GENERAL REPORT

ON THE

Topographical Surveys

OF THE

BENGAL PRESIDENCY,

FOR SEASON

1866-67.

BY

COLONEL H. L. THUILLIER. *R.A.F.R.G.S.*

SURVEYOR GENERAL OF INDIA.

SUBMITTED TO THE GOVERNMENT OF INDIA, HOME DEPARTMENT.

Surveys

CALCUTTA:
OFFICE OF SUPERINTENDENT OF GOVERNMENT PRINTI
1868.

No. 53.

SURVEYOR GENERAL'S OFFICE,
Calcutta, the 2nd January 1868.

FROM

THE SURVEYOR GENERAL OF INDIA,

To

THE SECRETARY TO THE GOVERNMENT OF INDIA,
HOME DEPARTMENT.

SIR,

I have the honor to submit for the information of the Government of India, my Annual General Report* on the operations of the Topographical Surveys in the Bengal Presidency for the past season of 1866-67, together with a detailed account of the proceedings in the Head Quarter Offices.

*Dated 3rd January 1868.

I have the honor to be,
Sir,
Your most obedient Servant,

H. L. THUILLIER, *Colonel,*
Surveyor General of India.

GENERAL REPORT

ON THE

Topographical Surveys

OF THE

BENGAL PRESIDENCY,

FOR

SEASON 1866-67.

Dated Calcutta, 2nd January 1868.

INTRODUCTORY.—On my return from leave to Europe, I resumed charge on the 12th December 1866* of the several Branches of my Office at the Presidency, and of the Topographical Surveys from Lieutenant Colonel Walker. The following report will therefore embrace a general review of the work performed in my Office, and of the operations of the Topographical Survey Parties from the date of the last report submitted to Government by the Officiating Surveyor General, with his letter No. 1105, dated 28th December 1866, up to the present time, or for the Professional season of 1866-67.

* *Vide* letter to Secretary to Government, Home Department, No. 579, dated 12th December 1866.

2. There are seven regular Survey Parties in this branch of the Department, three of which are employed in Native States within the Central India and Rajpootana Agencies; two in the Central Provinces combined with the Vizagapatam Agency in the Madras Presidency, and two in Bengal. The designation of these Topographical parties and their field of employment during the season under report, are as follow:—

Number of Survey Parties and field of employment.

No. I.—Topographical Party, Gwalior and Central India Survey.	Details in Jeypore and Gwalior, triangulation in Jeypore, Gwalior, Kotah, Boondi and Jhalawar.
No. II.—Topographical Party, Central Provinces Survey.	Southern or hilly portion of the Hoshungabad district; triangulation in Baitool, Hoshungabad and Chindwarra.
No. III.—Topographical Party, Central Provinces and Vizagapatam Agency Survey.	Details in Bustar, Jeypore and Kalahandy; triangulation in Jeypore, Madagul and Bustar.
No. IV.—Topographical Party, Chota Nagpore Division Survey.	Details in Sirgoojah and Jushpoor, triangulation in Sirgoojah, Korea and Chung-Bokhar.
No. V.—Topographical Party, Rewah and Bundelcund Survey.	Details in Rewah and Bundelcund; triangulation in ditto ditto.
No. VI.—Topographical Party, Cossyah and Garrow Hills Survey.	Details in Cossyah Hills; triangulation in Jyntcah hills.
No. VII.—Topographical Party, Rajpootana Survey.	Details in Shekawattee, Jeypore, and Jodhpoor; triangulation in Bikaneer and Jodhpoor.

The field operations of the Pegu Survey having been brought to a close, as already reported by the Officiating Surveyor General, and as it never formed one of the regular Topographical Parties, and will cease to exist on the completion of the small amount of

mapping now in hand (as detailed in the remarks on the Pegu Survey), it is not included in the above.

3. The aggregate area of final survey completed during the season of 1866-67 by the seven parties above described, is 14,630 square miles, the whole of which is rendered on a scale of one inch to the mile: the triangulation in advance of the details and which serve as a basis for the topography, has been extended over an area of no less than 25,165 square miles ; in addition to the above, special surveys of the Cantonments of Morar, on a scale of 500 feet to the inch, have been completed as well as of five forts and cities in the Native States of Bundelcund and Rewah, on the large scale of 8 inches to the mile, or 660 feet to the inch, *viz.*, Rewah, Nagode, Myhere, Punnah and Kalinger.

Area of Topography completed.
,, of Triangulation in advance completed.

4. The amount of work accomplished by each party and the total cost of each, including every charge for the season of 1866-67, are given in the following Statement :—

Designation of Survey.	Topography on scale one inch to the mile of square miles.	Triangulation in square miles.	Survey of cities and cantonments on large scales.	Cost.	Remarks.
No. 1 Party, Gwalior and Central India.	2,667	4,942	1 on 500 feet, equal 1 inch	51,168	Ground broken and jungly.
No. 2 Party, Central Provinces ...	915	6,299	.....	58,229	Ground difficult; work just commenced in a new province.
No. 3 Party, Central Provinces and Vizagapatam Agency.	2,317	2,300	.....	71,915	Ground very difficult and unhealthy.
No. 4 Party, Chota Nagpore Division :—	2,378	4,500	.....	56,331	Ground difficult, jungle covered.
No. 5 Party, Rewah and Bundelkund.	1,409	1,474	5 on 8 inches equal 1 mile.	51,395	Ground difficult, and unhealthy.
No. 6 Party, Cossyah and Garrow Hills.	1,287	1,570	.....	69,066	Ground very difficult.
No. 7 Party, Rajpootana ...	3,657	4,080	.....	47,410	Easy ground.
Total ...	14,630	25,165	6	4,05,514	This sum includes the extra charge incurred for arrears of salary, or difference between new and old rates of pay, consequent on the re-organization of the Survey Department.

5. The entire cost of all the Topographical Parties for the season amounts to Rs. 4,05,514; from this Rs. 15,522 must be deducted as an *incidental charge, consequent on the re-organiza*tion of the Department for arrears of salary, or difference between old and new rates of pay, nearly all of which was actually a charge debitable against the former season of 1865-66, and which it would be unfair to bring against the work of a single season; so that the average rate of final, or detailed survey, is calculated on Rs. 3,89,992,* and yields an average rate of Rs. 26-10-6 per square mile. This result however is not absolutely accurate, inasmuch as a portion of the Rs. 15,522 for arrears of salary is certainly due to the season under review ; a more equitable and correct value is therefore obtained by combining the cost and out-turn of the two seasons of 1865-66 and 1866-67 (*vide* margin), which gives an average rate for the two seasons of Rs. 23-10 per square mile.

Cost and average rate of Final Survey.

* Rs. 4,05,514 − 15,522 = Rs. 3,89,992

14,630) 3,89,992

26-10-6 = average rate per square mile.

Seasons.	Square Miles.	Cost.
1865-66 ...	17,889	3,48,654
1866-67 ...	14,630	4,05,514
	32,519)	7,54,168

Average rate Rs. 23-10 per square mile, inclusive of the cost of 43,849 square miles of triangulation and large scale surveys of cantonments, forts, and cities.

6. The re-organization of the Survey Department with new grades having been sanctioned with the increased rates of pay, from 1st April 1866,* and as the survey season closed on 30th September 1866, the higher rates of salary for only six months could be debited against the season of 1865-66, whereas the professional year of 1866-67 has to bear the increased rates for full 12 months, and under these circumstances no comparison of the total cost or rate of survey between the two seasons can be made; while in contrasting the out-turn, due allowance must be made for the increased area triangulated in advance, against the decrease in final topography completed.

* G O.G.G. No. 62, dated the 16th April 1866.

7. The decrease in topographical delineation is 3,259 square miles and the increase in triangulated area 6,481 square miles. The defect in the former is chiefly owing to the very short return of work on the Rewah Survey, as well as on the Central Provinces, or No. 2, late Hyderabad Party, which entered on new ground. The causes of the Rewah diminution of area are explained at length under the head of that survey. The out-turn in No. 3, Vizagapatam Agency Party, is also much smaller than that of the previous season.

Results of the Triangulation

8. The professional results of the triangulation completed are given in the following Tabular Statement:—

Designation of Party.	No. of Triangles.				Triangular errors in seconds.		Discrepancies between common sides in inch per mile.				Remarks.
	1st Class.	2nd Class.	3rd Class.	4th Class.	1st Class.	2nd Class.	1st Class.	2nd Class.	3rd Class.	4th Class.	
No. 1 Party, Gwalior and Central India ...	2	128	970	37	2·6	6·5	0·03	2·5	5·6	14·0	
No. 2 „ Central Provinces Survey ...	11	202	911	...	2·3	2·4	4·08	5·9	...	...	
No. 3 „ Central Provinces and Vizagapatam Agency	0	23	233	...	6·1	8·0	0·24	2·0	...	...	
No. 4 Party, Chota Nagpore Division ...	6	...	...	...	2·5	...	0·18	6·0	7·0	...	Returns incomplete.
No. 5 „ Rewah and Bundelkund ...	...	47	195	...	...	5·3	...	3·6	6·5	...	
No. 6 „ Cossyah and Garrow Hills ...	0	102	...	350	4·1	*25·4	2·03	*11·5	...	*25·8	* These large differences are due to observations having been taken to large objects, such as trees, rocks, &c., with no defined points for intersection in consequence of the difficulty and expense of fixing poles.
No. 7 „ Rajpootana	4	98	8	581	1·0	4·2	0·08	1·2	4·5	9·4	
Average ...	...	...	...	...	3·1	8·7	1·09	4·7	6·3	16·4	

The same Instruments have been used as in preceding seasons, and the quality of the work maintains its excellence.

9. With the view of meeting the growing demands of the public service, the insertion of reliable levels on the Maps of the Survey of India has lately received considerable attention, and in consequence of a reference made by the Government of Bombay relative to "the extent and nature of the geological action on the Coast of Kattywar and Cutch," and as the relative level of land and sea in the Runn, the subject of spirit and geodesical levelling has been prominently brought to the notice of Government in a correspondence between the Superintendents of the Great Trigonometrical Survey and of the Geological Survey.† For purposes of a higher order, the most valuable levels are now being taken on the most approved principles and with a rigorous test, hitherto unknown, by the officers attached to the Trigonometrical Survey; and these great lines in connection with tidal observations at the several ports, and the stations of the Great Triangulation from Kurrachee to Calcutta, and other parts of Northern India, afford the most reliable data for all future extension of the system.

Heights obtained by trigonometrical and spirit levelling.

† *Vide* Home Department endorsement No. 5999, dated 31st October 1867.

10. The Superintendent of the Revenue Surveys, in his report to Government on the Revenue Survey Operations for the season of 1865-66, No. 17, dated 13th December 1866, paras. 18 and 19, has likewise recommended the combination of spirit levelling with the Revenue survey measurements. The proposed measure met with the general approval of Government, and a matured scheme for effecting this desirable object was called for, and has lately been submitted for the orders of Government with my report as per margin.

To the Secretary to the Government of India, Home Department, No. 1638, dated the 28th November 1867, and enclosures.

11. On the proposal generally of furnishing a larger number of reliable determinations of heights on all our detailed topographical maps, but one opinion can be entertained. Such data given with the accuracy which is essential, and with points in sufficient numbers to be really and practically useful, would of course add greatly to the value of our maps for all purposes, but to attempt to obtain them to the extent referred to in the correspondence, without additional agency, would certainly materially affect the annual out-turn, cost, and duration of the present operations. The amount of work already performed is enormous, as will be shown in the sequel, whilst the existing Executive Staff performs at present all that can possibly be expected; any additional labor imposed on it would assuredly lead, therefore either to a diminution in the quantity, or quality of the work now accomplished.

12. In adding various refinements to the Survey of India, and in attempting to bring the operations up to the standard of the Ordnance Survey of England, the nature and cost of our first Survey has to be borne in mind, as well as the value of the ground traversed, the extraordinary difficulties in the way of progress, and the demand so pressing and urgent for geographical information of a preliminary character. The time which all such additions involve is a further consideration, and when we are in possession of some sort of maps which will suffice for the more pressing necessities of good government, and which cost so little, a general system of contour levels may be introduced with great advantage, into he rich and fertile districts, where irrigation or other works may be practicable and probable. A favorable opportunity now presents itself in the commencement of the re-survey of the North-Western Provinces.

13. The extent of trigonometrical levelling at present performed by the several topographical parties, and the average for every ten miles of area, are shown in the following Statement:—

Designation of Survey.	No. of Heights trigonometrically determined.	Average No. for every 10 miles of area.	Remarks.
No. 1 Party, Gwalior and Central India Survey.	64	·13	Or nearly 4 heights per plane table of 270 square miles.
No. 2 Party, Central Provinces Topographical Survey.	107	·17	Ditto 8 ditto ditto ditto
No. 3 Party, Central Provinces and Vizagapatam Agency Survey.	102	·44	,, 13 ,, ,, ,,
No. 4 Party, Chota Nagpore Division Survey	301	·67	,, 18 ,, ,, ,,
No. 5 Party, Rewah and Bundelcund Survey	30 trigonometrical 28 barometrical	·41	,, 12 ,, ,, ,,
No. 6 Party, Cossyah and Garrow Hills Survey	44	·28	,, 7 ,, ,, ,,
No. 7 Party, Rajpootana Survey ...	154	·31	,, 10 ,, ,, ,,
General average over all...		·33	or 1 height in every 31 square miles nearly.

14. In the Chota Nagpore Division Survey, the number of determination of height rise as high as 1 point for every 15 miles of area; but in the Gwalior and Central India Survey it falls as low as 1 point to about 80 miles of area, the general average obtained from all the parties being about 1 point to 30 square miles of area. These averages are not sufficient to satisfy the original intentions and conditions of the Topographical Survey system as so clearly laid down in Sir A. Waugh's printed instructions which form the guide of the Department; with a trifling amount of additional labor, the number of heights in this branch of the Department may be raised with advantage. I have therefore directed that the minimum for the future is not to be below about 1 point or height to every 10 miles of area, and that a larger number of obligatory points must be obtained and fixed, in open country and in places of importance and of easy access, in addition to the heights of the principal stations of the survey which are mostly on inaccessible hills. This I hope will meet all ordinary requirements in Native States and other wild and hilly districts of little value, such as are generally dealt with in the Topographical operations.

Verificatory measurements, check or test lines, &c.

15. The system of running lines across ground that has been surveyed to test the accuracy of the work, has long been in vogue in the Revenue Survey Department, and is laid down by myself in the "Manual of Surveying for India" (Part IV, Chapter II, page 526 of the second edition), and the introduction into the Topographical Branch, of this simple and effective method of checking the details, had my attention as early as 1861* when the Topographical Parties first came under my control. Instructions were then issued on the subject, to the several parties as they were started, and the importance of the measure has been repeatedly urged in my orders to Executive Officers.

* Surveyor General's printed Reports to Government on Topographical Surveys for seasons 1860 to 1862, paras. 178 and 183.
Ditto ditto, 1862-63, para. 111.
Ditto ditto, 1863-64, paras. 76, 85, 92.

16. The principle, therefore, of the "out-turn of work not being permitted to exceed the amount that can be accomplished with an appropriate degree of fidelity," although only so recently enunciated by the Government and printed in Lieutenant Colonel Walker's last report, has always been the leading characteristic of the conditions on which Executive Officers have invariably been instructed to conduct their operations, as evidenced in the quotations given above from my printed reports.

17. Owing however to the extremely unhealthy, jungly and rugged nature of the ground in which nearly all the surveys have been progressing, testing by regularly chained lines of routes was not always practicable, and was chiefly adopted by Captain Depree in the Chota Nagpore Division Survey. There are however several other modes of testing plane table surveys, and as these entail less labor and expense in hilly and jungly tracts, and are quite as effective if thoroughly carried out, they have been adopted generally, while the measured routes or check lines have been used under more favorable circumstances. The inspection of the work of every detail Surveyor in the field has also been rigorously enforced, and the work of the field season is not considered satisfactory or complete, unless this duty has been attended to.

18. It was therefore with much satisfaction that I noticed the remarks made by the Government in letter No. 5497, dated 16th October 1866, and found that the subject had attracted attention with a desire for further information, as to the result of the measures taken, to test the accuracy of the work performed. I shall now proceed to discuss the subject as far as the detailed information obtained during the past field season will admit.

Amount and nature of check applied.

19. The total amount of check survey accomplished is in linear measure equal to 811 miles, *viz.*:—

By No. I Party ...	82 miles ...	Results reported satisfactory; plane tables checked.
,, ,, II ,, ...	21·3 ,, ...	Number of coincidences 24; number of differences 30; greatest difference in mile 0·20 in the work of a Native Surveyor; average difference in miles 0·06; plane tables checked from commanding heights.
,, ,, III ,, ...	52·5 ,, ...	Extreme difference 0·24 mile in very difficult ground. Plane tables checked as far as possible from commanding heights.
,, ,, IV ,, ...	232 ,, ...	2,057 features tested; extreme difference 0·27 mile; Plane tables also tested from commanding points; Mr. Low's work rejected.
,, ,, V ,, ...	47 ,, ...	Results not reported. Mr. Ryan's work rejected.
,, ,, VI ,, ...	Nil ...	Very hilly and rugged ground and altogether unsuited to test lines of survey. Plane tables checked by intersections from various points; revisions made wherever necessary, portions of work rejected.
,, ,, VII ,, ...	376 miles ...	Extreme difference in miles 0·29 in one Sub-Assistant's work; ground open and easy; plane tables checked by intersections from numerous points.
Total ...	810·8 miles	

These results are satisfactory as far as I can possibly judge at present, and there can hardly be a doubt that the effect of the measure will certainly in time, and as it is more generally and systematically worked out, secure a much higher order of accuracy in our detailed topography, I have great satisfaction in recording that the Executive Officers in the Topographical Survey Department are fully impressed with the importance of the subject, and are, to the utmost of their power, co-operating heartily in carrying out and perfecting the various methods of check applied to final surveys, as it is the only means by which Surveyors can satisfy themselves regarding the quality of the work executed under their supervision.

20. In connection with this subject, the following Tabular Statement is given showing for each Survey Party the average relative number of fixed points and plane table stations per square mile of survey.

Designation of Party.	No. of points fixed by triangulation per square mile.	No. of plane table stations per square mile.
No. 1 Party, Gwalior and Central India...	·128	0·7
,, 2 ,, Central Provinces	·080	3·1
,, 3 ,, Central Provinces and Vizigapatam Agency	·050	7·3
,, 4 ,, Chota Nagpore Division	·104	6·6
,, 5 ,, Rewah and Bundelkund	·079	6·1
,, 6 ,, Cossyah and Garrow Hills	·091	3·0
,, 7 ,, Rajpootana	·104	3·7
General Average ...	·091	5·4

21. In this statement, results are shown which bear directly on the accuracy of the detailed topography:—for 1st the triangulation which furnishes fixed points on which the details are filled in; and 2nd, the number of points used by the plane tabler in fixing and delineating the features of the ground, must furnish a good criterion of the value of the

Survey. Where either of these are infrequent, in small numbers, or at great intervals, the survey must necessarily be largely dependent on the accuracy and facility with which the Detail Surveyor can sketch to any distance.

22. I have therefore always made it a point of the first importance to secure in our Topographical Surveys—

1*st*.—A maximum number of fixed points by triangulation.
2*nd*.—A maximum number of plane table fixings.
3*rd*.—A minimum limit of eye sketching.

If these conditions are well attended to, the Surveyor can always rely on the value of the work performed by his subordinates; but in none of the ground allotted to the several Topographical Parties, except probably Rajpootana, owing to forest and the extremely rugged nature of the country, is it possible to secure without a heavy outlay in time and money all the above terms, and hence the necessity arises for test lines to verify the details, or some rigorous system of check, and the more especially when Native agency is employed.

Effects produced by the introduction of rigorous testing.

23. One of the effects produced by the introduction of a rigorous system of check is increased caution on the part of the Detail Surveyors in delineating ground, and this in itself is productive of more accurate and elaborate survey. The second will necessarily be a decrease in the detail area completed annually, with a proportionate increase in the cost.

24. The following Tabular Statement exhibits the cost and extent of some of the old Topographical surveys, and of all the improved and later surveys for the periods specified opposite each.—

Designation of Survey.	Duration of Survey.	Total area accomplished in square miles.	Total Cost.	Average rate of survey per square mile.	Remarks.
			Rs.	Rs.	
M (Nizam's Territory)	1841-1851	24,462	1,95,764	8·0	Does not include the salary of Military Officers. The survey partook of the character of a rough reconnoissance, and was with difficulty assimilated with the new Survey—1 Inch Scale.
Mr. Chill was to take	1851-1860	20,090	3,50,710	17·47	A fairly reliable Topographical Survey on the 1 Inch Scale.
Mr. Allnut was to take	1854	10,997	2,45,707	22·34	Includes in part Military pay of Officers. Rough reconnoissance executed on ¼ Inch, ½ Inch and 1 Inch Scales.
Messrs. Murphy and F					
Mr. Cornelius was to	1854-1860	31,378	4,26,905	13·61	Includes in part Military pay of Officers. A 2nd class Topographical Survey, 1 Inch Scale.
from Mr. Bolst.	1851-1860	10,555	2,14,539	20·31	Does not include the salary of Military Officers. A 1st class Topographical Survey of British districts on 1 Inch Scale.
Joalapershad,	1860-1860	16,018	3,51,539	21·95	Includes pay of Military Officers. An excellent Topographical Survey of Native States.
the Gwalior jungle	1860-1860	19,068	2,57,084	12·01	Includes pay of Military Officers. A reliable Topographical Survey of British Districts and Gurjat States.
Churam	1862-1860	7,794	1,67,623	25·36	Includes pay of Military Officers. A good Topographical Survey of Native States.
observations.	1863-1860	1,764	99,440	56·37	A fairly reliable Topographical Survey of very difficult ground. Military pay of Officers included.
Hills	1865-1860	2,370	30,020	15·20	An excellent Topographical Survey of Natives States. Military pay of Officers included.
him	1830-1860	1,45,300	23,75,949	10·34	Or Rs. 10-6½ the general average cost per square mile on all up to 1860.
ana Survey	1660 to 1867	14,030	40,5,5514		
ju					
Total					
Season under review					
Total of Topographical Surveys Revenue Survey Plains on 4 Inches =1 mile		1,00,026	27,81,402		
and Topographical of Hills, on 1 inch and 2 inches=1 mile	1840-1860	3,51,178	88,90,533	25·32	Or Rs. 25-5-7 the general average cost per square mile on all up to 1860.
	1866-1867	12,999	8,48,596	...	Season 1866-67.
Grand Total		5,24,203	1,25,20,591	23·85	Or Rs. 23-14-2 general average per square mile for all Revenue and Topographical Surveys.

25. This interesting statement fairly exhibits the results of our Indian Topographical Surveys, both as to cost and progress. In a period of 30 years with but very few parties at the commencement and only increasing very gradually, 160,000 square miles of country, an area considerably larger than the whole of the British Islands has been completed and mapped by this Branch of the Department alone, at a cost of not more than 32 shillings and 8 pence per mile. Whilst the Revenue Surveys have likewise yielded excellent topographical maps on a similar scale, of 3,64,000 square miles of country, between the years 1846 and 1866, or during my own incumbency and superintendence of the operations, at a mean average cost of 50 shillings and 8 pence per square mile. The combined results aggregate the large area of 5,24,000 square miles, or upwards of four times that of Great Britain executed at a total cost of Rs. 125,20,000 (one hundred and twentyfive lakhs), yielding a mean average rate of 47 shillings and 9 pence. For this, we have all the records in a methodical and systematic form, fit for geographical incorporation in the Atlas of India, and I do not include the older Revenue Surveys of the North-West Provinces, which for want of proper supervision in former years never were regularly reduced or generalized, and the records of which were never lodged in this Office, and consequently have for the most part been destroyed and are not now forthcoming. The whole of these districts will have to be surveyed over again in a style very superior to that of the last survey.

26. The magnitude and importance of these operations are scarcely considered or thought much of in India, but the amount of work produced annually by the completion of such areas, and on such scales, is enormous, and even without any correspondence at all; the reduction, manipulation, compilation, and publication of such a mass of geographical materials is more than sufficient to keep an infinitely larger Establishment than is allowed to this Office, in ample employment.

27. I much regret it is not in my power to furnish complete information of a similar kind for all India, or even for any single Presidency. The required data no doubt exist, bu[t] are scattered in various Offices, and surveys are in progress and have been from time to time undertaken and completed, of which the Surveyor General has no cognizance, and [g]erally quently the statistics of the Survey of India cannot be placed before the Governme[nt] topogra- complete and perfect a manner as seems desirable. Topogra-

28. A large amount of fair mapping, computations, and gener[al] and are, of profess[ional] and perfecting the various pleted [u]ns by which Surveyors can submitte[d] der their supervision.

Recess-work or fair Mapping and Computations, with Professional Reports, completed and rendered by Surveyors.

all these records is retained in this Office for future reference. Statement is given showing warded to the India Office in England. The number and descr[ip]s and plane table stations the season of 1866-67, are shown in the following Tabular Stateme[nt].

Topographical Survey Parties.	Index Maps and Charts to illustrate progress.	Original Plane Table Sheets	Standard or Fair Maps, scale one mile to the inch, for translission to England.	Exaggerated sheets of one inch Maps, for reduction by photography to one-fourth, or 4 inch scale to form Degree sheets.	Charts of Triangulation.	Plans. Original.	Plans. Fair Copy.	Professional Papers. Angle Books.	Professional Papers. Sets of completed fixed Computations.	No. of plane table stations per square mile.
	(a)	(b)	(c)	(c)	(d)					0·7
										3·1
No. 1 Party	1	8	5	5	1	1	...	2	2	
" 2 "	1	31	5	5	1	...	...	...	1	All the standard fair maps, and the exaggerated maps for reduction to one-fourth scale, have been especially drawn for reproduction and multiplication by Photo-Lithography or Zincography.
" 3 "	1	13	6	7	1	...	...	2	2	
" 4 "	1	19	7	7	1	...	...	2	2	
5 "	1	13	4	4	3	6	6	A complete Report will be submitted on completion of the Rewah territory.		
" 6 "	2		1	2					2	
" 7 "	1	28	9	9	1			3	4	
Total	8	105	42	35	8	7	6	9	11	

(a) on either 8 or 16 miles to the Inch;—(b) on 1-inch = 1 mile; size of sheets 15′ of Latitude by 15′ of Longitude—(c) on 1 Inch = 1 mile; size of sheets 15′ of Latitude by 30′ of Longitude;—(d) on 4 miles = 1 Inch, with numerical data.—

EXTRACT FROM THE NARRATIVE REPORT OF LIEUT. C. STRAHAN, R. E., OFFG. IN CHARGE No. 1, TOPOGRAPHICAL PARTY, GWALIOR AND CENTRAL INDIA SURVEY No. 58 (A,) DATED 3RD OCTOBER 1867.

The Party left Dehra under charge of Captain Melville on the 3rd October 1866, and reached Delhi on the 16th. Captain Melville had originally intended that those Assistants who were to work in the Gwalior district should march through Agra, but so much difficulty in obtaining supplies was experienced on account of the crowds flocking to Agra to attend the Durbar which was held there last November, that he took the whole camp to Delhi. Here the camp separated, half marching towards Jeypúr near which city the plane tabling was to be carried on and the remainder marching to Gwalior viâ Muttra and Dholpoor thus avoiding Agra.

Lieut. C. Strahan was to carry on the triangulation south of the Chambal commencing from Bhurtia, G. T. S. to Siwassa G. T. S., or Siwassa G. T. S. to Undika P. S., and work southwards joining on to Mr. Horst's work, also to revise a small portion of Plane table 111, surveyed by Mr. M'Carthy, which did not agree with the adjoining table, and to inspect and check the Plane tablers under his charge in the Jeypúr state.

Mr. Horst was to triangulate south of the Chambal, starting from Dhaolara G. T. S. to Kankra G. T. S. down to Latitude 25°, and if possible lay out a principal triangulation, connecting the Great Arc and Rahoon series at about the Latitude of 25°-10′. He was also to check the work of the Native Surveyors in his neighbourhood as far as possible.

Mr. Bolst was to instruct Mr. Cornelius in plane tabling, take up Plane Table 107 and then receive some instructions in triangulation.

Mr. Chill was to take up Plane tables 48 and 58, but being ill and away on medical certificate till February, his part of the programme was not carried out.

Mr. Allnut was to take up Plane table 108.

Messrs. Murphy and Esteve were to take up Plane table 105 between them.

Mr. Cornelius was to take up half of Plane table 106 after having received instruction from Mr. Bolst.

Joalapershad, Abdul Samad Khan, and Golam Mahomed were to fill in the gaps left in the Gwalior jungle.

Churaman was to take up half of 106 with Mr. Cornelius, and Abdul Suban to record observations.

Captain Melville, hearing that Lieutenant Riddell, R. E., was not likely to relieve him for some little time, marched to Tongra to fix some more points in Plane Table 48 in the jungle, in which there was a scarcity. From there he returned to Dholpoor and awaited Lieut. Riddell's arrival, who relieved him on the 31st December 1866.

Lieut. Riddell, R. E., received charge from Captain Melville on the 31st December and marched at once to Palighat at the junction of the Parbutty and Chambal Rivers, in the neighbourhood of which place he arrived on the 16th January. Finding that the Jeypúr Vakeel with his staff who had been directed to await his arrival at that place had not arrived, he went to inspect Native Surveyor Golam Mahomed's Plane table in the Kerahl Jungle. Having seen him he returned to Palighat on the 21st January and crossed over into the Jeypúr territory. For the remainder of the season he was engaged entirely in the Jeypúr state.

Lieut. Riddell met Lieut. C. Strahan at Madhopúr on the 23rd January, projected some fresh Plane tables there, and received information from him as to his own progress, and that of the Plane Tablers in the Jeypúr district, who had up to that time been under Lieut. C. Strahan's immediate charge. Having made arrangements with him concerning the disposal of the work for the rest of the season, Lieut. Riddell marched to Jeypúr with a view of obtaining further assistance from the Jeypúr Durbar, both for himself and Lieut. C. Strahan, who was very badly attended, and had been unable to get any help from the Political Agent. On arrival at the city of Jeypúr he found Major Beynon was absent, and was delayed about 10 days before he could procure about half the requisite amount of sowars and sepoys to accompany his camp; he employed himself during this time in projecting fresh Plane Tables for the various Assistants in the neighbourhood, and, on the 11th February, commenced on the western edge of Plane Table No. 107 on the high road from Jeypúr to Agra, a check survey in accordance with the instruction of Departmental Order No. 64, dated 25th May 1866. This he carried on along the road as far as Dosah in Plane Table 105, whence he followed a southerly course down to the S. E. corner of the same Plane Table. From there he went across Plane Table 106, in a south-westerly direction through Plane Table 108, and then back eastwards across Plane Table 115, completing 82 linear miles of check survey. The whole of these checks agreed very well with the Topographical features as laid down by the Plane tabler. Having finished checking all the plane tables then in hand, he commenced on the Plane Table No. 113, which Lieut. Strahan and he proposed to complete together. He completed his portion of 193 square miles by the 30th March, and then took up two of the northern sections of Plane Table, No. 114, having completed which by the 9th April, he proceeded to inspect the work of Mr. M'Carthy of season 1865-66, which had been found incorrect, and a portion of which had been re-surveyed by Lieut. Strahan, who reported that it was very carelessly executed. The villages and larger features appeared to be pretty accurately fixed, but the details were badly represented and the ground had evidently in some places not been sufficiently examined.

Lieut. Strahan having finished his Plane tabling, joined Lieut. Riddell at Dongri Malarna and having satisfied himself that no one had more than 2 or 3 days work left in order to finish the portion allotted them, which would complete the eight Plane tables in the Jeypúr state, composing half of Degree sheet No. 6, left orders that each Assistant on completion of his work should march at once for Agra, to which place Lieut. Strahan and Lieut. Riddell proceeded; the whole camp was assembled there by the 24th April and left the next day for Recess Quarters.

The country through which I had to carry my triangulation was very easy both for triangulation and Plane tabling, but I met with considerable annoyance on account of the small [illegible] supplied me by the Jeypúr Durbar. * * * * *

I carried on my triangulation without other difficulties than those I have mentioned above, until I approached the Boondi territory, and having occasion to visit a hill near Indargarh, only 4 or 5 miles within the boundary, I marched my camp to the foot of it in order to reconnoitre it before fixing on it for a station.

Talawas, the village at which I encamped, I found deserted except by a few iron smelters and some sepoys who were very insolent and refused all supplies, so that I was obliged to kill my own sheep for my camp. When I visited the hill the next morning, I met with so much insolence from some sepoys whom I met there, that I was obliged to leave and apply for help to the Political Agent of Harowti, Captain Bruce. I found that the reason of this resistance and insolence was that on this hill in the Jungle there is a fort called Ajitgurh, but the existence of which I did not know at the time I visited the place. The natives appear to be very jealous about the approach of any one to this fort and the village had been deserted and all supplies stopped by order of the Killadar. I detailed all these circumstances to Captain Melville and asked for a Vakeel from Captain Bruce, and meanwhile I returned into the Jeypúr state, observ-

can see through thick walls and that our heliotropes can set places or crops on fire. Captain Bruce twice wrote in very strong terms to the Ahilkars, but it was not till the return of the Rajahs of Kota and Boondi from Agra that Mr. Horst was enabled to carry on his work without interference.

On the 7th of December he commenced observing, and by dint of hard work he finished the triangulation allotted to him, embracing 2504 square miles, on the 11th March.

Mr. Horst observed at 47 stations for Horizontal angles, and at 37 for vertical, gives 71 secondary triangles and 31 minor secondary and about 750 triangles to intersected points. He also completed 89·4 square miles of plane tabling in jungly ground.

The country worked over by him is very flat with the exception of the Chambal scarp on which his base is situated, and is intersected by several large rivers of which the three principal are the Chambal, Parbutty and Kalisind: in consequence of the country being so level, stations could only be made at 8 or 10 miles apart which increased the labour, and made the selection of the stations both difficult and tedious.

The country in Jeypúr surveyed in detail this year was for the most part flat with parallel rocky ridges running across at distances of about 8 or 10 miles, and about 200 to 500 feet in height. Some of these are mere knife edges and very steep; others again are more broken and sub-divided into 2 or 3 smaller ranges; most of them are surmounted by forts, but we met with none of much importance this year. The country between these ranges is generally well cultivated, well water being used for irrigation. The water in many places, although abundant in quantity, is bad in quality, frequently being quite undrinkable; opium is grown in considerable quantities round the larger villages and is very largely consumed in the whole state of Jeypúr.

The country farther south, through which I carried a triangulation is similar in character, until reaching Indargurh and Balwan where it is much more hilly; a range of hills, sometimes broken and sometimes like a wall across the country and for miles impassable except on foot, runs from Balwan to the western boundary of our survey viz. 76° E Longitude, and I believe for several miles beyond. The country near Madhopúr and Rimtimbour was described last year by Captain Melville and for some few miles the same formation continues, but about Indargurh and Balwan the hills become more broken, and it is easy to pass through from one side to the other. West of Indargurh again, however, they rise up in two ridges, like a double wall, and this is only passable for laden beasts in two places, the whole way from Boondi to Indargurh, a distance of about 30 miles. Near Gaind in longitude 76° E., the range widens, and in the centre there rises up a third and fourth ridge higher than the outer ones. Near the Mej River which runs through this ortion of the range under Gaind H. S. (G. T. S.) there is much jungle which abounds with game.

The fort of Ajitgurh, of which I have spoken above, is situated on a hill in the centre of about 8 or 9 miles N. E. of Gaind. The hill is difficult of approach, there being only er which you can take laden camels; the one from the North might without much nade passable for carts. I cannot give any description of the Fort itself, as all I could when I visited the hill on which it is situated, was a large stone wall well built, se stones, no mortar being used in its construction; this wall is most jealously placed at intervals along it.

t is surveyed in detail, if we are allowed to examine the ground we shall hin this wall, but although I could see nearly all of the top of the hill I visited in the neighbourhood, I never was able to discover any build- of the jungle which is very thick over the whole country round it. ever heard given for the extreme vigilance with which this place is in which political offenders are confined. Captain Bruce himself (a) on sixth size of sheets] le information regarding it. I was also told that Mr. Keelan of the ng for the Rahoon series, met with opposition at the same place.

Continued.

Maps.	Scale.	Remarks.
	Miles Inch.	
General compilation of the Hyderabad Topographical Survey.	4 = 1	Inserted Talooks Nugoor, Albaka, Cherla, Rakapali, and Badrachellum, work of season 1865-66.
General compilation of Rewah and part of Bundlecund.	4 = 1	Inserted work of season 1865-66, northern portion of Rewah.
Exaggerated Sheet No. 19 of Rewah Topographical Survey of season 1865-66.	1 = 1	Completed for reduction by Photography.
Duplicate copies of the Degree Sheets or General Maps of season 1865-66 of Hyderabad Topographical Survey.	4 = 1	For Office record, prior to despatch of the originals to England. All completed.
Ganjam and Orissa Topographical Survey.	4 = 1	
Chota Nagpore Division Survey.	4 = 1	
Gwalior and Central India Topographical Survey, Degree Sheet No. 3, season 1864-65.	4 = 1	
Chart of ditto ditto to accompany Degree Sheet No. 4.	4 = 1	
Chart of Triangulation of Hyderabad Topographical Survey.	4 = 1	
Chart of Triangulation of Cossyah and Garrow Hills Topographical Survey.	4 = 1	
Chart of Triangulation of Ganjam and Orissa Topographical Survey.	4 = 1	
Ditto ditto of Chota Nagpore Division Survey.	4 = 1	
Compilation of the Delhi and Hissar Divisions, lapsed Jagheers and adjoining Native States.	4 = 1	Inserted Districts of Ferozepore, Sirsah and portions of Meerut and Ulwar. Ready for Press.
Sketch Map of the District of Cachar compiled from latest and best materials.	4 = 1	Compiled for Bengal Government. Tracings supplied to Revenue Office and Boundary Commissioner.
Southern Section of Eastern Bengal Compilation.	8 = 1	Completed; inserted Districts of Chittagong, Noacolly, Backergunge and portions of Nuddeah, Jessore, Soonderbuns, Hooghly, Burdwan and Cachar.
Portion of Southern Bengal between the parallels of 20° to 22° 30′ North Latitude and Meridian of 86° to 88° East Longitude.	8 = 1	Completed; inserted Cuttack and Balasore and portions of Midnapore, Poorce, Keonjur, and Mohurbunj.
Punjab Map in 8 Sections.	8 = 1	Revised portion of Sheet 8 from recent survey, and smaller additions and corrections to other Sheets. Revisions to date in progress.
Central Provinces, and adjacent British and Native States.	8 = 1	Inserted portions of Bonai, Bamra and Jeypoor, also Chinoor and Nandair Circars, and the Talooks in the Upper Godavery District.
India—Bengal Section between the parallels of 20° and 25° North Latitude and Meridians of 86° to 90° East Longitude.	10 = 1	In progress; inserted 24-Pergunnahs, Nuddeah, Jessore, Pubnah, and Rajshayee, and portions of Furreedpore, Backergunge Mymensing, Bograh and Maldah.
General Index Map of Punjab, Skeleton.	16 = 1	Both Sections completed. Ready for Press
Index Map of Bengal and Behar.	32 = 1	Completed; revised the old Map. Sent Press.

Continued.

Maps.	Scale.	Remarks.
	Miles Inch.	
Map of Central India Agency Sketch.	16 = 1	Completed and sent to Press.
Compilation of Kurrachee and Hydrabad Collectorates, Sindh.	4 = 1	In progress; Kurrachee Collectorate nearly completed; Hills in Skeleton.
Sketch Map of India revised to date, new and additional information inserted.	32 = 1	Completed and Lithographed.
Map of the Garrow Hills prepared from best materials.	4 = 1	For Lieutenant Williams, Assistant Commissioner, Garrow Hills.
District Chittagong.	4 = 1	Inserted M. C. 22 and 23, and additions and corrections on different parts of the Map completed.
District Hill Tipperah.	4 = 1	Completed; partly done by the Revenue Survey Office. Ready for Press.
Main Circuit Nos. 4, 5, 6, and 7, Pergunnahs Rampoor, Belaspoor, and Miluk Rampore Jagheer.	1 = 1	Tracings for J. C. Macdonald, Esq., Assistant Superintendent of Terrais, Nynee Tal.
Extract from Main Circuit Nos. 1, 2, 3, 4, 5 and 6, District Peshawur, by Major H. C. Johnstone, Revenue Surveyor.	1 = 1	For Punjab Government.
Military Map of the Survey of Peshawur by Lieutenant J. T. Walker, Bombay Engineers.	1 = 1	
Extract from Main Circuit of Districts Goojrat, Shahpoor, Goojranwalah, Lahore, Umritsur and Sealkote. In 3 large Sections.	1 = 1	
Skeleton Map of the Cuttack Division comprising the Districts of Balasore, Pooree, and Cuttack, showing all the roads, imperial and local, in existence or proposed.	8 = 1	Two Tracings prepared for Home Department.
Extracts from Pergunnahs Bunjeebhoom, Brahmunbhoom, and Bogree, District Midnapore.	1 = 1	Tracings for Lieutenant R. Smyth, Executive Engineer, Midnapore.
Main Circuit No. 11, District Maunbhoom.	1 = 1	
Pergunnah Burdah, District Hooghly.	1 = 1	
Map of Bedenore, Mysore.	2 = 1	Copies for Chief Commissioner of Mysore.
Map of forty-three of the central districts of Mysore.	2 = 1	
Killah Bodamba, Cuttack Tributary Mehals.	2 = 1	Prepared and forwarded to T. Ravenshaw Esq., Commissioner and Superintendent, Cuttack.
Extracts from Main Circuit Nos. 38, 39, 40, 41, 44, 45, 46, 47, 48 and 49 of southern portion of District Hoshungabad.	1 = 1	For J. Mulheran, Esq. In Charge No. 2 Topographical Party.
Index Map of the Chota Nagpore Division Topographical Survey.	16 = 1	Compiled for the *Geological* Survey Office, and subsequently Photo-lithographed.
Index Map of the Gwalior and Central India Topographical Survey.	16 = 1	
ditto ditto Rewah Topographical Survey.	16 = 1	
ract from Pergunnah Singrowlee, District irzapore.	1 = 1	Tracing for Captain G. C. Depree. In charge No. 4 Topographical Party
"		

(Concluded.)

Maps.	Scale.	Remarks.
	Miles Inch.	
Extract from Chart of the Aboo Meridional series, Triangulation extending through southern part of Sindh, with trigonometrical data.	4 = 1	For Revenue Surveyor in Sindh.
Extract from Charts of the Great Arc and Khanpasura Series, Great Trigonometrical Survey, and minor Triangulation of Hyderabad Topographical Survey, with data.	4 = 1	For Revenue Surveyor.
Chart of Triangulation of Ganjam and Orissa Topographical Survey through portions of Ryepore and Belaspore, work of season 1863-64.	4 = 1	Trace for Revenue Surveyor.
Northern boundary of Pergunnah Jynteah, District Cachar, in 3 Sections.	1 = 2	Trace for Surveyor, in charge Cossayh and Garrow Hills Topographical Survey.
Map of the Districts of Podella, Dursbee, and Paurpoor, forming the Jagheer of the Rajahs of Venketgerry and Calastry.	4 = 1	Tracings for Lieutenant Colonel J. B. Priestly Superintendent of Revenue Surveys Madras.
Plan of part of Perreacolum and Bodannikenoor, Pergunnahs in Dendigul.	1 = 1	
Plan of the southern and north-western part of Poodoocottah Survey, grounded on triangulation.	1 = 1	
Map of the great range of mountains dividing the Tinnevelly Province from that of Travancore, in 3 Sections.	1 = 1	
Sketch of the Boundary between Tinnevelly and Travancore.	4 = 1	
Sketch showing the line of demarcation between Cochin and British States.	4 = 1	
Main Circuits Nos. 17, 18, 20, 21, 22, 23, 24, and 25 in 5 Sheets.	1 = 1	Tracings for the Geological Survey Department.
Pergunnahs Kurribarree, Kooloomaloo, Aurungabad, and Kurribarree coal locality, in 3 Sheets.	1 = 1	
Extract from M. C. Maps of Districts Mooltan, Googaira, Lahore, Umritsur, Loodhiannah, Umbala, &c., in 4 Sections.	1 = 1	Tracings forwarded to Consulting Engineer for insertion of Railway line.
Coast of India from Kurrachi to Singapore.	.....	For Master Attendant's Department, Photo-zincographed.
Plan of the Fort of Gwalior and Cantonment of Morar.	1 = 6	In progress.
Index Map of Gwalior Topographical Survey.	16 = 1	

N. B.—Besides the above, a number of small extracts, little sketches, &c., &c., have been prepared for various officials.

Lithographed Maps colored.	Various ...	1,634 copies for issue to Government Officials and sale.
Atlas Sheets colored	4 = 1	196 copies for issue to Government Officials and sale.
Photographed Maps colored	Various ...	133 copies for issue to Government Officials and sale.

Proofs of Lithographed Maps 105 examined, and corrections and additions made.

38. A new sketch map of India, scale 32 miles=1 inch, in 6 sheets, showing our political relations with Native States, and the limits of every British District, Division, and Jurisdiction, has been prepared, corrected up to date, lithographed, and largely circulated to Local Administrations and the Chief Officials throughout India. Corrections and additions as regards Orthography, and the names of places, which may have become important of late years, have been asked for, with the view of preparing a more accurate and complete map of India, which is still a great desideratum. This map has also been utilized largely to illustrate various schemes, projects, and reports, and several copies have been specially prepared for, and rendered to the Financial Department, to illustrate its circles and treasuries.

Political and general map of India.

39. A new map of Bengal, illustrating the jurisdiction of the Lieutenant Governor and the new Civil and Criminal jurisdictions, has also been prepared with corrections up to date from the latest surveys, scale 32 miles=1 inch, and is now passing through Press. Another map or section of the lower half of Eastern Bengal from the parallel of North Latitude 24° 40' Southwards to the Bay of Bengal, and extending from the Meridian of East Longitude 88° to that of 98°, on the scale of 8 miles to the inch, is ready for Press. This map, when joined to the one of the North-Eastern frontier, will form a complete map on this scale, (which is half that of the Atlas sheets) of all Eastern Bengal to the meridian of 88°, or about half of the present jurisdiction of the Lieutenant Governor.

Bengal Proper.

40. An entirely new map of the Delhi and Hissar Divisions, scale 4 miles to the inch, embodying all the old surveys, and including the lapsed Jagheers lately surveyed, has been completed and awaits publication. I have great hopes of being able to re-produce and multiply this important map by the Photo-zincographic process. It altogether supersedes the old published Atlas Sheets Nos. 49, 48, 31, and meets an urgent want of the Local Government. A complete general map of the Punjab and its dependencies on the scale of 16 miles to the inch, forming an index to the divisions and districts, has been compiled and will shortly be published. Sheets 1, 3 and 4 of a large and new general map of the Punjab, scale 8 miles to the inch have been published, sheets 2 and 7 are nearly ready for issue, and the remaining 3 sheets have to be drawn on the stone; each sheet of this valuable and beautiful map, under preparation for many years past, measures 20½ inches by 36 inches, and will, I trust, prove highly acceptable to the authorities.

Punjab.

41. A general map of Sindh, scale 4 miles to the inch, is under compilation, and has been well advanced. The western half of this map, from the meridian of Longitude 69°, including all the Sindh Kohistan, is being compiled in my Office, while the eastern half, containing the plains, is in progress in the Revenue Survey Drawing Office. This division has been made to facilitate the completion of an entire map of Sindh on a proper projection from our latest surveys, the want of which is greatly felt, as no trustworthy map of the province exists. The survey of the lower districts on the left bank of the Indus is still incomplete.

Sindh.

42. The results of our latest Topographical surveys in the shape of general compilations, on the usual scales of 4 miles and 8 miles to the inch, have also been well advanced to the extent of the new surveys received, and materials forwarded to England for the filling up of various Atlas Sheets now being engraved under the Geographer to the Secretary of State at the India Office. During the past year, copies on various scales, from 1 inch to ¼ inch to the mile, re-produced by photography or photo-zincography, have been circulated largely.

Maps of Native States, Chota Nagpore Division, Central Provinces, Ganjam, and Vizagapatam Agencies, &c.

43. In this Branch of my Office, rapid strides have been made towards the attainment of speedy re-production and multiplication of maps, by the exceedingly accurate and cheap process of Photo-zincography and Photo-lithography, the earlier steps in which were detailed in my former Report for Season 1863-64, para. 20, page 8.

Photographic Branch.

44. With the view of placing this very important branch of the Department on a more efficient footing, and turning the increased knowledge of the art to more practical account, the Officiating Surveyor General, in the month of July 1866, obtained the sanction of Government * for the appointment of Lieutenant J. Waterhouse, R. A., a young Officer possessing a taste for, and a good deal of practical experience in the art of Photography, in order that the services of a competent Officer might be specially devoted to this particular line of duty, growing into such importance. Lieutenant Waterhouse accordingly joined the Dehra Doon Office where he practised the carbon process of transfer to zinc for a few months, and was then directed to take charge of the Photographic Branch of my Office and joined Head Quarters on the 10th December 1866. This Officer appears to have been in weak health for some time, and before the summer season had fairly set in, he was compelled to obtain leave to Europe on medical certificate for a period of six months† which has since been extended to 12 months.

* Home Department, No. 3124, dated 30th May 1866.

† Military Department, Notification No. 328, dated 20th March 1867.

45. To supply the place of Lieutenant Waterhouse, I brought down, with the sanction of Government, Captain A. B. Melville, Executive Surveyor attached to the Topographical Branch of the Department, who was well known to be an excellent Photographer, and he took charge of the Office on the 3rd April 1867. Captain Melville had the advantage of working in the Dehra Office for a few months, and receiving instruction there in the carbon transfer process, which he practised with so much success as to be able, immediately on his arrival in Calcutta, to produce very superior results from any that had hitherto been effected, and he was the first to inaugurate printing from zinc, a good supply of plates having been sent out from England on my recommendation when at home on furlough. In short, what had previously been mere experiments in the shape of small unimportant specimens produced by this process, has now turned into real practical adaptation of the full-size sheets of the survey, for immediate publication of the same, the moment they are received in this Office. Under the able and most zealous superintendence of this Officer, this description of work has progressed most satisfactorily. Photo-lithography and Photo-zincography have been largely turned to good account, and made the most useful agents. By the employment of new formulæ introduced by himself, the expensive process of silver-printing, which is required for many of the older maps not adapted for the Carbon transfers, has been reduced in cost by nearly 40 per cent.

46. During the year, 84 complete subjects, several of them of an intricate description, *viz.* Topographical and Revenue Survey maps on various scales, plans of Cities and Cantonments, and various charts and diagrams, have been transferred by the carbon process to stone or zinc and the required number of impressions (8,442) have been obtained. To have completed the same number of Lithographic transfer drawings of similar subjects, would have occupied about eight expert draftsmen at the very least a year.

Out-turn of work.

47. Specimens of some of the full size sheet maps *re-produced* by Photo-zincography and Photo-lithography accompany this Report in a separate atlas, and to which I would invite attention The speed with which maps and drawings can now be re-produced and multiplied will be readily understood, from the circumstance of nearly all

Specimens of Photo-zincography and Photo-lithography submitted for inspection.

the 1 inch Topographical Sheets of the season under review, which were received in the month of October or November last, having already been transferred to zinc or stone, and several hundreds of impressions of some of them struck off. The whole of the previous season's sheets have likewise been similarly re-produced, and thus for the first time, the results of the Topographical Surveys on this scale, have been made public. Useful Index Maps of the Gwalior, Cuota Nagpore, and Rewah Surveys reduced and printed by the same process are attached, and form good guides to the Sections of the operations, to enable the Public to apply for any particular portions of country, Indices of the other Surveys are under construction.

Reduction of maps by Photography.

48. The *reduction* of the large scale exaggerated maps, to the geographical scale of $\frac{1}{4}$ inch to the mile by the same process, is another important step recently taken, and the experiments made have been very successful. The photographic process of reduction yields beautiful specimens and is most accurate in results, while the saving in time and labour is hardly credible. The tedious process of examination and all fears of omissions and inaccuracies in transcript, are entirely obviated. But the entire process, whether for the re-production of subjects to scale or reduction to any required smaller scale, to admit of satisfactory transfers being obtained on to stone or zinc for multiplication, imperatively demands that the originals should be specially prepared in simple pen and ink without the use of colors or brush shading.

49. For the purpose of *reduction*, therefore, the Executives are enjoined to draw their one inch maps in a bold, free, and exaggerated style, leaving out all minor and unimportant details, so that when put up before the Camera, the originals may be susceptible of showing every thing that is required and no more on the one-fourth scale, with the writing of the names properly legible. In proportion to the success attained with these originals, will the impressions taken from the carbon transfers prove. After another season or two, of course, there will be greater improvement in this respect by the executive surveyors.

50. To the detailed report on the Photographic Branch by Captain A. B. Melville, given in the Appendix, I would draw special attention, evincing as it does the extent and perfection to which that Officer has, by his indefatigable industry and superior attainments, brought this part of the work, which cannot fail to completely revolutionize the entire system of publication of the results of our surveys. The following brief abstract shows the nature and description of the Photozincographic or transfer work executed by this process during the past year.—

Description of Work.	No. of Plates or Negatives.	No. of Silver Prints.	No. of Carbon Prints.	Transfers to		Total Number of Transfers of Complete Subjects.
				Zinc.	Stone.	
Topographical	360	1,044	520	13	28	41
Revenue	269	1,115	192	5	9	14
Cities and Cantonments	127	44	113	4	8	12
Miscellaneous	186	527	270	1	16	17
Total	942	2,703	1,095	23	61	84

51. To Captain Melville the highest praise is eminently due; he not only excels in this particular branch of the work, but he combines high professional qualifications and departmental experience, which is so essential in an Officer attached to the Administrative Office; whilst his energy and determination to overcome all obstacles is remarkable. It is therefore a great pleasure to me thus to acknowledge the valuable assistance I have received from this

Officer, to whom the credit of the success now attained is due. Captain Melville has been placed in immediate charge of all the Printing Branch, both Photographic as well as Lithographic, where his assistance is much needed.

Increase of Photographic Establishment necessary.

52. If such results are attainable with the very slight means and strength of Establishment at present allowed, it follows that, with an adequate and proper number of persons, still more satisfactory progress will be arrived at, in publishing the vast extent of survey materials at our disposal, and which for want of the possible means, have hitherto baffled all attempts and have never been issued to the public. To this end, Captain Melville has submitted a detailed report showing what he is most in need of, and strongly urging an increase in the Establishment for the Photographic and zinc printing processes. This subject will be treated separately, and a report in favor of the application submitted shortly.

Press Branch—Out-turn of work.

53. The detailed statement, showing the nature and amount of Lithographic transfer, drawing and printing executed during the past year, also the number of impressions taken from Photo-carbon transfers to stone and zinc, is so voluminous as to render its incorporation in this report unadvisable, but the general description and value of the work with the total cost to Government of the Lithographic Press Establishment, and the difference showing a sum of Rs. 16,786 to the credit of the Department, is concisely shown in the following abstract :—

Description of Maps executed.	No. of Sheets or Sections.	No. of complete Copies.	No. of Impressions.	Value or Selling price.
				Rs. A. P.
Maps, &c., printed, the drawings of which were completed last year	37	7,460	10,460	17,920 0 0
Maps, &c., printed, the drawings of which were completed during the present year	40	9,408	14,868	6,310 8 0
Reprints of old Maps, &c., the stones of which had been preserved	19	2,375	4,005	7,455 4 0
Maps, &c., drawn and transferred, but not yet printed	36	.....	.....	.....
Miscellaneous Forms printed from stone	13	5,275	8,070	650 0 0
Extra work drawn and printed	45	16,834	19,517	8,954 12 0
Ditto ditto but not yet printed	18	.....	.....	.....
Photo-Carbon Transfers	75	7,688	9,258	9,053 0 0
Survey Department Forms, Circulars, &c.	117	1,47,631	1,64,373	13,145 7 0
Memos. and Docket Forms, &c.	43	21,057	21,057	421 2 3
Total value of work performed ...	443	2,17,728	2,51,608	63,910 1 3
Cost of the Lithographic Press Establishment.				
Permanent Establishment				31,373 3 0
Contingent Expenses				4,732 6 5
Extra ditto				2,009 0 0
Cost of Paper (estimated)				4,721 1 11
Add 10 per cent. on Cost of Stock, Stone, and for wear and tear of Machinery (estimated) ...				4,288 0 0
				47,123 11 4
Difference to credit of Department				16,786 5 11

54. It will be observed that after paying all expenses, permanent as well as contingent, and allowing 10 per cent. more for wear and tear of Presses, &c., there is a sum of Rs. 16,786 to the credit of the Department on a valuation of the number of sheets issued, estimated at Rs. 63,910, and this credit is arrived at, after taking the selling price of most of the Maps, at a much lower figure than formerly, or at Rs. 1, instead of Rs. 2.

55. During the past year, 154 successful transfer drawings of Maps and Plans have been made; from 98 of these transfers no less than 34,395 impressions have been taken, while 54 transfers await slight corrections and revisions prior to being printed from. In addition to the above, from 37 transfer drawings, which were included in the report of 1866, 10,460 impressions have been taken; 4,005 reprints of Maps have been made from old transfers, the stones of which had been preserved; 8,070 impressions have been pulled of Miscellaneous Forms from stone, in addition to the impressions of Maps taken from carbon transfers to stone or zinc, already shown above.

56. A very large proportion of the Maps drawn and printed are of the first class and of a size requiring the use of the largest stones and presses. Printing from zinc or *zincography* which affords so many facilities, has been introduced during the year, and some of the Establishment have been well trained to the work, but the two Sapper Printers, under orders to come out from the Ordnance Survey Office at Southampton, and who are reported to have left England in October last, have not yet arrived, their services are now very urgently wanted.

57. At the close of last year, Mr. J. H. D. Lawrence, a practical Lithographer and Engraver from Mr. Stanford's Geographical Establishment in London, whom I had selected during my stay in England with the sanction of the Secretary of State, joined his appointment as Head Assistant of the Lithographic Press Branch on the 27th of December 1866, in the room of Mr. H. M. Smith retired on a superannuation pension. In superintending such an Office, composed entirely of Natives and conducted on principles peculiar to India, Mr. Lawrence has had many difficulties to contend with. The amount of work to be performed and the pressing urgency for most of it, is embarrassing to a new comer, but I trust with the practical knowledge possessed by the Head Assistant, and as his Indian experience and energy extend, the style and character of the issues emanating from the Department, may go on improving and maintain the credit hitherto accorded to them.

58. From want of space the Gripper Printing machine worked by steam and other large Lithographic Presses, which were selected by myself under the orders of the Right Hon'ble the Secretary of State during my stay in England, have not yet been set up, and the pressing necessity of larger accommodation and concentration of all the different branches of the Head Quarter Office, is daily more apparent. The original records of the Department are increasing so rapidly with the vast progress of the survey of India, and the out-turn from the Printing Press, especially now that the new process by Photo-zincography has taken such root, is so great that it is found impossible longer to provide properly for the safe custody, arrangement, receipt, of manuscript as well as issue and sale of such a quantity of printed materials. The combination of the Revenue Branch of the Department, and the extensive additions of rough field books and other documents from that survey, with the space they occupy in this Office, cause me great anxiety, which has not been lessened by the appearance of white-ants, which have demanded special precautions and care. A special report has been submitted on this subject, as per margin, and I trust that suitable premises may soon be obtained to meet the increasing and special requirements of a Department like the Survey, the records of which have cost such enormous sums of money.

No. 210, dated the 19th March 1867.

59. In addition to the numerous details of business which fall to the lot of the Head Quarter Offices, it is now proposed by the Right Hon'ble the Secretary of State to transfer the whole of the Engraving of the Sheets of the Atlas of India, hitherto performed by the Geographer in England to this Office. This change, in the advantages of which I entirely concur, as likely to prove most beneficial in every way, will entail a heavy amount of responsibility and extra labor on the

Engraving of the Sheets of Atlas of India.

Head Quarter Offices, for which adequate supervision and establishment as well as more especially, proper accommodation, will be essentially necessary. A full report on this subject, as per margin, has been submitted.

No. 50, dated the 24th September 1867.

60. The sale and issue of the published Maps of this Department is a business of itself, the extent of which may be gleaned from the following statement. In a period of eight years only, the money value of Maps given away to Officials represents nearly one lakh of Rupees. The sales to the public during the same period come up to nearly half a lakh, and this return for some of our work should be borne in mind as a slight proof of the usefulness of the Department.

Sale and issue of published Maps.

		Service issues of Maps.	Value of service issues.	Value of Maps sold.
			Rs.	Rs.
Report of 1858 to 61, Revenue and Topogl.	From April 1859 to 31st July 1862	11,040	38,470	11,775 0 0
Report of 1861 to 1863, Revenue Surveys	Account from August 1862 to June 1864	4,020	13,166	14,251 0 0
Report of 1863-64	Account ending 31st March 1865	Included in reports	of 1862 to 64	634 12 0
Report of 1864-65	Account from April 1865 to December 1866	3,147	10,451	9,025 10 0
Report of 1865-66	Account ending 31st December 1866.	5,081	13,456	3,801 10 0 1,152 4 0
Report of 1866-67	Account ending 30th September 1867	7,407	21,279	4,155 12 0
1858 to 1867, ...	Grand Totals ...	30,695	96,822	44,796 0 0

61. The references and correspondence connected with this part of our duty, is very severe, detracting seriously from more important considerations and attention to legitimate avocations. Every endeavour has been made to transfer the business to the book-sellers and agents in Calcutta, but they perform the duty so badly, complaints are universal. Without some geographical knowledge and experience of Indian localities on the part of the issuer, the public are not properly served, and hence the trouble falls chiefly on this Office, where a competent Assistant of intelligence and position is much needed as a Librarian and Record-keeper. Measures have further been taken to deposit Maps with local agents under each Administration for sale to the public.

62. During the past year, 7,407 engraved and lithographed Maps have been despatched to Government Officials, the value of which amounts to Rs. 21,279. The sums realized by sales to the public, including a portion of the fees for copying Revenue Maps, amount to Rs. 4,155-12 and the statement of the cash account since last report stands as follows :—

Dr. Cr.

To	Rs.	A.	P.	By	Rs.	A.	P.
Balance in hand or in deposit in Bank of Bengal as per printed Report for 1865-66	1,647	2	7	Amount shown in last Report as a deposit in the Bank of Bengal and since paid to Draftsmen for the copying of a special map	453	8	0
„ Amount realized by sale of maps and collection of map fees from 12th December 1866 up to 30th September 1867	2,531	2	3	„ Cash in Bank and outstanding ...	3,724	12	10
„ Proceeds of map sales by Messrs. Thacker, Spink & Co.	1,718	3	6	„ Amount due by Messrs Thacker, Spink & Co., for account sales of map, ...	1,718	3	6
Total Rs.	5,896	8	4	Total Rs.	5,896	8	4

63. A very valuable despatch of geographical materials was made to the India Office embodied in Tabular Statement *A*, with letter as per margin. This despatch embraced a period of two years and the chief Atlas Sheets, which will thus be filled up or partially so, are detailed in the margin.* The new Atlas Sheets engraved and received from England during the past two years 1866 and 1867, have been unusually numerous, and comprise Nos. 5, 6, 7, 8, 16, 17, 28, & 29, eight Sheets altogether, a most valuable addition.

No. 1207, dated the 22nd August 1867.

* Atlas Sheets Nos. 1, 8, & 9, Sindh.
Ditto 28, 45, 46, Kahsmir and Ladak.
Ditto 50 & 51, Gwalior, Jeypore, Dholpore Kerowlee, &c.
Ditto 55, 56, 73 & 74, Nizam's Dominions, Maiker and Woon and Upper Godavery Talooks.
Ditto 70 & 71, Saugor.
Ditto 89, Rewah,
Ditto 90, 91, 92 & 97, Parts of Belaspoor, Ryepoor, handi, &c.
Ditto 105, 113 & 114, Chota Nagpore Division.
Ditto 127 & 134, Backergunj and Akyab.

64. During the past year, the scheme for the re-organization of the entire Department has been carried out and brought into working order, notwithstanding many difficulties and anomalies which have unavoidably been caused. In a large and wide spread Department so peculiarly constituted with three different Branches, all having its own special interests and previous gradations or organizations, it could not be expected that every thing would be set to rights at once, or that there might not be some individual cases affecting particular interests, requiring adjustment and settlement on the special merits of the case. In consequence of my absence in England at the time of the submission of the gradation lists by the Officiating Surveyor General, the name of the Assistant Surveyor and Chief Assistant of the Head Quarter Office, Mr. James, was omitted, I believe from inadvertence, or owing to the difficulties of carrying out, the provisions of the new scheme under the special restrictions imposed. That excellent Officer has done such good service, and is so thoroughly master of his profession in all its details, that I should consider it a dereliction of duty were I to pass over his merits and qualifications for regular departmental promotion.

Re-organization of Department.

65. Mr. James being a practical Surveyor and having served for 22 years in the Trigonometrical and Topographical Branches, as well as in the Head Quarter Office, to which he was transferred solely for the benefit of the public service, has enjoyed unusual opportunities for attaining departmental knowledge and experience, of which he has fully and meritoriously availed himself. He cannot, therefore, with any degree of justice lose his gradation in the Department in which he is eminently entitled to rise with his contemporaries, and which in fact was guaranteed to him by Sir Andrew Waugh, the late Surveyor General. With a view therefore to prevent supercession, and to accord to the Assistant Surveyor the place to which he has an undoubted claim, I propose submitting a special report suggesting in what way the object may be carried out with the least inconvenience and expense. To Mr. James the highest praise is due for his most zealous and efficient aid at all times, not only in his own immediate sphere with the cartography, but also in the general correspondence and business of the Department, which is of so pressing a nature, and to which he devotes many of his leisure hours.

Head Assistant of Administrative Office.

EXECUTIVE SURVEYS.

No. 1.—TOPOGRAPHICAL PARTY.

Gwalior and Central India Survey.

66. On the 3rd October 1866, this party under the command of Captain A. B. Melville, having completed the details of work described in the last report, took the field and arrived at Delhi on the 16th idem. The party then proceeded in two divisions, one proceeding *viâ* Dholpore and Gwalior southward, and the other westward to the Jeypore Territory, a considerable portion of which was assigned to this party in order to make a good division with the Rajpootana Survey from the parallel of 28° and along the meridian of 76° of Longitude. This arrangement of marching to their grounds was necessary so

Personnel.

Captain A. B. Melville, S. C. Executive Officer in charge to the 31st December 1866.
Lt. R. V. Riddell, R. E. Assistant Surveyor, Officiating in charge from the 1st January 1867.
Lt. C. Strahan, R. E., Assistant Surveyor, Officiating in charge from the 1st June 1867.
Mr. H. Horst 2nd Grade Civil Assistant
„ H. J. Bolst, 3rd „ „ „
„ G. P. Chill, 2nd „ Sub-Assistant.
„ G. K. Allnutt, 4th „ „ „
„ G. T. Murphy „ „ „
„ G. L. Esteve „ „ „
„ W. J. Cornelius „ „ „
and five Native Surveyors.

as to avoid Agra, to which place, in consequence of the Durbar then about to be held, all the Chiefs of Central India with their retinue were crowding.

Plan of operations for the season.

67. The ground taken up by the detail parties was situated chiefly in the Jeypore State between Latitudes 26° and 27° and Longitudes 76° and 76°-30′ with some small tracts in Scindia's Territory further south and east. The final survey of nearly the whole of the Jeypore Territory, extending down to the Chumbul has been completed, and the Gwalior Territory also, including what was effected in former seasons down to the parallel of 25°.

68. The triangulation had to be extended southwards from the parallel of 26°-30′ to 24°-50′, keeping within the meridians of 76° and 77° and connecting on the East with the work of previous seasons.

Changes in the Executive Staff.

69. Captain Melville laid down the programme, started the field operations of the season, and remained with the party until the 31st December, when his services were required by Lieutenant Colonel Walker in the Photographic Office at Dehra Doon, and he was then relieved by Lieutenant R. V. Riddell, Assistant Surveyor, 1st Grade, who had been officiating in charge of the Cossyah and Garrow Hills Survey, and who had been relieved there owing to the cessation of the operations with the Bhootan Field Force. Lieutenant Riddell completed the season's field operations and returned with the party to recess quarters, when it was necessary to transfer him to the officiating charge of the Rewah Topographical Survey, vacated by Captain Murray, who had proceeded to Europe on furlough on medical certificate. Lieutenant Charles Strahan, the Military Assistant, who had been several seasons with this party and the Senior Assistant without a charge, was then placed officiating in charge of the Gwalior and Central India Survey on the 1st June 1867, and the whole of the mapping and computations were brought up by this Officer.

Triangulation and details completed during the season.—

		Square Miles.
By Lieut. C. Strahan	...	2,438
„ Mr. H. Horst	...	2,504
Total	...	4,942

70. The triangulation executed during the season covers an area of 4,942 square miles, and consists of two principal, and 128 first class secondary triangles and 1,007 secondaries and minor secondaries within the States of Gwalior, Jeypore, Kotah, Boondi and Jhalawar. Observations were taken at 76 stations, fixing the position of 554 points as a basis for future detail survey and observations for the determination of heights were taken at 60 stations.

71. The area plane tabled or finally surveyed was 2,667 square miles in Jeypore and Gwalior. The following Statement shows the area executed by each Assistant and the average number of times the plane Table was set up per square mile :—

Name of Surveyors.	Area Surveyed.	Average No. of Plane Table Stations.	Remarks.
Lieut. Riddell	229·0	3·9	Ground more or less difficult, broken and jungly.
Lieut. C. Strahan	133·2	5·8	
Mr. Horst	89.4	4·3	
„ Bolst	344·6	7.5	
„ Chill	138·0	6·0	
„ Allnutt	510·7	4·6	
„ Murphy	211·7	6·0	
„ Esteve	246·5	7·5	
„ Cornelius	208 0	6·5	
Native Surveyors.			
Abdool Summud Khan	181·3	9·5	
Golam Mahomed	171·1	11.7	
Abdool Sobhan	22·6	7·4	
Choramun	180·7	10·7	
General Average	.....	7·0	

72. A plan of the Cantonments at Morar on the scale of 500 feet to the inch, was also completed, based on triangulation executed by Captain Melville.

73. The detail Surveyors were visited in the field, and the work of each Sub-Assistant and Native Surveyor was tested by check lines.

Operations retarded from want of assistance in Native States.

74. Considerable difficulty was experienced in several Native States this year, and the operations of this survey were retarded frequently from the want of proper vaqueels and escorts for the Surveyors. In the petty States of Kotah and Boondi in particular, the Native Officials are reported to have given great trouble and to have thrown many obstacles in the way. Lieutenant C. Strahan and his Civil Assistant Mr. Horst were not permitted to approach certain localities owing to the existence of Forts, which the killadars feared might be overlooked from the heights near them, but which were the most suitable for survey stations. Provisions and assistance of any kind were refused, and even stronger threats were made, if the Surveyors attempted to approach certain hills.

75. The loss of time entailed by the opposition of Native Chiefs, who fail to appreciate the nature and object of the survey, frequently leads to the entire season's programme being defeated, while the cost of the operations is enhanced to a considerable extent. The Political Officers have always rendered aid on being applied to, but reference to them cannot be made without much loss of time, and even then, the resident proprietors will not obey the orders of their Chiefs, and thus delay the Surveyor longer on the spot and put him to great additional labor by permitting only certain places to be visited. In these Native States, great tact and forbearance is necessary in carrying on the work, and I cannot speak too highly of the manner in which the Officers engaged, both Military and Civil, perform their duties and avoid all collision.

Recess work.

76. During the recess, the following work was completed :—

1,137 Triangles computed.

108 Latitudes, Longitudes and Azimuths.

64 Computations of Heights.

213 Pages of Angles with Synopsis.

7 Standard Maps, scale 1 mile=1 inch, for transmission to England.

5 Exaggerated ditto, ditto, for reduction to ¼ scale by Photography and multiplication by Photo-zincography.

1 Chart of Triangulation, scale 4 miles=1 inch, to accompany Degree Sheet No. 6.

1 Ditto for Office use, and 2 Index Charts.

Cost of Survey for season under review.

77. The total cost of this survey for the season under review up to the 30th September 1867, is Rs. 51,168, including all miscellaneous and contingent charges.

Party inspected by the Surveyor General.

78. During the recess, I proceeded on a tour of inspection and visited this party at Mussooree in the month of September, when the whole of the work was in a forward state. I derived much satisfaction from the manner in which I found everything conducted in this survey. Captain Melville's arrangements and system have been well carried out, and the state of discipline of the establishment as well as the out-turn of their work is highly creditable to both Officers and Subordinates. No arrears exist of computations, and the whole of the mapping has been well brought up and rendered, with the exception of some of the duplicate or exaggerated one-inch sheets, which it was found impracticable to complete, owing to the novelty and great change in the system of thus providing for the reduced or

½ inch Maps. These will all be completed in due time. The superior style of the maps on this survey has always been proverbial and fully noticed in my reports, and I am wel satisfied with the exertions of Lieutenant C. Strahan in maintaining their reputation This officer is a most promising one, and highly deserving of the promotion for which he has been recommended, in consideration of the position he holds in charge of a survey.

79. Mr. Civil Assistant Horst has rendered excellent service both in the field and recess, his zeal and ability are favorably reported on both by Lieutenant Strahan and the other Executive Officers under whom he has served. Mr. Horst is a valuable Officer, and I have a high opinion of him. Mr. H. J. Bolst, Civil Assistant, 3rd Grade, has also been favorably mentioned, and I am able to commend his praiseworthy exertions and the superior excellence of his drawing and field sketching.

Plan of operations for season 1867-1868.

80. Since this survey commenced work in November 1860, 27,666 square miles of triangulation have been completed as a basis for plane tabling, and 18,735 square miles of plane tabling or final survey have been finished: as therefore the triangulation is nearly 9,000 square miles in advance of the detail survey, it will not be necessary to undertake any during the season of 1867-1868. The detail parties will be employed in the Native State of Ulwar, which remains to complete the division of territory assigned to this party to the north of the work already finished. The sections to the south of Scindia's Territory will then be proceeded with, so as to advance in a systematic and compact manner, with the view of getting each sheet of the great Atlas of India out of hand in regular order, whereby the publication of the materials will be greatly hastened.

81. Of the Ulwar State, it is expected the survey will be entirely completed, and a large scale survey will also be made during the season, of the Civil and Military Station, and Fort and City of Agra with the country around.

82. Extracts from the Officiating Executive Officer's report are given in the Appendix and afford full information on all details connected with the work, both in the field and Office.

No. 2.—TOPOGRAPHICAL PARTY.

Central Provinces Survey.

(Late Hydrabad Topographical Survey.)

83. In para. 22 of the Officiating Surveyor General's last Report on the Topographical Surveys, the completion of the Hydrabad or Berar Survey was reported, and in para. 27 relating to the future operations of the party, the new field of Survey in the Central Provinces was described. The designation of the party has now been altered to accord with the new ground occupied, which includes all the hilly and difficult ground comprising the Sathpoora and Maha Deva Ranges unsuited for Revenue detail Survey, extending from Nimar on the west, to Ummer-Kuntuk and the Frontier of Rewah and the Chota Nagpore Division; bounded on the north by the valley of the Nerbudda with the Districts of Hoshungabad, Nursingpore, Jubbulpore and Seonee, under Revenue treatment, and on the south by the plains of Berar and Nagpore District, or all the country between the meridians of 77° and 83° and parallels of 21°-30′ and 23°.

Personnel.

James Mulheran, Esq., Executive Officer in charge.
Mr. C. T. Neale, 3rd Grade Civil Assistant.
„ A. Chamarett „ „ „ „
„ J. B Smith, 1st Grade Sub-Assistant.
„ R. D. Farrell, 2nd „ „ „
„ C. Scanlan, 3rd „ „ „
„ A. Chennell, „ „ „ „
„ B. Maine, „ „ „ „
„ J. Chennell, 4th „ „ „
appointed 1st September 1867, and five Native surveyors.

84. Under instructions from this Office, the Surveyor in charge was directed to give his first attention to the completion of the hill portions of the Hooshungabad District, which had not been taken up by the 1st Division Revenue Survey, owing to the difficult nature of the ground, and to extend his triangulation in due continuation of his own previous operations from Nimar eastward, over the Districts of Baitool, Chindwarra, and Seonee. These instructions have been carefully and ably carried out, and the work is proceeding in perfect connection with the Revenue Survey, and by the combination of the two branches, a very complete survey of the remaining extensive area of the Central Provinces, both hills and plains, may be anticipated in a short time.

85. A portion of the Establishment, marginally* named, has been continuously employed in bringing up the General Report of all the computations and final charts of the Hydrabad Topographical Survey. The Surveyor reports favorably of the progress made towards the completion of these important records, which is shown in the margin†. This report with all final records, it is hoped, will be lodged in this Office by the end of next recess.

*Mr. Smith.
„ Farrell.
Mr. Scanlan.
Pandurao Native Surveyor.

† *Fair Records completed.*

Triangles	sheets 72	fair copied.
Heights ...	„ 16	ditto.
Synopsis of Latitudes, Longitudes and Azimuths	„ 27¼	ditto.
Alphabetical lists of principal and secondary stations with Latitudes and Longitudes ...	„ 13	ditto.
Abstract of Horizontal Angles	„ 56	ditto.
Triangulation Charts, projected	„ 4	ditto.
Alphabetical lists of Villages arranged with Latitudes and Longitudes, in rough ...	8,000 Names.	

86. The remainder of the party under the Surveyor took the field on the 29th October 1866, and returned to recess quarters at Ellichpore by 20th June 1867, completing 6,299‡ square miles of triangulation extending over portions of the Districts of Hooshungabad, Baitool, Chindwarra and Seonee, and 915 square miles of final Topographical Survey in the Hooshungabad District.

‡ J. Mulheran, Esq., assisted by Mr. Sub-Assistant Chennell	2,949	in Baitool, Seonee and Chindwarra.
Mr. Neale, assisted by Mr. Maine	1,572	Hooshungabad and Boitool.
Mr. Chamarett	1,778	Ditto.
Total Area triangulated ...	6,299	Square Miles.

87. The initial elements for the triangulation were obtained from the Great Arc Series of the Great Trigonometrical Survey, which runs through the Baitool District. Observations were taken at 191 stations, by which the position of 503 points were trigonometrically determined, giving an average of 1 point to every 12·5 square miles of ground.

88. The following Table shows the Area of final survey on the scale of 1 mile =1 inch, completed by each person, and the average number of Plane Table stations per square mile.

Name of Surveyors.	Area Surveyed.	Average number of Plane Table Stations in a square mile.	Remarks.
	Sq. miles.		
Mr. Neale	73	3·2	Hills and Forest.
„ Chamarett	72	3·8	Ditto.
„ Chennell	83*	4·1	Ditto.
„ Maine	198*	1 9	Ditto.
Baparao, Native Surveyor	270*	3·2	Ditto.
Ram Chunder, do.	38*	3·0	Ditto.
Janardhan Rao, do.	181*	2·8	Open and easy.
General Average	.....	3·1	* Plane tabling tested in the field by check lines.

89. In addition to the above, on a requisition from the Conservator of Forests, a survey of the boundaries of the Rajabari Reserve on the large scale of 4 inches =1 mile was undertaken, but in consequence of difficulties experienced in clearing and defining the boundaries, the work could not be completed. Arrangements have been made to secure the completion of the survey of the reserves of Rajabari, Katangi, and Saoligar during the current field season.

90. Owing to the party having just entered upon a new field of work, the area of final or Topographical survey is small, but the triangulation has been well advanced as so essentially necessary, and ample ground is now prepared for the full employment of all the detail Surveyors.

91. During the recess the following fair records have been completed :—

5 General Maps, scale 1 mile = 1 inch. (Standard Maps for transmission to England).

5 Exaggerated Maps, ditto. (For reduction by Photography to ¼ inch scale, and multiplication by Photography).

1 Chart of Triangulation with Numerical data.

1 Preliminary Sketch Map of Area triangulated in advance, and showing Areas fitted for Revenue and Topographical Survey.

Computations.

11 Principal, and 202 1st class Triangles; 708, 2nd Class and 183, 3rd Class Triangles.

24 Deductions of Principal, and 224 Deductions of Secondary Latitudes, Longitudes, and Azimuths.—1,043 Deductions of minor secondaries ditto.

For General Report of 1866-67.

Title page, General Skeleton plan and Introduction.
Description of Principal Stations.
Computations of Principal, Secondary, and Minor Secondary Stations.
Abstract of Heights, Principal and Secondary Stations.
Synopsis of Latitudes, Longitudes, and Azimuths of Principal and Secondary Stations.
Alphabetical Lists of Towns and Villages.
Abstract of Horizontal angles.

92. The total expenditure for the season amounts to Rs. 58,229.

93. The Surveyor reports most favorably of the exertions of his Civil Assistant Mr. Neale and of all the Sub-Assistants under his orders. Full details connected with his operations will be found in the extract from the Surveyor's Narrative Report given in the Appendix. Mr. Mulheran, in consideration of his long and good services was promoted to 2nd Grade Surveyor from the 1st January 1867.

94. During the current field season, the Surveyor will be employed in extending his triangulation eastwards through Chindwarra and Seonee; the Civil Assistant, Sub-Assistants, and Native Surveyors will be employed on Topographical details in the District of Baitool, and survey of Forest Reserves, and on the general or final report of the Hydrabad survey.

No. 3 TOPOGRAPHICAL PARTY.

Central Provinces and Vizagapatam Agency Survey.

(Late Ganjam and Orissa Survey).

95. The designation of this party has been altered from "Ganjam and Orissa Survey" to "Central Provinces and Vizagapatam Agency Survey" to suit its present field of operations

and their extension southwards, after the completion of all the Tributary Cuttack Mehals and portions of the Ganjam Agency in Sheets 106 and 107 of the Atlas which have been published.

Personnel.

Lieut Colonel, G. H. Saxton, Executive Officer in charge.
Lieut. A. E, Downing, Asst. Surveyor, 2nd Grade.
Mr. D. Atkinson, Civil Asst., 4th Grade.
„ R. W. Chew, Sub-Asst, 1st Grade.
„ J. Harper, „ „ „
„ J. A. May, „ 2nd „
„ F. Adams, „ „ „
„ T. E. M. Claudius, „ 3rd „
„ F. W. Pettigrew, „ 4th „
and 3 Native Surveyors and Draftsmen.

96. The party started from recess quarters at Ootacamund on the 21st November 1866, and proceeded to Vizianagram, at which place arrangements were made for detaching the Assistants to the ground allotted to each for survey. Considerable delay and difficulty is reported to have been experienced in obtaining carriage and labor for the conveyance of Camp Equipage, Instruments, &c., into the interior of this almost impracticable country, and no assistance could be obtained from the Local Authorities.

Field of Survey described.

97. The ground for survey was situated within the wild, hilly, and unexplored tracts of Bustar and Kalahandy within the limits of the Central Provinces, and in Jeypore and Madagul within the Vizagapatam Agency of the Madras Presidency.

Triangulation—Junction with Coast Series, G. T. Survey.

98. Lieutenant Colonel Saxton had, during the previous season, carried a series of 1st Class secondary triangles southward from the parallel of 19°-30′ to 18°-15′, with the object of effecting a junction with the Coast Series, Great Trigonometrical Survey, but had failed in carrying out his intentions in consequence of bad weather setting in and other causes. During the season under review, he has connected with the Coast Series, Great Trigonometrical Survey, in Latitude 18°, and has covered an area of about 2,300 square miles with six 1st Class and 256 minor triangles, fixing the position of 116 points, giving one point on an average to every 20 square miles. Angles were observed at 41 stations and 102 determinations of heights were obtained. Portions of the area triangulated will necessarily require closer triangulation before the ground comes under detail survey: the Surveyor seems fully alive to the necessity of providing a larger number of fixed points for his Plane Tablers than the triangulation now completed affords, and he will have ample time to do this, as his triangulation is in advance of final survey by nearly 10,000 square miles.

Kap. H. S.	Latitude.	Longitude.	Height in feet.
By G. T. Survey ...	17°-56′-52″-82	82°-39′-37″-47	5,214·2
By Lieut. Col. Saxton's triangulation ...	17°-56′-52″-48	82° 39′-38″-78	5,187·6
Difference ...	0″-34	1″-31	26·6

At Kap H. S. Azimuth of Dher H. S.		Kap to Dher in feet.
By G. T. Survey ...	32°-58′-50″-2	92,672·0
By Lieut. Col. Saxton's triangulation ...	32°-58′-25″-7	92,676·8
Difference ...	24″·5	4·8

The discrepancy in the distance Dher to Kap being 3 inches per mile.

99. The values by Lieutenant Colonel Saxton's triangulation and those of the Great Trigonometrical Survey for the H. S. of Kap, are given in the margin; they prove that the work performed by the Topographical Survey is trustworthy, and considering the size of the instrument employed, and the distance traversed before this test has been obtained, the results are satisfactory and most creditable to the Surveyor.

Detail Survey Completed.

100. The Plane Tabling executed is situated between the parallels of 19°-15′ and 19°-45′, and extends from Longitude 81°-20′ to 82°-55′, embracing an area of 2,316 square miles, which will contribute to the filling up of Atlas Sheet No. 92. The amount of final survey, on the 1 inch scale, completed by each

Assistant, and the average number of Plane Table fixings in each square mile, are given in the following Table :—

Name of Surveyors.	Area Surveyed.	Average Number of Plane Table Stations.	Remarks.
Lieut. Downing	62·2	4·3	Ground in parts, extremely difficult; hills and plains covered with dense tree jungle and infested by tigers.
Mr. D. Atkinson	279·9	15·7	
„ Chew	372·1	2·4	
„ Harper	342·1	7·5	
„ May	214·6	13·3	
„ Adams	356·5	5·2	
„ Claudius	388·7	4·0	
„ Pettigrew	114·0	7·4	
Shaik Hidaitoolah, Native Surveyor...	186·6	6·0	
General Average	...	7·3	

101. The entire country through which the operations of this party are carried is unhealthy, covered with dense jungle, in parts destitute of water and infested with tigers and other wild animals. Large tracts are totally uninhabited, and supplies of every description must be carried out. No means of communication exist, and survey operations are only carried on, with any degree of safety, for a very short period of the year, and under the utmost difficulties.

102. Owing to the circumstances above described, it was impossible to carry out thoroughly the system of check lines of routes which was chiefly entrusted to Mr. D. Atkinson. Checks were partially applied where possible, and all the junior hands were visited and their plane tabling checked on the ground. The Executive Officer's health, I regret to report, failed completely about the first week in March 1867, and necessitated his withdrawal from the field to obtain medical aid, and he was allowed to precede his party to recess quarters on two months' privilege leave from the 6th April 1867. Lieut. Downing, the Military Assistant, from various causes, appears to have accomplished only the very small area of 69 square miles of Plane Tabling, with two traverse routes of about 13 miles. Mr. Harper, Sub-Assistant, has been obliged to proceed to Europe on medical certificate, and several of the Sub-Assistants and Native Surveyors suffered much from jungle fever. A most promising Native Surveyor Hidaitoollah died, I regret to add, from the effects of fever after return from the field.

Recess duties.

103. The several detail parties did not return to the coast and reach their recess quarters until late in the months of May and June, and they were all greatly prostrated during the recess from the effects of climate, which the Sanatarium of the Nielgherries has alone been the means of remedying. The following Mapping and Computations are reported to have been completed :—

6	Standard Maps,	scale 1 mile=1 inch,	for transmission to England.
3	Exaggerated Maps,	ditto,	for reduction by Photography to ¼ inch scale, and multiplication by Photozincography.
4	Ditto	ditto,	partially completed.

1 Chart of triangulation, scale 4 miles=1 inch, with numerical data in duplicate.

2 Index Charts.

Sets in triplicate of Principal and Secondary Triangles.

Ditto of Latitudes, Longitudes, and Azimuths.

In duplicate, Secondary ditto ditto.

Ditto Computations of Heights.

In triplicate, Synopsis of results and registers.

96 Pages of Horizontal Angles in duplicate.

44 Ditto Vertical ditto ditto.

Cost of Survey.

104. The total survey expenditure of this party up to 30th September 1867 amounts to Rs. 71,915-2-0.

Transfers, appointments, &c.

105. Lieutenant Downing, Assistant Surveyor, 2nd Grade, has been transferred as Officiating Executive Officer in charge of No. 7 Topographical Party, Rajpootana Survey. Lieutenant C. Saxton, Royal Artillery (Madras), was appointed under the orders of Government, marginally noted*, as a probationary Assistant Surveyor and attached to this party, but his services have since been placed at the disposal of the Government of Madras in the Military Department for employment with the Abyssinian Field Force, and no suitable candidate to fill the vacancy thus caused, has yet been obtained. Mr. Civil Assistant Atkinson has been transferred to do duty at my Head Quarter Office to fill a vacancy.

* G. O. G. G. No. 2968, dated 2nd August 1867.

Future Operations.

106. During the field season of 1867-68, the triangulation will be extended south of the parallel of 18° and westwards, from the meridian of 82°. The junction with the Coast Series will be extended, and if possible, a junction will also be effected with the triangulation of the Hydrabad Topographical Survey in the Godavery Talooks to the west and south on the Godavery River. The detail parties will occupy ground in the Jeypoor and Bustar States south of the work just completed. The strength of the Establishment has been much weakened from the causes above explained, and I regret I have been unable to supplement the party further at present, owing to the pressing demands for qualified Civil Assistants on the other surveys, where the progress is of still greater importance.

107. Mr. Cooper, Sub-Assistant of the 4th Grade, from the Pegu Survey has been transferred to this party from the 1st December. Further details will be found in the extracts from the Surveyor's Report in the Appendix.

No. 4 TOPOGRAPHICAL PARTY.

Chota Nagpore Division Survey.

Personnel.

Captain G. C. Depree, Surveyor in charge.
Mr. F. B. Girdlestone, Assistant Surveyor.
„ G. A. McGill, 4th Grade Civil Assistant.
„ J. Vanderputt, 1st Grade Sub-Assistant.
„ A. J. Wilson, 2nd „ „
„ T. W. Bobanau, 2nd „ „
„ A. James, 3rd „ „
„ C. Low, 3rd „ „
„ J. Wilson, Draftsman, and two Native Surveyors.

108. On the 17th November 1866, the party under Captain Depree started for the field from Dorundah: the several Assistants commenced work by the 10th December, and continued on the ground allotted to each until 1st May following.

Triangulation completed.

109. A series of six triangles, emanating from the Calcutta Longitudinal Series, Great Trigonometrical Survey, was carried southwards through the Native State of Korea along the Meridian of 82°45′, and a net-work of minor triangles was extended over portions of Sirgoojah, Korea, and Chang

Bokhar on the borders of the Rewah State. The total area triangulated is estimated to be 4,500 square miles. Observations were taken at 60* stations, and 466 points were fixed, giving on an average one point in every 9·6 square miles.

*17 Principal Stations by Captain Depree.
28 Secondary ditto by Mr. Girdlestone.
15 Village ditto ditto.

110. An area of 2,378 square miles of final survey on the 1 inch scale was completed in Sirgoojah and Jushpore, and a junction has been effected with the Revenue Survey Operations in Palamow and also with the old Revenue Survey of District Mirzapore, along the south-western boundary of Singrowlee.

Final area accomplished.

111. I have much satisfaction in stating that every portion of the Topography was carefully checked by "pertal lines" or check routes, and intersections from commanding heights.† The results have proved satisfactory, and are creditable to all parties employed on the detail operations; the area completed by each person and the average number of plane table stations in a square mile are given in the following Table. The materials thus rendered will come into Sheets Nos. 104 and 105 of the Atlas :—

† The Surveyor reports that each plane tabler was visited, and the field sections were tested in situ, and in addition to this 232 running miles of check routes were run by him.

Name of Surveyors.	Area Surveyed.	Average Number of Plane Table Stations.	Remarks.
Mr. Girdlestone	97·3	6·7	A plateau uninhabited, with a precipitous fall of 1,700 feet.
,, McGill	373·4	5·1	A mountainous, difficult, thinly inhabited tract; also some fair villages.
,, Vanderputt	336·4	6·5	Ditto ditto with some good country.
,, Wilson, Senior	429·7	4·5	Chiefly jungle, hills and plains.
,, James	363·0	6·6	A mountainous tract, with cultivated valleys.
,, Barker	91·5	10·8	An easy tract with villages and few hills.
,, Wilson, Junior, Draftsman ...	308·0	3·8	A jungly tract, with few villages and no large hills.
M. S. Dutt, Native Surveyor ...	368·5	8·6	Hills, jungle, and well cultivated country.
General Average ...	...	6·6	

Recess work completed.

112. Recess duties commenced on the 3rd May, and the following records and computations were completed :—

7 Fair Maps 15′×30′, scale 1 mile=1 inch ... Standard for transmission to England.

7 Exaggerated Maps ditto } For reduction by Photography to ¼ inch scale, and multiplication by Photo-zincography.

1 Chart of Triangulation with numerical data.

Computations and Report Volume.

6 Principal, 63 Secondary, 796 Tertiary Triangles.
4 Principal, 70 Secondary, and 392 Tertiary Stations.
Latitudes, Longitudes, and Azimuths.
323 Computations of Heights.
25 Pages, Alphabetical Lists in triplicate.
32 ,, Synopsis of Latitudes, Longitudes, and Azimuths in triplicate.
252 ,, Horizontal Angles ... ... } In duplicate.
76 ,, Vertical ,, ... }
112 ,, Villages, Alphabetical List in duplicate.

Cost of Survey.

113. The total cost of the party up to 30th September amounts to Rs. 56,331-7-11.

Training of new Sub-Assistants.

114. The Surveyor and his Assistant have devoted much time and attention to the training and instruction of newly appointed Sub-Assistants and Native Surveyors. Captain Depree takes much interest in this important part of his duty, and has lately prepared papers on the method he adopts, in imparting initiatory instruction to novices on the delineation of ground, the method of testing, and the use of the plane table.

115. The Surveyor reports in highly commendatory terms of his Assistant Mr. Girdlestone, and the Government have been pleased to promote this deserving Officer, on my recommendation, to 1st Grade Assistant in the Senior Department from 1st August last. I regret to add that failing health necessitated his leaving India on medical certificate for 20 months, from the 23rd September.* With the view of giving this Assistant a wider experience and the advantage of different modes of conducting Survey operations under various managements, he was transferred to No. 1 Topographical Party, Gwalior and Central India Survey, but unfortunately was not able to join the party. The conduct and services of the Civil Assistant and Sub-Assistants have been favorably mentioned.

* The Home Department Notification No. 5304, dated 10th October 1867.

Future Operations.

116. The triangulation in advance of the detail survey amounts to 6,000 square miles, providing amply for all the plane tabling likely to be executed during the next two seasons; all hands will therefore be employed on topographical details in portions of Sirgoojah, towards the north-western side of the Chota-Nagpore Division.

117. All this tract is extremely wild, difficult for survey, and sparsely populated, and the Surveyor will find full employment in training new hands, testing plane tabling, and providing generally for the wants of his detail parties.

118. The resignation of Mr. C. Low, Sub-Assistant of the 3rd Grade, was accepted from the 11th May 1867.

119. The details, extracted from the Surveyor's Report, evince the zeal and assiduity with which all his duties are carried out. Captain Depree having completed 12 years' qualifying service on the 20th October 1866 was promoted to the 1st Grade from that date to fill an existing vacancy in the Department.†

† *Vide* General Order No. 5974, dated 31st October 1867.

No. 5 TOPOGRAPHICAL PARTY.

Rewah and Bundelkund Survey.

120. The operations of this party extended during the season under review over portions of the Native States of Rewah (south of Soane River) and Myhere, Punnah, and Nagode. The party left recess quarters (Mussoorie) under Captain Murray on the 20th October 1866, who superintended the field operations, until his health having failed he obtained Medical leave to Europe for 20 months, from 25th March 1867‡, and he quitted his post on preparatory leave on the 1st March 1867.

Personnel.

Captain W. G. Murray, Executive Officer in charge.
Lieutenant R. V. Riddell, R. E., Officiating ditto.
Lieutenant W. F. Badgley, Assistant Surveyor.
Mr. R. A. Bell, Civil Assistant, 2nd Grade.
E. S. P. Atkinson, 2nd Grade Sub-Assistant.
C. F. Hamer, 3rd ditto.
A. D. Howard, „ ditto.
C. T. Evans, 4th ditto.
T. D. Ryan, „ ditto.
E. A. Wainright, „ ditto.
Native Surveyors five.

‡ G. G., Military Department, No. 328 of 1867.

Change in the Executive Officer.

121. The season having so far advanced, it was then not practicable to bring down another Executive Officer from a distance without detriment to other surveys, and consequently the Military Assistant, Lieutenant Badgley, was placed in temporary charge, to complete the field work for the short remaining time of the season and to conduct the party back to recess quarters. Captain Murray left the field at a most critical time, but this was unavoidable, as his health, which had been failing for some time past, prevented his taking any active share in the field duties.

Plan of Operation.

122. The plan of operations for the season, as originally intended, may be briefly described as follows:—The completion of the whole unsurveyed portion of Rewah, south of the Soane River, comprising an area of about 2,300 square miles; large scale surveys of the forts and town of Rewah, Myhere, Nagode, and Punnah; extension of the triangulation westwards up to the Meridian of 80° in Bundelkund, and completion of triangulation in the southern portions of Rewah.

123. This programme was well designed, and fully relied on by Captain Murray prior to his departure, but he depended on his subordinates all performing a very large area, by directing them to remain in this part of the Rewah District to a very late period of the season, without ever visiting the spot himself, and without calculating on the stoppages of the work by disease or other local causes, and consequently the completion of the work could only be partially carried out, owing to the very unhealthy and difficult nature of the tract for detail survey, and the prostration of the several members of the party from jungle fever. Mr. Bell, 2nd Grade Civil Assistant, a most excellent and promising Assistant, I much regret to report, fell a victim to this disease during the season. He was attacked on the 20th of April, and being carried into Myhere, died there on the night of the 4th May 1867. The loss of his services was a great misfortune to the entire Department. Some of the other Sub-Assistants also suffered a good deal and left the field incapacitated.

124. Soon after the Rewah Survey was instituted, I obtained the sanction of Government for extending the operations by degrees into the Bundelkund States for the express purpose of employing this party on fairly healthy ground in the earlier and later months of the season, when it is notorious that the country south of the Soane cannot be occupied without great danger to health. It is therefore much to be regretted that Captain Murray should have made such arrangements which ended in disaster, without any corresponding advantages. In the Narrative Report which this Officer submitted prior to his departure, he speaks very confidently of the entire area being got through, whereas in reality, so much remains as it is feared cannot be accomplished even during the current season. This wide discrepancy in expected results arises from Captain Murray having remained at too great a distance from the scene of action, and from his failing to appreciate the real nature and extent of the task to be performed by others, and being unable to participate in it himself throughout the season.

Amount of work completed. Triangulation.

125. Lieutenant Badgley, Assistant Surveyor, was entrusted with the triangulation. He covered an area of 1,474 square miles south of the Soane River, with 47 secondary and 185 minor secondary triangles, fixing the positions of 117 points. Observations were taken at 20 stations, and 68 heights were trigonometrically determined. The average triangular error in 47 secondary triangles was 5·34 seconds and the average linear discrepancy of common sides was 3·59 inches per mile. Some ground was also reconnoitred, and stations selected in Punnah and Adjygurh, and barometrical observations were taken at 28 stations.

Plane Tabling.

126. The ground for final survey was of an extremely difficult nature, very unhealthy, in parts low and swampy, and covered with rank forests. The total area completed on the 1 inch scale is 1,409 square miles only, and is comprised in Sheet No. 89 of the Atlas. This topography was most urgently called

for by the Geological Survey; the failure to complete what was cut out for the survey is therefore the more unfortunate. The following Tabular Statement gives the area surveyed by each Plane Tabler, and the average number of times the Plane Table was set up per square mile :—

Name of Surveyors.	Area Surveyed.	Average Number of Plane Table Stations.	Remarks.
Mr. R. A. Bell	116·8	7·6	Died on 4th May 1867.
„ E. S. P. Atkinson ...	292·2	4·9	Left the field sick.
„ Hamer	132·6	7·7	
„ Howard	159·8	4·1	Ground difficult; covered with broken hills, forest, grass, and shrubs.
„ Evans	379·3	4·4	
„ Wainright	30·2	7·5	
Native Surveyors.			
Nabbi Buksh	106·0	6·5	
Prem Raj	95·0	6·5	
Abdurahim	97·4	6·5	
General Average ...	.....	6·1	

127. In addition to the above, large scale 8 inch=1 mile surveys have been completed of the cities and suburbs of Rewah, Punnah, Kalinger, Nagode, and Myhere, and 47 miles of check routes have been run. The several portions of ground allotted to each Surveyor were detached over a large area with the object of squaring up work, which could not be completed during previous seasons.

Recess duties.

128. The party marched back to Allahabad, and from thence returned to recess quarters at Mussoorie by the end of May, when Lieutenant Badgley, on the 1st June, made over charge to Lieutenant R. V. Riddell, 1st Grade Assistant Surveyor, who had been conducting the operations of No. 1 Topographical Party, Gwalior and Central India Survey, and who at that period had just brought his party to the same recess station.

129. The amount of work completed during the recess is as follows :—

Computations.—47 1st Class Secondary and 185 2nd Class Secondary Triangles.
34 Deductions (double) of Latitudes, Longitudes, and Azimuths.
68 ditto of Heights.
28 ditto ditto from barometric observations.
2 Computations of Ray traces.
Alphabetical Lists of Latitudes, Longitudes, and Azimuths of Stations.
Ditto ditto ditto of Villages.
73 pages in duplicate of Horizontal and Vertical Angles.

Mapping.—6 Fair Sheets, complete and 2 in part, scale 1 mile=1 inch, for transmission to England.
4 Exaggerated Sheets complete and 3 in part for reduction by Photography to ¼ inch scale, and multiplication by Photozincography.
3½ Degree Charts of Triangulation with data, scale 1 mile=1 inch.
6 ditto ditto ditto partially drawn.

Cost for the Season.

130. The cost of this survey for the season ending 30th September 1867, amounts to Rs. 51,395.

Inspection by Surveyor General.

131. During my late tour of inspection, I visited the Office of this party on several occasions during the months of September and October last, and had various opportunities of observing its internal economy. The administration of Captain Murray and the manner in which he quitted his post without personally delivering over charge of the accounts and Government property to his successor or to any European Officer caused, I regret to say, very considerable inconvenience, and I have had extreme trouble in balancing the accounts and settling things in proper order. Lieutenant Riddell assumed charge, therefore, under considerable disadvantages, and a good deal of arrears of mapping existed which could not entirely be brought up during one recess. Fair exertions are now being made, and I trust as the Military Assistant becomes more efficient, there will be no difficulty in rendering each season's work as it is due, in future.

132. The out-turn of such a party and at such a cost cannot be considered satisfactory. What has been brought up, appears to be well done, but there is much more remaining to be done than there ought to be, considering the small area effected. I was also sorry to find a bad tone of discipline amongst some of the junior Sub-Assistants, which I had occasion to animadvert on, and I trust that the steps taken to instil proper views and principles into the minds of the subordinates, will have due effect. Lieutenant Riddell has taken the field, and I hope is duly impressed with the importance of duty before him; he is in no way responsible for the field work executed prior to his joining the party, but only for the results of the recess work.

Appointments and transfers.

133. In consequence of the death of Mr. Civil Assistant Bell, Mr. A. Chamarett, 3rd Grade Civil Assistant from No. 2 Central Provinces Survey, has been posted to this survey, to supply the vacancy. Mr. E. S. P. Atkinson, Sub-Assistant, 1st Grade, has been removed to No. 7 Topographical Party. Mr. C. T. Evans, Sub-Assistant, 4th Grade, having tendered his resignation for the purpose of entering the College at Roorkee, has been allowed one year's leave of absence without pay. Mr. F. Kitchen from the Rajpootana Survey has been transferred to this party in the room of Mr. Atkinson, and Mr. H. T. Kitchen was appointed a 4th Grade Sub-Assistant, and attached to the Rewah Survey from 1st November 1867, *vice* C. T. Evans.

134. During the season of 1867-68 now commenced, the entire strength of the party will be employed up to the middle of December in the Bundelkund States, North of Latitude 25° and between the Meridians of 80° and 81° East Longitude, both in the extension of the Triangulation in advance as well as in the Topographical details to the extent of as much as can be accomplished up to that date, after which every available hand, including the Executive Officer and his Military Assistant, will move down south of the Soane River to complete, if possible, the remaining unsurveyed portions of the Rewah State from the parallel of 24° southwards. This work will continue to about the end of March, after which it is not safe to remain in the jungles and highly malarious tract of countries in that direction. The several Assistants will then return to retake up their Plane Table Sections in the Bundela States, and so it is hoped a full season's work may be obtained without sacrificing the health of the party. The Triangulation will be further extended westward into Bundelkund by Lieutenant Badgley after his return from Plane Tabling in Rewah.

135. The Executive Officer has been directed to exert his best energies to secure the completion of the unsurveyed portions of Rewah, and by his presence there to encourage and support his subordinates in the difficult task before them; but to effect this object, he is instructed not to permit the same mistake of remaining there too late in the season as was made by his predecessor.

* Dated the 2nd July 1867.

136. I have received from Captain Murray since his departure from this country an appeal * against the decision of the Government as to his grading in the reorganization scheme, as published in the

Gazette of the 2nd February 1867, made in accordance with the special recommendations submitted in the Officiating Surveyor General's letter No. 1016, dated the 16th October 1866. After carefully considering all that Captain Murray advances in favor of his assumed right of precedence or seniority over Captains Austen and Melville, as well as what is stated in Lieutenant Colonel Walker's Report, and the refutations of Captain Murray's statements by the two former Officers to whom the memorial was referred, I am of opinion that there is no necessity whatever to alter the grading of the Officers of the Topographical Branch. The standing of the three Officers in question is identical; their services have been all excellent in their respective vocations in different branches of the Department, and whilst Captains Austen and Melville were toiling in the higher altitudes of Kashmir, Ladak, and the Karra Korum Range under great privations and difficulties on lower salaries, Captain Murray fortunately enjoyed the charge of a Topographical Survey Party in the plains, and consequently lays claim to priority of rank in the list of 3rd Grade Surveyors. If a comparison must be made between the relative qualifications, attainments, and usefulness of the three Surveyors, the preference must be given in the order in which the Government have directed the grading of the Officers in question, and as I consider the case requires no further action on the part of the Government, I simply record it in this place.

137. Further details from the Executive Officer's Report are given in the Appendix.

No. 6 TOPOGRAPHICAL PARTY.

Cossyah and Garrow Hills Survey.

138. In the Administrative Reports of season 1864-65 and 1865-66 of the Topographical Survey Department, the employment of Captain Godwin Austen, Executive Officer, as Surveyor to the Bhootan Mission and subsequently with the Military Force under General Dunsford, has been referred to on the completion of his report at Mussoorie where he resorted on sick leave. He was also for a short time attached to the Office of the Great Trigonometrical Survey, Dehra Doon, but in November 1866 was deputed to take up his own substantive appointment, the charge of the Topographical Survey of the Cossyah and Garrow Hills, and he consequently relieved Lieutenant R. V. Riddell, who had officiated in charge of this party since 23rd November 1864.

Personnel.

Captain H. Godwin Austen, Surveyor in charge.
Lieutenant M. T. Sale, R. E., Assistant Surveyor.
Mr. N. T. Belletty, 1st Grade Civil Assistant.
,, H. M. Atkinson, 1st Grade Sub-Assistant.
,, A. G. Wyatt, 3rd Grade ditto.
,, P. C. Gilhooly, 4th Grade ditto, and three Native Surveyors.

Plan of Operation.

139. The plan of operations for the season under review was to complete the unfinished portions of Cossyah territory between the lines of Latitude $\frac{25°10'}{25°45'}$ and Longitude $\frac{91°}{92°}$, and to extend the triangulation eastward of the meridian of 92°.

Country under Survey described.

140. A more difficult country for survey operations can scarcely exist in any part of India. In addition to the very rugged character of the ground, the view at every commanding point is obstructed by almost impenetrable jungle; the hill sides are precipitous and often inaccessible except at certain points, and the low ground and valleys are unhealthy in the extreme. Stations cannot be fixed without jungle clearing to a large extent, nor can the detail surveyor see a step in advance without the erection of scaffolding on the loftiest forest trees, while labor and carriage is exorbitant in price and frequently cannot be procured at any price.

Scale of Survey reduced.

141. Owing to these difficulties, the progress of the survey has been extremely slow and unsatisfactory, and the cost far beyond that which it is desirable should be incurred for a preliminary topographical delineation of such a country. On my return from Europe last season, my first attention was given to the progress and cost of this Topographical Party, and with reference to the remarks

made by my *locum tenens*, Lieutenant Colonel Walker, in paragraph 44 of his last printed Report (page 39), suggesting a reduction of the scale of this survey from 1 inch to ½ inch to the mile, Captain Godwin Austen was directed to report without delay on the nature of the ground in advance, the difficulties he experienced in the conduct of survey operations, and the cost of the work. My own experience in the low hills below Cherra Poonjee and knowledge of the country, gained while conducting the survey of Jynteah in 1836 to 1840, also enabled me to judge of the difficulties which would be experienced by this party as the work extended westward and eastward of Cherra Poonjee, into the Garrow and Naga country respectively. On receipt of Captain Godwin Austen's Report, no time was lost in directing a reduction of the scale from 1 to ½ inch to the mile for all the difficult, jungly, and thinly populated portions, and he was further directed only to finish up on the large scale such tracts as were open and easy of access, necessary to complete the maps immediately in the vicinity of Cherra Poonjee and Shillong or Yeodo. I consider the reduced scale ample for all practical purposes in such a country.

Detail Area completed.

142. The ground on which the plane tablers had to be employed was detached and spread over a large area in consequence of gaps in the sections of previous seasons, owing to fever having prostrated the detail surveyors and their camps, before completion of entire sections or blocks of work. Nearly all these gaps or blanks were taken up and resurveys were made of several partially completed and unexamined portions of ground. The total out-turn of final survey thus completed amounts to 1,287 square miles;* the area surveyed by each Assistant, and the average number of Plane Table Stations per square mile, are as follow :—

* On 1 inch=1 mile, 1,038 square miles.
„ ½ inch=1 mile, 249 „
Total 1,287 „

Name of Surveyors.	Area Surveyed.	Average Number of Plane Table Stations.	Remarks.
Captain Godwin Austen ...	249·0	4·8	
Lieutenant M. T. Sale ...	77·0	4·2	Incapacitated from further field duty owing to an accident.
Mr. H. M. Atkinson ...	125·0	2·3	
„ Wyatt	147·0	2·0	Ground extremely difficult and covered with dense forest, and lying in detached portions over a large area.
„ Ogle	121·5	5·3	
„ Gilhooly	304·0	3·2	
Native Surveyors.			
Nasirudin	216·5	3·7	
Daliludin	47·0	5·6	
General Average	....	3·9	

Triangulation.

143. The triangulation completed in advance is situated chiefly to the east of the Meridian of 92°, and embraces an area of 1,570 square miles. The number of stations observed at were 68,† giving 252 triangles by which the positions of 43 points were determined, or nearly one point for every 10 square miles of ground.

† 14 Stations observed at by Capt. Godwin Austen.
54 Ditto ditto by Mr. Belletty.

Cost of Survey.

144. The total cost of these operations for the season ending 30th September is Rs. 69,066, the contingencies for carriage by means of coolies only (every one of whom cost Rs. 10 per mensem each to carry 30 seers weight only), being excessive.

145. The entire progress for the season, though small, contrasts favorably with that of previous years, and speaks favorably of the energy brought to bear by Captain Godwin Austen on the operations of this party. Captain Austen's experience in mountainous countries, and his talent in drawing, as well as energy in all he undertakes, render him a valuable Officer for the particular survey on which he is engaged, and I have every expectation of a new turn in the tide of prosperity on this survey from the results of his first season of independent charge.

Opinion on the Season's progress.

146. With the reduction of the scale of detail survey, it is expected that much more favorable results will be obtained during the current season; but the difficulties under which this survey labors are perfectly exceptional, and it would be unfair to compare the out-turn or cost with those of other Topographical Parties which are working in more favorable localities.

147. The Surveyor has lately made a representation of the difficulties he is now experiencing in obtaining transport labor, except at exorbitant rates, and not even then in sufficient quantity, and the unwillingness of the Local Authorities to afford him any aid. As his letter contains questions of vital importance relating to the future cost and progress of the Cossyah and Garrow Hills Survey, the subject has been separately submitted for the special orders of the Government of Bengal, with the view of determining the best course to pursue under such circumstances.

Recess Work.

148. During the recess, the following maps and computations were completed:—

Fair Maps, Sheets 11, 15, 16, 17 and part of 12 and 13 ... } 1 inch scale, for transmission to England.

Exaggerated Maps, Sheets 15 and 16 Scale 1 mile = 1 inch ... .. } For reduction to ¼ inch by Photography, and reproduction by Photozincography.

3 Fair Tracings for the Civil authorities on 1 inch and ½ inch scales.

1 Chart of Triangulation, scale 4 miles = 1 inch.

Computations—Triangles: 9 Principal, 112 Secondary, 188 Minor Secondary.

Heights of principal Stations, 6.

Latitudes, Longitudes and Azimuths: Principal, 6; Secondary, 37; Minor Secondary 128.

149. The state of the efficiency of the party, for the peculiar country and climate in which they are engaged, has given me considerable anxiety, and several changes have been effected in order to accelerate progress, and to obtain good hill-sketchers. Mr. H. M. Atkinson, Sub-Assistant, 1st grade, whose topography was pronounced inaccurate and had to be redone, was permitted to resign his appointment from the 5th August 1867. Mr. Bobanau, Sub-Assistant from the Chota Nagpore Division, was transferred in his place. Two probationary Sub-Assistants, Messrs. Stratford and Doran, who were kept under training for some months in this Office and had made satisfactory progress in the delineation of ground and use of the plane table, have been appointed, and two experienced Native Surveyors have been transferred from the Pegu Survey.

Changes in Personnel.

150. Extracts from the Surveyor's Report, and a very interesting paper descriptive of the country, and its inhabitants to the West of Cherra Poonjee, are given in the Appendix.

151. Captain Godwin Austen, under orders fromt he Bengal Government, was directed to make a rough reconnoissance of the Garrow Hills, which appear never yet to have been penetrated thoroughly by any European, but was unable to undertake this duty at the most favorable time of the year, and when the Assistant Superintendent, Lieutenant Williamson, could manage to accompany him, owing

Exploration of the Garrow Hills Deferred.

to his presence being absolutely necessary with his detail parties for the systematic prosecution of the operations, which hitherto have not progressed under other management so well as could be desired. He attempted to penetrate the Garrow country towards the close of the field season, but was prostrated with jungle fever together with all his Native establishment, and any exploration in this direction must be deferred until the ensuing season and the Assistant Superintendent is able to make the necessary political arrangements, which require delicate treatment.

Plan of future Operations.

152. During the Field season now commenced, the detail parties will be employed in the ground immediately east of Shillong and around Jowye Poonjee; along portions of the low hills skirting the southern boundary of Gowhatty on the north face of the Cossyah Hills, and along the south face, above the District of Cachar and part of Jynteah in Sylhet. The triangulation will be extended eastward into the new district of the Naga Hills. The mention of the Military Assistant Lieutenant M. T. Sale, R. E., is favorable and very promising. This officer, although unable to take any active share in field duties during the early part of the season, in consequence of an accident which injured his leg severely, rendered efficient aid in camp, in computations, projection of plane tables, &c., and afterwards executed some good topography.

153. Mr. Belletty, Civil Assistant, to whom the triangulation in advance was entrusted, was also disabled for six weeks by an accident to his wrist. This Civil Assistant has recently received promotion to the 1st Grade, and Captain Austen states that, he hopes, the Assistant will now push on the triangulation with greater zeal and rapidity with the reduction of scale, which necessitates fewer points. I share in this expectation with the Executive Officer and have intimated the same for the Assistant Surveyor's future guidance.

No. 7 TOPOGRAPHICAL PARTY.

RAJPOOTANA SURVEY.

Personnel.

Lieutenant Geo. Strahan, R. E., Executive Officer in charge.
" Holdich, R. E., Assistant Surveyor.
Mr. J. F. Baness, Civil Assistant, 3rd Grade.
" R. Todd, Sub-Assistant, 3rd Grade.
" C. Tapsell, ditto ditto.
" J. H. Hussey, ditto 4th grade.
" F. Kitchen, ditto ditto.
" C. Kirk, ditto ditto.
" W. Stotesbury, ditto ditto.
and two Native Surveyors.

154. The field of operations for this party is situated to the West of the Meridian of 76° East Longitude, and South of the parallel of 30° North Latitude, and includes the greater portion of the Native States in the Rajpootana Agency.

Triangulation.

155. During the season now reported on, the triangulation was extended north and south of that executed during the previous years. Northwards between Latitudes 27°—45′ and 29°—15′, and southwards between Latitudes 26°—10′ and 26°—50′; both portions being flanked on the east and west by the Rahoon and Gurhagurh Series of the Great Trigonometrical Survey. The total area covered with points for future detail operations is 4,080* square miles. Observations were taken at 67 stations from which the positions of 423 points were trigonometrically determined, giving an average of 1 point to every 9·5 square miles of ground, and the heights of 154 stations were obtained.

* 1,590 square miles triangulated by Lieutenant Geo. Strahan.
2,490 square miles by Mr. Baness.

Topographical details or final survey.

156. The plane tabling or final survey completed embraces an area of 3,657 square miles, extending over portions of the Native States of Shekawatee, Jeypoor, and Jodhpoor, in Atlas Sheets Nos. 32 and 33. The

area delineated by each Surveyor on the 1 inch scale, and the average number of Plane Table Stations in every square mile, are given in the following Table :—

Name of Surveyors.	Area Surveyed.	Average Number of Plane Table Stations.	Remarks.
Lieutenant Holdich, R. A. ...	540	3·1	Ground open and easy.
Mr. Todd	405	5·8	
„ Tapsell	345	3·4	
„ Hussey	375	2·7	Check traverses were run over 376 miles, and every plane Tabler's work was examined in addition, in the field.
„ Kitchen	545	2·3	
„ Stotesbury	502	4·2	The field season extended over seven months, *viz.*, from October to May.
„ Kirk	540	4·7	
Kalka Pershad, Native Surveyor ...	405	not given	
General Average per Square Mile ...		3·7	

157. In some of the Native States the Surveyors were threatened, and work obstructed for a time; but on a representation made to the Governor General's Agent for Rajpootana (Colonel Eden) immediate measures were adopted to overcome these difficulties, and Major Beynon, the Political Agent at Jeypoor, also most cordially and readily afforded aid to the Surveyors.

Recess duties.

158. The party returned to recess quarters at Mussoorie and completed the following Maps and Computations :—

9 Standard Maps, scale 1 mile = 1 inch, for transmission to England.

6 Exaggerated ditto ditto { for reduction by photography to ¼ inch scale and multiplication by photozincography.

3 Ditto ditto partially completed ditto.

2 Charts of Triangulation, scale 4 miles = 1 inch.

1 Ditto ditto ditto for General Report Volume.

2 Index Charts, scale 8 miles = 1 inch, to illustrate Reports.

Computations.—4 Principal, 107 Secondary, and 477 Minor Secondary Triangles.
168 Deductions of Latitudes, Longitudes, and Azimuths.
227 Ditto of Heights.
252 Pages of Angle Books in duplicate.

159. A complete General Report Volume for transmission to the Home Government has been lodged in this Office together with duplicate computations.

Cost of Survey.

160. The total cost of this survey for the season ending 30th September 1867 amounts to Rs. 47,409-8. Extracts from the Surveyor's Report and a description of the Sambur Salt Lake by Lieutenant Holdich, R. E., Assistant Surveyor, are given in the Appendix.

Inspection by Surveyor General.

161. The party was inspected by myself, and the Office visited on several occasions during the recess. I found it in admirable order in every respect; the whole of the work well brought up and no arrears of any kind; the one inch maps have been drawn in a superior style in strict conformity with the new requirements for *reproduction* as well as *reduction* by photography and transfer to zinc, and have proved most successful. The out-turn of area is exceedingly satisfactory, and I have much pleasure in testifying to the very creditable manner in which Lieutenant Geo. Strahan, R. E., in charge of this party, has performed all his duties. I much regret that the failing health of this

talented officer has deprived the Department of his services for a time. His application for 20 months' leave to visit Europe on medical certificate was sanctioned by Government Orders marginally cited, and he left India on the 9th November last. Lieutenant A. E. Downing, s. c., the Senior Assistant Surveyor in the Department, or transferred from the Vizagapatam Agency and Central Provinces Survey, was appointed to officiate during Lieutenant Strahan's absence and took charge at Delhi on the 26th October 1867.

Home Dept. Notification No. 1046, dated 11th November 1867.

Home Dept. Notification No. 5540 dated the 16th October 1867.

162. Lieutenant Holdich, R. E., Assistant Surveyor attached to the Rajpootana Survey, rendered good aid both in the field and recess. His services have been transferred temporarily for employment with the Survey Party attached to the Abyssinian Field Force under special orders from the Home Department, and he has proceeded to Bombay to embark from that port, having been struck off the strength of the Rajpootana Party from the 6th October 1867.

163. The Surveyor makes special mention of the very satisfactory manner in which Mr. J. F. Baness, Civil Assistant, conducted the triangulation entrusted to him, and of the ability and zeal generally displayed by him in the performance of all his duties. Mr. Baness is a very meritorious officer, and the report made in the 7th para. (page 3) of the Executive Officer's extract in the Appendix, is most creditable to the Assistant. Messrs. Todd and Kitchen are also favorably mentioned, and the plane tabling of the former specially approved.

164. For the field season now commenced of 1867-68, full arrangements have been agreed on between the Surveyor and myself, and the whole programme discussed as detailed in the Appendix, and which I have instructed the new Executive Officer scrupulously to follow. The detail parties will be employed in completing the portion of the Bhikaneer State situated east of the Meridian of 75° and the northern portion of Shekawatee; also some ground south of Jeypoor and in the vicinity of the city of Tonk. The triangulation will be carried through the State of Tonk and extended westwards into Bhikaneer and Jodhpoor by both the Executive Officer and his head Assistant, so as to secure ample points well in advance of the Topography which is proceeding at a rapid rate, owing to the easy character of the ground as well as to the efficiency of the party which has enjoyed special advantages in an administrative point of view.

Future Operations.

165. The following changes in the personnel of this party have taken place:—

Mr. E. P. S. Atkinson, Sub-Assistant, 2nd Grade, joined from the Rewah Survey on the 12th September 1867.

Mr. Hussey, Sub-Assistant, 4th Grade, resigned his appointment on the 30th November last, and applied for a gratuity after five years' service, in consequence of severe bodily infirmity contracted from exposure in the performance of his duties during the winter in the Cossyah Hills.

Mr. F. Kitchen, 4th Grade Sub-Assistant, was transferred to the Rewah Survey from the 4th October 1867, *vice* Atkinson.

Mr. W. McNair was appointed a 4th Grade Sub-Assistant and posted to this party from 1st September 1867, *vice* Hussey resigned.

THE PEGU SURVEY.

166. In the Officiating Surveyor General's last printed Report on the administration of the Topographical Surveys, in the Bengal Presidency, paragraph 53, the completion of all the field work of this extra Departmental Topographical Survey or Military reconnoissance on a small scale, was reported. The Assistant Surveyor, Mr. Montgomeric, after discharging

Captain W. H. Edgcome, R. E., Supdt.
Mr. Montgomeric, Assistant Surveyor.
" Barnett, Sub-Assistant.
" Cooper, "
and 2 Native Surveyors.

the Native Establishment at Rangoon and disposing of all Government Instruments and Ordnance Stores, accompanied by two Native Surveyors, whose services were needed for the completion of some maps of townships on the one inch scale, embarked for Captain Edgcome's Head Quarters at Madras and joined on the 28th December 1866.

167. The remainder of the establishment was then employed in completing the final records of the survey, *viz.*, General Map Sheet 3, on the scale of 4 miles = 1 inch, embracing an area of 9,553 square miles in Pegu, and 2,500 in Martaban, being the last of the series of the Pegu Division, which was finished and forwarded to this Office for publication by the end of March 1867, and has since been transferred to stone, and is at present under revision, considerable alterations having been made in the proof returned to Madras for examination; the plans of townships on the scales of 1 inch and ½ inch to the mile, according to the size of township, in sheets of uniform size; Gazetteers of villages, lakes, rivers, &c., and tabular statements of statistics for publication with the township maps in Atlases of districts, together with the examination and revision of proofs.

168. The total out-turn of work completed and remaining to be done is as follows:—

Completed.

1. Fair Sheet 3, of the Pegu Division, British Burmah, scale 4 miles=1 inch.
2. 49 Township Maps, scale ½ inch to the mile, and redrawing of a few others. Thirty-three of these have been lithographed, and 100 copies of each printed.
3. Gazetteers of 66 Townships in Province Pegu completed.

Remaining for completion.

2 Township Maps.
33 Ditto for Lithography.
19 Gazetteers of Townships in the Districts of Rangoon and Bassein.
Closing of accounts and final disposal of records, &c.

169. On the 31st June 1867, Mr. Assistant Surveyor Montgomerie's services were dispensed with, as no further work remained for him. Having served for 15 years, his claim for a pension was submitted, with my recommendations for the orders of Government in letter No. 1468, dated the 25th October 1867. The Superintendent reports very favorably on the assistance rendered by Mr. Montgomerie both in field and recess duties.

170. Mr. Sub-Assistant Cooper being no longer required in this party, and having been recommended by Captain Edgcome, was, on the 1st December, transferred to No. 3 Topographical Party, and appointed a 4th Grade Sub-Assistant in the Topographical Survey Department to fill an existing vacancy. The two Native Surveyors marginally named were also reported as efficient, trustworthy and hard working field Assistants, and from the 19th June were transferred to No. 6 Topographical Party, Cossyah and Garrow Hills Survey, where, it is hoped, their experience in Pegu may be turned to good account.

Ramlossin.
Gorechundra.

171. Mr. Sub-Assistant Barnett is the only Assistant now with Captain Edgcome, and his services will be retained to complete the trifling amount of work which remains, and to assist in examining Press proofs of Maps and Gazetteers. A report has been called for on Mr. Barnett's qualifications, and should it be desirable, he will be transferred to a Topographical Party after completion of the duties on which he is now engaged. The rest of the old establishment have been discharged from different dates, and some recommended for the usual gratuity.

172. Capt Edgcome reports that by March next, all trifling arrears connected with the Pegu Survey w completed and the township plans published; his best efforts are being made to secure very desirable end, and I shall have great satisfaction in reporting the circumstance t vernment. Captain Edgcome's services have been most valuable in winding up this protra survey.

173. N ovision has been made for the cost of any portion of the Pegu Establishment beyond Mar xt, or the end of the financial year.

H. L. THUILLIER, *Colonel,*
Surveyor General of India.

SURVEYOR GENL.'S OFFICE,
Calcutta, the 2nd January 1868.

APHI(

172. Capt
Pegu Survey wi
made to secure
circumstance to
up this protrac

173. No
beyond Mareb

APPENDIX

EXTRACTS FROM THE NARRATIVE REPORTS

OF THE

EXECUTIVE OFFICERS IN CHARGE OF THE

TOPOGRAPHICAL SURVEY PARTIES.

ANNUAL PROGRESS REPORT, PHOTOGRAPHIC BRANCH SURVEYOR GENERAL'S OFFICE, FROM 1st DECEMBER 1866 to 30th NOVEMBER 1867.

Dated 1st December 1867.

To

THE SURVEYOR GENERAL OF INDIA,

SIR,

I have the honor to forward for your information a Tabulated Statement shewing the amount and nature of the work performed by the Photographic Branch of your Office during the past year extending from 1st December 1866 to 30th November 1867.

Introductory.

2. The origin and progress of this Establishment has been described fully in former administrative Reports to Government, and the essentially experimental character of the operations and small sanctioned Establishment have been prominently remarked on.

Agency employed.

3. Up to beginning of last December (1866) there were only two Serjeant Photographers, with a very small staff of natives employed; but Lieut. J. Waterhouse who had been appointed to the Survey Department in July 1866, and who had been kept under training in the different process of multiplying maps by Photo-zincography, &c. at the Office of the Superintendent Great Trigonometrical Survey at Dehra Doon, joined your Head Quarters, Calcutta, and took charge on the 10th December.

Lieut. Waterhouse in charge.

4. Lieut. Waterhouse continued in charge for nearly four months or up to the 23rd March, and his attention seems to have been chiefly directed to perfecting the process of Silver printing and obtaining hard Carbon prin[t] Only a very few successful transfers were made to Stone or Zinc, and these required a consider[a]ble amount of re-touching, cleaning, &c. The amount is shewn in the statement of work perfo[r]med during Lieut. Waterhouse's incumbency. Mr. graphic

Change of Superintendent.

Captain Melville placed in charge.

5. In March Lieut. Waterhouse's health having completely failed, he was ordered t[o] and obtained medical leave for six months, which has sub[se]quently been extended to 12 months, I was directed to relieve him[,] your Head Quarters and took charge of the Photogra[phic] on his departure.

Requirement of the Department.

6. At this period it appeared to me that the great desideratum of the Dep[art]ment, perfect as far as possible, the transfering by Photo[graphy] to Stone or Zinc, for rapid reproduction, or multipli[cation] meet the constant and ever increasing demands for [the] latest Surveys. I accordingly endeavoured to push forward Photo-lithog[raphic] zincography so as to supersede the more tedio[us] cesses of silver printing and hard Carbon [pro]

Photo Branch Report.

Statement attached will shew what has been done, and will, I trust, pro[ve] your Office has under my Superintendence made good progress and yield[s] considered satisfactory both by yourself and Government.

A S G. O.

	ne	
	one	
	....	
	Stone	
	....	
	....	
	Stone	
	....	For Litho

7. Since 1st April 23 transfers to Zinc and 50 to stone have been successfully made; a fair number of impressions have been obtained from most of these transfers, while others owing to the want of suitable agency still await trifling corrections and additions, before impressions can be taken.

Out-turn of work under Captain Melville's superintendence.

8. Some of the latter transfers on Zinc, of Revenue and Topographical Survey maps, impressions of which have been laid before you, will, I think, bear favorable comparison with hand Lithography.

Quality of Photo. Zinco and Lithographs.

9. The formulae used in the ordnance Office, Southampton, have had to be considerably modified to suit the hot damp and variable climate of Calcutta, and, we have had many difficulties to encounter and overcome during the hot and rainy seasons. For a fortnight the temperature during working hours in my Office stood at 112° Faht.; a temperature which has a very unfavorable influence on the chemicals used in the different processes. During the height of the monsoon again, the extreme humidity of the atmosphere seriously retarded work.

Climatic influence on chemicals.

10. Great delay was occasioned at first on account of the difficulty of training native printers, to print from Zinc, all their former experience was in printing from stone, and there is a great difference in the two processes. I am happy now to be able to report that two or three natives have been successfully trained to print from Zinc but they still need experience and have to be constantly watched. Others are under training. During the hot wheather Zinc printing becomes exceedingly difficult as the plates get so heated that the ink runs and smudges. My attention has been given to the preparation of cooling solutions to keep down the temperature of the plates and I hope to overcome this difficulty.

Zinc-Printing.

11. The Photo-Carbon Transfers to stone and Zinc when made from suitable originals, are equal to Lithographic Transfers and render just as many impressions, but hitherto great difficulty has been experienced in obtaining manuscript originals which come up to the requirements of Photo-Lithography and Zincography. Rules, however, have now been framed and circulated with your Departmental Orders Nos. 109, 110, and 111 for the guidance of Survey Executives in the preparation of original maps.

Measures taken to secure good and suitable original maps for Photo-Zincography.

12. There will always be a certain amount of "silver printing" required, as there must necessarily be maps and subjects unsuited to the Carbon transfer process. I have much satisfaction therefore in reporting that by the use of new formulæ, I have reduced the cost of this process by at least 40 per cent., at the same time obtaining better results.

Silver Printing.

An apprentice class has been established and I have several young natives under instruction, some of whom evince considerable aptitude and give fair promise of proving useful, should therefore an increase of the existing establishment be sanctioned, trained agency will be at hand for immediate employment.

vision made for increase in trained agency.

The work passing through the Photographic Branch has increased enormously of late, and as the establishment and its capabilities are now beginning to be better understood, the demands made on it are very numerous, daily increasing and altogether so disproportioned to the means and appliances in command, that the question of additional establishment, and space and money for the Photographic Branch requires immediate consideration.

Increase in the demand.

I have already submitted a detailed scheme for your approval, and the orders of Government, for an increased establishment likely to meet the wants of the Department, and I hope it may be soon sanctioned, as the necessity for the establishment becomes more evident daily, and without it, arrears must accumulate.

Establishment

A larger amount of contingent money and more space for manipulation and storing of negatives, chemicals, apparatus, &c. are equally necessary. Without these it is hopeless to attempt to work this branch satisfactorily or to expect it to meet the expectations of Government and the public; or to yield results commensurate to the expenditure. With the increase I have asked for in Establishment and Contingent money, the actual return in maps multiplied to any extent, will, I have no hesitation in saying, prove a great saving to Government, so that even on economical grounds, not to provide what is now absolutely necessary, is only to pay at exceedingly high rates for a very small or minimum outturn of work.

Zinc Printers from England.

16. The two Sapper Serjeants trained to Zincography promised long ago, by the Right Hon'ble the Secretary of State, have not yet arrived; but I am daily expecting them now, and their assistance will materially help towards overcoming the arrears in printing which are now fast accumulating.

Conduct of Establishment.

17. I have much pleasure to report most favorably of the members of the existing establishment. Serjeant Mackenzie in charge of this Branch for the production of negative plates, and Mr. Crossley in charge of the Silver and Carbon Printing Branch, have both rendered me efficient aid, they are zealous, willing and painstaking assistants, and I beg to bring them to your favorable notice; amongst the native Subordinates Ruhimoodin and Tuffazul are well deserving of commendation, they have both made good progress in acquiring a knowledge of their duties.

Damage and delay caused by the cyclone.

18. Considerable damage was done to the glass-house and the quarters occupied by the Photo-Branch by the storm which passed over Calcutta on the night of the 1st November 1867, partial temporary repairs have been carried out, but even in effecting this work has been considerably retarded, and it would be a waste of money to make further permanent repairs or additions before it is decided whether the Photo. Office will remain in its present quarters.

Increase and better accommodation absolutely necessary.

19. The present accommodation for this Branch is not only unsuitable, but so limited that it is hardly possible to find space for keeping the chemicals and negatives we have now; some of the apparatus we now possess and which could with advantage be employed, cannot be used for want of space, while the constant temporary provisions made only retard our progress and cause a waste of money. With the various increased apparatus and appliances which are now being sent out to us from England, and which it is very desirable should be worked on arrival without delay; we shall certainly need nearly twice the accommodation at present provided.

20. Lastly I should bring to your notice the great assistance I have received from Mr. Lawrence and Mr. Niven in introducing and pushing forward Zinc printing in the Lithographic Press Department.

I have the honor to be,

Sir,

Your most obedient servant,

A. B. MELVILLE, *Captain*,

In charge P ... *h S. G. O.*

	Stone	
	Stone	
	....	
	Stone	
2	....	
2	....	
19	Stone	
4		
....	....	For Lithr

Tabular Statement, shewing the nature and outturn of work in the Photographic Branch, Surveyor General's Office, from 1st December, 1866, to 30th November 1867.

Maps Photographed.	No. of Plates.	No. of Silver Prints.	No. of Carbon Prints.	Transfers to Stone or Zinc.	Remarks.
Topographical Maps 1 Inch = 1 Mile.					
Gwalior Topgl. Survey No. 1 Party.					
Sheet No. 8	...	...	...	Zinc	
„ 8½	...	...	...	Stone	
„ 10	...	...	...	...	
„ 11	...	...	...	...	
„ 12	...	...	...	Stone	
„ 13	115	611	102	Do.	
„ 14	...	...	...	Do.	
„ 16	...	...	...	Do.	
„ 38	...	...	...	Do.	
„ 39	...	...	...	Zinc	
„ 43	...	...	...	Stone	
„ 46	...	...	...	Zinc	
Hydrabad Topgl Survey	...	12	...	...	Reprints.
Ganjam „ „ Sheet 1	...	...	...	Stone	
„ 2	...	...	...	Do.	
„ 3	...	...	...	Do.	
„ 4	50	151	84	Do.	
„ 5	...	...	...	Do.	
„ 6	...	...	...	Do.	
„ 7	...	...	...	Do.	
„ 8	...	...	...	Do.	
Chota-Nagpore „ „ „ 18	...	...	...	Do.	
„ „ „ 28	...	...	...	Zinc	
„ „ „ 37	36	103	88	Do.	
„ „ „ 38	...	...	...	Do.	
„ „ „ 41	...	...	...	Stone	
„ „ „ 48	...	...	...	Zinc	
Rewah „ „ „ 3	...	...	...		
„ „ „ 5	...	...	...	Zinc	
„ „ „ 6	...	...	...	Do.	
„ „ „ 7	...	...	...	Stone	
„ „ „ 9	...	...	...	Do.	
„ „ „ 11	91	163	118	Do.	
„ „ „ 14	...	...	...	Zinc	
„ „ „ 17	...	...	...	...	
„ „ „ 19	...	...	...	Stone	
„ „ „ 32	...	...	...	Do.	
„ „ „ 36	...	...	...	Zinc	
Rajpootana „ „ „ 1	...	...	...	Stone	
„ „ „ 6	...	...	...	Zinc	
„ „ „ 11	38	14	84	Do.	
„ „ „ 12	...	...	...	Stone	
„ „ „ 14	...	...	...	Do.	
Cossyah, „ „ „ 16&17	6	0	12	Do.	
2 *miles* = 1 quires it *iles* = 1 *inch.*					
Cossyah eady su 2 = 1	1	0	4	Stone	
4 = 1	1	0	4	Do.	
C shment 4 = 1	3	...	...		
4 = 1	6	...	...		
hment 4 = 1	5	...	...		
= 1	8	...	12		
al	360	1044	520	Zinc 13 / Stone 28 } 41	

Tabular Statement—(Continued.

Maps Photographed.	No. of Plates.	No. of Silver Prints.	No. of Carbon Prints.	Transfers to Zinc or Stone.	Remarks.
Carried over, ...	360	1044	520	Zinc 13 / Stone 28 } 41	
Revenue Survey Maps.					
Tipperah and Noacally, ...	....	189	....	....	Reprints.
Dumoh, ...	....	60	....	....	Do.
Singhboom, ...	4	45	....	....	
Central Provinces, ...	2	8	....	....	
Village Plans Bahraitch, Sylhet, &c....	10	52	7	....	
Do. Do. ½ scale	4	....	....	....	
M. Cs. 3 & 4 Purgunnah Seetapoor, ...	18	34	....	....	
M. C. 6, ,, Palamow, ...	8	8	....	....	
M. Cs. 1, 2, & 3, Bahraitch, ...	19	51	....	....	
Nursinghpoor, ...	4	36	....	....	
Hoshungabad, ...	7	54	7	Stone	
Oudh Rev. Survey (Compilation Sheet)	7	....	21	Stone	
Rampoor Jagheer, ...	2	....	9	Stone	
Purgunnah Bazpoor, ...	6	....	....	....	Not printed.
M. C. 8. Khurruckdeah, ...	9	....	9	Stone	
Do. 9. Do.	9	....	9	Stone	
Do. Do. ¼ scale	2	....	8		
Do. 5 & 6 Palamow Lohardugga,....	23	....	23	Stone	
District Hazareebaugh, 1858 to 1863,	8	32	....	....	
Kohistan, Kurrachee	20	184	....	....	
Lucknadown M. Cs. 1, 2, & 3, ...	21	....	25	Stone	
Chittagong District	33	119	....	....	
District Hoshangabad	7	....	9	Stone	
Do. Sagur	19	243	30	....	
Map of British Sikhim (Darjeeling	25	....	31	Zinc	5 Plates.
Boundary of the Damin-i-Koh	2	....	4	Stone	
Total Revenue,...	269	1115	192	Zinc 5 / Stone 9 } 14	
Plans of Cities and Cantonments.					
Plan of Sipree	8	....	8	Stone	
,, Campbellpoor	7	....	8	Stone	
,, Rawul Pindee	12	....	18	Stone	
,, Jeypore	8	....	31	Zinc	2 Plates.
,, Seetabuldee 16 inches, ...	14	....	17	Zinc	2 Plates.
,, do. 6 inches, ... }	...18	....	10	Stone	2 Plates.
,, do. with Nagpore 6 inches, ... }					
,, Lahore	32	34	....	....	
,, Morar	4	4	....	....	
,, Nagpore	4	....	6	Stone	
,, Chunar	4	....	4	Stone	
Saugor City and Cantonments	10	....	11	Stone	
Lahore and Mean Meer ½ scale	6	6	....	....	
Total, Plans, Cities and Cantonments,	127	44	113	Zinc 4 / Stone 8 } 12	
Miscellaneous.					
Village Plan specimens (Oudh R. S.)	30	....	90	Stone	2 Store.
Ground Plan of Temple	4	....	4	Stone	
Carbon Specimens	6	....	6	....	
Plan of Musjid	6	....	6	Stone	
Atlas sheets Lr. Bengal ½ Scale	19	2	12	....	
Topographical Drawings	3	13	2	....	
Map of Khirgis Steppes	13	136	19	Stone	
Do. Do. ½ Scale	2	0	4		
Telegraph Route Map ½ Scale	2	2	....	....	For Lithe

Tabular Statement—(Continued.)

Maps Photographed.	No. of Plates.	No. of Silver Prints.	No. of Carbon Prints.	Transfers to Zinc or Stone.	Remarks.
Carried over...	85	153	143	....	
Specimens of Blue Shading	2	6	6	....	[size.
Upper Nubia and Abyssinia	21	131	....	....	Enlarged to double
Compass Card	1	....	1	Stone	
Telegraph Message	1	....	6	....	
Index to Punjab Map	1	2	....	....	For Litho. tracing
Topographical Items	1	0	6	Stone	
Do. Do. Rimtumbour	2	1	4	....	
Pages of Report	7	....	17	....	
Village Plans	....	....	12	....	
Nagpore Exhibition Medal	2	12	....	....	
Ground Plan of High Court, Calcutta..	4	....	4	Stone	
Index to Rewah Survey	2	....	8	Stone	
Do. Central Provinces	4	....	4	Stone	
Chart of Andaman Islands	4	....	20	Stone	
Do. Nicobar Islands	6	176	....	....	
Burmah and Cambodia	4	22	....	....	
Table of Zymotic Diseases	4	....	4	Stone	
Chart of Coast of India	11	....	22	Stone	
Portion of Rewah Survey	1	2	....	....	To double scale.
M. S. Setlers	4	....	4	....	
Diagrams, Telegraph Department	4	....	4	Stone	
Grass Cultivation Port Blair	1	....	2	Stone	
Details of Barrack Cots	2	....	2	Zinc	
Scales of Lat. and Long.	1	....	1	Stone	
Telegraph Huts (Plan and Elevations)					
Pictures of 7lb mountain Battery ...	11	22	....	....	For Ordnance Dept.
Total miscellaneous....	186	527	270	Zinc 1 / Stone 16 } 17	

Abstract of work performed of the Photo. Branch S. G. O. during the year commencing 1st December 1866 and ending 30th November 1867.

Description of Work.	Number of Plates.	Number of Silver Prints.	Number of Carbon Prints.	Transfers to		Total No. of Transfers.
				Zinc.	Stone.	
Topographical, ...	360	1044	520	13	28	41
Revenue, ...	269	1115	192	5	9	14
Cities & Cantonments	127	44	113	4	8	12
Miscellaneous	186	527	270	1	16	17
Total, ...	942	2703	1095	23	61	84

Above outturn during the period of Superintendence of

Superintendence.	Number of Originals.	No. of Plates.	No. of Silver Prints.	No. of Carbon Prints.	Transfers to		Impressions from		Remarks.
					Stone.	Zinc.	Stone.	Zinc.	
Lieut. J. Waterhouse, December 1866 to March 1867 inclusive, ...	38	160	1457	184	3	0			Detailed statement of number of impressions from each map will be found in the Report of the Lithographic Department Surveyor General's Office, as the Printing was all done there.
Capt. A. B. Melville, April 1867, to November inclusive. ...	94	782	1273	911	58	23	6976	1466	
Total,...	132	942	2730	1095	84		8442		

A. B. MELVILLE, *Captain.*

[-5-]

I am very much afraid that without a very strong representation from Government, our detail surveyors will not be allowed to go near this Fort.

This will not however be required till the season after this one now approaching, as the whole party will be employed in Ulwar during this field season.

Mr. Horst has done very good work both in the field and in recess. His triangulation has come out well, and he has fixed a large quantity of points in difficult ground. He has also been of great assistance in the recess both in mapping and in computations, having taken much off my hands in the absence of a Military Assistant.

Mr. Bolst did excellent work in plane tabling; his outturn is not large, but his work is first rate both in quality of drawing and in accuracy; he lost a month or so in instructing Mr. Cornelius: I cannot speak too highly of both his and Mr. Horsts' steadiness aud regularity during the recess, and the good example they have both set to the younger assistants.

Lieut. Riddell according to Departmental Order No. 106, dated 26th April 1867, took over charge of the Rewah Party on its return from the Field, and I took charge of this party from the 1st June.

I propose to make the following arrangements for the operations during the approaching field season. The party will march straight to Ulwar and commence plane tabling, I hope before the 1st November. Having ascertained that every body is satisfactorily at work, I propose to visit Agra in order to fix points for the plan of the Cantonments and city, the orders for which I have just received; after which I shall return to Ulwar. At the close of the season I shall again visit Agra and leave Mr. Chill and two Native Surveyors to complete the detail of the large scale Plan of Agra. I hope the whole of Ulwar will be finished this year, and that the maps of Agra will be ready for transmission to Calcutta at the end of the recess.

.cal survey,
during the
Maine a
Triangle
rh. al of Mr. Civil
on the scale of 4
1778 completed on the 1
Series zari by the Settlement
the outer boundary that

EXTRACT FROM THE NARRATIVE REPORT OF J. MULHERAN, ESQUIRE, SURVEYOR, IN CHARGE NO. 2, TOPOGRAPHICAL PARTY, CENTRAL PROVINCES SURVEY.—NO. 366, FOR THE SEASON 1866-67.

The early completion of the Hydrabad Survey having been brought to the notice of the Officiating Surveyor General in my narrative report No. 296, of the 1st November 1866, detailed instructions were received in July 1866 regarding the employment of No. 2, Topographical party in the Central Provinces upon the hilly country, comprised between the parallels of north Latitude 21°-30′ and 23°, and the meridians of 77° and 83°; extending from British Nimar on the west, to Odeypore on the east, comprising portions of the Districts of Hoshangabad, Baitool, Chindwara, Seoni, Mandla, Bandara, and Belaspur.

Subsequent to the receipt of the above instructions the Officiating Surveyor General was informed of the arrangements proposed for completing 6000 square miles of the Triangulation authorised, but as some difficulty was anticipated in giving full employment to the whole party, pending the determination of a sufficient number of points for basing the detail survey, the assistants noted in the margin were recommended for employment upon the General Report of the Hydrabad survey.

Mr. Smith,
" Farrel,
" Scanlan,
N. Surveyor Pundarao,
" Ramchander,
" Baparao,
" Janardhanrao

In sanctioning what was proposed, the Officiating Surveyor General drew my attention to the necessity of completing the Topographical survey of 800 square miles of what remained of the survey of the Hoshangabad District, as soon as points for basing the same could be furnished, and as this involved the employment of more assistants in the field than was at first contemplated, Ramchander, Baparao, and Janardhan Rao, were warned for employment under Mr. Civil Assistant Neale.

Prior to the close of last recess Mr. Sub-Assistant Ogle was transferred to No. 6 Topographical party and was allowed leave for a short time, to prepare for the journey to Cheera Poonjee, for which place he left Ellichpore on the 17th October.

The remaining portion of the party as per margin took the field on the 29th October and completed the following extent of work shortly before the setting in of the rainy season in June, viz:

EXECUTIVE OFFICERS.
Mr. Civil Asst. Neale,
" " Chamarett,
Mr. Sub- Asst. Chennell,
" " Maine
N. Surveyor Ramchander,
" Baparao,
" Janardhan Rao,
" Shaik Omar,

6299 square miles of Principal and Secondary Triangulation.
915 square miles of Topographical details.

The extent of Triangulation completed by myself and Mr. Sub-Assistant Chennell assisted by Native Surveyor Sheik Omar, embraced 994 square miles of the Chindwara and Baitool districts, situated to the West of the Great Arc stations of Salbaldi, Jagdhar, Dhabadeo and Tek.

That completed by Mr. Civil Assistant Neale, Mr. Sub-Assistant Maine and Surveyor Ramchander embraces 1572 square miles of 1st and 2nd class Triangles situated West of the Great Arc Stations of Nilgurh, Akanpur and Narwargurh.

That completed by Mr. Civil Assistant Chamarett embraces 1778 square miles of 1st and 2nd Class Triangles situated between the flanks of the Great Arc Series and Dhar in Baitool, to Tek, and Morpani in Hoshangabad.

The following is the extent of Topographical details completed by each of the assistants employed :—

Mr.	Civil Assistant	Neale	73	Square Miles.
Mr.	Do.	Chamarett	72	„
Mr.	Sub-Assistant	Chennell	83	„
Mr.	Do.	Maine	198	„
	Native Surveyor	Ramchander	38	„
	Do.	Baparao	270	„
	Do.	Janardhan Rao	181	„

The average discrepancy exhibited in apportioning the angular errors of the Principal Triangles is 0.78 for each angle of the Barangwari Heptagon, which has been used as the basis of the rest of the Triangulation East of the principal sides of the great Arc Series.

The Secondary Triangulation based upon the above gives an average error of 0.30 feet per mile on 204 common sides, or upon

79 sides, of	1st Class	Triangles	0.25	feet per mile.
125 Do.	2nd Class	Do.	0.33	feet do.
17 Do.	3rd Class	by Mr. Chennell	0.75	feet do.

The 1st Class Triangles completed by Mr. Civil Assistant Neale gives an average Triangular error of 2.34. That completed by Mr. Civil Assistant Chamarett an average Triangular error of 2.45.

The following are the average errors per mile of their common sides :

Average error of 1st	Class Δ's by Mr. Neale	...	0.53	feet.
Do.	2nd Class Do.	...	0.25	„
Do.	3rd Class Do.	...	0.72	„
Do.	3rd Class by Mr. Maine	...	0.39	„
Average error of 1st	Class Δ's by Mr. Chamarett	0.25	feet	per mile.
Do.	of 2nd & 3rd Class Do.	0.47	feet	do.

The following are the average differences exhibited in 224 deductions of Trigonometrical Heights of Principal and Secondary stations :

Average difference in deductions of	Principal stations by Executive Officer	...	1.35 feet.
Do. ...	of Secondary do. by do. ...	...	2.59 „
Do. ...	1st Class stations by Mr. Neale ...	...	1.70 „
Do. ...	2nd & 3rd Class ... by do. ...	...	1.72 „
Do. ...	of 1st Class ... by Mr. Chamarett	...	2.40 „
Do. ...	of 2nd Class ... by do. ...	...	1.82 „

Shortly after [illegible] reaching Mooltye in November last, and while the Flagmen in advance were [illegible]earing the sum[illegible] its of hill stations, the Commissioner of the Nerbudda Division prohibited the [illegible]f trees [illegible]t impeded the view to surrounding stations, pending my obtaining the consent [illegible] the removal of such trees as were within their respective boundaries; and as this [illegible]cied out would have rendered it impossible for me to complete the triangulation [illegible]to, I am induced to bring the same to your notice with a view to my being [illegible] the adjustment of all claims for compensation to the Deputy Commissioner of [illegible]is the best judge of what is fair to the people, and to Government.

[illegible] of the necessity of this I beg to mention that the first Malguzar with whom [illegible] year, although only paying 75 rupees annually for the village of Konder [illegible]t the rate of 12 Rs. a year for 20 years, for each Mowa tree that I had been [illegible] as there were 35 trees of sizes for which he demanded payment at this [illegible] meet his claim would have been equivalent to the rent of the entire

ntendence.	Numb of Original		
J. Waterhouse, mber 1866 to h 1867 inclu- ...	38	160	
A. B. Melville, 1867, to No[illegible] clusive. ...	94	782	
Total,...	132	942	27[illegible]

village for a period of 99 years, or more than twice the amount allowed to meet compensation claims of the whole district. For two days during my detention near the station of Konder, I used every argument that occurred to me to prove the unreasonable nature of this demand, noticing particularly the number of wild Mowa trees peculiar to this portion of the Mooltye plateau, and the fact of these not having been taken into consideration when the assessment for 30 years was made by Mr. Ramsay, but the only reply received from Malguzar was, that he possessed the right to demand what he considered to be fair, and that he would make no abatement in his claim.

Unfortunately before I reached the next station the above had been circulated by the people, and on again opening the question of compensation I found that there was, no hope of any abatement in the amount demanded pending a reference to the civil authorities of the district. The annexed extract from a letter received from the Commissioner of the Nerbudda Division will satisfy you that he does not object to compensation money being paid into the district treasury; and as it is of the greatest importance to the progress of the triangulation, I beg to express a hope that you will kindly obtain the sanction of the Chief Commissioner to my being relieved of all enquiries relating to the amount of compensation to be paid to Malguzars, which can only be fairly decided by the Civil officers of the district with whose decisions only the people will be satisfied.

The country through which the triangulation has been extended East of Chichale and Maisdai consists of an undulating plateau varying in height from 2,000 to 2,700 feet above the level of the sea, and is extensively cultivated and fairly watered, the Tapti, Warda, Bail, Purna and other streams having their source in the watershed east of Baitool and Mooltye. Extensive fields of Sugarcane, Wheat, Gram and Dhal, are cultivated upon the whole of this tract, and the people are clamorous for a Revenue Survey.

The area of the portion of the Baitool, Mooltye, and adjoining plateaus is about 1700 square miles, and is fully fitted for a Revenue Survey.

In addition to the above, considerable portions of the rich land adjoining Shápúr, and Ránipúr, in the valley of the Towa, are equally fitted for Revenue measurement, but as the land adjoining the greater portion of that under cultivation, is overrun with high grass and heavy forest. I think it would be advisable to include the whole of the Towa valley in the area that is to be topographically surveyed, selecting such portions hereafter of the area under cultivation as may be considered fitted for Revenue measurement. This if sanctioned will prevent any hiatus in the map of Baitool, and will obviate the necessity of revisiting any portion of the unhealthy forest east of Shapur and Ranipur in which the Gonds are located.

The accompanying sketch (marked A) will afford a clear idea of the situation of the several portions of the Baitool District that I consider fitted for Revenue measurement. That west of Maisdai and south of Masode, marked with a wash of green, forms the continuation of the northern and eastern portions of the Satpura range, and is broken into ridges varying in height from 1500 to 3500 feet, and is inhabited principally, if not entirely, by Gonds and Korkus who cultivate Kodo, Mergi and other hill grains.

This portion of the Baitool District I have marked as fitted for topographical survey, and is the portion upon which I propose with your permission to employ my party during the approaching field season.

Two perambulators and a 7 inch Theodolite were placed at the disposal of Mr. Civil Assistant Neale to enable him to survey the Forest Reserve of Rajabarari on the scale of 4 inches to the mile, and test the correctness of the Topographical de[illegible]s completed on the 1 inch scale. As no settlement however was made of the Malpara M[illegible]guzari by the Settlement Officer Mr. Ramsay, and some difficulty was experienced in tracin[illegible] the outer boundary that

was cleared by the Assistant Conservator, Mr. Neale was unable to complete the survey of the Rajabarari Reserve.

The correspondence relating to the above having been submitted for your perusal, I have only to add that I intend to relieve Mr. Sub-Assistant Maine of all other work, and to employ him in surveying the boundaries of the forest reserves of Rajabarari, Kotangi and Sauligar, and will, if possible, furnish the maps and areas of these Reserves before the close of next recess. At present the boundaries of these Reserves so far as they have been cleared are marked by wooden posts, and pegs varying from 3 to 6 feet in height, but as the erection of masonry pillars has been authorized by the conservator of Forests concomitantly with progress of the survey, no delay is anticipated from the want of these in the first instance. Mr. Maine's particular attention however will be drawn to the necessity of his seeing that the whole of the pillars erected are connected with the Stations chosen for the survey of the interior and outer boundaries.

The following are the differences exhibited by the check line in the Topographical work completed by the following assistants:

Name of Surveyor.	Nature of ground.	Check line in miles.	Number of coincidences.	Number of differences.	Greatest difference in miles.	Average difference in miles.	Extent surveyed in square miles.	Number of Plane table stations.	Averages No. of stations per sq. mile.
Mr. Civil Assistant Neale	hills & forest	-	-	-	-	-	73	233	3·2
„ Chamarett	„	-	-	-	-	-	72	279	3·8
Mr. Sub-assistant Chennell	„	4.3	8	11	0·17	0.08	83	342	4·1
„ Maine	„	5·6	6	6	0·10	0.05	198	389	1·9
Native Surveyor Baparao	„	5.2	4	9	0·20	0.09	270	860	3.2
„ Ramchander	„	Tested	by Mr.	Neale	& found	correct	38	119	3.0
„ Janardhan Rao	open & easy	6·2	6	4	0·05	0.03	181	534	2.8

The following is the extent of work completed during the recess:

5 General Maps No. 1, 2, 3, 4, 5, scale 1 mile = 1 inch.

5 Exaggerated Maps Nos. 1, 2, 3, 4, 5, ditto.

1 Triangulation chart with numerical data, season 1866-67—scale 4 miles = 1 inch.

1 Preliminary sketch of tract triangulated shewing area fitted for Revenue Survey, and area fitted for Topographical survey.

COMPUTATIONS.

11 Principal Triangles.
202 First Class Triangles.
708 Second Class ditto.
182 Third Class ditto.
224 Reductions of Heights of Principal and Secondary stations.
24 Reductions of Principal Latitudes, Longitudes and Azimuths.
1043 Reductions of Secondary Latitudes, Longitude and Azimuths.

GENERAL REPORT, SEASON 1866-67.

1 Title page.
2 General Skeleton Plan, Scale 8 miles = 1 inch.
3 Introduction.
4 Description of Principal Stations.
5 Computations
- Barangwari Heptagon.
- Principal Triangles.
- 1st Class Secondary Triangles.
- 2nd Class ... Do. ...
- 3rd Class ... Do. ...

6 Abstract of Heights of Principal and Secondary stations.
7 Synopsis of Latitudes, Longitudes and Azimuths of Principal and Secondary stations.
8 Alphabetical list of Latitudes and Longitude of Trigonometrical Stations.
9 Alphabetical list of Latitudes and Longitudes of Towns and villages.
10 Abstract of Horizontal angles and approximate Azimuths.

In reporting the approaching completion of the above, it affords me great pleasure bringing to your favourable notice that I am greatly indebted to Mr. Civil-Assistant Neale for the able way in which the fair maps have been completed this season. He has not only taken a principal part in their completion, but has afforded the necessary instruction to Mr. Scanlan, by whom Maps No. 3 and 5 and No. 1 Exaggerated, have been satisfactorily contoured.

Maps No. 4 and 5 Exaggerated, were completed by Mr. Civil Assistant Chamarett who has been transferred to No. 5 Topographical party, and who left Ellichpore on the 4th of the present month in progress to Myhere agreeably to instructions from Lieut. Riddell.

I have much pleasure in bringing to your favourable notice that Mr. Chamarett completed 1778 square miles of 1st and 2nd Class Triangulation during the past field season, and that the results of his common sides, with a few exceptions are considerably within the limits allowed for such work. I beg further to testify to his having served with zeal and ability while under me, and to my being in a great measure indebted to him for the retention of the Native Surveyors, who at one time, owing to the prostrating effects of jungle fever contracted in the forest adjoining the Pemganga, expressed their intention to leave. One Native Surveyor died from the effects of exposure in the forest, and a second while in a state of great prostration insisted upon being allowed to return to his own country. The others, although only suffering slightly, were so scared that considerable tact and judgment were required to induce them to remain, and in effecting this the aid rendered by Mr. Chamarett was of the most material service.

Mr. First Grade Sub-assistant Smith and Mr. Second Grade Sub-assistant Farrell have worked assiduously throughout the recess. To the former I entrusted the greater portion of the computations, and to the latter the whole of the printing required for the fair and Exaggerated Maps, Charts, Plans and headings, of the General Report. Both have given great satisfaction.

EXTRACT FROM THE NARRATIVE REPORT OF LIEUT. COLONEL G. H. SAXTON IN CHARGE No. 3. TOPOGRAPHICAL PARTY, CENTRAL PROVINCES AND VIZIGAPATAM AGENCY SURVEY, No. 121, FOR THE SEASON 1866-67.

After closing the recess duties, the Party left Ootacamund on the 21st November, and proceeding by steamer up the coast, reached Vizianagram where final preparations for taking the field were made. The strength of the Party was nearly the same as the previous season, * *

Preparation for taking the field.

The breaking down of a steamer had caused some delay in reaching Vizianagram, where considerable work had to be arranged. All the Plane tables were mounted and projected. There was a great difficulty about our marching equipments. The Collector of the District had been applied to and every inducement offered to obtain cattle and coolies, but none were willing to take service with us. We did not obtain a single man or bullock, through the assistance of the District authorities, and at last were compelled to take the field insufficiently equipped. I obtained a limited number of bullocks by hiring and purchasing, and had previously imported from the Northern District of Ganjam 60 bearers, but some surveyors marched without any permanent carriage for their tents and had to employ coolies from village to village. * * * * * *

A re-junction with the coast series is effected as shewn in the sketch map. Two principal angles have yet to be observed, but the final results will not be materially changed. The values shewn in the margin may be taken as approximately correct, and are quite satisfactory after unchecked operations extending over such a distance, and a period of about eight years. The area given in the sketch map, as triangulated in advance, is fairly filled with secondary points. When necessary the number of points will be increased before the ground is given over for detail survey. The computations are now being completed and a chart will be submitted at the close of this recess.

TRIANGULATION.

Kap H. S.	G. T. S.	C.P.&V.A.S.	Diff.
Latitude.	17°-56′-52″.82	17°-56′-52″.48	0″.34
Longitude.	82 -39 -37 .47	82 -39 -38 .78	1 .31
Azimuth of Dhar.	32 -58 -50 . 2	32 -58 -25 . 7	24. 5
Height.	5214.2 feet	5187-6 feet.	26. 6ft.
Distance Kapto Dhar	92672.0 feet	92676.8	4.8
		or 3 inches per mile.	

Detail Survey.

The advanced Triangulation duties occupied me during nearly all January, and I then proceeded to the detail survey ground and reached Mr. Chew's camp on 30th January. I observed on several stations and tested work by computing their positions. I also pertalled nearly 6 miles through his finished work and was satisfied with what I saw. Mr. Chew's position of Bakawandi where I made a Trigonometrical station, was quite accurate. After a few days I entered Lieut. Downing's board. We were for several days unable to find each other. Lieut. Downing joined my camp on 8th February when we found that several days previous we had both been clearing hills almost within hail of each other. This instance shews how difficult it is to keep up any system of communication whilst employed in such country. With Lieut. Downing I observed on several stations and computed them improving his boards in that respect. Mr. Trewman was instructed to carry on some survey under special directions. He evinced great zeal and has since completed a very fair amount of mapping, 134 square miles, which has been compared with Lieut. Downing's own work. The comparison shews fairly enough for a beginner. The table is not

Mr. Chew.

Lt. Downing & Mr. Trewman.

completed, and as his work is not sufficiently good to be passed as final, it will not be sent in this season. The revision and completion of that portion will receive special attention next season. Lieut. Downing was instructed to continue more immediately to superintend Mr. Trewman and make a traverse in, and otherwise test, Mr. Claudius' work which adjoined on the north. I joined Mr. Adams on the 14th February, Lieut. Downing remaining with me that and the following day. On the 15th I made a march with Mr. Adams making several Plane table stations on the road. This was through unsurveyed country. On the 16th I went with Mr. Adams on to Puri Rock station. This height was only accessible after erecting several series of ladders, and I had great difficulty in getting my Theodolite into position. Mr. Adams had this point and a cleared hill tree in another part of his board laid down by himself. After observing I was able to compute the position of these two points, with which Mr. Adams' stations accurately coincided; with these two additional points his board was well provided. Whilst on Puri Rock, I was very ill and never again during this season was I, for many days at a time, sufficiently free from pain to do much work. After computing the new points for Mr. Adams, I made a very long march to Mr. Harper's camp, which I reached on the 18th. I found Mr. Harper ill, and to all appearance quite unfit for duty. During my stay in his camp, he regularly, notwithstanding the state of his health, went out from early morning till late in the afternoon. At first I was too ill to attempt going with him myself. On the 21st and 22nd, I was able to observe on Loa, an old, and Lanjora, a new, station, and computed a few more points for the boards in use with Mr. Harper and Mr. Clandius. Mr. Harper's work was not sufficiently advanced (except a difficult portion in another part of his table) for examination, and I was too ill to have done much. On the 25th, I left Mr. Harper, and joined Mr. Claudius' camp. I remained with Mr. Claudius till the 2nd March. I went out with him each day and we traversed right across his boards, from west to east. The boundary between Bustar, and Jeypúr runs north and south just beyond Mr. Claudius' limit, and I gave him orders to lay down this boundary, though outside his line, thinking it would be a good check with the adjoining board, under survey by Mr. Atkinson, into which I now proceeded. * * * *

Mr. Adams.

Mr. Harper.

Mr. Claudius.

* * * * I reached Mr. Atkinsons' camp on 4th March. You are aware, that my ill health after this, quite disabled me, and that, later in the month, I retired from the field. Mr. Atkinson was unwell, but at work. I had intended, after this, proceeding on my inspecting tour into Hidiatoola's, and Mr. May's portions. With the latter Surveyor, I had every confidence that all would go on well, and with regard to Hidiatoola, Mr. Atkinson was instructed to carefully inspect that Native Surveyor, and carry a traverse into his work. * * * *

Mr: Atkinson.

Mr. May and Hidiatolla.

	S. M.
Lieut. Downing	... 6·9
D. Atkinson	... 279·1
R. W. Chew	... 372·.
J. Harper	... 342·1
J. A. May	... 214·6
E. Adams	... 356·5
T. E. Claudius	... 388·7
W. F. Pettigrew	... 114·0
Hidiatoola	... 186·6
Total	... 2316·7

* * * * * * * * The amount of detail surveyed executed by each surveyor is given in the sketch map, and for ready reference, repeated in the margin.

The Portal system of check.

The portal system of check has been carried out to a limited extent. Illness quite incapacitated me from personally undertaking such duties during the latter portion of the Field season, and I do not think it applicable, unless carried out after the completion of the detail survey.

General remarks on the season's outturn.

The total area surveyed this season is not so much, as I laid out for completion. The extra labor of increasing the number of Plane table stations, per square mile, in such country, as our field of survey, has been greater than was expected. Every surveyor remained longer than usual in

the field, and after every effort, shewing a zeal most creditable, nearly every surveyor returned without completing the quantity allotted to him. * * * *

The recess duties are backward, owing to the protracted stay in the Field of all the Party, except myself, who, as reported, and under medical certificate, retired to recess quarters immediately after close of the authorized date for closing Field work. The completion of the maps will fully tax my strength; and the computations, now in good progress, have chiefly devolved upon myself, assisted in great part only by new hands. The fair one-inch maps have not been projected on sheets strictly to size, Latitude 15° by 30° Longitude, an order has just reached me requiring them to be so, but it was too late for guidance this season. The Exaggerated maps are, however, so arranged, and the instructions for the others to be so, will be attended to in future. Owing to the surveyors not having completed up to allotted line this season, several of my maps are not squared up to complete sections, and will be retained for submission next year.

With the exception of my own illness, there was perhaps less sickness during this Field season, than during any former one; even amongst the new hands, there was but comparatively little. Mr. Harper's constitution is very much enfeebled, and he is constantly more or less an invalid. Mr. Claudius has suffered much since retiring from the field. Hidiatoola, during the field season, reported much illness in his camp; he had fever himself, but not apparently of consequence. In one of his reports he stated that every man in his camp had fever. His subsequent death has been reported to you. The remainder of the older surveyors have not suffered much this season. Of the new hands, as is invariably the case, I have to give an account of frequent fever. As above stated, there was comparatively little sickness out in the Field, but since return every one has been attacked. Mr. Pettigrew is now constantly getting fever and Mr. Trewman is the same. At first he was seriously ill from frequent attacks of jungle fever, and, subsequently, has been completely laid up with other ailments preventing his attending Office altogether. Mr. Wilson suffered least, but has resigned. The Apothecary, Mr. Dawson, was ill with fever in my camp, and, subsequently, had more serious attacks, and even now suffers still.

Changes in the Party.

Serious changes in the strength of my Party require to be mentioned in this report, especially as they materially interfere with my future plans and progress. The death of Native Surveyor Hidiatoola has been reported to you. I am now without any Native Surveyor. I am not inclined to make further attempts to recruit from that class; such men as Abdul Rahaman, who died in 1865, and Hidiatoola, now deceased, are not readily procurable, and no other satisfactory candidates have been willing to stay with this Party. The emoluments offered to sub-surveyors are not high enough to induce other than natives to enlist. Lieut. Downing, and Civil Assistant Atkinson, have been transferred. This reduction in my strength makes it quite out of my power to undertake the Saora Gap survey this season. The Madras Government, as you know, has pressed for the completion of that bit, but it is a duty I could not undertake without due preparation and suitable arrangements. My new Assistant Lieut. Saxton will not this season be prepared for any independent duties. Mr. Pettigrew promises well as a field surveyor, and computer.

Transfers from the Party.

New hands.

* * * *

Future Plans.

The state of my Party, as detailed in the preceding two paras, bears great weight in arranging my plans for the approaching season. The requirements of my Party at present are men capable of efficiently conducting plane table surveying, and men of still higher standard competent to carry out the late instructions for testing and supervising, and it is clear that the changes by transfer and death, above noted weaken the party in these particulars. For myself I purpose conducting triangulation operations during the early part of the season, the rejunction with coast series will be made final and complete, and secondary work will be executed in the direction of Mr. Mulheran's

EXTRACT FROM THE NARRATIVE REPORT OF CAPTAIN G. C. DEPREE IN CHARGE No. 4, TOPOGRAPHICAL PARTY CHOTA-NAGPORE DIVISION SURVEY.— No. 51, FOR THE SEASON 1866-67.

Programme of employment of Party.

Para. 52 of my last professional Report describes as follows, the proposed employment of the Party during the last season. "I propose to observe the angles of the Korea series with the new 12 inch Theodolite, commencing from the side of the Calcutta Longitudinal series and working southwards; some one sub-assistant to accompany me as recorder and to learn the use of the Theodolite; and I would depute Mr. Girdlestone to assist by filling in secondary stations with the 10 inch. All the other Surveyors will then be available for pushing on the detail."

Narrative of triangulation.

The programme given above was exactly followed. The principal angles were observed by myself with the 12 inch while Mr. Low recorded; this duty employed me about six weeks, after which the Native establishment was transferred to Mr. Girdlestone, who continued the secon[illegible] triangulation until the end of the season. He had moreover in the meantime surveyed with [illegible] Plane table 97 square miles of very difficult country in a superior manner. Moonshee Mahomed Khan recorded for Mr. Girdlestone, and Mr. Low was put to survey some easy ground with the plane table.

Korea Series.

The northern figure of the Korea series, which extends southwards and conforms to the meridian of 82°.45′, is a pentagon with sides of 24 miles average length, based on the side Lul. H.S. to Harai H.S. (correct name Harhi) of the Calcutta Longitudinal series G. T. S. The fifteen angles of this figure were observed with the 12 inch, No. 41, Troughton and Simms, to luminous signals: six zeros were employed, and two observations were made on each zero as a rule, except when the resulting angles differing by 3″, a third value was taken.

Triangular error principal series.

The Triangular errors are all nearly identical in five triangles, averaging 1″.5. In the other there is a large error of 7″.6 which is probably owing to the fact of the rays composing it being grazing rays. The mean triangular error of the six triangles thus is raised to 2″.5.

Linear error principal series.

The linear error obtained from three common sides amounts to only 0′.18 inches per mile and the three individual values are all about the same.

The angles to the stations of the advanced figure of the series have been all observed, so that it will not be necessary to re-visit any principal station.

Secondary and tertiary Stations.

From the principal stations I observed numerous Tertiary and Secondary stations which latter were afterwards visited and observed upon by Mr. Girdlestone, who did an admirable season's work with the 10 inch. In addition, numerous village and river bed stations were observed upon, for the purpose of determining the level of their respective sites; altogether the theodolites were set up 60 times, on about thirty hills and thirty village stations.

Area of Triangulation and average of Trigonometrical points per mile.

I estimate the area of country triangulated to be 4,500 square miles, it includes portions of Sirgooja, Rewah, Korea and Bhokar (or Chang Bhokar); 466 trigonometrical points have been fixed thereon, giving an average of one to every 9.7 square miles. The said country is very thinly inhabited and in a great measure by wild tribes. It consists of ranges of rocky barren hills, or is covered with forest, except

points; some of which, I hope, will be made common to both series. I shall be in a position favorable for adjudicating in an important boundary dispute, which has been given over to me to settle. In February and March I intend being with my detail surveyors, testing, &c., and giving extra points, when necessary. I shall not keep any assistant with me, and the whole strength of the Party will be put to plane tabling, the new hands under instruction with the best qualified surveyors. On reaching the detail survey field, in February, I shall be able to judge better, how to dispose of my staff, so as to secure a large amount of pertal, and other check, with the least loss to the season's outturn of work.

EXTRACT FROM THE NARRATIVE REPORT OF CAPTAIN G. C. DEPREE IN CHARGE No. 4, TOPOGRAPHICAL PARTY CHOTA-NAGPORE DIVISION SURVEY.— No. 51, FOR THE SEASON 1866-67.

Programme of employment of Party.

Para. 52 of my last professional Report describes as follows, the proposed employment of the Party during the last season. "I propose to observe the angles of the Korea series with the new 12 inch Theodolite, commencing from the side of the Calcutta Longitudinal series and working southwards; some one sub-assistant to accompany me as recorder and to learn the use of the Theodolite; and I would depute Mr. Girdlestone to assist by filling in secondary stations with the 10 inch. All the other Surveyors will then be available for pushing on the detail."

Narrative of triangulation.

The programme given above was exactly followed. The principal angles were observed by myself with the 12 inch while Mr. Low recorded; this duty employed me about six weeks, after which the Native establishment was transferred to Mr. Girdlestone, who continued the secondary triangulation until the end of the season. He had moreover in the meantime surveyed with the Plane table 97 square miles of very difficult country in a superior manner. Moonshee Mahomed Khan recorded for Mr. Girdlestone, and Mr. Low was put to survey some easy ground with the plane table.

Korea Series.

The northern figure of the Korea series, which extends southwards and conforms to the meridian of 82°.45′, is a pentagon with sides of 24 miles average length, based on the side Lul. H.S. to Harai H.S. (correct name Harhi) of the Calcutta Longitudinal series G. T. S. The fifteen angles of this figure were observed with the 12 inch, No. 41, Troughton and Simms, to luminous signals: six zeros were employed, and two observations were made on each zero as a rule, except when the resulting angles differing by 3″, a third value was taken.

Triangular error principal series.

The Triangular errors are all nearly identical in five triangles, averaging 1″.5. In the other there is a large error of 7″.6 which is probably owing to the fact of the rays composing it being grazing rays. The mean triangular error of the six triangles thus is raised to 2″.5.

Linear error principal series.

The linear error obtained from three common sides amounts to only 0′.18 inches per mile and the three individual values are all about the same.

The angles to the stations of the advanced figure of the series have been all observed, so that it will not be necessary to re-visit any principal station.

Secondary and tertiary Stations.

From the principal stations I observed numerous Tertiary and Secondary stations which latter were afterwards visited and observed upon by Mr. Girdlestone, who did an admirable season's work with the 10 inch. In addition, numerous village and river bed stations were observed upon, for the purpose of determining the level of their respective sites; altogether the theodolites were set up 60 times, on about thirty hills and thirty village stations.

Area of Triangulation and average of Trigonometrical points per mile.

I estimate the area of country triangulated to be 4,500 square miles, it includes portions of Sirgooja, Rewah, Korea and Bhokar (or Chang Bhokar); 466 trigonometrical points have been fixed thereon, giving an average of one to every 9.7 square miles. The said country is very thinly inhabited and in a great measure by wild tribes. It consists of ranges of rocky barren hills, or is covered with forest, except

points; some of which, I hope, will be made common to both series. I shall be in a position favorable for adjudicating in an important boundary dispute, which has been given over to me to settle. In February and March I intend being with my detail surveyors, testing, &c., and giving extra points, when necessary. I shall not keep any assistant with me, and the whole strength of the Party will be put to plane tabling, the new hands under instruction with the best qualified surveyors. On reaching the detail survey field, in February, I shall be able to judge better, how to dispose of my staff, so as to secure a large amount of pertal, and other check, with the least loss to the season's outturn of work.

EXTRACT FROM THE NARRATIVE REPORT OF CAPTAIN G. C. DEPREE IN CHARGE No. 4, TOPOGRAPHICAL PARTY CHOTA-NAGPORE DIVISION SURVEY.— No. 51, FOR THE SEASON 1866-67.

Programme of employment of Party.

Para. 52 of my last professional Report describes as follows, the proposed employment of the Party during the last season. "I propose to observe the angles of the Korea series with the new 12 inch Theodolite, commencing from the side of the Calcutta Longitudinal series and working southwards; some one sub-assistant to accompany me as recorder and to learn the use of the Theodolite; and I would depute Mr. Girdlestone to assist by filling in secondary stations with the 10 inch. All the other Surveyors will then be available for pushing on the detail."

Narrative of triangulation.

The programme given above was exactly followed. The principal angles were observed by myself with the 12 inch while Mr. Low recorded; this duty employed me about six weeks, after which the Native establishment was transferred to Mr. Girdlestone, who continued the secondary triangulation until the end of the season. He had moreover in the meantime surveyed with the Plane table 97 square miles of very difficult country in a superior manner. Moonshee Mahomed Khan recorded for Mr. Girdlestone, and Mr. Low was put to survey some easy ground with the plane table.

Korea Series.

The northern figure of the Korea series, which extends southwards and conforms to the meridian of 82°.45′, is a pentagon with sides of 24 miles average length, based on the side Lul. H.S. to Harai H.S. (correct name Harhi) of the Calcutta Longitudinal series G. T. S. The fifteen angles of this figure were observed with the 12 inch, No. 41, Troughton and Simms, to luminous signals: six zeros were employed, and two observations were made on each zero as a rule, except when the resulting angles differing by 3″, a third value was taken.

Triangular error principal series.

The Triangular errors are all nearly identical in five triangles, averaging 1″.5. In the other there is a large error of 7″.6 which is probably owing to the fact of the rays composing it being grazing rays. The mean triangular error of the six triangles thus is raised to 2″.5.

Linear error principal series.

The linear error obtained from three common sides amounts to only 0′.18 inches per mile and the three individual values are all about the same.

The angles to the stations of the advanced figure of the series have been all observed, so that it will not be necessary to re-visit any principal station.

Secondary and tertiary Stations.

From the principal stations I observed numerous Tertiary and Secondary stations which latter were afterwards visited and observed upon by Mr. Girdlestone, who did an admirable season's work with the 10 inch. In addition, numerous village and river bed stations were observed upon, for the purpose of determining the level of their respective sites; altogether the theodolites were set up 60 times, on about thirty hills and thirty village stations.

Area of Triangulation and average of Trigonometrical points per mile.

I estimate the area of country triangulated to be 4,500 square miles, it includes portions of Sirgooja, Rewah, Korea and Bhokar (or Chang Bhokar); 466 trigonometrical points have been fixed thereon, giving an average of one to every 9.7 square miles. The said country is very thinly inhabited and in a great measure by wild tribes. It consists of ranges of rocky barren hills, or is covered with forest, except

that part which forms the summit of the plateau of Sirgooja, this is level and open, and supports some flourishing villages.

Linear error, Secondary and Tertiary points.

The Secondary and Tertiary triangulation shows a linear error per mile of 6·0 and 7·0 inches respectively: the former is derived from the mean of 35 values, and the latter from the 50 values, the first on the season's list of triangles.

Heights.

The principal heights' observations were made at reciprocal times; two on FL and two on FR. The mean difference obtained from six pairs of deduced heights amounts to 2·9 feet. The Secondary and Tertiary observations were made in rounds, one on FL and FR each. Altogether 301 heights of hill, village and river bed stations have been determined.

Detail Plane Table Survey.

The out-turn of detail survey is less this season than usual, owing to the quota of work required from a trained surveyor having been reduced from $1\frac{1}{2}$ to $1\frac{1}{3}$ sections of 15′ × 15′, with the object of giving more time to the Surveyor so as to secure better work; also owing to one surveyor Mr. Babonau having been detached on the boundary re-survey of Hazaribagh; and also owing to it being necessary to reject the work done by Mr. Low. Thus the 2551 square miles actually executed have been reduced to 2378 miles of final survey. It is still doubtful whether the 42 miles surveyed by Draftsman Dutt Junior can be passed or not, it has therefore not been taken in account.

Plane Table stations per square mile.

The average number of Plane Table fixings of the 8 surveyors is 6.6 per square mile. The lowest that of Mr. Wilson Junior is 3.8; and the corresponding field section is that which is the least satisfactory of the whole.

I here give a table showing the names of Surveyors, the number of fixings per square mile and remarks on the country delineated :—

Names.	Square miles surveyed.	Number of Plane Table fixings.	Remarks.
Mr. Girdlestone	97.25	6.7	A plateau uninhabited, with a precipitous fall of 1700 feet.
,, McGill	373.43	5.1	A mountanious, difficult, thinly inhabited tract, also some fair villages.
,, Vanderputt	336.43	6.5	Do. Do. with some good country.
,, Wilson, *Senior*	429.70	4.5	Chiefly jungle, hills and plains.
,, James	363.00	6.6	A mountanious tract with cultivated valleys.
,, Barker	91.50	10.8	An easy tract with villages and few hills.
,, Wilson, *Junior*	308.00	3.0	A jungly tract with few villages and no large hills.
,, Dutt, *Senior*	368.50	7.1	Hills jungly and well cultivated country.
,, Low	10.00	no return.	Open cultivation.
Total	2377.81	6.6	Mean.

Period of employment of detail surveyors and rates of working.

The surveyors generally got to work by the 10th December and all concluded about 1st May. Mr. Barker however was under training until 3rd February and K. D. Dutt until 7th March, when they respectively commenced independent work. Thus a trained surveyor covered something less than 2.5 square miles per diem; while Mr. Barker did 1.0 miles nearly; K. D. Dutt about 0.7 miles; and Mr. Low who commenced on 25th January worked at the rate of 1.4 miles.

1st test of the detail *in situ*.

On the close of the principal triangulation on 24th January, I turned my attention entirely to the examination and inspection of the several detail surveyors, being convinced, that this is the most important of the duties of an Executive Officer. I therefore visited each surveyor in succession and examined his field section *in situ* from the top of one or more commanding hills. Such an examination would occupy me on an average for 3 hours, during which the correct positions and names of about 180 objects would be tested, including a range of six to ten miles radius. This test, thus rigorously applied, than which nothing can well be more searching, failed to detect any errors other than the most trifling. It is particularly applicable to the examination of hill features, village sites, and bends of cultivation in open country.

2nd test of the detail by Pertal.

For the test of nullahs hidden from the view in forest, and for all features equally in plain cultivated country, a series of check lines or Pertals were run by myself aggregating 232 miles in length. They intersect from end to end the work of every surveyor, and afford the test of 2057 features which were cut by the measured lines.

Country.

The area surveyed consists of parts of the Tributary Estates of Jushpur and Sirgoojah: the former is very nearly completed, the latter is only commenced. The Jameera Pat, which appears in all the old maps as a remarkable hill feature has now been delineated.

Duration of the field season.

The party marched from quarters on 22nd November, and all had returned from the field on 12th May.

Recess.

Office was opened on 3rd May and has continued open daily from 10 to 4, no holiday having been taken on Saturday. It will close for one week during the Doorga Poojah holidays.

Leave of absence.

The absentees during the recess have been as follows:—

Captain	Depree	... Two	months on Privilege leave
Mr.	McGill	... Two	do. ... ...do.
„	Vanderputt	... Three	do. ... ...do.
„	Wilson, Junior.	Three months doing duty, Surveyor General's Office.	
„	Girdlestone,	On Medical certificate after 11th September.	
„	Babonau	Transferred on 7th September.	

Computations.

The principal triangles, Latitude deduction and Heights, as well as the same computations of secondaries, were done by myself assisted by Mr. Gridlestone, who also computed with the assistance of Messrs. McGill, Wilson Senior, Babonau, James, and Barker, the remainder of the secondary, and all the Tertiary points. The Secondary and Tertiary heights are now being computed by Messrs. McGill and Wilson. The arrangement of Tertiary Triangles, a most laborious and difficult work, was done by Mr. Gridlestone to the extent of three-fourths of the whole number, and the remainder by myself. In this duty Mr. Gridlestone laboured in extra hours, and I here notice for your information the self-denying zeal of this assistant, especially in this instance.

The computations consist of as follows:—

6	Principal Triangles ...	Including general report.
63	Secondary do. ...	
796	Tertiary do. ...	
4	Principal Lat. and Long. double deductions....	Duplicate.
70	Secondary do. do. do. ...	
392	Tertiary do. do. single deduction. ...	

323	Heights Principal Secondary & Tertiary deductions	...	Triplicate.
×	do. of Stations calculated	...	
25	pages Alphabetical List	...	Triplicate.
32	,, Synopsis	...	

The above will be bound up in one volume of General Report, and two of original computations; and the following Angle Books will be completed in duplicate.

Angle Books.

252	Pages Horizontal angles	...	In duplicate.
76	Do. Vertical do.	...	

112 Do. Alphabetical village list arranged by Pergunnahs for (Surveyor General's Office)
Do. do. do. do. do. do. (Commissioner)

Maps, fair Copies.

Seven sheets of the Atlas of Chota-Nagpore. (Nos. 45, 46, 47, 48, 49, 50, and 55) scale 1 mile=1 inch, will be submitted as well as the same series of "Exaggerated copies" prepared for Photographic reduction. Sixteen original Plane Table field sections will also be sent in, on which have been inserted the pertal lines in red ink; moreover all discrepancies having been shown in red on the face of the map, a glance at the map will lead to an opinion of the value of the test and of the accuracy of the delineation. The 3 pertal sheets in original with their field books will also be submitted.

Exaggerated Maps.

Pertals.

Expenditure and rate per mile of detail

The total of bills for the year ending 30th September is Rupees 56,331-7-11, which divided by 2,378 gives Rs. 23-11 per square mile being an increase over the rate of last year of Rupees 9-9-5, but it should be borne in mind that the total above set down includes the arrear pay, owing to re-organisation, of all Civil members of the party, as well as one month's pay of myself which was drawn in arrear for September, besides none of the rejected or doubtful detail is taken into account. You will also probably have already observed that the triangulation has been placed so far in advance that no more need be done for two years, except only a small quantity of secondary in an outlying corner of Bhokar.

Mr Girdlestone.

During my absence on privilege leave, the Assistant Surveyor conducted the Office duties with entire success. I have no hesitation in reporting that he is in every way qualified for the charge of a field Party, and in expressing the high opinion I have of his industry, zeal and intelligence. It is with much satisfaction that I have been informed of your favourable recommendation that he be promoted to the 1st grade from the earliest date allowed by the regulations. It was with as much regret that I learned it was necessary to transfer his services to the No. 1 Party, and now unfortunately his health has broken down altogether, and he left this Party on Medical Certificate on the 7th September.

Civil Establishment.

I have again the satisfaction of reporting that the conduct of the Civil establishment and Draftsmen has been exemplary. Each individual has vied with the other in the careful performance of his duty, and I find it difficult to name any man as peculiarly deserving of mention.

EXTRACT FROM THE NARRATIVE REPORT OF LIEUT. R. V. RIDDELL, R. E. OFFICIATING IN CHARGE NO. 5, TOPOGRAPHICAL PARTY, REWAH TERRITORY SURVEY.—NO. 233, (A) FOR THE SEASON 1866-67.

Having been appointed to officiate in charge of No. 5, Topographical Party, Rewah Survey, consequent on the departure of Captain W. G. Murray on sick leave to England, I have the honor to submit the following Report of the operations of this Party since 1st. October 1866.

The Total area surveyed is 1409.3 square miles, and large scale surveys of the cities of Rewah, Nagode, Meyhere and Punnah have been finished. The Triangulation of the Rewah Territory was completed by Lieut. Badgley, but the extension westwards in the Bundelcund, states, proposed by Captain Murray, has not been carried out, the ground having been not more than partially reconnoitred.

Lieut. Badgley proceeded according to orders, to triangulate portions of the states of Punnah and Adjigurh, allowing time for Mr. Howard to have reconnoitred and poled up that tract of country in advance. But this was delayed on account of the nature of the ground to so late a period that Lieut. Badgley was only able to observe at four stations before he was ordered to proceed to meet Captain Murray at Nagode towards the end of December, whence he proceeded to the southern portion of Rewah. There he reconnoitred and triangulated an area of 1474 square miles by the end of March, after which he was obliged to complete some observation at the great Trigonometrical station of Murergarh (Calcutta Longitudinal series) left incomplete in the field season of 1865-66. Lieut. Badgley observed at 20 stations and at 16 of these vertical observations were made. He then proceeded to meet the office in route to Plane Table No. 31 across which he ran a test line from west to east, this he completed by 25th April and marched to Meyhere where he found Mr. Bell sick, there he remained until all the Party, but two had arrived and then proceeded to Mussoorie.

Mr. R. A. Bell, Civil assistant 2nd grade, commenced work on the large scale survey of the city of Rewah, on the 20th November, teaching Messrs. Ryan and Wainright. This survey was completed by the 4th December, when Mr. Bell proceeded to Nagode with Mr. Wainright and completed this survey by the 9th January, he then proceeded to the south portion of Rewah where he took up portions of Plane Tables 51 and 52, comprising an area of 116·8 square miles, which he completed by the 20th March, he then proceeded to run test lines across Plane Tables 29 and 42, on which he was occupied from the 28th March to 20th April. Of the illness and death of this much lamented officer, Lieut. Badgley furnished you with such full particulars in Paras. 30 and 31 of his letter No. $\frac{153}{A}$ dated Mussoorie 7th June last, that I need not here enlarge on the subject.

Mr. E. S. P. Atkinson, Sub-assistant 2nd grade, commenced work on the 14th November, on Plane Table 26 on the Kymore range, north of the Sone river, and finished this Table by the 3th February; met Captain Murray on the 24th February, after which date he was engaged on portion of Plane Table No. 30 up to the 15th March, having completed the survey of an area of 292·2 square miles. From the 15th March to the end of the field season Mr. Atkinson was unable to do any work, as he was obliged to proceed to Meyhere for medical advice, and after returning from that station, he found himself unable to carry on his field duties and proceeded to Mirzapoor, from which place he was directed to proceed to Recess quarters at Mussoorie.

Mr. C. F. Hamer, Sub-Assistant 3rd grade, commenced work on the 20th November in Plane Table No. 71, in Bundelcund, of which he completed 63 square miles by the end of December, part of this was also surveyed by Mr. Ryan. On the 3rd January, Mr. Hamer proceeded to Plane Table No. 43, arrived at the southern portion of that Table and commenced work by the 28th January and completed 36 square miles of Topography by the 6th April, the whole of this work being done with the use of the chain. On the 7th April Mr. Hamer by Lieut. Badgley's orders left Plane Table No. 43 of the completion of which Lieut. Badgley entertained no hope and proceeded to take up some of the work in Plane Table No. 30, left unfinished by Mr. Atkinson; of this he finished about 33.5 square miles by the 9th May, and then left the field for Recess quarters where he arrived on the 27th May. His total of work completed amounted to 132.6 square miles; a small quantity, but most of the ground is described as of an intricate and difficult character.

Mr. A. D. Howard, Sub-Assistant 3rd Grade, commenced work on the 18th November, starting from Amua H. S. (a principal station of the Calcutta Longitudinal series) and was occupied until the end of December reconnoitring and selecting stations between Latitude 24°-0, and 25°-0, and as far west as the meridian of 80° east Longitude in the states of Punnah and Adjigarh during the month of January. Mr. Howard was delayed about 10 days waiting for Rewah Officials to accompany his camp, consequently he did not arrive at his Plane Table No. 8, on the extreme East of the Rewah Territory, until the 2nd of February. On the survey of the unfinished portions of which Table as well as of No. 13, he was occupied until the 24th April completing 159.8 square miles of Topography in difficult ground; Mr. Howard then marched to Meyhere where he arrived on the 9th May and thence proceeded to Recess quarters.

Mr. C. T. Evans, Sub-Assistant 4th Grade, commenced work on the 15th November in Plane Table No. 74 (Bundelcund state) completed the unfinished portion of that Table about 82 square miles by the 22nd December, and he took up the adjoining Table No. 32 in Rewah Territory, the whole of which he completed by the 11th May, the aggregate amount of his work was 379.3 square miles.

Mr. T. D. Ryan, Sub-Assistant 4th Grade, commenced work on the 20th November, assisting Mr. Bell at the survey of the city of Rewah. He commenced the survey of the city of Meyhere on the 8th December which he finished by the 18th of that month and then marched to Nagode to receive instructions from Captain Murray as to his next work. On the 3rd January, he proceeded to take up the unfinished portion of Plane Table 71; this an area of 106 square miles, he completed by the 24th April, and then marched to Meyhere, but as I reported to you on a former occasion I was obliged to reject the whole of his work.

Mr. E. A. Wainright, Sub-assistant 4th grade, commenced work by assisting Mr. Bell in the cities of Rewah and Nagode, remaining with Mr. Bell until these surveys had been completed, he proceeded to take up the survey of the city of Punnah, which he completed by the 9th February, and then went to Captain Murray's camp where he received orders to join Mr. Bell to receive instructions in the art of Plane Tabling on the scale of one mile to the inch: he left Mr. Bell's camp on the 28th March by Lieut. Badgley's orders, to join and assist Mr. Howard in the completion of some unfinished portions of Plane Table 34 on the eastern boundary of Rewah, he completed 30·2 square miles by the 25th April, when he marched to Meyhere with Mr. Howard, arriving at that place on the 9th May. Unfortunately a small portion of about 45 square miles in that neighbourhood, several marches distant from the fields of the remainder of the work is yet unfinished.

Sheikh Nabbi Baksh, Native Surveyor, was employed on the general maps with Captain Murray's camp until the end of January, when he proceeded to take up the unfinished portion of Plane Table 31 south of the Sone, an area of 106 square miles; this he completed by the 24th April, having been sick for 24 days of this time in broken periods.

Prem Raj, Native Surveyor, was employed with Captain Murray's camp until the middle of January when he proceeded to take up Plane Table No. 43, of which he completed 95 square miles by the 10th May, he then left the field for Recess quarters.

Abdul Rahim, Native Surveyor, was employed with Captain Murray's camp until the middle of January, he then went to take up Plane Table section No. 47, Rewah Territory, of which he completed 97·4 square miles by the 22nd April, after which he marched to Meyhere en route for Recess quarters.

General Remarks on above.—With the exception of a test line along the northern boundary of Plane Table No. 42, none of the work done during the season under review has been checked in that manner. Captain Murray intended to have test lines surveyed over most of it, but it was found impossible to complete this part of Captain Murray's programme. Lieut. Badgley reports that the work done by Messrs. Atkinson, Hamer, Evans and native surveyors Nabbi Baksh and Abdul Rahim, appears to him from general recollection of the country to be correct, and they have turned out their work neatly. Tables 51 and 52 by Mr. Bell were performed in the usual neat and accurate style for which that Gentleman was always noted. Lieut. Badgley cannot say whether the work done by Messrs. Howard and Wainright is accurate or not, but it seems carefully performed with plenty of detail and judging from Mr. Howard's former work this should be accurate.

Country Plane Tabled.—Plane Tables No. 32 and 74 are open with ridges of hills and light jungle in some parts but mostly cultivated.

The southern part of Plane Tables 31 and 32 are more difficult, the hills being covered with thick tree jungle and the lower ground, half of which is cultivated, is intersected by ravines and covered with jungle.

Plane Table 42 is for the most part occupied by the plateau on the northern edge of which the G. T. Station of Marhwas (Calcutta Longitudinal series) is situated. This plateau is covered with dense tree jungle and will have to be worked entirely by chain and traverse.

Tables 43 and 47 are also very difficult, in these there are numbers of low hills with swamps intervening, and the whole is covered with dense forest. Tables 14, 34, 51 and 52 are comparatively easy, the features being more marked and the jungle less dense.

Country Triangulated.—The whole of the country triangulated by Lieut. Badgley in the South-west portion of Rewah partakes more or less of the nature of Plane Table sections 43 and 47 described above. The Triangulation was entirely of a Secondary nature, but the computations shew the work to be good, the average linear discrepancy of the common sides of the 1st class secondary Triangles is 2.69 inches per mile, and of the 2nd class secondary triangles 8.46 inches per mile, while the sides Karara to Rampur and Rampur to Panchi of the Calcutta Longitudinal series respectively about 29 and 28 miles in length computed on the Ray Trace principal from the sides of Lieut. Badgley's triangles showed a mean discrepancy of 6.3 inches per mile: the mean discrepancy between the heights of the 1st class secondary points is 2.11 feet, and of the 2nd class secondary points 2.35 feet.

The amount of out-turn during this season is much less than was anticipated, but in connection with this it must be remembered that the field of operations in Bundelcund is at a considerable distance from that in Rewah, south of the Sone River, and that in addition to a double number of Plane Table sections being required to be projected during the Field season, great delay is involved marching from the one field to the other, also that all the Native Surveyors and two of the assistants were employed until the end of January on the survey of native cities and on the fair maps of the same with the Head Quarter camp. I trust that this will not be the case during the ensuing season.

I the

[—4—]

PLAN OF OPERATIONS.—My plan of operations as explained in my No. $\frac{185}{A}$ dated 12th July is to commence work on those portions of the Bundelcund states situated north of the parallel 26° North Latitude and between the meridians 80° and 81° East Longitude, comprised in the half degree sheets marked IX in the Index which accompanied my Tabular Statement at the end of the last Field season. I propose to employ the whole Party with the exception of Lieut. Badgley on this until about the middle of December, then to march down to the country south of the Sone and complete as much as possible of the unfinished portion of that work before the end of March. Lieut. Badgley will commence work on the Triangulation and extend as far as the meridian of 80° East Longitude; whatever time he may have afterwards at disposal will be occupied in Plane Tabling. I shall also endeavour to visit Ummarkuntak in order to be able to submit the report on that place so long due.

EXTRACT FROM THE NARRATIVE REPORT OF CAPTAIN H. H. GODWIN AUSTEN, IN CHARGE No. 6, TOPOGRAPHICAL PARTY, COSSYAH AND GARROW HILLS SURVEY.—No. 107 (A) FOR THE SEASON 1866-67.

The plan of operations (given in Narrative Report for 1865-66) formed by my predecessor was adopted, and in the main carried out, the only addition being the re-survey of ground executed in previous year found on further inspection to be incorrect. All arrangements for carriage of supplies &c. by the enlistment of a large number of Cossyah coolies and of interpreters for each assistant had been made by Lieut. Riddell, and the Party was fully organized for the field on my arrival in the middle of November at Cherra-Poonjee. Mr. Belletty was to continue the Triangulation towards Longitude 92°-30″ in the Jyntiah Hills while the Topographical work lay all in the Western Cossyah Hills and the northern slopes of the Range.

As some of the Assistants were to work in the hills contiguous and perhaps within the Garrow territory, a Party order was circulated to avoid all collision with these people or with neighbouring villages in that direction; also to be particular regarding the behaviour and conduct of their retainers, and Government servants, when surveying in those localities. I am glad to state that no opposition was encountered by any assistant, and that no fracas occurred during the season of any kind whatever. Orders regarding greater carefulness in the detail, and general working with Plane Table were issued.

The greater aim of the seasons operations was the completion of all the Cossyah territory on the West up to Longitude 91°, and the Triangulation of sufficient ground on the East by Mr. Belletty for next years work. I am sorry to say that owing to Lieut. Sale's bad accident at the time of starting for the Field, added to the extra work of re-survey of a large area, prevented this being carried out completely, but very little remains to be now done up to the above line of Longitude.

The Party which had been delayed for a short time awaiting my arrival from the Upper Provinces began to leave Cherra on the 18th of November. Mr. Atkinson was detained by sickness until the 31st of same month, while the severe accident to knee-cap sustained by Lieut. Sale, rendered him unable to move from his bed, and he was thus prevented leaving Head Quarters for some time after this date.

The Field season extended over 6 months from about 20th November 1866 to the 20th May 1867.

The main Triangulation was carried on by Mr. N. A. Belletty in the Jyntiah District commencing at the Stations of Nongjirong and Maocharain. This is to form the commencement of a Principal series of Triangles to extend thence towards the East in the direction of the Angami Naga Hills. This I propose designating the Jyntiah Series in contradistinction to that on the West of the G. T. Survey Triangulation. Mr. Belletty completed a Polygon of 6 sides and connected this with the net work of Trigonometrical stations on the South. From this Polygon a short minor Meridional Series will be carried North into the Assam valley. A small amount of Triangulation was extended by myself from the last Principal Stations of the Cossyah Series towards Longitude 91 in order to give points in the South-west for the Topographical work on that side. This will be more satisfactorily computed when one or two more stations have been visited.

Lieut. M. T. Sale, R. E.,—owing to the accident referred to in Para. 6, could not take the Field until January. He joined my Head Quarters, camp Mokassa, on the 15th, and at once

began Plane Tabling in the vicinity. The exercise consequent on this work caused a relapse and laid him up again until the 20th March. He had so far advanced in use of Plane Table that he was able to revise a very large portion of Mr. Gilhooly's work of the previous year. A portion adjoining this ground, I took up at the same time, and was thus able to test well the accuracy of his work. Mr. Stratford accompanied Lieut. Sale for instruction. I must state that while prevented from taking his share in the active Field duties, Lieut. Sale rendered me very great assistance at the Head Quarters Camp during my absence towards the Garrow boundary, and by making up returns, projecting the graticule of new Plane Tables, and some computations of extra points required, enabled me to remain on the West, engaged at the half inch sketch of the country, much longer than I should otherwise have been able to do. Lieut. Sale's Field work was very correct, and he showed great aptitude for it both in delineation and physical ability in rough ground. Lieut. Sale completed 77 square miles on the scale of one inch to one mile.

Mr. N. A. Belletty, Civil Assistant, 1st grade, was employed for the whole of the season in the Juwai district extending the triangulation eastwards towards 92°- 45′. He observed with the 14 inch Theodolite at the stations of Nongjirong, Naocharain, Nongjingh, Sonoriang, Sunrum, Liniang and Saruntha, completing a Polygon, the stations of which had been selected and prepared the previous year. Mr. Belletty fixed a number of secondary points in the neighbourhood of Juwai. On January 26th he dislocated his left wrist rather severally by a fall from his pony and returned to Juwai. This accident prevented his doing any further work until the 8th March. Thus unfortunately he lost quite a month and a half the best time of the field season, and the triangulation was sadly retarded. I have not seen any of the ground over which the triangulation was carried. The clearing of several stations was accomplished. I am sorry to say instructions issued by me regarding the clearing of hills were not received in time, and thus prevent the unnecessary extensive way this had been effected at some stations on the west, where the men of establishment in charge of the work were left to themselves.

The total area triangulated by Mr. Belletty was 1,570 square miles. The amount is very small, more especially when the numerous Great Trigonometrical stations south of Juwai are taken into consideration, but as I have no experience of the Jyntiah sides of these hills, I cannot give any decided opinion on the subject, a great deal of course depending on the country and facilities that exist there for travelling from one hill station to another. I trust that with the reduction in scale this Officer's triangulation will be pushed on with greater zeal and rapidity, and cover a much larger area during this next season.

The total area surveyed amounts altogether to.—

Square miles on the 1 inch = 1 mile scale ...	1038.0
On 2 miles = 1 inch ...	249.0
Total, ...	1287.0
Mr. Atkinson's rejected on examination ...	77.0

The amount is not large, but is I think satisfactory.

The general average Plane Table Stations per square mile is 3·9 or nearly four. A wide difference of course is to be noticed between the high open ground, and that on the flanks of the hills in the densely wooded portion, of 5·4 in the former to 2·0 in the latter. The last average of 2 will amply suffice for future work in jungly forest ground on the half inch scale to mile. This I found from practice to be the case, nor could I with any benefit to the amount of detail have set up the Plane Table oftener.

During the Recess, Office has been steadily held daily (Saturdays excepted) from 10 A M, to 4 P M., and I have much pleasure in testifying to the steady and regular attendance, and the

manner in which all the Assistants have carried on their Computations, Compilation work and Drawing.

The Computations Consist of

Triangles	Principal	9
	Secondary	112
Heights	Minor Secondary	188
	Principal Stations	6
Latitudes and Longitudes	Principal	6
	Secondary	37
	Minor Secondary	128

Mr. Belletty, whose Triangulation was being computed, chiefly superintended this portion of the Office duties as well as the instruction of the young hands in the use of the different forms of computation.

The following Maps and Charts have been finished or partly prepared during the present recess:—

1.	Fair Copy Map.		No. XVI.	between Latitude	$\frac{25°\text{-}15'}{25°\text{-}30'}$	Longitude	$\frac{91°\text{-}30'}{92°\text{-}\ 0}$
2.	Do.		No. XV.		$\frac{25\ \text{-}30}{25\ \text{-}45}$	,,	$\frac{91\ \text{-}30}{92\ \text{-}\ 0}$
3.	Do.	part of	No. XII & XIII	,,	$\frac{25\text{-}\ 0}{25\ \text{-}30}$	,,	$\frac{91\ \text{-}15}{91\ \text{-}45}$
4.	Do.		No. XVII	,,	$\frac{25\ \text{-}\ 0}{25\ \text{-}15}$	,,	$\frac{91\ \text{-}30}{92\ \text{-}\ 0}$
5.	Do.		No. XI	,,	$\frac{25\ \text{-}30}{25\ \text{-}45}$	,,	$\frac{91\ \text{-}\ 0}{91\ \text{-}30}$

Exaggerated Maps for reduction by Photo-Zincography to ¼ inch scale.—

1.	Sheet	No. XVI.	Scale one mile=one inch.
2.	,,	No. XV.	

Traces for Civil Authorities Cossyah Hills.

1.	Portion	between	Latitude	$\frac{25\text{-}15}{25\text{-}30}$	& Logitude	$\frac{91\text{-}15}{91\text{-}30}$	Scale 1 mile=1 inch.
2.	do.	,,	,,	$\frac{25\text{-}30}{25\text{-}45}$	,,	$\frac{91\text{-}\ 0}{91\text{-}30}$	
3.	do.	,,	,,	$\frac{25\text{-}10}{25\text{-}30}$	,,	$\frac{91\text{-}\ 0}{91\text{-}15}$	Scale 2 miles=1 inch.

1. New Office Chart of Triangulation.—Scale 4 miles=1 inch.

In the preparation of fair copy maps, Native Surveyor Nussiroodin has taken a leading part, his neatness and care in compiling are most commendable, and I am exceedingly pleased with the great advance he has made in hill shading with pen. He is a most valuable aid. One fair copy map has been compiled and entirely executed by Lieut. Sale whose drawing is good. In the projection of graticules of maps and Charts, Lieut. Sale has given much assistance, and at this work he is exceedingly accurate and careful.

Mr. Ogle has given me much aid in the compilations of maps, both fair copy and in the Exaggerated form for reduction, being both careful and neat in execution. To Messrs. Wyatt, Dilhooly, Stratford and Doran, instruction and practice has been given in hill sketching, but the computations have prevented the two first from doing so much as I should desire. Mr. Doran has made good progress and will I think make a very good Topographer. Mr. Stratford has also much improved as well as Native Surveyor Daliloodin. The Exaggerated maps being new and requiring some consideration in their preparation, I have taken up myself; the tracing, &c. being executed by Lieut. Sale and Mr. Ogle. Moonshi Daliloodin is a good printer and this portion of

the mapping has devolved on him and Nussiroodin. It is much to be regretted that, owing to unavoidable gaps caused by sickness in the field, Fair copy map No. XI cannot be sent in this year, but as the gaps are small and the map to a large extent finished, I hope to have it ready very early next Recess, as well as the Exaggerated map of the same.

Towards the close of the Recess whenever the weather permitted, Messrs. Stratford and Doran have been enabled to practice Plane Tabling. Mr. Ogle has also learnt the use of the 7 inch Theodolite, and is in the same way measuring a Triangle or two in the vicinity.

The health of the Party on the whole has been exceedingly good, and considering the malarious and unhealthy character of the ground that several members of it had to work in, and who were attacked by fever in March and April; all soon shook off the disease on return to Cherra-Poonjee, and are now perfectly well and strong. This says much for the healthiness of our Head Quarters notwithstanding the extraordinary amount of rain-fall for so continuous a period. For this reason principally I have decided that it is better to remain in Cherra-Poonjee another year, instead of removing to the new station of Shillong. To do this at present much valuable time would be lost in the ensuing field season, while extra expense must be entailed of removal and building by most of the members of the party.

The late appointment of an Apothecary has removed all immediate necessity for changing our Head Quarters, and all energies and thought can be directed to pushing on the work so very much in arrears.

The establishment is principally still composed of Hindustanies, but a reduction has been effected. A certain number must be kept, though they are not so useful as they might be, from being foreign to the country, and not the men as a rule for very jungly work. Several Goorkhas have been entertained and I hope to get more. These men are better adapted for our ground in the more distant parts. During last season no difficulty was experienced in obtaining the services of men of the country in the position of Interpreters, Chuprassies, Calashies, Coolies. These Khasias require high wages, but I shall make every endeavour to reduce the rate next field season.

During recess several new hands among Native establishment have been instructed and made available as Heliotropers, and the Party is well ready for the field.

The rate of progress of this party has been hitherto extremely slow, and I consider much slower than native obstacles or the climate will account for. Added to this the local rates for carriage and service are excessive, and this has raised the rate per square mile to an extremely high figure. The sanctioned reduction of scale will tend to lower this rate by degrees and, it is my intention now to survey only the neighbourhood of Juwai on the one inch to one mile scale. The whole of the remaining country will be mapped on the half inch to mile, a scale quite large enough for sparsely populated and jungle clad districts like the Garrow and North Cachar hills.

My predecessor Lieut. Riddell, R. E., having planned the extention of the triangulation towards the East into Juwai, and the country being there ready for the detail Surveyors, I have decided to throw the whole of the strength of the party into Jyntiah and North Cachar. The recent accession of strength to this Party will entail in the first place much instruction, and second supervision of work, which could not be accomplished satisfactorily were ground to be broken on the West in the Garrow hills as well; therefore it will not be possible as yet to attempt the dispersal of the party into two separate divisions.

Mr. Belletty, I propose to employ first in selecting Principal stations towards Asaloo and the observations at the same extending as far eastwards as he can get.

Lieut. Sale will take up Plane Tables $\frac{49|52}{51|52}$ on half inch and will carry on all the second Triangulation in that and adjacent area as well as look up the ground in course of survey on North and West.

I shall myself after seeing Messrs. Stratford and Doran, and the two new Native Surveyors fairly at work, proceed to the south towards Jyntiapur, sketch Plane Tables 45 and 46 and fill up the intermediate ground between the G. T. Series in Cachar, and Mr. Belletty's on the North, in order that Plane Tables 53and54 may also be taken up. Inspection of the field work of all engaged will then occupy all my time.

The rest of the Party will be distributed as most convenient, and with the view of completing as much of the degree sheet $\frac{25°\text{-}26°}{92°\text{-}93°}$ as can be done, and also the gaps and portions up to 91° Longitude that still remain, both on the north and south of the Cossyah hills and near their base.

* * * * *

SHORT DESCRIPTION OF COUNTRY ITS RIVERS AND GENERAL FEATURES ON THE WEST.

After crossing the Boga Pani river and proceeding from Cherra Poonjee in a nearly direct line towards the country of the Siem of Nongstein, the last of the plateau-like ridges are left behind, and with the granite formation commences a total change in the Topographical features of the country. The general level of the hill-tops remains pretty nearly the same, but they are cut into by innumerable streams that form a most puzzling drainage to delineate. The heads of these rivers and all lateral ravines run up into high open, grassy, undulating ground, the beds widening out into broad grassy flats extremely swampy, and some of them of large extent. The hills are bare of all save grass; are of rounded form, and on some, huge grey granite bosses project, while the steeper slopes present a tumbled débris of these large weathered masses. Very little wood is to be seen—occasionally the northern face of a ridge side will be covered with a low scanty jungle, and between Kynchi and Kollong some patches of large forest trees remain.

From the appearance of the country and the information I received from some of the natives, these jungles and forests were once much more extensive. In some parts iron workings and in others the constant yearly burning of the grass no doubt have led to the present bleak and bare look of the country. Slag from Blacksmith's furnaces was often seen on hills now quite bare, and at considerable distances from-present villages. The Fir trees have also been much thinned along their southern limits. The high ridge of Maotherichan forms on this side the back-bone as it were of the Cossyah hills, taking a bend thence to the north-west. The south face of this ridge near Mokarsa is very steep, overlooking an undulating country, traversed by some large streams, the beds of which occasionally widen out into large flat areas cultivated with rice, and have all the appearance of an old system of shallow lakes. Far to the south rise a few isolated and conspicuous hills, the remains of a formerly wide-spread extension of the sandstone formation on the southern face of these hills. Ten miles to the north of Maotherichan Great Trigonometrical Survey, the northern scarp is reached; as one nears it the ravines become more wooded, fir trees increase and form patches of dense woods until at last, with the scarp itself, the tropical forest that extends to the plains of Assam commences. Twelve miles to the west of Maotherichan near Nongstein, the high general level of the hills terminates, and from the station of Nongsingriang a very curious and rather sudden fall of the country is seen. This depression extends in this Longitude right across the hills towards Assam, and from no other point can a better idea of the general Topography of this western side be obtained than from Nongsingriang. In the lowest portion of the depression are seen the low scarped hills near Langdekar, while to the south the hills rising higher, seem to form a low wall between the main drainage and the plains. Beyond Langdekar and to the south is a sea of forest, dark colored and flat, broken here and there by flat topped isolated hills, among which Koklam is the most conspicuous. This sea of low forest ground is backed by the Garrow hills that rise gradually on the west, the culminating point being Mamai peak which from Nongsingriang looms up finely in the distance; these hills dip gradually from Pandengroo to the plains, and through the glass are seen clothed with dense forest to the very summit.

The whole of this area is drained by the tributaries of the river Um-Blay, the finest and broadest on this side. Its width in the lower portion of its course is seldom less than 100 yards, flowing very sluggishly with deep pools scooped here and there out of the rocks; in other parts still and broad with about 5 to 6 feet of water very equable in depth from the hard nature of the nearly horizontally stralified sandstone, the deeper parts generally lying under the banks shaded by heavy over-hanging trees, from this the hills rise abruptly becoming cliffs above, showing here and there through the forest; this line of cliffs running straight and level as a wall. The several Tributaries of the Um-Blay that rise in the West or Garrow side are the rivers Wyyow and Maoptil, both of them are large and broad rivers, and must drain a very considerable tract of country from the North and West, the Um-Blay receives at 15 miles from the plains. The large river the Kanchiang that taking its rise in the hills near Mairang, brings down an enormous water supply from all those hills and the Maotherichan range; this is a very large river and below Katilao hill where I crossed it, was very deep with formidable rapids, it was crossed there at a very deep pool by Bamboo rafts.

The cliffs bounding the Um-Blay are rich in Coal in thick extensive beds (a Geological map of this area is under compilation). The Coal occurs in a massive sandstone series with coarse thick bedding, and is topped above near Nonkulang H. S. by the Nummulitic limestone, so that its age is much older than the coal of Cherra Poonjee. It is also very constant over a large area. A very curious Topographical feature is to be seen in the hills to the S. W. of the Nonkulang ridge, where I discovered that the drainage of some 15 square miles of country finds no exit to the plains. On the south rises the high ridge of Yindku and Kuta-Bram composed of sandstone resting on a great thickness of Nummulitic limestone; in dense forest under Kuta-Bram, the streams Shibak and Wakit flow towards each other, and disappear in the limestone down deep crevasses that have been formed in it. Owing to the dense forest it was sometime before I could understand where the drainage (which as I supposed went out into the plains) could possibly run. The effect of weathering on the limestone rock of this district is most wonderful: it stands in huge isolated columns and blocks eaten by the elements (excessive damp taking a large share) into deep hollows and caves. This surface is buried in the gloom of high forest trees whose roots find a deeply seated hold in the fissures and cracks of the rock, the underwood being comparatively thin, so that it is in parts quite accessible in any direction.

Due south of Nongkulang this limestone formation striking N. W—S. E. abuts upon the plains near Bagholi, and the first Quarries are met with that supply the Calcutta market with lime, thence towards the East this formation is found in a like position as far as Teria Ghat.

The hills here terminate very suddenly upon the dead level of the plains and the tilted strata sink as it were into the marshes of Mymensing. This is not the case further East, where the last slopes terminate in a series of low *Tilas* that extend for some distance out into the plains.

There is a very gradual change in the people on leaving Nongstein and entering the forests of the Um-Blay valley. The villagers nearer Nongstein, such as those of Moomarin &c. still call themselves Khasias, but in appearance and habitations differ considerably; burial rites do not seem to be performed in the same manner, and the upright stones set up near the ashes of the dead are not seen. The men and women begin to wear brass ear-rings and the dress of both sexes is more scanty. In Nongkulang a still greater departure from the Khasia is seen, and the language has so much altered that people from Nongstein have a difficulty in understanding them well. A few of the women were seen wearing red bead necklaces, and all brass ear-rings, to the number of six or eight.

These people call themselves Langam and are to be found as far West as Nongmen, and in the villages on the Um-Blay N. and N. W. of Langdekar.

South of Nongkulang skirting the plains and living in the most unhealthy tracts extending from the débouchment of the Um-Blay into the plains as far as Chanda Dinga, is found a

tribe of Garos called Habiang, and the tract also is known generally among the hill people by this name. The dress of both men and women is scanty particularly the latter, from the waist up, they are generally quite nude, while the strip of cloth that is worn round the loins is exceedingly short. They encumber their necks with such a mass of red bead necklaces that it gives to their coarse ugly faces a still more disagreeable appearance, while the ear lobe is so extended by weighty brass rings that it appears almost on the point of rupture; these rings actually rest on the shoulder. They are at first a little timid of Europeans, but those I saw were all civil and turned out to carry loads, act as guides and open up the hill tops. They clear patches of jungle, here and there, on hill sides, on which they grow cotton mixed generally with red pepper. Rice is also grown in like situations during the rains. Their houses are long and large and raised about 4 feet from the ground. The women appeared much more retired than the Khasias, and the men much more jealous of any one speaking to them or intruding into their houses.

Besides the Langam and Habiang Garos near the plains there is another tribe that inhabits the tract of country on the West and North-west quite within the Garo Hills proper, they are called Dekor. No villages of these people have as yet been visited. They are situated well within the Garo Boundary.

EXTRACT FROM THE NARRATIVE REPORT OF LIEUT. G. STRAHAN, R. E., IN CHARGE No. 7, TOPOGRAPHICAL PARTY, RAJPOOTANA SURVEY, FOR SEASON 1866-67.

Owing to our recess work of last year having been delayed by our protracted stay at Pokri, while making the contoured survey of the site of the new sanitarium there, the camp was unable to leave Dehra till the 20th October. The march down to Delhi occupied 13 days, during which time the Assistants were employed as usual in mounting and projecting the Plane Tables.

We left Delhi on the 5th November, and on the fifth day I detached Mr. Todd, to finish a portion of a table in the north of Ulwar, which would complete the degree sheet in which it occurred. On the sixth day I detached Mr. Baness to complete the triangulation of the ground, lying between the meridians 75° and 76°, and bounded on the north by British territory. Mr. Stotesbury was also detached on the same day to proceed to his last years ground in Shekawatty to complete one unfinished table, and to take up the adjoining one. On the 16th November Messrs. Tapsell and Kitchen left my camp to proceed to their ground near Jeypoor. Messrs. Hussey and Kirk and Kalka Pershad on the 18th. Having thus disposed of all the Sub-Assistants, I proceeded with Lieut. Holdich to the ground I had allotted to him, to instruct him. Lieut. Holdich had already learnt the principles of Plane Tabling in Bhootan, so that after five days instruction I found he was quite able to execute good work by himself, and accordingly left him to his own resources and started towards the district I had marked out for myself for triangulation during the season, south of latitude 26° 45′.

I commenced selecting stations on the 1st December, and by the end of the month I had sufficient ground prepared to begin observing. The trangulation consists of a minor series, emanating from the side "Nowai" to "Rasia" of the Great Trigonometrical Survey, Rahoon series; and after pursuing a somewhat irregular course, it joins on to the side 'Sakoon' to 'Koharseena' of our own principal Triangulation. The greater part of it consists of compound figures, but the excessive flatness of the ground over which it runs, forbade their adoption throughout, and induced me to adopt the method of minor series in preference to net work as usually carried out in Topographical Surveys in hilly ground. My experience this year quite coincides with Colonel Waugh's recommendation to adopt this method in flat ground as explained in his treatise on Surveying. The signals were chiefly Heliotropes, but in cloudy weather I used white bell tents at Colonel Walker's suggestion with the most perfect success. All three angles of the triangles were observed, with 14″ Theodolite on Zeros $\frac{0}{180}$, $\frac{30}{210}$, and the heights of all the stations determined by reciprocal observations with only two exceptions. A few secondary points had been fixed by the Rahoon Series over the same ground, and with the help of these sufficient points for 8 Plane Table Sections are fixed. At the point of junction with our former work the discrepancies are as follows:—

	Lat.	Long.	Azth.	Height.
At Sakoon	− 0″.01	− 0″.08	− 2″.6	− 2.8 feet
Koharseena	+ 0.03	− 0.10	− 3.9	

Linear discrepancy in feet + 3.4

Difference of logs 0.0000209.

The triangular error of the series is 3″.8, and linear discrepancy 0.59 inches per mile.

The observations were finished on January 31st, and I then proceeded to carry on the Principal Series which emanates from 'Kho' to 'Bhoortia' of the Rahoon Series, to join the side 'Goodha' to 'Kinsirra' of the Gurhagarh Series, only one quadrilateral was required which took me 12 working days owing to bad weather.

estimate correctly what should be shewn as 'cultivation', and what as 'waste' in the ... maps. The crops grown are wheat, barley, carrots, bajra and in a few place ... opium and sugarcane. The wheat and barley are only grown in small quantities and close ro ... the wells, as they cannot thrive in such a dry soil without irrigation. The irrigation ... holly done from wells in the ordinary way with bullocks and a leather bag.

The natives are almost without exception insolent, uneducated, ...praved and ground down by the tyranny of the Thakoors: many of them especially the 'Meena' caste are professionally robbers. The trafic is principally confined to the Sambar salt and the manufactures almost 'nil'.

The climate is very dry, but not unhealthy, and the annual rain fall at Jeypoor seldom exceeds 40 inches.

I regret extremely that I have been recommended by my medical attendant to apply for 20 months sick leave to Europe. This will necessitate a temporary separation from the charge of this party, but I trust the programme which I have marked out for the ensuing season may be adhered to by my successor if approved of by you. This programme is as follows: Mr. Baness with six Plane Tablers will proceed viâ Hissar to survey in detail the ground in the north of Bikaneer and Shikawatti, completing all that lies between the meridians of 75° and 76° up to the British frontier on the north, and joining on to last year's work on the south. This being completed, he and his six Plane Tablers will move down south of Jeypoor where there is more ground ready triangulated. Mr. Baness himself will pass the remainder of the season in triangulating, and the Officer in charge will spend such part of the season as is not taken up in superintending, in triangulating new ground and in giving points in and about the city of Tonk for the large scale plan of it.

NOTE ON THE SAMBAR SALT LAKE BY LIEUT. HOLDICH, R. E. ASSISTANT SURVEYOR.

Description of lake, source of salt, &c.

The Sambar Salt lake occupies the low ground south of Marot, a great part of it lying between abrupt rocky ridges which cross out from the surrounding sand, something like rocks from the sea. Its position renders it apparently the principal salt reservoir of the country. The hills which partially surround it belong to the Permian group, the rocks of which system are generally more or less impregnated with salt wherever they occur. The country in the immediate neighbourhood of the lake gives strong evidence of the presence of salt in the soil. The two principal feeders of the lake are the Mendha Nuddee from the north, and another from the south which falls into the Lake immediately under the Koharsina hill. The bed of the Mendha Nuddee is salt in most places, and on the banks of a small stream which runs into it from Ramgurgh a considerable quantity of salt is collected and prepared for market by the usual method of salt pans. Indeed, almost every circumstance connected with the source of salt in the lake points rather to a general collection of salt from the surrounding country, washed into it during the rainy season, than to the existence of any bed of rock salt beneath the surface. Certainly no traces of such a bed are visible.

Appearance.

The appearance of the Lake during the dry months is very singular. In March 1867 a great part of it was dry, and that extent of it, chiefly towards the centre, in which the salt formed, was of a brilliant rose colour, broken here and there by the outcropping lines of black mud.

Examination of the bed of the Lake.

An examination of the Lake from Hanwah to Koharsina (nearly N. and S.) gave the following results:—

Near the northern banks (apart from the salt pans) no properly crystalised salt was apparent, but a semi-crystalised form of it (called 'rae') intensely bitter in taste covered the ground like hoar frost. About three feet below the surface, water, saturated with salt, was met with. Half a mile further south, the apparent depth of the black muddy salt was

about the same; and about 3'-6" of water lie above this during the height of the rainy season. The same depth of water continues far out into the lake, gradually deepening, however, to over 6' in the centre. In this part of the lake, salt crystallises in enormous masses, presenting the appearance of rose coloured ice from 3" to 6" in thickness, and resting on from 3' to 4' of black mud. It is here, too, that the salt forms the largest crystals, but it is never extracted owing to the re-occurrence of the rainy season before the Hanwah salt extracters can work so far into the lake from the banks. From about the centre to the Koharsina banks, salt apparently never forms at all. The lake is shallow (about 2' water in the rains) and the bottom is formed of the ordinary salt of nullah beds shewing but very slight traces of salt. The salt formations of the lake appear, generally, to be confined to the centre and northern and eastern banks.

Formation of Lake Salt.

The salt which forms of itself on the bed of the Lake varies in depth and size of crystals with the amount of water above it during the rains. This depth rarely exceeds 9"; an amount which could only be extracted from the silt beneath, and dissolved by about 3' of water. As the dry weather commences, the water becomes supersaturated, and the salt is crystallised accordingly. When the water above it evaporates, the salt gradually assumes a bitter taste, and a red colour is imparted to the water by the occurrence of a very minute red parasitical plant, which is rapidly developed over the crystals, and tinges the whole surface of the lake. When the water has entirely disappeared the salt frequently loses its crystalline form and pink colour, and becomes 'rae' or bitter. It does not change its chemical character however.

Working of Salt.

When the salt which crystallises naturally is worked, the process is simple enough. It is broken up and carried to the banks precisely in the manner that ice is collected from ponds for the London market. It is made up into heaps on the bank by which means it becomes broken and dirty (curiously enough, this process secures a slightly higher price for it than clean salt would fetch) and is sold on the spot to itinerant merchants from Delhi and elsewhere at 10 annas per maund.

Salt Pans.

By far the greatest amount of salt prepared for the market is made in salt pans, which are formed year after year in exactly the same part of the Lake, their size varies indefinitely. They are usually sunk about 20" below the surface of the lake mud and smoothed flat, a well is dug conveniently near to such a depth as to secure about 3' of water. The water thus obtained is beautifully clear, but contains less salt in solution than the lake water above. It is run into the salt pans by means of a basket swung between two men. In about seven days the salt crystallises and is taken out, so that one salt pan can be worked about four times a month. It is said that the fourth time, the salt so collected is inferior both in quality and quantity which seems to prove that the salt exists in the silt, and not beneath it; and that it is gradually exhausted by repeated washings. These salt pans are of course washed over during the rainy season and work suspended.

The following are a few statistics about the salt works:—

Statistics.

After four days evaporation in a salt pan about $\frac{3}{4}$" salt is deposited gradually increasing to about 1.5" which is about the greatest depth of salt ever formed in a salt pan. By making use of the surface water of the lake the salt is deposited much more rapidly and is frequently ready for working in four or five days. The whole extent of land occupied by salt pans is about two square miles, but they are very much scattered.

Salt pans covering about one bigah of land or about 130' × 130' turn out about 90 bullock loads, which would amount to 225 maunds with the ordinary weight of a bullock load. The salt as sold at Hanwah or Goodha fetches from 8 annas to 10 annas per maund; a duty of three rupees per maund is paid at Harasin before it reaches the Delhi market. The salt workers receive pay by the amount of salt they collect in a day. Their usual daily wages bring about 15 annas. The revenue derived from the salt works of Hanwah and Goodha varies from 1 to 2 lakhs per

annum according to the length of the working season. The whole of this belongs to Jodhpoor half the revenue derived from the Sambar salt works belong to Jeypoor. This is estimated at from 4 to 5 lakhs per annum.

Chemical analysis of salt &c.

An analysis of the salt, earth water, &c., of the lake gives the following results :—

Specimen No. 1.—White semi-crystalline substance called 'Rae.'

Composition Na. Cl. or Chloride of Sodium with a trace of Chloride of Magnesium as impurity.

No. 2.—Salt in complete crystals from the centre of the lake.

Composition precisely as above.

No. 3.—A lump of mud from the bed of the lake thickly interspersed with small pink crystals. On being heated with water lost 29 per cent of its weight, which being tested proved to be Na. Cl. The residue consists of 60 per cent earthy matter, and 11 per cent earths, of which the greater proportion is (Cao. Po. 5.) Phosphate of lime.

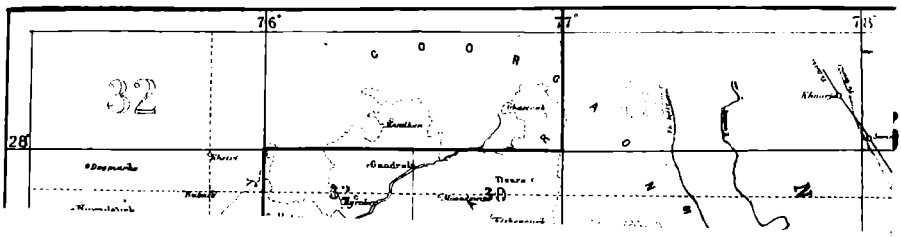
No. 4.—Surface water from the lake spec. grav. 1.351, colour pink.

In 1000 grains 297 consist of Na. Cl. The coloring matter being highly concentrated and tested as a mineral substance, gave no result whatever.

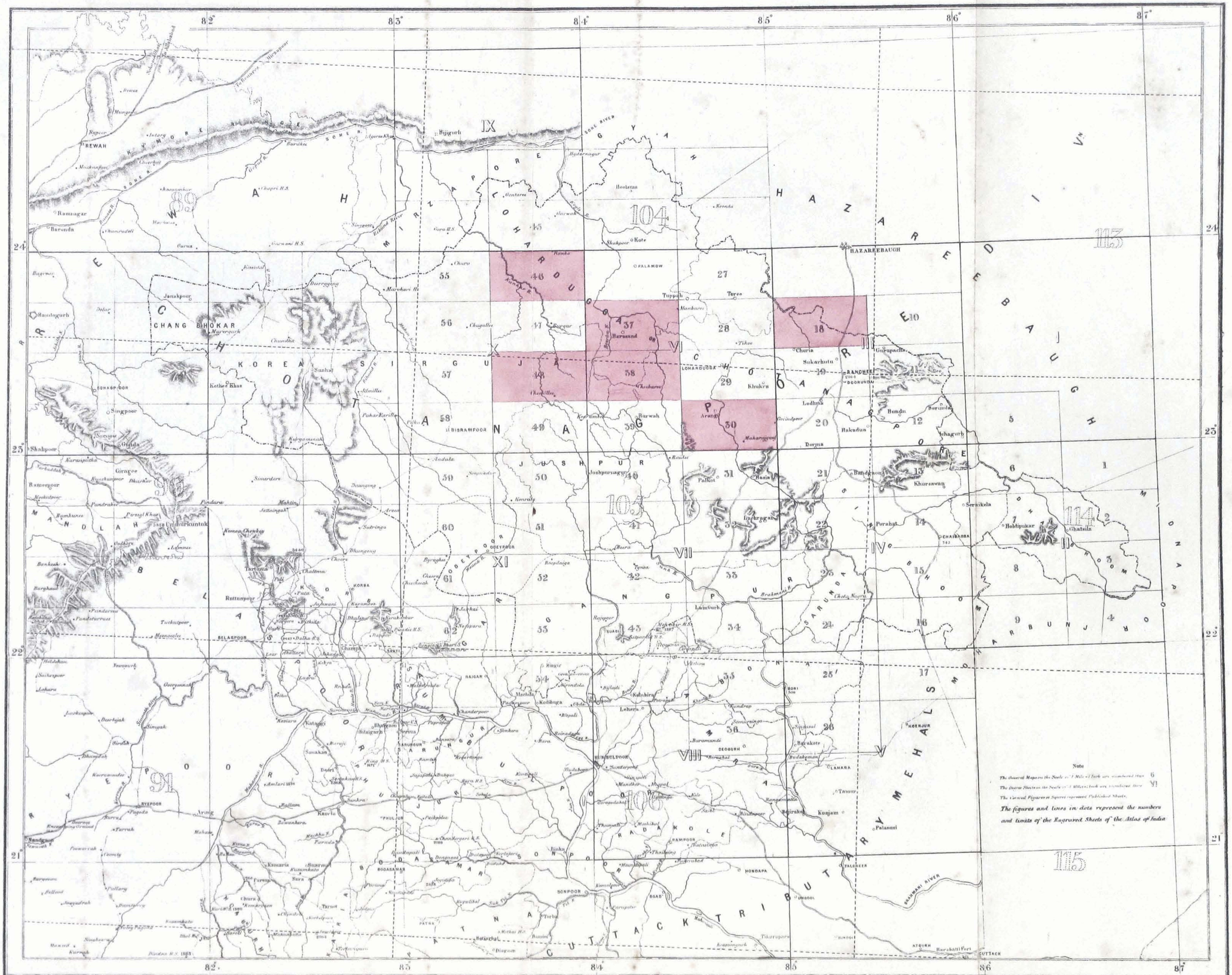
T. H. HOLDICH—*Lieut. R. E.,*

Military Assistant Rajpootana Survey.

INDEX TO THE SHEETS OF THE GWALIOR AND CENTRA

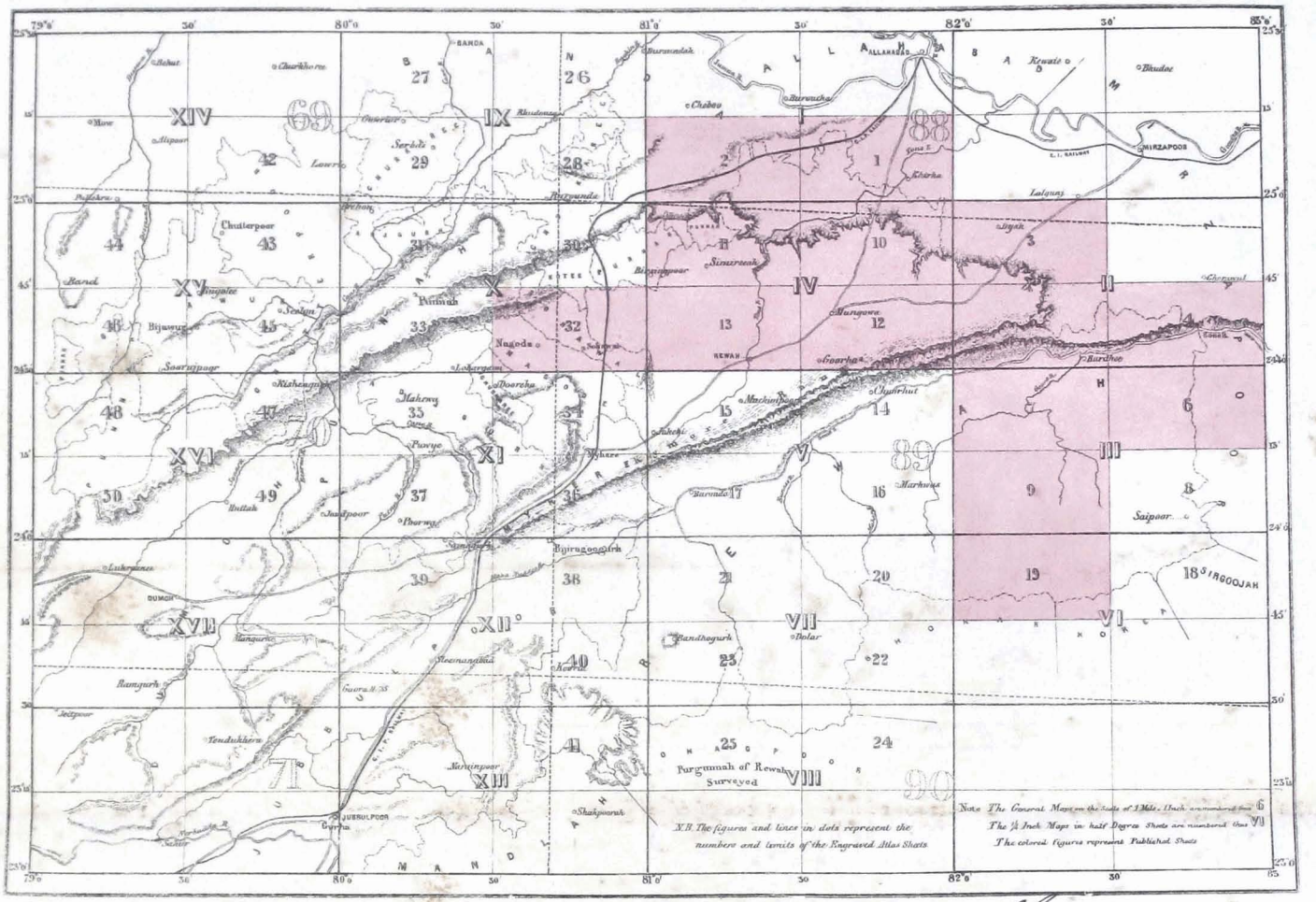


INDEX TO THE SHEETS OF THE CHOTA NAGPORE DIV^N SURVEY.



Photozinco. at the Surveyor General's Office, Calcutta,
January 1868.

INDEX TO THE SHEETS OF THE REWAH SURVEY.



Surveyor General of India.

Photolithographed by Captain A. R. Melville, at the Surveyor General's Office, and published under the direction of Colonel H. L. Thuillier, F.R.G.S. Surveyor General of India.
Calcutta. September 1857.