 62·00	h 54·40 h 56·43	h 59·13 h 60·07 d 64·23	h 62·26 h 60·66	M = 57″·07 w = 1·19 1/w = 0·84 C = 22° 34′ 57″·05
	53·35	55·52	54·96	53·63	57·38	54·74	57·58	57·25	62·45	55·41	61·14	61·46	
XXXVIII & XXXIV	h 18·66 h 17·30 d 18·76 d 18·30	h 19·70 h 16·70 h 20·30 d 16·33 d 15·37	h 20·73 h 18·67 h 20·64 d 18·80 d 19·47 d 18·90	h 21·20 h 20·97	h 23·10 h 23·67	h 20·73 h 20·04 d 19·78	h 22·00 h 21·53 h 22·07 d 20·61	h 21·53 h 21·06	l 18·67 h 18·90	h 24·07 h 25·50	h 17·70 h 19·03 d 23·00	h 20·97 h 23·64	M = 20″·73 w = 2·44 1/w = 0·41 C = 38° 5′ 20″·69
	18·26	17·68	19·53	21·09	23·38	20·18	21·55	21·30	18·78	24·79	19·91	22·30	
XXXIV & XXX	h 67·87 h 67·37	h 56·07 h 58·23 h 55·30	h 64·50 h 62·60	h 65·43 h 64·33	h 51·83 h 55·27 h 50·17	h 63·84 h 63·23	l 60·37 l 59·30	l 57·50 l 56·07	l 54·40 l 53·70	l 59·37 l 57·66	h 50·93 h 56·20 h 50·23	l 53·70 l 55·20	M = 58″·72 w = 0·44 1/w = 2·28 C = 60° 3′ 58″·71
	67·62	56·53	63·55	64·88	52·42	63·54	59·83	56·79	54·05	58·51	52·45	54·45	

At XXXIV (Konkáwáo)

April 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	265° 1′	85° 1′	275° 13′	95° 12′	285° 20′	105° 20′	295° 29′	115° 29′	305° 38′	125° 38′	315° 50′	135° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXII & XXX	*h* 10·83 *h* 11·93	*h* 11·97 *h* 9·83	*l* 15·40 *l* 17·37	*l* 14·34 *l* 14·70	*l* 18·00 *l* 17·57	*l* 17·57 *l* 18·17	*l* 15·86 *l* 16·57	*l* 13·47 *l* 12·00	*l* 12·16 *l* 11·00	*l* 18·50 *l* 16·80	*l* 12·60 *l* 12·56	*l* 14·67 *l* 11·90 *l* 12·53	$M = 14''·39$ $w = 1·62$ $\frac{1}{w} = 0·62$
	11·38	10·90	16·39	14·52	17·78	17·87	16·22	12·73	11·58	17·65	12·58	13·03	$C = 77° 0' 14''·39$
XXX & XXXIII	*d* 65·59 *d* 65·99	*h* 63·70 *h* 64·20	*h* 60·17 *h* 63·86 *h* 64·56	*h* 59·10 *h* 61·50	*h* 65·23 *h* 65·53	*h* 60·53 *h* 59·97	*l* 57·04 *l* 57·06	*h* 58·30 *h* 59·33 *l* 56·93	*l* 59·70 *l* 60·70	*l* 56·60 *l* 56·36	*l* 60·20 *l* 59·00	*l* 62·40 *l* 62·63	$M = 61''·05$ $w = 1·22$ $\frac{1}{w} = 0·82$
	65·79	63·95	62·86	60·30	65·38	60·25	57·05	58·19	60·20	56·48	59·60	62·52	$C = 81° 19' 1''·05$
XXXIII & XXXVII	*h* 16·17 *h* 15·10	*h* 14·14 *h* 14·27	*h* 14·87 *h* 14·47	*h* 20·70 *h* 18·10 *h* 19·03	*h* 19·37 *h* 17·87	*h* 24·00 *h* 21·40 *h* 24·83	*l* 25·60 *l* 26·94	*h* 24·50 *l* 22·80	*l* 24·90 *l* 25·03	*l* 27·13 *l* 25·40	*l* 25·80 *l* 26·80	*l* 24·67 *l* 24·47	$M = 21''·49$ $w = 0·53$ $\frac{1}{w} = 1·89$
	15·64	14·20	14·67	19·28	18·62	23·41	26·27	23·65	24·97	26·26	26·30	24·57	$C = 89° 47' 21''·49$
XXXVII & XXXVIII	*h* 65·33 *h* 65·60	*h* 61·87 *h* 64·60 *h* 64·94	*h* 62·20 *h* 62·87	*h* 59·07 *h* 59·77	*h* 54·30 *h* 55·70	*h* 56·40 *h* 57·87	*h* 56·36 *h* 56·93	*h* 57·66 *h* 58·80	*h* 55·80 *h* 55·54	*h* 57·37 *h* 58·20	*h* 56·80 *h* 55·37	*h* 60·97 *h* 59·97	$M = 59''·02$ $w = 1·03$ $\frac{1}{w} = 0·98$
	65·47	63·80	62·53	59·42	55·00	57·14	56·64	58·23	55·67	57·79	56·08	60·47	$C = 37° 44' 59''·02$
XXX & R.M.	*l* 52·43 *h* 53·20 *h* 53·63	*h* 56·60 *h* 55·13	*h* 44·84 *h* 44·46	*h* 43·93 *h* 45·30	*h* 50·47 *h* 49·03	*h* 50·97 *h* 50·74	*l* 47·40 *l* 47·63	*h* 46·40 *h* 49·13 *l* 47·00	*l* 49·20 *l* 48·97	*l* 43·40 *l* 43·36	*l* 49·10 *l* 48·77	*l* 55·07 *l* 53·27	$M = 49''·12$ $w = 0·77$ $\frac{1}{w} = 1·29$
	53·09	55·87	44·65	44·61	49·75	50·86	47·51	47·51	49·09	43·38	48·93	54·17	$C = 17° 59' 49''·12$

At XXXV (Itria)

April and May 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXVI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 2′	180° 2′	10° 13′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 49′	230° 49′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXVI & XXXIII	*h* 61·90 *h* 59·47	*h* 53·13 *h* 55·10	*l* 58·33 *l* 57·27	*h* 57·33 *l* 58·94	*l* 60·10 *l* 59·83	*l* 55·97 *h* 55·70	*h* 59·87 *h* 58·76	*h* 60·23 *h* 61·96	*h* 59·17 *h* 61·90	*h* 60·20 *h* 60·07	*l* 66·20 *l* 64·43	*h* 60·07 *l* 60·14	$M = 59''·42$ $w = 1·46$ $\frac{1}{w} = 0·68$
	60·69	54·11	57·80	58·14	59·96	55·84	59·31	61·10	60·53	60·14	65·31	60·11	$C = 66° 29' 59''·42$

NOTE.—R.M. denotes Referring Mark.

At XXXV (Itria)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 2′	180° 2′	10° 13′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 49′	230° 49′	
XXXIII & XXIX	″ h 27·17 h 28·37	″ h 29·24 h 29·90	″ l 31·67 l 30·00	″ l 30·76 l 30·33	″ l 30·40 l 28·93	″ l 31·66 h 30·57	″ h 26·37 h 26·40	″ h 31·27 h 29·07	″ l 32·26 l 31·73	″ h 33·37 h 31·77	″ l 23·97 l 25·50	″ l 30·30 l 29·53	$M = 29''\cdot61$ $w = 2\cdot23$ $\frac{1}{w} = 0\cdot45$
	27·77	29·57	30·84	30·54	29·67	31·11	26·39	30·17	31·99	32·57	24·74	29·91	$C = 59° 13' 29''\cdot61$

At XXXVI (Sakpur)

May 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXVII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	139° 3′	319° 3′	149° 14′	329° 13′	159° 22′	339° 22′	169° 30′	349° 30′	179° 39′	359° 39′	189° 50′	9° 50′	
XXXVII & XXXIII	″ h 9·80 h 8·60	″ h 5·73 h 5·60	″ h 14·90 h 15·03	″ h 12·67 h 13·10	″ h 2·87 h 2·63	″ h 7·66 h 7·93	″ h 7·83 h 8·83	″ h 7·20 h 8·93	″ l 4·83 h 3·03	″ h 6·10 h 6·73	″ h 6·56 h 6·77 h 7·16	″ h 8·44 h 7·37	$M = 7''\cdot90$ $w = 1\cdot03$ $\frac{1}{w} = 0\cdot97$
	9·20	5·67	14·96	12·89	2·75	7·79	8·33	8·07	3·93	6·41	6·83	7·91	$C = 51° 32' 7''\cdot90$
XXXIII & XXXV	h 50·90 h 52·20	h 56·27 h 56·54	h 46·97 h 48·17	h 53·50 h 53·10	h 54·73 h 55·70	h 55·13 h 56·87	h 54·13 h 53·57	h 51·93 h 49·83	l 50·07 l 49·27	l 50·10 l 50·97	h 52·50 h 52·23	h 49·40 h 50·20	$M = 52''\cdot26$ $w = 1\cdot55$ $\frac{1}{w} = 0\cdot65$
	51·55	56·41	47·57	53·30	55·21	56·00	53·85	50·88	49·67	50·54	52·36	49·80	$C = 50° 22' 52''\cdot26$

At XXXVII (Manáwa)

February 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXIX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	230° 53′	50° 53′	241° 4′	61° 4′	251° 12′	71° 12′	261° 21′	81° 21′	271° 30′	91° 29′	281° 42′	101° 42′	
XXXIX & XXXVIII	″ h 6·66 h 5·67	″ h 6·17 h 5·27	″ h 5·87 h 6·47	″ h 7·00 h 5·00	″ h 6·00 h 4·60	″ h 5·70 h 4·37 h 2·90	″ l 11·66 l 10·76	″ l 2·53 l 2·47	″ l 4·63 l 6·23	″ l 6·90 l 7·90	″ h 9·87 h 12·47 h 11·00	″ h 2·96 h 5·30 h 3·93	$M = 6''\cdot28$ $w = 1\cdot71$ $\frac{1}{w} = 0\cdot58$
	6·17	5·72	6·17	6·00	5·30	4·32	11·21	2·50	5·43	7·40	11·11	4·06	$C = 59° 35' 6''\cdot28$
XXXVIII & XXXIV	d 58·84 d 61·00	d 67·26 d 69·30	h 58·70 h 57·73	h 63·46 h 56·60 h 57·90	h 58·66 h 61·13	h 64·80 h 63·10	l 60·17 l 61·50	l 64·07 l 68·73	l 67·00 l 67·50	l 65·00 l 68·50 l 62·77	h 65·43 h 64·43 h 65·74	h 63·90 h 60·83	$M = 63''\cdot09$ $w = 0\cdot92$ $\frac{1}{w} = 1\cdot09$
	59·92	68·28	58·22	59·32	59·89	63·95	60·84	66·40	67·25	65·42	65·20	62·36	$C = 97° 22' 3''\cdot09$

At XXXVII (Manáwa)—(*Continued*).

March 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXIV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 2′	180° 2′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 51′	230° 50′	
XXXIV & XXXIII	″ h 21·07 h 19·77	″ h 19·60 h 18·93	″ h 19·86 h 19·04	″ h 19·53 h 19·37	″ h 19·80 h 20·00	″ h 17·36 h 17·67 h 16·17	″ l 27·06 l 29·40 l 26·97	″ l 24·20 l 27·06 l 27·04	″ l 27·06 l 27·14	″ l 24·70 l 26·00	″ l 27·10 l 26·96	″ l 20·03 l 18·93	$M = 22''·37$ $w = 0·77$ $\frac{1}{w} = 1·30$ $C = 29° 32' 22''·37$
	20·42	19·27	19·45	19·45	19·90	17·07	27·81	26·10	27·10	25·35	27·03	19·48	
XXXIII & XXXVI	h 13·17 h 14·80	h 18·70 h 17·47	h 12·24 h 13·30	h 11·47 h 10·23	h 17·40 h 16·17	h 15·13 h 17·90	l 10·70 l 10·33	l 14·16 l 13·97	l 11·77 l 12·96	l 16·47 l 15·96	l 11·60 l 11·30	l 21·80 l 22·80	$M = 14''·66$ $w = 0·98$ $\frac{1}{w} = 1·02$ $C = 61° 18' 14''·66$
	13·99	18·08	12·77	10·85	16·79	16·51	10·52	14·06	12·37	16·21	11·45	22·30	

At XXXVIII (Sarkala)

**April* 1853; *observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.
†*February* 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXIV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	315° 8′	135° 8′	325° 19′	145° 19′	335° 27′	155° 27′	345° 36′	165° 36′	355° 45′	175° 45′	5° 57′	185° 57′	
* XXXIV & XXXIII	″ h 17·50 h 17·27	″ h 20·53 h 20·23	″ h 17·23 h 18·53	″ h 19·20 h 22·60	″ h 20·84 h 20·20	″ h 20·66 h 21·40	″ h 23·24 h 22·14	″ h 26·60 h 24·40	″ h 19·63 h 19·34	″ h 24·93 h 23·93	″ h 18·10 h 18·83	″ h 24·07 h 25·17	$M = 21''·11$ $w = 1·60$ $\frac{1}{w} = 0·63$ $C = 14° 22' 21''·11$
	17·39	20·38	17·88	20·90	20·52	21·03	22·69	25·50	19·48	24·43	18·47	24·62	
* XXXIII XXXVII	h 42·00 h 43·13	h 45·24 h 45·77	h 44·80 h 44·30	h 43·47 h 43·24	h 42·63 h 42·43	h 49·00 h 47·20	h 37·66 h 39·00	h 38·24 h 37·83	h 38·07 h 36·46	h 36·17 h 35·50	h 36·14 h 36·27	h 30·83 h 31·03	$M = 40''·27$ $w = 0·49$ $\frac{1}{w} = 2·04$ $C = 30° 30' 40''·27$
	42·57	45·50	44·55	43·36	42·53	48·10	38·33	38·03	37·27	35·83	36·21	30·93	

Angle between	Circle readings, telescope being set on XXXVII												
	45° 28′	225° 27′	55° 38′	235° 38′	65° 46′	245° 46′	75° 56′	255° 55′	86° 4′	266° 4′	96° 16′	276° 16′	
† XXXVII & XXXIX	″ h 62·43 h 60·97 h 61·20	″ h 59·37 h 60·37	″ h 54·86 h 57·83 h 56·70	″ h 56·17 h 56·23	″ h 53·47 h 55·07	″ h 60·24 h 59·10	″ l 49·86 l 51·74	″ h 57·84 l 57·23	″ l 52·90 l 51·10	″ l 59·53 l 55·74 l 58·30	″ l 59·74 l 58·03	″ l 56·10 l 56·50	$M = 56''·78$ $w = 1·14$ $\frac{1}{w} = 0·88$ $C = 67° 21' 56''·79$
	61·53	59·87	56·46	56·20	54·27	59·67	50·80	57·54	52·00	57·86	58·88	56·30	

At XXXVIII (Sarkala)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVII 45° 28′	225° 27′	55° 38′	235° 38′	65° 46′	245° 46′	75° 56′	255° 55′	86° 4′	266° 4′	96° 16′	276° 16′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† XXXIX & XL	″ h 7·16 h 6·23	″ h 10·83 h 10·23	″ h 6·34 h 6·20 h 7·30	″ h 6·33 h 7·83	″ h 11·50 h 10·80	″ h 7·43 h 9·87	″ l 15·74 l 13·26	″ h 7·76 h 7·33 l 5·53	″ l 15·03 l 17·03	″ l 9·87 l 11·80	″ l 6·73 l 8·27	″ l 12·60 l 11·13	$M = 9''\cdot86$ $w = 1\cdot15$ $\frac{1}{w} = 0\cdot87$ $C = 46^\circ 41' 9''\cdot85$
	6·70	10·53	6·61	7·08	11·15	8·65	14·50	6·87	16·03	10·83	7·50	11·87	

At XXXIX (Nandivela)

***March* 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XLI 0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 30′	210° 29′	40° 38′	220° 38′	50° 51′	230° 51′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XLI & XL	″ h 47·94 h 47·00	″ h 46·00 h 46·13	″ h 51·03 h 52·67	″ h 48·47 h 50·30	″ h 53·20 h 52·63	″ l 38·87 l 41·83 l 39·16 h 43·00 h 42·60	″ l 46·37 l 45·13	″ l 45·60 l 44·00	″ l 47·87 l 46·93	″ l 45·40 l 46·90	″ l 48·70 l 50·27	″ l 43·60 l 43·60	$M = 47''\cdot16$ $w = 1\cdot02$ $\frac{1}{w} = 0\cdot98$ $C = 65^\circ 23' 47''\cdot15$
	47·47	46·07	51·85	49·38	52·92	41·09	45·75	44·80	47·40	46·15	49 48	43·60	
XL & XXXVIII	h 40·13 h 40·30	h 45·20 h 43·43	h 33·47 h 32·03	h 36·06 h 36·10	h 35·63 h 37·67	l 48·30 l 46·50	l 38·96 l 41·30	l 45·37 l 44·20	l 38·40 l 36·40	l 40·77 l 40·74	l 35·53 l 34·23	l 39·67 l 38·67	$M = 39''\cdot54$ $w = 0\cdot63$ $\frac{1}{w} = 1\cdot59$ $C = 52^\circ 3' 39''\cdot54$
	40·22	44·31	32·75	36·08	36·65	47·40	40·13	44·79	37·40	40·75	34·88	39·17	
XXXVIII & XXXVII	h 54·77 h 55·80	h 53·80 h 55·40	h 57·50 h 57·30	h 59·34 h 57·07 h 56·70	h 61·00 h 60·67	h 57·50 h 57·66	l 69·54 l 69·63	l 63·40 l 62·20	l 59·46 l 60·64	l 59·00 l 57·80	l 58·20 l 59·04	l 62·60 l 62·93	$M = 59''\cdot64$ $w = 0\cdot73$ $\frac{1}{w} = 1\cdot38$ $C = 53^\circ 2' 59''\cdot64$
	55·29	54·60	57·40	57·70	60·83	57·58	69·59	62·80	60·05	58·40	58·62	62·76	

At XL (Jákia)

***March* 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XXXVIII 0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 30′	210° 30′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXVIII & XXXIX	″ h 14·33 h 15·70 h 15·60	″ h 11·00 h 10·04	″ h 7·50 h 9·53	″ h 10·33 h 8·10 h 7·80	″ h 8·73 h 9·17	″ h 4·70 h 5·60	″ l 18·07 l 16·50	″ h 17·33 h 14·47 h 14·50	″ l 13·74 l 10·80 l 12·96	″ l 15·57 l 15·93	″ l 16·67 l 14·60 l 15·74	″ l 14·37 l 15·80	$M = 12''\cdot40$ $w = 0\cdot78$ $\frac{1}{w} = 1\cdot29$ $C = 81^\circ 15' 12''\cdot40$
	15·21	10·52	8·52	8·74	8·95	5·15	17·28	15·43	12·50	15·75	15·67	15·09	

At XL (Jákia)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 30′	210° 30′	40° 38′	220° 38′	50° 50′	230° 50′	
XXXIX & XLI	″ h 58·00 h 60·96 h 60·50	″ h 63·30 h 64·46	″ h 66·93 h 65·17 h 64·84	″ h 66·83 h 68·07	″ h 64·54 h 64·43	″ h 61·67 h 60·97	″ l 60·93 l 61·46	″ h 59·80 h 61·27	″ l 60·83 l 63·63 l 62·04	″ l 62·73 l 63·10	″ l 65·17 l 65·57 l 64·10	″ l 65·10 l 66·33	$M = 63''\cdot34$ $w = 2\cdot01$
	59·82	63·88	65·65	67·45	64·49	61·32	61·19	60·54	62·17	62·91	64·95	65·72	$\frac{1}{w} = 0\cdot50$ $C = 50^\circ 35' 3''\cdot34$
XLI & XLII	h 21·20 h 18·90 h 21·06	h 20·83 h 21·04	h 21·27 h 20·10	h 17·77 h 15·76	h 24·53 h 24·93	h 24·00 h 22·40	l 22·84 l 22·24	h 21·97 h 21·30	l 20·10 l 18·60	l 19·57 l 19·43	l 20·63 l 17·57 l 20·33	l 19·63 l 16·17 l 20·60	$M = 20''\cdot67$ $w = 2\cdot38$
	20·39	20·94	20·68	16·77	24·73	23·20	22·54	21·63	19·35	19·50	19·51	18·80	$\frac{1}{w} = 0\cdot42$ $C = 48^\circ 48' 20''\cdot66$

At XLI (Nántej)

March 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XLII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	223° 38′	43° 38′	233° 49′	53° 49′	243° 57′	63° 57′	254° 6′	74° 6′	264° 15′	84° 15′	274° 27′	94° 27′	
XLII & XL	″ h 28·24 h 28·46	″ h 29·17 h 28·63	″ h 31·60 h 31·50	″ h 30·24 h 32·53	″ l 34·60 l 37·33 l 35·26	″ l 31·27 l 29·60	″ l 32·30 l 34·04	″ l 28·60 l 29·40	″ l 32·83 l 30·03	″ l 28·60 l 29·97	″ h 33·60 h 35·00	″ h 32·67 h 33·10	$M = 31''\cdot37$ $w = 2\cdot10$
	28·35	28·90	31·55	31·39	35·73	30·43	33·17	29·00	31·43	29·29	34·30	32·88	$\frac{1}{w} = 0\cdot48$ $C = 72^\circ 22' 31''\cdot38$
XL & XXXIX	h 15·50 h 17·07	h 10·17 h 11·30	h 10·50 h 10·40	h 12·43 h 11·60	l 4·90 l 3·04 l 3·40	l 11·43 l 12·67	l 8·60 l 6·10 l 8·10	l 10·20 l 8·27	l 3·73 l 2·84	l 9·13 l 9·17	h 6·86 h 4·86	h 9·00 h 10·80	$M = 9''\cdot20$ $w = 0\cdot87$
	16·29	10·73	10·45	12·02	3·78	12·05	7·60	9·23	3·29	9·15	5·86	9·90	$\frac{1}{w} = 1\cdot15$ $C = 64^\circ 1' 9''\cdot20$

At XLII (Dangarwári)

March 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XL												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 13′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	
XL & XLI	″ h 9·60 h 9·37 h 10·34	″ h 9·50 h 11·34	″ h 10·83 h 10·17	″ h 8·37 h 8·40	″ l 14·97 l 15·67	″ l 6·46 l 7·30	″ l 7·90 l 12·23 l 11·60	″ l 14·17 l 14·50	″ l 10·20 l 12·20	″ l 8·77 l 11·80 l 12·34	″ l 11·10 l 9·63	″ l 8·47 l 11·53 l 9·57	$M = 10''\cdot72$ $w = 2\cdot13$
	9·77	10·42	10·50	8·39	15·32	6·88	10·58	14·33	11·20	10·97	10·37	9·86	$\frac{1}{w} = 0\cdot47$ $C = 58^\circ 49' 10''\cdot72$

March 1880.

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

KATTYWAR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. SUMS OF SQUARES OF APPARENT ERRORS.

Sums of Squares of Apparent Errors of Single Observations, and of Apparent Errors of Single Zeros.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
LXI	I & LXIV	27	8·38	12	64·53	Troughton and Simms' 18-inch Theodolite No. 2.
LXIV	LXI & I	26	7·80	12	124·17	
„	I & III	27	7·41	12	79·15	
„	III & II	28	7·22	12	123·45	
„	II & LXVI	25	8·29	12	134·64	
LXVI	LXIV & II	27	7·82	12	110·70	
I	IV & V	25	6·92	12	160·47	
„	V & III	28	9·20	12	100·47	
„	III & II	27	7·45	12	157·10	
„	II & LXIV	26	6·15	12	56·49	
„	LXIV & LXI	26	7·01	12	99·91	
II	LXVI & LXIV	24	3·80	12	163·36	
„	LXIV & I	25	6·03	12	57·30	
„	I & III	25	4·91	12	96·44	
III	II & LXIV	26	10·14	12	86·17	
„	LXIV & I	26	7·65	12	103·27	
„	I & IV	25	7·76	12	63·27	
„	IV & V	24	5·51	12	65·42	

NOTE.—Stations LXI, LXIV and LXVI appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
IV	VIII & VI	27	8·04	12	173·99	Troughton and Simms' 18-inch Theodolite No. 2.
"	VI & V	25	10·68	12	70·80	
"	V & III	35	17·77	12	81·25	
"	III & I	32	11·00	12	186·47	
V	III & I	27	7·91	12	156·43	
"	III & I	27	7·36	12	133·05	
"	I & IV	25	7·95	12	80·47	
"	I & IV	27	8·87	12	78·92	
"	IV & VI	25	5·27	12	90·44	
"	VI & VII	25	8·85	12	91·10	
VI	V & IV	28	13·38	12	77·27	
"	IV & VIII	28	12·72	12	185·40	
"	VIII & IX	29	12·98	12	211·05	
"	IX & VII	27	7·40	12	72·81	
"	VII & V	26	8·44	12	79·62	
VII	V & VI	27	13·97	12	153·23	
"	VI & IX	28	14·39	12	112·04	
VIII	X & XI	25	7·79	12	128·36	
"	X & XI	26	8·18	12	112·00	
"	XI & IX	27	17·32	12	43·45	
"	IX & VI	26	11·82	12	105·55	
"	VI & IV	24	7·02	12	96·11	
IX	VII & VI	26	6·25	12	177·18	
"	VI & VIII	25	3·83	12	199·32	
"	VIII & X	24	9·65	12	120·50	
"	X & XI	27	6·38	12	91·99	
X	XIII & XII	25	6·41	12	45·22	
"	XII & XI	25	7·12	12	66·73	
"	XI & IX	26	8·59	12	125·66	
"	IX & VIII	26	10·99	12	73·77	
XI	IX & VIII	24	3·21	12	136·80	
"	VIII & X	26	10·92	12	117·36	
"	VIII & X	25	9·32	12	173·70	
"	X & XII	26	5·25	12	110·40	
"	XII & XIV	27	9·50	12	130·69	
XII	X & XIII	26	15·85	12	69·16	
"	X & XIII	26	5·40	12	80·31	
"	XIII & XV	28	22·38	12	87·82	
"	XIII & XV	26	11·58	12	91·38	
"	XV & XVI	29	32·38	12	185·37	
"	XV & XVI	27	19·83	12	128·85	

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XII	XVI & XIV	30	36·39	12	170·82	Troughton and Simms' 18-inch Theodolite No. 2.
"	XVI & XIV	27	20·13	12	135·95	
"	XIV & XI	29	25·94	12	124·41	
"	XIV & XI	29	21·70	12	105·20	
"	XI & X	26	9·77	12	124·74	
"	XI & X	26	8·26	12	95·60	
XIII	XV & XII	26	12·56	12	100·83	
"	XII & X	26	9·78	12	126·75	
XIV	XI & XII	26	12·75	12	123·20	
"	XI & XII	25	7·70	12	47·90	
"	XII & XVI	25	10·84	12	128·86	
"	XII & XVI	25	6·10	12	75·78	
XV	XVIII & XVII	27	6·85	12	128·08	
"	XVIII & XVII	24	5·32	12	78·89	
"	XVII & XIX	27	10·87	12	145·36	
"	XVII & XIX	24	7·54	12	105·31	
"	XIX & XVI	29	7·11	12	94·01	
"	XIX & XVI	24	3·63	12	154·08	
"	XVI & XII	24	5·07	12	95·35	
"	XII & XIII	25	5·48	12	115·79	
XVI	XIV & XII	27	18·77	12	81·38	
"	XII & XV	28	17·25	12	152·62	
"	XV & XVII	27	7·17	12	160·13	
"	XV & XVII	31	22·02	12	154·76	
"	XVII & XIX	26	6·59	12	44·06	
"	XVII & XIX	30	19·01	12	109·92	
XVII	XXII & XIX	35	15·89	12	286·93	
"	XXII & XIX	28	14·86	12	93·01	
"	XIX & XVI	30	7·69	12	199·85	
"	XIX & XVI	27	25·51	12	116·19	
"	XVI & XV	30	15·38	12	297·84	
"	XVI & XV	25	13·06	12	93·38	
"	XVI & XV	27	16·06	12	245·45	
"	XV & XVIII	25	8·28	12	216·39	
"	XV & XVIII	30	32·83	12	165·07	
"	XVIII & XX	29	27·16	12	80·35	
"	XVIII & XX	28	18·18	12	54·11	
"	XX & XXII	28	31·15	12	150·73	
"	XX & XXII	27	13·53	12	102·25	
XVIII	XXI & XX	30	32·56	12	86·29	
"	XX & XVII	29	34·63	12	46·65	

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XVIII	XX & XVII	24	2·75	12	75·51	Troughton and Simms' 18-inch Theodolite No. 2.
"	XVII & XV	24	8·26	12	125·96	
"	XVII & XV	25	7·41	12	43·78	
XIX	XVI & XV	27	13·19	12	240·10	
"	XVI & XV	28	13·00	12	66·66	
"	XVI & XV	27	15·30	12	138·03	
"	XV & XVII	26	16·80	12	85·82	
"	XV & XVII	27	13·93	12	91·08	
"	XV & XVII	25	7·43	12	145·93	
"	XVII & XXII	27	11·93	12	28·75	
"	XVII & XXII	27	13·58	12	159·42	
XX	R.M. & XVIII	25	15·45	12	112·68	
"	XVIII & XXI	24	9·84	12	59·34	
"	XXI & XXIII	26	21·65	12	75·25	
"	XXIII & XXIV	27	30·57	12	98·02	
"	XXIV & XXII	27	32·44	12	111·12	
"	XXIV & XXII	25	9·26	12	112·83	
"	XXII & XVII	26	31·58	12	106·80	
"	XXII & XVII	26	11·90	12	141·07	
"	XVII & XVIII	25	13·48	12	93·99	
"	XVII & XVIII	25	8·64	12	116·44	
XXI	XXIII & XX	27	28·62	12	99·09	
"	XX & XVIII	27	37·14	12	138·71	
XXII	XIX & XVII	31	17·76	12	239·00	
"	XIX & XVII	26	13·08	12	74·22	
"	XVII & XX	24	11·90	12	141·18	
"	XVII & XX	28	19·69	12	136·97	
"	XX & XXIV	25	11·07	12	131·60	
"	XX & XXIV	27	14·91	12	107·04	
XXIII	XXV & XXVI	25	20·75	12	141·78	
"	XXVI & XXIV	25	13·79	12	97·63	
"	XXIV & XX	27	23·51	12	164·37	
"	XX & XXI	27	25·74	12	170·52	
XXIV	XXII & XX	27	30·38	12	91·37	
"	XXII & XX	26	16·63	12	124·66	
"	XX & XXIII	29	28·79	12	42·44	
"	XXIII & XXV	24	10·03	12	76·25	
"	XXV & XXVI	25	8·53	12	123·85	
XXV	XXVII & XXVI	27	22·15	12	163·33	
"	XXVI & XXIV	27	21·29	12	69·37	
"	XXIV & XXIII	26	15·86	12	86·79	

NOTE.—R.M. denotes Referring Mark.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXVI	XXIV & XXIII	28	36·25	12	204·51	Troughton and Simms' 18-inch Theodolite No. 2.
"	XXIII & XXV	27	23·67	12	184·11	
"	XXV & XXVII	28	27·13	12	89·75	
"	XXVII & XXVIII	25	23·70	12	50·69	
XXVII	XXIX & XXVIII	27	22·30	12	60·34	
"	XXVIII & XXVI	25	14·58	12	85·99	
"	XXVI & XXV	26	9·82	12	78·17	
XXVIII	XXVI & XXVII	25	12·16	12	53·80	
"	XXVII & XXIX	24	6·48	12	74·08	
"	XXIX & XXX	25	9·61	12	79·84	
"	XXX & XXXI	25	6·04	12	183·64	
XXIX	XXXV & XXXIII	26	11·48	12	101·78	
"	XXXIII & XXX	27	7·42	12	100·17	
"	XXX & XXVIII	25	6·00	12	64·04	
"	XXVIII & XXVII	25	8·71	12	64·49	
XXX	XXIX & XXXIII	27	20·86	12	78·32	
"	XXXIII & XXXIV	28	17·79	12	136·73	
"	XXXIV & XXXII	26	16·25	12	66·75	
"	XXXII & XXXI	26	18·90	12	224·08	
"	XXXI & XXVIII	26	11·72	12	108·10	
"	XXVIII & XXIX	27	12·65	12	71·18	
XXXI	XXVIII & XXX	24	6·50	12	115·59	
"	XXX & XXXII	25	11·65	12	131·00	
XXXII	XXXI & XXX	24	2·30	12	288·42	
"	XXX & XXXIV	25	8·37	12	45·72	
XXXIII	XXX & XXIX	27	30·55	12	166·73	
"	XXIX & XXXV	30	37·08	12	153·43	
"	XXXV & XXXVI	28	44·23	12	65·03	
"	XXXVI & XXXVII	29	80·93	12	164·02	
"	XXXVII & XXXVIII	37	45·77	12	105·87	
"	XXXVIII & XXXIV	37	46·66	12	48·69	
"	XXXIV & XXX	27	46·56	12	292·55	
XXXIV	XXXII & XXX	25	12·82	12	78·63	
"	XXX & XXXIII	26	18·57	12	104·15	
"	XXXIII & XXXVII	26	16·01	12	245·69	
"	XXXVII & XXXVIII	25	10·94	12	126·37	
"	XXX & R.M.	26	9·73	12	168·74	
XXXV	XXXVI & XXXIII	24	14·23	12	86·93	
"	XXXIII & XXIX	24	9·40	12	56·92	
XXXVI	XXXVII & XXXIII	25	5·44	12	127·26	
"	XXXIII & XXXV	24	7·08	12	83·65	

NOTE.—R.M. denotes Referring Mark.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXXVII	XXXIX & XXXVIII	27	16·32	12	74·03	Troughton and Simms' 18-inch Theodolite No. 2.
„	XXXVIII & XXXIV	27	70·14	12	129·64	
„	XXXIV & XXXIII	27	13·35	12	169·48	
„	XXXIII & XXXVI	24	9·45	12	132·01	
XXXVIII	XXXIV & XXXIII	24	11·59	12	79·94	
„	XXXIII & XXXVII	24	5·08	12	268·14	
„	XXXVII & XXXIX	27	20·73	12	112·20	
„	XXXIX & XL	26	17·67	12	110·94	
XXXIX	XLI & XL	27	23·58	12	124·93	
„	XL & XXXVIII	24	13·09	12	207·22	
„	XXXVIII & XXXVII	25	8·56	12	180·23	
XL	XXXVIII & XXXIX	29	22·48	12	166·49	
„	XXXIX & XLI	28	16·42	12	62·57	
„	XLI & XLII	27	25·48	12	50·62	
XLI	XLII & XL	25	16·01	12	59·19	
„	XL & XXXIX	26	14·28	12	148·76	
XLII	XL & XLI	28	29·32	12	56·58	

From the preceding data of the sums of the squares of the apparent errors, in the measurement of each angle, we may ascertain the *e.m.s.* (error of mean square) *of observation* of a single measure of an angle, and the *e.m.s. of graduation and observation* of the mean of the measures on a single zero, for each group of angles measured with the same instrument, by the same observer, and under similar circumstances.

The instrument employed was Troughton and Simms' 18-inch Theodolite No. 2, having 3 microscopes to read the azimuthal circle; observations were taken on 6 pairs of zeros (*face left* and *face right*) giving circle readings at 10° apart.

The *e.m.s. of observation* of a single measure of an angle $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of observations.}}{\text{No. of observations} - \text{No. of angles} \times \text{No. of changes of zero.}}}$

The *e.m.s. of graduation and observation* of the mean of the measures on a single zero $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of zero.}}{\text{No. of angles} \times (\text{No. of changes of zero} - 1).}}$

Group	Instrument and Observer	Position of stations	Intervals between microscope readings of circle	Number of: Measures on each zero (average)	Angles	Single measures	Single zeros	*e.m.s.* of observation of a single measure	*e.m.s.* of graduation and observation of a single zero
			° ′					″	″
I	Troughton and Simms' 18-inch Theodolite No. 2; Lieutenant D. J. Nasmyth.	Hills,	10 0	2·17	96	2501	1152	$\left\{\frac{967·43}{2501-1152}\right\}^{\frac{1}{2}} = \pm 0·847$	$\left\{\frac{10927·59}{1152-96}\right\}^{\frac{1}{2}} = \pm 3·217$
II	Ditto.	Plains,	10 0	2·25	46	1241	552	$\left\{\frac{630·76}{1241-552}\right\}^{\frac{1}{2}} = \pm 0·957$	$\left\{\frac{6038·53}{552-46}\right\}^{\frac{1}{2}} = \pm 3·455$
III	Troughton and Simms' 18-inch Theodolite No. 2; Lieutenant H. Rivers.	Hills,	10 0	2·19	40	1052	480	$\left\{\frac{839·50}{1052-480}\right\}^{\frac{1}{2}} = \pm 1·211$	$\left\{\frac{4284·79}{480-40}\right\}^{\frac{1}{2}} = \pm 3·121$
IV	Ditto.	Plains,	10 0	2·28	10	273	120	$\left\{\frac{247·20}{273-120}\right\}^{\frac{1}{2}} = \pm 1·271$	$\left\{\frac{1143·04}{120-10}\right\}^{\frac{1}{2}} = \pm 3·224$
V	Troughton and Simms' 18-inch Theodolite No. 2; Lieutenants D. J. Nasmyth and H. Rivers.	Hills,	10 0	2·56	7	215	84	$\left\{\frac{331·78}{215-84}\right\}^{\frac{1}{2}} = \pm 1·591$	$\left\{\frac{996·32}{84-7}\right\}^{\frac{1}{2}} = \pm 3·597$

March 1880.

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

KATTYWAR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

Figure No. 18.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	79	45	20·92	0·95
2	64	34	53·93	0·50
3	35	39	48·33	0·77
4	44	56	51·69	0.61
5	55	49	37·31	0·44
6	42	14	37·13	1·20
7	36	58	56·60	0·79
8	26	10	47·18	0·94
9	32	30	29·03	0·67
10	68	16	0·66	0·74
11	53	2	46·90	0·44
12	74	19	49·17	1·03
13	27	42	20·40	1·24
14	77	57	51·35	0·85

Fixed data†

Log. Ratio of side *A* to side *B* (see diagram) = 0·1177875,2

Sum of angles 1, 4, 8 and 12 = 225° 12′ 47″·60

Equations to be satisfied

Equation		Factor
$x_1 + x_2 + x_3$	$= e_1 = +1·63,$	λ_1
$x_4 + x_5 + x_8 + x_{11}$	$= e_2 = +0·70,$	λ_2
$x_{12} + x_{13} + x_{14}$	$= e_3 = -0·27,$	λ_3
$x_6 + x_7 + x_9 + x_{10}$	$= e_4 = +1·14,$	λ_4
$x_8 + x_9 + x_{10} + x_{11}$	$= e_5 = +1·94,$	λ_5
$x_1 + x_4 + x_8 + x_{12}$	$= e_6 = +1·36,$	λ_6
$10 x_2 - 29 x_3 + 14 x_5 - 16 x_{11} + 40 x_{13} - 5 x_{14}$	$= e_7 = -11·4,$	λ_7
$7 x_4 - 14 x_5 + 23 x_6 - 8 x_7 - 36 x_8 + 25 x_9$	$= e_8 = -50·9,$	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	+ 1·63	+2·22					+0·95	− 17·33	...
2	+ 0·70		+2·43			+1·38	+1·55	− 0·88	− 35·73
3	− 0·27			+3·12			+1·03	+ 45·35	...
4	+ 1·14				+3·40	+1·41	...	...	+ 38·03
5	+ 1·94					+2·79	+0·94	− 7·04	− 17·09
6	+ 1·36			*			+3·53	...	− 29·57
7	−11·4							+2901·70	− 86·24
8	−50·9								+2438·48

Values of the Factors

$\lambda_1 = +0·7363$

$\lambda_2 = -0·4776$

$\lambda_3 = -0·1425$

$\lambda_4 = +0·4845$

$\lambda_5 = +0·4861$

$\lambda_6 = +0·0463$

$\lambda_7 = +0·0028$

$\lambda_8 = -0·0314$

Angular errors in seconds

$x_1 = +·75$	$x_6 = -·28$	$x_{11} = -·01$
$x_2 = +·38$	$x_7 = +·58$	$x_{12} = -·10$
$x_3 = +·50$	$x_8 = +1·11$	$x_{13} = -·04$
$x_4 = -·40$	$x_9 = +·12$	$x_{14} = -·13$
$x_5 = ·00$	$x_{10} = +·72$	

$[wx^2] = 4·02$

† The fixed data here given are obtained from figure No. 24 of the Karáchi Longitudinal Series 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.

Figure No. 19.

Observed Angles

No.	Value	Reciprocal Weight
	° ′ ″	
1	31 35 45·14	0·55
2	35 3 28·22	0·51
3	69 33 10·02	0·49
4	43 47 41·02	0·77
5	32 28 51·20	1·23
6	34 10 24·09	1·42
7	49 29 32·63	0·63
8	63 51 15·32	0·31

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = +0·11,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = +0·89,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = -2·32,$	λ_3
$\left.\begin{array}{l}-34x_1 - 5x_2 - 13x_3 \\ +29x_6 - 2x_7 + 11x_8\end{array}\right\} = e_4 = +7·3,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	+ 0·11	+2·32	+1·26	...	− 27·62
2	+ 0·89		+3·91	+2·65	+ 34·81
3	− 2·32		*	+3·59	+ 43·33
4	+ 7·3				+1965·61

Values of the Factors

$\lambda_1 = -1·0188$

$\lambda_2 = +1·9874$

$\lambda_3 = -2·1265$

$\lambda_4 = +0·0011$

Angular errors in seconds

$x_1 = -·58$	$x_5 = -·17$
$x_2 = -·52$	$x_6 = -·15$
$x_3 = +·47$	$x_7 = -1·34$
$x_4 = +·74$	$x_8 = -·66$

$[wx^2] = 6·60$

Figure No. 20.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	72	54	7·80	0·60
2	40	6	35·27	0·55
3	66	59	19·45	0·69
4	65	0	34·85	0·62
5	71	40	10·89	0·71
6	43	19	16·98	1·18
7	54	21	27·42	0·56
8	36	51	25·51	0·87
9	88	47	8·66	1·35
10	82	30	7·03	1·62
11	47	2	21·58	1·52
12	50	27	31·30	0·82
13	85	13	43·09	1·42
14	64	50	7·42	0·74
15	29	56	12·52	1·33

Equations to be satisfied

Equations	Factor
$x_1 + x_2 + x_3 = e_1 = + 0·45,$	λ_1
$x_4 + x_5 + x_6 = e_2 = + 0·81,$	λ_2
$x_7 + x_8 + x_9 = e_3 = + 0·17,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = - 1·07,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = + 1·33,$	λ_5
$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = + 0·19,$	λ_6
$\left.\begin{array}{l} 9x_3 - 25x_2 + 23x_6 - 7x_5 + x_9 \\ -28x_8 + 18x_{12} - 20x_{11} + 37x_{15} - 10x_{14} \end{array}\right\} = e_7 = - 4·0,$	λ_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	+0·45	+1·84					+0·60	−7·54
2	+0·81		+2·51				+0·62	+22·17
3	+0·17			+2·78			+0·56	−23·01
4	−1·07				+3·96		+1·62	−15·64
5	+1·33			*		+3·49	+1·42	+41·81
6	+0·19						+4·82	...
7	−4·0							+4510·53

Values of the Factors

$\lambda_1 = + 0·2495$

$\lambda_2 = + 0·4243$

$\lambda_3 = + 0·0171$

$\lambda_4 = - 0·2543$

$\lambda_5 = + 0·5274$

$\lambda_6 = - 0·1181$

$\lambda_7 = - 0·0082$

Angular errors in seconds

$x_1 = + ·08$	$x_6 = + ·28$	$x_{11} = - ·14$
$x_2 = + ·25$	$x_7 = - ·06$	$x_{12} = - ·33$
$x_3 = + ·12$	$x_8 = + ·22$	$x_{13} = + ·58$
$x_4 = + ·19$	$x_9 = + ·01$	$x_{14} = + ·45$
$x_5 = + ·34$	$x_{10} = - ·60$	$x_{15} = + ·30$

$[wx^2] = 1·44$

Figure No. 21.

Observed Angles

No.	Value			Reciprocal Weight
	°	′	″	
1	53	50	6·79	1·04
2	48	36	5·23	0·71
3	42	19	58·33	0·93
4	35	13	50·70	0·35
5	34	21	53·85	0·46
6	68	4	20·92	0·58
7	44	54	9·75	0·97
8	32	39	39·17	0·54

Equations to be satisfied — Factor

$x_1 + x_2 + x_3 + x_4 = e_1 = -0·19,\quad \lambda_1$

$x_3 + x_4 + x_5 + x_6 = e_2 = +2·62,\quad \lambda_2$

$x_5 + x_6 + x_7 + x_8 = e_3 = +2·81,\quad \lambda_3$

$\left.\begin{array}{l}-16x_1 - x_2 - 24x_3 \\ +18x_6 + 9x_7 + 33x_8\end{array}\right\} = e_4 = +43·4,\quad \lambda_4$

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 0·19	+3·03	+1·28	...	− 39·67
2	+ 2·62		+2·32	+1·04	− 11·88
3	+ 2·81		*	+2·55	+ 36·99
4	+43·4				+1657·18

Values of the Factors

$\lambda_1 = -0·3233$

$\lambda_2 = +1·3172$

$\lambda_3 = +0·2369$

$\lambda_4 = +0·0226$

Angular errors in seconds

$x_1 = -·71$	$x_5 = +·71$
$x_2 = -·25$	$x_6 = +1·14$
$x_3 = +·42$	$x_7 = +·43$
$x_4 = +·35$	$x_8 = +·53$

$[wx^2] = 5·16$

Figure No. 22.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	72	14	45·40	0·42
2	61	37	46·83	0·52
3	46	7	27·54	0·84
4	53	53	8·73	0·45
5	69	37	34·23	1·00
6	56	29	14·26	0·27
7	61	54	53·31	0·59
8	63	9	21·45	0·37
9	54	55	42·30	0·64
10	45	26	55·42	0·59
11	73	56	44·46	1·18
12	60	36	23·96	0·73
13	63	43	48·58	0·35
14	52	11	1·17	0·89
15	64	5	12·31	0·78
16	62	46	28·01	0·29
17	41	52	28·42	0·98
18	75	21	6·67	0·35

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = -0·89,$	λ_1
$x_4 + x_5 + x_6 = e_2 = -3·55,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -3·98,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = +2·83,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = +0·83,$	λ_5
$x_{16} + x_{17} + x_{18} = e_6 = +2·36,$	λ_6
$x_1 + x_4 + x_7 + x_{10} + x_{13} + x_{16} = e_7 = -0·55,$	λ_7
$\left.\begin{matrix} 20\,x_3 & -11\,x_2 & +14\,x_6 \\ -8\,x_5 & +14\,x_9 & -11\,x_8 \\ +12\,x_{12} & -6\,x_{11} & +10\,x_{15} \\ -16\,x_{14} & +5\,x_{18} & -23\,x_{17} \end{matrix}\right\} = e_8 = +40·7,$	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	− 0·89	+1·78						+0·42	+ 11·08
2	− 3·55		+1·72					+0·45	− 4·22
3	− 3·98			+1·60				+0·59	+ 4·89
4	+ 2·83				+2·50			+0·59	+ 1·68
5	+ 0·83					+2·02		+0·35	− 6·44
6	+ 2·36						+1·62	+0·29	− 20·79
7	− 0·55							+2·69	...
8	+ 40·7								+1666·66

Values of the Factors

$\lambda_1 = -0·9775$

$\lambda_2 = -2·0087$

$\lambda_3 = -2·8168$

$\lambda_4 = +1·0015$

$\lambda_5 = +0·5451$

$\lambda_6 = +2·1917$

$\lambda_7 = +0·3751$

$\lambda_8 = +0·0625$

Angular errors in seconds

$x_1 = -\ ·25$	$x_7 = -1·44$	$x_{13} = +\ ·32$
$x_2 = -\ ·87$	$x_8 = -1·30$	$x_{14} = -\ ·40$
$x_3 = +\ ·23$	$x_9 = -1·24$	$x_{15} = +\ ·91$
$x_4 = -\ ·73$	$x_{10} = +\ ·81$	$x_{16} = +\ ·74$
$x_5 = -2·51$	$x_{11} = +\ ·74$	$x_{17} = +\ ·74$
$x_6 = -\ ·31$	$x_{12} = +1·28$	$x_{18} = +\ ·88$

$[wx^2] = 30·01$

Figure No. 23.

Observed Angles

No.	Value	Reciprocal Weight	No.	Value	Reciprocal Weight	No.	Value	Reciprocal Weight
	° ′ ″			° ′ ″			° ′ ″	
1	47 47 35·13	0·43	12	63 39 45·52	0·48	23	52 12 34·20	0·42
2	46 44 25·02	0·47	13	46 43 14·04	0·54	24	62 4 7·53	0·79
3	38 48 17·15	0·45	14	69 37 2·23	0·48	25	56 24 51·91	0·36
4	46 39 42·49	0·60	15	67 51 23·24	0·26	26	61 31 3·61	1·28
5	45 28 50·16	0·25	16	57 37 35·26	0·40	27	59 37 7·59	0·60
6	49 3 12·47	0·29	17	54 31 4·71	0·24	28	68 50 38·85	1·33
7	47 43 26·87	0·26	18	67 28 55·62	0·72	29	51 32 15·07	0·79
8	37 44 31·11	0·57	19	60 25 12·27	0·25	30	53 54 23·68	0·47
9	75 27 48·35	0·54	20	52 5 55·16	0·37	31	42 54 32·23	1·10
10	57 14 31·54	0·20	21	57 9 43·42	0·44	32	83 11 3·09	0·69
11	47 17 39·19	0·44	22	70 37 42·14	0·46			

Equations to be satisfied

								Factor
x_1	$+x_2$	$+x_3$	$+x_4$	...	...	...	$= e_1 = -1·05,$	λ_1
x_5	$+x_6$	$+x_7$	$+x_8$	...	...	...	$= e_2 = -0·07,$	λ_2
x_9	$+x_{10}$	$+x_{11}$	...	...	...	...	$= e_3 = -1·81,$	λ_3
x_{12}	$+x_{13}$	$+x_{14}$	...	...	...	...	$= e_4 = +1·06,$	λ_4
x_{15}	$+x_{16}$	$+x_{17}$	...	...	...	...	$= e_5 = +2·60,$	λ_5
x_{18}	$+x_{19}$	$+x_{20}$	...	...	...	...	$= e_6 = +2·36,$	λ_6
x_{21}	$+x_{22}$	$+x_{23}$	...	...	...	...	$= e_7 = -1·20,$	λ_7
x_{24}	$+x_{25}$	$+x_{26}$	...	...	...	...	$= e_8 = +1·91,$	λ_8
x_{27}	$+x_{28}$	$+x_{29}$	...	...	...	...	$= e_9 = +0·25,$	λ_9
x_{30}	$+x_{31}$	$+x_{32}$	...	...	...	...	$= e_{10} = -1·96,$	λ_{10}
x_3	$+x_4$	$+x_5$	$+x_6$	...	...	...	$= e_{11} = +1·56,$	λ_{11}
x_1	$+x_8$	$+x_9$	$+x_{12}$	$+x_{15}$	$+x_{18}$	...	$= e_{12} = -1·03,$	λ_{12}
x_{14}	$+x_{16}$	$+x_{21}$	$+x_{24}$	$+x_{27}$	$+x_{30}$	...	$= e_{13} = -0·29,$	λ_{13}
$2x_2$	$-19x_1$	$+21x_6$	$-24x_3$	$+27x_8$	$+3x_7$	...	$= e_{14} = -36·9,$	λ_{14}
$19x_7$	$-20x_2$	$+20x_{11}$	$-13x_{10}$	$+8x_{14}$	$-20x_{13}$	...	$= e_{15} = +1·3,$	λ_{15}
$+15x_{17}$	$-14x_{16}$	$+17x_{20}$	$-12x_{19}$					
$8x_{15}$	$-15x_{17}$	$+20x_{18}$	$-11x_{12}$	$+16x_{23}$	$-7x_{22}$	...	$= e_{16} = +51·2,$	λ_{16}
$+11x_{26}$	$-14x_{25}$	$+17x_{29}$	$-8x_{28}$	$+2x_{32}$	$-23x_{31}$			

Figure No. 23—(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}	λ_{15}	λ_{16}
1	− 1·05	+1·95										+1·05	+0·43	...	− 18·03	− 9·40	...
2	− 0·07		+1·37									+0·54	+0·57	...	+ 22·26	+ 4·94	...
3	− 1·81			+1·18								...	+0·54	...	...	+ 6·20	...
4	+ 1·06				+1·50							...	+0·48	+0·48	...	− 6·96	+ 5·52
5	+ 2·60					+0·90						...	+0·26	+0·40	...	− 2·00	− 1·52
6	+ 2·36						+1·34					...	+0·72	...	...	+ 3·29	...
7	− 1·20							+1·32				...	...	+0·44	...	...	+ 3·50
8	+ 1·91								+2·43			...	...	+0·79	...	...	+ 9·04
9	+ 0·25									+2·72		...	...	+0·60	...	...	+ 2·79
10	− 1·96										+2·26	...	...	+0·47	...	...	− 23·92
11	+ 1·56											+1·59	...	...	− 4·71	...	...
12	− 1·03												+3·00	...	+ 7·22	...	− 3·20
13	− 0·29													+3·18	...	− 1·76	...
14	−36·9														+962·07	− 3·98	...
15	+ 1·3															+1013·71	− 270·00
16	+51·2																+1598·31

Values of the Factors

λ_1	=	−2·1850
λ_2	=	+1·0314
λ_3	=	−1·1253
λ_4	=	+1·1414
λ_5	=	+3·5061
λ_6	=	+2·2149
λ_7	=	−0·6738
λ_8	=	+0·9972
λ_9	=	+0·2594
λ_{10}	=	−0·5225
λ_{11}	=	+1·8124
λ_{12}	=	−0·8121
λ_{13}	=	−0·8347
λ_{14}	=	−0·0882
λ_{15}	=	−0·0070
λ_{16}	=	+0·0162

Angular errors in seconds

x_1	=	− ·57	x_{12}	=	+ ·07	x_{23}	=	− ·18
x_2	=	−1·04	x_{13}	=	+ ·87	x_{24}	=	+ ·13
x_3	=	+ ·78	x_{14}	=	+ ·12	x_{25}	=	+ ·28
x_4	=	− ·22	x_{15}	=	+ ·73	x_{26}	=	+1·50
x_5	=	+ ·71	x_{16}	=	+1·11	x_{27}	=	− ·35
x_6	=	+ ·29	x_{17}	=	+ ·76	x_{28}	=	+ ·17
x_7	=	+ ·16	x_{18}	=	+1·01	x_{29}	=	+ ·43
x_8	=	−1·23	x_{19}	=	+ ·57	x_{30}	=	− ·64
x_9	=	−1·04	x_{20}	=	+ ·78	x_{31}	=	− ·98
x_{10}	=	− ·21	x_{21}	=	− ·66	x_{32}	=	− ·34
x_{11}	=	− ·56	x_{22}	=	− ·36			

$[wx^2] = 31·59$

Figure No. 24.

Observed Angles

No.	°	′	″	Reciprocal Weight
1	40	37	51·08	1·60
2	58	21	58·83	0·95
3	47	32	16·03	0·60
4	33	27	55·27	0·76
5	43	7	16·54	1·11
6	55	52	32·51	0·68
7	44	36	34·36	0·56
8	36	23	39·57	1·43

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = +0{\cdot}09,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = -0{\cdot}84,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = +1{\cdot}74,$	λ_3
$\left.\begin{matrix} -25x_1 & -6x_2 & -25x_3 \\ +18x_6 & +4x_7 & +28x_8 \end{matrix}\right\} = e_4 = +64{\cdot}9,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	+ 0·09	+3·91	+1·36	...	− 60·70
2	− 0·84		+3·15	+1·79	− 2·76
3	+ 1·74		*	+3·78	+ 54·52
4	+64·9				+2759·60

Values of the Factors

$\lambda_1 = +0{\cdot}8292$

$\lambda_2 = -0{\cdot}7868$

$\lambda_3 = +0{\cdot}3382$

$\lambda_4 = +0{\cdot}0343$

Angular errors in seconds

$x_1 = -\ {\cdot}04$	$x_5 = -\ {\cdot}49$
$x_2 = +\ {\cdot}59$	$x_6 = +\ {\cdot}11$
$x_3 = -\ {\cdot}48$	$x_7 = +\ {\cdot}27$
$x_4 = +\ {\cdot}02$	$x_8 = +1{\cdot}85$

$[wx^2] = 3{\cdot}55$

Figure No. 25.

Observed Angles

No.	Value			Reciprocal Weight	No.	Value			Reciprocal Weight	No.	Value			Reciprocal Weight
	°	′	″			°	′	″			°	′	″	
1	53	52	47·93	0·56	13	38	37	3·65	1·06	25	51	32	7·90	0·97
2	52	27	4·21	0·50	14	81	19	1·05	0·82	26	63	7	11·92	0·55
3	73	40	12·42	0·62	15	60	3	58·71	2·28	27	50	22	52·26	0·65
4	81	59	48·56	0·84	16	60	10	40·65	0·62	28	66	29	59·42	0·68
5	44	8	46·57	1·40	17	65	7	3·80	1·31	29	43	51	47·39	1·21
6	53	51	28·35	0·89	18	54	42	15·21	0·77	30	59	13	29·61	0·45
7	77	25	2·65	1·73	19	38	5	20·69	0·41	31	76	54	44·51	0·79
8	60	56	0·60	1·01	20	22	34	57·05	0·84	32	97	22	3·09	1·09
9	41	38	56·93	2·19	21	89	47	21·49	1·89	33	30	30	40·27	2·04
10	47	54	35·64	0·53	22	29	32	22·37	1·30	34	14	22	21·11	0·63
11	55	5	12·12	0·36	23	67	9	40·18	1·35	35	37	44	59·02	0·98
12	77	0	14·39	0·62	24	61	18	14·66	1·02					

Equations to be satisfied

								Factor
x_1	$+x_2$	$+x_3$	...	...	...	...	$= e_1 = +\ 2{\cdot}38$,	λ_1
x_4	$+x_5$	$+x_6$	...	...	...	...	$= e_2 = +\ 1{\cdot}57$,	λ_2
x_7	$+x_8$	$+x_9$	...	...	...	...	$= e_3 = -\ 1{\cdot}95$,	λ_3
x_{10}	$+x_{11}$	$+x_{12}$	...	...	...	...	$= e_4 = +\ 0{\cdot}36$,	λ_4
x_{13}	$+x_{14}$	$+x_{15}$	...	...	...	...	$= e_5 = +\ 1{\cdot}96$,	λ_5
x_{16}	$+x_{17}$	$+x_{18}$	...	...	...	...	$= e_6 = -\ 2{\cdot}89$,	λ_6
x_{19}	$+x_{20}$	$+x_{21}$	$+x_{22}$	...	...	...	$= e_7 = -\ 0{\cdot}27$,	λ_7
x_{23}	$+x_{24}$	$+x_{25}$	...	...	...	...	$= e_8 = -\ 1{\cdot}74$,	λ_8
x_{26}	$+x_{27}$	$+x_{28}$	...	...	...	...	$= e_9 = -\ 0{\cdot}48$,	λ_9
x_{29}	$+x_{30}$	$+x_{31}$	...	...	...	...	$= e_{10} = -\ 0{\cdot}84$,	λ_{10}
x_{32}	$+x_{33}$	$+x_{34}$	$+x_{35}$	...	...	...	$= e_{11} = +\ 0{\cdot}65$,	λ_{11}
x_{19}	$+x_{21}$	$+x_{34}$	$+x_{35}$	...	...	...	$= e_{12} = +\ 0{\cdot}23$,	λ_{12}
x_1	$+x_4$	$+x_7$	$+x_{10}$	$+x_{13}$	$+x_{16}$	...	$= e_{13} = -\ 0{\cdot}92$,	λ_{13}
x_{15}	$+x_{17}$	$+x_{19}$	$+x_{20}$	$+x_{23}$	$+x_{26}$	$+x_{29}$	$= e_{14} = -\ 0{\cdot}26$,	λ_{14}
$6x_3$	$-17x_2$	$+16x_6$	$-22x_5$	$+24x_9$	$-12x_8$	...	$= e_{15} = +196{\cdot}1$,	λ_{15}
$+\ 4x_{12}$	$-15x_{11}$	$+12x_{15}$	$-\ 3x_{14}$	$+14x_{18}$	$-10x_{17}$			
$3x_{14}$	$-26x_{13}$	$+12x_{16}$	$-14x_{18}$	$+38x_{22}$	$-\ 0x_{21}$	...	$= e_{16} = +\ 62{\cdot}0$,	λ_{16}
$+16x_{25}$	$-11x_{24}$	$+\ 9x_{28}$	$-18x_{27}$	$+\ 5x_{31}$	$-12x_{30}$			
$15x_{19}$	$-12x_{20}$	$+38x_{22}$	$+\ 3x_{32}$	$+21x_{33}$	$-61x_{34}$	...	$= e_{17} = -\ 11{\cdot}9$,	λ_{17}

Figure No. 25—(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}	λ_{15}	λ_{16}	λ_{17}
1	+ 2·38	+1·68	...	...	...	...	...	...	...	...	...	...	...	+0·56	...	− 4·78	...	...
2	+ 1·57		+3·13	...	...	...	...	...	...	...	...	...	...	+0·84	...	− 16·56	...	...
3	− 1·95			+4·93	...	...	...	...	...	...	...	...	...	+1·73	...	+ 40·44	...	...
4	+ 0·36				+1·51	...	...	...	...	...	...	...	...	+0·53	...	− 2·92	...	...
5	+ 1·96					+4·16	...	...	...	...	...	...	...	+1·06	+2·28	+ 24·90	− 25·10	...
6	− 2·89						+2·70	...	...	...	...	...	...	+0·62	+1·31	− 2·32	− 3·34	...
7	− 0·27							+4·44	...	...	...	...	+2·30	...	+1·25	...	+ 49·40	+ 45·47
8	− 1·74								+3·34	...	...	...	...	...	+1·35	...	+ 4·30	...
9	− 0·48									+1·88	...	...	...	...	+0·55	...	− 5·58	...
10	− 0·84										+2·45	...	...	...	+1·21	...	− 1·45	...
11	+ 0·65											+4·74	+1·61	...	...	...	...	+ 7·68
12	+ 0·23												+3·91	...	+0·41	...	...	− 32·28
13	− 0·92													+5·34	...	...	− 20·12	...
14	− 0·26														+7·95	+ 14·26	...	− 3·93
15	+196·1															+3187·68	− 158·30	....
16	+ 62·0																+3563·31	+1877·20
17	− 11·9																	+5344·09

Values of the Factors

λ_1	=	+ 1·6229
λ_2	=	+ 0·9155
λ_3	=	− 1·1036
λ_4	=	+ 0·3678
λ_5	=	− 0·0026
λ_6	=	− 1·1144
λ_7	=	− 0·5884
λ_8	=	− 0·6753
λ_9	=	− 0·2407
λ_{10}	=	− 0·4613
λ_{11}	=	+ 0·0452
λ_{12}	=	+ 0·3023
λ_{13}	=	+ 0·0865
λ_{14}	=	+ 0·2787
λ_{15}	=	+ 0·0826
λ_{16}	=	+ 0·0324
λ_{17}	=	− 0·0066

Angular errors in seconds

x_1	= + ·96	x_{13}	= − ·81	x_{25}	= − ·14
x_2	= + ·10	x_{14}	= − ·14	x_{26}	= + ·02
x_3	= + 1·32	x_{15}	= + 2·91	x_{27}	= − ·55
x_4	= + ·84	x_{16}	= − ·39	x_{28}	= + ·05
x_5	= − 1·27	x_{17}	= − 2·20	x_{29}	= − ·22
x_6	= + 2·00	x_{18}	= − ·30	x_{30}	= − ·38
x_7	= − 1·76	x_{19}	= − ·05	x_{31}	= − ·24
x_8	= − 2·13	x_{20}	= − ·18	x_{32}	= + ·03
x_9	= + 1·94	x_{21}	= − ·54	x_{33}	= − ·20
x_{10}	= + ·24	x_{22}	= + ·50	x_{34}	= + ·48
x_{11}	= − ·32	x_{23}	= − ·54	x_{35}	= + ·34
x_{12}	= + ·44	x_{24}	= − 1·06		

$[wx^2] = 30·87$

May, 1890.

W. H. COLE,
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KATTYWAR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of 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
			″	″	″	″	″	° ′ ″			
125		LXI (Akoria)	·52	− ·38	+ ·35		− ·03	64 34 53·38	5·0061437,4	101424·71	19·209
		LXIV (Bhilgaon)	·52	− ·75	+ ·13		− ·62	79 45 19·78	5·0433819,7	110505·01	20·929
		I (Viráwáh)	·51	− ·50	− ·48		− ·98	35 39 46·84	4·8160424,8	65470·03	12·004
			1·55				−1·63	180 0 0·00			
126		LXIV (Bhilgaon)	·94	+ ·40	+ ·39		+ ·79	44 56 51·54	5·0759511,1	119110·80	22·559
		I (Viráwáh)	·95	+ ·28	·00		+ ·28	98 4 13·77	5·2225406,5	166932·40	31·616
		III (Kálunjhar)	·94	− ·58	− ·39		− ·97	36 58 54·69	5·0061437,4	101424·71	19·209
			2·83				+ ·10	180 0 0·00			
	214	LXVI (Jhund)	·40	+ ·13		+ ·85	+ ·98	77 57 51·93	5·0212179,3	105006·92	19·888
		LXIV (Bhilgaon)	·40	+ ·10		− ·40	− ·30	74 19 48·47	5·0144223,4	103376·63	19·579
		II (Khársar)	·39	+ ·04		− ·45	− ·41	27 42 19·60	4·6982549,6	49917·74	9·454
			1·19				+ ·27	180 0 0·00			
	215	LXIV (Bhilgaon)	·80	− ·71		+ ·27	− ·44	71 7 37·63	5·0795327,7	120097·17	22·746
		I (Viráwáh)	·79	·00		− ·03	− ·03	55 49 36·49	5·0212179,2	105006·91	19·888
		II (Khársar)	·79	+ ·01		− ·24	− ·23	53 2 45·88	5·0061437,4	101424·71	19·209
			2·38				− ·70	180 0 0·00			
	216	II (Khársar)	·76	− ·72		+ ·82	+ ·10	68 16 0·00	5·0759511,1	119110·80	22·559
		I (Viráwáh)	·76	+ ·28		+ ·03	+ ·31	42 14 36·68	4·9355261,7	86203·75	16·326
		III (Kálunjhar)	·76	− ·70		− ·85	−1·55	69 29 23·32	5·0795327,7	120097·17	22·746
			2·28				−1·14	180 0 0·00			

NOTES.—1. The values of the sides are given in the same lines with the opposite angles.
2. Stations LXI (Akoria), LXIV (Bhilgaon) and LXVI (Jhund) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of 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
			″	″	″	″	″	° ′ ″			
127		I (Viráwáh)	1·82	− ·57	+ ·18		− ·39	76 16 30·01	5·3138727,4	206002·63	39·016
		III (Kálunjhar)	1·81	− ·47	+ ·29		− ·18	69 33 8·03	5·2981896,5	198696·23	37·632
		IV (Iwália)	1·81	+ ·15	− ·47		− ·32	34 10 21·96	5·0759511,1	119110·80	22·559
			5·44				− ·89	180 0 0·00			
128		III (Kálunjhar)	1·47	+ ·52	+ ·17		+ ·69	35 3 27·44	5·0750549,1	118865·25	22·512
		IV (Iwália)	1·47	+1·34	− ·18		+1·16	49 29 32·32	5·1968362,7	157338·97	29·799
		V (Bela)	1·47	+1·24	+ ·01		+1·25	95 27 0·24	5·3138727,4	206002·63	39·016
			4·41				+3·10	180 0 0·00			
	217	I (Viráwáh)	1·85	+ ·17		+ ·19	+ ·36	32 28 49·71	5·0750549,0	118865·25	22·512
		IV (Iwália)	1·86	+1·49		− ·65	+ ·84	83 39 55·70	5·3424111,0	219994·14	41·666
		V (Bela)	1·85	+ ·66		+ ·46	+1·12	63 51 14·59	5·2981896,5	198696·23	37·632
			5·56				+2·32	180 0 0·00			
129		V (Bela)	·69	− ·12	+ ·17		+ ·05	66 59 18·81	5·0586757,0	114465·79	21·679
		IV (Iwália)	·69	− ·25	− ·21		− ·46	40 6 34·12	4·9037409,7	80120·01	15·174
		VI (Dájka)	·69	− ·08	+ ·04		− ·04	72 54 7·07	5·0750549,1	118865·25	22·512
			2·07				− ·45	180 0 0·00			
130		IV (Iwália)	·56	− ·30	+ ·07		− ·23	29 56 11·73	4·8001218,3	63113·44	11·953
		VI (Dájka)	·57	− ·58	+ ·26		− ·32	85 13 42·20	5·1004775,5	126031·06	23·870
		VIII (Pata-i-Sháh)	·57	− ·45	− ·33		− ·78	64 50 6·07	5·0586757,0	114465·79	21·679
			1·70				−1·33	180 0 0·00			
131		VI (Dájka)	·33	+ ·60	+ ·19		+ ·79	82 30 7·49	4·9319873,4	85504·18	16·194
		VIII (Pata-i-Sháh)	·33	+ ·33	− ·31		+ ·02	50 27 30·99	4·8228639,7	66506·48	12·596
		IX (Kanduka)	·32	+ ·14	+ ·12		+ ·26	47 2 21·52	4·8001218,3	63113·44	11·953
			·98				+1·07	180 0 0·00			
	218	V (Bela)	·64	− ·34		+ ·15	− ·19	71 40 10·06	5·0447460,9	110852·65	20·995
		VI (Dájka)	·64	− ·19		− ·22	− ·41	65 0 33·80	5·0246707,5	105845·10	20·046
		VII (Gángta)	·63	− ·28		+ ·07	− ·21	43 19 16·14	4·9037409,7	80120·01	15·174
			1·91				− ·81	180 0 0·00			
	219	VII (Gángta)	·47	− ·22		+ ·18	− ·04	36 51 25·00	4·8228639,6	66506·48	12·596
		VI (Dájka)	·47	+ ·06		− ·27	− ·21	54 21 26·74	4·9547568,4	90106·65	17·066
		IX (Kanduka)	·48	− ·01		+ ·09	+ ·08	88 47 8·26	5·0447460,9	110852·65	20·995
			1·42				− ·17	180 0 0·00			
132		VIII (Pata-i-Sháh)	·40	−1·06	− ·11		−1·17	69 35 42·98	4·9364583,4	86388·99	16·362
		IX (Kanduka)	·39	− ·42	+ ·28		− ·14	42 19 57·80	4·7928969,0	62072·17	11·756
		X (Khánmír)	·39	−1·14	− ·17		−1·31	68 4 19·22	4·9319873,4	85504·18	16·194
			1·18				−2·62	180 0 0·00			
133		IX (Kanduka)	·31	+ ·25	+ ·13		+ ·38	48 36 5·30	4·8124063,9	64924·16	12·296
		X (Khánmír)	·31	− ·43	− ·26		− ·69	44 54 8·75	4·7860151,3	61096·33	11·571
		XI (Chitror)	·32	+ ·18	+ ·13		+ ·31	86 29 45·95	4·9364583,4	86388·99	16·362
			·94				·00	180 0 0·00			
	220	VIII (Pata-i-Sháh)	·41	− ·35		− ·27	− ·62	35 13 49·67	4·7860151,3	61096·33	11·571
		IX (Kanduka)	·42	− ·17		+ ·41	+ ·24	90 56 3·38	5·0248818,8	105896·56	20·056
		XI (Chitror)	·41	+ ·71		− ·14	+ ·57	53 50 6·95	4·9319873,4	85504·18	16·194
			1·24				+ ·19	180 0 0·00			
134		X (Khánmír)	·22	+ ·87	− ·13		+ ·74	61 37 47·35	4·7780301,5	59983·27	11·360
		XI (Chitror)	·22	− ·23	+ ·30		+ ·07	46 7 27·39	4·6914406,1	49140·61	9·307
		XII (Monába)	·22	+ ·25	− ·17		+ ·08	72 14 45·26	4·8124063,9	64924·16	12·296
			·66				+ ·89	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
135		XI (Chitror)	·26	+2·51	+ ·48		+2·99	69 37 36·96	4·8289333,4	67442·45	12·773
		XII (Monába)	·25	+ ·73	− ·51		+ ·22	53 53 8·70	4·7643143,2	58118·49	11·007
		XIV (Wándia)	·26	+ ·31	+ ·03		+ ·34	56 29 14·34	4·7780301,5	59983·27	11·360
			·77				+3·55	180 0 0·00			
124		XIV (Wándia)	·35	+1·30	+ ·33		+1·63	63 9 22·73	4·8664308,6	73524·30	13·925
		XII (Monába)	·35	+1·44	− ·07		+1·37	61 54 54·33	4·8615404,3	72701·00	13·769
		XVI (Mália)	·34	+1·24	− ·26		+ ·98	54 55 42·94	4·8289333,4	67442·45	12·773
			1·04				+3·98	180 0 0·00			
123		XII (Monába)	·33	− ·81	+ ·25		− ·56	45 26 54·53	4·7791380,3	60136·48	11·389
		XVI (Mália)	·34	− ·74	+ ·10		− ·64	73 56 43·48	4·9090028,6	81096·64	15·359
		XV (Kákraji)	·34	−1·28	− ·35		−1·63	60 36 21·99	4·8664308,6	73524·30	13·925
			1·01				−2·83	180 0 0·00			
	221	X (Khánmír)	·25	− ·88		− ·07	− ·95	75 21 5·47	4·8526397,9	71226·20	13·490
		XII (Monába)	·25	− ·74		+ ·26	− ·48	62 46 27·28	4·8159955,2	65462·94	12·398
		XIII (Kesmára)	·24	− ·74		− ·19	− ·93	41 52 27·25	4·6914406,1	49140·61	9·307
			·74				−2·36	180 0 0·00			
	222	XIII (Kesmára)	·41	− ·91		− ·06	− ·97	64 5 10·93	4·9090028,4	81096·64	15·359
		XII (Monába)	·41	− ·32		+ ·24	− ·08	63 43 48·09	4·9076800,2	80850·00	15·313
		XV (Kákraji)	·41	+ ·40		− ·18	+ ·22	52 11 0·98	4·8526397,9	71226·20	13·490
			1·23				− ·83	180 0 0·00			
122		XVI (Mália)	·28	+ ·22	+ ·38		+ ·60	46 39 42·81	4·7712053,0	59048·01	11·183
		XV (Kákraji)	·28	+ ·26	− ·09		+ ·17	85 32 42·06	4·9081677,9	80940·85	15·330
		XVII (Rangpur)	·28	+ ·57	− ·29		+ ·28	47 47 35·13	4·7791380,3	60136·48	11·389
			·84				+1·05	180 0 0·00			
121		XV (Kákraji)	·23	− ·78	+ ·15		− ·63	52 5 54·30	4·7289670,2	53575·59	10·147
		XVII (Rangpur)	·23	−1·01	+ ·08		− ·93	67 28 54·46	4·7974112,8	62720·75	11·879
		XVIII (Chalarwa)	·23	− ·57	− ·23		− ·80	60 25 11·24	4·7712053,0	59048·01	11·183
			·69				−2·36	180 0 0·00			
120		XVII (Rangpur)	·21	− ·73	+ ·16		− ·57	67 51 22·46	4·7690545,6	58756·32	11·128
		XVIII (Chalarwa)	·20	− ·76	− ·03		− ·79	54 31 3·72	4·7131122,3	51654·98	9·783
		XX (Dúngarpur)	·20	−1·11	− ·13		−1·24	57 37 33·82	4·7289670,2	53575·59	10·147
			·61				−2·60	180 0 0·00			
119		XX (Dúngarpur)	·32	+ ·64	+ ·26		+ ·90	53 54 24·26	4·8434547,2	69735·63	13·208
		XVIII (Chalarwa)	·32	+ ·34	− ·02		+ ·32	83 11 3·09	4·9329313,6	85690·25	16·229
		XXI (Sápakra)	·32	+ ·98	− ·24		+ ·74	42 54 32·65	4·7690545,6	58756·32	11·128
			·96				+1·96	180 0 0·00			
	223	XVI (Mália)	·24	− ·49		+ ·49	·00	92 8 32·41	4·9007042,1	79561·73	15·069
		XV (Kákraji)	·23	− ·78		− ·12	− ·90	38 48 16·02	4·6980428,0	49893·37	9·450
		XIX (Pangasia)	·24	− ·29		− ·37	− ·66	49 3 11·57	4·7791380,3	60136·48	11·389
			·71				−1·56	180 0 0·00			
	224	XV (Kákraji)	·27	+1·04		+ ·03	+1·07	46 44 25·82	4·7643089,6	58117·77	11·007
		XIX (Pangasia)	·27	− ·16		+ ·29	+ ·13	47 43 26·73	4·7712053,1	59048·01	11·183
		XVII (Rangpur)	·27	+1·80		− ·32	+1·48	85 32 7·45	4·9007042,1	79561·73	15·069
			·81				+2·68	180 0 0·00			
	225	XIX (Pangasia)	·30	+ ·21		+ ·21	+ ·42	57 14 31·66	4·8228901,8	66510·50	12·597
		XVII (Rangpur)	·30	+1·04		+ ·02	+1·06	75 27 49·11	4·8839826,8	76556·61	14·499
		XXII (Virpur)	·29	+ ·56		− ·23	+ ·33	47 17 39·23	4·7643089,6	58117·77	11·007
			·89				+1·81	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
		XVII (Rangpur)	·24	− ·07		+ ·06	− ·01	63 39 45·27	4·8033750,0	63587·97	12·043
	226	XXII (Virpur)	·24	− ·87		+ ·08	− ·79	46 43 13·01	4·7131122,2	51654·98	9·783
		XX (Dúngarpur)	·25	− ·12		− ·14	− ·26	69 37 1·72	4·8228901,8	66510·50	12·597
			·73				−1·06	180 0 0·00			
		XXII (Virpur)	·32	+ ·36		+ ·09	+ ·45	70 37 42·27	4·8802972,7	75909·69	14·377
	227	XX (Dúngarpur)	·32	+ ·66		+ ·02	+ ·68	57 9 43·78	4·8299944,7	67607·43	12·804
		XXIV (Wánkáner)	·32	+ ·18		− ·11	+ ·07	52 12 33·95	4·8033750,0	63587·97	12·043
			·96				+1·20	180 0 0·00			
		XXIV (Wánkáner)	·38	− ·28		+ ·12	− ·16	56 24 51·37	4·8570041,3	71945·58	13·626
	228	XX (Dúngarpur)	·38	− ·13		− ·02	− ·15	62 4 7·00	4·8825394,1	76302·61	14·451
		XXIII (Chatrikhera)	·38	−1·50		− ·10	−1·60	61 31 1·63	4·8802972,7	75909·69	14·377
			1·14				−1·91	180 0 0·00			
		XXIII (Chatrikhera)	·42	− ·17		+ ·11	− ·06	68 50 38·37	4·9329313,6	85690·25	16·229
	229	XX (Dúngarpur)	·42	+ ·35		+ ·01	+ ·36	59 37 7·53	4·8990847,5	79265·60	15·012
		XXI (Sápakra)	·42	− ·43		− ·12	− ·55	51 32 14·10	4·8570041,3	71945·58	13·626
			1·26				− ·25	180 0 0·00			
		XXIII (Chatrikhera)	·40	+ ·47			+ ·47	76 35 11·88	4·9525915,5	89658·52	16·981
	230	XXIV (Wánkáner)	·39	+ ·48			+ ·48	47 32 16·12	4·8324962,4	67998·02	12·878
		XXV (Tarkia)	·40	− ·11			− ·11	55 52 32·00	4·8825394,1	76302·61	14·451
			1·19				+ ·84	180 0 0·00			
		XXIV (Wánkáner)	·39	− ·59			− ·59	58 21 57·85	4·8939666,3	78336·95	14·837
	231	XXV (Tarkia)	·39	− ·27			− ·27	44 36 33·70	4·8103283,6	64614·26	12·238
		XXVI (Kakána)	·39	−1·81			−1·81	77 1 28·45	4·9525915,5	89658·52	16·981
			1·17				−2·67	180 0 0·00			
		XXIII (Chatrikhera)	·37	− ·02			− ·02	33 27 54·88	4·8103283,5	64614·26	12·238
	232	XXIV (Wánkáner)	·38	− ·11			− ·11	105 54 14·37	5·0518868,1	112690·36	21·343
		XXVI (Kakána)	·37	+ ·04			+ ·04	40 37 50·75	4·8825394,1	76302·61	14·451
			1·12				− ·09	180 0 0·00			
		XXV (Tarkia)	·44	− ·36			− ·36	83 33 48·72	5·0002128,8	100049·03	18·949
	233	XXVI (Kakána)	·44	− ·20			− ·20	45 21 14·64	4·8551112,8	71632·70	13·567
		XXVII (Maidhar)	·44	− ·17			− ·17	51 4 56·64	4·8939666,3	78336·95	14·837
			1·32				− ·73	180 0 0·00			
		XXVI (Kakána)	·72	− ·18			− ·18	68 30 43·83	5·0458550,4	111136·07	21·048
	234	XXVII (Maidhar)	·71	− ·29			− ·29	54 35 35·17	4·9883293,4	97348·52	18·437
		XXVIII (Bháyásar)	·72	− ·19			− ·19	56 53 41·00	5·0002128,8	100049·03	18·949
			2·15				− ·66	180 0 0·00			
		XXVII (Maidhar)	·66	− ·94			− ·94	57 53 27·78	4·9953560,0	98936·38	18·738
	235	XXVIII (Bháyásar)	·66	−1·09			−1·09	50 1 45·00	4·9518920,9	89514·23	16·953
		XXIX (Chitália)	·67	− ·95			− ·95	72 4 47·22	5·0458550,4	111136·07	21·048
			1·99				−2·98	180 0 0·00			
		XXIX (Chitália)	·72	− ·10			− ·10	52 27 3·39	4·9872444,0	97105·62	18·391
	236	XXVIII (Bháyásar)	·73	−1·32			−1·32	73 40 10·37	5·0701789,0	117538·16	22·261
		XXX (Mumaiya)	·73	− ·96			− ·96	53 52 46·24	4·9953560,0	98936·38	18·738
			2·18				−2·38	180 0 0·00			
		XXVIII (Bháyásar)	·63	+1·27			+1·27	44 8 47·21	4·9229933,7	83751·65	15·862
	237	XXX (Mumaiya)	·64	− ·84			− ·84	81 59 47·08	5·0758244,5	119076·05	22·552
		XXXI (Trákura)	·64	−2·00			−2·00	53 51 25·71	4·9872444,0	97105·62	18·391
			1·91				−1·57	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
	238	XXXI (Trákura)	·71	+2·13			+2·13	60 56 2·02	5·0420017,2	110154·37	20·863
		XXX (Mumaiya)	·71	+1·76			+1·76	77 25 3·70	5·0899033,5	122999·50	23·295
		XXXII (Deo-ki-Galol)	·71	−1·94			−1·94	41 38 54·28	4·9229933,7	83751·65	15·862
			2·13				+1·95	180 0 0·00			
	239	XXXII (Deo-ki-Galol)	·60	+ ·32			+ ·32	55 5 11·84	4·9670948,4	92703·22	17·557
		XXX (Mumaiya)	·59	− ·24			− ·24	47 54 34·81	4·9237272,2	83893·29	15·889
		XXXIV (Konkáwáo)	·60	− ·44			− ·44	77 0 13·35	5·0420017,2	110154·37	20·863
			1·79				− ·36	180 0 0·00			
	240	XXX (Mumaiya)	·48	+ ·81			+ ·81	38 37 3·98	4·8245480,1	66764·86	12·645
		XXXIV (Konkáwáo)	·49	+ ·14			+ ·14	81 19 0·70	5·0242720,7	105747·97	20·028
		XXXIII (Jitori)	·48	−2·91			−2·91	60 3 55·32	4·9670948,4	92703·22	17·557
			1·45				−1·96	180 0 0·00			
	241	XXX (Mumaiya)	·85	+ ·39			+ ·39	60 10 40·19	5·0507929,1	112406·89	21·289
		XXIX (Chitália)	·85	+ ·30			+ ·30	54 42 14·66	5·0242720,8	105747·97	20·028
		XXXIII (Jitori)	·85	+2·20			+2·20	65 7 5·15	5·0701789,0	117538·16	22·261
			2·55				+2·89	180 0 0·00			
	242	XXIX (Chitália)	·79	+ ·24			+ ·24	76 54 43·96	5·1052779,2	127431·82	24·135
		XXXIII (Jitori)	·78	+ ·22			+ ·22	43 51 46·83	4·9574015,7	90657·05	17·170
		XXXV (Itria)	·78	+ ·38			+ ·38	59 13 29·21	5·0507929,1	112406·89	21·289
			2·35				+ ·84	180 0 0·00			
	243	XXXV (Itria)	1·36	− ·05			− ·05	66 29 58·01	5·1810132,6	151709·67	28·733
		XXXIII (Jitori)	1·36	− ·02			− ·02	63 7 10·54	5·1689588,4	147556·68	27·946
		XXXVI (Sakpur)	1·36	+ ·55			+ ·55	50 22 51·45	5·1052779,2	127431·82	24·135
			4·08				+ ·48	180 0 0·00			
	244	XXXVI (Sakpur)	1·49	+ ·14			+ ·14	51 32 6·55	5·1316810,6	135419·45	25·648
		XXXIII (Jitori)	1·50	+ ·54			+ ·54	67 9 39·22	5·2024665,8	159392·01	30·188
		XXXVII (Manáwa)	1·49	+1·06			+1·06	61 18 14·23	5·1810132,6	151709·67	28·733
			4·48				+1·74	180 0 0·00			
	245	XXXIII (Jitori)	·62	+ ·23			+ ·23	60 40 17·35	5·0721135,8	118062·93	22·360
		XXXIV (Konkáwáo)	·63	+ ·54			+ ·54	89 47 21·40	5·1316810,6	135419·45	25·648
		XXXVII (Manáwa)	·62	− ·50			− ·50	29 32 21·25	4·8245480,1	66764·86	12·645
			1·87				+ ·27	180 0 0·00			
	246	XXXIV (Konkáwáo)	·94	− ·34			− ·34	37 44 57·74	5·0104137,6	102426·83	19·399
		XXXVII (Manáwa)	·95	− ·03			− ·03	97 22 2·11	5·2199142,3	165925·92	31·425
		XXXVIII (Sarkala)	·95	− ·28			− ·28	44 53 0·15	5·0721135,8	118062·93	22·360
			2·84				− ·65	180 0 0·00			
	247	XXXIII (Jitori)	·87	+ ·18			+ ·18	22 34 56·36	5·0104137,8	102426·83	19·399
		XXXVII (Manáwa)	·88	− ·53			− ·53	126 54 24·05	5·3289514,6	213280·66	40·394
		XXXVIII (Sarkala)	·88	+ ·20			+ ·20	30 30 39·59	5·1316810,6	135419·45	25·648
			2·63				− ·15	180 0 0·00			
	248	XXXVII (Manáwa)	·82	− ·05			− ·05	59 35 5·41	5·0434803,8	110530·04	20·934
		XXXVIII (Sarkala)	·83	− ·07			− ·07	67 21 55·89	5·0729735,6	118296·96	22·405
		XXXIX (Nandivela)	·82	− ·12			− ·12	53 2 58·70	5·0104137,7	102426·83	19·399
			2·47				− ·24	180 0 0·00			
	249	XXXVIII (Sarkala)	·56	− ·02			− ·02	46 41 9·27	4·9104558,8	81368·42	15·411
		XXXIX (Nandivela)	·56	− ·05			− ·05	52 3 38·93	4·9454526,3	88196·76	16·704
		XL (Jákia)	·56	− ·04			− ·04	81 15 11·80	5·0434803,8	110530·04	20·934
			1·68				− ·11	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
	250	XXXIX (Nandivela)	·41	+ ·57			+ ·57	65 23 47·31	4·9153888,3	82297·91	15·587
		XL (Jákia)	·40	+ ·29			+ ·29	50 35 3·23	4·8446560,1	69928·79	13·244
		XLI (Nántej)	·41	+ ·67			+ ·67	64 1 9·46	4·9104558,8	81368·42	15·411
			1·22				+1·53	180 0 0·00			
	251	XL (Jákia)	·44	− ·43			− ·43	48 48 19·79	4·8596426,9	72384·01	13·709
		XLI (Nántej)	·45	− ·50			− ·50	72 22 30·43	4·9622686,9	91678·75	17·363
		XLII (Dangarwári)	·45	− ·49			− ·49	58 49 9·78	4·9153888,3	82297·91	15·587
			1·34				−1·42	180 0 0·00			

May, 1890.

W. H. COLE,

In charge of Computing Office.

KATTYWAR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	LXI (Akoria)	24 40 43·31	71 18 58·74	94 32 23·18	4·8160424,8	274 27 27·60	LXIV (Bhilgaon)
	" "	"	"	29 57 29·28	5·0433819,7	209 53 21·23	I (Viráwáh)
57	LXIV (Bhilgaon)	24 41 34·19	71 7 11·00	139 40 15·19	4·6982549,6	319 37 48·43	LXVI (Jhund)
	" "	"	"	354 12 47·90	5·0061437,4	174 13 33·88	I (Viráwáh)
	" "	"	"	65 20 26·32	5·0212179,3	245 13 15·41	II (Khársar)
	" "	"	"	39 9 40·38	5·2225406,5	219 1 47·38	III (Kálunjhar)
	LXVI (Jhund)	24 47 51·07	71 1 20·38	37 35 40·76	5·0144223,4	217 30 55·42	II (Khársar)
	I (Viráwáh)	24 24 54·47	71 9 1·65	118 23 56·60	5·0795327,7	298 16 2·08	" "
	" "	"	"	76 9 19·16	5·0759511,1	256 0 43·01	III (Kálunjhar)
	" "	"	"	359 52 47·33	5·2981896,5	179 52 49·17	IV (Iwália)
	" "	"	"	32 21 38·89	5·3424111,0	212 12 59·50	V (Bela)
	II (Khársar)	24 34 19·16	70 49 57·12	6 32 2·84	4·9355261,7	186 31 18·93	III (Kálunjhar)
58	III (Kálunjhar)	24 20 10·65	70 48 11·05	325 33 52·85	5·3138727,4	145 42 25·40	IV (Iwália)
	" "	"	"	0 37 21·76	5·1968362,7	180 37 14·23	V (Bela)
	IV (Iwália)	23 52 5·86	71 9 6·14	96 12 51·61	5·0750549,1	276 4 15·94	" "
	" "	"	"	56 6 16·80	5·0586757,0	235 59 24·56	VI (Dájka)
	" "	"	"	26 10 4·51	5·1004775,5	206 6 4·24	VIII (Pata-i-Sháh)
59	V (Bela)	23 54 11·88	70 47 52·62	343 3 35·44	4·9037409,7	163 5 16·80	VI (Dájka)
	" "	"	"	54 43 46·14	5·0246707,5	234 37 30·51	VII (Gángta)
60	VI (Dájka)	23 41 32·43	70 52 3·81	98 4 42·36	5·0447460,9	277 56 47·28	" "
	" "	"	"	321 13 7·33	4·8001218,3	141 15 57·60	VIII (Pata-i-Sháh)
	" "	"	"	43 43 15·15	4·8228639,7	223 39 57·13	IX (Kanduka)
	VII (Gángta)	23 44 5·53	70 32 22·49	314 48 12·75	4·9547568,4	134 52 48·39	" "
	VIII (Pata-i-Sháh)	23 33 24·78	70 59 8·72	90 48 26·28	4·9319873,4	270 42 18·97	" "
	" "	"	"	21 12 42·90	4·7928969,0	201 11 6·85	X (Khánmír)

Note.—Stations LXI (Akoria), LXIV (Bhilgaon) and LXVI (Jhund) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	VIII (Pata-i-Sháh)	23 33 24·78	70 59 8·72	55 34 36·20	5·0248818,8	235 28 22·66	XI (Chitror)
61	IX (Kanduka)	23 33 35·97	70 43 49·72	313 2 17·16	4·9364583,4	133 6 47·24	X (Khánmír)
	„ „	„	„	1 38 22·77	4·7860151,3	181 38 15·30	XI (Chitror)
	X (Khánmír)	23 23 51·36	70 55 7·60	88 12 38·18	4·8124063,9	268 8 1·57	„ „
	„ „	„	„	26 34 50·61	4·6914406,1	206 33 17·18	XII (Monába)
	„ „	„	„	311 13 44·89	4·8159955,2	131 17 14·10	XIII (Kesmára)
62	XI (Chitror)	23 23 30·84	70 43 30·95	314 15 29·18	4·7780301,5	134 18 31·70	XII (Monába)
	„ „	„	„	23 53 6·40	4·7643143,2	203 51 26·50	XIV (Wándia)
	XII (Monába)	23 16 35·86	70 51 11·75	269 19 44·71	4·8526397,9	89 24 46·61	XIII (Kesmára)
	„ „	„	„	80 25 22·75	4·8289333,4	260 20 41·10	XIV (Wándia)
	„ „	„	„	333 3 33·21	4·9090028,5	153 6 8·09	XV (Kákraji)
	„ „	„	„	18 30 28·07	4·8664308,5	198 28 49·66	XVI (Mália)
	XIII (Kesmára)	23 16 43·60	71 3 55·70	25 19 35·27	4·9076800,2	205 17 9·48	XV (Kákraji)
	XIV (Wándia)	„	„	323 30 4·18	4·8615404,2	143 33 6·38	XVI (Mália)
	XV (Kákraji)	23 4 39·35	70 57 45·28	92 29 45·76	4·7791380,2	272 25 33·48	„ „
	„ „	„	„	6 57 3·42	4·7712052,9	186 56 33·55	XVII (Rangpur)
	„ „	„	„	314 51 8·89	4·7974112,7	134 54 14·92	XVIII (Chalarwa)
	„ „	„	„	53 41 29·51	4·9007042,0	233 37 1·31	XIX (Pangasia)
	XVI (Mália)	23 5 4·94	70 47 1·77	319 5 16·57	4·9081677,8	139 8 58·14	XVII (Rangpur)
	„ „	„	„	4 34 6·13	4·6980427,9	184 33 49·50	XIX (Pangasia)
	XVII (Rangpur)	22 54 58·53	70 56 28·83	254 25 28·24	4·7289670,1	74 29 3·45	XVIII (Chalarwa)
	„ „	„	„	101 24 25·83	4·7643089,5	281 20 28·31	XIX (Pangasia)
	„ „	„	„	322 16 50·91	4·7131122,2	142 19 2·13	XX (Dúngarpur)
	„ „	„	„	25 56 36·42	4·8228901,7	205 54 35·77	XXII (Virpur)
	XVIII (Chalarwa)	22 57 20·81	71 5 41·08	19 57 59·53	4·7690545,5	199 56 36·15	XX (Dúngarpur)
	„ „	„	„	296 46 56·12	4·8434547,1	116 51 15·31	XXI (Sápakra)
	XIX (Pangasia)	22 56 52·11	70 46 19·25	338 35 0·27	4·8839826,7	158 36 56·25	XXII (Virpur)
	XX (Dúngarpur)	22 48 13·54	71 2 6·62	253 51 0·73	4·9329313,5	73 56 42·34	XXI (Sápakra)
	„ „	„	„	72 42 0·16	4·8033749,9	252 37 49·02	XXII (Virpur)
	„ „	„	„	313 28 8·68	4·8570041,2	133 31 44·17	XXIII (Chatrikhera)
	„ „	„	„	15 32 16·06	4·8802972,6	195 30 52·30	XXIV (Wánkáner)
	XXI (Sápakra)	22 52 9·05	71 16 46·83	22 24 27·82	4·8990847,4	202 22 22·96	XXIII (Chatrikhera)
	XXII (Virpur)	22 45 5·79	70 51 17·93	323 15 31·61	4·8299944,6	143 18 18·03	XXIV (Wánkáner)
	XXIII (Chatrikhera)	22 40 2·79	71 11 24·18	72 0 42·16	4·8825394,0	251 55 44·05	„ „
	„ „	„	„	355 25 29·88	4·8324962,3	175 25 52·08	XXV (Tarkia)
	„ „	„	„	38 32 46·91	5·0518868,0	218 27 59·89	XXVI (Kakána)
	XXIV (Wánkáner)	22 36 8·76	70 58 29·59	299 28 0·56	4·9525915,4	119 33 19·68	XXV (Tarkia)
	„ „	„	„	357 49 58·80	4·8103283,5	177 50 8·77	XXVI (Kakána)
	XXV (Tarkia)	22 28 51·10	71 12 22·02	74 56 45·59	4·8939666,2	254 51 37·61	„ „
	„ „	„	„	351 22 56·43	4·8551112,7	171 23 39·96	XXVII (Maidhar)

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XXVI (Kakána)	22 25 28·91	70 58 55·63	300 12 52·69	5·0002128,7	120 18 42·88	XXVII (Maidhar)
	„ „	„	„	8 43 37·24	4·9883293,3	188 42 37·63	XXVIII (Bháyásar)
	XXVII (Maidhar)	22 17 9·23	71 14 16·32	65 43 7·00	5·0458550,3	245 36 19·35	„ „
	„ „	„	„	7 49 38·56	4·9518920,8	187 48 49·66	XXIX (Chitália)
	XXVIII (Bháyásar)	22 9 35·34	70 56 18·48	295 38 5·01	4·9953559,9	115 44 1·77	„ „
	„ „	„	„	9 18 16·11	4·9872443,9	189 17 13·58	XXX (Mumaiya)
	„ „	„	„	53 27 3·95	5·0758244,4	233 20 42·18	XXXI (Trákura)
	XXIX (Chitália)	22 2 30·38	71 12 6·72	63 16 57·66	5·0701788,9	243 10 0·55	XXX (Mumaiya)
	„ „	„	„	8 34 42·15	5·0507929,0	188 33 35·85	XXXIII (Jitori)
	„ „	„	„	291 39 57·40	4·9574015,6	111 45 32·64	XXXV (Itria)
	XXX (Mumaiya)	21 53 45·63	70 53 31·75	107 17 25·86	4·9229933,6	287 12 8·53	XXXI (Trákura)
	„ „	„	„	29 52 21·45	5·0420017,1	209 48 45·80	XXXII (Deo-ki-Galol)
	„ „	„	„	303 20 41·59	5·0242720,7	123 26 29·85	XXXIII (Jitori)
	„ „	„	„	341 57 46·05	4·9670948,3	161 59 38·94	XXXIV (Konkáwáo)
	XXXI (Trákura)	21 57 51·72	70 39 22·11	348 8 11·26	5·0899033,4	168 9 50·81	XXXII (Deo-ki-Galol)
	XXXII (Deo-ki-Galol)	21 37 58·70	70 43 50·16	264 53 58·24	4·9237272,1	84 59 24·99	XXXIV (Konkáwáo)
	XXXIII (Jitori)	21 44 8·82	71 9 8·86	63 22 34·05	4·8245480,0	243 18 40·13	„ „
	„ „	„	„	232 25 23·46	5·1052779,1	52 32 2·65	XXXV (Itria)
	„ „	„	„	295 32 35·36	5·1810132,5	115 41 30·30	XXXVI (Sakpur)
	„ „	„	„	2 42 16·08	5·1316810,5	182 41 51·24	XXXVII (Manáwa)
	„ „	„	„	25 17 13·31	5·3289514,5	205 11 20·85	XXXVIII (Sarkala)
	XXXIV (Konkáwáo)	21 39 11·96	70 58 36·07	333 6 2·16	5·0721135,7	153 9 29·37	XXXVII (Manáwa)
	„ „	„	„	10 51 0·84	5·2199142,2	190 49 0·22	XXXVIII (Sarkala)
	XXXV (Itria)	21 56 58·01	71 27 1·80	346 2 3·28	5·1689588,3	166 4 23·11	XXXVI (Sakpur)
	XXXVI (Sakpur)	21 33 18·74	71 33 19·10	64 9 22·26	5·2024665,7	244 0 6·96	XXXVII (Manáwa)
	XXXVII (Manáwa)	21 21 48·18	71 8 1·25	55 47 26·31	5·0104137,6	235 42 1·32	XXXVIII (Sarkala)
	„ „	„	„	356 12 20·08	5·0729735,5	176 12 49·97	XXXIX (Nandivela)
	XXXVIII (Sarkala)	21 12 16·78	70 53 5·94	303 3 58·04	5·0434803,7	123 9 50·45	„ „
	„ „	„	„	349 45 7·87	4·9454526,2	169 46 7·44	XL (Jákia)
	XXXIX (Nandivela)	21 2 18·28	71 9 23·90	71 6 10·96	4·9104558,7	251 1 19·80	„ „
	„ „	„	„	5 42 23·24	4·8446560,0	185 41 57·04	XLI (Nántej)
	XL (Jákia)	20 57 56·54	70 55 51·52	301 36 23·43	4·9153888,2	121 40 47·17	„ „
	„ „	„	„	350 24 43·66	4·9622686,8	170 25 40·91	XLII (Dangarwári)
	XLI (Nántej)	20 50 48·60	71 8 10·58	49 18 16·29	4·8596426,8	229 14 51·14	„ „
	XLII (Dangarwári)	20 43 0·53	70 58 32·39				

May, 1890.

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KATTYWAR 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 levelling operations, wherever a junction between the two has been effected. The spirit levelled determinations are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the levelling operations are adjusted by simple proportion to accord with the latter. In the table the spirit levelled values are printed thus, **284·00**, &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. XXVI from Stn. XXV, page 77—J., to indicate that one set of adjustments ends and another begins. The trigonometrical heights always refer to the upper mark in the surface of the circular pillar on which the theodolite stood. Descriptions follow this table, exactly indicating the surfaces on which the levelling staff stood during the determinations of the spirit levelled heights.

The height given in the last column is the approximate height of the structure above the ground at the base of the station.

The heights of the initial stations above Mean Sea Level are taken from the Karáchi Longitudinal Series of the North-West Quadrilateral, and are as follows:—

LXI (Akoria) 55·9 feet; LXIV (Bhilgaon) 100·4 feet; LXVI (Jhund) 373·8 feet.

Astronomical Date 1856	Mean of Times of observation	Number and Name of 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	2 47	LXI (Akoria)	E 0 5 9·3	8	2·6	5·6	1092	61	·056	+428·8	484·7			
„ 30,31, Feb. 1	2 57	I (Viráwáh)	D 0 21 31·5	14	2·6	5·7								
„ 21,22,25	2 30	LXIV (Bhilgaon)	E 0 5 36·1	12	2·6	5·6	1002	60	·060	+385·1	485·5	485·0	485	1
„ 30,31, Feb. 1	2 47	I (Viráwáh)	D 0 20 30·1	14	2·6	5·7								

Note.—Stations LXI (Akoria) and LXIV (Bhilgaon) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

Astronomical Date 1856	Astronomical Date: Mean of Times of observation	Number and Name of 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. 15,16,17	2 36	II (Khársar)	D 0 9 1·2	12	2·6	5·6	1187	80	·067	− 12·9	484·8			
„ 30,31, Feb. 1	3 10	I (Viráwáh)	D 0 8 16·4	12	3·0	5·7								
„ 21,22,25	2 47	LXIV (Bhilgaon)	E 0 5 12·4	18	2·6	5·6	1038	58	·056	+ 397·0	497·4			
„ 15,16,17	2 45	II (Khársar)	D 0 20 47·1	12	2·6	5·6								
„ 18,19	3 16	LXVI (Jhund)	D 0 3 29·7	16	2·6	5·6	1021	59	·058	+ 124·2	498·0	497·8	498	2
„ 16,17	2 45	II (Khársar)	D 0 11 45·2	12	2·6	5·6								
„ 30,31, Feb. 1	3 10	I (Viráwáh)	D 0 8 16·4	12	3·0	5·7	1187	80	·067	+ 12·9	498·0			
„ 15,16,17	2 36	II (Khársar)	D 0 9 1·2	12	2·6	5·6								
„ 21,22,25	3 4	LXIV (Bhilgaon)	E 0 9 54·1	16	2·7	5·6	1649	105	·064	+1066·1	1166·5			
„ 11,12	2 9	III (Kálunjhar)	D 0 34 0·5	8	2·6	5·6								
„ 31, Feb. 1	2 44	I (Viráwáh)	E 0 11 13·6	10	2·7	5·7	1177	82	·070	+ 684·2	1169·2	1168·2	1169	*
„ 11,12	1 42	III (Kálunjhar)	D 0 28 16·1	8	2·6	5·6								
„ 15,16,17	2 41	II (Khársar)	E 0 20 27·8	14	2·7	5·6	852	55	·065	+ 671·0	1168·8			
„ 11,12	2 12	III (Kálunjhar)	D 0 33 3·2	8	2·6	5·6								
„ 31, Feb. 1	2 59	I (Viráwáh)	D 0 17 42·5	10	2·7	5·7	1963	125	·064	− 195·5	289·5			
Feb. 8,9	2 30	IV (Iwália)	D 0 10 56·7	10	2·6	5·6								
Jan. 11,12	2 10	III (Kálunjhar)	D 0 29 37·0	10	2·6	5·6	2036	131	·064	− 885·9	282·3	285·3	287	5
Feb. 8,9	3 19	IV (Iwália)	D 0 0 3·0	10	2·6	5·6								
„ 4,5,6	3 4	V (Bela)	D 0 22 20·5	12	2·6	5·6	1174	71	·060	− 472·1	284·1			
„ 8,9	2 48	IV (Iwália)	E 0 4 57·9	12	2·6	5·6								
Jan. 31, Feb. 1	3 19	I (Viráwáh)	D 0 11 26·9	10	2·6	5·7	2174	146	·067	+ 273·9	758·9			
Feb. 4,5,6	2 58	V (Bela)	D 0 20 0·5	12	2·6	5·6								
Jan. 11,12	2 30	III (Kálunjhar)	D 0 20 28·6	8	2·6	5·6	1555	97	·062	− 414·8	753·4	756·8	758	5
Feb. 4,5,6, Mar. 5	2 45	V (Bela)	D 0 2 21·0	16	2·7	5·6								
„ 8,9	2 48	IV (Iwália)	E 0 4 57·9	12	2·6	5·6	1174	71	·060	+ 472·1	758·0			
„ 4,5,6	3 4	V (Bela)	D 0 22 20·5	12	2·6	5·6								
„ 29, Mar. 1	2 52	IV (Iwália)	D 0 13 25·0	12	2·6	5·8	1131	53	·047	− 158·9	126·4			
„ 26,27,28	2 49	VI (Dájka)	D 0 3 51·7	12	2·6	5·4						124·4	126	*
Mar. 3,4,5	2 56	V (Bela)	D 0 33 11·2	14	2·6	5·6	791	46	·058	− 634·5	122·3			
Feb. 26,27,28	2 52	VI (Dájka)	E 0 21 16·5	12	2·6	5·4								
„ 8,9	3 8	IV (Iwália)	D 0 9 22·0	12	2·6	5·6	1245	71	·057	− 3·1	282·2			
„ 15,18,21,23	2 51	VIII (Pata-i-Sháh)	D 0 9 11·9	20	2·6	5·7						281·6	284·00	5
„ 26,27,28	2 54	VI (Dájka)	E 0 3 28·5	20	10·4	5·4	623	− 7	·011	+ 156·5	280·9			
„ 21,23	2 51	VIII (Pata-i-Sháh)	D 0 13 26·0	12	13·2	5·7								
„ 15,16,18,21,23	2 41	VIII (Pata-i-Sháh)	D 0 3 34·1	22	2·6	5·7	613	33	·054	+ 21·1	305·1	305·1	304·51	5
Apr. 1,2	3 3	X (Khánmír)	D 0 5 54·0	10	2·6	5·6								

NOTE.—Stations LXIV (Bhilgaon) and LXVI (Jhund) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.
* No pillars built at these stations, see descriptions, page 4—J.

Astronomical Date 1856	Mean of Times of observation	Number and Name of 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. 21,22	2 59	X (Khánmír)	D 0 21 8·9	8	2·6	5·6	486	27	·056	−247·7	56·8	56·8	56·72	5
„ 11,12,13	2 51	XII (Monába)	E 0 13 30·5	12	2·6	5·6								
„ 12,13	2 51	XII (Monába)	D 0 2 31·5	10	2·6	5·6	666	8	·012	+ 59·7	116·4	116·4	116·37	5
„ 17	3 3	XIV (Wándia)	D 0 8 36·9	4	2·6	5·6								
Feb. 15,16,18,21,23	3 5	VIII (Pata-i-Sháb)	D 0 1 11·1	20	3·2	5·7	1047	55	·053	+206·7	490·7			
Mar. 14,15	3 5	XI (Chitror)	D 0 14 38·5	8	2·6	6·2								
(1)	3 13	X (Khánmír)	E 0 4 55·4	16	3·2	5·6	642	35	·055	+185·3	489·8			
(2)	3 9	XI (Chitror)	D 0 14 45·8	16	2·6	6·2						490·0	490	*
Nov. 12,13	2 47	XII (Monába)	E 0 20 23·6	8	3·0	5·6	593	37	·062	+433·9	490·6			
„ 19,20	3 5	XI (Chitror)	D 0 29 23·9	8	2·6	6·2								
„ 17	3 13	XIV (Wándia)	E 0 17 31·5	4	3·2	5·6	574	25	·044	+372·6	489·0			
„ 19,20	2 57	XI (Chitror)	D 0 26 36·8	8	2·6	6·2								
Feb. 26,27,28	3 2	VI (Dájka)	E 0 12 29·3	14	2·6	5·4	657	27	·041	+341·6	467·9			
Mar. 8,10,12	3 12	IX (Kanduka)	D 0 22 50·2	14	2·8	5·6								
Feb. 18,21	3 21	VIII (Pata-i-Sháb)	E 0 0 44·2	10	2·6	5·7	845	30	·036	+184·2	468·2			
Mar. 10,12	2 57	IX (Kanduka)	D 0 13 45·0	8	10·6	5·6						467·7	468	12
Apr. 1,2	3 5	X (Khánmír)	D 0 0 7·5	12	2·6	5·6	854	35	·041	+164·0	468·5			
Mar. 8,10,12	3 37	IX (Kanduka)	D 0 13 10·7	14	2·6	5·6								
„ 14,15	2 43	XI (Chitror)	D 0 6 17·9	8	2·6	6·2	604	17	·028	− 23·9	466·1			
„ 8,10,12	3 27	IX (Kanduka)	D 0 3 32·6	14	3·2	5·6								
Feb. 4,5,6, Mar. 4,5	3 12	V (Bela)	D 0 25 26·6	20	2·7	5·6	1046	65	·062	−545·4	212·8			
Mar. 6,7	2 57	VII (Gángta)	E 0 9 59·0	8	2·6	5·6								
Feb. 26,27,28	3 25	VI (Dájka)	D 0 6 14·9	18	2·6	5·4	1096	31	·028	+ 79·1	205·4	210·7	211	5
Mar. 6,7	3 8	VII (Gángta)	D 0 11 8·2	8	3·5	5·6								
„ 8,10,12	3 26	IX (Kanduka)	D 0 16 21·9	12	2·6	5·6	891	52	·058	−253·9	213·8			
„ 6,7	3 10	VII (Gángta)	E 0 3 0·3	8	2·6	5·6								
Nov. 11, 12, 13	3 24	XII (Monába)	D 0 6 12·8	14	2·6	5·6	727	5	·007	− 2·0	54·7			
„ 8,10	3 36	XVI (Mália)	D 0 6 1·5	8	2·6	5·7						54·0	53·57	18
„ 17	2 36	XIV (Wándia)	D 0 8 46·9	4	2·6	5·6	718	20	·028	− 63·1	53·3			
„ 8,10	2 49	XVI (Mália)	D 0 2 48·9	10	2·6	5·7								
„ 21,22	2 50	X (Khánmír)	D 0 16 28·6	8	2·6	5·6	647	36	·056	−219·6	84·9			
„ 23,24	2 50	XIII (Kesmára)	E 0 6 35·1	10	2·6	5·6								
„ 12,13	2 56	XII (Monába)	D 0 4 21·3	10	2·6	5·6	704	17	·024	+ 28·7	85·4	84·3	84	5
„ 23,24	3 13	XIII (Kesmára)	D 0 7 7·1	10	2·6	5·6								
„ 25,26,27	3 1	XV (Kákraji)	D 0 7 9·4	14	2·6	5·6	799	28	·035	− 19·3	82·6			
„ 23,24	3 1	XIII (Kesmára)	D 0 5 30·8	10	2·6	5·6								

(1) The mean of observations taken on 1st and 2nd April, and 21st and 22nd November, 1856.
(2) Do. do. 14th and 15th March, and 19th and 20th November, 1856.
* Not forthcoming.

Astronomical Date 1856	Mean of Times of observation	Number and Name of 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. 11,12,18	3 10	XII (Monába)	D 0 4 25·9	14	2·6	5·6	801	27	·034	+ 45·6	102·3			
„ 25,26	3 0	XV (Kákraji)	D 0 8 18·1	14	2·6	5·6								
(1)	3 38	XVI (Mália)	D 0 2 20·7	26	3·3	5·6	594	0	·000	+ 47·8	101·4	102·7	103	36
(2)	3 29	XV (Kákraji)	D 0 7 48·2	45	3·2	5·5								
„ 23,24	3 1	XIII (Kesmára)	D 0 5 30·8	10	2·6	5·6	799	28	·035	+ 19·3	104·5			
„ 25,26,27	3 1	XV (Kákraji)	D 0 7 9·4	14	2·6	5·6								
(3)	3 26	XV (Kákraji)	D 0 0 47·1	34	3·3	5·5	583	−13	·022	+ 76·0	178·7			
(4)	3 21	XVII (Rangpur)	D 0 9 38·3	42	3·2	5·5								
(5)	3 30	XIX (Pangasia)	D 0 1 26·1	20	3·2	5·5	574	−14	·024	+ 62·8	180·1	179·4	179	16
(6)	3 17	XVII (Rangpur)	D 0 8 52·1	32	3·2	5·5								
(7)	3 33	XVI (Mália)	D 0 0 18·3	31	3·2	5·6	493	−25	·051	+ 63·7	117·3			
(8)	3 20	XIX (Pangasia)	D 0 9 4·7	30	3·2	5·5								
(6)	3 17	XVII (Rangpur)	D 0 8 52·1	32	3·2	5·5	574	−14	·024	− 62·8	115·9	116·6	117	20
(5)	3 30	XIX (Pangasia)	D 0 1 26·1	20	3·2	5·5								
Nov. 27	3 42	XV (Kákraji)	E 0 1 2·0	4	2·6	5·6	620	5	·008	+114·5	217·2			
„ 29,30	3 41	XVIII (Chalarwa)	D 0 11 31·1	10	2·6	5·6								
1852-53														
Jan. 17	4 27	XVII (Rangpur)	D 0 2 4·6	4	4·3	5·4	530	− 6	·011	+ 39·0	218·4	217·8	218	16
Dec. 16	4 22	XVIII (Chalarwa)	D 0 7 6·9	4	3·8	5·4								
Jan. 17	2 52	XVII (Rangpur)	E 0 10 49·7	6	3·7	5·4	510	1	·002	+228·0	407·4			
Dec. 25	3 46	XX (Dúngarpur)	D 0 19 29·6	4	4·0	5·4								
„ 16	3 1	XVIII (Chalarwa)	E 0 6 4·9	4	3·9	5·4	581	15	·026	+184·1	401·9	404·7	404	*
„ 25	3 10	XX (Dúngarpur)	D 0 15 26·2	6	4·3	5·4								
„ 16	3 21	XVIII (Chalarwa)	D 0 1 4·3	4	6·9	5·4	689	− 7	·010	+ 95·3	313·1			
Jan. 6	3 53	XXI (Sápakra)	D 0 10 36·8	4	3·8	5·4								
Dec. 25	3 18	XX (Dúngarpur)	D 0 10 6·9	4	3·8	5·4	847	39	·046	− 90·9	313·8	313·5	313	26
Jan. 6,7	3 13	XXI (Sápakra)	D 0 2 49·3	8	3·9	5·4								
„ 17	3 40	XVII (Rangpur)	D 0 2 21·7	4	3·8	5·4	657	−18	·027	+ 67·7	247·1			
„ 18	3 31	XXII (Virpur)	D 0 9 21·7	4	3·9	5·4								
Dec. 25	3 37	XX (Dúngarpur)	D 0 13 25·2	4	3·8	5·4	628	15	·024	−154·4	250·3	248·7	248	5
Jan. 18	2 43	XXII (Virpur)	E 0 3 15·7	4	3·7	5·4								
(9)	3 24	XIX (Pangasia)	D 0 0 33·2	18	3·2	5·5	756	−30	·040	+141·5	258·1 †			
(10)	3 23	XXII (Virpur)	D 0 13 15·6	24	3·2	5·5								

(1) The mean of observations taken on 4th and 9th April, 1854, and 7th, 8th, and 10th November, 1856. (2) The mean of observations taken on 10th, 11th, 15th, 16th and 17th April, 1854, and 25th, 26th, and 27th November, 1856. (3) The mean of observations taken on 15th, 16th, and 17th April, 1854, and 25th, 26th and 27th November, 1856. (4) The mean of observations taken on 20th and 23rd April, 1854, and 1st, 2nd and 5th December, 1856. (5) The mean of observations taken on 27th and 28th April, 1854, and 14th December, 1856. (6) The mean of observations taken on 23rd and 24th April, 1854, and 2nd and 5th December, 1856. (7) The mean of observations taken on 9th April, 1854, and 8th and 10th November, 1856. (8) The mean of observations taken on 27th and 28th April, 1854, and 6th November, and 14th December, 1856. (9) The mean of observations taken on 27th and 28th April, 1854, and 14th December 1856. (10) The mean of observations taken on 26th April, 1854, and 16th December, 1856. * Not forthcoming. † Rejected.

Astronomical Date 1852-53		Mean of Times of observation	Number and Name of 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
Dec.	25	3 24	XX (Dúngarpur)	D 0 1 47·3	4	3·6	5·4	711	33	·046	+ 77·0	481·7	481·3	481	8
Jan.	21	3 10	XXIII (Chatrikhera)	D 0 9 8·3	6	3·8	5·5								
„	6	3 5	XXI (Sápakra)	E 0 1 11·0	6	3·7	5·4	783	31	·040	+167·6	481·1			
„	21	3 21	XXIII (Chatrikhera)	D 0 13 21·4	4	3·7	5·5								
Jan.	20	2 42	XXIV (Wánkáner)	D 0 11 0·4	6	3·8	5·4	754	46	·061	−120·0	481·1			
„	21	3 41	XXIII (Chatrikhera)	D 0 0 11·7	4	3·8	5·5								
Dec.	27	2 55	XX (Dúngarpur)	E 0 3 18·1	4	3·7	5·4	750	45	·060	+196·0	600·7	601·2	601	5
Jan.	20	2 49	XXIV (Wánkáner)	D 0 14 26·9	4	3·7	5·4								
„	18	2 53	XXII (Virpur)	E 0 12 39·1	4	3·9	5·4	668	22	·033	+352·7	601·4			
„	20	2 58	XXIV (Wánkáner)	D 0 23 13·3	4	3·9	5·4								
„	21	3 41	XXIII (Chatrikhera)	D 0 0 11·7	4	3·8	5·5	754	46	·061	+120·0	601·4			
„	20	2 42	XXIV (Wánkáner)	D 0 11 0·4	6	3·8	5·4								
„	21	3 29	XXIII (Chatrikhera)	E 0 15 5·3	4	3·8	5·5	672	38	·057	+398·2	879·5	879·4	877·66	5
„	24	3 0	XXV (Tarkia)	D 0 25 10·9	6	3·7	5·5								
„	20	3 7	XXIV (Wánkáner)	E 0 4 8·0	6	3·8	5·4	886	55	·062	+278·1	879·3			
„	24	2 51	XXV (Tarkia)	D 0 17 11·8	4	3·8	5·5								
„	20	3 20	XXIV (Wánkáner)	D 0 8 7·5	6	3·8	5·4	639	20	·031	− 57·2	544·0	544·9	545·68	*
„	26	3 7	XXVI (Kakána)	D 0 2 2·3	4	3·8	5·4								
„	24	3 16	XXV (Tarkia)	D 0 20 26·8	6	3·9	5·5	774	43	·056	−333·6	545·8			
„	26,27	3 16	XXVI (Kakána)	E 0 8 50·1	10	3·8	5·4								
„	27	3 16	XXVI (Kakána)	E 0 12 6·8	4	3·8	5·4	989	36	·036	+576·8	1122·5	1117·9	1118	5
„	31	3 31	XXVII (Maidhar)	D 0 27 31·7	4	3·8	5·4								
„	24	3 7	XXV (Tarkia)	E 0 6 0·4	4	3·8	5·5	708	41	·058	+235·6	1113·3			
„	31	3 5	XXVII (Maidhar)	D 0 16 36·3	4	3·8	5·4								
„	27	2 54	XXVI (Kakána)	E 0 4 4·2	6	3·8	5·4	962	46	·048	+322·2	867·9	868·1	868	5
„	29	2 55	XXVIII (Bháyásar)	D 0 18 41·3	4	3·8	5·4								
„	31	3 13	XXVII (Maidhar)	D 0 15 53·6	4	3·8	5·4	1098	62	·056	−249·6	868·3			
„	29	3 32	XXVIII (Bháyásar)	D 0 0 27·2	4	3·7	5·4								
„	31	3 20	XXVII (Maidhar)	D 0 17 41·3	6	3·8	5·4	884	39	·044	−284·1	833·8	834·0	834	5
Feb.	3	3 16	XXIX (Chitália)	E 0 4 7·8	4	3·9	5·5								
Jan.	29	3 20	XXVIII (Bháyásar)	D 0 8 35·4	6	3·8	5·4	978	48	·049	− 33·9	834·2			
Feb.	3	3 7	XXIX (Chitália)	D 0 6 14·2	4	3·8	5·5								
Apr.	25	3 37	XXVIII (Bháyásar)	D 0 19 4·1	4	3·8	5·4	960	45	·047	−332·1	536·0	536·2	537	4
„	15,16	3 50	XXX (Mumaiya)	E 0 4 26·7	10	3·9	5·4								
„	28	3 31	XXIX (Chitália)	D 0 17 33·4	4	3·6	5·4	1161	53	·046	−297·6	536·4			
„	15,16	3 50	XXX (Mumaiya)	D 0 0 8·9	10	3·7	5·4								

* Not forthcoming.

Astronomical Date 1853		Mean of Times of observation	Number and Name of 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.	26	2 52	XXVIII (Bháyásar)	D 0 17 11·9	4	3·7	5·4	1177	59	·050	−288·5	579·6			
„	23	3 25	XXXI (Trákura)	D 0 0 32·3	6	3·9	5·4						579·3	580	4
„	16	3 28	XXX (Mumaiya)	D 0 4 35·5	4	3·6	5·4	828	38	·046	+ 42·7	578·9			
„	23	3 9	XXXI (Trákura)	D 0 8 5·9	4	3·7	5·4								
„	28	2 52	XXIX (Chitália)	D 0 15 19·5	4	3·8	5·4	1111	34	·031	−215·1	618·9			
Mar.	24	3 27	XXXIII (Jitori)	D 0 2 10·3	4	3·7	5·4						619·2	620	5
Apr.	16	3 14	XXX (Mumaiya)	D 0 5 35·8	4	3·8	5·4	1045	24	·023	+ 83·3	619·5			
Mar.	25	3 59	XXXIII (Jitori)	D 0 11 8·5	6	*0·2	5·4								
Apr.	16	3 40	XXX (Mumaiya)	D 0 9 12·3	4	3·8	5·4	1088	51	·047	− 29·9	506·3			
„	20	3 18	XXXII (Deo-ki-Galol)	D 0 7 20·4	6	3·7	5·5								
(1)		3 48	XXXI (Trákura)	D 0 11 4·7	14	3·8	5·4	1216	68	·056	− 72·7	506·6	508·3	509	4
(2)		3 5	XXXII (Deo-ki-Galol)	D 0 7 1·1	10	3·8	5·5								
Apr.	8	4 20	XXXIV (Konkáwáo)	D 0 11 15·0	6	†0·2	5·4	829	23	·028	−111·4	512·0			
„	21	3 20	XXXII (Deo-ki-Galol)	D 0 1 57·0	6	4·0	5·5								
„	16	3 3	XXX (Mumaiya)	D 0 3 51·8	4	3·9	5·4	916	40	·044	+ 85·2	621·4			
„	5	3 29	XXXIV (Konkáwáo)	D 0 10 11·1	6	3·9	5·4								
„	21	3 20	XXXII (Deo-ki-Galol)	D 0 1 57·0	6	4·0	5·5	829	23	·028	+111·4	617·9	621·5	622	30
„	8	4 20	XXXIV (Konkáwáo)	D 0 11 15·0	6	†0·2	5·4								
Mar.	24	4 8	XXXIII (Jitori)	D 0 5 2·1	4	3·8	5·4	660	14	·021	+ 6·1	625·3			
Apr.	5	2 56	XXXIV (Konkáwáo)	D 0 5 39·8	4	3·7	5·4								
„	28	3 14	XXIX (Chitália)	D 0 1 9·5	4	3·7	5·4	896	45	·050	+148·6	‡ 982·6			
„	30	3 54	XXXV (Itria)	D 0 12 25·1	8	3·8	5·4								
Mar.	24	3 31	XXXIII (Jitori)	D 0 0 26·0	4	3·7	5·4	1260	34	·027	+353·7	972·9	971·6	972	1
Apr.	30	3 19	XXXV (Itria)	D 0 19 30·9	4	3·8	5·4								
Dec.	12,13	2 50	XXXVI (Sakpur)	D 0 2 48·4	10	2·3	5·4	1458	92	·063	+338·6	970·2			
„	10	2 50	XXXV (Itria)	D 0 18 32·9	4	3·8	5·4								
Mar.	24	3 58	XXXIII (Jitori)	D 0 11 27·8	4	3·1	5·4	1499	48	·032	+ 12·4	631·6			
May	6	3 21	XXXVI (Sakpur)	D 0 12 0·6	6	3·8	5·4						633·0	634	1
Dec.	10	2 50	XXXV (Itria)	D 0 18 32·9	4	3·8	5·4	1458	92	·063	−338·6	634·3			
„	12,13	2 50	XXXVI (Sakpur)	D 0 2 48·4	10	2·3	5·4								
Mar.	24	4 27	XXXIII (Jitori)	D 0 4 58·7	4	3·8	5·4	1338	71	·054	+198·0	817·2			
„	28	3 39	XXXVII (Manáwa)	D 0 15 1·9	4	3·7	5·4								
Apr.	5	3 16	XXXIV (Konkáwáo)	D 0 3 14·6	4	3·8	5·4	1167	59	·051	+190·5	812·0	814·6	815	5
Mar.	28	3 26	XXXVII (Manáwa)	D 0 14 20·3	4	3·8	5·4								
May	6	3 1	XXXVI (Sakpur)	D 0 8 2·4	4	3·7	5·4	1575	94	·060	+165·2	‡ 794·0			
Mar.	30	4 5	XXXVII (Manáwa)	D 0 15 10·0	4	3·7	5·4								

(1) The mean of observations taken on 23rd April, and 5th and 6th December, 1853.
(2) Ditto ditto 20th ditto 3rd December, 1853.
* This height is to be combined with negative sign on account of change in the height of the pillar at Station XXX (Mumaiya).
† These heights are to be combined with negative signs on account of change in the height of the pillar at Station XXXII (Deo-ki-Galol). ‡ Rejected.

Astronomical Date 1853		Mean of Times of observation	Number and Name of 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.	5	3 59	XXXIV (Konkáwáo)	E 0 18 42·6	6	3·8	5·4	1640	94	·057	+1489·0	2110·5	2109·4	2110	5
„	1	3 17	XXXVIII (Sarkala)	D 0 42 58·9	6	3·8	5·4								
Feb.	26	3 25	XXXVII (Manáwa)	E 0 35 50·9	4	3·8	5·4	1012	55	·054	+1293·7	2108·3			
Apr.	1	3 3	XXXVIII (Sarkala)	D 0 50 58·9	4	3·8	5·4								
Feb.	26	3 43	XXXVII (Manáwa)	E 0 18 9·7	4	3·8	5·4	1169	65	·056	+ 924·9	1739·5	1736·8	1738	5
Mar.	4	3 37	XXXIX (Nandivela)	D 0 35 35·5	4	3·7	5·5								
Feb.	28	3 43	XXXVIII (Sarkala)	D 0 19 38·8	4	3·8	5·4	1092	71	·065	− 375·4	1734·0			
Mar.	4	3 43	XXXIX (Nandivela)	E 0 3 42·2	4	3·8	5·5								
Feb.	28	3 37	XXXVIII (Sarkala)	D 0 56 3·7	4	3·8	5·4	871	44	·051	−1269·4	840·0	840·3	842	5
Mar.	8	3 7	XL (Jákia)	E 0 42 52·6	4	3·8	5·5								
„	4	3 52	XXXIX (Nandivela)	D 0 43 42·2	6	3·8	5·5	804	56	·070	− 896·2	840·6			
„	8	3 14	XL (Jákia)	E 0 32 0·7	4	3·7	5·5								
„	4	3 41	XXXIX (Nandivela)	D 1 25 29·7	10	3·8	5·5	691	40	·058	−1634·3	102·5	104·7	106	8
„	9	3 2	XLI (Nántej)	E 1 15 9·2	4	3·7	5·5								
„	8	3 20	XL (Jákia)	D 0 36 49·7	4	3·8	5·5	814	39	·048	− 733·4	106·9			
„	9	3 9	XLI (Nántej)	E 0 24 22·5	4	2·3	5·5								
„	8	3 27	XL (Jákia)	D 0 34 37·7	4	3·8	5·5	906	53	·058	− 743·9	96·4	94·8	96	†
„	11	3 14	XLII (Dangarwári)	E 0 21 9·5	6	3·8	5·5								
„	9	4 20	XLI (Nántej)	D 0 6 46·3	4	3·8	5·5	715	−11	·015	− 11·6	93·1			
„	11	4 50	XLII (Dangarwári)	D 0 5 40·3	6	3·9	5·5								
1855 Mar.	13	3 38	XLII (Dangarwári)	D 0 18 56·2	6	4·7	5·1	160	− 3	·019	− 82·1	12·7	12·7	14·28	
„	12	3 26	* Diu Level Datum Tower	E 0 15 53·1	8	3·9	4·8								

* This is an auxiliary Station for the determination of height only, and its data are not published in this volume. † Not forthcoming.

Description of Spirit-levelled Points.

When determining the Spirit-levelled heights, given on pages 74—J. to 77—J., the levelling staff stood on the surfaces hereafter described.

VIII (Pata-i-Sháh)	On a peg at the foot of the station, height = 278·97 feet. To this value, 5·03 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 284·00 feet.
X (Khánmír)	On a peg at the side of the station, height = 300·84 feet. To this value, 3·67 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 304·51 feet.
XII (Monába)	On a peg close to the pillar, height = 55·15 feet. To this value, 1·57 feet (the height of the upper surface of the pillar above this peg) being added, the height of the upper surface of the pillar was found to be 56·72 feet.
XIV (Wándia)	On the upper mark-stone.
XVI (Mália)	On a peg at the side of the station, height = 38·77 feet. To this value, 14·80 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 53·57 feet.
XXV (Tarkia) XXVI (Kakána)	On the upper surface of the circular pillar.

For further particulars of these stations, see pages 4—J. to 7—J.

The height of Diu Level Datum Tower above mean sea level, *viz.*, 14·28 feet, refers to the upper surface of the slab, on which is engraved the numeral 14, which is flush with the stone pavement of the tower. The height was obtained by direct comparison with the adjoining Tide Gauge, *vide* pages XI—J. and XII—J.

June, 1890.

W. H. COLE,
In charge of Computing Office.

KATTYWAR MERIDIONAL SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XX (Dúngarpur)

Lat. N. 22° 48′ 13″·54; Long. E. 71° 2′ 6″·62 = 4h 44m 8s·4; Height above Mean Sea Level, 404 feet.
December 1852; observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed	δ Ursæ Minoris (West and East).
Mean Right Ascension 1852·0	18h 20m 5s
Mean North Polar Distance 1852·0	3° 24′ 6″·38
Local Mean Times of Elongation, December 22	Western 6h 9m; Eastern 18 18

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. 22	W.	180 1	+ 3 41 16·13	14 28	+ 0 26·45	+ 3 41 42·58	+ 3 40 14·07	25 48	+ 1 24·14	+ 3 41 38·21
		&	41 20·83	11 59	0 18·13	38·96	40 24·10	23 54	1 12·17	36·27
		0 1	41 28·27	9 12	0 10·65	38·92	41 43·27	2 48	0 0·99	44·26
			41 25·17	11 12	0 15·80	40·97	41 41·77	0 53	0 0·10	41·87
„ 22	E.	180 1	− 3 40 11·84	20 17	− 0 51·80	− 3 40 63·64	− 3 39 15·76	30 5	− 1 53·66	− 3 40 69·42
		&	40 16·87	18 27	0 42·85	59·72	39 21·90	28 23	1 41·17	63·07
		0 1	41 5·83	1 3	0 0·14	65·97	40 54·67	9 18	0 10·89	65·56
			41 4·30	3 11	0 1·28	65·58	41 6·63	7 0	0 6·19	72·82
„ 23	W.	190 12	+ 3 41 1·03	17 3	+ 0 36·72	+ 3 41 37·75	+ 3 40 22·33	24 42	+ 1 17·11	+ 3 41 39·44
		&	41 6·43	15 24	0 29·94	36·37	40 28·00	23 24	1 9·19	37·19
		10 12	41 35·03	1 30	0 0·29	35·32	41 32·47	8 25	0 8·96	41·43
			41 32·40	0 3	0 0·00	32·40	41 30·67	7 5	0 6·34	37·01
„ 23	E.	190 12	− 3 39 57·94	22 33	− 1 3·95	− 3 40 61·89	− 3 39 0·97	31 56	− 2 8·08	− 3 40 69·05
		&	40 13·20	21 9	0 56·25	69·45	39 14·27	30 22	1 55·83	70·10
		10 12	40 59·87	3 32	0 1·57	61·44	40 42·66	13 33	0 23·10	65·76
			41 4·93	1 25	0 0·25	65·18	40 54·00	11 3	0 15·39	69·39
			41 6·56	1 2	0 0·13	66·69				

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	′ ″	° ′ ″
Dec. 24	W.	200 20	+ 3 41 24·26	11 18	+ 0 16·12	+ 3 41 40·38	+ 3 40 49·40	20 23	+ 0 52·53	+ 3 41 41·93
		&	41 26·76	9 1	0 10·28	37·04	40 54·13	18 44	0 44·34	38·47
		20 20	41 37·00	5 23	0 3·65	40·65	41 40·96	2 10	0 0·60	41·56
			41 36·33	7 7	0 6·39	42·72	41 39·40	0 16	0 0·01	39·41
„ 24	E.	200 20	− 3 40 42·73	13 38	− 0 23·43	− 3 40 66·16	− 3 39 22·86	28 21	− 1 40·94	− 3 40 63·80
		&	40 49·70	11 50	0 17·65	67·35	39 33·10	26 42	1 29·64	62·74
		20 20	40 56·03	9 37	0 11·70	67·73	41 1·26	2 22	0 0·70	61·96
			40 55·83	11 15	0 15·97	71·80	41 2·94	1 9	0 0·17	63·11
„ 25	W.	210 29	+ 3 41 18·47	12 24	+ 0 19·44	+ 3 41 37·91	+ 3 40 35·74	21 44	+ 0 59·68	+ 3 41 35·42
		&	41 19·53	10 55	0 15·06	34·59	40 49·13	19 37	0 48·59	37·72
		30 29	41 35·03	5 3	0 3·22	38·25	41 41·33	3 12	0 1·29	42·62
			41 27·23	6 46	0 5·76	32·99	41 39·30	1 58	0 0·49	39·79
„ 25	E.	210 29	− 3 40 26·17	17 29	− 0 38·47	− 3 40 64·64	− 3 39 30·27	27 36	− 1 35·68	− 3 40 65·95
		&	40 32·06	15 48	0 31·42	63·48	39 46·87	25 43	1 23·17	70·04
		30 29	40 52·46	11 51	0 17·73	70·19	41 6·07	2 46	0 0·97	67·04
			40 49·63	13 23	0 22·63	72·26	41 1·33	4 42	0 2·78	64·11
„ 26	W.	220 38	+ 3 41 25·43	10 48	+ 0 14·75	+ 3 41 40·18	+ 3 40 47·14	20 18	+ 0 52·08	+ 3 41 39·22
		&	41 28·47	9 14	0 10·78	39·25	40 58·56	17 54	0 40·45	39·01
		40 38	41 30·80	9 26	0 11·21	42·01	41 39·07	3 0	0 1·14	40·21
			41 25·94	11 11	0 15·76	41·70	41 37·70	1 34	0 0·31	38·01
„ 26	E.	220 38	− 3 40 57·44	9 45	− 0 11·99	− 3 40 69·43	− 3 39 56·90	23 56	− 1 12·07	− 3 40 68·97
		&	40 59·46	8 17	0 8·65	68·11	40 9·60	21 29	0 58·06	67·66
		40 38	41 8·30	2 17	0 0·66	68·96	40 51·27	10 59	0 15·25	66·52
			41 5·97	4 0	0 2·02	67·99	40 45·73	13 5	0 21·60	67·33
„ 27	W.	230 50	+ 3 41 48·00	3 36	+ 0 1·63	+ 3 41 49·63	+ 3 41 28·27	10 32	+ 0 14·01	+ 3 41 42·28
		&	41 40·63	2 33	0 0·82	41·45	41 31·80	9 24	0 11·15	42·95
		50 50	41 29·54	9 45	0 11·99	41·53	41 44·20	2 2	0 0·52	44·72
			41 23·93	11 4	0 15·41	39·34	41 40·44	3 20	0 1·40	41·84
„ 27	E.	230 50	− 3 40 51·17	12 32	− 0 19·79	− 3 40 70·96	− 3 40 6·17	21 39	− 0 58·99	− 3 40 65·16
		&	40 55·57	11 8	0 15·60	71·17	40 24·87	19 33	0 48·09	72·96
		50 50	41 9·36	1 12	0 0·18	69·54	40 53·27	9 31	0 11·43	64·70
			41 6·93	0 11	0 0·00	66·93	40 44·13	11 17	0 16·08	60·21
							40 15·53	19 34	0 48·41	63·94
							40 16·24	20 14	0 51·78	68·02

Abstract of Astronomical Azimuth observed at XX (Dúngarpur) 1852.

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°	221°	41°	231°	51°
Date	December 22		December 23		December 24		December 25		December 26		December 27	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	63·64 59·72 65·97 65·58	69·42 63·07 65·56 72·82	61·89 69·45 61·44 65·18 66·69	69·05 70·10 65·76 69·39	66·16 67·35 67·73 71·80	63·80 62·74 61·96 63·11	64·64 63·48 70·19 72·26	65·95 70·04 67·04 64·11	69·43 68·11 68·96 67·99	68·97 67·66 66·52 67·33	70·96 71·17 69·54 66·93	65·16 72·96 64·70 60·21 63·94 68·02
Means	63·73	67·72	64·93	68·58	68·26	62·90	67·64	66·79	68·62	67·62	69·65	65·83

	°	′	″	″	″	″	″	″
Means of both faces	− 3	40	65·73	66·75	65·58	67·21	68·12	67·74
Az. of Star fr. S., by W.	183	41	23·22	23·54	23·97	24·41	24·73	25·06
Az. of Ref. M. „	180	0	17·49	16·79	18·39	17·20	16·61	17·32

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°	221°	41°	231°	51°
Date	December 22		December 23		December 24		December 25		December 26		December 27	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star Reduced to Elongation	42·58 38·96 38·92 40·97	38·21 36·27 44·26 41·87	37·75 36·37 35·32 32·40	39·44 37·19 41·43 37·01	40·38 37·04 40·65 42·72	41·93 38·47 41·56 39·41	37·91 34·59 38·25 32·99	35·42 37·72 42·62 39·79	40·18 39·25 42·01 41·70	39·22 39·01 40·21 38·01	49·63 41·45 41·53 39·34	42·28 42·95 44·72 41·84
Means	40·36	40·15	35·46	38·77	40·20	40·34	35·94	38·89	40·79	39·11	42·99	42·95

	°	′	″	″	″	″	″	″
Means of both faces	+ 3	41	40·26	37·11	40·27	37·41	39·95	42·97
Az. of Star fr. S., by W.	176	18	37·00	36·57	36·24	35·81	35·38	35·05
Az. of Ref. M. „	180	0	17·26	13·68	16·51	13·22	15·33	18·02

		°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation	180	0	17·30
	by Western „		„	15·67
	Mean		„	16·49
Angle Referring Mark and XVIII (Chalarwa), *see page* 29—J. *ante*		+ 19	56	21·95
Astronomical Azimuth of Chalarwa by observation		199	56	38·44
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur, *see page* 71—J. *ante* ...		199	56	36·15
Astronomical—Geodetical Azimuth at XX (Dúngarpur)		+		2·29

At XXXIV (Konkáwáo)

Lat. N. 21° 39′ 11″·96; Long. E. 70° 58′ 36″·07 = 4^h 43^m 54^s·4; Height above Mean Sea Level, 622 feet.
October 1853; observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed	*a* Ursæ Minoris (West and East).
Mean Right Ascension 1853·0	1^h 5^m 54^s
Mean North Polar Distance 1853·0	1° 28′ 26″·93
Local Mean Times of Elongation, October 7	Eastern 6^h 5^m Western 17 58

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. 7	W.	180 1	+ 1 34 18·57	7 3	+ 0 2·70	+ 1 34 21·27	+ 1 34 26·26	0 4	+ 0 0·00	+ 1 34 26·26
		&	34 21·03	9 6	0 4·48	25·51	34 30·04	1 52	0 0·19	30·23
		0 1					34 17·40	15 45	0 13·43	30·83
„ 8	E.	180 2	− 1 35 18·40	15 43	− 0 13·39	− 1 35 31·79	− 1 35 5·40	22 44	− 0 28·00	− 1 35 33·40
		&	35 19·50	13 46	0 10·27	29·77	35 1·53	21 40	0 25·43	26·96
		0 2	35 28·83	3 32	0 0·68	29·51	35 23·80	4 21	0 1·03	24·83
			35 27·70	4 46	0 1·23	28·93	35 27·83	3 13	0 0·56	28·39
			35 2·87	21 40	0 25·46	28·33	35 12·53	13 38	0 10·07	22·60
			35 3·96	22 51	0 28·32	32·28	35 13·37	14 52	0 11·98	25·35
							35 12·60	16 9	0 14·15	26·75
„ 9	E.	190 13	− 1 35 35·54	2 42	− 0 0·40	− 1 35 35·94	− 1 35 26·77	8 58	− 0 4·36	− 1 35 31·13
		&	35 31·76	1 21	0 0·10	31·86	35 29·67	7 28	0 3·02	32·69
		10 13	35 34·03	2 5	0 0·23	34·26	35 26·23	7 24	0 2·96	29·19
			35 20·56	13 52	0 10·42	30·98	35 21·27	8 40	0 4·07	25·34
			35 20·67	15 1	0 12·23	32·90	35 1·84	21 37	0 25·34	27·18
			34 37·30	31 38	0 54·23	31·53	34 51·34	26 6	0 36·92	28·26
			34 16·24	37 14	1 15·17	31·41				
„ 9	W.	190 12	+ 1 33 40·86	30 29	+ 0 50·39	+ 1 34 31·25	+ 1 33 14·06	36 43	+ 1 13·07	+ 1 34 27·13
		&	33 42·60	28 55	0 45·33	27·93	34 13·20	21 1	0 23·97	37·17
		10 12	34 18·47	11 56	0 7·73	26·20	34 11·83	18 52	0 19·31	31·14
			34 19·70	10 41	0 6·19	25·89	34 13·77	17 33	0 16·71	30·48
			34 26·87	0 47	0 0·03	26·90	34 24·83	5 47	0 1·81	26·64
			34 25·27	2 2	0 0·22	25·49	34 28·90	4 20	0 1·02	29·92
							34 25·13	9 7	0 4·51	29·64
							34 26·20	10 27	0 5·91	32·11
„ 10	E.	200 21	− 1 35 18·27	13 8	− 0 9·34	− 1 35 27·61	− 1 35 10·27	19 30	− 0 20·57	− 1 35 30·84
		&	35 26·00	11 44	0 7·47	33·47	35 12·20	17 55	0 17·39	29·59
		20 21	35 31·74	0 34	0 0·02	31·76	35 27·47	6 38	0 2·38	29·85
			35 32·80	2 8	0 0·25	33·05	35 28·87	4 44	0 1·22	30·09
			35 10·17	18 30	0 18·55	28·72	35 20·07	11 6	0 6·69	26·76
			35 12·00	20 19	0 22·38	34·38	35 22·37	12 25	0 8·35	30·72
			35 7·50	21 29	0 25·03	32·53				

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. 10	W.	200 20 & 20 20	+ 1 33 32·10	32 38	+ 0 57·72	+ 1 34 29·82	+ 1 33 3·40	39 7	+ 1 22·90	+ 1 34 26·30
			33 41·06	31 4	0 52·30	33·36	33 8·33	38 43	1 21·21	29·54
			34 20·80	12 11	0 8·04	28·84	34 5·66	21 6	0 24·14	29·80
			34 21·76	10 36	0 6·10	27·86	34 11·36	19 21	0 20·30	31·66
			34 25·20	2 39	0 0·38	25·58	34 14·50	17 48	0 17·20	31·70
			34 25·44	4 22	0 1·04	26·48	34 28·94	5 2	0 1·38	30·32
			34 24·60	5 32	0 1·66	26·26	34 35·00	3 43	0 0·75	35·75
„ 11	E.	210 30 & 30 30	− 1 35 20·36	15 35	− 0 13·14	− 1 35 33·50	− 1 35 2·03	22 24	− 0 27·14	− 1 35 29·17
			35 23·33	14 16	0 11·04	34·37	35 7·77	21 3	0 24·00	31·77
			35 32·56	0 36	0 0·02	32·58	35 26·53	8 28	0 3·89	30·42
			35 32·00	0 49	0 0·04	32·04	35 27·77	7 13	0 2·83	30·60
			35 8·03	20 21	0 22·47	30·50	35 29·27	5 48	0 1·82	31·09
			35 4·73	21 51	0 25·91	30·64	35 24·97	7 28	0 3·03	28·00
							35 26·50	8 56	0 4·34	30·84
„ 12	E.	220 39 & 40 39	− 1 35 15·80	16 22	− 0 14·51	− 1 35 30·31	− 1 35 1·90	23 4	− 0 28·80	− 1 35 30·70
			35 18·20	14 59	0 12·15	30·35	35 4·54	21 28	0 24·94	29·48
			35 31·06	2 5	0 0·23	31·29	35 24·43	9 56	0 5·35	29·78
			35 33·06	0 47	0 0·03	33·09	35 24·20	8 36	0 4·00	28·20
			35 32·06	0 25	0 0·01	32·07	35 26·34	7 6	0 2·73	29·07
			35 21·46	14 20	0 11·14	32·60	35 22·47	8 0	0 3·47	25·94
			35 17·10	15 52	0 13·66	30·76	35 21·26	9 15	0 4·64	25·90
			35 17·83	17 23	0 16·37	34·20				
„ 13	E.	230 48 & 50 48	− 1 35 28·97	4 35	− 0 1·14	− 1 35 30·11	− 1 35 15·93	13 7	− 0 9·31	− 1 35 25·24
			35 28·37	3 1	0 0·49	28·86	35 20·30	11 33	0 7·23	27·53
			35 30·60	1 51	0 0·18	30·78	35 25·87	2 47	0 0·42	26·29
			35 26·56	9 47	0 5·19	31·75	35 26·76	3 59	0 0·86	27·62
			35 23·93	11 19	0 6·94	30·87	35 6·90	19 53	0 21·43	28·33
			34 45·00	27 29	0 40·96	25·96	35 6·53	21 11	0 24·34	30·87
			34 41·34	28 42	0 44·67	26·01				
			34 41·07	29 55	0 48·49	29·56				
„ 13	W.	230 47 & 50 47	+ 1 34 25·57	13 53	+ 0 10·45	+ 1 34 36·02	+ 1 34 7·17	21 7	+ 0 24·19	+ 1 34 31·36
			34 23·40	11 29	0 7·14	30·54	34 11·63	19 47	0 21·22	32·85
			34 23·17	0 38	0 0·02	23·19	34 29·40	6 21	0 2·18	31·58
			34 22·03	4 20	0 1·02	23·05	34 29·60	4 47	0 1·24	30·84
			34 5·40	17 13	0 16·05	21·45	34 23·84	9 31	0 4·90	28·74
			34 5·30	18 42	0 18·94	24·24	34 22·30	12 8	0 7·98	30·28
„ 14	E.	180 1 & 0 1	− 1 35 22·47	9 37	− 0 5·01	− 1 35 27·48	− 1 35 13·37	17 7	− 0 15·87	− 1 35 29·24
			35 26·13	8 1	0 3·48	29·61	35 15·67	15 20	0 12·73	28·40
			35 30·46	4 2	0 0·88	31·34	35 26·10	3 21	0 0·61	26·71
			35 29·40	5 7	0 1·42	30·82	35 27·26	2 3	0 0·23	27·49
			35 27·27	6 43	0 2·44	29·71	35 18·27	12 23	0 8·31	26·58
			35 1·06	21 42	0 25·54	26·60	35 17·43	13 41	0 10·15	27·58
			35 1·80	23 1	0 28·74	30·54	35 14·53	15 7	0 12·40	26·93
			34 58·70	24 22	0 32·17	30·87				

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. 14	W.	180 0	+ 1 34 10·13	14 16	+ 0 11·05	+ 1 34 21·18	+ 1 34 4·23	22 29	+ 0 27·39	+ 1 34 31·62
		&	34 11·70	11 25	0 7·06	18·76	34 5·54	20 57	0 23·81	29·35
		0 0	34 15·30	2 28	0 0·33	15·63	34 25·96	5 22	0 1·56	27·52
			34 15·16	4 28	0 1·08	16·24	34 29·00	3 34	0 0·69	29·69
			34 16·40	5 49	0 1·83	18·23	34 21·23	12 32	0 8·51	29·74
			33 55·16	20 50	0 23·50	18·66	34 16·60	14 11	0 10·90	27·50
			33 52·53	22 20	0 26·98	19·51				
„ 15	W.	210 29	+ 1 34 14·00	16 20	+ 0 14·47	+ 1 34 28·47	+ 1 34 0·80	22 7	+ 0 26·53	+ 1 34 27·33
		&	34 15·46	13 22	0 9·69	25·15	34 2·20	21 1	0 23·95	26·15
		30 29	34 20·10	12 9	0 8·00	28·10	34 29·63	6 37	0 2·37	32·00
			34 18·17	4 52	0 1·28	19·45	34 27·83	5 17	0 1·51	29·34
			34 17·23	6 8	0 2·04	19·27	34 24·40	4 7	0 0·92	25·32
			34 4·80	18 31	0 18·57	23·37	34 20·00	11 54	0 7·67	27·67
			34 0·10	19 43	0 21·02	21·12	34 16·84	13 6	0 9·30	26·14
			33 58·50	20 44	0 23·25	21·75				
„ 16	W.	220 38	+ 1 34 12·93	8 51	+ 0 4·25	+ 1 34 17·18	+ 1 34 7·60	20 21	+ 0 22·45	+ 1 34 30·05
		&	34 19·97	6 49	0 2·52	22·49	34 8·13	18 38	0 18·81	26·94
		40 38	34 16·60	8 54	0 4·29	20·89	34 27·80	1 8	0 0·07	27·87
			34 13·46	10 19	0 5·77	19·23	34 26·00	2 24	0 0·31	26·31
			34 11·16	11 45	0 7·48	18·64	34 7·33	18 36	0 18·74	26·07
			33 41·30	26 40	0 38·44	19·74	34 4·87	19 58	0 21·56	26·43
			33 39·56	27 58	0 42·28	21·84				

Abstract of Astronomical Azimuth observed at XXXIV (Konkáwáo) 1853.

1. By Eastern Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	211°	31°	221°	41°	231°	51°
Date	October 14		October 9		October 10		October 11		October 12		October 13	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	*29·32	*30·93	35·94	31·13	27·61	30·84	33·50	29·17	30·31	30·70	30·11	25·24
	*27·30	*24·49	31·86	32·69	33·47	29·59	34·37	31·77	30·35	29·48	28·86	27·53
	*27·04	*22·36	34·26	29·19	31·76	29·85	32·58	30·42	31·29	29·78	30·78	26·29
	*26·46	*25·92	30·98	25·34	33·05	30·09	32·04	30·60	33·09	28·20	31·75	27·62
	*25·86	*20·13	32·90	27·18	28·72	26·76	30·50	31·09	32·07	29·07	30·87	28·33
	*29·81	*22·88	31·53	28·26	34·38	30·72	30·64	28·00	32·60	25·94	25·96	30·87
	27·48	*24·28	31·41		32·53			30·84	30·76	25·90	26·01	
	29·61	29·24							34·20		29·56	
	31·34	28·40										
	30·82	26·71										
	29·71	27·49										
	26·60	26·58										
	30·54	27·58										
	30·87	26·93										
Means	28·77	25·99	32·70	28·97	31·65	29·64	32·27	30·27	31·83	28·44	29·24	27·65
	° ′ ″		″		″		″		″		″	
Means of both faces	− 1 35 27·38		30·83		30·65		31·27		30·14		28·45	
Az. of Star fr. S., by W.	181 34 57·44		59·48		59·16		58·73		58·30		57·87	
Az. of Ref. M. „	179 59 30·06		28·65		28·51		27·46		28·16		29·42	

2. By Western Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	210°	30°	221°	41°	231°	51°
Date	October 14		October 9		October 10		October 15		October 16		October 18	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M.—Star reduced to Elongation	*18·36	*23·35	31·25	27·13	29·82	26·30	28·47	27·33	17·18	30·05	36·02	31·36
	*22·60	*27·32	27·93	37·17	33·36	29·54	25·15	26·15	22·49	26·94	30·54	32·85
	21·18	*27·92	26·20	31·14	28·84	29·80	28·10	32·00	20·89	27·87	23·19	31·58
	18·76	31·62	25·89	30·48	27·86	31·66	19·45	29·34	19·23	26·31	23·05	30·84
	15·63	29·35	26·90	26·64	25·58	31·70	19·27	25·32	18·64	26·07	21·45	28·74
	16·24	27·52	25·49	29·92	26·48	30·32	23·37	27·67	19·74	26·43	24·24	30·28
	18·23	29·69		29·64	26·26	35·75	21·12	26·14	21·84			
	18·66	29·74		32·11			21·75					
	19·51	27·50										
Means	18·80	28·22	27·28	30·53	28·31	30·72	23·34	27·71	20·00	27·28	26·42	30·94
	° ′ ″		″		″		″		″		″	
Means of both faces	+ 1 34 23·51		28·91		29·52		25·52		23·64		28·68	
Az. of Star fr. S., by W.	178 25 2·78		0·73		1·05		3·21		3·64		2·34	
Az. of Ref. M. „	179 59 26·29		29·64		30·57		28·73		27·28		31·02	

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.

Abstract of Astronomical Azimuth observed at XXXIV (Konkáwáo) 1853—(*Continued*).

		°	'	"
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation... ...	179	59	28·71
	by Western "		"	28·92
	Mean		"	28·82
Angle Referring Mark and XXX (Mumaiya), *see page* 41—J. *ante*		− 17	59	49·12
Astronomical Azimuth of Mumaiya by observation		161	59	39·70
Geodetical Azimuth of " by calculation from that adopted (Vol. II, page 141) at Kaliánpur, *see page* 72—J. *ante*		161	59	38·94
Astronomical—Geodetical Azimuth at XXXIV (Konkáwáo)		+		0·76

June, 1890.

W. H. COLE,
In charge of Computing Office.

PLATE 1.

PRINCIPAL TRIANGULATION—KATTYWAR MERIDIONAL SERIES.

Fig. No. 18

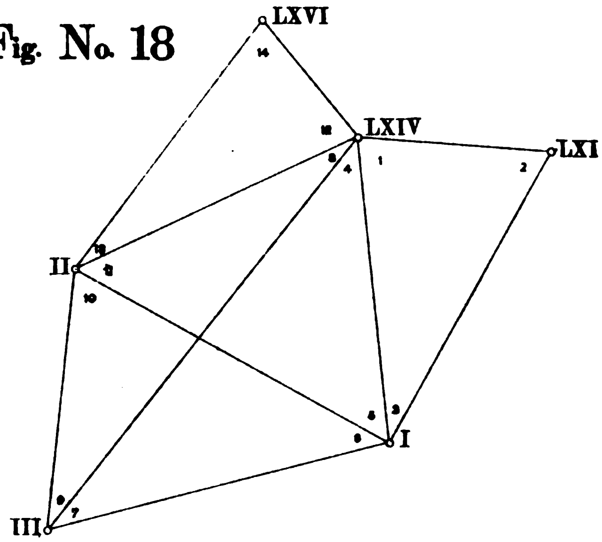


Fig. No. 19

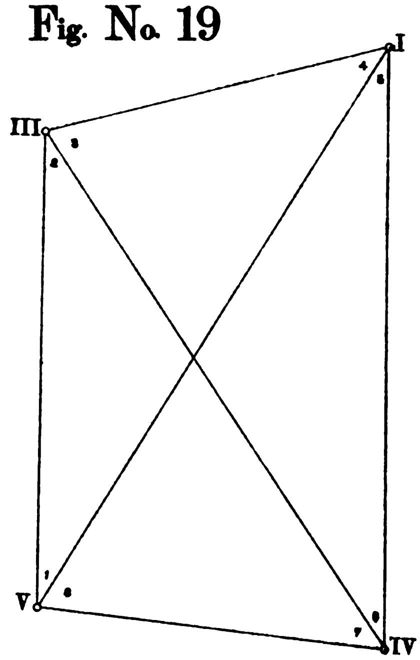


Fig. No. 20

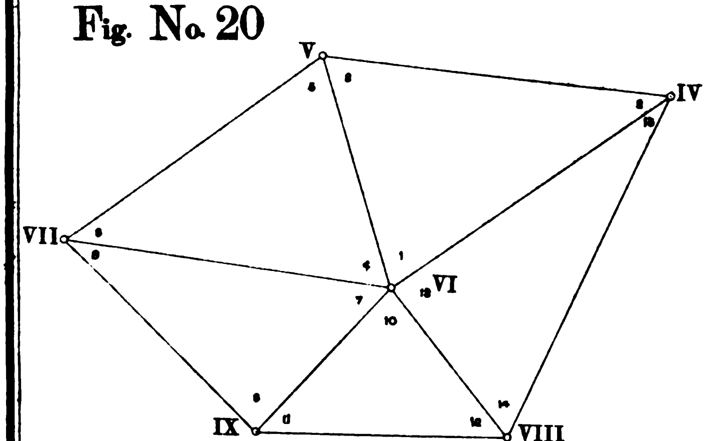


Fig. No. 21

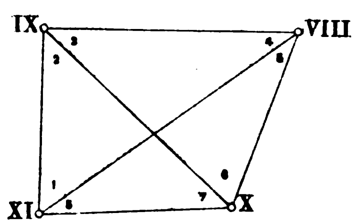
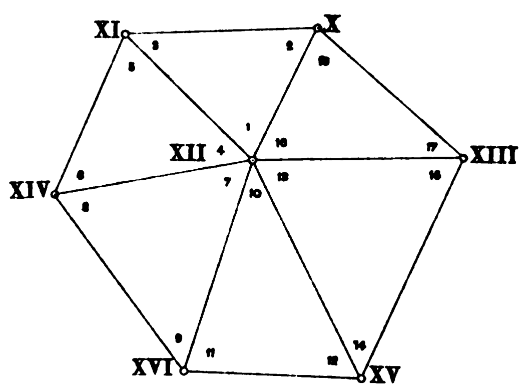


Fig. No. 22



Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, January 1880

PRINCIPAL TRIANGULATION—KATTYWAR MERIDIONAL SERIES.

Fig. No. 23

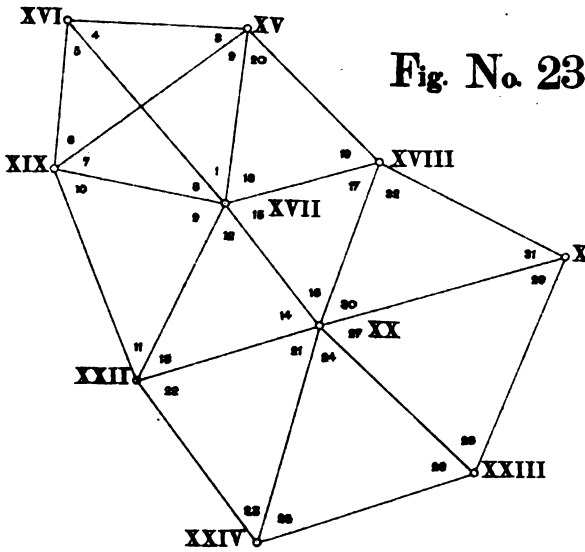


Fig. No. 24

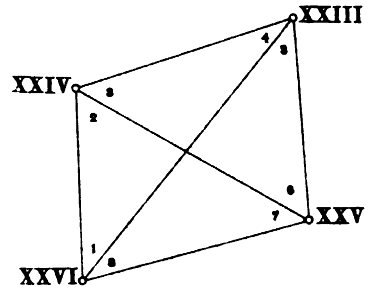
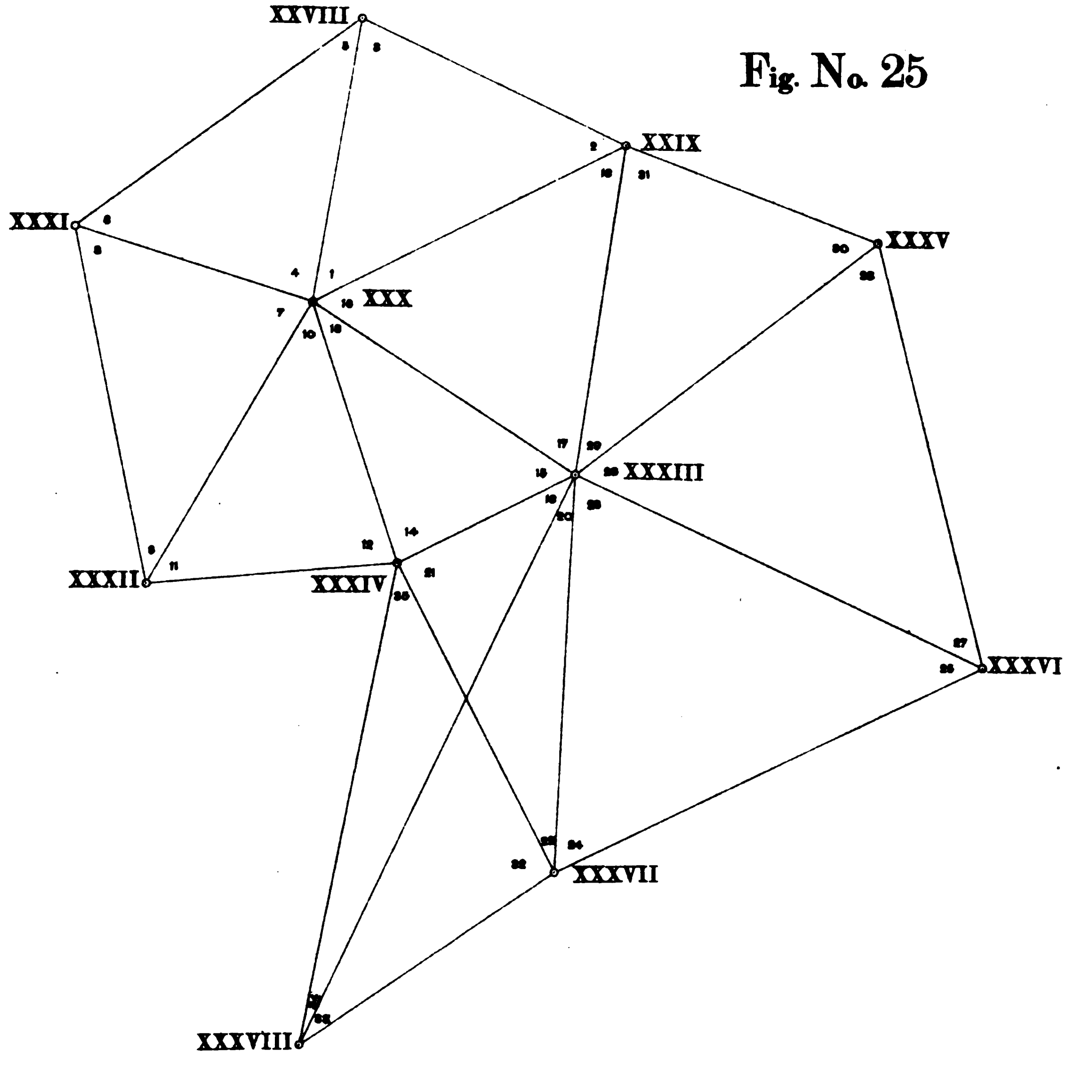


Fig. No. 25



Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun, February 1880.

GUZERAT LONGITUDINAL SERIES.

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INTRODUCTION.

The Guzerat (Gujarát) Longitudinal Series of the South-West Quadrilateral is the chain of Principal Triangles that follows the parallel of 23° from the meridian of 75° to that of 71°. It starts in the Vindhyáchal Mountain Range, some thirty miles west of Indore (Indor) and Mhow (Mau), traverses the plains of Gujarát by way of Ahmedabad (Amdávád), and ends in the Káthiáwár (Káthiávád) peninsula near the southern edge of the Ran of Cutch (Kachh). It emanates from Karsod–Indráwan, a side of the Khánpisura Meridional Series, and it closes 260 miles to the westward on the side Chalarwa–Sápakra of the Kattywar (Káthiávád) Meridional Series. In longitude 73° 50′ it is cut at right angles by the Singi Meridional Series, and in longitude 72° 50′ it is met from the north, but not crossed, by the Abu Meridional Series, the side of junction being Sanoda–Mirzápur.

At the junction of the Guzerat Longitudinal and the Singi Meridional Series is situated the Kágarol compound figure: this figure has been allotted to the latter series, and the stations have been numbered accordingly; but in order to avoid a hiatus, the figure and all details connected with it are included in this Series. A pentagon round the station of Wastrál has been constructed where the Abu Meridional Series meets the Guzerat: it has been apportioned to the latter. A pentagon, with one central angle wanting, exists on the Guzerat Longitudinal Series in longitude 74° 40′ round the station of Mehwása: its existence was unintentional and was due to an unsuccessful attempt to make Indráwan–Gumánpur the side of junction of the Khánpisura and Guzerat Series. With the exception of the Kágarol compound figure and the Wastrál and Mehwása pentagons, the Series under review consists of single triangles throughout, thirty-one in number.

The Guzerat Longitudinal Series was designed in 1850, in conjunction with the Abu Meridional Series, for the purpose of affording a trigonometrical basis for the topographical surveys of Gujarát and the Káthiáwár peninsula, countries not then incorporated in the Indian Atlas.

During the summer of 1850 the Bombay Triangulation Party, then located at Neemuch (Nimach) under Lieutenant Harry Rivers of the Bombay Engineers, received orders to discontinue their work on the Gurhágarh Meridional Series, and were directed instead to carry a series down the meridian of Mount Abu and on reaching Ahmedabad to change its direction and follow the parallel of 23° both to the east and west. Captain A. Strange had by this time carried the principal work of the Karáchi Longitudinal Series from Sironj to within a few miles of Mount Abu and the approximate work some 40 miles to the westward beyond, and Lieutenant Rivers had to select a base from the latter.

During the Field Season of 1850-51 the approximate work of the Abu Meridional Series was completed as far south as the stations of Lakwára, Rakhiál and Amalyára, and several of the final angles had been observed, but nothing was done on the Guzerat Longitudinal Series. South of the side Kárdo–Kaináth of the Abu Series, the country had proved very difficult and unsuitable for triangulation: it was absolutely flat and covered with trees, and towers had to be built at all the stations: many delays were encountered in clearing the rays and every line required a distinct ray-trace survey. If Rivers could have seen this country before commencing work he would have recommended the adoption of a chain of single triangles for the Abu Series instead of polygons, but now that he was on the ground it was too late to get his instructions changed. He asked leave, however, to make the Guzerat Longitudinal into a single series, and to this the Surveyor General assented: as high towers were required at all the stations and great numbers of valuable fruit trees had to be cut down on every ray, a double series would undoubtedly have entailed enormous additional expenditure.

Season 1851-52.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 1st Assistant.
Lieutenant D. J. Nasmyth, Bombay Engineers, 2nd Assistant.
Mr. T. Sanger, Senior Sub-Assistant.
„ J. DaCosta, Sub-Assistant.
„ J. W. Rossenrode, Ditto.
„ J. McGill, Ditto.

The Bombay Party passed the summer of 1851 at Ahmedabad. Towards the end of the rainy season the native portion suffered so much from fever, that they were not in a fit state to take the field before November. During October, however, Rivers himself succeeded in selecting a few stations of the Guzerat Longitudinal Series in the vicinity of Ahmedabad. In November he regularly took up its approximate work, working westwards from the meridian of $72\frac{1}{2}°$ along the parallel of 23°. Messrs. Sanger and DaCosta were left behind on the Abu Series clearing the rays. They were the only two assistants with the party available for work, Mr. McGill having only lately joined the survey; but as the nature of the country was such that every line required a ray-trace survey and numerous fruit trees of great value had to be cut, Rivers considered it advisable to place them both on this duty. Rivers returned to the Abu Series on December 15th, in the hopes of finding sufficient rays cleared to allow him to commence the observations of the final angles, but he was disappointed as only a few were ready.

On December 22nd he went to Sanoda, as being the station at which the Abu Meridional and the Guzerat Longitudinal Series meet, and observed δ Ursæ Minoris for azimuth. He was joined here on December 29th by Lieutenant D. Nasmyth, a young officer of the Bombay Engineers, who had been appointed to the Great Trigonometrical Survey of India a few weeks previously. Towards the beginning of January Rivers proceeded to the head of the Gulf of Cambay (Khambhat) to make arrangements for connecting the heights of the stations of the Guzerat Longitudinal Series and thence those of the Abu Meridional and Karáchi Longitudinal Series with mean sea level. His plan was to erect a tidal station near the mouth of the Sábarmati river and to then connect it by levelling with the nearest principal station of the Guzerat Longitudinal Series: he afterwards found, however, that such operations would occupy him entirely to the exclusion of trigonometrical work; as too he had much difficulty in obtaining a level capable of such accurate observations as were required, he abandoned the enterprise, and substituted for his line of levels a minor series of triangulation, the approximate work of which Mr. DaCosta proceeded to take up. This latter series is known as the Sábarmati Minor Series; it appertains to the principal Series under review, and is described in detail at the end of this Introduction.

On Rivers's return from Cambay he took up the final angles of the Abu Series; and during February he succeeded in completing the observations at all the stations with the exception of Siniána. In December he observed for azimuth at Sanoda station to δ Ursæ Minoris. He then took up the principal work of the Guzerat Longitudinal Series, commencing in longitude 72° 50′ and working westwards: the stations of Jhinjhar, Bhagwánji and Rundan had not yet been selected and were therefore not now observed from Mirzápur, Wastrál or Pálri. It would in fact appear that the Wastrál pentagon as afterwards constructed by Nasmyth was foreign to the original intention of Rivers, who probably purposed to extend the Guzerat Longitudinal Series eastward from the side Bárdoli–Mirzápur: this explanation too would account for the one single triangle, that exists on the Abu Series of hexagons. By the end of March Rivers had carried a principal Series of single triangles from Mirzápur and Sanoda as far west as the side Hasalpur–Kárigángar. In April he added two more stations, Por and Ingrori, and at the latter observed an astronomical azimuth of verification to α Ursæ Minoris: he then returned to his recess quarters at Ahmedabad, which he reached about the middle of May.

In October, 1851, at the urgent request of Lieutenant Rivers, Mr. J. W. Rossenrode, who had had great experience in trigonometrical operations in flat and wooded countries, was withdrawn from Bengal, and appointed an additional assistant to the Bombay Party to instruct the assistants in the ray-trace system. Unfortunately, however, owing to the immense distance that he had to travel, he did not join Lieutenant Rivers till February 15th, when the clearance of the rays, the special work for which he had been sent, had with much labour and trouble been carried out in the most difficult parts of the country. He was therefore on arrival despatched to the southern edge of the Ran of Cutch and was employed up to the first of May in selecting stations, clearing rays and building towers both for the western extremity of the Guzerat Longitudinal Series and the central portion of the Kattywar Meridional Series. He rejoined Lieutenant Rivers at Ahmedabad on May 15th.

The section of the Guzerat Longitudinal Series, situated between the meridians of 71° and 73°, runs through a perfectly flat country, for the most part covered with trees: towers of twenty-five feet high were required to command sides of 12 miles, and after mutual visibility had been obtained between two stations in November, three or four additional feet had to be added in order to allow for the decreased effect of refraction in April. In the rocky table-land of Káthiáwár, where the western end of the Series had now arrived, bricks were unknown, and the pillars had to be constructed of stone.

Season 1852-53.

PERSONNEL.

Lieutenant H. Rivers, Bombay Engineers, 1st Assistant.
Lieutenant D. J. Nasmyth, Bombay Engineers, 2nd Assistant.
Mr. T. Sanger, Sub-Assistant.
„ J. DaCosta, Ditto.
„ J. McGill, Ditto.

When the party again took the field, Rivers having applied for furlough, and having every expectation of its being granted, handed the party over to Nasmyth, who at once set out for the Káthiáwár peninsula to resume operations on the Guzerat Longitudinal Series, Rivers remaining behind. The *personnel* was further weakened by the return of Mr. Rossenrode to Bengal and by the absence of Mr. Sanger on sick-leave: the only assistants that remained for duty were Mr. DaCosta and Mr. McGill, the latter of whom had been but one year in the Department. During the previous season Mr. Rossenrode had selected stations as far west as Rangpur*, and had built the towers up to Kuária and Nárechána; but the hexagon that he had constructed round Rangpur was, owing to the smallness of the sides, not considered suitable for inclusion in a principal series, the more especially as the country in that part was comparatively open and no real necessity had existed for curtailing the lengths of the rays. On arrival at Ingrori, the first station visited, careful examination shewed that nothing less than adding 20 feet to the Degám tower and 10 feet to that of Ingrori would render the stations mutually visible, and the work of raising the towers was therefore commenced at once. Nasmyth decided, whilst this was being done, to make a reconnaissance of the country to the westward to see whether he could not improve Rossenrode's approximate series and especially the hexagon round Rangpur, the stations of which were only some 5 or 6 miles apart; he was engaged on this work when he was rejoined by Rivers, who had in the meantime learnt that his application for furlough had been refused and who had, on receipt of the unwelcome news, set out post-haste in no easy frame of mind to resume charge of the triangulation. The result of the revision of the approximate series was that the triangles were made more symmetrical, and but seven stations were required to get over the same extent of country as under the original arrangement had taken ten. By December 1st the towers at all the stations of the Guzerat Longitudinal Series, west of the meridian of 72°, were in readiness for the final observations.

The main body of the party with Rivers and Nasmyth now returned to Ingrori to take up the final angles, whilst Mr. DaCosta was detached to conduct the approximate work of the Kattywar Meridional Series. During December, 1852, five stations of the Guzerat Series were visited and observed from, and in January, 1853, the principal angles of its western section were completed. The party then took up the final work of the Kattywar Meridional Series.

In November, 1854, Mr. Sanger was detached from the main body of the party,

* Rangpur is one of the centres of a compound figure situated at the junction of the Guzerat Longitudinal and the Kattywar Meridional Series, which belongs to the latter.

then employed in Káthiáwár, with orders to carry the approximate work of the Guzerat Longitudinal Series eastwards from Ahmedabad: he began at Wastrál, and before the season was over had selected all the stations as far east as Kágarol: during the latter half of the field season of 1856-57, Mr. McGill followed over the same ground, building the pillars at Mr. Sanger's stations and clearing the rays.

Season 1858-59.

PERSONNEL.

Lieutenant D. J. Nasmyth, Bombay Engineers, 2nd Assistant.
Mr. J. DaCosta, Sub-Assistant.
„ J. McGill, Ditto.
„ C. McGill, Ditto.

By May, 1858, the Kattywar Meridional Series and the Cutch Coast Series were both fully completed, and the only principal triangulation of the South-West Quadrilateral that still remained to be done was the portion of the Series under review that lies between the meridians of 73° and 75°. In October, 1858, as the Political Agents in Gujarát reported that the country had quieted down from the excitement of the mutiny, Nasmyth, who had succeeded to the charge of the party, considered it a favorable opportunity to take up the final observations of the central section of the Guzerat Longitudinal Series, *i.e.*, the portion that is situated between the stations of Mirzápur and Kágarol. The mutiny had not yet died out in Malwa (Málwa), and so the approximate work on the eastern section of the Series between Kágarol and Indráwan had to be left in abeyance. Ground was broken in Gujarát on October 25th, and as Mr. Sanger's approximate work appeared in parts defective, Nasmyth began by revising it: having definitely settled on the first two or three triangles in the vicinity of Mirzápur he returned to Pálri to commence the final observations, leaving the revision of the approximate series to Mr. DaCosta. Early in November he received notice of a disturbance that had broken out among the Náikrás at Nárukot, and shortly after he learnt that the Rao Sahib and Tantia Topi had appeared on the frontiers of Gujarát: armed bands of plunderers were often now to be met traversing the country, and the operations of detached surveyors became unsafe. Mr. DaCosta, who was on in advance at Kágarol received warning from the Political authorities to retire at once to Baroda (Vadodra), which he succeeded in reaching in safety: he had been, though unaware of it, within 14 miles of the ubiquitous Tantia's camp. By the end of December, 1858, the final work had been completed as far as the side Rundan–Bhagwánji, and in January five more stations were observed at, bringing the Series up to Ghoráráo–Wardhari. News then arrived that the Bhíls were rising, and the Political officers warned Lieutenant Nasmyth not to cross the Mahi. He had, therefore, no alternative but to leave off at Ghoráráo and to withdraw to Cutch where he took up some minor triangulation.

On the rays Poera–Rámesri and Poera–Gohilia the signals were not visible till sunset, and it therefore became necessary to determine the relative heights of those stations by simultaneous vertical observations to lamp signals from the two extremities of each ray: this was done on the former by Lieutenant Nasmyth and Mr. DaCosta and on the latter by Messrs. DaCosta and McGill who were both equipped with 12-inch theodolites.

On December 31st, 1858, some severe shocks of earthquake were felt all over Gujarát, in consequence of which Nasmyth thought it advisable to check the position of the upper mark-stones at all stations which had high towers: these stones had been plumbed over the lower buried marks by Mr. J. McGill. Nasmyth examined three towers, and found that Poera, Rámesri and Gohilia had all slightly deflected. New marks were accordingly established to which all observations have been referred.

The Bombay Triangulation Party passed the summer of 1859 at Rájkot, where they were joined in October by Lieutenant (now Major-General) Charles Haig of the Royal Engineers, an officer of the Bombay Engineers, who had lately been appointed to the Great Trigonometrical Survey. For two months both Captain Nasmyth and Lieutenant Haig were employed as Military Engineers at the siege of Dwárka (Dvárka); but at the fall of that place in December, 1859, they resumed the trigonometrical operations, and the remainder of the field season 1859-60 was spent in extending the minor triangulation of Cutch and Káthiáwár. On March 10th, 1860, Captain Nasmyth proceeded on furlough and Lieutenant Haig assumed charge of the work: on April 19th, the party marched under Mr. DaCosta to their recess quarters at Rájkot, and Lieutenant Haig set out for Murree (Mari) where he joined Major J. T. Walker's Party.

Season 1860-61.

PERSONNEL.

Lieutenant C. T. Haig, Bombay Engineers, 2nd Assistant.
Mr. J. DaCosta, Civil 2nd Assistant.
„ J. McGill, Senior Sub-Assistant.
„ G. A. Anding, 3rd Class Sub-Assistant.

The programme of work laid down for the Bombay Party, during this field season, was to take up the Guzerat Longitudinal Series at the side Wardhari–Ghoráráo, carry it eastward until it met the Khánpisura Meridional Series, and then to return and work southwards from a side of this new work down the meridian of $73\frac{1}{2}°$ to meet the southern unfinished portion of the Singi Meridional Series. The head-quarters of the party quitted Rájkot on November 15th, and reached Wardhari on the 30th. Mr. McGill had taken the field about a month previously to lay out the approximate work. Up to the middle of January, Mr. DaCosta was employed on the secondary triangulation in Káthiáwár: he then left for the Deccan to take up the approximate work of the Mangalore (Mangalúr) Meridional Series, on which he remained employed till the close of the field season.

At the beginning of the season the progress of the party met with some serious checks. The stations of Játhrábhor, Kágarol and Rencha, which are situated at the junction of the Singi and Guzerat Series, had been selected some years previously. In the approximate chart furnished to Lieutenant Haig the ray between Játhrábhor and Ghoráráo was laid down, but after several days had been spent in felling trees it was found to be impracticable. Another delay was caused by a mistake of the mason who instead of repairing the old Rencha station, built a new station at another village also called Rencha, and the signal-man shewed his heliotrope to Ghoráráo from this latter. Lieutenant Haig himself too went to this new station and did not find out his mistake until he had put up his instrument.

On arriving at Bhor Lieutenant Haig found the ray Bhor–Patángri impossible owing to a large hill intervening: having observed all the other rays he went to Patángri and selected a new station there: whilst the pillar was being built he visited Játhrábhor and Kágarol, and then went back to Ghoráráo and observed there the correct ray to Rencha: Kágarol, Patángri, and Bhor were then revisited, and on January 20th, 1861, the Kágarol compound figure at the junction of the two Principal Series was finished.

In the meanwhile Mr. McGill, who had been carrying the approximate series southwards on the Singi meridian, made excellent progress until he reached Kesarwa, when he and all his party were prostrated with jungle fever and had to retire to Broach (Bharúch): he was unable to resume his work during the field season. Mr. McGill's absence necessitated a change of programme; for he was the only officer available for the approximate work and it had been expected that he would be able to select all the stations of the Singi Meridional Series and also make considerable progress with the approximate work of the Guzerat Longitudinal Series to the east of the Singi meridian before Lieutenant Haig had finished the observations of the Kágarol compound figure, as he would have done, if all had gone right. Lieutenant Haig thus found no approximate work ready for him on the Guzerat Longitudinal Series and had to commence selecting his stations himself; but his progress proved so slow, that towards the end of January he gave it up and returned to Bhor with the object of observing at the new stations of the Singi Meridional Series already selected. On this work he remained employed for the remainder of the season of 1860-61.

It may be mentioned that the cause of McGill's party being prostrated was due to his entering a tract of country which, earlier than the middle of February, is most deadly; but this fact was unknown to Lieutenant Haig or Mr. McGill till after the unfortunate experience.

Season 1861-62.

PERSONNEL.

Lieutenant C. T. Haig, Bombay Engineers, 1st Assistant.
Mr. J. DaCosta, Civil 2nd Assistant.
„ J. McGill, Junior Civil 2nd Assistant.
„ G. A. Anding, 3rd Class Sub-Assistant.

The party passed the recess season of 1861 at Poona (Puna), and in October following again took the field. The first stations visited were Játhrábhor and Patángri of the Kágarol compound figure, and an attempt was made to prolong the Guzerat Longitudinal Series eastwards from the side that joined them. The plan, however, was found impracticable, and the side Patángri–Bhor had to be substituted. At first Lieutenant Haig himself took up the approximate work and carried it eastwards to the meridian of $74\frac{1}{2}°$, where he left it in charge of Mr. McGill, and returned to Patángri to observe δ Ursæ Minoris for azimuth; and shortly after Christmas he commenced the observations of the final angles of the Series. By the end of January, 1862, he had carried the principal work eastwards to the side Samohi–Kukinda, and on February 22nd at Karsod he completed the Guzerat Longitudinal Series. During this season a verificatory azimuth at the station of Patángri was observed to δ Ursæ Minoris.

Lieutenant Haig had instructed Mr. McGill, when carrying on the approximate work, to maintain the series single throughout and to close on the side Indráwan–Gumánpur of the Khánpisura Meridional Series, and he had accordingly made the northern flank of his series run *viá* the stations Kukinda, Mehwása, Tharkheri, and Indráwan, and had chosen Samohi and Pípliabán on the southern flank. When Haig had observed the angles at Pípliabán he learnt from Mr. McGill that he was unable to close on the side Indráwan–Gumánpur; for the station of Gumánpur had been selected during the progress of the Khánpisura Meridional Series solely with a view to its suitability for the Mograba hexagon, and without any regard to exterior use, it being concealed from the north and west by a ridge that rendered the rays Pípliabán–Gumánpur and Tharkeri–Gumánpur impracticable.

On hearing of this check Haig decided to try and close on the side Kaula-ka-Máta–Indráwan of the Khánpisura Meridional Series, and to attain this object he added the station of Kuwása; thus unintentionally constructing a pentagon round Mehwása. But Kaula-ka-Máta like Gumánpur had been selected with regard to its own series only and was situated on the roof of a temple, the spire of which intercepted all view from the west. It therefore became necessary to build a new station on the same hill,* which was the only one available in the vicinity, and to make the side Karsod–Indráwan the closing side of the Guzerat Longitudinal Series, for which it proved admirably suited.

The Mehwása pentagon is incomplete, the angle at Mehwása between Samohi and Pípliabán being wanting. When the observations at Mehwása were being taken, the surrounding stations were observed in the following order, Samohi, Kukinda, Kuwása, Tharkheri, Pípliabán, and the mistake was made of not re-observing Samohi and of completing the round at Pípliabán. When the station of observation is at the centre of a polygon, a round of intersections is incomplete, and consequently no central equation can be formed, unless the first station in the round is intersected again at the end of the round.

All the angles of the Guzerat Longitudinal Series, were observed with Troughton and Simms' 18-inch Theodolite No. 2†, and were taken on 6 pairs of zeros. Rivers's method of changing zeros on the western section of the Series was one that he had introduced himself and first employed on the Abu Meridional Series: the zeros he used were as follows:—

$$\frac{0^\circ\ 1'}{180^\circ\ 1'},\ \frac{10^\circ\ 12'}{190^\circ\ 12'},\ \frac{20^\circ\ 20'}{200^\circ\ 20'},\ \frac{30^\circ\ 29'}{210^\circ\ 29'},\ \frac{40^\circ\ 38'}{220^\circ\ 38'}\ \text{and}\ \frac{50^\circ\ 50'}{230^\circ\ 50'}.$$

Over the ordinary method, usually followed then in the survey, *viz.*:—

$$\frac{0^\circ\ 0'}{180^\circ\ 0'},\ \frac{10^\circ\ 0'}{190^\circ\ 0'},\ \frac{20^\circ\ 0'}{200^\circ\ 0'},\ \frac{30^\circ\ 0'}{210^\circ\ 0'},\ \frac{40^\circ\ 0'}{220^\circ\ 0'}\ \text{and}\ \frac{50^\circ\ 0'}{230^\circ\ 0'},$$

he claimed the advantage for his system that it brought the zero of the micrometer over every 10 minutes of the degree and also so shifted the reading as to cancel error of "run".

Each change of zero was made in fact to fulfil the following conditions:—(1) In the degrees each zero was 10° in excess of the preceding one; (2) At each zero a different 10′

* It therefore ensues that there are now in existence two Principal Stations of the same name, Kaula-ka-Máta, one appertaining to the Khánpisura Meridional Series and the other to the Guzerat Longitudinal Series: they are between 20 and 30 yards apart.

† For a description of this instrument and its performances see Appendix No. 2 of Volume II of the *Account of the Operations of the Great Trigonometrical Survey of India.*

division in the degree was intersected; (3) Each zero was a different number of minutes from the division to be intersected, being in two cases to the right of that division and in three to the left.

Nasmyth on the central section of the Series followed Rivers, as also did Haig in the Kágarol compound figure: in 1860, however, Colonel A. S. Waugh, for reasons which will be found fully explained at pages XII to XVII of the Introduction to the Great Indus Series (*vide* Volume III of the *Account of the Operations of the Great Trigonometrical Survey of India*) ordered the following to be the zero settings of theodolites with three microscopes:—

$$\frac{0^\circ\ 0'}{180^\circ\ 0'},\ \frac{70^\circ\ 1'}{250^\circ\ 1'},\ \frac{140^\circ\ 2'}{320^\circ\ 2'},\ \frac{210^\circ\ 3'}{30^\circ\ 3'},\ \frac{280^\circ\ 4'}{100^\circ\ 4'}\ \text{and}\ \frac{350^\circ\ 5'}{170^\circ\ 5'},$$

the changes in the minutes were introduced with a view to cancelling the effects of any errors in the construction of the threads of the micrometer screws. In consequence of this order Haig worked with the following pairs of zeros, *viz*:—

$$\frac{0^\circ\ 1'}{180^\circ\ 1'},\ \frac{70^\circ\ 11'}{250^\circ\ 11'},\ \frac{140^\circ\ 22'}{320^\circ\ 22'},\ \frac{210^\circ\ 28'}{30^\circ\ 28'},\ \frac{280^\circ\ 39'}{100^\circ\ 39'}\ \text{and}\ \frac{350^\circ\ 50'}{170^\circ\ 50'},$$

on the eastern section of the Series, a system that combined Colonel Waugh's large sweeps in the degrees with Rivers's changes in the ten-minute divisions to be intersected and in the odd minutes.

When the triangulation of the South-West Quadrilateral was completed two values were obtainable for both the latitude and longitude of each of the three stations Patángri, Mirzápur and Monába, and also for both the length and azimuth of each of the three sides Patángri–Bhor, Mirzápur–Wastrál, and Monába–Wándia: the closing errors in all these cases may be exhibited as follows:—

	Patángri.		Patángri–Bhor.	
	Latitude.	Longitude.	Azimuth.	Side in feet.
When calculated from the side Bálágara–Búda of the Karáchi Longitudinal Series *viâ* the northern section of the Khánpisura Meridional Series and the eastern section of the Guzerat Longitudinal Series.	22° 52′ 15″·603	73° 55′ 49″·156	16° 47′ 34″·449	80457·2
When calculated from the side Tána–Lakarwás of the Karáchi Longitudinal Series *viâ* the northern section of the Singi Meridional Series.	22 52 15 ·671	73 55 49 ·563	16 47 27 ·336	80453·2
Closing errors ...	+ 0·068*	+ 0·407*	− 7·113	− 4·0

* The geographical error in feet is available from these quantities, as 1 foot = 0″·01, both on meridian and parallel.

	Mirzápur.		Mirzápur–Wastrál.	
	Latitude.	Longitude.	Azimuth.	Side in feet.
When calculated from the side Jeráj–Márd of the Karáchi Longitudinal Series *viâ* the Abu Meridional Series.	22° 59′ 17″·859	72° 52′ 34″·695	91° 4′ 29″·147	56132·7
When calculated from the side Tána–Lakarwás of the Karáchi Longitudinal Series *viâ* the northern section of the Singi Meridional Series and the central section of the Guzerat Longitudinal Series.	22 59 17 ·708	72 52 34 ·708	91 4 26 ·190	56135·1
Closing errors ...	+ 0·151*	− 0·013*	+ 2·957	− 2·4

	Monába†.		Monába–Wándia.	
	Latitude.	Longitude.	Azimuth.	Side in feet.
When calculated from the side Bhilgaon–Akoria of the Karáchi Longitudinal Series *viâ* the Kattywar Meridional Series.	23° 16′ 35″·909	70° 51′ 11″·778	80° 25′ 20″·028	67441·4
When calculated from the side Jeráj–Márd of the Karáchi Longitudinal Series *viâ* the Abu Meridional Series and the western section of the Guzerat Longitudinal Series.	23 16 35 ·770	70 51 11 ·850	80 25 16 ·982	67442·4
Closing errors ...	+ 0·139†	− 0·072†	+ 3·046	− 1·0

* The geographical error in feet is available from these quantities, as 1 foot = 0″·01, both on meridian and parallel.

† It should be noted that Monába is a station of the Kattywar Meridional Series, and situated some 25 miles north of the junction of that Series with the Guzerat Longitudinal Series. It is selected here as the point of comparison because it was so employed in the Simultaneous Reduction of the South-West Quadrilateral.

On the completion of the simultaneous reduction of the South-West Quadrilateral, it was found that the portions of the errors which had actually fallen to the Guzerat Longitudinal Series were, and had been dispersed on it as follows:—

	In Latitude.	In Longitude.	In Azimuth.	In Side. Log. feet.
On the eastern or Haig's section between Karsod and Patángri, length 75 miles.	″ + 0·061	″ − 0·331	″ − 0·479	+0·000,0045,0 or 0·65 inch per mile.
On the central or Nasmyth's section between Patángri and Mirzápur, length 68 miles.	− 0·050	− 0·037	− 1·453	−0·000,0201,6 or 2·95 inches per mile.
On the western or Rivers's section between Mirzápur and Chalarwa, length 113 miles.	− 0·125	+ 0·134	− 5·048	−0·000,0118,9 or 1·74 inches per mile.

The heights of the Principal Stations of the Guzerat Longitudinal Series depend in the first instance on the values of the stations of Karsod and Indrawán of the Khánpisura Meridional Series; next on the heights of the stations of Poera, Jhinjhar, Wastrál, Sola, Sánand, Khoraj, Hasalpur, and Ingrori determined by spirit-levelling operations executed during the seasons of 1875-76 and 1876-77; and lastly on the heights of the stations of Chalarwa and Sápakra which were fixed in the adjustment of the Kattywar Meridional Series. The intermediate heights, of which the values were obtained trigonometrically, shewed at Poera a cumulative error of + 3 feet and at Jhinjhar and Wastrál a further error of + 2 feet, and on the section Ingrori to Sápakra of − 3 feet: these were dispersed by simple proportion. Between Jhinjhar and Ingrori the spirit-levelled heights are sufficiently numerous to give the heights of the remaining stations directly.

Several stations of the Sábarmati Minor Series were also connected with in the spirit-levelling operations referred to above, and their values of height thus finally fixed.

Secondary Triangulation.

An important secondary chain of triangulation known as the Sábarmati Minor Series appertains to the Guzerat Longitudinal Series. It starts from the side Sánand–Pálri of the latter, 10 miles south-west of Ahmedabad, and follows the Sábarmati River to its mouth at the head of the Gulf of Cambay: from thence it runs along the western edge of the gulf until it joins the Kattywar Minor Meridional Series No. IV at the side Haibatpur–Bharbhír. Some 6 miles north of the town of Cambay, the Guzerat Coast Minor Series, that emanates near Surat from a principal side of the Singi Meridional Series, meets the Sábarmati Minor Series at the side Rhoni–Omliála of the latter in latitude 22½°.

The Sábarmati Minor Series is 75 miles long, and consists of three quadrilaterals and twenty-one single triangles, the rays averaging 6 miles in length: it was designed by Lieutenant Rivers for the purpose of connecting the heights of the stations of the Guzerat Longitudinal Series and thence those of the Abu Meridional Series and the Karáchi Longitudinal Series with mean sea level.

This connection was originally intended to be made by a line of levels; but a chain of triangulation was ultimately preferred as the more suitable method; no sufficiently accurate instrument could be procured for the levelling operations, and an officer of special training would have been required to conduct them: besides this a great advantage was gained by adopting triangulation, in that the position of the head of the Gulf of Cambay was geographically fixed. The angles were observed on two pairs of zeros, *viz*:— $\frac{0^\circ}{180^\circ}$ and $\frac{30^\circ}{210^\circ}$.

The work of selecting the stations was first taken up by Mr. J. DaCosta in February 1851, who by the end of the field season had carried the approximate work as far as the head of the gulf. In November, 1853, he had, however to return, and do some of his work over again: in the interval trees had grown and obscured a few of the rays, and here and there a platform had been destroyed: in one or two instances too the symmetry of the triangles required improvement. By the middle of December he had performed these duties and crossed the gulf at Gogha to take up the triangulation on the Kattywar Coast.

In January, 1854, Lieutenant Nasmyth having lately completed the Kattywar Minor Longitudinal Series decided to take up the observations of the final angles of the Sábarmati Series. Leaving the establishment to reach Khún Bandar in a larger boat, Nasmyth hurried onward from Gogha in a smaller one to the mouth of the Sábarmati river, and commenced at once a reconnaissance of the locality, having in the meantime wandered over the whole tract of mud, through which the Sábarmati river finds its way to the sea, in search of a suitable spot for the tide gauge. But the party whom he had left behind were forced, owing to the inundation of the spring tides, to make a considerable detour before they could reach Sikotar–Máta, and a week had elapsed before tents, horses and baggage had arrived at their destination. DaCosta had brought the approximate work only as far south as the side Mitli–Rhoni, and had selected Sikotar–Máta as the site for the tide gauge. Nasmyth however, preferred Tarakpur to Sikotar–Máta and built a trigonometrical station there: he then heard that at Tarakpur during the neap tides cattle could drink from the Sábarmati, and fearing therefore that the spot was under the influence of the river and not suitable for tidal observations, he detached Mr. McGill to choose some point nearer the sea. The latter eventually chose the two stations, Pipli and Ambli, of the Sábarmati Series, from which could be fixed a more suitable site and one which Nasmyth approved for the tide gauge, the latter was situated 660 yards south by west of Sikotar–Máta station, on what appeared hard, solid mud, that was unlikely to be washed away by the river. By the end of January Nasmyth had observed all the final angles from Sikotar–Máta as far north as Nandhanpur, and by

February 13th he had joined on the principal side Sánand–Pálri of the Guzerat Longitudinal Series: this completed the minor series from Ahmedabad to the head of the gulf.

Tidal observations were taken by Mr. DaCosta in the early months of 1855 at Miáni Bandar and Diu (Dív) on the Káthiáwár Coast. Sikotar–Máta proved a most ineligible spot for the gauge: sand silted over it, the mud bank on which it stood was gradually shifting, and it was exposed to the whole force of the current of the Sábarmati; it was thereupon decided that no tidal station could be erected nearer to the mouth of the Sábarmati than Gogha. The Kattywar Minor Meridional Series No. IV was designed in 1855 to follow the meridian of 72° and to thus connect the Guzerat Longitudinal and Kattywar Minor Longitudinal Series, but by 1860 the work had not been carried out. The only means therefore of checking the heights of stations of the Abu Meridional Series by means of a tidal station at Gogha was by computing the heights through the Kattywar Minor Longitudinal, Kattywar Meridional and Guzerat Longitudinal Series. This was considered too long a circuit, and consequently in November, 1860, Mr. DaCosta was detached by Lieutenant Haig to Bhávnagar with orders to connect the eastern extremity of the Kattywar Minor Longitudinal with the southern extremity of the Sábarmati Minor Series by means of a small chain of triangles. The stations of the Kattywar Meridional Minor Series No. IV had been previously selected as far north as Haibatpur by Mr. DaCosta, and the pillars both at Haibatpur and Bharbhír, the extremities of his side of origin, had been built. He left Rájkot on November 5th, 1860, and by the 13th of January following he had selected the stations, built the pillars, and observed the angles. He effected a connection with Nasmyth's former work at the side Ambli–Pipli, and this connection completed the triangulation of the Sábarmati Minor Series.

Two Minor Series, known as Kattywar Minor Meridional Series Nos. III and IV, are connected with principal sides of the Guzerat Longitudinal Series near its western extremity, the former with the side Nárechána–Charári, along the meridian of $71\frac{1}{2}$°, the latter with Ingrori–Kárigángar along the meridian of 72°: they close at their southern extremities on sides of the Kattywar Coast Minor Series and Kattywar Minor Longitudinal Series respectively. They were of great value to the topography of Káthiáwár. As they have been apportioned to the Kattywar Meridional Series and not to the Guzerat Longitudinal Series, and have been fully dealt with in the Introduction to the former, no further reference is necessary to them here.

The Guzerat Longitudinal Series running as it does throughout its whole length through a flat and densely wooded country, had to be made a single chain owing to the great expenses of tower-building and ray-clearing: on these accounts too the amount of secondary work that was carried out during the principal operations was very limited. No secondary stations were built, not half a dozen peaks were intersected, and it was useless to lay down the positions of particular trees when the whole country was covered with them. On the western section of the Series some fifteen intersected points exist, including the palace of Halvad: in Ahmedabad the clock tower and five or six domes and minarets were fixed, and four points in the city of Kaira were laid down from the Sábarmati Minor Series: on the central section of the Series the positions of the palace of Bálásinór (Vádashinor), of the town of Godhra, and of eleven other points were determined. On the eastern section of the Series some 15 or 20 buildings of different kinds were intersected.

In 1869-72 when the Topographical Survey of Gujarát was in hand, a minor series of triangles was carried down the river Mahi. It started from the principal side Ghoráráo–Poera and closed on the side Dhuváran–Sárod of the Guzerat Coast Minor Series.* It was commenced by Lieutenants A. W. Baird and J. R. McCullagh and finished by Messrs. A. D. Christie and C. H. McA'Fee, an observer working at each end simultaneously. The observations were taken with 10-inch theodolites on four zeros, except at one station where a 6-inch theodolite was used: the average length of the rays was 8 miles.

* This series belongs to the Singi Meridional Series.

S. G. BURRARD.

October, 1889.

GUZERAT LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. ALPHABETICAL LIST OF STATIONS.

GUZERAT LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. NUMERICAL LIST OF STATIONS.

IX (Of the Khánpisura Meridional Series).	Karsod.
XIII (Of the Khánpisura Meridional Series).	Indráwan.
I	Kaula-ka-Máta.
II	Tharkheri.
III	Kuwása.
IV	Mehwása.
V	Pípliabán.
VI	Samohi.
VII	Kukinda.
VIII	Kápri.
IX	Punákot.
XII (Of the Singi Meridional Series).	Játhrábhor.
XIII (Of the Singi Meridional Series).	Patángri.
XIV (Of the Singi Meridional Series).	Kágarol.
XV (Of the Singi Meridional Series).	Wardhari.
XVI (Of the Singi Meridional Series).	Ghoráráo.
XVII (Of the Singi Meridional Series).	Bhor.
XVIII (Of the Singi Meridional Series).	Rencha.
X	Jhiria.
XI	Poera.
XII	Rámesri.
XIII	Gohilia.
XIV	Bhagwánji.
XV	Rundan.
XVI	Mirzápur.
XVII	Jhinjhar.
XVIII	Wastrál.
XIX	Sanoda.
XX	Pálri.
XXI	Sola.
XXII	Sánand.
XXIII	Hájipur.
XXIV	Khoraj.
XXV	Wádrora.
XXVI	Hasalpur.
XXVII	Thuleta.
XXVIII	Kárigángar.
XXIX	Por.
XXX	Ingrori.
XXXI	Degám.
XXXII	Charári.
XXXIII	Dhrángadra.
XXXIV	Nárechána.
XXXV	Kuária.
XVIII (Of the Kattywar Meridional Series).	Chalarwa.
XXI (Of the Kattywar Meridional Series).	Sápakra.

GUZERAT LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. DESCRIPTION OF STATIONS.

This Series is divided into two portions by the Singi Meridional Series and in order to make it continuous it has been necessary to include the data appertaining to Stations XII to XVIII of the Singi Series. Of the Principal Stations, the stations of origin, and those numbered I to X, XVII, XVIII, XX, and XXIII as also those which belong to the Singi Meridional Series, are situated on hills or rising ground, and with the exception of Station IX of the Khánpisura Meridional Series, of which the construction is not known, and of Station XVII of the Singi Meridional Series, where there is only one mark on a projecting rock, consist of isolated and perforated pillars of masonry from 5 to 7 feet high, having a mark engraved on the rock *in sitú* or on a stone embedded at the ground level, and another mark at the surface in the normal of the first. Round these pillars, platforms of earth and rubble or earth and wood have been built for the observatory tent to rest on. At several of these stations an aperture through the platform and pillar was left for reference to the ground level mark. At all the remaining stations which are situated in the plains it was found necessary to construct towers to overlook the curvature of the earth. These are solid, 12 to 40 feet in height, built either of sun-dried bricks or stones set in mud cement and in a few cases of loose stones, and having a broad base. Each encloses a central pillar of masonry, sometimes solid, sometimes perforated, which carries marks at the top and at the ground level; in the former, other marks are inserted generally at every 5 feet: the upper portion of these pillars, about 5 feet, is circular and isolated. Access to the mark at ground level is obtained by an aperture which was left for the purpose.

The following descriptions have been compiled from those given by the Officers who executed the Series, from the records of Captain Baird's Leveling Operations in 1874 to 1876, and from General Reports of the Kattywar Topographical Survey, supplemented as regards adjacent villages, &c., from the Topographical maps of the country traversed. Some details regarding the heights and the construction of the stations have been gathered from reports, contingent bill, and other records of the Series. The local sub-divisions in which the several stations are situated, have been derived, where practicable, from the latest Annual Reports furnished by the District Officers to whose charge the stations are committed.

IX.—(*Of the Khánpisura Meridional Series*). Karsod Hill Station, lat. 23° 7′, long. 75° 28′—observed at in 1848 and 1862—is situated on a small hill about 1½ miles W. of Chota Karsod, and 1 mile N. of Rojri village. It is towards the S. extremity of the hill, and 119 (ft.?) 8 (in.?) S. of the southern wall of a pagoda (temple): pargana Barnagar, Gwalior territory.

The station consists of a platform most probably constructed in a manner similar to those at the adjacent stations and contains two marks, the upper 4·27 feet above the lower. When again visited in 1862, in the course of the Operations of this Series, the station was found to be about 5 feet in height. The nearest villages are Rasulabad and Maulana.

XIII.—(*Of the Khánpisura Meridional Series*). Indráwan Tower Station, lat. 22° 49′, long. 75° 13′—observed at in 1847, 1848 and 1862—is situated on rising ground, about 1 mile N.E. of the village from which the station obtains its name, 1½ miles from Barwál, and 8 miles N.N.E. of Desi: pargana Baduáwar, district Dhár, Bheel Agency.

The station as originally built in April 1847 consisted of a solid pillar of masonry sunk to a depth of 6·3 feet, containing two marks, the upper in the surface of the pillar being at the ground level; over this a platform of loose stones, 7·46 feet in height, with a mark at the top was constructed. In November 1848 an addition of 2·17 feet was made to the height of the platform. It was again visited in February 1862 in the course of the Operations of this Series, when it was simply stated that it is built 4·75 feet high. In 1869 the loose stone platform was removed, and over the original mark at the ground level, a pillar of masonry 7·46 feet in height was built surrounded by a platform of stones of the same height as the pillar. An arched aperture from E. to W. gives access to the ground level mark. It thus appears that the station as last constructed is 2·17 feet lower than that of November 1848.

I. Kaula-ka-Máta Hill Station, lat. 23° 8′, long. 75° 13′—observed at in 1862—is situated on an isolated and symmetrically shaped hill, about 20 yards S. of the large temple of Kaula-Máta from which the hill derives its name. On the roof of the temple and E. of the spire is station "XI. Kaula-ka-Máta" of the Khánpisura Meridional Series; but as all view towards the west was intercepted by the temple, it became necessary to establish this station for the Guzerat Longitudinal Series: Sailána State of the Western Malwa Agency.

The station consists of a platform of earth and rubble enclosing an isolated and perforated pillar of masonry, 5·93 feet in height, which contains a lower and upper mark, the former engraved on a projecting rock about 10 inches above the ground.

II. Tharkheri Hill Station, lat. 22° 52′, long. 74° 53′—observed at in 1862—is situated on a high table-land, about 2 miles S.E. of the village which gives its name to the station: Jhábua State, Bheel Agency.

The station consists of a platform enclosing an isolated and perforated pillar of masonry, 4·81 feet in height, which contains a lower and upper mark-stone.

III. Kuwása Hill Station, lat. 23° 8′, long. 74° 42′—observed at in 1862—is situated on the highest and about the centre of a group of low hills, about 4 miles W. of the town of Kuwása: Jhábua State, Bheel Agency.

The station consists of a platform of earth and rubble and logs of wood, enclosing an isolated and perforated pillar of masonry, 5·00 feet in height, with lower and upper mark-stone.

IV. Mehwása Hill Station, lat. 22° 55′, long. 74° 40′—observed at in 1862—is situated on the highest point of the two S.E. hills about 2½ miles N.E. of the town Bhágor: Jhábua State, Bheel Agency.

The station of 1862 consisted of a platform of earth and rubble and logs of wood, about 5 feet in height, enclosing an isolated and perforated pillar of masonry 2·37 feet in height which contained a lower and upper mark-stone. It was visited in 1878-79 by Lieutenant Gore who rebuilt the platform 2½ feet in height.

V. Pípliabán Hill Station, lat. 22° 42′, long. 74° 49′—observed at in 1862—is situated on the site of the deserted village so called, and about 2 miles S. of Sonar: Jhábua State, Bheel Agency.

The station consists of a platform of earth and rubble, enclosing an isolated and perforated pillar of masonry, 5 feet in height, which contains a lower and upper mark-stone.

VI. Samohi Hill Station, lat. 22° 39′, long. 74° 28′—observed at in 1862—is situated on the eastern and highest part of a hill, about 1 mile S.S.W. of village so called: Jhábua State, Bheel Agency.

The station consists of a platform of earth and rubble, enclosing an isolated and perforated pillar of masonry, 5·47 feet in height, which contains a lower and upper mark-stone.

VII. Kukinda Hill Station, lat. 23° 2′, long. 74° 29′—observed at in 1862—is situated on a high hill of that name about a mile W. of the small village of Morjeri: Jhábua State, Bheel Agency.

The station consists of a platform of earth and rubble and logs of wood, enclosing an isolated and perforated pillar of masonry, 5 feet in height, which contains a lower and upper mark-stone. Access to the lower mark is provided for.

VIII. Kápri Hill Station, lat. 22° 55′, long. 74° 13′—observed at in 1862—is situated on a table-land of the Vindhyáchal range of hills which run N. and S. and partially divide the Báriya State from the parganas of Dohad and Jhálod, about 1½ miles N. of Kápri village, and the same distance S.W. of the village of Dagária: sub-division Jhálod, district Panch Máháls.

The station consists of a platform of earth and rubble and logs of wood, enclosing an isolated and perforated pillar of masonry, 5 feet in height, which contains a lower and upper mark-stone.

IX. Punákot Hill Station, lat. 22° 37′, long. 74° 12′—observed at in 1862—is situated on the ridge of a high hill to the S.S.W. of the village from which the station has been named. The ascent from the village of Punákot is very gradual and is practicable for laden carts. Báriya State, district Rewákánta.

The station consists of a platform of earth and rubble, enclosing an isolated and perforated pillar of masonry, 5·06 feet in height, which contains a lower and upper mark-stone.

XII.—(*Of the Singi Meridional Series*). Játhrábhor Hill Station, lat. 23° 2′, long. 73° 43′—observed at in 1860, 1861 and 1862—is situated on a range of hills, about 2 miles to S.W. of Játhrábhor village: thána Lunáwára, district Rewákánta.

The station consists of a platform of earth and rubble, enclosing an isolated and perforated pillar of masonry 5 feet in height, with an aperture for access to the lower mark. The nearest villages are Káli, Gugulia and Sagarda.

XIII.—(*Of the Singi Meridional Series*). Patángri Hill Station, lat. 22° 52′, long. 73° 56′—observed at in 1861-62—is situated on a high, flat-topped hill forming portion of a range, about ½ a mile S.E. by S. of the village of Patángri: thána and state Báriya, district Rewákánta.

The station consists of a platform of earth and rubble, enclosing an isolated and perforated pillar of masonry 2 feet in height with mark-stones at top and bottom, and an aperture giving access to the latter. The nearest villages are Diwigám, Nawágám, Kupda and Pála.

XIV.—(*Of the Singi Meridional Series*). Kágarol Hill Station, lat. 22° 53′, long. 73° 42′—observed at in 1860-61—is situated on a low, isolated hill, about 1½ miles N.W. of the village of Pipalia; the hill is also named Pipalia-ni-Dúngari, and is in lands of the town of Serah: pargana Godhra, district Panch Máháls.

The station consists of a platform of earth and rubble, enclosing an isolated and perforated pillar of masonry 5 feet in height, having an aperture for access to the lower mark. The nearest villages are Dharaula, Jhoj and Nawágám.

XV.—(*Of the Singi Meridional Series*). Wardhari Hill Station, lat. 23° 6′, long. 73° 30′—observed at in 1860—is situated on one of the ranges of hills to S.E. of the village of Wardhari from which there is an ascent of a quarter of a mile to the station: thána and state Lunáwára, district Rewákánta.

The station consists of a platform of earth and rubble, enclosing an isolated and perforated pillar of masonry, 5·83 feet in height, with an aperture giving access to the lower mark. The nearest village is Kadáchla.

XVI.—(*Of the Singi Meridional Series*). Ghoráráo Hill Station, lat. 22° 52′, long. 73° 24′—observed at in 1859 and 1860—is situated on a ridge of hills in lands of the village of Kuni which is ½ a mile nearly N., the town of Bálásinor is about 6 miles distant in the same direction: taluka Thásra, district Kaira.

The station consists of a platform of earth and rubble, enclosing an isolated and perforated pillar of masonry, 5 feet in height, having an aperture for access to the lower mark. The directions of the following villages are:—Mahi Itadi, Wanora and Rauja, N.; Panch Máháls villages, E.; Sanjol and Menpur, S.; and Rauja and Balara, W.

XVII.—(*Of the Singi Meridional Series*). Bhor Hill Station, lat. 22° 40′, long. 73° 52′—observed at in 1860-61 and 1862—is situated on the southern of two rocks on the high hill of Bhalapur to the S. of the village of Bhor: thána Báriya, district Rewákánta.

As regards the construction of the station the following is all that is forthcoming:—"The platform for the observatory was made of bamboos resting on logs of wood fixed in the crevices of the rocks and the mark is made on the rock". The nearest villages are Virol, Khánpáda, Jhab and Sagarmu.

XVIII.—(*Of the Singi Meridional Series*). Rencha Hill Station, lat. 22° 42′, long. 73° 39′—observed at in 1860-61—is situated on an isolated hill locally known as Wagh Dúngar, having the village of Rencha at its western foot: pargana Kálol, district Panch Máháls.

The station consists of a platform of logs of wood covered over with earth, enclosing an isolated and perforated pillar of masonry 5 feet in height, with marks at top and bottom, and an aperture for access to the lower mark which is cut on the rock. The nearest villages are Sárangpur and Chaláli.

X. Jhiria Hill Station, lat. 23° 1′, long. 73° 18′—observed at in 1859—is situated on a hill about 1 mile W. of the village of Hotwár and 6 miles N.W. of Bálásinor: thána and state Bálásinor, district Rewákánta.

The station consists of a platform of rubble, 6 feet in height, enclosing an isolated and perforated pillar of stone and mortar, with an arched aperture on the S. side for access to the lower mark.

XI. Poera or Poeda Tower Station, lat. 22° 55′, long. 73° 15′—observed at in 1859—stands about ⅛ of a mile E. of the village of Phagwel Poeda, and 8 miles nearly W. of Bálásinor: taluka Kapadwanj, district Kaira.

The station consists of a tower of sun-dried bricks supported by earthwork and brushwood, enclosing a central, perforated pillar of masonry 30·8 feet in height, the upper 5 feet of which is isolated, with an aperture on the N. side for access to the lower mark. The original lower mark, indicated by a circle and dot engraved on a stone, is in the intersection of lines drawn through marks at the outer part of small apertures, through and through the tower, left for the purpose. Subsequent to an earthquake on the 31st December 1858, a new lower mark was engraved, 1·25 inches to the S.W., and just without the circle of the original mark. The new mark was employed when the observations were taken.

XII. Rámesri Tower Station, lat. 23° 0′, long. 73° 10′—observed at in 1859—stands S. of the village of Rámesri to which it appertains: taluka Kapadwanj, district Kaira.

The station consists of a tower of sun-dried bricks supported by earthwork and brushwood, enclosing a central, perforated pillar of masonry 30·82 feet in height, the upper 5 feet of which is isolated, with an aperture on the N. side for access to the lower mark. The upper mark was displaced by the earthquake of the 31st December 1858, and a new mark to which the observations refer indicated by a dot, 0·6 of an inch E. of the original mark, which has been left undisturbed.

XIII. Gohilia Tower Station, lat. 22° 53′, long. 73° 7′—observed at in 1859—stands adjoining the village of Gohilia, hamlet of the Gaekwar village of Mahisa: taluka Báwisi, Mahi Kánta Agency.

The station consists of a tower of sun-dried bricks and mud cement, enclosing a central, perforated pillar of masonry 24·2 feet in height, with an arched aperture on the E. side for access to the lower mark. The earthquake of the 31st December 1858 displaced the upper mark, and a new mark, 0·8 of an inch to S.W. of the original, was made, both marks have circles engraved round them. The observations refer to the new mark. The directions and distances of the circumjacent villages are:—Katana N., mile ½; Kaklia W., mile 1; and Bársída N.W., mile 1.

XIV. Bhagwánji Tower Station, lat. 23° 0′, long. 73° 2′—observed at in 1858—stands within the limits of and about a mile S. of the village from which it has been named: taluka Kapadwanj, district Kaira.

The station consists of a tower of sun-dried bricks and mud cement, enclosing a central, perforated pillar of masonry 23·12 feet in height, with an aperture on the N. side for access to the lower mark.

XV. Rundan Tower Station, lat. 22° 53′, long. 72° 57′—observed at in 1858—stands about ⅓ of a mile N. of the village of Rundan, and 4¾ miles N.N.E. of the large village of Súnj: taluka Mehmadabad, district Kaira.

The station consists of a tower of sun-dried bricks and mud cement, enclosing a central, perforated pillar of burnt bricks and morter, 23·04 feet in height, which has a mark at the level of the ground and another at top; access to the lower mark being obtained by an aperture on the N. side of the tower. The directions and distances of the circumjacent villages are:—Bilia Muwára W., mile ½; Jália N.N.E., mile ¾; Kaloli S.W., miles 1¼; and Sárasauni (on the Wátrak river) W.N.W., miles 2¼.

XVI. Mirzápur Tower Station, lat. 22° 59′, long. 72° 53′—observed at in 1852 and 1858—is situated on a sandy hill about a mile W. by S. of the village of Mirzápur, and 4 miles N.N.W. of the large village of Haldarwás on the right bank of the Wátrak river: taluka Daskroi, district Ahmedabad.

The station consists of a tower enclosing a solid pillar of masonry, 18 feet in height, which has a mark-stone at top and others at 3, 8, 13 and 18 feet respectively below it, the lowest being at the ground level. The directions and estimated distances of the circumjacent villages are:—Chándivel Bhátpura W.N.W., mile ¾; Wárod (on the left bank of the Meswo river) W.S.W., miles 2¾; Kániel S. by E., miles 1½; and Patáwat (on the western bank of the Wátaok) S.E., miles 3. When visited in 1858 in the course of the operations of this Series, no alteration appears to have been made in the construction of the station.

XVII. Jhinjhar Hill Station, lat. 22° 53′, long. 72° 48′—observed at in 1858—is situated on a hill, about 1¼ miles S. by W. of the village from which it takes its name, and 4½ miles N. of the city of Mehmadabad on the B.B. and C.I. Railway: taluka Mehmadabad, district Kaira.

The station consists of a tower of sun-dried bricks and mud cement, enclosing a central, perforated pillar of masonry 10·04 feet in height, with an aperture on the N. side for access to the ground level mark. The directions and distances of the circumjacent villages are:—Rohisa W. by N., mile 1; Dájipura E. by N., miles 1½; and Ghoráli on the Wátrak river, S.S.E. miles 2.

XVIII. Wastrál Hill Station, lat. 22° 59′, long. 72° 43′—observed at in 1852 and 1858-1859—is situated on a small sandy hill about half a mile S.W. of the village of Wastrál, and 2½ miles W.N.W. of Gátrád on the western bank of the Khári river: Taluka Daskroi, district Ahmedabad.

The station consists of a solid platform 7 feet in height, enclosing a central, isolated pillar of masonry. The directions and distances of the circumjacent villages are:—Rámol S.W. by S., mile 1; Mehmadpur S.E. by S., miles 1¼; Khokhra Mehmadabad W. by N., miles 3¼: and Wánch S.S.E., miles 3½.

XIX. Sanoda Tower Station, lat. 23° 7′, long. 72° 48′—observed at in 1852—stands on the rising ground about ¾ of a mile S.E. of the village from which the station has been named. The whole country in the neighbourhood is much covered with large trees: sub-division Degám, Baroda State.

The station consists of a tower (most probably built in a manner similar to those at the adjacent stations) enclosing a solid pillar of masonry. Four small pillars have been built outside the tower, and the intersection of lines engraved on them will give the position of the upper station mark. Other mark-stones have also been fixed at every 5 feet in the pillar.

XX. Pálri Hill Station, lat. 22° 54′, long. 72° 34′—observed at in 1852 and 1858—is on a sandy hill, about ¾ of a mile E. of the village from which it has been named, and 2¼ miles E. by N. of the large village of Kásandra on the right bank of the Sábarmati river: taluka Daskroi, district Ahmedabad.

The station consists of a platform 6 feet in height, enclosing a central, isolated pillar of masonry. The directions and distances of the circumjacent villages are:—Miroli S., miles 1¾; Giramtha S.E. by E., miles 2¼; and Ord N.E. by E., miles 1¾.

XXI. Sola Tower Station, lat. 23° 5′, long. 72° 34′—observed at in 1852—is situated on a small sandy hill about a mile N.E. of the village of Sola, 200 yards S. of a Bar or Banyan tree, and 1½ miles due N. of mile post No. 318 of the B.B. and C.I. Railway: taluka Sánand, district Ahmedabad.

The station consists of a tower 25 feet in height, enclosing a pillar of masonry in which mark-stones have been placed at every 5 feet. Four small pillars are built outside on the production of the diagonal lines of the tower, and the intersection of the lines on these will give the position of the upper mark. The village of Gotha lies to N.E. about ¾ of a mile, and the city of Ahmedabad to S.E., about 6 miles.

XXII. Sánand Tower Station, lat. 22° 59′, long. 72° 25′—observed at in 1852—is situated on a small hill, about a mile W. of the large and well known town of Sánand, and about 45 feet E. of a large temple called Hazari Máta. The hill is formed by the ruins of some old buildings: taluka Sánand, district Ahmedabad.

The station consists of a tower 12 feet in height, enclosing a pillar of masonry in which three mark-stones have been fixed. The tower is towards the N.E. corner of the temple, and the mark is 49·2 feet from the S. E. corner and 45·9 feet from the N. E. corner, measured at the height of the top of the tower, equivalent to a height of 9·9 feet measured on the corner of the temple.

XXIII. Hájipur Hill Station, lat. 23° 9′, long. 72° 26′—observed at in 1852—is situated on a hill, about 1½ miles S. W. of the village from which the station takes its name, and the same distance N. N. E. of the village of Thol: taluka Kadi of the Gaekwar's territory.

The station consists of a platform about 5 feet in height, the lower mark is engraved on a large stone embedded in masonry.

XXIV. Khoraj Tower Station, lat. 23° 2′, long. 72° 17′—observed at in 1852—stands on a mound on the northern edge of a small tank, about 1½ miles E. of the village of Khoraj Nándoda, and 2½ miles W. by S. of the Railway Station of Chárori on the B.B. and C.I. Line: Gaekwar's territory.

The station consists of a tower of sun-dried bricks and mud cement, faced with burnt bricks, 18 feet in height, enclosing a central pillar of burnt bricks and mortar. When again visited in 1875-76 by Captain Baird the station was found tolerably perfect, but the upper mark-stone had disappeared: the upper course of masonry was imperfect, but one portion of it appeared to be about the level of the upper mark-stone. The directions and distances of the circumjacent villages are:—Kalána E.S.E., mile 1; Shiawára S., miles 2¼; Chárori E.N.E., miles 2; and Sutárki N., miles 2¼.

XXV. Wádrora Tower Station, lat. 23° 11′, long. 72° 15′—observed at in 1852—stands on a mound some 12 feet in height, at the N. E. corner of a small tank, about ¾ of a mile E. by S. of Wádrora village: and 2¼ miles E. of Kádipur: Kadi taluka of the Gaekwar's territory.

The station consists of a tower 12 feet in height, enclosing a pillar of masonry, the upper 5 feet of which is isolated. The directions and distances of the circumjacent villages are:—Melaj S. W. by W., miles 2¾; and Warkharia S. by W., miles 1¾.

XXVI. Hasalpur Tower Station, lat. 23° 5′, long. 72° 7′—observed at in 1852—stands on the north-western of two mounds which are on the N. E. margin of a large tank, the other mound having a ruined temple on it. It is about 3 miles S. E. by S. of the town of Viramgám: taluka Viramgám, district Ahmedabad.

The station consists of a tower 21 feet in height, having a mark-stone at the top: it was originally built 16 feet in height and was raised to its present height on the 5th April 1852. The directions and distances of the circumjacent villages are:—Hasalpur Sareswar W.N.W., mile ¾; Soklai (on the B. B. and C. I. Railway) E.N.E., miles 2¼; and Thori Mubárak S.W. by S., miles 3.

XXVII. Thuleta Tower Station, lat. 22° 57′, long. 72° 9′—observed at in 1852—stands on the eastern bank of a large tank which lies immediately N. of the village of Thuleta, and about 250 yards S. W. of the south-western bank of Hir tank: taluka Viramgám, district Ahmedabad.

The station consists of a tower of sun-dried bricks and mud cement, 16 feet in height, enclosing a central pillar of masonry. The directions and distances of the circumjacent villages are:—Wáswa N., miles 2; Wásan E. N. E., miles 2¼; Asalgám, miles 3; and Jetapur S. S. E., miles 3¾.

XXVIII. Kárigángar or Khárigángard Tower Station, lat. 22° 58′, long. 72° 1′—observed at in 1852—stands on a mound some 12 feet high on the S. E. corner of a tank, about a mile N. of Khárigángard village and 2 miles S. of that of Vitalgarh or Wátu: taluka Vithalgarh, district Jhalawad.

The station consists of a tower of sun-dried bricks and mud cement, faced with burnt bricks, 12 feet in height, enclosing a central pillar of burnt bricks and mortar, with marks at every 5 feet of height. The directions and distances of the circumjacent villages are:—Kalánpura N. E., miles 2¾; Kamijla S. E. by E., miles 3¼; and Wardla S. S. E., miles 3.

XXIX. Por or Porda Tower Station, lat. 23° 7′, long. 71° 55′—observed at in 1852—stands on a mound on the S. E. corner of the tank, about 200 yards S. of Porda village, and 4¾ miles S.W. by W. of the Railway Station of Jhúnd on the B. B. and C. I. Railway: taluka Bajána, district Jhalawad.

The station consists of a tower 13·2 feet in height. The directions and distances of the circumjacent villages are:—Charáda E. S. E., miles 1½; Khákharla or Jorawárapura N. N. W., miles 2; and Shedla W. N. W., miles 2¾.

XXX. Ingrori or Ingrodi Tower Station, lat. 22° 57′, long. 71° 51′—observed at in 1852—stands on the western bank of a tank, about 1¼ miles S. by E. of Ingrori village, and 3¼ miles W. of the Railway Station of Lilápur on the B. B. and C. I. Line: taluka Lakhtar, district Jhalawad.

The station, a tower of sun-dried bricks and mud cement, faced with burnt bricks, enclosing a central pillar of burnt bricks, was 16 feet in height in March 1852. In August of the same year it appears to have been raised 8 feet 5 inches and again in December a further addition of 10 feet was made; it has marks at the top, bottom and intermediately. The directions and distances of the circumjacent villages are:—Kesaria S.S.W., miles 2; Shaulána W. by N., miles 2; and Kárela N.E., miles 2¾.

XXXI. Degám Tower Station, lat. 23° 5′, long. 71° 42′—observed at in 1852 and 1853—stands on the bank of a small tank in the plain south of the village of Degám, about 8 miles W. by S. of the town of Bajána and 3½ miles W.N.W. of Pipli village: taluka Bajána, district Jhalawad.

The station consists of a tower enclosing a central pillar 40 feet in height. "The upper mark which was used for the signals for the Por observation of season 1851-52 and all the connecting stations of 1852-53 was 12 feet lower than the present one. Outer marks had been fixed, the intersection of which defined the position of the old one, but the mark from which the final angles were observed was found to differ 1·27 inches N. W. from that, or in a line forming an azimuth of 126½° less than Por." The size of pillar did not admit of a new mark being made which would agree with the old, and it has been necessary to apply to the angles observed at the surrounding stations, corrections to reduce them to the present upper mark. The directions and distances of the circumjacent villages are:—Degám N., miles 2; Bharáda W.S.W., miles 4¼; and Dhrumat S. by W., miles 3¼.

XXXII. Charári Tower Station, lat. 22° 55′, long. 71° 38′—observed at in 1852—stands on the eastern bank of a small dry tank on the rising ground about 2 miles W.S.W. of the village of Charári, and 3¾ miles N. by E. of the town of Sitha on metalled road from Dhrángadra: taluka Dhrángadra, district Jhalawad.

The station consists of a tower half solid and half hollow, built of stones and mud cement, 13 feet square and 30 feet in height, having a pillar of stone and mortar in its centre. The station as built in the previous season was only 22 feet in height and consisted of a solid tower of loose stones, enclosing a central pillar of stone and mortar. The directions and distances of the circumjacent villages are:—Bharad S. by E., miles 2½; Hámpur S.W. by W., miles 1¾; and Lawána N.W. by N., miles 3.

XXXIII. Dhrángadra Tower Station, lat. 23° 1′, long. 71° 31′—observed at in 1852—stands on a rocky table-land, about 2 miles N. of the town of Dhrángadra: taluka Dhrángadra, district Jhalawad.

The station consists of a tower of loose stones 16 feet in height, enclosing a central pillar of stone and mortar. The directions and distances of the circumjacent villages are:—Isadara (on the right bank of the Phulka river) E.N.E., miles 2¼; Haripur E.S.E., miles 3¼; Rájpur W. by S., miles 3¼; and Sathapur N.W. by N., miles 4.

XXXIV. Nárechána or Nárisána Tower Station, lat. 22° 53′, long. 71° 25′—observed at in 1853—stands on a small rocky hill near intersection of roads, and about ¼ of a mile N. of the country road connecting the villages of Nárechána and Kodh: taluka Sáyla, district Jhalawad.

The station consists of a tower of loose stones with a broad base, 22 feet in height, enclosing a central pillar of stone and mortar. The directions and distances of the circumjacent villages are:—Nárechána E.S.E., miles 2½; Gájanwáo N.E. by N., miles 2¾; Kodh W. by N., miles 4¼; and Rauliawadar S. by E., miles 3½.

XXXV. Kuária or Kowaria Tower Station, lat. 23° 1′, long. 71° 20′—observed at in 1852—stands on the rising ground about 1½ miles N. by E. of the small village of Kuária, and 7 miles E. of the town of Halwad: taluka Dhrángadra, district Jhalawad.

The station consists of a tower of loose stones 16 feet in height, enclosing a central pillar of stone masonry, the upper 5 feet of which is isolated. The directions and distances of the circumjacent villages are:—Pándhara W.N.W., miles 2; Pipalia E.N.E., miles 2¼; Chúli E. by S., miles 3¾; and Butora N.N.W., miles 3.

XVIII.—(*Of the Kattywar Meridional Series*). Chalarwa or Charádwa Tower Station, lat. 22° 57′, long. 71° 6′—observed at in 1852, 1854 and 1856—stands on the bank of a small dry tank near junction of roads from Kariana, Suswáo and Chalarwa, and about 2¾ miles N.E. of the town of Chalarwa: taluka Dhrángadra, district Jhalawad.

The station consists of a tower of stones set in mud cement, 11 feet square and 16 feet in height, enclosing a pillar of stone and mortar. Four pillars are built outside the tower, and the intersection of the lines engraved on them indicated the position of the upper mark on which the theodolite was centered; the mark at the ground level is 0·65 of an inch to E. of the upper one. When again visited in 1856, the upper mark-stone was found displaced by 0·95 of an inch to N.E., but no statement of any alteration in the construction of the station is forthcoming. The directions and distances of the circumjacent villages are:—Suswáo N.E. by N., miles 3¼; and Kariana S.E. by S., miles 2½.

XXI.—(*Of the Kattywar Meridional Series*). Sápakra Tower Station, lat. 22° 52′, long. 71° 17′—observed at in 1853—stands on the rising ground south of the village of Sápakra: taluka Dhrángadra, district Jhalawad.

The station consists of a tower of loose stones with a broad base, 26 feet in height, enclosing a pillar of stone and lime cement. The directions and distances of the circumjacent villages are:—Bhalgámda N.W., miles 3¼; Digaria W. by S., miles 3; Ratewália E.S.E., miles 2¾; and Chitrori (on the right bank of the Bámbhan river) S. by W., miles 2½.

April 1880.

J. B. N. HENNESSEY,

In charge of Computing Office.

GUZERAT LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. OBSERVED ANGLES.

At IX (Karsod)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIII 303° 21′	123° 21′	13° 32′	193° 32′	83° 43′	263° 43′	153° 48′	333° 48′	223° 59′	43° 59′	294° 10′	114° 10′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XIII & I	*h* 45·40 *h* 45·87	*h* 48·17 *h* 48·33	*h* 44·80 *h* 45·73	*h* 47·20 *h* 46·37	*h* 42·37 *h* 41·60	*l* 50·90 *l* 51·77	*l* 50·20 *l* 51·60	*l* 44·17 *l* 43·80	*l* 43·40 *l* 44·33	*l* 41·90 *l* 42·60	*l* 46·47 *l* 45·14	*l* 45·00 *l* 44·07	$M = 45''\cdot88$ $w = 1\cdot31$
	45·64	48·25	45·26	46·79	41·98	51·34	50·90	43·98	43·87	42·25	45·80	44·54	$\frac{1}{w} = 0\cdot76$ $C = 56°\ 39'\ 45''\cdot88$

At XIII (Indráwan)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on II 0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
II & I	*l* 66·46 *l* 66·60	*l* 65·84 *l* 65·00	*l* 64·00 *l* 64·17	*l* 68·93 *l* 68·97	*l* 64·60 *l* 64·53	*l* 59·94 *l* 59·37	*l* 66·47 *l* 66·30	*l* 62·60 *l* 61·40	*l* 72·50 *l* 71·10	*l* 73·80 *l* 73·24	*h* 65·83 *h* 66·90	*l* 65·80 *l* 65·17	$M = 66''\cdot23$ $w = 0\cdot81$
	66·53	65·42	64·09	68·95	64·56	59·66	66·38	62·00	71·80	73·52	66·37	65·48	$\frac{1}{w} = 1\cdot23$ $C = 77°\ 9'\ 6''\cdot23$

NOTE.—Stations IX and XIII appertain to the Khánpisura Meridional Series.

At XIII (Indráwan)—(*Continued*).

Angle between	Circle readings, telescope being set on II: 0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
I & IX	"	"	"	"	"	"	"	"	"	"	"	"	M = 57″·35
	h 59·07	l 56·00	h 59·50	l 60·17	l 61·70	l 57·00	l 59·03	l 59·77	l 49·93	l 51·27	h 56·97	l 56·37	w = 0·93
	h 57·87	l 56·97	h 59·73	l 60·30	l 63·60	l 58·33	l 58·37	l 60·17	l 50·06	l 52·16	h 55·30	l 56·67	$\frac{1}{w}$ = 1·07
	58·47	56·49	59·61	60·24	62·65	57·66	58·70	59·97	50·00	51·71	56·14	56·52	C = 39° 39′ 57″·35

At I (Kaula-ka-Máta)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX: 0° 1′	180° 1′	70° 11′	250° 11′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
IX & XIII	"	"	"	"	"	"	"	"	"	"	"	"	M = 18″·25
	h 15·70	h 13·90	l 18·10	l 15·34	h 18·20	h 13·27	h 20·40	h 21·13	l 17·80	l 23·80	l 19·94	l 20·10	w = 1·17
	h 15·80	l 13·43	l 17·03	l 16·67	h 18·97	h 13·24	h 21·13	h 21·73	l 18·40	l 23·86	l 20·60	l 19·43	$\frac{1}{w}$ = 0·85
	15·75	13·67	17·56	16·01	18·58	13·26	20·76	21·43	18·10	23·83	20·27	19·77	C = 83° 40′ 18″·25
XIII & II	h 28·17	h 34·87	l 34·07	l 30·46	h 28·44	h 29·47	h 28·83	h 26·27	l 30·27	l 27·40	l 28·93	l 32·40	M = 29″·94
	h 28·27	l 34·57	l 34·63	l 29·23	h 27·20	h 30·90	h 27·30	h 26·67	l 29·87	l 29·00	l 28·30	l 33·04	w = 1·66
													$\frac{1}{w}$ = 0·60
	28·22	34·72	34·35	29·85	27·82	30·18	28·07	26·47	30·07	28·20	28·61	32·72	C = 51° 36′ 29″·94
II & III	h 21·20	l 17·90	l 21·37	l 25·04	h 24·23	h 21·63	h 18·93	h 24·83	l 23·73	h 16·13	h 20·60	h 20·64	M = 21″·58
	h 22·90	l 17·40	l 21·90	l 24·83	h 24·93	h 22·60	h 20·23	h 24·70	l 24·16	h 17·27	h 19·60	h 21·10	w = 1·58
													$\frac{1}{w}$ = 0·63
	22·05	17·65	21·64	24·93	24·58	22·12	19·58	24·79	23·95	16·70	20·10	20·87	C = 40° 39′ 21″·58

At II (Tharkheri)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on V: 0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
V & IV	"	"	"	"	"	"	"	"	"	"	"	"	M = 38″·13
	h 37·02	h 32·63	l 38·73	h 37·22	l 37·62	l 35·63	l 42·07	l 38·[illegible]	l 42·50	l 45·07	l 33·46	l 30·62	w = 0·99
	h 36·[illegible]	h 33·50	l 32·[illegible]	h 35·13	l 37·2[illegible]	l 33·7[illegible]	h 42·27	l 40·30	l 41·20	l 44·23	l 34·94	l 30·07	$\frac{1}{w}$ = 1·01
	3[illegible]·45	33·0[illegible]	30·15	35·[illegible]	37·42	34·[illegible]	42·17	39·[illegible]	41·85	44·65	34·20	30·34	C = 82° 39′ 38″·13

NOTE.—Stations IX and XIII appertain to the Khánpisura Meridional Series.

At II (Tharkheri)—(*Continued*).

Angle between	Circle readings, telescope being set on V 0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
IV & III	″ *h* 26·73 *h* 26·87	″ *h* 32·60 *h* 31·37	″ *l* 30·50 *l* 30·33	″ *h* 30·46 *h* 30·60	″ *l* 29·66 *l* 29·56	″ *l* 28·87 *l* 28·90	″ *l* 25·86 *h* 27·33 *d* 26·73	″ *l* 26·70 *l* 26·84	″ *l* 23·57 *l* 23·30	″ *l* 22·30 *l* 23·04	″ *l* 31·84 *d* 30·81	″ *l* 26·67 *l* 27·23	$M = 28''·00$ $w = 1·34$ $\frac{1}{w} = 0·75$ $C = 44° 19' 28''·00$
	26·80	31·99	30·41	30·53	29·61	28·89	26·64	26·77	23·43	22·67	31·33	26·95	
III & I	*d* 24·21 *d* 24·24	*d* 18·29 *d* 18·25	*l* 16·50 *l* 17·37	*h* 19·60 *h* 19·03	*l* 20·50 *l* 21·37	*l* 15·63 *l* 16·87	*l* 20·17 *h* 20·77 *d* 20·60	*l* 27·44 *l* 25·73	*l* 23·50 *d* 22·53	*l* 24·50 *l* 24·06	*l* 23·23 *h* 23·00	*l* 19·13 *l* 17·67	$M = 20''·99$ $w = 1·11$ $\frac{1}{w} = 0·90$ $C = 82° 27' 20''·99$
	24·23	18·27	16·93	19·32	20·93	16·25	20·51	26·59	23·01	24·28	23·12	18·40	
I & XIII	*l* 24·34 *l* 22·64	*l* 32·10 *l* 31·66	*l* 28·93 *l* 28·30	*h* 26·17 *d* 26·15	*l* 21·80 *l* 20·80	*l* 28·44 *l* 28·30	*h* 26·53 *h* 24·87	*l* 21·46 *l* 22·10	*l* 29·47 *l* 29·80	*l* 24·60 *l* 25·00	*l* 24·73 *l* 24·13	*l* 29·83 *l* 31·30	$M = 26''·39$ $w = 1·01$ $\frac{1}{w} = 0·99$ $C = 51° 14' 26''·39$
	23·49	31·88	28·62	26·16	21·30	28·37	25·70	21·78	29·63	24·80	24·43	30·57	

At III (Kuwása)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on I 205° 43′	25° 43′	275° 53′	95° 53′	346° 19′	166° 4′	56° 10′	236° 10′	126° 21′	306° 21′	196° 32′	16° 32′	M = Mean of Groups w = Relative Weight C = Concluded Angle
I & II	″ *h* 18·10 *h* 18·00	″ *h* 26·70 *h* 25·67	″ *h* 18·76 *h* 19·73	″ *h* 19·57 *h* 19·30	″ *l* 22·00 *l* 20·47	″ *l* 21·94 *l* 20·36	″ *l* 19·50 *l* 20·74	″ *l* 17·27 *l* 16·20	″ *h* 20·60 *h* 20·14	″ *h* 17·23 *h* 18·14	″ *h* 19·97 *h* 20·20	″ *h* 22·44 *h* 23·03	$M = 20''·25$ $w = 1·89$ $\frac{1}{w} = 0·53$ $C = 56° 53' 20''·25$
	18·05	26·19	19·24	19·44	21·23	21·15	20·12	16·74	20·37	17·68	20·09	22·73	
II & IV	*h* 64·40 *h* 65·63	*h* 58·96 *h* 59·16	*h* 65·30 *h* 64·10	*h* 64·06 *h* 65·00	*l* 65·10 *l* 66·20	*l* 65·03 *l* 64·44	*l* 64·06 *l* 62·40	*l* 63·77 *l* 64·47	*h* 62·13 *h* 62·26	*h* 64·20 *h* 63·06	*h* 60·67 *h* 61·37	*h* 62·30 *h* 63·57	$M = 63''·40$ $w = 3·25$ $\frac{1}{w} = 0·31$ $C = 43° 36' 3''·40$
	65·02	59·06	64·70	64·53	65·65	64·73	63·23	64·12	62·20	63·63	61·02	62·93	

Note.—Station XIII appertains to the Khánpisura Meridional Series.

At XIII (Indráwan)—(*Continued*).

Angle between	Circle readings, telescope being set on II: 0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
I & IX	h 59·07	l 56·00	h 59·50	l 60·17	l 61·70	l 57·00	l 59·03	l 59·77	l 49·93	l 51·27	h 56·97	l 56·37	M = 57″·35
	h 57·87	l 56·97	h 59·73	l 60·30	l 63·60	l 58·33	l 58·37	l 60·17	l 50·06	l 52·16	h 55·30	l 56·67	w = 0·93
	58·47	56·49	59·61	60·24	62·65	57·66	58·70	59·97	50·00	51·71	56·14	56·52	$\frac{1}{w}$ = 1·07 C = 39° 39′ 57″·35

At I (Kaula-ka-Máta)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX: 0° 1′	180° 1′	70° 11′	250° 11′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
IX & XIII	h 15·70	h 13·90	l 18·10	l 15·34	h 18·20	h 13·27	h 20·40	h 21·13	l 17·80	l 23·80	l 19·94	l 20·10	M = 18″·25
	h 15·80	l 13·43	l 17·03	l 16·67	h 18·97	h 13·24	h 21·13	h 21·73	l 18·40	l 23·86	l 20·60	l 19·43	w = 1·17
	15·75	13·67	17·56	16·01	18·58	13·26	20·76	21·43	18·10	23·83	20·27	19·77	$\frac{1}{w}$ = 0·85 C = 83° 40′ 18″·25
XIII & II	h 28·17	h 34·87	l 34·07	l 30·46	h 28·44	h 29·47	h 28·83	h 26·27	l 30·27	l 27·40	l 28·93	l 32·40	M = 29″·94
	h 28·27	l 34·57	l 34·63	l 29·23	h 27·20	h 30·90	h 27·30	h 26·67	l 29·87	l 29·00	l 28·30	l 33·04	w = 1·66
	28·22	34·72	34·35	29·85	27·82	30·18	28·07	26·47	30·07	28·20	28·61	32·72	$\frac{1}{w}$ = 0·60 C = 51° 36′ 29″·94
II & III	h 21·20	l 17·90	l 21·37	l 25·04	h 24·23	h 21·63	h 18·93	h 24·83	l 23·73	h 16·13	h 20·60	h 20·64	M = 21″·58
	h 22·90	l 17·40	l 21·90	l 24·83	h 24·93	h 22·60	h 20·23	h 24·76	l 24·16	h 17·27	h 19·60	h 21·10	w = 1·58
	22·05	17·65	21·64	24·93	24·58	22·12	19·58	24·79	23·95	16·70	20·10	20·87	$\frac{1}{w}$ = 0·63 C = 40° 39′ 21″·58

At II (Tharkheri)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on V: 0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
V & IV	h 37·90	h 32·63	l 38·73	h 36·20	l 36·60	l 35·63	l 40·07	l 38·96	l 42·50	l 45·67	l 33·46	l 39·60	M = 38″·13
	h 39·00	h 33·50	l 39·60	h 35·13	l 36·20	l 33·76	h 40·27	l 40·36	l 41·20	l 44·23	l 34·94	l 39·07	w = 0·99
	38·45	33·07	39·16	35·67	36·40	34·69	40·17	39·66	41·85	44·95	34·20	39·34	$\frac{1}{w}$ = 1·01 C = 82° 39′ 38″·13

Note.—Stations IX and XIII appertain to the Khánpisura Meridional Series.

At II (Tharkheri)—(*Continued*).

Angle between	Circle readings, telescope being set on V 0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
IV & III	h 26·73	h 32·60	l 30·50	h 30·46	l 29·66	l 28·87	l 25·86	l 26·70	l 23·57	l 22·30	l 31·84	l 26·67	$M = 28''\cdot00$
	h 26·87	h 31·37	l 30·33	h 30·60	l 29·56	l 28·90	h 27·33	l 26·84	l 23·30	l 23·04	d 30·81	l 27·23	$w = 1\cdot34$
							d 26·73						$\frac{1}{w} = 0\cdot75$
	26·80	31·99	30·41	30·53	29·61	28·89	26·64	26·77	23·43	22·67	31·33	26·95	$C = 44° 19' 28''\cdot00$
III & I	d 24·21	d 18·29	l 16·50	h 19·60	l 20·50	l 15·63	l 20·17	l 27·44	l 23·50	l 24·50	l 23·23	l 19·13	$M = 20''\cdot99$
	d 24·24	d 18·25	l 17·37	h 19·03	l 21·37	l 16·87	h 20·77	l 25·73	d 22·53	l 24·06	h 23·00	l 17·67	$w = 1\cdot11$
							d 20·60						$\frac{1}{w} = 0\cdot90$
	24·23	18·27	16·93	19·32	20·93	16·25	20·51	26·59	23·01	24·28	23·12	18·40	$C = 82° 27' 20''\cdot99$
I & XIII	l 24·34	l 32·10	l 28·93	h 26·17	l 21·80	l 28·44	h 26·53	l 21·46	l 29·47	l 24·60	l 24·73	l 29·83	$M = 26''\cdot39$
	l 22·64	l 31·66	l 28·30	d 26·15	l 20·80	l 28·30	h 24·87	l 22·10	l 29·80	l 25·00	l 24·13	l 31·30	$w = 1\cdot01$
													$\frac{1}{w} = 0\cdot99$
	23·49	31·88	28·62	26·16	21·30	28·37	25·70	21·78	29·63	24·80	24·43	30·57	$C = 51° 14' 26''\cdot39$

At III (Kuwása)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on I 205° 43′	25° 43′	275° 53′	95° 53′	346° 19′	166° 4′	56° 10′	236° 10′	126° 21′	306° 21′	196° 32′	16° 32′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
I & II	h 18·10	h 26·70	h 18·76	h 19·57	l 22·00	l 21·94	l 19·50	l 17·27	h 20·60	h 17·23	h 19·97	h 22·44	$M = 20''\cdot25$
	h 18·00	h 25·67	h 19·73	h 19·30	l 20·47	l 20·36	l 20·74	l 16·20	h 20·14	h 18·14	h 20·20	h 23·03	$w = 1\cdot89$
													$\frac{1}{w} = 0\cdot53$
	18·05	26·19	19·24	19·44	21·23	21·15	20·12	16·74	20·37	17·68	20·09	22·73	$C = 56° 53' 20''\cdot25$
II & IV	h 64·40	h 58·96	h 65·30	h 64·06	l 65·10	l 65·03	l 64·06	l 63·77	h 62·13	h 64·20	h 60·67	h 62·30	$M = 63''\cdot40$
	h 65·63	h 59·16	h 64·10	h 65·00	l 66·20	l 64·44	l 62·40	l 64·47	h 62·26	h 63·06	h 61·37	h 63·57	$w = 3\cdot25$
													$\frac{1}{w} = 0\cdot31$
	65·02	59·06	64·70	64·53	65·65	64·73	63·23	64·12	62·20	63·63	61·02	62·93	$C = 43° 36' 3''\cdot40$

Note.—Station XIII appertains to the Khánpisura Meridional Series.

At XIII (Indráwan)—(*Continued*).

Angle between	Circle readings, telescope being set on II												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
I & IX	″ h 59·07 h 57·87	″ l 56·00 l 56·97	″ h 59·50 h 59·73	″ l 60·17 l 60·30	″ l 61·70 l 63·60	″ l 57·00 l 58·33	″ l 59·03 l 58·37	″ l 59·77 l 60·17	″ l 49·93 l 50·06	″ l 51·27 l 52·16	″ h 56·97 h 55·30	″ l 56·37 l 56·67	$M = 57''\cdot35$ $w = 0\cdot93$ $\frac{1}{w} = 1\cdot07$
	58·47	56·49	59·61	60·24	62·65	57·66	58·70	59·97	50·00	51·71	56·14	56·52	$C = 39° 39' 57''\cdot35$

At I (Kaula-ka-Máta)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 11′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
IX & XIII	″ h 15·70 h 15·80	″ h 13·90 l 13·43	″ l 18·10 l 17·03	″ l 15·34 l 16·67	″ h 18·20 h 18·97	″ h 13·27 h 13·24	″ h 20·40 h 21·13	″ h 21·13 h 21·73	″ l 17·80 l 18·40	″ l 23·80 l 23·86	″ l 19·94 l 20·60	″ l 20·10 l 19·43	$M = 18''\cdot25$ $w = 1\cdot17$ $\frac{1}{w} = 0\cdot85$
	15·75	13·67	17·56	16·01	18·58	13·26	20·76	21·43	18·10	23·83	20·27	19·77	$C = 83° 40' 18''\cdot25$
XIII & II	h 28·17 h 28·27	h 34·87 l 34·57	l 34·07 l 34·63	l 30·46 l 29·23	h 28·44 h 27·20	h 29·47 h 30·90	h 28·83 h 27·30	h 26·27 h 26·67	l 30·27 l 29·87	l 27·40 l 29·00	l 28·93 l 28·30	l 32·40 l 33·04	$M = 29''\cdot94$ $w = 1\cdot66$ $\frac{1}{w} = 0\cdot60$
	28·22	34·72	34·35	29·85	27·82	30·18	28·07	26·47	30·07	28·20	28·61	32·72	$C = 51° 36' 29''\cdot94$
II & III	h 21·20 h 22·90	l 17·90 l 17·40	l 21·37 l 21·90	l 25·04 l 24·83	h 24·23 h 24·93	h 21·63 h 22·60	h 18·93 h 20·23	h 24·83 h 24·76	l 23·73 l 24·16	h 16·13 h 17·27	h 20·60 h 19·60	h 20·64 h 21·10	$M = 21''\cdot58$ $w = 1\cdot58$ $\frac{1}{w} = 0\cdot63$
	22·05	17·65	21·64	24·93	24·58	22·12	19·58	24·79	23·95	16·70	20·10	20·87	$C = 40° 39' 21''\cdot58$

At II (Tharkheri)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on V												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
V & IV	″ h 37·90 h 39·00	″ h 32·63 h 33·50	″ l 38·73 l 39·60	″ h 36·20 h 35·13	″ l 36·60 l 36·20	″ l 35·63 l 33·76	″ l 40·07 h 40·27	″ l 38·96 l 40·36	″ l 42·50 l 41·20	″ l 45·67 l 44·23	″ l 33·46 l 34·94	″ l 39·60 l 39·07	$M = 38''\cdot13$ $w = 0\cdot99$ $\frac{1}{w} = 1\cdot01$
	38·45	33·07	39·16	35·67	36·40	34·69	40·17	39·66	41·85	44·95	34·20	39·34	$C = 82° 39' 38''\cdot13$

NOTE.—Stations IX and XIII appertain to the Khánpisura Meridional Series.

At II (Tharkheri)—(*Continued*).

Angle between	Circle readings, telescope being set on V												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
IV & III	″ *h* 26·73 *h* 26·87	″ *h* 32·60 *h* 31·37	″ *l* 30·50 *l* 30·33	″ *h* 30·46 *h* 30·60	″ *l* 29·66 *l* 29·56	″ *l* 28·87 *l* 28·90	″ *l* 25·86 *h* 27·33 *d* 26·73	″ *l* 26·70 *l* 26·84	″ *l* 23·57 *l* 23·30	″ *l* 22·30 *l* 23·04	″ *l* 31·84 *d* 30·81	″ *l* 26·67 *l* 27·23	$M = 28''\cdot00$ $w = 1\ \cdot34$ $\frac{1}{w} = 0\ \cdot75$ $C = 44^\circ\ 19'\ 28''\cdot00$
	26·80	31·99	30·41	30·53	29·61	28·89	26·64	26·77	23·43	22·67	31·33	26·95	
III & I	*d* 24·21 *d* 24·24	*d* 18·29 *d* 18·25	*l* 16·50 *l* 17·37	*h* 19·60 *h* 19·03	*l* 20·50 *l* 21·37	*l* 15·63 *l* 16·87	*l* 20·17 *h* 20·77 *d* 20·60	*l* 27·44 *l* 25·73	*l* 23·50 *d* 22·53	*l* 24·50 *l* 24·06	*l* 23·23 *h* 23·00	*l* 19·13 *l* 17·67	$M = 20''\cdot99$ $w = 1\ \cdot11$ $\frac{1}{w} = 0\ \cdot90$ $C = 82^\circ\ 27'\ 20''\cdot99$
	24·23	18·27	16·93	19·32	20·93	16·25	20·51	26·59	23·01	24·28	23·12	18·40	
I & XIII	*l* 24·34 *l* 22·64	*l* 32·10 *l* 31·66	*l* 28·93 *l* 28·30	*h* 26·17 *d* 26·15	*l* 21·80 *l* 20·80	*l* 28·44 *l* 28·30	*h* 26·53 *h* 24·87	*l* 21·46 *l* 22·10	*l* 29·47 *l* 29·80	*l* 24·60 *l* 25·00	*l* 24·73 *l* 24·13	*l* 29·83 *l* 31·30	$M = 26''\cdot39$ $w = 1\ \cdot01$ $\frac{1}{w} = 0\ \cdot99$ $C = 51^\circ\ 14'\ 26''\cdot39$
	23·49	31·88	28·62	26·16	21·30	28·37	25·70	21·78	29·63	24·80	24·43	30·57	

At III (Kuwása)

***February* 1862 ; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on I												M = Mean of Groups w = Relative Weight C = Concluded Angle
	205° 43′	25° 43′	275° 53′	95° 53′	346° 19′	166° 4′	56° 10′	236° 10′	126° 21′	306° 21′	196° 32′	16° 32′	
I & II	″ *h* 18·10 *h* 18·00	″ *h* 26·70 *h* 25·67	″ *h* 18·76 *h* 19·73	″ *h* 19·57 *h* 19·30	″ *l* 22·00 *l* 20·47	″ *l* 21·94 *l* 20·36	″ *l* 19·50 *l* 20·74	″ *l* 17·27 *l* 16·20	″ *h* 20·60 *h* 20·14	″ *h* 17·23 *h* 18·14	″ *h* 19·97 *h* 20·20	″ *h* 22·44 *h* 23·03	$M = 20''\cdot25$ $w = 1\ \cdot89$ $\frac{1}{w} = 0\ \cdot53$ $C = 56^\circ\ 53'\ 20''\cdot25$
	18·05	26·19	19·24	19·44	21·23	21·15	20·12	16·74	20·37	17·68	20·09	22·73	
II & IV	*h* 64·40 *h* 65·63	*h* 58·96 *h* 59·16	*h* 65·30 *h* 64·10	*h* 64·06 *h* 65·00	*l* 65·10 *l* 66·20	*l* 65·03 *l* 64·44	*l* 64·06 *l* 62·40	*l* 63·77 *l* 64·47	*h* 62·13 *h* 62·26	*h* 64·20 *h* 63·06	*h* 60·67 *h* 61·37	*h* 62·30 *h* 63·57	$M = 63''\cdot40$ $w = 3\ \cdot25$ $\frac{1}{w} = 0\ \cdot31$ $C = 43^\circ\ 36'\ 3''\cdot40$
	65·02	59·06	64·70	64·53	65·65	64·73	63·23	64·12	62·20	63·63	61·02	62·93	

Note.—Station XIII appertains to the Khánpisura Meridional Series.

At III (Kuwása)—(*Continued*).

Angle between	Circle readings, telescope being set on I												M = Mean of Groups w = Relative Weight C = Concluded Angle
	205° 43′	25° 43′	275° 53′	95° 53′	346° 19′	166° 4′	56° 10′	236° 10′	126° 21′	306° 21′	196° 32′	16° 32′	
	″	″	″	″	″	″	″	″	″	″	″	″	
IV & VII	h 40·97	h 41·87	h 40·07	h 43·20	l 39·90	l 44·93	l 40·17	l 36·80	h 37·77	h 35·37	h 36·46	h 37·06	$M = 39''·56$
	h 40·47	h 42·34	h 42·03	h 42·20	l 38·90	l 44·40	l 39·36	l 38·40	h 37·27	h 35·40	h 37·57	h 36·50	$w = 1·52$
	40·72	42·11	41·05	42·70	39·40	44·66	39·77	37·60	37·52	35·38	37·02	36·78	$\frac{1}{w} = 0·66$ $C = 53° 48' 39''·56$

At IV (Mehwása)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on III												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
III & II	h 29·57	h 30·36	h 34·27	h 31·00	l 34·57	l 25·83	l 37·44	l 33·73	l 35·66	h 32·47	h 33·37	h 31·23	$M = 32''·03$
	h 28·40	h 29·40	h 32·63	h 30·67	l 33·23	l 25·33	l 35·10	l 32·46	h 35·96	h 32·46	h 33·73	h 29·87	$w = 1·29$
	28·99	29·88	33·45	30·83	33·90	25·58	36·27	33·10	35·81	32·46	33·55	30·55	$\frac{1}{w} = 0·78$ $C = 92° 4' 32''·03$
II & V	h 47·40	h 46·87	h 45·80	h 40·60	l 39·43	l 43·57	l 37·80	l 42·67	l 38·67	h 45·87	h 39·97	h 46·00	$M = 43''·02$
	h 48·33	h 46·73	h 45·84	h 42·43	l 39·97	l 42·97	l 39·97	l 41·84	h 39·04	h 45·00	h 39·90	h 45·70	$w = 1·11$
	47·87	46·80	45·82	41·51	39·70	43·27	38·89	42·25	38·86	45·43	39·94	45·85	$\frac{1}{w} = 0·90$ $C = 42° 19' 43''·02$

Angle between	Circle readings, telescope being set on VI												
	203° 20′	23° 20′	273° 31′	93° 31′	343° 42′	163° 42′	53° 47′	233° 48′	123° 59′	303° 59′	194° 9′	14° 10′	
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & VII	h 64·67	h 67·36	h 66·20	h 68·10	l 65·82	l 67·30	l 66·67	l 62·80	l 62·47	h 59·13	h 61·23	h 61·10	$M = 64''·46$
	h 65·50	h 65·83	h 66·37	h 67·53	l 66·16	l 67·10	l 65·90	l 63·83	h 62·66	h 59·87	h 62·24	h 61·20	$w = 1·62$
	65·09	66·59	66·29	67·81	65·99	67·20	66·29	63·31	62·57	59·50	61·73	61·15	$\frac{1}{w} = 0·62$ $C = 92° 6' 4''·46$
VII & III	h 17·33	h 21·54	h 18·07	h 19·83	l 20·40	l 25·14	l 20·86	l 19·87	l 21·37	h 23·40	h 23·03	h 24·33	$M = 21''·58$
	h 17·47	h 22·40	h 20·00	h 19·53	l 21·47	l 25·94	l 22·53	l 20·17	h 21·14	h 23·67	h 22·63	h 25·67	$w = 2·04$
	17·40	21·97	19·04	19·68	20·93	25·54	21·70	20·02	21·25	23·54	22·83	25·00	$\frac{1}{w} = 0·49$ $C = 64° 34' 21''·58$

At V (Pípliabán)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VI												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	241° 15′	61° 15′	311° 26′	131° 26′	21° 37′	201° 37′	91° 42′	271° 42′	161° 53′	341° 53′	232° 4′	52° 4′	
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & IV	h 58·00	h 55·17	h 57·84	h 58·33	h 60·13	l 51·56	l 57·36	l 56·00	l 59·70	l 56·43	l 54·04	l 58·14	$M = 56''\cdot83$
	h 58·23	h 54·57	h 57·07	h 58·37	h 59·80	l 51·90	l 57·57	l 57·07	l 60·16	l 56·56	l 52·70	l 57·10	$w = 1\cdot95$; $\frac{1}{w} = 0\cdot51$
	58·12	54·87	57·45	58·35	59·97	51·73	57·46	56·54	59·93	56·49	53·37	57·62	$C = 63^\circ\ 44'\ 56''\cdot83$
IV & II	h 43·33	h 42·23	h 39·23	h 40·87	h 42·70	l 47·17	l 41·77	l 41·87	l 41·37	l 39·37	l 43·23	l 38·50	$M = 41''\cdot73$
	h 43·10	h 43·33	h 40·47	h 39·90	h 42·00	l 46·17	l 40·83	l 39·93	l 41·30	l 40·90	l 43·67	l 38·37	$w = 2\cdot52$; $\frac{1}{w} = 0\cdot40$
	43·22	42·78	39·85	40·38	42·35	46·67	41·30	40·90	41·34	40·13	43·45	38·44	$C = 55^\circ\ 0'\ 41''\cdot73$

At VI (Samohi)

January 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	228° 29′	48° 29′	298° 40′	118° 40′	8° 50′	188° 51′	78° 57′	258° 57′	149° 7′	329° 8′	219° 18′	39° 18′	
	″	″	″	″	″	″	″	″	″	″	″	″	
IX & VIII	h 43·20	h 43·53	l 40·60	l 41·40	l 42·47	l 40·57	h 43·74	h 48·36	h 47·73	h 44·20	l 40·40	l 45·70	$M = 43''\cdot70$
	h 44·06	h 43·80	l 41·64	l 42·90	l 42·60	l 39·37	h 42·67	h 49·26	h 47·44	h 44·84	l 41·87	l 46·46	$w = 1\cdot65$; $\frac{1}{w} = 0\cdot61$
	43·63	43·67	41·12	42·15	42·53	39·97	43·21	48·81	47·58	44·52	41·14	46·08	$C = 56^\circ\ 6'\ 43''\cdot70$
VIII & VII	h 54·10	h 54·50	l 47·06	l 49·80	l 46·80	l 51·30	h 51·53	h 51·94	h 51·97	h 52·03	l 58·07	l 53·90	$M = 51''\cdot75$
	h 53·40	h 53·53	l 46·90	l 49·00	l 46·54	l 51·03	h 51·87	h 50·90	h 52·16	h 52·90	l 57·06	l 53·77	$w = 1\cdot28$; $\frac{1}{w} = 0\cdot78$
	53·75	54·02	46·98	49·40	46·67	51·16	51·70	51·42	52·07	52·46	57·57	53·83	$C = 43^\circ\ 49'\ 51''\cdot75$
VII & IV	h 60·56	h 60·50	l 62·44	l 62·20	l 63·90	l 66·03	h 57·13	h 53·23	h 58·00	h 57·83	l 54·97	l 58·90	$M = 59''\cdot67$
	h 60·07	h 60·43	l 62·16	l 62·33	l 63·90	l 66·97	h 57·33	h 54·80	h 57·54	h 58·20	l 54·84	l 57·77	$w = 0\cdot89$; $\frac{1}{w} = 1\cdot13$
	60·32	60·46	62·30	62·27	63·90	66·50	57·23	54·01	57·77	58·02	54·90	58·34	$C = 31^\circ\ 34'\ 59''\cdot67$

At III (Kuwása)—(*Continued*).

Angle between	Circle readings, telescope being set on I												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	205° 43′	25° 43′	275° 53′	95° 53′	346° 19′	166° 4′	56° 10′	236° 10′	126° 21′	306° 21′	196° 32′	16° 32′	
	″	″	″	″	″	″	″	″	″	″	″	″	
IV & VII	h 40·97	h 41·87	h 40·07	h 43·20	l 39·90	l 44·93	l 40·17	l 36·80	h 37·77	h 35·37	h 36·46	h 37·06	$M = 39''·56$
	h 40·47	h 42·34	h 42·03	h 42·20	l 38·90	l 44·40	l 39·36	l 38·40	h 37·27	h 35·40	h 37·57	h 36·50	$w = 1·52$
													$\frac{1}{w} = 0·66$
	40·72	42·11	41·05	42·70	39·40	44·66	39·77	37·60	37·52	35·38	37·02	36·78	$C = 53° 48' 39''·56$

At IV (Mehwása)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on III												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
III & II	h 29·57	h 30·36	h 34·27	h 31·00	l 34·57	l 25·83	l 37·44	l 33·73	l 35·66	h 32·47	h 33·37	h 31·23	$M = 32''·03$
	h 28·40	h 29·40	h 32·63	h 30·67	l 33·23	l 25·33	l 35·10	l 32·46	h 35·96	h 32·46	h 33·73	h 29·87	$w = 1·29$
													$\frac{1}{w} = 0·78$
	28·99	29·88	33·45	30·83	33·90	25·58	36·27	33·10	35·81	32·46	33·55	30·55	$C = 92° 4' 32''·03$
II & V	h 47·40	h 46·87	h 45·80	h 40·60	l 39·43	l 43·57	l 37·80	l 42·67	l 38·67	h 45·87	h 39·97	h 46·00	$M = 43''·02$
	h 48·33	h 46·73	h 45·84	h 42·43	l 39·97	l 42·97	l 39·97	l 41·84	h 39·04	h 45·00	h 39·90	h 45·70	$w = 1·11$
													$\frac{1}{w} = 0·90$
	47·87	46·80	45·82	41·51	39·70	43·27	38·89	42·25	38·86	45·43	39·94	45·85	$C = 42° 19' 43''·02$

Angle between	Circle readings, telescope being set on VI												
	203° 20′	23° 20′	273° 31′	93° 31′	343° 42′	163° 42′	53° 47′	233° 48′	123° 59′	303° 59′	194° 9′	14° 10′	
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & VII	h 64·67	h 67·36	h 66·20	h 68·10	l 65·82	l 67·30	l 66·67	l 62·80	l 62·47	h 59·13	h 61·23	h 61·10	$M = 64''·46$
	h 65·50	h 65·83	h 66·37	h 67·53	l 66·16	l 67·10	l 65·90	l 63·83	h 62·66	h 59·87	h 62·24	h 61·20	$w = 1·62$
													$\frac{1}{w} = 0·62$
	65·09	66·59	66·29	67·81	65·99	67·20	66·29	63·31	62·57	59·50	61·73	61·15	$C = 92° 6' 4''·46$
VII & III	h 17·33	h 21·54	h 18·07	h 19·83	l 20·40	l 25·14	l 20·86	l 19·87	l 21·37	h 23·40	h 23·03	h 24·33	$M = 21''·58$
	h 17·47	h 22·40	h 20·00	h 19·53	l 21·47	l 25·94	l 22·53	l 20·17	h 21·14	h 23·67	h 22·63	h 25·67	$w = 2·04$
													$\frac{1}{w} = 0·49$
	17·40	21·97	19·04	19·68	20·93	25·54	21·70	20·02	21·25	23·54	22·83	25·00	$C = 64° 34' 21''·58$

At V (Pípliabán)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	241° 15′	61° 15′	311° 26′	131° 26′	21° 37′	201° 37′	91° 42′	271° 42′	161° 58′	341° 58′	232° 4′	52° 4′	
VI & IV	″	″	″	″	″	″	″	″	″	″	″	″	$M = 56''·83$
	h 58·00	h 55·17	h 57·84	h 58·33	h 60·13	l 51·56	l 57·36	l 56·00	l 59·70	l 56·43	l 54·04	l 58·14	$w = 1·95$
	h 58·23	h 54·57	h 57·07	h 58·37	h 59·80	l 51·90	l 57·57	l 57·07	l 60·16	l 56·56	l 52·70	l 57·10	$\frac{1}{w} = 0·51$
	58·12	54·87	57·45	58·35	59·97	51·73	57·46	56·54	59·93	56·49	53·37	57·62	$C = 63° 44' 56''·83$
IV & II	h 43·33	h 42·23	h 39·23	h 40·87	h 42·70	l 47·17	l 41·77	l 41·87	l 41·37	l 39·37	l 43·23	l 38·50	$M = 41''·73$
	h 43·10	h 43·33	h 40·47	h 39·90	h 42·00	l 46·17	l 40·83	l 39·93	l 41·30	l 40·90	l 43·67	l 38·37	$w = 2·52$ $\frac{1}{w} = 0·40$
	43·22	42·78	39·85	40·38	42·35	46·67	41·30	40·90	41·34	40·13	43·45	38·44	$C = 55° 0' 41''·73$

At VI (Samohi)

January 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	228° 29′	48° 29′	298° 40′	118° 40′	8° 50′	188° 51′	78° 57′	258° 57′	149° 7′	329° 8′	219° 18′	39° 18′	
IX & VIII	″	″	″	″	″	″	″	″	″	″	″	″	$M = 43''·70$
	h 43·20	h 43·53	l 40·60	l 41·40	l 42·47	l 40·57	h 43·74	h 48·36	h 47·73	h 44·20	l 40·40	l 45·70	$w = 1·65$
	h 44·06	h 43·80	l 41·64	l 42·90	l 42·60	l 39·37	h 42·67	h 49·26	h 47·44	h 44·84	l 41·87	l 46·46	$\frac{1}{w} = 0·61$
	43·63	43·67	41·12	42·15	42·53	39·97	43·21	48·81	47·58	44·52	41·14	46·08	$C = 56° 6' 43''·70$
VIII & VII	h 54·10	h 54·50	l 47·06	l 49·80	l 46·80	l 51·30	h 51·53	h 51·94	h 51·97	h 52·03	l 58·07	l 53·90	$M = 51''·75$
	h 53·40	h 53·53	l 46·90	l 49·00	l 46·54	l 51·03	h 51·87	h 50·90	h 52·16	h 52·90	l 57·06	l 53·77	$w = 1·28$ $\frac{1}{w} = 0·78$
	53·75	54·02	46·98	49·40	46·67	51·16	51·70	51·42	52·07	52·46	57·57	53·83	$C = 43° 49' 51''·75$
VII & IV	h 60·56	h 60·50	l 62·44	l 62·20	l 63·90	l 66·03	h 57·13	h 53·23	h 58·00	h 57·83	l 54·97	l 58·90	$M = 59''·67$
	h 60·07	h 60·43	l 62·16	l 62·33	l 63·90	l 66·97	h 57·33	h 54·80	h 57·54	h 58·20	l 54·84	l 57·77	$w = 0·89$ $\frac{1}{w} = 1·13$
	60·32	60·46	62·30	62·27	63·90	66·50	57·23	54·01	57·77	58·02	54·90	58·34	$C = 31° 34' 59''·67$

At III (Kuwása)—(*Continued*).

Angle between	Circle readings, telescope being set on I												M = Mean of Groups w = Relative Weight C = Concluded Angle
	205° 43′	25° 43′	275° 53′	95° 53′	346° 19′	166° 4′	56° 10′	236° 10′	126° 21′	306° 21′	196° 32′	16° 32′	
IV & VII	″ h 40·97 h 40·47	″ h 41·87 h 42·34	″ h 40·07 h 42·03	″ h 43·20 h 42·20	″ l 39·90 l 38·90	″ l 44·93 l 44·40	″ l 40·17 l 39·36	″ l 36·80 l 38·40	″ h 37·77 h 37·27	″ h 35·37 h 35·40	″ h 36·46 h 37·57	″ h 37·06 h 36·50	$M = 39''\cdot 56$ $w = 1\cdot 52$ $\frac{1}{w} = 0\cdot 66$
	40·72	42·11	41·05	42·70	39·40	44·66	39·77	37·60	37·52	35·38	37·02	36·78	$C = 53^\circ 48' 39''\cdot 56$

At IV (Mehwása)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on III												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
III & II	″ h 29·57 h 28·40	″ h 30·36 h 29·40	″ h 34·27 h 32·63	″ h 31·00 h 30·67	″ l 34·57 l 33·23	″ l 25·83 l 25·33	″ l 37·44 l 35·10	″ l 33·73 l 32·46	″ l 35·66 h 35·96	″ h 32·47 h 32·46	″ h 33·37 h 33·73	″ h 31·23 h 29·87	$M = 32''\cdot 03$ $w = 1\cdot 29$ $\frac{1}{w} = 0\cdot 78$
	28·99	29·88	33·45	30·83	33·90	25·58	36·27	33·10	35·81	32·46	33·55	30·55	$C = 92^\circ 4' 32''\cdot 03$
II & V	h 47·40 h 48·33	h 46·87 h 46·73	h 45·80 h 45·84	h 40·60 h 42·43	l 39·43 l 39·97	l 43·57 l 42·97	l 37·80 l 39·97	l 42·67 l 41·84	l 38·67 h 39·04	h 45·87 h 45·00	h 39·97 h 39·90	h 46·00 h 45·70	$M = 43''\cdot 02$ $w = 1\cdot 11$ $\frac{1}{w} = 0\cdot 90$
	47·87	46·80	45·82	41·51	39·70	43·27	38·89	42·25	38·86	45·43	39·94	45·85	$C = 42^\circ 19' 43''\cdot 02$

Angle between	Circle readings, telescope being set on VI												
	203° 20′	23° 20′	273° 31′	93° 31′	343° 42′	163° 42′	53° 47′	233° 48′	123° 59′	303° 59′	194° 9′	14° 10′	
VI & VII	″ h 64·67 h 65·50	″ h 67·36 h 65·83	″ h 66·20 h 66·37	″ h 68·10 h 67·53	″ l 65·82 l 66·16	″ l 67·30 l 67·10	″ l 66·67 l 65·90	″ l 62·80 l 63·83	″ l 62·47 h 62·66	″ h 59·13 h 59·87	″ h 61·23 h 62·24	″ h 61·10 h 61·20	$M = 64''\cdot 46$ $w = 1\cdot 62$ $\frac{1}{w} = 0\cdot 62$
	65·09	66·59	66·29	67·81	65·99	67·20	66·29	63·31	62·57	59·50	61·73	61·15	$C = 92^\circ 6' 4''\cdot 46$
VII & III	h 17·33 h 17·47	h 21·54 h 22·40	h 18·07 h 20·00	h 19·83 h 19·53	l 20·40 l 21·47	l 25·14 l 25·94	l 20·86 l 22·53	l 19·87 l 20·17	l 21·37 h 21·14	h 23·40 h 23·67	h 23·03 h 22·63	h 24·33 h 25·67	$M = 21''\cdot 58$ $w = 2\cdot 04$ $\frac{1}{w} = 0\cdot 49$
	17·40	21·97	19·04	19·68	20·93	25·54	21·70	20·02	21·25	23·54	22·83	25·00	$C = 64^\circ 34' 21''\cdot 58$

At V (Pípliabán)

February 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VI 241° 15′	61° 15′	311° 26′	131° 26′	21° 37′	201° 37′	91° 42′	271° 42′	161° 53′	341° 53′	232° 4′	52° 4′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & IV	*h* 58·00	*h* 55·17	*h* 57·84	*h* 58·33	*h* 60·13	*l* 51·56	*l* 57·36	*l* 56·00	*l* 59·70	*l* 56·43	*l* 54·04	*l* 58·14	*M* = 56″·83
	h 58·23	*h* 54·57	*h* 57·07	*h* 58·37	*h* 59·80	*l* 51·90	*l* 57·57	*l* 57·07	*l* 60·16	*l* 56·56	*l* 52·70	*l* 57·10	*w* = 1·95
	58·12	54·87	57·45	58·35	59·97	51·73	57·46	56·54	59·93	56·49	53·37	57·62	$\frac{1}{w}$ = 0·51 *C* = 63° 44′ 56″·83
IV & II	*h* 43·33	*h* 42·23	*h* 39·23	*h* 40·87	*h* 42·70	*l* 47·17	*l* 41·77	*l* 41·87	*l* 41·37	*l* 39·37	*l* 43·23	*l* 38·50	*M* = 41″·73
	h 43·10	*h* 43·33	*h* 40·47	*h* 39·90	*h* 42·00	*l* 46·17	*l* 40·83	*l* 39·93	*l* 41·30	*l* 40·90	*l* 43·67	*l* 38·37	*w* = 2·52
	43·22	42·78	39·85	40·38	42·35	46·67	41·30	40·90	41·34	40·13	43·45	38·44	$\frac{1}{w}$ = 0·40 *C* = 55° 0′ 41″·73

At VI (Samohi)

January 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX 228° 29′	48° 29′	298° 40′	118° 40′	8° 50′	188° 51′	78° 57′	258° 57′	149° 7′	329° 8′	219° 18′	39° 18′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
IX & VIII	*h* 43·20	*h* 43·53	*l* 40·60	*l* 41·40	*l* 42·47	*l* 40·57	*h* 43·74	*h* 48·36	*h* 47·73	*h* 44·20	*l* 40·40	*l* 45·70	*M* = 43″·70
	h 44·06	*h* 43·80	*l* 41·64	*l* 42·90	*l* 42·60	*l* 39·37	*h* 42·67	*h* 49·26	*h* 47·44	*h* 44·84	*l* 41·87	*l* 46·46	*w* = 1·65
	43·63	43·67	41·12	42·15	42·53	39·97	43·21	48·81	47·58	44·52	41·14	46·08	$\frac{1}{w}$ = 0·61 *C* = 56° 6′ 43″·70
VIII & VII	*h* 54·10	*h* 54·50	*l* 47·06	*l* 49·80	*l* 46·80	*l* 51·30	*h* 51·53	*h* 51·94	*h* 51·97	*h* 52·03	*l* 58·07	*l* 53·90	*M* = 51″·75
	h 53·40	*h* 53·53	*l* 46·90	*l* 49·00	*l* 46·54	*l* 51·03	*h* 51·87	*h* 50·90	*h* 52·16	*h* 52·90	*l* 57·06	*l* 53·77	*w* = 1·28
	53·75	54·02	46·98	49·40	46·67	51·16	51·70	51·42	52·07	52·46	57·57	53·83	$\frac{1}{w}$ = 0·78 *C* = 43° 49′ 51″·75
VII & IV	*h* 60·56	*h* 60·50	*l* 62·44	*l* 62·20	*l* 63·90	*l* 66·03	*h* 57·13	*h* 53·23	*h* 58·00	*h* 57·83	*l* 54·97	*l* 58·90	*M* = 59″·67
	h 60·07	*h* 60·43	*l* 62·16	*l* 62·33	*l* 63·90	*l* 66·97	*h* 57·33	*h* 54·80	*h* 57·54	*h* 58·20	*l* 54·84	*l* 57·77	*w* = 0·89
	60·32	60·46	62·30	62·27	63·90	66·50	57·23	54·01	57·77	58·02	54·90	58·34	$\frac{1}{w}$ = 1·13 *C* = 31° 34′ 59″·67

At VI (Samohi)—(*Continued*).

Angle between	Circle readings, telescope being set on IX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	228° 29′	48° 29′	298° 40′	118° 40′	8° 50′	188° 51′	78° 57′	258° 57′	149° 7′	329° 8′	219° 18′	39° 18′	
	″	″	″	″	″	″	″	″	″	″	″	″	
IV & V	*l* 36·83	*l* 39·93	*h* 43·23	*h* 44·10	*h* 43·77	*h* 42·93	*h* 45·80	*h* 48·47	*h* 44·53	*h* 46·70	*l* 40·10	*l* 42·43	$M = 43''\cdot 23$
	l 38·23	*l* 39·57	*h* 42·57	*h* 44·44	*h* 43·13	*h* 42·13	*h* 46·13	*h* 49·20	*h* 45·20	*h* 45·53	*l* 39·86	*l* 42·70	$w = 1\cdot 22$ $\frac{1}{w} = 0\cdot 82$
	37·53	39·75	42·90	44·27	43·45	42·53	45·97	48·83	44·87	46·11	39·98	42·57	$C = 47° 19' 43''\cdot 23$

At VII (Kukinda)

January 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms*' 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on III												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 22′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
III & IV	*h* 60·63	*h* 58·47	*l* 61·10	*l* 63·37	*l* 66·33	*l* 55·67	*l* 65·56	*l* 61·00	*h* 58·07	*h* 58·87	*h* 58·13	*h* 61·27	$M = 60''\cdot 81$
	h 58·70	*h* 59·20	*l* 62·40	*l* 63·30	*l* 66·57	*l* 54·80	*l* 65·76	*l* 62·53	*h* 58·70	*h* 59·14	*h* 58·54	*h* 61·27	$w = 1\cdot 13$ $\frac{1}{w} = 0\cdot 88$
	59·67	58·83	61.75	63·34	66·45	55·23	65·66	61·77	58·38	59·01	58·33	61·27	$C = 61° 37' 0''\cdot 81$
IV & VI	*h* 56·97	*h* 59·60	*l* 60·16	*l* 56·67	*l* 54·10	*l* 62·13	*l* 59·00	*l* 62·07	*h* 57·00	*h* 58·90	*h* 56·40	*h* 55·26	$M = 58''\cdot 05$
	h 57·13	*h* 59·10	*l* 58·97	*l* 55·24	*l* 54·93	*l* 63·10	*l* 58·44	*l* 60·80	*h* 56·37	*h* 59·83	*h* 56·00	*h* 54·90	$w = 1\cdot 85$ $\frac{1}{w} = 0\cdot 54$
	57·05	59·35	59·57	55·95	54·52	62·61	58·72	61·44	56·68	59·37	56·20	55·08	$C = 56° 18' 58''\cdot 05$
VI & VIII	*l* 8·47	*l* 7·60	*l* 6·24	*l* 7·66	*l* 12·27	*l* 3·70	*l* 0·67	*l* 5·70	*l* 7·90	*h* 8·73	*l* 12·47	*l* 13·20	$M = 7''\cdot 75$
	l 8·63	*l* 7·13	*l* 6·36	*l* 8·26	*l* 10·74	*l* 4·64	*l* 1·80	*l* 5·90	*l* 6·33	*l* 7·36	*l* 11·93	*l* 12·00	$w = 1\cdot 09$
										l 8·64			$\frac{1}{w} = 0\cdot 92$
	8·55	7·37	6·30	7·96	11·50	4·17	1·24	5·80	7·11	8·24	12·20	12·60	$C = 64° 54' 7''\cdot 75$

At VIII (Kápri)

January 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms*' 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	167° 39′	347° 39′	237° 50′	57° 50′	308° 1′	128° 1′	18° 7′	198° 7′	88° 17′	268° 18′	158° 59′	338° 59′	
	″	″	″	″	″	″	″	″	″	″	″	″	
VII & VI	*h* 67·70	*h* 66·83	*h* 64·53	*h* 62·17	*h* 59·77	*l* 62·03	*h* 60·23	*h* 59·70	*h* 63·84	*h* 62·10	*h* 66·80	*h* 62·03	$M = 63''\cdot 15$
	h 67·50	*h* 66·14	*h* 64·06	*h* 62·46	*h* 60·27	*l* 63·07	*h* 60·00	*h* 60·50	*h* 63·10	*h* 62·34	*h* 66·14	*h* 61·40	$w = 1\cdot 74$
						h 63·24							
						h 63·64							$\frac{1}{w} = 0\cdot 58$
	67·60	66·49	64·29	62·32	60·02	62·99	60·12	60·10	63·47	62·22	66·47	61·71	$C = 71° 16' 3''\cdot 15$

At VIII (Kápri)—(*Continued*).

Angle between	Circle readings, telescope being set on VII 167° 39′	347° 39′	237° 50′	57° 50′	308° 1′	128° 1′	18° 7′	198° 7′	88° 17′	268° 18′	158° 59′	338° 59′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & IX	h 26·10	h 26·77	l 30·20	l 29·60	l 33·80	l 31·04	l 35·34	h 30·87	l 36·57	l 29·57	l 30·87	l 30·67	$M = 30''\cdot98$
	h 26·14	h 26·80	l 31·70	l 28·90	l 33·87	l 30·03	l 35·80	h 30·64	l 36·13	l 29·60	l 31·00	l 31·47	$w = 1\cdot26$
													$\frac{1}{w} = 0\cdot80$
	26·12	26·79	30·95	29·25	33·83	30·54	35·57	30·75	36·35	29·59	30·93	31·07	$C = 44^\circ 53' 30''\cdot98$
IX & XIII	h 58·26	h 57·53	l 52·33	l 57·10	l 51·17	l 56·76	l 51·30	h 52·83	l 51·63	l 54·46	l 57·70	l 55·93	$M = 54''\cdot58$
	h 57·70	h 57·00	l 51·20	l 56·00	l 51·06	l 57·54	l 49·83	l 53·93	l 52·17	l 54·00	l 57·36	l 55·10	$w = 1\cdot56$
													$\frac{1}{w} = 0\cdot64$
	57·98	57·27	51·76	56·55	51·12	57·15	50·56	53·38	51·90	54·23	57·53	55·52	$C = 76^\circ 11' 54''\cdot58$

At IX (Punákot)

January 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVII 0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XVII & XIII	h 54·30	h 55·43	h 55·63	h 56·96	l 61·07	l 55·60	l 66·27	l 61·20	l 62·30	l 60·00	h 55·46	h 58·10	$M = 58''\cdot46$
	h 54·04	h 54·43	h 56·67	h 56·80	l 60·80	l 55·43	l 64·73	l 60·63	l 63·34	l 60·47	h 55·80	h 57·50	$w = 0\cdot94$
													$\frac{1}{w} = 1\cdot06$
	54·17	54·93	56·15	56·88	60·94	55·51	65·50	60·92	62·82	60·23	55·63	57·80	$C = 38^\circ 1' 58''\cdot46$
XIII & VIII	h 53·24	h 49·64	h 51·87	h 50·14	l 46·63	l 48·93	l 47·40	l 50·83	l 45·30	l 51·00	h 52·57	h 51·70	$M = 49''\cdot92$
	h 52·83	h 50·50	h 51·03	h 49·43	l 47·73	l 48·47	l 47·60	l 50·80	l 45·50	l 50·77	h 53·40	h 50·76	$w = 2\cdot17$
													$\frac{1}{w} = 0\cdot46$
	53·04	50·07	51·45	49·78	47·18	48·70	47·50	50·82	45·40	50·88	52·99	51·23	$C = 47^\circ 13' 49''\cdot92$
VIII & VI	h 47·60	h 47·56	h 51·53	h 48·13	l 53·40	l 49·07	l 47·47	l 48·64	l 53·20	l 45·74	h 44·77	h 47·74	$M = 48''\cdot78$
	h 47·60	h 46·10	h 51·80	h 48·57	l 53·54	l 49·50	l 47·70	l 49·24	l 51·96	l 46·90	h 44·33	h 48·67	$w = 1\cdot71$
													$\frac{1}{w} = 0\cdot58$
	47·60	46·83	51·67	48·35	53·47	49·28	47·59	48·94	52·58	46·32	44·55	48·20	$C = 78^\circ 59' 48''\cdot78$

NOTE.—Stations XIII and XVII appertain to the Singi Meridional Series.

At XIII (Patángri)

***January 1861; † December 1861, and January 1862; observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms' 18-inch Theodolite No. 2.**

Angle between	Circle readings, telescope being set on R. M.												M = Mean of Groups w = Relative Weight C = Concluded Angle
	359° 44′	179° 45′	69° 55′	249° 55′	140° 6′	320° 6′	210° 11′	30° 12′	280° 23′	100° 23′	350° 34′	170° 34′	
	″	″	″	″	″	″	″	″	″	″	″	″	
R.M. & VIII †	l 27·10	l 29·84	h 31·14	h 29·17	h 27·73	h 23·50	h 30·94	h 31·86	h 33·30	h 31·30	h 28·73	h 30·80	$M = 29''\cdot68$
	l 27·60	l 30·20	h 30·54	h 29·00	h 28·50	h 23·17	h 31·46	h 31·00	h 33·56	h 32·17	h 28·93	h 30·80	$w = 1\cdot74$ $\frac{1}{w} = 0\cdot58$
	27·35	30.02	30·84	29.09	28·11	23·34	31·20	31·43	33·43	31·73	28·83	30·80	$C = 79^\circ\ 10'\ 29''\cdot68$
VIII & IX †	h 19·34	h 22·40	h 20·73	h 19·10	h 20·10	h 21·80	h 19·37	h 19·13	l 15·70	l 19·76	l 17·20	l 22·43	$M = 19''\cdot86$
	h 18·40	h 22·53	h 21·76	h 19·46	h 18·20	h 22·60	h 18·47	h 20·10	l 15·44	l 19·63	l 19·24	l 23·64	$w = 2\cdot65$ $\frac{1}{w} = 0\cdot38$
	18·87	22·47	21·24	19·28	19·15	22·20	18·92	19·62	15·57	19·69	18·22	23·04	$C = 56^\circ\ 34'\ 19''\cdot86$
IX & XVII †	d 62·07	d 54·38	d 56·01	d 61·32	d 60·62	d 57·23	d 54·41	d 55·05	d 59·28	d 58·67	d 57·78	d 55·86	$M = 57''\cdot75$
	d 61·37	d 54·25	d 56·51	d 61·52	d 61·52	d 57·23	d 54·42	d 55·15	d 59·54	d 58·60	d 57·52	d 55·63	$w = 1\cdot64$ $\frac{1}{w} = 0\cdot61$
	61·72	54·32	56·26	61·42	61·07	57·23	54·41	55·10	59·41	58·64	57·65	55·74	$C = 61^\circ\ 18'\ 57''\cdot75$
	Circle readings, telescope being set on XVII												
	0° 0′	180° 0′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XVII & XVIII *	h 3·20	h 3·53	l 6·33	l 4·20	l 12·00	l 8·36	l 15·34	l 11·77	l 14·37	l 6·54	h 5·37	h 3·10	$M = 7''\cdot75$
	h 2·10	h 2·13	l 5·63	l 4·93	l 11·27	l 7·30	l 15·20	l 12·70	l 14·06	l 7·03	h 5·23	h 4·27	$w = 0\cdot60$ $\frac{1}{w} = 1\cdot68$
	2·65	2·83	5·98	4·57	11·63	7·83	15·27	12·24	14·21	6.79	5·30	3·68	$C = 39^\circ\ 26'\ 7''\cdot75$
XVIII & XIV *	h 67·30	h 65·37	l 62·94	l 61·87	l 56·90	l 55·80	l 56·60	l 60·06	l 60·40	l 66·23	h 66·43	h 66·20	$M = 62''\cdot35$
	h 69·30	h 66·33	l 63·07	l 61·53	l 57·43	l 57·23	l 56·50	l 59·20	l 60·00	l 65·97	h 67·74	h 65·97	$w = 0\cdot64$ $\frac{1}{w} = 1\cdot57$
	68·30	65·85	63·01	61·70	57·16	56·52	56·55	59·63	60·20	66·10	67·08	66·09	$C = 38^\circ\ 36'\ 2''\cdot35$
XIV & XII *	h 57·97	h 59·40	l 63·66	l 64·40	l 64·74	l 66·77	l 63·66	l 66·34	l 60·73	l 56·93	h 57·50	h 59·57	$M = 61''\cdot77$
	h 57·80	h 59·54	l 63·70	l 64·80	l 63·37	l 67·07	l 64·00	l 67·33	l 59·14	l 56·77	h 57·06	h 60·10	$w = 0\cdot90$ $\frac{1}{w} = 1\cdot11$
	57·89	59·47	63·68	64·60	64·05	66·92	63·83	66·84	59·93	56·85	57·28	59·84	$C = 33^\circ\ 23'\ 1''\cdot77$

NOTE.—Stations XII, XIII, XIV, XVII and XVIII appertain to the Singi Meridional Series. R.M. denotes Referring Mark.

At XVII (Bhor)

‡*December* 1860; §*January* 1861; *and* ***January* 1862; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	95° 43′	275° 43′	105° 54′	285° 53′	116° 4′	296° 4′	126° 10′	306° 10′	136° 11′	316° 11′	146° 32′	326° 32′	
XVIII ‡ & XIV	″ h 45·87 h 46·56	″ h 50·47 h 50·73	″ h 44·54 h 45·57	″ h 45·70 h 46·94	″ l 42·03 l 43·57	″ l 47·23 l 46·93	″ l 44·00 l 43·10	″ l 40·70 l 42·13	″ h 43·97 h 43·80	″ h 44·14 h 43·70	″ h 44·00 h 45·20	″ h 45·90 h 43·80	M = 45″·02 w = 2·10 1/w = 0·48 C = 43° 15′ 45″·02
	46·22	50·60	45·05	46·32	42·80	47·08	43·55	41·42	43·88	43·92	44·60	44·85	
Lesser circle readings	0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
XIV § & XIII	h 8·00 h 8·34	h 14·00 h 13·80	h 12·70 h 13·94	h 15·87 h 16·14	h 15·60 h 15·50	h 12·94 h 13·26	h 23·24 h 21·80	h 16·40 h 16·80	h 14·57 h 14·60	h 14·97 h 15·80	h 13·43 h 12·14	h 14·84 h 13·23	M = 14″·66 w = 1·09 1/w = 0·91 C = 50° 58′ 14″·66
	8·17	13·90	13·32	16·01	15·55	13·10	22·52	16·60	14·58	15·39	12·78	14·04	
Lesser circle readings	0° 1′	180° 1′	70° 11′	250° 12′	140° 22′	320° 23′	210° 28′	30° 28′	280° 39′	100° 39′	350° 50′	170° 50′	
XIII ** & IX	h 7·70 l 6·90	l 2·30 l 3·07	l 3·87 l 4·23	l 1·74 l 3·17	l 3·43 l 4·43	l 0·60 l 0·47	h 7·60 h 7·10	h 3·93 h 4·36	h 6·54 h 7·00	h 8·93 h 8·80	h 6·67 h 5·70	h 7·16 h 6·67	M = 5″·10 w = 1·91 1/w = 0·52 C = 80° 39′ 5″·10
	7·30	2·69	4·05	2·45	3·93	0·54	7·35	4·14	6·77	8·87	6·18	6·92	

At XIV (Kágarol)

December 1860, *and January* 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	71° 52′	251° 52′	82° 8′	262° 8′	92° 14′	272° 14′	102° 20′	282° 20′	112° 30′	292° 30′	122° 41′	302° 41′	
XIII & XVIII	″ h 62·67 h 61·33	″ h 57·90 h 59·23	″ h 59·16 h 57·44	″ h 62·90 h 63·27	″ h 66·90 h 66·16	″ h 63·33 h 62·33	″ h 67·66 h 67·70	″ h 65·40 h 65·10	″ l 64·70 l 64·50	″ l 61·53 l 62·33	″ l 62·53 l 63·67	″ l 56·17 l 54·90	M = 62″·45 w = 0·95 1/w = 1·06 C = 95° 10′ 2″·45
	62·00	58·57	58·30	63·08	66·53	62·83	67·68	65·25	64·60	61·93	63·10	55·54	
XVII & XVIII	h 19·17 h 20·30	h 22·63 h 20·74	h 26·34 h 25·60	h 24·50 h 23·83	h 27·87 h 27·63	h 21·33 h 21·40	h 32·76 h 31·43	h 29·87 h 28·54	h 31·13 h 31·60	h 27·07 h 27·14	h 25·37 h 24·46	h 21·50 h 22·06	M = 25″·60 w = 0·73 1/w = 1·38 C = 44° 10′ 25″·60
	19·74	21·68	25·97	24·17	27·75	21·36	32·10	29·20	31·37	27·10	24·92	21·78	

NOTE.—Stations XIII, XIV, XVII and XVIII appertain to the Singi Meridional Series.

At XIV (Kágarol)—(*Continued*).

Angle between	Circle readings, telescope being set on XIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	71° 52′	251° 52′	82° 3′	262° 3′	92° 14′	272° 14′	102° 20′	282° 20′	112° 30′	292° 30′	122° 41′	302° 41′	
XVIII & XVI	″	″	″	″	″	″	″	″	″	″	″	″	$M = 13''\cdot37$
	h 20·40	h 16·54	h 12·23	h 12·03	h 9·00	h 17·27	h 9·14	h 9·50	h 9·23	h 12·83	h 12·16	h 17·80	$w = 0\cdot83$
	h 19·57	h 18·30	h 13·17	h 12·13	h 9·77	h 16·60	h 9·10	h 10·30	h 9·64	h 12·93	h 13·30	h 18·00	$\frac{1}{w} = 1\cdot20$
	19·99	17·42	12·70	12·08	9·38	16·94	9·12	9·90	9·43	12·88	12·73	17·90	$C = 76°\ 1'\ 13''\cdot37$
XVI & XV	h 47·86	h 48·60	h 51·37	h 49·00	h 56·53	h 46·80	h 51·30	h 51·46	h 50·34	h 49·13	h 47·37	h 43·37	$M = 49''\cdot33$ $w = 1\cdot24$
	h 48·26	h 48·26	h 50·70	h 47·87	h 55·13	h 48·67	h 51·90	h 51·90	h 50·23	h 47·97	h 46·84	h 43·14	$\frac{1}{w} = 0\cdot80$
	48·06	48·43	51·04	48·43	55·83	47·74	51·60	51·68	50·28	48·55	47·11	43·25	$C = 53°\ 22'\ 49''\cdot33$
XV & XII	h 59·40	h 57·43	h 58·86	h 59·00	h 55·53	h 61·00	h 58·70	h 63·17	h 56·70	h 64·47	h 59·93	h 65·50	$M = 59''\cdot93$ $w = 1\cdot61$
	h 59·67	h 56·84	h 59·03	h 60·30	h 56·44	h 59·83	h 58·73	h 62·36	h 57·93	h 63·90	h 60·00	h 63·56	$\frac{1}{w} = 0\cdot62$
	59·54	57·13	58·95	59·65	55·98	60·42	58·71	62·77	57·31	64·19	59·96	64·53	$C = 47°\ 51'\ 59''\cdot93$
XII & R.M.	h 10·80	h 15·80	h 12·97	h 13·60	h 10·70	h 12·53	h 8·23	h 6·57	h 13·03	h 9·77	h 13·50	h 14·53	$M = 11''\cdot76$ $w = 1\cdot68$
	h 11·90	h 16·06	h 11·90	h 12·70	h 10·10	h 12·90	h 7·34	h 6·84	h 12·34	h 10·50	h 12·66	h 14·97	$\frac{1}{w} = 0\cdot60$
	11·35	15·93	12·44	13·15	10·40	12·71	7·79	6·70	12·69	10·13	13·08	14·75	$C = 15°\ 42'\ 11''\cdot76$

At XVIII (Rencha)

******December* 1860; *and* †*January* 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms' 18-inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	295° 16′	115° 16′	305° 27′	125° 27′	315° 38′	135° 38′	325° 44′	145° 44′	335° 54′	155° 54′	346° 5′	166° 5′	
* XVI & XIV	″	″	″	″	″	″	″	″	″	″	″	″	$M = 31''\cdot67$
	h 36·60	h 32·13	h 27·47	h 35·70	l 26·37	l 34·30	l 28·40	l 30·60	h 32·47	h 31·76	h 31·13	h 35·44	$w = 1\cdot14$
	h 35·43	h 32·40	h 27·60	h 34·13	l 27·97	l 34·03	l 27·33	l 29·23	h 32·33	h 30·70	h 31·80	h 36·00	$\frac{1}{w} = 0\cdot88$
					l 24·77								
					l 27·23								
	36·02	32·26	27·54	34·91	26·59	34·16	27·87	29·91	32·40	31·23	31·47	35·72	$C = 64°\ 44'\ 31''\cdot67$
* XIV & XVII	h 45·84	h 46·54	h 45·57	h 46·33	h 49·30	h 44·40	l 51·44	l 54·93	l 51·60	l 52·00	l 50·73	l 54·27	$M = 49''\cdot69$ $w = 0\cdot92$
	h 46·10	h 46·17	h 46·87	h 45·63	h 49·80	h 45·47	l 53·00	l 54·70	l 53·13	l 53·86	l 51·46	l 53·34	$\frac{1}{w} = 1\cdot09$
	45·97	46·36	46·22	45·98	49·55	44·93	52·22	54·82	52·36	52·93	51·10	53·80	$C = 92°\ 33'\ 49''\cdot69$

Note.—R.M. denotes Referring Mark. Stations XII, XIV, XV, XVI, XVII and XVIII appertain to the Singi Meridional Series.

At XVIII (Rencha)—(*Continued*).

Angle between	Circle readings, telescope being set on XIV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0°1′	180°1′	10°11′	190°11′	20°22′	200°22′	30°28′	210°28′	40°39′	220°39′	50°50′	230°50′	
XIV † & XIII	″ l 52·17 l 51·70	″ l 51·77 l 51·23	″ l 53·50 l 53·97	″ l 54·97 l 55·36	″ l 55·44 l 55·37	″ h 55·10 h 55·20	″ h 57·66 h 57·66	″ h 55·90 h 57·23	″ h 58·60 h 58·23	″ h 54·83 h 55·50	″ h 56·07 h 56·06	″ h 52·87 h 51·27	M = 54″·90 w = 2 ·40 1/w = 0 ·42
	51·94	51·50	53·73	55·17	55·40	55·15	57·66	56·57	58·41	55·17	56·06	52·07	C = 46° 13′ 54″·90

At XII (Játhrábhor)

‡*December* 1860; *and* §*January* 1861; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0°0′	180°0′	10°12′	190°12′	20°22′	200°22′	30°28′	210°28′	40°39′	220°39′	50°50′	230°50′	
XIII § & XIV	″ h 6·33 h 6·37	″ h 4·46 h 4·73	″ h 3·20 h 3·10	″ h 3·93 h 4·27	″ h 4·46 h 5·67	″ h 2·04 h 1·63	″ h 6·23 h 6·27	″ h 5·76 h 6·24	″ h 5·30 h 5·63	″ h 3·83 h 3·33	″ l 1·73 l 0·94	″ l 0·63 l 0·66	M = 4″·03 w = 3 ·11 1/w = 0 ·32
	6·35	4·60	3·15	4·10	5·06	1·84	6·25	6·00	5·46	3·58	1·34	0·64	C = 59° 3′ 4″·03
	Circle readings, telescope being set on XIV												
	0°1′	180°1′	10°12′	190°12′	20°22′	200°22′	30°28′	210°28′	40°39′	220°39′	50°50′	230°50′	
XIV ‡ & XV	″ h 54·77 h 54·76	″ h 53·93 h 53·70	″ l 58·63 l 59·07	″ h 57·54 l 56·63	″ l 63·43 l 62·86	″ l 59·33 l 59·30	″ l 63·96 l 65·17	″ l 60·70 l 61·20	″ l 60·66 l 61·13	″ l 67·10 l 66·76	″ h 55·94 h 56.00	″ h 58·47 h 57·86	M = 59″·54 w = 0 ·76 1/w = 1 ·32
	54·77	53·81	58·85	57·09	63·14	59·32	64·56	60·95	60·90	66·93	55·97	58·16	C = 100° 43′ 59″·54

At XVI (Ghoráráo)

January 1859; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	320°27′	140°27′	330°38′	150°38′	340°49′	160°49′	350°55′	170°55′	1°5′	181°5′	11°16′	191°16′	
XI & X	″ h 20·86 h 21·93	″ h 25·40 h 24·24	″ h 25·26 h 24·57	″ h 24·90 h 26·10	″ h 23·30 h 22·90	″ h 29·30 l 28·10	″ h 21·70 h 20·76	″ h 22·56 h 21·57	″ h 21·27 h 20·14	″ h 19·77 h 19·83	″ h 18·57 h 20·27	″ h 19·76 h 20·10	M = 22″·63 w = 1 ·47 1/w = 0 ·68
	21·40	24·82	24·91	25·50	23·10	28·70	21·23	22·07	20·70	19·80	19·42	19·93	C = 39° 33′ 22″·63

NOTE.—Stations XII, XIII, XIV, XV, XVI and XVIII appertain to the Singi Meridional Series.

At XVI (Ghoráráo)—(*Continued*).

**January* 1859; *observed by Captain D. J. Nasmyth, R.E., with Troughtan and Simms'* 18-*inch Theodolite No.* 2.
†*December* 1860; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	320° 27′	140° 27′	330° 38′	150° 38′	340° 49′	160° 49′	350° 55′	170° 55′	1° 5′	181° 5′	11° 16′	191° 16′	
X & XV *	″ h 20·14 h 21·20	″ h 24·47 h 24·26	″ h 25·10 h 25·06	″ h 24·40 h 23·90	″ h 28·00 h 28·60	″ h 22·86 l 20·83 l 22·67	″ h 31·13 h 30·44	″ h 26·30 h 27·23	″ h 26·80 h 25·86	″ h 24·77 h 23·60	″ h 25·43 h 26·07	″ h 26·30 h 24·90	$M = 25''\cdot34$ $w = 1\cdot67$ $\frac{1}{w} = 0\cdot60$
	20·67	24·37	25·08	24·15	28·30	22·12	30·78	26·77	26·33	24·18	25·75	25·60	$C = 54^\circ\ 20'\ 25''\cdot34$
	Circle readings, telescope being set on XV												
	0° 1′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
XV & XIV †	″ h 39·84 h 40·20	″ h 39·87 h 41·07	″ h 42·66 h 42·40	″ h 42·24 h 41·60	″ h 44·96 h 43·94	″ l 35·97 l 36·13	″ l 39·54 l 38·13	″ l 44·34 l 43·54	″ h 41·00 h 40·40	″ h 39·23 h 39·53	″ h 41·66 h 41·70	″ h 39·30 h 41·27	$M = 40''\cdot86$ $w = 2\cdot25$ $\frac{1}{w} = 0\cdot45$
	40·02	40·47	42·53	41·92	44·45	36·05	38·84	43·94	40·70	39·38	41·68	40·28	$C = 62^\circ\ 7'\ 40''\cdot86$
XIV & XVIII †	h 10·97 h 10·43	h 13·54 h 12·16	h 14·83 h 14·00	h 10·73 h 11·03	h 17·87 h 19·00	h 15·93 h 16·10	h 18·67 h 18·33	h 17·73 h 18·77	l 17·66 l 17·00	l 15·13 l 13·60	l 10·83 l 12·60	l 11·57 l 11·73	$M = 14''\cdot59$ $w = 1\cdot28$ $\frac{1}{w} = 0\cdot78$
	10·70	12·85	14·42	10·88	18·43	16·02	18·50	18·25	17·33	14·36	11·72	11·65	$C = 39^\circ\ 14'\ 14''\cdot59$

At XV (Wardhari)

November and December 1860; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	328° 37′	148° 37′	338° 37′	158° 37′	348° 58′	168° 58′	359° 4′	179° 4′	9° 15′	189° 15′	19° 26′	199° 26′	
XII & XIV	″ h 65·10 h 64·24	″ h 63·67 h 62·24	″ l 64·27 l 63·70	″ l 67·44 l 65·97	″ l 64·13 l 63·67	″ l 65·37 l 66·20	″ h 57·74 h 57·54	″ h 56·20 h 57·24	″ h 59·20 h 60·13	″ h 58·13 h 58·77	″ h 58·30 h 59·50	″ h 61·30 h 59·37	$M = 61''\cdot64$ $w = 1\cdot02$ $\frac{1}{w} = 0\cdot98$
	64·67	62·96	63·98	66·71	63·90	65·78	57·64	56·72	59·67	58·45	58·90	60·33	$C = 31^\circ\ 24'\ 1''\cdot64$
XIV & XVI	h 33·63 h 33·86	h 28·96 h 30·23	l 34·36 l 34·47	l 31·20 l 31·96	l 34·00 l 33·83	l 28·67 l 29·23	h 33·46 h 32·56	h 33·66 h 34·40	h 35·73 h 36·97	h 36·87 h 38·06	h 37·67 h 38·03	h 32·97 h 34·83	$M = 33''\cdot73$ $w = 1\cdot56$ $\frac{1}{w} = 0\cdot64$
	33·75	29·59	34·42	31·58	33·91	28·95	33·01	34·03	36·35	37·47	37·85	33·90	$C = 64^\circ\ 29'\ 33''\cdot73$

Note.—Stations XII, XIV, XV, XVI and XVIII appertain to the Singi Meridional Series.

At XV (Wardhari)—(*Continued*).

Angle between	Circle readings, telescope being set on XII 328° 37′	148° 37′	338° 37′	158° 37′	348° 58′	168° 58′	359° 4′	179° 4′	9° 15′	189° 15′	19° 26′	199° 26′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XVI & X	″ *h* 34·94 *h* 36·04	″ *h* 43·17 *h* 44·43	″ *l* 42·74 *l* 42·67	″ *l* 46·00 *l* 46·77	″ *l* 46·50 *l* 45·53	″ *l* 48·23 *l* 46·74	″ *h* 44·00 *h* 46·30	″ *h* 51·04 *h* 49·30	″ *h* 43·80 *h* 41·87	″ *h* 41·50 *h* 39·94	″ *h* 40·26 *h* 37·54	″ *h* 40·53 *h* 39·14	$M = 43''·29$ $w = 0·70$ $\frac{1}{w} = 1·43$
	35·49	43·80	42·71	46·38	46·02	47·48	45·15	50·17	42·84	40·72	38·90	39·83	$C = 43° 8' 43''·29$

At X (Jhiria)

January 1859; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XV 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XV & XVI	″ *l* 52·70 *l* 50·34 *l* 51·40	″ *l* 47·27 *l* 47·20 *h* 47·84	″ *l* 48·00 *l* 48·63	″ *l* 48·17 *l* 48·90	″ *l* 49·66 *l* 50·03	″ *l* 47·13 *l* 45·26	″ *h* 55·60 *h* 55·30	″ *l* 56·93 *l* 56·94	″ *h* 54·56 *h* 54·83	″ *h* 55·26 *h* 54·87	″ *h* 54·10 *h* 55·47	″ *h* 54·30 *h* 54·44	$M = 51''·93$ $w = 0·86$ $\frac{1}{w} = 1·16$
	51·48	47·44	48·32	48·53	49·85	46·19	55·45	56·94	54·69	55·07	54·78	54·37	$C = 82° 30' 51''·93$
XVI & XI	*l* 28·06 *l* 30·80 *l* 29·30	*l* 41·16 *l* 39·23 *h* 42·53 *h* 41·43	*l* 33·33 *l* 33·47	*l* 31·00 *l* 32·46	*l* 36·27 *l* 35·17	*l* 32·63 *l* 34·04	*h* 29·07 *h* 30·50	*l* 31·57 *l* 32·16	*h* 33·94 *h* 34·57	*h* 32·74 *h* 32·33	*h* 35·40 *h* 34·27	*h* 31·80 *h* 33·46	$M = 33''·38$ $w = 1·25$ $\frac{1}{w} = 0·80$
	29·39	41·09	33·40	31·73	35·72	33·34	29·78	31·87	34·25	32·54	34·83	32·63	$C = 57° 46' 33''·39$
XI & XII	*l* 20·37 *l* 18·03 *l* 18·84	*l* 5·04 *l* 6·34 *h* 7·63 *h* 6·37	*l* 15·93 *l* 15·63	*l* 15·50 *l* 14·77	*l* 12·73 *l* 14·37	*l* 12·37 *l* 11·70	*h* 14·43 *h* 15·07	*l* 13·10 *l* 13·20	*h* 15·63 *h* 14·53	*h* 16·76 *h* 15·97	*h* 13·07 *h* 14·26	*h* 15·86 *h* 14·54	$M = 14''·18$ $w = 1·27$ $\frac{1}{w} = 0·79$
	19·08	6·35	15·78	15·13	13·55	12·04	14·75	13·15	15·08	16·36	13·67	15·20	$C = 58° 34' 14''·18$

At XI (Poera)

January 1859; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIII 228° 23′	48° 23′	238° 34′	58° 34′	248° 45′	68° 45′	258° 51′	78° 51′	269° 2′	89° 2′	279° 12′	99° 12′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XIII & XII	″ *l* 16·33 *l* 16·37	″ *l* 16·07 *l* 14·06 *l* 14·06	″ *l* 16·00 *l* 16·16 *l* 14·96	″ *l* 13·20 *l* 13·70	″ *l* 16·23 *l* 15·17	″ *l* 17·10 *l* 15·40	″ *l* 17·67 *l* 18·30	″ *l* 11·80 *l* 10·74	″ *l* 13·36 *l* 12·16	″ *l* 14·00 *l* 11·63 *l* 11·97	″ *l* 16·00 *l* 15·80	″ *l* 15·87 *l* 17·03	$M = 14''·92$ $w = 2·88$ $\frac{1}{w} = 0·35$
	16·35	14·73	15·71	13·45	15·70	16·25	17·99	11·27	12·76	12·53	15·90	16·45	$C = 62° 51' 14''·92$

NOTE.—Stations XV and XVI appertain to the Singi Meridional Series.

At XVI (Ghorárão)—(*Continued*).

**January* 1859; *observed by Captain D. J. Nasmyth, R.E., with Troughtan and Simms'* 18-*inch Theodolite No.* 2.
†*December* 1860; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	320° 27′	140° 27′	330° 38′	150° 38′	340° 49′	160° 49′	350° 55′	170° 55′	1° 5′	181° 5′	11° 16′	191° 16′	
X & XV*	″ h 20·14 h 21·20	″ h 24·47 h 24·26	″ h 25·10 h 25·06	″ h 24·40 h 23·90	″ h 28·00 h 28·60	″ h 22·86 l 20·83 l 22·67	″ h 31·13 h 30·44	″ h 26·30 h 27·23	″ h 26·80 h 25·86	″ h 24·77 h 23·60	″ h 25·43 h 26·07	″ h 26·30 h 24·90	$M = 25''\cdot34$ $w = 1\cdot67$ $\frac{1}{w} = 0\cdot60$
	20·67	24·37	25·08	24·15	28·30	22·12	30·78	26·77	26·33	24·18	25·75	25·60	$C = 54°\ 20'\ 25''\cdot34$
	Circle readings, telescope being set on XV												
	0° 1′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
XV & XIV†	″ h 39·84 h 40·20	″ h 39·87 h 41·07	″ h 42·66 h 42·40	″ h 42·24 h 41·60	″ h 44·96 h 43·94	″ l 35·97 l 36·13	″ l 39·54 l 38·13	″ l 44·34 l 43·54	″ h 41·00 h 40·40	″ h 39·23 h 39·53	″ h 41·66 h 41·70	″ h 39·30 h 41·27	$M = 40''\cdot86$ $w = 2\cdot25$ $\frac{1}{w} = 0\cdot45$
	40·02	40·47	42·53	41·92	44·45	36·05	38·84	43·94	40·70	39·38	41·68	40·28	$C = 62°\ 7'\ 40''\cdot86$
XIV & XVIII†	h 10·97 h 10·43	h 13·54 h 12·16	h 14·83 h 14·00	h 10·73 h 11·03	h 17·87 h 19·00	h 15·93 h 16·10	h 18·67 h 18·33	h 17·73 h 18·77	l 17·66 l 17·00	l 15·13 l 13·60	l 10·83 l 12·60	l 11·57 l 11·73	$M = 14''\cdot59$ $w = 1\cdot28$ $\frac{1}{w} = 0\cdot78$
	10·70	12·85	14·42	10·88	18·43	16·02	18·50	18·25	17·33	14·36	11·72	11·65	$C = 39°\ 14'\ 14''\cdot59$

At XV (Wardhari)

November and December 1860; *observed by Lieutenant C. T. Haig, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	328° 37′	148° 37′	338° 37′	158° 37′	348° 58′	168° 58′	359° 4′	179° 4′	9° 15′	189° 15′	19° 26′	199° 26′	
XII & XIV	″ h 65·10 h 64·24	″ h 63·67 h 62·24	″ l 64·27 l 63·70	″ l 67·44 l 65·97	″ l 64·13 l 63·67	″ l 65·37 l 66·20	″ h 57·74 h 57·54	″ h 56·20 h 57·24	″ h 59·20 h 60·13	″ h 58·13 h 58·77	″ h 58·30 h 59·50	″ h 61·30 h 59·37	$M = 61''\cdot64$ $w = 1\cdot02$ $\frac{1}{w} = 0\cdot98$
	64·67	62·96	63·98	66·71	63·90	65·78	57·64	56·72	59·67	58·45	58·90	60·33	$C = 31°\ 24'\ 1''\cdot64$
XIV & XVI	h 33·63 h 33·86	h 28·96 h 30·23	l 34·36 l 34·47	l 31·20 l 31·96	l 34·00 l 33·83	l 28·67 l 29·23	h 33·46 h 32·56	h 33·66 h 34·40	h 35·73 h 36·97	h 36·87 h 38·06	h 37·67 h 38·03	h 32·97 h 34·83	$M = 33''\cdot73$ $w = 1\cdot56$ $\frac{1}{w} = 0\cdot64$
	33·75	29·59	34·42	31·58	33·91	28·95	33·01	34·03	36·35	37·47	37·85	33·90	$C = 64°\ 29'\ 33''\cdot73$

Note.—Stations XII, XIV, XV, XVI and XVIII appertain to the Singi Meridional Series.

At XV (Wardhari)—(*Continued*).

Angle between	Circle readings, telescope being set on XII											M = Mean of Groups w = Relative Weight C = Concluded Angle
	328° 37′	148° 37′	338° 37′	158° 37′	348° 58′	168° 58′	359° 4′	179° 4′	9° 15′	189° 15′	19° 26′	199° 26′	
XVI & X	″ h 34·94 h 36·04	″ h 43·17 h 44·43	″ l 42·74 l 42·67	″ l 46·00 l 46·77	″ l 46·50 l 45·53	″ l 48·23 l 46·74	″ h 44·00 h 46·30	″ h 51·04 h 49·30	″ h 43·80 h 41·87	″ h 41·50 h 39·94	″ h 40·26 h 37·54	″ h 40·53 h 39·14	$M = 43''\cdot29$ $w = 0\cdot70$ $\frac{1}{w} = 1\cdot43$
	35·49	43·80	42·71	46·38	46·02	47·48	45·15	50·17	42·84	40·72	38·90	39·83	$C = 43° \; 8' \; 43''\cdot29$

At X (Jhiria)

January 1859; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XV											M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
XV & XVI	″ l 52·70 l 50·34 l 51·40	″ l 47·27 l 47·20 h 47·84	″ l 48·00 l 48·63	″ l 48·17 l 48·90	″ l 49·66 l 50·03	″ l 47·13 l 45·26	″ h 55·60 h 55·30	″ l 56·93 l 56·94	″ h 54·56 h 54·83	″ h 55·26 h 54·87	″ h 54·10 h 55·47	″ h 54·30 h 54·44	$M = 51''\cdot93$ $w = 0\cdot86$ $\frac{1}{w} = 1\cdot16$
	51·48	47·44	48·32	48·53	49·85	46·19	55·45	56·94	54·69	55·07	54·78	54·37	$C = 82° \; 30' \; 51''\cdot93$
XVI & XI	l 28·06 l 30·80 l 29·30	l 41·16 l 39·23 h 42·53 h 41·43	l 33·33 l 33·47	l 31·00 l 32·46	l 36·27 l 35·17	l 32·63 l 34·04	h 29·07 h 30·50	l 31·57 l 32·16	h 33·94 h 34·57	h 32·74 h 32·33	h 35·40 h 34·27	h 31·80 h 33·46	$M = 33''\cdot38$ $w = 1\cdot25$ $\frac{1}{w} = 0\cdot80$
	29·39	41·09	33·40	31·73	35·72	33·34	29·78	31·87	34·25	32·54	34·83	32·63	$C = 57° \; 46' \; 33''\cdot39$
XI & XII	l 20·37 l 18·03 l 18·84	l 5·04 l 6·34 h 7·63 h 6·37	l 15·93 l 15·63	l 15·50 l 14·77	l 12·73 l 14·37	l 12·37 l 11·70	h 14·43 h 15·07	l 13·10 l 13·20	h 15·63 h 14·53	h 16·76 h 15·97	h 13·07 h 14·26	h 15·86 h 14·54	$M = 14''\cdot18$ $w = 1\cdot27$ $\frac{1}{w} = 0\cdot79$
	19·08	6·35	15·78	15·13	13·55	12·04	14·75	13·15	15·08	16·36	13·67	15·20	$C = 58° \; 34' \; 14''\cdot18$

At XI (Poera)

January 1859; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIII											M = Mean of Groups w = Relative Weight C = Concluded Angle
	228° 23′	48° 23′	238° 34′	58° 34′	248° 45′	68° 45′	258° 51′	78° 51′	269° 2′	89° 2′	279° 12′	99° 12′	
XIII & XII	″ l 16·33 l 16·37	″ l 16·07 l 14·06 l 14·06	″ l 16·00 l 16·16 l 14·96	″ l 13·20 l 13·70	″ l 16·23 l 15·17	″ l 17·10 l 15·40	″ l 17·67 l 18·30	″ l 11·80 l 10·74	″ l 13·36 l 12·16	″ l 14·00 l 11·63 l 11·97	″ l 16·00 l 15·80	″ l 15·87 l 17·03	$M = 14''\cdot92$ $w = 2\cdot88$ $\frac{1}{w} = 0\cdot35$
	16·35	14·73	15·71	13·45	15·70	16·25	17·99	11·27	12·76	12·53	15·90	16·45	$C = 62° \; 51' \; 14''\cdot92$

NOTE.—Stations XV and XVI appertain to the Singi Meridional Series.

At XI (Poera)—(*Continued*).

Angle between	Circle readings, telescope being set on XIII 228° 23′	48° 23′	238° 34′	58° 34′	248° 45′	68° 45′	258° 51′	78° 51′	269° 2′	89° 2′	279° 12′	99° 12′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & X	l 65·04	l 67·36	l 61·43	l 64·70	l 58·84	l 63·77	l 56·03	l 59·64	l 60·87	l 60·13	l 62·47	l 64·73	M = 62″·27
	l 64·53	l 67·47	l 60·50	l 65·60	l 58·37	l 65·30	l 56·07	l 58·20	l 61·14	l 63·70	l 61·37	l 64·97	w = 1·09
			l 62·70							l 62·97			1/w = 0·92
			l 62·30										
	64·79	67·41	61·73	65·15	58·61	64·53	56·05	58·92	61·01	62·27	61·92	64·85	C = 68° 46′ 2″·27
X & XVI	h 63·90	h 59·63	h 60·27	h 62·00	h 62·44	h 58·74	l 68·74	h 67·13	h 70·17	h 67·30	h 65·70	h 65·33	M = 64″·30
	h 64·33	h 59·74	h 59·57	h 60·80	h 62·47	h 58·86	l 70·06	h 67·50	h 68·20	h 67·90	h 65·27	h 67·10	w = 0·83
													1/w = 1·20
	64·12	59·68	59·92	61·40	62·46	58·80	69·40	67·31	69·19	67·60	65·48	66·22	C = 82° 40′ 4″·30

At XII (Rámesri)

January 1859; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on X 242° 22′	62° 22′	252° 33′	72° 33′	262° 44′	82° 44′	272° 49′	92° 49′	283° 0′	103° 0′	293° 11′	113° 11′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
X & XI	l 39·07	l 40·97	l 47·13	l 43·66	l 51·73	l 43·70	l 48·53	l 43·06	l 48·53	h 48·17	l 41·57	h 43·66	M = 45″·00
	l 40·76	l 42·94	l 48·24	l 43·10	l 50·87	l 42·33	l 48·64	l 44·30	l 48·27	h 46·94	l 41·67	h 42·17	w = 0·95
													1/w = 1·05
	39·92	41·95	47·69	43·38	51·30	43·01	48·59	43·68	48·40	47·55	41·62	42·92	C = 52° 39′ 45″·00
XI & XIII	l 60·26	l 55·73	l 50·70	l 56·37	l 50·57	l 56·70	l 49·24	l 52·34	h 51·06	h 53·43	l 57·83	h 54·27	M = 53″·77
	l 59·24	l 56·70	l 49·33	l 56·53	l 47·86	l 56·07	l 50·23	l 51·90	l 50·37	h 53·03	l 55·86	h 56·13	w = 0·94
					l 47·34								1/w = 1·06
	59·75	56·22	50·01	56·45	48·59	56·39	49·73	52·12	50·72	53·23	56·84	55·20	C = 64° 58′ 53″·77
XIII & XIV	h 18·34	h 16·30	h 19·46	h 19·37	h 22·57	h 13·76	h 19·27	h 17·87	h 17·74	h 20·06	h 23·63	h 20·00	M = 18″·93
	h 16·84	h 16·17	h 17·67	h 19·00	h 22·77	h 14·90	h 19·07	h 19·67	h 17·90	h 18·80	h 24·03	h 19·03	w = 1·84
													1/w = 0·54
	17·59	16·24	18·56	19·19	22·67	14·33	19·17	18·77	17·82	19·43	23·83	19·51	C = 63° 38′ 18″·93

NOTE.—Station XVI appertains to the Singi Meridional Series.

At XIII (Gohilia)

January 1859; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XV 307° 2′	127° 2′	317° 13′	137° 13′	327° 23′	147° 23′	337° 29′	157° 29′	347° 40′	167° 40′	357° 51′	177° 51′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XV & XIV	″ h 48·34 h 48·00	″ h 49·40 h 50·90	″ h 46·70 h 46·54	″ h 49·90 h 51·10	″ h 46·66 h 44·43 h 45·57	″ h 52·80 h 53·60	″ h 45·00 l 47·30 l 47·57	″ l 51·00 l 49·96	″ h 46·57 h 46·84	″ l 53·33 l 50·83	″ h 42·90 h 42·20	″ h 44·20 h 45·37	$M = 48''\cdot 12$ $w = 1\cdot 15$ $\frac{1}{w} = 0\cdot 87$ $C = 52^\circ\ 58'\ 48''\cdot 12$
	48·17	50·15	46·62	50·50	45·55	53·20	46·62	50·48	46·71	52·08	42·55	44·78	
XIV & XII	h 14·10 h 11·33 h 11·83	h 12·30 h 13·97	h 12·10 h 11·10	h 11·97 h 10·97	h 15·07 h 16·33	h 8·53 h 8·40	h 12·46 h 13·80	l 13·63 l 15·57	h 13·90 h 13·86	l 12·77 l 13·73	h 11·77 h 12·43	h 10·80 h 10·90	$M = 12''\cdot 55$ $w = 3\cdot 19$ $\frac{1}{w} = 0\cdot 31$ $C = 58^\circ\ 37'\ 12''\cdot 55$
	12·42	13·14	11·60	11·47	15·70	8·46	13·13	14·60	13·88	13·25	12·10	10·85	
XII & XI	l 51·27 l 49·37	l 51·23 l 49·03 l 52·27	h 49·24 h 51·73 h 51·87	h 54·67 h 54·66	h 49·30 h 49·74	h 54·27 h 53·63	h 48·34 h 49·60	l 57·00 l 56·43	h 50·33 h 50·87	l 52·03 l 51·43	h 50·30 h 50·67	h 50·14 h 49·30	$M = 51''\cdot 54$ $w = 2\cdot 08$ $\frac{1}{w} = 0\cdot 48$ $C = 52^\circ\ 9'\ 51''\cdot 54$
	50·32	50·84	50·95	54·67	49·52	53·95	48·97	56·71	50·60	51·73	50·49	49·72	

At XIV (Bhagwánji)

December 1858; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XII 302° 16′	122° 16′	312° 27′	132° 27′	322° 38′	142° 37′	332° 44′	152° 44′	342° 54′	162° 54′	353° 5′	173° 5′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XII & XIII	″ h 28·30 h 28·87 h 28·33 h 28·90	″ h 31·83 h 31·80	″ l 28·40 l 28·43	″ l 29·00 l 28·53	″ l 20·17 l 20·03	″ l 33·47 l 33·57	″ l 27·94 l 29·54	″ l 28·10 l 29·57	″ l 28·50 l 28·00	″ l 30·06 l 28·27	″ l 26·50 l 27·83	″ l 31·00 h 30·43	$M = 28''\cdot 67$ $w = 1\cdot 15$ $\frac{1}{w} = 0\cdot 87$ $C = 57^\circ\ 44'\ 28''\cdot 67$
	28·60	31·82	28·41	28·77	20·10	33·52	28·74	28·83	28·25	29·17	27·16	30·72	
XIII & XV	h 24·63 h 21·96 h 23·27 h 23·04	h 21·14 h 22·20	l 24·10 l 24·50	l 21·50 l 21·53	l 21·90 l 20·13	l 16·90 l 18·13	l 23·40 l 23·33	l 25·27 l 24·53	l 26·64 l 25·67	l 23·44 l 24·73	l 27·43 l 29·70 l 29·77	l 29·97 l 27·27 l 29·47	$M = 23''\cdot 80$ $w = 1\cdot 10$ $\frac{1}{w} = 0\cdot 91$ $C = 69^\circ\ 59'\ 23''\cdot 81$
	23·23	21·67	24·30	21·51	21·02	17·51	23·37	24·90	26·15	24·09	28·97	28·90	

At XIV (Bhagwánji)—(*Continued*).

Circle readings, telescope being set on XII

Angle between	302° 16′	122° 16′	312° 27′	132° 27′	322° 38′	142° 37′	332° 44′	152° 44′	342° 54′	162° 54′	353° 5′	173° 5′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XV & XVI	h 22·94 h 24·57 h 23·53 h 24·16	h 26·10 h 25·33	l 19·03 l 18·70	h 23·23 h 25·96 l 24·33	l 21·86 l 22·77	l 29·67 l 30·07	l 20·50 l 20·93	l 19·30 l 18·73	l 19·46 l 20·83	l 20·13 l 19·84	l 19·27 l 17·44	l 20·73 l 20·77	M = 22″·00 w = 1·02 $\frac{1}{w}$ = 0·99
	23·80	25·72	18·86	24·51	22·32	29·87	20·71	19·02	20·14	19·99	18·35	20·75	C = 51° 50′ 22″·00

At XV (Rundan)

December 1858; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Circle readings, telescope being set on XVII

Angle between	302° 24′	122° 24′	312° 35′	132° 35′	322° 46′	142° 46′	332° 52′	152° 52′	343° 2′	163° 2′	353° 13′	173° 13′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XVII & XVI	h 30·03 h 31·10	h 33·83 h 34·57	l 31·43 l 30·63	h 34·63 l 34·80	l 28·50 l 29·00	l 38·63 l 38·23	h 29·77 h 30·00	h 30·27 h 29·20	h 31·10 h 31·10	h 29·37 h 30·00	l 28·17 l 28·36	l 33·30 l 32·04 l 33·43	M = 31″·61 w = 1·37 $\frac{1}{w}$ = 0·73
	30·57	34·20	31·03	34·71	28·75	38·43	29·89	29·73	31·10	29·69	28·26	32·92	C = 57° 36′ 31″·61
XVI & XIV	h 44·54 h 43·77	h 43·87 h 43·60	l 47·20 l 46·50	h 45·83 l 46·83	l 47·67 l 48·27	l 40·57 l 40·07	h 47·10 h 45·83	h 44·70 h 46·00	h 45·16 h 44·50	h 48·80 h 47·40	l 45·47 l 46·30 l 46·07 l 47·76	l 49·10 l 49·20 l 47·00	M = 45″·75 w = 2·23 $\frac{1}{w}$ = 0·45
	44·16	43·73	46·85	46·33	47·97	40·32	46·47	45·35	44·83	48·10	46·40	48·43	C = 68° 2′ 45″·75
XIV & XIII	h 46·56 h 46·20	h 49·03 h 48·80	l 42·70 l 44·00	h 48·90 l 47·13	l 43·83 l 43·57	l 50·46 l 51·90	h 44·93 h 46·64	h 47·13 h 47·73	h 47·27 h 47·80	h 45·77 l 48·67 l 47·20	l 46·40 l 47·33 l 48·83 l 48·37	l 45·13 l 46·94 l 48·04	M = 46″·99 w = 2·51 $\frac{1}{w}$ = 0·40
	46·38	48·92	43·35	48·01	43·70	51·18	45·79	47·43	47·53	47·21	47·73	46·70	C = 57° 1′ 46″·99

At XVI (Mirzápur)

December 1858; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Circle readings, telescope being set on XIV

Angle between	231° 46′	51° 46′	241° 57′	61° 57′	252° 8′	72° 8′	262° 14′	82° 14′	272° 25′	92° 24′	282° 36′	102° 35′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XIV & XV	h 53·90 h 53·20	h 54·47 h 54·63	h 54·93 l 54·13	h 51·46 h 51·83	l 52·30 l 53·24	l 49·00 l 49·60	l 55·17 l 56·20	l 49·33 l 47·16 l 47·40	l 51·90 l 51·14	l 53·86 l 52·70	h 51·33 h 51·90	h 54·30 h 53·50	M = 52″·53 w = 2·32 $\frac{1}{w}$ = 0·43
	53·55	54·55	54·53	51·65	52·77	49·30	55·68	47·96	51·52	53·28	51·62	53·90	C = 60° 6′ 52″·53

At XVI (Mirzápur)—(*Continued*).

† *February* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.
* *December* 1858; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIV 231° 46′	51° 46′	241° 57′	61° 57′	252° 8′	72° 8′	262° 14′	82° 14′	272° 25′	92° 24′	282° 36′	102° 35′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XV & XVII	″ h 27·23 h 28·24	″ h 27·30 h 27·97	″ h 23·40 l 23·14	″ h 26·34 h 25·70	″ l 23·27 l 21·93	″ l 32·43 l 31·50	″ l 20·67 l 20·30	″ l 22·04 l 22·50	″ l 26·37 l 25·56	″ l 25·00 l 24·74	″ h 26·67 h 25·50	″ h 27·70 h 27·64	$M = 25''\cdot55$ $w = 1\cdot23$ $\frac{1}{w} = 0\cdot81$ $C = 68^\circ\ 7'\ 25''\cdot55$
	27·74	27·63	23·27	26·02	22·60	31·97	20·48	22·27	25·97	24·87	26·08	27·67	
* XVII & XVIII	h 55·27 h 54·93	h 57·87 h 56·66	h 56·33 h 56·03	h 57·23 h 56·87	l 57·93 l 60·03 l 60·03	l 53·10 l 54·60	l 58·96 l 60·60	l 60·93 l 61·00	l 58·50 l 58·54	l 58·47 l 60·26	h 55·40 h 57·77 h 57·10	h 56·20 h 56·30	$M = 57''\cdot54$ $w = 2\cdot61$ $\frac{1}{w} = 0\cdot38$ $C = 56^\circ\ 29'\ 57''\cdot54$
	55·10	57·27	56·18	57·05	59·33	53·85	59·78	60·96	58·52	59·37	56·76	56·25	

Angle between	Circle readings, telescope being set on XVIII 0° 2′	180° 1′	10° 13′	190° 12′	20° 20′	200° 20′	30° 30′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	
† XVIII & XIX	″ h 17·03 h 18·00	″ h 18·47 h 18·56	″ h 20·06 h 19·40	″ h 20·80 h 21·30	″ h 21·90 h 23·64	″ h 18·83 h 17·67	″ h 20·76 h 21·16	″ h 24·43 h 24·20	″ h 19·94 h 22·83 h 21·83	″ h 19·53 h 20·13	″ l 23·60 l 25·10	″ l 20·20 l 23·57 l 24·30	$M = 20''\cdot96$ $w = 2\cdot16$ $\frac{1}{w} = 0\cdot46$ $C = 63^\circ\ 32'\ 20''\cdot96$
	17·52	18·51	19·73	21·05	22·77	18·25	20·96	24·32	21·53	19·83	24·35	22·69	

At XVII (Jhinjhar)

December 1858; *observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XX 238° 55′	58° 55′	249° 6′	69° 6′	259° 17′	79° 17′	269° 23′	89° 23′	279° 33′	99° 33′	289° 44′	109° 44′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XX & XVIII	″ h 0·70 h 0·23	″ h 1·20 h 1·23	″ l 5·60 l 3·84	″ h 4·60 l 5·07	″ l 5·56 l 6·00	″ l 3·13 l 1·77	″ h 10·26 h 9·20	″ h 6·96 h 6·17	″ h 8·77 h 9·86	″ l 8·06 l 7·04	″ l 5·40 l 7·00	″ l 5·14 l 5·33	$M = 5''\cdot34$ $w = 1\cdot41$ $\frac{1}{w} = 0\cdot71$ $C = 47^\circ\ 46'\ 5''\cdot34$
	0·47	1·21	4·72	4·84	5·78	2·45	9·73	6·56	9·32	7·55	6·20	5·23	
XVIII & XVI	h 29·00 h 30·90	h 31·50 h 30·43	l 23·40 l 25·26	h 25·33 l 25·93	l 24·37 l 23·40	l 29·70 l 28·77	h 18·67 h 18·70	l 19·26 l 21·06	h 22·17 h 20·44	l 20·14 l 21·93	l 23·80 l 22·00	l 29·26 l 28·50	$M = 24''\cdot75$ $w = 0\cdot68$ $\frac{1}{w} = 1\cdot47$ $C = 73^\circ\ 19'\ 24''\cdot75$
	29·95	30·97	24·33	25·63	23·88	29·24	18·68	20·16	21·31	21·03	22·90	28·88	

At XVII (Jhinjhar)—(*Continued*).

Angle between	Circle readings, telescope being set on XX 238° 55′	58° 55′	249° 6′	69° 6′	259° 17′	79° 17′	269° 23′	89° 23′	279° 33′	99° 33′	289° 44′	109° 44′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XVI & XV	″ *h* 59·24 *h* 58·50	″ *h* 61·23 *h* 61·64	″ *l* 61·70 *l* 61·24	″ *l* 58·54 *l* 60·53	″ *l* 65·10 *l* 64·37	″ *l* 59·97 *l* 61·40	″ *h* 67·63 *h* 67·16	″ *l* 67·30 *l* 65·64	″ *h* 63·00 *l* 64·63	″ *l* 64·66 *l* 64·63	″ *l* 64·53 *l* 66·27	″ *l* 61·20 *l* 61·53	*M* = 62″·99 *w* = 1·51 $\frac{1}{w}$ = 0·66
	58·87	61·44	61·47	59·53	64·74	60·68	67·40	66·47	63·81	64·65	65·40	61·36	*C* = 54° 16′ 2″·99

At XVIII (Wastrál)

****February*** **1852;** ***observed by Lieutenant H. Rivers with Troughton and Simms'*** **18-*inch Theodolite No.* 2.**
†*December* **1858;** ***and*** **‡*January*** **1859;** ***observed by Captain D. J. Nasmyth, R.E., with Troughton and Simms'*** **18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XVI 309° 50′	129° 50′	320° 1′	140° 1′	330° 11′	150° 11′	340° 17′	160° 17′	350° 28′	170° 28′	0° 39′	180° 39′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
† XVI & XVII	″ *h* 35·27 *h* 35·76	″ *h* 39·67 *h* 39·06	″ *h* 34·77 *h* 33·56	″ *h* 38·16 *h* 39·37	″ *h* 36·33 *h* 35·50	″ *l* 41·64 *l* 40·97	″ *l* 36·23 *l* 34·80	″ *l* 38·20 *l* 36·77	″ *l* 35·37 *l* 34·86	″ *l* 33·16 *l* 33·67	″ *l* 29·93 *l* 29·04	″ *l* 33·37 *l* 32·07	
	35·52	39·36	34·17	38·76	35·92	41·30	35·52	37·48	35·12	33·41	29·49	32·72	*M* = 35″·73 *w* = 1·16
‡ XVI & XVII	*h* 36·50 *h* 36·10	*h* 35·57 *h* 36·27 *h* 35·43	*h* 33·47 *h* 33·80	*h* 39·76 *h* 39·57	*h* 37·40 *h* 38·33	*h* 39·70 *h* 40·40	*h* 36·83 *h* 36·60	*h* 36·66 *h* 37·37	*l* 34·14 *l* 37·50 *l* 36·07	*l* 38·73 *l* 36·77 *l* 38·07	*l* 33·84 *l* 32·93 *l* 32·53	*l* 36·64 *l* 35·86 *l* 36·03	*w* = 3·86 $\frac{1}{w}$ = 0·26 *C* = 50° 10′ 36″·38
	36·30	35·76	33·64	39·66	37·87	40·05	36·71	37·02	35·90	37·86	33·10	36·18	*M* = 36″·67 *w* = 2·70
† XVII & XX	*h* 24·00 *h* 25·04	*h* 24·16 *h* 22·77	*h* 25·16 *h* 25·87	*h* 25·24 *h* 27·13	*h* 34·30 *h* 32·33	*l* 24·50 *l* 24·27	*l* 32·57 *l* 33·70	*l* 34·13 *l* 36·00	*l* 30·53 *l* 30·70	*l* 34·17 *l* 34·83	*l* 29·13 *l* 31·73 *l* 31·14	*l* 33·37 *l* 33·66	*M* = 29″·57 *w* = 0·60 $\frac{1}{w}$ = 1·66
	24·52	23·47	25·51	26·19	33·31	24·39	33·13	35·07	30·61	34·50	30·67	33·52	*C* = 94° 8′ 29″·57
Lesser circle readings	200° 40′	20° 40′	210° 50′	30° 50′	220° 59′	40° 58′	231° 7′	51° 7′	241° 16′	61° 16′	251° 29′	71° 28′	
* XX & XXI	*h* 42·10 *h* 41·30 *h* 39·67 *h* 41·26	*h* 42·80 *h* 42·00 *h* 41·27	*h* 46·00 *h* 48·83 *h* 46·13	*h* 42·93 *h* 43·66	*h* 44·73 *h* 44·97	*h* 45·03 *h* 45·13	*h* 45·20 *h* 45·57	*h* 41·73 *h* 41·20	*l* 48·43 *l* 46·34 *l* 47·04	*l* 44·90 *l* 45·97	*l* 46·67 *l* 45·07	*l* 41·86 *l* 44·40 *l* 42·57	*M* = 44″·31 *w* = 2·58 $\frac{1}{w}$ = 0·39
	41·08	42·02	46·99	43·30	44·85	45·08	45·38	41·47	47·27	45·43	45·87	42·94	*C* = 70° 19′ 44″·30

At XVIII (Wastrál)—(*Continued*).

Angle between	Circle readings, telescope being set on XX 200° 40′	20° 40′	210° 50′	30° 50′	220° 59′	40° 58′	231° 7′	51° 7′	241° 16′	61° 16′	251° 29′	71° 28′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XX & XIX	″ h 7·70 h 8·20 h 5·33 h 6·57	″ h 10·80 h 9·86 h 9·13	″ h 5·57 h 4·93 h 7·64	″ h 8·30 h 8·87	″ h 7·40 h 7·67	″ h 10·54 h 11·27	″ h 5·14 h 3·23	″ h 3·14 h 4·90	″ l 3·77 l 2·36 l 2·30	″ l 4·40 l 4·43	″ l 4·13 l 5·16	″ l 7·87 l 9·53 l 8·70	M = 6″·56 w = 1·70 $\frac{1}{w}$ = 0·59
	6·95	9·93	6·05	8·59	7·53	10·91	4·18	4·02	2·81	4·42	4·64	8·70	C = 89° 2′ 6″·56
* XIX & XVI	h 60·53 h 59·67	h 58·76 h 59·64 h 59·04	h 62·53 h 66 10 h 64·13	h 62·47 h 62·97	h 65·40 h 64·60	h 60·90 h 59·80	h 63·66 h 64·87	h 65·26 h 64·07	l 60·06 l 60·04 l 64·13	l 59·53 l 60·50	l 60·70 l 61·17	l 61·87 l 59·50 l 57·50	M = 61″·87 w = 2·29 $\frac{1}{w}$ = 0·44
	60·10	59·15	64·25	62·72	65·00	60·35	64·27	64·66	61·41	60·02	60·93	59·62	C = 56° 19′ 1″·86

At XIX (Sanoda)

February 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVI 154° 7′	334° 7′	164° 17′	344° 17′	174° 25′	354° 25′	184° 34′	4° 34′	194° 43′	14° 43′	204° 55′	24° 55′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XVI & XVIII	″ h 39·17 h 39·33	″ h 39·06 h 39·67	″ h 40·17 h 39·83	″ l 40·77 l 40·23	″ h 41·44 h 43·06	″ h 39·26 h 38·20	″ l 36·03 h 33·60	″ h 38·14 h 39·93	″ h 38·56 h 40·37	″ h 44·76 h 44·10	″ l 27·53 l 30·10	″ h 37·83 h 37·17	M = 38″·68 w = 0·78 $\frac{1}{w}$ = 1·28
	39·25	39·37	40·00	40·50	42·25	38·73	34·81	39·04	39·46	44·43	28·82	37·50	C = 60° 8′ 38″·68
XVIII & XXI	h 59·73 h 58·07	h 68·23 h 69·67	h 55·13 h 57·17	h 57·90 h 56·94	l 59·37 l 60·50	h 57·40 h 58·40	l 69·34 h 68·10	h 59·73 h 58·27	l 58·17 l 59·80	l 57·23 l 57·67	l 64·27 l 62·50	l 54·06 l 51·23	M = 59″·95 w = 0·51 $\frac{1}{w}$ = 1·98
	58·90	68·95	56·15	57·42	59·94	57·90	68·72	59·00	58·98	57·45	63·39	52·64	C = 46° 43′ 59″·95

At XX (Pálri)

‖*March* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.
§*December* 1858; *observed by Capt. D. J. Nasmyth, R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXII 303° 29′	123° 28′	313° 39′	133° 39′	323° 47′	143° 47′	333° 56′	153° 56′	344° 5′	164° 5′	354° 18′	174° 17′	M = Mean of Groups w = Relative Weight C = Concluded Angle
‖ XXII & XXI	″ h 4.10 h 4.80 h 6·50	″ h 13·17 h 11·57	″ l 6·30 l 5·10	″ l 9·77 l 8·67	″ l 1·73 l 0·54	″ l 10·37 l 8·90 l 8·70	″ l 5·07 l 3.63 l 3·80	″ l 6·70 l 5·30	″ l 4·63 l 5·14 h 7·23	″ h 5·20 h 5·47	″ h 5·97 h 2·64 h 3·43	″ h 7·34 h 5·07	M = 6″·19 w = 1·35 $\frac{1}{w}$ = 0·74
	5·13	12.37	5·70	9·22	1·14	9·32	4·17	6·00	5·67	5·33	4·01	6·21	C = 56° 33′ 6″·19

At XX (Pálri)—(*Continued*).

Angle between	Circle readings, telescope being set on XXII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	303° 29′	123° 28′	313° 39′	133° 39′	323° 47′	143° 47′	333° 56′	153° 56′	344° 5′	164° 5′	354° 18′	174° 17′	
XXI & XVIII ‖	″ h 23·93 h 26·20 h 26·87	″ h 23·80 h 24·57	″ l 25·56 l 26·13	″ l 21·40 l 22·13	″ l 31·60 l 29·80	″ l 22·60 l 24·66 l 26 67	″ l 30·00 l 27·10 l 26·03	″ l 29·83 l 30·03	″ l 22·80 h 22·44	″ h 25·03 h 22·43 h 23·20	″ h 23·83 h 21·43 h 22·80	″ h 24·03 h 23·03	$M = 25''\cdot24$ $w = 1\cdot37$ $\frac{1}{w} = 0\cdot73$ $C = 56^\circ\ 5'\ 25''\cdot24$
	25·67	24·19	25·84	21·77	30·70	24·64	27·71	29·93	22·62	23·55	22·69	23·53	

Angle between	Circle readings, telescope being set on XVIII												
	0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	
§ XVIII & XVII	″ h 22·20 h 20·76	″ h 27·00 h 26·60	″ l 20·66 l 21·03	″ l 25·90 l 22·83 l 23·23	″ l 26·84 l 26·64	″ l 21·07 l 22·03	″ l 28·30 l 28·47	″ l 29·46 l 29·74	″ l 30·60 l 31·46	″ l 25·04 l 26·00	″ l 30·43 l 28·60	″ l 24·96 l 24·03	$M = 25''\cdot83$ $w = 0\cdot99$ $\frac{1}{w} = 1\cdot01$ $C = 38^\circ\ 5'\ 25''\cdot83$
	21·48	26·80	20·85	23·99	26·74	21·55	28·38	29·60	31·03	25·52	29·52	24·49	

At XXI (Sola)

March 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	141° 41′	321° 41′	151° 52′	331° 52′	162° 1′	342° 1′	172° 9′	352° 9′	182° 18′	2° 18′	192° 30′	12° 31′	
XIX & XVIII	″ h 61·37 h 57·97 h 57·13	″ h 52·13 h 51·17	″ l 57·73 l 60·20	″ h 55·77 h 58·30 h 58·83	″ h 56·17 h 61·17 h 57·23	″ h 56·60 h 54·27 h 51·83	″ h 51·46 h 52·93	″ h 47·64 h 48·24	″ h 49·26 h 48·56	″ h 51·37 h 49·13 h 50·43	″ h 56·03 h 55·17 h 52·73	″ h 47·67 h 50·54 h 51·50	$M = 53''\cdot62$ $w = 0\cdot70$ $\frac{1}{w} = 1\cdot43$ $C = 44^\circ\ 13'\ 53''\cdot63$
	58·82	51·65	58·97	57·63	58·19	54·23	52·19	47·94	48·91	50·31	54·64	49·90	
XVIII & XX	h 47·90 h 48·40	h 52·07 h 51·07 h 49·84	h 48·23 h 47·87 l 49·63	h 53·50 h 49·10 h 47·67	h 46·20 h 49·26 h 46·57	h 52·60 h 53·40	h 49·40 h 47·24 h 48·57	h 48·56 h 48·16	h 52·44 h 50·30	h 47·26 h 48·37	h 44·67 h 43·10	h 43·66 h 46·03	$M = 48''\cdot57$ $w = 1\cdot65$ $\frac{1}{w} = 0\cdot61$ $C = 53^\circ\ 34'\ 48''\cdot56$
	48·15	50·99	48·58	50·09	47·34	53·00	48·40	48·36	51·37	47·82	43·88	44·85	
XX & XXII	h 33·70 h 32·46	h 34·20 h 31·10 h 30·50	h 33·97 l 34·90	l 33·63 l 32·33	h 39·53 h 40·97	h 32·47 h 31·90	h 38·30 h 41·53	h 38·04 h 39·27	l 34·60 l 37·03 l 36·37	l 35·74 l 35·26	h 36·20 h 36·93	h 38·90 h 40·20	$M = 35''\cdot92$ $w = 1\cdot21$ $\frac{1}{w} = 0\cdot83$ $C = 56^\circ\ 23'\ 35''\cdot92$
	33·08	31·93	34·44	32·98	40·25	32·18	39·92	38·65	36·00	35·50	36·57	39·55	

At XXI (Sola)—(*Continued*).

Angle between	141° 41′	321° 41′	151° 52′	331° 52′	162° 1′	342° 1′	172° 9′	352° 9′	182° 18′	2° 18′	192° 30′	12° 31′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	Circle readings, telescope being set on XIX												
	″	″	″	″	″	″	″	″	″	″	″	″	
XXII & XXIII	*h* 37·73 *h* 37·50	*h* 35·03 *h* 39·50 *h* 37·23	*h* 37·50 *l* 36·34	*l* 38·23 *l* 40·07	*h* 31·07 *h* 29·20	*h* 38·76 *h* 38·63	*h* 32·67 *h* 29·60	*h* 31·93 *h* 30·07	*l* 34·23 *l* 31·47 *l* 31·06	*l* 34·06 *l* 33·64	*h* 33·73 *h* 35·17	*h* 35·73 *h* 34·90	$M = 34''·81$ $w = 1·14$ $\frac{1}{w} = 0·88$
	37·62	37·25	36·92	39·15	30·13	38·70	31·13	31·00	32·25	33·85	34·45	35·32	$C = 64° 7' 34''·81$

At XXII (Sánand)

March 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	281° 40′	101° 40′	291° 51′	111° 51′	302° 0′	122° 0′	312° 9′	132° 8′	322° 18′	142° 18′	332° 29′	152° 29′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	Circle readings, telescope being set on XXIV												
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIV & XXIII	*h* 49·53 *h* 47·30 *h* 46·46	*h* 48·76 *h* 48·83	*h* 46·83 *h* 47·37 *h* 48·60	*h* 45·14 *h* 43·70 *h* 46·63	*h* 43·00 *h* 45·03	*h* 50·06 *h* 50·17	*h* 41·80 *h* 40·67	*h* 41·54 *h* 41·67	*h* 40·04 *h* 41·17	*h* 43·76 *h* 40·60 *h* 41·80	*h* 44·20 *l* 48·26 *l* 45·83	*l* 45·97 *l* 46·13	$M = 45''·09$ $w = 1·13$ $\frac{1}{w} = 0·88$
	47·76	48·80	47·60	45·16	44·01	50·12	41·23	41·61	40·60	42·05	46·10	46·05	$C = 78° 20' 45''·09$
XXIII & XXI	*h* 9·00 *h* 10·20	*h* 7·97 *h* 8·70	*h* 14·37 *h* 12·76	*h* 16·23 *h* 16 30 *h* 14·90	*h* 15·17 *h* 15·44	*h* 10·87 *h* 9·63	*h* 17·87 *h* 16·87 *h* 19·70	*h* 15·50 *h* 14·60	*h* 13·96 *h* 13·60	*h* 11·94 *h* 12·17	*h* 11·23 *l* 13·00	*l* 10·83 *l* 10·53	$M = 12''·89$ $w = 1·39$ $\frac{1}{w} = 0·72$
	9·60	8·34	13·56	15·81	15·31	10·25	18·15	15·05	13·78	12·05	12·12	10·68	$C = 48° 25' 12''·90$
XXI & XX	*h* 20·83 *h* 19·80	*h* 21·77 *h* 20·53	*h* 16·46 *h* 17·34	*h* 19·03 *h* 18·10	*h* 20·46 *h* 18·53	*h* 18·87 *h* 19·07	*h* 16·53 *h* 19·16 *h* 13·96	*h* 18·73 *h* 19·83	*h* 19·50 *h* 19·97	*h* 20·16 *h* 21·90	*h* 18·27 *h* 18·16	*l* 20·77 *l* 19·34	$M = 19''·19$ $w = 4·74$ $\frac{1}{w} = 0·21$
	20·32	21·15	16·90	18·56	19·50	18·97	16·55	19·28	19·73	21·03	18·22	20·05	$C = 67° 3' 19''·18$

At XXIII (Hájipur)

March 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	Circle readings, telescope being set on XXI												
	″	″	″	″	″	″	″	″	″	″	″	″	
XXI & XXII	*h* 14·77 *h* 14·47 *h* 16·50	*h* 13·97 *h* 13·97	*h* 17·67 *h* 19·20	*h* 15·03 *h* 15·10	*h* 16·43 *l* 16·03	*l* 10·47 *l* 12·06	*l* 17·07 *l* 16·23	*l* 14·50 *l* 16·56	*h* 13·44 *h* 12·77	*h* 15·20 *h* 13·10	*h* 16·27 *h* 14·20	*h* 15·40 *h* 15·80	$M = 15''·04$ $w = 3·40$ $\frac{1}{w} = 0·29$
	15·25	13·97	18·44	15·06	16·23	11·27	16·65	15·53	13·10	14·15	15·24	15·60	$C = 67° 27' 15'·04$

At XXIII (Hájipur)—(*Continued*).

Angle between	Circle readings, telescope being set on XXI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 39′	50° 50′	230° 50′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXII & XXIV	*h* 30·63 *h* 32·67 *h* 30·27	*h* 32·56 *h* 31·33	*h* 29·43 *h* 28·74	*h* 34·04 *h* 35·23	*l* 31·00 *l* 31·74	*l* 33·33 *l* 34·44	*l* 30·93 *l* 31·64	*l* 37·23 *l* 38·34	*h* 34·36 *h* 34·53	*h* 33·87 *h* 33·27 *h* 31·00	*h* 30·63 *h* 31·53	*h* 28·90 *h* 30·00	*M* = 32″·41 *w* = 1·93 1/*w* = 0·52 *C* = 42° 18′ 32″·41
	31·19	31·95	29·08	34·64	31·37	33·88	31·29	37·78	34·45	32·71	31·08	29·45	
XXIV & XXV	*l* 19·34 *l* 18·43	*l* 16·60 *l* 17·90	*l* 16·54 *l* 15·63	*l* 21·20 *l* 16·43 *l* 18·20	*l* 19·07 *l* 18·73	*l* 15·23 *l* 12·96	*l* 14·34 *l* 16·60	*l* 16·03 *l* 17·87	*l* 23·07 *l* 23·03	*h* 25·83 *h* 24·63	*h* 19·93 *h* 21·27	*h* 23·33 *h* 21·43	*M* = 18″·96 *w* = 1·04 1/*w* = 0·96 *C* = 49° 56′ 18″·96
	18·89	17·25	16·08	18·61	18·90	14·10	15·47	16·95	23·05	25·23	20·60	22·38	

At XXIV (Khoraj)

***March* 1852 *; observed by Lieutenant H. Rivers with Troughton and Simms'* 18*-inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XXVII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	183° 58′	3° 57′	194° 9′	14° 8′	204° 16′	24° 16′	214° 25′	34° 25′	224° 35′	44° 34′	234° 47′	54° 46′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXVII & XXVI	*h* 20·54 *h* 19·36	*h* 20·80 *h* 23·40 *h* 21·87	*h* 8·36 *h* 10·46	*l* 17·90 *h* 18·00	*h* 14·74 *h* 13·47	*h* 19·56 *h* 21·54	*l* 18·06 *l* 17·94	*h* 16·64 *h* 16·40	*l* 16·80 *l* 13·97 *l* 15·86	*l* 13·10 *l* 16·67 *l* 15·13	*h* 13·40 *h* 14·74	*h* 15·34 *h* 15·96	*M* = 16″·56 *w* = 0·99 1/*w* = 1·01 *C* = 55° 48′ 16″·56
	19·95	22·02	9·41	17·95	14·11	20·55	18·00	16·52	15·54	14·97	14·07	15·65	
XXVI & XXV	*h* 56·70 *h* 56·00	*h* 54·30 *h* 53·83	*h* 54·67 *h* 51·84	*l* 59·20 *h* 58·10	*h* 63·06 *h* 61·93	*h* 54·40 *h* 54·66	*l* 62·70 *l* 61·96	*h* 60·13 *h* 62·50	*l* 58·60 *l* 59·27	*l* 62·84 *l* 61·07	*h* 60·10 *h* 59·46	*l* 60·20 *h* 60·26	*M* = 58″·66 *w* = 1·05 1/*w* = 0·95 *C* = 59° 22′ 58″·66
	56·35	54·07	53·25	58·65	62·50	54·53	62·33	61·31	58·94	61·95	59·78	60·23	
XXV & XXIII	*h* 43·50 *h* 45·17	*h* 44·14 *h* 47·67 *h* 46·07	*h* 42·70 *h* 42·60	*l* 43·97 *h* 44·97	*h* 42·04 *h* 41·90	*h* 49·00 *h* 48·00	*l* 42·04 *l* 42·30	*h* 41·20 *h* 39·84 *h* 39·53	*l* 46·00 *l* 45·13	*l* 43·70 *l* 43·33	*h* 45·76 *h* 47·17	*l* 43·10 *h* 45·90	*M* = 44″·19 *w* = 2·20 1/*w* = 0·45 *C* = 60° 52′ 44″·19
	44·34	45·96	42·65	44·47	41·97	48·50	42·17	40·19	45·56	43·52	46·46	44·50	

At XXIV (Khoraj)—(*Continued*).

Angle between	Circle readings, telescope being set on XXVII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	183° 58′	3° 57′	194° 9′	14° 8′	204° 16′	24° 16′	214° 25′	34° 25′	224° 35′	44° 34′	234° 47′	54° 46′	
XXIII & XXII	″ h 40·83 h 41·93	″ h 42·10 h 40·47 h 41·50	″ h 43·44 h 41·10 l 42·80	″ l 43·43 l 41·03 h 42·93	″ h 45·70 h 47·57	″ h 39·50 h 40·27	″ l 42·90 l 43·57	″ h 46·77 h 45·26	″ l 41·80 l 42·93	″ l 41·93 l 42·30	″ h 40·54 h 39·37	″ l 39·94 h 37·80	$M = 42''\cdot23$ $w = 2\cdot15$ $\frac{1}{w} = 0\cdot46$ $C = 59^\circ 20' 42''\cdot23$
	41·38	41·36	42·45	42·46	46·64	39·88	43·24	46·01	42·37	42·11	39·96	38·87	

At XXV (Wádrora)

March 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	230° 0′	50° 0′	240° 11′	60° 11′	250° 19′	17° 19′	260° 28′	80° 28′	270° 38′	90° 37′	280° 49′	100° 49′	
XXIII & XXIV	″ h 55·87 h 60·47 h 57·60	″ l 55·37 l 57·77 l 54·76	″ h 56·13 h 57·80	″ h 52·37 h 51·50 h 54·43	″ l 56·20 l 56·83	″ h 54·33 h 54·67	″ l 56·30 l 58·00	″ l 54·70 l 52·93	″ l 59·63 l 56·96	″ l 59·50 l 60·47	″ l 58·43 l 57·93	″ l 61·37 l 62·53 l 61·87	$M = 57''\cdot00$ $w = 1\cdot69$ $\frac{1}{w} = 0\cdot59$ $C = 69^\circ 10' 57''\cdot00$
	57·98	55·97	56·97	52·77	56·51	54·50	57·15	53·82	58·29	59·99	58·18	61·92	
XXIV & XXVI	h 13·37 h 15·06 h 14·94	l 12·83 l 13·20	h 15·37 h 14·50	h 18·63 h 17·27 h 13·37	h 12·90 l 11·30	h 18·77 h 19·17	l 10·97 l 11·00	l 5·90 l 7·70	l 11·17 l 9·20	l 9·80 l 8·66	l 11·83 l 11·77	l 7·20 l 7·47	$M = 12''\cdot19$ $w = 0\cdot89$ $\frac{1}{w} = 1\cdot13$ $C = 60^\circ 50' 12''\cdot20$
	14·46	13·02	14·93	16·42	12·10	18·97	10·99	6·80	10·18	9·23	11·80	7·34	

At XXVI (Hasalpur)

May 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 51′	230° 50′	
XXV & XXIV	″ h 48·04 h 50·44 h 47·90	″ h 43·47 h 43·30	″ l 49·57 l 46·33 l 46·53	″ l 52·37 l 49·40 l 48·10	″ l 54·53 l 52·66	″ l 46·87 l 48·00	″ l 49·13 l 48·63	″ l 51·87 l 52·20	″ l 48·57 l 46·10	″ h 49·66 h 48·47	″ h 49·63 l 46·93	″ h 51·27 l 50·63	$M = 48''\cdot93$ $w = 1\cdot64$ $\frac{1}{w} = 0\cdot61$ $C = 59^\circ 46' 48''\cdot93$
	48·79	43·39	47·48	49·96	53·59	47·44	48·88	52·03	47·34	49·06	48·28	50·95	
XXIV & XXVII	h 36·73 h 32·73 h 34·40	h 40·23 h 40·56	l 34·53 l 37·17 l 36·37	l 35·66 l 37·74	l 30·40 l 30·60	l 34·56 l 36·00	l 34·27 l 35·93	l 32·63 l 30·67	l 36·30 l 36·46	h 38·40 h 38·13 h 39·50	h 36·80 l 33·47	h 36·53 l 34·77	$M = 35''\cdot51$ $w = 1\cdot60$ $\frac{1}{w} = 0\cdot63$ $C = 60^\circ 21' 35''\cdot52$
	34·62	40·40	36·02	36·70	30·50	35·28	35·10	31·65	36·38	38·68	35·13	35·65	

At XXVI (Hasalpur)—(*Continued*).

Circle readings, telescope being set on XXV

Angle between	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 51′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVII & XXVIII	″ l 62·87 l 62·14	″ h 58·94 h 58·70	″ l 67·74 l 69·93	″ l 68·17 l 67·43	″ l 68·87 l 68·27	″ l 68·20 l 64·47 l 65·30	″ l 71·00 l 70·24	″ l 68·23 l 70·10	″ l 67·93 h 65·94	″ h 67·24 h 69·20 h 67·57	″ h 62·13 l 60·93	″ h 61·90 l 65·17	$M = 66''\cdot03$ $w = 0\cdot89$ $\frac{1}{w} = 1\cdot13$
	62·51	58·82	68·83	67·80	68·57	65·99	70·62	69·17	66·93	68·00	61·53	63·54	$C = 48° 35' 6''\cdot03$
XXVIII & XXIX	l 25·44 l 24·20	l 16·53 l 18·47	l 11·00 l 11·47	l 11·37 l 13·70	l 14·20 l 16·37	l 14·07 l 16·30	l 10·10 l 10·76	l 19·57 l 20·03	l 14·27 h 11·00 h 12·60	h 8·90 h 8·57	l 11·90 l 9·70	l 6·33 l 9·50 l 10·27	$M = 13''\cdot97$ $w = 0\cdot50$ $\frac{1}{w} = 1\cdot99$
	24·82	17·50	11·24	12·53	15·29	15·18	10·43	19·80	12·62	8·74	10·80	8·70	$C = 64° 8' 13''\cdot97$

At XXVII (Thuleta)

March 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Circle readings, telescope being set on XXVIII

Angle between	289° 36′	109° 36′	299° 47′	119° 47′	309° 55′	129° 55′	320° 4′	140° 4′	330° 13′	150° 13′	340° 25′	160° 24′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVIII & XXVI	″ h 34·97 h 37·03 h 35·57	″ h 41·20 h 42·56	″ l 37·00 l 34·83 l 35·23	″ h 36·60 h 35·44	″ l 34·17 l 33·93	″ l 40·80 l 41·20	″ l 33·73 l 36·37 h 32·93	″ l 36·40 l 35·83	″ h 38·74 h 36·70 h 36·96	″ h 38·44 h 38·54 h 38·94	″ h 35·37 h 34·63	″ h 35·33 h 37·93 h 38·70	$M = 36''\cdot95$ $w = 1\cdot86$ $\frac{1}{w} = 0\cdot54$
	35·86	41·88	35·69	36·02	34·05	41·00	34·34	36·12	37·47	38·64	35·00	37·32	$C = 70° 25' 36''\cdot95$
XXVI & XXIV	h 5·23 h 7·40 h 7·70	h 6·43 h 5·17	h 7·90 l 6·53	h 4·84 h 8·63 h 7·84	l 11·53 l 11·27	l 1·97 l 3·36	l 4·37 l 5·03.	l 8·70 l 6·80	h 4·86 h 7·20 h 4·97	h 4·96 h 2·96 h 4·10	h 8·73 h 7·50	h 5·80 h 5·67	$M = 6''\cdot41$ $w = 2\cdot23$ $\frac{1}{w} = 0\cdot45$
	6·78	5·80	7·22	7·10	11·40	2·66	4·70	7·75	5·68	4·01	8·12	5·73	$C = 63° 50' 6''\cdot41$

At XXVIII (Kárigángar)

March 1852; *observed by Lieutenants H. Rivers and D. J. Nasmyth R.E., with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Circle readings, telescope being set on XXX

Angle between	296° 9′	116° 9′	306° 20′	126° 20′	316° 28′	136° 28′	326° 36′	146° 36′	336° 45′	156° 45′	346° 57′	166° 57	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXX & XXIX	″ l 41·10 l 40·96	″ l 39·50 l 42·76 l 43·80	″ h 38·63 h 37·17	″ l* 42·53 h 45·53	″ h 38·87 l 40·24	″ l 46·30 l 46·67	″ l 34·87 l 36·06	″ l 38·94 l 38·60	″ l 37·00 l 38·17	″ l 42·13 l 42·20	″ l 37·50 h 39·86	″ l 44·23 h 41·00 h 42·23	$M = 40''\cdot52$ $w = 1\cdot19$ $\frac{1}{w} = 0\cdot84$
	41·03	42·02	37·90	44·03	39·56	46·48	35·47	38·77	37·58	42·17	38·68	42·49	$C = 63° 52' 40''\cdot53$

* This value should be 43·53; the error was not detected until after completion of the calculations.

At XXVIII (Kárigángar)—(*Continued*).

Angle between	Circle readings, telescope being set on XXX 296° 9′	116° 9′	306° 20′	126° 20′	316° 28′	136° 28′	326° 36′	146° 36′	336° 45′	156° 45′	346° 57′	166° 57′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIX & XXVI	″ *h* 39·24 *h* 37·47 *l* 39·24 *l* 37·40	″ *h* 31·96 *h* 32·53	″ *h* 41·90 *h* 41·66	″ *l* 38·27 *h* 35·90	″ *h* 38·83 *l* 37·93	″ *l* 32·37 *l* 32·53	″ *l* 38·94 *l* 40·53	″ *l* 41·03 *l* 41·47	″ *l* 36·90 *l* 38·07	″ *l* 40·53 *l* 40·96	″ *l* 42·00 *l* 40·43 *h* 38·44	″ *l* 39·60 *h* 37·07	$M = 38''\cdot18$ $w = 1\cdot21$ $\frac{1}{w} = 0\cdot83$
	38·34	32·25	41·78	37·08	38·38	32·45	39·74	41·25	37·48	40·75	40·29	38·33	$C = 67° 33' 38''\cdot18$
XXVI & XXVII	*h* 19·00 *l* 16·40 *l* 18·27	*h* 19·14 *h* 19·27	*h* 13·44 *h* 15·97	*l* 20·10 *h* 21·17	*h* 19·90 *l* 20·03	*l* 22·17 *l* 20·63	*l* 21·70 *l* 21·00	*l* 22·83 *l* 19·00 *l* 18·26	*l* 21·60 *l* 20·63	*l* 18·20 *l* 16·77	*h* 19·70 *h* 22·60 *h* 20·83	*l* 17·77 *l* 18·84 *h* 18·97	$M = 19''\cdot45$ $w = 2\cdot67$ $\frac{1}{w} = 0\cdot37$
	17·89	19·21	14·70	20·64	19·96	21·40	21·35	20·03	21·12	17·48	21·04	18·53	$C = 60° 59' 19''\cdot45$

At XXIX (Por)

***April* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XXVI 263° 35′	83° 35′	273° 46′	93° 46′	283° 54′	103° 54′	294° 3′	114° 3′	304° 12′	124° 12′	314° 24′	134° 24′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVI & XXVIII	″ *l* 13·93 *l* 13·57	″ *l* 4·53 *l* 9·77 *l* 5·00	″ *l* 13·30 *l* 12·20	″ *l* 6·33 *l* 5·36	″ *l* 12·04 *l* 9·17 *l* 7·57	″ *l* 9·90 *l* 10·13	″ *l* 6·24 *l* 8·17	″ *l* 6·76 *l* 4·93	″ *h* 7·13 *h* 8·60	″ *h* 7·97 *h* 10·83 *h* 10·40	″ *h* 6·16 *h* 7·34	″ *h* 8·97 *l* 8·90	$M = 8''\cdot73$ $w = 1\cdot63$ $\frac{1}{w} = 0\cdot61$
	13·75	6·43	12·75	5·85	9·59	10·01	7·21	5·84	7·87	9·73	6·75	8·93	$C = 48° 18' 8''\cdot73$
XXVIII & XXX	*l* 17·70 *l* 18·84	*l* 19·60 *h* 20·33	*h* 15·16 *h* 15·50	*h* 19·53 *h* 16·70 *h* 18·67	*l* 16·53 *l* 19·56 *l* 18·96	*l* 18·86 *l* 21·30 *l* 18·90	*l* 17·36 *l* 18·04	*l* 12·93 *l* 11·23	*h* 10·76 *h* 13·04	*h* 16·93 *h* 13·14 *h* 17·97	*h* 18·50 *h* 19·33	*h* 11·83 *l* 16·64 *l* 16·14	$M = 16''\cdot78$ $w = 1\cdot45$ $\frac{1}{w} = 0\cdot69$
	18·27	19·97	15·33	18·30	18·35	19·69	17·70	12·08	11·90	16·01	18·91	14·87	$C = 48° 8' 16''\cdot79$
XXX & XXXI	*l* 37·40 *l* 37·33	*l* 35·94 *h* 35·80	*h* 40·70 *h* 38·14	*h* 39·77 *h* 41·10	*l* 44·43 *l* 45·74 *l* 42·54	*l* 37·67 *l* 36·43	*l* 39·87 *l* 37·80	*l* 39·30 *l* 39·20 *l* 41·50	*h* 38·90 *h* 37·53	*h* 37·07 *h* 38·56	*h* 38·80 *h* 39·33	*h* 43·00 *l* 39·50 *l* 40·40	$M = 39''\cdot11$ $w = 2\cdot30$ $\frac{1}{w} = 0\cdot44$
	37·37	35·87	39·42	40·43	44·24	37·05	38·84	40·00	38·21	37·82	39·06	40·97	$C = \begin{cases} 61° 5' 39''\cdot13 \\ *+0\cdot24 \end{cases}$

* Correction to reduce to position of present station mark; see description of station XXXI.

At XXX (Ingrori)

* *April* 1852; *and* † *December* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	261° 1′	81° 1′	271° 12′	91° 12′	281° 20′	101° 20′	291° 29′	111° 29′	301° 38′	121° 38′	311° 50′	131° 50′	
† XXXII & XXXI	″ l 62·30 l 63·30 l 62·36	″ l 54·23 l 52·43	″ l 64·04 l 64·13	″ l 56·60 l 57·66	″ l 64·90 l 63·46	″ l 59·20 l 61·33	″ l 63·27 l 62·97	″ l 63·40 l 61·06 l 61·97	″ l 61·90 l 61·70	″ l 62·80 l 64·34	″ l 62·70 l 61·30	″ l 55·83 l 57·23	M = 60″·90 w = 0·99 1/w = 1·01
	62·65	53·33	64·09	57·13	64·18	60·26	63·12	62·14	61·80	63·57	62·00	56·53	C = {53° 26′ 0″·90 *−0·01
† XXXI & R. M.	l 22·94 l 16·97 l 21·17	l 20·90 l 22·60	l 14·96 l 18·67 l 18·93	l 25·60 l 22·84 l 22·07	l 15·76 l 16·84	l 19·70 l 19·20	l 16·23 l 17·03	l 13·13 l 10·37 l 11·70	l 12·60 l 13·73	l 14·33 l 12·93	l 12·50 l 15·04 l 14·36	l 16·77 l 17·10	M = 17″·08 w = 0·86 1/w = 1·17
	20·36	21·75	17·52	23·50	16·30	19·45	16·63	11·73	13·17	13·63	13·97	16·93	C = {45° 34′ 17″·08 *+0·01
* R. M. & XXIX	h 35·37 h 33·64 h 35·14	h 39·47 h 37·30 h 37·43	h 31·63 h 34·64 h 35·67	h 30·17 h 33·90 h 36·00 h 37·64	h 34·73 h 35·50	h 32·83 h 33·93	h 34·44 l 34·37 l 34·16	l 42·07 l 39·54 l 38·60	h 42·77 h 42·50	h 40·83 h 43·16	l 38·93 l 41·27	l 40·70 l 38·90	M = 37″·39 w = 0·97 1/w = 1·03
	34·72	38·07	33·98	34·43	35·12	33·38	34·32	40·07	42·63	42·00	40·10	39·80	C = 18° 26′ 37″·37
* XXIX & XXVIII	h 66·93 h 66·63 h 65·36	h 59·43 h 60·80 h 61·24	h 69·44 h 67·26 h 65·93	h 62·80 h 61·50 h 59·46	h 62·93 h 62·34	h 63·87 h 62·37	h 66·90 l 67·90 l 67·84	l 62·37 l 65·66 l 64·80	h 60·76 h 58·63	h 58·50 h 58·70	l 56·37 l 57·37	l 61·83 l 62·63	M = 62″·55 w = 0·99 1/w = 1·01
	66·31	60·49	67·54	61·25	62·64	63·12	67·55	64·28	59·69	58·60	56·87	62·23	C = 67° 59′ 2″·56

At XXXI (Degám)

January 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 2′	10° 12′	190° 13′	20° 21′	200° 21′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	
XXIX & XXX	″ l 26·20 l 26·73	″ l 34·10 l 31·80 l 33·17	″ l 30·13 l 29·33	″ l 27·47 l 29·63	″ l 33·60 l 33·06	″ l 23·80 l 24·20	″ l 31·63 l 28·60 l 31·80	″ l 28·96 l 29·10	″ l 29·60 l 28·10	″ l 27·47 l 30·50 l 25·90	″ l 27·57 l 29·24	″ l 25·00 l 27·33	M = 28″·85 w = 1·56 1/w = 0·64
	26·47	33·02	29·73	28·55	33·33	24·00	30·68	29·03	28·85	27·96	28·40	26·17	C = 54° 53′ 28″·86

NOTE.—R.M. denotes Referring Mark. * Correction to reduce to position of present station mark; see description of station XXXI.

At XXXI (Degám)—(*Continued*).

Angle between	0° 1′	180° 2′	10° 12′	190° 13′	20° 21′	200° 21′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXX & XXXII	*l* 40·50 *l* 43·90 *l* 40·50	*l* 35·84 *l* 34·64	*l* 35·70 *l* 35·44	*l* 40·80 *l* 38·13 *l* 37·86	*l* 36·43 *l* 37·53	*l* 44·37 *l* 40·10 *l* 44·63	*l* 32·30 *l* 33·57	*l* 38·04 *l* 38·20	*l* 40·50 *l* 38·83	*l* 39·96 *l* 39·70	*l* 41·40 *d* 41·50	*l* 42·56 *l* 41·83	$M = 38''\cdot80$ $w = 1\cdot16$ $\frac{1}{w} = 0\cdot86$ $C = 65^\circ 25' 38''\cdot81$
(means)	41·63	35·24	35·57	38·93	36·98	43·03	32·94	38·12	39·66	39·83	41·45	42·20	
XXXII & XXXIII	*l* 42·84 *l* 38·23 *l* 42·50	*l* 42·26 *l* 42·63	*l* 49·50 *l* 46·40 *l* 47·23	*l* 47·47 *l* 46·54	*h* 50·33 *h* 48·30	*h* 38·44 *h* 40·17	*l* 50·33 *l* 51·90	*l* 49·66 *l* 47·30	*l* 44·33 *l* 44·17	*l* 44·14 *l* 45·14	*l* 42·10 *d* 42·20	*l* 44·97 *l* 43·97	$M = 45''\cdot17$ $w = 0\cdot89$ $\frac{1}{w} = 1\cdot12$ $C = 49^\circ 38' 45''\cdot17$
(means)	41·19	42·45	47·71	47·00	49·32	39·30	51·12	48·48	44·25	44·64	42·15	44·47	

At XXXII (Charári)

***December* 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	304° 46′	124° 46′	314° 57′	134° 57′	325° 5′	145° 5′	335° 14′	155° 14′	345° 23′	165° 23′	355° 35′	175° 35′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXIV & XXXIII	*h* 39·40 *h* 37·17	*l* 41·53 *l* 40·67	*l* 41·20 *l* 39·30	*l* 37·23 *l* 36·73	*l* 38·10 *l* 37·83	*l* 40·46 *l* 39·93	*l* 38·16 *l* 37·76	*l* 35·34 *l* 36·17	*l* 35·36 *l* 34·43	*l* 31·20 *l* 29·17 *l* 34·24	*l* 38·73 *l* 37·34	*l* 35·27 *l* 37·27	$M = 37''\cdot44$ $w = 1\cdot63$ $\frac{1}{w} = 0\cdot61$ $C = 55^\circ 15' 37''\cdot43$
(means)	38·29	41·10	40·25	36·98	37·96	40·20	37·96	35·75	34·90	31·54	38·03	36·27	
XXXIII & XXXI	*h* 18·06 *h* 17·43	*h* 18·60 *h* 18·24 *l* 15·47 *l* 15·47	*l* 18·30 *l* 20·67	*l* 23·94 *l* 22·90	*l* 17·70 *l* 19·03	*l* 14·90 *l* 15·57	*l* 18·74 *l* 20·70 *l* 18·80	*l* 16·63 *l* 18·06	*l* 15·97 *l* 16·94	*l* 23·07 *l* 22·86	*l* 19·20 *l* 20·10	*l* 21·83 *l* 21·50	$M = 19''\cdot06$ $w = 1\cdot73$ $\frac{1}{w} = 0\cdot58$ $C = \begin{cases} 66^\circ 48' 19''\cdot06 \\ {}^*-0\cdot31 \end{cases}$
(means)	17·75	16·94	19·49	23·42	18·36	15·24	19·41	17·34	16·46	22·96	19·65	21·67	
XXXI & XXX	*h* 20·30 *h* 20·00	*h* 19·56 *l* 24·80 *l* 22·86	*l* 14·07 *l* 14·43	*l* 17·80 *l* 18·77	*l* 17·70 *l* 18·30	*l* 19·70 *l* 20·93	*l* 16·23 *l* 16·07	*l* 20·73 *l* 22·27	*l* 24·17 *l* 23·23	*l* 19·76 *l* 19·27	*l* 22·00 *l* 22·80	*l* 23·57 *l* 21·00 *l* 20·87	$M = 19''\cdot87$ $w = 1\cdot46$ $\frac{1}{w} = 0\cdot68$ $C = \begin{cases} 61^\circ 8' 19''\cdot88 \\ {}^*+0\cdot31 \end{cases}$
(means)	20·15	22·41	14·25	18·29	18·00	20·31	16·15	21·50	23·70	19·52	22·40	21·81	

* Correction to reduce to position of present station mark; see description of station XXXI.

At XXXIII (Dhrángadra)

December 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXI 0° 2′	180° 2′	10° 12′	190° 11′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXI & XXXII	″ h 58·70 h 56·27	″ h 53·97 h 53·73	″ h 59·16 h 57·60	″ h 56·77 l 60·67 h 58·87 h 59·60	″ l 62·66 l 64·43 h 63·36	″ l 53·27 l 54·40	″ l 57·24 l 58·04	″ l 62·37 l 62·70	″ l 55·93 l 54·73	″ l 60·90 l 60·13	″ l 58·27 l 59·30	″ l 58·20 h 59·50	M = 58″·31 w = 1·27 1/w = 0·79 C = {63° 32′ 58″·32 *+0·29
	57·49	53·85	58·38	58·98	63·48	53·83	57·64	62·54	55·33	60·51	58·79	58·85	
XXXII & XXXIV	h 5·27 h 5·33	h 10·50 h 11·77	l 2·97 l 2·07 l 4·87	h 3·66 h 4·16 h 1·30	l 3·20 l 1·44	l 5·20 l 5·47	l 7·53 l 8·46	l 10·20 l 8·67	l 11·37 l 8·00	l 9·23 l 10·57	l 7·43 l 9·96 l 7·90	l 13·00 l 9·56 l 8·67 h 11·00	M = 7″·20 w = 1·13 1/w = 0·88 C = 79° 3′ 7″·20
	5·30	11·14	3·30	3·04	2·32	5·33	8·00	9·43	9·69	9·90	8·43	10·56	
XXXIV & XXXV	h 62·86 h 63·30	h 60·73 h 62·10	l 65·06 l 63·83	h 62·60 h 59·27 h 62·67	l 59·97 l 59·33	l 59·46 l 58·13	l 55·50 l 54·47	l 57·13 l 57·50	l 58·00 l 61·03	l 56·87 l 56·63	l 54·73 l 54·64	l 51·93 l 53·30	M = 58″·73 w = 0·91 1/w = 1·10 C = 54° 14′ 58″·73
	63·08	61·42	64·44	61·51	59·65	58·80	54·98	57·32	59·51	56·75	54·69	52·61	

At XXXIV (Nárechána)

January 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXI 0° 2′	180° 2′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXI & XXXV	″ h 39·87 h 39·63	″ h 38·10 h 39·07	″ h 40·67 h 39·63	″ h 37·84 h 38·00	″ l 44·87 l 44·40	″ l 36·07 l 35·43	″ l 38·00 l 37·30	″ l 36·87 l 38·53	″ l 35·67 l 39·80 l 37·80	″ l 36·00 l 38·20	″ h 42·37 h 41·17	″ h 40·50 h 40·57	M = 39″·11 w = 1·96 1/w = 0·51 C = 63° 34′ 39″·11
	39·75	38·59	40·15	37·92	44·63	35·75	37·65	37·70	37·76	37·10	41·77	40·54	
XXXV & XXXIII	h 53·73 h 54·50	h 52·87 h 53·54	h 52·77 h 52·27	h 53·80 h 53·73	l 45·77 l 45·07	l 57·87 l 58·26 l 56·40	l 51·27 l 52·40	l 52·90 l 53·73	l 56·53 l 53·37 l 54·97	l 55·00 l 54·43	h 51·57 h 51·96	h 55·43 h 54·87	M = 53″·19 w = 1·38 1/w = 0·73 C = 61° 19′ 53″·19
	54·12	53·20	52·52	53·77	45·42	57·51	51·83	53·32	54·96	54·71	51·77	55·15	

Note.—Station XXI appertains to the Kattywar Meridional Series. * Correction to reduce to position of present station mark; see description of station XXXI.

At XXXIV (Nárechána)—(*Continued*).

Angle between	Circle readings, telescope being set on XXI: 0° 2′	180° 2′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 50′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
XXXIII & XXXII	″ h 15·46 h 15·40	″ h 16·50 h 15·60	″ h 17·36 h 15·70	″ h 17·00 h 15·20 h 15·03	″ l 25·86 l 26·03	″ l 16·97 l 19·37	″ l 23·66 l 20·77 l 24·37	″ l 18·40 l 19·50	″ l 23·43 l 24·03	″ l 16·67 l 15·13	″ h 14·73 h 13·50 h 16·03	″ h 14·26 h 13·90	$M = 18''·18$ $w = 0·76$ $\frac{1}{w} = 1·31$
	15·43	16·05	16·53	15·74	25·95	18·17	22·93	18·95	23·73	15·90	14·75	14·08	$C = 45° 41' 18''·18$

At XXXV (Kuária)

December 1852; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXIII: 295° 36′	115° 37′	305° 47′	125° 47′	315° 55′	135° 55′	326° 4′	146° 4′	336° 13′	156° 13′	346° 25′	166° 25′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
XXXIII & XXXIV	″ h 13·37 h 11·96	″ h 7·76 h 9·37	″ h 13·26 l 9·03 l 12·27	″ h 11·63 h 12·33	″ l 9·10 l 11·90 l 8·47	″ l 10·03 l 12·13	″ l 10·06 l 10·07	″ l 7·93 l 7·57	″ l 10·04 l 9·90	″ l 11·94 l 8·37 l 10·80	″ l 9·10 h 9·93	″ h 8·44 h 12·73 h 12·00	$M = 10''·36$ $w = 4·62$ $\frac{1}{w} = 0·22$
	12·67	8·56	11·52	11·98	9·82	11·08	10·07	7·75	9·97	10·37	9·51	11·06	$C = 64° 25' 10''·37$
XXXIV & XXI	h 64·93 h 64·57	h 62·57 h 62·27	h 68·60 l 68·94 l 68·90	h 64·87 h 63·54	l 61·44 l 59·70	l 65·37 l 63·17	l 72·67 l 72·53	l 69·37 l 71·16	l 70·76 l 69·70	l 70·03 l 72·30	l 65·53 l 64·24 h 67·20	h 65·66 h 63·07 h 64·17	$M = 66''·60$ $w = 0·79$ $\frac{1}{w} = 1·26$
	64·75	62·42	68·81	64·21	60·57	64·27	72·60	70·26	70·23	71·17	65·66	64·30	$C = 47° 53' 6''·60$
XXI & XVIII	h 43·57 h 41·10	h 46·83 h 47·30	l 49·93 l 49·50	l 43·50 l 44·26	l 54·13 l 55·40	l 50·37 l 49·23	l 46·80 l 46·14	l 50·97 l 49·20	l 48·84 l 47·23	l 45·53 l 46·17	l 48·40 l 52·63 h 49·00	h 50·94 h 49·43	$M = 48''·18$ $w = 1·05$ $\frac{1}{w} = 0·95$
	42·34	47·06	49·72	43·88	54·76	49·80	46·47	50·09	48·03	45·85	50·01	50·19	$C = 57° 2' 48''·18$

At XXI (Sápakra)

January 1853; *observed by Lieutenant H. Rivers with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVIII: 94° 28′	274° 28′	104° 39′	284° 39′	114° 47′	294° 47′	124° 56′	304° 56′	135° 5′	315° 5′	145° 17′	325° 17′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
XVIII & XXXV	″ h 58·10 h 58·70	″ h 57·43 h 59·50	″ h 56·83 h 60·53 l 61·60	″ l 52·00 l 51·40 l 55·73	″ l 59·10 l 57·83	″ l 58·70 l 59·80	″ l 63·37 l 60·70 l 60·90	″ l 52·10 l 51·83	″ h 58·90 h 57·50	″ h 55·40 h 58·80 h 58·14	″ h 52·53 h 53·40	″ h 56·30 h 56·03	$M = 57''·14$ $w = 1·24$ $\frac{1}{w} = 0·81$
	58·40	58·47	59·65	53·04	58·46	59·25	61·66	51·97	58·20	57·45	52·96	56·17	$C = 81° 34' 57''·15$

NOTE.—Stations XVIII and XXI appertain to the Kattywar Meridional Series.

At XXI (Sápakra)—(*Continued*).

Angle between	Circle readings, telescope being set on XVIII 94° 28′	274° 28′	104° 39′	284° 39′	114° 47′	294° 47′	124° 56′	304° 56′	135° 5′	315° 5′	145° 17′	325° 17′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XXXV & XXXIV	″ *h* 13·47 *h* 12·26	″ *h* 13·17 *h* 14·57	″ *h* 10·97 *h* 10·00	″ *l* 19·54 *l* 16·60 *l* 16·20	″ *l* 4·20 *l* 6·67 *l* 5·40	″ *l* 13·13 *l* 12·57	″ *l* 6·33 *l* 8·37	″ *l* 8·57 *l* 10·20	″ *h* 7·63 *h* 9·50	″ *h* 11·56 *h* 8·43 *h* 4·50 *h* 7·14	″ *h* 16·57 *h* 14·87	″ *h* 11·40 *h* 12·10	$M = 11''\cdot 14$ $w = 0\cdot 88$ $\frac{1}{w} = 1\cdot 14$ $C = 68^\circ 32' 11''\cdot 13$
	12·87	13·87	10·48	17·45	5·42	12·85	7·35	9·39	8·56	7·91	15·72	11·75	

At XVIII (Chalarwa)

December 1852; *observed by Lieutenant H. Rivers with Troughton and Simms*' 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXV 235° 28′	55° 28′	245° 39′	65° 39′	255° 47′	75° 47′	265° 56′	85° 56′	276° 5′	96° 5′	286° 16′	106° 17′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XXXV & XXI	″ *l* 12·96 *l* 12·07 *l* 11·50	″ *l* 20·23 *l* 19·00	″ *h* 16·07 *h* 14·80	″ *h* 13·16 *h* 13·37	″ *h* 22·17 *h* 20·94	″ *h* 23·93 *h* 23·06	″ *l* 20·77 *l* 18·46	″ *l* 23·47 *l* 20·33 *l* 23·34	″ *d* 20·37 *d* 19·69	″ *l* 24·40 *l* 22·50	″ *l* 23·20 *l* 22·67	″ *l* 18·70 *l* 18·50	$M = 19''\cdot 38$ $w = 0\cdot 78$ $\frac{1}{w} = 1\cdot 28$ $C = 41^\circ 22' 19''\cdot 38$
	12·18	19·62	15·43	13·27	21·55	23·50	19·61	22·38	20·03	23·45	22·94	18·60	

NOTE.—Stations XVIII and XXI appertain to the Kattywar Meridional Series.

September 1879.

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

GUZERAT LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. SUMS OF SQUARES OF APPARENT ERRORS.

Sums of Squares of Apparent Errors of Single Observations, and of Apparent Errors of Single Zeros.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of Single Observations	Number of Zeros	Sum of Squares of Errors of Single Zeros	Remarks
IX	XIII & I	24	4·61	12	99·75	Troughton and Simms' 18-inch Theodolite No. 2.
XIII	II & I	24	3·19	12	161·33	
„	I & IX	24	6·03	12	140·30	
I	IX & XIII	24	2·94	12	111·70	
„	XIII & II	24	5·74	12	77·91	
„	II & III	24	4·60	12	82·59	
II	V & IV	24	7·85	12	131·38	
„	IV & III	25	2·88	12	97·79	
„	III & I	25	4·97	12	117·38	
„	I & XIII	24	5·22	12	129·47	
III	I & II	24	5·48	12	68·70	
„	II & IV	24	6·01	12	39·18	
„	IV & VII	24	5·79	12	85·66	
IV	III & II	24	8·14	12	100·51	
„	II & V	24	5·62	12	117·28	
„	VI & VII	24	3·41	12	80·61	
„	VII & III	24	5·63	12	63·43	
V	VI & IV	24	2·74	12	66·86	

NOTE.—Stations IX and XIII appertain to the Khánpisura Meridional Series.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of Single Observations	Number of Zeros	Sum of Squares of Errors of Single Zeros	Remarks
V	IV & II	24	6·18	12	50·81	Troughton and Simms' 18-inch Theodolite No. 2.
VI	IX & VIII	24	5·35	12	78·62	
"	VIII & VII	24	2·63	12	102·49	
"	VII & IV	24	2·65	12	148·10	
"	IV & V	24	3·15	12	107·18	
VII	III & IV	24	4·87	12	115·39	
"	IV & VI	24	4·43	12	70·46	
"	VI & VIII	25	5·83	12	119·95	
VIII	VII & VI	26	3·00	12	75·31	
"	VI & IX	24	2·41	12	104·38	
"	IX & XIII	24	4·16	12	83·68	
IX	XVII & XIII	24	3·39	12	139·75	
"	XIII & VIII	24	2·60	12	60·27	
"	VIII & VI	24	3·46	12	76·14	
XIII	R. M. & VIII	24	1·66	12	75·51	
"	VIII & IX	24	6·87	12	48·18	
"	IX & XVII	24	0·88	12	80·28	
"	XVII & XVIII	24	4·21	12	220·44	
"	XVIII & XIV	24	5·04	12	205·52	
"	XIV & XII	24	3·15	12	145·14	
XVII	XVIII & XIV	24	7·25	12	61·28	
"	XIV & XIII	24	4·54	12	119·53	
"	XIII & IX	24	3·09	12	68·39	
XIV	XIII & XVIII	24	5·95	12	137·91	
"	XVII & XVIII	24	5·40	12	180·29	
"	XVIII & XVI	24	3·91	12	157·78	
"	XVI & XV	24	4·84	12	105·01	
"	XV & XII	24	5·29	12	80·60	
"	XII & R. M.	24	3·26	12	78·26	
XVIII	XVI & XIV	26	10·13	12	113·54	
"	XIV & XVII	24	6·71	12	142·64	
"	XIV & XIII	24	2·87	12	54·23	
XII	XIII & XIV	24	1·52	12	42·11	
"	XIV & XV	24	1·90	12	173·36	
XV	XII & XIV	24	6·84	12	127·85	
"	XIV & XVI	24	5·22	12	83·58	
"	XVI & X	24	15·18	12	184·83	
XVI	XI & X	24	6·07	12	88·40	
"	X & XV	25	6·37	12	77·57	
"	XV & XIV	24	5·03	12	57·60	
"	XIV & XVIII	24	5·71	12	101·87	

NOTE.—Stations XII, XIII, XIV, XV, XVI, XVII and XVIII appertain to the Singi Meridional Series. R. M. denotes Referring Mark.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
X	XV* & XVI*	26	6·43	12	151·27	Troughton and Simms' 18-inch Theodolite No. 2.
”	XVI* & XI	27	15·55	12	102·93	
”	XI & XII	27	10·76	12	102·00	
XI	XIII & XII	27	11·12	12	43·66	
”	XII & X	27	13·48	12	118·14	
”	X & XVI*	24	5·77	12	157·55	
XII	X & XI	24	8·10	12	137·06	
”	XI & XIII	25	12·73	12	136·86	
”	XIII & XIV	24	6·46	12	70·32	
XIII	XV & XIV	26	13·33	12	112·11	
”	XIV & XII	25	11·02	12	38·98	
”	XII & XI	26	13·66	12	60·68	
XIV	XII & XIII	26	5·56	12	113·90	
”	XIII & XV	28	15·80	12	117·37	
”	XV & XVI	27	9·05	12	128·20	
XV	XVII & XVI	25	3·37	12	95·81	
”	XVI & XIV	27	10·13	12	57·22	
”	XIV & XIII	28	17·41	12	49·36	
XVI	XIV & XV	25	6·07	12	55·47	
”	XV & XVII	24	3·54	12	106·34	
”	XVII & XVIII	26	10·88	12	48·23	
”	XVIII & XIX	26	18·28	12	57·34	
XVII	XX & XVIII	24	6·06	12	92·18	
”	XVIII & XVI	24	11·79	12	191·66	
”	XVI & XV	24	8·13	12	85·51	
XVIII	XVI & XVII	29	10·42	12	47·06	
”	XVI & XVII	24	5·88	12	112·74	
”	XVII & XX	25	11·86	12	216·54	
”	XX & XXI	30	17·44	12	48·28	
”	XXI & XIX	30	17·41	12	74·77	
”	XIX & XVI	28	30·87	12	52·13	
XIX	XVI & XVIII	24	12·22	12	165·98	
”	XVIII & XXI	24	14·91	12	257·41	
XX	XXII & XXI	29	22·71	12	93·91	
”	XXI & XVIII	29	30·84	12	91·09	
”	XVIII & XVII	25	10·24	12	130·47	
XXI	XIX & XVIII	31	62·02	12	179·19	
”	XVIII & XX	29	38·10	12	73·79	
”	XX & XXII	26	21·46	12	104·80	
”	XXII & XXIII	26	27·98	12	110·09	
XXII	XXIV & XXIII	29	27·73	12	112·01	

NOTE.—Stations XV* and XVI* appertain to the Singi Meridional Series.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXII	XXIII & XXI	26	10·54	12	92·64	Troughton and Simms' 18-inch Theodolite No. 2.
„	XXI & XX	25	20·75	12	23·25	
XXIII	XXI & XXII	25	12·04	12	36·10	
„	XXII & XXIV	26	12·40	12	65·87	
„	XXIV & XXV	25	23·61	12	121·60	
XXIV	XXVII & XXVI	27	20·77	12	128·94	
„	XXVI & XXV	24	10·71	12	122·59	
„	XXV & XXIII	26	15·61	12	56·77	
„	XXIII & XXII	27	15·15	12	58·33	
XXV	XXIII & XXIV	28	29·87	12	72·73	
„	XXIV & XXVI	26	22·72	12	144·18	
XXVI	XXV & XXIV	27	30·41	12	74·47	
„	XXIV & XXVII	27	26·47	12	77·57	
„	XXVII & XXVIII	26	23·09	12	143·86	
„	XXVIII & XXIX	26	27·17	12	256·41	
XXVII	XXVIII & XXVI	30	22·36	12	67·32	
„	XXVI & XXIV	28	22·64	12	55·00	
XXVIII	XXX & XXIX	26	26·20	12	105·32	
„	XXIX & XXVI	27	18·37	12	105·64	
„	XXVI & XXVII	28	27·44	12	44·53	
XXIX	XXVI & XXVIII	27	38·30	12	73·68	
„	XXVIII & XXX	29	45·76	12	83·27	
„	XXX & XXXI	27	24·42	12	52·72	
XXX	XXXII & XXXI	26	12·09	12	130·64	
„	XXXI & R.M.	29	46·95	12	145·91	
„	R.M. & XXIX	31	59·23	12	127·67	
„	XXIX & XXVIII	30	25·93	12	129·43	
XXXI	XXIX & XXX	27	28·35	12	79·05	
„	XXX & XXXII	27	29·83	12	107·51	
„	XXXII & XXXIII	26	27·44	12	141·82	
XXXII	XXXIV & XXXIII	25	21·80	12	76·23	
„	XXXIII & XXXI	27	17·89	12	72·69	
„	XXXI & XXX	26	22·25	12	85·75	
XXXIII	XXXI & XXXII	27	17·29	12	100·39	
„	XXXII & XXXIV	29	33·64	12	110·86	
„	XXXIV & XXXV	25	16·59	12	141·69	
XXXIV	XXI* & XXXV	25	14·65	12	64·04	
„	XXXV & XXXIII	26	9·17	12	93·85	
„	XXXIII & XXXII	27	19·55	12	168·86	
XXXV	XXXIII & XXXIV	28	38·77	12	21·61	
„	XXXIV & XXI*	27	17·53	12	162·90	

NOTE.—R. M. denotes Referring Mark. Station XXI* appertains to the Kattywar Meridional Series.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXXV	XXI & XVIII	25	19·87	12	121·55	Troughton and Simms' 18-inch Theodolite No. 2.
XXI	XVIII & XXXV	28	39·61	12	99·45	
,,	XXXV & XXXIV	28	44·68	12	142·20	
XVIII	XXXV & XXI	26	14·96	12	165·82	

Note.—Stations XVIII and XXI appertain to the Kattywar Meridional Series.

From the preceding data of the sums of the squares of the apparent errors, in the measurement of each angle, we may ascertain the *e.m.s.* (error of mean square) *of observation* of a single measure of an angle, and the *e.m.s. of graduation and observation* of the mean of the measures on a single zero, for each group of angles measured with the same instrument, by the same observer, and under similar circumstances.

The instrument employed was Troughton and Simms' 18-inch Theodolite No. 2, having 3 microscopes to read the azimuthal circle; observations were taken on 6 pairs of zeros (*face left* and *face right*), giving circle readings at 10° apart.

The *e.m.s. of observation* of a single measure of an angle $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of observations.}}{\text{No. of observations} - \text{No. of angles} \times \text{No. of changes of zero.}}}$

The *e.m.s. of graduation and observation* of the mean of the measures on a single zero $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of zero.}}{\text{No. of angles} \times (\text{No. of changes of zero} - 1).}}$

Group	Instrument and Observer	Position of stations	Intervals between microscope readings of circle	Number of: Measures on each zero (average)	Number of: Angles	Number of: Single measures	Number of: Single zeros	e. m. s. of observation of a single measure	e. m. s. of graduation and observation of a single zero
			° ′						″
I	Troughton and Simms' 18-inch Theodolite No. 2; Lieutenant C. T. Haig, R.E.	Hills,	10 0	2·01	57	1375	684	$\left\{\frac{271\cdot41}{1375-684}\right\}^{\frac{1}{2}} = \pm\ 0''\cdot627$	$\left\{\frac{5950\cdot09}{684-57}\right\}^{\frac{1}{2}} = \pm\ 3''\cdot081$
II	Troughton and Simms' 18-inch Theodolite No. 2; Captain D. J. Nasmyth.	„	10 0	2·10	8	202	96	$\left\{\frac{73\cdot46}{202-96}\right\}^{\frac{1}{2}} = \pm\ 0\cdot832$	$\left\{\frac{907\cdot59}{96-8}\right\}^{\frac{1}{2}} = \pm\ 3\cdot211$
III	Ditto.	Plains,	10 0	2·14	22	566	264	$\left\{\frac{213\cdot58}{566-264}\right\}^{\frac{1}{2}} = \pm\ 0\cdot841$	$\left\{\frac{2138\cdot09}{264-22}\right\}^{\frac{1}{2}} = \pm\ 2\ 972$
IV	Troughton and Simms' 18-inch Theodolite No. 2; Lieutenant H. Rivers.	„	10 0	2·25	58	1569	696	$\left\{\frac{1446\cdot84}{1569-696}\right\}^{\frac{1}{2}} = \pm\ 1\cdot287$	$\left\{\frac{5973\cdot50}{696-58}\right\}^{\frac{1}{2}} = \pm\ 3\cdot060$

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GUZERAT LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

Figure No. 26.

Observed Angles

No.	°	′	″	Reciprocal Weight
1	92	4	32·03	0·78
2	44	19	28·00	0.75
3	43	36	3·40	0·31
4	64	34	21·58	0·49
5	53	48	39·56	0·66
6	61	37	0.81	0·88
7	92	6	4·46	0·62
8	56	18	58·05	0·54
9	31	34	59·67	1·13
10	47	19	43·23	0·82
11	63	44	56.83	0·51
12	42	19	43·02	0·90
13	55	0	41·73	0·40
14	82	39	38·13	1·01

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = +2·00,$	λ_1
$x_4 + x_5 + x_6 = e_2 = +0·75,$	λ_2
$x_7 + x_8 + x_9 = e_3 = +0·24,$	λ_3
$x_{12} + x_{13} + x_{14} = e_4 = +1·73,$	λ_4
$x_1 + x_4 + x_7 + x_{12} - x_{10} - x_{11} = e_5 = +3·38,$	λ_5
$\left.\begin{array}{l} 22x_3 - 21x_2 + 11x_6 - 15x_5 + 34x_9 \\ -14x_8 + 10x_{11} - 19x_{10} + 3x_{14} - 14x_{13} \end{array}\right\} = e_6 = +23·3,$	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	+ 2·00	+1·84				+0·78	− 8·93
2	+ 0·75		+2·03			+0·49	− 0·22
3	+ 0·24			+2·29		+0·62	+ 30·86
4	+ 1·73		*		+2·31	+0·90	− 2·57
5	+ 3·38					+4·12	+ 10·48
6	+ 23·3						+2582·40

Values of the Factors

$\lambda_1 = +0·9478$

$\lambda_2 = +0·2546$

$\lambda_3 = -0·2063$

$\lambda_4 = +0·5761$

$\lambda_5 = +0·4818$

$\lambda_6 = +0·0134$

Angular errors in seconds

$x_1 = +1·12$	$x_6 = +·36$	$x_{11} = -·17$
$x_2 = +·50$	$x_7 = +·17$	$x_{12} = +·95$
$x_3 = +·38$	$x_8 = -·21$	$x_{13} = +·16$
$x_4 = +·36$	$x_9 = +·28$	$x_{14} = +·62$
$x_5 = +·03$	$x_{10} = -·61$	

$[wx^2] = 4·97$

* 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.

Figure No. 10 of the Singi Meridional Series.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	33	23	1·77	1·11
2	59	3	4·03	0·32
3	47	51	59·93	0·62
4	100	43	59·54	1·32
5	31	24	1·64	0·98
6	53	22	49·33	0·80
7	64	29	33·73	0·64
8	62	7	40·86	0·45
9	76	1	13·37	1·20
10	39	14	14·59	0·78
11	64	44	31·67	0·88
12	46	13	54·90	0·42
13	44	10	25·60	1·38
14	50	59	36·85	2·43
15	38	36	2·35	1·57
16	39	26	7·75	1·68
17	50	58	14·66	0·91
18	43	15	45·02	0·48
19	46	19	54·79	1·51

Equations to be satisfied

Equation	Factor
$x_3 + x_4 + x_5 \ldots \ldots \ldots \ldots = e_1 = +\ 0·23,$	λ_1
$x_6 + x_7 + x_8 \ldots \ldots \ldots \ldots = e_2 = +\ 2·08,$	λ_2
$x_9 + x_{10} + x_{11} \ldots \ldots \ldots \ldots = e_3 = -\ 1·96,$	λ_3
$x_{12} + x_{13} + x_{18} + x_{19} \ldots \ldots \ldots \ldots = e_4 = -\ 0·85,$	λ_4
$x_{14} + x_{15} + x_{16} + x_{17} \ldots \ldots \ldots \ldots = e_5 = +\ 0·11,$	λ_5
$x_{12} + x_{13} + x_{14} + x_{15} \ldots \ldots \ldots \ldots = e_6 = -\ 1·62,$	λ_6
$-x_1 - x_2 + x_3 + x_6 + x_9 + x_{13} + x_{14} \ldots = e_7 = +\ 0·26,$	λ_7
$\left.\begin{matrix} 12x_2 - 32x_1 + 35x_5 + 4x_4 + 11x_8 \\ -10x_7 + 10x_{11} - 26x_{10} + 27x_{15} - 20x_{12} \end{matrix}\right\} \ldots \ldots \ldots = e_8 = +\ 29·2,$	λ_8
$21x_{12} - 22x_{15} + 5x_{16} - 17x_{17} + 23x_{18} + x_{19} \ldots \ldots = e_9 = -\ 3·1,$	λ_9

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
1	+ 0·23	+2·92						+0·62	+ 39·58	...
2	+ 2·08		+1·89					+0·80	− 1·45	...
3	− 1·96			+2·86				+1·20	− 11·48	...
4	− 0·85				+3·79		+1·80	+1·38	− 8·40	+ 21·37
5	+ 0·11					+6·59	+4·00	+2·43	+ 42·39	− 41·61
6	− 1·62				*		+5·80	+3·81	+ 33·99	− 25·72
7	+ 0·26							+7·86	+ 31·68	...
8	+ 29·2								+4450·60	−1108·98
9	− 3·1									+1505·52

Values of the Factors

$\lambda_1 = -\ 0·0560$

$\lambda_2 = +\ 0·9805$

$\lambda_3 = -\ 0·7869$

$\lambda_4 = +\ 0·0519$

$\lambda_5 = +\ 0·3065$

$\lambda_6 = -\ 0·7446$

$\lambda_7 = +\ 0·2934$

$\lambda_8 = +\ 0·0054$

$\lambda_9 = -\ 0·0031$

Angular errors in seconds

$x_1 = -$ ·51	$x_8 = +$ ·47	$x_{15} = -$ ·36
$x_2 = -$ ·07	$x_9 = -$ ·59	$x_{16} = +$ ·49
$x_3 = +$ ·15	$x_{10} = -$ ·72	$x_{17} = +$ ·33
$x_4 = -$ ·05	$x_{11} = -$ ·65	$x_{18} = -$ ·01
$x_5 = +$ ·13	$x_{12} = -$ ·36	$x_{19} = +$ ·07
$x_6 = +$ 1·02	$x_{13} = -$ ·55	
$x_7 = +$ ·59	$x_{14} = -$ ·35	

$[wx^2] = 5·01$

Figure No. 27.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	50	10	36·38	0·26
2	73	19	24·75	1·47
3	56	29	57·54	0·38
4	56	19	1·86	0·44
5	63	32	20·96	0·46
6	60	8	38·68	1·28
7	89	2	6·56	0·59
8	46	43	59·95	1·98
9	44	13	53·63	1·43
10	70	19	44·30	0·39
11	53	34	48·56	0·61
12	56	5	25·24	0·73
13	94	8	29·57	1·66
14	38	5	25·83	1·01
15	47	46	5·34	0·71

Equations to be satisfied

Equations to be satisfied	Factor
$x_1 + x_2 + x_3 = e_1 = -\ 1{\cdot}83,$	λ_1
$x_4 + x_5 + x_6 = e_2 = +\ 0{\cdot}86,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -\ 0{\cdot}69,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = -\ 2{\cdot}69,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = +\ 0{\cdot}06,$	λ_5
$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = -\ 1{\cdot}33,$	λ_6
$\left.\begin{array}{l} 14x_3 - 6x_2 + 12x_6 - 11x_5 + 21x_9 \\ -20x_8 + 14x_{12} - 15x_{11} + 19x_{15} - 27x_{14} \end{array}\right\} = e_7 = +\ 64{\cdot}2,$	λ_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	− 1·83	+2·11					+0·26	− 3·50
2	+ 0·86		+2·18				+0·44	+ 10·30
3	− 0·69			+4·00			+0·59	− 9·57
4	− 2·69				+1·73		+0·39	+ 1·07
5	+ 0·06			*		+3·38	+1·66	− 13·78
6	− 1·33						+3·34	...
7	+64·2							+3062·94

Values of the Factors

$\lambda_1 = -\ 0{\cdot}7935$

$\lambda_2 = +\ 0{\cdot}3645$

$\lambda_3 = -\ 0{\cdot}0758$

$\lambda_4 = -\ 1{\cdot}4939$

$\lambda_5 = +\ 0{\cdot}2607$

$\lambda_6 = -\ 0{\cdot}3262$

$\lambda_7 = +\ 0{\cdot}0203$

Angular errors in seconds

$x_1 = -\ {\cdot}29$	$x_6 = +\ {\cdot}78$	$x_{11} = -\ 1{\cdot}10$
$x_2 = -\ 1{\cdot}34$	$x_7 = -\ {\cdot}24$	$x_{12} = -\ {\cdot}88$
$x_3 = -\ {\cdot}20$	$x_8 = -\ {\cdot}95$	$x_{13} = -\ {\cdot}11$
$x_4 = +\ {\cdot}02$	$x_9 = +\ {\cdot}50$	$x_{14} = -\ {\cdot}29$
$x_5 = +\ {\cdot}06$	$x_{10} = -\ {\cdot}71$	$x_{15} = +\ {\cdot}46$

$[wx^2] = 7{\cdot}59$

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GUZERAT LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
		IX (Karsod)	·79	+ ·25	+ ·03		+ ·28	56 39 45·37	5·0608817,1	115048·70	21·790
31		XIII (Indráwan)	·79	+ ·36	− ·26		+ ·10	39 39 56·66	4·9439919,4	87900·62	16·648
		I (Kaula-ka-Máta)	·80	+ ·29	+ ·23		+ ·52	83 40 17·97	5·1363074,8	136869·74	25·922
			2·38				+ ·90	180 0 0·00			
		XIII (Indráwan)	1·03	+ ·22	− ·32		− ·10	77 9 5·10	5·1578967,9	143845·66	27·243
32		I (Kaula-ka-Máta)	1·02	+ ·11	+ ·19		+ ·30	51 36 29·22	5·0631044,2	115639·02	21·901
		II (Tharkheri)	1·02	+ ·18	+ ·13		+ ·31	51 14 25·68	5·0608817,1	115048·70	21·790
			3·07				+ ·51	180 0 0·00			
		I (Kaula-ka-Máta)	1·26	+ ·29	− ·19		+ ·10	40 39 20·42	5·0487763,3	111886·14	21·191
33		II (Tharkheri)	1·26	+ ·42	− ·12		+ ·30	82 27 20·03	5·2310782,3	170246·52	32·244
		III (Kuwása)	1·26	+ ·25	+ ·31		+ ·56	56 53 19·55	5·1578967,9	143845·66	27·243
			3·78				+ ·96	180 0 0·00			
		II (Tharkheri)	·48	− ·50	− ·33		− ·83	44 19 26·69	4·8933619,5	78227·95	14·816
34		III (Kuwása)	·47	− ·38	+ ·24		− ·14	43 36 2·79	4·8876769,7	77210·60	14·623
		IV (Mehwása)	·48	−1·12	+ ·09		−1·03	92 4 30·52	5·0487763,3	111886·14	21·191
			1·43				−2·00	180 0 0·00			
		III (Kuwása)	·40	− ·03	− ·15		− ·18	53 48 38·98	4·8558964,5	71762·32	13·591
35		IV (Mehwása)	·40	− ·36	− ·05		− ·41	64 34 20·77	4·9047338,5	80303·38	15·209
		VII (Kukinda)	·40	− ·36	+ ·20		− ·16	61 37 0·25	4·8933619,5	78227·95	14·816
			1·20				− ·75	180 0 0·00			

NOTES—1. The values of the sides are given in the same lines with the opposite angles.
2. Stations IX (Karsod) and XIII (Indráwan) appertain to the Khánpisura Meridional Series.

No. of Triangle: Circuit	Non-circuit	Number and Name of Station	Spherical Excess	Corrections to Observed Angle: Figure	Circuit	Non-circuit	Total	Corrected Plane Angle	Distance: Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
		IV (Mehwása)	·65	− ·17	− ·18		− ·35	92 6 3·46	5·1364930,9	136928·26	25·933
36		VII (Kukinda)	·65	+ ·21	− ·22		− ·01	56 18 57·39	5·0569650,9	114015·82	21·594
		VI (Samohi)	·64	− ·28	+ ·40		+ ·12	31 34 59·15	4·8558964,5	71762·32	13·591
			1·94				− ·24	180 0 0·00			
		II (Tharkheri)	·39	− ·62		− ·53	−1·15	82 39 36·59	4·9706777,1	93471·18	17·703
	252	IV (Mehwása)	·38	− ·95		+ ·05	− ·90	42 19 41·74	4·8025094,3	63461·37	12·019
		V (Pípliabán)	·38	− ·16		+ ·48	+ ·32	55 0 41·67	4·8876769,7	77210·60	14·623
			1·15				−1·73	180 0 0·00			
		V (Pípliabán)	·78	+ ·17		− ·91	− ·74	63 44 55·31	5·0569650,8	114015·82	21·594
	253	IV (Mehwása)	·79			+ ·09		68 55 20·81	5·0741647,9	118621·88	22·466
		VI (Samohi)	·78	+ ·61		+ ·82	+1·43	47 19 43·88	4·9706777,1	93471·18	17·703
			2·35					180 0 0·00			
		VII (Kukinda)	·98	+ ·12	− ·04		+ ·08	64 54 6·85	5·1170589,4	130935·96	24·798
37		VI (Samohi)	·98	+ ·10	·00		+ ·10	43 49 50·87	5·0005699,0	100131·31	18·964
		VIII (Kápri)	·98	+ ·07	+ ·04		+ ·11	71 16 2·28	5·1364930,9	136928·26	25·933
			2·94				+ ·29	180 0 0·00			
		VI (Samohi)	·81	− ·32	− ·09		− ·41	56 6 42·48	5·0442618,8	110729·13	20·971
38		VIII (Kápri)	·80	− ·42	− ·06		− ·48	44 53 29·70	4·9737789,8	94141·04	17·830
		IX (Punákot)	·81	− ·30	+ ·15		− ·15	78 59 47·82	5·1170589,4	130935·96	24·798
			2·42				−1·04	180 0 0·00			
		VIII (Kápri)	·83	− ·81	− ·09		− ·90	76 11 52·85	5·1100710,9	128846·05	24·403
39		IX (Punákot)	·82	− ·59	+ ·10		− ·49	47 13 48·61	4·9885433,4	97396·50	18·446
		XIII (Patángri)	·83	− ·48	− ·01		− ·49	56 34 18·54	5·0442618,8	110729·13	20·971
			2·48				−1·88	180 0 0·00			
		IX (Punákot)	·71	+ ·41	− ·12		+ ·29	38 1 58·04	4·9055378,7	80452·20	15·237
40		XIII (Patángri)	·72	+ ·23	− ·13		+ ·10	61 18 57·13	5·0590158,0	114555·46	21·696
		XVII (Bhor)	·72	+ ·20	+ ·25		+ ·45	80 39 4·83	5·1100710,9	128846·05	24·403
			2·15				+ ·84	180 0 0·00			
		XVII (Bhor)	·50	− ·33	+ ·54		+ ·21	50 58 14·37	4·9053978,3	80426·25	15·232
55		XIII (Patángri)	·50	− ·13	− ·29		− ·42	78 2 9·18	5·0055374,9	101283·22	19·182
		XIV (Kágarol)	·50	+ ·35	− ·25		+ ·10	50 59 36·45	4·9055378,7	80452·20	15·237
			1·50				− ·11	180 0 0·00			
		XIV (Kágarol)	·39	+ ·55	− ·59		− ·04	44 10 25·17	4·8491027,1	70648·46	13·380
56		XVII (Bhor)	·38	+ ·01	+ ·57		+ ·58	43 15 45·22	4·8418802,3	69483·26	13·160
		XVIII (Rencha)	·39	+ ·29	+ ·02		+ ·31	92 33 49·61	5·0055374,9	101283·22	19·182
			1·16				+ ·85	180 0 0·00			
		XIII (Patángri)	·32	+ ·51	+ ·29		+ ·80	33 23 2·25	4·7126578,5	51600·97	9·773
54		XIV (Kágarol)	·33		− ·17			87 33 54·10	4·9717078,6	93693·16	17·745
		XII (Játhrábhor)	·33	+ ·07	− ·12		− ·05	59 3 3·65	4·9053978,3	80426·25	15·232
			·98					180 0 0·00			
		XII (Játhrábhor)	·30	+ ·05	+ ·16		+ ·21	100 43 59·45	4·9881430,5	97306·77	18·429
76		XIV (Kágarol)	·29	− ·15	− ·06		− ·21	47 51 59·43	4·8659684,5	73446·06	13·910
		XV (Wardhari)	·29	− ·13	− ·10		− ·23	31 24 1·12	4·7126578,5	51600·97	9·773
			·88				− ·23	180 0 0·00			
		XIV (Kágarol)	·61	−1·02	− ·10		−1·12	53 22 47·60	4·9461984,8	88348·37	16·733
77		XV (Wardhari)	·62	− ·59	+ ·22		− ·37	64 29 32·74	4·9971557,6	99347·23	18·816
		XVI (Ghoráráo)	·61	− ·47	− ·12		− ·59	62 7 39·66	4·9881430,5	97306·77	18·429
			1·84				−2·08	180 0 0·00			

NOTE.—Stations XII (Játhrábhor), XIII (Patángri), XIV (Kágarol), XV (Wardhari), XVI (Ghoráráo), XVII (Bhor) and XVIII (Rencha) appertain to the Singi Meridional Series.

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
	191	XIII (Patángri)	·44	+ ·36		+ ·42	+ ·78	38 36 2·69	4·8418802,4	69483·27	13·160
		XIV (Kágarol)	·44	+ ·90		− ·84	+ ·06	95 10 2·07	5·0450038,4	110918·46	21·007
		XVIII (Rencha)	·44	+ ·36		+ ·42	+ ·78	46 13 55·24	4·9053978,3	80426·25	15·232
			1·32				+1·62	180 0 0·00			
	192	XIV (Kágarol)	·53	+ ·59		+1·17	+1·76	76 1 14·60	5·0277404,7	106595·89	20·189
		XVI (Ghoráráo)	·53	+ ·72		− ·73	− ·01	39 14 14·05	4·8418802,4	69483·26	13·160
		XVIII (Rencha)	·53	+ ·65		− ·44	+ ·21	64 44 31·35	4·9971557,6	99347·23	18·816
			1·59				+1·96	180 0 0·00			
78		XV (Wardhari)	·34	+ ·22	+ ·25		+ ·47	43 8 43·42	4·7848777,0	60936·53	11·541
		XVI (Ghoráráo)	·35	+ ·09	− ·35		− ·26	54 20 24·73	4·8597350,3	72399·41	13·712
		X (Jhiria)	·35	+ ·17	+ ·10		+ ·27	82 30 51·85	4·9461984,8	88348·37	16·733
			1·04				+ ·48	180 0 0·00			
79		XVI (Ghoráráo)	·16	+ ·04	− ·23		− ·19	39 33 22·28	4·5924702,6	39126·43	7·410
		X (Jhiria)	·16	+ ·05	+ ·32		+ ·37	57 46 33·59	4·7157984,3	51975·47	9·844
		XI (Poera)	·16	+ ·08	− ·09		− ·01	82 40 4·13	4·7848777,0	60936·53	11·541
			·48				+ ·17	180 0 0·00			
80		X (Jhiria)	·12	− ·31	+ ·03		− ·28	58 34 13·78	4·6231546,8	41990·85	7·953
		XI (Poera)	·12	− ·36	− ·19		− ·55	68 46 1·60	4·6615318,5	45870·33	8·688
		XII (Rámesri)	·12	− ·42	+ ·16		− ·26	52 39 44·62	4·5924702,6	39126·43	7·410
			·36				−1·09	180 0 0·00			
81		XI (Poera)	·14	+ ·04	− ·26		− ·22	62 51 14·56	4·6749677,7	47311·62	8.961
		XII (Rámesri)	·15	+ ·11	+ ·19		+ ·30	64 58 53·92	4·6828631,7	48179·60	9·125
		XIII (Gohilia)	·14	+ ·05	+ ·07		+ ·12	52 9 51·52	4·6231546,8	41990·85	7·953
			·43				+ ·20	180 0 0·00			
82		XII (Rámesri)	·16	+ ·10	− ·03		+ ·07	63 38 18·84	4·7000919,1	50129·34	9·494
		XIII (Gohilia)	·16	+ ·06	− ·06		·00	58 37 12·39	4·6791010,8	47764·04	9·046
		XIV (Bhagwánji)	·16	+ ·17	+ ·09		+ ·26	57 44 28·77	4·6749677,7	47311·62	8·961
			·48				+ ·33	180 0 0·00			
83		XIII (Gohilia)	·17	+ ·64	− ·35		+ ·29	52 58 48·24	4·6785885,7	47707·71	9·036
		XIV (Bhagwánji)	·18	+ ·67	+ ·16		+ ·83	69 59 24·46	4·7493124,6	56145·18	10·634
		XV (Rundan)	·18	+ ·30	+ ·19		+ ·49	57 1 47·30	4·7000919,1	50129·34	9·494
			·53				+1·61	180 0 0·00			
84		XIV (Bhagwánji)	·15	+ ·09	− ·13		− ·04	51 50 21·81	4·6361358,8	43264·92	8·194
		XV (Rundan)	·15	+ ·04	− ·01		+ ·03	68 2 45·63	4·7078642,0	51034·54	9·656
		XVI (Mirzápur)	·15	+ ·04	+ ·14		+ ·18	60 6 52·56	4·6785885,7	47707·71	9·036
			·45				+ ·17	180 0 0·00			
85		XV (Rundan)	·14	+ ·09	− ·39		− ·30	57 36 31·17	4·6532646,8	45005·41	8·524
		XVI (Mirzápur)	·15	+ ·10	+ ·05		+ ·15	68 7 25·55	4·6942555,6	49460·17	9·367
		XVII (Jhinjhar)	·14	+ ·09	+ ·34		+ ·43	54 16 3·28	4·6361358,8	43264·92	8·194
			·43				+ ·28	180 0 0·00			
86		XVII (Jhinjhar)	·17	+1·34	− ·29		+1·05	73 19 25·63	4·7492281,3	56134·28	10·631
		XVI (Mirzápur)	·17	+ ·20	− ·05		+ ·15	56 29 57·52	4·6889921,8	48864·36	9·255
		XVIII (Wastrál)	·16	+ ·29	+ ·34		+ ·63	50 10 36·85	4·6532646,8	45005·41	8·524
			·50				+1·83	180 0 0·00			
100		XVI (Mirzápur)	·22	− ·06	− ·25		− ·31	63 32 20·43	4·7630074,9	57943·87	10·974
		XVIII (Wastrál)	·21	− ·02	− ·57		− ·59	56 19 1·06	4·7312541,0	53858·48	10·200
		XIX (Sanoda)	·21	− ·78	+ ·82		+ ·04	60 8 38·51	4·7492281,3	56134·28	10·631
			·64				− ·86	180 0 0·00			

Note.—Stations XIII (Patángri), XIV (Kágarol), XV (Wardhari), XVI (Ghoráráo) and XVIII (Rencha) appertain to the Singi Meridional Series.

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
		XIX (Sanoda)	·28	+ ·95	+ ·19		+1·14	46 44 0·81	4·7816622,7	60487·04	11·456
101		XVIII (Wastrál)	·28	+ ·24	− ·50		− ·26	89 2 6·02	4·9193653,3	83054·91	15·730
		XXI (Sola)	·27	− ·50	+ ·31		− ·19	44 13 53·17	4·7630074,9	57943·87	10·974
			·83				+ ·69	180 0 0·00			
		XVIII (Wastrál)	·27	+ ·71	− ·28		+ ·43	70 19 44·46	4·8365117,0	68629·63	12·998
102		XXI (Sola)	·26	+1·10	+ ·43		+1·53	53 34 49·83	4·7682559,1	58648·37	11·108
		XX (Pálri)	·26	+ ·88	− ·15		+ ·73	56 5 25·71	4·7816622,7	60487·04	11·456
			·79				+2·69	180 0 0·00			
		XVII (Jhinjhar)	·23	− ·46		− ·76	−1·22	47 46 3·89	4·7682559,1	58648·37	11·108
	254	XVIII (Wastrál)	·23	+ ·11		+1·01	+1·12	94 8 30·46	4·8976383,3	79002·04	14·963
		XX (Pálri)	·22	+ ·29		− ·25	+ ·04	38 5 25·65	4·6889921,8	48864·36	9·255
			·68				− ·06	180 0 0·00			
		XX (Pálri)	·28	− ·19	− ·15		− ·34	56 33 5·57	4·7936731,5	62183·21	11·777
103		XXI (Sola)	·28	− ·21	+ ·23		+ ·02	56 23 35·66	4·7928781,3	62069·49	11·756
		XXII (Sánand)	·28	− ·05	− ·08		− ·13	67 3 18·77	4·8365117,0	68629·63	12·998
			·84				− ·45	180 0 0·00			
		XXI (Sola)	·22	− ·97	+ ·15		− ·82	64 7 33·77	4·7823269,6	60579·68	11·473
104		XXII (Sánand)	·22	− ·79	− ·39		−1·18	48 25 11·50	4·7021200,4	50363·98	9·539
		XXIII (Hájipur)	·23	− ·32	+ ·24		− ·08	67 27 14·73	4·7936731,5	62183·21	11·777
			·67				−2·08	180 0 0·00			
		XXII (Sánand)	·23	+ ·45	− ·14		+ ·31	78 20 45·17	4·8386539,3	68969·00	13·062
105		XXIII (Hájipur)	·22	+ ·26	+ ·20		+ ·46	42 18 32·65	4·6757992,4	47402·28	8·978
		XXIV (Khoraj)	·22	+ ·23	− ·06		+ ·17	59 20 42·18	4·7823269,6	60579·68	11·473
			·67				+ ·94	180 0 0·00			
		XXIII (Hájipur)	·27	+ ·32	+ ·07		+ ·39	49 56 19·08	4·7518368,3	56472·47	10.696
106		XXIV (Khoraj)	·27	+ ·15	− ·33		− ·18	60 52 43·74	4·8092824,0	64458·82	12·208
		XXV (Wádrora)	·27	+ ·19	+ ·26		+ ·45	69 10 57·18	4·8386539,3	68969·00	13·062
			·81				+ ·66	180 0 0·00			
		XXV (Wádrora)	·22	+ ·36	+ ·09		+ ·45	60 50 12·43	4·7564030,5	57069·36	10·809
107		XXIV (Khoraj)	·22	+ ·31	− ·35		− ·04	59 22 58·40	4·7500681,1	56242·95	10·652
		XXVI (Hasalpur)	·22	+ ·20	+ ·26		+ ·46	59 46 49·17	4·7518368,3	56472·47	10·696
			·66				+ ·87	180 0 0·00			
		XXIV (Khoraj)	·20	+1·03	− ·28		+ ·75	55 48 17·11	4·7209267,0	52592·85	9·961
108		XXVI (Hasalpur)	·21	+ ·64	+ ·32		+ ·96	60 21 36·27	4·7424494,5	55264·91	10·467
		XXVII (Thuleta)	·21	+ ·46	− ·04		+ ·42	63 50 6·62	4·7564030,5	57069·36	10·809
			·62				+2·13	180 0 0·00			
		XXVII (Thuleta)	·18	− ·50	− ·24		− ·74	70 25 36·03	4·7533047,8	56663·68	10·732
109		XXVI (Hasalpur)	·17	−1·05	+ ·29		− ·76	48 35 5·10	4·6541791,4	45100·27	8·542
		XXVIII (Kárigángar)	·18	− ·35	− ·05		− ·40	60 59 18·87	4·7209267,0	52592·85	9·961
			·53				−1·90	180 0 0·00			
		XXVI (Hasalpur)	·28	− ·02	+ ·05		+ ·03	64 8 13·72	4·8343436,4	68287·88	12·933
110		XXVIII (Kárigángar)	·29	− ·01	− ·42		− ·43	67 33 37·46	4·8459827,3	70142·75	13·285
		XXIX (Por)	·28	·00	+ ·37		+ ·37	48 18 8·82	4·7533047,8	56663·68	10·732
			·85				− ·03	180 0 0·00			
		XXVIII (Kárigángar)	·27	+ ·30	− ·24		+ ·06	63 52 40·32	4·8204339,8	66135·40	12·526
111		XXIX (Por)	·26	+ ·25	+ ·25		+ ·50	48 8 17·03	4·7392400,2	54858·00	10·390
		XXX (Ingrori)	·27	+ ·37	− ·01		+ ·36	67 59 2·65	4·8343436,4	68287·88	12·933
			·80				+ ·92	180 0 0·00			

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of 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
			"	"	"	"	"	° ′ ″			
112		XXIX (Por)	·33	− ·23	+ ·01		− ·22	61 5 38·82	4·8498617,0	70772·03	13·404
		XXX (Ingrori)	·34	−1·13	− ·33		−1·46	64 0 52·66	4·8613620,6	72671·16	13·763
		XXXI (Degám)	·33	− ·33	+ ·32		− ·01	54 53 28·52	4·8204339,8	66135·40	12·526
			1·00				−1·69	180 0 0·00			
113		XXX (Ingrori)	·33	+ ·44	− ·27		+ ·17	53 26 0·73	4·8122657,8	64903·15	12·292
		XXXI (Degám)	·33	+ ·37	+ ·18		+ ·55	65 25 39·03	4·8662323,4	73490·69	13·919
		XXXII (Charári)	·33	+ ·29	+ ·09		+ ·38	61 8 20·24	4·8498617,0	70772·03	13·404
			·99				+1·10	180 0 0·00			
114		XXXI (Degám)	·26	− ·79	− ·07		− ·86	49 38 44·05	4·7422734,9	55242·52	10·463
		XXXII (Charári)	·26	− ·41	− ·11		− ·52	66 48 17·97	4·8236836,7	66632·13	12·620
		XXXIII (Dhrángadra)	·26	− ·55	+ ·18		− ·37	63 32 57·98	4·8122657,8	64903·15	12·292
			·78				−1·75	180 0 0·00			
115		XXXII (Charári)	·27	− ·44	− ·25		− ·69	55 15 36·47	4·8023734,9	63441·51	12·015
		XXXIII (Dhrángadra)	·27	− ·63	+ ·08		− ·55	79 3 6·38	4·8796576,3	75797·99	14·356
		XXXIV (Nárechána)	·27	− ·93	+ ·17		− ·76	45 41 17·15	4·7422734,9	55242·52	10·463
			·81				−2·00	180 0 0·00			
116		XXXIII (Dhrángadra)	·25	− ·83	− ·10		− ·93	54 14 57·55	4·7565013,3	57082·28	10·811
		XXXIV (Nárechána)	·25	− ·55	− ·03		− ·58	61 19 52·36	4·7903783,0	61713·23	11·688
		XXXV (Kuária)	·25	− ·16	+ ·13		− ·03	64 25 10·09	4·8023734,9	63441·51	12·015
			·75				−1·54	180 0 0·00			
117		XXXIV (Nárechána)	·18	+ ·65	− ·14		+ ·51	63 34 39·44	4·7397976,8	54928·49	10·403
		XXXV (Kuária)	·18	+1·61	+ ·04		+1·65	47 53 8·07	4·6580045,7	45499·28	8·617
		XXI (Sápakra)	·19	+1·45	+ ·10		+1·55	68 32 12·49	4·7565013,3	57082·28	10·811
			·55				+3·71	180 0 0·00			
118		XXXV (Kuária)	·30	−1·19	− ·16		−1·35	57 2 46·53	4·8434547,1	69735·63	13·208
		XXI (Sápakra)	·30	−1·02	− ·05		−1·07	81 34 55·78	4·9149316,5	82211·33	15·570
		XVIII (Chalarwa)	·30	−1·60	+ ·21		−1·39	41 22 17·69	4·7397976,8	54928·49	10·403
			·90				−3·81	180 0 0·00			

NOTE.—Stations XVIII (Chalarwa) and XXI (Sápakra) appertain to the Kattywar Meridional Series.

May, 1890.

W. H. COLE,
In charge of Computing Office.

GUZERAT LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
5	IX (Karsod)	23 6 46·48	75 28 12·70	37 24 48·90	5·1363074,8	217 19 2·10	XIII (Indráwan)
„	„ „	„	„	94 4 35·06	4·9439919,4	273 58 26·16	I (Kaula-ka-Máta)
6	XIII (Indráwan)	22 48 48·54	75 13 23·78	177 39 4·65	5·0608817,1	357 38 44·93	„ „
„	„ „	„	„	100 29 58·52	5·0631044,2	280 22 6·49	II (Tharkheri)
15	I (Kaula-ka-Máta)	23 7 47·62	75 12 33·27	49 15 15·17	5·1578967,9	229 7 39·79	„ „
„	„ „	„	„	89 54 36·85	5·2310782,3	269 42 40·34	III (Kuwása)
	II (Tharkheri)	22 52 16·07	74 53 7·83	146 40 18·50	5·0487763,3	326 36 1·15	„ „
	„ „	„	„	102 20 51·33	4·8876769,7	282 15 37·44	IV (Mehwása)
	„ „	„	„	19 41 14·35	4·8025094,3	199 39 45·90	V (Pípliabán)
16	III (Kuwása)	23 7 42·04	74 42 9·17	10 12 4·41	4·8933619,5	190 11 6·44	IV (Mehwása)
„	„ „	„	„	64 0 43·79	4·9047338,5	243 55 40·82	VII (Kukinda)
	IV (Mehwása)	22 54 59·11	74 39 40·96	324 35 19·56	4·9706777,1	144 39 3·85	V (Pípliabán)
	„ „	„	„	33 30 41·16	5·0569650,9	213 26 20·87	VI (Samohi)
	„ „	„	„	125 36 45·27	4·8558964,5	305 32 41·47	VII (Kukinda)
	V (Pípliabán)	22 42 23·92	74 49 19·47	80 54 7·76	5·0741647,9	260 46 5·53	VI (Samohi)
	VI (Samohi)	22 39 16·70	74 28 28·85	181 51 21·08	5·1364930,9	1 51 39·51	VII (Kukinda)
	„ „	„	„	138 1 29·23	5·1170589,4	317 55 26·36	VIII (Kápri)
	„ „	„	„	81 54 45·94	4·9737789,8	261 48 23·01	IX (Punákot)
17	VII (Kukinda)	23 1 52·85	74 29 16·32	66 45 47·34	5·0005699,0	246 39 23·10	VIII (Kápri)
18	VIII (Kápri)	22 55 20·54	74 12 52·00	2 48 56·86	5·0442618,8	182 48 34·38	IX (Punákot)

Note.—Stations IX (Karsod) and XIII (Indráwan) appertain to the Khánpisura Meridional Series.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
18	VIII (Kápri)	22 55 20·54	74 12 52·00	79 0 50·54	4·9885433,4	258 54 12·72	XIII (Patángri)
	IX (Punákot)	22 37 4·60	74 11 53·94	135 34 44·95	5·1100710,9	315 28 32·09	„ „
	„ „	„	„	97 32 46·20	5·0590158,0	277 24 59·46	XVII (Bhor)
	XIII (Patángri)	22 52 15·70	73 55 49·52	128 12 42·19	4·9717078,6	308 7 34·84	XII (Játhrábhor)
	„ „	„	„	94 49 39·62	4·9053978,3	274 44 6·35	XIV (Kágarol)
	„ „	„	„	16 47 29·94	4·9055378,7	196 45 53·91	XVII (Bhor)
	„ „	„	„	56 13 36·49	5·0450038,4	236 7 15·09	XVIII (Rencha)
	XVII (Bhor)	22 39 32·41	73 51 41·35	145 47 39·04	5·0055374,9	325 43 43·30	XIV (Kágarol)
	„ „	„	„	102 31 53·44	4·8491027,1	282 27 9·41	XVIII (Rencha)
26	XIV (Kágarol)	22 53 22·13	73 41 32·37	187 10 11·92	4·7126578,5	7 10 38·82	XII (Játhrábhor)
„	„ „	„	„	139 18 12·20	4·9881430,5	319 13 46·74	XV (Wardhari)
„	„ „	„	„	85 55 23·99	4·9971557,6	265 48 31·98	XVI (Ghoráráo)
„	„ „	„	„	9 54 8·86	4·8418802,3	189 53 19·41	XVIII (Rencha)
27	XVIII (Rencha)	22 42 3·84	73 39 24·74	125 8 47·53	5·0277404,7	305 2 46·56	XVI (Ghoráráo)
25	XII (Játhrábhor)	23 1 49·45	73 42 41·32	107 54 38·57	4·8659684,5	287 49 45·33	XV (Wardhari)
36	XV (Wardhari)	23 5 32·78	73 30 12·73	23 43 20·10	4·9461984,8	203 40 51·71	XVI (Ghoráráo)
„	„ „	„	„	66 52 3·86	4·8597350,3	246 47 24·76	X (Jhiria)
	XVI (Ghoráráo)	22 52 11·17	73 23 52·63	149 20 26·63	4·7848777,0	329 18 16·96	„ „
	„ „	„	„	109 47 4·19	4·7157984,3	289 43 40·65	XI (Poera)
37	X (Jhiria)	23 0 50·50	73 18 19·98	27 4 50·71	4·5924702,6	207 3 36·36	„ „
„	„ „	„	„	85 39 4·61	4·6615318,5	265 35 53·23	XII (Rámesri)
	XI (Poera)	22 55 5·26	73 15 9·43	138 17 34·64	4·6231546,8	318 15 37·97	„ „
	„ „	„	„	75 26 19·94	4·6828631,7	255 23 5·86	XIII (Gohilia)
38	XII (Rámesri)	23 0 15·82	73 10 10·37	23 14 32·04	4·6749677,7	203 13 14·20	„ „
„	„ „	„	„	86 52 51·04	4·6791010,8	266 49 31·56	XIV (Bhagwánji)
	XIII (Gohilia)	22 53 5·01	73 6 50·69	144 36 1·65	4·7000919,1	324 34 0·49	„ „
	„ „	„	„	91 37 13·24	4·7493124,6	271 33 19·79	XV (Rundan)
39	XIV (Bhagwánji)	22 59 49·84	73 1 39·86	34 33 25·13	4·6785885,7	214 31 32·31	„ „
„	„ „	„	„	86 23 47·09	4·7078642,0	266 20 14·15	XVI (Mirzápur)
	XV (Rundan)	22 53 20·43	72 56 50·43	146 28 46·53	4·6361358,8	326 27 6·86	„ „
	„ „	„	„	88 52 15·22	4·6942555,6	268 48 49·52	XVII (Jhinjhar)
	XVI (Mirzápur)	22 59 17·79	72 52 34·70	34 34 32·56	4·6532646,8	214 32 46·10	„ „
	„ „	„	„	91 4 30·25	4·7492281,3	271 0 35·62	XVIII (Wastrál)
	„ „	„	„	154 36 50·89	4·7312541,0	334 35 14·01	XIX (Sanoda)
	XVII (Jhinjhar)	22 53 10·53	72 48 1·54	141 13 20·30	4·6889921,8	321 11 12·63	XVIII (Wastrál)
	„ „	„	„	93 27 16·18	4·8976383,4	273 21 48·05	XX (Pálri)
	XVIII (Wastrál)	22 59 27·91	72 42 33·97	214 41 34·35	4·7630074,9	34 43 52·73	XIX (Sanoda)
	„ „	„	„	55 19 43·32	4·7682559,1	235 16 22·18	XX (Pálri)
	„ „	„	„	125 39 28·05	4·7816622,7	305 36 2·02	XXI (Sola)
46	XIX (Sanoda)	23 7 19·89	72 48 27·32	81 27 53·82	4·9193653,3	261 22 8·58	„ „

Note.—Stations XII (Játhrábhor), XIII (Patángri), XIV (Kágarol), XV (Wardhari), XVI (Ghoráráo), XVII (Bhor) and XVIII (Rencha) appertain to the Singi Meridional Series.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	XX (Pálri)	22 53 57·07	72 33 58·04	179 10 56·21	4·8365117,0	359 10 52·11	XXI (Sola)
	” ”	”	”	122 37 50·36	4·7928781,3	302 34 12·24	XXII (Sánand)
47	XXI (Sola)	23 5 17·06	72 33 47·55	55 34 28·05	4·7936731,5	235 30 53·19	” ”
”	” ”	”	”	119 42 2·04	4·7021200,4	299 38 57·94	XXIII (Hájipur)
	XXII (Sánand)	22 59 28·45	72 24 38·54	187 5 41·47	4·7823269,6	7 6 12·90	” ”
	” ”	”	”	108 44 56·07	4·6757992,4	288 41 48·19	XXIV (Khoraj)
48	XXIII (Hájipur)	23 9 24·14	72 25 58·72	49 24 45·77	4·8386539,3	229 21 5·79	” ”
”	” ”	”	”	99 21 5·12	4·8092824,0	279 16 36·86	XXV (Wádrora)
	XXIV (Khoraj)	23 1 59·23	72 16 37·94	168 28 21·78	4·7518368,3	348 27 34·31	” ”
	” ”	”	”	109 5 23·16	4·7564030,5	289 1 36·92	XXVI (Hasalpur)
	” ”	”	”	53 17 5·85	4·7424494,5	233 14 0·75	XXVII (Thuleta)
49	XXV (Wádrora)	23 11 7·51	72 14 36·97	49 17 46·96	4·7500681,1	229 14 47·53	XXVI (Hasalpur)
50	XXVI (Hasalpur)	23 5 3·88	72 7 0·29	349 23 13·40	4·7209267,0	169 23 53·92	XXVII (Thuleta)
”	” ”	”	”	37 58 18·67	4·7533047,8	217 55 52·76	XXVIII (Kárigángar)
”	” ”	”	”	102 6 32·67	4·8459827,3	282 1 44·33	XXIX (Por)
	XXVII (Thuleta)	22 56 31·64	72 8 43·93	98 58 17·71	4·6541791,4	278 55 11·81	XXVIII (Kárigángar)
	XXVIII (Kárigángar)	22 57 41·13	72 0 47·20	150 22 15·01	4·8343436,4	330 19 53·43	XXIX (Por)
	” ”	”	”	86 29 34·42	4·7392400,2	266 25 45·90	XXX (Ingrori)
51	XXIX (Por)	23 7 29·21	71 54 45·49	18 28 10·72	4·8204339,8	198 26 42·98	” ”
”	” ”	”	”	79 33 49·87	4·8613620,6	259 28 49·44	XXXI (Degám)
	XXX (Ingrori)	22 57 7·58	71 51 1·30	134 25 49·98	4·8498617,0	314 22 18·29	” ”
	” ”	”	”	80 59 48·92	4·8662323,4	260 54 46·31	XXXII (Charári)
52	XXXI (Degám)	23 5 18·25	71 41 59·97	19 47 57·65	4·8122657,8	199 46 25·74	” ”
”	” ”	”	”	69 26 41·96	4·8236836,7	249 22 20·37	XXXIII (Dhrángadra)
	XXXII (Charári)	22 55 13·09	71 38 4·78	132 58 7·51	4·7422734,9	312 55 18·61	” ”
	” ”	”	”	77 42 30·77	4·8796576,3	257 37 22·59	XXXIV (Nárechána)
53	XXXIII (Dhrángadra)	23 1 26·04	71 30 52·01	31 58 25·26	4·8023734,9	211 56 5·17	” ”
”	” ”	”	”	86 13 23·06	4·7903783,0	266 9 5·29	XXXV (Kuária)
	XXXIV (Nárechána)	22 52 32·65	71 24 52·74	150 36 12·56	4·7565013,3	330 34 15·63	” ”
	” ”	”	”	87 1 32·94	4·6580045,7	266 58 24·07	XXI (Sápakra)
54	XXXV (Kuária)	23 0 45·38	71 19 52·79	75 30 10·71	4·9149316,5	255 24 38·13	XVIII (Chalarwa)
”	” ”	”	”	18 27 23·88	4·7397976,8	198 26 11·39	XXI (Sápakra)
55	XVIII (Chalarwa)	22 57 20·81	71 5 41·08	296 46 56·12	4·8434547,1	116 51 15·31	” ”
	XXI (Sápakra)	22 52 9·05	71 16 46·83				

NOTE.—Stations XVIII (Chalarwa) and XXI (Sápakra) appertain to the Kattywar Meridional Series.

May, 1890.

W. H. COLE,
In charge of Computing Office.

GUZERAT 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 levelling operations, wherever a junction between the two has been effected. The spirit levelled determinations are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the levelling operations are adjusted by simple proportion to accord with the latter. In the table the spirit levelled values are printed thus, **309·77**, &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. X, page 60—$_{K.}$, to indicate that one set of adjustments ends and another begins. The trigonometrical heights always refer to the upper mark or to the upper surface of the pillar or structure on which the theodolite stood. Descriptions follow this table, exactly indicating the surfaces on which the levelling staff stood during the determinations of the spirit levelled 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 the ground level mark-stone in the floor of the passage; otherwise, it is the approximate height of the structure above the ground at the base of the station.

The heights of the fixed stations above Mean Sea Level are as follows:—

IX (Karsod) 1780·6 feet } From the Khánpisura Meridional Series.
XIII (Indráwan) 1833·9 „ }

XVIII (Chalarwa) 218 feet } From the Kattywar Meridional Series.
XXI (Sápakra) 313 „ }

Astronomical Date 1862	Mean of Times of observation	Number and Name of 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. 19	2 57	IX (Karsod)	D 0 0 30·2	4	2·7	5·1	866	44	·051	+155·4	1936·0	1935·8	1936	5·9
„ 20,21	2 54	I (Kaula-ka-Máta)	D 0 12 39·1	8	2·7	5·1								
„ 8	2 25	II (Tharkheri)	D 0 6 0·7	4	2·6	5·1	1421	76	·053	+193·5	1935·6			
„ 20,21	2 45	I (Kaula-ka-Máta)	D 0 15 15·4	8	2·6	5·1								

NOTE.—Station IX (Karsod) appertains to the Khánpisura Meridional Series.

Astronomical Date 1862	Mean of Times of observation	Number and Name of 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. 12, 14, 15, 17	2 42	XIII (Indráwan)	D 0 11 36·7	16	2·6	2·5	1140	37	·032	− 91·8	1742·1			
" 8	3 19	II (Tharkheri)	D 0 6 19·0	4	*0·1	5·1						1742·3	1742	4·8
" 20,21	2 45	I (Kaula-ka-Máta)	D 0 15 15·4	8	2·6	5·1	1421	76	·053	−193·5	1742·5			
" 8	2 25	II (Tharkheri)	D 0 6 0·7	4	2·6	5·1								
" 20,21	2 34	I (Kaula-ka-Máta)	D 0 18 52·2	8	2·6	5·1	1677	96	·057	−319·1	1616·7			
" 3,4	2 49	III (Kuwása)	D 0 5 59·0	8	2·6	5·1						1618·9	1618	5
" 8	2 34	II (Tharkheri)	D 0 11 58·6	4	2·7	5·1	1107	63	·057	−121·3	1621·0			
" 3,4	2 41	III (Kuwása)	D 0 4 31·5	8	2·6	5·1								
" 8	2 47	II (Tharkheri)	D 0 21 47·4	4	2·8	5·1	761	38	·049	−358·7	1383·6			
" 6	2 20	IV (Mehwása)	E 0 10 8·5	4	2·6	5·2						1383·0	1382	2·4
" 3,4	2 31	III (Kuwása)	D 0 16 14·7	8	2·6	5·1	775	43	·056	−236·6	1382·3			
" 5	3 0	IV (Mehwása)	E 0 4 33·1	4	2·7	5·2								
" 7,8	2 54	II (Tharkheri)	D 0 2 49·1	8	2·6	5·2	628	12	·019	+ 43·6	1785·9			
" 10	2 23	V (Pípliabán)	D 0 7 32·3	4	2·6	5·1						1784·5	1784	5
" 6	2 31	IV (Mehwása)	E 0 7 40·6	4	2·6	5·2	924	46	·050	+400·1	1783·1			
" 10	2 34	V (Pípliabán)	D 0 21 44·6	4	2·8	5·2								
" 6	2 41	IV (Mehwása)	E 0 2 33·1	4	2·5	5·2	1128	68	·060	+361·6	1744·6			
Jan. 27,28	2 49	VI (Samohi)	D 0 19 14·7	8	2·6	5·1								
Feb. 10	2 50	V (Pípliabán)	D 0 9 45·6	4	2·5	5·2	1169	71	·061	− 38·7	1745·8	1745·2	1744	5·5
Jan. 27,28	2 56	VI (Samohi)	D 0 7 30·8	8	2·6	5·1								
" 30,31	2 55	VII (Kukinda)	D 0 5 20·9	8	2·5	5·1	1357	87	·064	+182·0	1745·3			
" 27,28	2 42	VI (Samohi)	D 0 14 29·1	8	2·6	5·1								
Feb. 3,4	2 21	III (Kuwása)	D 0 8 22·6	8	2·7	5·1	792	42	·053	− 55·4	1563·5			
Jan. 30,31	2 21	VII (Kukinda)	D 0 3 38·3	8	2·6	5·1								
Feb. 5	2 48	IV (Mehwása)	E 0 3 15·9	4	2·7	5·2	708	40	·056	+180·1	1563·1	1563·3	1562	5
Jan. 30,31	2 33	VII (Kukinda)	D 0 13 59·5	8	2·6	5·1								
" 27,28	2 42	VI (Samohi)	D 0 14 29·1	8	2·6	5·1	1357	87	·064	−182·0	1563·2			
" 30,31	2 55	VII (Kukinda)	D 0 5 20·9	8	2·5	5·1								
" 27,28	2 30	VI (Samohi)	D 0 22 46·9	8	2·7	5·1	1294	77	·060	−503·6	1241·6			
" 20,23	2 49	VIII (Kápri)	E 0 3 39·2	8	2·5	5·1						1240·4	1239	5
" 30,31	2 44	VII (Kukinda)	D 0 18 28·4	8	2·7	5·1	987	58	·059	−324·2	1239·1			
" 22,23	2 54	VIII (Kápri)	E 0 3 46·7	8	2·5	5·1								
" 27	2 17	VI (Samohi)	D 0 6 50·5	4	2·6	5·1	928	49	·053	+ 4·6	1749·8			
" 16,17	2 55	IX (Punákot)	D 0 7 10·8	8	2·5	5·1						1749·8	1748	5·1
" 20	2 29	VIII (Kápri)	E 0 7 23·6	4	2·7	5·1	1097	48	·044	+509·3	1749·7			
" 16,17	2 41	IX (Punákot)	D 0 24 13·8	8	2·6	5·1								

NOTE.—Station XIII (Indráwan) appertains to the Khánpisura Meridional Series.
* This height is to be combined with negative sign on account of change in the height of the pillar at Station XIII (Indráwan).

Astronomical Date 1861-62	Mean of Times of observation	Number and Name of 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. 20,21	2 25	VIII (Kápri)	D 0 18 34·4	8	2·8	5·1	960	45	·047	−318·5	921·9			
Dec. 24, Jan. 10	2 42	XIII (Patángri)	E 0 3 54·2	8	2·6	5·2						923·7	922	2
Jan. 16,17	2 30	IX (Punákot)	D 0 31 22·7	8	2·8	5·1	1273	77	·061	−824·4	925·4			
„ 10	2 22	XIII (Patángri)	E 0 12 36·3	4	2·6	5·2								
„ 16,17	2 17	IX (Punákot)	D 0 29 30·1	8	2·6	5·1	1129	74	·065	−708·0	1041·8			
„ 12	2 19	XVII (Bhor)	E 0 12 59·4	4	2·6	5·1						1039·4	1037	*
1860-61 Jan. 5,6	2 24	XIII (Patángri)	D 0 1 6·5	8	2·7	5·2	797	48	·060	+113·2	1036·9			
„ 20	2 25	XVII (Bhor)	D 0 10 47·3	4	2·6	5·1								
„ 5,6	2 41	XIII (Patángri)	D 0 20 1·2	8	2·6	5·2	792	41	·052	−327·4	596·3			
„ 2	2 21	XIV (Kágarol)	E 0 7 58·0	4	2·6	5·1								
Dec. 14,15	2 50	XVII (Bhor)	D 0 22 26·0	8	2·7	5·1	1002	59	·059	−441·4	598·0	597·0	595	5
„ 21,27	2 38	XIV (Kágarol)	E 0 7 31·6	8	2·7	5·1								
Jan. 19	2 20	XVIII (Rencha)	D 0 2 42·1	4	2·7	5·1	688	33	·048	+ 52·7	596·6			
„ 2	2 36	XIV (Kágarol)	D 0 7 55·1	4	2·7	5·1								
„ 5,6	2 39	XIII (Patángri)	D 0 20 2·9	8	2·7	5·2	1095	52	·048	−378·2	545·5			
„ 19	2 31	XVIII (Rencha)	E 0 3 23·6	4	2·6	5·1								
Dec. 14,15	2 41	XVII (Bhor)	D 0 29 23·7	8	2·6	5·1	696	44	·063	−497·2	542·2	544·1	542	5
„ 10,11	2 32	XVIII (Rencha)	E 0 19 0·1	8	2·8	5·1								
Jan. 2	2 36	XIV (Kágarol)	D 0 7 55·1	4	2·7	5·1	688	33	·048	− 52·7	544·5			
„ 19	2 20	XVIII (Rencha)	D 0 2 42·1	4	2·7	5·1								
„ 5,6	2 46	XIII (Patángri)	D 0 11 23·3	8	2·6	5·2	925	57	·062	−123·7	800·0			
„ 15	2 22	XII (Játhrábhor)	D 0 2 18·3	4	2·6	5·1						800·6	798	5
Dec. 21,27	2 33	XIV (Kágarol)	E 0 9 37·3	8	2·6	5·1	511	27	·052	+204·2	801·2			
„ 19,20	2 30	XII (Játhrábhor)	D 0 17 35·4	8	2·6	5·2								
„ 21,27	2 35	XIV (Kágarol)	D 0 8 29·8	8	2·8	5·1	962	58	·060	− 38·7	558·3			
Nov. 30, Dec. 1	2 45	XV (Wardhari)	D 0 5 46·2	8	2·7	5·2								
Dec. 19,20	2 41	XII (Játhrábhor)	D 0 16 47·7	8	2·8	5·2	724	46	·063	−243·8	556·8	558·3	556	5·8
„ 1	2 38	XV (Wardhari)	E 0 6 1·1	4	2·6	5·2								
„ 3,4	2 7	XVI (Ghoráráo)	E 0 2 31·2	8	2·8	5·1	875	49	·056	+233·5	559·8			
„ 1	2 12	XV (Wardhari)	D 0 15 39·6	4	2·6	5·2								
„ 21,27,28	2 28	XIV (Kágarol)	D 0 16 42·8	12	2·7	5·1	979	54	·055	−270·9	326·1			
„ 3,4	2 20	XVI (Ghoráráo)	E 0 2 2·2	8	2·7	5·1								
„ 12	2 42	XVIII (Rencha)	D 0 14 54·5	4	2·7	5·1	1052	58	·055	−217·7	326·4	325·5	323	5
„ 31	2 25	XVI (Ghoráráo)	D 0 0 52·0	4	2·7	5·1								
„ 1	2 12	XV (Wardhari)	D 0 15 39·6	4	2·6	5·2	875	49	·056	−233·5	324·1			
„ 3,4	2 7	XVI (Ghoráráo)	E 0 2 31·2	8	2·8	5·1								

NOTE.—Stations XII (Játhrábhor), XIII (Patángri), XIV (Kágarol), XV (Wardhari), XVI (Ghoráráo), XVII (Bhor), and XVIII (Rencha) appertain to the Singi Meridional Series. * See description of this station, page 5—K.

Astronomical Date 1860	Mean of Times of observation	Number and Name of 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. 30, Dec. 1	2 27	XV (Wardhari)	D 0 10 32·0	8	2·5	5·2	714	41	·057	−108·2	450·1			
1858-59 Jan. 3,4,5	2 10	X (Jhiria)	D 0 0 16·3	14	2·6	5·6						449·8	447	6
„ 14,15,16	2 4	XVI (Ghoráráo)	E 0 2 17·8	12	2·6	5·6	603	30	·050	+123·9	449·4			
„ 4,5	2 24	X (Jhiria)	D 0 11 40·4	10	2·6	5·6								
„ 14,15,16	2 10	XVI (Ghoráráo)	D 0 4 54·3	12	2·6	5·6	512	23	·045	− 12·4	313·1			
„ 18,19,20	1 57	XI (Poera)	D 0 3 15·8	12	2·6	5·6						313·0	309·77	30·8
„ 3,4,5	2 20	X (Jhiria)	D 0 15 15·9	12	2·6	5·6	387	16	·040	−137·0	312·8			
„ 18,19,20	2 5	XI (Poera)	E 0 8 48·0	12	2·6	5·6								
„ 3,4,5	2 23	X (Jhiria)	D 0 12 42·6	16	2·6	5·6	452	16	·035	−112·9	333·9			
„ 21,22,24	2 16	XII (Rámesri)	E 0 4 12·2	14	2·6	5·6						336·5	336	30·8
„ 24	8 43	XI (Poera)	E 0 2 58·0	4	1·4	4·9	415	259	·611	+ 29·2	339·0			
„ 24	8 43	XII (Rámesri)	D 0 1 4·6	4	11·2	5·6								
„ 22,23	*	XI (Poera)	D 0 5 23·1	14	8·8	4·9	475	159	·334	− 61·0	248·8			
„ 22,23	*	XIII (Gohilia)	E 0 3 32·5	14	11·9	4·9						249·6	249	24·2
„ 21,22,24	2 32	XII (Rámesri)	D 0 9 52·4	16	9·5	5·6	468	0	·000	− 86·1	250·4			
„ 7,8	2 22	XIII (Gohilia)	E 0 2 8·3	10	2·6	5·6								
„ 21,22,24	2 16	XII (Rámesri)	D 0 9 41·7	12	2·6	5·6	471	10	·022	− 79·6	256·9			
Dec. 27,28	2 33	XIV (Bhagwánji)	E 0 1 45·5	10	2·6	5·6						255·9	255	23·1
Jan. 7,8	2 4	XIII (Gohilia)	D 0 3 53·9	8	2·6	5·6	496	4	·009	+ 5·3	254·9			
Dec. 27,28	2 12	XIV (Bhagwánji)	D 0 4 37·9	10	2·6	5·6								
Jan. 7,8	2 20	XIII (Gohilia)	D 0 8 11·8	10	2·6	5·6	553	8	·015	− 53·2	196·4			
Dec. 18,20	2 19	XV (Rundan)	D 0 1 40·4	8	2·6	5·6						197·4	196	23·0
„ 27,28	2 33	XIV (Bhagwánji)	D 0 8 12·3	8	2·6	5·6	472	6	·012	− 57·5	198·4			
„ 18,20	2 12	XV (Rundan)	E 0 0 5·4	12	2·6	5·6								
„ 27,28	2 14	XIV (Bhagwánji)	D 0 5 16·6	8	2·6	5·6	503	16	·033	− 17·1	238·8			
„ 22,23	2 14	XVI (Mirzápur)	D 0 2 57·9	8	2·6	5·6						239·1	238	18
„ 18,20	2 23	XV (Rundan)	D 0 0 15·2	8	2·7	5·6	428	12	·029	+ 42·0	239·4			
„ 22,23	2 14	XVI (Mirzápur)	D 0 6 55·9	8	2·6	5·6								
„ 18,20	2 31	XV (Rundan)	D 0 2 47·4	8	2·6	5·6	487	18	·037	+ 16·9	214·3			
„ 15,16	2 24	XVII (Jhinjhar)	D 0 5 8·2	10	2·7	5·6						214·5	213·00	10·0
„ 22,23	2 28	XVI (Mirzápur)	D 0 5 28·2	10	2·6	5·6	445	20	·045	− 24·4	214·7			
„ 15,16	2 24	XVII (Jhinjhar)	D 0 1 44·5	8	2·6	5·6								
1852 Feb. 28	3 28	XVI (Mirzápur)	D 0 4 48·3	6	4·1	5·5	553	16	·029	− 6·2	232·9			
„ 25	3 15	XVIII (Wastrál)	D 0 4 3·9	6	3·7	5·4						232·1	229·48	7
1858-59 Dec. 16	2 44	XVII (Jhinjhar)	D 0 2 40·7	4	2·7	5·6	483	22	·046	+ 16·8	231·3			
„ 24, Jan. 11	2 16	XVIII (Wastrál)	D 0 5 2·6	8	2·6	5·6								

NOTE.—Stations XV (Wardhari) and XVI (Ghoráráo) appertain to the Singi Meridional Series. * Observations taken at 18h 44m of 22nd and at 6h 12m of 23rd January 1859.

Astronomical Date 1852		Mean of Times of observation	Number and Name of 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.	23	3 6	XVI (Mirzápur)	D 0 3 26·1	4	3·8	5·5	533	14	·027	+ 13·7	251·4			
„	17	3 18	XIX (Sanoda)	D 0 5 10·4	4	3·8	5·4						250·4	250	*
„	25	3 4	XVIII (Wastrál)	D 0 3 34·1	4	3·8	5·4	573	7	·013	+ 19·9	249·4			
„	17	3 27	XIX (Sanoda)	D 0 5 51·5	4	5·0	5·4								
„	28	3 14	XVIII (Wastrál)	D 0 4 0·7	6	4·1	5·4	597	17	·029	+ 13·2	242·7	242·7	242·06	25
Mar.	4	3 22	XXI (Sola)	D 0 5 32·3	6	3·8	5·5								
„	4	3 42	XXI (Sola)	D 0 9 17·8	6	3·8	5·5	614	12	·019	− 77·5	164·6	164·6	163·66	12
„	9	3 35	XXII (Sánand)	D 0 0 43·4	6	3·9	5·4								
Feb.	25	3 33	XVIII (Wastrál)	D 0 5 52·4	6	3·8	5·4	579	15	·026	− 20·6	208·9			
Mar.	1	3 57	XX (Pálri)	D 0 3 28·1	6	3·7	5·4								
1858															
Dec.	15,16	2 41	XVII (Jhinjhar)	D 0 6 11·9	10	2·7	5·6	778	36	·046	− 4·0	209·0			
„	18	2 44	XX (Pálri)	D 0 5 50·8	6	2·7	5·6						208·5	208	6
1852															
Mar.	4	3 8	XXI (Sola)	D 0 7 2·1	6	3·8	5·5	680	24	·035	− 33·7	208·4			
„	1	3 46	XX (Pálri)	D 0 3 38·7	4	4·1	5·4								
(1)		3 31	XXII (Sánand)	D 0 2 31·5	16	3·8	5·4	613	14	·024	+ 43·8	207·5			
(2)		3 9	XX (Pálri)	D 0 7 22·9	10	3·8	5·4								
Mar.	9	4 8	XXII (Sánand)	D 0 6 6·2	6	3·8	5·4	467	7	·014	− 30·3	133·4	133·4	132·11	18
„	17	3 11	XXIV (Khoraj)	D 0 1 42·1	6	3·8	5·4								
„	17	4 9	XXIV (Khoraj)	D 0 5 10·4	4	†1·1	5·4	563	−14	·024	+ 2·3	134·4	134·4	133·27	21
May	1	4 56	XXVI (Hasalpur)	D 0 5 9·6	6	3·7	5·4								
Mar.	8	3 36	XXI (Sola)	D 0 2 46·5	6	3·9	5·5	497	17	·034	+ 17·4	259·5			
„	11	3 1	XXIII (Hájipur)	D 0 5 9·4	4	3·8	5·4								
„	9	3 56	XXII (Sánand)	E 0 0 44·6	4	3·9	5·4	600	21	·035	+ 96·6	260·3	259·1	259	5
„	11	3 25	XXIII (Hájipur)	D 0 10 13·7	4	3·8	5·4								
„	17	3 25	XXIV (Khoraj)	E 0 0 27·5	4	3·7	5·4	681	− 2	·002	+125·4	257·5			
„	11	3 13	XXIII (Hájipur)	D 0 12 1·9	6	3·8	5·4								
„	11	4 16	XXIII (Hájipur)	D 0 10 25·4	4	3·9	5·4	635	17	·026	− 99·8	159·3			
„	15	3 27	XXV (Wádrora)	E 0 0 42·4	4	12·9	5·4								
„	17	4 16	XXIV (Khoraj)	D 0 3 20·4	4	6·9	5·4	559	−12	·022	+ 23·6	155·7	158·1	158	12
„	15	4 17	XXV (Wádrora)	D 0 6 23·9	4	3·8	5·4								
May	1	4 46	XXVI (Hasalpur)	D 0 3 24·4	4	3·8	5·4	556	−16	·028	+ 25·9	159·2			
Mar.	15	3 49	XXV (Wádrora)	D 0 6 52·3	6	†1·1	5·4								
„	17	3 46	XXIV (Khoraj)	D 0 7 17·1	4	3·8	5·4	546	−28	·050	− 35·0	97·1			
„	27	3 14	XXVII (Thuleta)	D 0 2 55·8	6	3·8	5·4								
May	8	5 3	XXVI (Hasalpur)	D 0 6 38·4	6	3·8	5·4	521	− 3	·005	− 32·9	100·4	101·0	101	16
Mar.	27	3 25	XXVII (Thuleta)	D 0 2 13·2	4	5·6	5·4								

* Not forthcoming. (1) The mean of observations taken on 9th March, 1852, and 12th February, 1854. (2) The mean of observations taken on 2nd March, 1852, and 9th February, 1854. † These heights are to be combined with negative signs on account of change in the height of the pillar at Station XXVI (Hasalpur).

Astronomical Date 1852		Mean of Times of observation	Number and Name of 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 1	XXVIII (Kárigángar)	D 0 2 37·2	4	9·9	5·5	444	−21	·048	+ 14·5	102·7			
„	27	3 47	XXVII (Thuleta)	D 0 4 49·6	6	9·9	5·4								
May	4	5 17	XXVI (Hasalpur)	D 0 7 35·5	6	3·9	5·4	560	−11	·020	− 43·5	89·8			
Mar.	30	3 56	XXVIII (Kárigángar)	D 0 2 38·0	4	*1·3	5·5								
Apr.	9	4 36	XXX (Ingrori)	D 0 7 43·0	4	3·8	§13·0	541	−10	·019	− 65·3	86·5	86·9	87	12
Mar.	30	3 18	XXVIII (Kárigángar)	D 0 1 50·3	6	§14·5	5·5								
„	27	3 47	XXVII (Thuleta)	D 0 4 49·6	6	9·9	5·4	444	−21	·048	− 14·5	84·3			
„	30	4 1	XXVIII (Kárigángar)	D 0 2 37·2	4	9·9	5·5								
May	4	6 19	XXVI (Hasalpur)	D 0 6 46·1	4	5·3	5·4	691	33	·048	− 31·7	101·6			
Apr.	30	5 46	XXIX (Por)	D 0 3 23·6	6	10·7	5·4								
Mar.	30	5 22	XXVIII (Kárigángar)	D 0 6 0·3	4	†1·3	5·5	676	−26	·039	+ 8·0	94·9	97·1	97	13·2
Apr.	2	5 9	XXIX (Por)	D 0 6 8·7	4	3·8	†2·7								
„	9	4 43	XXX (Ingrori)	D 0 8 5·6	4	†4·5	§13·0	655	− 6	·010	− 57·1	94·7			
„	2	4 19	XXIX (Por)	D 0 3 12·9	4	§14·6	†2·7								
Mar.	30	3 18	XXVIII (Kárigángar)	D 0 1 50·3	6	§14·5	5·5	541	−10	·019	+ 65·3	152·3	152·3	151·78	34·4
Apr.	9	4 36	XXX (Ingrori)	D 0 7 43·0	4	3·8	§13·0								
„	2	5 26	XXIX (Por)	D 0 6 6·0	4	‡7·9	†2·7	716	6	·009	+ 0·2	97·2			
May	7	5 47	XXXI (Degám)	D 0 5 23·1	4	3·8	‡6·6								
1852-53													101·4	102	40
Dec.	11	3 53	XXXII (Charári)	D 0 13 37·6	4	‡8·1	5·4	643	− 7	·011	−140·3	105·5			
Jan.	11	3 57	XXXI (Degám)	E 0 2 30·0	4	3·8	‡6·5								
Dec.	8	3 55	XXX (Ingrori)	D 0 2 0·1	6	4·5	5·4	724	−20	·028	+ 94·0	245·8			
„	11	3 31	XXXII (Charári)	D 0 10 39·2	4	7·9	5·4						241·7	242	30
Jan.	11	3 57	XXXI (Degám)	E 0 2 30·0	4	3·8	‡6·5	643	− 7	·011	+140·3	237·5			
Dec.	11	3 53	XXXII (Charári)	D 0 13 37·6	4	‡8·1	5·4								
Jan.	11	4 13	XXXI (Degám)	E 0 0 31·9	4	3·9	‡6·5	657	7	·011	+103·7	205·1			
Dec.	13	2 57	XXXIII (Dhrángadra)	D 0 11 24·6	6	‡8·1	5·5						205·9	207	16
„	11	4 7	XXXII (Charári)	D 0 6 37·4	6	3·8	5·4	546	12	·023	− 35·0	206·7			
„	13	3 6	XXXIII (Dhrángadra)	D 0 2 15·9	4	3·8	5·5								
„	11	5 3	XXXII (Charári)	E 0 1 29·8	6	4·9	5·4	747	98	·131	+134·8	‖ 376·5			
Jan.	5	4 43	XXXIV (Nárechána)	D 0 10 46·9	4	3·8	5·4						359·0	360	22
Dec.	13	3 18	XXXIII (Dhrángadra)	E 0 3 34·9	4	4·4	5·5	628	34	·055	+153·1	359·0			
Jan.	5	3 14	XXXIV (Nárechána)	D 0 13 2·8	4	3·8	5·4								
Dec.	13	4 1	XXXIII (Dhrángadra)	D 0 4 15·6	4	3·9	5·5	608	6	·011	+ 14·2	220·1			
„	15	3 46	XXXV (Kuária)	D 0 5 43·8	6	5·8	5·4						220·2	222	16
Jan.	4,5	3 32	XXXIV (Nárechána)	D 0 12 52·7	8	3·9	5·4	565	16	·029	−138·7	220·3			
Dec.	15	2 59	XXXV (Kuária)	E 0 3 49·2	6	3·8	5·4								

* This height is to be combined with a negative sign on account of change in the height of the pillar at Station XXVI (Hasalpur).
§ These heights are to be combined with negative signs on account of change in the height of the pillar at Station XXX (Ingrori).
† Ditto ditto ditto at Station XXIX (Por).
‡ Ditto ditto ditto at Station XXXI (Degám). ‖ Rejected.

Astronomical Date 1852-53	Mean of Times of observation	Number and Name of 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. 4	3 25	XXXIV (Nárechána)	D 0 7 21·0	6	3·8	5·4	448	15	·034	− 49·6	309·4	310·2	313	26
„ 6,7	3 19	XXI (Sápakra)	E 0 0 8·2	8	3·8	5·4								
Dec. 15	3 12	XXXV (Kuária)	E 0 1 16·3	4	3·8	5·4	544	13	·025	+ 90·8	311·0			
Jan. 6	3 28	XXI (Sápakra)	D 0 10 5·3	6	3·8	5·4								
Dec. 30	4 38	XXXV (Kuária)	D 0 6 3·0	6	5·6	5·4	810	29	·036	+ 4·9	225·1*	214·9	218	16
„ 16	4 6	XVIII (Chalarwa)	D 0 6 22·3	4	7·8	5·4								
Jan. 6	3 53	XXI (Sápakra)	D 0 10 36·8	4	3·8	5·4	689	− 7	·010	− 95·3	214·9			
Dec. 16	3 21	XVIII (Chalarwa)	D 0 1 4·3	4	6·9	5·4								

NOTE.—Stations XVIII (Chalarwa) and XXI (Sápakra) appertain to the Kattywar Meridional Series. * Rejected.

Description of Spirit-levelled Points.

When determining the Spirit-levelled heights, given on pages 60—K. to 62—K., the levelling staff stood on the surfaces hereafter described.

XI (Poera) — On a peg at the foot of the station, height = 279·19 feet. To this value, 30·58 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 309·77 feet.

XVII (Jhinjhar) — On a peg at the foot of the station, height = 206·95 feet. To this value, 6·05 feet (the height of the upper surface of the circular pillar above this peg) being added, the height of the upper surface of the circular pillar was found to be 213·00 feet.

XVIII (Wastrál) — On a peg at the foot of the station, height = 224·70 feet. To this value, 4·78 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 229·48 feet.

XXI (Sola) — On a peg at the foot of the station, height = 218·82 feet. To this value 23·24 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 242·06 feet.

XXII (Sánand) — On a peg at the foot of the station, height = 153·31 feet. To this value 10·35 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 163·66 feet.

Description of Spirit-levelled Points—(Continued).

XXIV (Khoraj) — On a peg at the foot of the hillock on which the station is built, height = 102·71 feet. To this value, 29·40 feet (the height of the upper surface of the central pillar above this peg) being added, the height of the upper surface of the station was found to be 132·11 feet.

XXVI (Hasalpur) — On a peg at the side of the station, height = 118·73 feet. To this value, 14·54 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 133·27 feet.

XXX (Ingrori) — On a peg below the station, height = 110·62 feet. To this value, 41·16 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 151·78 feet.

For further particulars of these stations, see pages 5—K. to 7—K.

May, 1890.

W. H. COLE,
In charge of Computing Office.

GUZERAT LONGITUDINAL SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XIX (Sanoda)

Lat. N. 23° 7′ 19″·89; Long. E. 72° 48′ 27″·32 = 4h 51m 13s·8; Height above Mean Sea Level, 250 feet.
December 1851; observed by Lieutenant H. Rivers with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed — δ Ursæ Minoris (West and East).
Mean Right Ascension 1851·0 — 18h 20m 24s
Mean North Polar Distance 1851·0 — 3° 24′ 8″·17
Local Mean Times of Elongation, December 23 — Western 6h 8m; Eastern 18 18

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.	180 1	+ 4 10 39·27	30 1	+ 1 54·14	+ 4 12 33·41	+ 4 8 59·04	40 39	+ 3 29·34	+ 4 12 28·38
		&	10 48·00	28 25	1 42·29	30·29	9 20·80	38 27	3 7·30	28·10
		0 1	12 23·57	7 29	0 7·08	30·65	11 41·74	19 25	0 47·74	29·48
			12 25·16	1 31	0 0·29	25·45	11 49·00	17 17	0 37·82	26·82
„ 23	E.	180 0	− 3 10 28·90	19 58	− 0 50·26	− 3 11 19·16	− 3 9 9·07	31 8	− 2 1·95	− 3 11 11·02
		&	10 36·20	18 15	0 42·00	18·20	9 27·90	29 7	1 46·71	14·61
		0 0	11 18·74	1 43	0 0·37	19·11	11 3·80	9 43	0 11·92	15·72
			11 16·70	3 43	0 1·75	18·45	11 9·94	7 24	0 6·91	16·85
„ 24	W.	190 11	+ 4 11 42·20	19 40	+ 0 49·00	+ 4 12 31·20	+ 4 10 4·77	33 3	+ 2 18·42	+ 4 12 23·19
		&	11 50·04	17 30	0 38·79	28·83	10 24·36	30 42	1 59·43	23·79
		10 12	12 25·57	3 0	0 1·14	26·71	12 19·83	6 26	0 5·24	25·07
			12 24·93	5 0	0 3·16	28·09	12 23·67	3 21	0 1·42	25·09
„ 24	E.	190 11	− 3 10 44·60	15 53	− 0 31·84	− 3 11 16·44	− 3 9 45·40	27 59	− 1 38·62	− 3 11 24·02
		&	10 57·43	13 25	0 22·73	20·16	9 56·80	26 1	1 25·27	22·07
		10 11	11 8·50	7 46	0 7·63	16·13	11 19·10	3 12	0 1·30	20·40
			11 2·70	10 31	0 14·00	16·70	11 20·40	1 9	0 0·17	20·57

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. 25	W.	200 21	+ 4 10 30·27	30 29	+ 1 57·77	+ 4 12 28·04	+ 4 11 35·07	20 4	+ 0 51·03	+ 4 12 26·10
		&	10 47·53	28 35	1 43·55	31·08	11 50·64	17 51	0 40·37	31·01
		20 21	12 24·67	5 31	0 3·86	28·53	12 27·34	4 26	0 2·48	29·82
			12 31·07	3 33	0 1·60	32·67	12 24·70	6 28	0 5·28	29·98
„ 25	E.	200 20	− 3 11 2·10	13 8	− 0 21·78	− 3 11 23·88	− 3 9 32·87	28 54	− 1 45·15	− 3 11 18·02
		&	11 10·77	9 45	0 12·01	22·78	10 1·30	25 21	1 20·96	22·26
		20 20	10 57·07	13 25	0 22·79	19·86	11 14·03	0 11	0 0·00	14·03
			10 49·94	15 50	0 31·74	21·68	11 17·10	2 27	0 0·76	17·86
„ 26	W.	210 30	+ 4 11 2·43	25 2	+ 1 19·44	+ 4 12 21·87	+ 4 12 3·93	12 29	+ 0 19·75	+ 4 12 23·68
		&	11 18·47	21 38	0 59·32	17·79	12 11·93	10 30	0 13·97	25·90
		30 29	12 20·77	2 1	0 0·52	21·29	12 24·23	5 58	0 4·49	28·72
			12 19·16	0 15	0 0·01	19·17	12 24·10	7 51	0 7·77	31·87
„ 26	E.	210 29	− 3 11 11·63	9 58	− 0 12·53	− 3 11 24·16	− 3 10 4·03	24 20	− 1 14·58	− 3 11 18·61
		&	11 16·10	7 41	0 7·45	23·55	10 31·00	19 22	0 47·28	18·28
		30 29	11 0·97	13 14	0 22·19	23·16	11 16·70	3 47	0 1·82	18·52
			10 52·24	15 25	0 30·12	22·36	11 14·53	5 23	0 3·67	18·20
„ 27	W.	220 38	+ 4 11 28·36	21 53	+ 1 0·70	+ 4 12 29·06	+ 4 12 9·07	12 16	+ 0 19·07	+ 4 12 28·14
		&	11 41·96	18 59	0 45·68	27·64	12 11·50	10 26	0 13·80	25·30
		40 38	12 22·33	2 21	0 0·70	23·03	12 18·70	6 48	0 5·83	24·53
			12 23·07	0 6	0 0·00	23·07	12 18·10	8 22	0 8·83	26·93
„ 27	E.	220 38	− 3 11 15·57	5 14	− 0 3·47	− 3 11 19·04	− 3 10 27·64	21 40	− 0 59·23	− 3 11 26·87
		&	11 16·87	3 17	0 1·37	18·24	10 30·66	19 15	0 46·78	17·44
		40 38	10 53·94	14 23	0 26·17	20·11	11 17·37	5 23	0 3·66	21·03
			10 46·70	16 26	0 34·17	20·87	11 13·80	6 58	0 6·13	19·93
„ 28	W.	230 50	+ 4 12 31·07	2 46	+ 0 0·97	+ 4 12 32·04	+ 4 12 0·20	14 56	+ 0 28·23	+ 4 12 28·43
		&	12 31·97	0 36	0 0·04	32·01	12 6·57	12 59	0 21·33	27·90
		50 50	11 52·07	17 43	0 39·62	31·69	12 24·30	6 47	0 5·82	30·12
			11 43·60	19 19	0 47·09	30·69	12 22·10	8 44	0 9·65	31·75
„ 28	E.	230 50	− 3 10 15·54	22 31	− 1 3·93	− 3 11 19·47	− 3 11 10·50	9 48	− 0 12·14	− 3 11 22·64
		&	10 28·13	20 28	0 52·84	20·97	11 13·73	7 22	0 6·86	20·59
		50 50	11 23·60	2 8	0 0·57	24·17	11 4·94	10 51	0 14·90	19·84
			11 23·90	4 11	0 2·21	26·11	10 59·50	12 39	0 20·25	19·75

Abstract of Astronomical Azimuth observed at XIX (Sanoda) 1851.

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°	221°	41°	231°	51°
Date	December 23		December 24		December 25		December 26		December 27		December 28	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference	19·16	11·02	16·44	24·02	23·88	18·02	24·16	18·61	19·04	26·87	19·47	22·64
of Circle-Readings,	18·20	14·61	20·16	22·07	22·78	22·26	23·55	18·28	18·24	17·44	20·97	20·59
Ref. M.—Star	19·11	15·72	16·13	20·40	19·86	14·03	23·16	18·52	20·11	21·03	24·17	19·84
reduced to Elongation	18·45	16·85	16·70	20·57	21·68	17·86	22·36	18·20	20·87	19·93	26·11	19·75
Means	18·73	14·55	17·36	21·77	22·05	18·04	23·31	18·40	19·57	21·32	22·68	20·71
	° ′ ″		″		″		″		″		″	
Means of both faces	− 3 11 16·64		19·56		20·05		20·85		20·44		21·69	
Az. of Star fr. S., by W.	183 41 53·27		53·66		54·06		54·45		54·84		55·24	
Az. of Ref. M. „	180 30 36·63		34·10		34·01		33·60		34·40		33·55	

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°	221°	41°	231°	51°
Date	December 23		December 24		December 25		December 26		December 27		December 28	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference	33·41	28·38	31·20	23·19	28·04	26·10	21·87	23·68	29·06	28·14	32·04	28·43
of Circle-Readings,	30·29	28·10	28·83	23·79	31·08	31·01	17·79	25·90	27·64	25·30	32·01	27·90
Ref. M.—Star	30·65	29·48	26·71	25·07	28·53	29·82	21·29	28·72	23·03	24·53	31·69	30·12
reduced to Elongation	25·45	26·82	28·09	25·09	32·67	29·98	19·17	31·87	23·07	26·93	30·69	31·75
Means	29·95	28·20	28·71	24·29	30·08	29·23	20·03	27·54	25·70	26·23	31·61	29·55
	° ′ ″		″		″		″		″		″	
Means of both faces	+ 4 12 29·07		26·50		29·66		23·78		25·96		30·58	
Az. of Star fr. S., by W.	176 18 6·93		6·54		6·14		5·75		5·35		4·96	
Az. of Ref. M. „	180 30 36·00		33·04		35·80		29·53		31·31		35·54	

		°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation	180	30	34·38
	by Western „		„	33·54
	Mean		„	33·96
Angle Referring Mark and XVI (Mirzápur) *see pages* 18—I. and 19—I. of Abu Meridional Series		+154	4	43·80
Astronomical Azimuth of Mirzápur by observation		334	35	17·76
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur: *see page* 55—K. *ante*		334	35	14·01
Astronomical — Geodetical Azimuth at XIX (Sanoda)		+		3·75

At XXX (Ingrori)

Lat. N. 22° 57′ 7″·58; Long. E. 71° 51′ 1″·30 = 4ʰ 47ᵐ 24ˢ·1; Height above Mean Sea Level, 152 feet.
April 1852; observed by Lieutenant H. Rivers with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed	α Ursæ Minoris (West and East).
Mean Right Ascension 1852·0	1ʰ 5ᵐ 36ˢ
Mean North Polar Distance 1852·0	1° 28′ 46″·18
Local Mean Times of Elongation, April 5	Western 6ʰ 6ᵐ; Eastern 18 9

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	′ ″	° ′ ″
Apr. 5	W.	180 1	+ 1 36 30·10	17 19	+ 0 16·50	+ 1 36 46·60	+ 1 36 25·63	1 20	+ 0 0·10	+ 1 36 25·73
		&	36 26·70	18 32	0 18·90	45·60	36 25·77	0 33	0 0·02	25·79
		0 1	35 45·84	33 29	1 1·54	47·38	35 49·60	26 42	0 39·17	28·77
			35 36·74	34 51	1 6·64	43·38	35 43·20	27 45	0 42·31	25·51
„ 5	E.	180 0	− 1 35 48·73	22 28	− 0 27·74	− 1 36 16·47	− 1 35 32·26	31 31	− 0 54·52	− 1 36 26·78
		&	35 48·26	20 29	0 23·06	11·32	35 35·64	30 9	0 49·90	25·54
		0 1	36 10·14	5 11	0 1·48	11·62	36 18·33	13 55	0 10·65	28·98
			36 9·73	3 4	0 0·52	10·25	36 17·23	11 35	0 7·39	24·62
„ 6	W.	190 12	+ 1 36 12·70	18 49	+ 0 19·47	+ 1 36 32·17	+ 1 36 32·30	12 13	+ 0 8·21	+ 1 36 40·51
		&	36 6·63	19 58	0 21·92	28·55	36 26·50	13 15	0 9·66	36·16
		10 13	35 30·30	33 42	1 2·31	32·61	35 51·50	27 29	0 41·48	32·98
			35 24·60	35 1	1 7·26	31·86	35 47·07	28 42	0 45·22	32·29
„ 6	E.	190 12	− 1 35 50·17	24 50	− 0 33·90	− 1 36 24·07	− 1 35 21·54	31 36	− 0 54·83	− 1 36 16·37
		&	35 58·10	22 51	0 28·71	26·81	35 29·33	30 0	0 49·43	18·76
		10 12	36 24·36	2 17	0 0·29	24·65	36 4·40	14 21	0 11·34	15·74
			36 18·14	6 56	0 2·65	20·79	36 6·74	10 52	0 6·49	13·23
„ 7	W.	200 20	+ 1 36 33·03	6 38	+ 0 2·42	+ 1 36 35·45	+ 1 36 36·50	2 12	+ 0 0·27	+ 1 36 36·77
		&	36 30·03	8 21	0 3·83	33·86	36 36·47	0 14	0 0·00	36·47
		20 20	35 54·80	27 24	0 41·26	36·06	36 14·86	19 44	0 21·39	36·25
			35 51·24	28 25	0 44·37	35·61	36 11·26	20 50	0 23·88	35·14
„ 7	E.	200 20	− 1 35 39·74	24 29	− 0 32·92	− 1 36 12·66	− 1 35 29·14	30 57	− 0 52·57	− 1 36 21·71
		&	35 53·93	22 53	0 28·77	22·70	35 30·30	29 51	0 48·91	19·21
		20 20	36 20·20	7 7	0 2·79	22·99	36 4·93	16 41	0 15·30	20·23
			36 23·17	5 31	0 1·67	24·84	36 4·06	15 23	0 13·01	17·07
			36 23·30	4 10	0 0·96	24·26				

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. 8	W.	210 29	+ 1 36 25·47	11 52	+ 0 7·75	+ 1 36 33·22	+ 1 36 31·84	3 35	+ 0 0·71	+ 1 36 32·55
		&	36 19·50	13 3	0 9·37	28·87	36 32·73	5 57	0 1·95	34·68
		30 29	36 1·03	24 11	0 32·13	33·16	36 11·84	18 42	0 19·22	31·06
			35 56·93	25 14	0 34·97	31·90	36 1·50	19 35	0 21·08	22·58
" 8	E.	210 28	− 1 35 54·20	22 42	− 0 28·31	− 1 36 22·51	− 1 35 40·53	28 45	− 0 45·38	− 1 36 25·91
		&	35 59·67	21 25	0 25·20	24·87	35 40·60	27 32	0 41·62	22·22
		30 28	36 23·03	8 50	0 4·29	27·32	36 9·57	16 4	0 14·19	23·76
			36 19·40	6 46	0 2·52	21·92	36 10·47	14 35	0 11·69	22·16
			36 20·96	5 22	0 1·58	22·54				
" 9	W.	220 38	+ 1 36 23·30	14 24	+ 0 11·40	+ 1 36 34·70	+ 1 36 28·34	9 4	+ 0 4·52	+ 1 36 32·86
		&	36 23·63	16 4	0 14·20	37·83	36 29·50	10 26	0 5·99	35·49
		40 38	35 54·56	27 15	0 40·78	35·34	36 10·16	21 18	0 24·93	35·09
			35 52·40	28 25	0 44·34	36·74	36 8·24	22 24	0 27·57	35·81
" 9	E.	220 38	− 1 35 56·87	21 3	− 0 24·35	− 1 36 21·22	− 1 35 33·20	29 45	− 0 48·63	− 1 36 21·83
		&	35 59·16	19 43	0 21·36	20·52	35 38·27	28 28	0 44·54	22·81
		40 38	36 23·47	8 41	0 4·15	27·62	36 6·64	14 37	0 11·74	18·38
			36 11·94	12 42	0 8·89	20·83	36 8·36	13 16	0 9·68	18·04
" 10	W.	230 50	+ 1 36 10·80	20 13	+ 0 22·49	+ 1 36 33·29	+ 1 36 28·23	14 12	+ 0 11·11	+ 1 36 39·34
		&	36 10·33	21 24	0 25·19	35·52	36 24·80	15 39	0 13·49	38·29
		50 50	35 39·20	32 37	0 58·42	37·62	35 56·97	27 55	0 42·83	39·80
			35 33·50	33 38	1 2·11	35·61	35 54·36	28 50	0 45·68	40·04
" 10	E.	230 50	− 1 35 57·43	21 25	− 0 25·22	− 1 36 22·65	− 1 35 37·33	28 0	− 0 43·06	− 1 36 20·39
		&	36 0·56	20 17	0 22·62	23·18	35 38·90	26 42	0 39·16	18·06
		50 50	36 17·67	10 58	0 6·62	24·29	36 5·70	15 48	0 13·73	19·43
			36 19·03	9 59	0 5·49	24·52	36 5·27	14 51	0 12·13	17·40
" 12	W.	180 1	+ 1 35 50·33	27 45	+ 0 42·29	+ 1 36 32·62	+ 1 36 13·80	22 22	+ 0 27·49	+ 1 36 41·29
		&	35 49·57	28 47	0 45·49	35·06	36 10·10	23 28	0 30·26	40·36
		0 1	35 19·90	36 46	1 14·21	34·11	35 38·50	32 12	0 56·96	35·46
			35 16·83	37 39	1 17·80	34·63	35 37·90	33 8	1 0·30	38·20
" 12	E.	180 1	− 1 35 55·47	23 30	− 0 30·35	− 1 36 25·82	− 1 35 37·03	29 22	− 0 47·36	− 1 36 24·39
		&	35 59·70	22 32	0 27·91	27·61	35 42·73	28 22	0 44·19	26·92
		0 1	36 24·40	3 51	0 0·82	25·22	36 7·56	14 12	0 11·09	18·65
			36 23·24	1 56	0 0·21	23·45	36 10·26	12 7	0 8·08	18·34

Abstract of Astronomical Azimuth observed at XXX (Ingrori) 1852.

1. By Eastern Elongation of *α* Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	210°	30°	221°	41°	231°	51°
Date	April 5		April 6		April 7		April 8		April 9		April 10	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference	16·47	26·78	24·07	16·37	12·66	21·71	22·51	25·91	21·22	21·83	22·65	20·39
of Circle-Readings,	11·32	25·54	26·81	18·76	22·70	19·21	24·87	22·22	20·52	22·81	23·18	18·06
Ref. M.—Star	11·62	28·98	24·65	15·74	22·99	20·23	27·32	23·76	27·62	18·38	24·29	19·43
reduced to Elongation	10·25	24·62	20·79	13·23	24·84	17·07	21·92	22·16	20·83	18·04	24·52	17·40
	*23·54	*22·11			24·26		22·54					
	*25·33	*24·64										
	*22·94	*16·37										
	*21·17	*16·06										
Means	17·83	23·14	24·08	16·03	21·49	19·56	23·83	23·51	22·55	20·27	23·66	18·82
	° ′ ″		″		″		″		″		″	
Means of both faces	− 1 36 20·49		20·05		20·52		23·67		21·41		21·24	
Az. of Star fr. S., by W.	181 36 27·17		27·49		27·82		28·15		28·47		28·80	
Az. of Ref. M. „	180 0 6·68		7·44		7·30		4·48		7·06		7·56	

2. By Western Elongation of *α* Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	210°	30°	221°	41°	231°	51°
Date	April 5		April 6		April 7		April 8		April 9		April 10	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference	46·60	25·73	32·17	40·51	35·45	36·77	33·22	32·55	34·70	32·86	33·29	39·34
of Circle-Readings,	45·60	25·79	28·55	36·16	33·86	36·47	28·87	34·68	37·83	35·49	35·52	38·29
Ref. M.—Star	47·38	28·77	32·61	32·98	36·06	36·25	33·16	31·06	35·34	35·09	37·62	39·80
reduced to Elongation	43·38	25·51	31·86	32·29	35·61	35·14	31·90	22·58	36·74	35·81	35·61	40·04
	*30·34	*39·01										
	*32·78	*38·08										
	*31·83	*33·18										
	*32·35	*35·92										
Means	38·78	31·50	31·30	35·49	35·25	36·16	31·79	30·22	36·15	34·81	35·51	39·37
	° ′ ″		″		″		″		″		″	
Means of both faces	+ 1 36 35·14		33·39		35·70		31·01		35·48		37·44	
Az. of Star fr. S., by W.	178 23 32·94		32·61		32·29		31·96		31·64		31·31	
Az. of Ref. M. „	180 0 8·08		6·00		7·99		2·97		7·12		8·75	

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.

Abstract of Astronomical Azimuth observed at XXX (Ingrori) 1852—(*Continued*).

			°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation		180	0	6·75
	by Western „			„	6·82
	Mean...			„	6·79
Angle Referring Mark and XXIX (Por) *see page* 34—K. *ante*		+	18	26	37·37
Astronomical Azimuth of Por by observation			198	26	44·16
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur, *see page* 56—K. *ante*			198	26	42·98
Astronomical — Geodetical Azimuth at XXX (Ingrori)		+			1·18

May, 1890.

W. H. COLE,
In charge of Computing Office.

Fig. No. 10 (of the Singi Meridional Series)

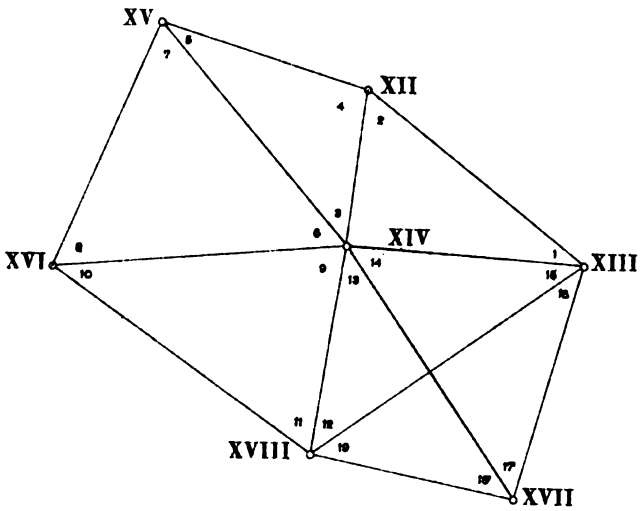


Fig. No. 26

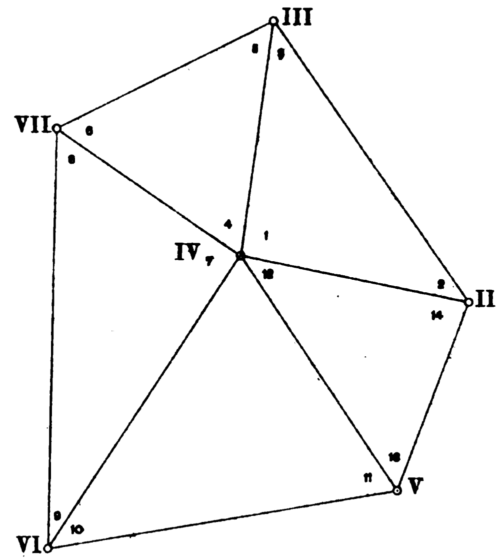
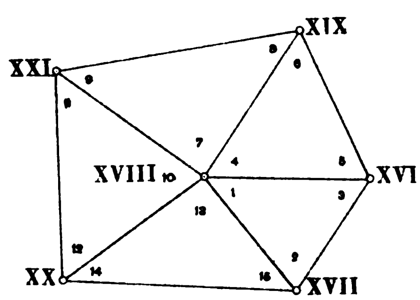


Fig. No. 27



Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, January 1880

CUTCH COAST SERIES.

CUTCH COAST SERIES.

INTRODUCTION.

The Cutch (Kachh) Coast Series of the South-West Quadrilateral is the chain of principal triangles, that commences at the head of the Gulf of Cutch, trends first south-westwards and then north-westwards through the province of Cutch, crosses the western end of the Ran and the southern mouths of the Indus, and terminates near Tatta, 50 miles east of Karáchi. It emanates from Chitror–Wándia, a side of the Kattywar (Káthiávád) Meridional Series, and closes, after a run of 235 miles, on the side Kárathol–Sáhiji of the Karáchi Longitudinal Series. It is double throughout and consists of one compound figure, one double hexagon, six pentagons and five quadrilaterals.

Season 1853-54.

During the field season of 1853-54 the Bombay Triangulation Party was employed under Lieutenant Nasmyth on trigonometrical work in the Kattywar Peninsula; one of the assistants, however, Mr. T. Sanger, was deputed to take up the approximate work of the Cutch Coast Principal Series, and this he carried from Wándia to Dinoda. By May, 1853, the Kattywar Meridional Series had been completed from the parallel of 23° to its southern extremity near Diu; and in April and May, 1854, Lieutenant Nasmyth succeeded in carrying the final observations northwards across the Ran of Cutch to Chitror. He was precluded, however, from observing at any of the stations of the Cutch Coast Series by the weakness of Mr. Sanger's approximate work, which had made the Cutch triangulation at its junction with the Kattywar principal chain depend on one single triangle and one quadrilateral, in the latter of which were two angles less than 30°.

Season 1854-55.

During the early part of the field season of 1854-55, Lieutenant Nasmyth and Mr. McGill were at Karáchi, taking part in the measurement of the Base-line that was being carried out with Colby's apparatus under Colonel A. Strange. Messrs. Sanger and DaCosta, the only other assistants with the party, were both placed on the duty of improving the approximate work at the junction of the Cutch and Kattywar Principal Series.

The district of Wagan in which they were operating was bounded on the one side by the sea and on the other by the Ran, and was not sufficiently broad to admit of symmetrical triangles. The surveyors, therefore, found their task no easy one; but at length they submitted a design that was approved by Nasmyth. Mr. Sanger then took up the approximate work of the Guzerat Longitudinal Series east of Ahmedabad (Amdávád), and Mr. DaCosta continued his observations of the angles of the Kattywar Coast Minor Series which he had been unable to finish the previous year. Towards the end of the measurement of the Karáchi Base-line Lieutenant Nasmyth fell ill, and was on this account detained some weeks at Karáchi. When sufficiently recovered for the journey he had to be moved to Mahábaleshvar. The final work of the Cutch Coast Principal Series was in consequence not taken up during the season 1854-55.

Season 1855-56.

PERSONNEL.

Lieutenant D. J. Nasmyth, Bombay Engineers, 2nd Assistant.
Mr. J. DaCosta, Sub-Assistant.
" T. Sanger, "
" J. McGill, "
" C. McGill, "

The climate of Cutch in the Autumn is so bad and fever is so prevalent that it is injudicious to undertake the general duties of a survey there before November. As, however, the town of Naithra was situated in the western part of Cutch and at a comparatively high altitude, Nasmyth decided to move there early in October, and observe Polaris at both elongations for azimuth, and then to return to the sea coast and to remain till the unhealthy season had passed. Mr. Sanger's approximate work of 1853-54 had not been carried westward of Dinoda and Roha, but as the town of Naithra formed an equilateral triangle with these two stations it was evident that a station would eventually have to be built in its vicinity.

The party's departure was constantly delayed owing to the unsettled state of the weather, and it was not till October 15th that they set out from Poona (Puna). On arrival at Bombay the large theodolite, heliotropes, lamps and all other apparatus were embarked in a Government boat, whilst a sailing ship from Cutch was chartered to carry the native establishment, horses and baggage. About this time scarcity of water was anticipated in Bombay and boats had already been interdicted from drawing their supplies from the island except on payment. That the establishment might not be delayed Nasmyth agreed to a heavy charge; but hardly had the vessel left Bombay when it was found that the alleged supply of water had not been shipped: a day had to be spent in filling the spare tanks before the vessel weighed again for Cutch. The voyagers, however, seemed doomed to misfortune; the wind was against them and the tindal of the ship got out of his reckoning. With but little water left on board, he found himself at the mouth of the Persian gulf within a short distance of Muscat. Changing his course he sought to make some port on the Kattywar Coast, but was again unfortunate; for the wind died away and there was no land in sight. Scarcity of water now began to press inconveniently on all, and a Brahmin of the party was deputed to pray for better things: he accordingly spent the night invoking the protecting aid of Wiloda, and, as morning broke, concluded his devotions and predicted a coming breeze: the breeze indeed came, but it blew the wrong way. The Kattywar Coast was passed unseen, and before the Konkan shore was gained, the horses had been three days without water. In these extremities a steamer hove in sight; a signal of distress was run to the masthead and great was the joy of the voyagers when the steamer was seen to steer towards them: greater still, however, was their mortification, when the Captain of the steamer, having learnt that it was merely for water that he had been summoned out of his course, abused them roundly and steamed away out of sight. Having replenished their water supply from the Konkan Coast, the party was at length landed safely at Mándvi on November 11th and began their march the following evening.

The country through which the triangulation was to be carried was rocky and unfavorable for carts, and camels could not be procured; for although there were many of these animals in every village, the natives refused to lend them. The camelmen from Gujarát objected to serve in Cutch, and the Rao declined to assist the survey party; Nasmyth had therefore to employ carts, which were very slow and generally broke down. Much inconvenience was next caused by the sudden withdrawal of the native guard by order of the Bombay Government; and as his establishment had been divided and distributed all over the country, Nasmyth's arrangements were quite upset. He submitted the matter to Colonel A. S. Waugh, Surveyor General of India and Superintendent of the Trigonometrical Survey, and by order of the Supreme Government the guard was eventually restored. The party reached Naithra on November 15th and the station of Háthria was immediately selected in the vicinity. Whilst the platform was being built the establishment moved to Roha, Nasmyth himself visiting the country to the north to decide on the best way of completing the figure. On November 19th he followed the establishment to Roha and set up the instrument, intending to take observations of the final angles, but an unforeseen impediment occurred: Mr. Sanger, who had been sent on in advance to visit the selected stations and assure himself that the preliminary arrangements were perfect, had allowed the ray from a station named Jhuria to Roha to escape his notice: and when Nasmyth arrived he found it hopelessly obstructed by an intervening hill. Nasmyth at once proceeded to Jhuria and after a week's work decided to transfer Mr. Sanger's station to Wára.

He began the final work at Sámethra, and then visited the stations of Bolári and Katror; and before the year 1855 had closed he had completed the observations at Wára and Roha and had observed as many of the angles at Dinoda, Naliya and Háthria as the unfinished state of the approximate series would allow. He then took up the work of the Kattywar Meridional Series and remained employed on it till the close of the field-work in May 1856.

In the meantime Mr. DaCosta had been carrying on the approximate work of a

Principal Series that was to connect the Cutch Coast Series with the Karáchi Longitudinal. He first selected the stations of Saind, Sura Gandára and Manjal and thus formed a somewhat symmetrical hexagon round Háthria: then with the side Manjal–Sura Gandára as his base he carried the approximate series due north up the meridian of 69°, till he joined on to the side Sha Turel–Adúri of the Karáchi Longitudinal Series. As the season advanced he suffered much from the heat of the desert, whilst his marches backwards and forwards over the Ran and across the low swampy land that lies between the Kori and Indus were very trying. He rejoined the head-quarters of the party in May.

It had now become evident that Cutch was a very difficult country to triangulate: the hills were steep and difficult of ascent, and the valleys were obstructed by loose sand and quicksands: the scantiness of the population too in the wild places visited, greatly augmented the troubles of moving about. But of all the parts of the country, that lately traversed by DaCosta seemed the least favorable for trigonometrical work: many of his stations had of necessity been placed on the very border of the Ran; and from experience gained on the Kattywar Meridional Series it was known that such positions would never yield good results. Nasmyth therefore determined to throw over DaCosta's work on the meridian of 69°, and to carry the Cutch Principal Series across the mouths of the Indus parallel to the Coast, and make it join the Karáchi Longitudinal Series north of Tatta.

Season 1856-57.

PERSONNEL.

Lieutenant D. J. Nasmyth, Bombay Engineers, 2nd Assistant.
Mr. J. DaCosta, Sub-Assistant.
" T. Sanger, "
" J. McGill, "
" C. McGill, "

The party took the field again on August 31st, 1856, but were forced by unfavorable weather to seek shelter in the town of Anjár. On September 8th Nasmyth commenced laying out supplementary triangles to connect the principal triangulation with the sea; and on October 1st he proceeded to Háthria, where he observed Polaris at both elongations for azimuth. He then returned eastwards and continued his work on the Kattywar Meridional Series.

Early in October Mr. DaCosta, who was now assisted by Mr. Sanger, began the extension of the Cutch Coast Series through Sind from the Ran to Tatta. The side Saind–Sura Gandára proved unsuitable to start from, a station at Suri Muri had to be selected. On the side Suri Muri–Sura Gandára a pentagon was then constructed round Bábia as a centre, which brought the Series to the northern border of Cutch. Beyond, however, the mere selection of the sites of the stations nothing could be done, for no means of building the towers existed, no masons were to be found within miles, and neither bricks nor lime were known.

The country for 40 miles north of the Ran is always inundated in November and December and does not become thoroughly drained till April; so after selecting Lakhpat and Pinjor Pir the two Surveyors proceeded by boat to Karáchi to recommence their work from its northern extremity. The new series started from the side Sáhiji–Károthol of the Karáchi

Longitudinal Series, and after passing Tatta crossed a flat, damp country, thickly overgrown with bastard cypress and bantle: at first water was good and plentiful, but as the Ran was approached it became scarce and bad. Having selected all the stations DaCosta commenced building the towers near the Ran. During his stay in Karáchi he had made arrangements for their construction and had despatched material by boat to the north-west of Cutch; but statute labor had lately been abolished in Sind, and no workmen could be procured; the inhabitants, as long as fish were in the canals, had no care for their livelihood, and those in the Ran were especially averse to work: at times it seemed as if the operations would fall through, and they probably would have done so if assistance had not arrived from Mándvi. The towers themselves were not easy to build: the foundations could not be dug two feet without water rushing in and rendering the sand loose and yielding. A large supply of bricks had been prepared at Guni and other places, but an unexpected fall of rain in February converted them into mud and threw the builders out of employment. Towards the beginning of June the Indus overflowed its banks and flooded the whole country round, obliging DaCosta to return to recess quarters at Bhúj.

On December 21st Nasmyth completed the Kattywar Meridional Series at Wánkáner, and again resumed work on the Cutch Coast Series first visiting the stations at the junction of the two principal series and then working westwards till he joined on to his side Bolári–Katror of the previous season. He utilised Gángta, one of the principal stations of the Kattywar Meridional Series, as the northern point of the Kakarwa pentagon, but left the interior angles of the Gángta–Chitror quadrilateral unobserved. The employment in the two series of the same station rendered the figure at their junction one of great complexity. If the reduction had been carried out rigorously all the triangles within the periphery Gángta–Bela–Iwália–Pata-i-Sháh–Khánmír–Kesmára–Kákraji–Mália–Wándia–Sakpur–Ráhida–Ran–Gángta would have had to be regarded as belonging to one compound geometrical figure: the fact too that the interior angles of the quadrilateral Gángta–Chitror had not been observed would not have lessened the complication. The reduction however was not carried out rigorously: the Dájka pentagon was first reduced independently of any exterior observations and then in the following order the Kanduka–Khánmír quadrilateral, the Monába hexagon and the Nara–Wándia quadrilateral were taken in hand. When, therefore, it came to the turn of the Kakarwa pentagon to be reduced, three of its angular points—Gángta, Nara and Sakpur—had already been fixed in position. In addition thus to the seven geometrical conditions that have to be satisfied in the case of every complete simple pentagon, two others entered into this figure: the sum of the two angles at Nara had a fixed value, and the side Sakpur–Nara had to bear a fixed ratio in length to the side Nara–Gángta.

In January an earthquake occurred which nearly brought down the tower of Karárho, on which the instrument happened to be standing. In March Nasmyth exhausted all the approximate work that was ready for him and then occupied himself in carrying out several repetitions of supposed bad work. Triangular errors of 3″ were common in the neighbourhood of Lakhpat and Pinjor Pir; but though the faulty angles were repeated many times their values always remained the same and the errors were not decreased. The only explanation of the difficulty offered by Nasmyth was, that signals were not only rendered unsteady by haze but were also distorted in a constant direction by currents from the Ran, leaving unequal densities in the air: where the country was *all* Ran, increased triangular errors did not present themselves. The field work was brought to a close on April 17th, 1857, and the party returned to their recess quarters at Bhúj.

In October, 1857, with a view to relieve General Lawrence, a column was being organised at Deesa (Disa) in all haste to attack Áuwa a walled town situated half way between Abu and Nusseerabad (Nasirabad) which was held by mutineers of the Jodhpore (Jodhpur) legion. As General Lawrence was urgently in want of the services of an Engineer Officer and there was no other available, Lieutenant Nasmyth was requested to accompany the force and remain with it for three months: this he consented to do anticipating Colonel Waugh's approval. Nasmyth reached Deesa on October 16th, a week after the force had left, and at once made arrangements to follow; but on the eve of marching, he was officially informed that the delay in his arrival had been attributed to his inability to leave his work in Cutch, and that consequently other arrangements had been made and his services were no longer required: on hearing this he had no alternative but to retrace his steps.

Season 1857-58.

PERSONNEL.

Lieutenant D. J. Nasmyth, Bombay Engineers, 1st Assistant.
Mr. J. DaCosta, Sub-Assistant.
„ T. Sanger, „
„ J. McGill, „
„ C. McGill, „

The party took the field on October 16th and moved towards the narrow strip of the Ran near the stations of Lakhpat and Pinjor Pir. As the northern section of the Cutch Coast Series had presented in its approximate work so many difficulties, the whole *personnel* were to be concentrated on it, until all the stations had been selected, towers built and rays cleared. Mr. DaCosta took upon himself the task of building the towers at the Ran stations, and deputed Mr. Sanger to clear the rays. Mr. McGill was detached to the vicinity of Mugalbhin where he found the country flooded, one of his rays in fact, the clearance of which required much tree-cutting, running entirely over water: as was to be expected his detachment suffered considerably from fever. Nasmyth joined the party at the end of November and resumed the observations of the final angles on December 10th. He decided to work from north to south and so visited the stations of the Karáchi Longitudinal Series, Kárathol and Sáhiji, first. The upper mark-stone at Kárathol was found destroyed, and a new one had to be placed by cutting into the centre of the pillar and plumbing from the lowest mark: its correctness was however even then open to doubt, and the stations of Kára and Ghatána had to be revisited and the position of Kárathol re-determined from them. By the end of January the first pentagon round Dománi had been completed, and by March 10th the final work had been brought down as far as the side Patha-ka-beri–Mod. Early in April the northern section of the series closed on the side Lakhpat–Pinjor Pir, where the operations of the previous year had been brought to an end: the stations of Jim and Mugalbhin had to be then revisited and an angle at each re-observed. The principal work of the Cutch Coast Series was completed on May 7th, 1858, when the party returned to their recess quarters at Bhúj.

On the Sind section of the Series it was found impossible to take the vertical angles in the usual way: many of the signals were not visible at the time of minimum refraction, and on approaching the Ran there were only a few that were so, and these were unsatisfactory and unsteady. Under these circumstances the method was resorted to of placing an observer at each extremity of a ray to observe the vertical angles simultaneously at any time of the day or night that the signals might happen to be visible and steady. Nasmyth always observed at one extremity of every ray himself while either DaCosta or McGill—who were each equipped with a 12-inch theodolite—was at the other. By placing two assistants on this work Nasmyth was enabled to observe the vertical angles on two rays himself every day. The effects of refraction were very uncertain and could not be relied on: on the ray Patha-ki-beri–Sugandia the signals one day were not seen till 9 P.M., while another day they were visible at 7 o'clock in the morning.

In April, 1858, Mr. Thomas Sanger, who for some years had suffered from ill health, resigned his appointment and retired to the Deccan on a pension: he had entered the Bombay Survey Department in 1825 and had been employed from 1828 to 1834 on the Trigonometrical Survey of the Bombay Presidency, which was being carried out by Lieutenant R. Shortrede under the orders of Captain Jopp. On the amalgamation of this Survey in 1834 with the Great Trigonometrical Survey of India, he had been transferred to the latter and had worked for the last twenty-four years of his service under Lieutenants Jacob, Rivers and Nasmyth.

All the angles of the Cutch Coast Series were observed with Troughton and Simms' 18-inch Theodolite No. 2*, and were taken on six pairs of zeros. The method adopted of changing zeros was one that had been introduced by Lieutenant Rivers and first employed on the Abu Meridional Series. By it each change of zero was made to fulfil the following conditions:—(1) Each zero was 10° in excess of the preceding one. (2) At each zero a different 10′ graduation in the degree was employed. (3) Each micrometer zero was a different number of minutes from the division to be intersected, being in three cases to the right of that division and in three to the left. The method is fully described in the Introduction to the Guzerat Longitudinal Series.

The accuracy of the triangulation of the Cutch Coast Series may be tested as follows:—The Kattywar Meridional Series originates from a finally fixed side, Bhilgaon–Akoria, of the Karáchi Longitudinal Series, and runs south to the parallel of 23½°: at this point the Cutch Coast Series branches off from it to the west, moves round the Coast line and closes on another finally fixed side Károthol–Sáhiji of the Karáchi Longitudinal Series. The latitude and longitude of Károthol and the length and azimuth of the side Károthol–Sáhiji could thus be computed from Bhilgaon–Akoria through these 350 miles of triangulation, and a comparison of the computed and correct values afford a test of the accuracy of the work.

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* For a full description of this instrument and its performances *see* Appendix No. 2 of Volume II of the *Account of the Operations of the Great Trigonometrical Survey of India.*

The closing errors that exist may be exhibited as follows:—

Values.	Károthol.		Károthol–Sáhiji.	
	Latitude.	Longitude.	Azimuth.	Side in feet.
Calculated from the side Bhilgaon–Akoria of the Karáchi Longitudinal Series, *viá* the Kattywar Meridional and Cutch Coast Series.	24° 53′ 46″·752	67° 55′ 59″·395	80° 16′ 11″·140	98418·2
Accepted as correct from the Simultaneous Reduction of the North-West Quadrilateral.	24° 53′ 46″·692	67° 55′ 59″·651	80° 16′ 15″·052	98412·3
Closing errors ...	+ 0″·060	− 0″·256	− 3″·912	+ 5·9

On the completion of the simultaneous reduction of the South-West Quadrilateral it was found that the portions of the corrections which had actually fallen to the Cutch Coast Series were as follows:—

In Latitude of Károthol (CIV) ... ... — 0″·014

„ Longitude of „ ... ... + 0 ·285

„ Azimuth of Károthol (CIV)—Sáhiji (CVII) ... + 1 ·222

In Side { Logarithm of feet ... ... — 0 ·000,0313,4
giving a ratio of about 4·58 inches per mile.

Astronomical observations for azimuth have been taken at but one station of the Cutch Coast Series, *viz.*, Háthria.

The heights of the principal stations of this Series at the present time depend in the first instance on the values of the stations of Gángta, Chitror and Wándia of the Kattywar Meridional Series; next on those of the stations Bhacháo, Sakpur and Charakra, of which the values were determined by spirit-levelling operations in season 1874-75; and thirdly on those of the stations of Károthol and Sáhiji of the Karáchi Longitudinal Series, which were finally fixed in the reduction of the North-West Quadrilateral: but as the trigonometrical differences of height westward of the meridian of 70° are in several parts of the Series very unsatisfactory, owing to the abnormal refraction along the coast, it is intended, if possible, to defer their final adjustment pending the execution of a contemplated line of levels from the station of Charakra along the Series to Tatta.

Secondary Triangulation.

A network of secondary triangulation has been thrown over the whole country of Cutch between the principal series and the sea-coast, the area covered being 100 miles long and 20 broad. The triangulation though in the end it practically became a network, was not originally intended to be so. It consisted of two contiguous minor series, one following the coast exactly and the other running between it and the principal chain: as the southern stations of the latter were always used as stations of the intermediary series, and the stations of the two minor series along their contiguous flank were almost in every case identical; the series are no longer to be distinguished but are lost in a network.

In September, 1856, Nasmyth starting from the principal side Charakra–Karárho and working westward laid out some six or seven small triangles along the coast line, but was unable to continue further as he had so much principal work then on hand. In March and April, 1858, Mr. Sanger widened the principal series by carrying the approximate work of a minor series along the southern flank of the former: he commenced at Katror and ended at Jamanwála, having succeeded also in breaking up the southern triangles of the principal heptagon round Háthria.

In January, 1859, owing to the disturbed state of the country and to a rising amongst the Bhils, the Bombay Party were compelled to withdraw from Gujarát where they were working on the principal Longitudinal Series; they retired to Cutch, where Lieutenant Nasmyth on February 5th commenced observing the angles of the minor series that had been chosen by Mr. Sanger on the southern flank of the principal chain. Mr. J. McGill at the same time was directed to select the stations of another minor series, the southern flank of which was to run along the sea-shore, the northern coinciding with the southern flank of Mr. Sanger's.

By March 21st Nasmyth had observed almost all the angles of the upper minor series from Katror to Naliya, taking them with the 18-inch theodolite on two pairs of zeros: the eight stations that remained to the westwards, on the coast, were difficult of access and the observations from them were taken by Mr. McGill with a 12-inch theodolite. As the stations of the lower secondary series lately chosen along the coast by Mr. McGill were not ready, the party crossed over to Káthiáwár to take up some minor triangulation there.

The field season of 1859-60 opened late, owing to the absence of Captain Nasmyth and of Lieutenant C. T. Haig, who had joined the party in October, 1859, on active service with the Okhámandal Field Force. The first work taken up on their return was the final observation of the angles of the minor series on the coast: these were begun on December 5th, 1859, and finished on January 12th, 1860, an astronomical azimuth of verification having been also observed on three pairs of zeros in the meantime at the secondary station of Mándvi.

In addition to the network of minor triangulation that was thrown over the whole province of Cutch, a great deal of additional secondary work was executed. All the large principal triangles were broken up into smaller ones, and numerous temples, trees and peaks were intersected from two or more stations in every part of the country. The positions of the important cities of Bhúj and Mándvi were determined, as also of the towns of Fatiagad, Rahpur, Bhamaka, Túna, Kera and Tera. Sufficient points were fixed to enable the line of the coast and the borders of the Ran to be accurately delineated, and there exists no spot in Cutch that is not within two miles of some point whose geodetic elements are known.

Beyond the Ran of Cutch on the north-western portion of the principal series barely any secondary work was executed. The country was a sandy desert, and being situated in the delta of the Indus was frequently under water: the difficulties of carrying the principal series were great, and enormous additional expense would have been entailed, if the party had delayed their progress with secondary work.

Four principal figures exist north of the Ran: in two of them, the Guni and Randa pentagons, no secondary station was established and no natural object or building intersected at all. In the Koti–Jim double hexagon four domes over the tombs of Muhammadan saints were intersected from two or more principal stations, and in the Dománi pentagon the highest dome of the city of Tatta and three minarets of the large town of Pir Patho were laid down.

September, 1889. S. G. BURRARD.

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. ALPHABETICAL LIST OF STATIONS.

Abanshấh	XXXVIII.
Bábia	XXII.
Bhacháo	I.
Bíbi Mariam	XLII.
Bolári	XI.
Charakra	VIII.
Chitror	XI. (Of the Kattywar Meridional Series).
Dhui	XXXIV.
Dinoda	XV.
Dománi	XLIV.
Gada	XXXIX.
Gángta	VII. (Of the Kattywar Meridional Series).
Guni	XXVIII.
Hakra	XXIX.
Háthria	XVI.
Jamanwála	XXIII.
Jim	XXXII.
Joran	IX.
Kakarwa	III.
Karárho	VII.
Károthol	CIV. (Of the Karáchi Longitudinal Series).
Katror	X.
Khar	XLI.
Koti	XXXV.
Lakhpat	XXV.
Manjal	XVIII.
Mod	XXXI.
Mugalbhin	XXXVII.
Naliya	XVII.
Nara	II.
Nindámani	XXXVI.
Nurlisháh	XXXIII.
Patha-ki-beri	XXX.
Pinjor Pir	XXIV.
Ráhida	IV.
Ran	V.
Randa	XL.
Roha	XIV.
Sáhiji	CVII. (Of the Karáchi Longitudinal Series).
Said Ali	XXVII.
Saind	XIX.
Sakpur	VI.
Sámethra	XII.
Sugandia	XXVI.
Sukpur	XLV.
Sura Gandára	XXI.
Suri Muri	XX.
Vikia	XLIII.
Wándia	XIV. (Of the Kattywar Meridional Series).
Wára	XIII.

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. NUMERICAL LIST OF STATIONS.

VII (Of the Kattywar Meridional Series).	Gángta.
XI (Of the Kattywar Meridional Series).	Chitror.
XIV (Of the Kattywar Meridional Series).	Wándia.
I	Bhacháo.
II	Nara.
III	Kakarwa.
IV	Ráhida.
V	Ran.
VI	Sakpur.
VII	Karárho.
VIII	Charakra.
IX	Joran.
X	Katror.
XI	Bolári.
XII	Sámethra.
XIII	Wára.
XIV	Roha.
XV	Dinoda.
XVI	Háthria.
XVII	Naliya.
XVIII	Manjal.
XIX	Saind.
XX	Suri Muri.
XXI	Sura Gandára.
XXII	Bábia.
XXIII	Jamanwála.
XXIV	Pinjor Pir.
XXV	Lakhpat.
XXVI	Sugandia.
XXVII	Said Ali.
XXVIII	Guni.
XXIX	Hakra.
XXX	Patha-ki-beri.
XXXI	Mod.
XXXII	Jim.
XXXIII	Nurlisháh.
XXXIV	Dhui.
XXXV	Koti.
XXXVI	Nindámani.
XXXVII	Mugalbhin.
XXXVIII	Abansháh.
XXXIX	Gada.
XL	Randa.
XLI	Khar.
XLII	Bíbi Mariam.
XLIII	Vikia.
XLIV	Dománi.
XLV	Sukpur.
CIV (Of the Karáchi Longitudinal Series).	Károthol.
CVII (Of the Karáchi Longitudinal Series).	Sáhiji.

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. DESCRIPTION OF STATIONS.

Of the Principal Stations of this Series those numbered I to XXII, XXIV, XXV, XXXVIII, XLII, XLIV and the two Stations of the Karáchi Series, CIV and CVII, on which this triangulation terminates, are situated on hills or rising ground, and consist of isolated, circular pillars of masonry, either solid or perforated, 3 to 13 feet high, each of which carries a mark-stone (⊙) engraved either on the rock *in sitû* or on a stone embedded at about the ground level. The solid pillars have a mark at the summit and sometimes also one or more other marks engraved on stones inserted in them in the normal of the lower mark. Around the pillars and level with their summits platforms of clay, wood and clay, or other materials, have been constructed for the observatory tent to rest on. At those stations where the pillars are perforated, access to the ground level mark is obtained through an aperture prepared for the purpose. At the remaining stations which were situated in the plains it was found necessary to construct towers to overlook the curvature of the earth. These range from 10 to 27 feet in height, and are built in a similar manner to those already described which have perforated pillars.

The following descriptions have been compiled from those given by the Officers who executed the Series, supplemented as regards adjacent villages from the Topographical Survey maps (where available) of the country traversed, and corrected, so far as the local sub-divisions in which the several stations are situated, from the latest Annual Reports furnished by the District Officers to whose charge the stations are committed.

VII.—(*Of the Kattywar Meridional Series*). Gángta Hill Station, lat. 23° 44′, long. 70° 32′—observed at in 1856—is situated on the highest part of a hill in the Ran. The road from the village of Rau, at the time the station was visited, was dry but the Ran generally around the station was muddy: it is in the lands of Rau village, pargana Wágad, Cutch State. The ruins of a tower and walls are to be seen here, the place having once been the stronghold of freebooters.

The station consists of a platform about 5 feet in height, enclosing an isolated pillar of masonry which is built in a manner similar to those at the adjacent stations. The approximate directions and distances of the following villages are:—Rau S.E., miles 6; and Dauri N., miles 9.

XI.—(*Of the Kattywar Meridional Series*). Chitror or Chitrod Hill Station, lat. 23° 24′, long. 70° 44′—observed at in 1854 and 1856—is situated on the highest point of the hill called Dhia which is within a couple of miles of the town of Chitrod: pargana Wágad, Cutch State.

The station consists of a platform enclosing an isolated pillar of masonry, but as it was not sufficiently large for the stand of the instrument, it had to be increased, in effecting which the height of the pillar was increased a little. This addition of about 6 to 7 inches was made after the 30th March 1854. It was again visited in 1856, but no statement of any alteration in the construction of the station is forthcoming.

XIV.—(*Of the Kattywar Meridional Series*). Wándia Station, Lat. 23° 15′, long. 70° 39′—observed at in 1856—is on the middle tower or bastion at the re-entering angle on the western face of the town wall of Wándia: pargana Wágad, Cutch State.

The station consists of a mud platform, about 5 feet in height, built on the centre of the solid bastion, enclosing an isolated pillar of masonry, which has a mark-stone at its upper surface. The village of Janghi is to S.W. by W., about 3¼ miles.

I. Bhacháo Hill Station, Lat. 23° 18′, long. 70° 23′—observed at in 1857—is situated at the centre of the highest, round bastion or tower at the northern corner of a fort on the summit of the hill. It is in the lands of the village of Bhacháo, pargana Wágad, Cutch State.

The station consists of a platform, about 5 feet in height, enclosing a solid, isolated pillar of masonry, which has a mark-stone at top. The town of Bhacháo lies at the foot of the hill.

II. Nara Hill Station, lat. 23° 26′, long. 70° 36′—observed at in 1856—is situated on one of the hills about 5 miles N.E. of the town of Adhoi, which belongs to Morvi taluka in Kattywar. The little village of Nara, in lands of which the station is, lies at the foot of the hill on the N.W. side: pargana Wágad, Cutch State.

The station consists of a platform of rubble enclosing an isolated pillar of masonry 5 feet in height.

III. Kakarwa Hill Station, lat. 23° 30′, long. 70° 26′—observed at in 1857—is situated on a hill about a mile N. of the village of that name, but in the lands of Lakarwa village: pargana Wágad, Cutch State.

The station consists of a platform of rubble, about 5 feet in height, enclosing an isolated pillar of masonry, which is built in a manner similar to those at the adjacent stations.

IV. Ráhida Station, lat. 23° 28′, long. 70° 12′—observed at in 1857—is on the bank of a tank so called which is in Banni, the name of a tract of pasture land on the borders of and extending into the Ran: pargana Banni, Cutch State.

The station consists of a platform of wood and clay enclosing an isolated pillar of masonry.

V. Ran Station, lat. 23° 37′, long. 70° 19′—observed at in 1857—is in that part of the Ran, which appertains to the lands of the village of Chaubári, and which at the time that the station was visited was encrusted with salt all round as far as the eye could reach: pargana Chaubári, Cutch State.

The station consists of a platform of wood and clay enclosing an isolated pillar of masonry, which is 4·75 feet in height above the general surface of the Ran.

VI. Sakpur, locally called Lathara, Hill Station, lat. 23° 17′, long. 70° 12′—observed at in 1857—is situated on a hill, about 1½ miles W. of the village of Sakpur and 3½ miles S. of Dhamarka. It is in the lands of Sakpur village, pargana Wágad, Cutch State.

The station consists of a platform of rubble, 5 feet in height, enclosing an isolated pillar of masonry.

VII. Karárho Tower Station, lat. 23° 5′, long. 70° 13′—observed at in 1857—is situated on a round tower at the N.E. corner of the village from which the station is named, and in the neighbourhood of the ferry at which the mails cross from Sind to Kattywar: pargana Anjár, Cutch State.

The station consists of a tower, about 13 feet in height, enclosing an isolated pillar of masonry.

VIII. Charakra Hill Station, lat. 23° 9′, long. 70° 2′—observed at in 1857—is situated on a hill so called, about ½ a mile E. of the village of Sapárda, and 2 miles N.E. of the town of Anjár: pargana Anjár, Cutch State.

The station consists of a platform of rubble enclosing an isolated pillar of masonry about 5 feet in height.

IX. Joran Hill Station, lat. 23° 22′, long. 70° 1′—observed at in 1857—is situated about ½ a mile E. of the village from which it derives its name: pargana Miáni, Cutch State.

The station consists of a platform of rubble enclosing an isolated pillar of masonry about 5 feet in height, with mark-stones at top and bottom.

X. Katror Hill Station, lat. 23° 11′, long. 69° 51′—observed at in 1855 and 1857—is situated on the highest part of a hill so called, and about 100 yards W. of a pile of stones which bears the name of Asapura Máta: village Wauri, pargana Banni, Cutch State.

The station consists of a platform enclosing an isolated pillar of masonry 5 feet in height. It was again visited in 1857, but no statement of any alteration in the construction of the station is forthcoming. The directions and estimated distances of the following villages are:—Wauri E., miles 2; Warwa S.W., mile 1; Kukma N.E., miles 5.

XI. Bolári Hill Station, lat. 23° 22′, long. 69° 51′—observed at in 1855 and 1857—is situated on one of the high knolls of the group of hills about 2 miles to the N. of the village from which it takes its name: pargana Bhuj, Cutch State.

The station consists of a platform, about 5 feet in height, enclosing an isolated pillar of masonry, with mark-stones at top and bottom. When again visited in 1857 "the upper mark-stone had been removed, and in placing a new one due attention was not paid to its being plumbed over the lower mark at the level of the ground; the top of the pillar was therefore scored with four cuts, the intersection of which will determine the position of the present mark should it ever be effaced."

XII. Sámethra Hill Station, lat. 23° 10′, long. 69° 33′—observed at in 1855—is situated on the range of hills lying about 2 miles S.W. of the village from which the station has been named: pargana Bhuj, Cutch State.

The station consists of a platform of rubble, 5 feet in height, enclosing an isolated pillar of masonry.

XIII. Wára Hill Station, lat. 23° 21′, long. 69° 36′—observed at in 1855—is situated on the highest part and at the southern extremity of a high, bluff hill, about 8 miles N. of Bhuj. Close to the station is the tomb, surmounted by a lofty flagstaff, of a Fakir and his relatives who formerly frequented the hill: village Tankiasar, pargana Bhuj, Cutch State.

The station consists of a platform, about 5 feet in height, enclosing an isolated pillar of masonry having an aperture on the S. side for access to the lower mark. The village of Tankiasar lies about a mile off on the western side of the hill.

XIV. Roha Hill Station, lat. 23° 12′, long. 69° 19′—observed at in 1855—is situated at the eastern side of the hill fort whence it takes its name, and within a few yards of the easternmost bastion: village Roha, pargana Abrása, Cutch State.

The station consists of a platform, about 4 feet in height, enclosing an isolated pillar of masonry. "The upper mark-stone is supposed to be plumbed over the lower one, but fine scores have been made on the top of the pillar, the intersection of which will determine the position of the present station mark, should it ever be effaced."

XV. Dinoda Hill Station, lat. 23° 27′, long. 69° 23′—observed at in 1855 and 1857—is situated on the western part of the high hill of that name lying towards the northern coast of Cutch, and about 40 yards E. of a small Hindu temple. It is in the lands appertaining to the village of Dinoda, pargana Abrása, Cutch State.

The station consists of a platform of rubble, 5 feet in height, enclosing an isolated pillar of masonry. It was again visited in 1857, but no statement of any alteration in the construction of the station is forthcoming.

XVI. Háthria Hill Station, lat. 23° 27′, long. 69° 5′—observed at in 1855 and 1857—is situated on the highest part of a range of hills. It is in the lands of Naithra village which lies about 3 miles to S., pargana Abrása, Cutch State.

The station consists of a platform of rubble, 5 feet in height, enclosing an isolated pillar of masonry, with an aperture for access to the lower mark-stone. It was again visited in 1857, but no statement of any alteration in the construction of the station is forthcoming.

XVII. Naliya Station, lat. 23° 14′, long. 68° 52′—observed at in 1855 and 1857—is situated on the rising ground about 2 miles S. of the town from which the station has been named: pargana Abrása, Cutch State.

The station consists of the usual platform of rubble, about 5 feet in height, enclosing an isolated pillar of masonry. It was again visited in 1857, but no statement of any alteration in the construction of the station is forthcoming.

XVIII. Manjal, locally called Shersháh, Hill Station, lat. 23° 38′, long. 69° 11′—observed at in 1857—

is situated on the highest part of the hill from which it takes its name, and about a mile S.E. of the village of Nára: pargana Kora, Cutch State.

The station consists of a platform, about 5 feet in height, enclosing an isolated pillar of masonry.

XIX. Saind Hill Station, lat. 23° 25′, long. 68° 49′—observed at in 1857—is situated on a hill which is in lands of Ida village: pargana Jakháwu, Cutch State.

The station consists of a platform of loose rubble enclosing an isolated pillar of masonry 4 feet in height, with an aperture on the S. side for access to the lower mark.

XX. Suri Muri, locally named Suri Bhit, Hill Station, lat. 23° 33′, long. 68° 47′—observed at in 1857—is situated on a hill about $\frac{1}{4}$ of a mile E. of the village of Chakrahi to which it appertains: pargana Abrása, Cutch State.

The station consists of a tower of stone and earth, 12 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated, having an aperture of 3 feet by 2 feet on the S. side for access to the lower mark.

XXI. Sura Gandára Hill Station, lat. 23° 40′, long. 68° 59′—observed at in 1857—is situated on the highest of the Gandára hills, about 3 miles S.W. of the village of Kora, and in the lands appertaining to Sokapur village which is at the foot of the hill: pargana Gardo, Cutch State.

The station consists of a platform of rubble enclosing an isolated pillar of masonry about 5 feet in height.

XXII. Bábia Hill Station, lat. 23° 42′, long. 68° 49′—observed at in 1857—is situated on the low, rocky hill about a mile N. of the hamlet of Bábia: pargana Gardo, Cutch State.

The station consists of a platform of rubble, about 10 feet in height, enclosing a pillar of masonry of which the upper 5 feet is isolated.

XXIII. Jamanwála Tower Station, lat. 23° 35′, long. 68° 39′—observed at in 1857—stands at a distance of about $\frac{3}{8}$ of a mile N.E. of the village so called. It is in the lands of Lakmi Ráni village, pargana Gardo, Cutch State.

The station consists of a tower of loose rubble, 12 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated, having an aperture of 3 feet by 2 feet, on the S. side for access to the lower mark.

XXIV. Pinjor Pir Hill Station, lat. 23° 43′, long. 68° 36′—observed at in 1857 and 1858—is situated on a sand hillock locally called Bhorda Bhit, on the bank of the Kori Salt river: village Náráyan Sir, pargana Lakhpat, Cutch State.

The station consists of a platform of loose rubble enclosing a perforated pillar of masonry 12 feet in height, with an aperture on the S. side for access to the lower mark. It was again visited in 1858, but no statement of any alteration in the construction of the station is forthcoming. The town of Náráyan Sir is about 4 miles to S.W., and Kotesar about as far but more westerly.

XXV. Lakhpat Station, lat. 23° 49′, long. 68° 50′—observed at in 1857 and 1858—is upon the south-eastern and highest tower of the town of Lakhpat on the left bank of the Kori mouth of the Indus river: pargana Lakhpat, Cutch State.

The station consists of the usual platform of rubble, 5 feet in height, enclosing an isolated pillar of masonry. It was again visited in 1858, but no statement of any alteration in the construction of the station is forthcoming.

XXVI. Sugandia Tower Station, lat. 23° 52′, long. 68° 32′—observed at in 1858—is situated about 8 miles W. of Kot Bhasti Bandar village, and 12 miles S.W. of Guni; it takes its name from a village said to have existed in the locality at a former time: taluka Játi, district Sháhbandar, Karáchi.

The station consists of a tower of masonry, 24 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture gives access to the lower mark.

XXVII. Said Ali Tower Station, lat. 23° 56′, long. 68° 43′—observed at in 1858—is about 4 miles from *Kotir* the hut and platform for the refuge of travellers between Cutch and Sind, and $1\frac{3}{4}$ miles S.E. of Bulji Chauki: taluka Játi, district Sháhbandar, Karáchi.

The station consists of a tower of masonry, 24 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture gives access to the lower mark. Kot Bhasti Bandar is to S.S.W., about 6 miles.

XXVIII. Guni Tower Station, lat. 24° 2', long. 68° 35'—observed at in 1858—is about a mile E. of the village of Guni at which there is a Dharmshála (rest house), and about ½ a mile N. of Loharwárikar northernmost boundary: taluka Játi, district Karáchi.

The station consists of a tower of sun-dried bricks and mud cement enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture on the S. side, which is now closed up, gave access to the lower mark.

XXIX. Hakra Tower Station, lat. 24° 7', long. 68° 44'—observed at in 1858—stands in the Ran and about 2¼ miles N. of the southern edge of the Hakriwaro Nar: taluka Játi, district Karáchi.

The station consists of a tower of masonry, 24 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture gives access to the mark.

XXX. Patha-ki-beri, locally known as Sírkap, Tower Station, lat. 24° 3', long. 68° 25'—observed at in 1858—stands on a small mound on the Sugandia creek on which there is a small shrine, and about 10 miles W. of Guni: taluka Játi, district Karáchi.

The station consists of a tower of masonry, 25 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture gives access to the lower mark. The village of Sháh Samálio is about 5 miles to N.E.

XXXI. Mod Tower Station, lat. 24° 12', long. 68° 34'—observed at in 1858—stands in a patch of land which had been under cultivation, and is about 2 miles E. of the Tappa Dâk Chauki at Vehr: taluka Játi, district Karáchi.

The station consists of a tower of masonry, 25 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture gives access to the lower mark. The village of Dhand is about 1½ miles to W.

XXXII. Jim Tower Station, lat. 24° 13', long. 68° 22'—observed at in 1858—stands about 4 miles S. of the village of Miáni: taluka Játi, district Karáchi.

The station consists of a tower enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture on the S. side gives access to the lower mark. The approximate directions and distances of the following villages are:—Jehánkhán N.E., miles 3; and Kunwáro Ghot E., miles 4.

XXXIII. Nurlisháh or Nursháh Tower Station, lat. 24° 7', long. 68° 16'—observed at in 1858—stands about 2 miles N.E. of Allah Mehmán's old tomb, and some 4 miles S. of the village of Jatanjo, the country in the neighbourhood being a waste: taluka Játi, district Karáchi.

The station consists of a tower, but no particulars of its construction are forthcoming; it may however be presumed that it is similar to those at the adjacent stations. The approximate directions and distances of the following villages are:—Jaltan N.N.W., miles 4; and Kotia Allah Mehmán S.S.W., miles 3.

XXXIV. Dhui Tower Station, lat. 24° 20', long. 68° 29'—observed at in 1858—stands in a patch of arable land subject to inundation, and is about 10 miles S.E. of the town of Mugalbhin: taluka Játi, district Karáchi.

The station consists of a tower enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture on the S. side gives access to the lower mark. Pindi Ráj and Hasan Lund villages are about 2½ miles to S.E.

XXXV. Koti Tower Station, lat. 24° 16', long. 68' 12'—observed at in 1858—stands about a mile S. of the village of Koti on the road from Mugalbhin to Sháhbandar: taluka Játi, district Karáchi.

The station consists of a tower, 27 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture gives access to the lower mark. The approximate directions and distances of the following villages are:—Hasan Ját S.W., mile ¾; Chach W., miles 2½; and Buteh S.S.W., miles 1¼.

XXXVI. Nindámani, locally called Sháh Miro, Tower Station, lat. 24° 11', long. 68° 3'—observed at in 1858—is about a mile N.W. of Nindámani village, and some 6 miles E. of the town of Sháhbandar: village Jholu, taluka Sháhbandar, district Karáchi.

The station consists of a tower of brick and clay enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: a passage roofed with wood gives access to the lower mark. The approximate directions and distances of the following villages are:—Doli Mirani S.E., miles 1¼; and Musijo Ghoti W.N.W., miles 3½.

XXXVII. Mugalbhin, locally called Jhurra, Tower Station, lat. 24° 21′, long. 68° 20′—observed at in 1858—is about a mile E. of the town from which it takes its name, and a few hundred yards from the huts known as Khere-ka-wála: taluka Játi, district Karáchi.

The station consists of a tower, 20 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated, having an arched aperture for access to the lower mark. The village of Khamisa Kheru is about ¾ of a mile to N.E.

XXXVIII. Abansháh, local name Abansháhjo Takiar, Hill Station, lat. 24° 22′, long. 68° 1′—observed at in 1858—is situated on the southern extremity of a hill on the road from Sujáwal to Sháhbandar; the hill is used as a place of burial for the chief people of the surrounding districts, and appertains to the village of Khamiso Majawar: taluka Sháhbandar, district Karáchi.

The station consists of a platform of stone and clay enclosing an isolated and perforated pillar of masonry 10 feet in height: an arched aperture on the E. side gives access to the lower mark. The approximate directions and distances of the following villages are:—Shekh Husainsháh N., mile ½; Ibrahim Odajo S.E., mile 1; and Sháh Yakik E., miles 5.

XXXIX. Gada, locally called Bakhi, Tower Station, lat. 24° 26′, long. 68° 13′—observed at in 1858—is about a mile S. of the village of Gada, and 8 miles N.W. of the town of Mugalbhin. It is in the lands of the village of Makán Bakhi, taluka Játi, district Karáchi.

The station consists of a tower of brick and clay, 25 feet in height, enclosing a perforated pillar of masonry of which the upper 5 feet is isolated: an arched aperture gives access to the lower mark. The approximate directions and distances of the following villages are:—Kásim Gada N.W., mile ½; Husain Baka S.S.E., miles 2½; and Muhammad Hingora S., miles 2.

XL. Randa, also known as Rakhal, Tower Station, lat. 24° 32′, long. 68° 5′—observed at in 1858—stands at a distance of ⅛ of a mile N. of the village from which it takes its name: taluka Sujáwal, district Karáchi.

The station consists of a tower enclosing a perforated pillar of masonry 25 feet in height of which the upper 5 feet is isolated: an arched aperture on the S. side gives access to the ground level mark. The approximate directions and distances of the circumjacent villages are:—Karmali Khosa S.W., miles 2; and Alamkhán E., miles 3.

XLI. Khar Tower Station, lat. 24° 36′, long. 68° 13′—observed at in 1858—stands adjoining the small village of Khar which appertains to Deh Abad Páncho, and is about 5 miles E. of the town of Sujáwal: taluka Sujáwal, district Karáchi.

The station consists of a tower of brick and mud, 25·08 feet in height, enclosing a perforated pillar of masonry: an arched aperture on the S. side gives access to the lower mark. The approximate directions and distances of the following villages are:—Nindo Baran (new) S.SW., mile ½; and Rajo Mian N.E., miles 1¼.

XLII. Bíbi Mariam, locally called Bíbi Mariamjo Thul, Hill Station, lat. 24° 33′, long. 67° 56′—observed at in 1858—is situated on a hill so called, close to the road from Tatta to Kotri Allahrakhyo and about ¾ of a mile S.E. of the well known place of Pir Patho: village Pir Patho, taluka Tatta, division Jerruck, district Karáchi.

The station consists of a platform enclosing an isolated and perforated pillar of masonry 5 feet in height, and having an arched aperture on the S. side for access to the lower mark. The approximate directions and distances of the following villages are:—Themáni N.E., miles 5; and Gházi Chándia W., miles 5.

XLIII. Vikia Tower Station, lat. 24° 42′, long. 68° 6′—observed at in 1858—stands a few hundred yards N.N.E. of Vikia village to which it appertains, and is about ¼ of a mile off the high road between Mugalbhin and Belo: taluka Sujáwal, district Karáchi.

The station consists of a mud tower, 20 feet in height, enclosing a perforated pillar of brickwork of which the upper 5 feet is isolated: an arched aperture on the S. side gives access to the lower mark. The approximate directions and distances of the circumjacent villages are:—Belo N., miles 2½; Isa Mohana S.E., mile ¼; and Kadu Mula N., mile ½.

XLIV. Dománi, locally called Domanjo Thul, Hill Station, lat. 24° 40′, long. 67° 54′—observed at in 1858—is situated on a hill about 1 mile N.W., of the village of Dománi (Chota), and ¼ of a mile off the high road from Tatta to the village of Ghulám Muhammad: taluka Tatta, division Jerruck, district Karáchi.

The station consists of a platform of masonry enclosing a hollow, isolated pillar of masonry 5 feet in height: an arched aperture on the S. side gives access to the lower mark. The approximate directions and distances of the circumjacent villages are:—Dománi W., miles 2; Kalan Kot S., miles 3; and Zakrio Khajo E., miles 2.

XLV. Sukpur, locally known as Sukpurwáro Thul, Tower Station, lat. 24° 33′, long. 67° 45′—observed at in 1857—is about a mile S. of the village of Sukpur, and 4 miles E. of the town of Mirpur Sákro. It is in the lands of Makán Gházi Deh Sukpur, tappa Mirpur, taluka Sákro, district Karáchi.

The station consists of a tower enclosing a perforated pillar of masonry 10 feet in height of which the upper 5 feet is isolated: an arched aperture on the S. side gives access to the lower mark. The nearest villages are Sukpur Gházi Khán and Umedali.

CIV.—(*Of the Karáchi Longitudinal Series*). Károthol, locally called Kárewáro Thul, Hill Station, lat. 24° 54′, long. 67° 56′—observed at in 1853 and 1857—is situated on the highest part of a hill so called, which appertains to the village of Suf Shoro: taluka Tatta, division Jerruck, district Karáchi.

The station consisted of a platform enclosing a solid, circular and isolated pillar of masonry, 3 feet in height, which had a mark-stone at top, another at bottom, and a third 1 foot below the former. It was again visited in 1857 in the course of the Cutch Coast Series Operations when the upper mark-stone having been destroyed the station was rebuilt with a perforated pillar and with an aperture to admit of access to the lower mark. In cutting down the pillar intermediate marks were found but these were engraved on such small stones that from the pillar being built solid over them they were displaced before they were detected. The Railway Station of Jhimpir is 3 miles to N. There is no village in the neighbourhood, excepting a few huts on the verge of a pool of water to S. of the station, which are generally occupied by herdsmen.

CVII.—(*Of the Karáchi Longitudinal Series*). Sáhiji or Sahij Hill Station, lat. 24° 51′, long 67° 38′—observed at in 1853 and 1857—is situated on a small mound so called, adjoining a tomb on the northern edge of a long flat range of hills, forming the southern bank of a stream or dry watercourse, from which it is distant about 300 yards. It is 1½ miles S. of the small and well known temple of Runpitiáni close to the hill road from Karáchi to Kotri: taluka Tatta, district Karáchi.

The station consists of a platform enclosing a solid, circular and isolated pillar of masonry 3 feet in height, which has a mark-stone at surface, another at level of foundation, and a third 2 feet above the latter. It was again visited in 1857 in the course of the Cutch Coast Series Operations, but no statement of any alteration in the construction of the station is forthcoming.

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

April 1880.

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. OBSERVED ANGLES.

At XI (Chitror)

November 1856; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIV 115° 46′	295° 46′	125° 56′	305° 56′	136° 7′	316° 7	146° 18′	326° 18′	156° 24′	336° 24′	166° 34′	346° 35′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XIV & I	″ *h* 23·40 *h* 23·83	″ *h* 25·00 *h* 26·84	″ *h* 26·03 *h* 26·40	″ *h* 24·60 *h* 26·50 *h* 27·14	″ *l* 30·80 *l* 30·70	″ *l* 28·53 *l* 29·53	″ *h* 33·90 *h* 35·27	″ *h* 28·26 *h* 29·63	″ *l* 37·26 *l* 36·37	″ *h* 27·84 *l* 28·37	″ *l* 31·14 *l* 32·30	″ *l* 28·10 *l* 28·43	$M = 29''·17$ $w = 0·82$ $\frac{1}{w} = 1·22$
	23·62	25·92	26·21	26·08	30·75	29·03	34·59	28·94	36·82	28·10	31·72	28·27	$C = 49° 40' 29''·17$
I & II	*h* 62·90 *h* 64·13	*h* 57·80 *h* 57·63	*h* 57·04 *h* 58·23	*h* 53·90 *h* 54·16	*l* 54·23 *l* 53·53	*l* 52·33 *l* 52·20	*h* 57·54 *h* 55·33	*h* 56·40 *h* 55·07	*l* 52·94 *l* 53·63	*h* 60·03 *l* 59·20	*l* 56·90 *l* 55·93	*l* 61·53 *l* 60·74	$M = 56''·81$ $w = 1·05$ $\frac{1}{w} = 0·95$
	63·52	57·71	57·64	54·03	53·88	52·26	56·44	55·73	53·29	59·61	56·42	61·13	$C = 38° 21' 56''·81$

At XIV (Wándia)

November and December 1856; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on I 258° 30′	78° 30′	268° 40′	88° 40′	278° 51′	98° 51′	288° 57′	108° 57′	299° 8′	119° 8′	309° 19′	129° 19′	*M* = Mean of Groups *w* = Relative Weight C = Concluded Angle
I & II	″ *h* 51·97 *h* 52·70	″ *h* 45·76 *h* 45·03	″ *h* 47·80 *h* 46·10 *h* 47·56	″ *h* 46·17 *h* 44·20	″ *h* 50·50 *h* 50·23	″ *l* 52·57 *l* 50·90	″ *l* 53·47 *l* 52·77	″ *l* 51·10 *l* 51·36	″ *l* 52·70 *l* 51·90	″ *h* 50·06 *h* 49·97	″ *h* 50·14 *l* 47·27 *l* 49·97	″ *h* 51·63 *h* 50·37	$M = 49''·91$ $w = 1·61$ $\frac{1}{w} = 0·62$
	52·34	45·39	47·15	45·19	50·36	51·74	53·12	51·23	52·30	50·01	49·13	51·00	$C = 61° 12' 49''·91$

Note.—Stations XI and XIV appertain to the Kattywar Meridional Series.

At XIV (Wándia)—(*Continued*).

Angle between	Circle readings, telescope being set on I 258° 30′	78° 30′	268° 40′	88° 40′	278° 51′	98° 51′	288° 57′	108° 57′	299° 8′	119° 8′	309° 19′	129° 19′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
II & XI	″ *h* 56·53 *h* 55·36	″ *h* 60·14 *h* 60·04	″ *h* 61·40 *h* 62·70 *h* 62·47	″ *h* 63·30 *h* 63·30	″ *h* 58·17 *h* 59·07	″ *l* 63·17 *l* 64·10	″ *l* 54·96 *l* 55·56	″ *l* 58·27 *l* 57·10	″ *l* 52·44 *l* 54·40 *h* 53·90	″ *h* 54·54 *h* 54·56	″ *h* 55·10 *l* 53·37	″ *h* 56·17 *h* 56·33	$M = 57''\cdot95$ $w = 0\cdot92$ $\frac{1}{w} = 1\cdot09$ $C = 40° 17' 57''\cdot95$
	55·95	60·09	62·19	63·30	58·62	63·63	55·26	57·69	53·58	54·55	54·23	56·25	

At I (Bhacháo)

January 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on VII 201° 52′	21° 51′	212° 2′	32° 2′	222° 18′	42° 18′	232° 19′	52° 19′	242° 30′	62° 30′	252° 41′	72° 41′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
VII & VI	″ *l* 8·17 *l* 9·00	″ *l* 18·17 *l* 18·97	″ *h* 17·30 *h* 16·40	″ *l* 18·70 *l* 18·96	″ *l* 16·50 *l* 14·06 *l* 14·16	″ *l* 15·26 *l* 15·80	″ *h* 9·73 *h* 9·23	″ *h* 12·20 *h* 13·50	″ *l* 13·43 *l* 12·67	″ *l* 12·40 *l* 10·70	″ *h* 13·64 *h* 13·57	″ *h* 11·34 *h* 11·74	$M = 13''\cdot78$ $w = 1\cdot09$ $\frac{1}{w} = 0\cdot92$ $C = 47° 41' 13''\cdot78$
	8·59	18·57	16·85	18·83	14·91	15·53	9·48	12·85	13·05	11·55	13·60	11·54	
VI & IV	*l* 15·47 *l* 16·93	*l* 13·16 *l* 12·54	*l* 15·54 *h* 17·27	*l* 13·90 *l* 11·00 *l* 15·00	*l* 18·00 *l* 21·04 *l* 18·24	*l* 16·57 *l* 17·96	*h* 13·47 *h* 16·77 *h* 15·30	*h* 15·16 *h* 16·36	*l* 14·07 *l* 15·83	*l* 13·54 *l* 13·94	*h* 16·23 *h* 15·57	*l* 16·00 *l* 17·10	$M = 15''\cdot60$ $w = 3\cdot38$ $\frac{1}{w} = 0\cdot30$ $C = 49° 54' 15''\cdot60$
	16·20	12·85	16·41	13·30	19·09	17·26	15·18	15·76	14·95	13·74	15·90	16·55	
IV & III	*l* 26·56 *l* 26·40	*l* 29·24 *l* 29·06	*l* 28·60 *h* 28·53	*l* 28·64 *l* 31·40 *l* 29·40	*l* 25·90 *l* 24·66	*l* 34·33 *l* 33·17	*h* 28·40 *h* 28·00	*h* 27·00 *h* 26·50	*l* 27·50 *l* 26·50	*l* 30·00 *l* 29·10	*h* 26·17 *h* 25·00	*l* 30·64 *l* 30·43	$M = 28''\cdot39$ $w = 2\cdot04$ $\frac{1}{w} = 0\cdot49$ $C = 60° 33' 28''\cdot39$
	26·48	29·15	28·57	29·81	25·28	33·75	28·20	26·75	27·00	29·55	25·58	30·54	
III & II	*l* 24·83 *l* 24·26	*l* 25·93 *l* 27·50	*l* 26·73 *h* 29·07 *h* 29·87	*h* 28·13 *l* 26·53	*l* 29·60 *l* 30·84	*l* 26·30 *l* 28·00 *l* 28·20	*h* 34·87 *h* 34·00	*h* 32·64 *h* 33·34	*l* 34·70 *l* 34·47	*l* 30·10 *l* 31·03	*h* 29·16 *h* 29·66	*l* 25·83 *l* 26·20	$M = 29''\cdot41$ $w = 1\cdot09$ $\frac{1}{w} = 0\cdot91$ $C = 39° 6' 29''\cdot41$
	24·55	26·71	28·56	27·33	30·22	27·50	34·44	32·99	34·58	30·57	29·41	26·01	
II & XI	*l* 40·27 *l* 40·27	*l* 40·47 *l* 40·76	*l* 38·40 *h* 35·87 *h* 36·80	*h* 35·07 *l* 36·53	*l* 37·30 *l* 35·26 *h* 36·50	*l* 33·40 *l* 31·37 *l* 30·23	*h* 32·80 *h* 32·57	*h* 32·43 *h* 33·13	*l* 29·80 *l* 31·20	*l* 32·30 *l* 33·57	*h* 36·47 *h* 37·24	*l* 35·50 *l* 35·44	$M = 35''\cdot25$ $w = 1\cdot12$ $\frac{1}{w} = 0\cdot89$ $C = 20° 15' 35''\cdot25$
	40·27	40·62	37·02	35·80	36·35	31·67	32·68	32·78	30·50	32·94	36·85	35·47	

NOTE.—Stations XI and XIV appertain to the Kattywar Meridional Series.

At I (Bhacháo)—(*Continued*).

Angle between	Circle readings, telescope being set on VII: 201° 52′	21° 51′	212° 2′	32° 2′	222° 13′	42° 13′	232° 19′	52° 19′	242° 30′	62° 30′	252° 41′	72° 41′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XI & XIV	*l* 46·17 *l* 45·67	*l* 42·30 *l* 45·00 *l* 43·87	*l* 44·50 *h* 44·30	*h* 43·93 *l* 44·07	*l* 43·13 *l* 44·74	*l* 44·96 *l* 46·23	*h* 51·16 *h* 50·50	*h* 48·80 *h* 49·13	*l* 51·80 *l* 50·20	*l* 53·50 *l* 53·60	*h* 44·30 *h* 43·56	*l* 48·93 *l* 49·53	$M = 47''\cdot09$ $w = 1\cdot00$ $\frac{1}{w} = 1\cdot00$ $C = 28^\circ 48' 47''\cdot09$
Mean	45·92	43·72	44·40	44·00	43·94	45·59	50·83	48·97	51·00	53·55	43·93	49·23	

At II (Nara)

December 1856; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XI: 180° 27′	0° 27′	190° 38′	10° 38′	200° 49′	20° 49′	210° 55′	30° 55′	221° 5′	41° 5′	231° 16′	51° 16′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XI & XIV	*h* 39·53 *h* 41·57 *h* 41·70	*h* 38·50 *h* 37·63	*h* 38·26 *h* 39·33	*h* 39·27 *h* 38·76	*l* 32·10 *l* 33·26 *l* 32·27	*l* 42·57 *l* 41·67 *l* 42·24	*h* 40·93 *h* 39·77	*h* 44·53 *h* 44·43	*l* 36·64 *l* 37·94	*l* 39·57 *l* 39·00	*l* 36·83 *l* 36·26	*l* 34·93 *l* 36·33	$M = 38''\cdot76$ $w = 1\cdot21$ $\frac{1}{w} = 0\cdot83$ $C = 51^\circ 39' 38''\cdot76$
Mean	40·93	38·07	38·79	39·02	32·54	42·16	40·35	44·48	37·29	39·28	36·55	35·63	
XIV & I	*l* 47·00 *l* 46·70	*l* 49·20 *h* 48·37	*l* 47·90 *l* 48·43	*l* 47·27 *l* 45·60 *l* 46·80 *d* 44·72	*l* 54·50 *l* 53·70 *l* 53·13	*l* 42·70 *l* 42·97 *l* 40·80	*l* 47·96 *l* 48·57	*l* 42·33 *l* 41·53	*l* 51·70 *l* 50·83	*l* 49·10 *l* 49·10	*l* 52·14 *l* 53·77	*l* 51·20 *l* 50·47	$M = 48''\cdot35$ $w = 0\cdot85$ $\frac{1}{w} = 1\cdot17$ $C = 69^\circ 42' 48''\cdot35$
Mean	46·85	48·79	48·16	46·10	53·78	42·16	48·27	41·93	51·26	49·10	52·96	50·83	
I & III	*l* 56·43 *l* 56·76	*l* 58·00 *h* 57·17	*l* 57·60 *l* 57·87	*l* 58·97 *l* 60·73 *d* 58·01	*l* 50·66 *l* 49·94 *l* 51·87	*l* 65·13 *l* 66·16 *l* 63·70	*l* 57·50 *l* 57·27	*l* 57·93 *l* 57·57	*l* 58·76 *l* 58·43	*l* 57·16 *l* 58·56	*l* 52·46 *l* 53·03	*l* 56·04 *l* 57·03	$M = 57''\cdot32$ $w = 1\cdot00$ $\frac{1}{w} = 1\cdot00$ $C = 58^\circ 10' 57''\cdot32$
Mean	56·60	57·58	57·74	59·24	50·82	65·00	57·38	57·75	58·60	57·86	52·74	56·54	
III & VII	*l* 54·14 *l* 55·44	*h* 56·87 *l* 55·83 *h* 56·30	*h* 58·26 *h* 57·13	*l* 54·23 *h* 56·07 *h* 54·57	*l* 60·86 *l* 60·34 *l* 60·53	*l* 51·50 *l* 49·87	*h* 55·83 *h* 55·87	*h* 58·30 *h* 56·87	*h* 55·40 *l* 52·87 *l* 53·60	*h* 57·30 *h* 56·47	*l* 54·97 *l* 55·07	*l* 52·70 *l* 51·00 *l* 51·03	$M = 55''\cdot49$ $w = 1\cdot61$ $\frac{1}{w} = 0\cdot62$ $C = 59^\circ 7' 55''\cdot49$
Mean	54·79	56·33	57·70	54·96	60·58	50·68	55·85	57·59	53·96	56·88	55·02	51·58	

NOTE.—Stations VII, XI and XIV appertain to the Kattywar Meridional Series.

At III (Kakarwa)

January 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on II 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
II & I	″ *h* 38·43 *h* 38·90 *h* 38·33	″ *h* 33·77 *h* 33·43 *h* 33·60 *h* 32·56 *l* 33·20	″ *h* 36·20 *h* 34·80 *h* 34·90	″ *h* 32·94 *h* 33·20 *l* 33·77 *l* 32·57	″ *l* 34·27 *l* 35·60 *l* 35·66	″ *l* 32·63 *l* 33·27 *l* 31·97	″ *h* 39·97 *h* 38·73 *l* 41·14	″ *h* 39·73 *h* 37·36 *h* 38·26 *l* 39·13	″ *h* 38·90 *h* 39·27 *l* 37·27 *l* 37·30	″ *h* 40·97 *l* 41·70 *l* 38·93 *l* 39·04	″ *l* 35·70 *l* 34·87 *h* 37·97 *h* 37·83	″ *l* 36·70 *l* 36·57 *h* 35·87 *h* 35·73	$M = 36''{\cdot}48$ $w = 1{\cdot}68$ $\frac{1}{w} = 0{\cdot}60$ $C = 82^\circ\ 42'\ 36''{\cdot}48$
	38·55	33·31	35·30	33·12	35·18	32·62	39·95	38·62	38·19	40·16	36·59	36·22	
I & IV	*l* 39·00 *h* 39·67 *h* 40·77	*l* 46·66 *l* 43·63 *h* 45·67	*h* 47·14 *h* 46·67 *l* 47·07	*h* 48·06 *h* 47·76 *l* 46·07	*l* 47·90 *l* 47·40 *l* 49·34	*l* 49·24 *l* 48·87 *l* 50·67 *l* 50·93	*l* 48·40 *l* 47·84 *l* 46·96	*l* 50·23 *h* 50·27 *h* 51·94 *l* 48·90	*h* 49·90 *h* 48·86 *l* 51·00	*h* 47·40 *l* 48·20 *h* 47·93	*l* 56·17 *l* 55·10 *h* 52·90 *h* 53·14	*l* 46·00 *l* 46·90 *h* 46·20 *h* 47·30	$M = 47''{\cdot}86$ $w = 0{\cdot}99$ $\frac{1}{w} = 1{\cdot}01$ $C = 68^\circ\ 55'\ 47''{\cdot}86$
	39·81	45·32	46·96	47·30	48·21	49·93	47·73	50·34	49·92	47·84	54·33	46·60	
IV & V	*l* 19·97 *l* 19·00 *h* 19·96 *h* 20·30	*l* 10·20 *l* 11·40 *h* 10·66	*h* 11·30 *h* 11·93 *l* 12·80	*h* 8·47 *h* 8·54 *l* 10·60	*l* 10·66 *l* 9·57 *l* 8·00	*l* 7·33 *l* 6·43 *l* 3·96 *l* 4·20	*l* 11·50 *l* 10·26 *l* 8·10 *l* 8·83	*l* 6·83 *h* 8·30 *h* 6·90	*h* 6·30 *h* 8·10 *l* 8·20	*h* 9·97 *l* 8·53 *h* 9·30	*l* 4·07 *l* 6·10 *l* 4·40 *h* 6·17 *h* 4·60	*l* 13·90 *l* 13·00 *h* 10·40 *h* 11·00	$M = 9''{\cdot}80$ $w = 0{\cdot}79$ $\frac{1}{w} = 1{\cdot}27$ $C = 51^\circ\ 45'\ 9''{\cdot}80$
	19·81	10·75	12·01	9·20	9·41	5·48	9·67	7·34	7·53	9·27	5·07	12·08	
V & VII	*h* 27·94 *h* 30·40 *h* 28·60 *h* 28·70	*h* 33·20 *h* 34·57	*h* 36·10 *h* 34·97	*h* 35·23 *h* 34·86 *h* 36·77 *h* 37·00	*l* 33·94 *l* 34·43 *l* 32·63 *l* 31·63	*l* 32·77 *l* 34·93 *l* 33·10 *l* 35·23 *l* 35·97	*l* 30·33 *l* 31·94 *l* 32·30 *l* 31·54	*h* 32·50 *h* 33·93 *l* 34·46 *l* 34·23	*h* 36·10 *h* 36·00 *h* 35·34	*h* 31·60 *l* 31·97 *h* 32·14 *h* 32·30	*l* 35·60 *l* 36·17 *h* 36·13	*l* 31·30 *l* 31·73 *h* 31·60	$M = 33''{\cdot}54$ $w = 2{\cdot}36$ $\frac{1}{w} = 0{\cdot}42$ $C = 66^\circ\ 3'\ 33''{\cdot}53$
	28·91	33·89	35·53	35·97	33·16	34·40	31·53	33·78	35·81	32·00	35·97	31·54	
VII & II	*h* 54·64 *h* 53·60 *h* 55·74	*h* 54·66 *h* 53·34 *h* 54·27	*h* 52·67 *h* 54·07	*h* 55·04 *h* 54·87	*l* 52·23 *l* 52·10 *l* 53·90	*l* 57·66 *l* 57·87 *l* 57·93 *l* 56·90	*h* 50·87 *h* 50·37 *h* 51·47 *l* 50·13	*h* 49·17 *h* 49·27 *l* 50·74	*h* 47·70 *h* 47·24 *l* 50·23 *h* 49·73	*l* 50·40 *l* 51·63 *h* 51·77	*l* 48·66 *l* 49·26 *h* 47·43 *h* 48·53	*l* 51·74 *l* 52·30 *h* 53·93	$M = 52''{\cdot}41$ $w = 1{\cdot}55$ $\frac{1}{w} = 0{\cdot}64$ $C = 90^\circ\ 32'\ 52''{\cdot}40$
	54·66	54·09	53·37	54·96	52·74	57·59	50·71	49·73	48·72	51·27	48·47	52·66	

NOTE.—Station VII appertains to the Kattywar Meridional Series.

At VII (Gángta)

December 1856; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on II												*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 11′	20° 22′	200° 23′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	
	″	″	″	″	″	″	″	″	″	″	″	″	
II & III	*h* 9·56 *h* 9·94	*h* 10·94 *h* 9·87	*h* 10·37 *h* 9·40	*l* 8·63 *h* 11·04 *h* 9·63 *h* 10·64	*l* 11·90 *l* 12·90	*l* 10·64 *l* 10·33	*l* 17·43 *l* 18·63	*l* 16·74 *l* 15·44	*l* 16·70 *l* 15·46	*l* 13·14 *l* 15·33 *l* 16·03	*l* 20·07 *l* 19·54	*l* 14·20 *l* 12·16 *l* 11·40 *h* 11·30	$M = 13''\cdot33$ $w = 0\cdot95$ $\frac{1}{w} = 1\cdot05$ $C = 30° 19' 13''\cdot33$
	9·75	10·41	9·88	9·99	12·40	10·48	18·03	16·09	16·08	14·83	19·81	12·26	
III & V	*h* 36·53 *h* 35·54	*h* 35·03 *h* 35·10	*h* 40·07 *h* 40·74 *h* 40·46	*h* 33·27 *h* 33·10	*l* 32·63 *l* 32·66	*l* 28·33 *l* 29·23	*l* 26·94 *l* 28·07	*l* 26·00 *l* 28·00	*l* 29·27 *l* 28·10	*l* 30·06 *l* 30·53	*l* 27·90 *l* 27·53	*l* 31·23 *l* 30·90	$M = 31''\cdot53$ $w = 0\cdot71$ $\frac{1}{w} = 1\cdot41$ $C = 39° 37' 31''\cdot53$
	36·04	35·06	40·42	33·19	32·64	28·78	27·51	27·00	28·68	30·30	27·71	31·07	

At IV (Ráhida)

January 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on V												*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
	160° 8′	340° 8′	170° 19′	350° 19′	180° 29′	0° 29′	190° 35′	10° 35′	200° 45′	20° 45′	210° 57′	30° 57′	
	″	″	″	″	″	″	″	″	″	″	″	″	
V & III	*h* 28·76 *h* 28·04	*h* 27·40 *h* 27·90	*l* 30·13 *l* 29·40	*l* 21·70 *l* 21·37	*h* 21·57 *h* 23·23	*h* 22·73 *h* 21·30	*h* 26·13 *h* 25·67	*l* 27·57 *l* 25·64	*h* 24·00 *h* 23·40	*h* 29·47 *l* 29·70	*h* 28·37 *h* 26·80	*h* 26·64 *h* 28·16	$M = 26''\cdot05$ $w = 1\cdot37$ $\frac{1}{w} = 0\cdot73$ $C = 47° 4' 26''\cdot05$
	28·40	27·65	29·77	21·53	22·40	22·02	25·90	26·60	23·70	29·59	27·58	27·40	
III & I	*h* 42·47 *h* 45·14 *h* 45·87	*h* 51·03 *h* 49·10	*l* 44·37 *l* 43·77	*h* 52·13 *h* 50·20	*h* 45·86 *h* 44·93	*h* 47·23 *h* 46·87	*l* 42·80 *l* 42·40	*l* 43·07 *l* 42·47	*l* 45·30 *l* 44·87	*l* 44·30 *l* 45·76	*h* 46·87 *h* 46·96	*h* 45·53 *h* 45·73	$M = 45''\cdot86$ $w = 1\cdot69$ $\frac{1}{w} = 0\cdot59$ $C = 50° 30' 45''\cdot86$
	44·49	50·07	44·07	51·16	45·40	47·05	42·60	42·77	45·08	45·03	46·92	45·63	
I & VI	*h* 8·93 *h* 8·16	*h* 5·10 *h* 5·77	*h* 10·97 *l* 11·13 *l* 11·87	*h* 6·30 *h* 6·43	*h* 13·10 *h* 13·97	*h* 4·67 *h* 5·20	*l* 4·96 *l* 5·63	*l* 7·53 *l* 6·33	*l* 7·36 *l* 6·56	*l* 4·87 *l* 4·80	*h* 12·43 *h* 9·70 *h* 10·13	*h* 5·10 *h* 7·77 *h* 6·13	$M = 7''\cdot60$ $w = 1\cdot46$ $\frac{1}{w} = 0\cdot69$ $C = 43° 39' 7''\cdot60$
	8·55	5·43	11·32	6·37	13·53	4·94	5·29	6·93	6·96	4·84	10·75	6·33	

Note.—Station VII appertains to the Kattywar Meridional Series.

At IV (Ráhida)—(*Continued*).

Angle between	160° 8′	340° 8′	170° 19′	350° 19′	180° 29′	0° 29′	190° 35′	10° 35′	200° 45′	20° 45′	210° 57′	30° 57′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
VI & IX	h 38·07 h 37·54	h 38·90 h 37·87	l 39·97 l 38·23	h 39·03 h 39·30	h 32·97 h 31·50	h 43·97 h 44·77	l 38·57 l 36·07 l 36·87	l 36·57 l 37·20	l 36·67 l 37·54	l 39·90 l 37·57 l 40·10 h 39·60	h 32·27 h 34·87 h 34·73	h 37·17 h 38·37	
	37·81	38·38	39·10	39·17	32·23	44·37	37·17	36·89	37·10	39·29	33·96	37·77	M = 37″·77 w = 1·32
VI & IX	h 37·73 h 37·03	h 37·77 h 37·83	h 35·97 l 34·90	l 39·53 l 38·97	l 34·64 l 34·33	l 43·17 l 43·60	l 37·73 l 38·03	l 38·83 l 37·67	l 40·13 l 39·30	l 38·07 l 39·83	l 35·20 l 35·23	l 34·90 l 35·14	w = 3·19 1/w = 0·31 C = 58° 38′ 37″·75
	37·38	37·80	35·44	39·25	34·48	43·39	37·88	38·25	39·71	38·95	35·22	35·02	M = 37″·73 w = 1·87

At V (Ran)

January 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
VII* & III	l 53·10 l 53·70	l 50·87 l 51·40	l 56·23 l 58·06	l 50·00 l 49·27	h 52·67 l 54·77 l 53·90	h 45·14 h 44·60	l 52·73 l 51·73	l 54·94 l 53·44	l 55·96 l 57·27	l 52·43 l 53·27	l 55·63 l 55·04	l 53·87 l 54·90	M = 52″·96 w = 1·07 1/w = 0·93
	53·40	51·14	57·14	49·64	53·78	44·87	52·23	54·19	56·61	52·85	55·34	54·38	C = 74° 18′ 52″·96
III & IV	l 18·97 l 20·17	l 26·23 l 24·43	l 19·23 l 19·47	l 26·03 l 25·50	l 26·96 l 24·86	l 27·94 l 29·47	l 25·14 l 24·57	l 26·33 l 25·03	l 23·00 l 23·36	l 27·43 l 27·70	l 26·54 l 29·73 l 27·64	l 25·50 l 23·83	M = 24″·88 w = 1·34 1/w = 0·75
	19·57	25·33	19·35	25·77	25·91	28·70	24·86	25·68	23·18	27·56	27·97	24·67	C = 81° 10′ 24″·88

At VI (Sakpur)

January 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 1′	180° 1′	10° 11′	190° 11′	20° 23′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
I & VII	h 19·40 h 20·07	h 19·13 h 17·76	l 19·10 l 19·86	l 18·17 l 17·30	h 23·84 h 24·90	l 17·10 l 16·76 h 17·20	h 24·33 h 25·16	h 28·17 h 26·96	h 23·80 h 22·20	h 24·37 h 25·14	l 20·43 l 19·76	l 23·67 l 22·50	M = 21″·67 w = 1·06 1/w = 0·94
	19·74	18·44	19·48	17·74	24·37	17·02	24·74	27·57	23·00	24·75	20·10	23·08	C = 94° 40′ 21″·67

NOTE.—Station VII* appertains to the Kattywar Meridional Series.

At VI (Sakpur)—(*Continued*).

Angle between	0° 1′	180° 1′	10° 11′	190° 11′	20° 23′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	Circle readings, telescope being set on I												
	"	"	"	"	"	"	"	"	"	"	"	"	
VII & VIII	*l* 3·57	*l* 9·80	*l* 7·06	*l* 6·17	*h* 1·03	*l* 8·73	*l* 14·66	*h* 8·37	*h* 10·70	*h* 8·80	*l* 14·84	*l* 6·87	$M = 8''\cdot35$
	l 3·13	*l* 9·80	*l* 5·87	*l* 6·66	*h* 0·03	*l* 9·67	*l* 12·74	*h* 8·87	*h* 11·30	*h* 8·60	*l* 15·44	*l* 7·60	$w = 0\cdot73$
					l 0·57								$\frac{1}{w} = 1\cdot37$
	3·35	9·80	6·47	6·41	0·54	9·20	13·70	8·62	11·00	8·70	15·14	7·24	$C = 52^\circ 53' 8''\cdot35$
VIII & IX	*l* 45·03	*l* 42·33	*l* 43·67	*l* 43·96	*h* 48·53	*l* 41·10	*l* 39·07	*h* 39·06	*h* 39·73	*h* 41·36	*l* 34·76	*l* 44·93	$M = 41''\cdot92$
	l 44·60	*l* 43·10	*l* 45·17	*l* 42·17	*h* 47·57	*l* 42·33	*l* 39·86	*h* 39·73	*l* 39·20	*h* 40·50	*l* 33·80	*l* 45·13	$w = 0\cdot94$
					l 47·23								$\frac{1}{w} = 1\cdot06$
	44·82	42·71	44·42	43·07	47·78	41·71	39·47	39·39	39·47	40·93	34·28	45·03	$C = 64^\circ 30' 41''\cdot92$
IX & IV	*h* 5·70	*h* 9·70	*l* 7·33	*l* 8·67	*h* 5·37	*l* 10·10	*h* 8·60	*h* 6·23	*h* 10·04	*h* 7·03	*l* 15·74	*l* 2·73	$M = 8''\cdot03$
	h 7·73	*h* 8·80	*l* 7·26	*l* 8·33	*h* 5·40	*l* 8·27	*h* 8·83	*h* 6·27	*h* 9·20	*h* 7·23	*l* 15·80	*l* 2·83	$w = 1\cdot22$
	l 6·10												$\frac{1}{w} = 0\cdot82$
	6·51	9·25	7·30	8·50	5·38	9·19	8·71	6·25	9·62	7·13	15·77	2·78	$C = 61^\circ 29' 8''\cdot03$
IV & I	*h* 44·23	*h* 42·67	*l* 42·34	*l* 43·07	*h* 40·93	*l* 42·14	*h* 38·00	*h* 37·10	*h* 36·93	*h* 37·47	*l* 34·80	*l* 41·24	$M = 40''\cdot22$
	h 44·57	*h* 43·14	*l* 41·37	*l* 43·60	*h* 40·37	*l* 43·53	*h* 36·24	*h* 38·07	*h* 36·87	*h* 38·73	*l* 34·80	*l* 43·00	$w = 1\cdot19$; $\frac{1}{w} = 0\cdot84$
	44·40	42·91	41·85	43·34	40·65	42·83	37·12	37·59	36·90	38·10	34·80	42·12	$C = 86^\circ 26' 40''\cdot22$

At VII (Karárho)

January 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	258° 35′	78° 35′	268° 46′	88° 46′	278° 57′	98° 57′	289° 3′	109° 3′	299° 13′	119° 13′	309° 24′	129° 24′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	Circle readings, telescope being set on VIII												
	"	"	"	"	"	"	"	"	"	"	"	"	
VIII & VI	*h* 42·77	*h* 35·26	*h* 38·73	*h* 33·37	*h* 42·03	*h* 38·20	*l* 45·44	*l* 44·66	*l* 42·90	*l* 44·90	*l* 41·47	*l* 42·37	$M = 40''\cdot96$
	h 41·83	*h* 36·10	*l* 40·94	*h* 33·96	*h* 41·13	*h* 38·77	*l* 45·10	*l* 45·23	*l* 40·64	*l* 45·10	*l* 40·83	*l* 43·93	$w = 0\cdot87$
			h 37·40						*l* 40·17				$\frac{1}{w} = 1\cdot15$
	42·30	35·68	39·02	33·67	41·58	38·48	45·27	44·95	41·24	45·00	41·15	43·15	$C = 63^\circ 46' 40''\cdot96$

At VII (Karárho)—(*Continued*).

Angle between	Circle readings, telescope being set on VIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	258° 35′	78° 35′	268° 46′	88° 46′	278° 57′	98° 57′	289° 3′	109° 3′	299° 13′	119° 13′	309° 24′	129° 24′	
VI & I	″ h 22·76 h 23·34	″ h 29·50 h 28·30	″ l 28·90 h 28·84	″ h 29·76 h 31·60	″ h 24·80 h 24·57	″ h 29·83 h 30·17	″ l 21·37 l 20·76	″ l 23·64 l 22·77	″ l 19·90 l 19·76	″ l 20·13 l 20·34	″ l 21·20 l 22·73	″ l 23·13 l 22·77	$M = 24''\cdot62$ $w = 0\cdot77$ $\frac{1}{w} = 1\cdot30$
	23·05	28·90	28·87	30·68	24·69	30·00	21·06	23·21	19·83	20·23	21·97	22·95	$C = 37°\ 38'\ 24''\cdot62$

At VIII (Charakra)

February 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on X												M = Mean of Groups w = Relative Weight C = Concluded Angle
	281° 29′	101° 29′	291° 40′	111° 40′	301° 50′	121° 50′	311° 56′	131° 56′	322° 7′	142° 7′	332° 18′	152° 18′	
X & XI	″ l 29·40 l 30·90	″ h 25·10 h 25·53	″ h 24·43 h 24·40	″ h 21·57 h 20·57	″ l 23·50 l 21·63	″ l 22·90 l 22·70	″ l 28·07 l 27·13	″ l 25·00 l 25·00	″ l 19·40 l 21·07 l 21·43	″ l 29·03 l 30·44	″ l 27·33 l 26·97	″ l 30·67 l 30·50	$M = 25''\cdot59$ $w = 0\cdot98$ $\frac{1}{w} = 1\cdot02$
	30·15	25·32	24·41	21·07	22·57	22·80	27·60	25·00	20·63	29·73	27·15	30·59	$C = 42°\ 41'\ 25''\cdot59$
XI & IX	l 21·73 l 22·93	h 24·84 h 27·30 h 28·43	h 25·47 h 24·50	h 30·20 h 28·13 h 27·97	l 22·90 l 23·83	l 30·16 l 29·33	l 19·63 l 19·94	l 21·93 l 21·47	l 23·23 l 21·83 l 23·83	l 19·90 l 20·06	l 22·37 l 22·06	l 20·50 l 21·33	$M = 23''\cdot63$ $w = 1\cdot08$ $\frac{1}{w} = 0\cdot93$
	22·33	26·86	24·99	28·77	23·36	29·75	19·78	21·70	22·96	19·98	22·22	20·91	$C = 35°\ 50'\ 23''\cdot63$
IX & VI	l 1·74 l 1·87	h 6·33 h 4·40 h 5·00	h 6·40 h 6·60	h 3·43 h 3·64 h 3·47	l 9·04 l 9·50	l 2·04 l 2·50	l 10·63 l 10·43	l 6·04 l 5·90	l 6·10 l 5·90 l 5·40	l 3·20 l 2·60	l 3·70 l 4·30	l 1·33 l 0·70	$M = 4''\cdot90$ $w = 1\cdot40$ $\frac{1}{w} = 0\cdot71$
	1·81	5·24	6·50	3·51	9·27	2·27	10·53	5·97	5·80	2·90	4·00	1·01	$C = 52°\ 59'\ 4''\cdot90$
VI & VII	l 16·90 l 17·47	h 10·07 h 10·77	h 10·76 h 11·50	h 13·33 h 13·43	l 10·90 l 9·84	l 13·06 l 11·67	l 6·20 l 5·57	l 11·70 l 12·76	l 9·50 l 8·17 l 8·17	l 13·97 l 13·87	l 11·63 l 9·44 l 10·90	l 12·10 l 12·20	$M = 11''\cdot53$ $w = 1\cdot50$ $\frac{1}{w} = 0\cdot67$
	17·19	10·42	11·13	13·38	10·37	12·36	5·89	12·23	8·61	13·92	10·66	12·15	$C = 63°\ 20'\ 11''\cdot53$

At IX (Joran)

January 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IV 300° 8′	120° 8′	310° 19′	130° 19′	320° 30′	140° 30′	330° 35′	150° 35′	340° 46′	160° 46′	350° 57′	170° 57′	M = Mean of Groups w = Relative Weight C = Concluded Angle
IV & VI	″ h 17·80 h 18·40	″ h 17·80 h 17·06	″ l 15·73 l 16·63	″ l 18·53 l 19·17	″ l 13·63 l 10·30 h 12·07	″ h 19 50 h 19·84	″ h 18·03 h 17·86	″ h 15·73 h 16·04	″ h 15·33 h 15·97	″ h 17·63 h 16·57	″ h 13·80 h 12·90	″ h 17·50 h 15·67 h 16·87	$M = 16''\cdot57$ $w = 2\cdot41$ $\frac{1}{w} = 0\cdot42$
	18·10	17.43	16·18	18·85	12·00	19·67	17·95	15·88	15·65	17·10	13·35	16·68	$C = 59° 52' 16''\cdot57$
VI & VIII	h 14·60 h 13·96	h 13·77 h 15·27	l 14·60 l 15·04	l 12·80 l 13·90	l 17·27 l 19·43 h 18·70	h 10·46 h 9·83	h 14·44 h 14·27	h 13·60 h 13·10	h 14·20 h 14·90	h 11·87 h 14·63	h 18·70 h 17·56	h 13·16 h 13·53 h 12·80	$M = 14''\cdot37$ $w = 2\cdot36$ $\frac{1}{w} = 0\cdot42$
	14·28	14·52	14·82	13·35	18·47	10·15	14·35	13·35	14·55	13·25	18·13	13·16	$C = 62° 30' 14''\cdot37$
VIII & X	h 6·04 h 5·30	h 7·30 h 5·17 h 7·26	l 10·03 l 10·00	l 10·17 l 10·66	l 6·16 l 5·50	h 12·80 h 12·20	h 7·36 h 8·37	h 11·23 h 12·80	h 6·63 h 8·23	h 9·07 h 10·63	h 4·80 h 3·90	h 7·64 h 8·87 h 8·56	$M = 8''\cdot41$ $w = 1\cdot75$ $\frac{1}{w} = 0\cdot57$
	5·67	6·58	10·02	10·41	5·83	12·50	7·87	12·01	7·43	9·85	4·35	8·36	$C = 44° 48' 8''\cdot41$
X & XI	h 18·96 h 20·77	h 23·63 h 23·20	l 21·07 l 21·03	l 22·60 l 21·00	l 25·64 l 26·64	h 25·10 h 26·70	h 25·67 h 26·70	h 23·64 h 23·86	h 30·07 h 31·04	h 27·00 h 26·10	h 31·54 h 30·17	h 26·83 h 29·03 h 27·30	$M = 25''\cdot32$ $w = 0\cdot97$ $\frac{1}{w} = 1\cdot03$
	19·87	23·41	21·05	21·80	26·14	25·90	26·19	23·75	30·55	26·55	30·86	27·72	$C = 48° 42' 25''\cdot32$

At X (Katror)

December 1855 *and February* 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XII 320° 34′	140° 34′	330° 44′	150° 44′	340° 55′	160° 55′	351° 1′	171° 1′	1° 12′	181° 12′	11° 22′	191° 22′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XII & XIII	″ h 6·07 h 5·43	″ h 12·36 h 11·07	″ l 9·57 l 10·14	″ l 10·84 l 12·00	″ l 7·10 l 7·63	″ l 13·74 l 13·50	″ l 7·40 l 8·50	″ l 5·24 l 7·03	″ l 2·94 l 3·60	″ l 3·20 l 4·70	″ l 4·63 l 3·44 l 5·67 l 6·70	″ l 6·63 l 7·84	$M = 7''\cdot78$ $w = 1\cdot11$ $\frac{1}{w} = 0\cdot90$
	5·75	11·72	9·85	11·42	7·37	13·62	7·95	6·13	3·27	3·95	5·11	7·24	$C = 39° 27' 7''\cdot78$

At X (Katror)—(*Continued*).

Angle between	Circle readings, telescope being set on XII 320° 34′	140° 34′	330° 44′	150° 44′	340° 55′	160° 55′	351° 1′	171° 1′	1° 12′	181° 12′	11° 22′	191° 22′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XIII & XI	h 47·90 h 46·86 h 48·30 h 48·87	h 48·44 h 49·74 h 48·27 h 48·76	l 51·24 l 49·50	l 46·86 l 47·20	l 51·33 l 50·33	l 43·66 l 42·23	l 50·00 l 50·43	l 48·66 l 48·03	l 46·56 l 47·10	h 45·70 h 46·03 l 46·53 l 45·70	l 44·00 l 44·23 l 45·00 l 44·54	h 42·50 l 43·33 l 44·20 l 43·56	$M = 47''\cdot27$ $w = 1\cdot66$ $\frac{1}{w} = 0\cdot60$ $C = 56°\ 35'\ 47''\cdot27$
	47·98	48·80	50·37	47.03	50·83	42·95	50·21	48·35	46·83	45·99	44·44	43·40	
XI & IX	h 39·86 h 39·40 h 40·17 h 38·93	h 35·36 h 34·00 h 35·83 h 35·14	l 34·93 l 35·56 h 38·16 h 38·77	l 35·07 l 35·96 h 37·44 h 37·27	l 38·23 l 38·44 h 37·40 h 37·33	l 41·00 l 42·64 l 41·80 l 41·00	l 36·73 l 36·44 l 36·30 l 35·36	l 42·57 l 41·54 l 38·10 l 39·70	l 40·04 l 39·86 l 39·70 l 39·90	h 45·47 h 46·43 l 44·10 l 43·50	l 42·77 l 41·30 l 39·90 l 40·13	h 44·07 l 42·44 l 40·33 l 40·74	$M = 39''\cdot32$ $w = 1\cdot40$ $\frac{1}{w} = 0\cdot72$ $C = 40°\ 11'\ 39''\cdot32$
	39·59	35·08	36·86	36·43	37·85	41·61	36·21	40·48	39·88	44·87	41·03	41·89	
IX & VIII	h 59·00 h 60·17	h 63·44 h 63·83	h 64·90 h 63·06 h 64·66	h 67·40 h 66·66	l 62·93 l 62·13	l 66·93 l 67·03	l 67·60 l 68·30	l 66·80 l 65·50	l 70·54 l 69·73	l 65·03 l 64·66	l 72·77 l 73·43	l 63·74 l 64·53	$M = 65''\cdot86$ $w = 0\cdot94$ $\frac{1}{w} = 1\cdot07$ $C = 56°\ 40'\ 5''\cdot86$
	59·59	63·63	64·21	67·03	62·53	66·98	67·95	66·15	70·14	64·84	73·10	64·14	

At XI (Bolári)

**December* 1855; *and* †*February* 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms' 18-inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on IX 268° 54′	88° 54′	279° 6′	99° 6′	289° 16′	109° 16′	299° 22′	119° 22′	309° 33′	129° 33′	319° 44′	139° 44′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
† IX & VIII	h 7·27 h 7·93	h 3·17 h 2·30	h 3·53 h 4·30	h 1·80 h 3·07	l 5·17 l 6·30 l 6·83	l 4·63 l 2·77	l 5·37 l 5·60	l 5·47 l 4·80	l 8·23 h 6·70 h 6·34	h 9·97 h 8·60 h 9·73	h 2·50 h 3·20	h 7·43 h 9·23 h 7·10 h 8·27	$M = 5''\cdot37$ $w = 2\cdot18$ $\frac{1}{w} = 0\cdot46$ $C = 50°\ 39'\ 5''\cdot38$
	7·60	2·74	3·91	2·44	6·10	3·70	5·48	5·14	7·09	9·43	2·85	8·01	

At XI (Bolári)—(*Continued*).

Angle between	Circle readings, telescope being set on IX 268° 54′	88° 54′	279° 6′	99° 6′	289° 16′	109° 16′	299° 22′	119° 22′	309° 33′	129° 33′	319° 44′	139° 44′	M = Mean of Groups w = Relative Weight C = Concluded Angle
† VIII & X	″ h 53·30 h 52·43	″ h 56·77 h 56·23	″ h 57·47 h 56·64	″ h 59·60 h 60·00	″ l 55·87 l 53·54 l 53·97	″ l 59·23 l 61·40 l 59·23	″ l 50·70 l 50·70	″ l 51·20 l 52·80	″ l 47·64 l 46·27 h 47·83	″ h 49·26 h 50·64 h 48·90	″ h 51·50 h 50·43	″ h 52·00 h 50·40 h 52·03 h 51·00	$M = 53''\cdot54$ $w = 0\cdot73$ $\frac{1}{w} = 1\cdot38$ $C = 40^\circ 26' 53''\cdot54$
	52·87	56·50	57·05	59·80	54·46	59·95	50·70	52·00	47·25	49·60	50·97	51·36	
* X & XII	l 31·86 l 32·20	l 27·56 l 28·86	l 35·17 l 34·67	l 30·36 l 31·80	l 33·50 l 34·77	l 27·10 l 26·93	l 36·96 l 37·77	l 33·20 l 32·57	l 30·36 l 30·27	l 32·90 l 33·10	l 30·23 l 30·77	l 28·20 l 27·50	$M = 31''\cdot61$ $w = 1\cdot26$ $\frac{1}{w} = 0\cdot80$ $C = 51^\circ 23' 31''\cdot61$
	32·03	28·21	34·92	31·08	34·14	27·01	37·37	32·88	30·32	33·00	30·50	27·85	
* XII & XIII	l 49·70 l 48·93	l 48·24 l 46·24	l 39·93 l 42·03 l 43·70	l 44·07 l 42·24	l 43·43 l 42·50	l 44·30 l 44·54	l 42·50 l 42·60	l 45·03 l 44·93	l 48·30 l 48·13	l 48·14 l 48·23	l 44·97 l 44·73	l 49·23 l 50·03	$M = 45''\cdot62$ $w = 1\cdot51$ $\frac{1}{w} = 0\cdot66$ $C = 30^\circ 40' 45''\cdot62$
	49·32	47·24	41·89	43·15	42·97	44·42	42·55	44·98	48·21	48·19	44·85	49·63	

At XII (Sámethra)

November 1855; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIV 0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 51′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XIV & XV	″ h 52·16 h 51·27	″ h 53·36 h 54·07	″ h 57·77 l 56·77	″ h 54·30 h 54·90	″ l 56·57 l 58·04	″ l 50·37 l 52·17	″ l 61·30 l 61·27	″ l 56·44 l 56·40	″ l 55·43 l 57·07	″ l 57·10 l 57·33	″ l 54·66 h 53·24	″ h 52·87 h 53·34	$M = 55''\cdot34$ $w = 1\cdot47$ $\frac{1}{w} = 0\cdot68$ $C = 51^\circ 47' 55''\cdot34$
	51·72	53·71	57·27	54·60	57·31	51·27	61·28	56·42	56·25	57·22	53·95	53·10	
XV & XIII	h 56·27 h 56·30	h 51·93 h 52·47	h 51·33 l 52·60	h 53·50 h 51·14 h 53·16	l 58.17 l 56·64 l 55·30	l 54·50 l 53·83	l 50·84 l 50·43	l 57·86 l 58·56	l 59·17 l 59·23	l 57·14 l 56·43	h 56·36 h 52·90	h 60·83 h 61·46	$M = 55''\cdot38$ $w = 1\cdot12$ $\frac{1}{w} = 0\cdot89$ $C = 42^\circ 2' 55''\cdot38$
	56·29	52·20	51·96	52·60	56·70	54·17	50·63	58·21	59·20	56·79	54·63	61·14	

At XII (Sámethra)—(*Continued*).

Angle between	Circle readings, telescope being set on XIV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 12′	190° 12′	20° 20′	200° 20′	30° 29′	210° 29′	40° 38′	220° 38′	50° 50′	230° 51′	
XIII & XI	″ *h* 42·43 *h* 41·80 *h* 41·60	″ *h* 45·64 *h* 46·13	″ *l* 40·27 *l* 42·66 *h* 42·40	″ *l* 45·84 *l* 45·67	″ *l* 32·73 *l* 34·33 *l* 34·40	″ *l* 42·00 *l* 41·94	″ *l* 41·80 *l* 41·07	″ *l* 40·74 *l* 40·24	″ *l* 40·73 *l* 40·77	″ *l* 43·40 *l* 44·60	″ *h* 47·84 *h* 47·00	″ *h* 39·50 *h* 39·57 *h* 39·90	$M = 42''\cdot08$ $w = 0\cdot94$ $\frac{1}{w} = 1\cdot06$ $C = 40° 17' 42''\cdot08$
	41·94	45·89	41·78	45·75	33·82	41·97	41·44	40·49	40·75	44·00	47·42	39·66	
XI & X	*h* 35·37 *h* 32·74 *h* 32·30	*h* 33·73 *h* 31·77	*l* 38·33 *l* 36·77	*l* 33·73 *l* 34·20	*l* 43·90 *l* 43·43 *l* 44·30	*l* 39·70 *l* 37·40 *l* 39·23	*l* 41·00 *l* 40·30	*l* 35·83 *l* 35·66	*l* 35·60 *l* 35·97	*l* 30·73 *l* 30·57	*h* 34·43 *h* 34·26	*h* 30·74 *h* 29·97 *h* 29·17	$M = 35''\cdot63$ $w = 0\cdot72$ $\frac{1}{w} = 1\cdot39$ $C = 32° 33' 35''\cdot63$
	33·47	32·75	37·55	33·97	43·88	38·78	40·65	35·74	35·79	30·65	34·34	29·96	

At XIII (Wára)

December 1855; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	318° 40′	138° 40′	328° 52′	148° 52′	339° 2′	159° 2′	349° 8′	169° 8′	359° 19′	179° 19′	9° 30′	189° 30′	
XI & X	″ *h* 54·54 *h* 54·04	″ *h* 57·60 *h* 57·10	″ *l* 53·50 *l* 52·80	″ *l* 58·66 *l* 59·43	″ *l* 55·77 *l* 56·30	″ *l* 62·07 *l* 62·76	″ *h* 55·17 *h* 54·76	″ *h* 56·70 *h* 59·14 *h* 59·13	″ *h* 50·20 *l* 51·57	″ *h* 54·37 *h* 54·13	″ *l* 54·70 *l* 56·53	″ *l* 53·93 *l* 55·67	$M = 55''\cdot93$ $w = 1\cdot29$ $\frac{1}{w} = 0\cdot78$ $C = 41° 19' 55''\cdot93$
	54·29	57·35	53·15	59·05	56·03	62·42	54·96	58·32	50·89	54·25	55·61	54·80	
X & XII	*h* 38·20 *h* 36·70	*h* 38·00 *h* 38·80	*l* 40·83 *l* 41·06	*l* 35·54 *l* 34·27	*l* 39·47 *l* 37·40	*l* 32·83 *l* 32·27	*h* 38·47 *h* 39·30	*h* 35·87 *h* 37·10	*h* 37·33 *l* 37·80	*h* 36·93 *h* 36·47	*l* 40·74 *l* 39·50	*l* 37·36 *l* 39·13	$M = 37''\cdot56$ $w = 2\cdot28$ $\frac{1}{w} = 0\cdot44$ $C = 67° 41' 37''\cdot56$
	37·45	38·40	40·95	34·90	38·44	32·55	38·88	36·49	37·56	36·70	40·12	38·25	
XII & XIV	*l* 10·53 *l* 10·30 *d* 8·69	*l* 11·90 *l* 11·86	*l* 6·97 *l* 6·24	*l* 11·00 *l* 11·76	*l* 8·80 *l* 9·40	*l* 13·23 *l* 12·63	*l* 9·23 *l* 10·00	*l* 13·23 *l* 12·73	*l* 11·03 *l* 11·33	*l* 11·57 *l* 11·40	*l* 6·06 *l* 7·40	*l* 10·14 *l* 8·70	$M = 10''\cdot26$ $w = 2\cdot62$ $\frac{1}{w} = 0\cdot38$ $C = 48° 20' 10''\cdot26$
	9·84	11·88	6·61	11·38	9·10	12·93	9·61	12·98	11·18	11·49	6·73	9·42	
XIV & XV	*l* 31·97 *l* 29·76 *d* 29·14	*l* 31·07 *d* 29·98	*d* 34·02 *d* 34·06	*d* 32·25 *d* 31·49	*d* 34·16 *d* 33·93	*d* 30·91 *d* 31·51	*d* 37·28 *d* 36·75	*d* 28·47 *d* 28·97	*l* 32·77 *l* 31·37	*d* 27·45 *d* 27·62	*l* 35·94 *l* 33·87	*l* 28·26 *l* 29·50	$M = 31''\cdot76$ $w = 1\cdot47$ $\frac{1}{w} = 0\cdot68$ $C = 57° 8' 31''\cdot76$
	30·29	30·53	34·04	31·87	34·04	31·21	37·02	28·72	32·07	27·53	34·91	28·88	

At XIV (Roha)

December 1855; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVII: 211° 44′	31° 44′	221° 53′	41° 53′	232° 5′	52° 5′	242° 10′	62° 10′	252° 21′	72° 21′	262° 32′	82° 32′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XVII & XVI	″ l 59·04 l 58·40	″ h 60·20 h 61·66	″ h 54·36 h 56·03	″ h 60·40 h 61·66	″ l 51·24 l 51·20	″ l 57·90 l 55·83	″ l 54·54 l 52·60	″ l 51·10 l 51·70	″ l 56·24 l 56·50	″ h 53·90 h 54·00	″ h 55·66 h 55·64 h 57·37 h 55·73	″ h 49·44 h 48·90 h 51·97 h 50·87	M = 55″·47 w = 0·91 $\frac{1}{w}$ = 1·10 C = 46° 47′ 55″·47
	58·72	60·93	55·20	61·03	51·22	56·86	53·57	51·40	56·37	53·95	56·10	50·30	
XVI & XV	l 17·40 l 17·93	l 12·87 l 14·40 h 14·93	h 23·37 h 22·57	h 13·06 h 11·47	h 17.33 h 18·54	l 14·86 l 14·30	l 17·10 l 17·40	l 16·23 l 16·84	l 18·66 l 16·27 h 19·33 h 16·43 h 17·80	h 13·14 h 14·27	h 13·87 h 13·47 h 14·47	h 15·03 h 14·96	M = 16″·13 w = 1·43 $\frac{1}{w}$ = 0·70 C = 53° 42′ 16″·13
	17·67	14·07	22·97	12·26	17·94	14·58	17·25	16·53	17·70	13·71	13·94	14·99	
XV & XIII	l 28·23 l 29·53	l 29·90 l 27·83 h 28·47	h 23·23 h 23·73	h 30·10 h 30·90	h 26·80 h 27·53	l 34·34 l 33·90	l 26·73 l 27·47	l 28·07 l 28·30	l 24·07 l 23·50	h 29·66 h 27·13 h 28·17	h 27·17 h 27·96	h 26·80 h 26·43 h 28·74 h 26·84	M = 27″·92 w = 1·51 $\frac{1}{w}$ = 0·66 C = 47° 47′ 27″·92
	28·88	28·73	23·48	30·50	27·17	34·12	27·10	28·18	23·79	28·32	27·56	27·20	
XIII & XII	l 54·73 l 53·50	l 55·90 l 55·54 h 57·70	h 55·20 h 55·30	h 57·64 h 57·13	h 61·43 h 61·67 l 61·64	l 57·13 l 56·37	l 59·73 l 59·80	l 59·10 l 60·13	l 61·30 l 62·16	l 58·33 h 60·94 h 59·46	h 63·70 h 62·80	h 56·83 h 58·30 h 57·26 h 55·23	M = 58″·53 w = 1·47 $\frac{1}{w}$ = 0·68 C = 37° 48′ 58″·53
	54·12	56·38	55·25	57·38	61·58	56·75	59·77	59·61	61·73	59·58	63·25	56·91	

At XV (Dinoda)

**December* 1855; *and* †*February* 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XIII: 0° 0′	180° 0′	10° 12′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XIII & XII	″ h 20·43 h 19·44	″ h 20·14 h 20·06	″ h 20·03 l 21·47	″ h 19·36 l 21·17	″ l 23·84 l 24·26	″ l 19·10 l 18·37	″ l 25·67 l 27·23	″ l 25·50 l 25·63	″ h 25·87 h 26·67	″ h 24·40 h 24·10	″ h 27·13 h 27·60	″ h 18·50 h 18·30	M = 22″·68 w = 1·09 $\frac{1}{w}$ = 0·91 C = 32° 28′ 22″·68
	19·94	20·10	20·75	20·26	24·05	18·74	26·45	25·56	26·27	24·25	27·37	18·40	

At XV (Dinoda)—(*Continued*).

Angle between	Circle readings, telescope being set on XIII: 0° 0′	180° 0′	10° 12′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XII & XIV *	h 45·70	h 40·03	l 45·70	l 39·43	l 39·60	l 35·17	l 38·10	l 39·40	h 41·20	h 39·70	h 35·30	h 43·24	$M = 40''\cdot30$
	h 45·20	h 40·64	l 45·30	h 39·90	l 40·44	l 36·63	l 37·90	l 38·57	h 39·80	h 40·74	h 35·44	h 44·10	$w = 1\cdot13$
													$\frac{1}{w} = 0\cdot89$
	45·45	40·34	45·50	39·66	40·02	35·90	38·00	38·99	40·50	40·22	35·37	43·67	$C = 42°\ 35'\ 40''\cdot30$
XIV & XVI *	l 55·53	l 56·07	l 53·06	l 61·17	l 59·90	l 62·23	l 60·70	l 60·37	h 58·30	h 59·90	h 63·24	h 56·03	$M = 58''\cdot73$
	l 54·07	l 55·94	l 54·50	l 59·36	l 59·60	l 60·83	l 62·17	l 60·40	h 59·20	h 58·10	h 63·96	h 56·63	$w = 1\cdot34$
				h 58·24						h 58·50			$\frac{1}{w} = 0\cdot75$
	54·80	56·01	53·78	59·59	59·75	61·53	61·43	60·39	58·75	58·83	63·60	56·33	$C = 76°\ 3'\ 58''\cdot73$
XVI & XVIII †	h 13·57	h 10·86	h 13·00	h 8·17	l 6·87	h 3·06	l 6·10	l 6·63	l 7·10	l 6·47	h 4·80	h 10·56	$M = 8''\cdot06$
	h 14·14	h 9·74	h 15·23	h 7·00	l 5·37	h 3·83	l 4·80	l 6·04	l 7·23	l 7·24	h 4·43	h 11·24	$w = 0\cdot98$
			h 14·13										$\frac{1}{w} = 1\cdot02$
	13·86	10·30	14·12	7·58	6·12	3·45	5·45	6·33	7·17	6·85	4·62	10·90	$C = 43°\ 14'\ 8''\cdot06$

At XVI (Háthria)

‡*December* 1855; *and* §*February* 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XV: 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XV & XIV ‡	h 46·90	h 45·57	h 49·23	h 47·40	l 50·26	l 44·23	l 54·27	l 49·66	l 48·17	l 47·34	h 49·67	h 42·73	$M = 48''\cdot15$
	h 46·37	h 45·17	l 50·26	h 47·70	l 50·90	l 44·87	l 55·03	l 48·36	l 48·53	h 48·67	h 50·90	h 43·43	$w = 1\cdot24$
													$\frac{1}{w} = 0\cdot80$
	46·64	45·37	49·74	47·55	50·58	44·55	54·65	49·01	48·35	48·01	50·28	43·08	$C = 50°\ 13'\ 48''\cdot15$
XIV & XVII ‡	h 26·40	h 26·33	h 20·90	h 26·26	l 23·30	l 24·10	l 19·67	l 24·10	l 26·16	l 29·86	h 27·56	h 30·20	$M = 25''\cdot53$
	h 26·46	h 27·53	l 21·60	h 27·26	l 22·83	l 23·13	l 19·00	l 26·07	l 26·27	h 28·40	h 29·46	h 29·90	$w = 1\cdot14$
													$\frac{1}{w} = 0\cdot87$
	26·43	26·93	21·25	26·76	23·07	23·61	19·34	25·08	26·22	29·13	28·51	30·05	$C = 82°\ 11'\ 25''\cdot53$
Lesser circle readings	231° 1′	51° 1′	241° 12′	61° 12′	251° 23′	71° 23′	261° 29′	81° 29′	271° 39′	91° 39′	281° 50′	101° 50′	
XVII & XIX §	l 57·73	l 63·74	h 58·17	h 57·50	l 57·73	h 60·60	h 66·80	h 59·07	h 63·67	l 67·00	h 70·84	h 62·80	$M = 62''\cdot29$
	l 58·33	l 62·07	h 58·03	h 59·63	l 56·64	l 59·40	h 67·93	h 60·57	h 64·24	l 65·96	h 71·27	h 64·53	$w = 0\cdot62$
				h 59·70									$\frac{1}{w} = 1\cdot61$
	58·03	62·91	58·10	58·94	57·18	60·00	67·37	59·82	63·95	66·48	71·06	63·66	$C = 37°\ 43'\ 2''\cdot29$

At XVI (Háthria)—(*Continued*).

Circle readings, telescope being set on XVII

Angle between	231° 1′	51° 1′	241° 12′	61° 12′	251° 23′	71° 23′	261° 29′	81° 29′	271° 39′	91° 39′	281° 50′	101° 50′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
§ XIX & XX	″ *l* 59·10 *l* 61·73 *l* 58·23	″ *l* 58·60 *l* 58·67	″ *h* 60·97 *h* 60·53	″ *h* 59·27 *h* 57·84	″ *l* 60·34 *l* 59·06	″ *h* 57·27 *l* 58·00	″ *h* 56·80 *h* 58·17	″ *h* 54·23 *h* 56·40 *h* 56·66	″ *h* 58·03 *h* 58·66	″ *l* 54·67 *l* 53·24	″ *h* 55·26 *h* 54·53	″ *h* 62·04 *h* 60·90	$M = 58''\cdot07$ $w = 2\cdot17$ $\frac{1}{w} = 0\cdot46$ $C = 29°\ 47'\ 58''\cdot07$
	59·69	58·64	60·75	58·55	59·70	57·64	57·48	55·76	58·35	53·95	54·90	61·47	
§ XX & XXI	*h* 55·00 *h* 53·70	*h* 53·70 *h* 55·37 *h* 55·33	*h* 62·20 *h* 62·70	*h* 58·93 *h* 58·93	*l* 65·20 *l* 66·24	*h* 64·23 *h* 62·00 *l* 64·43	*h* 60·60 *h* 59·40	*h* 62·04 *h* 61·73	*h* 59·60 *h* 59·34	*l* 66·20 *l* 68·96 *l* 70·34	*h* 54·30 *h* 56·14	*h* 56·13 *h* 58·34 *h* 58·73	$M = 60''\cdot22$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot66$ $C = 45°\ 2'\ 0''\cdot22$
	54·35	54·80	62·45	58·93	65·72	63·55	60·00	61·89	59·47	68·50	55·22	57·73	
§ XXI & XVIII	*h* 8·40 *h* 7·50	*h* 11·40 *h* 10·63	*h* 4·46 *h* 4·40	*h* 6·83 *h* 7·77	*l* 7·36 *h* 7·50	*h* 9·57 *l* 9·67 *l* 9·14	*h* 7·97 *h* 8·23	*h* 8·13 *h* 8·03	*h* 10·63 *h* 10·23	*l* 4·47 *l* 2·50	*h* 14·23 *h* 15·46	*h* 10·73 *h* 9·63	$M = 8''\cdot56$ $w = 1\cdot32$ $\frac{1}{w} = 0\cdot76$ $C = 51°\ 37'\ 8''\cdot56$
	7·95	11·02	4·43	7·30	7·43	9·46	8·10	8·08	10·43	3·48	14·85	10·18	
§ XVIII & XV	*h* 40·17 *h* 39·06	*h* 35·57 *h* 36·00	*h* 36·04 *h* 35·47	*h* 38·37 *h* 38·00	*l* 36·04 *l* 37·54	*l* 38·13 *l* 35·96 *l* 36·10	*h* 33·90 *h* 33·90	*h* 36·33 *h* 35·47	*h* 30·10 *h* 31·23	*l* 35·83 *l* 35·03	*h* 31·47 *h* 30·30	*h* 33·07 *h* 34·27	$M = 35''\cdot28$ $w = 1\cdot66$ $\frac{1}{w} = 0\cdot60$ $C = 63°\ 24'\ 35''\cdot28$
	39·62	35·78	35·76	38·18	36·79	36·73	33·90	35·90	30·67	35·43	30·88	33·67	

At XVII (Naliya)

March 1857 ; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Circle readings, telescope being set on XIX

Angle between	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XIX & XVI	″ *h* 14·93 *h* 15·66	″ *h* 19·20 *h* 19·24	″ *h* 15·87 *h* 15·86	″ *h* 14·63 *h* 14·60	″ *h* 19·43 *l* 19·16	″ *l* 12·10 *l* 11·50	″ *l* 21·80 *l* 20·50	″ *l* 15·63 *l* 18·57 *l* 15·06	″ *l* 17·67 *h* 17·93	″ *h* 16·06 *h* 17·83	″ *h* 14·10 *h* 15·56	″ *h* 15·53 *h* 13·96	$M = 16''\cdot50$ $w = 1\cdot76$ $\frac{1}{w} = 0\cdot57$ $C = 56°\ 41'\ 16''\cdot50$
	15·30	19·22	15·86	14·62	19·29	11·80	21·15	16·42	17·80	16·95	14·83	14·74	

At XVII (Naliya)—(*Continued*).

December 1855; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between													
	Circle readings, telescope being set on XVI												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	81°47′	261°47′	91°58′	271°58′	102°9′	282°9′	112°15′	292°15′	122°26′	302°26′	132°36′	312°36′	
XVI & XIV	″	″	″	″	″	″	″	″	″	″	″	″	M = 41″·76
	h 38·37	h 41·33	h 39·80	h 46·60	l 38·23	l 43·36	l 40·66	l 45·77	l 40·30	h 39·70	h 42·73	h 43·53	w = 1·83
	h 38·10	h 42·84	h 40·30	h 46·37	l 39·64	l 42·87	l 41·60	l 44·10	h 39·47	h 39·40	h 42·96	h 43·87	1/w = 0·55
									h 40·20				
	38·24	42·08	40·05	46·49	38·93	43·12	41·13	44·93	39·99	39·55	42·85	43·70	C = 51° 0′ 41″·76

At XVIII (Manjal)

February 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between													
	Circle readings, telescope being set on XV												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	0°1′	180°1′	10°11′	190°11′	20°22′	200°22′	30°28′	210°28′	40°39′	220°39′	50°49′	230°49′	
XV & XVI	″	″	″	″	″	″	″	″	″	″	″	″	M = 16″·30
	h 17·20	h 16·33	h 20·00	h 13·26	l 14·67	h 9·56	l 15·87	l 16·10	l 20·96	l 16·87	h 17·17	h 16·73	w = 1·42
	h 16·80	h 17·47	h 21·44	h 13·27	l 16·43	h 9·63	l 17·33	l 16·00	l 19·43	l 15·47	h 15·10	h 17·40	1/w = 0·71
											h 17·07		
	17·00	16·90	20·72	13·27	15·55	9·59	16·60	16·05	20·20	16·17	16·45	17·06	C = 73° 21′ 16″·30
XVI & XXI	h 41·23	h 41·13	h 39·94	h 46·57	l 44·23	h 48·47	l 47·17	l 47·73	l 43·34	l 46·00	h 51·93	h 43·27	M = 45″·14
	h 42·10	h 41·56	h 39·13	h 47·40	l 44·17	h 48·13	l 45·94	l 48·47	l 43·47	l 47·86	h 52·43	h 42·67	w = 0·96
											h 50·77		1/w = 1·05
	41·67	41·34	39·54	46·98	44·20	48·30	46·56	48·10	43·40	46·93	51·71	42·97	C = 76° 7′ 45″·14

At XIX (Saind)

March and April 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between													
	Circle readings, telescope being set on XX												M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	0°0′	180°0′	10°11′	190°11′	20°22′	200°22′	30°30′	210°30′	40°39′	220°39′	50°48′	230°48′	
XX & XXI	″	″	″	″	″	″	″	″	″	″	″	″	M = 33″·97
	h 27·60	h 31·73	h 30·47	h 28·20	l 38·77	l 33·73	h 35·94	h 37·83	h 37·64	h 36·53	l 38·80	l 32·87	
	h 28·76	h 31·10	h 29·70	h 28·23	l 38·50	l 33·93	h 35·13	h 35·07	h 37·97	h 36·47	l 37·40	l 34·04	w = 0·88
	h 26·80	h 32·44	l 33·33	h 27·47	l 37·40	l 35·70	l 35·53	h 35·07	l 37·86	l 35·20	l 36·03	l 33·10	
	h 26·20	l 31·70	l 31·56	h 29·07	l 37·57	l 34·40	h 35·83	h 38·00	l 38·37	l 35·30	l 37·47	l 33·17	1/w = 1·13
	l 26·37		l 30·00	h 29·70				l 36·43					
	27·15	31·74	31·01	28·53	38·06	34·44	35·61	36·48	37·96	35·88	37·42	33·30	C = 37° 27′ 33″·97

At XIX (Saind)—(*Continued*).

Angle between	Circle readings, telescope being set on XX												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 30′	210° 30′	40° 39′	220° 39′	50° 48′	230° 48′	
	″	″	″	″	″	″	″	″	″	″	″	″	
XXI & XVI	h 52·64 h 52·90 h 51·90 h 53·60	h 46·04 h 44·43 l 45·10 l 45·60	l 47·33 l 47·36 l 46·57 l 50·24 l 49·14	h 47·03 h 47·40 h 48·06 h 48·36	l 41·17 l 43·70 l 42·47 l 42·57 l 44·20	l 40·94 h 44·16 h 43·87 l 39·47 l 40·70	h 46·56 h 47·90 l 47·44 h 49·74 h 48·17	h 48·40 h 48·56 l 49·53 l 49·20	h 44·83 h 45·93 l 47·54 l 45·80	h 47·10 h 48·06 l 48·67 l 48·56	l 45·73 l 44·50 l 44·43 l 45·37 l 44·03	l 50·77 l 49·56 l 51·26 l 50·56	$M = 47''\cdot08$ $w = 1\cdot22$ $\frac{1}{w} = 0\cdot82$ $C = 49^\circ 45' 47''\cdot08$
	52·76	45·29	48·13	47·71	42·82	41·83	47·96	48·92	46·03	48·10	44·81	50·54	
XVI & XVII	h 37·13 h 36·00 h 35·36 h 36·13	h 41·76 h 42·73 l 42·70 l 42·40	l 39·83 l 39·17 l 41·20 l 40·03	h 40·50 h 41·63 h 41·27 h 42·07	l 41·90 l 40·60 l 42·00 l 44·30 l 43·10	l 43·60 l 40·40 h 42·34 l 42·27 l 44·37 l 41·90	h 43·47 h 43·93 l 42·43 l 41·14	h 35·73 h 36·94 l 37·87 l 38·07	h 35·73 h 36·87 l 38·06 l 37·33	h 35·93 h 36·10 l 37·53 l 36·57	l 40·70 l 40·60 l 40·30 l 39·54	l 39·06 l 38·24 l 36·44 l 35·97 h 33·67	$M = 39''\cdot60$ $w = 1\cdot59$ $\frac{1}{w} = 0\cdot63$ $C = 85^\circ 35' 39''\cdot60$
	36·16	42·40	40·06	41·37	42·38	42·48	42·74	37·15	37·00	36·53	40·28	36·68	

At XX (Suri Muri)

March*; and †*April* 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms' 18-inch Theodolite No. 2.

Angle between	Circle readings, telescope being set on XXIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	224° 23′	44° 22′	234° 34′	54° 33′	244° 44′	64° 44′	254° 52′	74° 52′	265° 1′	85° 1′	275° 10′	95° 10′	
	″	″	″	″	″	″	″	″	″	″	″	″	
* XXIII & XXII	l 61·33 l 61·37	l 60·67 l 61·64	l 55·87 l 54·67	l 53·90 l 53·90	l 56·10 l 55·37	l 50·07 l 53·93 h 53·37	h 53·47 h 52·57	h 53·63 h 53·80	h 60·00 h 59·63	h 54·96 h 54·10	h 60·87 h 60·13	h 59·54 h 57·57 h 58·07	$M = 56''\cdot65$ $w = 1\cdot04$ $\frac{1}{w} = 0\cdot96$ $C = 87^\circ 39' 56''\cdot65$
	61·35	61·16	55·27	53·90	55·73	52·46	53·02	53·72	59·81	54·53	60·50	58·39	
* XXII & XXI	l 57·37 l 55·63	l 57·00 l 56·40	l 56·23 l 55·83	l 59·76 l 59·60	l 59·66 l 59·10	l 64·50 l 63·73	h 54·53 h 56·97 h 57·63	h 57·37 h 55·30 h 55·63	h 53·54 h 53·30	h 56·94 h 55·80	h 52·66 h 52·10 h 52·23	h 56·53 h 55·53 h 54·76	$M = 56''\cdot89$ $w = 1\cdot26$ $\frac{1}{w} = 0\cdot80$ $C = 47^\circ 57' 56''\cdot88$
	56·50	56·70	56·03	59·68	59·38	64·12	56·38	56·10	53·42	56·37	52·33	55·61	
* XXI & XVI	h 23·40 l 24·56 l 24·34	l 28·90 l 28·96	l 26·87 l 26·94	l 26·10 l 25·77	l 28·00 l 29·43	l 24·13 l 24·74	h 32·30 h 31·03	h 29·57 h 30·10	h 28·36 h 27·10	h 26·03 h 25·80	h 27·74 h 25·50 h 26·80	h 25·57 h 25·37 h 25·10	
	24·10	28·93	26·91	25·93	28·72	24·43	31·67	29·83	27·73	25·92	26·68	25·35	$M = 27''\cdot18$ $w = 2\cdot27$

At XX (Suri Muri)—(*Continued*).

Angle between	Circle readings, telescope being set on XXIII 224° 23′	44° 22′	234° 34′	54° 33′	244° 44′	64° 44′	254° 52′	74° 52′	265° 1′	85° 1′	275° 10′	95° 10′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
† XXI & XVI	h 24·27 h 23·67	h 25·34 l 25·63	l 26·06 l 26·37	l 23·16 l 23·03	l 28·10 l 28·44	h 22·47 h 22·90	h 32·46 h 31·50	h 27·30 h 28·43	l 25·17 l 27·27 l 26·77	l 24·77 l 24·43	l 23·37 l 22·66	l 24·80 l 24·44	w = 3·90 1/w = 0·26 C = 54° 37′ 26″·55
	23·97	25·49	26·21	23·10	28·27	22·68	31·98	27·87	26·40	24·60	23·01	24·62	M = 25″·68 w = 1·63
* XVI & XIX	h 43·00 l 39·64 l 40·90	l 37·83 l 39·00	l 36·13 l 35·96	l 39·63 l 40·07	l 35·24 l 34·17	l 38·64 h 40·80 h 39·03 h 37·90	h 33·47 h 33·27	h 38·70 h 38·40	h 34·87 h 34·80	h 38·17 h 39·20	h 37·93 h 36·70	h 38·60 h 36·23 h 36·80	
	41·18	38·42	36·04	39·85	34·71	39·09	33·37	38·55	34·83	38·69	37·31	37·21	M = 37″·44 w = 2·13
† XVI & XIX	h 40·16 h 40·47	l 39·90 l 39·50	l 39·24 l 40·10	l 39·94 l 41·10	l 35·50 l 35·06	h 40·33 h 40·10	h 34·20 h 34·34	h 41·16 h 40·60	l 36·27 l 36·36	l 41·10 l 40·70	l 39·93 l 40·20	l 38·63 l 39·56	w = 4·38 1/w = 0·23 C = 62° 58′ 38″·22
	40·32	39·70	39·67	40·52	35·28	40·21	34·27	40·88	36·32	40·90	40·06	39·10	M = 38″·94 w = 2·25

At XXI (Sura Gandára)

‡*February*; *and* §*April* 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XVIII 307° 45′	127° 45′	317° 56′	137° 57′	328° 7′	148° 7′	338° 13′	158° 13′	348° 24′	168° 24′	358° 33′	178° 33′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
‡ XVIII & XVI	h 5·90 h 6·10	h 7·64 h 9·23	h 3·10 h 3·07	h 7·80 h 8·26	h 3·10 l 3·56	h 13·43 h 11·57	h 4·34 h 3·36	h 8·74 h 8·50	h 3·40 h 5·06	h 8·37 h 8·20	h 3·10 l 5·23 l 3·30 l 3·83	h 5·34 h 6·30	M = 6″·34 w = 1·42 1/w = 0·70 C = 52° 15′ 6″·34
	6·00	8·44	3·08	8·03	3·33	12·50	3·85	8·62	4·23	8·29	3·86	5·82	
‡ XVI & XIX	h 13·10 h 13·17	h 16·63 h 17·10	h 16·17 h 18·66 h 16·90	h 15·33 h 14·97	l 16·77 l 18·06	h 12·73 h 14·13	h 21·86 h 22·07	h 18·33 h 19·33	h 19·40 h 18·90	h 15·37 h 16·34	h 13·37 l 13·60 l 12·40	h 12·90 h 11·93	M = 16″·21 w = 1·38 1/w = 0·72 C = 55° 24′ 16″·21
	13·14	16·86	17·24	15·15	17·42	13·43	21·96	18·83	19·15	15·86	13·12	12·41	

At XXI (Sura Gandára)—(*Continued*).

Angle between	Circle readings, telescope being set on XVIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	307° 45′	127° 45′	317° 56′	137° 57′	328° 7′	148° 7′	338° 13′	158° 13′	348° 24′	168° 24′	358° 33′	178° 33′	
‡ XIX & XX	″ h 24·70 h 24·76	″ h 17·20 h 17·67	″ h 16·00 h 17·07	″ h 18·24 h 19·60	″ l 17·93 l 19·60	″ h 17·27 h 18·60	″ h 16·40 h 18·57 h 16·66	″ h 18·30 h 19·07	″ h 19·33 h 18·94	″ h 22·03 h 22·80	″ l 21·96 l 21·50	″ h 22·86 h 21·80	$M = 19''·65$ $w = 1·81$ $\frac{1}{w} = 0·55$ $C = 24° 56' 19''·65$
	24·73	17·44	16·53	18·92	18·77	17·93	17·21	18·69	19·13	22·42	21·73	22·33	
‡ XX & XXII	h 53·57 h 53·87	h 60·13 h 58·60	h 59·53 h 58·47	h 59·96 h 60·43	l 54·47 l 55·17	h 58·47 h 60·00	h 53·37 h 53·96	h 56·33 h 58·56 l 56·73	h 53·80 h 54·13	h 54·90 h 54·66	l 57·33 l 58·20	h 56·57 h 57·54	$M = 56''·73$ $w = 1·97$ $\frac{1}{w} = 0·51$ $C = 46° 33' 56''·73$
	53·72	59·37	59·00	60·19	54·82	59·24	53·66	57·21	53·97	54·78	57·76	57·06	
‡ XXII & XXV	h 37·26 h 38·23	h 35·40 h 35·50	h 37·53 h 37·96	h 38·07 h 38·54	l 42·93 l 42·83	h 38·46 h 37·13	h 45·23 h 44·54	h 40·77 h 40·34 l 43·77	h 46·77 h 47·00	h 38·67 h 39·14	l 38·70 l 39·20	h 34·30 h 34·93	
	37·75	35·45	37·74	38·31	42·88	37·79	44·89	41·63	46·88	38·91	38·95	34·61	$M = 39''·65$ $w = 0·86$
§ XXII & XXV	h 36·87 l 35·83	l 35·80 l 34·37	l 38·86 l 38·46	l 38·07 l 37·57	l 41·17 l 42·60	l 35·77 l 38·97 l 37·40	l 45·46 l 43·56	l 40·13 l 39·10	l 48·70 l 47·33 l 47·44	l 39·34 l 39·80	l 38·77 l 38·43	l 36·87 l 34·87 l 36·06	$w = 1·72$ $\frac{1}{w} = 0·58$ $C = 35° 36' 39''·55$
	36·35	35·09	38·66	37·82	41·88	37·38	44·51	39·62	47·82	39·57	38·60	35·93	$M = 39''·44$ $w = 0·86$

At XXII (Bábia)

March 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	
XXI & XX	″ l 65·10 l 64·00	″ l 65·93 l 64·00	″ h 62·63 l 64·73 l 62·53	″ h 59·20 h 60·13	″ l 63·50 l 64·24	″ l 58·60 l 57·90	″ h 67·43 l 68·53	″ h 68·17 h 67·70	″ l 66·97 l 67·16	″ l 66·40 l 66·87	″ l 66·90 l 66·53	″ l 67·17 l 66·34	$M = 64''·81$ $w = 1·20$ $\frac{1}{w} = 0·83$ $C = 85° 28' 4''·81$
	64·55	64·97	63·30	59·66	63·87	58·25	67·98	67·94	67·06	66·64	66·71	66·76	

At XXII (Bábia)—(*Continued*).

Angle between	0°0′	180°0′	10°11′	190°11′	20°22′	200°22′	30°28′	210°28′	40°39′	220°39′	50°49′	230°49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XX & XXIII	l 63.36 l 62.94	l 67.53 l 65.97	l 65.73 l 63.87 l 65.43	h 69.43 h 71.10	l 67.97 l 67.76	l 69.47 l 67.97	l 60.60 l 59.70	h 63.93 h 65.30	l 64.16 l 66.60 l 63.47	l 66.00 l 65.00	l 66.90 l 68.00	l 66.06 l 67.40	M = 65″.91 w = 1.60 1/w = 0.62
	63.15	66.75	65.01	70.27	67.86	68.72	60.15	64.62	64.74	65.50	67.45	66.73	C = 43° 5′ 5″.91
XXIII & XXIV	l 8.47 l 8.86	l 6.74 h 9.93 h 6.74	l 11.04 l 13.36 l 12.34	l 8.94 l 8.17	l 10.37 l 11.50	l 8.06 l 8.10	l 16.63 l 18.63	l 8.60 l 7.37	l 11.54 l 9.07 l 10.80	l 7.43 l 7.60	l 5.06 l 5.87	l 4.40 l 2.90	M = 9″.08 w = 0.93 1/w = 1.07
	8.67	7.80	12.25	8.55	10.94	8.08	17.63	7.98	10.47	7.52	5.46	3.65	C = 42°38′ 9″.08
XXIV & XXV	l 52.67 l 53.47	l 57.36 h 59.14 h 60.86	l 47.53 l 47.84	l 49.06 l 49.10	l 48.73 l 48.90	l 52.14 l 53.20	l 46.07 l 46.64	l 54.17 l 54.46	l 54.36 l 55.20	l 55.00 l 55.07	l 56.47 l 56.33	l 55.10 l 54.93	
	53.07	59.12	47.69	49.08	48.81	52.67	46.36	54.31	54.78	55.04	56.40	55.01	M = 52″.70 w = 0.79
* XXIV & XXV	h 56.03 h 53.26 h 53.50	h 57.20 l 56.13	l 47.63 l 48.57	l 51.50 l 50.97	l 48.10 l 48.30	l 50.93 l 50.13	l 47.10 l 46.90	l 55.13 l 56.04	l 56.43 l 56.60	l 54.00 l 55.80	h 57.07 h 56.10	h 56.76 h 56.90	w = 1.62 1/w = 0.62 C = 93° 15′ 52″.87
	54.26	56.67	48.10	51.23	48.20	50.53	47.00	55.59	56.51	54.90	56.59	56.83	M = 53″.03 w = 0.83
XXV & XXI	l 48.36 l 48.83	l 43.70 h 42.13	h 49.57 l 48.57	h 49.53 h 49.30	l 48.97 l 47.70	l 52.16 l 51.60	h 44.17 l 46.07	h 43.00 h 43.83	l 43.24 l 43.30	l 45.40 l 45.80	l 43.47 l 44.97	l 45.77 l 47.30	
	48.60	42.91	49.07	49.42	48.33	51.88	45.12	43.42	43.27	45.60	44.22	46.53	M = 46″.53 w = 1.40
* XXV & XXI	h 46.17 h 47.84	l 42.63 l 42.80	l 50.73 l 49.43	l 49.06 l 48.77	l 46.56 l 46.90	l 52.87 l 51.84	l 44.80 l 44.46	l 41.44 l 42.20	l 43.27 l 42.30	l 44.26 l 44.43	h 43.27 h 43.46	h 46.87 h 45.13	w = 2.52 1/w = 0.40 C = 95° 32′ 46″.25
	47.01	42.71	50.08	48.92	46.73	52.35	44.63	41.82	42.79	44.34	43.37	46.00	M = 45″.90 w = 1.12

At XXIII (Jamanwála)

March 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0°0′	180°0′	10°11′	190°11′	20°22′	200°22′	30°28′	210°28′	40°39′	220°39′	50°49′	230°49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXIV & XXII	h 47.07 h 46.90	h 47.83 h 46.44	h 48.34 h 48.83 h 48.13	l 44.64 l 45.83	l 49.33 l 50.30	l 40.80 l 41.44	l 46.20 l 47.23	l 44.77 l 45.94	h 46.23 h 47 57	l 43.40 l 45.14	h 48.17 h 48.90	h 46.54 h 47.04	M = 46″.44 w = 2.27 1/w = 0.44
	46.99	47.13	48.43	45.24	49.81	41.12	46.72	45.35	46.90	44.27	48.54	46.79	C = 68° 19′ 46″.44

NOTE.—Station XXII was visited twice in March 1857. The angles not marked were measured during the first visit; those marked * during the second visit.

At XXIII (Jamanwála)—(*Continued*).

Angle between	Circle readings, telescope being set on XXIV 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXII & XX	″ *h* 55.80 *h* 56.76	″ *h* 58.43 *h* 59.80	″ *h* 55.07 *l* 53.97	″ *l* 57.93 *l* 56.77	″ *l* 54.14 *l* 54.30	″ *l* 60.93 *l* 60.40	″ *l* 54.40 *l* 55.33	″ *l* 62.53 *l* 61.63	″ *h* 55.23 *h* 54.03	″ *l* 56.67 *l* 56.56	″ *h* 53.60 *h* 53.93	″ *h* 53.60 *h* 53.96	$M = 56''.49$ $w = 1.51$ $\frac{1}{w} = 0.66$
	56.28	59.12	54.52	57.35	54.22	60.66	54.87	62.08	54.63	56.61	53.77	53.78	$C = 49° 14′ 56''.49$

At XXIV (Pinjor Pir)

**March* 1857; †*April* 1857; *and* ‡*April* 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXVI 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 23′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
‡ XXVI & XXVII	″ *l* 23.40 *l* 22.43	″ *l* 21.07 *l* 21.00	″ *h* 22.80 *h* 20.84	″ *l* 27.10 *l* 27.26	″ *h* 28.80 *h* 27.03	″ *h* 22.93 *h* 20.83 *l* 21.87	″ *l* 28.80 *l* 29.03	″ *l* 30.30 *l* 29.27	″ *l* 30.14 *l* 32.07 *h* 32.93	″ *h* 26.43 *h* 27.36	″ *l* 27.30 *l* 25.40	″ *l* 25.53 *l* 22.80 *l* 22.90	$M = 25''.85$ $w = 0.95$ $\frac{1}{w} = 1.05$
	22.92	21.03	21.82	27.18	27.92	21.88	28.91	29.79	31.71	26.89	26.35	23.74	$C = 43° 53′ 25''.85$
‡ XXVII & XXV	*l* 59.50 *l* 57.90	*l* 56.50 *l* 57.10	*h* 54.30 *h* 53.06	*l* 50.84 *l* 52.90 *h* 51.60	*h* 53.10 *h* 52.87	*l* 52.73 *l* 53.54	*l* 53.63 *l* 53.20	*l* 54.84 *l* 55.43	*l* 52.60 *h* 53.27	*h* 59.77 *h* 59.94	*l* 52.93 *l* 54.70	*l* 60.73 *l* 60.70 *l* 59.40	$M = 55''.21$ $w = 1.36$ $\frac{1}{w} = 0.74$
	58.70	56.80	53.68	51.78	52.99	53.13	53.42	55.13	52.94	59.85	53.82	60.28	$C = 37° 35′ 55''.21$
‡ XXV & XXII	*l* 4.07 *l* 4.57	*l* 9.26 *l* 8.60	*h* 7.17 *h* 8.80	*l* 11.53 *l* 9.64	*h* 7.17 *h* 8.37	*l* 7.80 *l* 6.63	*l* 3.20 *l* 5.03	*l* 8.63 *l* 8.57	*l* 7.40 *l* 8.70 *h* 5.90	*h* 0.97 *h* 2.86	*l* 5.53 *l* 6.13	*l* 1.80 *l* 2.57 *l* 1.40	
	4.32	8.93	7.99	10.58	7.77	7.22	4.11	8.60	7.33	1.92	5.83	1.92	$M = 6''.38$ $w = 1.51$
	Circle readings, telescope being set on XXV 329° 49′	149° 49′	340° 0′	160° 0′	350° 11′	170° 11′	0° 17′	180° 17′	10° 27′	190° 27′	20° 38′	200° 39′	
XXV & XXII *	″ *l* 11.70 *l* 9.30 *l* 10.60	″ *h* 13.07 *l* 14.67 *l* 13.66	″ *l* 9.37 *l* 10.67	″ *l* 12.20 *l* 12.90	″ *l* 8.07 *l* 8.47	″ *l* 13.94 *l* 13.16	″ *l* 4.70 *l* 5.03	″ *l* 3.67 *l* 3.87	″ *l* 5.80 *l* 4.80	″ *l* 4.13 *l* 6.00	″ *l* 7.47 *l* 7.64	″ *l* 4.83 *l* 3.04	$w = 2.33$ $\frac{1}{w} = 0.43$ $C = 30° 11′ 7''.13$
†	*l* 13.30 *l* 13.90	*h* 11.16 *l* 11.50	*l* 11.40 *l* 11.50	*l* 12.50 *l* 14.70 *l* 13.90	*l* 6.77 *l* 6.84	*l* 12.60 *l* 14.47	*l* 3.24 *l* 3.27	*l* 3.77 *l* 5.53	*l* 7.60 *l* 7.30	*l* 7.37 *l* 5.40	*l* 10.40 *l* 9.26	*l* 2.70 *l* 3.97 *l* 3.23 *l* 3.66	
	11.76	12.81	10.74	13.24	7.54	13.54	4.06	4.21	6.37	5.73	8.69	3.57	$M = 8''.52$ $w = 0.82$

At XXIV (Pinjor Pir)—(*Continued*).

Angle between	Circle readings, telescope being set on XXV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	329° 49′	149° 49′	340° 0′	160° 0′	350° 11′	170° 11′	0° 17′	180° 17′	10° 27′	190° 27′	20° 38′	200° 39′	
* XXII & XXIII	″ *l* 66·57 *l* 66·53	″ *h* 64·80 *h* 65·80 *l* 64·37	″ *l* 69·46 *l* 67·57	″ *l* 61·26 *l* 60·43	″ *l* 65·00 *l* 65·64	″ *l* 59·50 *l* 59·60	″ *l* 69·06 *l* 69·20	″ *l* 63·46 *l* 64·70	″ *l* 67·10 *l* 68·10	″ *l* 65·27 *l* 63·90	″ *l* 69·87 *l* 69·06	″ *l* 66·04 *l* 66·30	$M = 65''·57$ $w = 1·25$ $\frac{1}{w} = 0·80$
	66·55	64·99	68·52	60·84	65·32	59·55	69·13	64·08	67·60	64·59	69·46	66·17	$C = 69°\ 2'\ 5''·57$

At XXV (Lakhpat)

§ *March* 1857; ¶ *April* 1857; *and* ‖ *March* 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	
XXI & XXII §	″ *l* 34·67 *l* 36·10	″ *l* 33·14 *l* 34·77	″ *l* 39·70 *l* 40·97	″ *l* 37·03 *l* 38·37	″ *l* 39·00 *l* 40·34	″ *l* 34·77 *l* 33·96	″ *l* 42·56 *l* 41·40	″ *l* 40·40 *l* 39·43	″ *l* 40·00 *l* 40·03	″ *l* 38·80 *l* 39·90	″ *l* 36·86 *l* 37·83	″ *l* 35·70 *l* 34·93	$M = 37''·50$
¶	*l* 33·77 *l* 34·00	*l* 33·60 *l* 35·40	*l* 37·60 *l* 38·87 *l* 39·60	*l* 38·10 *l* 36·37	*l* 40·33 *l* 38·70	*l* 32·64 *l* 32·97	*l* 43·70 *l* 42·13	*l* 39·77 *l* 39·94	*l* 36·40 *l* 38·24	*l* 37·00 *l* 37·77	*l* 36·87 *l* 36·40	*l* 33·63 *l* 34·80	$w = 1·56$ $\frac{1}{w} = 0·64$ $C = 48°\ 50'\ 37''·50$
	34·64	34·23	39·35	37·47	39·59	33·58	42·45	39·89	38·67	38·37	36·99	34·76	
XXII & XXIV §	*l* 53·80 *l* 53·63	*l* 56·36 *l* 54·90	*l* 57·57 *l* 56·90	*l* 53·24 *l* 52·37	*l* 53·80 *l* 53·20	*l* 56·30 *l* 57·70	*l* 52·84 *l* 53·90	*l* 56·07 *l* 56·43	*l* 56·20 *l* 54·94	*l* 57·80 *l* 56·20	*l* 49·64 *l* 49·60	*l* 52·87 *l* 54·33	
¶	*l* 54·66 *l* 54·80	*l* 54·13 *l* 53·27	*l* 53·33 *l* 55·23 *l* 55·13	*l* 54·37 *l* 55·26	*l* 54·57 *l* 55·84	*l* 53·53 *l* 54·97 *l* 55·23	*l* 48·64 *l* 50·60 *l* 52·04 *l* 51·20	*l* 55·53 *l* 55·26	*l* 56·36 *l* 57·03	*l* 56·83 *l* 55·16 *l* 57·93	*l* 51·60 *l* 50·60	*l* 57·07 *l* 56·40	
	54·22	54·67	55·63	53·81	54·35	55·55	51·54	55·82	56·13	56·78	50·36	55·17	$M = 54''·50$ $w = 3·10$

Angle between	Circle readings, telescope being set on XXII												
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 29′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	$w = 4·39$
‖ XXII & XXIV	″ *l* 50·77 *l* 52·80 *h* 53·50	″ *l* 56·34 *l* 57·23	″ *l* 53·63 *l* 53·70	″ *l* 54·47 *l* 56·60 *l* 55·26	″ *l* 60·30 *l* 59·17	″ *l* 53·63 *l* 52·07	″ *l* 63·57 *l* 61·03 *l* 61·47	″ *l* 60·13 *l* 59·17	″ *l* 57·67 *l* 57·50	″ *l* 58·43 *l* 58·44	″ *l* 53·87 *l* 55·40	″ *l* 56·20 *l* 55·26	$\frac{1}{w} = 0·23$ $C = 56°\ 32'\ 55''·11$
	52·36	56·79	53·66	55·44	59·74	52·85	62·02	59·65	57·58	58·44	54·63	55·73	$M = 56''·57$ $w = 1·29$
‖ XXIV & XXVI	*l* 11·63 *l* 9·83	*l* 6·20 *l* 4·47	*l* 9·93 *l* 10·80	*l* 12·43 *l* 9·40 *l* 10·30	*l* 9·00 *l* 10·57	*l* 10·97 *l* 12·43	*l* 5·50 *l* 7·30	*l* 9·50 *l* 9·43	*l* 11·43 *l* 11·17	*l* 11·07 *l* 11·83	*l* 10·00 *l* 8·73	*l* 10·23 *l* 10·54	$M = 9''·75$ $w = 2·89$ $\frac{1}{w} = 0·35$
	10·73	5·34	10·36	10·71	9·79	11·70	6·40	9·46	11·30	11·45	9·37	10·38	$C = 38°\ 27'\ 9''·75$

At XXV (Lakhpat)—(*Continued*).

Angle between	Circle readings, telescope being set on XXII: 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 29′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
‖ XXVI & XXVII	″ l 19·44 l 20·57	″ l 21·63 l 23·00	″ l 15·00 l 15·54	″ l 21·63 l 23·43	″ l 15·54 l 16·06	″ l 13·47 l 14·40	″ l 15·53 l 15·77	″ l 14·34 l 13·83	″ l 20·37 l 21·43	″ l 16·53 l 18·40	″ l 24·63 l 26·00	″ l 20·24 l 20·60	M = 18″·64 w = 0·84 1/w = 1·19
	20·01	22·31	15·27	22·53	15·80	13·94	15·65	14·08	20·90	17·47	25·31	20·42	C = 37° 14′ 18″·64

At XXVI (Sugandia)

March 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXX: 169° 44′	349° 44′	179° 55′	359° 55′	190° 5′	10° 5′	200° 11′	20° 11′	210° 22′	30° 22′	220° 33′	40° 33′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXX & XXVIII	″ l 16·80 l 17·47	″ l 16·33 l 15·57	″ l 13·40 l 14·33	″ l 12·64 l 13·47	″ l 16·24 l 16·73	″ l 15·83 l 14·23	″ l 10·46 l 11·13	″ l 14·57 l 15·30	″ l 14·67 l 12·90	″ l 16·30 l 14·76	″ l 13·66 l 12·24	″ l 15·26 l 14·73	M = 14″·54 w = 3·72 1/w = 0·27
	17·14	15·95	13·86	13·06	16·48	15·03	10·80	14·93	13·79	15·53	12·95	14·99	C = 46° 43′ 14″·54
XXVIII & XXVII	l 32·70 l 33·77	l 36·13 l 35·67	l 31·80 l 30·97	l 34·33 l 34·07	l 26·83 l 26·47	l 27·93 l 27·33 l 28·80	l 32·50 l 31·07	l 35·37 l 32·83 l 33·36	l 33·90 l 35·36	l 29·57 l 30·67	l 36·70 l 36·63	l 33·87 l 33·60	M = 32″·52 w = 1·27 1/w = 0·79
	33·24	35·90	31·38	34·20	26·65	28·02	31·79	33·85	34·63	30·12	36·66	33·74	C = 50° 13′ 32″·52
XXVII & XXV	l 32·93 l 31·53	l 29·93 l 29·40	l 35·70 l 34·60	l 32·30 l 32·73	l 38·30 l 38·47	l 33·77 l 34·30	l 27·60 l 28·03	l 30·16 l 28·67	l 29·23 l 28·94	l 31·03 l 30·80	l 28·64 l 29·07	l 29·93 l 29·40	M = 31″·48 w = 1·23 1/w = 0·81
	32·23	29·67	35·15	32·51	38·39	34·03	27·82	29·41	29·09	30·91	28·86	29·66	C = 33° 16′ 31″·48
XXV & XXIV	l 33·20 l 32·96	l 34·90 l 33·77	l 30·94 l 32·17	l 30·10 l 30·00	l 25·63 l 24·53	l 37·46 l 36·30	l 31·44 l 29·67	l 29·14 l 29·90	l 30·40 l 28·93	l 31·27 l 30·10	l 29·83 l 27·50 l 26·93	l 31·67 l 32·77	M = 30″·98 w = 1·28 1/w = 0·78
	33·08	34·34	31·55	30·05	25·08	36·88	30·56	29·52	29·66	30·69	28·09	32·22	C = 60° 3′ 30″·98

At XXVII (Said Ali)

March 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXV: 187° 31′	7° 31′	197° 42′	17° 42′	207° 53′	27° 53′	217° 59′	37° 59′	228° 10′	48° 10′	238° 21′	58° 21′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXV & XXIV	″ l 36·17 l 37·53	″ l 38·06 l 38·37	″ l 34·10 l 31·83 l 32·73	″ l 39·13 l 40·60	″ l 33·17 l 31·00 l 32·73 l 32·90	″ l 35·80 l 35·73	″ l 31·90 l 33·20	″ l 32·87 l 35·46 l 35·90	″ l 39·03 l 37·44	″ l 40·43 l 40·00	″ l 35·67 l 35·27	″ l 33·10 l 33·47	M = 35″·88 w = 1·48 1/w = 0·68
	36·85	38·22	32·89	39·86	32·45	35·77	32·55	34·74	38·23	40·22	35·47	33·28	C = 66° 42′ 35″·87

At XXVII (Said Ali)—(*Continued*).

Angle between	Circle readings, telescope being set on XXV 187° 31′	7° 31′	197° 42′	17° 42′	207° 53′	27° 53′	217° 59′	37° 59′	228° 10′	48° 10′	238° 21′	58° 21′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XXIV & XXVI	″ *l* 30·93 *l* 31·07	″ *l* 29·50 *l* 30·40	″ *l* 32·70 *l* 35·87 *l* 33·47 *l* 34·70	″ *l* 28·53 *l* 29·87	″ *l* 39·56 *l* 40·04 *l* 38·10 *l* 39·33	″ *l* 32·00 *l* 33·94	″ *l* 34·26 *l* 35·24	″ *l* 35·40 *l* 35·57	″ *l* 30·87 *l* 32·66	″ *l* 27·84 *l* 30·74 *l* 29·53	″ *l* 30·10 *l* 30·50	″ *l* 34·67 *l* 33·56	$M = 32''\cdot70$ $w = 1\cdot28$ $\frac{1}{w} = 0\cdot78$ $C = 42^\circ 46' 32''\cdot71$
	31·00	29·95	34·19	29·20	39·26	32·97	34·75	35·48	31·77	29·37	30·30	34·11	
XXVI & XXVIII	*l* 54·27 *l* 54·90	*l* 56·27 *l* 55·84	*l* 54·17 *l* 55·17	*l* 55·17 *l* 54·97	*l* 52·16 *l* 50·97 *l* 50·04	*l* 60·83 *l* 60·66	*l* 49·60 *l* 49·20	*l* 53·70 *l* 53·33	*l* 53·17 *l* 51·54	*l* 54·03 *l* 54·86	*l* 53·17 *l* 51·86	*l* 54·37 *l* 54·70	$M = 54''\cdot08$ $w = 1\cdot49$ $\frac{1}{w} = 0\cdot67$ $C = 62^\circ 59' 54''\cdot08$
	54·59	56·05	54·67	55·07	51·06	60·75	49·40	53·51	52·36	54·44	52·52	54·53	
XXVIII & XXIX	*l* 11·07 *l* 9·60	*l* 10·70 *l* 11·26	*l* 10·70 *l* 11·43	*l* 10·10 *l* 10·56	*l* 16.13 *l* 15·27	*l* 9·77 *l* 9·34	*l* 16·67 *l* 17·13	*l* 15·50 *l* 14·64	*l* 12·66 *l* 13·73	*l* 14·03 *l* 12·74	*l* 12·23 *l* 11·60	*l* 10·40 *l* 9·87	$M = 12''\cdot38$ $w = 1\cdot98$ $\frac{1}{w} = 0\cdot50$ $C = 56^\circ 43' 12''\cdot38$
	10·34	10·98	11·06	10·33	15·70	9·56	16·90	15·07	13·19	13·39	11·91	10·14	

At XXVIII (Guni)

March 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms*' 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXVII 0° 0′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	*M* = Mean of Groups *w* = Relative Weight *C* = Concluded Angle
XXVII & XXVI	″ *l* 31·07 *l* 32·07 *l* 30·14	″ *h* 30·30 *l* 29·57 *l* 28·76	″ *l* 32·40 *l* 32·23	″ *l* 30·73 *l* 31·26	″ *l* 33·57 *l* 34·73	″ *l* 26·87 *l* 27·30	″ *l* 34·64 *l* 32·86	″ *l* 33·44 *l* 33·63	″ *l* 31·63 *l* 31·13	″ *l* 31·96 *l* 32·13	″ *l* 36·73 *l* 35·57	″ *l* 33·10 *l* 34·36	$M = 32''\cdot15$ $w = 2\cdot06$ $\frac{1}{w} = 0\cdot48$ $C = 66^\circ 46' 32''\cdot15$
	31·09	29·54	32·32	30·99	34·15	27·09	33·75	33·53	31·38	32·05	36·15	33·73	
XXVI & XXX	*l* 17·07 *l* 17·56 *l* 19·27 *l* 19·53	*l* 21·53 *l* 21·97	*l* 15·74 *l* 16·04	*l* 21·27 *l* 20·90	*l* 18·36 *l* 18·90	*l* 21·13 *l* 20·13	*l* 27·93 *l* 28·37	*l* 27·40 *l* 27·34	*l* 27·90 *l* 28·80	*l* 28·27 *l* 27·30	*l* 22·40 *l* 23·03	*l* 23·63 *l* 22·27	$M = 22''\cdot81$ $w = 0\cdot66$ $\frac{1}{w} = 1\cdot52$ $C = 80^\circ 42' 22''\cdot81$
	18·36	21·75	15·89	21·09	18·63	20·63	28·15	27·37	28·35	27·78	22·72	22·95	

At XXVIII (Guni)—(*Continued*).

Angle between	Circle readings, telescope being set on XXVII 0° 0′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXX & XXXI	″ *l* 41·10 *l* 39·93 *l* 40·27	″ *l* 35·63 *l* 37·50	″ *l* 40·00 *l* 40·76	″ *l* 36·37 *l* 37·24	″ *l* 40·77 *l* 40·80	″ *l* 41·90 *l* 42·90	″ *l* 33·53 *l* 34·63	″ *l* 33·53 *l* 34·06	″ *l* 33·47 *l* 32·74	″ *l* 33·73 *l* 34·24	″ *l* 29·33 *l* 29·50	″ *l* 30·67 *l* 30·20	$M = 36''\cdot02$ $w = 0\cdot66$ $\frac{1}{w} = 1\cdot51$ $C = 71°\ 39'\ 36''\cdot02$
	40·43	36·57	40·38	36·80	40·79	42·40	34·08	33·79	33·11	33·98	29·42	30·43	
XXXI & XXIX	*l* 52·60 *l* 53·67 *l* 50·57	*h* 51·40 *l* 52·80 *l* 51·13	*l* 56·96 *l* 55·14	*l* 53·73 *l* 53·96	*l* 54·73 *l* 53·54	*l* 49·80 *l* 50·77	*l* 54·10 *l* 54·80	*l* 53·47 *l* 52·54	*l* 51·56 *l* 50·96	*l* 49·10 *l* 48·86	*l* 55·64 *l* 56·10	*l* 55·40 *l* 55·97	$M = 53''\cdot14$ $w = 2\cdot22$ $\frac{1}{w} = 0\cdot45$ $C = 69°\ 45'\ 53''\cdot14$
	52·28	51·78	56·05	53·85	54·13	50·29	54·45	53·00	51·26	48·98	55·87	55·69	
XXIX & XXVII	*l* 38·57 *l* 39·86	*h* 41·00 *l* 40·70	*l* 35·37 *l* 36·10	*l* 36·73 *l* 37·87	*l* 31·77 *l* 33·23	*l* 39·97 *l* 39·70	*l* 30·54 *l* 29·04	*l* 32·23 *l* 32·76	*l* 35·17 *l* 36·04	*l* 37·54 *l* 37·14	*l* 35·76 *l* 35·90	*l* 37·56 *l* 38·40	$M = 36''\cdot21$ $w = 1\cdot10$ $\frac{1}{w} = 0\cdot91$ $C = 71°\ 5'\ 36''\cdot21$
	39·22	40·85	35·73	37·30	32·50	39·84	29·79	32·49	35·61	37·34	35·83	37·98	

At XXIX (Hakra)

March 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXVII 307° 49′	127° 49′	318° 1′	138° 0′	328° 11′	148° 11′	338° 17′	158° 17′	348° 28′	168° 28′	358° 38′	178° 39′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXVII & XXVIII	″ *h* 14·37 *l* 13·26	″ *l* 15·50 *l* 12·60 *l* 13·50	″ *h* 11·20 *h* 11·10	″ *l* 11·63 *l* 13·74 *l* 11·90 *l* 14·87	″ *h* 10·80 *l* 11·33	″ *l* 17·97 *l* 19·46	″ *l* 12·53 *l* 12·86	″ *l* 13·37 *l* 12·46	″ *l* 13·73 *l* 11·97	″ *l* 11·53 *l* 11·50	″ *l* 8·23 *l* 7·00	″ *l* 13·77 *l* 13·80	$M = 12''\cdot75$ $w = 1\cdot75$ $\frac{1}{w} = 0\cdot57$ $C = 52°\ 11'\ 12''\cdot75$
	13·82	13·87	11·15	13·03	11·07	18·71	12·70	12·91	12·85	11·52	7·61	13·79	
XXVIII & XXXI	*h* 14·13 *l* 12·97	*l* 16·20 *l* 17·43	*h* 14·06 *h* 13·54	*l* 17·73 *l* 15·50 *l* 18·83 *l* 15·43	*h* 21·84 *l* 20·03	*l* 12·64 *l* 12·10 *l* 13·47	*l* 18·10 *l* 18·10	*l* 16·73 *l* 18·77	*l* 13·80 *l* 12·96	*l* 13·26 *l* 12·14	*l* 14·83 *l* 14·46	*l* 9·97 *l* 12·74 *l* 11·70	$M = 15''\cdot23$ $w = 1\cdot45$ $\frac{1}{w} = 0\cdot69$ $C = 57°\ 20'\ 15''\cdot23$
	13·55	16·82	13·80	16·87	20·93	12·73	18·10	17·75	13·38	12·70	14·65	11·47	

At XXX (Patha-ki-beri)

March 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXIII 192° 6′	12° 6′	202° 16′	22° 16′	212° 27′	32° 28′	222° 33′	42° 33′	232° 44′	52° 44′	242° 55′	62° 55′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXIII & XXXII	″ h 10·80 h 11·47	″ h 11·27 l 12·20	″ l 6·37 l 6·80	″ l 14·67 l 14·00	″ l 13·10 l 11·94	″ h 17·00 l 17·54	″ l 14·40 l 12·43	″ l 9·50 l 11·00	″ l 6·74 l 5·43	″ l 10·83 l 9·74	″ l 8·50 l 9·26	″ h 9·37 h 7·00 h 8·06	M = 10″·89 w = 1·11 1/w = 0·90
	11·14	11·73	6·59	14·33	12·52	17·27	13·42	10·25	6·08	10·29	8·88	8·14	C = 48° 28′ 10″·89
XXXII & XXXI	h 60·74 h 62·40	h 59·80 l 59·94	l 65·93 l 64·67	l 61·84 l 64·00 l 63·06	l 68·20 l 70·26	h 58·40 l 57·03	l 62·43 l 62·70	l 65·97 l 66·04	l 64·83 l 65·14	l 64·67 l 63·33	l 68·67 l 67·64	l 67·76 l 69·24	M = 64″·24 w = 0·95 1/w = 1·05
	61·57	59·87	65·30	62·97	69·23	57·72	62·56	66·01	64·98	64·00	68·16	68·50	C = 63° 18′ 4″·24
XXXI & XXVIII	h 39·96 h 40·70	h 41·36 l 43·63 l 43·20 l 42·44	l 36·57 l 39·37 l 38·03	l 36·46 l 35·56	l 29·90 l 32·14 l 31·90	h 44·47 l 42·83	l 34·94 l 34·97	l 36·90 l 35·80	l 38·30 l 37·03	l 38·26 l 39·73	l 34·40 l 35·13	l 35·77 l 36·56	M = 37″·57 w = 0·98 1/w = 1·03
	40·33	42·66	37·99	36·01	31·31	43·65	34·96	36·35	37·66	39·00	34·76	36·17	C = 56° 8′ 37″·57
XXVIII & XXVI	l 19·00 l 20·87	l 23·93 l 22·80	l 23·03 l 25·73 l 25·20	l 27·07 l 25·84	l 27·67 l 26·96	l 22·20 l 21·36	l 28·10 l 30·80 l 30·54	l 26·80 l 25·76	l 24·43 l 25·73	l 22·74 l 22·94	l 25·16 l 24·10	l 23·50 l 21·77	M = 24″·57 w = 1·60 1/w = 0·62
	19·94	23·36	24·65	26·46	27·31	21·78	29·81	26·28	25·08	22·84	24·63	22·64	C = 52° 34′ 24″·58

At XXXI (Mod)

March 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXIX 143° 55′	323° 55′	154° 6′	334° 6′	164° 17′	344° 17′	174° 22′	354° 23′	184° 33′	4° 33′	194° 44′	14° 44′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXIX & XXVIII	″ h 61·50 h 58·67 h 57·20	″ h 50·10 h 51·10 l 50·43	″ l 55·83 l 55·66	″ l 53·70 l 52·97	″ l 56·87 l 55·54	″ l 51·87 l 52·90 h 52·90 l 54·90	″ l 52·00 l 52·87	″ l 47·37 l 49·33	″ l 51·16 l 52·43	″ l 51·20 l 49·77	″ l 48·87 l 47·77	″ l 51·20 l 50·60	M = 52″·53 w = 1·11 1/w = 0·90
	59·12	50·54	55·75	53·33	56·21	53·14	52·43	48·35	51·80	50·48	48·32	50·90	C = 52° 53′ 52″·54

At XXXI (Mod)—(*Continued*).

Angle between	143° 55′	323° 55′	154° 6′	334° 6′	164° 17′	344° 17′	174° 22′	354° 23′	184° 33′	4° 33′	194° 44′	14° 44′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	Circle readings, telescope being set on XXIX												
XXVIII & XXX	″ *h* 47·37 *h* 46·93	″ *l* 45·47 *l* 46·90	″ *l* 46·77 *l* 48·57 *l* 47·37	″ *l* 49·80 *l* 49·67 *l* 49·33	″ *l* 44·03 *l* 44·53	″ *l* 50·03 *h* 49·67 *l* 47·67	″ *l* 46·93 *l* 45·43	″ *l* 46·76 *l* 45·60	″ *l* 43·84 *l* 42·47	″ *l* 42·20 *l* 42·30	″ *l* 47·70 *l* 46·90	″ *l* 46·87 *l* 45·57	$M = 46''\cdot27$ $w = 2\cdot42$ $\frac{1}{w} = 0\cdot41$
	47·15	46·19	47·57	49·60	44·28	49·12	46·18	46·18	43·15	42·25	47·30	46·22	$C = 52°\ 11'\ 46''\cdot28$
XXX & XXXII	*h* 20·73 *h* 19·20	*l* 17·60 *l* 16·20	*l* 20·16 *l* 19·07 *l* 17·53 *l* 18·43	*l* 17·07 *l* 16·26 *l* 14·47	*l* 25·10 *l* 24·57	*l* 16·03 *l* 18·67 *h* 19·60 *l* 19·06	*l* 19·94 *l* 20·90	*l* 22·67 *l* 21·33	*l* 22·36 *l* 23·96	*l* 23·13 *l* 22·90	*l* 17·67 *l* 17·40	*l* 18·83 *l* 20·86	$M = 20''\cdot06$ $w = 1\cdot52$ $\frac{1}{w} = 0\cdot66$
	19·97	16·90	18·80	15·93	24·83	18·34	20·42	22·00	23·16	23·02	17·53	19·85	$C = 52°\ 42'\ 20''\cdot05$
XXXII & XXXIV	*h* 25·44 *h* 23·80	*h* 26·44 *l* 26.50	*l* 23·40 *l* 24·07 *l* 24·03	*l* 24·44 *l* 25·77 *l* 26·86	*l* 20·84 *l* 19·73	*l* 31·17 *h* 31·77 *l* 30·07	*l* 24·56 *l* 23·54	*l* 22·37 *l* 22·87	*l* 22·34 *l* 21·90	*l* 25·10 *l* 23·63	*l* 21·53 *l* 23·10	*l* 27·53 *l* 27·64	$M = 24''\cdot58$ $w = 1\cdot45$ $\frac{1}{w} = 0\cdot69$
	24·62	26·47	23·83	25·69	20·29	31·00	24·05	22·62	22·12	24·36	22·32	27·58	$C = 58°\ 17'\ 24''\cdot58$

At XXXII (Jim)

* *February* 1858; *and* † *April* 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 38′	220° 38′	50° 49′	230° 49′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	Circle readings, telescope being set on XXXVII												
* XXXVII & XXXIV	″ *h* 49·24 *h* 48·17	″ *h* 50·30 *h* 51·87 *h* 51·00	″ *l* 49·56 *l* 50·43	″ *l* 54·90 *l* 53·50	″ *h* 55·70 *h* 54·57	″ *l* 47·17 *l* 47·97	″ *l* 51·33 *l* 53·96 *l* 54·43	″ *h* 52·33 *l* 51·47	″ *l* 54·50 *l* 54·10	″ *l* 51·57 *l* 52·66	″ *l* 50·83 *l* 48·60 *l* 50·17 *l* 48·53	″ *l* 49·90 *l* 49·30	$M = 51''\cdot45$ $w = 1\cdot95$ $\frac{1}{w} = 0\cdot51$
	48·71	51·06	49·99	54·20	55·14	47·57	53·24	51·90	54·30	52·11	49·53	49·60	$C = 57°\ 46'\ 51''\cdot45$
* XXXIV & XXXI	*h* 34·70 *h* 36·26	*h* 34·17 *h* 35·10	*l* 41·27 *l* 39·60	*l* 37·43 *l* 37·06	*h* 33·20 *h* 33·83	*h* 34·73 *h* 36·53	*l* 38·37 *l* 35·17 *l* 36·80	*h* 39·47 *l* 40·36	*l* 33·00 *l* 33·13	*l* 39·47 *l* 38·87	*l* 32·40 *l* 34·83 *l* 34·06	*l* 37·40 *l* 37·14	$M = 36''\cdot41$ $w = 1\cdot84$ $\frac{1}{w} = 0\cdot54$
	35·48	34·64	40·43	37·25	33·51	35·63	36·78	39·92	33·06	39·17	33·76	37·27	$C = 49°\ 16'\ 36''\cdot41$
* XXXI & XXX	*h* 36·60 *h* 36·00	*h* 36·23 *h* 35·23	*l* 34·93 *l* 36·13	*l* 34·30 *l* 33·84	*h* 35·46 *h* 34·30	*h* 35·80 *h* 35·37	*l* 37·70 *l* 39·70 *l* 39·67	*h* 31·37 *l* 29·77	*l* 38·40 *l* 37·20	*l* 37·80 *l* 36·37	*l* 41·14 *l* 42·70	*h* 36·13 *h* 37·63	$M = 36''\cdot28$ $w = 1\cdot54$ $\frac{1}{w} = 0\cdot65$
	36·30	35·73	35·53	34·07	34·88	35·59	39·02	30·57	37·80	37·08	41·92	36·88	$C = 63°\ 59'\ 36''\cdot28$

At XXXII (Jim)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVII 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 38′	220° 38′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
* XXX & XXXIII	″ h 62·43 h 63·60	″ h 56·77 h 58·23	″ l 59·00 l 58·70	″ l 56·80 l 57·50	″ h 60·63 h 61·76	″ h 54·80 h 56·07	″ l 54·40 l 53·23	″ l 63·27 l 63·63	″ l 55·40 l 56·97	″ l 54·46 l 55·00	″ l 56·43 l 53·90 h 54·63	″ l 51·50 l 52·80	$M = 57''·37$ $w = 0·91$ $\frac{1}{w} = 1·10$
	63·02	57·50	58·85	57·15	61·19	55·44	53·81	63·45	56·19	54·73	54·99	52·15	$C = 61°\ 9'\ 57''·37$
* XXXIII & XXXV	h 41·57 h 43·07	h 42·93 h 43·64	l 44·00 l 42·97	l 44·46 l 43·20	h 49·57 h 48·57 l 47·40	h 41·00 h 39·53	l 40·26 l 40·74	l 35·50 l 37·30	l 44·67 l 43·66	l 45·00 l 44·86	l 48·20 l 49·37	l 45·63 l 47·20	$M = 43''·57$ $w = 0·96$ $\frac{1}{w} = 1·04$
	42·32	43·29	43·48	43·83	48·51	40·27	40·50	36·40	44·16	44·93	48·79	46·41	$C = 70°\ 43'\ 43''·57$
* XXXV & XXXVII	h 13·26 h 11·83	h 16·77 h 14·63 h 16·60	l 14·20 l 13·77	l 10·77 l 10·60	h 5·13 l 7·36 l 7·23	h 19·63 h 20·57 l 21·60 l 18·83 l 19·00	l 12·54 l 12·13	l 14·23 l 11·87 l 12·90	l 13·60 l 11·07	l 12·00 l 13·60	l 9·70 l 7·00 l 9·14	l 16·13 l 14·43	
	12·55	16·00	13·98	10·69	6·57	19·93	12·33	13·00	12·34	12·80	8·61	15·28	$M = 12''·84$ $w = 0·99$
	Circle readings, telescope being set on XXXV 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	$w = 3·03$
† XXXV & XXXVII	″ l 8·23 l 10·93 l 9·50	″ l 9·57 l 11·00	″ l 10·67 l 10·80	″ l 13·86 l 13·33	″ l 13·87 l 12·53	″ l 5·16 l 5·03	″ l 12·70 l 13·50	″ l 11·16 l 11·60	″ l 13·83 l 13·53	″ l 12·60 l 11·24	″ l 11·56 l 13·00	″ l 10·56 l 10·17	$\frac{1}{w} = 0·33$ $C = 57°\ 3'\ 11''·79$
	9·55	10·29	10·73	13·60	13·20	5·09	13·10	11·38	13·68	11·92	12·28	10·37	$M = 11''·27$ $w = 2·04$

At XXXIII (Nurlisháh)

February 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms*' 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXVI 180° 50′	0° 50′	192° 0′	12° 0′	202° 12′	22° 11′	212° 17′	32° 17′	222° 28′	42° 28′	232° 38′	52° 38′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXVI & XXXV	″ l 60·53 l 60·23	″ l 61·64 l 61·17	″ l 63·90 l 62·24	″ l 59·96 l 59·54	″ l 56·24 l 57·07	″ l 61·67 l 61·16	″ l 65·37 l 64·77	″ l 67·87 l 66·50	″ l 64·06 l 63·47	″ l 65·47 l 64·44	″ l 55·44 l 56·47	″ l 58·13 l 58·50	$M = 61''·49$ $w = 0·98$ $\frac{1}{w} = 1·02$
	60·38	61·41	63·07	59·75	56·65	61·42	65·07	67·18	63·77	64·95	55·96	58·31	$C = 44°\ 34'\ 1''·49$
XXXV & XXXII	h 52·80 h 51·97	h 52·13 h 52·86	l 53·30 l 52·50	l 53·17 l 53·46	l 54·86 l 54·77	l 52·30 l 52·64	l 56·20 l 55·47	l 49·20 l 49·67	l 49·07 l 50·13	l 51·26 l 51·10	l 53·40 l 52·57	l 56·10 l 55·30	$M = 52''·76$ $w = 2·80$ $\frac{1}{w} = 0·36$
	52·39	52·49	52·90	53·32	54·81	52·47	55·84	49·43	49·60	51·18	52·99	55·70	$C = 63°\ 14'\ 52''·76$

At XXXIII (Nurlisháh)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	180° 50′	0° 50′	192° 0′	12° 0′	202° 12′	22° 11′	212° 17′	32° 17′	222° 28′	42° 28′	232° 38′	52° 38′	
XXXII & XXX	″ h 53·10 h 53·66	″ h 54·44 h 54·84	″ l 48·60 l 49·00	″ h 50·50 l 51·47	″ l 47·67 l 46·96	″ l 56·10 l 55·53	″ l 43·47 l 43·26	″ l 47·27 l 48·93	″ l 51·43 l 50·63	″ l 50·90 l 51·46	″ l 52·50 l 51·80	″ l 50·37 l 51·64	M = 50″·65 w = 1·03 $\frac{1}{w}$ = 0·97 C = 70° 21′ 50″·65
	53·38	54·64	48·80	50·99	47·31	55·82	43·36	48·10	51·03	51·18	52·15	51·01	

At XXXIV (Dhui)

February 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXI												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 11′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 40′	220° 39′	50° 49′	230° 49′	
XXXI & XXXII	″ h 56·87 h 58·57	″ h 60·73 h 59·40	″ h 61·76 h 60·97	″ h 57·27 h 59·20	″ l 57·47 l 58·60	″ l 56·37 l 55·76	″ l 61·87 l 61·73	″ l 63·10 l 59·60 h 62·03	″ h 62·80 h 62·20	″ h 63·07 h 62·13	″ h 60·83 h 62·13	″ h 61·94 h 61·00	M = 60″·24 w = 2·40 $\frac{1}{w}$ = 0·42 C = 72° 26′ 0″·24
	57·72	60·07	61·36	58·24	58·03	56·07	61·80	61·58	62·50	62·60	61·48	61·47	
XXXII & XXXVII	h 46·10 h 45·53	h 47·07 h 46·36	h 43·34 h 42·70	h 49·60 h 50·30	l 45·03 l 44·36	l 48·00 l 46·67	l 42·06 l 40·27	l 43·40 l 44·23	h 41·90 h 41·74	h 42·07 h 42·30	h 49·34 h 48·34	h 50·10 h 51·06	M = 45″·50 w = 1·14 $\frac{1}{w}$ = 0·88 C = 53° 50′ 45″·50
	45·82	46·71	43·02	49·95	44·70	47·33	41·17	43·81	41·82	42·19	48·84	50·58	

At XXXV (Koti)

February and March 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXVIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 50′	
XXXVIII & XXXIX	″ h 21·10 h 21·47	″ h 24·27 h 23·83	″ l 26·33 l 26·10	″ l 24·67 l 24·23	″ l 25·04 l 28·17 l 26·44	″ l 21·90 l 21·13	″ l 23·37 l 24·03	″ l 26·40 l 24·53	″ h 24·26 h 25·40	″ l 27·57 l 25·90	″ l 28·86 l 29·73	″ l 26·86 l 27·83	M = 25″·12 w = 2·13 $\frac{1}{w}$ = 0·47 C = 67° 28′ 25″·12
	21·29	24·05	26·21	24·45	26·55	21·52	23·70	25·46	24·83	26·74	29·29	27·35	
XXXIX & XXXVII	h 41·96 h 40·40	h 41·37 h 40·70	l 36·40 l 35·03 h 38·27 h 36·66	h 39·63 h 37·80	l 36·83 l 37·63	l 40·37 l 41·20	l 37·96 l 38·60	l 43·56 l 45·20	h 34·74 h 34·36	l 34·27 l 33·80	l 30·74 l 34·10 l 32·56	l 32·70 l 33·73	M = 37″·71 w = 0·85 $\frac{1}{w}$ = 1·17 C = 46° 42′ 37″·71
	41·18	41·04	36·59	38·71	37·23	40·79	38·28	44·38	34·55	34·03	32·47	33·22	

At XXXV (Koti)—(*Continued*).

Angle between	Circle readings, telescope being set on XXXVIII												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 50′	
XXXVI & XXXVIII	″ h 28·00 h 26·83 l 24·90	″ h 26·56 l 26·13	″ l 24·83 l 25·37	″ l 27·87 l 25·63 l 26·60	″ l 22·03 l 21·80 l 21·46	″ l 27·40 l 28·20	″ l 23·40 l 22·97	″ l 24·10 l 23·30	″ h 23·27 h 22·20	″ h 25·07 l 26·90	″ l 23·43 l 25·57 l 26·60	″ l 28·64 l 28·54	$M = 25''\cdot31$ $w = 2\cdot57$ $\frac{1}{w} = 0\cdot39$
	26·58	26·35	25·10	26·70	21·76	27·80	23·18	23·70	22·74	25·98	25·20	28·59	$C = 62^\circ 23' 25''\cdot31$

Angle between	Circle readings, telescope being set on XXXVII												
	0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	$M = 20''\cdot73$
* XXXVII & XXXII	″ h 16·70 h 15·97	″ h 20·70 h 19·07	″ l 21·70 l 22·27	″ l 23·97 l 22·57	″ l 21·83 l 22·93	″ l 17·63 l 18·56	″ l 25·43 l 23·93	″ l 20·64 l 22·60	″ l 23·67 h 24·00	″ h 21·07 h 18·63 h 19·30	″ h 20·80 h 21·10	″ l 15·60 l 16·47	$w = 1\cdot48$ $\frac{1}{w} = 0\cdot68$ $C = 54^\circ 55' 20''\cdot73$
	16·34	19·88	21·99	23·27	22·38	18·09	24·68	21·62	23·84	19·67	20·95	16·03	
* XXXII & XXXIII	h 20·57 h 22·00	h 20·77 h 21·53	l 21·37 l 20·83	l 22·10 l 24·33	l 21·54 l 21·80	l 22·90 l 24·90	l 19·20 l 22·17 l 22·44	l 25·20 l 25·27	l 19·87 l 20·73 h 20·16	h 27·67 h 28·07 h 28·20	h 22·30 h 21·13	l 24·57 l 23·23	$M = 22''\cdot72$ $w = 2\cdot30$ $\frac{1}{w} = 0\cdot43$
	21·29	21·15	21·10	23·21	21·67	23·90	21·27	25·24	20·25	27·98	21·71	23·90	$C = 46^\circ 1' 22''\cdot72$
* XXXIII & XXXVI	h 48·80 h 49·63	h 49·53 h 48·87	l 52·37 l 51·07	l 49·20 l 48·13	l 52·16 l 52·67	l 44·83 l 44·60	l 48·70 l 47·10	l 43·06 l 42·17	h 48·67 h 49·54	h 42·43 h 46·13 h 42·50 h 42·30	h 54·24 h 54·40	l 50·47 l 50·33	$M = 48''\cdot63$ $w = 0\cdot92$ $\frac{1}{w} = 1\cdot09$
	49·22	49·20	51·72	48·66	52·42	44·71	47·90	42·62	49·10	43·34	54·32	50·40	$C = 82^\circ 28' 48''\cdot62$

At XXXVI (Nindámani)

***February* 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on XXXVIII												M = Mean of Groups. w = Relative Weight C = Concluded Angle
	0° 0′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 38′	220° 39′	50° 50′	230° 50′	
XXXVIII & XXXV	″ l 14·93 l 15·64	″ h 15·30 h 16·77	″ l 20·73 l 22·13	″ l 18·94 l 18·54	″ l 16·56 l 17·63	″ l 13·16 l 15·64 l 15·24	″ l 18·40 l 21·63 l 19·03	″ l 21·97 l 22·93	″ h 21·50 h 20·40	″ h 19·87 h 19·14 h 20·23	″ l 21·20 l 21·76	″ l 21·56 l 22·23	$M = 19''\cdot12$ $w = 1\cdot56$ $\frac{1}{w} = 0\cdot64$
	15·29	16·03	21·43	18·74	17·10	14·68	19·69	22·45	20·95	19·75	21·48	21·89	$C = 69^\circ 37' 19''\cdot12$
XXXV & XXXIII	h 10·37 l 10 47	h 11·93 h 12·70	l 6·97 l 5·03	l 11·16 l 8·93 l 11·07	l 11 37 l 9·70	l 13·47 l 12·90 l 13·60	l 10·44 l 7·67 l 8·97	l 4·20 l 2·90	h 8·80 h 8·06	l 8·14 l 7·40 l 6·86	l 5·43 l 5·74	l 8·30 l 7·00 l 7·20	$M = 8''\cdot71$ $w = 1\cdot43$ $\frac{1}{w} = 0\cdot70$
	10·42	12·32	6·00	10·39	10·53	13·32	9·03	3·55	8·43	7·47	5·59	7·50	$C = 52^\circ 57' 8''\cdot71$

* Two sets of observations were made at Koti station, the first set included all the angles at that station, but those marked with an asterisk were rejected and were re-observed.

At XXXVII (Mugalbhin)

**February* 1858; †*March* 1858; *and* ‡*April* 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXIV												M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	146° 42′	326° 42′	156° 52′	336° 52′	167° 4′	347° 4′	177° 9′	357° 9′	187° 20′	7° 20′	197° 31′	17° 31′	
	″	″	″	″	″	″	″	″	″	″	″	″	
* XXXIV & XXXII	h 22·17	h 20·07	l 28·00	l 26·97	h 26·77	h 23·20	l 21·43	l 23·73	l 25·30	l 25·87	l 20·37	l 21·76	$M = 23''·86$
	h 22·10	h 20·90	l 28·50	l 27·03	h 25·83	h 23·30	l 22·53	l 23·83	l 23·87	l 26·06	l 19·47	l 23·60	$w = 1·73$
													$\frac{1}{w} = 0·58$
	22·14	20·48	28·25	27·00	26·30	23·25	21·98	23·78	24·59	25·96	19·92	22·68	$C = 68° 22' 23''·86$
* XXXII & XXXV	h 27·27	h 23·73	l 26·06	h 25·87	l 22·84	l 18·80	l 23·97	l 20·53	l 25·13	l 20·63	l 24·76	l 20·04	
	h 25·50	h 22·50	l 23·83	l 25·16	l 22·36	l 20·24	l 25·07	l 19·07	l 26·03	l 20·07	l 25·13	l 19·83	
			l 23·97			l 19·04							
	26·39	23·11	24·62	25·52	22·60	19·36	24·52	19·80	25·58	20·35	24·94	19·94	$M = 23''·06$, $w = 1·76$
	Circle readings, telescope being set on XXXII												
	291° 59′	111° 59′	302° 10′	122° 10′	312° 21′	132° 21′	322° 26′	142° 26′	332° 37′	152° 37′	342° 48′	162° 48′	$w = 3·80$
	″	″	″	″	″	″	″	″	″	″	″	″	$\frac{1}{w} = 0·26$
† XXXII & XXXV	h 29·23	h 32·17	h 28·40	h 28·20	h 23·40	h 30·93	l 23·10	l 31·64	l 29·06	l 28·10	l 28·33	l 30·20	$C = 68° 1' 25''·89$
	h 32·06	h 31·33	h 29·13	h 28·63	h 22·10	h 31·80	l 23·43	l 30·07	l 29·90	l 27·70	l 30·63	l 30·00	
	h 31·40										l 29·27		
	30·90	31·75	28·77	28·41	22·75	31·37	23·26	30·86	29·48	27·90	29·41	30·10	$M = 28''·75$, $w = 1·36$
	Circle readings, telescope being set on XXXII												
	0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	
	″	″	″	″	″	″	″	″	″	″	″	″	
‡ XXXII & XXXV	l 26·23	l 27·20	l 25·37	l 22·83	l 25·70	l 19·77	l 30·87	l 29·10	h 29·37	l 33·64	l 31·13	l 32·67	
	l 24·96	l 25·63	l 24·44	l 23·90	l 23·27	l 18·14	l 30·80	l 28·37	h 28·33	h 31·90	l 32·53	l 32·00	
					l 26·03								
	25·60	26·41	24·91	23·36	25·00	18·96	30·83	28·74	28·85	32·77	31·83	32·33	$M = 27''·47$, $w = 0·68$
	Circle readings, telescope being set on XXXIV												
	146° 42′	326° 42′	156° 52′	336° 52′	167° 4′	347° 4′	177° 9′	357° 9′	187° 20′	7° 20′	197° 31′	17° 31′	
	″	″	″	″	″	″	″	″	″	″	″	″	$M = 61''·78$
* XXXV & XXXIX	h 62·70	h 65·50	l 63·14	h 61·26	l 58·00	l 66·23	l 57·00	l 57·34	l 55·83	l 62·77	l 60·24	l 67·43	$w = 0·86$
	h 64·57	h 66·87	l 63·17	h 62·80	l 59·00	l 67·30	l 57·46	l 57·73	l 57·10	l 64·36	l 59·60	l 65·20	$\frac{1}{w} = 1·17$
				l 63·27								l 65·10	$C = 76° 55' 1''·78$
	63·64	66·18	63·16	62·44	58·50	66·76	57·23	57·54	56·46	63·57	59·92	65·91	

At XXXVIII (Abanshâh)

***February* 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	0°0′	180°0′	10°11′	190°11′	20°22′	200°22′	30°28′	210°28′	40°39′	220°39′	50°49′	230°49′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XLII & XL	h 27·90	h 28·56	h 29·87	h 32·30	l 37·40	l 29·36	l 36·13	l 36·06	h 39·30	h 34·43	l 33·90	l 33·60	M = 33″·33
	h 27·26	h 28·37	h 31·20	l 33·73	l 35·70	l 30·30	l 36·30	l 36·07	h 40·37	h 34·80	l 32·50	l 34·50	w = 0·89
													$\frac{1}{w}$ = 1·13
mean	27·58	28·47	30·53	33·02	36·55	29·83	36·21	36·07	39·83	34·62	33·20	34·05	C = 41° 22′ 33″·33
XL & XXXIX	h 62·87	h 61·40	h 61·46	l 61·60	l 63·10	l 63·54	l 60·57	h 62·03	h 60·03	l 66·03	l 63·70	l 65·60	M = 62″·61
	h 64·14	h 61·66	h 62·33	l 62·80	l 63·03	l 61·70	h 59·70	h 63·26	h 60·33	l 64·90	l 64·33	l 64·17	w = 3·80
						l 61·40	h 58·73						$\frac{1}{w}$ = 0·26
mean	63·51	61·53	61·89	62·20	63·07	62·21	59·67	62·64	60·18	65·47	64·01	64·89	C = 51° 53′ 2″·60
XXXIX & XXXV	h 13·50	h 14·50	h 10·87	h 11·13	l 6·63	l 7·66	l 11·36	h 13·34	h 15·57	l 13·27	l 16·33	l 11·44	M = 12″·25
	h 14·03	h 15·20	h 9·27	l 9·67	l 8·20	l 9·87	h 12·03	h 11·07	h 16·07	l 13·70	l 17·63	l 11·60	w = 1·41
				l 10·14		l 8·36	h 13·53	h 11·04					$\frac{1}{w}$ = 0·71
mean	13·77	14·85	10·07	10·31	7·41	8·63	12·31	11·82	15·82	13·49	16·98	11·52	C = 51° 53′ 12″·24
XXXV & XXXVI	l 18·10	h 12·56	l 24·03	l 15·06	l 18·30	l 13·37	h 19·10	h 15·53	h 18·50	h 15·20	l 15·34	l 14·90	M = 16″·97
	l 21·14	h 12·70	l 24·50	l 16·07	l 17·50	l 14·83	h 20·07	h 14·47	h 17·20	h 16·40	l 16·24	l 16·30	w = 1·22
	h 19·54												$\frac{1}{w}$ = 0·82
mean	19·59	12·63	24·27	15·56	17·90	14·10	19·59	15·00	17·85	15·80	15·79	15·60	C = 47° 59′ 16″·97

At XXXIX (Gada)

***February* 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	0°0′	180°0′	10°11′	190°12′	20°22′	200°22′	30°28′	210°28′	40°39′	220°39′	50°49′	230°49′	M = Mean of Groups; w = Relative Weight; C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXVII & XXXV	l 17·70	l 17·83	h 20·46	h 20·47	l 21·60	l 16·03	l 21·73	l 20·17	h 20·54	h 20·77	l 15·33	l 18·70	M = 19″·58
	l 18·57	l 19·80	h 17·13	h 19·37	l 22·40	l 17·03	l 24·47	l 21·13	h 19·84	h 22·17	l 17·34	l 18·83	w = 2·68
	l 19·73	l 21·30	h 16·33	h 20·00			l 22·00						$\frac{1}{w}$ = 0·37
			l 17·97										
mean	18·67	19·64	17·97	19·95	22·00	16·53	22·73	20·65	20·19	21·47	16·34	18·76	C = 56° 22′ 19″·58
XXXV & XXXVIII	l 23·04	l 23·20	h 22·77	h 23·20	l 19·33	l 27·57	l 23·44	l 24·90	h 21·20	h 24·06	l 24·63	l 23·96	M = 24″·18
	l 26·43	l 23·63	h 26·43	h 26·60	l 19·37	l 28·37	l 22·96	l 25·53	h 22·70	h 23·43	l 24·83	l 25·00	w = 2·35
	l 27·57		l 26·57	h 26·20			l 22·80						$\frac{1}{w}$ = 0·43
mean	25·68	23·42	25·26	25·33	19·35	27·97	23·07	25·21	21·95	23·75	24·73	24·48	C* = 60° 38′ 24″·19

At XXXIX (Gada)—(*Continued*).

Angle between	0° 0′	180° 0′	10° 11′	190° 12′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XXXVIII & XL	*l* 10·93 *l* 12·77	*l* 16·24 *l* 18·20	*h* 16·63 *h* 14·40 *l* 14·33	*h* 12·23 *h* 9·03 *h* 9·53	*l* 19·20 *l* 20·07	*l* 11·16 *l* 14·47 *l* 14·13	*l* 20·90 *l* 18·80 *l* 20·50	*l* 15·26 *l* 13·87	*h* 19·06 *h* 19·46	*h* 13·84 *h* 15·57	*l* 17·70 *l* 16·17	*l* 16·43 *l* 15·27 *l* 18·67 *l* 17·53	$M = 15''\cdot82$ $w = 1\cdot19$ $\frac{1}{w} = 0\cdot84$
	11·85	17·22	15·12	10·26	19·64	13·25	20·07	14·56	19·26	14·71	16·93	16·98	$C = 56° 50' 15''\cdot82$
XL & XLI	*l* 17·87 *l* 17·70	*l* 13·46 *l* 14·37	*h* 18·17 *h* 20·34 *l* 21·60	*h* 22·84 *h* 19·44 *h* 20·07	*l* 19·40 *l* 19·13	*l* 21·87 *l* 19·16 *l* 20·43	*l* 16·90 *l* 18·80	*l* 22·37 *l* 22·97	*h* 15·90 *h* 15·64	*h* 25·57 *h* 23·36 *h* 23·20	*l* 17·37 *l* 18·66	*l* 18·76 *l* 18·46 *l* 16·64	$M = 19''\cdot05$ $w = 1\cdot45$ $\frac{1}{w} = 0\cdot69$
	17·79	13·91	20·04	20·78	19·27	20·49	17·85	22·67	15·77	24·04	18·01	17·95	$C = 50° 23' 19''\cdot06$

At XL (Randa)

February 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	0° 1′	180° 1′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XLII & XLIII	*h* 51·00 *h* 53·00	*h* 53·57 *h* 51·86	*h* 53·06 *h* 53·10	*l* 53·33 *h* 52·00 *h* 54·23	*h* 57·30 *l* 56·87 *l* 56·97	*h* 52·90 *h* 51·67	*l* 57·66 *l* 59·34	*l* 56·16 *l* 58·63 *l* 58·53	*h* 59·03 *h* 58·30	*h* 60·66 *h* 59·54	*l* 54·63 *l* 56·50	*h* 57·36 *l* 55·97	$M = 55''\cdot63$ $w = 1\cdot41$ $\frac{1}{w} = 0\cdot71$
	52·00	52·72	53·08	53·19	57·05	52·28	58·50	57·77	58·67	60·10	55·56	56·67	$C = 97° 5' 55''\cdot63$
XLIII & XLI	*h* 13·40 *h* 12·67	*h* 12·60 *l* 10·70	*h* 11·87 *h* 13·76	*l* 16·03 *l* 15·37 *l* 13·10 *l* 13·43	*l* 13·23 *l* 13·76	*h* 14·80 *l* 15·73 *l* 16·07	*l* 16·77 *l* 16·94	*l* 15·37 *l* 16·00	*h* 20·17 *h* 18·93	*h* 14·27 *h* 14·70	*l* 22·50 *l* 21·17	*h* 14·37 *l* 16·43 *l* 14·40	$M = 15''\cdot37$ $w = 1\cdot38$ $\frac{1}{w} = 0\cdot72$
	13·04	11·65	12·81	14·48	13·50	15·53	16·85	15·69	19·55	14·48	21·84	15·07	$C = 55° 10' 15''\cdot37$
XLI & XXXIX	*h* 37·26 *h* 35·77	*h* 33·76 *l* 33·50	*h* 37·87 *h* 37·00	*l* 33·47 *h* 32·24	*l* 37·17 *l* 37·17	*l* 30·30 *l* 28·66	*l* 32·30 *l* 34·36 *h* 33·60	*l* 36·57 *l* 34·17 *l* 34·60	*h* 30·43 *h* 30·73 *h* 29·60	*h* 32·10 *h* 32·54	*l* 27·90 *l* 28·37	*h* 35·03 *h* 36·37	$M = 33''\cdot50$ $w = 1\cdot26$ $\frac{1}{w} = 0\cdot80$
	36·52	33·63	37·43	32·86	37·17	29·48	33·42	35·11	30·25	32·32	28·13	35·70	$C = 62° 34' 33''\cdot50$
XXXIX & XXXVIII	*h* 40·43 *h* 39·40	*l* 45·47 *l* 45·10	*h* 46·06 *h* 44·50	*l* 45·07 *h* 45·33	*l* 42·90 *l* 42·30	*h* 39·00 *h* 38·86	*l* 46·43 *l* 43·54 *h* 44·30	*l* 43·43 *l* 41·26 *l* 40·96	*h* 42·50 *h* 43·83	*h* 41·56 *h* 41·73	*l* 42·87 *l* 42·00	*h* 39·73 *l* 42·20 *l* 40·87	$M = 42''\cdot67$ $w = 2\cdot46$ $\frac{1}{w} = 0\cdot41$
	39·92	45·28	45·28	45·20	42·60	38·93	44·76	41·88	43·17	41·64	42·44	40·93	$C = 71° 16' 42''\cdot67$

At XL (Randa)—(*Continued*).

Angle between	Circle readings, telescope being set on XLII 0° 1′	180° 1′	10° 12′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXVIII & XLII	″ h 36.60 h 35.67	″ l 35.93 l 35.84	″ h 31.24 h 32.24	″ l 31.26 h 33.03	″ l 29.30 l 28.80	″ h 38.00 h 38.50	″ l 26.64 l 26.46	″ l 30.73 l 33.64 l 31.44	″ h 28.50 h 28.20	″ h 31.24 h 33.23	″ l 30.24 l 30.66	″ h 34.94 l 33.90	$M = 32''.26$ $w = 0.99$ $\frac{1}{w} = 1.01$
	36.14	35.88	31.74	32.15	29.05	38.25	26.55	31.94	28.35	32.23	30.45	34.42	$C = 73° 52' 32''.26$

At XLI (Khar)

February 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XXXIX 223° 12′	43° 12′	233° 21′	53° 21′	243° 30′	63° 30′	253° 37′	73° 38′	263° 48′	83° 48′	273° 59′	93° 59′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XXXIX & XL	″ h 8.40 h 9.50	″ h 10.36 h 9.00	″ l 7.50 l 6.60	″ h 8.33 h 6.64 h 9.16	″ l 10.13 l 8.13	″ l 6.73 l 6.60 h 7.03	″ l 13.13 l 11.47	″ l 7.87 l 6.90	″ l 5.90 l 6.17	″ l 4.17 l 3.67	″ l 9.10 l 8.00	″ l 10.60 l 10.70	$M = 8''.21$ $w = 2.37$ $\frac{1}{w} = 0.42$
	8.95	9.68	7.05	8.04	9.13	6.79	12.30	7.39	6.03	3.92	8.55	10.65	$C = 67° 2' 8''.21$
XL & XLIII	h 26.06 h 26.60	h 25.84 h 26.60	l 24.87 l 24.57	h 25.56 h 26.00	l 17.94 l 19.30	l 28.63 l 30.07	l 14.44 l 14.93 h 16.37 h 17.20	l 20.53 l 21.14	l 24.03 l 25.16	l 24.23 l 22.33	l 23.30 l 23.63	l 24.90 l 26.30	$M = 23''.71$ $w = 0.85$ $\frac{1}{w} = 1.17$
	26.33	26.22	24.72	25.78	18.62	29.35	15.74	20.83	24.60	23.28	23.46	25.60	$C = 69° 48' 23''.71$

At XLII (Bíbi Mariam)

January 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XLV 289° 16′	109° 16′	299° 26′	119° 26′	309° 37′	129° 37′	319° 43′	139° 43′	329° 55′	149° 55′	340° 4′	160° 4′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XLV & XLIV	″ h 68.50 h 67.77	″ h 68.00 h 68.73	″ h 62.20 h 61.66	″ l 64.66 l 65.56	″ l 61.67 l 61.97	″ l 65.93 l 66.90	″ l 56.80 l 58.27	″ l 66.84 l 65.60	″ h 60.53 h 61.70	″ h 61.60 h 60.10	″ l 60.70 l 61.63	″ l 64.03 l 65.50	$M = 63''.62$ $w = 1.05$ $\frac{1}{w} = 0.95$
	68.14	68.36	61.93	65.11	61.82	66.42	57.53	66.22	61.12	60.85	61.16	64.77	$C = 70° 45' 3''.62$

At XLII (Bíbi Mariam)—(*Continued*).

Angle between	Circle readings, telescope being set on XLV 289° 16′	109° 16′	299° 26′	119° 26′	309° 37′	129° 37′	319° 43′	139° 43′	329° 55′	149° 55′	340° 4′	160° 4′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XLIV & XLIII	h 4·17	h 6·17	h 5·57	l 10·64	l 10·83	l 6·23	l 8·80	l 7·70	h 8·47	h 6·94	l 10·00	l 10·67	$M = 8''\cdot11$
	h 5·80	h 5·37	h 6·24	l 10·54	l 9·00	l 7·07	l 9·13	l 5·94	h 10·56	h 8·76	l 11·10	l 8·90	$w = 2\cdot78$
									h 9·53				$\frac{1}{w} = 0\cdot36$
	4·99	5·77	5·90	10·59	9·92	6·65	8·96	6·82	9·52	7·85	10·55	9·79	$C = 60° 10' 8''\cdot11$
XLIII & XL	h 13·70	h 13·76	h 17·93	l 14·43	l 14·34	l 13·77	l 18·63	l 19·96	h 15·33	h 20·40	l 13·67	l 14·66	$M = 16''\cdot00$
	h 14·50	h 14·60	h 17·43	l 15·06	l 14·13	l 16·90	l 17·07	l 19·10	h 14·84	h 19·84	l 14·70	l 13·96	$w = 2\cdot32$
						l 17·43							$\frac{1}{w} = 0\cdot43$
	14·10	14·18	17·68	14·75	14·23	16·03	17·85	19·53	15·09	20·12	14·18	14·31	$C = 46° 42' 16''\cdot00$
XL & XXXVIII	h 56·67	h 56·64	h 53·44	l 57·07	l 55·03	l 55·00	l 57·27	l 49·36	h 55·90	h 55·00	l 59·20	l 55·44	$M = 55''\cdot35$
	h 55·83	h 58·30	h 55·03	l 54·87	l 54·27	l 54·43	l 57·83	h 46·86	h 56·20	h 55·27	l 57·37	l 56·77	$w = 1\cdot66$
				l 55·50				h 47·57					$\frac{1}{w} = 0\cdot60$
	56·25	57·47	54·24	55·81	54·65	54·71	57·55	47·93	56·05	55·14	58·28	56·11	$C = 64° 44' 55''\cdot34$

At XLIII (Vikia)

January 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XLI 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 23′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups, w = Relative Weight, C = Concluded Angle
	″	″	″	″	″	″	″	″	″	″	″	″	
XLI & XL	l 12·77	l 15·30	l 19·27	l 18·60	l 18·44	h 13·70	l 24·46	l 24·23	l 23·33	h 20·86	l 22·10	l 19·03	$M = 19''\cdot35$
	l 12·53	l 16·47	l 19·00	l 20·30	l 17·16	h 14·13	l 25·03	l 24·30	l 22·33	h 22·03	l 21·50	l 18·93	$w = 0\cdot75$
	l 10·63												$\frac{1}{w} = 1\cdot34$
	l 11·66												
	11·90	15·89	19·13	19·45	17·80	13·92	24·74	24·27	22·83	21·44	21·80	18·98	$C = 55° 1' 19''\cdot35$
XL & XLII	l 50·00	l 43·86	l 39·20	l 44·30	l 46·23	l 42·47	l 45·93	l 47·60	h 46·44	h 50·80	h 46·40	h 53·63	$M = 46''\cdot50$
	l 50·40	l 42·80	l 40·26	l 43·13	l 47·74	l 42·40	l 45·57	l 48·67	h 46·86	h 53·20	l 46·56	h 54·20	$w = 0\cdot77$
	l 48·03					l 43·14	l 45·44			h 49·93			$\frac{1}{w} = 1\cdot30$
	49·48	43·33	39·73	43·72	46·98	42·67	45·65	48·14	46·65	51·31	46·48	53·91	$C = 36° 11' 46''\cdot50$

At XLIII (Vikia)—(*Continued*).

Angle between	Circle readings, telescope being set on XLI 0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 23′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 50′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XLII & XLIV	″ l 47·50 l 47·90 l 45·67 l 46·57	″ l 48·14 l 48·36 l 46·40 l 46·54	″ l 47·74 l 46·27 l 46·67	″ l 46·73 l 46·90 l 48·67	″ l 41·13 l 42·20	″ l 46·26 l 47·74 l 45·03	″ l 36·97 l 36·76	″ l 38·53 l 37·86	″ h 42·23 h 40·87	″ h 37·60 h 37·07	″ h 44·34 l 44·74 l 45·73	″ h 37·60 h 35·80	$M = 42''\cdot68$ $w = 0\cdot60$ $\frac{1}{w} = 1\cdot68$ $C = 34^\circ\ 42'\ 42''\cdot69$
	46·91	47·36	46·89	47·43	41·67	46·34	36·86	38·20	41·55	37·33	44·94	36·70	
XLIV & CIV	l 28·10 l 27·94	l 28·00 l 27·27	l 34·16 l 33·76	l 25·14 l 24·33	l 31·80 l 30·73	h 26·17 h 25·00	l 29·84 l 31·06	l 26·13 l 25·50	h 28·14 h 28·50	h 28·23 h 28·23	l 31·26 l 30·83	l 28·90 l 29·40	$M = 28''\cdot68$ $w = 1\cdot66$ $\frac{1}{w} = 0\cdot60$ $C = 62^\circ\ 39'\ 28''\cdot68$
	28·02	27·64	33·96	24·73	31·27	25·58	30·45	25·82	28·32	28·23	31·04	29·15	

At XLIV (Dománi)

***January* 1858; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.**

Angle between	Circle readings, telescope being set on CVII 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 38′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
CVII & CIV	″ h 40·20 h 42·40 h 42·67	″ h 41·56 h 42·63	″ h 44·40 h 44·20	″ h 44·27 h 41·00 l 41·76	″ h 48·30 h 47·50	″ h 39·43 h 39·43	″ l 44·43 l 44·93	″ l 45·96 l 45·80	″ l 44·54 l 45·83	″ l 44·87 l 45·20	″ l 46·76 l 47·00	″ l 45·27 l 45·10	$M = 44''\cdot22$ $w = 2\cdot01$ $\frac{1}{w} = 0\cdot50$ $C = 59^\circ\ 27'\ 44''\cdot22$
	41·76	42·10	44·30	42·34	47·90	39·43	44·68	45·88	45·18	45·04	46·88	45·18	
CIV & XLIII	h 58·56 h 60·83 h 59·07	h 61·07 h 61·90	h 54·93 h 57·27 h 57·20	l 63·80 h 61·77 h 62·17	h 54·60 h 55·36	h 56·03 h 55·63	l 60·87 l 60·53	l 57·87 l 56·67	l 60·03 l 59·77	l 59·33 l 60·07	l 65·60 l 64·26	l 57·66 l 57·73	$M = 59''\cdot25$ $w = 1\cdot36$ $\frac{1}{w} = 0\cdot74$ $C = 71^\circ\ 15'\ 59''\cdot25$
	59·49	61·49	56·47	62·58	54·98	55·83	60·70	57·27	59·90	59·70	64·93	57·69	
XLIII & XLII	h 12·04 h 10·87 h 10·93	h 9·10 h 9·77	h 11·40 h 10·36	h 7·36 h 5·43	h 16·46 h 15·70	h 13·87 h 14·20	l 12·13 l 13·37	l 15·10 l 16·36	l 15·63 l 14·53	l 13·20 l 12·97	l 4·50 l 5·17	l 12·10 l 14·03	$M = 11''\cdot89$ $w = 0\cdot94$ $\frac{1}{w} = 1\cdot06$ $C = 85^\circ\ 7'\ 11'\cdot89$
	11·28	9·44	10·88	6·39	16·08	14·04	12·75	15·73	15·08	13·08	4·84	13·06	
XLII & XLV	h 52·40 h 53·90 h 55·00	h 52·53 h 52·47	h 57·14 h 58·34	h 58·93 h 59·20	h 53·77 h 54·90	h 54·83 l 53·77	l 57·00 l 57·53	l 54·47 l 54·60	l 58·87 l 58·70	l 53·50 l 52·73	l 55·90 l 56·70	l 52·94 l 51·30	$M = 55''\cdot32$ $w = 1\cdot99$ $\frac{1}{w} = 0\cdot50$ $C = 67^\circ\ 33'\ 55''\cdot32$
	53·77	52·50	57·74	59·07	54·33	54·30	57·27	54·53	58·79	53·11	56·30	52·12	

NOTE.—Stations CIV and CVII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At XLIV (Dománi)—(*Continued*).

Angle between	Circle readings, telescope being set on CVII 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 38′	50° 49′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XLV & CVII	″ h 14·63 h 12·27 h 12·83	″ h 16·00 h 15·40	″ h 10·73 h 9·83	″ h 9·00 h 7·90	″ h 8·33 h 7·64	″ h 13·74 l 16·37 l 16·40	″ l 5·83 l 4·64	″ l 5·23 l 6·50	″ l 0·30 l 0·27	″ l 8·80 l 9·90	″ l 7·30 l 6·97	″ l 11·90 l 11·34	M = 9″·22 w = 0·60 1/w = 1·67
	13·24	15·70	10·28	8·45	7·99	15·50	5·23	5·87	0·28	9·35	7·14	11·62	C = 76° 35′ 9″·22

At XLV (Sukpur)

December 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on CVII 0° 0′	180° 0′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 39′	220° 39′	50° 50′	230° 49′	M = Mean of Groups w = Relative Weight C = Concluded Angle
CVII & XLIV	″ h 20·10 h 19·30	″ h 19·73 h 20·56	″ h 22·07 h 22·70 h 24·13	″ h 15·66 h 18·50 h 17·77	″ h 20·93 h 20·03	″ h 17·13 h 16·26	″ h 20·64 h 20·10	″ h 21·46 h 24·50 l 21·27	″ l 20·67 l 20·44	″ l 19·46 l 20·77	″ h 25·17 h 24·77	″ h 21·46 h 20·26	M = 20″·55 w = 2·25 1/w = 0·44
	19·70	20·15	22·97	17·31	20·48	16·70	20·37	22·41	20·55	20·12	24·97	20·86	C = 69° 32′ 20″·55
XLIV & XLII	h 58·93 h 60·17	h 59·40 h 59·97	l 60·06 h 60·87 h 60·60	h 62·90 h 62·73	h 62·84 h 66·04 h 65·67	h 65·60 h 64·17	h 64·60 h 65·83	h 66·34 h 65·80	l 58·46 l 58·90	l 57·50 l 58·20	h 57·50 h 56·27	h 58·30 h 57·64	M = 61″·25 w = 1·07 1/w = 0·94
	59·55	59·69	60·51	62·81	64·85	64·89	65·21	66·07	58·68	57·85	56·89	57·97	C = 41° 41′ 1″·25

At CIV (Károthol)

December 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on XLIII 117° 53′	297° 53′	128° 3′	308° 3′	138° 14′	318° 14′	148° 20′	328° 20′	158° 31′	338° 31′	168° 42′	348° 42′	M = Mean of Groups w = Relative Weight C = Concluded Angle
XLIII & XLIV	″ h 26·60 h 26·20 l 28·87 l 28·00 l 27·30	″ h 25·44 h 25·13 l 27·40 l 26·60 l 26·50	″ l 34·24 l 33·66	″ h 32·20 h 31·60	″ l 37·06 l 36·17	″ l 34·04 l 33·76	″ l 35·94 l 33·54 l 34·47	″ l 37·00 l 36·07	″ h 40·07 h 38·10	″ h 34·50 h 32·50	″ h 32·23 l 33·57	″ h 29·67 h 30·76	M = 33″·07 w = 0·84 1/w = 1·19
	27·39	26·21	33·95	31·90	36·62	33·90	34·65	36·53	39·09	33·50	32·90	30·21	C = 46° 4′ 33″·06
XLIV & CVII	h 25·07 h 24·16	h 24·90 h 24·90	l 19·70 l 18·97	h 20·57 h 20·77	l 17·44 l 17·16	l 20·53 l 18·20 l 19·94	l 16·60 l 17·14 l 15·20	l 17·70 l 16·70	h 12·30 h 14·10	h 19·96 h 20·44	l 16·73 l 17·00	h 19·97 h 18·20	M = 19″·10 w = 1·06 1/w = 0·94
	24·62	24·90	19·33	20·67	17·30	19·56	16·31	17·20	13·20	20·20	16·87	19·08	C = 72° 2′ 19″·10

NOTE.—Stations CIV and CVII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

At CVII (Sáhiji)

December 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on CIV												M = Mean of Groups w = Relative Weight C = Concluded Angle
	64° 17′	244° 16′	74° 27′	254° 28′	84° 38′	264° 38′	94° 44′	274° 44′	104° 55′	284° 55′	115° 6′	295° 6′	
	″	″	″	″	″	″	″	″	″	″	″	″	
CIV & XLIV	*h* 57·44 *h* 56·30	*h* 58·93 *h* 59·14	*l* 58·64 *l* 58·03	*l* 58·07 *l* 58·03	*l* 55·50 *l* 55·60	*l* 61·80 *l* 61·36	*l* 55·00 *l* 57·60 *l* 56·87	*l* 61·77 *l* 61·80	*l* 59·66 *l* 58·40	*h* 57·67 *h* 57·87	*l* 55·17 *l* 56·13	*h* 55·70 *h* 55·43	$M = 57''\cdot98$ $w = 2\cdot55$ $\frac{1}{w} = 0\cdot39$ $C = 48^\circ\ 29'\ 57''\cdot98$
	56·87	59·04	58·33	58·05	55·55	61·58	56·49	61·79	59·03	57·77	55·65	55·56	
XLIV & XLV	*l* 29·17 *l* 29·57	*l* 29·00 *l* 27·86	*h* 27·97 *h* 28·33	*h* 28·86 *h* 27·70	*h* 26·06 *h* 25·50	*h* 26·26 *h* 26·56	*h* 34·10 *h* 32·90	*h* 28·84 *h* 29·90	*l* 31·90 *l* 32·13	*l* 33·84 *l* 33·13	*l* 39·00 *l* 38·94 *l* 38·47 *l* 38·57	*h* 34·76 *l* 33·30 *l* 32·63	$M = 30''\cdot59$ $w = 0\cdot85$ $\frac{1}{w} = 1\cdot17$ $C = 33^\circ\ 52'\ 30''\cdot59$
	29·37	28·43	28·15	28·28	25·78	26·41	33·50	29·37	32·02	33·48	38·75	33·56	

NOTE.—Stations CIV and CVII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

ADDENDUM.

The observer having measured all the angles at IV (Ráhida) was informed that the upper mark-stone at IX (Joran) had been destroyed by some evil disposed individual: on this, a new upper mark-stone plumbed over the lower one was fixed at IX, and to test the identity of the old and new marks at this station, one of the angles at IV already measured, *viz.*, VI and IX, was measured over again. As the two sets thus obtained agreed closely, both were retained.

Certain triangles defined by stations here marginally noted, (besides others) gave large triangular errors. On this the observer remeasured some of the angles, so that in some instances he took two complete sets, and in others three sets were observed as at XXIV (Pinjor Pir), XXV (Lakhpat) &c.—

XX (Suri Muri)
XXI (Sura Gandára)
XXII (Bábia)
XXIII (Jamanwála)
XXIV (Pinjor Pir)
XXV (Lakhpat)
XXXII (Jim)
XXXVII (Mugalbhin)

Now when sets of observations are repeated under the same circumstances *i.e.* without change of instrument, zeros, or observers, all the individual measures on each zero should be combined to give *one* zero mean, so that the several sets may be represented by one combined set, as in the case of angle XXI and XXII at XXV.

But instead of this rule, different sets of the same angle, measured under the same circumstances, have in some instances been manipulated separately, by oversight; as at IV angle VI and IX; and eventually the values of *M* have been combined with their weights to find *C*. This procedure was necessarily accepted when the value of *C* had already been used in grinding the figure; because to recast the separate sets into one set, according to rule, would have altered *C* and its weight, and this would have entailed grinding the figure over again. The difference in procedure, illustrated by the angles quoted above, has arisen in this manner.

August 1880.

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

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. SUMS OF SQUARES OF APPARENT ERRORS.

Sums of Squares of Apparent Errors of Single Observations, and of Apparent Errors of Single Zeros.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XI	XIV & I	25	9·00	12	158·59	Troughton and Simms' 18-inch Theodolite No. 2.
,,	I & II	24	6·46	12	123·88	
XIV	I & II	26	12·20	12	79·34	
,,	II & XI	26	6·94	12	142·59	
I	VII & VI	25	7·82	12	119·04	
,,	VI & IV	27	26·60	12	33·89	
,,	IV & III	25	7·36	12	63·21	
,,	III & II	26	12·19	12	118·03	
,,	II & XI	27	13·97	12	114·71	
,,	XI & XIV	25	7·95	12	130·80	
II	XI & XIV	27	8·05	12	107·87	
,,	XIV & I	28	10·77	12	153·00	
,,	I & III	27	10·98	12	129·39	
,,	III & VII*	29	12·04	12	79·73	
III	II & I	44	28·23	12	76·76	
,,	I & IV	40	30·84	12	130·63	
,,	IV & V	42	41·24	12	164·22	
,,	V & VII*	42	26·41	12	53·82	

NOTE.—Stations VII*, XI and XIV appertain to the Kattywar Meridional Series.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
III	VII* & II	38	21·51	12	82·81	Troughton and Simms' 18-inch Theodolite No. 2.
VII*	II & III	29	17·61	12	136·04	
„	III & V	25	4·69	12	184·49	
IV	V & III	24	7·66	12	94·44	
„	III & I	25	12·22	12	75·17	
„	I & VI	27	10·68	12	88·55	
„	VI & IX	28	16·55	12	96·76	
„	VI & IX	24	3·74	12	69·61	
V	VII* & III	25	8·17	12	121·16	
„	III & IV	25	13·62	12	95·72	
VI	I & VII	25	6·06	12	123·24	
„	VII & VIII	25	4·48	12	179·27	
„	VIII & IX	25	6·27	12	138·40	
„	IX & IV	25	4·86	12	107·36	
„	IV & I	24	6·26	12	109·12	
VII	VIII & VI	26	13·84	12	148·85	
„	VI & I	24	4·47	12	171·18	
VIII	X & XI	25	7·32	12	133·14	
„	XI & IX	27	14·47	12	119·61	
„	IX & VI	27	3·05	12	93·77	
„	VI & VII	26	6·63	12	86·57	
IX	IV & VI	26	9·63	12	52·81	
„	VI & VIII	26	9·72	12	53·81	
„	VIII & X	26	9·23	12	73·60	
„	X & XI	25	9·84	12	133·51	
X	XII & XIII	26	12·16	12	116·63	
„	XIII & XI	34	9·45	12	78·47	
„	XI & IX	48	52·17	12	91·50	
„	IX & VIII	25	5·38	12	139·90	
XI	IX & VIII	29	11·14	12	58·74	
„	VIII & X	30	14·06	12	179·53	
„	X & XII	24	3·82	12	104·29	
„	XII & XIII	25	11·92	12	84·59	
XII	XIV & XV	24	6·49	12	88·23	
„	XV & XIII	26	15·30	12	114·46	
„	XIII & XI	28	7·31	12	139·12	
„	XI & X	28	13·69	12	181·24	
XIII	XI & X	25	9·34	12	100·55	
„	X & XII	24	8·20	12	55·81	
„	XII & IV	25	5·33	12	49·20	
„	XIV & XV	25	9·65	12	87·49	

NOTE.—Station VII* appertains to the Kattywar Meridional Series.

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XIV	XVII & XVI	28	15·66	12	141·76	Troughton and Simms' 18-inch Theodolite No. 2.
"	XVI & XV	29	13·50	12	89·89	
"	XV & XIII	28	11·16	12	85·56	
"	XIII & XII	29	13·46	12	87·57	
XV	XIII & XII	24	5·23	12	119·32	
"	XII & XIV	24	4·17	12	116·13	
"	XIV & XVI	26	11·19	12	96·50	
"	XVI & XVIII	25	6·97	12	132·57	
XVI	XV & XIV	24	4·25	12	105·05	
"	XIV & XVII	24	7·11	12	113·61	
"	XVII & XIX	25	10·06	12	209·68	
"	XIX & XX	26	15·48	12	57·54	
"	XX & XXI	28	22·27	12	214·97	
"	XXI & XVIII	25	4·69	12	99·09	
"	XVIII & XV	25	7·72	12	77·61	
XVII	XIX & XVI	25	12·31	12	72·06	
"	XVI & XIV	25	4·80	12	71·05	
XVIII	XV & XVI	25	9·46	12	91·13	
"	XVI & XXI	25	5·58	12	136·98	
XIX	XX & XXI	52	35·71	12	147·69	
"	XXI & XVI	53	51·09	12	106·09	
"	XVI & XVII	52	53·97	12	80·06	
XX	XXIII & XXII	26	13·38	12	124·39	
"	XXII & XXI	28	12·46	12	102·80	
"	XXI & XVI	27	6·43	12	56·78	
"	XXI & XVI	25	4·29	12	80·04	
"	XVI & XIX	28	16·08	12	59·12	
"	XVI & XIX	24	2·00	12	58·07	
XXI	XVIII & XVI	26	8·33	12	91·10	
"	XVI & XIX	26	7·65	12	93·88	
"	XIX & XX	25	8·02	12	71·00	
"	XX & XXII	25	7·20	12	65·34	
"	XXII & XXV	25	9·23	12	150·68	
"	XXII & XXV	27	13·56	12	150·89	
XXII	XXI & XX	25	7·75	12	108·48	
"	XX & XXIII	26	14·59	12	79·27	
"	XXIII & XXIV	27	17·91	12	137·85	
"	XXIV & XXV	25	7·66	12	166·32	
"	XXIV & XXV	25	8·74	12	157·51	
"	XXV & XXI	24	7·35	12	92·53	
"	XXV & XXI	24	5·26	12	117·06	

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXIII	XXIV & XXII	25	6·66	12	56·56	Troughton and Simms' 18-inch Theodolite No. 2.
"	XXII & XX	24	4·51	12	86·20	
XXIV	XXVI & XXVII	27	17·82	12	134·86	
"	XXVII & XXV	26	7·95	12	95·59	
"	XXV & XXII	26	13·12	12	84·67	
"	XXV & XXII	53	58·83	12	157·67	
"	XXII & XXIII	25	5·98	12	104·13	
XXV	XXI & XXII	49	40·55	12	82·14	
"	XXII & XXIV	53	74·84	12	38·94	
"	XXII & XXIV	27	14·35	12	99·59	
"	XXIV & XXVI	25	13·43	12	42·63	
"	XXVI & XXVII	24	7·35	12	155·87	
XXVI	XXX & XXVIII	24	7·07	12	33·81	
"	XXVIII & XXVII	26	8·53	12	101·91	
"	XXVII & XXV	24	3·46	12	106·50	
"	XXV & XXIV	25	11·62	12	100·52	
XXVII	XXV & XXIV	28	15·27	12	86·65	
"	XXIV & XXVI	29	18·09	12	99·65	
"	XXVI & XXVIII	25	5·84	12	87·02	
"	XXVIII & XXIX	24	4·26	12	65·62	
XXVIII	XXVII & XXVI	26	7·20	12	62·47	
"	XXVI & XXX	26	7·44	12	198·72	
"	XXX & XXXI	25	4·89	12	198·99	
"	XXXI & XXIX	26	10·54	12	57·19	
"	XXIX & XXVII	24	4·95	12	118·92	
XXIX	XXVII & XXVIII	27	16·16	12	72·42	
"	XXVIII & XXXI	28	19·74	12	87·71	
XXX	XXXIII & XXXII	25	9·41	12	116·36	
"	XXXII & XXXI	25	10·21	12	136·45	
"	XXXI & XXVIII	28	15·01	12	132·51	
"	XXVIII & XXVI	26	15·71	12	79·12	
XXXI	XXIX & XXVIII	28	20·97	12	114·90	
"	XXVIII & XXX	27	10·16	12	52·61	
"	XXX & XXXII	29	21·82	12	83·06	
"	XXXII & XXXIV	27	9·70	12	89·31	
XXXII	XXXVII & XXXIV	28	14·87	12	65·09	
"	XXXIV & XXXI	26	13·75	12	68·94	
"	XXXI & XXX	25	10·25	12	83·41	
"	XXX & XXXIII	25	9·82	12	143·40	
"	XXXIII & XXXV	25	10·30	12	135·36	
"	XXXV & XXXVII	31	25·31	12	129·95	

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XXXII	XXXV & XXXVII	25	8·20	12	62·97	Troughton and Simms' 18-inch Theodolite No. 2.
XXXIII	XXXVI & XXXV	24	4·51	12	133·26	
"	XXXV & XXXII	24	2·67	12	46·58	
"	XXXII & XXX	24	4·13	12	127·24	
XXXIV	XXXI & XXXII	25	13·65	12	51·86	
"	XXXII & XXXVII	24	4·92	12	114·58	
XXXV	XXXVIII & XXXIX	25	10·33	12	59·65	
"	XXXIX & XXXVII	27	17·01	12	151·06	
"	XXXVII & XXXII	25	10·46	12	87·04	
"	XXXII & XXXIII	27	14·55	12	54·48	
"	XXXIII & XXXVI	26	14·59	12	140·31	
"	XXXVI & XXXVIII	28	16·02	12	48·41	
XXXVI	XXXVIII & XXXV	27	14·42	12	81·89	
"	XXXV & XXXIII	29	13·84	12	90·21	
XXXVII	XXXIV & XXXII	24	4·65	12	75·22	
"	XXXII & XXXV	26	9·28	12	73·18	
"	XXXII & XXXV	26	10·75	12	94·70	
"	XXXII & XXXV	25	12·45	12	192·10	
"	XXXV & XXXIX	26	11·88	12	151·42	
XXXVIII	XLII & XL	24	6·05	12	147·49	
"	XL & XXXIX	26	8·96	12	32·92	
"	XXXIX & XXXV	28	13·57	12	91·47	
"	XXXV & XXXVI	25	10·59	12	106·23	
XXXIX	XXXVII & XXXV	30	27·43	12	44·89	
"	XXXV & XXXVIII	28	30·01	12	50·84	
"	XXXVIII & XL	30	32·54	12	105·60	
"	XL & XLI	29	25·70	12	86·59	
XL	XLII & XLIII	27	15·76	12	90·46	
"	XLIII & XLI	28	15·79	12	92·64	
"	XLI & XXXIX	27	10·83	12	102·85	
"	XXXIX & XXXVIII	27	14·49	12	50·95	
"	XXXVIII & XLII	25	9·99	12	130·55	
XLI	XXXIX & XL	26	9·92	12	53·58	
"	XL & XLIII	26	11·06	12	152·59	
XLII	XLV & XLIV	24	6·75	12	124·20	
"	XLIV & XLIII	25	11·52	12	44·86	
"	XLIII & XL	25	11·48	12	54·28	
"	XL & XXXVIII	26	12·13	12	77·23	
XLIII	XLI & XL	26	7·44	12	175·29	
"	XL & XLII	28	13·19	12	168·87	
"	XLII & XLIV	32	17·86	12	219·20	

Station of Observation	Observed Angle	Number of Observations	Sum of Squares of Errors of single Observations	Number of Zeros	Sum of Squares of Errors of single Zeros	Remarks
XLIII	XLIV & CIV	24	3·17	12	78·75	Troughton and Simms' 18-inch Theodolite No. 2.
XLIV	CVII & CIV	26	11·51	12	63·12	
„	CIV & XLIII	27	11·41	12	95·16	
„	XLIII & XLII	25	8·11	12	137·98	
„	XLII & XLV	25	7·47	12	64·83	
„	XLV & CVII	26	11·47	12	217·98	
XLV	CVII & XLIV	27	16·41	12	55·37	
„	XLIV & XLII	26	10·63	12	121·35	
CIV	XLIII & XLIV	31	17·57	12	153·85	
„	XLIV & CVII	26	9·51	12	122·45	
CVII	CIV & XLIV	25	5·86	12	50·50	
„	XLIV & XLV	27	5·79	12	153·82	

Note.—Stations CIV and CVII appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

From the preceding data of the sums of the squares of the apparent errors, in the measurement of each angle, we may ascertain the *e.m.s.* (error of mean square) *of observation* of a single measure of an angle, and the *e.m.s. of graduation and observation* of the mean of the measures on a single zero, for each group of angles measured with the same instrument, by the same observer, and under similar circumstances.

The instrument employed was Troughton and Simms' 18-inch Theodolite No. 2, having 3 microscopes to read the azimuthal circle; observations were taken on 6 pairs of zeros (*face left* and *face right*) giving circle readings at 10° apart.

The *e.m.s. of observation* of a single measure of an angle $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of observations.}}{\text{No. of observations} - \text{No. of angles} \times \text{No. of changes of zero.}}}$

The *e.m.s. of graduation and observation* of the mean of the measures on a single zero $= \sqrt{\dfrac{\text{Sum of squares of apparent errors of zero.}}{\text{No. of angles} \times (\text{No. of changes of zero} - 1).}}$

Group	Instrument and Observer	Position of stations	Intervals between microscope readings of circle	Number of: Measures on each zero (average)	Number of: Angles	Number of: Single measures	Number of: Single zeros	*e.m.s.* of observation of a single measure	*e.m.s.* of graduation and observation of a single zero
			° ′					″	″
I	Troughton and Simms' 18-inch Theodolite No. 2; Lieutenant D. J. Nasmyth.	Hills,	10 0	2·32	123	3430	1476	$\left\{\dfrac{1550\cdot30}{3430-1476}\right\}^{\frac{1}{2}} = \pm\ 0\cdot891$	$\left\{\dfrac{13247\cdot47}{1476-123}\right\}^{\frac{1}{2}} = \pm\ 3\cdot129$
II	Ditto.	Plains,	10 0	2·20	71	1878	852	$\left\{\dfrac{908\cdot49}{1878-852}\right\}^{\frac{1}{2}} = \pm\ 0\cdot941$	$\left\{\dfrac{6988\cdot11}{852-71}\right\}^{\frac{1}{2}} = \pm\ 2\cdot991$

July 1880.

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

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. REDUCTION OF FIGURES.

Figure No. 28.

Observed Angles

No.	Value (° ′ ″)	Reciprocal Weight
1	51 39 38·76	0·83
2	38 21 56·81	0·95
3	49 40 29·17	1·22
4	40 17 57·95	1·09
5	61 12 49·91	0·62
6	28 48 47·09	1·00
7	20 15 35·25	0·89
8	69 42 48·35	1·17

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = +2·03,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = +2·88,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = -0·81,$	λ_3
$-17x_1 + x_2 - 16x_3 + 20x_6 - 18x_7 + 8x_8 = e_4 = -33·2,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	+ 2·03	+4·09	+2·31	...	− 32·68
2	+ 2·88		+3·93	+1·62	+ 0·48
3	− 0·81		*	+3·68	+ 13·34
4	−33·2				+1316·38

Values of the Factors

$\lambda_1 = -0·4836$

$\lambda_2 = +1·3008$

$\lambda_3 = -0·6790$

$\lambda_4 = -0·0307$

Angular errors in seconds

$x_1 = +·03$	$x_5 = +·38$
$x_2 = -·49$	$x_6 = +·01$
$x_3 = +1·60$	$x_7 = -·12$
$x_4 = +·89$	$x_8 = -1·08$

$[wx^2] = 4·33$

* 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.

Figure No. 29.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	82	42	36·48	0·60
2	39	6	29·41	0·91
3	58	10	57·32	1·00
4	90	32	52·40	0·64
5	59	7	55·49	0·62
6	30	19	13·33	1·05
7	66	3	33·53	0·42
8	39	37	31·53	1·41
9	74	18	52·96	0·93
10	51	45	9·80	1·27
11	81	10	24·88	0·75
12	47	4	26·05	0·73
13	68	55	47·86	1·01
14	50	30	45·86	0·59
15	60	33	28·39	0·49

Fixed data †

Log. Ratio of side *A* to side *B* (see diagram) $= \bar{1}\cdot 8997583{,}5$

Sum of angles 3 and 5 $= 117^\circ\ 18'\ 51''\cdot 39$

Equations to be satisfied

Equation		Factor
$x_1 + x_2 + x_3$	$= e_1 = +\ 2\cdot 27,$	λ_1
$x_4 + x_5 + x_6$	$= e_2 = +\ 0\cdot 02,$	λ_2
$x_7 + x_8 + x_9$	$= e_3 = -\ 3\cdot 22,$	λ_3
$x_{10} + x_{11} + x_{12}$	$= e_4 = -\ 0\cdot 22,$	λ_4
$x_{13} + x_{14} + x_{15}$	$= e_5 = +\ 0\cdot 76,$	λ_5
$x_1 + x_4 + x_7 + x_{10} + x_{13}$	$= e_6 = +\ 0\cdot 07,$	λ_6
$x_3 + x_5$	$= e_7 = +\ 1\cdot 42,$	λ_7
$13x_3 - 26x_2 + 36x_6 - 12x_5 + 6x_9 - 26x_8 + 20x_{12} - 3x_{11} + 12x_{15} - 18x_{14}$	$= e_8 = +227\cdot 0,$	λ_8
$26x_2 - 2x_1 - x_4 - 36x_6$	$= e_9 = -\ 27\cdot 7,$	λ_9

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
1	+ 2·27	+2·51					+0·60	+1·00	− 10·66	+ 22·46
2	+ 0·02		+2·31				+0·64	+0·62	+ 30·36	− 38·44
3	− 3·22			+2·76			+0·42	...	− 31·08	...
4	− 0·22				+2·75		+1·27	...	+ 12·35	...
5	+ 0·76					+2·09	+1·01	...	− 4·74	...
6	+ 0·07				*		+3·94	...	...	− 1·84
7	+ 1·42							+1·62	+ 5·56	...
8	+227·0								+3781·35	−1975·96
9	− 27·7									+1979·00

Values of the Factors

$\lambda_1 = +\ 0\cdot 4549$

$\lambda_2 = +\ 0\cdot 0585$

$\lambda_3 = +\ 0\cdot 1262$

$\lambda_4 = -\ 0\cdot 5976$

$\lambda_5 = +\ 0\cdot 6223$

$\lambda_6 = +\ 0\cdot 0038$

$\lambda_7 = +\ 0\cdot 1791$

$\lambda_8 = +\ 0\cdot 1149$

$\lambda_9 = +\ 0\cdot 0967$

Angular errors in seconds

$x_1 = +\ \cdot 16$	$x_6 = +\ \cdot 75$	$x_{11} = -\ \cdot 71$
$x_2 = -\ \cdot 02$	$x_7 = +\ \cdot 05$	$x_{12} = +\ 1\cdot 24$
$x_3 = +\ 2\cdot 13$	$x_8 = -\ 4\cdot 03$	$x_{13} = +\ \cdot 63$
$x_4 = -\ \cdot 02$	$x_9 = +\ \cdot 76$	$x_{14} = -\ \cdot 85$
$x_5 = -\ \cdot 71$	$x_{10} = -\ \cdot 75$	$x_{15} = +\ \cdot 98$

$[wx^2] = 24\cdot 89$

† It will appear on reference to the Reduction Chart of the S. W. Quadrilateral that Figures 20, 21, 22, 28 and 29 really constitute one figure, and might have been reduced as such, had this been thought desirable. Their reduction having, however, been performed separately, in the order in which they are numbered, it became necessary when Figure 29 was taken in hand to subject it to other conditions than those afforded only by its geometrical construction, so that no inconsistency should be exhibited in its connection with the other figures. These extra conditions are given by the fact that while Figure 29 rests on a side of Figure 28 it has a point indentical with one of Figure 20, *viz.*, Gángta (VII of the Kattywar Meridional Series). In order that the position of Gángta as already fixed by Figure 20 should be maintained

Figure No. 30.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	86	26	40·22	0·84
2	49	54	15·60	0·30
3	43	39	7·60	0·69
4	61	29	8·03	0·82
5	58	38	37·75	0·31
6	59	52	16·57	0·42
7	64	30	41·92	1·06
8	62	30	14·37	0·42
9	52	59	4·90	0·71
10	52	53	8·35	1·37
11	63	20	11·53	0·67
12	63	46	40·96	1·15
13	94	40	21·67	0·94
14	37	38	24·62	1·30
15	47	41	13·78	0·92

Equations to be satisfied — Factor

$$x_1 + x_2 + x_3 = e_1 = +2{\cdot}43, \qquad \lambda_1$$

$$x_4 + x_5 + x_6 = e_2 = +1.40, \qquad \lambda_2$$

$$x_7 + x_8 + x_9 = e_3 = +0{\cdot}11, \qquad \lambda_3$$

$$x_{10} + x_{11} + x_{12} = e_4 = -0{\cdot}21, \qquad \lambda_4$$

$$x_{13} + x_{14} + x_{15} = e_5 = -1{\cdot}01, \qquad \lambda_5$$

$$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = +0{\cdot}19, \qquad \lambda_6$$

$$\left.\begin{array}{l} 23\,x_3 - 18\,x_2 + 12\,x_6 - 13\,x_5 + 16x_9 \\ -11\,x_8 + 10\,x_{12} - 10\,x_{11} + 19\,x_{15} - 27\,x_{14} \end{array}\right\} = e_7 = -76{\cdot}6, \qquad \lambda_7$$

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	+ 2·43	+1·83					+0·84	+ 10·47
2	+ 1·40		+1·55				+0·82	+ 1·01
3	+ 0·11			+2·19			+1·06	+ 6·74
4	− 0·21				+3·19		+1·37	+ 4·80
5	− 1·01					+3·16	+0·94	− 17·62
6	+ 0·19						+5·03	...
7	−76·6							+2269·48

Values of the Factors

$\lambda_1 = +1{\cdot}8609$

$\lambda_2 = +1{\cdot}2317$

$\lambda_3 = +0{\cdot}4701$

$\lambda_4 = +0{\cdot}2478$

$\lambda_5 = -0{\cdot}4207$

$\lambda_6 = -0.5617$

$\lambda_7 = -0{\cdot}0481$

Angular errors in seconds

$x_1 = +1{\cdot}09$	$x_6 = +{\cdot}27$	$x_{11} = +{\cdot}49$
$x_2 = +{\cdot}82$	$x_7 = -{\cdot}10$	$x_{12} = -{\cdot}27$
$x_3 = +{\cdot}52$	$x_8 = +{\cdot}42$	$x_{13} = -{\cdot}92$
$x_4 = +{\cdot}55$	$x_9 = -{\cdot}21$	$x_{14} = +1{\cdot}14$
$x_5 = +{\cdot}58$	$x_{10} = -.43$	$x_{15} = -1{\cdot}23$

$[wx^2] = 10{\cdot}25$

in Figure 29, the length and direction of the side Nara (II of the Cutch Coast Series) to Gángta, as given by calculations from the data afforded by the figures already reduced, should be reproduced by Figure 29. The length Nara-Gángta was accordingly computed and its ratio to the side Bhachâo (I of the Cutch Coast Series) to Nara assigned as one of the conditions for Figure 29; the spherical angle between these two sides was also determined from the data previously fixed and was adopted as a second condition of the same figure.

Figure No. 31.

Observed Angles

No.	Value			Reciprocal Weight
	°	′	″	
1	50	39	5·38	0·46
2	48	42	25·32	1·03
3	44	48	8·41	0·57
4	35	50	23·63	0·93
5	42	41	25·59	1·02
6	56	40	5·86	1·07
7	40	11	39·32	0·72
8	40	26	53·54	1·38

Equations to be satisfied

					Factor
x_1	$+x_2$	$+x_3$	$+x_4$	$= e_1 = +1·70,$	λ_1
x_3	$+x_4$	$+x_5$	$+x_6$	$= e_2 = +2·36,$	λ_2
x_5	$+x_6$	$+x_7$	$+x_8$	$= e_3 = +3·30,$	λ_3
	$-18\,x_1$ $+17\,x_6$	$-\ x_2$ $+3\,x_7$	$-22\,x_3$ $+25\,x_8$	$= e_4 = +83·8,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	+ 1·70	+2·99	+1·50	...	− 21·85
2	+ 2·36		+3·59	+2·09	+ 5·65
3	+ 3·30		*	+4·19	+ 54·85
4	+83·8				+1604·16

Values of the Factors

$\lambda_1 = +0·9465$

$\lambda_2 = +0·3945$

$\lambda_3 = -0·4407$

$\lambda_4 = +0·0788$

Angular errors in seconds

$x_1 = -·22$	$x_5 = -·05$
$x_2 = +·89$	$x_6 = +1·38$
$x_3 = -·22$	$x_7 = -·14$
$x_4 = +1·25$	$x_8 = +2·11$

$[wx^2] = 7·69$

Figure No. 30.

Observed Angles

No.	°	′	″	Reciprocal Weight
1	86	26	40·22	0·84
2	49	54	15·60	0·30
3	43	39	7·60	0·69
4	61	29	8·03	0·82
5	58	38	37·75	0·31
6	59	52	16·57	0·42
7	64	30	41·92	1·06
8	62	30	14·37	0·42
9	52	59	4·90	0·71
10	52	53	8·35	1·37
11	63	20	11·53	0·67
12	63	46	40·96	1·15
13	94	40	21·67	0·94
14	37	38	24·62	1·30
15	47	41	13·78	0·92

Equations to be satisfied — Factor

$x_1 + x_2 + x_3 = e_1 = +2·43,$ λ_1

$x_4 + x_5 + x_6 = e_2 = +1·40,$ λ_2

$x_7 + x_8 + x_9 = e_3 = +0·11,$ λ_3

$x_{10} + x_{11} + x_{12} = e_4 = -0·21,$ λ_4

$x_{13} + x_{14} + x_{15} = e_5 = -1·01,$ λ_5

$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = +0·19,$ λ_6

$$\left.\begin{matrix} 23x_3 - 18x_2 + 12x_6 - 13x_5 + 16x_9 \\ -11x_8 + 10x_{12} - 10x_{11} + 19x_{15} - 27x_{14} \end{matrix}\right\} = e_7 = -76·6,$$ λ_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	+ 2·43	+1·83					+0·84	+ 10·47
2	+ 1·40		+1·55				+0·82	+ 1·01
3	+ 0·11			+2·19			+1·06	+ 6·74
4	− 0·21				+3·19		+1·37	+ 4·80
5	− 1·01			*		+3·16	+0·94	− 17·62
6	+ 0·19						+5·03	...
7	−76·6							+2269·48

Values of the Factors

$\lambda_1 = +1·8609$

$\lambda_2 = +1·2317$

$\lambda_3 = +0·4701$

$\lambda_4 = +0·2478$

$\lambda_5 = -0·4207$

$\lambda_6 = -0.5617$

$\lambda_7 = -0·0481$

Angular errors in seconds

$x_1 = +1·09$	$x_6 = +·27$	$x_{11} = +·49$
$x_2 = +·82$	$x_7 = -·10$	$x_{12} = -·27$
$x_3 = +·52$	$x_8 = +·42$	$x_{13} = -·92$
$x_4 = +·55$	$x_9 = -·21$	$x_{14} = +1·14$
$x_5 = +·58$	$x_{10} = -.43$	$x_{15} = -1·23$

$[wx^2] = 10·25$

in Figure 29, the length and direction of the side Nara (II of the Cutch Coast Series) to Gángta, as given by calculations from the data afforded by the figures already reduced, should be reproduced by Figure 29. The length Nara-Gángta was accordingly computed and its ratio to the side Bhacháo (I of the Cutch Coast Series) to Nara assigned as one of the conditions for Figure 29; the spherical angle between these two sides was also determined from the data previously fixed and was adopted as a second condition of the same figure.

Figure No. 31.

Observed Angles

No.	Value	Reciprocal Weight
	° ′ ″	
1	50 39 5·38	0·46
2	48 42 25·32	1·03
3	44 48 8·41	0·57
4	35 50 23·63	0·93
5	42 41 25·59	1·02
6	56 40 5·86	1·07
7	40 11 39·32	0·72
8	40 26 53·54	1·38

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = +1·70,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = +2·36,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = +3·30,$	λ_3
$-18\,x_1 - x_2 - 22\,x_3 + 17\,x_6 + 3\,x_7 + 25\,x_8 = e_4 = +83·8,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	+ 1·70	+2·99	+1·50	...	− 21·85
2	+ 2·36		+3·59	+2·09	+ 5·65
3	+ 3·30		*	+4·19	+ 54·85
4	+83·8				+1604·16

Values of the Factors

$\lambda_1 = +0·9465$

$\lambda_2 = +0·3945$

$\lambda_3 = -0·4407$

$\lambda_4 = +0·0788$

Angular errors in seconds

$x_1 = -·22$	$x_5 = -·05$
$x_2 = +·89$	$x_6 = +1·38$
$x_3 = -·22$	$x_7 = -·14$
$x_4 = +1·25$	$x_8 = +2·11$

$[wx^2] = 7·69$

Figure No. 32.

Observed Angles

No.	°	′	″	Reciprocal Weight
1	41	19	55·93	0·78
2	30	40	45·62	0·66
3	51	23	31·61	0·80
4	56	35	47·27	0·60
5	39	27	7·78	0·90
6	32	33	35·63	1·39
7	40	17	42·08	1·06
8	67	41	37·56	0·44

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = -0{\cdot}90,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = +0{\cdot}75,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = +1{\cdot}58,$	λ_3
$\left.\begin{matrix}-24x_1 + 3x_2 - 14x_3 \\ +26x_6 - 7x_7 + 9x_8\end{matrix}\right\} = e_4 = +37{\cdot}9,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 0·90	+2·84	+1·40	...	− 27·94
2	+ 0·75		+3·69	+2·29	+ 24·94
3	+ 1·58		*	+3·79	+ 32·68
4	+37·9				+1639·24

Values of the Factors

$\lambda_1 = -0{\cdot}1602$

$\lambda_2 = -0{\cdot}0246$

$\lambda_3 = +0{\cdot}3050$

$\lambda_4 = +0{\cdot}0147$

Angular errors in seconds

$x_1 = -{\cdot}40$	$x_5 = +{\cdot}25$
$x_2 = -{\cdot}08$	$x_6 = +{\cdot}92$
$x_3 = -{\cdot}31$	$x_7 = +{\cdot}22$
$x_4 = -{\cdot}11$	$x_8 = +{\cdot}19$

$[wx^2] = 1{\cdot}16$

Figure No. 33.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	32	28	22·68	0·91
2	57	8	31·76	0·68
3	48	20	10·26	0·38
4	42	2	55·38	0·89
5	51	47	55·34	0·68
6	37	48	58·53	0·68
7	47	47	27·92	0·66
8	42	35	40·30	0·89

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = -1·19,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = -1·78,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = +0·27,$	λ_3
$-33x_1 - 6x_2 - 25x_3 + 26x_6 - x_7 + 23x_8 = e_4 = +19·1,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 1·19	+2·86	+1·27	...	− 43·61
2	− 1·78		+2·63	+1·36	+ 8·18
3	+ 0·27		*	+2·91	+ 37·49
4	+19·1				+2184·12

Values of the Factors

$\lambda_1 = +0·1475$

$\lambda_2 = -1·0151$

$\lambda_3 = +0·4719$

$\lambda_4 = +0·0074$

Angular errors in seconds

$x_1 = -·09$	$x_5 = -·37$
$x_2 = +·07$	$x_6 = -·24$
$x_3 = -·40$	$x_7 = +·31$
$x_4 = -·77$	$x_8 = +·57$

$[wx^2] = 1·90$

Figure No. 34.

Observed Angles

No.	°	′	″	Reciprocal Weight	No.	°	′	″	Reciprocal Weight	No.	°	′	″	Reciprocal Weight
1	50	13	48·15	0·80	9	52	15	6·34	0·70	17	49	45	47·08	0·82
2	53	42	16·13	0·70	10	45	2	0·22	1·66	18	37	43	2·29	1·61
3	76	3	58·73	0·75	11	55	24	16·21	0·72	19	85	35	39·60	0·63
4	63	24	35·28	0·60	12	24	56	19·65	0·55	20	56	41	16·50	0·57
5	43	14	8·06	1·02	13	54	37	26·55	0·26	21	82	11	25·53	0·87
6	73	21	16·30	0·71	14	29	47	58·07	0·46	22	51	0	41·76	0·55
7	51	37	8·56	0·76	15	62	58	38·22	0·23	23	46	47	55·47	1·10
8	76	7	45·14	1·05	16	37	27	33·97	1·13					

Equations to be satisfied — **Factor**

	x_1	$+x_2$	$+x_3$	..	..	..	..	$= e_1 = +0{\cdot}85,$	λ_1
	x_4	$+x_5$	$+x_6$	..	..	..	..	$= e_2 = -1{\cdot}85,$	λ_2
	x_7	$+x_8$	$+x_9$	..	..	..	..	$= e_3 = -1{\cdot}11,$	λ_3
	x_{10}	$+x_{11}$	$+x_{14}$	$+x_{17}$	..	..	..	$= e_4 = -0{\cdot}29,$	λ_4
	x_{18}	$+x_{19}$	$+x_{20}$	..	..	..	..	$= e_5 = -3{\cdot}14,$	λ_5
	x_{21}	$+x_{22}$	$+x_{23}$	..	..	..	..	$= e_6 = -0{\cdot}38,$	λ_6
	x_{14}	$+x_{15}$	$+x_{16}$	$+x_{17}$	..	..	..	$= e_7 = -3{\cdot}82,$	λ_7
	x_{12}	$+x_{13}$	$+x_{15}$	$+x_{16}$	..	..	..	$= e_8 = -2{\cdot}44,$	λ_8
x_1	$+x_4$	$+x_7$	$+x_{10}$	$+x_{14}$	$+x_{18}$	$+x_{21}$	..	$= e_9 = -1{\cdot}90,$	λ_9
	$5x_3$ $+18x_{17}$	$-15x_2$ $-14x_{11}$	$+6x_6$ $+14x_{20}$	$-23x_5$ $-2x_{19}$	$+16x_9$ $+20x_{23}$	$-6x_8$ $-17x_{22}$ }	..	$= e_{10} = -17{\cdot}3,$	λ_{10}
	$6x_{10}$	$-14x_{11}$	$+45x_{12}$	$+11x_{13}$	$-31x_{14}$	$+22x_{15}$	..	$= e_{11} = -27{\cdot}2,$	λ_{11}

Figure No. 34—(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}
1	+ 0·85	+2·25						..		+ 0·80	− 6·75	..
2	− 1·85		+2·33					..		+ 0·60	− 19·20	..
3	− 1·11			+2·51				..		+ 0·76	+ 4·90	..
4	− 0·29				+3·66			+1·28		+ 2·12	+ 4·68	− 14·38
5	− 3·14					+2·81		..		+ 1·61	+ 6·72	..
6	− 0·38						+2·52	..		+ 0·87	+ 12·65	..
7	− 3·82					*		+2·64	+1·36	+ 0·46	+ 14·76	− 9·20
8	− 2·44								+2·17	..	..	+ 32·67
9	− 1·90									+ 6·76	..	− 4·30
10	−17·3										+2078·38	+ 141·12
11	−27·2											+1899·47

Values of the Factors

λ_1 = + 0·3905
λ_2 = − 0·7128
λ_3 = − 0·4848
λ_4 = + 0·5777
λ_5 = − 1·1825
λ_6 = − 0·2325
λ_7 = − 2·4855
λ_8 = + 1·0462
λ_9 = + 0·0641
λ_{10} = + 0·0119
λ_{11} = − 0·0407

Angular errors in seconds

x_1 = + ·36	x_9 = − ·21	x_{17} = − 1·39
x_2 = + ·15	x_{10} = + ·66	x_{18} = − 1·80
x_3 = + ·34	x_{11} = + ·71	x_{19} = − ·76
x_4 = − ·39	x_{12} = − ·43	x_{20} = − ·58
x_5 = − 1·01	x_{13} = + ·15	x_{21} = − ·14
x_6 = − ·45	x_{14} = − ·27	x_{22} = − ·24
x_7 = − ·32	x_{15} = − ·53	x_{23} = − ·00
x_8 = − ·58	x_{16} = − 1·63	

$[wx^2] = 13·54$

Figure No. 35.

Observed Angles

No.	°	′	″	Reciprocal Weight
1	85	28	4·81	0·83
2	47	57	56·88	0·80
3	46	33	56·73	0·51
4	95	32	46·25	0·40
5	35	36	39·55	0·58
6	48	50	37·50	0·64
7	93	15	52·87	0·62
8	56	32	55·11	0·23
9	30	11	7·13	0·43
10	42	38	9·08	1·07
11	69	2	5·57	0·80
12	68	19	46·44	0·44
13	43	5	5·91	0·62
14	49	14	56·49	0·66
15	87	39	56·65	0·96

Equations to be satisfied

Equation	Factor
$x_1 + x_2 + x_3 = e_1 = -2·31,$	λ_1
$x_4 + x_5 + x_6 = e_2 = +2·72,$	λ_2
$x_7 + x_8 + x_9 = e_3 = -5·63,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = +0·25,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = -1·60,$	λ_5
$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = -1·08,$	λ_6
$\left.\begin{array}{l} 20x_3 - 19x_2 + 18x_6 - 30x_5 + 36x_9 \\ -13x_8 + 9x_{12} - 8x_{11} + x_{15} - 19x_{14} \end{array}\right\} = e_7 = -56·4,$	λ_7

Equations between the Factors

No. of e	Value of e	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7
		Co-efficients of						
1	− 2·31	+2·14					+0·83	− 5·00
2	+ 2·72		+1·62				+0·40	− 5·88
3	− 5·63			+1·28			+0·62	+ 12·49
4	+ 0·25				+2·31		+1·07	− 2·44
5	− 1·60			*		+2·24	+0·62	− 11·58
6	− 1·08						+3·54	...
7	−56·4							+2144·37

Values of the Factors

$\lambda_1 = -1·4850$

$\lambda_2 = +1·4133$

$\lambda_3 = -4·8605$

$\lambda_4 = -0·3700$

$\lambda_5 = -1·0159$

$\lambda_6 = +1·0244$

$\lambda_7 = -0·0035$

Angular errors in seconds

$x_1 = -·39$	$x_6 = +·86$	$x_{11} = -·27$
$x_2 = -1·13$	$x_7 = -2·38$	$x_{12} = -·18$
$x_3 = -·79$	$x_8 = -1·11$	$x_{13} = +·01$
$x_4 = +·98$	$x_9 = -2·14$	$x_{14} = -·63$
$x_5 = +·88$	$x_{10} = +·70$	$x_{15} = -·98$

$[wx^2] = 35·26$

Figure No. 36.

Observed Angles

No.	Value			Reciprocal Weight
	°	′	″	
1	66	42	35·87	0·68
2	37	14	18·64	1·19
3	38	27	9·75	0·35
4	37	35	55·21	0·74
5	43	53	25·85	1·05
6	60	3	30·98	0·78
7	33	16	31·48	0·81
8	42	46	32·71	0·78

Equations to be satisfied

Equations to be satisfied	Factor
$x_1 + x_2 + x_3 + x_4 = e_1 = -1{\cdot}67,$	λ_1
$x_3 + x_4 + x_5 + x_6 = e_2 = +0{\cdot}53,$	λ_2
$x_5 + x_6 + x_7 + x_8 = e_3 = +0{\cdot}09,$	λ_3
$\left.\begin{array}{l} -9x_1 + 6x_2 - 21x_3 \\ +13x_6 + x_7 + 22x_8 \end{array}\right\} = e_4 = +48{\cdot}5,$	λ_4

Equations between the Factors

No. of e	Value of e	Co-efficients of λ_1	λ_2	λ_3	λ_4
1	− 1·67	+2·96	+1·09	...	− 6·33
2	+ 0·53		+2·92	+1·83	+ 2·79
3	+ 0·09		*	+3·42	+ 28·11
4	+48·5				+ 762·42

Values of the Factors

$\lambda_1 = -0{\cdot}8530$

$\lambda_2 = +1{\cdot}4400$

$\lambda_3 = -1{\cdot}6722$

$\lambda_4 = +0{\cdot}1129$

Angular errors in seconds

$x_1 = -1{\cdot}27$	$x_5 = -{\cdot}24$
$x_2 = -{\cdot}21$	$x_6 = +{\cdot}96$
$x_3 = -{\cdot}62$	$x_7 = -1{\cdot}26$
$x_4 = +{\cdot}43$	$x_8 = +{\cdot}63$

$[wx^2] = 7{\cdot}51$

Figure No. 37.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	66	46	32·15	0·48
2	50	13	32·52	0·79
3	62	59	54·08	0·67
4	71	5	36·21	0·91
5	56	43	12·38	0·50
6	52	11	12·75	0·57
7	69	45	53·14	0·45
8	57	20	15·23	0·69
9	52	53	52·54	0·90
10	71	39	36·02	1·51
11	52	11	46·28	0·41
12	56	8	37·57	1·03
13	80	42	22·81	1·52
14	52	34	24·58	0·62
15	46	43	14·54	0·27

Equations to be satisfied

Equations to be satisfied	Factor
$x_1 + x_2 + x_3 = e_1 = -1·96,$	λ_1
$x_4 + x_5 + x_6 = e_2 = +0·67,$	λ_2
$x_7 + x_8 + x_9 = e_3 = +0·17,$	λ_3
$x_{10} + x_{11} + x_{12} = e_4 = -0·88,$	λ_4
$x_{13} + x_{14} + x_{15} = e_5 = +1·12,$	λ_5
$x_1 + x_4 + x_7 + x_{10} + x_{13} = e_6 = +0·33,$	λ_6
$\left.\begin{matrix} 10x_3 - 18x_2 + 16x_6 - 14x_5 + 15x_9 \\ -13x_8 + 14x_{12} - 17x_{11} + 20x_{15} - 16x_{14} \end{matrix}\right\} = e_7 = +94·7,$	λ_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	− 1·96	+1·94					+0·48	− 7·52
2	+ 0·67		+1·98				+0·91	+ 2·12
3	+ 0·17			+2·04			+0·45	+ 4·53
4	− 0·88				+2·95		+1·51	+ 7·45
5	+ 1·12			*		+2·41	+1·52	− 4·52
6	+ 0·33						+4·87	...
7	+94·7							+1473·08

Values of the Factors

$\lambda_1 = -0·7886$

$\lambda_2 = +0·2175$

$\lambda_3 = -0·0846$

$\lambda_4 = -0·5188$

$\lambda_5 = +0·5142$

$\lambda_6 = +0·1130$

$\lambda_7 = +0·0644$

Angular errors in seconds

$x_1 = -·32$	$x_6 = +·71$	$x_{11} = -·66$
$x_2 = -1·54$	$x_7 = +·01$	$x_{12} = +·39$
$x_3 = -·10$	$x_8 = -·64$	$x_{13} = +·95$
$x_4 = +·30$	$x_9 = +·80$	$x_{14} = -·32$
$x_5 = -·34$	$x_{10} = -·61$	$x_{15} = +·49$

$[wx^2] = 8·85$

Figure No. 38.

Observed Angles

No.	Value °	′	″	Reciprocal Weight	No.	Value °	′	″	Reciprocal Weight	No.	Value °	′	″	Reciprocal Weight
1	63	59	36·28	0·65	11	68	1	25·89	0·26	21	56	22	19·58	0·37
2	63	18	4·24	1·05	12	54	55	20·73	0·68	22	67	28	25·12	0·47
3	52	42	20·05	0·66	13	70	43	43·57	1·04	23	60	38	24·19	0·43
4	49	16	36·41	0·54	14	46	1	22·72	0·43	24	51	53	12·24	0·71
5	58	17	24·58	0·69	15	63	14	52·76	0·36	25	62	23	25·31	0·39
6	72	26	0·24	0·42	16	61	9	57·37	1·10	26	47	59	16·97	0·82
7	57	46	51·45	0·51	17	70	21	50·65	0·97	27	69	37	19·12	0·64
8	53	50	45·50	0·88	18	48	28	10·89	0·90	28	82	28	48·62	1·09
9	68	22	23·86	0·58	19	46	42	37·71	1·17	29	52	57	8·71	0·70
10	57	3	11·79	0·33	20	76	55	1·78	1·17	30	44	34	1·49	1·02

Equations to be satisfied

								Factor
x_1	$+x_2$	$+x_3$	..	..	..	..	$= e_1 = -0·29,$	λ_1
x_4	$+x_5$	$+x_6$	..	..	..	..	$= e_2 = +0·51,$	λ_2
x_7	$+x_8$	$+x_9$	..	..	..	..	$= e_3 = +0·18,$	λ_3
x_{10}	$+x_{11}$	$+x_{12}$	..	..	..	..	$= e_4 = -2·20,$	λ_4
x_{13}	$+x_{14}$	$+x_{15}$	..	..	..	..	$= e_5 = -1·58,$	λ_5
x_{16}	$+x_{17}$	$+x_{18}$	..	..	..	..	$= e_6 = -1·68,$	λ_6
x_{19}	$+x_{20}$	$+x_{21}$	..	..	..	..	$= e_7 = -1·51,$	λ_7
x_{22}	$+x_{23}$	$+x_{24}$	..	..	..	..	$= e_8 = +0·60,$	λ_8
x_{25}	$+x_{26}$	$+x_{27}$	..	..	..	..	$= e_9 = +0·60,$	λ_9
x_{28}	$+x_{29}$	$+x_{30}$	..	..	..	..	$= e_{10} = -1·98,$	λ_{10}
x_1	$+x_4$	$+x_7$	$+x_{10}$	$+x_{13}$	$+x_{16}$	..	$= e_{11} = -3·13,$	λ_{11}
x_{12}	$+x_{14}$	$+x_{19}$	$+x_{22}$	$+x_{25}$	$+x_{28}$	..	$= e_{12} = +0·21,$	λ_{12}
$16x_3$	$-11x_2$	$+6x_6$	$-13x_5$	$+9x_9$	$-16x_8$			
$+15x_{12}$	$-9x_{11}$	$+11x_{15}$	$-20x_{14}$	$+19x_{18}$	$-8x_{17}$	..	$= e_{13} = +28·2,$	λ_{13}
$9x_{11}$	$-14x_{10}$	$+14x_{21}$	$-5x_{20}$	$+16x_{24}$	$-12x_{23}$			
$+8x_{27}$	$-19x_{26}$	$+21x_{30}$	$-16x_{29}$	$+7x_{18}$	$-11x_{15}$	..	$= e_{14} = +2·4,$	λ_{14}

Figure No. 38—(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	− 0·29	+2·36										+0·65	...	− 0·99	...
2	+ 0·51		+1·65									+0·54	...	− 6·45	...
3	+ 0·18			+1·97								+0·51	...	− 8·86	...
4	− 2·20				+1·27							+0·33	+0·68	+ 7·86	− 2·28
5	− 1·58					+1·83						+1·04	+0·43	− 4·64	+ 3·32
6	− 1·68						+2·97					+1·10	...	+ 9·34	...
7	− 1·51							+2·71				...	+1·17	...	− 0·67
8	+ 0·60								+1·61			...	+0·47	...	+ 6·20
9	+ 0·60									+1·85		...	+0·39	...	− 10·46
10	− 1·98										+2·81	...	+1·09	...	+ 10·22
11	− 3·13											+4·17	...	...	+ 2·66
12	+ 0·21												+4·23	+ 1·60	...
13	+28·2													+1476·60	− 64·62
14	+ 2·4														+1491·71

Values of the Factors

λ_1	= − 0·0231
λ_2	= + 0·5525
λ_3	= + 0·3354
λ_4	= − 2·4400
λ_5	= − 0·8698
λ_6	= − 0·5672
λ_7	= − 1·0220
λ_8	= + 0·0162
λ_9	= + 0·1555
λ_{10}	= − 1·1627
λ_{11}	= − 0·3066
λ_{12}	= + 1·0826
λ_{13}	= + 0·0366
λ_{14}	= + 0·0105

Angular errors in seconds

x_1 = − ·21	x_{11} = − ·70	x_{21} = − ·32
x_2 = − ·45	x_{12} = − ·55	x_{22} = + ·52
x_3 = + ·37	x_{13} = − 1·15	x_{23} = − ·05
x_4 = + ·13	x_{14} = − ·22	x_{24} = + ·13
x_5 = + ·05	x_{15} = − ·21	x_{25} = + ·48
x_6 = + ·33	x_{16} = − ·96	x_{26} = − ·04
x_7 = + ·01	x_{17} = − ·84	x_{27} = + ·16
x_8 = − ·22	x_{18} = + ·12	x_{28} = − ·09
x_9 = + ·39	x_{19} = + ·07	x_{29} = − ·93
x_{10} = − ·95	x_{20} = − 1·26	x_{30} = − ·96

$[wx^2]$ = 14·24

Figure No. 39.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	71	16	42·67	0·41
2	51	53	2·60	0·26
3	56	50	15·82	0·84
4	62	34	33·50	0·80
5	50	23	19·06	0·69
6	67	2	8·21	0·42
7	55	10	15·37	0·72
8	69	48	23·71	1·17
9	55	1	19·35	1·34
10	97	5	55·63	0·71
11	36	11	46·50	1·30
12	46	42	16·00	0·43
13	73	52	32·26	1·01
14	64	44	55·34	0·60
15	41	22	33·33	1·13

Equations to be satisfied

Equation		Factor
$x_1 + x_2 + x_3$	$= e_1 = +0{\cdot}20,$	λ_1
$x_4 + x_5 + x_6$	$= e_2 = +0{\cdot}12,$	λ_2
$x_7 + x_8 + x_9$	$= e_3 = -2{\cdot}15,$	λ_3
$x_{10} + x_{11} + x_{12}$	$= e_4 = -2{\cdot}52,$	λ_4
$x_{13} + x_{14} + x_{15}$	$= e_5 = +0{\cdot}23,$	λ_5
$x_1 + x_4 + x_7 + x_{10} + x_{13}$	$= e_6 = -0{\cdot}57,$	λ_6
$14x_3 - 16x_2 + 9x_6 - 18x_5 + 15x_9 - 7x_8 + 19x_{12} - 29x_{11} + 24x_{15} - 10x_{14}$	$= e_7 = -46{\cdot}6,$	λ_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	+ 0·20	+1·51					+0·41	+ 7·60
2	+ 0·12		+1·91				+0·80	− 8·64
3	− 2·15			+3·23			+0·72	+ 11·91
4	− 2·52				+2·44		+0·71	− 29·53
5	+ 0·23					+2·74	+1·01	+ 21·12
6	− 0·57						+3·65	...
7	− 46·6							+2807·02

Values of the Factors

$\lambda_1 = +0{\cdot}2491$

$\lambda_2 = -0{\cdot}1614$

$\lambda_3 = -0{\cdot}5845$

$\lambda_4 = -1{\cdot}4833$

$\lambda_5 = +0{\cdot}2712$

$\lambda_6 = +0{\cdot}1800$

$\lambda_7 = -0{\cdot}0329$

Angular errors in seconds

$x_1 = +{\cdot}18$	$x_6 = -{\cdot}19$	$x_{11} = -{\cdot}69$
$x_2 = +{\cdot}20$	$x_7 = -{\cdot}29$	$x_{12} = -{\cdot}90$
$x_3 = -{\cdot}18$	$x_8 = -{\cdot}41$	$x_{13} = +{\cdot}46$
$x_4 = +{\cdot}01$	$x_9 = -1{\cdot}45$	$x_{14} = +{\cdot}36$
$x_5 = +{\cdot}30$	$x_{10} = -{\cdot}93$	$x_{15} = -{\cdot}59$

$[wx^2] = 6{\cdot}52$

Figure No. 40.

Observed Angles

No.	Value °	′	″	Reciprocal Weight
1	85	7	11·89	1·06
2	60	10	8·11	0·36
3	34	42	42·69	1·68
4	71	15	59·25	0·74
5	62	39	28·68	0·60
6	46	4	33·06	1·19
7	59	27	44·22	0·50
8	72	2	19·10	0·94
9	48	29	57·98	0·39
10	76	35	9·22	1·67
11	33	52	30·59	1·17
12	69	32	20·55	0·44
13	67	33	55·32	0·50
14	41	41	1·25	0·94
15	70	45	3·62	0·95

Equations to be satisfied

Equation		Factor
$x_1 + x_2 + x_3$	$= e_1 = +\ 1{\cdot}94,$	λ_1
$x_4 + x_5 + x_6$	$= e_2 = -\ 0{\cdot}34,$	λ_2
$x_7 + x_8 + x_9$	$= e_3 = -\ 0{\cdot}60,$	λ_3
$x_{10} + x_{11} + x_{12}$	$= e_4 = -\ 1{\cdot}26,$	λ_4
$x_{13} + x_{14} + x_{15}$	$= e_5 = -\ 0{\cdot}45,$	λ_5
$x_1 + x_4 + x_7 + x_{10} + x_{13}$	$= e_6 = -\ 0{\cdot}10,$	λ_6
$31x_3 - 12x_2 + 20x_6 - 11x_5 + 18x_9$ $-7x_8 + 8x_{12} - 32x_{11} + 7x_{15} - 24x_{14}$	$= e_7 = +\ 25{\cdot}5,$	λ_7

Equations between the Factors

No. of e	Value of e	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7
1	+ 1·94	+3·10					+1·06	+ 47·76
2	− 0·34		+2·53				+0·74	+ 17·20
3	− 0·60			+1·83			+0·50	+ 0·44
4	− 1·26				+3·28		+1·67	− 33·92
5	− 0·45			*		+2·39	+0·50	− 15·91
6	− 0·10						+4·47	...
7	+25·5							+4201·57

Values of the Factors

$\lambda_1 = +\ 0{\cdot}6932$
$\lambda_2 = -\ 0{\cdot}1163$
$\lambda_3 = -\ 0{\cdot}3489$
$\lambda_4 = -\ 0{\cdot}4901$
$\lambda_5 = -\ 0{\cdot}2467$
$\lambda_6 = +\ 0{\cdot}0822$
$\lambda_7 = -\ 0{\cdot}0062$

Angular errors in seconds

$x_1 = +\ {\cdot}82$	$x_6 = -\ {\cdot}28$	$x_{11} = -\ {\cdot}34$
$x_2 = +\ {\cdot}28$	$x_7 = -\ {\cdot}13$	$x_{12} = -\ {\cdot}24$
$x_3 = +\ {\cdot}84$	$x_8 = -\ {\cdot}29$	$x_{13} = -\ {\cdot}08$
$x_4 = -\ {\cdot}03$	$x_9 = -\ {\cdot}18$	$x_{14} = -\ {\cdot}09$
$x_5 = -\ {\cdot}03$	$x_{10} = -\ {\cdot}68$	$x_{15} = -\ {\cdot}28$

$[wx^2] = 2{\cdot}16$

September 1880.

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

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. TRIANGLES.

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			″	″	″	″	″	° ′ ″			
136		XI (Chitror)	·22	−1·11	− ·08		−1·19	88 2 24·57	4·8695487,3	74054·04	14·025
		XIV (Wándia)	·22	− ·89	− ·50		−1·39	40 17 56·34	4·6805569,2	47924·42	9·077
		II (Nara)	·22	− ·03	+ ·58		+ ·55	51 39 39·09	4·7643143,2	58118·49	11·007
			·66				−2·03	180 0 0·00			
137		XIV (Wándia)	·47	− ·38	− ·67		−1·05	61 12 48·39	4·9340012,5	85901·60	16·269
		II (Nara)	·47	+1·08	+ ·20		+1·28	69 42 49·16	4·9634788,3	91934·56	17·412
		I (Bhacháo)	·47	+ ·11	+ ·47		+ ·58	49 4 22·45	4·8695487,3	74054·04	14·025
			1·41				+ ·81	180 0 0·00			
	255	XI (Chitror)	·41	−1·60		+ ·50	−1·10	49 40 27·66	4·9634788,2	91934·56	17·412
		XIV (Wándia)	·42	−1·27		−1·17	−2·44	101 30 45·00	5·0724814,3	118162·98	22·379
		I (Bhacháo)	·41	− ·01		+ ·67	+ ·66	28 48 47·34	4·7643143,2	58118·49	11·007
			1·24				−2·88	180 0 0·00			
138		II (Nara)	·31	−1·93	− ·14		−2·07	58 10 54·94	4·8668051,2	73587·68	13·937
		I (Bhacháo)	·31	− ·23	− ·08		− ·31	39 6 28·79	4·7374067,5	54626·92	10·346
		III (Kakarwa)	·32	− ·11	+ ·22		+ ·11	82 42 36·27	4·9340012,5	85901·60	16·269
			·94				−2·27	180 0 0·00			
139		III (Kakarwa)	·45	− ·62	− ·18		− ·80	68 55 46·61	4·9492645,4	88974·29	16·851
		I (Bhacháo)	·45	−1·06	− ·24		−1·30	60 33 26·64	4·9192606,2	83034·89	15·726
		IV (Ráhida)	·45	+ ·92	+ ·42		+1·34	50 30 46·75	4·8668051,2	73587·68	13·937
			1·35				− ·76	180 0 0·00			

Notes.—1. The values of the sides are given in the same lines with the opposite angles.
2. Stations XI (Chitror) and XIV (Wándia) appertain to the Kattywar Meridional Series.

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
		II (Nara)	·40	+ ·80		−2·51	−1·71	59 7 53·38	4·9679266,7	92880·95	17·591
	256	III (Kakarwa)	·40	− ·12		+3·11	+2·99	90 32 54·99	5·0342438,8	108204·11	20·493
		VII (Gángta)	·40	− ·70		− ·60	−1·30	30 19 11·63	4·7374067,5	54626·92	10·346
			1·20				− ·02	180 0 0·00			
		VII (Gángta)	·41	+4·20		+ ·82	+5·02	39 37 36·14	4·7890813,9	61529·21	11·653
	257	III (Kakarwa)	·41	− ·07		−1·59	−1·66	66 3 31·46	4·9453365,4	88173·19	16·699
		V (Ran)	·42	− ·91		+ ·77	− ·14	74 18 52·40	4·9679266,7	92880·95	17·591
			1·24				+3·22	180 0 0·00			
		V (Ran)	·32	+ ·73		+ ·79	+1·52	81 10 26·08	4·9192606,2	83034·89	15·726
	258	III (Kakarwa)	·32	+ ·85		−1·56	− ·71	51 45 8·77	4·8194935,0	65992·33	12·499
		IV (Ráhida)	·31	−1·36		+ ·77	− ·59	47 4 25·15	4·7890813,9	61529·21	11·653
			·95				+ ·22	180 0 0·00			
		I (Bhacháo)	·33	− ·82	− ·37		−1·19	49 54 14·08	4·8337431,9	68193·53	12·915
140		IV (Ráhida)	·33	− ·52	+ ·28		− ·24	43 39 7·03	4·7891241,2	61535·27	11·654
		VI (Sakpur)	·33	−1·09	+ ·09		−1·00	86 26 38·89	4·9492645,4	88974·29	16·851
			·99				−2·43	180 0 0·00			
		IV (Ráhida)	·31	− ·58	− ·21		− ·79	58 38 36·65	4·8282082,3	67329·94	12·752
141		VI (Sakpur)	·32	− ·55	− ·15		− ·70	61 29 7·01	4·8406155,9	69281·24	13·121
		IX (Joran)	·32	− ·27	+ ·36		+ ·09	59 52 16·34	4·8337431,9	68193·53	12·915
			·95				−1·40	180 0 0·00			
		VI (Sakpur)	·36	+ ·10	− ·34		− ·24	64 30 41·32	4·8814766,5	76116·11	14·416
142		IX (Joran)	·36	− ·42	+ ·09		− ·33	62 30 13·68	4·8738908,8	74798·15	14·166
		VIII (Charakra)	·36	+ ·21	+ ·25		+ ·46	52 59 5·00	4·8282082,3	67329·94	12·752
			1·08				− ·11	180 0 0·00			
		I (Bhacháo)	·36	+1·23		− ·53	+ ·70	47 41 14·12	4·8722261,8	74512·00	14·112
	259	VI (Sakpur)	·36	+ ·92		+ ·18	+1·10	94 40 22·41	5·0018529,7	100427·57	19·020
		VII (Karárho)	·36	−1·14		+ ·35	− ·79	37 38 23·47	4·7891241,2	61535·27	11·654
			1·08				+1·01	180 0 0·00			
		VII (Karárho)	·35	+ ·27		− ·31	− ·04	63 46 40·57	4·8738908,9	74798·15	14·166
	260	VI (Sakpur)	·35	+ ·43		+ ·22	+ ·65	52 53 8·65	4·8227503,6	66489·09	12·593
		VIII (Charakra)	·35	− ·49		+ ·09	− ·40	63 20 10·78	4·8722261,8	74512·00	14·112
			1·05				+ ·21	180 0 0·00			
		VIII (Charakra)	·38	−1·20	− ·33		−1·53	78 31 47·31	4·9507691,1	89283·06	16·910
143		IX (Joran)	·37	+ ·22	+ ·08		+ ·30	44 48 8·34	4·8075119,0	64196·58	12·158
		X (Katror)	·38	−1·38	+ ·25		−1·13	56 40 4·35	4·8814766,5	76116·11	14·416
			1·13				−2·36	180 0 0·00			
		IX (Joran)	·31	− ·89	− ·31		−1·20	48 42 23·81	4·8266856,7	67094·30	12·707
144		X (Katror)	·30	+ ·14	+ ·01		+ ·15	40 11 39·17	4·7606648,4	57632·15	10·915
		XI (Bolári)	·31	−1·89	+ ·30		−1·59	91 5 57·02	4·9507691,1	89283·06	16·910
			·92				−2·64	180 0 0·00			
		VIII (Charakra)	·34	−1·25		− ·08	−1·33	35 50 21·96	4·7606648,2	57632·15	10·915
	261	IX (Joran)	·35	− ·67		− ·23	− ·90	93 30 32·48	4·9923112,4	98245·17	18·607
		XI (Bolári)	·35	+ ·22		+ ·31	+ ·53	50 39 5·56	4·8814766,5	76116·11	14·416
			1·04				−1·70	180 0 0·00			
		XI (Bolári)	·45	+ ·39	− ·15		+ ·24	82 4 17·02	5·0026905,4	100621·44	19·057
145		X (Katror)	·44	+ ·11	− ·27		− ·16	56 35 46·67	4·9284508,7	84810·74	16·063
		XIII (Wára)	·44	+ ·40	+ ·42		+ ·82	41 19 56·31	4·8266856,7	67094·30	12·707
			1·33				+ ·90	180 0 0·00			

Note.—Station VII (Gángta) appertains to the Kattywar Meridional Series.

No. of Triangle: Circuit	No. of Triangle: Non-circuit	Number and Name of 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
			"	"	"	"	"	° ′ "			
		X (Katror)	·49	− ·25	− ·44		− ·69	39 27 6·60	4·8255001,3	66911·40	12·673
146		XIII (Wára)	·49	− ·19	+ ·24		+ ·05	67 41 37·12	4·9886532,8	97421·15	18·451
		XII (Sámethra)	·49	−1·14	+ ·20		− ·94	72 51 16·28	5·0026905,4	100621·44	19·057
			1·47				−1·58	180 0 0·00			
		XI (Bolári)	·51	+ ·31		+ ·26	+ ·57	51 23 31·67	4·9886532,6	97421·15	18·451
	262	X (Katror)	·52	− ·14		− ·71	− ·85	96 2 53·68	5·0933362,8	123975·62	23·480
		XII (Sámethra)	·51	− ·92		+ ·45	− ·47	32 33 34·65	4·8266856,7	67094·30	12·707
			1·54				− ·75	180 0 0·00			
		XII (Sámethra)	·43	+1·14	− ·21		+ ·93	93 50 51·22	5·0369663,8	108884·58	20·622
147		XIII (Wára)	·43	+ ·40	− ·12		+ ·28	48 20 10·11	4·9113004,3	81526·80	15·441
		XIV (Roha)	·43	+ ·24	+ ·33		+ ·57	37 48 58·67	4·8255001,3	66911·40	12·673
			1·29				+1·78	180 0 0·00			
		XIII (Wára)	·60	− ·07	− ·18		− ·25	57 8 30·91	4·9761744,1	94661·72	17·928
148		XIV (Roha)	·60	− ·31	− ·02		− ·33	47 47 26·99	4·9215270,1	83469·35	15·809
		XV (Dinoda)	·60	− ·48	+ ·20		− ·28	75 4 2·10	5·0369663,8	108884·58	20·622
			1·80				− ·86	180 0 0·00			
		XII (Sámethra)	·61	+ ·37		− ·20	+ ·17	51 47 54·90	4·9761744,1	94661·72	17·928
	263	XIV (Roha)	·61	− ·07		+ ·31	+ ·24	85 36 26·08	5·0795617,0	120105·17	22·747
		XV (Dinoda)	·60	− ·57		− ·11	− ·68	42 35 39·02	4·9113004,3	81526·80	15·441
			1·82				− ·27	180 0 0·00			
		XIV (Roha)	·72	− ·15	− ·38		− ·53	53 42 14·88	4·9967840,2	99262·23	18·800
149		XV (Dinoda)	·72	− ·34	+ ·06		− ·28	76 3 57·73	5·0774932,5	119534·49	22·639
		XVI (Háthria)	·72	− ·36	+ ·32		− ·04	50 13 47·39	4·9761744,1	94661·72	17·928
			2·16				− ·85	180 0 0·00			
		XV (Dinoda)	·49	+1·01	− ·32		+ ·69	43 14 8·26	4·8510658,3	70968·53	13·441
150		XVI (Háthria)	·50	+ ·39	+ ·06		+ ·45	63 24 35·23	4·9668246,1	92645·56	17·547
		XVIII (Manjal)	·50	+ ·45	+ ·26		+ ·71	73 21 16·51	4·9967840,2	99262·23	18·800
			1·49				+1·85	180 0 0·00			
		XVIII (Manjal)	·39	+ ·58	− ·15		+ ·43	76 7 45·18	4·9401965,3	87135·79	16·503
151		XVI (Háthria)	·38	+ ·32	− ·11		+ ·21	51 37 8·39	4·8473096,6	70357·38	13·325
		XXI (Sura Gandára)	·38	+ ·21	+ ·26		+ ·47	52 15 6·43	4·8510658,3	70968·53	13·441
			1·15				+1·11	180 0 0·00			
		XVI (Háthria)	·51	− ·66	− ·40		−1·06	45 1 58·65	4·8785765,6	75609·54	14·320
152		XXI (Sura Gandára)	·52	− ·28	+ ·06		− ·22	80 20 35·12	5·0226438,4	105352·26	19·953
		XX (Suri Muri)	·51	− ·15	+ ·34		+ ·19	54 37 26·23	4·9401965,3	87135·79	16·503
			1·54				−1·09	180 0 0·00			
		XIV (Roha)	1·04	·00		− ·55	− ·55	46 47 53·88	5·0496166,8	112102·86	21·232
	264	XVI (Háthria)	1·05	+ ·14		+ ·01	+ ·15	82 11 24·63	5·1828728,1	152360·64	28·856
		XVII (Naliya)	1·05	+ ·24		+ ·54	+ ·78	51 0 41·49	5·0774932,5	119534·49	22·639
			3·14				+ ·38	180 0 0·00			
		XVII (Naliya)	·51	+ ·58		− ·29	+ ·29	56 41 16·28	4·9729474,6	93960·97	17·796
	265	XVI (Háthria)	·51	+1·80		+ ·11	+1·91	37 43 3·69	4·8374909,0	68784·56	13·027
		XIX (Saind)	·51	+ ·76		+ ·18	+ ·94	85 35 40·03	5·0496166,8	112102·86	21·232
			1·53				+3·14	180 0 0·00			
		XIX (Saind)	·39	+3·02		− ·10	+2·92	87 13 23·58	5·0226438,7	105352·27	19·953
	266	XVI (Háthria)	·38	+ ·27		+ ·01	+ ·28	29 47 57·97	4·7194803,0	52417·99	9·928
		XX (Suri Muri)	·39	+ ·53		+ ·09	+ ·62	62 58 38·45	4·9729474,6	93960·97	17·796
			1·16				+3·82	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
	267	XIX (Saind)	·62	+1·39		+ ·29	+1·68	49 45 48·14	4·9401965,4	87135·79	16·503
		XVI (Háthria)	·63	− ·39		− ·39	− ·78	74 49 56·88	5·0420554,2	110168·00	20·865
		XXI (Sura Gandára)	·62	− ·71		+ ·10	− ·61	55 24 14·98	4·9729474,6	93960·97	17·796
			1·87				+ ·29	180 0 0·00			
153		XX (Suri Muri)	·24	+1·13	− ·28		+ ·85	47 57 57·49	4·7507775,7	56334·91	10·669
		XXI (Sura Gandára)	·24	+ ·79	+ ·14		+ ·93	46 33 57·42	4·7409725,8	55077·29	10·431
		XXII (Bábia)	·25	+ ·39	+ ·14		+ ·53	85 28 5·09	4·8785765,6	75609·54	14·320
			·73				+2·31	180 0 0·00			
154		XXI (Sura Gandára)	·19	− ·88	− ·52		−1·40	35 36 37·96	4·6391575,4	43566·98	8·251
		XXII (Bábia)	·20	− ·98	+ ·07		− ·91	95 32 45·14	4·8719935,3	74472·09	14·105
		XXV (Lakhpat)	·19	− ·86	+ ·45		− ·41	48 50 36·90	4·7507775,7	56334·91	10·669
			·58				−2·72	180 0 0·00			
155		XXII (Bábia)	·25	+2·38	− ·22		+2·16	93 15 54·78	4·9370493,9	86506·63	16·384
		XXV (Lakhpat)	·25	+1·11	− ·27		+ ·84	56 32 55·70	4·8591061,5	72294·64	13·692
		XXIV (Pinjor Pir)	·24	+2·14	+ ·49		+2·63	30 11 9·52	4·6391575,4	43566·98	8·251
			·74				+5·63	180 0 0·00			
	268	XX (Suri Muri)	·22	+ ·98		−1·25	− ·27	87 39 56·16	4·8611946,4	72643·14	13·758
		XXII (Bábia)	·21	− ·01		− ·44	− ·45	43 5 5·25	4·6960267,7	49662·29	9·406
		XXIII (Jamanwála)	·22	+ ·63		+1·69	+2·32	49 14 58·59	4·7409725,8	55077·29	10·431
			·65				+1·60	180 0 0·00			
	269	XXIII (Jamanwála)	·28	+ ·18		−1·49	−1·31	68 19 44·85	4·8591061,4	72294·64	13·692
		XXII (Bábia)	·28	− ·70		+ ·45	− ·25	42 38 8·55	4·7217439,3	52691·91	9·980
		XXIV (Pinjor Pir)	·28	+ ·27		+1·04	+1·31	69 2 6·60	4·8611946,4	72643·14	13·758
			·84				− ·25	180 0 0·00			
156		XXV (Lakhpat)	·38	+ ·83	− ·16		+ ·67	75 41 28·68	4·9602760,8	91259·08	17·284
		XXIV (Pinjor Pir)	·38	− ·43	·00		− ·43	37 35 54·40	4·7593799,5	57461·90	10·883
		XXVII (Said Ali)	·38	+1·27	+ ·16		+1·43	66 42 36·92	4·9370493,9	86506·63	16·384
			1·14				+1·67	180 0 0·00			
157		XXIV (Pinjor Pir)	·31	+ ·24	− ·29		− ·05	43 53 25·49	4·8019212,2	63375·47	12·003
		XXVII (Said Ali)	·31	− ·63	+ ·13		− ·50	42 46 31·90	4·7929633,1	62081·66	11·758
		XXVI (Sugandia)	·31	+ ·30	+ ·16		+ ·46	93 20 2·61	4·9602760,8	91259·08	17·284
			·93				− ·09	180 0 0·00			
	270	XXV (Lakhpat)	·42	+ ·62		+ ·08	+ ·70	38 27 10·03	4·7929633,0	62081·66	11·758
		XXIV (Pinjor Pir)	·42	− ·19		− ·29	− ·48	81 29 20·16	4·9944547,7	98731·29	18·699
		XXVI (Sugandia)	·42	− ·96		+ ·21	− ·75	60 3 29·81	4·9370493,9	86506·63	16·384
			1·26				− ·53	180 0 0·00			
158		XXVII (Said Ali)	·24	+ ·10	− ·22		− ·12	62 59 53·72	4·7884949,7	61446·19	11·638
		XXVI (Sugandia)	·23	+1·54	+ ·04		+1·58	50 13 33·87	4·7243069,3	53003·79	10·039
		XXVIII (Guni)	·24	+ ·32	+ ·18		+ ·50	66 46 32·41	4·8019212,2	63375·47	12·003
			·71				+1·96	180 0 0·00			
159		XXVI (Sugandia)	·27	− ·49	− ·38		− ·87	46 43 13·40	4·7507421,2	56330·30	10·669
		XXVIII (Guni)	·27	− ·95	− ·02		− ·97	80 42 21·57	4·8828617,9	76359·28	14·462
		XXX (Patha-ki-beri)	·27	+ ·32	+ ·40		+ ·72	52 34 25·03	4·7884949,7	61446·19	11·638
			·81				−1·12	180 0 0·00			
160		XXVIII (Guni)	·25	+ ·61	− ·25		+ ·36	71 39 36·13	4·8304117,0	67672·42	12·817
		XXX (Patha-ki-beri)	·25	− ·39	− ·01		− ·40	56 8 36·92	4·7723575,0	59204·88	11·213
		XXXI (Mod)	·25	+ ·66	+ ·26		+ ·92	52 11 46·95	4·7507421,2	56330·30	10·669
			·75				+ ·88	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ "			
		XXVII (Said Ali)	·22	+ ·34		− ·40	− ·06	56 43 12·10	4·7488786,0	56089·12	10·623
	271	XXVIII (Guni)	·23	− ·30		+ ·05	− ·25	71 5 35·73	4·8025855,7	63472·50	12·021
		XXIX (Hakra)	·22	− ·71		+ ·35	− ·36	52 11 12·17	4·7243069,3	53003·79	10·039
			·67				− ·67	180 0 0·00			
		XXIX (Hakra)	·25	+ ·64		− ·38	+ ·26	57 20 15·24	4·7723575,0	59204·88	11·213
	272	XXVIII (Guni)	·25	− ·01		+ ·04	+ ·03	69 45 52·92	4·8194477,0	65985·38	12·497
		XXXI (Mod)	·24	− ·80		+ ·34	− ·46	52 53 51·84	4·7488786,0	56089·12	10·623
			·74				− ·17	180 0 0·00			
		XXX (Patha-ki-beri)	·29	+ ·45	− ·21		+ ·24	63 18 4·19	4·8278121,7	67268·56	12·740
161		XXXI (Mod)	·28	− ·37	− ·06		− ·43	52 42 19·34	4·7774324,2	59900·77	11·345
		XXXII (Jim)	·29	+ ·21	+ ·27		+ ·48	63 59 36·47	4·8304117,0	67672·42	12·817
			·86				+ ·29	180 0 0·00			
		XXXI (Mod)	·24	− ·05	− ·28		− ·33	58 17 24·01	4·7783386,9	60025·90	11·369
162		XXXII (Jim)	·24	− ·13	+ ·11		− ·02	49 16 36·15	4·7281466,5	53474·49	10·128
		XXXIV (Dhui)	·24	− ·33	+ ·17		− ·16	72 25 59·84	4·8278121,7	67268·56	12·740
			·72				− ·51	180 0 0·00			
		XXXIV (Dhui)	·21	+ ·22	− ·34		− ·12	53 50 45·17	4·7171471,3	52137·13	9·874
163		XXXII (Jim)	·21	− ·01	+ ·12		+ ·11	57 46 51·35	4·7374191,2	54628·48	10·346
		XXXVII (Mugalbhin)	·21	− ·39	+ ·22		− ·17	68 22 23·48	4·7783386,9	60025·90	11·369
			·63				− ·18	180 0 0·00			
		XXXII (Jim)	·20	+ ·95	− ·27		+ ·68	57 3 12·27	4·7280479,1	53462·33	10·125
164		XXXVII (Mugalbhin)	·21	+ ·70	− ·10		+ ·60	68 1 26·28	4·7714330,8	59079·00	11·189
		XXXV (Koti)	·20	+ ·55	+ ·37		+ ·92	54 55 21·45	4·7171471,3	52137·13	9·874
			·61				+2·20	180 0 0·00			
		XXXVII (Mugalbhin)	·20	+1·26	− ·22		+1·04	76 55 2·62	4·7961629,5	62540·73	11·845
165		XXXV (Koti)	·19	− ·07	+ ·02		− ·05	46 42 37·47	4·6696541,8	46736·29	8·852
		XXXIX (Gada)	·19	+ ·32	+ ·20		+ ·52	56 22 19·91	4·7280479,1	53462·33	10·125
			·58				+1·51	180 0 0·00			
		XXXV (Koti)	·32	− ·52	− ·20		− ·72	67 28 24·08	4·8658347,4	73423·45	13·906
166		XXXIX (Gada)	·32	+ ·05	− ·16		− ·11	60 38 23·76	4·8405982,9	69278·47	13·121
		XXXVIII (Abanshâh)	·31	− ·13	+ ·36		+ ·23	51 53 12·16	4·7961629,5	62540·73	11·845
			·95				− ·60	180 0 0·00			
		XXX (Patha-ki-beri)	·19	− ·12		− ·44	− ·56	48 28 10·14	4·6777026,7	47610·49	9·017
	273	XXXII (Jim)	·20	+ ·96		− ·01	+ ·95	61 9 58·12	4·7459662,4	55714·25	10·552
		XXXIII (Nurlishâh)	·20	+ ·84		+ ·45	+1·29	70 21 51·74	4·7774324,2	59900·77	11·345
			·59				+1·68	180 0 0·00			
		XXXII (Jim)	·21	+1·15		− ·22	+ ·93	70 43 44·29	4·7955569,2	62453·52	11·828
	274	XXXIII (Nurlishâh)	·21	+ ·21		− ·14	+ ·07	63 14 52·62	4·7714330,7	59079·00	11·189
		XXXV (Koti)	·21	+ ·22		+ ·36	+ ·58	46 1 23·09	4·6777026,7	47610·49	9·017
			·63				+1·58	180 0 0·00			
		XXXIII (Nurlishâh)	·26	+ ·96		− ·12	+ ·84	44 34 2·07	4·7396585,0	54910·89	10·400
	275	XXXV (Koti)	·27	+ ·09		− ·24	− ·15	82 28 48·20	4·8897273,1	77575·98	14·692
		XXXVI (Nindâmani)	·27	+ ·93		+ ·36	+1·29	52 57 9·73	4·7955569,2	62453·52	11·828
			·80				+1·98	180 0 0·00			
		XXXVI (Nindâmani)	·27	− ·16		− ·02	− ·18	69 37 18·67	4·8405982,9	69278·47	13·121
	276	XXXV (Koti)	·27	− ·48		− ·31	− ·79	62 23 24·25	4·8161606,3	65487·84	12·403
		XXXVIII (Abanshâh)	·26	+ ·04		+ ·33	+ ·37	47 59 17·08	4·7396585,0	54910·89	10·400
			·80				− ·60	180 0 0·00			

No. of Triangle		Number and Name of Station	Spherical Excess	Corrections to Observed Angle				Corrected Plane Angle	Distance		
Circuit	Non-circuit			Figure	Circuit	Non-circuit	Total		Log. feet	Feet	Miles
			"	"	"	"	"	° ′ ″			
167		XXXIX (Gada)	·30	+ ·18	— ·31		— ·13	56 50 15·39	4·8122332,5	64898·29	12·291
		XXXVIII (Abansháh)	·29	— ·20	+ ·16		— ·04	51 53 2·27	4·7852872,3	60994·02	11·552
		XL (Randa)	·30	— ·18	+ ·15		— ·03	71 16 42·34	4·8658347,4	73423·45	13·906
			·89				— ·20	180 0 0·00			
168		XXXVIII (Abansháh)	·23	+ ·59	— ·39		+ ·20	41 22 33·30	4·6760501,2	47429·67	8·983
		XL (Randa)	·24	— ·46	— ·01		— ·47	73 52 31·55	4·8384207,3	68931·97	13·055
		XLII (Bíbi Mariam)	·23	— ·36	+ ·40		+ ·04	64 44 55·15	4·8122332,5	64898·29	12·291
			·70				— ·23	180 0 0·00			
169		XL (Randa)	·22	+ ·93	— ·25		+ ·68	97 5 56·09	4·9014469,4	79697·91	15·094
		XLII (Bíbi Mariam)	·22	+ ·90	— ·10		+ ·80	46 42 16·58	4·7668176,2	58454·46	11·071
		XLIII (Vikia)	·21	+ ·69	+ ·35		+1·04	36 11 47·33	4·6760501,2	47429·67	8·983
			·65				+2·52	180 0 0·00			
	277	XXXIX (Gada)	·21	— ·30		— ·78	—1·08	50 23 17·77	4·7078526,5	51033·18	9·665
		XL (Randa)	·22	— ·01		+ ·19	+ ·18	62 34 33·46	4·7693743,5	58799·60	11·136
		XLI (Khar)	·22	+ ·19		+ ·59	+ ·78	67 2 8·77	4·7852872,3	60994·02	11·552
			·65				— ·12	180 0 0·00			
	278	XLI (Khar)	·20	+ ·41		— ·52	— ·11	69 48 23·40	4·7668176,1	58454·45	11·071
		XL (Randa)	·19	+ ·29		— ·08	+ ·21	55 10 15·39	4·7086373,2	51125·47	9·683
		XLIII (Vikia)	·19	+1·45		+ ·60	+2·05	55 1 21·21	4·7078526,5	51033·18	9·665
			·58				+2·15	180 0 0·00			
170		XLII (Bíbi Mariam)	·25	— ·28	— ·14		— ·42	60 10 7·44	4·8412907,7	69389·03	13·143
		XLIII (Vikia)	·25	— ·84	— ·05		— ·89	34 42 41·55	4·6584760,9	45548·71	8·627
		XLIV (Dománi)	·25	— ·82	+ ·19		— ·63	85 7 11·01	4·9014469,4	79697·91	15·094
			·75				—1·94	180 0 0·00			
171		XLIII (Vikia)	·44	+ ·03	— ·40		— ·37	62 39 27·87	4·9323511,7	85575·84	16·208
		XLIV (Dománi)	·45	+ ·03	+ ·08		+ ·11	71 15 58·91	4·9601619,5	91235·10	17·279
		CIV (Károthol)	·44	+ ·28	+ ·32		+ ·60	46 4 33·22	4·8412907,7	69389·03	13·142
			1·33				+ ·34	180 0 0·00			
172		XLIV (Dománi)	·63	+ ·13	— ·29		— ·16	59 27 43·43	4·9930495,9	98412·34	18·639
		CIV (Károthol)	·64	+ ·29	— ·20		+ ·09	72 2 18·55	5·0361997,2	108692·54	20·586
		CVII (Sáhiji)	·63	+ ·18	+ ·49		+ ·67	48 29 58·02	4·9323511,7	85575·84	16·208
			1·90				+ ·60	180 0 0·00			
	279	XLII (Bíbi Mariam)	·22	+ ·28		— ·28	·00	70 45 3·40	4·8106580,6	64663·33	12·247
		XLIV (Dománi)	·21	+ ·08		+ ·03	+ ·11	67 33 55·22	4·8014627,6	63308·60	11·990
		XLV (Sukpur)	·21	+ ·09		+ ·25	+ ·34	41 41 1·38	4·6584760,9	45548·71	8·627
			·64				+ ·45	180 0 0·00			
	280	XLV (Sukpur)	·54	+ ·24		— ·34	— ·10	69 32 19·91	5·0361997,2	108692·54	20·586
		XLIV (Dománi)	·54	+ ·68		— ·01	+ ·67	76 35 9·35	5·0524894,7	112846·85	21·373
		CVII (Sáhiji)	·54	+ ·34		+ ·35	+ ·69	33 52 30·74	4·8106580,6	64663·33	12·247
			1·62				+1·26	180 0 0·00			

NOTE.—Stations CIV (Károthol) and CVII (Sáhiji) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

June, 1890.

W. H. COLE,

In charge of Computing Office.

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. LATITUDES, LONGITUDES AND AZIMUTHS.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	VII (Gángta)	23 44 5·53	70 32 22·49				
62	XI (Chitror)	23 23 30·84	70 43 30·95	23 53 6·40	4·7643143,2	203 51 26·50	XIV (Wándia)
„	„ „	„	„	73 33 34·47	5·0724814,3	253 25 32·66	I (Bhacháo)
„	„ „	„	„	111 55 31·19	4·6805569,2	291 52 21·44	II (Nara)
	XIV (Wándia)	23 14 44·22	70 39 18·59	102 20 41·08	4·9634788,3	282 14 20·41	I (Bhacháo)
	„ „	„	„	163 33 29·94	4·8695487,3	343 32 0·75	II (Nara)
	I (Bhacháo)	23 17 58·16	70 23 15·11	233 9 57·49	4·9340012,5	53 14 50·38	„ „
	„ „	„	„	194 3 28·39	4·8668051,2	14 4 44·64	III (Kakarwa)
	„ „	„	„	133 30 1·30	4·9492645,4	313 25 26·15	IV (Ráhida)
	„ „	„	„	83 35 46·89	4·7891241,2	263 31 27·53	VI (Sakpur)
	„ „	„	„	35 54 32·41	5·0018529,7	215 50 24·02	VII (Karárho)
63	II (Nara)	23 26 27·95	70 35 33·49	170 33 39·41	5·0342438,8	350 32 22·99	VII (Gángta)
„	„ „	„	„	111 25 45·63	4·7374067,5	291 22 8·05	III (Kakarwá)
64	III (Kakarwa)	23 29 45·44	70 26 27·16	200 49 12·66	4·9679266,7	20 51 35·02	VII (Gángta)
„	„ „	„	„	83 0 31·70	4·9192606,2	262 54 38·95	IV (Ráhida)
„	„ „	„	„	134 45 40·79	4·7890813,9	314 42 33·04	V (Ran)
65	IV (Ráhida)	23 28 4·60	70 11 41·86	215 50 13·49	4·8194935,0	35 52 59·44	„ „
„	„ „	„	„	357 4 33·51	4·8337431,9	177 4 48·31	VI (Sakpur)
„	„ „	„	„	55 43 10·47	4·8406155,9	235 39 6·31	IX (Joran)
	V (Ran)	23 36 54·54	70 18 37·35	240 23 40·22	4·9453365,4	60 29 11·57	VII (Gángta)
	VI (Sakpur)	23 16 49·77	70 12 19·17	358 11 50·30	4·8722261,8	178 12 0·19	VII (Karárho)
	„ „	„	„	51 4 59·30	4·8738908,8	231 0 53·46	VIII (Charakra)
	„ „	„	„	115 35 40·98	4·8282082,3	295 31 22·97	IX (Joran)
	VII (Karárho)	23 4 31·81	70 12 44·28	114 25 19·27	4·8227503,6	294 21 4·59	VIII (Charakra)
	VIII (Charakra)	23 9 3·84	70 1 55·52	178 1 48·10	4·8814766,5	358 1 37·01	IX (Joran)

NOTE.—Stations VII (Gángta), XI (Chitror) and XIV (Wándia) appertain to the Kattywar Meridional Series.

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
	VIII (Charakra)	23 9 3·84	70 1 55·52	99 30 0·41	4·8075119,0	279 25 33·43	X (Katror)
	" "	"	"	142 11 25·80	4·9923112,4	322 7 10·54	XI (Bolári)
66	IX (Joran)	23 21 37·61	70 1 27·43	42 49 45·72	4·9507691,1	222 45 28·70	X (Katror)
"	" "	"	"	91 32 9·84	4·7606648,4	271 28 4·63	XI (Bolári)
	X (Katror)	23 10 48·42	69 50 36·86	182 33 49·23	4·8266856,7	2 34 1·96	" "
	" "	"	"	86 30 55·03	4·9886532,8	266 24 4·95	XII (Sámethra)
	" "	"	"	125 58 2·12	5·0026905,4	305 52 16·97	XIII (Wára)
67	XI (Bolári)	23 21 52·58	69 51 9·07	53 57 34·14	5·0933362,8	233 50 29·79	XII (Sámethra)
"	" "	"	"	84 38 19·43	4·9284508,7	264 32 20·22	XIII (Wára)
	XII (Sámethra)	23 9 48·79	69 33 14·71	193 32 48·18	4·8255001,3	13 33 54·58	" "
	" "	"	"	99 41 56·53	4·9113004,3	279 36 17·39	XIV (Roha)
	" "	"	"	151 29 52·04	5·0795617,0	331 25 48·46	XV (Dinoda)
68	XIII (Wára)	23 20 33·33	69 36 2·91	61 54 5·12	5·0369663,8	241 47 18·29	XIV (Roha)
"	" "	"	"	119 2 36·63	4·9215270,1	298 57 25·38	XV (Dinoda)
	XIV (Roha)	23 12 4·23	69 18 53·22	193 59 50·70	4·9761744,1	14 1 28·08	" "
	" "	"	"	140 17 35·10	5·0774932,5	320 12 10·31	XVI (Háthria)
	" "	"	"	93 29 40·18	5·1828728,1	273 18 57·46	XVII (Naliya)
69	XV (Dinoda)	23 27 14·30	69 22 59·14	90 5 26·53	4·9967840,2	269 58 22·20	XVI (Háthria)
"	" "	"	"	133 19 35·28	4·9668246,1	313 14 45·78	XVIII (Manjal)
	XVI (Háthria)	23 27 14·85	69 5 13·01	42 23 35·99	5·0496166,8	222 18 14·92	XVII (Naliya)
	" "	"	"	206 33 46·47	4·8510658,3	26 36 2·79	XVIII (Manjal)
	" "	"	"	80 6 40·19	4·9729474,6	260 0 4·97	XIX (Saind)
	" "	"	"	109 54 38·54	5·0226438,4	289 47 33·94	XX (Suri Muri)
	" "	"	"	154 56 37·70	4·9401965,3	334 53 59·00	XXI (Sura Gandára)
	XVII (Naliya)	23 13 33·91	68 51 42·61	165 36 58·13	4·8374909,0	345 35 45·51	XIX (Saind)
70	XVIII (Manjal)	23 37 43·70	69 10 54·32	102 43 48·36	4·8473096,6	282 38 52·19	XXI (Sura Gandára)
	XIX (Saind)	23 24 34·08	68 48 39·14	172 46 41·00	4·7194803,0	352 46 12·78	XX (Suri Muri)
	" "	"	"	210 14 16·21	5·0420554,2	30 18 14·60	XXI (Sura Gandára)
	XX (Suri Muri)	23 33 9·34	68 47 28·31	235 10 7·20	4·8785765,6	55 14 34·64	" "
	" "	"	"	187 12 9·47	4·7409725,8	7 12 39·25	XXII (Bábia)
	" "	"	"	99 32 13·09	4·6960267,7	279 28 42·61	XXIII (Jamanwála)
71	XXI (Sura Gandára)	23 40 16·83	68 58 36·00	101 48 32·30	4·7507775,7	281 44 33·91	XXII (Bábia)
"	" "	"	"	137 25 10·45	4·8719935,3	317 21 31·89	XXV (Lakhpat)
	XXII (Bábia)	23 42 10·75	68 48 42·62	50 17 44·71	4·8611946,4	230 13 43·80	XXIII (Jamanwála)
	" "	"	"	92 55 53·54	4·8591061,5	272 50 41·13	XXIV (Pinjor Pir)
	" "	"	"	186 11 48·57	4·6391575,4	6 12 8·98	XXV (Lakhpat)
	XXIII (Jamanwála)	23 34 30·62	68 38 41·80	161 53 58·67	4·7217439,3	341 52 48·01	XXIV (Pinjor Pir)
	XXIV (Pinjor Pir)	23 42 46·84	68 35 45·63	242 39 31·37	4·9370493,9	62 45 4·93	XXV (Lakhpat)
	" "	"	"	161 10 10·79	4·7929633,1	341 8 43·68	XXVI (Sugandia)
	" "	"	"	205 3 36·59	4·9602760,8	25 6 24·93	XXVII (Said Ali)

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ″		° ′ ″	
72	XXV (Lakhpat)	23 49 19·89	68 49 33·27	101 12 15·38	4·9944547,7	281 5 13·45	XXVI (Sugandia)
"	" "	"	"	138 26 33·99	4·7593799,5	318 23 47·63	XXVII (Said Ali)
	XXVI (Sugandia)	23 52 28·99	68 32 9·72	247 48 40·76	4·8019212,2	67 52 57·14	" "
	" "	"	"	197 35 6·66	4·7884949,7	17 36 27·98	XXVIII (Guni)
	" "	"	"	150 51 52·99	4·8828617,9	330 49 10·05	XXX (Patha-ki-beri)
73	XXVII (Said Ali)	23 56 25·77	68 42 42·34	130 52 51·10	4·7243069,3	310 49 55·33	XXVIII (Guni)
"	" "	"	"	187 36 3·42	4·8025855,7	7 36 40·32	XXIX (Hakra)
74	XXVIII (Guni)	24 2 9·30	68 35 30·00	239 44 19·37	4·7488786,0	59 47 52·71	" "
"	" "	"	"	98 18 49·82	4·7507421,2	278 14 44·75	XXX (Patha-ki-beri)
"	" "	"	"	169 58 26·20	4·7723575,0	349 57 40·71	XXXI (Mod)
	XXIX (Hakra)	24 6 49·11	68 44 12·97	117 8 8·20	4·8194477,0	297 3 48·63	" "
	XXX (Patha-ki-beri)	24 3 29·68	68 25 28·57	222 6 7·58	4·8304117,0	42 9 27·91	" "
	" "	"	"	158 48 3·10	4·7774324,2	338 46 27·42	XXXII (Jim)
	" "	"	"	110 19 52·77	4·7459662,4	290 16 2·63	XXXIII (Nurlisháh)
75	XXXI (Mod)	24 11 46·92	68 33 38·66	94 51 47·53	4·8278121,7	274 46 50·66	XXXII (Jim)
"	" "	"	"	153 9 11·78	4·7281466,5	333 7 24·48	XXXIV (Dhui)
	XXXII (Jim)	24 12 42·94	68 21 34·57	39 56 25·74	4·6777026,7	219 54 10·69	XXXIII (Nurlisháh)
	" "	"	"	225 30 14·27	4·7783386,9	260 41 24·40	XXXIV (Dhui)
	" "	"	"	110 40 10·24	4·7714330,8	290 36 4·96	XXXV (Koti)
	" "	"	"	167 43 22·71	4·7171471,3	347 42 33·40	XXXVII (Mugalbhin)
	XXXIII (Nurlisháh)	24 6 41·18	68 16 4·63	156 39 17·86	4·7955569,2	336 37 28·26	XXXV (Koti)
	" "	"	"	112 5 15·53	4·8897273,1	291 59 57·85	XXXVI (Nindámani)
76	XXXIV (Dhui)	24 19 39·55	68 29 17·54	99 24 9·94	4·7374191,2	279 20 9·71	XXXVII (Mugalbhin)
	XXXV (Koti)	24 16 9·22	68 11 37·15	59 6 16·73	4·7396585,0	239 2 47·85	XXXVI (Nindámani)
	" "	"	"	235 40 43·31	4·7280479,1	55 43 59·89	XXXVII (Mugalbhin)
	" "	"	"	121 29 41·25	4·8405982,9	301 25 18·12	XXXVIII (Abansháh)
	" "	"	"	188 58 5·65	4·7961629,5	8 58 49·16	XXXIX (Gada)
	XXXVI (Nindámani)	24 11 29·64	68 3 8·19	169 25 28·91	4·8161606,3	349 24 35·46	XXXVIII (Abansháh)
77	XXXVII (Mugalbhin)	24 21 7·66	68 19 34·67	132 39 2·71	4·6696541,8	312 36 29·06	XXXIX (Gada)
	XXXVIII (Abansháh)	24 22 7·43	68 0 58·19	249 32 5·65	4·8658347,4	69 37 13·24	" "
	" "	"	"	197 39 3·09	4·8122332,5	17 40 31·32	XL (Randa)
	" "	"	"	156 16 29·56	4·8384207,3	336 14 25·20	XLII (Bíbi Mariam)
78	XXXIX (Gada)	24 26 21·25	68 13 22·66	126 27 28·93	4·7852872,3	306 23 48·68	XL (Randa)
"	" "	"	"	176 50 46·91	4·7693743,5	356 50 32·36	XLI (Khar)
79	XL (Randa)	24 32 20·08	68 4 31·32	243 49 15·00	4·7078526,5	63 52 41·35	" "
"	" "	"	"	91 33 3·11	4·6760501,2	271 29 29·82	XLII (Bíbi Mariam)
"	" "	"	"	188 38 59·42	4·7668176,2	8 39 39·14	XLIII (Vikia)
	XLI (Khar)	24 36 2·91	68 12 47·60	133 41 4·95	4·7086373,2	313 38 17·74	" "
	XLII (Bíbi Mariam)	24 32 32·55	67 55 57·79	224 47 13·02	4·9014469,4	44 51 26·68	" "
	" "	"	"	164 37 5·33	4·6584760,9	344 36 10·80	XLIV (Dománi)

Station A				Side A B			Station B
Circuit No.	Number and Name of Station	Latitude North	Longitude East of Greenwich	Azimuth at A	Log. Feet	Azimuth at B	Number and Name of Station
		° ′ ″	° ′ ″	° ′ ′		° ′ ″	
	XLII (Bíbi Mariam)	24 32 32·55	67 55 57·79	93 52 1·71	4·8014627,6	273 47 17·45	XLV (Sukpur)
80	XLIII (Vikia)	24 41 52·60	68 6 6·66	79 34 8·48	4·8412907,7	259 28 59·54	XLIV (Dománi)
"	" "	"	"	142 13 36·79	4·9601619,5	322 9 22·20	CIV (Károthol)
	XLIV (Dománi)	24 39 47·63	67 53 46·80	52 10 6·23	4·8106580,6	232 6 15·86	XLV (Sukpur)
	" "	"	"	188 13 0·18	4·9323511,7	8 13 55·86	CIV (Károthol)
	" "	"	"	128 45 16·12	5·0361997,2	308 38 50·72	CVII (Sáhiji)
	XLV (Sukpur)	24 33 14·42	67 44 33·58	162 33 55·41	5·0524894,7	342 31 22·00	" "
	CIV (Károthol)	24 53 46·69	67 55 59·65	80 16 15·05	4·9930495,9	260 8 52·07	" "
	CVII (Sáhiji)	24 51 0·90	67 38 26·47				

Note.—Stations CIV (Károthol) and CVII (Sáhiji) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral.

June, 1890.

W. H. COLE,
In charge of Computing Office.

CUTCH COAST 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 levelling operations, wherever a junction between the two has been effected. The spirit levelled determinations are always accepted as final, and the trigonometrical heights of stations lying between those fixed by the levelling operations are adjusted by simple proportion to accord with the latter. In the table the spirit levelled values are printed thus, **303·69**, &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. I from Stn. XIV, see below, to indicate that one set of adjustments ends and another begins. The trigonometrical heights always refer to the upper mark or to the upper surface of the circular pillar or structure on which the theodolite stood. Descriptions follow this table, exactly indicating the surfaces on which the levelling staff stood during the determinations of the spirit levelled heights.

The height given in the last column is the approximate height of the structure above the ground at the base of the station.

The heights of the initial stations above Mean Sea Level are taken from the Kattywar Meridional Series and are as follows:—

VII (Gángta) 210·7 feet; XI (Chitror) 490·0 feet; XIV (Wándia) **116·37** feet.

Astronomical Date 1856-57	Astronomical Date: Mean of Times of observation	Number and Name of 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. 19,20	2 48	XI (Chitror)	D 0 14 10·9	8	2·6	6·2	1168	69	·059	−188·8	301·2			
Jan. 13,14	2 35	I (Bhacháo)	D 0 3 10·6	12	2·7	5·6						301·4	**303·69**	5
Nov. 17, Dec. 21	2 49	XIV (Wándia)	D 0 0 18·7	8	2·6	5·7	908	27	·030	+185·1	301·5			
Jan. 13,14	2 13	I (Bhacháo)	D 0 14 9·5	8	2·6	5·6								

Astronomical Date 1856-57	Mean of Times of observation	Number and Name of 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
Dec. 30	2 22	VII (Gángta)	E 0 7 59·4	4	2·6	5·6	1069	62	·058	+502·6	713·3			
„ 23,24,25	3 19	II (Nara)	D 0 23 56·8	14	2·6	5·6								
Nov. 19,20	2 38	XI (Chitror)	E 0 12 14·1	10	2·6	6·2	474	25	·053	+223·3	713·3			
Dec. 24,25	2 36	II (Nara)	D 0 19 43·5	8	3·2	5·6								
Nov. 17, Dec. 21	2 42	XIV (Wándia)	E 0 22 2·9	8	2·6	5·7	732	38	·051	+595·9	712·3	713·0	713	5
Dec. 23,24,25	3 6	II (Nara)	D 0 33 16·5	12	2·6	5·6								
Jan. 13,14	2 25	I (Bhacháo)	E 0 10 4·8	8	2·6	5·6	849	53	·063	+409·6	713·3			
Dec. 23,24,25	3 17	II (Nara)	D 0 22 42·1	12	2·6	5·6								
„ 30	2 57	VII (Gángta)	E 0 2 36·9	6	3·1	5·6	918	59	·064	+253·4	464·1			
Jan. 16,17,18,27	2 55	III (Kakarwa)	D 0 16 10·9	20	2·6	6·2								
„ 13,14	2 34	I (Bhacháo)	E 0 2 5·3	12	3·2	5·6	727	44	·060	+161·3	465·0			
„ 16,17,18,27	3 0	III (Kakarwa)	D 0 13 2·0	18	2·6	6·2						464·7	465	5
Dec. 23,24,25	2 58	II (Nara)	D 0 19 45·9	14	2·7	5·6	540	32	·058	−248·0	465·0			
Jan. 17,18,27	3 7	III (Kakarwa)	E 0 11 24·5	20	2·6	6·2								
Dec. 30	2 36	VII (Gángta)	D 0 14 19·3	8	2·6	5·6	871	41	·048	−195·7	15·0			
Jan. 1,2	2 43	V (Ran)	E 0 0 56·6	16	2·6	5·6								
„ 16,17,18	3 3	III (Kakarwa)	D 0 29 55·7	12	2·6	6·2	608	35	·058	−452·1	12·6	13·8	14	4·8
„ 1,2	2 49	V (Ran)	E 0 20 38·0	10	3·0	5·6								
„ 13,14	2 52	I (Bhacháo)	D 0 17 24·2	8	2·6	5·6	879	26	·029	−269·0	34·7			
„ 5,6,7	3 16	IV (Ráhida)	E 0 3 24·2	14	3·2	5·6								
„ 16,17,18,27	3 9	III (Kakarwa)	D 0 24 17·9	22	2·6	6·2	821	38	·046	−433·5	31·2	32·0	32	
„ 5,6,7,28	3 4	IV (Ráhida)	E 0 11 38·5	20	3·1	5·6								
„ 19,21,22	2 51	VI (Sakpur)	D 0 21 49·3	12	2·6	5·7	674	26	·039	−327·0	30·2			
„ 5,6,7,28	3 5	IV (Ráhida)	E 0 11 9·3	20	2·6	5·6								
„ 17	3 11	III (Kakarwa)	D 0 11 24·9	4	2·6	6·2	1099	69	·063	−107·3*	357·4			
„ 21,22	3 8	VI (Sakpur)	D 0 4 48·8	8	3·1	5·7								
„ 13,14	2 46	I (Bhacháo)	D 0 1 41·9	8	2·6	5·6	608	33	·054	+ 53·6	357·3	357·3	357·19	5
„ 19,21,22	2 40	VI (Sakpur)	D 0 7 41·3	12	2·6	5·7								
„ 13,14	2 54	I (Bhacháo)	D 0 16 36·3	8	2·6	5·6	992	45	·045	−262·2	41·5			
„ 24	4 5	VII (Karárho)	E 0 1 20·7	6	2·6	5·7								
„ 19,21,22	2 42	VI (Sakpur)	D 0 20 32·6	14	2·6	5·7	736	20	·026	−316·3	40·9	40·9	41	13
„ 24	3 6	VII (Karárho)	E 0 8 38·3	10	2·6	5·7								
Feb. 2,4	3 16	VIII (Charakra)	D 0 24 51·0	10	2·6	5·6	657	20	·031	−378·3	40·2			
Jan. 24	2 56	VII (Karárho)	E 0 14 16·1	6	2·6	5·7								
„ 21,22	2 59	VI (Sakpur)	D 0 2 45·0	10	2·6	5·7	739	44	·059	+ 61·4	418·6	418·6	418·52	5
Feb. 2,4	2 43	VIII (Charakra)	D 0 8 23·3	10	2·6	5·6								

NOTE.—Stations VII (Gángta), XI (Chitror) and XIV (Wándia) appertain to the Kattywar Meridional Series.
* This value is based on a deduced distance.

Astronomical Date 1857	Astronomical Date Mean of Times of observation	Number and Name of 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. 5,6,7,28	2 45	IV (Ráhida)	E 0 24 20·6	18	2·6	5·6	685	38	·055	+595·9	627·9			
„ 30,31	2 44	IX (Joran)	D 0 34 47·5	10	2·6	5·6								
„ 21,22	2 31	VI (Sakpur)	E 0 8 33·4	10	2·6	5·7	665	36	·053	+267·7	624·9	626·0	626	5
„ 31	2 21	IX (Joran)	D 0 18 46·4	4	2·6	5·6								
Feb. 2,4	2 59	VIII (Charakra)	E 0 3 38·1	10	2·6	5·6	752	42	·056	+206·8	625·3			
Jan. 30,31	2 38	IX (Joran)	D 0 15 2·7	10	2·6	5·6								
Feb. 2,4	3 2	VIII (Charakra)	E 0 34 9·5	10	2·6	5·6	634	36	·057	+728·5	1147·0			
„ 6,7	2 49	X (Katror)	D 0 43 51·5	12	2·6	5·6								
Jan. 30,31	2 56	IX (Joran)	E 0 13 27·1	8	2·6	5·6	882	55	·062	+519·7	1145·1	1146·1	1145	5
Feb. 6,7	3 1	X (Katror)	D 0 26 34·0	8	2·6	5·6								
„ 10	3 4	XI (Bolári)	E 0 3 36·1	6	2·6	5·6	663	42	·063	+167·6	1146·2			
„ 6,7	3 1	X (Katror)	D 0 13 34·4	10	2·6	5·6								
„ 2,4	2 54	VIII (Charakra)	E 0 12 20·8	8	2·6	5·6	971	57	·059	+560·0	978·5			
„ 9,10	3 15	XI (Bolári)	D 0 26 50·6	10	2·6	5·6								
Jan. 30,31	2 52	IX (Joran)	E 0 16 42·6	8	2·6	5·6	570	34	·059	+353·3	978·7	978·6	978	5
Feb. 9,10	3 16	XI (Bolári)	D 0 25 26·3	10	2·6	5·6								
„ 6,7	3 1	X (Katror)	D 0 13 34·4	10	2·6	5·6	663	42	·063	−167·6	978·5			
„ 10	3 4	XI (Bolári)	E 0 3 36·1	6	2·6	5·6								
1855 Dec. 3,4	2 55	X (Katror)	D 0 13 32·5	8	2·8	5·6	963	59	·061	−181·5	964·6			
Nov. 28,29,30	2 46	XII (Sámethra)	D 0 0 44·4	14	2·6	5·6								
Dec. 8	2 52	XI (Bolári)	D 0 9 20·4	4	2·7	5·6	1225	80	·065	− 13·9	964·7	965·1	964	5
Nov. 29,30	2 44	XII (Sámethra)	D 0 8 34·1	8	2·6	5·6								
Dec. 12,13	3 4	XIII (Wára)	D 0 13 25·1	8	2·5	5·6	661	40	·061	−163·9	965·9			
Nov. 29,30	2 26	XII (Sámethra)	E 0 3 25·6	10	2·5	5·6								
Dec. 6,7,8	2 49	XI (Bolári)	D 0 0 4·6	14	2·6	5·6	838	55	·066	+150·9	1129·5			
„ 12,13	2 44	XIII (Wára)	D 0 12 18·4	8	2·6	5·6								
„ 3,4	2 58	X (Katror)	D 0 7 47·7	10	2·6	5·6	994	69	·069	− 16·1	1130·0	1129·4	1128	5
„ 12,13	2 56	XIII (Wára)	D 0 6 41·8	10	2·6	5·6								
Nov. 29,30	2 26	XII (Sámethra)	E 0 3 25·6	10	2·5	5·6	661	40	·061	+163·9	1128·6			
Dec. 12,13	3 4	XIII (Wára)	D 0 13 25·1	8	2·5	5·6								
Nov. 28,29,30	2 51	XII (Sámethra)	D 0 9 43·5	14	4·4	5·6	806	49	·061	− 89·5	875·6			
Dec. 15,17,18	2 30	XIV (Roha)	D 0 2 15·0	16	2·6	5·6								
„ 12,13	2 50	XIII (Wára)	D 0 15 51·8	10	2·7	5·6	1076	69	·065	−252·1	877·3	876·5	875	4
„ 15,17,18	2 53	XIV (Roha)	E 0 0 3·3	16	2·6	5·6								
„ 26,28	3 6	XV (Dinoda)	D 0 21 17·0	8	4·6	5·7	935	58	·062	−396·9	876·7			
„ 15,17,18	2 50	XIV (Roha)	E 0 7 28·0	14	2·6	5·6								

Astronomical Date 1855	Mean of Times of observation	Number and Name of 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. 28,29,30	2 34	XII (Sámethra)	E 0 0 5·2	14	2·6	5·6	1187	74	·063	+ 308·2	1273·3			
Dec. 26,27,28	2 58	XV (Dinoda)	D 0 17 33·6	14	2·6	5·7								
„ 12,13	2 52	XIII (Wára)	D 0 0 3·4	8	6·1	5·6	825	51	·062	+ 144·5	1273·9	1273·5	1272	5
„ 26,27,28	2 40	XV (Dinoda)	D 0 12 6·0	14	2·6	5·7								
„ 15,17,18	2 50	XIV (Roha)	E 0 7 28·0	14	2·6	5·6	935	58	·062	+ 396·9	1273·4			
„ 26,28	3 6	XV (Dinoda)	D 0 21 17·0	8	4·6	5·7								
„ 15,17,18	2 41	XIV (Roha)	D 0 13 51·7	12	2·6	5·6	1181	72	·061	– 178·7	697·8			
„ 24,25	2 50	XVI (Háthria)	D 0 3 31·4	10	4·8	5·7								
1857 Feb. 13,14	3 7	XV (Dinoda)	D 0 27 10·8	10	2·6	5·7	981	61	·062	– 575·0	698·5	698·2	696·31	5
„ 25,26,28	3 11	XVI (Háthria)	E 0 12 38·7	12	2·6	5·6								
1855 Dec. 15,17,18	3 8	XIV (Roha)	D 0 28 40·8	12	2·8	5·6	1506	63	·042	– 758·9	116·1*			
„ 21,22	3 31	XVII (Naliya)	E 0 5 33·8	10	2·6	5·6								
1857 Feb. 26,28	3 19	XVI (Háthria)	D 0 26 33·7	8	2·6	5·6	1108	49	·044	– 588·5	107·8	107·8	107	5
Mar. 2,3	3 0	XVII (Naliya)	E 0 9 32·0	10	2·6	5·6								
Feb. 13,14	2 54	XV (Dinoda)	D 0 37 53·0	10	2·6	5·7	915	55	·060	– 837·0	435·0			
„ 16,17	2 46	XVIII (Manjal)	E 0 24 14·1	10	2·6	5·6								
„ 25,26,28	3 4	XVI (Háthria)	D 0 18 2·6	14	2·6	5·6	701	37	·052	– 261·4	434·9	435·0	435	5
„ 16,17	3 9	XVIII (Manjal)	E 0 7 16·8	8	2·6	5·6								
„ 25,26,28	3 5	XVI (Háthria)	D 0 21 47·7	16	2·7	5·6	928	52	·056	– 405·1	291·2			
Mar. 5,6,7	3 2	XIX (Saind)	E 0 7 50·8	12	2·6	5·6								
„ 2,3	2 51	XVII (Naliya)	E 0 3 57·2	16	2·6	5·6	680	24	·035	+ 187·4	295·2	293·2	292	4
„ 4,5,6,7	2 47	XIX (Saind)	D 0 14 46·8	24	2·6	5·6								
Feb. 25,26,28	3 3	XVI (Háthria)	D 0 16 21·0	16	2·6	5·6	1041	50	·048	– 257·9	438·4			
Mar. 9,10	3 14	XX (Suri Muri)	E 0 0 29·1	10	2·6	5·6								
„ 5,6,7	2 51	XIX (Saind)	E 0 5 13·0	18	2·6	5·6	518	4	·008	+ 147·3	440·5	438·3	437	12
„ 9,10	2 41	XX (Suri Muri)	D 0 14 6·0	8	2·6	5·6								
Feb. 19,20	3 13	XXI (Sura Gandára)	D 0 26 42·3	8	2·6	5·6	747	41	·054	– 462·3	436·1			
Mar. 9,10	2 51	XX (Suri Muri)	E 0 15 19·9	12	2·6	5·6								
Feb. 25,26,28	2 45	XVI (Háthria)	E 0 1 20·2	14	2·6	5·6	861	43	·049	+ 200·8	897·1			
„ 19,20,21	2 53	XXI (Sura Gandára)	D 0 14 30·3	16	2·6	5·6								
„ 16,17	2 55	XVIII (Manjal)	E 0 17 23·5	10	2·6	5·6	695	40	·058	+ 463·8	898·8			
„ 19,20,21	2 46	XXI (Sura Gandára)	D 0 27 55·6	12	2·6	5·6								
Mar. 5,6,7	2 54	XIX (Saind)	E 0 10 42·3	12	2·6	5·6	1089	58	·053	+ 606·0	899·2	899·2	898	5
Feb. 20,21	3 22	XXI (Sura Gandára)	D 0 27 6·8	10	2·7	5·6								
Mar. 9,10	2 51	XX (Suri Muri)	E 0 15 19·9	12	2·6	5·6	747	41	·054	+ 462·3	901·8			
Feb. 19,20	3 13	XXI (Sura Gandára)	D 0 26 42·3	8	2·6	5·6								

* Rejected.

Astronomical Date 1857	Mean of Times of observation	Number and Name of 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 50	XX (Suri Muri)	D 0 13 6·6	8	2·6	5·6	544	12	·023	−137·7	300·6			
„ 19,20	2 43	XXII (Bábia)	E 0 4 4·6	8	2·6	5·6						300·7	299	10
Feb.19,20,21	3 6	XXI (Sura Gandára)	D 0 40 49·9	12	2·6	5·6	557	30	·055	−598·5	300·7			
Mar. 19,20	2 28	XXII (Bábia)	E 0 32 11·9	10	2·6	5·6								
Feb.19,20,21	3 4	XXI (Sura Gandára)	D 0 40 57·8	12	2·6	5·6	736	39	·053	−765·6	133·6			
Mar. 22,24	2 35	XXV (Lakhpat)	E 0 29 42·7	10	2·6	5·6						134·5	132·13	5
„ 19,20	2 39	XXII (Bábia)	D 0 16 47·0	8	2·6	5·6	431	5	·012	−165·3	135·4			
„ 22,24	2 41	XXV (Lakhpat)	E 0 9 18·5	8	2·6	5·6								
„ 9,10	2 58	XX (Suri Muri)	D 0 18 26·1	8	2·6	5·6	491	− 4	·008	−203·4	233·5			
„ 11,15	2 39	XXIII (Jamanwála)	E 0 9 42·7	8	2·6	5·7						234·7	237	12
„ 19,20	3 5	XXII (Bábia)	D 0 8 59·5	8	2·6	5·6	718	7	·009	− 62·9	235·9			
„ 11,15	3 2	XXIII (Jamanwála)	D 0 3 2·3	18	2·6	5·7								
„ 19,20	2 47	XXII (Bábia)	D 0 14 27·7	8	2·6	5·6	714	34	·047	−187·7	111·1			
„ 16,17,18	2 33	XXIV (Pinjor Pir)	E 0 3 23·5	12	2·6	5·6								
„ 11,15	2 43	XXIII (Jamanwála)	D 0 12 25·9	10	2·6	5·7	521	4	·008	−122·1	112·6			
„ 16,17,18	2 40	XXIV (Pinjor Pir)	E 0 3 30·3	14	2·6	5·6						108·5	114	12
(1)	2 54	XXV (Lakhpat)	D 0 8 7·3	8	2·6	5·6	853	14	·016	− 28·2	103·9			
(2)	2 45	XXIV (Pinjor Pir)	D 0 5 52·7	24	2·6	5·6								
1858														
Mar. 22	2 45	XXVI (Sugandia)	D 0 0 49·5	6	2·6	5·6	615	19	·031	+ 74·9	106·2 *			
Apr. 3,4,5,6	2 39	XXIV (Pinjor Pir)	D 0 9 7·2	24	2·6	5·7								
„ 8	5 26	XXIV (Pinjor Pir)	D 0 8 28·6	10	2·6	5·7	903	102	·113	− 67·3	41·2			
„ 8	5 27	XXVII (Said Ali)	D 0 3 23·2	10	2·4	4·9						41·7	30·38	24
Mar. 29	2 44	XXV (Lakhpat)	D 0 9 29·3	6	2·6	5·6	568	47	·084	− 89·7	42·4			
„ 25	2 50	XXVII (Said Ali)	E 0 1 14·5	6	2·6	5·6								
„ 24	5 36	XXV (Lakhpat)	D 0 9 58·5	8	2·7	4·8	973	53	·055	− 77·1	55·0 *			
„ 24	5 33	XXVI (Sugandia)	D 0 4 36·9	8	3·3	5·6								
„ 25	18 47	XXVII (Said Ali)	D 0 4 50·0	10	2·6	5·6	625	30	·048	+ 0·8	31·2	31·2	31·27	24
„ 25	18 47	XXVI (Sugandia)	D 0 4 53·0	10	2·4	4·8								
„ 22	18 47	XXVI (Sugandia)	D 0 4 40·8	8	2·4	5·6	609	47	·078	− 3·9	27·4			
„ 22	18 47	XXVIII (Guni)	D 0 4 12·0	8	2·4	4·9						29·4	30·20	‡
„ 13	5 37	XXVII (Said Ali)	D 0 4 53·8	6	2·4	4·8	524	−26	·050	+ 0·9	31·3			
„ 13	5 36	XXVIII (Guni)	D 0 5 3·3	6	2·6	5·6								
„ 10	5 43	XXVIII (Guni)	D 0 3 22·0	12	2·6	4·9	587	83	·141	+ 4·7	34·9	34·9	35·34	25
„ 10	5 43	XXXI (Mod)	D 0 3 57·5	12	2·6	5·6								
Apr. 5	18 25	XXVII (Said Ali)	D 0 4 46·0	6	3·8	4·8	629	48	·077	− 5·2	25·2			
„ 5	18 25	XXIX (Hakra)	D 0 4 16·8	6	2·5	4·9								

(1) The mean of observations taken on 24th March, 1857 and 30th March, 1858.
(2) Ditto ditto 17th and 18th March, 1857 and 4th, 5th and 6th April, 1858.

* Rejected. ‡ Not forthcoming.

Astronomical Date 1858	Mean of Times of observation	Number and Name of 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. 13	18 43	XXVIII (Guni)	D 0 4 18·7	8	2·6	5·6	553	39	·071	− 2·7	27·5	26·4	26	24
„ 13	18 43	XXIX (Hakra)	D 0 3 55·2	8	2·8	4·9								
„ 11	18 40	XXXI (Mod)	D 0 2 12·7	6	2·6	4·9	651	178	·273	+ 7·1	* 42·4			
„ 11	18 40	XXIX (Hakra)	D 0 2 59·5	6	2·6	5·6								
„ 19	5 28	XXVIII (Guni)	D 0 4 10·7	10	2·4	4·8	555	5	·008	+ 8·5	38·7	39·2	39	25
„ 19	5 30	XXX (Patha-ki-beri)	D 0 5 15·2	10	2·6	5·6								
„ 10	5 33	XXXI (Mod)	D 0 4 16·8	8	2·6	5·6	669	74	·110	+ 4·3	39·6			
„ 10	5 34	XXX (Patha-ki-beri)	D 0 4 41·3	8	2·3	4·8								
„ 19	5 26	XXX (Patha-ki-beri)	D 0 4 59·3	10	2·6	5·6	593	10	·018	− 0·8	38·4	37·4	37	†
„ 19	5 27	XXXII (Jim)	D 0 4 50·7	10	2·7	4·9								
Apr. 15	5 47	XXXI (Mod)	D 0 4 52·7	6	2·8	4·8	663	42	·063	+ 1·1	36·4			
„ 15	5 47	XXXII (Jim)	D 0 5 2·1	6	2·7	5·7								
Mar. 6	19 16	XXXI (Mod)	D 0 3 57·0	12	2·6	5·6	529	33	·062	+ 1·7	37·0	37·0	37	†
„ 6	19 33	XXXIV (Dhui)	D 0 4 7·0	12	2·7	4·9								
Apr. 16	5 44	XXXII (Jim)	D 0 4 30·6	6	2·6	5·7	593	38	·064	− 0·4	37·0			
„ 16	5 45	XXXIV (Dhui)	D 0 4 24·3	6	2·7	4·8								
Feb. 24,25,26	2 44	XXXII (Jim)	D 0 5 10·2	16	2·7	5·6	516	−82	·160	+ 10·7	48·1	45·4	44·62	20
„ 19,20	2 37	XXXVII (Mugalbhin)	D 0 6 34·9	12	2·6	5·7								
„ 22,23	3 28	XXXIV (Dhui)	D 0 5 26·7	12	2·7	5·6	538	−67	·125	+ 5·6	42·6			
„ 19	3 12	XXXVII (Mugalbhin)	D 0 6 9·4	6	2·6	5·7								
May 7	8 28	XXX (Patha-ki-beri)	D 0 4 3·9	8	1·1	4·8	549	46	·085	− 0·5	38·7	39·7	40	†
„ 7	8 28	XXXIII (Nurlisháh)	D 0 3 59·7	8	1·3	4·9								
Feb. 24,25,26	3 3	XXXII (Jim)	D 0 4 49·1	18	2·6	5·6	471	−52	·111	+ 2·7	39·9			
„ 17,18	3 1	XXXIII (Nurlisháh)	D 0 5 12·4	14	2·6	5·6								
Apr. 19	5 36	XXXV (Koti)	D 0 6 9·0	10	2·8	5·7	618	−36	·059	− 4·3	40·4			
„ 19	5 36	XXXIII (Nurlisháh)	D 0 5 38·5	10	2·7	4·9								
„ 12	18 42	XXXII (Jim)	D 0 4 0·6	8	2·7	5·7	583	41	·070	+ 5·8	43·0	44·3	45	27
„ 12	18 42	XXXV (Koti)	D 0 4 38·5	8	2·7	4·9								
Feb. 19,20	3 9	XXXVII (Mugalbhin)	D 0 5 38·5	16	2·6	5·7	528	−70	·132	+ 1·8	46·4			
Mar. 1,2	2 43	XXXV (Koti)	D 0 5 51·9	10	2·7	5·7								
Apr. 19	5 36	XXXIII (Nurlisháh)	D 0 5 38·5	10	2·7	4·9	618	−36	·059	+ 4·3	43·6			
„ 19	5 36	XXXV (Koti)	D 0 6 9·0	10	2·8	5·7								
May 6	8 28	XXXIII (Nurlisháh)	D 0 4 52·3	8	1·3	4·8	765	120	·157	− 7·6	32·1	32·3	33	†
„ 6	8 28	XXXVI (Nindámani)	D 0 4 12·0	8	1·3	4·9								
Apr. 20	5 40	XXXV (Koti)	D 0 5 52·2	8	2·8	5·7	542	−26	·047	− 11·9	32·4			
„ 20	5 40	XXXVI (Nindámani)	D 0 4 20·1	8	2·7	4·9								

* Rejected. † Not forthcoming.

Astronomical Date 1858	Mean of Times of observation	Number and Name of 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. 2	3 24	XXXV (Koti)	D 0 4 43·5	8	2·6	5·7	684	−55	·081	+ 41·1	85·4			
Feb. 12,13,14	2 45	XXXVIII (Abanshāh)	D 0 8 48·3	16	2·7	5·7						84·7	86	10
„ 15,16	2 35	XXXVI (Nindámani)	D 0 3 52·2	12	2·6	5·6	649	−61	·095	+ 51·8	84·1			
„ 13,14	2 36	XXXVIII (Abanshāh)	D 0 9 18·4	12	2·6	5·7								
Apr. 21	5 47	XXXV (Koti)	D 0 4 46·8	12	2·6	5·7	620	23	·038	+ 2·9	47·2			
„ 21	5 49	XXXIX (Gada)	D 0 5 3·0	12	2·7	4·8								
„ 23	5 48	XXXVIII (Abanshāh)	D 0 7 40·9	10	2·9	4·8	724	36	·050	− 46·0	38·7	43·4	45·24	25
„ 23	5 44	XXXIX (Gada)	D 0 3 25·3	10	2·6	5·6								
Feb. 19,20	2 55	XXXVII (Mugalbhin)	D 0 4 52·5	12	2·6	5·7	462	−47	·102	− 0·2	44·4			
„ 9,10,11	2 35	XXXIX (Gada)	D 0 4 50·1	18	2·6	5·6								
„ 12,13,14	2 44	XXXVIII (Abanshāh)	D 0 7 32·8	16	2·6	5·7	643	−22	·034	− 31·5	54·1			
„ 5,6,8	2 57	XL (Randa)	D 0 4 12·2	20	2·6	5·6						55·8	56	25
Apr. 22	5 45	XXXIX (Gada)	D 0 3 50·8	12	2·6	5·6	602	39	·065	+ 12·3	57·5			
„ 22	5 45	XL (Randa)	D 0 5 10·5	12	2·8	4·9								
„ 23	5 45	XXXIX (Gada)	D 0 4 20·1	12	2·7	5·6	583	32	·054	+ 2·8	48·0			
„ 23	5 45	XLI (Khar)	D 0 4 36·6	12	2·8	4·9						50·3	51	25·1
Feb. 6,8	3 8	XL (Randa)	D 0 4 57·3	16	9·7	5·6	503	−49	·096	− 3·3	52·5			
„ 4	3 17	XLI (Khar)	D 0 4 30·4	8	9·7	5·6								
„ 12,13,14	2 50	XXXVIII (Abanshāh)	D 0 5 51·8	14	2·6	5·7	682	18	·027	− 6·6	79·0			
Jan. 20,21	2 36	XLII (Bíbi Mariam)	D 0 5 12·4	8	2·6	5·6								
Feb. 5,6,8	2 51	XL (Randa)	D 0 2 2·4	22	2·6	5·6	467	4	·009	+ 27·7	83·5	83·3	84	5
Jan. 20,21	2 23	XLII (Bíbi Mariam)	D 0 6 3·1	10	2·6	5·6								
Apr. 29	8 36	XLIII (Vikia)	D 0 3 17·0	6	1·3	5·6	787	100	·128	+ 41·6	87·3			
„ 29	8 42	XLII (Bíbi Mariam)	D 0 6 50·5	6	1·1	4·8								
„ 25	6 3	XL (Randa)	D 0 4 59·7	10	2·7	5·6	579	40	·069	− 11·4	44·4			
„ 25	6 3	XLIII (Vikia)	D 0 3 36·6	10	2·8	4·9						45·7	47·10	20
Feb. 3,4	2 21	XLI (Khar)	D 0 5 36·5	12	2·6	5·6	505	−59	·117	− 3·2	47·1			
„ 1,2	3 10	XLIII (Vikia)	D 0 4 34·7	18	11·5	5·6								
Jan. 20,21	2 22	XLII (Bíbi Mariam)	E 0 4 31·0	8	2·6	5·6	451	15	·033	+109·4	193·6			
„ 1,2	2 38	XLIV (Dománi)	D 0 11 57·9	10	3·0	5·6						192·7	191·17 + 5·0	5
„ 24,26, Feb. 2	3 16	XLIII (Vikia)	E 0 1 36·7	16	2·6	5·6	684	14	·020	+146·0	191·7			
„ 1,2	2 29	XLIV (Dománi)	D 0 12 51·2	10	2·6	5·6								
1857-58														
Jan. 20,21	2 49	XLII (Bíbi Mariam)	D 0 8 42·7	18	*3·6	5·6	624	−34	·054	− 52·3	31·9			
Dec. 30,31	3 3	XLV (Sukpur)	D 0 3 5·0	18	2·6	5·7						31·2	31	10·1
Jan. 1,2	2 47	XLIV (Dománi)	D 0 14 1·4	8	2·7	5·6	638	16	·025	−165·7	30·5			
Dec. 22,29,30,31	2 40	XLV (Sukpur)	E 0 3 35·4	26	2·6	5·7								

* This height is to be combined with a negative sign on account of change in the height of the tower at XLV (Sukpur).

Astronomical Date 1857-58	Mean of Times of observation	Number and Name of 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. 1,2	2 13	XLIV (Dománi)	D 0 0 3·5	8	2·6	5·6	1073	64	·059	+250·4	446·6	444·9	445	3
Dec. 17,18,19	2 41	CVII (Sáhiji)	D 0 15 54·0	16	2·6	5·6								
„ 22,29,30,31	2 35	XLV (Sukpur)	E 0 3 59·0	24	2·6	5·7	1117	50	·045	+412·0	443·2			
„ 18,19	2 31	CVII (Sáhiji)	D 0 21 7·2	12	2·6	5·6								
Jan. 24,26, Feb. 2	2 57	XLIII (Vikia)	E 0 0 23·8	26	2·6	5·6	902	24	·026	+202·6	249·7 *			
Dec. 10,11	2 22	CIV (Károthol)	D 0 14 53·0	10	2·2	5·6								
Jan. 1,2	2 19	XLIV (Dománi)	D 0 3 53·9	8	2·6	5·6	848	47	·056	+ 62·2	258·4	258·4	† 260	3
Dec. 10,11	2 13	CIV (Károthol)	D 0 8 54·4	10	2·4	5·6								
1853 Feb. 24	3 40	CVII (Sáhiji)	D 0 13 45·7	4	1·2	5·3	972	60	·062	−186·6	258·3			
„ 18	3 39	CIV (Károthol)	D 0 0 43·7	4	1·2	5·3								

NOTE.—Stations CIV (Károthol) and CVII (Sáhiji) appertain to the Karáchi Longitudinal Series of the North-West Quadrilateral. * Rejected.
† This height is taken from page 74—b of Volume III.

Description of Spirit-levelled Points.

When determining the Spirit-levelled heights, given on pages 81—L. to 87—L., the levelling staff stood on the surfaces hereafter described.

XIV (Wándia), I (Bhacháo), VI (Sakpur), VIII (Charakra) — On the upper mark-stone.

XVI (Háthria) — On a stone at the foot of the knoll on which the station stands, height = 563·12 feet. To this value 133·19 feet (the height of the upper surface of the circular pillar above this stone) being added, the height of the upper surface of the circular pillar was found to be 696·31 feet.

XXV (Lakhpat) — On a peg at the foot of the station, height = 94·19 feet. To this value 37·94 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 132·13 feet.

XXVI (Sugandia) — On a peg at the foot of the station, height = 5·94 feet. To this value 25·33 feet (the height of the upper mark-brick above this peg) being added, the height of the upper mark was found to be 31·27 feet.

XXVII (Said Ali) — On a peg at the foot of the station, height = 7·91 feet. To this value 22·47 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 30·38 feet.

NOTE.—Station XIV (Wándia) appertains to the Kattywar Meridional Series.

Description of Spirit-levelled Points—(Continued).

XXVIII (Guni) — On a peg at the foot of the station, height = 5·96 feet. To this value 24·24 feet (the height of the upper mark-stone above this peg) being added, the height of the upper mark-stone was found to be 30·20 feet.

XXXI (Mod) — On a peg at the foot of the station, height = 7·47 feet. To this value 27·87 feet (the height of the upper surface of the circular pillar above this peg) being added, the height of the upper surface of the circular pillar was found to be 35·34 feet.

XXXVII (Mugalbhin) — On a peg at the foot of the station, height = 20·52 feet. To this value 24·10 feet (the height of the upper surface of the circular pillar above this peg) being added, the height of the upper surface of the circular pillar was found to be 44·62 feet.

XXXIX (Gada) — On a peg at the foot of the station, height = 21·61 feet. To this value 23·63 feet (the height of the upper mark-brick above this peg) being added, the height of the upper mark was found to be 45·24 feet.

XLIII (Vikia) — On a peg at the foot of the station, height = 28·61 feet. To this value 18·49 feet (the height of the upper surface of the circular pillar above this peg) being added, the height of the upper surface of the circular pillar was found to be 47·10 feet.

XLIV (Dománi) — On the mark-stone at the ground level, height = 191·17 feet.

For further particulars of these stations, see pages 4—L. to 9—L.

July, 1890.

W. H. COLE,
In charge of Computing Office.

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XVI (Háthria)

Lat. N. 23° 27′ 14″·85; Long. E. 69° 5′ 13″·01 = 4ʰ 36ᵐ 20ˢ·9; Height above Mean Sea Level, 696 feet.
October 1856; observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed	α Ursæ Minoris (East and West).
Mean Right Ascension 1856·0	1ʰ 6ᵐ 49ˢ
Mean North Polar Distance 1856·0	1° 27′ 29″·42
Local Mean Times of Elongation, October 5	Eastern 6ʰ 12ᵐ Western 18 5

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	E.	180 0	− 10 11 55·80	18 46	− 0 19·11	− 10 12 14·91	− 10 11 41·17	25 40	− 0 35·67	− 10 12 16·84
		&	12 2·73	16 48	0 15·31	18·04	11 45·44	24 8	0 31·57	17·01
		0 0	12 19·36	4 15	0 0·98	20·34	12 12·84	11 48	0 7·56	20·40
			12 17·64	2 37	0 0·37	18·01	12 15·93	10 15	0 5·70	21·63
			12 17·20	1 21	0 0·10	17·30	12 16·53	5 33	0 1·67	18·20
			12 11·04	12 14	0 8·12	19·16	12 15·00	6 54	0 2·58	17·58
			12 9·10	13 45	0 10·27	19·37				
„ 6	E.	190 11	− 10 11 50·24	23 4	− 0 28·85	− 10 12 19·09	− 10 11 28·53	30 30	− 0 50·34	− 10 12 18·87
		&	11 54·00	21 46	0 25·68	19·68	11 34·40	28 34	0 44·21	18·61
		10 11	12 14·04	9 31	0 4·92	18·96	11 59·10	16 43	0 15·16	14·26
			12 17·87	7 25	0 2·98	20·85	12 2·03	15 21	0 12·78	14·81
			12 18·20	4 54	0 1·31	19·51	12 14·80	1 5	0 0·06	14·86
			12 18·26	6 15	0 2·13	20·39	12 16·47	0 42	0 0·03	16·50
							12 6·67	12 37	0 8·63	15·30
							12 5·90	13 46	0 10·29	16·19
							12 4·30	14 42	0 11·73	16·03
„ 6	W.	190 10	− 7 2 16·00	16 19	+ 0 14·45	− 7 1 61·55	− 7 2 29·76	22 40	+ 0 27·89	− 7 1 61·87
		&	2 12·74	14 19	0 11·14	61·60	2 25·40	21 11	0 24·35	61·05
		10 10	2 5·76	5 14	0 1·48	64·28	2 6·30	8 34	0 3·99	62·31
			2 6·06	6 49	0 2·52	63·54	2 5·43	6 59	0 2·65	62·78

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. 7	E.	200 22	− 10 12 9·70	2 10	− 0 0·25	− 10 12 9·95	− 10 12 14·96	5 31	− 0 1·66	− 10 12 16·62
		&	12 9·70	3 39	0 0·72	10·42	12 14·73	3 14	0 0·57	15·30
		20 22	11 53·53	16 56	0 15·58	9·11	12 8·74	9 35	0 4·98	13·72
			11 50·53	18 19	0 18·23	8·76	12 7·20	10 58	0 6·54	13·74
„ 7	W.	20 22					− 7 2 4·13	6 26	+ 0 2·24	− 7 1 61·89
							1 58·17	2 47	0 0·42	57·75
„ 8	E.	210 28	− 10 12 16·26	2 32	− 0 0·35	− 10 12 16·61	− 10 12 10·03	11 9	− 0 6·74	− 10 12 16·77
		&	12 16·50	0 53	0 0·04	16·54	12 14·94	9 21	0 4·75	19·69
		30 29	12 5·53	14 24	0 11·25	16·78	12 15·96	5 37	0 1·71	17·67
			12 4·60	15 47	0 13·52	18·12	12 15·83	7 5	0 2·73	18·56
„ 8	W.	210 28	− 7 2 18·80	15 1	+ 0 12·24	− 7 1 66·56	− 7 2 28·87	21 44	+ 0 25·64	− 7 1 63·23
		&	2 14·54	13 37	0 10·08	64·46	2 25·00	20 19	0 22·43	62·57
		30 28	2 13·47	11 57	0 7·76	65·71	2 3·44	5 44	0 1·78	61·66
			2 20·67	16 47	0 15·26	65·41	2 3·16	4 11	0 0·95	62·21
			2 23·43	18 19	0 18·18	65·25				
			2 38·07	23 42	0 30·42	67·65				
			2 41·56	25 31	0 35·27	66·29				
„ 9	E.	220 39	− 10 12 16·90	4 45	− 0 1·22	− 10 12 18·12	− 10 12 10·60	12 2	− 0 7·85	− 10 12 18·45
		&	12 17·57	3 15	0 0·57	18·14	12 13·77	10 47	0 6·30	20·07
		40 39	12 12·14	11 15	0 6·87	19·01	12 18·40	2 19	0 6·29	18·69
			12 10·14	13 10	0 9·42	19·56	12 17·73	3 54	0 0·82	18·55
„ 10	E.	230 50	− 10 12 15·67	0 31	− 0 0·01	− 10 12 15·68	− 10 12 12·97	8 20	− 0 3·77	− 10 12 16·74
		&	12 16·56	1 7	0 0·07	16·63	12 14·84	6 36	0 2·36	17·20
		50 50	12 0·23	18 17	0 18·15	18·38	12 14·73	8 24	0 3·84	18·57
			11 56·23	20 37	0 23·09	19·32	12 12·80	10 19	0 5·77	18·57
„ 10	W.	230 49	− 7 2 7·66	5 38	+ 0 1·72	− 7 1 65·94	− 7 2 21·60	13 56	+ 0 10·53	− 7 1 71·07
		&	2 8·83	3 55	0 0·83	68·00	2 17·04	12 34	0 8·58	68·46
		50 49	2 11·33	10 11	0 5·63	65·70	2 10·23	2 21	0 0·30	69·93
			2 14·74	11 58	0 7·76	66·98	2 9·27	3 46	0 0·77	68·50
„ 11	E.	220 39	− 10 12 13·06	8 8	− 0 3·59	− 10 12 16·65	− 10 12 14·40	1 24	− 0 0·11	− 10 12 14·51
		&	12 11·17	10 15	0 5·71	16·88	12 12·74	2 41	0 0·39	13·13
		40 39	11 36·17	27 48	0 41·97	18·14	11 52·70	18 35	0 18·74	11·44
			11 29·40	29 1	0 45·68	15·08	11 52·30	19 57	0 21·61	13·91
„ 11	W.	220 38	− 7 2 1·47	3 54	+ 0 0·82	− 7 1 60·65	− 7 2 9·60	13 11	+ 0 9·44	− 7 1 60·16
		&	2 2·94	2 4	0 0·23	62·71	2 10·76	11 20	0 6·97	63·79
		40 38	2 10·87	13 42	0 10·18	60·69	2 3·57	4 41	0 1·19	62·38
			2 15·57	15 8	0 12·41	63·16	2 3·20	6 6	0 2·02	61·18
„ 12	E.	180 0	− 10 12 4·60	11 17	− 0 6·91	− 10 12 11·51				
			12 6·20	14 39	0 11·64	17·84				

CUTCH COAST SERIES.

PRINCIPAL TRIANGULATION. AZIMUTHAL OBSERVATIONS.

At XVI (Háthria)

Lat. N. 23° 27′ 14″·85; Long. E. 69° 5′ 13″·01 = $4^h\ 36^m\ 20^s{\cdot}9$; Height above Mean Sea Level, 696 feet.
October 1856; observed by Lieutenant D. J. Nasmyth, R.E., with Troughton and Simms' 18-inch Theodolite No. 2.

Star observed	α Ursæ Minoris (East and West).
Mean Right Ascension 1856·0	$1^h\ 6^m\ 49^s$
Mean North Polar Distance 1856·0	1° 27′ 29″·42
Local Mean Times of Elongation, October 5	Eastern $6^h\ 12^m$; Western 18 5

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	E.	180 0	− 10 11 55·80	18 46	− 0 19·11	− 10 12 14·91	− 10 11 41·17	25 40	− 0 35·67	− 10 12 16·84
		&	12 2·73	16 48	0 15·31	18·04	11 45·44	24 8	0 31·57	17·01
		0 0	12 19·36	4 15	0 0·98	20·34	12 12·84	11 48	0 7·56	20·40
			12 17·64	2 37	0 0·37	18·01	12 15·93	10 15	0 5·70	21·63
			12 17·20	1 21	0 0·10	17·30	12 16·53	5 33	0 1·67	18·20
			12 11·04	12 14	0 8·12	19·16	12 15·00	6 54	0 2·58	17·58
			12 9·10	13 45	0 10·27	19·37				
„ 6	E.	190 11	− 10 11 50·24	23 4	− 0 28·85	− 10 12 19·09	− 10 11 28·53	30 30	− 0 50·34	− 10 12 18·87
		&	11 54·00	21 46	0 25·68	19·68	11 34·40	28 34	0 44·21	18·61
		10 11	12 14·04	9 31	0 4·92	18·96	11 59·10	16 43	0 15·16	14·26
			12 17·87	7 25	0 2·98	20·85	12 2·03	15 21	0 12·78	14·81
			12 18·20	4 54	0 1·31	19·51	12 14·80	1 5	0 0·06	14·86
			12 18·26	6 15	0 2·13	20·39	12 16·47	0 42	0 0·03	16·50
							12 6·67	12 37	0 8·63	15·30
							12 5·90	13 46	0 10·29	16·19
							12 4·30	14 42	0 11·73	16·03
„ 6	W.	190 10	− 7 2 16·00	16 19	+ 0 14·45	− 7 1 61·55	− 7 2 29·76	22 40	+ 0 27·89	− 7 1 61·87
		&	2 12·74	14 19	0 11·14	61·60	2 25·40	21 11	0 24·35	61·05
		10 10	2 5·76	5 14	0 1·48	64·28	2 6·30	8 34	0 3·99	62·31
			2 6·06	6 49	0 2·52	63·54	2 5·43	6 59	0 2·65	62·78

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. 7	E.	200 22	− 10 12 9·70	2 10	− 0 0·25	− 10 12 9·95	− 10 12 14·96	5 31	− 0 1·66	− 10 12 16·62
		&	12 9·70	3 39	0 0·72	10·42	12 14·73	3 14	0 0·57	15·30
		20 22	11 53·53	16 56	0 15·58	9·11	12 8·74	9 35	0 4·98	13·72
			11 50·53	18 19	0 18·23	8·76	12 7·20	10 58	0 6·54	13·74
„ 7	W.	20 22					− 7 2 4·13	6 26	+ 0 2·24	− 7 1 61·89
							1 58·17	2 47	0 0·42	57·75
„ 8	E.	210 28	− 10 12 16·26	2 32	− 0 0·35	− 10 12 16·61	− 10 12 10·03	11 9	− 0 6·74	− 10 12 16·77
		&	12 16·50	0 53	0 0·04	16·54	12 14·94	9 21	0 4·75	19·69
		30 29	12 5·53	14 24	0 11·25	16·78	12 15·96	5 37	0 1·71	17·67
			12 4·60	15 47	0 13·52	18·12	12 15·83	7 5	0 2·73	18·56
„ 8	W.	210 28	− 7 2 18·80	15 1	+ 0 12·24	− 7 1 66·56	− 7 2 28·87	21 44	+ 0 25·64	− 7 1 63·23
		&	2 14·54	13 37	0 10·08	64·46	2 25·00	20 19	0 22·43	62·57
		30 28	2 13·47	11 57	0 7·76	65·71	2 3·44	5 44	0 1·78	61·66
			2 20·67	16 47	0 15·26	65·41	2 3·16	4 11	0 0·95	62·21
			2 23·43	18 19	0 18·18	65·25				
			2 38·07	23 42	0 30·42	67·65				
			2 41·56	25 31	0 35·27	66·29				
„ 9	E.	220 39	− 10 12 16·90	4 45	− 0 1·22	− 10 12 18·12	− 10 12 10·60	12 2	− 0 7·85	− 10 12 18·45
		&	12 17·57	3 15	0 0·57	18·14	12 13·77	10 47	0 6·30	20·07
		40 39	12 12·14	11 15	0 6·87	19·01	12 18·40	2 19	0 6·29	18·69
			12 10·14	13 10	0 9·42	19·56	12 17·73	3 54	0 0·82	18·55
„ 10	E.	230 50	− 10 12 15·67	0 31	− 0 0·01	− 10 12 15·68	− 10 12 12·97	8 20	− 0 3·77	− 10 12 16·74
		&	12 16·56	1 7	0 0·07	16·63	12 14·84	6 36	0 2·36	17·20
		50 50	12 0·23	18 17	0 18·15	18·38	12 14·73	8 24	0 3·84	18·57
			11 56·23	20 37	0 23·09	19·32	12 12·80	10 19	0 5·77	18·57
„ 10	W.	230 49	− 7 2 7·66	5 38	+ 0 1·72	− 7 1 65·94	− 7 2 21·60	13 56	+ 0 10·53	− 7 1 71·07
		&	2 8·83	3 55	0 0·83	68·00	2 17·04	12 34	0 8·58	68·46
		50 49	2 11·33	10 11	0 5·63	65·70	2 10·23	2 21	0 0·30	69·93
			2 14·74	11 58	0 7·76	66·98	2 9·27	3 46	0 0·77	68·50
„ 11	E.	220 39	− 10 12 13·06	8 8	− 0 3·59	− 10 12 16·65	− 10 12 14·40	1 24	− 0 0·11	− 10 12 14·51
		&	12 11·17	10 15	0 5·71	16·88	12 12·74	2 41	0 0·39	13·13
		40 39	11 36·17	27 48	0 41·97	18·14	11 52·70	18 35	0 18·74	11·44
			11 29·40	29 1	0 45·68	15·08	11 52·30	19 57	0 21·61	13·91
„ 11	W.	220 38	− 7 2 1·47	3 54	+ 0 0·82	− 7 1 60·65	− 7 2 9·60	13 11	+ 0 9·44	− 7 1 60·16
		&	2 2·94	2 4	0 0·23	62·71	2 10·76	11 20	0 6·97	63·79
		40 38	2 10·87	13 42	0 10·18	60·69	2 3·57	4 41	0 1·19	62·38
			2 15·57	15 8	0 12·41	63·16	2 3·20	6 6	0 2·02	61·18
„ 12	E.	180 0	− 10 12 4·60	11 17	− 0 6·91	− 10 12 11·51				
			12 6·20	14 39	0 11·64	17·84				

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. 13	W.	180 0	− 7 2 9·53	7 37	+ 0 3·15	− 7 1 66·38	− 7 2 17·43	15 39	+ 0 13·28	− 7 1 64·15
		&	2 5·53	6 7	0 2·03	63·50	2 14·03	14 0	0 10·65	63·38
		0 0	2 10·86	10 33	0 6·03	64·83	2 7·24	0 17	0 0·00	67·24
			2 14·20	12 21	0 8·27	65·93	2 4·50	2 3	0 0·23	64·27
							2 5·73	4 7	0 9·92	64·81
							2 23·80	18 51	0 19·26	64·54
							2 29·83	20 51	0 23·53	66·30
							2 29·56	21 54	0 25·97	63·59
„ 14	W.	200 22	− 7 2 9·74	9 43	+ 0 5·12	− 7 1 64·62	− 7 2 25·34	19 15	+ 0 20·12	− 7 1 65·22
		&	2 9·66	7 51	0 3·35	66·31	2 21·73	17 37	0 16·84	64·89
		20 22	2 7·70	6 22	0 2·20	65·50	2 3·50	1 49	0 0·18	63·32
			2 11·30	10 24	0 5·86	65·44	2 5·23	4 2	0 0·88	64·35
			2 13·36	12 4	0 7·89	65·47				

Abstract of Astronomical Azimuth observed at XVI (Háthria) 1856.

1. By Eastern Elongation of *α* Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	210°	30°	221°	41°	231°	51°
Date	October 5		October 6		October 7		October 8		October 9		October 10	
	″	″	″	″	″	″	″	″	″	″	″	″
Observed difference of Circle-Readings, Ref. M. – Star reduced to Elongation	14·91	16·84	19·09	18·87	9·95	16·62	16·61	16·77	18·12	18·45	15·68	16·74
	18·04	17·01	19·68	18·61	10·42	15·30	16·54	19·69	18·14	20·07	16·63	17·20
	20·34	20·40	18·96	14·26	9·11	13·72	16·78	17·67	19·01	18·69	18·38	18·57
	18·01	21·63	20·85	14·81	8·76	13·74	18·12	18·56	19·56	18·55	19·32	18·57
	17·30	18·20	19·51	14·86					*17·52	*15·38		
	19·16	17·58	20·39	16·50					*17·75	*14·00		
	19·37			15·30					*19·01	*12·31		
	*14·45			16·19					*15·95	*14·78		
	*20·78			16·03								
Means	18·04	18·61	19·75	16·16	9·56	14·85	17·01	18·17	18·13	16·53	17·50	17·77
	° ′ ″		″		″		″		″		″	
Means of both faces	− 10 12 18·33		17·96		12·20		17·59		17·33		17·64	
Az. of Star fr. S., by W.	181 35 6·48		6·04		5·61		5·17		4·74		4·30	
Az. of Ref. M. „	171 22 48·15		48·08		53·41		47·58		47·41		46·66	

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.

Abstract of Astronomical Azimuth observed at XVI (Háthria) 1856—(*Continued*).

2. By Western Elongation of α Ursæ Minoris.

Face	L	R	L	R	L	R	L	R	L	R	L	R
Zero	180°	0°	190°	10°	200°	20°	210°	30°	221°	41°	231°	51°
Date	October 13		October 6		October 14		October 8		October 11		October 10	
	″	″	″	″	″	″	″	″	″	″	″	″
	66·38	64·15	61·55	61·87	64·62	*64·83	66·56	63·23	60·65	60·16	65·94	71·07
	63·50	63·38	61·60	61·05	66·31	*60·69	64·46	62·57	62·71	63·79	68·00	68·46
Observed difference	64·83	67·24	64·28	62·31	65·50	65·22	65·71	61·66	60·69	62·38	65·70	69·93
of Circle-Readings,	65·93	64·27	63·54	62·78	65·44	64·89	65·41	62·21	63·16	61·18	66·98	68·50
Ref. M.—Star		64·81			65·47	63·32	65·25					
reduced to Elongation		64·54				64·35	67·65					
		66·30					66·29					
		63·59										
Means	65·16	64·79	62·74	62·00	65·47	63·88	65·90	62·42	61·80	61·88	66·66	69·49
Means of both faces	− 7° 1′ 64·98″		62·37″		64·68″		64·16″		61·84″		68·08″	
Az. of Star fr. S., by W.	178° 24′ 57·11″		54·17		57·55		55·04		56·35		55·92	
Az. of Ref. M. „	171° 22′ 52·13″		51·80		52·87		50·88		54·51		47·84	

				°	′	″
Astronomical Azimuth of Referring Mark ...	by Eastern Elongation	...	...	171	22	48·55
	by Western „	...	...	„		51·67
	Mean	...	...	„		50·11
Angle Referring Mark and XXI (Sura Gandára) *see following page*		...	...	− 16	26	17·53
Astronomical Azimuth of Sura Gandára by observation	...	...	...	154	56	32·58
Geodetical Azimuth of „ by calculation from that adopted (Vol. II, page 141) at Kaliánpur, *see page* 78—L. *ante*		...	...	154	56	37·70
Astronomical — Geodetical Azimuth at XVI (Háthria) ...	...	...	...	−		5·12

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 XVI (Háthria)

February 1857; *observed by Lieutenant D. J. Nasmyth with Troughton and Simms'* 18-*inch Theodolite No.* 2.

Angle between	Circle readings, telescope being set on R.M.												M = Mean of Groups w = Relative Weight C = Concluded Angle
	0° 1′	180° 1′	10° 11′	190° 11′	20° 22′	200° 22′	30° 28′	210° 28′	40° 38′	220° 38′	50° 49′	230° 49′	
R.M. and XXI (Sura Gandára)	″ h 21·67 h 20·53	″ h 21·73 h 21·16	″ h 15·03 h 14·70	″ h 20·33 h 20·77	″ l 17·76 l 15·03 l 16·56	″ l 22·37 l 22·57	″ h 13·03 h 14·06	″ h 12·90 h 13·47	″ h 16·30 h 16·50	″ l 12·07 l 9·96 h 10·70	″ h 20·37 h 19·73	″ h 19·70 h 19·03	$M = 17''\cdot 53$ $w = 0\cdot 84$ $\frac{1}{w} = 1\cdot 19$ $C = 16^\circ\ 26'\ 17\cdot'' 53$
	21·10	21·45	14·86	20·55	16·45	22·47	13·55	13·18	16·40	10·91	20·05	19·37	

NOTE.—R. M. denotes Referring Mark.

July, 1890.

W. H. COLE,
In charge of Computing Office.

PRINCIPAL TRIANGULATION—CUTCH COAST SERIES.

Fig. No. 30

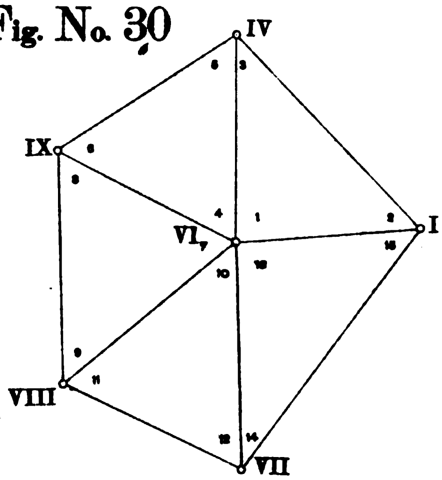
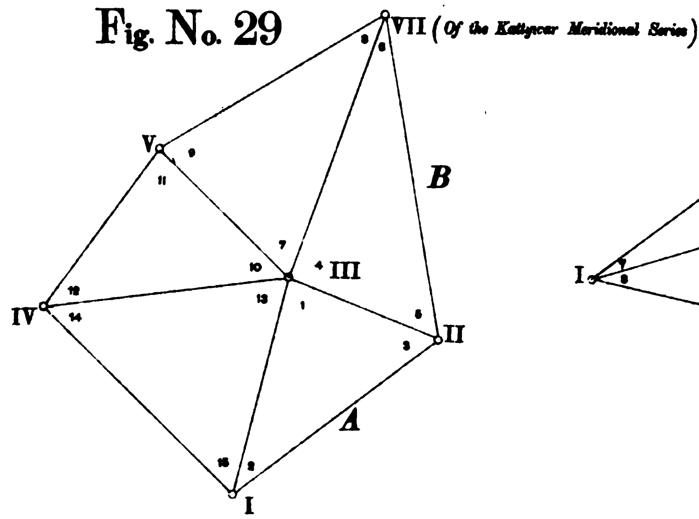


Fig. No. 29



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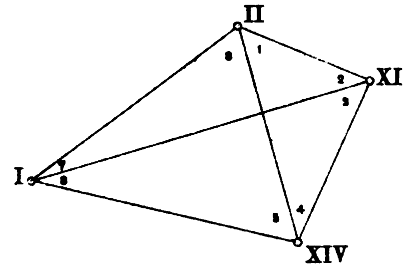

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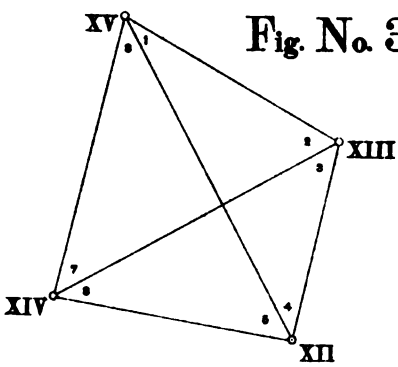

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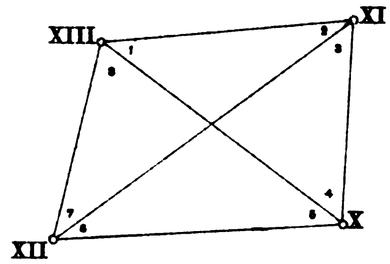

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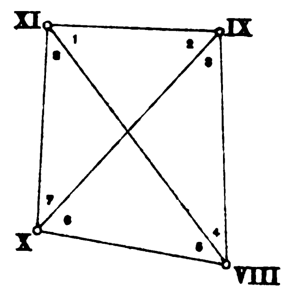

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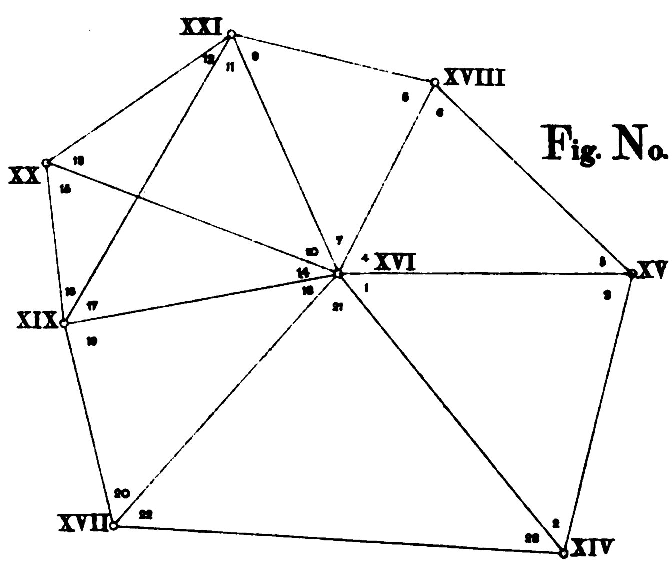

Scale 1 Inch = 12 Miles or $\frac{1}{760320}$

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PRINCIPAL TRIANGULATION—CUTCH COAST SERIES.

Fig. No. 37

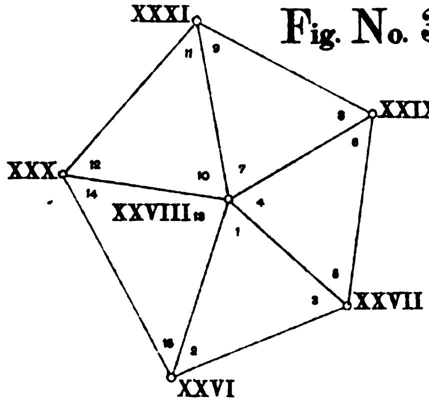


Fig. No. 36

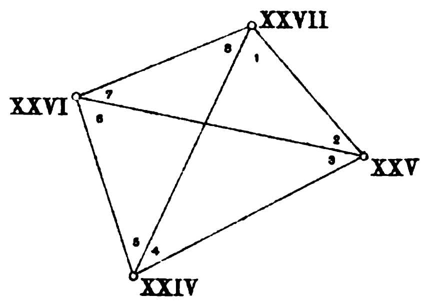


Fig. No. 35

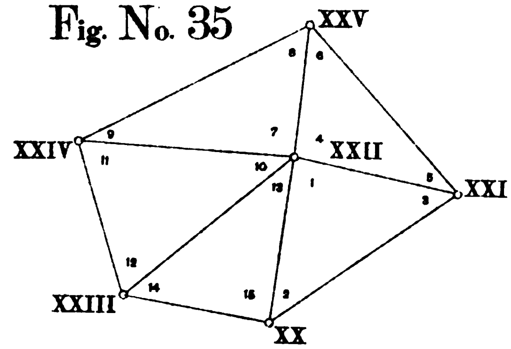


Fig. No. 39

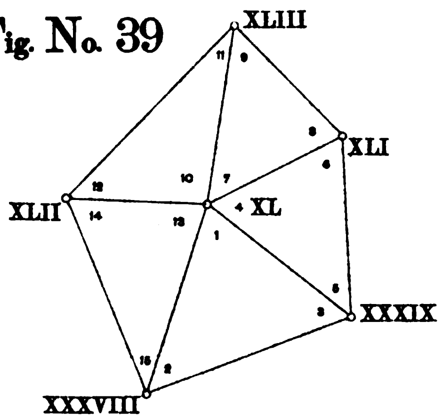


Fig. No. 38

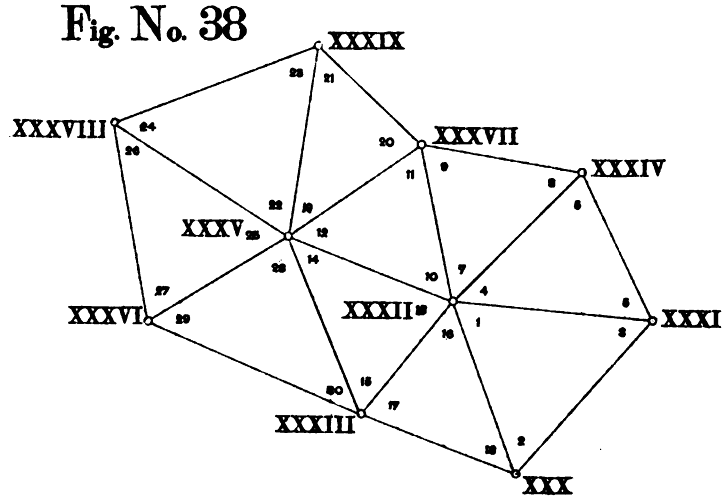
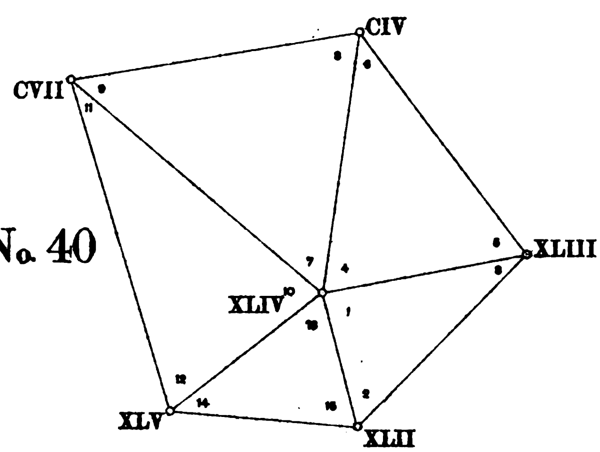


Fig. No. 40



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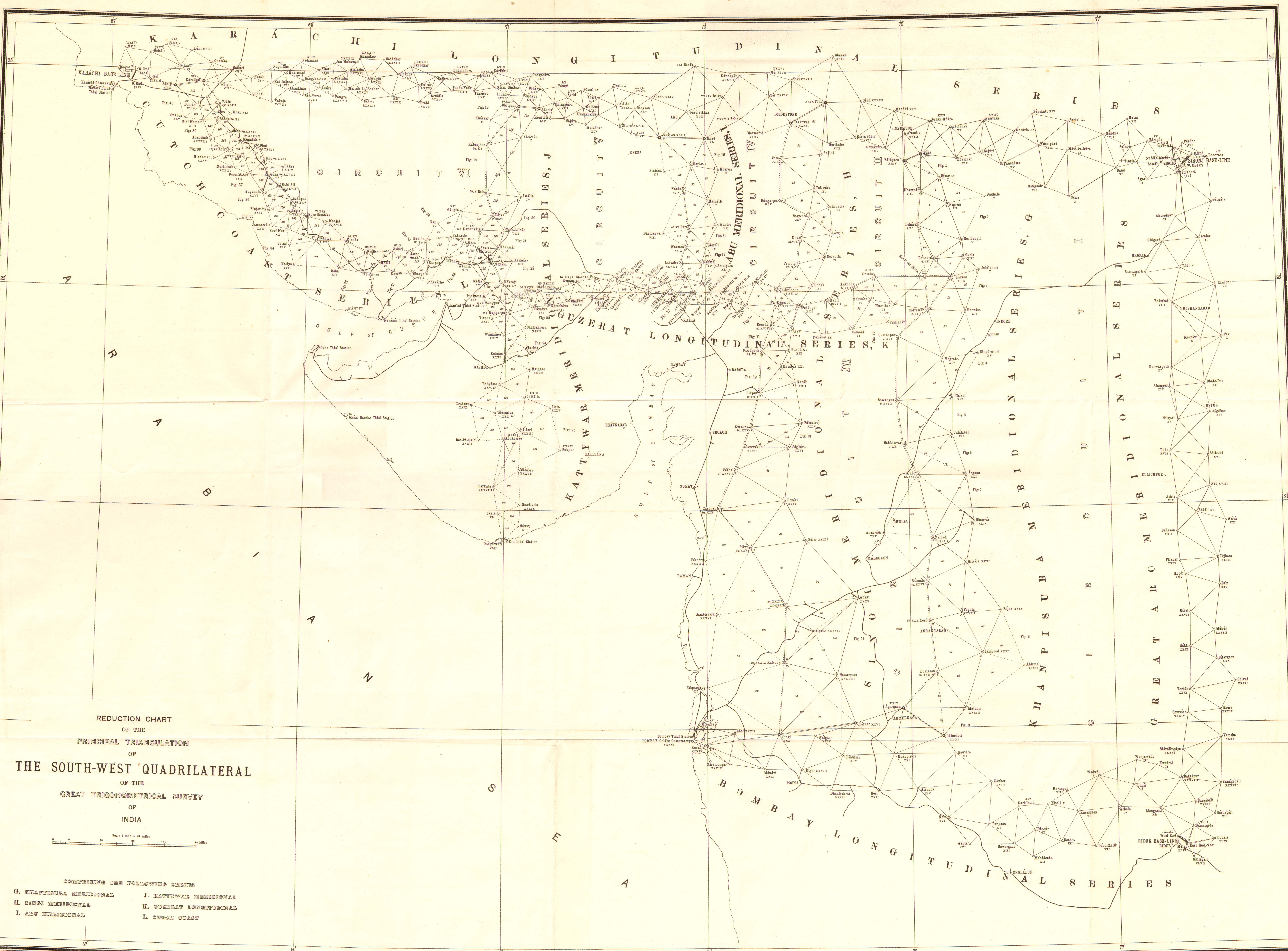

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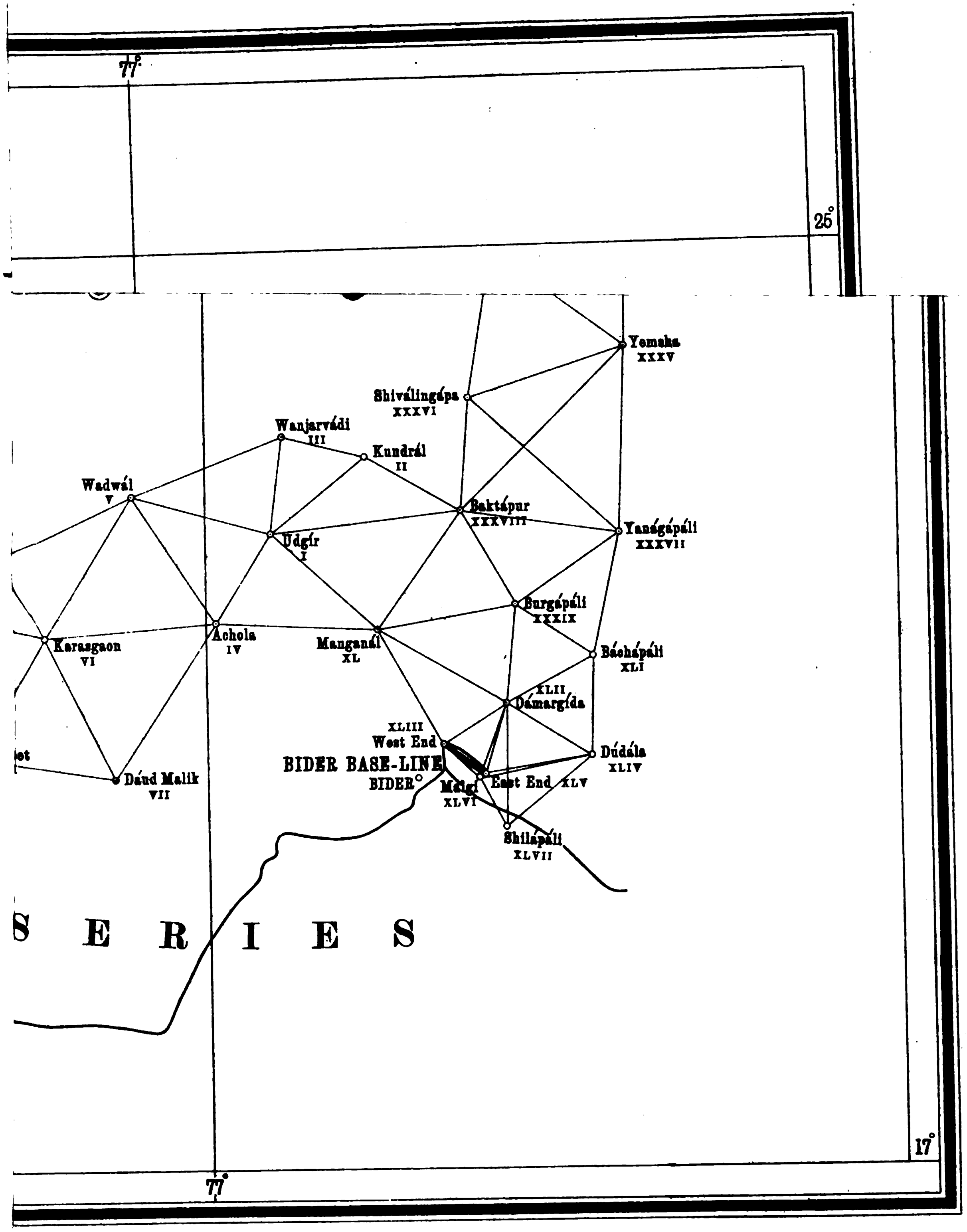
77°
25°
Yemaka
XXXV
Shiválingápa
XXXVI
Wanjarvádi
III
Kundrál
II
Wadwál
V
Baktápur
XXXVIII
Yanágapáli
XXXVII
Udgír
I
Burgápáli
XXXIX
Karasgaon
VI
Achola
IV
Manganál
XL
Báchápáli
XLI
XLII
Dámargída
XLIII
West End
BIDER BASE-LINE
BIDER
Dúdála
XLIV
East End
XLV
XLVI
Dáud Malik
VII
Shilápáli
XLVII
S E R I E S
17°
77°

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