

GENERAL REPORT
 ON THE
~~GREAT TRIGONOMETRICAL SURVEY~~
~~OF~~
~~India~~
 AND THE
 TOPOGRAPHICAL SURVEYS
 IN THE
 BENGAL PRESIDENCY,
 FOR
 1864-65.

No. 640,—dated Masoori, 19th July, 1866.

In his No. 166, dated 6th April 1865, Lieut.-Colonel Thuillier, R.A., the Surveyor General of India and Superintendent of Topographical and Revenue Surveys in Bengal, reported on the operations of the Surveys under his controul, during the year 1863-64. On the 25th of the same month he proceeded to Europe, having been granted twenty months leave of absence on Medical Certificate. I was appointed to officiate for him as Surveyor General of India, and Superintendent of Topographical Surveys in the Bengal Presidency, in addition to my duties as Superintendent of the Great Trigonometrical Survey of India. The Revenue Surveys in the Bengal Presidency were placed under a separate Superintendent, Lieut.-Colonel Robinson, R.E., who was also directed to officiate as Deputy Surveyor General. On the 24th of July, Lieut.-Colonel Robinson was appointed to officiate as Director General of the Telegraph Department, and was succeeded in the Survey Department, by Lieut.-Colonel Gastrell, s.c., Boundary Commissioner in Bengal.

Lieut.-Colonel Gastrell has already narrated the operations of the Revenue Surveys in the Bengal Presidency, during the year which is now under review, in two Reports, which the first, dated 29th January, 1866, embraces the operations in the Lower Provinces, and the second, dated 5th May, 1866, those in the Upper Provinces. In this last report, which has just reached me, I find that Lieut.-Colonel Gastrell has described the operations of the Surveyor General's Office, in its Drawing, Lithographic, and Photographic branches. I have therefore to report only on the operations of the Great Trigonometrical Survey of India, and the Topographical Surveys in the Bengal Presidency. But as a report from the Surveyor General can scarcely be considered to be complete without any mention of the work executed in his Office, a reprint of the information on this subject, which is contained in Lieut.-Colonel Gastrell's report on the Revenue Surveys in the Upper Provinces, will be appended to this report.

J. T. WALKER, *Lieut.-Colonel R.E.,*
Superintendent G. T. Survey,
and Offg. Surveyor General of India.

TOPOGRAPHICAL SURVEYS

IN THE

BENGAL PRESIDENCY.

(1.) The Regular Survey Parties were seven in number, and were employed as follows:—

The Regular Surveys.

No. I. In Gwalior, Central India, and Rajpootana, conjointly with No. VII party.

No. II. In the assigned districts of Berar, and the adjoining Talooks, appertaining to the Central Provinces, on the Godavery River.

No. III. In Ganjam and Orissa.

No. IV. In Chota Nagpore.

No. V. In Rewah, and Bundelkund.

No. VI. In the Kossia and Garrow Hills. This party supplied an Officer to make a Military Reconnoissance of Bhootan and a portion of the Dooars.

No. VII. In Gwalior, Central India, and Rajpootana, conjointly with No. I party.

(2.) Survey operations were also carried on in the province of Pegu, but these did not form a part of the regular operations of this Department, the Survey party having originally been raised under the orders of the local authorities, by whom it was supervised for several years, until placed under the orders of the Surveyor General, in order to be brought to a speedy and satisfactory termination.

Other operations unconnected with the Regular Surveys.

(3.) The Regular Topographical Survey Parties have accomplished areas of final Survey aggregating 20,579 square miles, on the scale of 1 inch to the mile, together with an aggregate area of 23,104 square miles of triangulation as a basis for future Topography, also six large scale maps of cities, and cantonments; at a total cost of Rs. 2,90,065 for all charges, permanent and contingent, and inclusive of the Military Pay of all Military Officers employed in the Department. The numerical details of the Topography and Triangulation are exhibited in the following statement, which shows the out-turn of work, and cost of each Survey Party:—

Designation of Survey.	PROGRESS.		Total Expenditure for the year 1864-65.			REMARKS.
	Triangulation.	Topogl. details completed.				
No. I and VII Parties ...	7,300	5,505	74,599	0	0	Cost per square mile of final work Re. 14-2.
No. II Party ...	1,923	3,865	40,920	0	0	
No. III Do. ...	4,500	4,556	51,555	0	0	
No. IV do. ...	4,000	3,288	44,229	0	0	
No. V do. ...	3,761	2,761	47,598	0	0	
No. VI do. ...	1,550	604	31,164	0	0	
Total ...	23,104	20,579	2,90,065	0	0	

(4.) Referring to Lieut.-Colonel Thuillier's Report for 1863-64, it will be seen that the out-turn of final Survey in that year was 14,485 square miles, executed at a total cost of Rs. 2,57,999, or an average cost of Rs. 17-13 per square mile. In the year under review, the out-turn of final Survey has been 20,579 square miles, at a total cost of Rs. 2,90,065, giving an average of Rs. 14-2 per square mile, inclusive of the cost of the large scale Surveys of cities, which entail considerable labor, and divert the Assistants employed thereon from the ordinary Topographical operations.

(5.) The advance in the annual out-turn of work for the past five years, has been steadily progressive, as is exhibited in the tabular statement in the margin. I am however of opinion that a further advance in this direction is not to be expected, and is certainly not to be desired. Already there is a tendency to aim at accomplishing an excessive out-turn of work, rather than an adequate amount of work of the very best description. The publication of the Annual Reports of this Department, which is a measure of comparatively recent date, has been beneficial in giving the members of this Department a greater insight into the general progress and style of

Annual out-turn of work.

	Triangulation square miles.	Final Survey square miles.
1860-61 ...	14,569	8,204
1861-62 ...	14,569	8,204
1862-63 ...	20,048	12,965
1863-64 ...	18,974	14,485
1864-65 ...	23,104	20,379

the work that is executed by the whole of the Survey Parties, than they formerly possessed, when each man knew little or nothing of the work executed out of his own Party. It has aroused a praiseworthy spirit of emulation, and excited every Surveyor to work with rapidity, and at the lowest possible cost to the State. But this has already reached, and probably has passed, the point at which such emulation is really conducive to the interests of the Public Service. For, while the maximum possible amount of work is required, the quality thereof is also required to be of the best description, or it may mislead, and become detrimental; the out-turn of work should not therefore, on any account, be permitted to exceed the amount that can be accomplished with an appropriate degree of fidelity.

(6.) Statistical Tables which exhibit the numerical returns of the work executed by the several Survey Parties, are very liable to mislead, if they are employed in contrasting and comparing the work of one party with another. The physical, and climatic difficulties, which have to be overcome in different portions of the Bengal Presidency, are exceedingly dissimilar. The ground presents every gradation of variety, from the smooth surface of plains, stretching for scores of miles with scarce an undulation, to the rugged features of the loftiest mountain ranges in the world. There are tracts of country which, though very rough and intricate, are everywhere open to view, and are consequently surveyable; while other tracts, though comparatively level, are clad with forests, which hide every feature from the eye of the Surveyor. There are districts which are so healthy that they may always be traversed with impunity, and others so deadly that they can only be entered during brief intervals. Statistical returns may indicate that one party has done apparently very much more work than another; but they are mute on the important questions as to which of the two has had the greatest difficulties to surmount, and which has worked with the greatest fidelity. All that can be said of such returns is that they are better than no returns at all, and that they may give a spur to waning energy, though for this latter purpose they have not hitherto been wanted.

(7.) In analyzing the quality of the work executed, it is necessary to consider first the Triangulation, and secondly the Topography. The former consists of a net work of triangles, emanating from, and closing on, the nearest sides of the triangles of the Great Trigonometrical Survey; it is usually divided into four classes, of different orders of accuracy. The triangles of the first class are fewest in number, but of most importance, as on them depends the accuracy of all other triangles, over the areas which intervene between the Series of the G. T. Survey; they are therefore executed with the largest sized Vernier Theodolites that are usually constructed by English Mathematical Instrument makers; the three angles of each triangle being measured in every instance. These are surrounded by triangles of the 2nd, 3rd, and 4th classes, which are so arranged as to furnish a suitable number of carefully fixed points, as the basis of the Survey of the Topographical details. The quality of the work is capable of being easily tested, in a variety of ways; by the amount by which the sum of the observed values of the three angles of a triangle exceeds, or is in defect of, $180^\circ +$ the spherical excess; by the difference between the calculated values of sides which are common to two or more triangles; and finally by the differences between the values of the elements (Latitude and Longitude) of the verificatory stations of the G. T. S., and the corresponding values of these elements, as obtained by a process of calculation with the *data* of the Topo-triangulation only. The following statement shows the triangular errors, and the linear differences between the common sides.

Designation of Party.	AVERAGE ERRORS OF TOPOGRAPHICAL TRIANGULATION.								REMARKS.
	TRIANGULAR ERRORS IN SECONDS.				Discrepancies between common sides, in inches per mile.				
	1st Class Triangles.		2nd Class Triangles.						
	Number.	Errors.	Number.	Errors.	1st Class.	2nd Class.	3rd Class.	4th Class.	
No. I Party } No. VII Do. }	29	2.29	160	4.9	0.48	1.20	2.20	11.40	
No. II do. ...	...	5.30	22	7.9	...	4.00	4.00	...	
No. III do. ...	8	3.44	290	16.0	0.24	12.00	12.00	...	* Exclusive of one Principal triangle which will be reobserved.
No. IV do. ...	7	2.25	50	...	...	2.04	2.64	12.96	
No. V do. ...	12	5.89	172	8.9	0.71	4.25	6.65	...	† By two sides only.
No. VI do. ...	7	2.06	5	13.4	...	6.48	...	8.85	
Averages, ...	...	3.59	...	10.2	0.48	5.00	5.50	11.07	

(8.) But to analyze the accuracy of the Topography, to ascertain its precise degree of fidelity, and whether it has given all the details of the configuration of the ground, and the objects on its surface, which the scale admits of portraying, is an exceedingly difficult matter. The details are laid down by the method of plane tabling, and for the most part without any assistance whatever from measuring chains. The

work is divided into a number of sections, each of which is 15 minutes in latitude, by 15 minutes in longitude, or 17·2 miles by 15·7, covering an area of about 270 square miles, on the parallel of 25° of latitude. These sections are termed 'plane tables,' and one or more are allotted, each season, to the respective Surveyors, who are then required to fill in the Topographical details, around the Trigonometrical points which have already been projected on their tables. The Surveyor proceeds, in the first instance, to the Trigonometrical Stations, at each of which he draws on his table a series of rays to the neighbouring visible objects, whose positions are determined with great accuracy by the intersection of the rays which are drawn at the different stations. The positions thus determined are then visited, and a similar process is gone through; by successive repetitions of this process, every detail can be laid down with such accuracy that its position shall not be more than $\frac{1}{50}$ of an inch in error on the table, which is equivalent to an error of 100 feet on the ground. Work of this style may be considered perfect, for all the practical purposes which a map, on the scale of one mile to the inch, can be legitimately expected to satisfy. But, to execute work of this style, the ground must be open to view, and not hid by forests and jungle, as is very frequently the case; it is often impossible to see the same point from two places, until the intermediate obstacles are cleared away in the first instance; this has frequently to be done in the course of the triangulation, which could not otherwise be carried on; but it cannot be done for the Topographical details, for it would be too laborious and expensive, and would cause much havoc and injury. In tracts of forest and jungle the Surveyor has to search about for points from which he can see at least three of the surrounding Trigonometrical stations; he then interpolates his position on his plane table, and draws rays to the surrounding objects; some of these objects will be seen from other stations similarly interpolated, and they will thus be accurately fixed by the intersections of the rays; but a considerable number may never be seen again by the Surveyor, and these are usually laid down by their estimated distances, from the stations at which they were seen, measuring chains or other instruments for rigorously determining these distances having hitherto been very rarely employed.

(9.) It is thus evident that the accuracy of the Topography will depend, to some extent, on the physical difficulties to be surmounted, and to a great extent on the skill and integrity of the Surveyor. *Cæteris paribus*, the work

Analysis of the accuracy of the Topography.

will be the more accurate, the oftener the plane table is set up, or, in other words, it will be most true when most pains are bestowed on its performance. But, unlike the triangulation, which affords its own tests of its own accuracy, it furnishes no internal checks whatever, and can only be verified by an independent re-survey. The belts of ground which fall under the marginal lines of the plane tables, and the boundary lines between contiguous Surveys, are necessarily delineated twice over, and here there are suitable checks over the respective operations; the areas thus checked are, however, but narrow strips, bearing a very small proportion to the total area surveyed; the only check over the internal details, has usually been such examinations in the field as the Executive Officer could find time to undertake, in addition to the execution of the triangulation, which has hitherto been considered an essential portion of his duties, and which usually removes him to a considerable distance in advance of the detail Surveyors. The comparisons between the successive independent surveys of the marginal lines are highly satisfactory, in the majority of instances, but in a few cases, they have brought to light very glaring discrepancies, which have necessitated the punishment of the offending Surveyors, either by fine, or by expulsion from the Department. When such discrepancies

occur on belts of ground which are known either to have been already surveyed, or to be about to be re-surveyed, and which are likely to be delineated with the greatest care, as the work is certain to be severely tested, it is very evident that some further check, over the accuracy of the interior details, is required, than the chance of their examination in the field, by Executive Officers who often have so great an amount of work of other descriptions to get through, that they have much difficulty in finding time to undertake these examinations of the Topographical details.

(10.) This subject has been long, and anxiously considered, by Lieut.-Colonel Thuillier, the Surveyor General, whose efforts to improve the general efficiency of this branch of the Survey Department, and the accuracy of the maps sent into his Office, cannot be too highly appreciated, and have been attended with the most satisfactory results. In the Revenue Surveys, he has long since introduced the system of running check lines over portions of the field work, the advantages of which have been very apparent; similar checks are now being introduced into the Topographical operations, and Executive Officers have been directed to undertake a smaller amount of the triangulation in future, in order that they may have more time to devote to the very important duty of supervising the Topographical details.

(11.) The relative merits of the Topography and the Triangulation may now be compared. It is evident that the accuracy of the former is limited by the smallest amount that can be plotted on a map drawn on the scale of one inch to the mile; this amount may be assumed to be the one hundredth part of an inch, representing a distance of 53 feet on the ground. But, on referring to the table at the foot of para. 7, it will be noticed that the errors of the triangulation are so small, that they have to be expressed in inches; they vary, on an average, from half an inch per mile, for the 1st class triangles, to twelve inches per mile, for those of the 4th class, or lowest order of accuracy. Now the longest line that can be drawn on a plane table is about 25 inches, representing 25 miles; it is evident therefore that the maximum error, due even to triangulation of the lowest order, in assigning the distance between the most widely separated trigonometrical stations, which fall on the same plane table, is practically an insensible quantity, being less than twenty-five feet on the ground, or the two hundred and twelfth part of an inch on the map. The several classes of triangles are thus shown to be measured with a degree of accuracy which greatly exceeds what is needed, and which would be injudicious, if it materially lengthened the time that has to be expended in the execution of the triangulation. Practically however it is found, that so much time has to be spent in moving from one station to another, that it is rarely possible for a Surveyor to visit more than one station daily; consequently the expenditure of a few more hours in measuring the angles with the highest degree of accuracy with a first-class instrument, than in measuring them with the lowest degree of accuracy with an inferior instrument, does not retard the general progress of the operations, when it does not induce the triangulator to remain for more than one day at each station. That it has done so in some instances, and that there is a tendency to take too much pains with the triangulation, and too little with the practically far more valuable topography, is I fear not to be denied.* This tendency is being watched

* Thus, an Executive Officer has recently expressed his dismay at finding that the mark-stone of a station at one end of a 35 mile-side of a G. T. S. triangle, had been removed, and has reported that as the point over which he had set up his instrument might be as much as two inches from the true centre of the station, he wished to re-visit the station, to search for a mark which he subsequently learnt had been engraved on the rock, underneath the removed mark-stone. Fastidiousness cannot be commended which troubles itself with an error of 2 inches in 35 miles, which is less than the millionth part of the distance involved, less than can be measured with certainty by the best instruments constructed for the most accurate Geodetical operations, and very much less than can be measured by the best instruments that are used in the Topographical operations.

and will be guarded against in future; for it is very evident that triangulation of which the average errors do not exceed those of the 4th class or lowest order of triangles, is amply sufficient as a basis for Topographical operations, on the scale adopted in these Surveys; and though the efforts of the Surveyors to execute this portion of their work, in the very best style, are highly commendable, when they do not retard the general progress of the operations, they cannot be commended when they absorb time which may be employed to better advantage.

(12.) I now proceed to report on the general operations of the respective Survey parties. Further details, which it does not appear advisable to introduce into the body of this report, will be found in Appendix A, containing extracts from the Annual Narrative Reports of the several Executive Officers, which also furnish much interesting information regarding the several districts that are under Survey.

EXECUTIVE SURVEYS.

Nos. 1 AND 7 PARTIES.

GWALIOR, CENTRAL INDIA, AND RAJPOOTANA SURVEY.

- (13.) These Parties had been under the orders of Lieut.-Colonel Robinson, ever since their first formation, but they were transferred to the charge of Captain Melville, 1st Assistant G. T. Survey, on my departure to Europe, in 1863, when Lieut.-Colonel Robinson was appointed to officiate for me, as Superintendent of the Trigonometrical Survey of India. Lieut.-Colonel Robinson resumed charge on the 15th March, 1865, but retained it for a few weeks only, until he was appointed to officiate as Deputy Surveyor General and Superintendent of Revenue Surveys, when he was again succeeded by Captain Melville, who has

PERSONNEL.

Capt. A. B. Melville, Officiating Executive Officer in Charge.
 Lieut. G. Strahan, R.E., Senior Assistant Surveyor.
 Lieut. C. Strahan, R.E., Assistant Surveyor.
 Lieut. A. E. Downing, Assistant Surveyor No. 3 Party, doing duty temporarily with No. 1.
 Mr. H. Horst, Civil Assistant.
 " J. F. Baues, do.
 " H. J. Bolst, do. 2nd Class.
 " G. Chill, Sub-Asst. do.
 " W. Chapman, do.
 " G. McCarthy, do. 3rd Class.
 " G. K. Allnutt, do.
 " J. Hussey, do.
 " R. Todd, do.
 " C. Tapsell, do.
 " F. Kitchen, do.
 " C. Kirk, do.
 " W. Stotesbury, do.

Native Surveyors.

Jolan Pershad, Abdool Samud Khan, Golam Mahomed, Chooramun, Kalka Pershad, and Hurlal Singh.

Other Executive Officers have reported that their triangulation, during the season under review, was much retarded by cloudy weather. This was attributable to the circumstance that it was considered indispensably necessary to take observations to heliostopes, instruments which can be so adjusted, by signallers at the station under observation, as to reflect the sun's rays to the observer, and thus present a luminous object to his view. Luminous signals are often very necessary in this country, to enable operations to be carried on when the atmosphere is so laden with dust that opaque signals, at the same distances, could not be distinguished. In cloudy weather heliostopes cannot be displayed, but opaque signals, such as pillars of earth and stones, may usually be observed with ease; it is therefore to be regretted that time should be lost under the mistaken impression that observations should be taken to luminous signals only. On the English and Continental Surveys, luminous signals are the exception, and opaque the rule, even in first-class Geodetical operations, while in Topographical operations, none but opaque signals are ever employed.

thus been in charge of this double party for the greater portion of the year under review.

(14.) The ground which was finally surveyed, and of which all details, Topographical, as well as Trigonometrical, were completed, lies within the parallels of 25° 15', and 27° 15', and the meridians of 76° 30' and 78°. It embraces portions of the States of Gwalior, Jeypoor, Kerowli, and Ulwar, and covers an area of 5,505 square miles, giving an average area of 324 square miles to each detail Surveyor, as is shown in the margin. In addition, large scale surveys (500 feet to the inch) were made, of the towns of Dholpoor, Duttiah, and Kerowli, entailing an amount of work which Captain Melville considers equivalent to 600 square miles of Topographical Survey, on the scale of one mile to the inch.

No. 1 PARTY.

	Square miles.
Lieut. C. Strahan, ...	275
Lieut. Downing, ...	300
Mr. Horst, ...	765
„ Baness, ...	385
„ Bolst, ...	90
„ Chill, ...	360
„ Chapman, ...	280
„ McCarthy, ...	390
„ Allnutt, ...	125
Joahn Pershad, ...	270
Abdool Samad Khan, ...	60

No. 7 PARTY.

Mr. Todd, ...	345
„ Tapsell, ...	495
„ Kitchen, ...	535
„ Kirk, ...	210
„ Stotesbury, ...	390
Kalka Pershad, ...	230
Total, ...	5505

(15.) The ground which was triangulated in advance, as a basis for future topography, lies within the parallels of 25° 15', and 28° 15', and the meridians of 75° 30' and 77°. It includes portions of the States of Ulwar, Jeypoor, Gwalior, Kotah and Jhalawar, and covers an area of 7,300 square miles (of which

5,860 were done by Lieutenant G. Strahan, R.E.), affording 619 trigonometrical points, determined by observations taken at 122 stations.

(16.) The Maharajah of Jeypoor was found to be very favorably-disposed towards the Survey operations. He was particularly anxious to obtain a large scale Survey of the city of Jeypoor, with a view to the introduction of Gas, and Tramways on which he proposes to employ Traction Engines. Due arrangements have, as a matter of course, been made to comply with a request which will enable us to obtain an accurate Survey of a city of such importance. The Thakoors of the Jeypoor district are imperfectly controlled by the Maharajah's Government, and are not so well-disposed towards the Survey. They look upon the operations with great suspicion, and our Surveyors found it very difficult to keep on a friendly footing with them; much annoyance and delay were occasionally caused by the destruction of the Survey poles, and other marks, which were removed as soon as the Surveyors quitted the district. On the other hand, it is satisfactory to be able to add that in the States of Gwalior and Kotah, every civility was met with, and whatever assistance was required was cheerfully rendered.

(17.) In the course of the following recess, six general maps were finished, on the scale of 1 mile to the inch. The greater portion of a degree sheet, on the scale of 4 miles to the inch, was compiled, but sufficient materials were not available for the completion of the sheet. Maps of the towns of Kerowli, Dholpoor and Duttiah, were also completed, on the scale of 500 feet to the inch. Also a Skeleton Chart of the operations. The amount of the computations is specified in the margin.

Recess operations.

Triangles, ...	1084
Latitudes Longitudes, and Azimuths, ...	178
Heights, ...	150

(18.) No. 7 Party having now been raised to the necessary strength to enable it to work independently, will be separated from No. 1 Party, the line of demarcation between their respective fields of operations being the meridian of 76°, the Native States

Future operations.

to the east of that meridian being allotted to No. 1 Party, and those to the west to No. 7. The operations during the field season of 1865-66 will embrace the southern portions of Jeypore and Gwalior, including the regions of dense forest on the banks of the Koonoo river, by No. 1 Party; and the country around the city of Jeypoor, as well as the city itself, by No. 7 Party.

No. 2 PARTY.

HYDERABAD SURVEY.

19. During the year under review, the operations of this party completed the Survey of the whole of what is known as the Sironcha Talook, one of the six Sub-divisions of the Upper Godavery

Final Survey. District, the entire area of which is about 574 square miles, mostly overrun with heavy forest, and tangled underwood, and very unhealthy to strangers. The Ramgeer Circar, on the west bank of the Godavery, opposite Sironcha, was also completed, in the course of which operation an area of 2,339 square miles was finally surveyed. In consequence of the great inaccuracies of portions of the old Hyderabad Surveys, the following pergunnahs, on the Pem Gunga river, adjoining Mahore, were

PERSONNEL.

James Mulheran, Esq., Executive Surveyor in charge.
 Mr. A. Chamarett, Senior Sub-Assistant.
 " J. B. Smith, do. do.
 " R. D. Farrell, 2nd Class Sub-Assistant.
 " M. J. Ogle, 3rd Class Sub-Assistant.
 " C. A. R. Scanlan, do. do.
 " A. Chennell, do. do.
 " B. Maine, do. do.

Native Surveyors.

Ram Chunder, Pandarao, Baparao, Janardanrao, and Sheik Oomer.

re-surveyed, viz.: Omerkeir, Pusad (portion of), Mahore (portion of), Hadgao, Shevala, Manata, Tamsa, and Warona; the total area thus re-surveyed amounts to 952 square miles. A comparison of the new and the old Surveys fully establishes the necessity for re-survey; large errors have been detected; the course of the river Pem Gunga, being occasionally upwards of a mile in error, villages considerably misplaced, hills and

streams depicted which have no existence, and others omitted which should have

been shown. In fact the original Survey appears to have merely been intended as a rude reconnoissance, probably in the absence of the requisite means for undertaking a rigorous Survey. The total area of final Survey thus amounts to 3,865 square miles, giving an average of 351 square miles to each detail Surveyor, as is shown in the margin.

	Square miles.	
Mr. Chamarett, ...	421	
" Smith, ...	540	
" Farrell, ...	436	
" Ogle, ...	330	
" Scanlan, ...	412	
" Chennell, ...	357	
" Maine, ...	60	
Ramchander, ...	289	
Pandarao, ...	350	
Baparao, ...	517	
Janardanrao, ...	153	
Total, ...	3,865	

(20.) An area of 1,993 square miles was triangulated in advance in the four southern pergunnahs of the

Triangulation in advance.

Upper Godavery district, as a basis for their Topographical delineation in the course of the following field season. That this is a smaller out-turn of triangulation than was accomplished in other parties, during the season under review, is due to the circumstance that the operations of this party, in the Hyderabad districts, are now nearly concluded, and there is no more ground to be triangulated. 83 points were fixed during the course of the season's triangulation, by observations which were taken at 25 stations.

(21.) The Topography of the following pergunnahs, Nugur, Albaka, Cherla, Badrachelan, and Rekapali, of the Upper Godavery district, will be completed at the urgent request of the local authorities; boundary Surveys will be made of the districts of Omraotee, Akola, Mekhur, and Woon of the Province of Berar.

Future operations.

No. 3 PARTY.

GANJAM AND ORISSA SURVEY.

(22.) In consideration of Lieut.-Colonel Saxton's long, arduous and valuable

PERSONNEL.

Lieut.-Colonel G. H. Saxton, Executive Officer in Charge.
 Lieut. A. E. Downing, Assistant Surveyor under training with No. 1.
 Mr. D. Atkinson, 2nd Civil Assistant.
 " R. W. Chew, Senior Sub-Assistant.
 " J. Harper, 1st Class Sub-Assistant.
 " F. Adams, 2nd Class do.
 " J. May, do. do.
 " R. P. Rayner, 3rd Class do.
 " T. E. M. Claudius, do. do.
 " T. Leonard, Apothecary.

Native Surveyors.

Abdool Rahman, P. Nilacuntum, Hediatoollah, Mahomed Kabil,
 and Mahomed Ameen.

services, in regions of a uniformly malarious and deadly nature, during the course of which a majority of the Military and Unconvenanted Officers who were associated with him have perished, the Government of India was pleased to raise his staff salary from Rs. 618 to Rs. 800, on the occurrence of the vacancy caused by the appointment of Lieut.-

Colonel Robinson to be Director of the Telegraph Department.

(23.) The country which was finally surveyed, and of which all details are

Final Survey.

now completed, lies within the parallels of 20° 25' and 22° 20', and the meridians of 81° 50' and 83°, embracing portions of the Chutisgarh and Bustar Divisions of the Central Provinces, and of Jaipur in Vizagapatam. It covers an area of 4,556 square miles, giving an average out-

Square miles.

Mr. D. Atkinson, ...	589
" R. Chew, ...	669
" J. Harper, ...	580
" F. Adams, ...	398
" J. A. May, ...	553
" R. P. Rayner, ...	318
" T. E. Claudius, ...	108
Abdool Rahman, ...	462
Hediatoollah, ...	464
Nilacuntum, ...	200
Mahomed Ameen, ...	215
Total, ...	4556

turn of 414 square miles, by each detail Surveyor, as is shown in the margin. Lieut.-Colonel Saxton reports that the amount of work exceeds what had ever been accomplished by his Party in preceding years, and that this is due, partly to an improvement in the efficiency of his subordinates, and partly to the less difficult, and comparatively more healthy, nature of a considerable portion of the tracts under survey.

(24.) The ground which was triangulated in advance, as a basis for the

Triangulation in advance.

topographical operations of future seasons, lies between the parallels of 18° 45' and 20° 30', and the meridians of 80° 15' and 83°. It covers an area of 4,500 square miles, mostly in the districts of Bustar and Jeypore, fixing 143 points by observations which were taken at 57 stations. This, in addition to the work of former seasons, gives a total area of about 8,000 square miles, ready for future topography.

(25.) The recess operations comprised the completion of 10 sheets of

Recess operations.

general maps on the scale of one inch to the mile, and tracings of the same for the use of the local authorities; also one general map on the scale of a quarter of an inch to the mile. No details have been submitted as to the amount of the computations, but they are reported to have been completed up to date, as far as is required for the topographical operations of the field season 1865-66.

(26.) The future operations will comprise the topography of Bustar and

Future operations.

Jeypore, and their respective dependencies, and the extension of the triangulation to the south-east, for verification by junction with the Madras Coast Series of the G. T. Survey, a measure the more necessary that these operations have been carried over an unusual extent of country without external check of any nature.

No. 4 PARTY.

CHOTA NAGPORE DIVISION SURVEY.

(27.) The extent of ground finally surveyed is comprised between the meridians of 84° 30' and 85° 30', and the parallels of 22° 30' and 23° 30', and appertains to the Chota Nagpore and the Singhbhum districts. It is bounded to the north by the Hazaribagh district, which is

Final Survey

PERSONNEL.

- Captain G. C. Depree, Executive Officer in charge.
- Mr. F. B. Girdleston, Assistant Surveyor.
- „ G. A. McGill, 2nd Civil Assistant.
- „ J. Vanderputt, Senior Sub-Assistant.
- „ A. J. Wilson, 1st class Sub-Assistant.
- „ T. W. Bobanau, 2nd class do.
- „ A. G. Wyatt, 3rd class do.
- „ A. J. James, do. do.
- „ J. A. Craven, do. do.
- „ J. Hamilton, Apothecary.

Native Surveyors.

- Baboo M. S. Dutt.
- Mr. J. H. Wilson.
- „ C. D'Cruz.
- R. C. Chuckerberty, Probationary Native Surveyor.

party, working in concert. The total area of detail Survey by the Chota Nagpore

Mr. McGill,	548
„ Vanderputt,	548
„ Wilson, Senior,	548
„ Bobanau,	60
„ Wyatt,	548
„ James,	514
„ Wilson, Junior,	60
„ Dutt,	548
„ D'Cruz,	214
	3288
Wilson, Junior, Area rejected,	293

at present under delineation by a Revenue Survey Party. The belt of ground in the vicinity of the boundary between the respective parties has been delineated by both, and I regret to state that considerable discrepancies between the respective operations have been brought to light. These will necessitate a re-survey of the tracts where discrepancies occur, which will have to be executed during the course of the field season of 1866-67, by a Surveyor from each Party amounts to 3,288 square miles, giving an average of 365 square miles to each Surveyor, as is shown in the margin, and is exclusive of an area of 293 square miles, executed by one of the Junior Members of the Party, which has been rejected. Very great credit is due to Captain Depree for the rigorous examination to which he has subjected the topographical details.

(28.) The triangulation which has been executed in advance, as a basis for future topography, lies to the west of the meridian of 84° 30', in the districts of Chota Nagpore, Odeypur, Juspur, and Sirgooja; it covers an area of about 4,000 square miles, fixing 224 points, by observations which were taken at 52 stations.

Triangulation in advance.

(29.) In the course of the subsequent recess, 7 sheets of the general maps, on the scale of one mile to the inch, were completed; also 4 sheets of Geographical maps, and a chart of the triangulation, on the scale of 4 miles to the inch. The number of the computations of various

Recess operations.

Triangles,	424
Latitudes, Longitudes and Azimuths,	224
Heights,	152

kinds is indicated in the margin. During the recess, Captain Depree obtained privilege leave of absence for three months,

one of which he obligingly gave up, and, proceeding to my Head Quarters, he did good service by compiling, under my superintendence, an Index to the standing orders and professional instructions in force in this Department, similar to the Index which had been prepared, under the orders of Lieut.-Colonel Thuillier, for the Revenue Surveys. The want of such an Index had long been felt; it is now, I am glad to say, complete, and has been printed and circulated among the several Executive Officers.

(30.) The future operations will be carried over the Western portions of Chota Nagpore, which are still unsurveyed, and will be continued into the Juspur, Odeypur, Sirgoojah, and Korea Districts, until it forms a junction with the Surveys which are being carried on in the Central Provinces.

Further operations.

No. 5 PARTY.

REWAH AND BUNDELKUND SURVEY.

(31.) The ground finally surveyed, and of which all the details are now completed, is comprised within the parallels of 24° 15' and 24° 50', and the meridian of 81° 0' to 82° 50', and lies wholly within the territories of the Maharajah of Rewah. It is bounded on the north by the districts of Allahabad and Mirzapore.

Final work.

PERSONNEL.

- Lieut. W. G. Murray, Executive Officer in charge.
- Mr. R. A. Bell, Senior Civil Assistant.
- „ C. H. Neale, do.
- „ D. Antrobus, 2nd Class Sub-Assistant.
- „ E. S. P. Atkinson, 2nd Class do.
- „ C. F. Hamer, 3rd Class Sub-Assistant.
- „ J. B. Landeman, do.
- „ A. D. Howard, do.
- „ C. T. Evans, do.

Native Surveyors.

Nubbee Bux, Prem Raj, Abdoor Ruheem, Ali Ahmed.

Very great difficulty has been experienced in surveying the boundary between these districts and the Rewah territories, because it had not been properly demarcated before the Survey operations were commenced. Owing to Lieut. Murray's repeated representations on this subject, the boundary has at last been marked out, and surveyed by Settlement Officers, whose Maps will furnish the requisite information to be added to the Rewah Maps. The total area of final Survey amounts to 2,761 square miles, giving an average of 276 square miles to each detail Surveyor, as is shown in the margin, exclusive of an area of 225 square miles, which had to be rejected in consequence of the magnitude of its errors.

	Square miles.
Mr. R. A. Bell,	97.8
„ C. H. Neale,	421.5
„ D. Atkinson,	400.5
„ D. Antrobus,	135.5
„ C. Hamer,	337.0
„ A. Howard,	447.5
„ C. Evans,	89.7
Nubbee Bux,	390.5
Prem Raj,	315.6
Abdoor Ruheem,	125.5
Total,	2761.1
Mr. D. Antrobus, rejected,	225.0

(32.) The triangulation which was executed in advance, lies to the west and south of the ground above indicated as finally Surveyed. It furnishes 368 Trigonometrical points, determined by observations at 81 stations, and embraces an area of 3,761 square miles, mostly along the southern boundary of Rewah, and in the Myhere, Nagode, Adjgurh and Sohawal States of Bundelkund.

Triangulation in advance.

(33.) During the course of the following recess, 8 General Maps on the scale of one mile to the inch were completed; also two Geographical Maps, and two Charts of triangulation on the scale of four miles to the inch, and an index Map for the use of the Surveyor General's Office. The number of computations is exhibited in the margin; with the exception of a few heights, not immediately required, all computations were completed by the close of the recess. The number of positions whose heights have been determined by this party, is very commendable, being greatly in excess of the work of this nature performed by other parties. These heights will be of value in assisting in the selection of the best lines for the construction of roads, as feeders to the Railway.

Recess operations.

- 701 Triangles,
- 72 Latitudes, Longitudes, and Azimuths,
- 359 Heights,
- 7 Ray Traces on the sides of the G. T. S. triangles, giving an average error of 4.9 inches per mile.

Future operations.

(34.) The operations of next field season will consist of the Topography of portions of the Bundelkund States, already enumerated in para. 33, and of Southern Rewah. The former are very much more healthy than the latter, and can be entered at the commencement of the field season; but the Ilaquas of Marhwas, Singraoli, Bardi, and Ramnugur, in Southern Rewah, are covered with dense forests, which are very deadly during a great portion of the year, and can only be traversed with safety by Europeans in the months of January, February and March. The fortunate occurrence of healthy

tracts of country in their neighbourhood enables the Surveyors to carry on their operations without check throughout the whole field season. The triangulation will be carried over the remainder of Rewah and the Bundlekund States, lying immediately to the south of the districts of Banda.

No. 6 PARTY.

KOSSIA AND GARROW HILLS SURVEY.

(35.) Captain Godwin-Austen, having served with the Bhootan Mission, under Mr. Eden, was directed, by the Government of India in the Military Department, to accompany the Dooar Field Force, as the information he had already acquired would be of much value to the Military authorities, and he would be able to obtain additional information, to be introduced into the Maps of Bhootan and the Dooars. He was present at the captures of Dalingkote and Chamoorchi, and his services were

PERSONNEL.

Captain Godwin-Austen, Staff Corps, Executive Officer,
on special duty in Bhootan.
Lieut. R. V. Riddell, R.E., Offg. Executive Officer.
Mr. N. A. Bolletty, Senior Civil Assistant.
" H. A. Atkinson, 1st class Sub-Assistant.
" H. Craven, 2nd class do.
" J. B. Landeman, 3rd class do.
" C. Low, 3rd class do.

Native Surveyors.

Nusseeruddeen, Abdoor Rahman.

favorably mentioned in the despatches of General Dunsford. When no longer required for the Military operations, he employed himself in making a reconnoissance, on the scale of 4 miles to the inch, of the Western Dooars, and the adjoining southern slopes of the Bhootan Hills, thus delineating an area of about 2,000 square miles, extending between the Teesta River and the meridian of Buxar, as far south as the line of the British boundary, prior to the annexation of the Dooars.

(36.) Lieutenant Riddell supervised the operations of No. 6 Party, which had been recently raised for the Kossia and Garrow Survey. During the season under review, its strength was much below that of all the other parties, and several of the Surveyors had only recently joined the Department. The physical and climatic difficulties encountered were more than usually severe, and the district was so thinly populated, that much trouble was met with in obtaining the necessary supplies for the Survey Camps, and in getting coolies to act as porters, and to clear the lines. The out-turn of final Survey was therefore small, but quite as much as ought to be expected. The topography on the one-inch scale embraces an area of 600* square miles, lying to the north of Cherra Poonjee, and divided into two nearly equal portions by the meridian of that station. A detailed Survey of the new sanatorium of Shillong was executed, on the scale of 15 inches to the mile.

Final Survey.

Mr. Atkinson, ...	40
" Craven, ...	245
" Landeman, ...	180
" Low, ...	60
Nusseeruddeen, ...	75
	<hr/> 600

(37.) The ground triangulated in advance, as a basis for future Topography may be described as that portion of the Kossia Hills lying between Cherra Poonjee and the Garrow Hills, and bounded to the north by the Kamroop district, to the south by Sylhet. It covers an area of 1,550 square miles, fixing 148 Trigonometrical points, by observations which were taken at 43 Stations.

Triangulation in advance.

(38.) During the recess, one general Map, on the scale of one inch to the mile was executed, in duplicate, also a Map of Shillong Sanatorium, on the scale of 12 inches to the mile, in duplicate,

Recess operations.

with a tracing for the use of the Local authorities ; also two charts of the triangulation. The computations of all descriptions were all brought up to date ; the number and nature of these is shown in the margin.

Triangles,	258
Latitudes, Longitudes, and Azimuths, 56	
Heights,	108

(39.) The future operations will embrace the final Topography of the remaining portions of the Kossia Hills, and the extension of the triangulation into the Garrow Hills, which last will be a work of no small difficulty and delicacy, requiring great tact on the part of the Surveyors. They will have to work over tracts of country into which few Europeans have yet penetrated, and then only very partially ; which are covered with dense forests, for the most part notoriously unhealthy ; and are inhabited by a race of men, who are believed to be lawless savages.

Future operations.

THE PEGU SURVEY.

(40.) Captain Fitzroy, R.A., superintended the operations of this Survey

PERSONNEL.

- Captain F. Fitzroy, R.A., Superintending Officer.
- Captain Edgcome, Principal of College of Civil Engineering, Madras.
- Lieut. Bagge, R.E., Assistant, on special duty in the Tenasserim Provinces.
- Mr. Montgomerie.
- „ W. S. Barnett.
- „ A. Cooper.

Native Surveyors.

- Gour Chunder, Eshan Chunder, Ramloosnin, Shuay Leng, Shuay Pho, Moug Pho, Kyan Zan, Moug Keng, Moug Ooh, Moug Gyweng, Shuay Bah, Yay Gyan, Moug Tot, Moug Pho Moug, Moug Kya.

throughout the greater portion of the field season of 1864-65 ; his health having required him to proceed to Europe on Medical Certificate, and his Assistant, Lieutenant Bagge, R.E., having been deputed for special employment with the Commissioners who were appointed to lay down the boundary between the Tenasserim Provinces and those of the King of Siam, it was considered desirable that the Survey of Pegu should be placed, temporarily, under

the supervision of Captain Edgcome, of the Royal Madras Engineers, by whom it had formerly been superintended. Captain Edgcome holds the appointment of Principal of the College of Civil Engineering at Madras ; but his services were temporarily placed at the disposal of the Government of India for the duty in question ; he relieved Captain Fitzroy on the 16th March, 1865.

(41.) Under instructions from the Government of India, Captain Edgcome

Instructions to Captain Edgcome.

was directed to submit a full and complete report on the following points :—1st—The area mapped ; 2ndly—The area surveyed ; 3rd—The area remaining for Survey ; and, 4th—The probability of any portion of the area surveyed, but not yet mapped, requiring re-Survey. He was also requested to ascertain the causes which had operated to retard the conclusion of this Survey, and to report on the quality of the work executed.

(42.) The area mapped, on the Geographical scale of 4 miles to the inch,

Captain Edgcome's Report.

which had been originally fixed for this Survey, was ascertained to be 19,471 square miles, leaving 13,743 square miles to be mapped ; the area surveyed, 24,519 square miles, leaving 8,695 square miles for future Survey ; the work already completed was pronounced to be of good quality, not needing revision ; but of the work in progress, no opinion could be expressed, until the return of the Surveyors from the field.

(43.) The causes which had so greatly retarded the progress of this Survey, that it had to be placed under the orders of the Surveyor General, in order to be speedily and satisfactorily terminated, were very soon explained. When Captain Fitzroy received charge, in 1859-60, the Survey Party had already been at work for six years, in the course of which about $\frac{9}{10}$ ths of the field work had been completed, and there is every reason to believe that, within a period of two years at furthest, the remainder of the field work, and the whole of the mapping connected therewith, might have been completed, if the original system of operations had been continued. The object which had all along been kept in view, and for which the system of operations was well adapted, was the preparation of a good Geographical Map of the Province, on the scale of 4 miles to the inch. But Captain Fitzroy took upon himself to condemn and reject the greater portion of the work that had been executed by his predecessors, and to commence a re-Survey of the Province *de novo*. He accepted the traverses which had already been executed, as the basis on which the Topographical details were to be fitted, but he caused all the said details to be re-Surveyed. In preparing the new field work, for the final Map, he adopted the following processes:—1st, the details were plotted, in an unconnected form, on the scale of 4 inches to the mile, which is no less than sixteen times greater than that of the required Map; 2ndly, the sheets thus prepared were reduced to the scale of 1-inch to the mile; 3rdly, the one-inch sheets were connected together, so as to form Teik, or district Maps, on the same scale; 4th, the Teik Maps were connected together, and reduced to the $\frac{1}{4}$ -inch scale, to form the Geographical Map of the Province. Notwithstanding the immense amount of additional work thus created, Captain Fitzroy had no sooner received charge, than he recommended that his establishment of Native Surveyors, &c., should be reduced by more than one-half, and of course he received sanction to carry out a measure which promised such a saving of expense to the State. All these circumstances account very readily and clearly for the delay in the completion of the Survey of the Province.

(44.) In contrasting the work executed by Captain Fitzroy, with that of his predecessors, it is very evident that his is much the most valuable, as he took the necessary steps to execute a more detailed Survey than their's, and to furnish one-inch Teik Maps, in addition to the quarter-inch Map which had been called for by the Government, and to the early completion of which their efforts had been solely directed. It is not to be supposed that any person would deliberately condemn an existing survey, and set to work to make a new one, without taking the requisite steps to ensure its superiority to the survey it is intended to supercede. But an Executive Officer is not the proper person to decide on a measure of this nature, in which he has no small personal interest; he may, if he pleases, submit his views on the subject for the consideration of the Government, duly setting forth, on the one hand, the advantages which may be anticipated from carrying out his proposals for executing a more detailed survey than that originally ordered, and, on the other hand, the probable cost that will be incurred, and the delay that will be caused, by such a modification of the original instructions. But for an Executive Officer to set about such an expensive operation as the re-Survey of a great Province, without taking these steps, and without receiving the sanction of the Government, is highly improper, and cannot at all be excused. Captain Fitzroy was removed from his appointment, at the recommendation of the Surveyor General, when Captain Edgcome was deputed to relieve him. On the 22nd April, the latter Officer sent in his report on the Pegu Survey, which was immediately submitted to the Government; while giving Captain Fitzroy due credit for the quality of the work executed under his superintendence, it clearly establishes the fact that his re-Survey was unnecessary for carrying out the original scheme of operations.

(45.) Captain Edgcome remained in Rangoon until the return of the Surveyors, on the close of their operations of field season 1864-65, when he ascertained that, so far as could be judged from the field books, the area remaining for survey had been so nearly completed, that it would be only necessary to retain the services of 1 European and 5 or 6 Native Surveyors to finish, in the following field season, the remaining details. As Captain Edgcome's services could only be temporarily spared by the Madras Government, he was permitted to return to his appointment of Principal of the Madras Civil Engineering College, on the understanding that he would continue to supervise the operations of the Pegu Survey, more particularly as connected with the preparation of the Maps of the Province. A portion of the establishment was discharged; a portion placed under the orders of the Senior Assistant, Mr. Montgomerie, to plot the field work of the last season's operations, and to take the field next season, to complete the remaining gaps in the work; the remainder, mostly Draftsmen, accompanied Captain Edgcome on his return to Madras, and have ever since been employed, under his superintendence, in completing the Teik Maps, instituted by Captain Fitzroy, as well as the Geographical Map of the Province. All the necessary details for the construction of the Teik Maps being available, it is better that they should be accepted, and made the best use of, than that they should be rejected, because they do not form a part of the original scheme of the survey; their larger scale will make them of more general use, than the Map of the Province, to the local authorities.

J. T. WALKER, *Lieut.-Colonel R.E.,*
Offg. Surveyor General and Supdt.
of Topographical Surveys in the
Bengal Presidency.

THE OPERATIONS IN THE DRAWING, LITHOGRAPHIC AND PHOTOGRAPHIC BRANCHES OF THE SURVEYOR GENERAL'S OFFICE DURING 1864-65; EXTRACTED FROM LIEUT.-COLONEL GASTRELL'S REPORT, NO. 36A, DATED 5TH MAY, 1866, ON THE REVENUE SURVEYS IN THE UPPER PROVINCES OF THE BENGAL PRESIDENCY.

(13.) In the General as well as in the Revenue Compiling and Drawing Branches a considerable amount of final mapping has been completed. The following Statements show the progress made in both branches on compilations or general maps, and with the Special Revenue Survey District Maps. Also the number of lithographed and engraved Maps colored.

Final Mapping completed, and compilation of the results of Revenue and Topographical Surveys.

General Drawing and Compiling Branch.

MAPS.	SCALE.	REMARKS.
Bengal Dooars, with Bhootan and portion of Assam,	4 miles = 1 in.	Completed and lithographed for the use of the Military and Civil Authorities in Bengal Dooars.
General Compilation Map of the Chota Nagpore Division,	Do. ...	Inserting field work of season 1863-64 in progress.
Ditto of Ganjam and Orissa,	Do. ...	Compiled up to work of season 1863-64.
Ditto Hyderabad Assigned Districts,	Do. ...	Inserting field work of season 1863-64.
Map of the Pergunnah Gangra,	Do. ...	Two copies prepared, one specially for Photography, and one for the printed Report on Gangra.
General Compilation Map of Rewah and part of Bundelcund,	Do. ...	Field work of seasons 1863-64 and 1865 inserted in part.
Duplicate copies of the 4-inch Maps (Degree Sheets) of Rewah, Chota Nagpore Division, Hyderabad Assigned Districts, and Sironcha, and Gangum and Orissa Topographical Surveys for the season 1864-65,	Do. ...	For office record, and prior to despatch of originals to the Home Government. All in progress, hill shading completed, names of villages in progress.
Charts with Trigonometrical data of the above Topographical Surveys for season 1864-65, Delhi and Hissar Divisions, with the lapsed Jagheers and Native States,	Do. ...	Duplicates for record, with the exception of the Rewah Survey Chart, all completed.
Punjab Map in 8 Sections,	8 miles = 1 in.	Sections 1, 2 and 3 have been corrected up to date and sent to Press for Lithography. Sections 4 and 7 also corrected to date and ready for press. Sections 5 and 6 have had considerable additions made to them from the latest results of the Cashmere Topographical Survey. Section 8, addition of Native States beyond the Southern boundary of the Punjab in progress.
Central Provinces and adjacent British and Native States in two Sections,	Do. ...	Added on portions of the Districts of Nursingpore, Hoshungabad, Nagpore, Bhundara, and some of the tributary states near Sumbulpore.
Map of the Country from Koorum Valley to Cabul and southwards to Bunnoo and Tonk,	Do. ...	For despatch to England.
Map of the North-Eastern Frontier with parts of Burmah and China,	Do. ...	Specially prepared for General Tytler, late Commanding Bhootan Field Force.
Punjab North-West Frontier, to illustrate the relations of the British Government with the Frontier Tribes,	16 miles = 1 in.	For the Punjab Government, completed and sent to Press for Lithography.
Lithographed Maps colored,	2,443 copies.	Of various scales and sizes. Of these 1,394 have been colored by the regular Establishment, and 1,049 by extra hands.
Corrections and additions to the engraved Sheets of the Indian Atlas,	214 sheets.	Boundaries corrected and names of Sub-Divisions added.

MAPS.		SCALE.	REMARKS.
<i>Revenue Branch.</i>			
Lower Provs. }	District Tipperah and Noncolly, ...	4 miles = 1 in.	Very near completion.
	" Chittagong with Hills, ...	Do. ...	Ditto.
	" Maunbhoom, ...	Do. ...	} Compiled to the extent of materials received.
	" Sylhet, ...	Do. ...	
	Central Provinces, Nursingpore District, ...	Do. ...	About $\frac{3}{4}$ ths completed.
	Oudh, in 4 Sheets—Sheet 3, ...	Do. ...	Containing Districts Oonao, Roy Bareilly and Lucknow, completed.
	" 4, ...	Do. ...	Containing Districts Pertabghur, Sooltanpore Durriabad (portion of), and Fyzabad, completed.
	" 1, ...	Do. ...	Containing Districts Seetapore, Hurdui, and Mohumdee, partly compiled.
	(Scind) Shikarpore Collectorate, ...	Do. ...	Hills completed and sent to Press.
	Nowshera District, ...	Do. ...	Compilation completed and sent to Press.
Central Provinces, Saugor District, ...	2 miles = 1 in.	Showing village boundaries, compilation in progress.	
Punjab lapsed Jagheers in the Delhie and Hissar Divisions, with adjoining British Districts and Native States, ...	Do. ...	Ditto ditto ditto.	
District Nuddeah, in 8 Sheets, ...	1 mile = 1 in.	Projected, and boundaries of Main Circuits outlined; proofs taken at Press, and will shortly be ready for issue.	
" 24-Pergunnahs, in 6 Sheets, ...	Do. ...	Projected, and boundaries of Main Circuits outlined; sent to Press for Lithography.	
Oudh, in 54 Sections (each Section 20' in Latitude by 30' in Longitude), containing the entire Province, ...	Do. ...	Projection compiled, and 11 Sections containing Districts Pertabghur, Roy Bareilly and Sooltanpore, outlined and sent to Press for Lithography.	
Districts Jessore and Backergunge, with Nuddea, 24-Pergunnahs, and the Soonderbuns, ...	6 miles = 1 in.	To illustrate a Geographical and Statistical Report, compilation completed, ready for Lithography.	
District Tipperah, ...	Do. ...	Ditto ditto, sent to Press for Lithography.	
" Fyzabad, ...	Do. ...	Ditto, now being printed at Press.	
Lithographed Maps colored, ...	1,666 copies	On various scales.	
Village Plans copied, ...	780		

(14.) In addition to the special mapping described in the above Statements, a larger amount than usual of miscellaneous and desultory work has been accomplished, which need not here be specified, but which has also occupied a good deal of time and labor.

(15.) The demand for manuscript copies of maps, village plans, &c., is increasing daily; and although this description of work (manuscript) is expensive, the public appear generally willing to pay for it in preference to waiting till survey results can be published. The only way in which such requisitions can be met is by extra hands, paid by the job. All this adds to the labors of the Regular Establishment, as the extra men must be supervised, and their work undergo careful examination by responsible parties prior to attestation and issue from this Office. During the year under review the cost of extra work of this description paid for by persons ordering the maps, amounts to Rupees 3,237-14.

(16.) The principal portion of the work executed in the Photographic Branch will be found detailed in the following Statement. Two hundred and eighty-nine negative plates have been taken, and 3,108 prints or impressions produced. By a comparison of these results with those given in the Surveyor General's last printed Report (for season 1863-64*), it will be noticed that while the number of negatives taken have decreased by 117, the number of prints have increased slightly, by 41. The large decrease in the number of negatives is due to the increased size of the plates which are now obtained by using a Ross's triplet lens of four inches diameter, without any distortion of the image. Formerly the largest size plates taken were 11 x 14, giving a surface of 154 square inches; but we are now able to produce negatives 23 x 25, or a surface of 575 square inches, (this being the largest size); while the ordinary plates are from 15 x 12 to 20 x 22, giving, respectively, 180 and 440 square inches of surface. The advantages gained by increased size of plates are numerous, not the least of these being the saving in time and chemicals in producing a smaller number of silver prints; the after-labor of joining the large prints correctly, to form complete maps, is also less than in joining up a number of small ones. It will also be seen that a larger proportion of maps are now re-produced on the same scale as the originals; perfect duplicates for record or issue are thus obtained, so that the tedious process of manuscript work, and its still more tedious examination to ensure *fac similes* is gradually being superseded.

(17.) In the Photographic Branch, moreover, it is worthy of notice that while formerly our labors, which may now be looked upon as chiefly experimental, were confined to subjects of a simple nature and small size; at the present time maps and plans of every description can be re-produced with facility. The results of many of the latest surveys have thus been at once placed at the disposal of Government, and of local and other Civil Officers, at a trifling cost, comparatively speaking.

Table showing the Nature and Quantity of Work performed in the Photographic Branch, Surveyor General's Office, for the Year commencing April, 1865, and ending March, 1866.

Description.	Original Sheets.	Subject.	No. of Plates.	No. of Prints.	Original Scale.		Photographic Scale.		Size of Plates.
					Miles.	In.	Miles.	In.	Inches.
TOPOGRAPHICAL.	7	Gwalior and Central India Topographical Survey (reprinted), ...	...	898	1	= 1	1	= 1	20 × 22
	1	Fort of Gwalior, ...	...	5	110	1	= 8	1	= 8
	1	Punjab Map (part of, for tracing from), ...	...	9	27	4	= 1	4	= 1
	3	Hyderabad Topographical Survey, ...	...	11	110	1	= 1	2	= 1
	1	Murree Sanitarium, ...	...	9	18	1	= 10	1	= 6
	1	Gangra (Berar), ...	...	8	40	4	= 1	4	= 1
	1	Plan of Dholpore, ...	...	8	80	500 ft.	= 1	500 ft.	= 1
	1	Western Doors (Hills), ...	...	2	4	Reproduced and	reduced to $\frac{1}{2}$		20 × 22 = 440 sq. ins.
	6	Gwalior Survey, ...	...	19	285	1	= 1	1	= 1
	1	Plan of Duttial, ...	...	2	12	500 ft.	= 1	500 ft.	= 1
	8	Rewah Topographical Survey, ...	...	16	240	1	= 1	1	= 1
	1	Plan of Kerowlie, ...	...	7	61	Reproduced and	reduced to $\frac{1}{4}$		20 × 22
	1	Plan of Derah Doon, ...	...	4	40	Reproduced.			15 × 12
	10	Ganjam and Orissa Survey, ...	...	20	300	1	= 1	2	= 1
	7	Chota Nagpore Survey, ...	...	14	210	1	= 1	2	= 1
REVENUE.	3	Pergunnah Palamow, ...	...	26	156	1	= 1	1	= 1
	1	City of Lucknow, ...	...	11	55	1	= 8	1	= 8
	1	Ditto ditto, ...	...	10	30	1	= 8	1	= 6
	1	Meerut Cantonments, ...	...	9	9	Reduced by one-third.			11 × 14
	1	Plan of Rohree, Sukkur and Bukkur, ...	...	1	2	...			20 × 22
	1	Preliminary Map of Oude, ...	...	4	100	4	= 1	4	= 1
	5	District Maunbhoom, ...	...	15	75	1	= 1	1	= 1
	3	Ditto Saugor, ...	...	9	36	1	= 1	1	= 1
	2	Ditto Hooshungabad, ...	...	10	40	1	= 1	1	= 1
	1	Pergunnah Palamow, ...	...	10	50	1	= 1	1	= 1
GENERAL.	2	District Maunbhoom, ...	...	7	35	1	= 1	1	= 1
	1	Ditto Hooshungabad, ...	...	8	32	1	= 1	1	= 1
	4	Conventional Signs, ...	...	11	17	Reproduced and reduced to $\frac{1}{2}$ and $\frac{1}{4}$.			11 × 14
	2	Specimens Topographical Printing Ordnance Survey, ...	...	2	12	Reproduced.			18 × 20 = 360 sq. ins.
	1	Sanscrit Inscription, ...	...	1	3	Reduced to $\frac{1}{2}$ size.			16 × 18 = 288 sq. ins.
	1	Plan of Attack, Dewangiri Fort, ...	...	1	1	Reproduced.			11 × 14
	1	Map of Western Doors, ...	...	2	2	"			20 × 22
	1	Index Map District Sooltaunpore, ...	...	1	1	"			18 × 20
	1	Punakha Fort, ...	...	1	1	"			11 × 14
	2	Plans of Forts in Bhootan, ...	...	2	2	"			16 × 18
CARBON.	1	Plan of Kerowlie, ...	...	1	1	To $\frac{1}{2}$ scale for Exhibition.			15 × 12
	1	Plan of Calcutta, ...	...	1	1	"			15 × 12
	1	Ground Plan of Calcutta Mint, ...	...	4	4	"			15 × 12
	1	Assam Revenue and Topographical Survey, ...	...	4	4	Reproduced.			18 × 20
	1	Pergunnah Maunghur, District Dumoh, ...	...	4	4				
			280	3,108					

(19.) No labor has been spared to attain success in this very important and useful branch of art; and I believe that our chief difficulties have been overcome. Lieutenant-Colonel Thwaiter (Surveyor General of India), now on medical leave in Europe, is making every possible exertion to improve this branch of the Mapping and Drawing Office; and with the superior means and appliances of his selection, which, ere long it is hoped, will be at our disposal, and aided by an Officer trained to the art in Europe, whose services have been requested to be placed at the disposal of this Department to supervise and work the Photographic Branch, it is certain that, ere long, a most efficient and first-class Photographic and Photozineographic Government Establishment will be formed in India. By the introduction of this art, not only will a vast amount of labor and time be saved, which is now expended in copying elaborate

drawings on transfer paper by hand, but the danger of errors of transcript creeping in being entirely obviated, the work of examination to detect such errors will be considerably lessened, if not altogether removed. In future it will be only necessary to see that the transfer of the carbon print to the stone or zinc plate is perfect in all parts,—these advantages cannot be too highly estimated. Great relief will thus be afforded to the Lithographic Branch ; the demands on which at present have been already shown to be far more than it can possibly meet.

(20.) The work in the Photographic Branch has hitherto been carried on entirely by the two W. Crossley and Jas. Mackenzie. Sergeants named in the margin, who were sent out specially to India by the Secretary of State for India. I have much pleasure in testifying to their exertions and endeavours to develop and turn photo-lithography to practical account in India.

(21.) The work performed by the Lithographic Press Establishment during the past year has been unusually large. From the details given in the following Statement, it will be seen how steadily the work of this branch increases yearly ; and from the immense number of maps, plans, and forms, &c., which have been printed, and the varied kinds of work performed, some idea can be arrived at of the extent of supervision necessary in working an Establishment of this nature, and of the amount of labor which is involved in watching each drawing through all its delicate stages,—from the first drawing on transfer paper to the final printing from stone. When it is further considered that the subordinate agency employed is almost entirely confined to Natives, who, though excellent copyists, are often uneducated, and consequently unable to detect errors in orthography, or examine proofs satisfactorily, and who need constant instruction and close watching through every stage of the process, the difficulties of getting an efficient Superintendent is easily understood. For the past 14 years, and until lately, the work has been supervised by Mr. H. M. Smith, to whom great credit is due for the perfection that has been attained. Mr. Smith, after serving Government for 43 years continuously, has, however, retired on a good service pension, and up to date all efforts to get a permanent successor have failed. Colonel Thuillier, Surveyor General, is now searching in Europe for the style of man we require, and I trust, ere long, to hear of his exertions being successful.

(22.) Meanwhile, the Drawing Branch of the Lithographic Department is placed under the supervision of Mr. J. O. N. James, the able and efficient head of the Mapping and Drawing Department, Surveyor General's Office. The charge of the Press having been entrusted to Mr. Niven who (brought up in some of the large Lithographic Establishments of Scotland) has, after a trial of three months, given me every satisfaction.

(23.) I would invite attention to the following facts, which fully prove that this branch is even, in its present state, very remunerative, and yields to the Government an ample return for the outlay in Establishment.

(24.) The total expense for the past year in permanent and extra establishments, paper, materials, and probable cost of new presses, wear and tear of block, &c., amounts to Rupees 44,709-13 (*vide* Abstract at foot of Statement of Work performed by Press Branch). The number of Maps, plans, forms, &c., printed, amounts to 213,547 impressions, and these at the selling price, or market value, are worth Rupees 77,743, yielding a profit, when all are sold, of Rupees 33,033 or nearly 70 per cent. on actual expenditure of Press Branch, as a set-off against the other heavy expenses incurred annually in the Survey of India.

Statement of the Works executed in the Surveyor General's Office, Lithographic Branch for the year 1865.

Description of Maps Lithographed.	Number of Maps or Sections.	Number of stones used.	Number of impressions or printings.	Maps transferred and not yet printed.
16 MILES = 1 INCH.				
Map of the Central Provinces and adjoining British and Native States, Sheet No. 2,	1	1	100	3
Ditto ditto ditto, Sheets Nos. 1, 3 and 4,	3	3	...	
8 MILES = 1 INCH.				
Map of North-Western Provinces, Sheets Nos. 3, 4 and 7,	3	3	750	
Map of the North-Eastern Frontier of Bengal, Bhootan and Assam, in 6 Sheets,	6	6	3,020	
Districts Dinajpore and Bograh in (colors),	1	7	2,520	

Description of Maps Lithographed.	Number of Maps or Sections.	Number of stones used.	Number of impressions or printings.	Maps transferred and not yet printed.
4 MILES = 1 INCH.				
Districts Dinajpore and Bograh,	3	3	435	
District Nagpore,	1	1	450	
„ Jubbulpore (in colors),	1	4	2,588	
„ Akyab (ditto),	1	6	600	
„ Sooltanpore,	1	1	234	
„ Backergunge (ditto),	1	2	260	
2 MILES = 1 INCH.				
Districts Nagpore and Wurdah (in colors),	4	8	1,000	
District Muzufferghur,	6	6	1,800	
„ Mooltan,	6	6	1,200	
1 MILE = 1 INCH.				
Main Circuit, No. 1, District Dinajpore, (in colors), ...	1	2	600	
Ditto Nos. 3 and 4, District Dinajpore, ...	1	1	...	1
Ditto No. 9 „ ditto, ...	1	1	...	1
Ditto No. 10 „ ditto, ...	1	1	250	
Ditto No. 12 „ ditto, ...	1	1	250	
Ditto No. 17 „ ditto, ...	1	1	200	
Ditto Nos. 12 and 13 „ Lullutpore, ...	1	1	200	
Ditto Nos. 17 and 18 „ ditto, ...	1	1	250	
Ditto Nos. 3 and 4 „ Jubbulpore, ...	1	1	200	
Ditto Nos. 8, 9, 10 & 11 „ ditto, ...	1	1	300	
Ditto No. 17, „ ditto, ...	1	1	200	
Ditto No. 18, „ ditto, ...	1	1	300	
Ditto Nos. 19, 20 and 21 „ ditto, ...	2	2	500	
Ditto No. 22 „ ditto, ...	1	1	250	
Ditto Nos. 5 and 9, District Backergunge, ...	1	1	300	
Ditto No. 6 „ ditto, ...	1	1	200	
Ditto No. 10 „ ditto, ...	1	1	200	
Ditto Nos. 18, 15 & 17 „ ditto, ...	1	1	200	
Ditto Nos. 16, 20, 22, 23 and 24, District, Backergunge,	2	2	...	1
Ditto Nos. 11 & 14, District Backergunge ...	1	1	...	1
Ditto Nos. 1 & 2 „ Akyab ...	1	1	...	1
Ditto No. 3 „ ditto, ...	1	1	...	1
Ditto No. 6 „ ditto, ...	1	1	...	1
Ditto Nos. 9 and 24 „ ditto, ...	1	1	...	1
Ditto No. 12 „ ditto, ...	1	1	...	1
Ditto No. 13 „ ditto, ...	1	1	...	1
Ditto No. 21 „ ditto, ...	1	1	...	1
Ditto No. 23 „ ditto, ...	1	1	...	1
Ditto Nos. 5 and 9 „ Maunbhoom ...	1	1	...	1
Ditto No. 8 „ ditto, ...	1	1	...	1
Ditto Nos. 23, 24 & 25 „ ditto, ...	1	1	...	1
Ditto Nos. 7 and 8 „ Sylhet, ...	1	1	...	1
Ditto No. 3 „ Tipperah, ...	1	1	...	1
Ditto No. 8 „ Nursingpore, ...	1	1	...	1
Pergunnahs Ookrah and Chourasee, District Nuddeah, ...	1	1	50	
Main Circuit No. 12, Sumpther State, ...	1	1	250	
Main Circuit No. 13, Pergunnah Nuddageon, Duttiah State,	1	1	200	
District Nuddeah, in 8 Sections, ...	8	8	...	8
Military Cantonment, Town and Suburbs of Akyab, ...	1	1	...	1
Town and Cantonment of Jacobabad, ...	1	1	...	1
Map of Simla,	1	3	600	
Kashmir Route Map, 5th Edition,	1	2	1,600	
Route Map of the Bengal Presidency,	2	4	2,050	
Civil Station of Jessore,	1	1	100	
Index to the Districts and Divisions of India, ...	1	1	165	
Map of Tea Districts in Assam,	5	5	5,000	
Skeleton Map of Gangra, attached to the Assigned Districts of Berar,	1	2	260	
Map of Western Dooars of Bengal,	1	1	125	
Map of Bhootan with the Bengal Dooars,	1	1	700	
Map of Bhootan and country adjacent,	1	1	100	

Description of Maps Lithographed.	Number of Maps or Sections.	Number of stones used.	Number of impressions or printings.	Maps transferred and not yet printed.
Small Map of India,	1	8	800	
Telegraph Map of India,	1	1	1,000	
Index to the Indian Atlas Sheets,	1	1	500	
Map of Mooltan Division, in 2 Sections,	2	2	160	
Environs of Calcutta, in 4 Sections,	4	4	200	
MISCELLANEOUS MAPS, PLANS, &c.				
Maps and Plans of Calcutta Water Works, Geological Map of Lower Ghur or Sheen Ghur in District Bunnoo, Geological Map of Island of Bombay, five Maps of Salt Water Lake, Calcutta Cyclone Report Charts and Diagrams, Oudh Exhibition Certificate, Sketch Map of Deodar Localities in the Northern part of Basin of the Beas, Sketch Map of Deodar Forests in Kanawar, and several Sketches, Plans, Diagrams, &c.,	104	108	40,524	
Total,	215	252	73,741	31
Survey Department Forms, Circulars, &c., ... ..	...	...	1,39,806	
Grand Total, ... ..	...	...	2,13,547	

A B S T R A C T.

Description of Works.	Number of Impressions.	Value or selling price.
Divisional, District and Pergunnah Maps, Plans of Towns, &c.,	33,217	Rs. 53,287
Miscellaneous Diagrams, Plans, Sketches, &c.,	40,524	„ 20,262
Departmental Forms } Ditto in type }	1,39,806	„ 4,194
Total,	2,13,547	Rs. 77,743

	RS.	AS.	P.
Permanent Establishment,	24,859	2	10
Contingent Expenses,	8,361	7	3
Extra ditto,	3,099	12	6
Cost of paper and materials,	4,769	7	0
Total,	41,089	13	7
Add 10 per cent. on cost of stock, stones, and for wear and tear of machinery,	3,620	0	0
Grand Total,	44,709	13	7

(25.) In comparing the above Statement with that of the preceding year (*vide* Surveyor General's last printed Report for 1863-64) it will be seen

* In 1863-64 impressions of maps taken ...	64,513
„ 1864-65 ditto ditto ...	73,741
Excess in 1864-65, ...	9,228

In the number of Forms printed, Departmental, &c., there is a decrease of 14,474 on 1864-65; the work of this description is now, as far as possible, executed by type presses.

completed were 119. During the season under review, ending 31st March, the number has increased to no less than 196 transfer drawings of maps and plans showing an excess of 77 in this item alone.

(26.) The increase to the Establishment of ten Draftsmen in July*, 1864, and the subsequent

* No. 1315, dated 12th July, 1864.

† 3 Draftsmen.	1 Stone-cleaner.
10 Pressmen.	2 Ink-makers.
9 Printers.	1 Carpenter.
7 Spongemen.	1 Dustery.

increase† sanctioned by Government Resolution, Financial Department, No. 704, dated 22nd February, 1866, have materially conduced towards the increased out-turn of work above noted. Heavy arrears, however, still exist in consequence of the large number of maps now rendered by our Revenue and Topographical

Surveyors annually; but it is hoped that, with the additional presses, stones, zinc-plates, and other materials, for the purchase of which an expenditure of Rupees 14,000 was sanctioned in Resolution of the Government of India, Financial Department, No. 3,996, dated 22nd December, 1864, these arrears will soon disappear. The new machinery has been selected by Colonel Thuillier himself in England, and includes

a patent French lithographic gripper printing machine, which, worked by a small steam engine, is capable with the aid of two or three ordinary Pressmen, on small salaries, of producing from 400 to 800 impressions per hour. With the advent of these new appliances, we shall be better able to meet the immensely increasing demands of the Government and the public; and to supply the latter with maps, at rates which will enable hundreds to purchase, who are now debarred from doing so by the high rates at which maps are at present produced,—thus furthering the desire of Government to place maps within the reach of all classes of the community. In connection with the new presses and machinery for the Lithographic Department, I may here remark that, on their arrival from Europe, arrangements must be made for their reception, as the present building is not capable of containing more than it at present holds.

(27.) The numerous requisitions sent to this Office from all parts of India for maps, and the delay, inconvenience, and expense, which must be experienced by Local Governments, and the public especially, in being able to obtain maps from Calcutta alone, renders it very desirable that some measures should be adopted for the sale and issue of the maps of this Department in each Presidency. If approved of by the Government of India, Agents might be appointed under each Local Government for the sale of Government maps. Such a measure would, I believe, further the interests of Government, and make the results of the surveys of India better known to, and appreciated by, the public at large. The increase of our Printing Establishment and machinery might always be so regulated as to ensure the supply being equal to the demand.

(28.) This Office has lately received from England supplies of the Revenue Survey District Map of Nagpore, and the Topographical Survey Map of districts Jhelum and Rawul Pindee,—both on the scale of 4 miles = 1 inch; together with the remaining five Sheets (Nos. 1, 2, 4, 5, and 7) of the Jhelum and Rawul Pindee Topographical Survey on the large scale of one mile = 1 inch. All these have been lithographed in excellent style. Of the engraved sheets of the Indian Atlas, the following new ones have been received:— Nos. 7, 17, 31, a quarter sheet of 105, and skeleton sheets of 28 and 29, showing only the drainage and sites and names of villages, omitting the hill drawing entirely. These last were sent out at the express desire of Colonel Thuillier, who considered they might be found useful in many ways in their present state without waiting for the entry of the hills, which will take some years to engrave. New and revised Editions of Sheets Nos. 46, 54, 55, 72, 73, 106, 107, and 114, have also been received; and as all these contain the results of some of our latest Revenue and Topographical Surveys, a very considerable amount of reliable geographical information, available to Government officials and for sale to the public, has been added to our stock.

(29.) The following is the state of the accounts connected with the sale of maps, in continuation of paragraph 26 of Surveyor General's Report for 1863-64:—
Sale proceeds of Maps.

<i>Dr.</i>	<i>Cr.</i>
RS. AS. P.	RS. AS. P.
Balance in hand or in deposit in Bank of Bengal of amount realized by sale of maps, and from manuscript map fees, from 11th June, 1864, to 31st March, 1865, 1,308 4 6	By amount paid into General Treasury as per letter No. 19, dated 15th July, 1865, to Accountant General to Government of India, 3,991 4 9
Amount realized by sale of maps and collection of map fees, 5,354 4 5	By cost of printing a map of the Tea districts of Assam, under orders of Bengal Government (<i>vide</i> letter No. 4,329, dated 20th December, 1865), ... 250 0 0
Proceeds of sales by Messrs. Thacker, Spink and Company, 3,671 6 0	
	RS. AS. P.
	Cash in hand, 301 5 1
	Deposit in Bank of Bengal, 911 3 1
	Unadjusted balance, 1,208 12 0
	2,421 4 2
	Amount due by Messrs. Thacker, Spink and Company, 3,671 6 0
Total, ... 10,333 14 11	Total, ... 10,333 14 11

Besides these 3, 147 Maps have been issued on Service to Government Officers representing a money value of Rupees 10,451 as shewn in table following:—

Division, District and Pergunnah Maps, Atlas Sheets, &c., lithographed or engraved, ditto ditto ditto	Number.	Price.
... ..	2,992	Rs. 9,546
... ..	155	,, 905
Total,	3,147	Rs. 10,451

APPENDIX A.

**EXTRACTS FROM THE NARRATIVE REPORTS
OF THE
EXECUTIVE OFFICERS IN CHARGE OF THE
TOPOGRAPHICAL SURVEY PARTIES.**

EXTRACTS FROM NARRATIVE REPORTS OF NOS. 1 AND 7 TOPOGRAPHICAL SURVEY PARTIES,
BY CAPTAIN A. B. MELVILLE, EXECUTIVE OFFICER IN CHARGE.

(1.) The Party left Dehra on the 4th October, 1864, reached Delhi on the 20th, and Muttra on the 29th. On the road down the Assistants were occupied in projecting plane tables, finishing up the synopsis, &c. Considerable delay was caused by the great difficulty there was in procuring carriage, and by the inferior camels that we obtained, numbers of them dying on the road, or falling so sick as to be unable to carry their loads. We had not much sickness. We lost one classic by cholera, and several of the classics were down with fever, but soon got well again.

(2.) On arrival at Muttra, where the first detachment was to separate from head-quarters, I made over all the strong camels to those who were leaving for work, and sent on the head-quarters' baggage by carts to Agra. The party that separated from head-quarters at Muttra was as follows:—Lieutenants George and Charles Strahan, Mr. Civil Assistant Horst, and Sub-Assistants Messrs. Tapsell, McCarthy and Allnutt, and Native Surveyor Kalka Pershad; these were to march for their ground, *via* Bhurtpore and Hindown.

(3.) Lieutenant G. Strahan was to instruct his brother in triangulation in plane table 31, where a small gap remained unfinished. After completing this, Lieutenant George Strahan marched for Ulwar and the northern portion of Jeypore, to continue his last year's triangulation. An account of his operations will appear in his own Narrative Report attached. Lieutenant C. Strahan marched south to take up the Sabulgurh plane table, No. 39.

(4.) Mr. Horst was to instruct the three new hands with him, and was to detach them as they appeared capable of working independently. The ground he and his detachment were to survey lay between latitudes $26^{\circ} 30'$ and $27^{\circ} 15'$, and longitudes $76^{\circ} 30'$ and $77^{\circ} 30'$, and included plane tables Nos. 31, 32 $\frac{1}{2}$, 33, 94, 96, 101, 102, 103, 104, 109 and 111. Mr. Allnutt, I am sorry to say, shot himself through the arm on the first march out of Muttra, and had to remain in the station on two months' sick leave. The remainder proceeded as had been arranged; and I detached Mr. Sub-Assistant Kitchen, who joined me at Agra, to take Mr. Allnutt's place with Mr. Horst.

(5.) I reached Agra on the 29th, having gone round by Bhurtpore, to make arrangements with the Political Agent. Here I was detained several days by the difficulties there were in procuring carriage. Having at length succeeded, I started for Gwalior to make arrangements about vauqeels, guards, &c.

(6.) My camp reached Gwalior on the 8th November, and I immediately detached Mr. Baness, and with him Messrs. Kirk and Stotesbury, and Native Surveyor Jonla Pershad. Mr. Baness was to instruct the two new Assistants, and was, with his party, to take up the tables lying between latitudes 25° and $25^{\circ} 45'$ and longitudes $77^{\circ} 30'$ and $78^{\circ} 0'$, *viz.*,—Nos. 43, 51, 52, 53 and 54. Mr. Todd I directed to take up the unfinished portion of plane tables 36 and 38, and to Messrs. Chill and Chapman were given plane tables 47 and 55 respectively, lying on the left bank of the Koonoo.

(7.) I took the opportunity of having to make a triangulation of Gwalior and Morar, for the large plan called for by the Surveyor General, to give Mr. Bolst a little instruction in the use of the theodolite. As I had also been directed to make large plans of Duttiah, Dholpore and Kerowli during this field season, I assigned this duty to Mr. Bolst, giving him Native Surveyor Abdool Sumud Khan to assist him.

(8.) About this time I received notice from the Surveyor General that Lieutenant Downing, of the Cuttuck Survey, was to do duty with No. 1 Party, and I had accordingly to arrange work for him. As plane table 46 formed an ugly gap in the chart, I determined he should take it up. On account of the heavy jungle in this plane table, only two or three points had been fixed. I accordingly marched to triangulate it, inspecting Lieutenant C. Strahan on my road. I reached Eklod on the 5th December, and was occupied observing and computing till the 15th, when I was joined by Lieutenant Downing at Chilwani. I spent two or three days with him, starting him, and then handed him over to Lieutenant C. Strahan for instruction in plane tabling. With the latter I also laid out the triangulation, to complete the Koonoo river, which I intended him to take up later in the season.

(9.) While engaged in this work, I received notice from Mr. Bolst that he had finished Duttiah, and would be in Dholpore on the 25th; I accordingly marched for Dholpore, which I reached on the 26th, and after finishing and computing the triangulation, and seeing Mr. Bolst fairly started, I marched to Kerowli, where another triangulation had to be made for the plan of that city.

(10.) I inspected Mr. Todd on my road, and, while at Gwalior, was joined by Mr. Allnutt, now completely recovered, and who I despatched to join Mr. Horst, for instruction, as I was refused any more vaqueels by the Gwalior Durbar.

(11.) While at Gwalior, I received notice from the Surveyor General that my services would be required in Burmah immediately, and at the same time hearing from Colonel Robinson that he would probably relieve me about the 28th January in Agra, I marched there, and remained there awaiting instructions till the 10th February, thus some eight or nine days were lost. Immediately I heard that Colonel Robinson was delayed in Calcutta, I marched back straight to Biloni, intending to carry on the triangulation up the Chumbul river, and then round south by Sheopore, so as to close on my work of the preceding season.

(12.) I had before this sent a 7-inch theodolite to Lieutenant C. Strahan, with instructions to him to observe at the stations we had laid out on the Koonoo river, as soon as he had finished his plane table. I reached Rugnathpore on the 17th, and met Lieutenant Strahan, and between us we managed to fix several points, and most of the villages, in the dense jungle on the left bank of the Koonoo, in plane tables 48 and 117. In the same way plane table 56 was divided between Messrs. Chill, Chapman and Kirk.

(14.) About this time orders reached me from the Surveyor General, directing Mr. Baness to proceed to Calcutta with as little delay as possible, to relieve Mr. James, proceeding on sick leave. I accordingly sent Mr. Baness instruction to make over his plane table 52 to Mr. Stotesbury, who was in want of work, and to proceed to Agra with as little delay as possible.

(15.) The latter end of February and the first few days in March were very cloudy and rainy, so as to render it impossible to triangulate. Lieutenant Strahan and myself were both encamped below Ootgir, as we both had jungle points to observe, so I had the opportunity of being able to see that Lieutenant Strahan was perfectly competent to triangulate independently, and, as he had never observed vertical angles, we took some together.

(16.) On the 5th of March I received a letter and telegram from Colonel Robinson, informing me that he would be in Agra on the 9th, and requesting me to meet him at Dholpore, to make over charge of the Party. I accordingly made over my triangulation to Lieutenant C. Strahan, directing him to work west up the Chumbul, till he joined the Rahoon Series, and then south up the Sheopore river, towards Ramgurh Great Trigonometrical Station, and so join on to my work of the preceding season; and, before marching, I saw that he was thoroughly equipped.

(17.) I reached Dholpore on the 12th, and made over charge of the Party to Colonel Robinson at Jajar on the morning of the 13th, and then proceeded to head-quarters of the Great Trigonometrical Survey at Dehra, where I obtained a month's privilege leave on private affairs

(18.) Colonel Robinson, after taking over charge of the Party, proceeded on a tour of inspection, first visiting the plane tablers in Jeypore, and then those south, near Sipree and Shahabad.

(20.) Consequent on Colonel Thuillier's departure for England on sick leave, Colonel Robinson was directed to proceed to Calcutta, to officiate as Deputy Surveyor General, and, in accordance with instructions received from the Officiating Surveyor General, I again, on the 12th May, 1865, received the officiating charge of the Gwalior and Central India Survey from Colonel Robinson at Landour.

(21.) The Office opened for work about the middle of May. A large amount of plane tabling—5,500 square miles—had been completed during the field season; and, considering the number of new hands, the sections are very fair, the plane tablers in Jeypore having much easier ground than those south.

Lieutenant C. Strahan completed the Sabalgurh plane table section in a very artistic way. He had considerable difficulties to encounter in the way of jungle, and also spent some time in instructing Lieutenant Downing.

Lieutenant Downing completed rather more than a plane table section. His work is very good, considering that this was his first season, and that his ground was very difficult for a new hand.

Mr. Horst, besides instructing the new Assistants under his charge, turned out two first-rate plane table sections, and though the ground is not as intricate as that in which he was working last year, the finish of these sections, and the manner in which they express the ground, do great credit to the professional capabilities of this Surveyor.

Mr. Baness turned out one very good section, besides instructing two new Assistants. He was unable to do more, on account of his being ordered to Calcutta.

Mr. Bolst, besides completing three plans of cities, viz., Duttiah, Dholpore, and Kerowli, on 500 feet to the inch, surveyed the third of a plane table section. This Surveyor deserves great credit for the style in which he completed the city plans, more particularly considering the unpleasant nature of the duty, and the obstacles thrown in his way.

Mr. Chill completed a very good plane table section and a third, in difficult ground, full of ravines, and covered with jungle.

Mr. Chapman also completed a capital section in very difficult jungly ground, where a large portion had to be traversed.

Mr. Todd completed about a plane table section and a-half in a very creditable way, and showing a very marked improvement on his last year's work. He promises to turn out a very fair plane tabler.

Mr. Tapsell turned out nearly two plane table sections. His work at present is coarse, but he is hard-working, and promises well.

Mr. Kitchen turned out rather more than two plane table sections, and considering this is his first season, promises very fairly indeed.

Mr. Kirk turned out the greater portion of a plane table section, and his work, though coarse, promises well.

Native Surveyor Joala Pershad turned out a remarkably good section, in which Sipree was situated.

Native Surveyor Abdool Sumud Khan assisted Mr. Bolst in the plane tabling of the large plans of the cities, and also completed two squares of a plane table section, near Ootgir Fort, in a very creditable way.

Native Surveyor Kalka Pershad completed portion of three table sections, in a very satisfactory way.

Taken altogether, the out-turn of plane tabling this year is satisfactory.

(22.) The total area triangulated between the two parties was 7,300 square miles; of this, Lieut. G. Strahan triangulated 5,400. An account of his operations is attached, as before stated.

Lieutenant C. Strahan completed the triangulation of about 1,900 square miles that I had laid out for him. The results seem very fair, considering the size of the instrument used, viz., 8-inch. The discrepancy between the value of the bases Kundaila station to Silmoni station obtained by the triangulation of last year, depending on the Great Arc Series values, and that obtained this year from the Rahoon Series values is 14 feet in a side of $13\frac{1}{4}$ miles, or very little over a foot a mile. Considering the distance this secondary work had extended, on account of the dense jungle, this error does not seem excessive.

(23.) In accordance with the wishes of the Surveyor General, the following arrangements were made for the recess:—Lieutenant G. Strahan took charge of the Computing Party in Dehra, consisting of Messrs. Tapsell, Kirk, Kitchen, Stotesbury, McCarthy and Allnut. The Drawing Office was under my superintendence at Mussoorie, and consisted of Lieutenants Strahan and Downing, and Messrs. Horst, Bolst, Chill, Chapman, Todd and Hussey. Mr. James also did duty in my office, in lieu of Mr. Baness, employed in Surveyor General's Office, Calcutta. Besides the mapping, the whole of the computations of Lieutenant C. Strahan's triangulation were computed in the Mussoorie office.

The amount of work turned out is shown in the accompanying statement. No arrears of computations remain. 6 General Maps on the inch scale and three finished plans of cities, on a scale of 500 feet = one inch, were completed, and sent to Calcutta. The hill shading of one $\frac{1}{4}$ -inch degree sheet and of an inch General Map and a-half was finished as far as materials exist, leaving in arrears only the following, which will be completed next recess:—

The printing and border of one General Map on the scale of 1 mile = one inch.

The printing and border of one degree sheet on the scale of 1 mile = one inch.

N.B. The General Map, containing Mr. Stotesbury's plane table, could not be taken in hand, in consequence of discrepancies between the sections, which will be examined into during the ensuing field season.

(24.) During the recess the two parties, Nos. 1 and 7, were definitely separated by order of the Surveyor General. Longitude 76 was fixed as the boundary line between the two Surveys, and next field season they will be working completely independent of each other, No. 1 working in the Chumbal valley, and to the west of the river Koonoo, and No. 7 working in the northern portion of Jeypore, and about the city of that name.

(25.) I am happy to be able to report favorably of the general conduct of the Assistants, and I beg to bring forward the claims of Messrs. Chill and Todd to promotion to the next senior grade. Mr.

Chill has been about two years in the grade of 2nd Class Sub-Assistant ; he is steady, hard-working, a good plane tabler, and a good draughtsman, and I strongly recommend his promotion to the grade of Senior Sub-Assistant.

Mr. Todd has been over two years a 3rd Class Sub-Assistant ; he has made great progress since he entered the Department, and is a very fair plane tabler, and has also a fair knowledge of the computations ; he is industrious and steady, and I hope his promotion to the grade of 2nd Class Sub-Assistant may be sanctioned.

Extracts of a Letter, No. 12 of 1865-66, from Lieutenant George Strahan, R.E., to Captain Melville.

Para. 2. I separated from the head-quarter's camp at Bhurtpore on the 31st October, taking Lieutenant Charles Strahan, the Military Assistant attached to the Gwalior Party, with me, to complete a small corner of triangulation near Hindown in the Jeypore district, which had been left unfinished last year, and at the same time to give that officer sufficient instruction in triangulation, to enable him to undertake the minor triangulation of the river Koonoo, which had been allotted to him for a later period of the field season. This work was completed by the 9th November, and I thinking that Lieutenant C. Strahan was then sufficiently conversant with this branch of his duty, detached him at Hindown, and proceeded to inspect Mr. Horst, and the new hands who were with him, viz., Messrs. McCarthy, Tapsell and Kitchen, on my way to Jeypore.

(3.) Mr. Horst having commenced work but a few days, there was little work for me to inspect, but Mr. Horst reported favorably of Mr. Kitchen's readiness in learning the use of the plane table, and the method of delineating ground.

(4.) I commenced my own triangulation a few miles to the south of the city of Jeypore, by selecting a station to form a quadrilateral with the station of Kho Banskho and Bhoortia, of the Rahoon Series, as a commencement of a series of principal triangles connecting the Rahoon and Gurhagurh Series on the parallel of $26^{\circ} 45'$. This connecting Series, as far as it is at present completed, consists of two quadrilaterals and a hexagon. The side of continuation of the last mentioned figure is in long. $75^{\circ} 5'$, and only one more figure is necessary to complete the junction. This Series was undertaken, in accordance with a general plan adopted by Captain Melville and myself, of running principal Series across the interval between the Rahoon and Gurhagurh Series at every degree of latitude, the angles to be measured with the greatest degree of accuracy of which the instrument employed (a 14-inch theodolite) was capable. By this means the ground to be surveyed will be so intersected with reliable work, that only a very small amount of error can be generated in the filling in of any portion of it. Later in the season I completed the first quadrilateral of a second principal Series on the parallel of $27^{\circ} 45'$, emanating from the base Jilo to Khelana of the Rahoon Series. All the angles of these two Series were measured on zeros $\frac{0}{180}$, $\frac{15}{195}$, $\frac{30}{210}$, $\frac{45}{225}$. The signals were all heliotropes, and the stations were invariably isolated. For the results of these measurements, *vide* below, para. No. 8. Some of these angles were measured late in the season, during dust storms and hot winds, which has tended to impair the exceeding accuracy which I was anxious for in this particular work ; but it will still, I hope, be considered satisfactory. The ground over which these Series passed has been broken up into smaller triangles, and sufficient points fixed for the use of the plane table Surveyors next field season.

(5.) From Jeypore I went north-eastwards, reconnoitering, and poling up the country as I proceeded, towards Ulwar. The triangulation of this state is now completed, and the topographical work may fairly be expected to be finished next season. During my operations in the northern part of Ulwar, I closed on part of my work of last year. On a side of 10.313 miles the difference of the common sides amounted to 8 feet, which was not more than I expected, as the distance between the Rahoon bases from which the work of the two seasons commences is upwards of 70 miles.

(6.) Having finished Ulwar, I went into the district of Patan, and completed the triangulation of it, and from thence to Shekawatee, where I prepared ground for plane tabling to the extent of about two tables, the triangulation being founded on the side Jilo to Singhana of the Rahoon Series. From thence I went southwards, through the Jeypore district, covering the country with secondary triangulation measured on zeros $\frac{0}{180}$, $\frac{30}{210}$, with 14-inch theodolite, and with sufficient intercepted points for the detail Surveyors up to longitude $75^{\circ} 45'$, and fixing a sufficient number of stations to the west of that meridian to serve as outside points, as I expect that all the country up to that meridian will be surveyed in detail next season.

(9.) When passing through Jeypore, I had an interview with Captain Beynon, Political Agent, who informed me that the Maharajah was very favorably-disposed towards the Survey, and promised us every assistance. The inhabitants, however, look upon us with great suspicion, and we found it very difficult to keep on a friendly footing with them; and they are so little under the control of their own Maharajah, that his support is of very little use in facilitating our progress. I constantly experienced the greatest annoyance and delay from the destruction of our poles; in some cases they were knocked down almost as soon as put up, and at last I contented myself with observing natural objects, such as trees, &c., almost entirely, which accounts for the errors of my common sides of intersected points being rather large. Many of the larger towns and forts of this state are quite beyond the control of the Maharajah, having been granted as jagheers to influential thakoors for services of various kinds, chiefly military. The ownership of these jagheers is hereditary, and never reverts to the Maharajah, and consequently the extent of his power and territory is now very much curtailed. The Maharajah is especially anxious for a complete survey of the city of Jeypore on a large scale, with a view to the introduction of gas, and tramways on which he proposes to employ traction-engines. This will be a favorable opportunity which may not occur again for executing the plan of the city, and I recommend that it should be taken in hand next season.

(10.) The side of the Jeypore state adjoining Ulwar is a fertile plain, intersected by numerous flat-topped ridges of sand-stone hills about 800 or 1,000 feet above the plain, but of insignificant breadth. The communications of the country are however much restricted by the difficulty of crossing these, as they sometimes extend for many miles without any pass through them practicable for beasts of burden. As you travel westward these hills disappear, or only rise at very long intervals, the plain becoming very barren and sandy, and covered with only a sort of dry sedgy grass as you approach the desert of Bikaner. About 35 miles to the west of Jeypore is the well-known Sambhar Salt Lake, which I visited this year. The peculiarities of this wonderful lake are probably too well-known to need any lengthened description here. Although of great extent (about 25 miles long, and from 1 to 7 miles broad), it is said to be nowhere six feet deep, but perfectly free from grass or weed, as well as from animal life, which is probably owing to the great quantity of salt contained in its water. A rough analysis gave 39 per cent. of salt by weight. Its smell is distinctly appreciable at a distance of a mile. The water is clear, though the bottom consists of soft black mud, which contains a great deal of crystallized salt. The lake is supposed by the natives to be under a curse from some deity who turned its waters salt in a fit of passion. A temple to commemorate this is built on a rocky promontory of the lake, which is visited annually by thousands of pilgrims. The scenery around is very wild and desolate, especially towards the western shore of the lake, where it is shut in by rocky hills. The city of Sambhur, where the manufacture of the salt is carried on, is situated at the extreme eastern end. The process is simply to allow the water to evaporate in shallow tanks about six inches deep, and to scrape up the salt as it crystallizes at the bottom. Half the revenue derived from this manufacture belongs to Jeypore, and half to Jodhpore. The Maharajah of Jeypore receives about 20 lakhs of rupees annually from this source.

(11.) The state of Ulwar is far more hilly than Jeypore, the greater part of the country being covered with jungles and rocks, in which a small patch of cultivation is cleared round each village. There are very few roads, and those very circuitous. I was several times obliged to leave my camp standing, and make excursions into the hills, with only a few coolies to carry absolute necessaries. The jungles here are much infested by wild beasts, to such an extent is this the case that I found some of the roads actually stopped by tigers, and nothing would induce the natives to go along them. This is more especially the case near a hot spring called Tallbrich, where the destruction of life by tigers during the last few months has been very great. The northern part of the state is more open and flat, but very barren and sandy, especially on the eastern side. The part of Shekawattee visited by me this year is little better than a desert, consisting of an open plain broken only by low rolling sand hills, spotted with a few leafless blackened trees, looking as if a fire had passed over the whole country. The people are very turbulent, always fighting among themselves, and great thieves. Though occasionally rather insolent, they did not show any hostility to my camp. The country is very favorable to surveying, and will, I expect, be quickly completed at a trifling expense. In some places, especially towards the Patan district, it is very rich in ores of iron and copper. I visited a copper mine near Singhana G. T. S. which has been very productive, though now almost deserted, from the quantity of water issuing from the rock, which has choked it. This water is saturated with alum, the manufacture of which seems almost to have superseded that of the copper. The overseer of the mine told me that he could quickly realize a fortune, if only the mine could be kept free from water; hitherto it has been always pumped out, but as the shafts from which the ore is dug are situated high upon the side of a hill, and the bottom of them not many feet from the surface of it, one would think the process of draining might be simply effected by boring an outlet for the water. A full account of the working of these ores, and of the manufacture of alum at this very spot, has recently appeared in the memoirs of the Asiatic Society.

(12.) The recording of my observations during this season was efficiently performed by Hurlall Singh, who has been recently appointed to the Department, and promises to become an excellent surveyor and draftsman.

EXTRACTS FROM NARRATIVE REPORT OF NO. 2 TOPOGRAPHICAL SURVEY PARTY BY
J. MULHERAN, ESQ., EXECUTIVE OFFICER IN CHARGE.



(2.) The final work of the previous season having been completed on the 21st October, the Office was closed on that date, and the Assistants divided into three parties. That immediately under myself was employed in furnishing Trigonometrical points for basing the details of the four southern pergunnahs of the Upper Godavery district; that under Mr. Civil Assistant Chamarett in completing the Topographical details of what remained of the Hyderabad Survey south of lat. $18^{\circ} 45'$; that under Mr. Senior Sub-Assistant Smith in completing the re-survey of a portion of the old Hyderabad Survey, near Omerkeir, the triangulation of which was completed during the previous season.

(3.) On reaching Sironcha, I examined the several plane tables, and after satisfying myself regarding the projection of points, left Mr. Chamarett in charge of the detail party, and proceeded to extend the triangulation as far south as the range bounding the Vizagapatam district.

(4.) The following is the extent of secondary work completed by myself and Native Surveyor Shaik Omer. Most of the stations occupied were in the heart of the forest, and the ascent to several over precipitous rocks, exceedingly dangerous to both men and instrument :—

1st Class Triangles,	...	...	...	22
2nd „ „	...	...	...	135

(5.) The average triangular error of the 1st class is $5''\cdot6$, that of the 2nd and 3rd class $7''\cdot9$, and the average error of 132 common sides of the latter $0\cdot33$ feet per mile. No comparison of the average error of the common sides of the 1st class triangles can be made, polygonal corrections to the extent of $0''\cdot9$ and $0''\cdot6$ having been applied to most of the angles.

(6.) The above embraces an area of 1,993 square miles, and includes all that remained of the triangulation of the Upper Godavery district, the Survey of which was requested in your letter No. 20 of the 13th April, 1861. The completion therefore this year of the Topographical details of the Nugur, Albaka, Cherla Badrachelam, and Rakapali talooks will close the operations of the Hyderabad Topographical Survey.

(8.) The work completed by Mr. Chamarett and Janardanrao, Native Surveyor, embraces the whole of what is known as the Sironcha talook, one of the six sub-divisions of the Upper Godavery district. The entire talook is more or less overrun with heavy forest and tangled underwood, and very unhealthy, in consequence, to strangers. The Gonds located in the talook are averse to leave it, being accustomed to the climate, and having a predilection for forest land. The entire area is slightly in excess of 574 square miles, and has been very correctly outlined by Mr. Chamarett and Janardanrao. Mr. Chamarett was promoted to the grade of Senior Civil Assistant on the 1st April, 1865, and has taken a leading part in all that has been necessary to complete the Survey of the Hyderabad territory.

(11.) The re-survey of the portion of Major Brown's work adjoining Mahore was entrusted to Messrs. Smith and Scanlan. The former has been attached to the Party since September, 1855, and the latter since September, 1863. The work completed by them is slightly in excess of 952 square miles, and is highly creditable to both.

(14.) The work completed by Messrs. Farrell, Ogle, Chennell and Maine, and Native Surveyors Ramchunder, Pandarao and Baparao is 2,339 square miles. The extent of work completed by Mr. 2nd Class Sub-Assistant Farrell is slightly under 436 square miles, and is highly creditable to him, both on account of the skill evinced in out-lining hills, and the care taken in tracing the sources of the tanks peculiar to this part of the country. Mr. Farrell was appointed on the 1st October, 1860, and joined my Party on the 23rd December, 1860. He is an active and zealous detail Surveyor, quick in computing, and neat in all that is entrusted to him. I beg therefore earnestly to recommend him to your favorable notice as deserving of promotion to the next superior grade.

(15.) The extent of work completed by Mr. 3rd Class Sub-Assistant Ogle amounts to 330 square miles, and is so neatly and carefully out-lined, both as regards the contouring of hills, the tracing of rivers, roads, out-lines of tanks, &c., as to have little to be desired. It is therefore with the greatest pleasure that I bring his merits as a detail Surveyor to your favorable notice.

(16.) The extent of work completed by Mr. 3rd Class Sub-Assistant A. W. Chennell is 357 square miles, and is highly creditable to him, the ridges being neatly and carefully out-lined, and the

direction of streams correctly rendered. He was appointed to my Party on the 10th November, 1862, as a probationary Sub-Assistant, and promoted to the grade of 3rd Class Sub-Assistant on the 1st May, 1864, and is a quiet, well-disposed lad, and very anxious to give satisfaction.

(17.) The extent of work entrusted to Mr. 3rd Class Sub-Assistant B. A. Maine embraced about 210 square miles. Of this, however, he was unable to complete more than 60 square miles, owing to the accidental discharge of his gun, which injured three of the fingers of his right hand, and rendered it necessary for him to proceed to Sironcha for medical advice. He rejoined the Party in March last in a convalescent state, and was unequal to work of any kind until the beginning of May, when he took a part in making copies of the field sections.

(18.) The extent of work completed by Native Surveyors Ram Chunder, Pandarao, and Baparao is slightly in excess of 1,156 square miles. Of this 517 square miles have been satisfactorily completed by Baparao, 350 by Pandarao, and 289 by Ram Chunder.

(20.) The following is the extent of work that remains to complete the Hyderabad Topographical Survey, and which I propose to take up during the ensuing season :—

Boundary Survey of the districts of Omraotee, Akola, Maiker and Yeotmahl; re-survey of 100 square miles of the portion of the tract adjoining the pergunnah outlined in sketch No. 1 herewith appended; Topographical details of the pergunnahs of Nugur, Albaka, Cherla, Badrachelam and Rakapali, Upper Godavery district; embracing in all about 1,955 square miles.

(22.) The boundary Survey of the four districts of Berar I propose to superintend myself, entrusting the superintendence of what is required south of Sironcha to Mr. Civil Assistant Chamarett. I do not think that more than fifteen stations will be required for basing the re-survey of the tract adjoining the Pem Gunga. These I intend to determine with the 12-inch, and to compute and project the points required, before moving in the direction of the boundaries.

EXTRACT FROM NARRATIVE REPORT OF NO. 3 TOPOGRAPHICAL SURVEY PARTY, BY LIEUT.-
COLONEL G. H. SAXTON, EXECUTIVE OFFICER IN CHARGE.

(3.) The programme for the season has already been made known, and having received assurances of proper treatment from the Bustar Rajah, I made arrangements accordingly. My probationary Sub-Assistant, Mr. Claudius, was appointed to the duties of observatory Assistant, and the rest of the Party were given plane tables, distributed so as to surround, with experienced hands, those on which the two new Native Surveyors were to work. The ground to be surveyed was that, the triangulation chart of which was sent in last year. Tables, as usual projected by myself, were prepared in quarters, and as the nature of the country, and the distance from my camp, would not admit of any intercourse by letter, even, between me and my Surveyors, large advances were made, and all arrangements completed for independent work during the earlier months, and the detail Surveyors marched from Cuttack on the 3rd December. On the same date my own camp marched to the Vizagapatam district, where my triangulation would commence, in a very different direction. I had a long march, which, being through good country, I got over quickly, and ascended the ghauts, and fixed my theodolite on my first station on 3rd January. For two and a-half months the triangulation was carried on in the provinces of Jeypore in Vizagapatam, and Bustar in the Godavery district, of the Central Provinces. The old Survey, as published on the Atlas sheet, extends along the Vizagapatam district, (below where my Survey has completed up to the old work) from the coast westward to nearly 83° longitude, and my object was to take up the unsurveyed country west of that, and in continuation, south of my own work.

(4.) To carry out the above arrangements, as I would for so long a period be beyond reach of my detail Surveyors, I directed my Senior Assistant, D. Atkinson (since promoted to Civil Assistant), to exercise a superintendence over the detail Surveyors, who were instructed to apply to him in case of need. Mr. Chew was specially placed adjacent to the two junior Native Surveyors, Nilacuntum and Mahomed Ameen, and was instructed to supervise them. The latter not having hitherto executed any field Survey, was to remain entirely with Mr. Chew, who would allow him to take up his work as soon as he thought him competent to do so.

(5.) I have nothing new to notice under this head; I used the same Troughton and Simms' 10-inch theodolite with complete vertical circle, and took with me a 5-inch instrument, which was used on only one or two occasions. The plane tables were supplied with new magnetic compasses, which were more satisfactory.

(6.) My operations during this season are in extension of those conducted the previous year by Lieutenant Armstrong and Mr. D. Atkinson, and which were left in last year's Report for future remark. Those Officers, during that season, fixed four additional principal stations, on which the angles were partly observed; and they completed the observations on the back stations. I revisited this season three of the above four new stations, and re-observed the angles, but am not satisfied with one of the triangles, of which I observed two angles to heliotropes, the third having been taken without luminous signals by Mr. Atkinson the previous year. The triangular error is 21", a great deal too large for such instruments, with well-centred signals; and I intend that the third angle shall be re-observed this season. On this account I should not have submitted any final computation of Principal Triangles this season, but I have another reason for delaying to do so. I hope the coming season to effect a rejunction of my principal triangulation with the Coast Series G. T. S. It is now many years since my work received any check, and I shall be anxious to see the result of this, and, if necessary, revise my computations before sending in any further papers. During the season I extended my Principal Triangulation by seven stations, on five of which I completed the observations, as well as on the three above-mentioned of Mr. Atkinson's fixing. The sides of these Principal Triangles average nearly thirty miles, and all my secondary triangulation is immediately based upon them. It is of large amount, as I observed upon fifty-seven stations altogether, and intersected points are numerous. I shall not be able to give the whole number with exactness in this report, as, owing to my absence on leave, I have not been yet able to finish them. I hope to do so before leaving quarters, and during the march to the field. The duties of triangulation were continued without the smallest relaxation till 15th March. On the 18th March I reached my nearest detail Surveyor's ground, and met Hediatoollah. Subsequent to this, however, I took some observations on stations within the cultivated plain, where the Revenue Survey operations will join mine. This gives a few more stations to assist the Revenue Surveyor to effect his junction, and in one instance was necessary, to revise a mistake of my own, in having made a false intersection of two different heliotropes. Mr. Claudius was always

very attentive and correct in his observatory duties; on the completion of them he was detached, and directed to assist in the plane tabling, whilst I proceeded to inspect my Surveyors, the remarks on which duty will be made when reporting on individual Surveyors.

(7.) The amount of detail Survey executed this season is in excess of all previous years. A fair

proportion of credit on this account is due to the exemplary and zealous service of my Surveyors. I had however reason to expect a large out-turn of work, as my efficient Party would in part be employed in easy and healthy country, such as never before came under survey by us. As anticipated in my last year's report, the usual amount of sickness was not experienced, excepting in my own camp, when at one time nearly every man was laid up. Mr. Leonard, the apothecary, and his brother (who was with my camp for a few days very ill), and Mr. Claudius, none of them escaped. Amongst the detail Surveyors, on the contrary, Mr. Adams only got fever. He had several attacks, which kept him from his duty for at least twenty days. Mr. Chew, with his usual alacrity, went to his assistance. On returning from the field, that portion (consisting of Messrs. Harper, Rayner, Claudius and Leonard) which travelled *via* Jeypore, the more direct road, all got ill. I shall now notice the amount of work executed, and give my opinion on each Surveyor's portion separately.

(8.) Mr. Atkinson has been very deservedly promoted to the grade of Junior Civil Assistant.

During the past season, in field and quarters, considerable responsibility has devolved upon him. Owing to my own field duties requiring me to remain so long quite beyond reach of the rest of the party, in case of need Mr. Atkinson was instructed to act as supervising Officer, in case of any detail Surveyor requiring advice or assistance. Every person was provided with funds for private and public expenditure, as far as probably necessary, until I came within reach; and Mr. Atkinson was given a limited credit on the Raipore and Belaspore Treasuries, in case of necessity. I purposely placed Mr. Atkinson on the extreme position for two reasons,—one that he might be near the district officer and Treasury, and another that I might confer with him before quitting the field, and give him necessary instructions before I proceeded on a different route, with the intention of taking privilege leave. I have every reason to be satisfied with this gentleman's conduct. He executed 589 square miles of survey, chiefly in difficult country. His trigonometrical points are fewer than usual, which, of course, enhances the labor of a detail Surveyor. He finished his work earlier than I had expected, and was prepared to assist others when I reached the northern boards. He came into my camp at mid-day of 31st March, and assisted me in my inspecting duties, marching with me again that afternoon. I passed through a portion of Mr. Atkinson's survey, and placed his table in position in several places, and examined his work which, as to be expected from him, was accurate, and carefully executed. Mr. Atkinson had charge of my office after return to quarters for nearly three months. He has projected the fair maps, hitherto invariably done by myself. In every respect I beg to acknowledge the best service from Mr. D. Atkinson throughout the year.

This Surveyor, as usual, completed a very large portion of country. After finishing his own

allotment, he went to the assistance of Mr. Adams, who was sick. I visited the country surveyed by Mr. Chew, but did not require him to join my camp. His plane tables were sent to me, and Mr. Atkinson and I put them up in several places, and found the map very accurate. I may mention an incident, on putting up the table at one place, and fixing one position thereon, there was recorded on the face of the map "Teak tree," which could not be seen, but on enquiry from a villager, were shown a single very small Teak tree in the field close by. A few miles from this spot stands the village "Donga Karnod," where there are many Teak trees, as noticed in the 15th para. of my last year's report, but I do not think they exist anywhere else in the cultivated plain of Chatigarh, and Mr. Chew had laid down this unique instance. Mr. Chew is equally efficient in recess duties, and takes a large share of the map drawing, and most of the printing.

Has executed 580 square miles, a very large quantity, especially considering it was chiefly of a very difficult nature. This amount includes about 93 miles above his own portion,

and to which extent he assisted Mr. Adams. The boards given to Messrs. Harper and Adams joined on to the Survey executed by two Sub-Assistants from No. 4 Party two seasons previous. The junction of the work agrees very well, excepting in one place, on which I purpose presently remarking. Mr. Harper was promoted to his present grade of 1st Class on 8th August, 1863. He served the full period of three years before promotion to each higher grade, having been entertained on arrival from England on 8th August, 1857. I now gladly recommend that Mr. Harper be promoted from the date of this report 1st October. He is a very painstaking Surveyor, and in recess duties, as a computer, second only to Mr. Atkinson. His health has suffered grievously, but he is at this time apparently stronger than for several years past.

As before noticed, this Surveyor was the only one this season who suffered from fever to an extent to interfere materially with the progress of his work. The difficulty was met by the ready assistance rendered by other hands. Mr. Adams usually executes

Mr. Adams.

a maximum share of plane tabling, and made special request to be given a full quantity this year, which was complied with. His out-turn was 398 square miles. Even after his illness he was disinclined to allow others to assist; and I was obliged to give orders against his wishes, as until the completion of his work was secured, and no gap left possible, other hands could not be permitted to quit the field. Mr. Adams completes two years service in the grade of 2nd Class on this day, 1st October. His conduct in field and quarters as a plane tabler and draftsman has always been highly satisfactory, and I recommend him for promotion to 1st Class from as early a date as the state of your Departmental arrangements will admit of. I did not visit Mr. Adams in the field. He and Mr. Harper were inspected at their field duty by me during the previous season, and were the only two whose plane tabling was not personally examined by me in the field this year.

Mr. May executed 553 square miles of very difficult country. As usual, his map is of a very superior order. The portion allotted to him was that which gave greatest scope to his talent for hill drawing, and I am sure you will admire the execution of his field and fair maps. Mr. May has done but little in the way of computing. His

Mr. J. A. May.

talent in map drawing makes his services too valuable in that way to admit of indulging his wish to compute to any great extent, but he has taken a very large share of the fair maps. His conduct is always all that I could wish. He, like Mr. Adams, completes two years in his present grade this day, 1st October. They both served the full three years in the junior grade, and I recommend them both for like early promotion to 1st Class. I visited Mr. May in the field, and went with him surveying. I had only occasion to approve of his proceedings, and after remaining with him for three days, including Sunday, I passed on.

This Surveyor's merits have been specially brought to notice, and his promotion with retrospective effect sanctioned. He executed 318 square miles—a fair quantity for a young

Mr. Rayner, and Mr.
Claudius.

Surveyor. He was disabled by a tiger, and had to leave the field. His comrade, Mr. Claudius, however, first killed the tiger, then assisted Mr. Rayner into the station of Raipore for medical aid, and without delay returned, and completed the remaining portion of Mr. Rayner's survey, to assist in which I had fortunately left him, before I had heard of assistance being required by Mr. Adams. I visited Mr. Rayner in the field, and went out surveying with him. He is a very efficient plane tabler, and an active and very promising Surveyor. Whilst with him, I mounted a board for Mr. Claudius, whose services as observatory assistant were no longer required with me, and directed him to assist Mr. Rayner. I went on to one station with him, and left these two young men together. Mr. Claudius completed 108 square miles.

The death of this Native Surveyor has been reported. I visited his camp, or rather he came into mine, and was present when I was with Mr. Claudius on Sirpur station, on 27th

Abdul Rahman.

March. On 28th, 29th and 30th I marched with Abdul Rahman, partly through surveyed portions, when I tested, with satisfactory result, his completed work, and partly through new ground, where I saw him fix his station, and sketch in the detail. The loss of this Surveyor is a serious blow to the working strength of my Party. His health was unusually proof against the deadly nature of the climate, and when he had fever, which I have witnessed in the field, his strength and pluck enabled him to bear it in a manner I have not seen in any other instance. I have seen him on the top of a hill with his plane table, able to work when the active stage of a fever was on him.

Hediatoollah has done right well. The previous season, under the immediate superintendence of

Hediatoollah.

Abdool Rahman, he gave good promise of success, and this season he has finished 464 square miles. It was country without very much detail, and there is not much to remark as to the delineation. With more experience, and some hints from the older Surveyors, I hope Hediatoollah will turn out a valuable Surveyor. He is very young, but I was desirous of making a special example in favor of his good conduct, and praiseworthy exertion, as a contrast to the treatment awarded to non-deserving members of his class; and am glad that my recommendation for increased pay has been acceded to. I beg to place on record, that Hediatoollah killed a man-eating tiger, which has caused the entire desertion of three villages on his ground. I feel sure that this Native Surveyor will continue to make zealous endeavours to merit further reward. I was with him on 18th, 19th, and 20th March. He brought to my notice the discrepancy in one of the points I gave in his board, as alluded to at the close of para. 6 of this report. I visited the stations, and by observing on them, was enabled to compute the position of both the confused heliotropes, which was done, and the points projected on the boards at once. One, coming on Hediatoollah's finished work, was a good test, and his position for the village close by was quite satisfactory. His map, under my examination, was as accurate as could be expected. I made particular enquiries from the people of the country regarding the demeanour of this very young man towards them, and was gratified by their assurance that, in all matters, his dealings with them had been quite fair, and I could not hear of anything like a complaint. I place this on record prominently, in contrast with the conduct of others.

Mr. Apothecary T. Leonard has continued to give me the utmost satisfaction, as usual always ready to give assistance in matters beyond his professional capacity. He suffered from fevers in field and quarters during the year, and I am sorry to say he is now not looking strong in health.

Mr. Apothecary
T. Leonard.

(9.) The above, I trust, will be received with satisfaction, and gain credit for my Assistants, who are in every particular deserving of my commendation. The zeal and general good behaviour of my Sub-Assistants leave me nothing to wish for on that head. In reply to my last year's report, the Surveyor General expressed himself satisfied that Messrs. Harper, Adams and May were fully deserving of promotion, but had scarcely served a sufficient time in their present grade. I trust that now, with another year's valuable service and praiseworthy conduct, my recommendation for their promotion will be complied with.

General Remarks.

(11.) This document will be found less complete than I could wish, or than for previous years. Owing to my absence on leave, and the very long march which the whole Party had to make to our new recess quarters, we have not had the usual advantage of a long recess, and from other causes discussed above, I have not desired to complete my computations, which has been my rule hitherto never deviated from. Though not finally computed as yet, my advance triangulation is, if anything, greater than reported last year, when the Surveyor General remarked that it was not desirable to carry the triangulation so far in advance. I expect to have the computations well towards completion, if not quite so, before entering field duties again, and trust that the estimated quantities will be accepted on this occasion. After my rejunction with the Coast Series, which my present plans anticipate for the coming season, this tabular statement will be prepared, so as to shew the results as compared with that high standard. I believe that no other Survey has such extended operations, based entirely on triangulation of a secondary order, conducted altogether with its own instruments and appliances of a Topographical Survey establishment, and I look forward with interest and anxiety to a rejunction.

The results given in tabular form and recess duties.

The recess duties have been of the usual kind. The large amount of mapping has fully employed the whole Party, and will be completed, as usual. The computations and triangulation chart are always my own particular duty, and it is in these only that this report gives a want of completeness for the season. I have arranged and computed about 290 triangles, and expect a few more. Up to nearly 200, those triangles have been computed by Mr. Atkinson, as my duplicate, and latitudes, longitudes and azimuths to same extent finished by Mr. Harper, with Messrs. Chew, Rayner and Claudius as duplicates. Principal work has been computed, but awaits revision, after one unsatisfactory angle shall have been re-observed. The heights have not been commenced, but I hope to arrange the sheets before taking the field. The height of nearly every intersected point has been observed from two or more stations. My party has been in better than usual health this season, and in this respect will take the field in usual strength, a matter for great congratulation, for the country to be surveyed is extremely jungly and wild.

Recess duties.

(12.) It will be seen by the maps that my Topographical operations have extended well up to, and within, the country hereafter to be surveyed by the Revenue branch of the Department. My Trigonometrical stations are fixed all along within the cultivated plain, and a junction of the future Survey with mine will be effected without difficulty. I trust the maps will give you satisfaction. I believe them to be very carefully executed in the field, and the style of drawing of the fair maps I think worthy of commendation. The late Abdool Rahman's maps were secured by the Deputy Commissioner at Raipore, and despatched under special instructions from this Office, where they were received in good preservation. Some parts of the maps required finishing up. This duty, under my own supervision, was given to those best capable (from knowledge of the country) of shewing the rendering, as intended by Abdool Rahman. The maps and the field books were, however, so well kept that no difficulty was felt. The names of one village and one considerable nullah could not be made out, but they have been ascertained by reference (with illustrating sketch) to the Deputy Commissioner. Along the right bank of the Hasdo river, above latitude 22°, coal appears at different places, as shewn in Mr. Chew's map. The existence of coal in these parts was discovered in 1840, but the locality has never, I believe, been examined by a competent person. The country triangulated last year consists partly of the high country extending nearly parallel with the coast some 50 or 80 miles inland. It separates the plateau of Jeypore proper and Bustar (which are in a plain of about 2,000 feet above sea level) from the Collectorate District. Here and there are ghâts, by which access is gained to this high country, which is very picturesque, and apparently healthy. The valleys are all cultivated more or less, and sparsely inhabited. They run into each other, so as to admit of travelling without the necessity of much ascending or descending amongst the immense hills, which rise to upwards of 4,000 feet, and a little further south to 5,500. These higher lands extend for a width of 30 or 40 miles, where an abrupt descent of some 1,000 feet through dense jungles, leads into Jeypore, through which, and into Bustar, the

The country surveyed.

triangulation extends to about 82° longitude. The chief places, Jeypore and Bustar, were visited, and at the latter a station fixed close to the Rajah's Fort on the east side. The latitude and longitude are 19° 5' 28" 77 and 82° 4' 16" 56.

(13.) Through this area runs the Indrabati river, a chief tributary of the Godavery. The source of this river, and for some distance, until it enters this lower plateau, is given in my maps of two or three seasons ago. It runs towards the west through the northern part of Jeypore (some 18 miles to the north of the capital of that state), and then runs under the northern wall of the fort, wherein resides the Rajah of Bustar. Along its course the country is well cultivated, and is a happy contrast to the wild and jungly tracts which characterise these provinces. I have never elsewhere in India seen a river like this. There is always a considerable stream from bank to bank. Even in the driest season is there nowhere any sandy bed exposed to much extent.

(14.) I visited the falls on the river at Chitterkote, a village about 18 or 20 miles further west than Bustar Fort. I was much pleased with the sight. From the village of Chitterkote the river is very deep and still water, with the banks lined with a profusion of green, thick, fern beds, and a line of trees on either side overhanging the water. I proceeded in a small boat for a mile or so along this, to reach the fall where the whole body of water in one mass falls over a quite perpendicular rock into a deep basin. The perpendicular rock which I, by rough observation, make from 80 to 100 feet, runs in a semicircle of perhaps one-third of a mile. The height in the centre is very little lower than elsewhere, and during a flood the fall would extend over the greater part of this semicircle, and be a grand sight. I had a 5-inch theodolite with me for the purpose of taking the exact height, but I found difficulties, chiefly from want of time (as I did not encamp within many miles of the place), to prevent my taking any exact observations. I purpose visiting the same locality next season, and hope to then ascertain the exact height, which can be readily done with only a plumb-line.

(15.) Close to the falls the jungles are full of spotted deer, which roam about in large herds, under the security of the Rajah's prohibition against their destruction. There is a firm belief held by the people that these deer are charmed, proof against any attempt to kill one unless under the special permission of the Rajah. I particularly ascertained from the Rajah's agent, then with me, that this story was not in the least to be taken as an indication that the Rajah would dislike my attempting to shoot them; on the contrary, I was invited to try, and was told that the deer would not even flee when shot at, but still I should not bag one. The result, however, was that, during our return to camp, Mr. Claudius and I each got one.

(16.) I am sorry to state that again this year my intercourse with the Bustar Rajah was marred by untoward circumstances. He proposed an interview which, however, did not take place, as, on his coming to a place 143 yards from my tent, he refused to approach nearer, until I went to meet him; after giving him ample time to reflect, and feel the unpleasantness of his own position, I sent a message that he need not come on such terms, and away he went. At the next encamping ground my camp suffered from a total want of supplies, and no agent from the Rajah appeared; this difficulty was removed on my sending him a perwanah. I reported the circumstances to the Chief Commissioner, and the Rajah having received special warning on the subject, was fined 300 rupees. Specific orders have been given by Mr. Temple to regulate the procedure at a formal visit between a European Officer and this Rajah, and his pretensions were pronounced absurd. The fine however has since been remitted, as I learn, quite lately from the district officer, who now cordially promises every requisite aid for the future.

(17.) In the physical features of the country I past through last year, there is little more to notice, all being hills and jungles, waste and desolation, with the scantiest population sunk in ignorance and vice. The idea so common that contact with the European element is necessary to induce drunkenness amongst natives of India, is utterly absurd, as exemplified in my last season. Fairs are frequently held all over these provinces, and at these fairs the chief, almost only, trade, is, a bartering between a spirituous liquor made from the Mohwa fruit, and any other articles, chiefly the materials for making the liquor. At one place where I was encamped, at the close of the evening, a man very drunk rushed into camp, with a fearful wound from an axe. His wound was sewed up and dressed by Mr. Leonard, and he remained in my camp for the night, yelling in his pain, and drunken state. On marching away next morning, within a few yards from the encamping ground was found the body of a man, with the head completely severed. The uninjured members of this family party returning from the fair, have since been under trial for the murder, but it has been impossible to ascertain who struck the murderous blow. These are people who have no intercourse whatever with Europeans, and this happened during their season of comparative sobriety. Later in the year they have special indulgences in this vice, when men and women are all always drunk, and I anticipate from this cause considerable difficulty in the progress of our Survey. Police have been recently introduced into Jeypore, but with inconsistency curious to the uninitiated mind,

the police, under an East Indian inspector, whom I met both of the last two seasons, has just now been altogether removed from the immediately adjacent Bustar territory, where they had been on duty for several years.

(18.) Wild animals abound in these provinces. Tigers, especially, are very destructive, and villages deserted from this cause, are very frequent. At one place I was told that several tigers had just left that place after, during a short stay, killing as many as threescore persons; of course, such accounts are always greatly exaggerated, but I see very frequent indications of the presence of these animals. One night, a fine milch goat, tied to my own tent rope, was carried off; and, a very unusual thing in my field season, we were on the same ground a second night, and I had my other goat tied in the centre of the camp with the bullocks, and during the night we were all disturbed by two tigers passing through the camp. The moon was up, and they were distinctly seen standing not far from the elephant picketed just outside camp. Wild buffaloes and deer of all kinds are numerous, indeed, the country as yet seems to belong to them more than to a more civilized occupant.

EXTRACTS FROM NARRATIVE REPORT OF NO. 4 TOPOGRAPHICAL SURVEY PARTY,
BY CAPTAIN G. C. DEPREE, EXECUTIVE OFFICER IN CHARGE.

Para. 3. The operations during the year have been based on Colonel Waugh's Topographical System of Survey. Instructions, viz., a sufficient number of Trigonometrical stations having been fixed in advance by triangulation and computation, the details have been sketched in by the aid of the plane table, used in the manner general in this branch of the Department; and, in addition, in certain tracts of plain country destitute of hill stations, plane table stations have been fixed by the detail Surveyors by means of route Surveys, carried on with a perambulator and plane table, the latter being placed in azimuth by the "Back Ray" system. Every route has been made to emanate from, and close upon, Trigonometrical Stations.

(4.) The proposed plan for continuation of the triangulation was approved of by the Surveyor General, *vide* his No. 43 of 12th September, and was as follows:—The Calcutta Programme of Triangulation. Longitudinal of the Great Trigonometrical Survey, and the Kolhan Longitudinal Series of this Party, lying parallel to one another at sixty miles apart, to run principal meridional series between the two at each degree of longitude. It will be seen that a series along meridian 84° was symmetrically and successfully completed, and that the very peculiar character of the country on 84° , consisting of perfectly level plateau of many miles in extent, completely baffled all endeavours to carry on a series of large triangles, and that eventually a symmetrical series of very small quadrilaterals was run in a linear direction of seventy miles.

(5.) The country of Chota Nagpore being under systematic Survey from east to west, the detail Programme of detail. Surveyors were employed on the west of, and adjoining, the work of 1863-64, and it will be seen that every man, with one exception, executed an excellent season's work.

(6.) Messrs. Girdlestone and Bobanau, who had hitherto been employed on the detail, required to Course of instruction. be taught the process of carrying on triangulation, and to learn the use of Vernier instruments and signals, and they accompanied myself to the field, and rapidly became efficient.

(7.) The whole Party took the field on the 22nd November, and I proceeded to the station of Narrative of Triangulation Principal. Patal G. T. S., where I found the old platform and mark intact (as also that of Kasiatu H. S., G. T. S., subsequently), and I set up the new 14-inch theodolite for the first time. Considering that it was my duty to both select the stations, and observe the final angles at the same time, I progressed without great difficulty or mishap, and without finding it necessary to return to any station once visited; and, on the 7th January, I completed a symmetrical series of 7 triangles observed on 4 zeros L 0° and 18° , R 180° and 198° , which connected the Kolhan with the Calcutta Longitudinal Lohardagga Series. Series by the side Gaordhasa to Koonwari H. S., and Kasiatu to Patal H. S., respectively. This Series I call the Lohardagga Series.

(8.) Several futile attempts were made to carry any kind of secondary series from the Lohardagga Series westwards, towards 84° meridian, so as to fix therefrom as many tertiary points as might be. But in a range of hills, or pats, as is the generic name of such geological formations, running fifty miles north and south, I found but one gap of half a mile broad, all the rest being one dead level, and I passed through there, convinced that by no means can a series of large size be carried over such hills, covered as they are with forests of large saul timber.

(9.) Arrived on the other side of the barrier, after other futile attempts to lay out a Series according to ordinary procedure. I succeeded in observing a Series curved in Jushpur Series. outline of quadrilaterals of short sides of two to six miles, which, emanating from the side Bura to Kinbira of the Kolhan Series, stretches through the independent estate of Jushpur into the east part of Sirgoojah, and to the Jamira pat in Palamow. This I propose to call the Jushpur Series. The stations of this Series for a great part of its length lie on the inner edges of pats, which overhang the valley of the Naua River; they were selected by Mr. Girdlestone, who afterwards also arranged a similar and parallel approximate Series through the unknown high land of Khuria, from Odeypur to Sirgoojah. Mr. Girdlestone also observed on, after selection, four secondary stations, with a 6-inch theodolite, and fixed numerous tertiary points therefrom. The Jushpur Series was observed with a 10-inch instrument on 4 zeros L 0° and 30° , and R 180° and 210° . This closed the triangulation of theseason.

(11.) There have been computed out from the above triangulation 7 principal, 36 secondary, and 181 intersected points, which consist of the ordinary poles and brushes, or of single cleared trees of large size. With these 224 points about 4,000 square miles of ground have been covered. The triangulation of former year was somewhat overlapped, and of necessity; however, more than 4,000 square miles of ground remain ready for the detail Surveyors.

(12.) The comparison of the length of side Kasiatu to Patal, as obtained by the Calcutta Longitudinal Series and Lohardagga Series data, is given in the following Statement :—

Comparison of side Patal to Kasiatu, as derived from the Lohardagga Series and Calcutta Longitudinal Series.

	Name of station.	Height feet.	Latitude.	Longitude.	Azimuth.	Feet of side.	Logarithms of feet of side.	Azimuth.	Longitude.	Latitude.	Height feet.	Name of station.	
By Lohardagga Series.	Patal H.S.	2171.5	23 40 28.40	85 9 54.62	146 17 42.0	131589.4	5.1192210	146 17 42.0	85 9 54.62	23 40 28.40	2171.5	Patal H.S.	
By Calcutta Longitudinal Series.	Kasiatu H.S.	2650.4	23 58 32.47	84 56 47.21	326 12 23.8	131582.52	5.1191982	326 12 23.66	84 56 45.46	23 58 30.60	2650.4	Kasiatu H.S.	
Difference,	...	8.69	1.82	1.79	0.32	6.98	0.000228	0.14	1.75	1.87	6.29	...	
Remarks.													

It must be borne in mind that the Lohardagga Series is based on the "Kolhan Series," which is brought up from the "junction Series", which emanates from the side Adapal to Jhaighati H. S. of the

“Sumbulpore Longitudinal” Series G. T. Survey, a length of 190 miles, or including the “Sumbulpore,” the Coast, and the Calcutta Longitudinal Series,” an irregular quadrilateral figure has been formed of 750 miles periphery, and I think that the discrepancy of 6.88 feet in 24.921 miles is therefore small. The azimuths are curiously accordant, and the latitudes and longitudes differ by about 180 feet.

(13.) The heights of 102 stations have been determined, or about one in two the whole number of points; these include numerous important obligatory points, and places of note, such as Jushpur Nagar, Lohardagga,—stations on the banks of the principal rivers, and on plains, proving that the lowest level of the plateau of Chota Nagpore is nowhere less than 2,000 feet, and that it rises to 3,700 feet above sea level.

(14.) The Surveyors named below were employed throughout the season in the Chota Nagpore district, and in that small portion of the Singboom district still wanting to be completed. The block of work turned out is without gap, and lies immediately to the west and north of last year's work. The total number of square miles is 3,288, and in addition 293 square miles were executed by Mr. J. H. Wilson, Draftsman, but which have been rejected, owing to evidence of gross carelessness having been discovered in it.

(15.) To test the accuracy of the detail pertals were run by Messrs. Girdlestone and Babonau through the sections of the Surveyors named below. I believe that this is the first time that so crucial a test has been applied to the work of any Topographical Party. The former ran 58½ miles, and the latter 128 miles, the angular bearings being measured with a plane table, and the linear distances with a perambulator.

(16.) The order of merit which the comparison between field section and pertal gives is as shown below :—

1ST CLASS, ...	{	Mr. Wilson, Senior, tested by 38 miles of Pertal.	
		Mr. Vanderputt, do. 23 do.	
2ND CLASS, ...	{	Mr. Wyatt, senior, tested by 6 miles of Pertal.	
		„ Babonau, do. 12½ do.	
		„ M'Gill, do. 34½ do.	
		„ C. D'Cruz, do. 13½ do.	
3RD CLASS, ...	{	Mr. James, Senior, tested by 10½ miles of Pertal.	
		„ Dutt, do. 19 do.	
		„ Wilson, Junior, do. 29½ do.	
		Total miles of Pertal run 186½	

(17.) The coincidences between the pertals and the sections of Class I., are almost perfect. The field sections have been corrected to agree with the pertals. The existence of discrepancies will be shown by the paper of the sheet being rough from erasure.

(18.) On the completion of the triangulation on 11th March, I visited every Surveyor in succession excepting only Mr. Wilson, Junior, who employed at one end of the field had moved to the opposite end by the time I was able to reach his ground. In every case I ascended one or more hills, and tested in succession each hill feature, river, village, or cultivation, &c., in sight. Such a test occupied me from two to three hours, and, in any opinion, is a most searching one, especially as the hills selected were those not before visited by the Surveyor. In addition, I remained with each Surveyor two days on an average, and accompanied him on his day's work, testing his completed detail by setting up the board at random, and examining his expertness as a draftsman and surveyor at the same time.

(19.) The order of merit as to accuracy of detail which I determined upon after applying the above test agrees exactly with the order given in para. 16. The detail of Mr. Babonau was not subjected to this test.

(20.) I believe that the plane table sections now about to be submitted to you are of most excellent quality. All my endeavours have been bent during the last three years on securing accuracy. If hill features are deficient in spirit, it must be borne in mind that the hills are all covered with dense jungle, that no fancy work is admitted, and that every endeavour is made to represent them as they appear by true contour lines.

(21.) There is found to be some discrepancy between Mr. Wyatt's field section and that of M. S. Dutt of season 1862-63. A river and a road in Mr. Wyatt's section have been made to agree with the old work. They lie in a sparsely-inhabited country in the midst of dense jungle, with no convenient hills to set the table upon for the

Discrepancy with old detail.

purpose of sketching, and I think that it is not desirable to re-survey the ground. In all other respects the coincidence with old work is most satisfactory.

(24.) The following pergunnahs of Chota Nagpore have been surveyed, and others are still in hand. They mostly consist of open undulating ground not highly cultivated, except only those portions surveyed by Messrs. Vanderputt, Wyatt, and M. S. Dutt in part.

Chota Nagpore district.

Surveyed 1863-64.	{	1 Tamar,	Surveyed. 1864-65.	{	7 Sonpur,	13 Lochra.
		2 Rahe,			8 Basia,	14 Bano.
		3 Sillee,			9 Belsia,	15 Lodma.
		4 Boranda,			10 Sasia,	16 Belkadiah.
		5 Hajam Banta,			11 Aringi,	17 Umendanda.
		6 Bundu,			12 Palkot,	

(26.) I returned to quarters in Dorundah on the 12th April, and the other members of the party followed, the last being in on the 14th of May. Thus the field season lasted 5 months and 22 days of nearly incessant labour. The work lying close to the station of Dorundah, no time was lost in marching out to the ground.

Termination and duration
of the field season.

(28.) Messrs Wilson and Babonau have each been granted one month's privilege leave; M. S. Dutt three months, and I, myself, three months. Mr. Wyatt was also ordered to do duty with No. 5 Party for three months. The work has therefore fallen heavily on the hands of the other members of the party, who have one and all worked steadily and industriously.

Leave of absence.

(29.) Before availing myself of leave of absence, I arranged the principal and secondary triangles and some tertiaries, the remainder of which have been all arranged by Mr. Girdlestone, a duty which I consider very meritorious. Messrs. McGill, Babonau, and Girdlestone have shared in the final deductions consisting of

Computations.

7	Principal Triangles,	}	total 424	}	In duplicate.
50	Secondary,				
10	2nd Class Secondary,				
181	Tertiary,				
7	Principal Latitude and Longitude deductions double,	}	224		
29	Secondary do. do.,				
7	2nd Class Secondary, do.,				
181	Tertiary, do.,				
Pages 11	Alphabetical List,	}	In triplicate.		
Pages 16½	Synopsis of Latitudes, Longitude and Azimuths,				

(30.) The following computations will be submitted to your office :—

- 2 Complete sets of computations bound in large volume,
- 2 Horizontal Angle Books, original, 3¼ quires, 3 Verniers,
- 2 do. do. fair copy, do. do.,
- 2 Alphabetical Lists, villages of Pergunnahs.

(32.) Four degree sheets will be submitted containing the work of the present season. They are produced in this form, and are not retained until the sheet is complete, so that the result may be published as soon as possible. A triangulation chart on this scale has also been prepared including the works of two seasons 1863-64-65.

Fair copy Degree Sheet
1 inch = 4 miles scale.

(33.) 12 Sections 15' × 15' will be submitted all fully completed, besides the original pertals. Mr. Wilson's rejected sheets will be retained for comparison with the re-survey.

Field Sections.

(34.) The total expenditure of the party from 1st November, 1864, to 31st October, 1865, amounts to Rs. 47,470, which divided by 3,288, gives the rate of Rs. 14-7-0 per square mile including triangulation. The pay of an apothecary is also included, a necessary expense which no other party, except No. 3, is called upon to bear.

Total cost and rate per square mile.

(35.) In the field, sickness was less than usual. Mr. James, a recruit, fell ill with fever, and was unable to finish his work, Mr. Babonau however took it up. Mr. Wyatt continued at intervals to have attacks of yellow fever, which had affected him for a year, and which the recent considerate posting of him to the No. 5 Party seems to have now eradicated,

Health of the party.

and I hope he has become acclimated. During the recess the prompt attention given by Mr. Apothecary Hamilton, in medical charge of the party, to cases of fever, which occurred to a great extent amongst the civil and native establishments after return from the field, has, I am happy to say, averted all fatal occurrences.

(36.) For the two late years I have acknowledged the excellent services and ability of Mr. Girdlestone, Assistant Surveyor, and I beg to refer you to those two reports.
 Mr. F. B. Girdlestone. He is now well versed in the computations, has arranged and observed independent triangulation, and is acquainted with the use of Vernier theodolites. During my absence on leave he has conducted the duties of this office in a manner which redounds to his credit. The maps and computations have been well and systematically carried on, and the absence of all complaints proves his power of managing a large and varied establishment. I would add my conviction that after Mr. Girdlestone has gone through another season in the field and recess, he will be capable of conducting a Survey party with credit and success. In a word, except that he is not a finished draftsman, he possesses all the energy and qualifications demanded of an officer in charge of a Survey party.

(38.) Mr. Babonau has been engaged on the computation for the first time, and has proved himself unusually quick, correct and neat. He also understands Vernier instruments, and I notice his good services during the year.

(39.) Probationary Draftsman R. C. Chuckerberty has been dismissed, as nothing could be made of him, and two promising youths, Shama Churn Dass and Haradhun Dutt by name, have been entertained.

(40.) I anticipate that the country to be brought under triangulation will prove of an unusually jungly nature, and I fear much sickness will be met with; we are fortunate, however, in having a dry season. There will be considerable difficulty in obtaining supplies also, owing to the wild character of the greatest part of Surgoojah and Odeypur.

(43.) Complete lists of villages have been alphabetically arranged for the pergunnahs of Singbhoom, now completed, and will be submitted, one copy to the Commissioner of the Division, and one to your office; these have been arranged by the English writer B. V. Tripatty, and have been properly compared. As many pergunnahs as have been surveyed in Chota Nagpore have been similarly treated.

(45.) I bring this report to a close by stating that no arrears of maps or computations exist.

EXTRACTS FROM NARRATIVE REPORT OF NO. 5 TOPOGRAPHICAL PARTY, BY LIEUTENANT
W. G. MURRAY, EXECUTIVE OFFICER IN CHARGE.

(3.) Government had agreed to my proposition to carry on the Survey of Bundelkund, in addition to the Rewah Survey, and I therefore charged myself with reconnoitering and triangulating this new country, whilst all hands were employed on the topography of the Rewah State. I put all hands upon this, because I knew it was the last time we could hope to employ the whole of the seven months of field season upon Rewah topography, owing to the unhealthiness of the forest tracts across the Soane River, and our inability to enter upon their survey till January each year. Mr. Bell was also directed to finish a certain amount of plane tabling, and then try and finish the whole of the triangulation remaining unfinished in Rewah, or, in other words, to make the complete connection between Lieutenant Riddell's triangulation of 1863-64 and Major Wroughton's of Sohagpoor in 1837.

Upon first starting, Mr. Bell was desired to instruct Mr. Howard and Native Surveyor Nubbee Bux in plain tabling. Mr. Neale had Native Surveyor Prem Raj to teach, and I detached Native Surveyor Abdor Ruheem with Mr. Atkinson, till the 1st January, in the hope that he would certainly, by that time, know something about plane tabling. As Messrs. Antrobus and Howard, and Native Surveyors Nubbee Bux and Prem Raj, had been devoting several leisure hours at Chunar to learning the use of the plane table, and practicing in the small hills in its vicinity, I did not anticipate any very great difficulty or loss of time, and, I am happy to say, that the beginners this year commenced independent work sooner than I had ever known them to do.

(4.) We had great difficulty in procuring the necessary camels for the carriage of the baggage and office records, &c. A small detachment made their appearance on the 23rd October, and the next day I marched the whole camp to Mirzapoor; and the remaining camels coming in on the 26th, I marched next day to Lalgunj, the first march on the Rewah road, taking a few obligatory heights *en route*. I left the different assistants on their own plane tables.

I give the dates on which each assistant commenced independent work, and the dates on which they returned to recess quarters, so that at one glance the total of each man's exertions may be seen.

	Obligatory Heights.	Triangulation Begun.	Triangulation Finished.	Return to Quarters.
Lieutenant Murray, ...	28th October.	23rd January.	14th April.	29th April.
Mr. Bell, ... ..	...	22nd February.	19th April.	29th April.

	Topography Begun.	Topography Finished.	Return to Quarters.
Mr. Bell,	19th November.	19th January.	29th April.
„ Neale,	17th November.	15th May.	31st May.
„ Antrobus,	2nd November.	24th April.	9th May.
„ Atkinson,	31st October.	30th April.	9th May.
„ Hamer,	4th November.	20th April.	30th April.
„ Howard,	7th November.	15th May.	18th May.
„ Evans,	20th January, 1865.	15th May.	18th May.
<i>Native Surveyors.</i>			
Nubbee Bux,	18th November.	23rd April.	7th May.
Prem Raj,	1st November.	19th April.	6th May.
Abdor Ruheem,	10th January, 1865.	20th April.	29th April.

As I wanted to send the classics into some of the native states of Bundelkund to pole up and build stations, I deemed it expedient in the first instance to go round to Myhere, and start from there, and through the kindness of Captain E. P. Gurdon, Superintendent of Myhere, I was enabled to leave the heavy baggage there, and start off the men for the purpose above stated. I had hoped to have met the Surveyor General at Myhere, but, unfortunately, he passed by my camp without inspecting it; he had however most thoroughly done so on his road up-country, and I do not think any harm was done, or that there remained anything for him to see that he had not already examined minutely.

From Myhere I marched through Rewah, to Allahabad, and there made arrangements with the Collector for a speedy settlement of the boundary disputes; but, unfortunately, although he made every exertion, and sent out an assistant for this purpose, it was not done before we had surveyed it, if indeed it has ever yet been done. In a similar way, the Mirzapoor boundary was so bad, that Mr. Neale was compelled to let it alone, differences of 3 and 4 miles being common. This boundary work is very tedious, and, unless properly defined, very harassing, and I may with justice state that, unless the boundary is properly settled, defined, and marked with pillars or stones, our work is seriously impeded. I hear that this year, without fail, the boundaries are to be finished; but I fear they will not be done till our own work is first completed.

From Allahabad I marched through part of Rewah, round by the Mynha Ghat, through Uchera and Nagode, to Kalinjir, thence round by Punnah to Moorwara, where I made arrangements with Mr. Olpherts, the Civil Engineer and Resident of the East India Railway, to take some meteorological observations for me. I hope to be able to state that these have been taken with care and correctness. Moorwara is almost the most southern of our secondary stations, a few only in the Rewah jungles being to the south of it. At Moorwara the laying out of my triangulation for Bundelkund was completed, and I commenced the observations on the 23rd January, but, although I had only some 54 stations to visit, this duty was, owing to clouds and rain (by which I lost 30 days), not completed till the 14th April, when it was too late to inspect the assistants. Mr. Bell, too, who was to have inspected those in his vicinity, was so unwell, that he was obliged to leave work and camp, and hastened to join me at Mhowgunge, where medical advice was obtainable. Mr. Bell came in very much reduced, and with more than half his camp prostrated with jungle fever.

(5.) The triangulation this year was simple in character, merely the connection between the

Karrara and Amua Series and extension to the westward—this in Bundelkund.
 Plan of triangulation. In Rewah it was simply the connection between our own work of 1863-64 and Captain Wroughton's triangulation of Sohagpore. This latter connection was most successfully done by Mr. Bell, though, as stated above, it was not completely observed, owing to Mr. Bell and more than half of his camp being prostrated by fever. The former, however, was a much more difficult matter and, I regret to say, that a complete and satisfactory connection was not obtained, owing to the G. T. S. station of Naso being at one corner of a large flat-topped hill, covered with jungle, which completely blocked out the view to the west and south-west of it. I remedied this by a station at the north-west corner, and connecting with Naso, but the side is so short that I do not think it could safely be used, and I have consequently based all the Bundelkund work on sides of the revised Calcutta longitudinal and Amua Series. As the two portions of work are perfectly separate and distinct, there will be no confusion or annoyance arising from this. The total amount of triangulation completed this year was 3760·8 square miles, of which 2,200 was done by the officer in charge in the Bundelkund States, and 1560·8 by Mr. Bell, in Rewah. This now makes the total area triangulated up to date 10291·8 square miles, of which 8091·8 is in Rewah proper, and the rest in Bundelkund; moreover, the triangulation is now 5,705 in advance of the topography.

(6.) Lieutenant W. F. Badgley, Assistant Executive Officer, only joined me at the end of the field

Work done by Assistant Executive Officer.

season, at Mussoorie, and was present when the office opened at that place on the 11th May, 1865, so that I have nothing to record of his exertions in the field. Whilst in quarters, however, I am happy to be able to state that Lieutenant Badgley has cheerfully rendered me any and every assistance he could, whilst his unwearied exertions have had, I am sure, a good effect on the computers, who were more particularly under his eye. Lieutenant Badgley has been extremely quick in learning and picking up the several computations, and I can only state that, if his exertions in the field are as great as in the performance of his office duties (and of this I have no doubt), this Survey party will have gained a most valuable assistant.

(7.) The total amount of topography executed by the party, and brought into quarters as finish-

Area topographically surveyed and success of detail parties.

ed work, was 2986·2 square miles; but of this, I am sorry to have to state, that 225·1 square miles were rejected. This work, done by Mr. Autrobus, bore internal evidence of having been surveyed in a most careless and unsatisfactory manner—large water-courses, broken ground, spurs and ravines having been left out in a most

ruthless manner; and as, moreover, it disagreed with the work surveyed on the adjacent tables to an amount of sometimes $1\frac{1}{2}$ miles in the position of large drainage water-courses and chains of hills, I was compelled to bring it to you, with an intimation that I must reject it. This has, I regret to say, reduced our total area to 2761.1 square miles. Having been able to practice several of our new hands on the low hills near Chunar during the rains, they all went into camp with a pretty good knowledge of what they had to do, and the Civil Assistants, Messrs. Bell and Neale, had less trouble than usual in starting them on independent work, whilst the work done by them appears to me, for a first season's work, to be very creditable.

(8.) Mr. Bell, Civil Assistant, promoted to that grade by G. O. G. G., Home Department, No.

2,719 of the 24th March, 1865, has been working with the same zeal and energy he has ever done since he came into the party, now three years ago. During part of the last year's recess at Chunar, Mr. Bell was engaged during his leisure hours in teaching Mr. Howard and Native Surveyor Nubbee Bux in the use of the plane table. There are some low hills not far from the station, and both of these hands made very fair progress. When the party entered the field I continued this arrangement, and Mr. Bell was enabled to start two new hands on independent topography in the same time, that, in other years, it had taken to start one. On the 19th November Mr. Bell commenced his own work, and by the 17th December he had completed about 75 square miles, when Mr. Evans, a newly-appointed Sub-Assistant, joined him, and he taught him, and left him to finish the half table he was himself doing. By the 1st January Mr. Bell was free to help Mr. Howard, who had got into difficulties, and he then inspected Nubbee Bux, and proceeded, after again seeing Mr. Evans, across the Soane river, to the scene of his operations south of Karrara, and near Bando-ghur. Mr. Bell plane tabled in all about 98 square miles, reconnoitered and poled about 3,260 square miles, built and selected 36 stations, and had observed from 27 stations, horizontal angle book 72 pages, vertical angle book 54 pages, and his finished triangulation had extended over 1240.8 square miles, when he and his party were attacked on the borders of Bhokhar by jungle fever, which completely prostrated him and more than half of his whole camp; and at last, when he had lost all strength, and was reduced to great shifts to obtain food, he was compelled to come into my camp at Mhoungunge for medical treatment. Mr. Bell did not completely recover from the effects of this fever till July.

In office, Mr. Bell was placed in charge of the draftsmen, and in addition to inspection and assistance rendered in many ways, Mr. Bell completely finished two general maps, one with, and one without, shading, shaded up two general maps, which had their contours put in by others, and assisted in putting in the contours of one other, which was finished this year. Mr. Bell has now one general map in hand.

Mr. C. Neale, Civil Assistant, promoted by the same G. O. G. G. as Mr. Bell, has worked well during the season under review, and has also cheerfully rendered me any assistance he could. Like Mr. Bell during the recess at Chunar, he instructed Mr. Antrobus and Native Surveyor Prem Raj in plane tabling, and on arrival at the scene of operations in Rowah, had Prem Raj more particularly under his orders for instruction. This duty, I am happy to say, Mr. Neale has done most successfully, as the Native Surveyor has done a very good season's work.

Mr. Neale plane tabled 421.5 square miles, the whole of which lay in a most intricate and densely-wooded region, a third in the valley of the Adh, and two-thirds in the broken ground south of the Soane river; and as this work was done in a most masterly manner, I consider Mr. Neale deserves great credit for the large area he has surveyed, and for the hard and energetic way in which he must have worked to have done so.

In office, Mr. Neale was put upon the quarter-inch maps, and has himself projected and pentagraphed parts of 4, and completed the whole of 2, with the exception of the printing. He has also projected the 2 quarter-inch charts which accompanied the maps sent in. Mr. Neale has now 2 quarter-inch maps on hand. The index map sent in this year was also made out by Mr. Neale.

Mr. Atkinson, 2nd Class Sub-Assistant, had Native Surveyor Abdoor Ruheem attached to him for two months, and had to teach him the use of the instruments used in topographical surveying. After two months, Mr. Atkinson reported the Native Surveyor fit for independent work, and he accordingly started him on his own table on the 10th January.

Mr. Atkinson finished in all 400.5 square miles of very good topography, but from a habit of working in several places at distances apart, on the same table, he only brought in one complete plane table, as he fell sick, and could not connect all his various beginnings; and had it not been for Mr. Neale, who came to his assistance, I do not think he would have brought even one complete plane table into quarters. This way of working is very annoying, and risky to a degree, and I have accordingly pointed out to Mr. Atkinson the harm he does, and the risk he runs, by working in this disjointed manner, and requested him to discontinue it.

In quarters, Mr. Atkinson has been of use in inking up the streams and villages in two general maps, also a little contouring in general map No. III., and the entire printing of general map No. XII. He has worked well, but not sufficiently well to warrant me in recommending him for promotion before the time. He has just returned from one month's privilege leave to Calcutta.

Mr. C. F. Hamer, 3rd Class Sub-Assistant, has done 337 square miles of topography, which, though not very good, still has passed muster.

If Mr. Hamer would take a little more trouble and pains over his work, he would, I think, be a good topographical Surveyor, but he is not very zealous over his work, and this, with a strong wish to generalize, leads him to send in work inferior to what, with his abilities, he ought to turn out as finished topography.

In office, Mr. Hamer was engaged in computing latitudes, longitudes, and secondary triangles against Lieutenant Badgley. He also has just returned from a month's leave to Calcutta.

Mr. A. D. Howard, 3rd Class Sub-Assistant, has, although this is his first season's work, completed 447.5 square miles of very accurate, though, in most places, very easy topography. Having a taste for the work, he easily and early mastered the principles, and all that is now required to make him a really good plane tabler is a little more practice in drawing.

In office, Mr. Howard has been computing with Mr. Evans, latitudes, longitudes, and all the heights.

Mr. Evans, 3rd Class Sub-Assistant, has only completed 89.7 square miles, but the reason of this is, that he did not commence independent work till the 20th January, and then his work was one of the most difficult and intricate a new hand was ever placed upon. I am quite satisfied with the amount Mr. Evans did.

In office, Mr. Evans has computed against Mr. Howard, latitudes, longitudes, and height of poles and stations. I must bring to your notice the zeal and energy displayed by both these young men, Messrs. Howard and Evans. In the field they are hard-workers, and always ready for any amount of work or privation. In office, for months, I have seen them working an hour before the time, and they generally used to be the last to leave. They are conscientious and steady workers both in field and office, and I trust I shall be able to have them promoted after this field season.

Mr. Ryan has only just joined, but I think he promises well.

Native Surveyor Nubbee Bux has also worked hard and well. His plane tabling looks good, but it may possibly be generalized too much. He has completed in all 390.5 square miles of topography. In office, he has worked very well, and with great energy, he outlined 2 whole, and half of one general map, and nearly all the contouring of general map No. XII., and printed all the names of the two quarter-inch maps and charts.

Native Surveyor Prem Raj traced the whole of the general maps, and outlined the greater part of one besides. In the field he surveyed 315.6 square miles of topography of a difficult nature.

Native Surveyor Abdool Ruheem completed 125.5 square miles of topography, which, for a beginner, was very good. In office he was employed in printing up one general map, outlining one also, and the names in the original plane table sheets.

Native Surveyor Abdool Ruhman came up during the office time from Calcutta. He printed the names in two general maps and in the index chart, and assisted also in various ways in the drafting office.

Native Surveyor Ali Ahmed is not a plane table Surveyor, but he is now useful in reconnoitering, poling up, and building stations. He built 18 stations, and poled up a large area in Bijragooghur, which now will not be required. He was also with Mr. Bell as recorder.

In office he has been very useful in copying angle books, and doing odds and ends of work, which would otherwise have taken up valuable time.

Baboo Gooroodoss Gangooly was my recorder in the field, and during the recess he has been copying angle books, and making an alphabetical list of the villages in Rewah, with their latitudes, longitudes, and number of houses.

(9.) The duty of inspecting the Assistant's work is more than the officer in charge can properly do; that is, if he has much triangulation to do, or has no military assistant to help him. The amount of inspection during the year under review, although laid out carefully, fell far short of what was intended, as a month was lost

during the time of observations, which put back the completion of my work from the 15th March to the 15th April; and Mr. Bell was delayed by rain and sickness, till, at length, he and his camp were prostrated with violent jungle fever.

Something was done; Mr. Antrobus was started on his own table by Mr. Bell and myself, who worked two days with him; and again, on my return from Myhere, I inspected him, and worked another day with him.

I also inspected Mr. Howard shortly after he was left by Mr. Bell, and found his work most satisfactory. Mr. Bell also at various times inspected Messrs. Howard and Evans, and Native Surveyor Nubbee Bux. Mr. Neale also inspected Prem Raj several times, and looked over parts of Messrs. Atkinson and Hamer's plane tables, and Native Surveyor Nubbee Bux's work on the Soane river.

(10.) The party took the field on the 24th October, 1864, and worked on till May, and taking the 15th May as a mean of the return of the party into quarters, the duration of the field season was 7 months all but 6 days.

(11.) The Kymore range of hills, of which nearly all that lies in Rewah has been plane tabled, is most peculiar. In some parts it is flat-topped, but scarcely even for three miles the same in character. The Rewah scarp, which we have followed up till it joins the Bundlecund States, and becomes broken up, emanates from the Kymore, and is very nearly the same height in parts.

In Rewah the Kymore is only broken in three places by drainage lines.

The Soane River runs through most of the work done this year. Near its banks, as a rule, the ravines are thick and heavy. A large fertile and well-cultivated plane lies between the Soane and the Kymore range, and till at Bomarsen the river breaks through the Kymore range, that lies also between the Kymore and the Soane. The country across the Soane, as far as we have yet seen, is a confused mass of broken hills, running for the most part in ranges, but exhibiting various and strange forms; some are so knife-like at top that we had the greatest difficulty in putting up stations upon them; some so rugged and precipitous that we could not get up to put even a survey mark upon them; some again with broad flat tops, which effectually blocked out the view in every direction, and as all these are densely covered with jungle, and with the villages sparsely scattered in the valleys, which are here and there, I am sure we will get credit for the survey of such a difficult country.

In Bundlecund, the greater part of the work done this year was over the Bundair hills, and across the Nagode and Kotee plains of the Satna, to the Punnah and Burringpoor hills. The Bundair range is a high plateau of about 700 feet, with undulating forest land on the top, pretty fairly populated, and peaky in parts.

The Satna valley is one dense mass of villages, topes and cultivation, with even undulations, and one of the most difficult places to carry a triangulation across I ever saw.

The Punnah hills are gently sloping from the south, then table-land, and ending up with a deep scarp to the north.

The states in Bundlecund are so divided and interlaced, and the boundaries between them so unsettled and undefined, that I anticipate great difficulty in getting this most necessary duty satisfactorily performed.

(12.) The computations done this year show that our work is slightly better than last year's.

Our 12 principal triangles show an error of $\cdot 707$ inches per mile, and a triangular error of $5''\cdot 89$.

Our 172 secondary triangles show an error of $4\cdot 25$ inches per mile, and a triangular error of $8''\cdot 89$.

Our 517 minor secondary triangles show an error of $6\cdot 65$ inches per mile, whilst the mean of 7 ray traces give $4''\cdot 9$ inches per mile.

The latitude and longitudes of 9 principal and 63 secondary stations were computed with double and triple values.

The height of 15 principal and 344 secondary stations and points were also computed with sometimes 3 or 4 values for one point.

The heights of 14 points, inaccessible to ordinary triangulation, were obtained by means of a 20 feet staff.

8 General maps have been finished and sent in.

5 General maps are now in hand outlined, and partly contoured.

2 Quarter-inch maps have been finished and sent in, and the charts to accompany the same have also been put in ; these charts show the triangulation necessary for each quarter-inch map.

4 Quarter-inch maps will, I trust, be finished and sent in this year.

An index map has also been prepared and sent in, showing at one glance the numbers of the plane tables, general maps and quarter-inch maps and charts, as also the principal divisions of the Bundelcund States. The angle books are *all* ready in duplicate.

(13.) The general health of this party has, on the whole, been good, although we have had several deaths, and scarcely a soul in camp has escaped free ; but this has been caused by an endemic fever, which has not, I think, impaired the tone and general health of the men. All, with one or two exceptions, now seem to be in the highest state of efficiency, and ready for the season's work.

(14.) The areatriangulated this field season was 3,760·8 square miles, and the total done up to date is 10,291·8 square miles.

(15.) The area plane tabled and accepted this field season was 2,761·1 square miles, and the total done up to date is 4,586·0 square miles.

(16.) The total cost during the season under review, *i.e.*, from 1st October, 1864, to the 30th September, 1865, amounts to Rs. 49,637·2·9, which for the amount finished, 2,761·1 square miles, gives an average of Rs. 17·15·8 per square mile. The triangulation has cost Rs. 20,824·5·8, and as the amount triangulated was 3,760·8 square miles, gives an average of Rs. 5·8·8 for that alone.

(18.) In conclusion, I would beg to bring to your notice the general good conduct of all the members of the party now with it. I am glad to be able to record my thanks to almost all the members for the way in which they have worked, and the assistance they have always cordially rendered me.

To Lieutenant Badgley, Messrs. Bell, Neale, Howard and Evans, and Native Surveyor Nubbeo Bux, my thanks are more pre-eminently due, not only for the way they have worked, but for the good example in all matters of discipline and professional routine they have shown.

EXTRACT FROM NARRATIVE REPORT OF CAPTAIN H. H. GODWIN-AUSTEN, EXECUTIVE
OFFICER IN CHARGE BHOOTAN SURVEY PARTY.

Para. 1. Agreeably to orders received, I left Calcutta on the 27th October, 1864, to join the right column of the Bhootan Field Force, arriving on the 19th November at Gowhatty. I found orders there to join the left column, under Brigadier-General Dunsford, C.B., and left that place on 20th in native boat for Doobri. On my way down the Bhramahputra I visited several G. T. stations of the Assam Series, and observed from Jogigopas Bhoirab. I was thus enabled to fix several peaks and hills in the Bhootan mountains, for future work in the Dooars. Proceeding as rapidly as I could obtain carriage, I reached Cooch Behar on the 1st December, Julpygori on the 4th, and Dalingkoto on the 5th. Was present at the capture of that place, remaining with General Dunsford the whole day, and was mentioned by him in his despatch as having been of assistance. On the 9th and 10th I went, at the General's request, to look for a road to Tsakamchu direct, at foot of hills; and having found it, returned to Dalingkote. From 14th to 19th proceeded to, and remained at, Kyranti, in hopes of being able to fix points on the hills for future work. This I was unable to do, by reason of the dense haze that hid the hills. I rejoined the left column on the 20th at foot of hills, in order to march with it to Tondoo and Chamoorchi. All the survey work I was able to do, being rough sketches of the route we took. It was not until after the capture of Chamoorchi, that I was enabled to leave the force, and begin regular work; for up to that time Brigadier-General Dunsford desired me to remain with him, and I was mentioned again by the General after the taking of Chamoorchi. On the 2nd January I left the column, and made route surveys about Ambari, Huldabari, and on to Ramshai Hât, into Minagori. I was employed up to the 16th in fixing points on the hills from that place, Julpygori G. T. S., and Kyranti, returning to Tondoo on the 18th January. I then proceeded to Sipchu and the Jangtsa valley; ascended to the Gyepmochi range at the Pango La, and sketched in the whole of the upper drainage of the Dechu, or Jholdaka river, returning to Tondoo on the 26th, after clearing the jungles off a spot on high cliff for a station, to facilitate the sketching in of the country on the west. I left Tondoo on the 30th, and from that time, until the 8th, surveyed the country from the Jholdaka to the Tsel river, down to the latitude of Ramsahai Hât; and, in order to fix that place, misty weather coming on, I ran a route survey thence to Minagori; I had also to make arrangements about thirty calashies, who had been sent down from Dera, and was also in hopes of meeting Mr. O'Donel, of the Revenue Survey, to whom I was directed to give some instructions. At Minagori I got fever; but when strong again, I finished the route into Julpygori, to connect with a fixed station. Marched for Ambari, near Chamoorchi, on the 22nd. The rain which now fell about this time much impeded work; but by the 6th March I had surveyed the northern portion of the Chamoorchi Dooar. On the 7th I reached Rungali Bujna, worked in the hills and country near that on the 8th and 9th, surveying on to Balla on 10th and 11th. I left to finish, while fine clear weather lasted, the remaining portion of the Lakhipur and Chamoorchi Dooars on the 12th, and had finished the whole, up to the old frontier line of Bhootan, as far as Fallacotta eastward, on the 18th, and by 19th March the whole of the Dooars west of the Torsa were completed, the rich portion near Julpygori-Kyranti, &c., being left to the Revenue Party. On account of the haze, which now entirely obscured the hills, even at a distance of 6 or 8 miles, I had to put the plane table on one side, and commence the slow and fatiguing process of route or traverse survey with chain; by which means I have, since the 20th up to the present time, surveyed the Dooars, up to the Gorum and Paro rivers, as far east as Alipur, near Chichacotta. Of the mountains, these have been sketched in, and all points fixed in them that were conspicuous, up as far as Balla, where I have connected the Torsa with the Ammochu river, in my work of last year with the Bhootan Mission. By reason of the haze before mentioned I have not been able to make much out of the hills between Balla and Buxa; and, until it clears, shall not be able to do so. It is useless to go into them, or near them, at present, for nothing can be seen, or position on plane table fixed. I now propose continuing the route, surveying to Buxa, and the country to the north and east of Chichacotta. These routes will also have to be connected with a fixed trigonometrical station near Kooch Behar, so that the latitude and longitude can be worked out, and the places plotted correctly into map. I trust to finish the Dooars, and the hills on the north, up to the Gudhadhur, or to longitude 90° this season; but I do not think I can get further before the rains. The area now mapped is about 2,000 square miles, on a scale of 4 miles to the inch—this, I trust, His Excellency the Viceroy will consider a fair average quantity. I have been unable to obtain the services of any qualified officer with the force,—much more would have been done with an able assistant, and one long used to the plane table. I also trust that the very close nature of some parts of the country be taken into consideration, when judging of the above amount of work, covered, as most parts are, with high grass, or forest trees, and intersected with innumerable streams and dry nullahs.

EXTRACT FROM NARRATIVE REPORT OF NO. 6 TOPOGRAPHICAL SURVEY PARTY, BY LIEUTENANT
R. V. RIDDELL, R.E., EXECUTIVE OFFICER IN CHARGE.

Para. 5. I left Cherrapoonjee on the 14th December, and inspecting Mr. Craven's work *en route*, proceeded to Shillong to instruct Mr. 3rd Class Sub-Assistant C. Low and Native Surveyor Nusseerooddeen in the use of the plane table, but, on the 22nd of December, while at Shillong, having received instructions from the Surveyor General in his No. 60 B, dated 8th December, 1864, to push on the survey of the new station of Shillong, on the scale of 12 inches = one mile, I was obliged to give up part of my plan of operations, and returned to Cherrapoonjee to prepare the boards necessary for this survey.

(7.) I observed at the G. T. Survey stations of Laidera and Maotherichan, to furnish a few points for plane table 31. I then proceeded to reconnoitre the country to the west of Maotherichan H. S., and northwards, as far as the valley of the Brahmapootra, with a view to extending a polygonal series of principal triangulation westward, the centre stations to be nearly in the same parallel as Maotherichan, and to be connected by a secondary triangulation with the Assam Longitudinal Series; the starting points being Mosingi H. S., Maotherichan H. S., and Mopon H. S., principal stations of the Sylhet and Cherrapoonjee G. T. Series. For this purpose I selected the stations of Suaiang, Lanbersat, Nongsingriang, Langdekar, and Mokullun for principal stations, leaving Mr. Belletty to select the two principal stations of Rangthang and Kokhlam, and to extend a secondary triangulation to the foot of the hills, on the boundary of the Sylhet district.

(8.) By the middle of February I had selected all the stations north of the parallel of $25^{\circ} 30'$ north latitude requisite to include the ground up to the Garrow territory; and leaving detachments of *klassies* at various places to build platforms and erect poles, I returned to Shillong by the Assam Dooars and Gowhatty trunk road, and inspected the detail survey of Shillong, which was being carried on by Messrs. Atkinson, Low, and Native Surveyor Nusseerooddeen.

(9.) Wishing to be out of the *terai* bordering on the plains of the valley of the Brahmapootra as early in the season as possible, and having been already delayed beyond expectation by the quantity of jungle which had to be cleared, and by the scarcity of roads, and all information connected with them, I commenced observations with the 14-inch theodolite on the 11th March at the G. T. Survey station of Maopani, and proceeded thence to the stations of Umter, Tepkilabama, Mokerson Mopon, which are situated in low ground, and thence to Lando Modo (which is at an elevation of about 5,000 feet) on the 27th March. During the following fortnight nearly two-thirds of my camp, as well as myself, were prostrated by fever of a most malignant nature; few of those attacked, who are now here, have thoroughly recovered, even at the present time, after a lapse of nearly six months.

(10.) Owing to the delay occasioned by so much sickness, I was unable to proceed to the stations of Langdekar, Mokullun, Nonkani, and Langturi, and the total area triangulated amounted to 1,550 square miles only, of which 650 are due to Mr. Belletty's exertions.

(11.) It is impossible to give an opinion on the quality of this work at present, as the checks are very few. The angular error of the principal triangles is $2^{\circ} 06'$ seconds per triangle, and the linear error in the minor secondary triangles, from observations with the 14-inch theodolite, 9.5 inches per mile.

(12.) The detail parties were, on the whole, not very successful, the area surveyed in detail being only about 600 square miles, of which 245 were done by Mr. J. A. Craven, who was the only assistant present with the party, from the commencement of the field season, who had any previous experience in surveying hilly tracts. The remaining quantity required the united efforts of Mr. J. B. Landeman and Native Surveyor Nusseerooddeen for about $4\frac{1}{2}$ months, Mr. H. M. Atkinson for about $1\frac{1}{2}$ months, and Mr. C. Low for 3 months; but, in connection with this, it must be remembered that from the middle of the month of April until the final return of all these detail parties, none of them could carry on their work for two days out of three on account of the frequent heavy, and nearly constant, fall of rain. Had it not been that without the completion of plane table 31, even one sheet of the fair map could not have been finished. I should have recalled the whole party from the field at the end of April.

The survey of the new sanatorium of Shillong took as much labor as would have occupied two detail Surveyors during the whole season.

(13.) I inspected Mr. Craven's work on the 15th December, and being satisfied that that gentleman was fully competent to execute the work allotted to him, I did not again inspect his work till the end of May, by which time he had finished it in a very satisfactory manner, and very carefully.

(16.) The field season extended from the 1st December, 1864, until the 10th June, 1865 (6 months and 10 days), but all the members of the party were not in the field during the whole of that period, partly on account of sickness, and partly that no work was laid out, except in the low ground at the foot of the hills, where none could have worked after the rains had commenced.

(17.) The commencement of the field season depends on the period of the cessation of the rains, which, I am given to understand, extend through the month of October; and as the field season could not often be extended beyond the middle of April (and only then so long as the operations on the high, and generally open, ground free from jungle, about the high spurs of the hills, remains incompleted), it appears probable that the duration of the field season would seldom be more than 5 months. The low jungly tracts cannot be visited with safety for a continued period before the middle of December, and the experience of the present season has shewn that such tracts ought to be vacated by the middle of March.

(18.) Mr. Senior Civil Assistant N. A. Belletty was directed to select the spots, and build platforms for two principal stations, Rangthang and Kokhland, and to extend from these and the G. T. S. principal stations of Thanginath and Mosingi a secondary triangulation to the boundary of the Kossyah territory, towards the south, or Sylhet district, and to break up the ground, south of the parallel $25^{\circ} 30'$ north latitude between the principal stations, by a secondary and minor triangulation. This he executed between the parallels of $25^{\circ} 15'$ and $25^{\circ} 30'$ north latitude, and as far west as the meridian of $91^{\circ} 10'$ east longitude—an area of about 650 square miles; and, considering that he had only a 7-inch theodolite for all his work, (except the observation of the angles of the principal triangles at Rangthang and Mosingi) the results are very satisfactory. Mr. Belletty selected three tilas (or small hillocks) in the plains at the foot of the hills, as secondary stations, and had the jungle cleared; but this was such heavy work, and occupied so much time, at almost every station selected over at least two-thirds of the ground that Mr. Belletty was overtaken by the rains before he had completed the observations at four of his most important stations on the higher and comparatively healthy ground; these occupied him for nearly a month, and he returned to recess quarters on the 17th May, after which it was impossible to carry on any farther operations in the low ground. Mr. Belletty has been employed on the computations, charts, &c., during the whole of the recess.

(19.) Mr. H. M. Atkinson was transferred from the office of the Surveyor General of India, and arrived at Cherrapoonjee on the 18th December, 1864. After making himself useful in projecting tables for the Shillong survey, he proceeded to Shillong, and commenced instructing Mr. C. Low and Native Surveyor Nusseerooddeen in the use of the plane table. He was employed on the Shillong survey until about the middle of April, after which he was relieved by Mr. Craven, and proceeded to take up a portion of the work allotted to Mr. Landeman, on which he was employed till the 10th June, completing the detail survey of about 40 square miles.

Mr. Atkinson has been employed since he returned to recess quarters in finishing up the original sheets of the Shillong survey, and making two fair copies of the same, and a trace for the local authorities, which was received by them on the 15th September. In this portion of the work he displayed considerable application, and has worked to my satisfaction during the entire recess.

(20.) Mr. J. A. Craven joined this party from the Chota Nagpore survey on the 21st November; took the field on the 5th of December; completed the detail survey of 245 square miles of intricate ground in a most satisfactory manner by the end of April, after which he relieved Mr. Atkinson at Shillong, and completed the survey of that station after a fortnight. After finishing up his plane table in recess quarters, he resigned his appointment in this Department. Mr. Craven fully sustained the character he had gained from Captain Depree.

(21.) Mr. Landeman obtained leave of absence for six weeks on medical certificate, while in Calcutta, *en route* from the recess quarters of No. 5 Party. He joined the head-quarters of this party on the 7th January, and proceeded to take up the work allotted to him. His progress was slow as he succeeded in completing the survey of 180 square miles. His health was not good when he arrived, and the country presented difficulties to which he had hitherto been unaccustomed. He has been employed during the recess on the computations, and on a duplicate copy of sheet No. 16 of the fair map, which he will, however, not be able to finish before the field season.

(22.) Mr. C. Low completed about 60 square miles of detail survey during the field season, and has been employed on the computations during the recess.

Mr. Low has been suffering in health repeatedly, which, perhaps, was the cause of his small output during the field season.

(23.) Native Surveyor Nusseerooddeen completed 75 square miles of detail survey in a very promising manner, for a first season's work; and during the recess completed entirely, with the exception of some contouring, the whole of sheet No. 16 of the fair map, very satisfactorily.

(24.) The operations of the past season were almost entirely confined to that portion of the Kossyah territory proper, lying to the west of the trunk road between Syllhet and Gowhatty. The highest ridge of this spur of hills runs nearly parallel with the parallel of $25^{\circ} 30'$ north latitude, Shillong G. T. Station being the highest point as yet known. From this to Matherichan G. T. S., and between Dinghie Maopani and Lando Modo G. T. S. stations, the fall is slight, and the general features of the country are small, consisting of an intricate mass of bare rounded hillocks. Between Maopani and Lando Modo lies the spring of a large valley, in which runs in a N. W. direction one of the chief tributaries of the Koolsee river, issuing from the hills near Bardooar. On the north side of Nunlow dāk bungalow, Maopani Lando Modo hill station, there is an abrupt fall in the general run of the country of about 2,000 feet, and west of Matherichan and Lando Modo nearly the same abrupt fall exists. The ridge on which the station of Lanbusat is built running in a north-westerly direction from the water-shed between the plains of Bengal and the valley of Assam. The whole country to the west of Mokersa village, at the foot of the hill on which Matherichan is situated, slopes away to the west, and is nearly free of jungle as far as the meridian of $91^{\circ} 10'$, with the exception of small patches of forest in sheltered valleys, and on the top of Lanbersat hill. West of this the jungle is dense, consisting of a variety of forest timber, bamboo jungle, and a dense undergrowth of bamboo, cane, reed-grass some nine or ten feet high, brambles, &c., as far as could be seen, and generally this exists below a level of 3,000 feet, above which but little timber is seen.

(26.) The only made road is the old trunk road from Terria Ghat, at the foot of the hills, whence the ascent to Cherrapoonjee commences; this road is paved nearly the whole way up, a distance of about nine miles, with an ascent of 4,000 feet.

From Cherrapoonjee the ascent to the village of Lairingao, a distance of 5 miles, is about 1,000 feet; no considerable fall is met with before the descent to the Kalapani, about $1\frac{1}{2}$ miles beyond the Surrarim dāk bungalow, where the road to Lailankot branches off from the Gowhatty road. Some 500 feet below this point the Kalapani runs; the descent to it, and subsequent ascent, are very steep; beyond this the road follows the winding of a stream, called the Unyand, over about $2\frac{1}{2}$ miles of nearly level ground, between wild scarps and disturbed masses of rock. On the east of this road, distant about half a mile, lies the village of Maobeh Larkhar, where Mr. Belletty, Civil Assistant, during the season 1863-64, found coal cropping out on the side of the hill above the Kalapani, and about 300 yards S.E. of the village. This was reported to the Deputy Commissioner, Major Bivar, at the time, and now the dāk bungalow at Moflong and Shillong are supplied with coal from this place. This will, doubtless, form a source of advantage to the future residents at Shillong, unless coal should be discovered in any quantity at a less distance. Mr. Belletty found some nuggets of coal in the Kinchi, S.W. of Nongsingriang, and some was also seen south of Kokhlain, on the road to Laour.

The road then descends down 1,500 feet, to the Bogapani, over which a slight bridge is suspended by canes fastened to the trees on the banks; the ascent to Moflong is steep and tedious, the Moflong dāk bungalow standing some 2,000 feet higher than the suspension bridge. From Moflong to Shillong the roads follow easy slopes, which are, however, excessively slippery during the rains. Between Moflong and Mairang, 14 miles, three or four deep valleys are crossed. Mairang and Nunklow, 11 miles, is a comparatively level road; but the fall from Nunklow to the Barapani suspension bridge is very abrupt. About two miles beyond this the terai commences, and in many places the road is completely arched over by a mass of bamboos; the undulations of this part of the country are all easy, until the descent from the Jyrang dāk bungalow to the plains.

On the high ground, in the centre portion of these hills, there are numberless footpaths, most of them passable to ponies, between all the villages; but in the terai there are very few. The people in these unhealthy parts are almost of a different race to the Kossiahs, and sometimes called Garrows, or Kossiah Garrows, and rely on the bazars and hauts of the Assam Dooars for their food.

The Kossiahs have a great dread of these places, and will not even pass through them as coolies during the unhealthy season, except for strong temptations of high wages.

(27.) The inhabitants of the villages in the jungle tracts have a great objection to carrying loads, beyond their own small requisites, and the Kossiah coolies from the Potalo districts will at present not go so far beyond the villages where their own language is spoken.

(28.) A great difficulty arises from the objection of almost all Kossiahs to take medicine; few will touch it, till fever has reduced them to utter helplessness. Two of those with me refused, although they could scarcely stand, to take any, but persisted in going away to their houses to sacrifice fowls and goats; both of these, I heard, were dead a week after they left my camp; after this I had less difficulty in persuading them to swallow medicine, but they would not ask for it, till much too late.

(29.) West of Nongstein, near the principal station of Nongsingriang, the people assume a different dialect to that spoken by the Kossiahs of Cherrapoonjee, Moflong, Nunklow, Rambri, and intervening

places. In the village of Nongstain itself, which is the residence of the rajah of the large district of the same name, few of the people understood the Kossiah coolies of my camp; and near the principal station of the Langdekar, the inhabitants are totally different in appearance, language and dress, and have no agricultural implements beyond a dao (a kind of axe), with which they dig and hoe their small fields.

These people show a great liking for colored beads, of which the women wear as many strings as they can heap between their shoulders and ears, if they can procure them, and both sexes wear numbers of large brass earrings. I have counted over thirty rings, forming a bunch as large as two turkeys' eggs, hanging from a man's ears; their features are consequently hideously deformed. They are a smaller race than the Kossiahs, as far as I saw. They barter cotton and coarse silk for iron, rice, and dried fish at the Nongstein bazar, where many of them are seen.

(30.) The inhabitants of the two or three Garrow villages I visited seemed very timid and suspicious; they deserted their villages on my arrival, and remained hid in the jungle for two or three nights, until I succeeded in catching one of them, and explaining that no harm was intended.

(31.) As far west as Matherichan, on the high ground, potatoes and a coarse kind of grain are the chief products; further west rice, a kind of pulse, Indian corn, and here and there a few yams are cultivated. But, except near a few of the larger villages, all these products are in small quantities, and scarcely more than sufficient for the wants of the inhabitants; dried fish are brought up from the foot of the hills.

(32.) To the poor description of food a great portion of the sickness experienced by the native part of the party may be attributed. A few of them were accustomed to feed on rice only; those men fared best who were not troubled with much caste, but would eat meat when they could procure it, and take a moderate amount of spirits, which the inhabitants consume largely.

(33.) The health of the native portion of the establishment, as far as those are concerned who are now here, is very unsatisfactory. There are about 25 men here, and out of these 8 or 10 have a very sickly appearance. Those who return from leave will probably be in good health; but as I gave them leave till the 30th of October, I cannot at present be certain of the efficiency of the party at the time of taking the field.

REPORT OF THE OPERATIONS OF THE PEGU SURVEY FOR THE YEAR 1864-65, BY CAPTAIN
W. H. EDGCOMBE, R.E., OFFICIATING SUPERINTENDENT.

A narrative of the operations of the Pegu Survey up to 30th November, 1864, having been submitted by my predecessor, Captain Fitzroy, R.A., it will only be necessary, in Introductory. compiling a report of the work of past official year, to notice briefly as much of the above-mentioned narrative as touches on the operations of 1864-65, and to supplement it with an account of subsequent operations, up to 1st May of current year.

The work accomplished in the year under notice will be best understood by treating it under two heads, viz.: work during recess (May, 1864, to December, 1864); work of field season (December, 1864, to April, 1865).

(2.) The recess work consisted in the completion of all computations, calculations, and plotting of previous season's field work, and compiling the same to the extent of over 5,000 square miles on No. 4 sheet of the general map, together with a portion of the work of the field season 1863, comprising the lower half of the same sheet.

This sheet embraces an area of 7689.76 square miles, and includes nearly the whole of the Prome and Myanoung Districts, with a portion of the District of Bassein, and about 2,500 square miles in Arracan.

(3.) For the work of the field season the strength of the establishment was as follows:—One Assistant (Mr. Montgomerie), *vice* Lieutenant Bagge, R.E., removed on 17th December, 1864, for special employ on Siam and Tenasserim Boundaries); two Sub-Assistants (Messrs. Barnett and Cooper), and fourteen Native Surveyors.

(4.) The Sub-Assistants and Native Surveyors left Rangoon on different dates, between 8th and 24th December, 1864, but Mr. Montgomerie did not join the Department till December, 1864, and could not be dispatched till 21st March, 1865.

(5.) The Superintendent (Captain Fitzroy) was unable to take the field, having obtained sick leave to England. He was relieved by me on 16th March, 1865, too late to be of much service in the jungles, even had I not been specially detained in Rangoon by the Surveyor General's order.

(6.) The work of the season under review has been almost entirely confined to the Tounggoo District, though provision was made for the completion of nearly 4,000 square miles in the Prome, Myanoung and Rangoon Districts, remaining unsurveyed in former seasons.

(7.) In order to effect the completion of the entire survey of the Pegu Division, British Burmah, during the past season, the work assigned to the various establishments was as follows:—To the Assistant and Sub-Assistants, 474 miles of traverse work, with theodolite; to the Native Surveyors, 8691.9 square miles, by compass and perrambulator in Pegu; 2025.9, ditto do. Martaban.

(8.) The monthly Progress Reports show that the whole of the detail Survey assigned above to the Native Surveyors has been completed by them save, perhaps, the running up a small and unimportant stream here and there to its source, and of the traverse work. All absolutely necessary longitudinal and latitudinal lines have been run, and I am therefore of opinion (from the written and verbal reports of the Surveyors) that it will hardly be requisite to enter upon another field season's operations, or, if necessary (which can only be *definitely* ascertained on the completion of the plotting of the Surveyor's work), that so little will remain to be done that the field establishment might be reduced to one Assistant with four or six Native Surveyors.

(9.) The greater part of the country surveyed during past season comprises wild, uninhabited and hilly tracts, covered with dense jungle, and extremely unhealthy.

(10.) The various parties have suffered a good deal of sickness in consequence, and 151 days work have thus been lost during the season, the exceedingly early and heavy rains also put a stop to work earlier than usual.

(11.) My Assistant, Mr. Montgomerie, was severely wounded by a tiger on 13th April, 1865, at Mahee in the Arracan hills, and was laid up for 28 days in consequence. Sub-Assistants Barnett and Cooper have suffered greatly from fever, and the present state of Mr. Cooper's health is such as to occasion great anxiety.

(12.) The total cost of the survey up to 1st May, 1864, as estimated by Captain Fitzroy, was Rs. 3,99,441-6-4; and the area surveyed up to the same date, 24,538-2 square miles, or at the rate of Rs. 16-9-11 per square mile; but my special report dated 24th April, 1865, (a copy of which was forwarded for your information) shows that this heavy mileage rate is due to the fact of Captain Fitzroy having inaugurated a new system of survey on his assuming charge of the Department, and having almost entirely re-surveyed the province on that system.

Up to 1st May, 1865, I estimate the area surveyed to be about 33,000 square miles, and the total cost of the survey up to that date to be Rs. 4,26,066-10-3, being at the rate of about Rs. 13 per square mile, which, though not a high rate for topographical surveys executed on the system which obtains in India, is certainly high for such a survey as that of Pegu, and is due, as before noticed, to the fact of the country having been almost entirely re-surveyed, under Captain Fitzroy's superintendence.

(13.) Sheets Nos. 1 and 2 of the General Map have been published, and the remaining sheets are in a very forward state, and I have every confidence in my being able, in about a month hence, to remove all the surveys and records, &c., to Madras, and finish the maps there, as was the original intention of Government, on my being specially deputed to take charge of this survey.

(14.) On the recommendation of the Surveyor General, the series of the township maps commenced by Captain Fitzroy will be continued by me, and supplemented by the aid of the Civil Engineering College students at Madras. I am of opinion that the Pegu Survey should be wound up by about the close of year 1866, though the general map of the province ought to be completed by end of current year and no efforts shall be wanting on my part to effect these objects.
