21

GENERAL REPORT

ON THE

Topographical Surveys of India,

AND OF THE

SURVEYOR GENERAL'S DEPARTMENT,

FOR SEASON

1871-72.

BY

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SUBMITTED TO THE GOVERNMENT OF INDIA, DEPARTMENT OF AGRICULTURE, REVENUE, AND COMMERCE.

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GENERAL REPORT

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Topographical Surveys of India,

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FOR SEASON

1871-72.

No. 154 B, dated Calcutta, 15th January 1873.

Introductory.

The general results of the operations of the Topographical Surveys of India, for the professional season of 1871-72, *viz.*, from 1st October 1871 to 30th September 1872, and the progress of work in the several branches of my head-quarters office, for the year ending 31st December 1872, are described as usual in the following report submitted in continuation of my general report, No. 150 B, dated 24th January 1872.

2. The frequency of these reviews of a single operation or description of surveys, carried on year after year on the same principles and with the same officers and men, over vast tracts of territory, which of necessity must occupy a long course of years in the completion, naturally entails much sameness of details and repetition of explanations, for which allowance must be made in the perusal of the history of a department so constantly describing its own proceedings and results. The professional and other details are more given as a necessary and useful record of departmental events, which from thus being strung together and printed annually, may hereafter be found and referred to, with greater certainty and convenience.

Surveys in progress.

3. The number of the Topographical Surveys under my direction has, by the resuscitation of No. 2 Party for Khandesh and Bombay Native States, been again raised to seven, as originally constituted prior to 1870; the prosecution of each field of survey has been carried systematically on towards filling up each degree of blank country in the respective divisions, so as to provide for each sheet of the Indian Atlas in due order. The several executive officers have again pursued their laborious course with equal advantage and success, and were, during the season under review, thus employed:—

No. 1.—Under Lieutenant T. H. Holdich, R. E., Assistant Superintendent Officiating in charge, in portions of the Native States of Gwalior, Holkar's Territory, Kotah, Tonk, Jhalawar and Kurwai, within the limits of the Indore and Rajputana Agencies;

No. 2.—Under F. B. Girdlestone, Esquire, Officiating Deputy Superintendent in Khandesh (Bombay Presidency), and the Native States lying between the Nerbudda and Taptee Rivers of Burwani, Dhar, Holkar and outlying portions of Sindiah's Territory in the Rajputana Agency embracing a continuation of the Sathpura Range, and the completed Surveys of the Central Provinces;

No. 3.—Under Colonel G. H. Saxton, Deputy Superintendent, in portion of Bustar Dependency of the South-Eastern portion of the Central Provinces, and in Jeypur, Panchpenta, Madgul and Vizianagram, in the Vizagapatam Agency of the Madras Presidency;

No. 4.—Under Major G. C. Depree, Deputy Superintendent, in the northern zemindarees of district Belaspur and district Mandlah in the Central Provinces, and in Tolooka Sohagpur of the Rewah State, in continuation of former work in the Chota Nagpur Province.

No. 5.—Under Captain R. V. Riddell, R. E., in Bhopal and Malwa, including portions of Gwalior, Kurwai, Mohamedgurh, Nawab, Basoda, and Pathari in the Indore Agency, in succession to the completed areas in Bundelkund and the Revenue Survey of the Saugor District;

No. 6.—Under Captain W. F. Badgley, Officiating Deputy Superintendent, in the South Cachar, Lushai and Munnipur Hills on the Eastern Frontier of Bengal, advancing under protection of the military expedition, to obtain geographical knowledge of the hitherto unknown territory outside the British districts of Cachar, Sylhet, Tipperah and Chittagong, occupied by various tribes not amenable to British rule;

No. 7.—Under Captain George Strahan, R. E., Deputy Superintendent, in the states of Jodhpur and Udeypur, and the district of Ajmere and Mhairwara within the Rajputana Agency. Also the large scale survey of the Sanitarium of Simla during the recess months.

4. These Surveys thus occupy every variety of ground extending from the extreme eastern limit beyond actual British possessions in Bengal, in about the meridian of 93° east longitude, to the eastern frontier of the Bombay Presidency, in about 74° east longitude, or from Munnipur territory on the east, to Dhoolia and the Western Ghats of Bombay on the west, and down nearly to the Godavery on the parallel of 18° north latitude on the south, the distance between the most eastern and western surveys being nearly 1,300 miles in a direct line.

5. As these surveys progress, the ground to be taken up becomes more insalubrious and difficult of access and occupation, both by reason of physical obstacles, bad climate, and bad water. Without exception almost, the ground now occupied by each party is very wild, much of it altogether uninhabited, and in many parts very hostile to health from malaria. While some parties cannot obtain, except from long distances, water fit for human drink, others have to carry about provisions, even the commonest necessaries of life, throughout the field season, which renders carriage difficult and expensive. In the hills inhabited by Gonds skirting the northern frontier of the Central Provinces, again within the Sathpura Hills, west of British Nimar, and also in the Bheel Country south and west of Ajmere and Mhairwara, even guides are not easily procured and the uncivilised inhabitants whose hamlets are occasionally found within the jungles, fly at the approach of strangers, and will afford no information when surprised and questioned.

6. These are but a few of the difficulties and obstacles which affect cost and progress, and have yearly to be contended against and overcome by the Topographical Surveyors now exploring and surveying in detail, the vast tracts still remaining which have never before come under the regular operations of the Survey Department, or indeed of any survey at all, but all and every corner of which must be penetrated and defined. Yet steadily a marked impression is being made in laying down the features of the country towards completing the first survey of all India, and an area of from 16,000 to 18,000 square miles on an average, is annually mapped by this one branch of the department.

Season's total out-turn of final topography.

7. The area of final survey completed during the season under review is the outturn of only six surveys, as the small nucleus of No. 2 Party could do no more than break ground in Khandesh by laying out the skeleton triangulation in advance, as previously reported, and no detail survey could be attempted. The topography actually obtained represents an area of 17,910 square miles, of which 13,110 square miles are on the inch to the mile scale, or $\frac{1}{63,360}$ of nature, as usual for the regular surveys in the ordinary divisions. Also 4,800 square miles on and beyond the eastern frontier of Bengal on the geographical scale of 4 miles to the inch or $\frac{1}{253,440}$ of nature, which being special, and in no way adapted or required for the former scale, partakes necessarily of the character of a rapid military reconnoissance having been conducted under very exceptional circumstances during the rapid advance of a military force into a hostile country, and achieved only under the protection of a large military force.

Triangulation completed in advance of detail survey.

8. The triangulation extended in advance for the ensuing or current, and future season's detail survey, covers an area of 16,336 square miles in addition to that represented in the previous paragraph; the basis for future topography is, therefore, very well provided for, as so essential for the correct conduct of the operations. This area of the skeleton work performed, although less than that of 1870-71, is considerably in excess of the out-turn of 1869-70.

Total cost of the season's operations.

9. The total cost at which these general results have been obtained amounts, under all heads both of permanent establishments and contingent charges, to Rs. 3,71,616, in the aggregate, as specified under each party, this includes the cost of triangulation in advance and the exceptional charges for the re-equipment of No. 2 survey in tents, tools, stores of various kinds, and railway and conveyance charges of the establishment (European and Native).

Average cost of final survey.

10. The average rate or cost per square mile of topography completed, and mapping rendered by the executives, is for the season Rs. 20-10, or in English money £ 2-1-3 per square mile, which contrasts favorably with the mean rates of the two previous seasons.

Statement of general results.

11. The following statement exhibits the amount and professional nature of the work performed and the actual cost of each survey :—

Designation of Survey.	Final Topography completed in square miles.	Triangulation completed in square miles.	Stations observed at.	Number of points fixed.	Square miles to each point.	Heights trigonometrically determined.	Square miles to each height.	Amount of fair map-prior rendered.	Total cost.	Remarks.
No. 1 Survey,—Gwalior and Central India, ...	2,780	4,200	78	430	0·0	334	12·0	2,090	54,527	
No. 2 Survey,—Khandesh and Bombay Native States ...	...	4,940	137	831	5·0	589	8·4	None.*	37,067	* Triangulation only.
No. 3 Survey,—Central Provinces and Vizagapatam Agency ...	2,003	...	42†	109†	...	99†	...	2,003	62,015	†Points interpolated in the triangulation of the previous seasons.
No. 4 Survey,—North-Eastern Division, Central Provinces ...	2,591	2,100	40	272	8·0	160	12·7	2,591	52,037	Ground very difficult, covered with hills and forest.
No. 5 Survey,—Bhopal and Malwa	3,124	...	...	...	...	...	...	3,124	58,156	No triangulation performed.
No. 6 Survey,—Khasia and Garo Hills, south Cachar and Lushai Hills	4,800‡	2,156	16	116	18·6	65	33·2	4,800	47,073	‡ Military reconnoissance on scale 4 miles=1 inch, also 191 miles of route survey in the Lushai Hills on scale 1 mile = 1 inch.
No. 7 Survey,—Rajputana ...	2,612	2,940	...	...	...	145	20·0	1,890	58,641	31 miles of traverse survey and triangulation for Simla special survey.—17 miles of traverse for the Sambhur Lake survey and triangulation round Delhi.
Total ..	17,910	16,336	333	1,707	..	1,398	...	17,398	3,71,610	Average rate or cost for final survey, Rs. 20—10 per square mile.

Remarks on general results.

12. The general results are good, showing for a slightly increased outlay an increase of area brought under final survey during the season of 3,318 square miles above that obtained during 1870-71, whilst the rate or cost per square mile has been materially decreased.

Comparison of results of 1870-71 *with* 1871-72.

	Final topography.	Triangulation in advance.	Cost.	Average mileage rate.	
	Square miles.	Square miles.	Rs.	Rs.	A.
Season 1870-71 ...	14,592	20,742	3,24,225	24	4
„ 1871-72 ...	17,910	16,336	3,71,616	20	10
Difference ...	+3,318	—4,406	+47,391	—3	10

13. The decrease in the area triangulated in advance of detail survey is, owing to Nos. 3 and 5 parties having obtained a sufficiency of such points during previous seasons for the plane table operations of nearly the next two years. It is injudicious to extend the triangulation too much in advance of details, because the marks and poles are frequently removed or destroyed by the people of the country, are blown down during the monsoon months, or are obscured by the rapid growth of underwood and jungle, so that, all the labor and cost of clearing sites and erecting marks would have to be incurred a second time.

14. With reference to the area triangulated, the number of points fixed and elevations determined, the results contrast favorably with those of the previous season as shown in the comparative statement.

	1870-71.	1871-72.	Remarks.
Number of stations observed at	459	313*	* No data given by No. 7, Rajputana Survey.
Points fixed Trigonometrically	1,850	1,787*	Interpolated points included in the return of No. 3 Central Provinces and Vizagapatam Agency Survey.
Heights determined Trigonometrically	1,216	1,398	Points of Naga Hills triangulation included in the return of No. 6, Khasia and Garo Hills Survey.

15. To obtain the required standard number of one fixed point and elevation within every 10 square miles of area, is undoubtedly difficult in forest-covered hilly ground, and it can only be secured under certain circumstances at a somewhat enhanced mileage cost, but I consider it of the utmost importance to uphold and enforce rigidly, every measure on which depends the system of topographical surveying with the plane table, and the accurate delineation of the features of the ground, and it affords me much satisfaction to state that the most strenuous exertions are made by the several executives in charge of parties, to arrive at, and maintain a high order of professional accuracy, as their maps and data rendered amply testify.

Nature of test applied to the season's outturn of final survey.

16. A rigorous system of check is now applied in each survey by test-lines or traversing, run through every plane table, and several hundred linear miles of chain or perambulator measurements, where practicable, have been made in addition to examination in *situ* or from fixed commanding points by means of intersections. Every executive in charge of a party is required to report before leaving the field of survey, that all the plane tabling has been duly examined and tested on the ground, and without this no season's work is considered complete.

Professional results.

17. The results and value of the season's triangulation and the plane table stations or fixings per square mile on which the accuracy of the delineation of the ground depends, are given in the following tabular statement:—

Surveys.	Number of Triangles.				Triangular Error in Seconds.		Mean Difference in Common Sides in Inches per Mile.				Average plane table fixings in each square mile of survey.	Remarks.
	1st Class.	2nd Class.	3rd Class.	4th Class.	1st Class.	2nd Class.	1st Class.	2nd Class.	2rd Class.	4th Class.		
								Inches.				
No. 1 ...	...	155	40	728	...	5·0″	...	2·02	2·49	0·40	10·5	
„ 2 ...	8	242	211	1,132	3·0″	12·9	...	6·20	11·00	20·30	..*	* No topography for the season, party reorganised.
„ 3 ...	...	250	...	...	...	17·1	...	6·00	...	...	4·7	
„ 4 ...	...	31	50	388	...	4·3	...	1·74	25·00	25·20	7·0	145 linear miles of check traversing.
„ 5 ...	...	...	...	...	...	...	...	...	...	...	0·0	
„ 6 ...	...	...	27	63	...	8·5	...	...	11·75	48·00†	..‡	† Distant peaks without marks. ‡ Military reconnoissance on scale 4 inches=1 mile
„ 7 ...	...	57	...	398	...	2·7	...	1·75	...	6·58	8·5	

18. These results are most satisfactory, and prove that every possible care has been taken to uphold the general value and accuracy of the operations on which the topographical work depends. The lowest average number of plane table fixings appears in No. 3 survey, but the ground is a mass of forest-covered hills, and beyond doubt the most difficult to deal with allotted to any survey.

Remarks on the season's fair maps.

19. The actual area represented on the standard 1 inch scale sheets or sections of 15 minutes of latitude by 30 minutes of longitude, is about 17,398 square miles, contained in 41 sheets of double elephant size paper. All these have been carefully examined and the greater number have been already reproduced to scale and printed by the photozincographic process, and are under issue to various Government departments and officials. The whole series of the past season's work very recently received in this office, will be thus published before this report can be printed.

20. The area surveyed and mapped as above described, being all closely based on the Great Triangulation, furnishes valuable geographical materials for the Indian Atlas Sheets, which it is so important to fill up as follows:—

Nos. 1-5 & 7 Surveys.—In Sindiah's and Holkar's territory, Bhopal, Jodhpur, Udepur, Kota, Tonk and some of the smaller or petty states interlaced. Ajmero and Mhairwara; all within the Indore and Rajputana Political Agencies. } For portions of Atlas Sheets 34, 51, 52 and 53.

No. 3 Survey.—In the dependency of Bustar (Central Provinces) and in Jeypur, Vizianagram, Madgul and Panchpenta in the Vizagapatam Agency of the Madras Presidency. } For portions of Atlas Sheet 93.

No. 4 SURVEY.—In the zemindarees situated within the northern portion of District Belaspur, Central Provinces, and in Taluka Sohagpur of the Rewah State. } For portion of Atlas Sheet 90.

No. 6 SURVEY.—In the South Cachar Hills, Munipur State and Lushai Hills on the Eastern Frontier of Bengal. } For portions of Atlas Sheets 131 and 132.

21. Fully two-thirds of these geographical materials have been reduced to the $\frac{1}{4}$ inch or 4 miles=1 inch scale, and fair drawn on Atlas Sheets in outline for engraving, and a considerable portion is already on copper in various stages; a result which, for a second time, it affords me the greatest gratification to report for the information of Government, for nothing can more clearly illustrate one of the great advantages secured by the transfer of the engraving of the Indian Atlas Sheets to India, and the means it affords us of pushing on with the final publication of the several surveys as annually produced.

22. In fact the due and proper prosecution in this country, under competent management of the engraving which has for so many years languished in England without the necessary agency or superintendence for its systematic and continuous conduct, will, I believe, do more for the utilisation of the survey results, and for the economical working of the Department, by saving many of the numerous preliminary lithographed issues, which we have always been obliged to make, than any other measure. The details connected with the engraving branch which follow, will explain this more fully.

Relative value of Fair Maps.

23. There is a marked improvement generally in the style and execution of the 1 inch standard maps of the season, most of them are exceedingly well drawn, and highly creditable productions, the most meritorious draftsmen being distinguished by name. Relatively the following opinion has been formed.

No. 1 *Gwalior and Central India Survey.*—All the sheets are well finished, and the ground is effectively delineated. A few of the sheets failed to reproduce clearly by photozinco-carbon transfer, owing to the extreme fineness of the lines (pen work) used in expressing subordinate features and undulating ground. The best sheets are by Messrs. Bolst and Cornelius.

No. 3 *Survey, Central Provinces and Vizagapatam Agency.*—The extremely complicated difficult nature of the ground is well expressed. The writing of names and general finish defective. Most of the maps have reproduced fairly. Those by Mr. May are fair specimens of hill delineation.

No. 4 *Survey, North-Eastern Division, Central Provinces.*—The sheets are well finished, shewing much improvement, and the drawing generally is clear and bold, although somewhat stiff and conventional in style. With the exception of one sheet in which ravines, undulations and the lower slopes of the hills were expressed in very fine lines, and in pale ink, all have reproduced well. Mr. J. H. Wilson's drawing is clear and effective.

No. 5 *Survey, Bhopal and Malwa.*—Very clear, effective and bold drawing; some of the hill ranges appear to be rather heavily expressed, considering their low elevation above the general level of the country. All the sheets have reproduced clearly and well, especially those by Captains Riddell and Wilmer, which are very good specimens.

No. 6 *Survey, Lushai and South Cachar Hills.*—(Scale 4 miles=1 inch) ground well and clearly expressed by Mr. Robert for the small scale. The sheets have reproduced very clearly.

No. 7 *Survey Rajputana.*—Delineation of ground good and effective, all the sheets are carefully executed and have reproduced well. Those by Messrs. Todd and McNair are the best. The sheets of the larger scale (24 inches=1 mile) Simla survey, are very clearly and beautifully drawn by Captain George Strahan, and have reproduced well. Others by Mr. Stotesbury are also good specimens. These sheets are under reproduction as well as reduction on two-thirds the scale (16 inches=1 mile) of the original drawings.

Extracts from the Narrative reports of executives.

24. Valuable and interesting geographical, historical and traditionary notes, with remarks on the people, their manners and customs in various portions of the country brought under survey, extracted from the narrative professional reports of executives, are given in Appendix A.

25. During the season under review the combined area completed by topographical and revenue surveys, and the aggregate cost and mileage rate for final survey are given in the following table.

Combined results of Topographical and Revenue Surveys.

	Area completed, Square miles.	Total cost.	Average rate of survey per square mile.	Remarks.
		Rs.	Rs. A.	
UPPER CIRCLE, Punjab and North-West Provinces	8,057	4,27,547	53—1	This includes the cadastral or "field survey" in the North West Provinces, area 807 square miles or 574,063 acres, on 16 inches=1 mile.
LOWER CIRCLE, Bengal, Central Provinces and Bombay	10,087	4,04,596	46—1	
REVENUE SURVEY Total ...	18,144	8,92,143	49—3	{ 4,873 villages. 1,109 blocks and grants, &c., 18 river circuits.
TOPOGRAPHICAL SURVEY Total ..	17,910	3,71,616	20—10	
GRAND TOTAL ..	36,054	12,63,759	35—1	General average rate for topographical and revenue surveys combined, equal in English money to £3-10-1½d.

26. In the Revenue Survey, Upper Circle, (North-West Provinces) is included the cadastral or "field" survey on 16 inches =1 mile: 801 villages giving an area of 574,063 acres were surveyed on this system at a cost of 5 annas or 7½ pence per acre. Excluding the cadastral or "field" survey operations which are special, and in no way comparable with the ordinary village revenue survey on 4 inches =1 mile, the results of the revenue surveys are as shown in the margin.

	Area completed, square miles.	Total cost.	Average rate per square mile.
		Rs.	Rs. A.
Upper Circle	7,160	2,44,161	34 2
Lower „	10,087	4,64,596	46 1
TOTAL ...	17,247	7,08,757	41 2

27. The operations of the Revenue Survey Branch are separately reported on in full detail for the information of Government, by the Superintendents respectively in charge of the Upper and Lower circles. The general results are given here in combination with those of the topographical operations, to place before Government a brief but complete resumé of all the work under my general control.

Colonel J. E. Gastrell, Upper.
„ D. C. Vanrenen, Lower.

28. The total area accomplished by the sixteen parties of the Revenue Surveys (18,144 square miles) is in excess of the out-turn of the previous season, and the average rate of survey per square mile, Rs. 49-3, inclusive of the cost of the 16-inch "field" measurements, is moderate. The average rate for the 4-inch survey only, is Rs. 41-2 per square mile, or Rs. 4 less than the rate of the previous season.

29. The comparison of survey results, such as yearly progress, cost and mileage rates, one season with another, in a country such as India, and with the operations scattered widely apart and conducted under ever-varying conditions in different provinces, native states and districts, merely shews how far one season has been more successful than another. To arrive at any safe or reliable conclusions as regards the absolute comparative value of the work performed, careful consideration of many professional details and of the precise circumstances favoring or retarding progress and the physical aspect of the province or district is necessary. Such details are not given here, but are briefly referred to in the detailed reports on each executive survey party.

Opinion on the comparison of survey results.

30. The combined area accomplished by both topographical and Revenue surveys, *viz.*, 36,054 square miles, is 4,524 square miles in excess of that obtained last year, while the total cost and general average rate of survey are necessarily increased, *first*, in the Topographical Branch by the addition of No. 2 party which has only performed triangulation, thus shewing no completed area for the expenditure incurred, and *second* in the Revenue Branch by the Cadastral operations or "field" survey. With the further expansion of the larger scale Revenue Cadastral Surveys, a proportionate increase in the mileage rate must certainly follow.

31. The area accomplished up to 1871 by the revenue and topographical surveys of later date, almost entirely within the period of my own superintendence, but not including the work in other Presidencies, distinct from my control, nor the operations completed, or in progress, by the

Aggregate results brought up to date.

parties under the Great Trigonometrical Survey, were given in paragraph 23 of the last printed report, and the following statement completes the information up to 1872 :—

	Area completed in square miles.	Total cost.	General average rate of survey per square mile.
		Rs.	Rs.
Total of Topographical and Revenue Surveys up to 1871 ...	6,65,909	1,73,15,790	26 0 0
Ditto ditto ditto for 1872 ...	36,054	12,63,759	35 1 0
GRAND TOTAL UP TO END OF 1872 ...	7,01,963	1,85,79,549	26 7 0

32. It is from this enormous area of completed survey that geographical materials have been reduced, compiled, and furnished for no less than 46½ of the full sized plates of the Indian Atlas, each containing an area of 15,100 square miles. The progress and present state of the Atlas was more particularly described in the last report,* and the additions actually since made to the engraving, will be found under that head.

* Paras. 29 to 33.

33. The experiment of the combined revenue survey and settlement measurements ordered by the Government of India, to be carried out in the Bombay Presidency with the single party referred to in paragraphs 35 and 36 of the last report, employed in the Nassik district, having been fully tried and reported on after the result of an entire season's work, it was determined by the Government of India not to have been sufficiently successful to warrant its continuance on the same principles for another season, and with a second revenue party now deputed to the Ahmednuggur Collectorate.

Revenue Survey Parties in the Bombay Presidency.

34. The views of Government on this highly important question and my own opinions have been given at considerable length, whilst this report is passing through the press, in the letters marginally quoted.

A. R. C. No. 777, dated 13th December 1872.
S. G. No. 801F, dated 12th October 1872.
Do. No. 311, dated 3rd February 1873.

35. This question which involves many serious considerations in a professional point of view, being still under discussion by the Government of India, I have not deemed it necessary to go into further details in this place, than to record that the instructions received from the Government both as to the principles of conducting the surveys, and the change or transfer of districts as per margin, in which they are now ordered to take place, are being vigorously carried out.

Utilisation of Bombay Revenue Survey measurements for geographical maps.

Sholapur, Puna.

36. The new cadastral surveys on the scale of 16 inches to the mile on strictly professional principles, are being extensively carried out in the districts of the North-Western Provinces as referred to in the last report.* The districts in hand are cited in the margin. I anticipate the very best results from these operations both financially and professionally as regards systematic and accurate measurement, with permanent recording of the maps of "fields" and ascertainment of true areas.

Cadastral Surveys.

* Paras. 37 to 39.

Moradabad, Muttra. Hummeerpur, Agra.

37. Eventually I believe they will prove not only invaluable as a correct permanent record of the landed tenures for all purposes of revenue assessment, water-rates, &c., but an immense saving of expense will be effected in the end, by doing away with the constant necessity for partial remeasurements for irrigation canals, railways, roads and other purposes, which are now perpetually being made in an irregular, unsatisfactory and expensive manner for emergent engineering objects. The results of the working of this new system of revenue survey on such large scales, are given in detail in the reports of the Revenue Branch of the Department. Head-quarter offices.

38. Having been called on to submit for the information of the Indian Finance Committee of the House of Commons, a succinct report as to the surveys carried on under the Government of India, the work performed and the cost of the same, a brief statement of all the surveys completed, in progress, and remaining, as well as of the mapping and publishing branches at head quarters, based on the cost for the season 1870-71, with which the sanctioned budget estimates could be compared, was rendered; and as it contains subjects of general interest, it is reprinted in the appendix,* but without its enclosures, which are not essential to its general scope or to a proper understanding of its contents.

Dated 27th December 1872.

* Vide Appendix B.

39. The important duty of preparing the survey results for publication devolves on the Drawing and Geographical Compiling Branch of my head quarters office, under the immediate and able superintendence of Mr. J. O. N. James, Assistant Surveyor General. Three publishing branches* have to be fed or supplied with work from this office, and all requisitions for the preparation of special maps, tracings, or copies of unpublished records and professional data, are also complied with by it.

Cartography.

* 1. Engraving.
2. Lithographic.
3. Photozincographic.

40. During the past year the usual compilation and reduction of geographical materials on various scales, and preparation of manuscript drawings, examination and correction of proofs, &c., has been carried on with increased activity and with great success. The usual details of the work performed are given in Appendix C, but the most important compilations and maps completed and in progress in various stages may be here briefly referred to.

41. Nine new quarter sheets of the Indian Atlas have been compiled and drawn (outlines and names) and delivered to the engravers, and hill drawing completed for five quarter sheets. Quarter Sheets 34 south-east, 34 north-east, 52 north-east and 52 south-east are under compilation. Of the proofs of Atlas Sheets received from the India Office, the engraving of which is to be completed in England, all blanks have been filled up in manuscript drawing on five quarter, and two full* plates, and the proofs have lately been returned to England. The drawings on the proofs of two more quarter plates, and three full plates (70 north-east, 71 north-west, 104, 54, 118) are in progress and will be returned to the India Office as soon as completed; 78 proofs (1st, 2nd, and 3rd) of plates in the engraver's hands have been examined and corrected.

Atlas Sheets.

* 50 and 89 (full plates) very heavy additions. Quarter plates 51 north-west, 70 north-west, 70 south-west, 105 north-west, 105 south-east.

42. The standard map of India, scale 32 miles=1 inch, has been further advanced and completed as far as survey results were available, to enable a photographed reduction to half scale to be made from it. One sheet of the latter map on 64 miles=1 inch is now engraving in outline, and the remaining three will be taken up as means admit, during the current year. It is a very great object to push on with this admirable sized map, which has long been under preparation, as it will supply a very great want long felt. With the skeleton once on copper, many advantages and great facilities will be obtained for bringing out new editions.

General Maps.

43. A new standard map of Bengal (in outline), scale 16 miles=1 inch, as a sister map to that of the Punjab and the North-Western Provinces, has been completed and photozincographed, but the boundaries of districts and divisions, pending their final adjustment have not been inserted. It has been printed in outline only, with the object of obtaining the latest information regarding territorial changes, canals, roads, &c., and, when completed, will be engraved.

44. A new general map of the Eastern Frontier of Bengal, on the scale of 4 miles=1 inch, has been commenced, and fair progress has been made on two sheets; it awaits further explorations now in course of execution, and after the present season's surveys the whole of the Eastern Frontier and Lushai territory it is hoped, will be fairly represented.

45. The Eastern Punjab Section of Sir Henry James' projection of a map of the World (scale 10 miles=1 inch) has been well advanced.

46. The introduction of photozincography, by which all the current standard sheets of the topographical surveys are now published, has left a great desideratum with regard to the maps of old surveys of former days, which being highly colored, and rendered in various styles and forms, are not susceptible of rapid treatment by the above process and have never seen the light. It is therefore an object to provide for this heavy task at head-quarters, and no less than 24 sections of the 1 inch standard maps, each 15 minutes of latitude by 30 minutes of longitude, of the earlier portions of the Rewah and Bundelkund, Chota Nagpur Division and Ganjam and Orissa Topographical Surveys, have been recompiled and redrawn in pen and ink and published: 20 more are in progress and the whole series must be similarly dealt with which will be a work of great labor and time, but the necessity of publishing all surveys is now admittedly so great, that I am anxious to secure the services of the best practical departmental draftsmen who have a knowledge of, and experience in, the difficult art of delineating ground, to go on with this work.

47. The services of Mr. J. O. N. James in the conduct of this branch of the Department, and as my Personal Assistant in all the various duties at head-quarters, call for a very strong expression of my approval and hearty acknowledgments.—Mr. James is a tried officer of 27 years departmental experience, and his knowledge is as varied and extensive, as his labors are indefatigable and cheerfully rendered. The value of this Deputy Superintendent's services cannot be too often or too strongly brought to the notice of superior authority.

48. Great progress has been made in the Engraving Branch during the past year with the plates of the Indian Atlas. Five quarter plates as per margin, have been completed and published as far as survey results were available, making in all 18 quarter plates engraved and published in India up to the end of the year 1872 and the quarter plates 9 south-east, 11 south-west, 33 north-east, 34 north-east, and 86 south-west have been finished but not published within the year; they are now being printed. 124 north-west and 125 north-east have been completed, but need trifling additions and corrections; 2 south-west and 53 south-east have been completed in outline and names. The old full plate, No. 68 containing a large portion of Oudh, has also been completed with the new surveys and the final corrections are in progress.

Engraving.

10 north-west.
11 north-west, north east.
32 south-east, 32 north-east.
Plates not quite full.

49. In addition to the above, 18 quarter plates are in various stages of progress, from outline and writing to hill etching and finishing, and heavy additions are being made to the old full plates of sheets Nos. 73 and 88 from the results of late surveys.

50. Corrections and additions of all the recent improvements in the Town, to the plates of Simm's plan of Calcutta, are also being pushed on to complete it up to date with a view to a new edition being brought out as early as possible. A very useful skeleton map of the Punjab and surrounding country scale 32 miles = 1 inch, to illustrate administration reports has been completed and published, and the outlines of the map of Oudh, scale 16 miles=1 inch, are nearly finished.

51. Details of all the work completed and in progress in the Engraving Branch are given in Appendix D. The European staff was for a considerable portion of the year greatly reduced in strength by sickness, which told much on the work, and I have with much regret to record the death of Mr. M. H. West on the 5th April last, whose place was not filled up for many months afterwards.

Increase of Engraving Staff.

52. A considerable increase has been made to both the European and Native establishment of engravers in accordance with the correspondence* marginally noted, sixteen Native apprentices were entertained from the 2nd September 1872, and are all under instruction and training in the first steps of the art of engraving on copper. One European Engraver (Mr. T. B. Rodger), was with the sanction of the Government of India* entertained in Calcutta on probation from the 20th August 1872, and three new engravers appointed by the Right Hon'ble the Secretary of State, besides one sent out in the place of Mr. West, deceased, joined on the dates specified opposite their names in the margin. Twelve European etchers and engravers were recommended and duly approved and sanctioned by the Government of India, but the number was reduced to three by the Home authorities.

Surveyor General's letters No. 514, dated 12th March 1872, No. 670, dated 9th April 1872.
Financial Department Resolution No. 3139, dated 30th April 1872.
Secretary of State's Despatch No. 19, dated 18th July 1872

* Financial Department order No. 1832, dated 8th August 1872.
† Mr. G. G. Palmer, 6th November 1872, Etcher.
Mr. O. Tarrant; 5th November 1872, Engraver.
Mr. D. Mitchell, 3rd December 1872, Etcher.
„ J. Fulford, 16th December 1872, Engraver.

53. A plate printer* (Mr. Martin,) is shortly expected to replace Mr. Haughton dismissed in September last.

* Appointed by the Secretary of State, vide despatch No. 36, dated India Office, 18th December 1872.

54. The old Native Staff of engravers and apprentices (11 in number) entertained in 1869, have made excellent progress, and are all now employed fully on the plates of the subordinate portions of the Indian Atlas, but they of course still need a considerable amount of aid and European supervision. Their progress in hill etching is very fair and commendable, but this is a most difficult art and needs years of careful study and practice even for Europeans, of whom there are very few proficients indeed, even in England. Yet under Mr. Coard's able tuition and guidance, four of the men give fair hopes of becoming skilful etchers in time, and some very creditable specimens of hill work have been already produced.

Remarks on the progress made by the Native engravers.

55. It will be seen from the statement (Appendix D) that less copper plate printing has been executed this year than in 1871, as with the primary object of saving the wear and tear of the plates, very few copies are pulled from the copper; transfers to stone from the engravings have been taken, and the full number of impressions required were printed from stone, and answer every purpose.

Copper plate printing.

56. The process of steel facing the copper plates to harden them before printing, has been discussed and ordered by the Home authorities to be carried out. The necessary apparatus

has been sent out from England for the purpose, but arrived in a very damaged state. It is now being renewed here, and will shortly be put in operation.

57. Consequent on the dismissal of Mr. Hanghton, plate printer, and his departure for England in September last, as well as the death of the head Native printer, considerable inconvenience has been felt and additional labor has been imposed on the Superintendent of the Engraving Branch, in looking after the details of the plate printing, which require careful and experienced supervision. It affords me great satisfaction to state that Mr. Coard continues well and ably to perform every duty connected with his department, and renders me the highest satisfaction. The European staff have likewise worked well.

Transfer of the copper plates of the Indian atlas from England to India.

58. With reference to the arrangements sanctioning the transfer to India of the engraving of the copper plates of the Indian Atlas under my immediate supervision, the plates as per margin have been received lately from the India Office, and advise of the despatch of the plates marginally* noted has been likewise received, while this report was passing through the press. The possession of the plates in this office, places us in a very advantageous position with respect to the power of revising the sheets by the new surveys received, and enables us to bring out fresh editions from time to time as emergencies arise.

1 N. E., 1 S. E., 8 S. W., 27 (A) N. E., 27 S. E., and 14, 15, 16 and 29 old full size plates, 44 (A) N. W. and S. W., 45 S. W. and N. W., 51 N. E., 69 N. E, N. W and S. W., 70 S. E., and 65, 66, 67 and 102 old full size plates.

* 106, 107, 108, 111, 115 and 116.

59. With the additional European agency now allowed, it is expected that most of the quarter plates reported as in progress will be completed during the year, and that some of the plates of the standard maps of India and Bengal (in outline) will be taken in hand. The new native engravers and apprentices, entertained only in September last, are not likely to be able to take a share in any Atlas Plates for at least another year, but the state of the native agency is most encouraging, and its instruction most carefully provided for.

Lithographic Branch.

60. Owing to the temporary deputation of Captain W. G. Murray, Assistant Surveyor General, to the Archæological Survey from the month of April last, and to the serious illness of that officer after his return to Calcutta from Kashmir in October last, the duties connected with the superintendence of the Lithographic Branch of this office, have been conducted by Captain J. Waterhouse, Assistant Surveyor General, for nearly the whole of the past year in addition to the work which usually devolves on him of the Photographic Department.

61. The heavy demands on this branch for all descriptions of lithographic drawing and printing of Survey and special maps, plans and illustrations for reports, from various departments, continues as usual. In addition to an immense amount of miscellaneous work the following new and important maps from the results of the operations of this department, have been published in excellent style since last report.

Province of Sindh, sheets 1, 2 and 4	Scale 4 miles = 1 inch.
Eastern Bengal sheet 7, 8, 9 and 10	Scale 8 miles = 1 inch.
Burdwan Division	8 miles = 1 inch.
Bhaugulpur Division	8 miles = 1 inch.
Province Sindh (standard Revenue Survey sheets) Nos. 43, 45, 46, 47, 48, 57, 58, 59, 60, 61, 70, 77, 80, 81, 84, 88, 89, 91	1 mile = 1 inch.
Province Oudh (standard Revenue Survey sheets) Nos. 25 and 26 — — — — —	1 mile = 1 inch.
District Lohardugga, Standard Revenue Sheets, 7 8, and 9—	1 mile = 1 inch.
„ Bijnour „ „ „ 5 and 6 —	1 mile 1 = 1 inch.
„ Chanda „ „ „ 2, 3 (a), 3 (c), 7 (a), 15 and 17 — — — — —	1 mile = 1 inch.
Kooch Behar State „ „ . „ 1, 2, 3 and 4	1 mile = 1 inch.

62. Complete details of the nature and value of the work performed are given in Appendix **E**. The improvements in color printing or chromo-lithography have made rapid strides of late, and the sheets of the geological survey may bear comparison with any thing of the same sort executed in England, which reflects great credit on the head printer Mr. Niven and on the Superintendent Mr. Jevezy. The general results are as follows :—

	Subjects or sheets.	Number of copies printed.	Value or selling price.	Remarks.
Province, District and General Maps, Index Maps and Plans	387	28,265	39,360	
Miscellaneous Maps, Plans, Sketches, Tints, Diagrams, &c.	315	1,49,721*	31,309	* Nearly all these were printed for various Government Departments, totally unconnected with this Office.
Total ..	702	1,77,986	70,669	

In addition to the above, 156,135 copies of professional forms, departmental orders and circulars have been printed.

63. Captain W. G. Murray, Assistant Surveyor General, rejoined from his special deputation on the Archæological tour to assist Major General Cunningham on the 21st of October 1872, but owing to his health having completely broken down, he has, I much regret to state been compelled to apply for furlough to Europe* for two years under medical advice. The loss of this experienced officer's services will be much felt, and they will be difficult to replace at the present moment. I have had frequent occasion to record my appreciation of this officer's professional ability, and the hearty and effective aid he has always rendered during the time he has been attached to this office since March 1869. Captain Murray's report of his Archæological pursuits in the Himalayas, now under submission, will, I doubt not, add materially to his reputation as an admirable photographer and keen observer. He took the silver medal prize at the Calcutta photographic exhibition of the present year for a very excellent series of views in Cashmere and Northern India.

* Since obtained furlough to Europe by G. O. No. 113, dated the 5th February 1873.

64. This branch of my head-quarter's office under the able and very energetic superintendence of Captain J. Waterhouse, Assistant Surveyor General, has worked most satisfactorily during the past year. Both the quality and quantity of the out-turn is much improved, and no efforts have been spared to meet the urgent demands for the immediate reproduction and issue of the regular survey and special maps and other subjects for all branches of the public service. At the recent exhibition of the Bengal photographic society, the silver medal for the best series of Indian subjects was awarded to this office for a collection of fine photographs of Indian jewelry, musical instruments, &c., originally prepared for the London International Exhibition of 1872.

Photographic Branch.

65. A detailed report on the working of this branch is given in Appendix F. The general results obtained are as follows :—

	Number of subjects.	Silver prints.	Number of complete copies printed.	Remarks.
Topographical and Revenue Survey Maps and Charts	840	139	34,760	Of the Revenue Survey Maps 3,700 copies were printed from Anastatic transfers.
District and general maps City and Cantonment plans	100	133	16,947	Of District Maps 1,230 copies were printed from Anastatic transfer.
Miscellaneous maps, plans, and diagrams, Proofs zincographic and Anastatic transfers	470	3,028	65,604	Of miscellaneous maps 85 copies were from Anastatic transfers, and 2216 copies from Zincographs.
Total ...	1,428	4,200	1,17,320	

66. Captain Waterhouse has been indefatigable in his endeavours to work out and apply to cartography all the latest improvements and especially the new "photocollotype" process, which promises to become of great importance and advantage, and has fairly succeeded in his efforts as will be seen from the beautiful specimen map of a reduced Atlas Sheet attached to Appendix F. He has had many difficulties to overcome in ascertaining the conditions of successful working in a tropical climate, as well as of obtaining or manufacturing the necessary inks and appliances essential to secure success, but with his usual energy and perseverance, he has by a continued series of experiments and careful study of each step of the process, worked out every detail, and has produced several very beautiful ink prints from the "insoluble gelatine films," on which the original subjects were copied by the photographic process.

New Photocollotype Process.

67. In the description of the process given in Appendix F, Captain Waterhouse has fully detailed the advantages likely to be gained by the adoption of the process in this office for the reproduction of all kinds of subjects, both in line and half tone, and thus replacing in many cases the slow and costly methods of lithography and silver printing for such subjects as are not susceptible of being reproduced by photozincography. By its means the finest and most delicate subjects in *line*, such as manuscript maps or pen and ink drawings, engravings, &c., may be copied with inimitable accuracy, clearness, and sharpness, and will thus yield a *far* more perfect transcript of the original than the comparatively coarse process of photozincography. The most important advantage of this process, however, is the facility it affords for making copies of colored or tinted drawings and also of ordinary photographs from nature. Such subjects cannot be reproduced successfully by photozincography, and therefore must either be lithographed or photographed in the ordinary manner, both of which methods involve a loss of time, and an expense which in many cases is quite prohibitory, but this application of the process will enable the Photographic Office to supply any demands for photographs to illustrate reports or any other purpose, with the utmost rapidity and at the smallest possible cost. The process also offers extraordinary facilities for color printing, but the development of this application must be postponed until perfect success is attained in the general working.

68. A very excellent collection of engravings, photographs, photozincographs, lithographs and chromos, has been made under Captain Waterhouse's superintendence for transmission to the Vienna Exhibition, which, it is hoped, will uphold the credit and reputation of the department.

69. Captain Waterhouse's services are most valuable to this Department in every way, and I desire to bring the same prominently to the notice of the Government of India as meriting every commendation and suitable improvement in his grading or Departmental position, for which he will be specially recommended. It would be impossible to find a more able and zealous coadjutor, or an officer more deserving.

70. Regular quarterly despatches of all maps, plans, and charts published by this Department have been made to the India Office, London, to the extent specified in the margin. These maps comprise the results of all the imperial surveys of India in the Topographical, Revenue and Trigonometrical Branches on every scale onwhich they are published. Of all the large scale plans and maps, from 10 to 30 copies are usually sent to the India Office, while of general maps, on various geographical scales, a larger number are forwarded in the belief that maps suited to purposes of general reference will be more useful and better appreciated in England than the special ones on large scales.

Despatch of maps to the India Office.

9th January 1872,	1,650	complete	maps, charts, &c.
4th April ,,	2,440	do.	do.
1st July ,,	1,160	do.	do.
4th October ,,	2,200	do.	do.
TOTAL	7,450	maps, plans, charts, &c.	

71. As the cost and labor of coloring, more especially the large scale maps and plans, is very great, it is very desirable that some expression of opinion should be obtained from the India Office as to whether any demand exists for these publications on large scales in England, and whether they are easily provided with convenient space at the Geographical Department of the India Office, and are accessible to the public, otherwise it may be advisable to reduce the number of copies of each description at present despatched. This point will be ascertained for future guidance.

72. During the year (1872) the issue of maps to Government officials and sales to the public through the several agents, as detailed in the following statement, show an increased demand for the publications of the Survey Department :—

Sale and issue of maps in India.

	Number of maps.	Value or selling price.	
		Rs.	
To Government officials issued on service	25,890	43,421	In 1871 the total number of maps issued and sold was 29,970, and the money value was Rs. 52,536, exclusive of those sent to the Superintendents of Revenue Survey Office.
To Geographical Department, India Office, London ...	7,450	11,460	
To Agents for sale to the public and issue to Government officials	4,017	7,837	
TOTAL ...	37,357*	62,718	* This does not include the special maps printed for Local Governments and various Departments issued from the Lithographic and Photozincographic Branches.

73. The correspondence and business connected with this growing duty of supplying maps gratis on the public service is very severe, entailing an amount of work and an expense for mounting, binding, coloring, and postage which this office is no longer equal to cope with, or to provide the funds from the Departmental Budget for gratuitous issue to such an extent. The cost of binding and mounting maps supplied *ad libitum* to every Government official, who newly takes charge of an appointment, has now risen to a very considerable sum monthly, and it becomes a question whether, under the existing financial system of every department paying for its own wants, this office ought to bear such heavy collateral expenses in addition to giving away its own maps. The whole system of the issue of maps gratis requires consideration, and proposals will be made for relieving this office of the entire duty and transferring it to the agents.

74. The cash account connected with map sales up to the 31st December 1872 is given with appendix C. The total sum paid into the Treasury during the year amounts to Rs. 11,324-3-7, and a further sum of about Rs. 4,000 is still due by map sales agents in different parts of the country, which, as soon as realised, will also be deposited in the Treasury. In accordance with the instructions of the Comptroller General of Accounts, no cash balances of any kind are now kept at credit of this office in the Bank of Bengal; and for all sums of money paid into the Treasury on Government account, the receipts are at once forwarded to the Comptroller General, and the transactionsare thus closed.

75. The above forms a brief but imperfect general review of the various transactions in the administrative offices, and I proceed now to describe in detail, what has been performed by the Executive Establishments in the Field.

EXECUTIVE ESTABLISHMENTS.

No. 1.—TOPOGRAPHICAL SURVEY.

GWALIOR AND CENTRAL INDIA.

76. Captain Charles Strahan, R. E. Deputy Superintendent, in charge of No. 1 Survey having obtained furlough to Europe by G. O. G. G. No. 983, dated the 4th November 1871, delivered over charge of the party, of the strength as per margin, to Lieutenant Holdich, R. E., Assistant Superintendent, on the 3rd of November 1871, who conducted it from Mussoorie into the field. The operations of the season (1871-72) lay in the blocks of Degrees Nos. 8 and 9 within portions of the Native States marginally named; the triangulation in advance was carried over the Square Degree No. 10, chiefly consisting of Jhalra Patan and Tonk, Rajputana Agency States, defined by the meridians 76° to 77°, Latitude 24° to 25°, and the topographical detail over the country within Longitude 77° and 77° 30′, Latitude 24° and 25°, with a small detached area east from Longitude 78° and extending to the Betwa River, or up to the Longitude 78° 15′ nearly.

Portions of Gwalior (Sindiah's territory), with interspersed portions of Holkar, Kotah, Touk, Jhalwar, and Kurwai Native States.

STRENGTH OF PARTY.	Field work executed in square miles.	
	Topography.	Triangulation.
Captain Charles Strahan, R. E., Deputy Superintendent, 3rd grade, on furlough to Europe, from the 3rd December 1871.		
Lieutenant T. H. Holdich, R. E., Assistant Superintendent, 1st grade, officiating in charge ...	61	2,040
Mr. J. H. Bolst, Surveyor, 2nd grade ...	63	2,160
„ R. D. Farrell, ditto 4th „ ...	271	
„ C. A. Scanlan, Asst. Surveyor, 1st „ ...	300	
„ G. K. Allnutt, ditto 3rd „ ...	337	
„ S. D. Ryan, ditto 3rd „ ...	270	
„ W. J. Cornelius, ditto 4th „ ...	395	
„ C. T. Templeton, ditto 4th „ ...	218	
SUB-SURVEYORS.		
Joala Pershad	304	
Abdul Samad Khan	254	
Abdul Sobhan	60	
Churamun Lall	150	
Abdul Guffur	97	
Total Square Miles ...	2,780	

77. The total out-turn for the season, as made up by the several assistants, is exceedingly good, amounting to 2,780 square miles of final topography, with triangulation in advance of details of 4,200 square miles.

Remarks on the country finally surveyed.

78. The eastern portion of the area brought under final surveys embraced the left bank of the Betwa River in the Mangouli Soubahdaree to the extreme limits of the assigned division for surveys on the parallel of 24° near Sironj, and is described by Lieutenant Holdich (*vide* extracts in Appendix) as an intricate forest-covered country: the remainder, or main block of topography accomplished, was along the Agra and Indore Road around Goonah in the District or Soubah of Bajraugarh through difficult ground; on the north, or towards the head of the Kunn Valley, the ground is covered by a mass of precipitous scarped hills overgrown with heavy scrub jungle, while to the south and westward the country slopes away to the Parbati River, and is overgrown with grass and heavy forest, in which water is scarce, and the population reduced to a minimum by constantly recurring famines. Both the square degrees above specified have thus been well completed up to margins.

79. Thus, from the commencement of the Gwalior Survey in 1860-61, no less than eight square degrees of country have been completed, extending from the parallel of 28° to the parallel of 24°, and confined by the British districts of the North-West Provinces on the east and the meridian of 76° on the west, comprising about 32,000 square miles. The chief portion of Sindiah's territory has been accomplished, and the 1 inch maps published. For this purpose all the old sheets of the earlier seasons' survey rendered in color and brush shading, had to be redrawn at head-quarters for reproduction by the photozinco process, and I am happy to say the whole of these arrears have been cleared off and the entire series of maps issued in a uniform style. There are still some interlaced and detached portions of the Soubahs, as per margin, remaining to be taken up, which will fall within the Bhopal Agency survey, whilst the Gwalior Party will now meet more with the Rajputana States lying within the limits before described.

Mundisore, Augur, Oogein, and Mangouli.

80. Interesting and valuable notes, descriptive of the country through which the season's operations extended, by Lieutenant Holdich and Messrs. Bolst and Scanlan, are given in the Appendix.

Professional results obtained.

81. By the season's triangulation 439 positions were fixed and 334 heights determined by observations at 78 stations; the average linear error for sides of secondary and minor triangles being 2·7 inches per mile, and for sides of intersected points 6·5 inches per mile. It is satisfactory to find that the average number of plane table fixings for the detail topography was 10·5 per square mile.

Cost of the season's operations.

82. The total cost of the season's operations, including all charges for establishments and contingencies, both for field and recess work, amounts to Rs. 54,527.

Opinion.

83. Great credit is due to Lieutenant Holdich for the very satisfactory manner in which he has conducted the duties entrusted to him, during this first year of his charge. The delineation of his topography appears to have been well maintained in the hilly, rugged, and forest clad, as well as in the open cultivated tracts; the work has been systematically squared up, and the whole of the records have been completed and rendered in a satisfactory and masterly manner. Lieutenant Holdich has served a long apprenticeship in the Department as an Assistant Superintendent, and being both highly qualified and energetic, is most deserving of a higher grade than the one in which he is still serving.

84. Lieutenant Holdich acknowledges his indebtedness to Major Martin the Political Agent at Goonah, for valuable advice and very effective aid rendered to the survey throughout the season. In the Kotah State little or no assistance was rendered by the native officials, and great difficulty was, in consequence, experienced in carrying the triangulation through it. In other States there has been great improvement this season as to the assistance rendered to the survey officers.

Future operations.

85. During the current season the topographical delineation of the country within the meridians of 76° 30′ and 77°, and parallels of 24° and 25°, or Degree No. X already triangulated, will be taken up, while the triangulation will be advanced westward from longitude 76° between the same parallels into Degree No. XI.

86. To provide a sufficient and convenient field for No. 5 Survey, Bhopal and Malwa, adjoining on the south (*vide* paragraph 99 of printed report for season 1870-71), and to relieve the Rajputana Survey (No. 7), immediately adjoining on the west, of some of the immense area originally allotted to it, it has been found necessary to extend the operations of No. 1 Survey westwards of its original meridian of 76° through Neemuch, Odeypur, and Sirohee, and to reduce it southwards. This party, therefore, will in consequence be confined in future between the parallels of 24° and 25°.

87. By this arrangement each of the three parties working in the Rajputana and Central India Agencies, will have a convenient sized field of operations before them without clashing, and sufficient to occupy such establishments for several years to come. A new index map has been published to show this distribution of area.

Changes in the strength of party.

88. The following changes in the personnel of this establishment have taken place during the year. Lieutenant Leach, R. E., who was appointed to the Department in November 1871, having completed the special duty in which he was detached with the Lushai Military Expedition on the Eastern Frontier, joined the party in the month of June last, and took part in the recess duties. Mr. Allnutt, Assistant Surveyor, was permitted, at his own request, to resign his appointment from the 1st June 1872. Mr. Ryan and Sub-Surveyor Churamun Lall were transferred to help to raise the new No. 2 Khandesh and Bombay Native States Party. To fill these vacancies the Assistant Surveyors marginally named, were appointed to the Department, and posted to this party to complete the sanctioned scale of European Field Establishment. The party is now in a very efficient state.

Mr. J. H. O'Brien, 1st November 1872.
„ W. M. Kelly, ditto ditto.

No. 2.—TOPOGRAPHICAL SURVEY.

Khandesh and Bombay Native States.

89. This party, which was originally employed in Hydrabad, the Berars, and Central Provinces and disbanded in 1870, was again revived under the orders of the Government of India, marginally cited, for the topographical survey of the hilly portion of the District of Khandesh in the Bombay Presidency, chiefly situated between the Taptee and Nerbudda Rivers, as well as of the Native States adjoining Khandesh on the north and north-west, as alluded to in paragraphs 34 and 77 of my printed last general report for season 1870-71.

District Khandesh, Bombay Presidency, portions of the Native States of Holkar, Sindiah, Burwani, and Dhar of the Rajputana Political Agency, and Allirajpur, Rajpipla, &c.

Strength of Party.

F. B. Girdlestone, Esq., Officiating Deputy Superintendent, 3rd grade, in charge.
Mr. N. A. Belletty, Surveyor, 1st grade.
„ P. J. Doran, Assistant Surveyor, 3rd grade.
„ W. C. G. Barckly, Ditto 4th grade.

Sub-Surveyors.

Gunesh Wamon.
Keshew Wamon.

Department of Agriculture, Revenue and Commerce letter No. 193, dated 6th September 1871.

90. The chief object of the deputation of this party is, for a proper topographical survey of the native and other hilly states in the Bombay Presidency, which in the northern division have been left untouched for so many years past, and to supply geographical materials for those sheets of the Atlas of India, which the operations of the Revenue Settlement Department have been unable to render, and which for so many years have remained blank on the index map of the Indian Atlas.

91. The area at present allotted to this survey, extends from the Taptee River northwards to the southern face of the Vindhya range, or from about Latitude 21° 0′ to 22° 30′, and from the western boundary of the District of Nimar in about Longitude 76° 10′ to about 74° 15′, or to the eastern limits of the Guzerat Survey under the Trigonometrical Branch of the Department. This tract comprises the continuation of the Sathpura range and other isolated hills south of the Taptee, as far as the limits of the western ghâts and is very little known indeed. The southern portion of Khandesh, consisting of the open cultivated and revenue-paying tracts, but of which no reliable maps exist, is open to future enquiry, as to the necessity or otherwise of further topographical operations, or as to the practicability of utilising the Bombay Settlement Officer's measurements, with a view to the production of tangible maps of reference for general engineering, revenue and other purposes.

92. Owing to the reductions effected in the strength of the Department during the year 1870, considerable difficulty was experienced in drafting even a small number of efficient assistants from other surveys to start the advance triangulation in Khandesh, and it was only towards the close of the year (December 1871), and at the cost of materially reducing the strength of other barely efficient surveys, and consequently their working power and cost per square mile, that this party was reformed as above described.

Difficulty experienced in recruiting the party.

93. During this first season, and for the purpose of breaking ground, it was not possible to effect more than the completion of a sufficient amount of skeleton triangulation on which to base the topography afterwards. With this object in view all the country from the meridian of the Khanpisura Series of the Great Trigonometrical Survey eastward, as far as the boundary of District Nimar already surveyed, or from the meridian of 75° to 76° 10′, was reconnoitred, and the triangulation of an area of about 4,940 square miles effected.

Season's operations and out-turn.

94. The initial elements for this triangulation were obtained from the Khanpisura Series stations, Argaon, Ajne, Babakor, Jelalabad, Tikree, Baumungur, and Mograba, situated between the Taptee and Nerbudda Rivers, and the net work was thrown to the north of the Nerbudda River to the full limits of the survey, where it will connect with the Bhopal and Malwa operations a little south of the city of Indore, nearly on the parallel of 22° 30′.

95. Observations were taken at 137 stations, from which 831 points, or on an average nearly 1 point or station was fixed in every 6 square miles of ground, and 589 heights were determined trigonometrically, giving on an average 1 height for every 8½ square miles.

96. The ground over which the triangulation was conducted was in parts very hilly, forest-clad and unpopulated, especially in the southern portion, along which runs the main range of the Sathpura. It was found to be highly malarious up to the middle of February. Provisions and water were scarce, and had to be carried about for the survey camps, which, together with the very high price of labor and of every necessary of life, has entailed a severe expense, especially for the first starting and equipment of a new party. Several plateaux were discovered, which are described by the Officiating Deputy Superintendent as possessing a delightful climate even in the month of May, and entirely free from hot winds. The most important of these are noted in the margin.

Remarks on the country triangulated.

Kotah—Latitude 21° 30′ 5″, Longitude 75 51 30 } Height 3,000 feet.

Huri—Latitude 21° 32′ 37″, Longitude 75 61 6 } Height 3,073 feet.

Distant 32 miles from the Great Indian Peninsula Railway Station of Raverce.

97. The highest hill fixed by the season's operations is that of "Panchpandia:" height 3,522 feet, Latitude 21° 19′ 5″, Longitude 75° 40′ 34″; the next in importance is the sacred hill of "Tasdin" height 3,389 feet. The character of the country will, however, be better described next season, when the topography has been laid down and every nook and corner visited, as it must be, by the detail surveyors. A few notes will be found in the Appendix.

98. The establishment, which experienced an unusually heavy and difficult season's work, repaired to the rendezvous at Bhosawul by the beginning of June, from whence they proceeded to Mussoorie, where the recruiting of their health, as well as the completion of the organisation of a full party, could best be arranged in concert with the other executive officers at that place. The usual professional computations were completed.

Recess duties.

99. The total cost of the season's operations from the time the establishment was inaugurated (December 1871) to September 30th, amounts to Rs. 37,967.

Cost of the season's operations.

100. The triangulation completed in advance being sufficient to afford a basis for the detail survey for the next two seasons, the main portion of the party will be employed on the topographical delineation of the country within Latitude 22° 15′ to 21° 45, Longitude 75° to 76°. The executive officer and one assistant will take up a small portion of triangulation remaining to be completed east of Longitude 76°, and also fill up whatever minor additional points may be found necessary in any of the triangles of the past season.

Programme for the current season.

101. The party has now been raised to full strength by the several transfers and postings marginally noted. These withdrawals require the training of new agency, and to ensure a fair out-turn of topography on each party during the current season, new hands have been carefully selected and appointed to fill up the vacancies; but it is a tedious and expensive task to train Topographical Surveyors, and though every precaution is taken to secure only the best men, and only those who show considerable aptitude for the work, it seldom happens that a good topographer is fully trained or returns a full and sufficiently reliable amount of work for his pay in less than three or four years.

ADDITIONS TO THE STRENGTH OF THE PARTY.

Mr. R. W. Chew, Surveyor, 3rd grade, from No. 3 Survey.
„ A. G. Wyatt, Asst. Survr., 1st grade, from „ 4 do.
„ T. D. Ryan, do. 2nd grade, from „ 5 do.
„ G. T. Lambert, do. 4th grade appointed 1st July 1872.
Sub-Surveyor Shaik Omer from No. 4 Survey.
Do. Churumun Lall from No. 1 Survey.

102. The skeleton out-turn of the season is good, considering that the party just raised was employed in entirely new and difficult ground and in a new presidency; much credit is due to the Officiating Deputy Superintendent, Mr. F. B. Girdlestone, for the energy displayed in the formation of the establishment, and success achieved in overcoming the many difficulties he had to contend against.

Opinion on the season's out-turn.

103. The party suffered considerably from fever throughout the season. An outbreak of cholera also took place, and one Assistant Mr. Doran, was totally incapacitated early in the season, and obliged to take nine months leave under medical certificate, and is unfitted for field duty during the whole of the present season.

104. I record these facts simply to shew what affects progress in this country, and the precariousness of such operations in many parts of India.

No. 3.—TOPOGRAPHICAL SURVEY.

CENTRAL PROVINCES AND VIZAGAPATAM AGENCY.

105. The topography in continuation of the previous season's operations was taken up in these wild States from the parallel of 18° 30′ and extended southwards to 18° 15′ with a small portion to the east lower south to 18°, and limited to the west and east by the meridians of 81° 30′ and 83° 10′, the tract of country immediately due west of Vizianagram. The triangulation of this party being very much in advance, there was no necessity to extend it further during this season; the Deputy Superintendent, Colonel Saxton, was therefore chiefly employed in inspecting the work of his detail parties, and rendering them such help as they needed from time to time, and his attention was also given to fixing by interpolation, within the triangulation of previous seasons, where required, additional points to facilitate the work of the plane tablers.

Portions of Bustar State in the eastern part of the Central Provinces, and of Jeypur, Madgul, Panchpenta and Vizianagram in the Vizagapatam Agency, Madras Presidency.

STRENGTH OF PARTY.	Out-turn of Topography.	
Col. G. H. Saxton, Depy. Supdt. 1st grade, in charge	40	Square miles and interpolation of points.
Mr. R. W. Chew, Surveyor, 3rd grade ...	341	Square miles.
„ J. Harper, do., do.	246	do.
„ J. A. May, do., 4th grade ...	240	do.
„ F. Adams, do., do. ...	282	do.
„ T. E. M. Clandius, Asst. Surveyor, 2nd grade.	329	do.
„ W. F. Pettigrew, do., 3rd do.	243	do.
„ A. Cooper, do., 3rd do.	282	do.
Total ...	2,003	Square Miles.

106. The whole season's operations lay through hilly, inhospitable, unhealthy, and very sparsely inhabited country, and is described as some of the wildest and most difficult in this province. Some of the ranges of these eastern ghauts attain a height of over 5,000 feet above sea level, amongst which are the Galikonda and Keverla Hills; the Hill of Sinkramkonda (5,300 feet above sea level) is situated within the season's work; *vide* margin. Teak forests were found west of the Kolab River in the Sunkom zemindary, a dependency of the Bustar State. Two considerable rivers, the Kolab and the Sileru, running in a south-westerly direction towards the Godavery.

Description of Country.

GALIKONDA HILL STATION.		Latitude 18° 12′ 51″ Longitude 82 58′ 16″	Height 5,300 feet.
KEVERLA	DO.	Latitude 18° 9′ 2″ Longitude 82° 57′ 59″	Do. 5,114 „
SINKRAM	DO.	Latitude 18° 23′ 28″ Longitude 82° 56′ 5″	Do. 5,300 „
ARMA	DO.	Latitude 18° 13′ 41″ Longitude 82° 45′ 58″	Do. 5,500 „

107. The area of final topography obtained covers an area of 2,003 square miles for Atlas sheet No. 93, all of which, the Deputy Superintendent states, is carefully surveyed, and the nature of the ground well and faithfully delineated in the season's maps; in fact, that officer characterises the detail survey as of the highest standard yet attained by his party, which is very encouraging. A good step has been taken in advance in dealing with the extensive area remaining in this neighbourhood for survey. A few seasons more will bring it as far south as the Godavery Talooks and Rajamundry District limits of former surveys, and the triangulation will now connect on the Great Trigonometrical Beder Longitudinal Series, extending along the parallel of 18° north latitude.

Season's out-turn.

But there is still a very large area remaining to be provided for west of the meridian of 81° 30 as far as the limits of the Chanda District of the Central Provinces, consisting of various zemindaries, all of the very worst physical aspect.

108. Theodolite observations were taken at 42 stations, by which 109 additional points were fixed within the triangulation of previous seasons, and the elevations of 99 points were trigonometrically determined.

Recess duties.

109. The whole party returned, during the months of April and May, to recess quarters at Ootacamund, where the usual mapping and computation were completed.

Cost of the season's operations.

110. The total cost of the season's operations under the heads of establishment and contingencies, amounts to Rs. 62,615 from 1st October 1871 to 30th September 1872.

Remarks on the season's out-turn.

111. Considering the nature of the country brought under survey, which is wild and unhealthy in the extreme, and the shortness of the period when alone the party are able to remain in the field, the out-turn is a fair average season's work, and it has been well squared up, and rendered in a compact and satisfactory form creditable to the whole party.

Programme for ensuing season.

112. During the present season (1872-73) the triangulation in advance will be completed and filled up with additional points down to the parallel of 17° 45', and the topographical delineation of the country between 18° and 18° 15' in continuation of last season's work will be completed as far as possible.

113. Mr. R. W. Chew, 3rd Grade Surveyor, long the senior assistant in this party, was necessarily transferred at the close of the recess season to help to form No. 2 Survey, Khandesh and Bombay Native States, where the services of an experienced Surveyor were much needed, and the new appointments marginally noted were effected to complete the strength of this party. The Sub-Surveyors are promising lads from the Ootacamund Lawrence Asylum, whom it is hoped to train up for Assistant Surveyorships. I am most desirous of holding out good prospects to such lads of this noble institution as may prove qualified to pass the prescribed examination, and to offer them the chance of learning an honorable and useful profession.

Mr. Geo. Vander Beck, 4th Grade Assistant Surveyor, from 1st July 1872.
„ D. Campbell, „ W. Chapman, „ Donald Campbell, } Sub-Surveyors, { from 3rd July 1872. „ 15th do.

114. Colonel Saxton states that during the past season, he suffered very much from climatic influence and returned to recess quarters greatly shaken, from which he has scarcely recovered yet. He thinks it unlikely that he will be able to take the field again another year, as he contemplates furlough when the results of his current season's operations are all completed and rendered. This officer has had a very long service in the highly unfavorable and unhealthy tracts which have fallen under his operations, and he has been wonderfully successful in maintaining his own as well as the health of assistants, under every description of drawback and difficulty. Recessing in a good hill climate has alone enabled the party to effect such out-turns of work annually, and every credit is due to the Deputy Superintendent for his tact and able management in the field.

115. Useful notes by the Deputy Superintendent and Messrs. Harper and May, Surveyors descriptive of the country visited by them, are given in the Appendix.

No. 4.—TOPOGRAPHICAL SURVEY.

North-Eastern Division, Central Provinces.

116. Owing to the very unhealthy nature of the country in which the operations of this party for the season under review lay, it was not allowed actually to commence field-work before the month of December, by which time the forest tracts in the district of Mandla and the northern portions of the Belaspur District, are believed to be comparatively healthy. The field camp was formed at Jubbulpur, and after the completion of all necessary arrangements for a long campaign in a very inhospitable country, the several detachments started for the ground, respectively allotted to each, by the 13th November.

The Zemindaries or Estates of Kenda, Lafa, Pendra and Mahtin in District Belaspur; Pergunnah Ramgurh of District Mandla, Central Provinces, and the Taluok of Sohagpur of the Native State of Rewah.

Strength of Party.

Major G. C. Depree, Deputy Superintendent, 1st grade, in charge.	2,100	square miles of triangulation.
Mr. G. A. McGill, Surveyor, 2nd Grade, on leave.		
„ J. Vanderputt, do., 3rd do., sick leave from 23rd January 1872 to 20th June.	31	square miles topography.
„ A. G. Wyatt, Assistant Surveyor, 1st grade ...	279	ditto.
„ A. James, ditto ditto, 2nd do. ...	353	ditto.
„ J. A. Barker, ditto ditto, 2nd do. ...	287	ditto.
„ J. H. Wilson, ditto ditto, 3rd do. ...	300	ditto.
Baboo H. D. Dutt, Sub-Surveyor	273	ditto.
Sheikh Eusuf Shareef, ditto	350	ditto.
Sheikh Omer, ditto	280	ditto.
Baboo M. S. Dutt, ditto	302	ditto.
Imam Shareef, ditto	136	ditto.
Total square miles ...	2,591	topography.

117. The Deputy Superintendent in charge (Major G. C. Depree) commenced the triangulation in advance from a secondary side of the Jubbulpur Meridional Series (" Churia" to " Bijagar") of the Great Trigonometrical Survey, within easy reach from Jubbulpur, and thus lost no time in starting field-work. The ground over which he had to triangulate was the northern portion of the Mandla District embraced the Talook or Pergunnah of Ramgurh, from about the meridian of 80° 5′ eastwards to 81° 15,′ and between the parallels of 22° 45,′ and 23° 22.′ This ground, which may be described as a series of level plateaux covered with forest and without any commanding peaks, is extremely difficult to triangulate.

Country triangulated.

118. With praiseworthy energy and perseverance, the Deputy Superintendent, by the end of December, reconnoitred this tract, fixed stations and cleared rays to secure vision between points for two series of triangles, one running north-west for 80 miles, the other north for 50 miles, as indicating their general directions, the former skirting on the north side the plateau which forms the water-shed between the Soane and Nerbudda rivers, the second series skirting the southside of the same plateau, the two series to unite at their western extremity, and thus to form a loop and a test of accuracy. Major Depree then commenced and completed by the 18th of February the observations at 40 stations, determining the positions of 272 points, giving an average of 1 point for every 8 miles of ground, and the elevations of 166 points, or on an average 1 height for every 12½ square miles, and covering an area of 2,100 square miles, after which he ran 145 linear miles of check-routes to test the detail survey of each plane tabler.

119. The detail survey was conducted, in continuation of the work of the previous season, through about half of the talook of Sohagpur, of the Rewah State, lying to the north of Amarkantak, and in the north-western portion of the district of Belaspur (Central Provinces) in the zemindaries or estates of Kenda, Lafa, Pendra, and Mahtin, or from Longitude 81° 30′ to 82° 15,′ and from Latitude 22° 30′ to 23° 30′; the area accomplished being 2,591 square miles.

Area topographically surveyed.

120. The country delineated topographically may be briefly described as the plateaux or table-lands, situated in Sheet No. 90 of the Atlas, within and about which the sources of the Nerbudda, the Johilla, the Soane, and the Mahanadi Rivers take their rise, or one of the great water-partings of the drainage into the Bay of Bengal to the east and the Gulf of Cambay to the west, and is of a very interesting character hitherto almost unknown.

Description of ground delineated.

121. The most important of these is the Mekal-pat, on which is situated the well known shrine of Amarkantak, from which the Nerbudda River rises, and within two miles of which the Johilla River has its source. The highest point of this plateau is 3,860 feet above sea-level. The second is the terre-plein of Pendra, Chateesgurh, and Sohagpur, to the south of which, at an elevation of 2,100 feet, is the source of the Soane River. The third plateau, or level, forms part of the Kenda State in District Belaspur, the waters of which drain into the Mahanadi River; Kenda is 1,150 feet above sea level.

122. For some slight further description of the country under survey, see extract, in Appendix, from the Deputy Superintendent's report, but it has not been sufficiently explored or examined yet to admit of a full statistical or geographical account being rendered. A systematic account of fords, ferries, and passes has been arranged to correspond with the standard sheets in the tabulated form required by the Quarter Master General of the Army; this will be rendered in due time.

123. By the end of April field-work closed, and the party returned by detachments to Jubbulpur, where the depôt is formed, and proceeded to Mussoorie for the recess.

Recess season.

Cost of the season's operations.

124. The total cost of the season's operations, under the heads Establishment and Contingencies, amounts to Rs. 53,637.

Opinion on the season's outturn and cost.

125. The total out-turn of the season, *viz.*, 2,100 square miles of triangulation and 2,591 square miles of topography, is very good, and, but for the absence on medical leave of the two Senior Surveyors (*vide* margin), would have been considerably more. The loss of the two best and most experienced Surveyors for the whole of the field season was a most serious drawback, but the excellent arrangements of the Deputy Superintendent, which have secured, in a very difficult country and at a very moderate cost, a fair out-turn of work, with an establishment considerably weakened, deserve high commendation.

Mr. G. A. McGill, Surveyor, 2nd grade. Leave, on medical certificate, from 1st November 1871 to 29th February 1872. Rejoined the party in Recess Quarters on the 7th May 1872.

Mr. J. Vanderputt, Surveyor, 3rd grade. Leave, on medical certificate, from 23rd January 1872 to 20th June.

126. The fair mapping rendered is well executed generally and improved in many respects; its relative value in comparison with the results of other parties has been separately commented on.

Changes in personnel of party.

127. There is no Assistant Superintendent attached to this party, because the exigencies of the Department and the great demand for competent agency elsewhere will not permit it. Mr. A. G. Wyatt, Assistant Surveyor, 1st grade, and Sub-Surveyor Sheikh Omer were drafted to supply the wants of the new No. 2 Survey during the month of August 1872. The party was strengthened by the new appointment of Messrs. Rourke and Read,* qualified candidates, and of Sub-Surveyor, Shere Shah, to fill a vacancy in the subordinate class of Sub-Surveyors.

* Appointed from 1st October 1872.

Programme for ensuing season.

128. During the season now current, the Deputy Superintendent, Major Depree, assisted by Mr. McGill, will execute the triangulation in advance of details of the central portion of the Mandla District, and the western zemindaries in District Belaspur, (Pandaria, Kawardha, &c.,) or between the parallels of 21° 50′ and 22° 45′, and the meridians of 80° 30′ and 81°. The topography of the remainder of Sohagpur (western half) and of the Amarkantak or Mekal-pat in district Mandla, together with some of the zemindaries north-west of Belaspur, will be taken up.

Inspection of party.

129. The party was inspected by myself at Jabbulpur in November 1871, and I was favorably impressed with the good management of the Deputy Superintendent, the orderly manner in which all the records were kept up, and the state of the instrumental and field equipment was all that could be desired.

130. With the exception of the Deputy Superintendent, all the members of the party suffered from, more or less, malarious fever throughout the field season, and two of the native establishment died. Messrs. McGill and Vanderputt were both unable to perform field duty during the whole of the season, and were absent under medical certificate. The country is one of the very worst for survey, but I am happy to say that the health of the establishment has been restored by a hill climate during the recess, and it has again taken the field with every prospect of success.

No. 5.—TOPOGRAPHICAL SURVEY.

Bhopal and Malwa Native States.

131. The camp of this party was formed at Hoshungabad, the field depôt station, by the end of October, and the several detached parties under the Deputy Superintendent in charge, Captain R. V. Riddell, R. E., moved into Bhopal territory north of the Nerbudda River, during the first week in November 1871.

The eastern portion of Bhopal, southern portion of Gwalior, Kurwai, Mohamedgurh, Nawab Basoda, and Pathari in the Bhopal Political Agency.

		Topography.
Captain R. V. Riddell, R. E., Deputy Superintendent, 3rd grade, in charge	125	Square miles and check routes.
Captain J. R. Wilmer, Assistant Superintendent	51	Square miles and 84 miles of check routes.
Mr. A. J. Wilson, Surveyor, 4th grade ...	298	Square miles and 56 miles of check routes.
,, C. F. Hamer, Assistant Surveyor, 1st grade ...	361	Square miles.
,, A. W. Chennell, ditto, 2nd ditto ...	307	ditto.
,, C. Kirk, ditto, 2nd ditto ...	233	ditto.
,, E. A. Wainright, ditto, 2nd ditto ...	351	ditto.
,, H. T. Kitchen, ditto, 3rd ditto ...	355	ditto.
,, W. H. Lilley, ditto, 3rd ditto ...	384	ditto.
Sheikh Nubbi Buksh, Sub-Surveyor	368	ditto.
Prem Raj, ditto, ...	115	ditto.
Abdur Rahim, ditto, ...	176	ditto.
TOTAL ...	3,124*	Square miles.

* Of this 230 square miles was overlap survey, taken up to establish a proper junction with the work of Revenue Surveys in Saugor, Nursingpur, and Hoshungabad long previously executed.

132. The triangulation in advance executed in the previous season in Bhopal (4,267 square miles), while the detail parties were employed in completing the topography of the unfinished portions of the Bundelkund States, together with that south of latitude 24° (equal 3,200 square miles) made over to this party from No. 1 Gwalior and Central India Survey, for reasons assigned in para. 70 of my last printed report, gave a total of 7,467 square miles of advanced triangulation within the new field allotted to this survey, thus rendering it unnecessary to undertake further work of this description during the season under review; the entire strength of the establishment was therefore employed on topographical delineation of the ground, limited on the south by the Nerbudda River, on the east by the boundary of the British district of Saugor, on the west by the meridian of 78°, and on the north by the parallel of 24°, embracing about one-third of the Bhopal State under the Nazims of Raiseen and Kulliakheree, with a small portion of Sindiah's territory in the Mangouli Soubadaree, Tehsils Bhilsa and Basoda, and the petty states of Kurwai, Mohamedgurh, Nawab Basoda and Pathari, much intermixed with Gwalior territory, but under the Bhopal Political Agency.

133. The total area of final survey completed was 3,124 square miles, of which 2,172 square miles belongs to Bhopal, 590 square miles to Gwalior territory, 30 square miles to Mohamedgurh, 40 square miles to Nawab Basoda, 16 square miles to Pathari, and 32 square miles to Kurwai.

Area accomplished.

134. The area under actual cultivation was found, on an average, to be about 60 per cent., the villages were numerous, the population in proportion, and the soil of the cultivated tracts rich and very productive. Diagonally across the season's surveys runs the Vindhya range, the general elevation of this portion being about 1,800 feet above sea level, while occasional peaks and ridges rise to nearly 2,400 feet.

Description of country.

135. This country is drained to the south by the Rivers Sindor, Tendoni, and Banna, feeders of the Nerbudda, and on the north and east by the Betwa, Binna, Dassan, and Beas. The estimated fall of the bed of the Nerbudda River between the meridians of 78° and 79°, is about one foot per mile.

136. In the Nerbudda Valley, during the month of April, the heat is represented as more than usually severe, the thermometer in the shade in a large tent registered 109° Fahrenheit. The field work then closed, and the party returned to recess quarters at Mussoorie, when the mapping and other duties were completed.

Recess season.

137. The total cost of the season's operations for establishment and contingencies, amounts to Rs. 58,157.

Cost of the season's operations.

138. The season's out-turn is very good, the party having been employed in country new to all the Surveyors, and differing considerably from that in Bundelkund which they had just left. The results are highly creditable to Captain Riddell and his assistants; the maps and other records have all been brought up and rendered systematically, and bear a very good comparison with those produced by the other parties. The testing of the topographical details in the field and supervision of the plane tablers has been excellent. The valuable services of Captain Wilmer, Assistant Superintendent, were unfortunately lost for three of the best working months owing to severe illness, which necessitated that officer taking leave under medical certificate from the 19th December 1871 to the 2nd March 1872. The Assistant Superintendent's previous and subsequent good services were brought to the notice of Government, and he received his promotion to 1st grade from the 28th August 1872, by orders marginally noted. Captain Wilmer is a most promising officer and fully qualified for the charge of independent survey operations.

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Notification No. 655, dated the 10th October 1872.

139. In the Appendix, extracts from the Deputy Superintendent's report will be found descriptive of the country surveyed, and a memorandum on the forts (existing or in ruins) met with. A statemant or schedule of fords, ferries, and mountain passes in the country visited by the Deputy Superintendent, was prepared and duly forwarded to the Quarter Master General of the Army.

140. The services of another experienced Assistant Surveyor being suddenly needed for one of the Eastern Frontier expeditions, Mr. A. W. Chennell was transferred to No. 6 Khasia and Garo Hill Party. Mr. C. Kirk, Assistant Surveyor, was permitted, after the whole of the work was brought up, to resign his appointment. To fill these vacancies, Messrs. J. Murray and A. Kitchen, duly qualified candidates, were posted to the party as 4th Grade Probationary Assistant Surveyors, from the 1st November 1872.

Changes in personnel.

141. During the current season, the detail survey of the country between the meridians of 77° 30′ and 78°, and parallels of 23° and 24° in Bhopal, Oojein, and Nursingurh territory in Square Degree No. III, will be taken up, together with a large scale survey of the city and environs of Bhopal and Sehore. The triangulation in advance will be extended westwards in Square Degrees Nos. III and IV from the vicinity of the city of Bhopal, and a series of first class triangles will be carried along about the parallel of 23°, to connect the Great Arc Series with the Khanpisura Series, Great Trigonometrical Survey, or from about longitude 78° to 75,° as well as to combine with the triangulation of the Khandesh Survey by No. 2 adjoining party. As the space between the Great Arc and the Khanpisura Meridional Series south of the western or Kurrachi Longitudinal Series is very large for the extension of secondary triangulation only, it is intended to run a first class secondary series on the high ground between the two meridional series, somewhere between the south of Bhopal and Indore or Mhow, to give a good basis for future extension into Square Degree No. VI resting on the Nerbudda River.

Programme for ensuing season.

No. 6.—TOPOGRAPHICAL SURVEY.

Khasia and Garo Hills.

142. This party was diverted from the field of its regular operations in the Garo and Naga Hills, to provide a competent staff of surveyors to accompany the Lushai Military Expeditionary Field Force, left or Cachar column, on a special requisition of His Excellency the Commander-in-Chief, *vide* paragraphs 120 and 121 of my last printed report, season 1870-71.

Eastern Frontier of Bengal.
Portions of the South Cachar and Lushai Hills and Munnipur State.

Captain W. F. Badgley, S. C., Officiating Deputy Superintendent, in charge.
Lieutenant R. G. Woodthorpe, R. E., Assistant Superintendent.
" E. P. Leach, R. E., ditto ditto.
Mr. M. J. Ogle, Assistant Surveyor, 1st grade.
" W. Robert, ditto, 4th "
" J. McCay, ditto, 4th "

143. With the object of placing the Government of India in early possession of the results of the survey expeditions on the Eastern Frontier, which accompanied the military columns under Brigadier Generals Bourchier and Brownlow from the Cachar and Chittagong sides, into the hills beyond the British Frontier, inhabited by the Lushai, Kuki, Sylu, Shendu, Howlong, and other minor tribes of semi-savages, a report was submitted (*vide* my special report No. 160F., dated the 22nd June 1872, reprinted in the Appendix) of the combined operations conducted by the two independent survey parties under the superintendence of Major John Macdonald, Officiating Deputy Surveyor General, and Captain Badgley, S. C., Officiating Deputy Superintendent of Survey, respectively, which with its enclosures was separately printed, and likewise published in full, by order of the Governor General in Council, in an extra supplement to the *Gazette of India*, dated 8th November 1872.

144. It is not necessary in the present place to go into the whole of these professional details again, on which the final review and orders of the Government of India have been passed, but with the object of rendering in a complete form the general results of the operations and administration of topographical surveys for the season under review, the work performed by No. 6 Survey under Captain Badgley's superintendence is briefly recorded here, in order to preserve the departmental history of survey events. Such portions of the statistical and geographical information which are of immediate value and interest of this hitherto unknown territory, are extracted in the appendix.

Vide Resolution of the Government of India, in the Department of Agriculture, Revenue and Commerce, No. $\frac{2}{502 \text{ to } 570}$, dated 13th September 1872, in the Appendix.

145. Emanating from a side of the Great Trigonometrical Secondary Series in South Cachar the secondary triangulation accomplished extended about 25 miles in a south-eastern direction over 612 square miles, and to this must now be added 1,544* square miles of tertiary triangulation, or points determined by intersections, giving a total of about 2,156 square miles of country thus covered. The most easterly position fixed is in Longitude 93° 3', and the most southerly in Latitude 23° 32'. The elevations of 65 points were trigonometrically determined, and the points reached ranged from 4,925 feet to 6,850 feet above sea level.

Season's out-turn triangulation.

* The area covered by tertiary points could not be given until the computations were completed and the points verified by common sides.

146. An area of 6,068 square miles based on the above triangulation, and including overlaps route survey, was topographically surveyed on the ¼ inch, or 4-miles = 1 inch scale. The actual area for which new geography was secured being about 4,800 square miles. In addition to this a route survey on the scale of 1 inch=1 mile was made of the line by which the force advanced, and between outposts in South Cachar, or over 191 linear miles of most difficult ground in an enemy's country.

Topography obtained.

147. Unfortunately, however, time did not permit of a junction between the northern and southern columns before the expiration of the military operations, when the country was rapidly vacated. A considerable gap, therefore, still exists, which it is most desirable to fill up, to enable us to complete the general geographical configuration of the Eastern Frontier, and of the extensive tract lying between the Cachar, Sylhet, Tipperah, and Chittagong British Districts. The total results obtained by the two combined parties with the military expedition, are given in my special report on this subject in the Appendix.

148. The total cost of the entire season's operations for this party amount to Rs. 47,073, which, considering the special nature of the work performed in a difficult and hostile country, with the exorbitant wages of coolies and the absence of all other means of transport, is exceedingly moderate. The recess duties were performed at Shillong.

Cost of the season's operations.

149. The operations of this party during the season may fairly be considered as most successful and encouraging. Reliable geography for a considerable area beyond the British Frontier has been obtained, and politically, we have gained very valuable information regarding various frontier tribes, who have long proved most troublesome neighbours. Our ignorance of their habits, manners, and, relations with each other, have, in a great measure, hitherto prevented proper

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communications being opened and intercourse with them, but with the knowledge now gained both as regards the country and the people, it is hoped more friendly relations will soon be established, and further opportunities be offered of gaining a complete knowledge of the *terra incognita* between Burmah and our eastern districts, which has long defied the efforts of all explorers on the Eastern Frontier.

150. The sources of the Tipai or Tin-Vi and its chief tributaries and the head waters of the Kolodyne River are now known. Captain Badgley describes the scenery in the interior of the Lushai Hills and at the higher elevations visited as "magnificent." The fir, rhododendron, and oak take the place of bamboo and low heavy jungle, and the climate is healthy and invigorating.

151. The recommendations made for prosecuting the survey of the remaining blanks, having been approved of by the Government of India, arrangements were timely made for another expedition under the excellent management of Captain Badgley, who is now actively employed in exploring the country along the Jampoi, Hachik ranges, one of which is supposed to form the eastern boundary of Hill Tipperah, or the territory of the Rajah of Tipperah, which it is desired to fix definitely in connection with the larger question of a continuous line of British Frontier from Assam to Arracan. Other special and very urgent surveys on the Eastern Frontier in three different directions have likewise been called for, which has taxed the resources of the department; the party having been strengthened, has now been divided into four widely separated detachments.

152. The return of Major Godwin-Austen, Deputy Superintendent, some months after the expiration of his two years' furlough to Europe, and his reappointment to the Department as junior of his former grade, by the orders marginally noted, placed at my disposal the services of an experienced officer well qualified to undertake the work on the extreme north-east for the exploration of the Patkoi range, for the purpose of defining a disputed boundary with the Munnipur State, in continuation of the regular survey brought up from the west through the Khasia, Jynteah, and Naga Hills.

* Agriculture, Revenue, and Commerce Department, No. 677, dated the 18th October 1872.

153. These detachments of No. 6 party and the work allotted to each are as follows:—

1ST DETACHMENT.—

Major Godwin-Austen, Deputy Superintendent, in charge.	To survey the Naga Hills and Munnipur boundary, and explore the Patkoi range.
Mr. Ogle, Assistant Surveyor, 2nd grade. „ McCay, ditto, 4th „	To carry on the old survey of the Mekir and Rengmah Naga Hills south of the district of Nowgong and north of the previous work in North Cachar and Samagooting.

2ND DETACHMENT.—

Captain Badgley, Officiating Deputy Superintendent, in charge of Special exploring party. Mr. A. Chennell, Assistant Surveyor, 1st grade, transferred from No. 2 Topographical Party.	To explore and survey the Jampoi and Hachik ranges between Hill Tipperah and the Lushai Hills, with portions of the north Chittagong Hills and the southern and western portion of the Lushai Hills, to fill up the blank left last season.

3RD DETACHMENT.—

Lieutenant Woodthorpe, R. E., Assistant Superintendent. Mr. W. Robert, Assistant Surveyor, 3rd grade. Surveyors Shah Nasirudin and Daliludin.	To accompany the police force expedition under Captain Williamson, Political Agent, for the triangulation and survey of the Garo Hills and western boundary between the Garo Hills and District Goalpara, with the view of completing all that previously remained of these hills, and especially of those portions hitherto termed independent, and which have never been entered or explored in any way.

4TH DETACHMENT.—

G. H. Cooke, Esq., Assistant Superintendent, Revenue Survey, previously employed with the party accompanying Brigadier General Brownlow's southern column, but specially for the occasion.	To explore the ranges south of Demagiri, in the Chittagong northern hills, with a view to adopting a continuous frontier line of defensive boundary down to the known limits of Arracan in the Akyab District of British Burmah, and to obtain as much information as practicable for filling up and correcting the meagre or imperfect topography in that direction.

154. These various and important operations of a particularly arduous character are now all in full force, and, I am happy to say, with every prospect of success in each case. The hardships and difficulties being experienced are very considerable, but the energies and abilities of the officers and assistants employed will, I am sure, be equal to this occasion, as they so eminently proved last season.

155. There will still much be left to get through on the North-East Frontier in the Naga country and towards the valley of Assam, for which I trust the uninterrupted services of the whole party will again be available next season, and under the able management of Major Godwin-Austen, who is so thoroughly acquainted with this part of the country, and who is such an accomplished explorer, the best results may be anticipated.

156. Lieutenant Leach, R. E., Assistant Superintendent, who was temporarily employed with this party on the military expedition, having completed all the work entrusted to him, was posted to the Gwalior party to supply the vacancy therein caused, and he joined it at Mussoorie in June 1872.

157. On the conclusion of the current season's field work, it will be necessary to make arrangements for the transfer of Captain Badgley, Officiating Deputy Superintendent, who has been relieved of the charge of No. 6 party by the return of Major Godwin-Austen. In consideration of the importance of the special duty on which Captain Badgley is now engaged, he has been allowed to retain his officiating position and salary until the completion of his work.

158. The successful exertions of Captain Badgley and his party and the valuable contribution thus made to the geography of the Eastern Frontier, under the favorable auspices of the military occupation of the country during the past season, were prominently brought to notice in my special report above quoted, and acknowledged by the Government of India, as well as by the Secretary of State for India, as recorded in the documents in the Appendix. There can be no doubt as to what the whole party had to go through, and with what devoted zeal and willingness both officers, assistants, and the men of the party worked under very adverse circumstances, not only throughout the military campaign, but for a considerable period afterwards, immediately south of the Cachar District boundary, until they returned to recess quarters very late in the season, with such satisfactory and important results. The officers and assistants named in the margin, are specially deserving of praise and encouragement for highly meritorious services.

Despatch No 34, dated 28th November 1872.

Captain Badgley, Deputy Superintendent.
Lieutenant Woodthorpe, R. E., Assistant Superintendent.
Lieutenant Leach, R. E., ditto ditto.
Mr. Ogle, Assistant Surveyor.
„ Robert, ditto.
„ McCay, ditto.

No. 7.—TOPOGRAPHICAL SURVEY.

Rajputana.

159. A detachment from this party, under the Assistant Superintendent Mr. H. Horst, started from recess quarters at Mussoorie on the 25th September 1871, to triangulate very closely the country around Delhi required by the Quarter Master General's Department, to give fixed points at close distances on which the plans of the Camp of Exercise, on a large scale, 4 inches = 1 mile might be based *(vide* paragraph 132 of my printed report for season 1870-71), and this work was very successfully completed, and the triangulation chart rendered with sufficient data for the purpose by Mr. Horst, by the beginning of December 1871.

Portions of the Native States of Udeypur or Meywar, Jodhpur or Marwar, and the British Districts of Ajmere and Mhairwara, within the Rajputana Political Agency.

Strength of Party.

	Topography.	Triangulation.
Captain George Strahan, R. E., Deputy Superintendent, 2nd Grade, in charge ...	165 Sq. Miles.	940 Sq. Miles.
H. Horst, Esp., Asst. Supdt.	...	2,000 „
Mr. R. Todd, Asstt. Surveyor, 1st Grade ...	227 „	
„ C. Tapsell, „ 2nd „ ...	297 „	
„ F. Kitchen, „ 2nd „ ...	243 „	
„ W. Stotesbury, „ 2nd „ ...	230 „	
„ W. McNair, „ 3rd „ ...	360 „	
„ F. Warde, „ 4th „ ...	255 „	
Sub-Surveyor J. Noah	210 „	
„ Kalka Pershad	315 „	
„ Harlall Singh	310 „	
Total ...	2,612 Sq. Miles.	2,940 Sq. Miles.

160. As the result, we have most interesting and valuable maps of the country to the north-west and south of Delhi, surveyed and drawn for the most part by the officers of the Quarter Master General's Department, which never existed before, and which will remain a most interesting and useful record of the military manœuvres conducted in the cold season of 1871-72, under the personal command of His Excellency the Commander-in-Chief of the Army, Lord Napier of Magdala. These maps, as prepared by the Quarter Master General's Department, were published by this Department in a very practical and satisfactory manner, and I had great pleasure in thus co-operating with the Quarter Master General of the Army in so important a matter.

161. The remainder of the party under Captain George Strahan, R.E., Deputy Superintendent, in charge, proceeded to Agra, the field depôt of this survey, and formed camp there by the middle of October, when the field equipment being completed, the party reached the ground allotted for survey by the first week in November.

Triangulation.

162. The ground requiring triangulation embraced small portions of Jodhpur and Udeypur territory, within the Degree Square No. VIII (about two-thirds of it) formed by the parallels of 25° and 26°, and the meridians of 73° and 74°, covering an area of 2,940 square miles, of which 940 square miles were triangulated by Captain George Strahan, Deputy Superintendent, and 2,000 square miles by Mr. H. Horst, Assistant Superintendent; 57 secondary and 398 minor secondary triangles were obtained, and the elevations of 145 points determined.

163. In addition to the above, Captain Strahan ran 302 linear miles of check-routes, and Mr. Horst completed nearly 17 linear miles of traverse along the western side of the Sambhar Lake.

Topography.

164. The ground delineated during the season covers an area of 2,612 square miles between the parallels of 25° and 26°, and the meridians of 74° and 75°, and includes portions of Jodhpur, Udeypur, the petty states of Bednor and Deogarh, a small portion of the District of Ajmere, and nearly half of Mhairwara, as contained in the Square Degree No. VII.

Description of country.

165. The Arabulla or Aravalli mountains runs through the eastern side of the country triangulated. Its greatest breadth was found to be about 20 miles from east to west, and the range is believed to attain its greatest altitude here, the peak named "Jargo" being 4,330 feet above sea level and only second to the peaks of the Abu plateau further south, of which "Gurusikkar" (5,653 feet above sea level) is the highest.

166. The Arabulla range forms one of the most important water-partings in this part of India, the drainage from the eastern side flowing into the Banas, which joins the Chambal River further east, while the waters on the western side form the sources of the Luni River draining into the Runn of Cutch. The country on the east of this range is from 800 to 900 feet above the level of that on the western side. Rising gradually from the plains of Meywar or Udeypur, the country is more or less broken up by little masses or hillocks of rock until a plateau is reached, from which rise parallel ridges, nearly precipitous on both sides, forming narrow valleys between, while on the Jodhpur or Marwar flank the fall is abrupt, the features more massive and covered with dense jungle. More intricate or difficult ground perhaps cannot be met with, as the extraordinary minuteness of the features on the maps testify, and thus completely altering the old maps of this district and placing the character of the ground on an entire new footing.

167. The special objects brought to notice by Colonel Brooke, Agent to the Governor General for Rajputana, for the purpose of drainage works in Mhairwara, caused great care and minuteness to be employed in shewing every detail of which the one-inch scale was capable, and it is hoped that the maps now rendered will materially tend to provide the necessary information for this peculiar and wild tract of country.

168. With the object of utilising the services of this party to the utmost during the recess as well as in the field season, the large scale survey of the Simla Sanitarium (referred to in paragraph 133 of my last printed report) was commenced before the rainy season set in, the field work in Rajputana, which consists of a very excellent average out-turn, was closed by the end of March, and the party proceeded *viâ* Agra, being well instructed in traverse surveying, *en route* to recess quarters at Simla.

Commencement of the survey of Simla.

169. Early in April, therefore, Captain George Strahan was enabled to start the minor triangulation, which forms the ground-work for the plan of Simla, on the large scale of 24 inches to the mile*, obtaining the initial values for his triangulation from the old stations of the Great Trigonometrical Survey, North-West Himalaya Series, "Shali" to "Phagu," from which a net-work of secondary and minor points were fixed in and around the sanitarium connecting with "Jakho" (altitude 8,059 feet) and "Observatory" (altitude 7,089 feet) stations, numbering in all 32 secondary stations and 169 intersected points, with the elevations, trigonometrically determined, of 83 points.

* or 220 feet=1 inch; natural scale $\frac{1}{2640}$.

170. Main traverse lines by chain and theodolite were then run along the principal roads, connected at the starting and terminal points with the triangulation; and these being plotted by computed co-ordinates on the plane tables, the details of the ground were taken up by a succession of minor traverses, on plane table bearings and chain measured distances, depending on and fully checked by the stations of the main traverse lines.

171. No less than 31 linear miles of elaborate main traverse lines with off-sets, were measured along roads in a small area of about six square miles, the chained distances along hill slopes having been reduced to horizontal measurements.

172. Each plane table field section contains a square of 2,500 by 3,500 feet, and four of these form, when combined and fair-copied, one standard sheet. The field work for seven of these standard sheets, representing 380 acres of ground on the 24-inch scale, has been completed, and six have been fair-drawn and rendered to this office, of the portion of Simla south and south-east of "Jacko Hill," containing "Chota Chelsea" and "Chota Simla," "May Day Hill" and the Band-stand.

173. The Simla and Jatog Sanitarium will be represented on 20 standard sheets, each measuring within margins 22·7 by 31·8 inches, and it is expected that the drawing of the 24-inch scale will be susceptible of producing good reduced sheets on a scale of 16 inches to the mile.

174. A first or preliminary edition of these sheets are under issue at present for immediate local purposes only, as the boundaries of the numerous estates have not yet been entered, and in many instances are not defined by permanent pillars or other suitable marks on the ground; this, however, is now being done by proprietors, who will have the maps to help them, and all the boundaries after adjustment of disputes will be shown on the final edition of the standard sheets.

175. The photographed copies of the original field plane table sections, taken immediately after survey, thus form most valuable documents for all local enquiries as to rights of properties, and enable us to preserve the fair maps from all risk of alteration and deterioration after execution, by the changes so constantly made in the boundaries of estates, and specially in a hill station like Simla, now so closely built over, and where private interests are so keenly contested.

176. The Simla survey field work can thus only be conducted for a very short period, both before and after the rainy season, while the party is in recess quarters and can devote spare time from its other duties; the actual working period is, therefore, necessarily limited to about three or four months.

177. To lay out and complete the secondary triangulation for the commencement of the detail delineation of ground was no ordinary labor, but Captain George Strahan, with his usual ability and energy for which he is ever conspicuous, ably aided by the Assistant Superintendent Mr. Horst, and an excellent staff of assistants, succeeded in all he undertook, and before the rains set in finished most of the observations and measurements for the triangulation and traverse lines, and then started the plane tablers for laying down the topographical details on a suitable system of drawing for so large a scale.

178. The six standard sheets completed, of which three have been fair-drawn by Captain George Strahan and three by Mr. Assistant Surveyor Stotesbury, are admirably finished specimens of hill drawing on a large scale, and faithfully represent the ground. The labor of drawing these sheets is very great, the requirements of reproduction and reduction by photography necessitating the whole being done in pen and ink, which demands first-rate artistic ability, so as to preserve the tone or relative command of the hill features.

Cost of the season's operations.

179. The expenditure for the season for establishment and contingencies from 1st October 1871 to 30th September 1872, both for the Rajputana and Simla surveys, including the bringing up of both, amounts to Rs. 58,641. The expenses of the Simla survey are consequently very little above the ordinary charges of the party during the recess.

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180. The whole season's operations have been of a very arduous character, without any intermission, but most successful; and whilst the results obtained are excellent, the cost is very moderate, especially when the additional results obtained during the recess season is considered. The expenditure has been well controlled and utilised to the utmost extent, with the greatest possible resulting advantage.

Programme for the ensuing season.

181. The triangulation in Rajputana being well in advance of details nearly the full strength of the party will be employed on plane tabling, within the eastern half of Degree sheet VIII between the meridians of 73° 30' and 74°, and the parallels of 25° and 26°, in portions of Jodhpur, Udeypur, and Mhairwara. To admit of the continuation of the Simla survey, the prosecution of which is very important, the party will square up the Rajputana work and proceed to Simla early in April, immediately to go on with the hill drawing there in the fine weather before the rains set in.

Personnel.

182. Captain Strahan states that Mr. Horst, Assistant Superintendent's duties this year have been very various, and in everything that he has undertaken he has given as usual the most unqualified satisfaction, both as regards field and recess work. I have great pleasure in again testifying to the value of this Assistant Superintendent's services. Messrs. Tapsell and McNair, Assistant Surveyors, are likewise entitled to special mention for zealous and highly efficient services, for which both have received departmental promotions to a higher grade.

Mr. P. White, Probationary 4th Grade Assistant Surveyor.
„ George Copping, Apprentice Assistant Surveyor.
„ T. Downes, Sub-Surveyor.
„ E. Graham, ditto.

183. To fill existing vacancies in the Department, and to secure the full advantage of the excellent training and tuition which every member of this survey receives, under the able management of Captain George Strahan, the postings marginally noted took effect from 1st October 1872. Messrs. Downes and Graham, two promising lads with the required qualifications, joined from the Sunawar Lawrence Asylum, and I trust they are in a fair way of learning a profession which ought to be of the greatest value to them.

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

SURVEYOR GENERAL'S OFFICE,
Calcutta, January 15th 1873.

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APPENDIX.

APPENDIX A.

REMARKS, PROFESSIONAL, GEOGRAPHICAL & STATISTICAL,

BY

EXECUTIVE OFFICERS.

Extract from the Narrative Report of LIEUTENANT T. H. HOLDICH, R. E., *Assistant Superintendent, Offg. in charge No. 1 Topographical Survey, Gwalior and Central India.*

Gwalior and Tonk &c.
Latitude 24°to 24° 45'.
Longitude 78°to 78° 20'

The country surveyed in detail by this party in Degree Sheet VIII which comprised the valley of the Betwa river on its left bank, has already been fully described. It is an intricate, forest-covered country in the neighbourhood of Chandairi and for a considerable distance south of it; but the Mangouli and Kurwai country is open and fertile. Provisions were cheap, and the survey work proceeded with comparatively little difficulty.

Latitude 24° to 25°
Longitude 77° to 77° 30'

The four standard sheets comprising the western half of Degree Sheet IX, which were completed in detail this year, include a large proportion of unusually troublesome country to work through. The head of the Kunu valley, a mass of precipitous scarped hills covered with a stunted growth of jungle, and almost devoid of cultivation, forms the northern section of this half degree. From it westward the country slopes away to the Parbati river, and the intervening ground is one continuous level of uninterrupted jungle. There is not much undergrowth, though the grass is dense and high immediately after the rains. It is an unwholesome country altogether. Scarcity of water and constantly recurring famines have reduced the population to a minimum; a few half-starved cattle constitute their wealth. Their cities are now hamlets standing in the midst of ruins. The extent and nature of these ruins, however, testify to a different state of things formerly, and doubtless this poverty-stricken country could furnish matter of great interest to the Archæologist. Mr. Scanlan has added a few notes on the country which came under his immediate observation near the source of the Kunu, and has compiled an interesting history of Umri.

South of this, the country worked in detail this year may be described as the basin of the Parbati.

The eastern limit of this basin is a ridge or step from the higher plateau drained by the Sind river. The water shed of the two rivers consists of intricate and broken ground with the usual undersized tree jungle, deserted villages and scanty population.

The nature of the country which came under triangulation this season, and which will be planetabled during the cold weather of 1872-73, or between Latitude 24° and 25° Longitude 76° and 77°, may be described as large tracts of open, flat, cultivated land towards the north with plateaux of stony jungle covered hills towards the south-east. The hills to the west extend in two narrow ridges from north-west to south-east, running strictly parallel to each other at a distance of about half a mile. The valley between the ridges here and there widens and deepens, and a string of small lakes occur giving a singularly picturesque appearance to the scenery. The fortified cities of Jhalra Patan, Gahgrun, Shergarh and Nahargarh are included in this half degree. Shergarh is a large fort in a strong position and will merit particular attention when the country in its neighbourhood is surveyed in detail. Nahargarh too is a fort of considerable size but it is difficult to imagine that it could even be of importance strategically, for it is situated on a level plain closely surrounded by jungle on all sides. It has no command whatever. Gahgrun fort covers a pass between Jhalra Patan and Shergarh, but it is a small fort and the pass it covers is by no means the best across that ridge of hills; Jhalra Patan fort will be surveyed in detail with the city.

The southern half of the degree was triangulated by Mr. Bolst, who thus describes his method of triangulation and the general nature of the country :—

"In proceeding to triangulate the country comprised within the limits of 24°0' to 24°30' north Latitude and 76° to 77° east Longitude. I started my reconnoissance from the Great Trigonometrical Stations of Nandna, Sartal, Banskati and Guraria which formed the northern flank of my work, and which extended in nearly a straight line from east to west; by this means I was enabled to select five commanding points as first class secondary stations, and also to pole up all prominent hills in the country about 4 miles south of this line. I then returned in an easterly direction parallel to the route I had taken before, visiting the Great Trigonometrical Stations of Kursalpura and Matabahora on my way, and selecting stations at distances varying from 9 to 12 miles from each other and falling within the triangles of the Great Trigonometrical Station. I proceeded in this way from west to east and back again till nearly the whole area to be brought under triangulation, with exception of a small piece to the west,

had been covered over with stations on commanding sites, and a number of intersected points had been duly marked and fixed on my plane table.

"Thus far my work had progressed satisfactorily, the nature of the ground being generally hilly with conspicuous peaks cropping up above the general level, and so affording facilities for the selection of stations. It was when I got to the tract of country to north-west that I experienced my great difficulty in finding stations which could see each other. The reason was that the general run of the country was undulating and covered with heavy jungle. From a distance it appeared to be an extensive plateau, but on nearer approach proved to be of the nature above mentioned. In consequence of this I had to content myself with such sites as would under more favorable circumstances have been rejected. Having brought my reconnoissance to a close on 14th January 1872, I commenced observing on the following day and finished my observations on the 13th March at Banskati, Great Trigonometrical Station, visiting 40 stations, in all of which two had to be visited twice. I was fortunate in having favorable weather almost throughout the time I was engaged in this work. Four or five days early in February formed the only exception when a heavy mist hung over the country.

"With regard to the nature of the country brought under triangulation it may be described generally as hilly and covered with thick jungle, with the exception of a portion to the west which is level and well cultivated, quite a pleasing contrast to the surrounding uninteresting country. The districts comprised within this area are portions of Gwalior and its sub-divisions. Rajgarh and Omatwar, Tonk, Jhalra Patan and Holkar. The chief towns are Dilanpur, picturesquely situated on the precipitous bank of the Chapi river; Manohar Thana a large and important town on the Purwan river, and Bukhani. These belong to Jhalra Patan, Machilpur and Jhirapur in Holkar are situated in the plains and surrounded for a short distance only with richly cultivated fields. Kalchipur on the Ghar Nuddi belongs to Scindia and is the residence of a Raja, not a single good road is to be found in all this extent of country; mere foot paths and cart tracks traverse it, nor is a single bridge to be met with. While this state of things lasts, the traffic of these native states, which might easily be extended with advantage, will never be opened up and the resources of the country will continue undeveloped."

Mr. Scanlan thus describes the district round the immediate source of the Kunu river:—

Topographical description of Plane Table 67
Latitude 24° 45 to 25°.
Longitude 77° 15' to 77° 30'.

"This tract of ground is very nearly throughout the whole of its eastern length traversed by the Kunu river which runs due north, while towards the west the ground slopes away giving tributaries to the Parbati. The range known to us as the Kunu scarp enters the north-western section and continues on in an unbroken course till it embraces the river on both its banks as far up as Agra H. S., so that we have a valley well and clearly defined with spurs emanating from the principal range. The general aspect of the ground is of a broken-up nature traversed by multitudinous streams with detached hills crowning its plateaux; but this formation of ground exists in its greatest dimensions for only about 7 or 8 miles, after which we meet with a plateau intersected by many streams running towards all points of the compass. So that I may without incongruity speak of my middle section as the water shed of this table. The hills are sometimes very abrupt, rising to an average height of 1800 and 1700 feet above sea level, whilst their altitude above the valley is only from 400 to 500 feet, the chief characteristic to be remarked in them being the very many deeply scarped gorges. Almost all these gorges have proved a haven of safety to marauders and the mutineers of the memorable year 1857; notably one known as Kedar Kuika Kho.

"The country, with the exception of a few square miles to the east and south-east, is very thinly peopled and sparsely cultivated, even where the few occasional villages do exist, and is throughout clothed with a most luxuriant growth of heavy jungle perfectly free however from any entanglement of undergrowth as found in other forests of India. The soil is very rocky, water scarce on the plateau, but abundant below, and the roads of through communication are all easily traversed by carts. At the spot known as Kedar Kuika Kho, to which I shall have occasion to allude further on, there is a small and common-place temple at the bottom of the left hand scarp which immediately begins the gorge. In the Hindu month of February a large concourse of people assembles here to pray, feast and make offerings, after the orthodox manner in honor of the presiding deity Kedarnath, *alias* Mahadeo.

"From the areas which the debris covered, I was led to the conclusion that two or three sites had once been occupied by large and populous towns, and had this opinion confirmed by the traditions of the people, but the vestiges of the ruins are very ordinary and above the surface show the existence of nothing worthy of notice in architecture. In one ruined site I was shewn large slabs with colossal human figures embossed on them; from the manner of their designs I am of opinion that they are connected with the ceremonies of the Sarangi Banias, who in days gone by must have had a very large town here, and were in all probability expelled from this locality when the hypocritical Aurangzebe carried his iconoclastic invasion throughout the length and breadth of India, for this ruthless Goth even evinced his savage zeal by defacing some of the beautiful Saracenic architecture at Fatehpur Sikri. In some other places I found engraved on slate an arm raised from the elbow perpendicular to its upper portion together with a sun, star and crescent-moon depicted. What these mystical signs alluded to I failed to find out.

"The whole of the area comprising this table is split up into little territories presided over by the petty chieftains of Bhadoura, Umri and Sirsi, the two former of whom are allied by

family ties and the incidents relating to the family of the one will quite answer for those of the other. These two collateral branches of the great Rajput family are at feud with one another, and so great is their rancour that I am of opinion nought but bloodshed would wipe out their hatred. Even in these times of the supremacy of British rule carrying with it all the wholesome dread it inspires, and notwithstanding the vicinity of a British Political in the cantonment of Goonah, only 8 and 10 miles off, these two families still practise raids into one anothers' districts, the invariable issue of which is bloodshed.

"The following narration I have obtained from the family archives of the Umri chief. The Raja is a Sisodia Rajput descended from the house of Udepur. Ude Sing is his progenitor and was after the general manner of native potentates the lusty father of an unhappy family of twenty-four sons who were always contriving to cut each other's throats. Of these Sagarji was the fore-father of the present Raja, he was the youngest son and Partab Sing the eldest, the former received as his patrimony the territory of Sirohi, whilst the latter succeeded the Rana Ude Sing, and deprived his brother of his territories. He refused to give any ear to the complaints of Sagarji who thereupon complained to the emperor Akbar, having previously enlisted the Jeypur Raja's sympathy and interest, for he had already married that chief's sister. Akbar then ordered an advance to be made on Udeypur and accompanied his forces in person. The reigning prince, Partab Sing, was expelled and Sagarji assumed the sceptre. He only reigned seven years, for at the end of that period, on account of his nephew's many amiable qualities, and seeing in him a future good ruler, he resigned the reins of Government to Amar Sing, the son of Partab Sing, and retired to the court of Jehangir, who had by this time succeeded Akbar. He was made a Dewan and received Khandar as a Jagir, and on his death was succeeded by his son Man Sing who had given to him the additional grants of land of Sapur and Toro. To him succeeded Mokam Sing with possession of Khandar only, being deprived of the two additional grants in which his father appeared only to have enjoyed a life interest.

"This prince had two sons, Sojan Sing and Chatter Sing. The latter owing to some family dissensions, took up his abode at the Imperial court, and there growing in favor, he was deputed to take command of the army proceeding against Cabool. He defeated the enemy at Ghazni, and in recognition of these services the emperor conferred titles on him, and made him Lord of 60 villages or 5 barais namely, Tharonto, Mendpur, Badarwas and Nagdo; the remaining barai somehow he did not get possession of, it is said to have been situated somewhere near Anterbed in Oudh. After 12 years, Chatter Sing returned home and died at Tharonto. His son, Pertab Sing, succeeded him and established a friendship with one Nahardil Nawab, who had founded Nahargarh. Umri was then in possession of the Thakurs called Tagurs; their chief was Pailad Sing, who ruled over 49 villages. Pertab Sing, in conjunction with Nahardil, took possession of this territory, gave his sister in marriage to the Kota Raja, Maharon Ram Sing, who was killed, at the battle of Dholepur, and appointed his own son Himmat Sing chief of Umri, who taking part in the above mentioned battle was severly wounded in it. When the Kota Raja was dying, he appointed Himmat Sing regent, as the heir Bhim Sing was only an infant. Himmat Sing in conducting the affairs of the child-king was obliged to take up his residence at Kotah which entailed on him the loss of three barais Mendpur, Badarwas and Nagdo. He had two brothers, Jaggat Sing and Jai Sing, with the Kheodaman as his umras, to him he gave for services rendered eight villages, of which five still belong to Kheoda and three are attached to Garha. He gave to Jaggat Sing with Bhadowra four villages and two others Mon and Bulapur from Tharonto. From the revenue of the former five Jaggat Sing had to render to him a tribute of 6 annas in the rupee. The latter were free. The three villages of Porsar, Mokhawan and Senera were conferred on Jai Sing who had also to pay the same tribute, with Senera free.

"At this time Saiman was Dewan of Sirsi, whilst Sosingji Khichi was chief of Rampura and had married the Umri chief's niece. These two were at variance with one another, but Saimon and Raja Himmat Sing were on most friendly terms. Sosingji told the Raja that if he would take his part and fight against Saimon he would give him 22 villages belonging to Rai, they coalesced and a battle was fought at Patai when Saimon Dhandera was beaten, and accordingly the Raja received the 22 villages of Rai. At Kadar Nath to which I have referred in the first part of this paper there were two pujaries or priests, both brothers; one lived at Bhadowra and the other at Umri and both divided the Pujari dues. The Raja of Ragogarh took possession of 15 villages of Rai and attached them to Bamori, thus only leaving in possession of Umri 7 villages which remained in the possession of the Umri Kings for six generations. In the fifth generation to Jagat Sing of Bhadowra, Man Sing was born and Ragogarh was attached to Gwalior. Man Sing enlisted John Baptist Filose on his side and induced him to secure to him in rental the above 15 villages. This was accordingly done, and it appears that in latter years Man Sing got the ear of some one in the pay of the English Government, and obtained thorough possession of those villages in addition to two others which he wrenched from the seven that belonged to Umri territory. This proceeding gave rise to a dispute on Agra. Man Sing died and Mohan Sing, the present Raja, was born and carried on the dispute for 30 years, and failing to consummate the ends he desired, he conferred with Mokam Sing the present chief of Umri and they divided the land of contention. However in 1862 Mohan Sing managed to secure the remaining five villages.

"This is the history of Umri up to its present date, and I have not the slighest doubt these two men will carry on their feud till they impoverish one another. Close on to Bhadowra directly above the banks of the Kunu, stands the hill of Sandor on which was once situated the strong-

hold of the same name. Below its base on all sides, covering an area of about 4 or 5 square miles, are the ruins of a very large and ancient city. It is traditioned that the Raja, who was then reigning, for some reasons deserted this site and established the stronghold of Rimtambour, which should properly be known as Ranth Bhounar. This Raja had made several attempts to establish himself in this locality, but was expelled each time till at last he was informed by a faithful retainer, whose name was Ranth, that unless he, together with his Doge, Bhounar, was decapitated, and their heads buried, the one under the right pillar and the other under the left pillar of the entrance gateway, and their trunks thrown into the fosse, the Raja could not obtain a firm footing. The sacrifice was made, and the retainer, a Seria by caste and race, nobly offered himself up a victim to the cupidity of the grasping chief, who of course now gained all he desired."

Extract from the Narrative Report of F. B. GIRDLESTONE, ESQ., *in charge of No. 2 Topographical Survey, Khandesh and Bombay Native States.*

Khandesh and portions of Holkar's and Scindia's territory, North and South of the Nerbudda River.

Remarks on the country triangulated.

The country triangulated this last season lay chiefly in the north-east corner of the British territory of Khandesh and Holkar's territory of Nimawur, lying to north-west of British Nimar in the Central Provinces. Small portions of the Native States of Burwani, Dhar and Scindia also came into the season's work. The southern half of the area triangulated, lying between Latitude $\frac{21° 15'}{21-30}$ and Longitude $\frac{74° 45'}{76-15'}$ may be described as a perfect wilderness of hills, covered with high grass and dense jungle, embracing the main ranges of the Sautpoorahs, which stretch in one continuous chain from the craggy fortress of Assirghar on the east to the very lofty plateau of Turan Mal on the west. To the south these hills descend very abruptly into the plains of Khandesh, while to the north they fall by gradual long spurs, which again break into smaller ridges and then isolated hills down to the valley of the Nerbudda.

Hills.

The highest hill met with was the peak called Panchpandin in Latitude 21° 19′ 5″, Longitude 75° 40′ 34″, rising to a height of 3,522 feet above sea level, and about 2,595 feet above the large town of Yawal, lying in the plains of Khandesh immediately to its south. The ground between the southern ridge of the Sautpoorahs on which Panchpandin is situated, and their northern limit just before they commence to slope downwards into the low lands of the Nerbudda valley, is exceedingly broken up into ridges and plateaux, most of which average over 3,000 feet above sea level. These plateaux are often of considerable extent, such as that of Kotah, the centre of which lies in Latitude 21° 30′ 5″ and Longitude 75° 51′ 30″. They are beautifully wooded, chiefly with the Anjan, which much resembles an English birch tree, and whose light feathery foliage gives a park-like appearance to these undulating high lands.

The plateau of Kotah is singularly picturesque; from its eastern edges there are grand views of the wild broken country of the Pal Thuppa, the north east talooka of the Khandesh District, whilst on its western and southern sides the Anir and Kunda rivers offer much beautiful scenery, from the edges of the deep and well wooded gorges in which they run. Though destitute of inhabitants now, this and many other of the plateaux to be found among the Sautpoorahs abound in architectural remains of temples and other large buildings, leading one to suppose that these hills had once been thickly populated but forming now the abodes and haunts of wild animals only.

The climate of these plateaux was found to be delightful compared with that of the plains of either Khandesh or Holkar's territory, where hot winds commence to blow early in March. In the middle of May, my camp was pitched in the open on the Huri plateau 3,073 feet above sea level. The temperature was then 10° cooler in the day than on the low ground of Khargoon, lying on its northern side and 2,136 feet below it. At nights the difference was very much greater, and blankets were found very acceptable. The hot winds were blowing very fiercely down below, but on the plateau there was not a trace of a hot wind during the ten days my camp was pitched thereon. Huri plateau is well wooded and watered. It lies in Latitude 21° 32′ 27″ Longitude 75° 51′ 6″, is 32 miles from the nearest railway station of Raveree on the Great Indian Peninsula line, and is easily got at by the road leading from thence to the village of Pal, from which there is a good bunjari track right up to the top of the plateau. All these hills are said to be exceedingly malarious up to the middle of February. This year, however, owing perhaps to the great scarcity of water, my camp enjoyed fairly good health while among them. The natives, as a rule, much dread being taken into these hills apparently from fear of fever.

To the west of Huri the ground becomes wilder and the hills higher. The sacred hill of 'Tasdin' is a magnificent landmark for 30 miles round, and is a favourite spot for pilgrimages by Hindoos and Mahomedans. The summit is 3,389 feet above sea level. To its north in Latitude 21° 41′ 6″, Longitude 75° 23′ 32″, stands the hill fortress of Bijagar, now in a ruined state. It could be made very strong, as the hill is scarped on both the northern and southern sides. There are several tanks on the summit which is 2,708 feet above sea level. Between

Tasdin and Bijagar, and right along to the westward the country is very wild and jungly. The inhabitants are very few, and game, especially leopards, bison, and nilgai are very plentiful.

Rivers.

The Anir and the Kundi rivers were the only ones of any importance met with in the hilly portion of the work. Both these rivers rise near Lanka hill, the former flowing south-west till it finds an exit through the Sautpoorahs in a deep gorge underneath the hill called Sik, in plane table 29, from whence it flows in a southerly direction to the Taptee. The Kundi flows in a north-westerly direction towards the Nerbuddah, and takes the whole of the drainage from the northern side of the Huri and Kotah plateaux. The whole of the tract within the Sautpoorahs is, as a rule, badly off for water. A hill stream or spring was hardly ever met with, and my camp was often in very great difficulties. To many of the hills, on which observations were made, water had to be carried a distance of several miles. There was the greatest difficulty also in getting information from the Bheels about the spots where water lay, as they feared probably that their scanty supply would be speedily dried up if they allowed my large camp to make use of the pools from which they drew their stock.

Inhabitants.

Whilst the Southern portion of the season's work among the Sautpoorahs was found almost destitude of inhabitants, that to the north executed by Messrs. Belletty and Barkley along the Nerbuddah Valley was fairly well populated. Here and there among the Sautpoorahs are small clusters of temporary huts occupied by Bheels and Bunjaris, but even these run away generally on the approach of strangers. They make their living by cutting timber and selling it to the Bunjäris who come up from the plains, and eke this out by jungle fruits and fish from the Anir and Kundi rivers. They are wretchedly poor, very proud, lazy and fond of liquor, but an honest and humourous race. They seem to do very little in the way of cultivation, having no cattle, but are expert sportsmen with the bow and arrow. I found it difficult to induce them to do any work such as hill clearing, except when bribed with liquor or very high rates of wages.

Products.

The great trade of the country appeared to be in timber. The whole of the forests on the Khandesh side of the boundary are strictly preserved, but in Holkar's territory they are let out to contractors, and trees of all descriptions, young and old, are being taken away by the Bunjaris in immense quantities, and the forests rapidly sacrificed for present revenue. There are large stores of teak, damar, anjan and other valuable timber trees all over the Sautpoorahs, more especially on the northern plateaux, but instead of thinning and a judicious selection being practised, any trees likely to sell are allowed to be cut down.

Extract from the Narrative Report of Colonel G. H. Saxton, *in charge of No. 3 Topographical Survey, Central Provinces and Vizagapatam Agency.*

Bustar State of the Central Provinces, and Jeypur, Panchpenta, Madgul and Vizianugram of the Vizagapatam Agency in the Madras Presidency.

Triangulation and description of the country visited.

No new ground or extension of triangulation was required. The Deputy Superintendent went through the portions of country, where fewest points existed and closely interpolated over the current season's ground, and also where needed for next season. A chart of this work is being sent in, which with the original triangulation chart, as well as the standard maps, will shew that the ground surveyed, was closely filled with Trigonometrical points. Heights are given to nearly all of them; those without heights were laid down with a five-inch instrument, not suited for vertical observations.

The country passed through this season, includes some of the wildest and most difficult in this province; the elevations range from above five thousand feet, down to as many hundreds. Two considerable rivers, the Kolab and Sileru, run in a south-westerly direction towards the Godavery. In parts the country is almost impassable, and this difficulty in a measure hindered my attempts to combine inspection of surveyors with my triangulating duties. I came across the Great Trigonometrical Party and witnessed their very different mode of proceeding, a path being cleared from station to station, long before the large instrument and observer passed from one to the other. The large Galikonda range of hills, on which a sanitarium and coffee planting have been unsuccessfully attempted, and another almost equally high, (above 5,000 feet), Keverla range, are shewn in standard sheets Nos. IX and XXIV. There are villages and cultivated ground nearly up to 4,000 feet. Burji village Latitude 18°12'58" Longitude 82°56'56" where I was encamped is 4,015 feet, and has nice open cultivated and waste ground on all sides of it. The Galikonda range rises on north-east side of the village, and affords a plentiful supply of water. I shot snipe at this village in the month of March. On the more Western portion of the country under report, lies the Malkangiri plain, of very little elevation above the sea and regarding which a detailed report has recently been made to the Madras Government by the district officer, H. G. Turner, Esq., C. S. On the extreme west, beyond the Kolab river, the plain at same moderate elevation, extends in the Sunkom zemindary of the Bustar estate. This is a very wild and very sparsely populated country. Teak is met with throughout the portion surveyed by Mr. Adams on west side of the Kolab, but none to east of that river, at this portion of its course.

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Geological notes on the country between Latitude $\frac{18° 15'}{18° 30'}$ *Longitude* $\frac{82° 30'}{82° 45'}$ *by*

Mr. JOHN HARPER *Surveyor, 3rd Grade.*

A Departmental Order by the Surveyor General of India, directing the attention of members of survey parties to the opportunities the nature of their field duties affords them, of throwing light on Geological, Archæological and other subjects of a kindred nature, emboldens me to offer the following remarks on the Geological structure of the portion of ground, which I surveyed in detail, during field season 1871-72, and I do so with the hope that this, my first attempt of the kind, may be treated with indulgence and taken for what it is worth.

"Page's Introductory Text Book on Geology" has been my principal instructor, and I have studied it during some of my leisure hours from beginning to end, availing myself of such opportunities of identifying rocks as presented themselves to me, and now quote such extracts from it as seem best to tally with the surface configuration of the ground under consideration. 'The old red sandstone' system seems to include every condition of this configuration, the first series of the second group more particularly which is summarised thus: 'coarse red conglomerates interrupted by beds of chocolate colored quartzose sandstone. Occasional fish scales and plants' and the following account of the physical features of the system, making allowance for some cases of disruption of trap rocks describes well the appearance of the country. 'The physical features of red sandstone districts in Great Britain are generally diversified and irregular; the hills being less bold and precipitous than those of primitive districts and more lofty and irregular than those of the later secondaries. Where the strata are unbroken by trap eruptions the scenery is rather flat and tame, but the soil is light and fertile, being based on sand gravel and friable clays, the ancient debris of the formation.

"On the other hand, the hills of old red districts present great diversity of scenery, here rising in rounded heights, there sinking in easy undulations, now swelling in sunny slopes and anon retiring in winding glens or rounded valley basins of great beauty and fertility. The igneous rocks connected with the system are varieties of trap. These traps are rarely interstratified with the sandstones and generally appear as disrupting and upheaving masses, either about the commencement or at the close of the period, when those hills and ranges were formed which confer on the old red districts their peculiarly undulating and diversified scenery. Looking at the whole system we are prominently reminded of marine conditions of sea shores whose sands formed sandstones, and of beaches whose gravel was consolidated into conglomerates and pudding stones. The reddish color which pervades the whole strata, shews that the waters of deposit must have been largely impregnated with iron, in all probability derived from the earlier granitic and metamorphic rocks whose degradation supplied the sands and gravels of the system.

"The scenery I am describing is considerably diversified, the hills varying from rounded heights to undulating ranges, and in some cases, hills with flat tops of considerable space, locally known as Bidings or Malies. On the two former the rocks are of sandstone with very few specimens of conglomerate among it, but on the Bidings I noticed that the sandstone prevailed for about two thirds of the height when it almost totally disappeared and the conglomerate took its place, generally enclosing the top with a precipitous wall and fragments being scattered all over it. These latter (Bidings) may be the result of an out crop of Trap Rocks and the conglomerate one of the rocks of that system, named trap-tuff, which is described as "occurring in every stage of texture from soft scoriaceous masses to compact aggregation, of rocky fragments cemented together by igneous action." The country is very pleasant to look on, is densely populated and extensively cultivated leading an eye witness to judge that it is very fertile. The presence of Trap Rocks may add to its fertility as well as to its beauty, as the following extract from the chapter devoted to them will shew. All the older secondary regions, that is, those occupied by the old red sandstone and carboniferous systems owe their surface configurations chiefly to manifestations of trap. Much of this is of contemporaneous origin with the rocks among which it occurs, and is of course interstratified with these deposits, but a great portion also is of posterior date, and in this case occurs as disrupting and overlaying masses. The scenery produced by assemblages of trap hills is often extremely picturesque and beautiful, and the soil produced by the decomposition is generally so dry and productive, that the term trap district is usually regarded as synonymous with amenity and fertility.

"The River Machkund of last year, in my ground known as Machieru (fish river) runs a very tortuous course about diagonally across my board, and after its junction with a tributary 'the Patal,' equally tortuous, becomes very deep, and fords only occur at considerable intervals. The beds of minor water courses are invariably covered with fragments of sandstone of sizes, all shewing a tendency to rectangular form."

Note by MR. J. A. MAY *Surveyor, 4th Grade on the country surveyed by him during field season* 1871-72.

Latitude 18°15' to 18°30'.
Longitude 82°15' to 82°30'.

The ground I was engaged on during the past season was of a very difficult nature, consisting of the out-fall of the Jeypore plateau to the south-west. High ranges of sandstone formation running parallel to one another, end in small confused hills

of the same formation, intersected by numerous large streams, which form many waterfalls at their descent from the table land, and run through deep rugged ravines. Of these the Boro-Kolab (great valley) river is the principal, being the same with the Machkund as given in the maps submitted last year.

To the south-east corner, and extending into my neighbour Mr. Harper's ground, are numerous flat topped hills, the out cropping rocks of which are a species of conglomerate, composed of sandstone and other rocks of a rusty color, cemented together with some substance resembling lava; their tops are bare, and the slopes, for the most part, covered with forest. The most remarkable hill in my ground is Cherubiding H. S. one of Colonel Saxton's stations, and has been described by him, but an account of which, I trust, will not be out of place here. This hill is about a square mile in extent, having two principal undulations, on which the stations are, and between them is a curious looking depression suggesting the idea of an extinct crater about 150 yards in length, being nearly in form of a square, with banks fifteen feet or thereabouts in height, in which, during the rains, water is retained to a depth of from four to five feet. There are two outlets to this little basin opposite to each other, forming rather considerable streams, which meet about four miles distant in the valley below.

A legend is current among the natives as to the origin of this hollow, and is as follows:—At a time, as is generally the case with such stories, beyond the memory of man, one of their gods, named Bhima, with his sister occupied this hill and jointly cultivated it; and as it was usual for them to labor apart in a state of nudity, Bhima, to prevent unseemly rencounters, had recourse to a string of bells which he wore round his waist, and served to make known his approach to his sister who immediately covered herself in order to receive him. But on one occasion she accidentally appeared before him naked, a circumstance which so shocked their modesty, that they fled precipitately from each other in opposite directions—thus the basin is said to have been formed by rice cultivation, and the two outlets of the respective paths taken by this highly modest couple. The presence of 'Paddy' unaccountable to the villagers has no doubt led them to the framing of this legend. I was encamped on Cherubiding for a day in the month of March, and found it delightfully cool and pleasant. A little way down the hill, in one of the streams above alluded to, is a spring of good water which I believe is perennial, as is the case with all streams on the highlands.

The Boro kolab or Machkund runs diagonally across the ground in a south-westerly direction parallel to the ranges of hills on either side in a deep narrow valley. It is fordable near the villages Sindgur, Bojugura and Amliwara during the dry season, but farther down it is very deep, and alligators are said to be plentiful. In these parts, the only means for crossing the river are small canoes scooped out of solid logs of sall *(Shoria Robusta)* about 15 to 20 feet long and 2 deep; these are at best unsafe, but by lashing two together, a boat, reliable and capable of bearing a pretty heavy load, is constructed, but the scarcity of canoes makes it a matter of the utmost difficulty to cross a camp. It is remarkable that this river seems to separate the Telegu from the Ooria speaking people, the former occupying the country on its left bank. Another peculiarity I noticed was that on its right bank the magnetic needle was deflected to a great extent and unequally by the iron stone so plentiful in the little hills about, and caused me great annoyance and extra labor while surveying, as I could not depend on a station unless made by reference to three or four points. On the opposite bank, however, the needle seldom or never varied.

The general aspect of the country is hilly, rugged and forest-clad, and, excepting on the highlands, cultivation of any kind is rarely to be seen. The villages in the valley are very few, scattered and small, seldom consisting of more than two or three huts, and inhabited by wretched specimens of humanity who are, for the most part, afflicted with loathsome scrofulous sores, which render them almost useless to themselves and to others.

Roads, which are nothing better than mere paths leading from one village to another, are few, and, with the exception of one or two, bad in the extreme, running as they do along steep ravines and over rocky ghâts quite impracticable to beasts of burden.

The several tribes inhabiting this portion of country are the Bhoudas, Dera Porja, and a caste of people who speak the Telegu language exclusively. Of these, the Bhondas are the most remarkable, the rest being in general like the other tribes to be found in Jeypur and the adjacent districts.

The marriage ceremony costume of the women and religious observances of the Bhondas are peculiar to themselves. These people, who are to be met with chiefly on the highland between Andrahal and Dangapara in the district of Jeypur, and comparatively few in number, keep themselves apart from all other tribes with whom they do not intermarry. The men are not bad looking, they are well built and active, and passionately fond of sport, of which they seem to be very jealous with regard to Europeans; they dress like the other Ooria tribes, and adorn their necks with beads, but to a moderate degree.

The women, however, are extremely ugly, both in features and form, which is rendered more repugnant by their short hair, and the scantiness of their attire which consists of just a piece of cloth, either made of the kerong bark and manufactured by themselves or purchased from the weavers of the country, about a foot square, and only sufficient to cover a part of one

hip; it is attached to their waists by a string on which it runs, and can be shifted round to any side. A most ludicrous sight has often been presented to me by a stampede among a number of these women, when I have happened to enter a village unexpectedly where they had been collected in the centre space usual in their villages intent upon their occupations. On my approach, each one and all hurried to their respective dwellings, and, as they ran in all directions, endeavoured to shift this rag round to the part most likely to be exposed to me. They are necessarily very shy, and are seldom to be met with out of the village, except at mid-day, when engaged assisting the men in the preparation of ground for cultivation and when there is the least possible chance of meeting with strangers; but among themselves they do not seem to be at all particular.

This peculiar mode of dress originated in the following legend, implicitly believed by the Bhondas:—'Time out of mind, the Goddess Sita happened to travel through this part of the country, and when she halted on one occasion while superintending the preperation of her mid-day repast, found herself surrounded by a large number of naked women; she blushed to behold such indecency, and forthwith presented them with a piece of tussur cloth, which was eagerly accepted, but when divided, found to supply each one with only just enough to cover one hip. The Goddess, whose travelling wardrobe evidently did not allow of greater liberality, then commanded that they should always in future cover themselves thus much, death being the penalty of their disobedience; my informant gave me to understand that one of the Government agents in these parts, some years ago, insisted on a young woman being properly clothed, the result was she survived the change only three days'! This story, which is declared to be strictly true, has unfortunately had the ill effect of confirming these people in their superstition.

Their marriages are consummated in a very curious manner. A number of youths, candidates for matrimony, start off to a village, where they hope to find a corresponding number of young women, and make known their wishes to the elders, who receive them with all due ceremony. The juice of the Sallop (sago palm) in a fermented state is of course in great requisition, as nothing can be done without the exhilerating effects of this their favourite beverage. They then proceed to excavate an under-ground chamber (if one is not already prepared), having an apperture at the top, admitting of the entrance of one at a time; into this the young gentlemen, with a corresponding number of young girls, are introduced, when they grope about and make their selection, after which they ascend out of it, each holding the young lady of his choice by the forefinger of one of her hands. Bracelets are now put on her arms by the elders (this has the same signification as the wedding ring among European nations), and two of the young men stand as sponsors for each bridegroom. The couples are then led to their respective parents, who approve and give their consent. After another application of Sallop, and sundry greetings, the bridegroom is permitted to take his bride home, where she lives with him for a week, and then, returning to her parents, is not allowed to see her husband for a period of one year, at the expiration of which she is finally made over to him.

Their religious ceremonies, like that of their neighbours, consist in offerings to some nameless deity, or to the memory of deceased relations. At each of the principal villages the Bhondas congregate once a year in some spot conveniently situated for their orgies, when a chicken, a few eggs and a pig or goat are offered, after which they retire to their houses, and next day assemble again when the Sallop juice is freely imbibed, till its intoxicating effects have thoroughly roused their pugnacity; the process of cudgelling one another with the branches of the Sallop now begins, which they apply indiscriminately without the smallest regard for each others feelings; this, with the attendant drum and shrieks, would give one the impression of a host of maniacs suddenly set at liberty. This amusement is continued till bruises, contusions and bleeding heads and backs have reduced them to a comparatively sober state, and I imagine, old scores paid off, when they return to their several houses. Thus ends the grand festival of the year. Their other festivals have nothing remarkable.

Country produce is poor and limited to Sua (a small grain resembling sago) and Khandol a large species of arrar dâll, which are cultivated on the slopes of hills; rice is also grown in the beds of small streams which are terraced and bunded for the purpose, but to a very small extent, Sua being the staple. This grain is prepared for food by either boiling to the consistency of gruel or hard-like rice.

The natural products are iron ore, gall nut, and stick lac. This last is to be found only on the Kussum tree (the hardest of all jungle wood), on the twigs of which the little lac insects build their gum-like nests which constitute the lac. These are collected by the villagers in small quantities, and sold or bartered for at the different hauts or fairs about the country.

The only timber trees I could recognise were the sall, a few wretched specimens of teak on the banks of the Boro kolab, and kendu, a species of ebony.

Game is plentiful, as must be the case, in a country so thinly populated. The Bison (gaor) sambur, pig, axis or spotted deer, the ravine deer, bears, and occasionally the wild buffalo and tigers, roam at large and fearless of man, with whom they are so little acquainted. Pea fowl and other wild fowls are abundant. The otter also is to be found, but only on the banks of the larger streams.

Extract from the Narrative Report of MAJOR G. C. DEPREE, *in charge No. 4, Topographical Survey, North-Eastern Division, Central Provinces.*

SOHAGPUR OF REWAH STATE AND BELASPUR DISTRICT.
Country Topographically Surveyed.
Latitude 22° 30′ to 23° 30′
Longitude 81-30 to 82-15.

The country surveyed in detail during the last season may be briefly described in three sections.

First or highest level.

First is the high plateau, called the Mekal-pât by the country people round about, from which rises at Amarkantak the Nerbudda river flowing westwards and falling into the Gulf of Cambay. Within two miles of the same spot, and from the same hill, rises the Johilla, which, flowing north-west, joins the Soan and flows into the Bay of Bengal. The highest part of the plateau is 3,860 feet above sea level, and the valley of the river Nerbudda is in this part 2,600 feet, and that of Johilla 3,000 feet above the sea. The northern face of the pleateau descends very abruptly to the plain of Sohagpur. This face has been surveyed for about 50 miles only. The valleys of this pleateau are perfectly bare of forest, and are covered with tall coarse grass. They are thinly inhabited by wild Gonds, who live in wretched mud huts. The Gonds are bad cultivators; they plough and sow the ground for three years, and desert it for other virgin soil. The country of rice cultivation and terraced fields, as found in Chota Nagpore, is no more met with, and the crops consist of kodo, wheat, gram and other grains, which grow on uplands with a small expenditure of labor. The chains of hills, separating the valleys and the summits of the various plateaux, are covered with heavy jungle.

Second level.

The second is the terreplein of Pendra of Chateesgurh and Sohagpur of Rewah. On the south part of this rises the Soan river at an elevation of 2,100 feet above the sea. It flows north and north-west through an undulating country, fairly inhabited and cultivated by a Hindoo population. The country below the fall of Mekal-pat is 1,600 feet.

Third level.

The third level is that on the south of the plateau on which is the source of the Soan. It forms part of the estate of Kenda of Chateesgur. All the streams of this tract fall into the Mahanadi river, which reaches the sea on the east of Cuttack. The elevation of Kenda is 1,150 feet. The hills and valleys are thinly inhabited by a mixed Hindoo and aboriginal population, and the jungle is very dense.

Extract from the Narrative Report of CAPTAIN R. V. RIDDELL, R. E., *in charge No. 5 Topographical Survey, Bhopal and Malwa.*

EASTERN PORTION OF BHOPAL PLANE TABLED.
Latitude 22° 45′ to 24°.
Longitude 78° to 78°-50′.

"The country plane tabled was chiefly in a fairly well cultivated tract, that is, villages were numerous, and the population in proportion, and the soil that was under cultivation was rich and easily manipulated. During the season under report, 2172·26 square miles of the Bhopal State were surveyed, of which 1,361 square miles were cultivated; 590·3 square miles of the Gwalior State, of which 419·1 were cultivated; 30·4 square miles of the principality of "Mohamedgarh", of which 13·3 were cultivated; 39·75 of the principality of "Nawáb Basoda," of which 23·1 were cultivated; 16·31 of the principality of "Pathári," of which 11·6 were cultivated; 32·4 of the principality of "Kurwai", of which 24·2 were cultivated; which shews a general proportion of land cultivated at 60 per cent. of the whole.

The three principalities of "Mohamedgarh," "Nawáb Basoda" and "Pathári," will not again be met with in the course of the work of this party, and I believe the whole of their territories were surveyed this last season by this party. The principality of "Kurwai" will again appear, but in very limited extent part of it must have fallen to the lot of No. 1 Party. The soil is almost entirely of the description commonly called (I believe) the black cotton soil. During the rains this becomes so soft that the flat parts of the country resemble a quagmire; every thing seems to grow very quickly; hills that I had cleared the previous year for observing for triangulation were covered with bush jungle about 15 feet high.

Hills.

Diagonally, through this season's work, a little south of the centre ran the back-bone of the "Vindya" range; the general level of its crest is about 1,800 feet above the sea level, but there are several peaks and ridges, dotted about the main ridge, which rise to nearly 2,400 feet. I am not quite sure where the main ridge of the "Vindya" range enters this survey, but I think that it lies between the "Dassán" and the Beas, and is defined by the water-shed between those two rivers as far as the hill called Jasarti H. S. If so, the hill north of the village of "Udka," 2,186 feet above the sea level in plane table, section 4, is the first peak commencing from the east, on the water-shed of the "Vindya" range. Then the hill called "Jasarti" H. S., 2,347 feet above the sea level, at the foot of which springs the "Dassan," is the next prominent point on the ridge, then a little peak on the ridge south of the village of "Bichna" in plane table No. 8, then the peak called by us "Dabri" H. S. height 2,365 feet above the sea level, between the villages "Pipalia", "Dabri" and "Nagpura."

The next prominent hill on this water-shed is "Baorgarh" H. S., height 2,056 feet, touching the village of "Baorgarh" in plane table No. 9; between "Dabri" and "Baorgarh" there is a prominent hill, height 2,121 feet north of the village of "Sodarpur," but this is about 1½ miles north of the main water-shed.

West of "Baorgarh" the next prominent feature on the ridge is the "Bilwani" hill, height 2,001 feet above the sea level; following the course of this ridge westwards the track lies over the low hills near the village of "Indiari" and "Mulameta" in plane table, section No. 10 to the village of "Jhamar," and thence to the summit of the "Rajghat" pass. This pass is the high road between Bhopal and the south-eastern mehals or pergunnahs of the Bhopal State; at this point a prominent water-shed springs into existence, *viz.*, the one between the "Bina" and the "Betwa," and this runs out from the "Vindya" range in a northerly direction; on the eastern side lies the "Bina" and its feeders, which run at a considerably higher level than those of the "Betwa" on the west side. At this latter side there is an abrupt fall of about 400 feet, and then a large plain drained by streams which run into the "Betwa" at a level of from 1,500 feet near the foot, the abrupt fall just mentioned, to 1,400 feet at a distance of 30 miles from the "Rajghati" pass; whereas on the eastern side the fall is at first very gradual up to a distance of 30 miles from the same pass; the plateaux between the streams are at a height of 1,800 feet, and the streams themselves are not less than 1,600 feet above the sea level. From the "Rajghati" pass westwards the water-shed of the Vindya range follows a much less well marked course, at a level in some places as low as 1,600 feet to "Narwar" H. S., height 1,937 feet above sea level.

The highest hill on this range, or in the ground as yet met with in this survey, is "Kheda" H.S., height 2,385 feet above sea level on a spur of the "Vindya" range, running eastwards from "Dabri" H. S. South of the water-shed between "Kheda" H. S. and the "Rajghati" pass there is an abrupt fall of about 750 feet below the general level of the water-shed, south of which is a richly cultivated plain, 10 miles wide at its greatest width, extending about 32 miles from west to east. This valley is encircled by spurs of the "Vindya" range, roughly resembling a distorted horse-shoe, one side of which springs from west of the "Rajghati" pass, and the other from "Kheda" H. S. Joining the heels of this horse-shoe is a bar of low hills, between which there are several passes. The main water-shed of the eastern spur takes the following course from "Kheda" southwards over the hill west of the village of "Ghana" to "Surkari", then eastwards and a little north-east as far as the meridian of 78° 40'; then down the spur on which the boundary between the Bhopal Territory and the "Saugor" District to a point called in our triangulation "Gogri" north pole (height 2,120), at a little west of which the water-shed is at a low level, and crossed by a road running northwards from "Gogri." From "Gogri" north pole the water-shed runs to "Narainpur" peak, then southwards through low ground past the villages of "Papro" and "Salabaru" across the hill on which the village of "Chargama" is situated to a hill about 1½ miles west of the point called "Katak" H. S. (height 1,530) in our triangulation, then westwards towards the peak called in our triangulation "Sara," east pole; along part of the ridge between "Sara," east pole, and the village of "Jujarpura," to south of the village of "Bana Deari," then up to the hill known as "Dudia" (height 1,987) on which our principal station of that name is situated, and from thence westwards to the foot of the hill near the village of Patna.

This line, as far as "Sara," east peak, is the water-shed between the "Sendur," on the east (which, for a long distance forms the boundary between the Bhopal territory and the British districts of "Saugor" and "Nursingarh") and the "Tendoni" on the west. The western side of the valley is bounded by a ridge running southwards from "Rajghati," on which "Singori" H. S. (height 2,148) and "Kartoli hill" pole (height 1,854) are situated, then nearly southwards as far as the parallel of 78° 15' to about two miles north of the village of "Udejri". Between this point and "Dudia" H. S. is a ridge of hills on which "Badalgarh" H. S. (height 1,792), "Dongeria" H. S. (height 1,532), "Piperia" pole (height 1,378), "Singota" pole (height 1,273), "Kissenpur" H. S. (height 1,435), are situated. The hills forming this belt are almost all abrupt and precipitous on the south face, but comparatively of a gentle slope towards the north. The belt is cut through by numerous streams, generally running southwards, but here and there, as if on purpose to break the monotony, the sources of the streams running between these hills are in the plain south of the belt of hills.

From about the meridian of 78° 7' another spur leaves the main ridge of the "Vindya" range, but this spur is so broken that it represents the appearance of isolated groups of hills, which terminate near the village of "Bari." These hills present features of every possible shape and slope, but throughout the southern portion the abrupt precipitous slope is facing the south, and the gentle slope faces the north; the most remarkable of these hills are the groups between the old fort of "Chokigarh" and "Badalgarh," which, from the north-east or from "Dudia" H. S., present the appearance somewhat like a saw, the difference being that the heights of the peaks of these hills are not so regular as the teeth of a saw.

A little west of the group of hills south of "Chokigarh," is a gorge, through which issues a river which collects the drainage of a circle of about 15 miles in diameter, although from either side a spectator might imagine, from the rocky and precipitous appearance of the hills, that a road to the other side would be impossible; yet there are two very fair roads on the right bank of the "Bamne," which join near the village of "Furtalla," and are extensively

used by the "Binjaras," are passable for carts and camels. On the left bank of the "Bamne" there is also a road which could very easily be made passable for carts and camels.

On the water-shed between the "Betwa" and the "Bina," starting from the "Rajghati" pass, the hills called "Bilgarh" (height 2,221), "Saugor" H. S. (height 1,956), "Lakoli" H. S. (height 2,184) in sheet No. 5, standard map "Mankapur," east tree (height 2,022), "hill pole" 15 (height 1,981), hill pole 24 (height 1,930), "Chiroda pole" (height 1,893) in sheet No. 3 of the standard map are situated. North of the last mentioned sheet the ridge takes the shape of isolated hills, of which there are several very conspicuous ones in sheet No. 1 of the standard maps, more especially the hills on which the stations of "Pathari" (height 1,885), "Teonda" (height 1,866), and "Udepur" (height 1,878), are situated, also the peaks called on the chart of triangulation, "hill pole 1" (height 1,715) "Belai pole" (height 1,871), "hill pole 3" (height 1,762), "Saiba tree" (height 1,838), and "hill pole 23" (height 1,867); these peaks rise up to 500 feet or nearly so above the surrounding plain.

Rivers.

The principal rivers met with in the season's work are the "Narbadda" with its feeders the "Sindor," the "Tendoni," the "Banna."

The "Betwa," the "Bina," with its tributaries, the "Dudai," the "Semri," and the "Babnai." The sources and small portions of the "Dassan" and the "Beas," both of which were large rivers in the Bundelcund States, formerly the field of survey of this party.

The "Narbadda".

The "Narbadda", where it enters the work of this party in standard sheet 6, is a river of a little more than 300 yards in width from bank to bank, running between steep banks, some 40 or 50 feet in height, between the "Sindor" and the "Narbadda," and about 1¼ miles from their junction, the level of the ground is 1,091 feet above sea level, at the station called "Hirapur," which was made in a field. At 63 miles further along its course where the "Narbadda" crosses the meridian of 78°, it is over 900 yards in width from bank to bank, and the general level of the country on either side at a distance of about a mile from its banks is 1028 feet, which would shew that the river had a fall of 63 feet in 63 miles, or an average of a foot a mile. There are numerous fords and ferries across this river, which are detailed in a separate form appended to this report.

The "Sindor."

The "Sindor," where it joins the "Narbadda," is a stream of about 100 yards in width; it rises in standard sheet No. IV in Latitude 23°-22′ Longitude 78°-40′, about 4 miles from "Kheda" H. S., and about a mile from a peak called in the triangulation "Berkheri" West peak. The course of the "Sindor" is about 40 miles in length, starting in a south easterly direction, and gradually turning towards the south.

The "Tendone."

The "Tendone" rises about 1½ miles south of the source of the "Sindor," starts in a south easterly direction, but turns round to the south west after it has run about 8 miles, continues more or less in that direction until it joins the "Narbadda" near the village of "Bagalwara," in sheet No. IX Longitude nearly 78°-15′: its entire length is about 70 miles, and its chief tributaries are the "Naharia," length 17 miles springing from nearly south of "Sirmow" in standard sheet No. IV.

The "Nakte," length 27 miles, springing a little west of the village of "Dabri" in standard sheet No. IV. The Bhurka, length 13 miles, springing about 2 miles south of "Jeithari" in standard sheet No. VI. The "Gajanda," length 20 miles, springing from near "Bilwani" hill near the middle of standard sheet No. V. The "Garanj," length 27 miles, springing from near the village of "Jhamar" west of the above, and in the same standard sheet.

The "Banne or Bamne."

The source of the "Banne" is somewhere near "Kaliakeri" in degree sheet No. III which will come into the field work of the coming cold weather, but the last 33 miles of its course lie in the country already surveyed. The "Banne" passes through the south west corner of standard sheet No. VII when it is joined by the "Chamarsel," a stream of about 15 miles in length springing near "Narwar," in standard sheet No. V; the "Jamner" which rises in degree sheet No. III and the "Narhari," a small stream of about 14 miles in length rising near the north of standard sheet No. VII. In sheet No. IX the "Jamner" is joined by the "Ghogra," a stream of about 25 miles, rising south of "Rajghati" in standard sheet No. V; finally the "Banne" joins the "Narbadda" west of "Bagalwar" at a distance of 1½ miles from the junction of the "Tendone" with the "Narbadda."

The "Beas."

The "Beas" rises at "Sirmow" standard sheet No. IV, and before it passes out the Bhopal Territory into the "Saugor" district near "Patha" in standard sheet No. II, it becomes a sluggish stream running between steep banks of a soft clay from 50 to 100 yards apart, in the last 6 miles of its course through standard sheet No. IV, and in this distance only three fords are met with.

The "Dassan" rises at the northern side of the hill called "Jasarte" H. S. in our triangulation, close to the village of the same name in standard sheet No. IV. The first 14 or 15 miles of this river come into this season's work standard sheet No. II; and in this distance there are numbers of fords. Where the "Dassan" leaves the Bhopal Territory; it is a stream about 80 yards in width.

The "Dassan."

The "Bina" rises near "Bilgarh" hill, Latitude 23°-19'-4" Longitude 78°-10'-42", south of the village of "Lutri;" in standard map No. V, after having run a course of about 35 miles; in a direction a little east of north, it is joined by a stream of about its own size formed by the junction; a mile further east of the "Semri," and the "Dudai" which take their sources near "Sodarpur" and "Dabri" respectively in sheets No. V and IV. Seven miles further on, the "Bina" leaves the field of survey of this party, and passing through a corner of the Saugor district is again met with in Latitude 23°-55' Longitude 78°-20' sheet No. I, where it is is joined by the "Babnei," and becomes the western boundary of the Saugar district. From this point the "Bina" is a river of formidable dimensions, its banks being from 200 to 300 yards apart. There are numerous fords and ferries across this river which are all detailed in a separate form.

The "Bina."

Only a small portion of the "Betwa" has fallen into the ground surveyed this season, *viz.*, 7 miles in the north-west corner of standard map No. I. It is here a river of from 200 to 300 yards in width; about a mile east of where the "Betwa" leaves the work of this party, another stream, the "Keotan," also passes into the work of the Gwalior party, and must very soon afterwards join the "Betwa." The "Keotan" takes its rise about 4½ miles south of "Garaspur" in sheet No. III and runs about 36 miles before it passes into the work of No. 1 party, drawing all the drainage of about 270 square miles of country, chiefly to the east of its course. One of the tributaries of the "Betwa" the "Neon" by name rises near "Rajghati" in sheet V, but passes out of the work surveyed at about 12 miles from its source.

The "Betwa."

The "Keotan."

The population is chiefly Hindu, the proportion as yet met with shows 15 Hindus to about 1 Mussulman, and these latter are seldom to be found except in the large villages and cities. At the eastern end of the valley of the "Tendoni," there are several "Jagirdars" descendants of the old Gond proprietors of the soil; their jaghirs do not seem to have a large proportion of the rich soil, but perhaps they and their ancestors have not been so industrious as the more pushing followers of the reigning creed.

The heat in the "Narbadda" valley and in the valleys south of the crest of the "Vindya" range is far greater than anything I ever experienced in Rewah, Bundelcund, Gwalior or Jeypur. In those districts I never remember registering a greater measure of heat than 102 Fahrenheit at the hottest time of the day, in a small hill tent, up to the end of the third week in April. But during the last two years south of the crest of the "Vindya" range I have registered 105° to 107° in a large and better tent, every day after the middle of March and sometimes in April as much as 109°. The Klassies who are chiefly inhabitants of Oudh show that they feel the difference of climate as much as we do."

Memo. of Forts and petty "Garhis."

Chokigarh Fort in standard sheet No. VII is situated on the northern end of a spur (600 feet above the plain) of the group of hills north of the town of "Bári." These two places are said to have been the chief residencies of a Gond Rajá who possessed this portion of the Bhopal territory, and built the fort some 200 years ago.

"Chokigarh" Fort

The fort is in shape, roughly speaking, that of a rhombus, the sides of which are about 600 yards in length, and whose corners point nearly to the north, east, south and west respectively, but as the wall follows the shape of the rock on which it is built, a cross fire could be brought to bear on several parts of the approaches in the immediate vicinity of the upper wall.

There are five gateways in the upper wall, one near the eastern corner, is called the Bhopal gate, and is the chief entrance to the fort; the road to this gate from the village of "Alampur" is such that carriages may be driven up to the outer gate, which is about half way up the ascent.

At the northern gateway the descent to the village of "Karanpur" is merely a foot-path, now used by the sepoys (whose wives and families all live at "Karanpur") on their way to and from their food.

At the eastern gateway the approach is passable to horses, but this is not used now.

The southern gateway is not used now, there is a ditch outside this portion of the rampart wall, which is here higher, thicker and more solid than at any other part. This leads out into a plateau on about the same level as the fort, and extending in a south-easterly

direction for nearly a mile, having an average width of about 300 yards, along which there is a foot-path past the point called "Nagpani hill pole" to "Bári". The fifth gateway lies between the southern and western ones, and is now seldom used."

The rampart wall varies in height; in some places when a natural wall is formed by the abrupt drop of the side of the rock, it is only 2 or 4 feet high, formed of stone without mortar, at others, especially at the southern corner, it is about 20 feet in height, built of squared blocks of stone averaging 27 by 18 by 9 inches in measurement, well and firmly set together.

The Bhopal gateway is the one on which the greatest amount of labor seems to have been bestowed; at this entrance there are three gates to be passed before an entrance to the top of the plateau or interior of the fort can be effected.

The remains of the old Raja's dwelling house are still standing, but in ruins. There is a tank among these ruins connected with what seems to be a deep well cut out of the solid rock, but the natives say that the water is all from the clouds; no spring exists. Lower down near the outer gate of the Bhopal entrance, there is a large tank which seemed full of water at the end of the month of March.

In ancient days this old fort might have been a formidable stronghold, but must have been useless as anything else, for it commands no great roads or important passes.

"Mahilpur Fort."

There is a small fort which though built of masonry can only be called a petty "Garhi" at "Mahilpur" in the "Raisin" pergunnah. Its shape is simple, being either a square or rectangle whose sides are about 120 yards in length, and at the corners of which are four circular towers; the walls are about 20 feet high, and two feet thick at the top.

"Garhi Fort."

At "Garhi" "Amapani" there is a small fort of the same character as the above, now merely used as a tehsil building. This was built by the late husband of the present Begum, and used to be of larger dimensions, and covered ground measuring 300 and 250 yards. Report says that during the mutiny the tehsildar mutinied, he burnt the village of "Garhi" and occupied the fort, but having been driven out by some British troops, he fled to "Ratgarh" where he was caught and hanged. After this the greater portion of the walls were knocked down. The above two are both in standard sheet No. V.

"Siwas Fort."

At Siwas, standard sheet No. III, there are the remains of an old fort of an irregular description in the centre of the village. This might be more formidable, if it were not for a hill on the south-east side of the village not more than three-fourths of a mile distant, from which the fort could be made untenable.

"Deori Fort."

Near the tehsil of "Deori," at the once eastern end of Bhopal, a thick wall enclosing a portion of the hills north of the village and extending for some distance eastwards along the crest of the ridge, is supposed to be the remains of an old fort or fortified camp built by the Gonds.

"Mohamedgarh Fort."

At "Mohomedgarh," standard map No. III, there is a small hill fort, a petty "Garhi" built of solid masonry situated at the northern end of the hill, at the foot of which is the village of "Mohamedgarh" overlooked by the fort. This fort is in shape a rectangle whose sides are about 200 yards and 150 yards, with circular towers at the corners. The hill on which this fort is built is said by the assistant who surveyed it to be inaccessible except from two points, one from the village of "Mohamedgarh" from which a foot-path ascends to a point a little south of the fort, and the other from the village of "Chichli;" this seems to have been the principal entrance. This is the residence of the Nawab of the principality of the same name, which is a feudatory of the British Government, but the principality is guaranteed to the Nawab by the British Government.

"Nawab Basoda Fort."

At "Nawab Basoda," 3 miles south-east of the above, there is a similar little fort, but larger and having an outer wall built on the east end of the hill, at the foot of which lies the village of "Nawab Basoda" also overlooked by the fort. The hill on which the fort is built is accessible to men on almost all sides, carts can ascend from the village of "Barwai." The Nawab of this principality acknowledges Gwalior as his Suzerain, but his principality is guaranteed to him and protected by the British Government.

Extract from the Narrative Report of CAPTAIN GEORGE STRAHAN, R. E., *in charge, No. 7 Topographical Survey, Rajputana.*

Odeypur, Jodhpur and Mairwarra.

The country over which my triangulation extends this season is on the eastern flank of the Arabulla range, the height of which appears to have attained its maximum about here, according to Mr. Horst's report, extracts from which are given below. Its breadth is about 20 miles.

There is a difference of 800 or 900 feet between the level of the plains on the eastern and western flanks, the latter being the lower. The forms and general appearance of these mountains differ greatly on the two sides. On the eastern or Meywar side the plain rises gradually, and becomes more and more broken up with little irregular hillocks of rock until a plateau is reached, from which the highest summits rise in long ridges nearly precipitous on both sides. In many parts there are two or three of such ridges running closely parallel to each other, and forming valleys which are entirely inaccessible to wheel conveyances or laden camels.

On the Marwar side the descent is abrupt, the features of the hills larger and the jungle thicker. The mountain outlines are more imposing, but their color is too monotonous to produce really beautiful effects. This chain forms one of the most important watersheds in India, the drainage on the western side converges for the most part to form the Luni river, and on the eastern the Banás, the former flows into the Runn of Cutch, and the latter into the Chambal and thence to the Bay of Bengal. I have not yet heard that any minerals of interest or importance are found in this range, but during the approaching season more information will be obtained as the detail survey is then to be taken in hand. These hills are but thinly populated; the inhabitants are almost entirely Bheels.

The main road from Nimuch to Mount Abu *viâ* Erinpura runs through the chain on the paralell of 25°-16′ in a gorge called the Desúri Pass. The road is very picturesque, bordered on both sides by cliffs nearly 1,000 feet high, between which glimpses of the far off plains of Jodhpur are obtained from the crest of the pass. Its length is about 19 miles, the road is quite practicable for carts, though the gradients are steep in places especially on the Marwar side. There are chokies at every two or three miles, but nevertheless highway robberies are not unfrequent."

Extract from report by H. Horst, Esq., *Assistant Superintendent.*

"The Arabulla Range runs along the eastern edge of the country triangulated, and so far as I know attains its greatest altitude here, next to Mount Abu which, however, can scarcely be considered as belonging to the range. The highest point Jargo is found to be 4,330 above the sea. It is about 28 miles north-north-west of Odeypur and 3 miles south-west of Kelwara. The range is visible for 80 or 100 miles onward from here, but there is apparently no other summit of equal altitude with this. Its form is similar to that of the other commanding summits of this chain, *viz.*, a long precipitous ridge rising abruptly from a plateau constituting the watershed of this part of India. The western portion of the country triangulated is in the plains of Marwar. These plains are dotted with small rocky hills appearing at long intervals, and varying in height from 600 to 2,000 feet above their bases.

"The cantonment of Erinpura is situated on the boundary between Marwar and Sirrohi, on the left bank of the Joai River, as a post of observation where the regiment called the Erinpura Irregular Force (formerly the Jodhpur legion) is located. Major Carnell commands this regiment and is also invested with political powers. He has done much towards suppressing the Bheels and Minas in Sirrohi and Marwar who are often taken red-handed in dacoity and murder. When I was working a few miles from Erinpura, a dacoity was committed on a caravan attended with bloodshed almost on the very spot on which two criminals were executed three days before, and hung up on the branch of a tree.

"While encamped at Sodabass, a large village in the Jodhpur district, a raid was about to be made by a large gang of robbers, but on seeing my camp they made off. The villagers assured me they had been frequently plundered, and most certainly would have been on this occasion but for the presence of my camp.

"I came across a very curious old temple in a gorge about 8 miles south of Ganerao built in the form of a cross. The length is about 100 feet. The central part where the arms of the cross meet is covered in by a circular dome in which are recesses for idols. The arms themselves consist merely of enclosures formed by stone pillars surmounted by a row of small domes, so that the whole building has the appearance of a group of temples. I have preserved a tracing of an inscription on one of the stones, but have not succeeded in finding any one who can decipher it. There are some traces of a ruined village called Ranpur adjoining."

REPORT ON THE SURVEY OPERATIONS IN THE LUSHAI AND NORTH CHITTAGONG HILLS.

From COLONEL H. L. THUILLIER, C. S. I., *Surveyor General of India, to* A. O. HUME, Esq., C. B., *Secretary to the Government of India*, DEPARTMENT OF AGRICULTURE, REVENUE AND COMMERCE, No. 160*F*, *dated Simla, the 22nd June* 1872.

I have the honor to submit, for the information of the Government of India, the professional results of the two survey parties employed with the northern and southern columns of the expeditionary force against the Lushaies on the Eastern Frontier under the command of Brigadiers General Brownlow and Bourchier, respectively, during the past field season of 1871-72.

2. As approved and sanctioned by Government on the recommendation of His Excellency the Commander-in-Chief, as conveyed in my previous reports cited in the margin, the two parties were organised and officered as follows :—

No. 411 F, dated 16th August 1871.
„ 496 F, „ 31st „ „

With the right southern, or Chittagong column, were the following officers of the Revenue Survey Department, *viz* :—

Major John Macdonald, Officiating Deputy Surveyor General in charge.

Captain H. B. Tanner, Deputy Superintendent.

Mr. Clifford Barrett, Assistant Superintendent.

Mr. Gorden Cooke, Assistant Superintendent.

3. From Major Macdonald's report* herewith attached, received this day, it appears that his party succeeded in establishing, under all the natural difficulties of this very peculiar and densely-covered country, added to those other obstacles and impediments attending on the advance of a military force in an enemy's country, a series of 27 first class secondary triangles, emanating from a well-constituted base of the Great Trigonometrical operations of the Eastern Frontier series, together with 76 minor triangles of a less rigorous character, establishing 40 well defined points, and covering an approximate area of about 2,300 square miles of country, lying between the parallels of 22° 30′ and 23° 45′ north latitude, and the meridians of of 92° 30′ and 93° of east longitude, never before laid down or attempted to be penetrated.

* Dated 16th May 1872.

4. Of these points, the heights of 37 stations have been computed from absolute trigonometrical results, varying in elevation from about 2,000 feet on the Uephown Klang, or range of hills, to 5,300 feet on the Muifang range or 6,056 feet at the Shendoo village on the Purang Klang, Blue Mountain, towards the south-east of the explored territory being found, by intersection, to be 7,100 feet.

5. The country thus identified and intersected by fixed points formed the basis of the topographical details, which, during their marches with the different columns and various other detached routes, as the military considerations permitted them to take, the several survey officers sketched in by the planetable, the mountain ranges and water-system to the extent of about 1,700 squire miles from the Burkhul Falls and Demagiri on the Kurnafoolee river, to the valley of the Koladyne and Burkoyas village on the extreme east, and in due connection with our old surveys in the Northern Chittagong Hills and Akyab, as shown in the preliminary map attached to the report, and which has been reduced and connected with the work of the northern or Cachar column in my office.

6. These results obtained, as fully described, only after many disappointments, and under very inadequate amount of coolie labor, not only for the necessary transport of the survey apparatus, but for the bare provisions and the absolute necessaries of life, may be said to be more satisfactory than at first we dared hope for and, under all circumstances, looking to the serious detentions at first starting, may be accepted with much thankfulness.

7. This preliminary general map of the entire results of the survey operations of both columns will, I trust, do more to explain the general effect of the new geographical information obtained on this frontier than any words of a professional report.

8. It will be observed that the two columns approached each other very closely about the parallel of 23° 30 not being more than about 40 miles apart in a straight line. But most unfortunately for the interests of this department and of geography in general, a junction was not formed owing to the lateness of the season when the final results of the military expedition were obtained, and it became essential to evacuate the country as fast as possible.

9. Thus a considerable gap, in conjunction with much else, intermediately between the southern boundary of the Cachar district and the northern limits of the present expedition, still remains to be filled up, which it is highly important, in a geographical sense, to become better acquainted with; and it is to be hoped that our improved relations with the tribes on this frontier and the good offices of the civil authorities may enable us hereafter to dispose of the whole of the blanks still disfiguring the map of India, and which have so long baffled all our attempts to describe, with even approximate truthfulness, the geography of our eastern territory.

10. The professional details of the survey operations are very clearly given by Captain Tanner in his report* and diary annexed to Major Macdonald's report. Of the arduous nature of such work in such a country, and under such hardships and difficulties, it is needless to enlarge; suffice it to say that the excellent officers and Assistant Superintendents engaged, fully realised the expectations formed of them when they were specially selected for this particular duty. Captain Tanner is an officer of rare qualifications and of the highest merit, and his untiring exertions throughout the whole of the campaign, as well known to the whole of the force, aided by two of the best civil officers attached to the Revenue Survey Department, Messrs. Barrett and Cooke, entitle them to the favorable consideration of the Government of India.

* Dated 31st May 1872.

11. Major Macdonald's and Captain Tanner's services were thus brought to the notice of the Government in the despatch of Brigadier General Brownlow, as cited in the margin, and in expressing my own acknowledgments to these officers for the success of the survey carried on under Major Macdonald's immediate direction, I would venture to hope that this officer's previous services during the seasons 1869-70 and 1870-71, in company with Mr. Edgar, C. S., from the Cachar side, on this frontier, and his labors under the most trying circumstances and privations, may not now be forgotten. I beg most earnestly to recommend Major Macdonald, who has done so many years' good and valuable service in this department, to the favorable notice of the Government of India for his special and lengthened services on the Eastern Frontier.

"VII.—The Survey Department, under Major John Macdonald, Deputy Surveyor General, with whom was associated Captain Tanner, Deputy Superintendent, achieved results which I have already referred to, and which Major Macdonald's report more fully describes. These officers were almost invariably present with the headquarters of the Brigade and, in addition to their other duties, afforded me much valuable advice and assistance. Major Macdonald attached himself to the 2nd Goorkhas throughout the campaign, and took part with them in all their encounters with the enemy."

12. With the left, northern or Cachar column, were the following officers and assistants of the Topographical Branch of the department, *viz.*:—

Captain W. F. Badgley, Deputy Superintendent, in charge.
Lieutenant R. G. Woodthorpe, R. E., Assistant Superintendent.
„ E. P. Leach, R. E., „ „
Mr. M. J. Ogle, Assistant Surveyor.
„ W. Robert, „ „
„ J. MacCay, „ „

13. From Captain Badgley's narrative report* herewith attached, it appears that, under similar circumstances as above described, the efforts of himself and party resulted in the attainment of a series of secondary triangles, emanating from a good side of the Cachar secondary series of the Great Trigonometrical Survey on the parallel of 24° 45′ near the Bárák river, and extending about 25 miles in a south-easterly direction into the Lushai country on the Munipoor frontier, and covering an area of about 612 square miles. This, combined with 191 linear miles of route survey, formed a connected basis for the delineation of no less than 1,800 square miles of entirely new topography, or including overlaps, of 6,068 square miles as actually sketched and mapped, some portion of which was duly connected with the old Cachar survey, and executed after the return of the expedition to Silchar.

* Dated 16th May 1872.

14. These operations took the party down south nearly as far as 23° north latitude, the column of General Bourchier having traversed this considerable distance southward, and as far eastward as 93° 30′ east longitude, and, as before stated, to within the short distance of about 40 miles only from the extreme limit of General Brownlow's march, the relative positions of the two distinct areas which have thus come under survey being clearly defined on the map herewith submitted.

15. The elevations attained by this party are—"Cheelam," 5,700 feet; "Tulcheng," 5,800 feet; "Muklung," 6,850 feet; "Kungnung," No. 12, 5,525 feet; No. 13 station 6,150 feet; "Champha," extreme south point attained by the force, 4,925 feet. From the valley of the Barák at Tipai Mukh, the expedition gradually ascended from 250 feet to the above heights.

16. On the return of General Bourchier's force to Cachar by the middle of March, I urged on the attention of Captain Badgley the necessity of availing himself of the opportunity to reconnoitre a good deal of the ground west of Tipai Mukh, with the view of rectifying the defective or uncertain topography of the southern portion of the Cachar district, as laid down in the old map; and this, I am happy to say, he has done with such good effect as to materially alter much of the details in the old map, and I believe the Cachar southern territory is now placed in a far more satisfactory state, and is as well defined as we can ever expect such ground to be.

17. Captain Badgley has achieved a most satisfactory amount of very good and reliable work. To his own share he accomplished the larger proportion of the above area, as specified in his report; and to his indefatigable zeal and energy we are indebted for this considerable addition to our knowledge of the country south and south-east of the Cachar district, previously totally unknown.

18. Lieutenants Woodthorpe and Leach, of the Royal Engineers, Assistant Superintendents, rendered good assistance, and have contributed, as far as their experience permitted, to the success of the work; they are both accomplished young officers, full of zeal and energy, and their sketches will, I have no doubt, add greatly to the interest and history of the campaign. These sketches are in course of publication, and will be reproduced by the photozinco process in my office in due course.

19. Messrs. Ogle, Robert, and MacCay, Civil Assistant Surveyors, have given great satisfaction, and performed every duty entrusted to them with great cheerfulness and success. Messrs. Ogle and Robert, specially, have maintained and increased their reputation as most zealous and efficient members of the department, ever ready to devote themselves to any duty, however difficult, and over any description of country.

20. Captain Badgley's report contains an interesting description of the country passed over, together with an account of the manners and customs of the people, which is worthy of publication.

21. Although Brigadier General Bourchier did not mention the presence of the survey party with his column in his despatches, yet I am authorised to state that he fully acknowledges the assistance he derived from the materials promptly furnished to him by Captain Badgley, whose preliminary map was made use of by the Brigadier-General to illustrate his own report and route.

22. The combined results of this short expedition in a country excessively hostile to survey operations, destitute of inhabitants, densely covered, and with military operations going on, are as follows:—

	Triangulation.	Topography.
	Square miles.	Square miles.
South Column	2,300	1,700
North Column	612	4,800
Total ...	2,912	6,500
Overlaps ...		1,268
GRAND TOTAL ...		7,768

23. It is not only this area of nearly 7,000 square miles of entirely new topography which has been obtained and mapped, but, by the correct delineation of the mountain ridges and the drainage of the country traversed, a far better idea of the general collateral run or configuration of the whole frontier has been obtained, and much which disfigured our old maps as absurdly conjectural, will now give place to what is more reliable and in harmony with actual survey.

24. What has been effected appears to me highly creditable to the energy, perseverance, and facility of resource of the several officers and assistants employed, upholding, as it does, the fair reputation and prestige of the department, and I express the hope that it may be so considered by the Government of India.

25. There is still left a good deal which it is desirable to define on or within the Eastern Frontier, before it will be possible to determine a fair and tangible boundary along the whole line, as referred to in Major Macdonald's 31st paragraph. With Captain Badgley's topographical party working in the Naga Hills and recessing at Shillong, and with their good knowledge of the country and aptitude for such operations, I shall be able to provide for all further work necessary to be done on this frontier, whenever it may be the pleasure of the Government to direct further surveys to be prosecuted there.

26. A new general map of the entire frontier, showing all these recent additions, is in course of preparation in my office, and will shortly be published, when the effect of all existing geographical information will be seen at a glance. The rough preliminary maps of each column, as now rendered, will also be replaced by the final and more perfect productions as soon as the fair maps can be drawn by executives and reproduced at head-quarters.

27. It will be obvious to the Government that in rapid surveys and reconnoisances made simultaneously with the march of an advancing military force, the survey officers must be dependent for success on the extent of the aid and assistance rendered by the military commanders. This department, therefore, desires to acknowledge in the fullest manner the hearty and generous co-operation and aid of Brigadiers General Brownlow and Bourchier and their staff, who did everything in their power to facilitate the survey operations, and to admit of the executive officers obtaining all the geographical information in their power. This object, I know, was frequently gained by sacrifices made by the Brigadiers General, with respect to other and more important requirements, and therefore calls for special and grateful acknowledgment.

Vide paragraph 34, Major Macdonald's report.

28. These survey operations were conducted on principles in conformity with the full general instructions issued for the guidance of the officers employed from my office, based partially on the experience of the survey officers employed in the Abyssinian expedition; and although the two countries were widely dissimilar, yet, I believe, by a proper attention to the chief heads of instruction issued, the results have proved as satisfactory as the peculiar circumstances met with would allow.

Extract from the Narrative Report of No. 6 Topographical Party, for the Field Season of 1871-72, with Brigadier-General Bourchier's Field Force, Northern or Cachar Column.

From—CAPTAIN W. F. BADGLEY, B. S. C., *Officiating Deputy Superintendent of Survey, in charge No. 6 Topographical Party, No. 26A, dated Shillong, the 16th May 1872.*

Description of country.—It will be better to consider the country in sections, beginning with the most westerly portion surveyed. This includes a third of South Cachar and a strip some 25 miles broad of Lushai country, the whole quite uninhabited, except where the Dallesar river, which is navigable for small craft of 100 maunds (?) throughout the year, has enabled the advancement of tea plantations as far as Jalnacharra, which, however, as well as one or two other gardens in its neighbourhood, is, I understand, considered too far forward, but only so on account of the difficulty found in retaining workers in what appears to them an unprotected position,—a matter which, however, a more thorough system of outposts and defence will soon rectify.

Five parallel hill ranges running from south to north intersect this country, and gradually lessening in height, are lost in the plains of Cachar. Between these lie four broad valleys, broken by innumerable small ridges and swamps, and in three cases drained by considerable streams more or less navigable for country boats.

Hill ranges.—The first of the ranges beginning to the westward is the Chattarchura. This, which is about 3,200 feet high at Chattarchura peak, is lost in small tilas at Alexandrapur. Along the entire ridge, as far as I visited it, and it is said continued into Chittagong, there is a broad elephant track, which, with a few hanging branches cleared away, might be used as a riding path. It was along this that the Lushais made their raid on these western gardens, and the remains of their encampments still point out their halting places.

The next range is the Bairabi, the highest point of which, 1,800 feet high, ends south of Burancharra, from whence northward a band of low knolls and ridges extends as far as Cachar.

Between the Chattarchura and the Bairabi, runs the largest of the rivers of which I spoke, the Dallesar, which winds between high banks with a moderate current, and has been found navigable throughout the year to Pachwa Mukh, and is so probably much further. The country through which it runs is, however, I believe, entirely uninhabited as far south as peak Z. Its principal tributary is the Gutar, which running from far south in a nearly direct northerly line joins it at Gutar Mukh; for thirty-five miles of its course this stream drains an uninhabited country. East of the Bairabi is the Koloshib range. The valley between is drained by branches of the Dallesar; it is an almost impenetrable tract of forest covered with low ridges and cane-covered swamp, which will probably not be opened up for many years to come.

Mr. Ogle, to whom fell the survey of the country from Koloshib eastward to the Buban range, has obligingly furnished me with notes, from which, merely premising that the general description is the same as that of the country to the west, I give the following extracts.

"The principal rivers in this tract are the Sonai and Rukni. The only large feeder of the former is the Tahsul Khal, and of the latter the Chem. This stream, in maps hitherto published, is made to join the Rukni eighteen miles further north than it actually does, and other smaller feeders, as the Noturcharra, rising near Parsansip, and the Tezia, are not shown; and herein lie the chief discripancies between previous maps and the season's survey.

"The Rukni runs with a rapid current, and, to its junction with the Chem, holds a considerable body of water. It is navigable so far for ten-maund boats at all times, and during the rains much further south. The Sonai, which has a much longer course, is not navigable much above Monir Khal.*

* Mr. Edger got small boats as far as Lushai Haut.

"Valuable timber is found in the valleys of these streams, which after being cut is dragged to the bank by elephants and floated down. Occasionally the wood-cutters are surprised by Lushais, who levy a tax on them of a rupee a head.

"There are numerous elephant tracks all over the country, which are utilized by the Lushais on their raids. Those usually used run along the tops of the main ranges. There is one from Tipai Mukh crossing the Buban range near L. 4 peak, skirting below it to the west, passing along the ridge of Dome peak, and thence joining the Monir Khal and Mainadhar road at Nága Khal. Another of their roads runs along the Parsansip ridge and over Bongong; this gives off a branch four or five miles north of Parsansip which turns down to the Sonai and follows the river. A third track is on the Koloshib range, and extends to Sonárban."

The easternmost of the Cachar ranges, the Buban, has its highest point (3,100 feet) between Monir Khal and Mainadhar. It ends south of Lakirpur. Between it and the Nunjaibong range, eight miles to the east, runs the Bárák, which is here the eastern boundary of the Cachar District, Munipur being across the river.

The Bárák.—This fine stream, though it drains all eastern Munipur and the north-east of the Lushai country as far as the Burmese frontier, is, owing to its rapids, impracticable except for ten-maund boats between March and June. During some months, however, the largest boats can reach Tipai Mukh.

Up to Tipai Mukh, the Bárák, running to the east of the Nunjaibong range, has a south-easterly direction, but from this, on receiving the Tui Vi, it changes to nearly due north, and keeps so as far as Alni. There is not much to notice about this part of the Bárák Valley. The river takes its course to the north, receiving the drainage of the hills on either side, which throw out numerous spurs, becoming lower and more broken as they descend, and covered above with timber and bamboo, and below with bamboo, cane, and other small and dense jungle. Fortunately for the Surveyor, elephant tracks were found here and there leading from the river to the hills, without which the prosecution of the work would have been immensely laborious.

South of Tipai Mukh begins the country of the Lushais. The part of it which, taking Tipai Mukh as its north-west corner, would be included in a square of 40 miles side is drained by the Tui Vi, or as pronounced by Hindustanis, Tipai, the principal feeder of the Bárák. South of this square the waters flow into the Kolodyne. A number of parallel north and south ranges intersect the country, and through these the Tui Vi winds and doubles till it has completed from its source, south-east of its debouchure at Tipai Mukh, a course of 125 miles, the direct distance being 50.

Tipai Mukh.—Tipai Mukh, the depôt to the expedition, a small breadth of open space consisting of a sandbank, a bit of shingle, and a ledge surrounded by hills, was the largest piece of open country we saw from Alni to the Champhai. Its height is 250 feet, and it was comparatively healthy till the hot weather and cholera set in. Diarrhœa or dysentery every one had, but so they had at most of the other camps at the beginning of the campaign. That a place so low, foggy, and damp, and crowded with coolies and boatmen on whom it was difficult to enforce sanitary rules, was not more sickly is probably due to its being washed by the two rivers.

From Tipai Mukh the route of the column lay at first south-east and then south, up hills and down to valleys, each rise being between 2,000 and 3,000 feet. The first ridge, Senbong, is 3,450 feet above the sea, and beyond this the hills rise higher and higher to Kungnung, a point on the range south of which was 7,000 feet or more in height. From this the highest ranges lie north-east and south south-east, and between them and Burmah, which is shut out by another towering ridge, the country is crossed by lower lines of hills, all keeping the general north and south direction. These are higher somewhat as they approach from north and south the watershed line of the Bárák and Kolodyne, but not remarkably so: one point on the line we found to be only 5,150 feet, and others were lower.

As we advanced into this magnificent country, a country of steep ridges and narrow valleys, we found the hills less covered with forest, the under-wood lighter, and the valleys dry and lined with grass instead of bamboo, reeds, and cane. We noticed oak as the principal timber, with fir and rhododendron on the highest hills; but there were many more trees unknown to us, among them one, of which we saw some magnificent specimens, called by the inhabitants Bongpui. It was before the season of flowers, but blackberries, strawberries, violets and several of the common English wild flowers had begun to show themselves, and in the woods the scarlet rhododendron and a species of Dâk (Butea) were in blossom. The oaks, of which there were several species, were hung like those on the Himalayas with streamers of grey moss, and the trunks and larger branches covered with small ferns and orchids. Of ferns there were a number of varieties; cinnamon, wild ginger, and other roots were to be found, as also in some places the lemon; but these last were said to have been introduced by the Kookees, the former masters of the country, and were only met with near old cultivation.

Formation.—The rocks were sandstone, with here and there clay slate.

Reptiles, insects, &c.—We saw no snakes, and very few of those disagreeables in the way of leeches, tick and fleas, which we had been led to expect to be bothered and eaten up by.

Scenery and climate.—The scenery is very fine, the country healthy, and the climate during our stay delightful on the hills, with very little rain and hoar-frost in January. In the valleys the nights and mornings were chill from the mists settling on them, and making trees and herbage damp and dripping. This cloud effect was grand seen from above—like a sea of snow, with the dark peaks rising from it like islands; a most difficult subject for a sketch, but which Lieutenant Leach has attempted to represent with considerable success. Of prevailing winds there was no particular indication, but the clouds and rain always came from the south-west. The rains probably begin early.

The Lushais.—The Lushais, of whom we met men of four different tribes, are fairer than the Bengalees, of a very uniform height of about five feet six inches, well made, active, intelligent, and energetic. Of their figures we had one or two opportunities of judging, especially on one occasion when some iron hoops of burnt barrels were in the fire, to get which, and to save their clothes from accident, they stripped,—an easy operation with men whose only covering is a large square of cloth. The figures they displayed were splendid, full and finely muscular, especially about the shoulders and calves, though in the latter they showed a more graceful shape than the large-legged Kookies and Nagas who were with us as coolies. That they were intelligent, we had, not knowing their language, less chance of forming an opinion; but from what we could judge from a few who understood some words of Hindustanee, and from their quick recognition of sketches, even in outline, and from their looks, which otherwise belied them, they were so. Of their energy and activity their raids are sufficient proof.

Their heads are well formed, with good foreheads, oblique eyes, heavy eyebrows, high cheek-bones, depressed noses, large but not thick lips, and scanty beards, a few straggling hairs in some being the only representatives of chin-tuft or moustache, beyond which none of them can boast. Their hair is straight and black or brownish, eyes brown or black, and teeth invariably good; their expression open, bold, and generally pleasing, and their voice loud and sonorous, partly probably from practice and education; the children having the same deep far-sounding tones when calling loudly.

Costume—Their dress is admirable in its ease; no boots, nor breeches, nor other tight clothing confine the freedom of their limbs; a large square cloth or two put on together, according to the temperature, is their only covering, which is worn passed under the right arm and with two corners thrown in opposite directions over the left shoulder, and managed for modesty with the most easy dexterity. To confine the cloth upon the left shoulder they carry, when anywhere from home, a bag slung so as to rest behind the right hip, the shoulder strap being of skin, tigers's apparently by preference, and the bag, which is of fine and strong net, covered with a large skin flap somewhat like a sporran, and often made of long white goat's hair, with three black streaks. In the bag they carry their smoking apparatus, flint and steel, a dhao or large chopping knife, and occasionally a bundle of *pungies*, which are small hardened bamboo skewers, and which stuck in the ground are very efficient protection to their owner when sleeping in strange places, and left behind him in his path, protect him in some degree when pursued.

Lushai Tribes.—We saw, as I said, men of four separate tribes, three of them distinguished by their mode of wearing their hair, and the southern tribes rather smaller and handsomer than the northern. Those we first met who had come from Kulel, and are now living on Banbong, called themselves Howlongs, and are governed by an old woman, Impanu, the mother of their former chief Vonpilal, whose grave on Kulel is one of Lieutenant Woodthorpe's illustrations. The name of the next tribe, those under Poiboi and Lal Bur, I quite forgot to ascertain. The remaining two were Pois and Paites. The former were inhabitants of

the country south of Lál Bur's, who had apparently hired themselves out as soldiers, and the latter, probably a very small tribe, living on and about Nurklang. Of these the two first wore there hair drawn smoothly back, and fastened in a knot behind by a thin bit of iron bent into a double prong. The Pois parted theirs across the head behind, and letting the lower part hang loose, drew the upper forward, twisting it with the front hair, tied it in a knot over their foreheads, where it was secured by an iron skewer or with a comb of ivory; round this knob, those who wore turbans tied one end in, putting them on after the manner of the Sikhs, which was remarked by some Lushais, who called the 22nd Poje; about a fourth of the Pois wore turbans, the other tribes, as a rule, going bareheaded. The Paités wore their hair frizzed up from their head, and cut about four inches long. Chiefs and headmen wear feathers in their hair knots on great occasions, that is, those who have them; how the Paités wear them, or whether they use any, I do not know. Of the Suktis, who live to the eastward, we saw next to nothing; they are at enmity with these other tribes, and thinking to take them at a disadvantage, had, just before we reached the Champhai, made an attack on Lál Bur's village of Chouchim, whence they had been repulsed with loss, leaving one body behind. This unfortunate's head and some limbs had been placed as ornaments to Vonolel's tomb in Lungvel, but as it had been scalped, gouged, and the skull smashed in, little could be made out from it.

Manners and Customs.—There are two things remarkable about these people—one, their indifference to ornaments; excepting two, which are very simple, they wear none; these are a tiger's tooth or tuft of goat's hair tied with a string round the neck, and a small tuft of scarlet feathers stuck in, or an amber bead hung by a string to the ear. Some of the children wore strings of beads, but very few of the men; and coloured chintz was scoffed at as a barter, though anything might be got for plain red or white; silver and gold have they none, and care little for, a few pice re-purchasing a rupee; but these are at a premium merely because they can be beaten into bullets or used to line pipes. The second is, that though not particularly cleanly, they are entirely free from any of those noisome skin diseases which are so common in Cachar, and only one man did we see marked with small-pox.

We saw no dwarfs or cripples; probably they are made away with early, after the Spartan fashion.

Qualities.—Of the mental and other qualities of the Lushais, as far as one could judge, they are quick-tempered, unstable in mind, loose in allegiance, thieving, and occasionally given to drunkenness, voilence, and barbarity; inquisitive, taciturn in conversation, patriotic, and too bold to be liars; their bump of locality must be strongly marked; they are great hunters and athletic, walking long distances and climbing with remarkable ease. From the smallest children they all smoke,—men and women,—and so much are they given to it that any of their recent camps can always be detected by their stale tobacco smell. Their pipes are neatly made of bamboo lined with iron or copper, and of the ordinary pipe shape for the men, those used by the women, having a receptacle for water, after the fashion of a hubble-bubble, which water—disgusting practice—is carried about by the men in little gourd bottles to take occasional nips from.

Religion.—They have some sort of belief, but I heard no mention of priest, nor were there any temples or images. Occasionally, in the field, we met with a little cleared space on which were arranged rows of clay pallets of various shapes, with a yard long flag-staff and coloured pendent waving over them; but it was in their tombs that we saw the greatest evidences of their religion. These were always in their villages and ornamented with trophies of skulls of animals and feathers. At burials they discharge firearms over the graves, and I believe slay the animals, whose heads afterwards go to their decoration, and whose spirits are intended for the delectation of the grave's occupant in the happy hunting grounds. The greater the man, the more animals are sent with him, and it is said that slaves are sometimes sacrificed and buried with a chief. Vonolel's and Vonpilal's tombs had the heads of many beasts over them (indeed one got a knowledge of the larger fauna of the country at a glance), the skulls of the most dangerous were muzzled, and there were hobbles to restain the feet.

Beyond what can be gathered from what I have mentioned,—that they must believe in a future state, and that there is some invisible power for evil against whom they make their incantation to protect their crops,—I could not discover anything, excepting that the tiger's tooth or tuft of hair which the men wear about their necks has a religious signification.

Their language is not monosyllabic like the Khassia and others, and there is no written character. Tradition is probably handed down by songs, which are of their battles, their hills, and love; and they can improvise. One night a party were invited to give us a specimen of their performances, and the first of the songs was on the subject of our expedition. They chaunt them in soft deep notes to the accompaniment of a drum and a set of weak organ-like pipes, whose stops include an octave; and the love song they afterwards gave us was acted to in a posturing dance by one of the number, at first slowly, but as the story went on, more and more quickly, till the corn cob which represented the young woman sung to was snatched up and whirled round quite excitedly.

Sport.—I have said before, I think they are mighty hunters; everything that runs or flies is game with them, from an elephant to a field-rat, from a hornbill to a wagtail; and they have many and clever devices for bringing them to the pot, using, besides firearms, traps and fenced drives for the larger, and springs for the small game, and for small birding employing the pellet-bow.

Game should be plentiful, judging from the numbers of heads we saw in front of the houses, which are not preserved beyond the owner's lifetime. These were of elephant, tiger, leopard, sambur, hog-deer, metna, pig, and monkey. This last—the hulak or howling monkey, black-faced, grey-whiskered, blackbodied and tailless, with very long arms and of extraordinary activity—is an abominably noisy beast, with a cry beginning with a yell and ending with a series of howls like men imitating jackals; they are always started by the way in their discordant chorus by a single sharp cry from one of them, which my fellows called the raja.

Of birds I saw the skulls of some cranes, and they have besides many which I did not find out—hornbills, jungle fowl, partridges (francolines), chir, and black pheasants.

Fish.—Of fish I only saw two varieties, the mashir and a small silurus, called in the north-west sol. They use nets, and also, as is the custom elsewhere, poison the water with the juice of a cactus which kills the fish without spoiling them as food, and in one place the camp on the Tui-burn, they had built a large dam and weir apparently for fishing purposes.

Fighting qualities.—Their mode of war is of surprises and bush-fighting and their ideas of bravery are amusing. At Vanoog (the first fight) they called out to the sepoys not to stick like cowards in the open, but to come against them in the jungle like men. For weapons they have flint-locks, some wonderfully old, dating back to Culloden, spears and dhaos; we saw a few leather shields, but no bows and arrows. For defence, though their villages are lightly palisaded, they prefer the employment of stockades in difficult passes defended by entanglements, a specimen of which, which was quite a lesson in military engineering, we met with, fortunately undefended, a mile or so from Poiboi's village of Tulcheng. I have been told, by the way, that the village of the chief is never palisaded, his outlying villages being guardians against attack, or at least unprepared for attack.

Raids.—They carry on feuds and make raids among themselves as well as on Munipur and the eastern provinces for arms, ammunition, women, and heads. When on raids they travel with remarkable celerity, carrying nothing but their arms and enough of rice for the journey, a fresh joint of bamboo at each new camp serving every purpose of water jar or cooking pot. About to make an attack, they are told off in three parties, gunmen, spearmen, and men to carry off the wounded on retreat; if they have been successful, and have made prisoners, the men are made to carry the provisions, and though they sometimes retain a few as slaves, specially Munipuries and Kookies, the carrier is, as a rule, relieved of his head when he has been relieved of his burthen. I think it was after the raid on Monir Khal that a body was found—a garden cooly's—which appeared as if an incantation had been practised by it; the head was not removed, and the chest was cut open and filled with boiled rice: why so I could not find out.

Notwithstanding their cruelty, they are fine fellows, taking pride in a fight, dressing themselves in their best and neatest for the occasion, and showing in their own way considerable pluck; and in their communities I imagine they are moral and courteous, the ever-ready dhaos being a potent preventive to bad conduct and bad manners.

Muntries (heralds ?), men wearing feathers and red puggries, are employed among these people to treat of war and peace and all matters, and at all times pass free; but besides these verbal means of communication they have modes of spreading intelligence known to themselves, as by fire signals, alarm drums and gongs, and others. A tree exuding a red sap, hacked and struck with spikes, is a serious warning; a red gourd stuck in a tuft of grass means bloody heads for those who persevere in advancing beyond it; a branch across the path is a notice not to go further, and a bamboo split, broken, and burnt means fire and fury.

Stockaded villages.—A Lushai village is usually built in a position which gives natural advantages for defence. It is slightly fenced, and the approaches guarded at difficult points by palisading, loop-holed, and strengthened by heavy stones, and on commanding viewpoints there are out-looks. The conservancy is admirable, and the houses, though smoked, begrimed from having their fire-places inside, are clean. Each house usually has its own enclosed patch of fenced kitchen garden to one side, and though not built perfectly symmetrical, they are ranged to form streets. In the middle of the town is a large house used as a town hall.

The frame-work of a house is of wood for the posts and beams, and bamboo for the roof; the floor is raised a few feet above the ground, and is laid with bamboo split and beaten flat, the walls being of the same material, woven in a large chequer pattern with very neat effect; the roof is a thatch of grass and palm leaves. The average dimensions are 30 by 12 (Poiboi's was 40 yards long), of which the first third is left open; a ramp of logs leads up to them, and on one side of the ramp is a platform for sitting out in fine weather; under the

caves are the fowl-houses, and hung over the house front are the skull and horns of animals captured in the chase. The interior, which is closed by a neatly-made sliding door, is usually undivided ; in some a half partition portions off a part as a granary ; a door at the back leads to a small platform behind. In the middle of one side an open fire-place is made of slabs of stone, above which hangs a frame for smoking meat and fish, and beyond it is usually a raised place for sleeping on.

In the open front of the house is the pig trough and the mortar for cleaning rice—a work done by the women daily. This rice, which is of large white grain and very nutritious, forms their principal food, and is grown by dry cultivation on cleared spots on the hill sides.

Agriculture.—Their method of agriculture is—having selected a patch of jungle and marked it by putting arrows in the split stumps of small trees round it, to fell and burn it when dry just before the rains, and scattering the ashes to dibble in the grain with dhaos, deserting the spot after three years when the soil is worked out. The crop cut at its proper season is threshed and stored on the ground till the end of the harvest, when it is carried in by the women in large baskets slung by a band across the forehead, their mode of carrying all burthens.

Besides the rice they raise maize, a sort of yam, sweet potatoes, beans of several sorts, ginger, tobacco, pot herbs, gourds, esquashes, cotton, plantains, and plants giving a dark-blue dye, and they domesticate pigs, goats, dogs, fowls, and pigeons, all for food ; milk they never touch, and the metna, which they allow to roam half wild, is kept only for its flesh and horns, the latter being made for one thing into powder and priming flasks. Sugar is a thing they do not seem to care about, but they liked our rum, and themselves prepare a liquor from rice which has a pleasant taste, and is drunk well diluted by suction through reeds from the jar in which it is made. We called it hill beer. Their name for it is "ju."

Manufactures.—They manufacture everything necessary to their simple mode of living—cooking and liquor pots, wooden platters, baskets, salt, saltpetre, cotton cloth, dhaos and axes. The earthenware is moulded. The baskets are of every shape and size, from the store basket, which will hold 50 maunds, to the little thing which holds the woman's needles and thread ; they are woven of shreds of bamboo with great neatness. Gourds and bamboos are used for water.

Their apparatus for cleaning, carding, spinning, and weaving the cotton is similar to that in use in Bengal. The cloth is very strong and close-grained, in breadths of three feet, unbleached, with a narrow blue border, or dyed entirely blue. Some of the cloth used by them, resembling a dark tartan, is said to come from Munipur. Salt they manufacture from the ashes of bamboo leaves, and saltpetre from cowdung urinated on. Their forges are not in any way remarkable, a pair of large bamboo cylinders being the bellows ; but they turn out remarkably good arms, working up the iron which they get from elsewhere to suit their own tastes as to shape. The axes are of that peculiar construction used among most of these tribes—a flat-ended peg tied in a socket in a bamboo handle.

There are no archæological remains, excepting the rough slabs, with rough outlines of figures cut on them, which cover old graves ; and there are no roads, communication being by footpaths, which in the more populated parts are broad and easy.

I had almost forgotten to mention the women, but we saw so little of them : they are pleasant, round, flat-faced creatures, continually smoking, and lively among themselves ; their dress is a scanty blue kilt, and cloth thrown over the shoulders, with the head usually uncovered, and the hair loose or neatly braided. They wear no ornaments. They vary in color, some being quite fair with rosy cheeks. Their children are carried on their backs.

The products of the country are India-rubber, wax, and ivory, usually bartered for salt. The traders are mostly Munipuries. It is, I believe, intended to attempt to open up the country by instituting a periodical fair at Tipai Mukh. The project would be sooner successful were it not that unfortunately the Tui Vi is unnavigable. Tipai Mukh is not suited for a military post, but in future years, when our rule has been extended to this country, many strong and salubrious hill positions will offer themselves for choice as stations, and the valleys attract the sportsman when there is no longer the danger of his being the pursued instead of the pursuer.

From Lieut. R. G. Woodthorpe, *R. E., Assistant Supdt., Topographical Survey, to* Captain W. F. Badgley, *Offg. Depy. Supdt. in charge of Survey with Lushai Expedition, dated Shillong, the* 10*th July* 1872.

In accordance with the instructions contained in the Surveyor General's letter No. 183F, dated Simla, 26th June 1872, I have the honor to forward the following notes on the country passed through by the left column of the Lushai Expedition of 1871-72. As anything which I could say concerning the Lushais themselves, their villages, warfare, &c., would be simply a repetition of your descriptions in the narrative report already submitted to the Surveyor General, I have confined myself more particularly to a description of the route as aforesaid.

2. The country about the station of Silchar is flat and open, but with the exception of the road to Munipur the communications are not good, and in some places mere tracks through the bheels or swamps which abound in this district, especially towards the foot of the Bhuban Hills. My first experience of the swamps and jungles of these hills was on the 17th December 1871, when, having arrived at Bewalia tea garden the evening before, we* started that morning for the point known as "Bhuban cliff" with the view of ascertaining its suitability as a survey station. Our way for about three miles lay through very long grass jungle and swamps, through which we should have had great difficulty in finding our way but for the kindness of Mr. Willington of Bewalia, who gave us two garden coolies as guides. There are a stone god and goddess set up in a romantic spot near the summit of the cliff, and thither the garden coolies and others make periodical pilgrimages, and their path was the one we followed.

Description of country.

* Mr. Ogle and myself.

3. On emerging from the long grass, we ascended and descended a succession of little *tilas*, some 300 or 400 feet in height, crossing a stream of excellent water several times till we arrived at the foot of a long spur, up which the path led very steeply for a continuous ascent of 1,800 feet: here the path turns along the main ridge for about five miles, when the cliff is reached. The top of the ridge, as seems to be the case with the whole of this range, and most of the Lushai hills also, we found to be but thinly wooded, there being very little undergrowth to impede our progress. There was a good spring of water close to the place of worship. A clearing had been made on the cliff, from which a good view of Munipur was obtained. The whole of the hills of this country appear to be densely wooded and very difficult, as indeed we afterwards found them to be; the jungle on the lower ranges and spurs is principally bamboo and cane, but higher up the India-rubber, Nagasur, and other large trees flourish. On returning from the cliff, which was found to be utterly unsuited for a station, in consequence of higher peaks on the same range shutting out the whole of the view to the south, we proceeded to Mainadhar *viâ* Monir Khal. The character of the country all along the foot of the "Bhuban" seems to be similar to that already described. The path from Monir Khal over the hill to Mainadhar runs strangely over the highest part, but, though certainly steep, in my opinion, could with a little engineering have been rendered, at any rate, as passable for troops, &c., as that taken round by Luckipore, which besides being longer was a series of rises and falls of a most fatiguing description, instead of one long ascent and descent. The hills afterwards encountered in the Lushai country were much more difficult than this route would have been, and roads were successfully engineered on them.

4. *Water.*—It was imagined that there was no water in the path from the foot of the hills on one side till Mainadhar was reached on the other; the first party of the survey under Captain Badgley, however, in passing over it discovered a very good spring almost at the highest point, and the water-supply was afterwards found to be sufficient for 400 coolies without any sensible decrease. The jungle on the hill side as the path descends into Mainadhar is almost entirely bamboo fortunately, as thus no difficulty was experienced in constructing the godowns and barracks which speedily covered the several acres of flat unoccupied land which stretches along the bank of the river below the lines of the labourers in the tea garden. The River Bárák presents many beautiful little pictures of water and woodland, and Mainadhar is not wanting in the beauty conferred by richly wooded hills coming down to the water's edge, broken here and there by masses of rock shading deep pools; on the left bank the yellow *tilas* dotted with the tea plants diversify the landscape, the whole forming a most pleasing scene.

5. From Mainadhar the road runs along the Munipur bank as far as about half way to Tipai Mukh, where it again crosses to the Cachar side; the troops being carried over by means of a floating bridge of ingenious construction. A strong cane rope is fastened to large trees on either bank and hangs slackly in the water; a large bamboo raft is swung to this rope by a couple of cane loops, and is worked by men sitting on the edge of the raft and hauling on the main rope.

6. The character of the country between Mainadhar and Tipai Mukh is the same on both banks—high and narrow spurs separated by deep and dark ravines thickly clothed with cane and bamboo jungle and tall forest trees, from which huge creepers hang in graceful festoons, while between these, tangled shrubs and thorns and long rope-like roots occupy every inch of ground. Elephant tracks or small paths used by wood-cutters are met with in many parts of these jungles, and it was by means of these that the military road was projected. Tipai Mukh, as will be seen from the plan accompanying Captain Badgley's narrative report, was admirably suited for a camp and depôt; a large open piece of sand and shingle on each side of the Tipai at its junction with the Bárák affording ample space for all requirements.

7. This open space is no doubt part of the bed of the river, but at this season it was perfectly dry. The disadvantage of the situation was that it was low and immediately surrounded by hills rising to a height of 1,000 or 1,200 feet above the river, and every evening as the sun sank behind the western ranges fog and mist slowly settled down upon the camp, remaining till late each morning. The Noonjaibong range, on each side of which flows the Bárák, ends here in a very narrow ridge, whose steep sides are almost entirely covered with bamboos, and the banks both of the Bárák and the Tipai are very rocky. The road from Tipai Mukh to No. 6 gradually ascends a spur of the "Senoong" Hill; the jungle is of a similar nature to

that on the Mainadhar road, though perhaps a little more open: along the ridge the road runs nearly level between No. 6 and "Senoong" Hill, on which a survey signal was erected. Mr. Edgar considers that this "Senoong" range is a spur of the great range overlooking the valley of "Kowpoom," and that Kholel is a continuation of that range; the survey operations were not sufficiently extended towards Munipur to enable us to verify this supposition; from an examination of the portion we did succeed in mapping, and also of Lushai Hills, it will be seen that all the ranges north of the Tipai are connected at various points with a high range running in the direction of "Kowpoom"; supposing that the position of this place is shown correctly on the earlier maps of the Eastern British Frontier, it seems, therefore, highly probable that Mr. Edgar's conjecture is the true one.

Hill ranges.

8. Before reaching the top of the "Senoong" range, only a few glimpses of the Lushai Hills had been obtained at intervals; from the survey station, however, a most extended view presented itself, which I shall endeavour to describe. Looking a little south of east the first range is the spur ending abruptly in the hill of "Pabarchang" with every shade of "verdure clad;" beyond this are the high peaks of the northern part of the Kholel range and the spurs of Bargpinlong, in which the dark green foliage is broken and relieved in many places by the sandstone and red clay, of which these hills are formed. In the distance is faintly seen the northern peak of lofty "Sungleng;" south of these and above "Pabarchang" the hill of "Chepin" appears brown and grey from the numerous jooms which cover its face and long level spur, on which stands the village of "Chepin," having from this stand-point the appearance of being strongly stockaded, —an appearance, however, which is deceptive, and in a nearer approach is found to be due to the small fences with which nearly every house is surrounded. Beyond "Chepin" bluff Surplang stands boldly out against the sky, and extending south from Surplang Moothelen and Lengteng are lost to sight behind the higher portions of the Kholel range, on which is visible the site of Vonpilal's great village, where still stands his tomb, a black speck on a long bare yellow ridge, forming a land-mark for miles around.

9. The slopes of this range are much cut up by numerous narrow spurs running down on either side to the Tipai. Looking down the valley of the Tipai, the scene is closed by a lofty remarkably-shaped hill, sloping gently eastwards, but terminating abruptly and precipitously on the west: this is known as Momrang. The southern hills are hidden by the near range of Vanvong, a long level mass, with broad spurs, from which much of the forest has been cleared for the villages and jooms of the people, who, on Vonpilal's death, removed thither from Kholel; but to the south-west and west Chelfil, Peak L, Noongoai, and Rengtipahar stretch far away, range upon range, till lost in the golden haze of the afternoon sky. Just beneath the station on "Senoong" the road turns down a steep spur and soon finds itself once more in the depths of the lofty bamboo jungle which clothes the banks of the "Tuibum." Between Tipai Mukh and the "Tuibum," near the sites of old villages, many fragrant limes and walnut and cinnamon trees were discovered.

10. The camp on the "Tuibum" was in a low unhealthy situation, but the scarcity of water on the higher ground prevented the establishment of a large camp and depôt for stores anywhere but on the banks of this stream. The road between "Tuibum" and No. 8 camp crossed Paharchang and descended to the Tuitu: the banks of this little river are covered with bamboo and a very tall, graceful, feathery reed. I may here mention that bamboos flourished in the neighbourhood of every stream till we crossed the Moothelen range, after which the general levels were much higher and the bamboo was seldom met with. The path from the Tuitu ascended steeply the Meidel hills through old jooms, in which wild heliotrope, coxcomb, and other flowering weeds flourished in great luxuriance. Between Kholel and Chepin, the Tipai is still a big stream, flowing rapidly over and between immense rocky boulders; the path thence to the village of Chepin ascends through some jooms, and then becomes very rocky and difficult, precipitous masses of rock overhanging it, small streams and miniature waterfalls occurring many times during the ascent.

11. The "Chepin" hills consist of three high peaks in a cluster, the northern slopes descending precipitously to the Tipai; one spur is sent out to the north, on which is built the village of Tingridum; to the south-west and south long level spurs extend the longest, to which the name of Gnoupa was given, runs due south for about ten miles, where it joins the Lengteng range. From Chepin we got a very fine near view of Surklang, Lengteng, Moothelen, and also of the Lungtul and Lungleng ranges. All these present strikingly different features from the western hills, being much more rocky and less covered with forest, long grass taking its place. Lungtul, which is perfectly square-topped for some distance, presents the appearance of an almost perpendicular buttressed wall, the buttresses being represented by a few sharp steep spurs; trees appear only near the summit, and the rocks peep out through the grass in a series of regular horizontal strata. In Lungleng, large and wild wooded spurs alternate with the steeper faces; in the latter the horizontal strata of rock are again visible; in Surklang, however, these strata are more or less inclined, often lying nearly parallel to the general slope of the spurs and ridges.

12. This curious hill, or rather mass of large hills, the highest peak of which is nearly 7,000 feet, tossed about in wild confusion, would appear to have been thrown up during some great convulsion of nature. On the south-eastern spur of Surklang is the village of Taikum, which was destroyed on the 20th January. From this village and the approach

to it an extensive view over the eastern hills was obtained, some high mountains towering far off on the horizon appearing to belong to Burmah. On the nearer and lower ranges were many villages; these dependent on Porboi, some of which, Mr. Edgar tells us, have now gone over to Munipur. South of Kungnung our way lay along the western grassy slopes of Moothelen, crossing two or three very rocky streams, and, going over the saddle which connects it with Lengteng, descends to the Tuighan, a very pleasant little stream with a gravelly bed running through a flat piece of ground, with an elevation of 5,200 feet, and covered with very fine forest trees.

13. The country for the rest of the route was much more open, the soil was less fertile than heretofore, and on the grassy slopes the bracken abounded. The road between Tuignan and Sellam led up the side of the Lengteng hill and over a very high rocky precipice, down which a little stream dashed with force; a little further on, descending into the valley of the Laiva, to the right of the path, a magnificent face of weather-beaten rock was visible, extending for about 100 yards, with a height of about 400 feet; on the other side of the Laiva we came upon a large flat grassy patch of land of a similar character to many which we afterwards passed through or saw, but which we had not hitherto met with.

14. The group of villages known as Sellam or "Chelam," as some of the natives pronounced it, is built on the southern slopes of a range of high peaks, which, rising some 300 feet above the villages, protect them from the northerly winds. The bleak sides of these hills are covered with the stubble of old jooms, blackened stumps still standing, and huge trunks of trees lying about in all directions. The view, looking south and east on a fine day, is magnificent; an endless sea of peaks stretching away far as the eye can reach, lighted up by a thousand soft and delicate tints; and nearly due south, distant some 14 miles as the crow flies, Dilklang and Murklang towering above their fellows, like two giant warders, guard the entrance to Lalboora's country; between these and Chelam lie many deep valleys and many high ranges, the sides of which are cut up by numberless gloomy gorges and dark ravines. Very drear and threatening does this country look on a stormy day, and very cold was our camp at night; in the early morning often we went out to find the ground about us white with hoar frost; but during the day usually the sun came out warm and bright, tempering the sharpness of the east wind.

15. Beyond this point we found ourselves in the land of pines, rhododendrons, and oaks. The marsh from Chelam took us through Rahmung, a pretty little village perched on the very edge of an immense precipice, and thence through the grassy valley of the Dimkai up through the village of Tulcheng, and so over a spur of Dilklang down to the valley of the Tuitan; here a tolerably wide stream flowing through a flat alluvial valley; the path crossed and re-crossed this stream several times for about five miles, when it commenced to climb the high hill of Murklang, crossing it nearly at its highest point at an elevation of 6,858 feet. The eastern face is very steep and precipitous throughout; the path by Enjow's village runs along the edge of a rocky precipice, clothed here and there with trees and grass, with a sheer descent of some thousand feet. Beneath nestles a small village, and beyond is a broad and smiling valley, through which far below, like a silver thread, the Thao winds its way. The beauty of the scene was heightened by the rhododendrons, which clothed the hill sides on each side of our path, and which were in their full glory of rich crimson blossoms, and by the tall pines which shed their sweet fragrance on our path as we descended the valley of "Chumfai."

16. This is the largest valley we saw, and is about five miles in length, and has an average width of about a mile; it has an elevation of 5,000 feet, and the hills immediately surrounding it rise to a height of about 1,200 feet above it. This valley seems once to have been a lake, and the process by which it has filled up seems to be described by Captain Pemberton in 1835 as that going on in the case of the Logtak lake in the following words:— "The bed has begun very perceptibly to fill up from the deposits of silt from the surrounding heights, which are continually carried into it, and, if this progress continues, a few years will suffice to obliterate the lake." Major McCulloch says—"Since 1835 the lake has very visibly filled up. There runs in the lake a range of low hills, the portions of which not covered with water form islands." These words might have been written of the "Chumfai" valley, which is still swampy in places, and the surface of which is dotted over with low hills covered with leafy trees, now apparently isolated, but which evidently at one time were the peaks of a low range similar to that existing in the Logtak lake. A small stream meanders through the Chumfai valley.

17. From Chumhim, and the heights west and south of the valley, a good view is obtained of the surrounding country; that to the south and west is very difficult to make out, being broken and confused, and not presenting the parallel appearance of the northern ranges; the various peaks of the latter are also very difficult of recognition from these points of view. I am inclined to agree with Mr. Edgar in thinking that the Thao, if not the Koladyne itself, is more likely to be a tributary of that river than of the Irrawaddy, as the higher ranges to the east, as far as I could make out, would prevent the great sweep in that direction which the river must take to reach the Irrawaddy. Mr. Edgar also says—"the Lushais, who know most about that part of the country, state that, in fact, a high range of hills does intervene between the "Thao" and some well-known tributaries of the Irrawaddy."

18. The word "tui" will have been observed to occur frequently in the names of rivers. This word means "water" generally. Mr. Edgar tells us that *Tui-tau* means the "sitting water" in reference to the comparatively level course of that stream. I was unable to find out the meaning of the names of other rivers or streams.

19. At the foot of the hills and low down into the ravines we found usually plenty of water, but on the higher ranges near the tops of the ridges the water-supply was very small, even in the neighbourhood of large villages, as the Lushais do not mind going long distances to fetch it, and, as they seldom bathe, they do not require very much. In endeavouring to improve the water-supply in the neighbourhood of our camps by digging wells, &c., I was much struck by finding near the villages two streams of water, one tolerably clear and bright, with small pools formed here and there, the other nearly stagnant, moving slowly through a mass of rank weeds and putrid soil; in one place this slugglish stream was slightly stockaded on the side furthest from the village. I think this arrangement may be part of their system of sanitation, and account for the absence from their villages and their immediate neighbourhood of those unpleasantness which are so common in all the villages I have seen in the Himalayas and elsewhere. If this is so, the Lushais have discovered the principle so strongly insisted on by advocates of the sewage manure system at home—that sewage floated on to any soil is speedily deprived of any unpleasant odour.

20. Captain Lewin's descriptions of the Lushais on the Chittagong side differ in some particulars from the results of our observations on this side; in most of these differences, however, I find that the descriptions of Kookies, their customs, &c., in Major McCulloch's book on Munipur, and in his quotations from Lieutenant Stewart, apply almost perfectly to the Lushais whom we met. This is accounted for in Mr. Edgar's report, in which he tells us that Lalul, the first chief of whom we knew anything, is said to have come of the same stock as that from which the Howlong and Syloo chiefs are descended; and that he and his descendants have reduced to submission or driven out all the Kookies who occupied the northern hills. Most of the men we met till we arrived in Lalboora's country were, therefore, probably descendants of those Kookies who had been reduced to submission.

21. Perhaps a few extracts from Mr. Baker's report on his route in 1869, a copy of which he has kindly lent me, containing a description of the country through which the column passed, and a few notes on the Lushais, may not be out of place here:

"The Lushais are divided into two large and distinct bodies, who are always more or less at feud. These are the 'Marshai' (or Marsa) and the 'Simshai' (or Simsai), but both are generally known as Lushais. The word 'loo' means head in the Kookie tongue; the tribes may, therefore, call themselves the head clans as compared with the more feeble tribes, or the term may apply to some peculiarity of head-dress among them. On this point I cannot offer an opinion.

"In like manner 'mar' means north, and 'sim' south.

"The country traversed by us from Ritabarie to the banks of the Gootur is altogether hilly. We passed no morasses, and, excepting the forests lying between the Munoo river and the Kamuntah range, and the banks of the Deo, the country was found to be high, dry, and quite free from malaria at this season (*i. e.*, February and March). Small streams were met with at the base of all the higher hills, and occasionally springs on the hill sides not far from the tops of the ridges. Besides many others, we crossed the Munoo, Deo, Pakooa, and Gootur, which may be from 20 to 30 yards wide, and at this season from one to three feet deep, having firm sandy beds easily forded; but in the rainy season they must become extremely deep and rapid streams. On the Kamuntah, the Jumpai, and Hachik we saw the sites of what had been large and flourishing poongies. These are now overgrown mostly with high grass, but there are still some fine trees left, among them a few lemon.

"The climate we found in February and March cooler than in the plains. The timber, bamboo, and cane are fine. In many places, notably the vally of the Langai, the scenery is exceedingly pretty, and may even be called beautiful.

"I should say that the country generally is particularly well suited for plantations of the coffee and hill cotton.

"The principal ranges of hills run due north and south, but between these smaller ranges are innumerable; in fact, the entire country is a jumble of hills. The main features, therefore, are mountain ranges of 1,000 to 2,000 feet in height, at intervals of 10 or 12 miles, trending north and south; of confused lines of hills and spurs running down to the bottom of these intervening spaces; and lastly of deep and narrow streams flowing along the lowest levels from south to north, over sandy and rocky beds, and in very winding courses, often under high and precipitous banks. Having penetrated far south, we crossed the valleys high up, near where the streams flowing northward take their rise, consequently we avoided the morasses met with, where the valleys spread out into what are here called 'haors,' *i. e.*, low grassy plains."

22. I fancy, from this description, that, that part of the country does not differ materially from the country through which we passed in the few marches from Tipai Mukh.

Extract from notes to accompany CAPTAIN BADGLEY'S *Report of the Survey Operations in the Lushai Hills, by* LIEUTENANT E. P. LEACH, R. E., *Assistant Superintendent, Topographical Survey Department.*

Limits of work.

The topography obtained lay between the limits $\frac{24^{\circ}}{24^{\circ}\ 40'}$ north latitude and $\frac{92^{\circ}\ 45'}{93^{\circ}}$ east longitude, comprising an area of upwards of 1,200 square miles.

Nature of country.

The country throughout was covered with dense jungle, and no signs of recent occupation existed, till the Kholel villages were reached. Sites of villages are shown on the published map of Munipur on the low ranges to the east of the Bárák river, but no traces of these were visible. This, however, is easily accounted for.

See genealogical table, Captain Badgley's report.

All were probably "Kookie" habitations; the term "Lushai" being more strictly applicable to a kindred clan that has sprung into a powerful existence within the last three generations.

Blood feuds seem to have existed from time immemorial. The "Kookies" representing the weaker clan were gradually driven further, and further north by the "Lushais," the more powerful forming successive settlements as they went, and finally taking refuge in British territory.

A few deserted tenements were met with at the head of the Tui Bum, probably belonging to the people of Kholee or "Lalhi," and an occasional hut on the high range to the north-west of Tipai Mukh near the Trigonometrical Station L4.

Bamboo and cane jungles usually reached a height of about 2,500 feet, interspersed with heavy timber and trees of a resinous nature.

Above this elevation the forest became more open, the under-growth disappeared, and little difficulty was experienced in reaching the various points.

The India-rubber tree, endless v rieties of the mountain ash, the ilex, and a tree locally termed "Nageysar," yielding an extremely hard red-grained wood, abounded on all these ranges.

Geological formation.

The valleys and bed of the Bárák contained boulders of metamorphic rock, changing in places to conglomerate of a deep red colour, showing unmistakeable signs of the presence of iron. This was more particularly the case on the river midway between Nos. 2 and 3 stations. The hills were of sandstone of similar formation to the undergoing strata of the Khasia Hills, and it is probable that granite also, as these, forms a component part of the higher ranges.

The sandstone was of recent formation, and extreme friable limestone is said to exist in the hills to the south of Munipur, but no traces were met with.

Prominent features.

The most remarkable feature in this portion of the country was that appeared to be viewed from the south a continuous range to the north of Tipai Mukh, running east and west between the Bárák and Sonai rivers, the south face apparently presenting a sheer wall of rock perfectly inaccessible and of uniform height.

On further examination, this range sub-divided itself into a series of spurs, rising one behind the other, and continued on either side of the water-shed to the Bárák and Sonai rivers.

Further to the south at the head of the Tui Bum river, and forming the extremity of the "Parbaclang" range, another precipitous face of red sandstone occurs, from which much valuable information regarding the water-shed between the Bárák (or rather Eerung) and Tipai might have been obtained had time permitted.

A very marked feature further to the south is the northern peak of the range marked in the map "Momrang."

This point, I am told by Mr. Baker, is visible from points along the route followed by his column in 1869, and as it had been accurately fixed, and is equally recognizable from the north and south at considerable distances, will form a valuable auxiliary to future surveys.

Another prominent point is the highest peak of the "Surklang" range, a few miles east of Chepui.

The position of "Far Peak" and "Conical Peak," two points fixed by Major Godwin-Austen's survey, have also been verified for future work south of Munipur.

To the west "peak Z," "Chutterchura" and "Purson Sip" are all well marked points and easy of identification.

The outpost at Bonkong lies comparatively low, but is easily recognized, the hill on which it is placed presenting a precipitous face of white rock visible at a considerable distance.

The only two rivers are the Tipai and Bárák rivers. The former has been traced nearly to its source by the Munipuri contingent under General Nuthall, and, shortly after its junction with the Bárák, assumes the character of a mountain torrent, though probably navigable for small boats at certain seasons as far as Kholel. The latter is a stream of considerable dimensions, upwards of 100 yards in width, and receiving a considerable portion of the drainage of the Munipur hills. The rapids which occur at intervals of three to four miles along its length above Mainadhar render navigation difficult; but these, by deepening channels when the water falls, might easily be surmounted and rendered available for much larger boats than latterly reached Tipai Mukh. The "Eerung," its principal tributary, is described on a route survey of Munipur, made in Captain Pemberton's time, as a stream running "knee deep," and 60 yards wide, at a point some 50 miles from the junction with the Tipai; and the Bárák itself takes its rise in the Naga hills south of "Samuguting."

Communication.

Elephants exist in large numbers all over these hills, and their tracks seem to answer all the purposes of the "Lushai," and are rarely improved upon.

They will invariably be found to take the nearest and easiest route to the high ranges, and may be looked for along the banks of all the small streams. Any attempt to penetrate the thick jungle covering the banks of the large streams, and take a direct line, will usually be found unsuccessful.

A track leaving the main path (which may be followed without difficulty), and descending the hill side almost certain to lead to water, and jungle fowl met with in any number towards evening, are a pretty sure sign that water is not far distant.

Scarcity of water.

Want of water, especially on some of the high ranges, was a source of constant trouble, and necessitated an early halt and additional load upon the coolies in the shape of bamboo "chungas" containing a short supply in case of accidents.

On ridges precipitous on one side, and with a gradual slope on the other, water may be confidently expected somewhere near the summit, but where both sides are steep, nothing short of a long descent is likely to be successful.

Salt springs.

A salt spring or "lick" is occasionally found on some of the small hill streams; but from the numbers of wild animals whose prints are to be seen leading from them in every direction, they are apparently of rare occurrence, and the want of this domestic staple will probably be the medium of all future trade with the Lushai hills.

The salt springs at "Purson Sip" were formerly largely resorted to by the Lushais, and the scene of many an encounter between rival manufacturers.

Climate.

A few remarks upon the climate of South Cachar and the state of the atmosphere at particular seasons may be of value.

During the rains, and up to the end of September, the greater part of the country is under water; the low lying valleys and hills are extremely unhealthy, and even the elephants take refuge on the high ranges.

In October the drying-up process commences, but the jungles are still dangerous, and little can be done by the surveyor till the beginning of November.

During the latter month, heavy fogs clearing of an hour or two before noon are very prevalent; but the country is sufficiently dry to commence work by the middle of the month, and the jungles may be penetrated without risk.

December and January are uniformly fine; the atmosphere clear, and the climate extremely pleasant. During these two months all instrumental work should, if possible, be completed.

Early in February rain may be expected, and the atmosphere becomes hazy, and the distant ranges obscured for days together.

Heavy rain sets in towards the end of March. The heat becomes offensive, and the jungles, abounding as they do with every discription of venomous fly, mosquitoes, and other noxious insects, are hardly tenable.

A few clear days may, however, be obtained after heavy rain before the rivers rise, and the country is otherwise impracticable.

Health of party.

The first two months of the expedition were comparatively healthy. Officers and men alike suffered from bowel complaints, but no casualties occurred till February, when cholera carried of a Khasia cooly and Goorkha khalasie. During this month, the sepoys comprising the guard suffered considerably from fever and had to be constantly relieved. The Khasias, however, were uniformly healthy till their return to Mainadhar, when cholera again made its appearance and more than decimated them.

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Extract from the Proceedings of the Government of India in the Department of Agriculture, Revenue, and Commerce,—Nos. $\frac{2}{562 \text{ to } 570}$ *dated 13th September* 1872.

SURVEYS.

Read—

A letter (with enclosures) from the Surveyor General of India, No. 160 F, dated 22nd June 1872, submitting reports on the professional results obtained by the above-mentioned survey parties.

RESOLUTION.—The Governor General in Council has read with much interest the report of the Surveyor General of India, with its accompanying papers, on the geographical results obtained by the two survey parties attached respectively to the right and left columns of the expeditionary force despatched into the Lushai hills in the cold weather of 1871-72.

2. Starting each from an assured base, these two parties have, in the space of one short season, topographically delineated 6,500 square miles of new, difficult, and hostile country, and contributed most materially to fill up the gap which had hitherto separated the survey of Chittagong from that of Cachar.

3. The Southern party under Major J. Macdonald, pushing north from Chittagong, succeeded in completing a triangulation of 2,300, and topographical mapping of 1,700 square miles, connected with the eastern frontier series of the Great Trigonometrical Survey. The tract thus explored lies between 22° 30′ and 23° 45′ north latitude and 92° 30′ and 93° east longitude, and its survey has determined a considerable extent of the water-shed between the Cachar and Chittagong, and Akyab water system. Forty well defined geographical points have been established, and the heights of 37 of these obtained with mathematical accuracy.

4. Captain Badgley, in charge of the northern party, started from Cachar, making connexion with a good base belonging to the secondary triangulation of the Great Trigonometrical Survey, and accomplished about 600 square miles of triangulation, with nearly 200 linear miles of route survey, and 4,800 square miles of topography. The region thus surveyed extends to 93° 30′ east longitude and nearly to 23° north latitude, and includes the whole course of the Tui-Vi and its tributaries, which pour their waters into the Bárák at Tipai Mukh. The labours of this party have also contributed to fix a portion of the water-shed between the affluents of the Bárák and those of the Koladan.

5. The reports of the various officers contain also much intersting information as to the physical aspect of the country surveyed, and the manners and customs of the inhabitants, while both these points are still further illustrated by the spirited sketches of Lieutenant Leach and Woodthorpe attached to the northern party.

6. Military considerations did not permit of a junction being made between the two parties, nor was the party under Major Macdonald able to push far enough north to determine the upper course of the Dhaleswari and the Sonai, more westerly affluents of the Bárák. Hence there still remains a blank in longitude, between those portions of the two surveys which overlap in latitude, as also a gap in latitude between the northern limit of the tract surveyed by the Chittagong party and the southern boundary of surveyed Cachar.

7. But the thanks of the Government of India are due for the valuable work accomplished in the face of many difficulties and hardships, and the Governor General in Council desires cordially to acknowledge the services of the officers named in the margin, who, under the able control of the Surveyor General, have contributed such valuable materials towards the knowledge of what has hitherto been an unknown country.

Major J. Macdonald, Offg. Depy. Surveyor General in charge.
Capt. W. F. Badgley, Depy. Superintendent.
„ H. B. Tanner, Depy. Superintendent.
Lieut. R. G. Woodthorpe, R. E., Asst. Superintendent.
„ E. P. Leach, R. E., Asst. Superintendent.
Mr. C. Barret, Asst. Superintendent.
„ G. Cook, Asst. Superintendent.
„ J. Ogle, Asst. Surveyor.
„ W. Robert „ „
„ J. McCay „ „

No. 34.

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INDIA OFFICE, LONDON,
Dated 28th November 1872.

To

HIS EXCELLENCY THE RIGHT HON'BLE THE GOVERNOR GENERAL OF INDIA IN COUNCIL.

MY LORD,

I have received and considered in Council your Excellency's despatch, dated September 9th, No. 23 ($\frac{\text{Geographical}}{\text{Surveys}}$) 1872, and the accompanying reports on the survey operations in connection with the Lushai Expeditionary Force on the Eastern Frontier in 1871-72.

Geographical.

2. The two parties attached to the right and left columns of the Expeditionary Force, under Major Macdonald and Captain Badgley, have executed valuable surveys of a previously unknown country in the face of considerable difficulties. Their work overlaps as regards latitude, and it is unfortunate that circumstances rendered it impossible to connect the two ends of the surveys, and so fill up the longitudinal gap. Nevertheless much good work has been done, and the fresh material will enable the Surveyor General to compile a map of the Eastern Frontier, which will be very much more complete than any that have preceded it. I have pleasure in expressing my concurrence in the opinion expressed by your government of the value of the services performed by the surveying officers.

I have &c.,

(Signed) ARGYLL.

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APPENDIX B.

RETURN to an order of the Financial Department of the Government of India for the information of the* INDIAN FINANCE COMMITTEE OF THE HOUSE OF COMMONS, *as to the Surveys carried on under the Government of India for the season* 1870-71, *the work performed and the cost thereof, corresponding with the actual expense shown in the budget estimates for that year.* BY COLONEL H. L. THUILLIER, C. S. I., F. R. S. *&c., Surveyor General of India.*

* No. 3494, dated 27th October, with despatch No. 323, dated 22nd August 1872, of Secretary of State.

1. The imperial survey carried on under the Government of India is of three kinds.—

Trigonometrical, for the accurate fixing of all important places and showing the latitudes, longitudes and heights above the mean sea level, of such a number of obligatory and other points as to form a complete basis for the connection and starting of all other surveys.

Topographical, on a Trigonometrical basis by breaking up the principal triangles obtained with the larger instruments into secondary and tertiary triangles, by means of which the topography is depicted by plane table sketching on a minor scale.

Revenue or Fiscal, which is likewise a good topographical survey on a larger scale with the depiction of the boundary of every village or parish, as well as of districts and other sub-divisions in the revenue-paying champaign provinces.

2. The following is a general outline of the several heads of account of the expenditure incurred, and of the system prevailing, in a succinct and brief form, on the supposition that no previous acquaintance with the Indian system prevails, and has been prepared under the extreme haste with which the information has been called for. The allotted budget estimates for the entire department amount in round numbers to £240,000 distributed as per margin.

	£
Trigonometrical	70,000
Topographical	70,000
Revenue	100,000
TOTAL ...	240,000

3. The Great Trigonometrical survey is under special management, and the general operations are fully described in the chart of triangulation published with the annual administrative report of that branch of the department, showing precisely to what extent the Great Triangulation has passed over the whole of India and what blanks remain to be filled up.

4. The several field, or executive parties as per margin† were at work in the season referred to for which the full details and the various particulars and cost of the operations will be found in the abstract report, dated the 19th December, now rendered by the Superintendent of this branch, Colonel Walker, R. E., and in his printed annual administration report for this season 1870-71.‡

† 6 Skeleton Principal Triangulation.
3 Topographical.
2 Astronomical.
1 Leveling.
1 Pendulum.

13 Total

‡ Dated the 1st December 1871.

5. The Topographical Surveys or representation of the Native States, or hilly British non-regulation territory, on the minor scale of one inch per mile, progress at the rate of about 16,000 to 20,000 square miles per annum, by the agency of seven distinct executive parties (one being in abeyance during the season referred to for want of funds) as specified in the margin.

No. 1. Originally raised for Jhelum and Rawul Pindi survey, and from which all the topographers were raised and transferred to other parties now employed in Gwalior or Scindhia's territory, from the Chumbul to the Nerbudda, east of meridian 76°.

No. 2. Established in 1855-56, the old Hydrabad party. In abeyance.

No. 3. The old Madras party, brought up from Ganjam, Goomsur, &c., for the Orissa Tributary States in 1854-55. Now employed in the Madras Subsidiary States or Agencies extending from Ganjam parallel with the Coromandel Coast, through the Vizagapatam Agency, Jeypur and other petty States recently transferred to the Central Provinces.

No. 4. Emanated from No. 3 party to work northward so as to cope with the immense area required to be done in this

6. During this season 14,592 square miles of survey were effected at an actual cost of Rs. 3,45,242. The survey is effected entirely on a trigonometrical basis, the Great Triangles being broken up into minor triangles of convenient small sides, suitable for sketching the features of the country by plane table, which is sufficient for general military purposes, and for filling up the Atlas of India, by reduction from the 1 inch to the ½ inch scale, and is as large as a first delineation, of such rugged and unprofitable ground, paying no revenue to Government warrants.

direction. Lately employed in the Chota Nagpur Province or Commissionership now extended to the north-east portion of the Central Provinces in Mandla, Belaspur, &c.

No. 5. Raised in 1862-63 for the Rewah or Baghelkund, Bundelkund Native States, both of which have been completed. Bhopal, north of Nerbudda and south of the assumed limits of the Gwalior survey, now in progress.

No. 6. Raised in 1863-64 for the Garo, Khasia and Naga Hills, Eastern Frontier, south of the Assam valley and north of the districts of Mymensing, Sylhet, and Cachar.

No. 7. Expanded from No. 1 party in 1864-65. The Rajputana Native States Agency west of the meridian of 76° and between the parallels of 25° and 30° embracing Odeypur, Jodhpur, Jesulmeer, Bikaneer, &c.

7. The mean average cost per square mile of this description of survey, comes to about Rs 22. or £2-4*s*. The average for the season 1870-71 was Rs. 23-3.

8. The equipment, training constitution and procedure of these topographical parties is especial and totally different to that of other survey establishments required for revenue, or minute land measurements, on a large scale. One system and one scale of survey for all India is not applicable or practicable, and therefore the machinary is adapted to the particular wants and necessities of so vast an empire, so as to deal with champaign rich revenue-paying districts, as well as, hilly, rugged, and unprofitable countries, in a way suitable to each.

9. The nature of, and the reasons for, the expense incurred, on account of the topographical surveys, will be understood from the following analysis of the actual outlay for a single season.

EXECUTIVE DEPARTMENT, OR FIELD ESTABLISHMENTS.

		Rs.
Salaries of 13 Deputy and Assistant Superintendents, including military pay and allowances		1,02,076
Salaries of 42 Surveyors and Assistant Surveyors and of Native establishments for survey parties		1,60,586
Travelling allowances to officers	7,420	38,494
„ „ to establishments	31,074	
Special Local allowances for exceptionally dear localities to officers ...	223	11,525
Local allowances to establishments	11,302	

CONTINGENCIES.

Purchase of stores, tents, &c., ...	1,232	32,561
Rent of offices for each party or division survey	3,318	
Feed and keep of elephants	4,399	
Postage charges	646	
Miscellaneous, line clearing, &c., &c.	22,966	
Total Topographical Surveys, Rs....		3,45,242

10. There is an immense area remaining to be effected on the 1-inch scale by these topographical parties of all the portions of the Native States not yet taken up, but urgently required for military, geographical, and other purposes. Each existing party has at least from 10 to 15 years work before it, and possibly more. The annual printed report by the Surveyor General for this season, dated 15th January 1872, enters fully into more minute details connected with the work in question, its nature, precise locality, and cost, and may be referred to if required.

General summary of topographical surveys accomplished.

11. The topographical operations divided into provinces and Native States, may be summed up as follows: as to what has been already done; what remains to be done; with a rough approximate estimate of the time required to finish present projects. But there is no fixity to the wants and requirements of India as its resources become better developed; the estimate cannot, therefore, be entirely depended upon.

See Markham's Memoir on the Indian Surveys, 1871

12. Orissa Tributary States, by No. 3 Party, under Colonel Saxton:—

BENGAL PROPER	Completed.	Remaining.
Or Lower Provinces under the jurisdiction of the Lieutenant-Governor of Bengal.	16,184 Sq. miles.	*Nil.*

Chota Nagpur, by No. 4 Party, under Major Depree.

28,636 Sq. miles. *Nil.*

Khasia, Garo and Naga Hills, by No. 6 Party, under Major Godwin Austen:—

Completed. Sq. miles.	Remaining. Sq. miles.	Likely to occupy.
11,333	23,674	7 years.

NORTH-WESTERN PROVINCES.

13. None executed in these provinces under this branch of the Department The Himalaya Survey, extending from Kashmir and Ladak to the Nipal Frontier, now in progress in Kumaon and Gurhwal, is conducted by a party of the Great Trigonometrical Survey, and is fully described in the separate report of that branch in conjunction with the Geodesical operations.

14. *Hazara.*—The first survey of this district was a military reconnoisance only, but based on the Great Triangulation. It has since been resurveyed topographically by Lieutenant-Colonel H. C. Johnstone of the Revenue Branch, on special demand. Area completed. 750 square miles.

PUNJAB.

15. This embraces the Districts of Jhelum and Rawul Pindi with portions of Hazara, Shahpur, and Bunnoo, and the salt range, admirably surveyed by Captain D. G. Robinson, R. E., on the 1-inch scale, from 1851 to 1859.

Kohistan, Sind, Sagur, Dooab.

Area completed. Sq. miles.	Cost Rs.
10,555	2,14,538

16. These were the first portions of the Himalayas topographically surveyed by the officers of the Great Trigonometrical Branch. The scale was only ½-inch to the mile. Kashmir and Jamu, the territory of the Maharaja Runbhir Sing, was also accomplished by the same Branch of the Department, and will be accounted for in the Trigonometrical Report. The rest of the Punjab Province, all champaign and revenue-paying districts, has been well surveyed by the Revenue Branch of the Department on the 4-inch scale, in close connection with the Great Triangulation.

Protected Hill States, Simla, and surrounding country.

17. The Sathpura range of mountains, comprising portions of Hoshungabad, Baitool, Chindwara, and Nursingpur Districts, have been topographically delineated by the Party No. 2, now in abeyance, which effected the survey of the Berars and part of the Nizam's (Hydrabad) dominions.

CENTRAL PROVINCES.

Completed. Sq. miles.	Remaining.
7,020	*Nil.*

Mandla, Belaspur, Balaghat, &c., by No. 4 Party, under Major Depree.

Completed.	Remaining. Sq. miles.	Likely to occupy.
Nil.	17,723	9 years.

Sumbulpur, Ryepur, Bustar, &c., by No. 3 Party under Colonel Saxton.

Completed.	Remaining.	Likely to occupy.
42,376	6,138	6 years.

Rajputana and Central India Political Agencies, by Nos. 1, 5 and 7 Parties under Lieutenant Charles Strahan, Captain Riddell, and Captain George Strahan, R. E.

Native States much intermixed.

Completed.	Remaining.	Likely to occupy.
68,697	1,40,106	20 years, with three Parties.

Bundelkund or Bundela States, as well as Baghelkund or Rewah, have been completed and are included in the above area of 68,697. The area here remaining to be accomplished embraces Bhopal and Malwa, as well as the rest of Rajputana and Scindhia's territories, &c.

18. *No. 3 Party.*—This party, under Colonel Saxton, has done a large area in the hilly mallias of the Ganjam and Vizagapatam Agencies. It has still much to do in Jeypur and other States of the above Agencies, as also in Bustar and other adjoining Native States of the eastern portion of the Central Provinces.

MADRAS.

Ganjam and Vizagapatam Agencies.

Completed.	Remaining.
10,048	5,196

19. The topographical survey of this State was commenced by the Madras Survey officers many years ago; and, after a considerable suspension in the operations caused by various untoward circumstances, the entire jurisdiction was completed after a period of about 50 years from the date of its first commencement by the Party No. 2 under the late Mr. Mulheran, Deputy Superintendent. The Assigned Districts (Berar) were also included in this field of survey.

Nizam's Dominion, Hydrabad, Deccan.

Completed. Sq. miles	Remaining.
97,137	*Nil.*

20. The above is all that has been done by the present system of topographical surveys in the Madras Presidency, but the officers of the old Military Institution acted as the pioneers of survey, early in the present century, in delineating the Southern Peninsula on the 1-inch scale, from which the existing sheets of the Indian Atlas have been published. A new revenue cadastral survey of the whole of the Madras districts has been in progress for the last 15 years under separate superintendence in that presidency, but no new geographical results have been furnished therefrom up to date. The imperative necessity of utilising some of the revenue surveys for geographical purposes has been strongly insisted on.

21. A topographical survey on the small scale of ¼-inch to the mile, which may be more fairly termed a close reconnoissance, has been made of the Pegu Division of British Burmah under the local administration, and independent of this Department, on an independent basis prior to the extension of the Great Triangulation in this direction. The area completed and mapped on the above scale is 32,250 square miles, the general map of which in four sheets has been lithographed in this office. It is probable that an entirely new survey, conducted on rigorous principles and based on the Great Triangulation, partially carried in this direction, will be necessary for the Pegu and Martaban Division, as well as of the whole of the Tenasserim Provinces, never yet surveyed.

BRITISH BURMAH.

22. The total area of the Bombay Presidency, including Native States, is 1,91,948 square miles; of this, the areas specified marginally have either been surveyed* or are under survey,† leaving about 72,552 remaining for survey, of which about 50,000 square miles are applicable for topographical delineation, and the remainder will require more minute revenue survey. The above figures are very approximate, as the results of the Bombay revenue measurements are altogether unknown; and how far any of the work may be susceptible of incorporation with the ordinary topographical maps for the purposes of geography and the atlas of India, it is impossible to say.

BOMBAY.

	Sq. miles.
Konkan	39,000*
Sindh	53,782*
Kattywar	19,650†
Cutch	6,764†

Remaining to be completed.	Likely to occupy.
50,000	25 years for a single party.

But with additional working power the time may be decreased in proportion.

23. For the last 30 or 40 years no geographical contributions whatever have been made from the Bombay Presidency towards the filling up of the sheets of the atlas, which are peculiarly blank throughout the Northern Division of the Presidency, but great exertions have lately been made by this Department to alter this state of things, and to obtain proper agency for regular topographical surveys of the blank portions. There are now five regular parties belonging to the Imperial Survey Department employed in that Presidency as per margin.

Gt. Trigonl. Branch.	Kattywar.
	Guzerat.
Topographical do.	Kandeish.
Revenue.	Nasik.
	Ahmednuggur.

24. Up to the past season a general area of both topographical and revenue surveys combined, the areas as per margin, have been accomplished and are still remaining to be dealt with in Bengal and Bombay Presidencies, which, with existing agency and allowed financial means, may possibly occupy about 20 years in the execution, but fresh wants for new surveys and on larger scales are springing up constantly, and what sufficed 30 or 40 years ago does not come up to the expectations or wants of the present day for engineering and other purposes. Consequently the first survey of India, which is so urgently needed for all purposes of administration, and which is so moderate in its mean average cost per square mile, which may be taken at £2-11s. will, no doubt, when completed, have to give place to some extent to a more minute and superior style of survey on improved scales and executed at a higher cost.

General combined topographical and revenue survey results.

Completed.	Remaining.
634,739	Sq. miles 251,243 Top.
	211,356 Rev.
	Total Sq miles 462,599

25. By the joint efforts of the several branches of the Imperial Survey of India an area of 35,000 to 40,000 square miles is annually effected, mapped, and for the most part published, in a preliminary style within the same period. The progress and outturn of course depends much on many local causes, over which the executives have but little control.

REVENUE OR FISCAL SURVEYS.

Punjab and Bhawulpur	3½
North-Western Provinces	1½
Oudh	1
Upper Circle, Total ...	6
Central Provinces	3
Lower Provinces, Bengal	4½
Lower Circle, Total ...	7½
Total Parties	13½

26. Since the reduction of the Department on financial grounds in 1870, there are the marginally noted revenue survey parties at work in the several local jurisdictions under the immediate superintendence of two Deputies, controlled generally by the Surveyor General, employed on a sort of tithe commutation survey, village by village, in the rich British champaign districts, on the scale of 4 inches = 1 mile. The unit of the survey is the village, and from the boundaries thus defined, every local jurisdiction of the civil and criminal limits can be laid down by following the cluster of villages forming each circle of police or revenue collection.

27. The positions of the current surveys and the precise field of employment for each party is given in the margin. The budget allotment for these fiscal surveys is £100,000 per annum, and this maximum is approached as near as possible with work of such peculiar and diversified character, influenced as it is by so many circumstances of localities affecting life and

Jurisdiction.	Districts.
Punjab.	Derajat.
	Delhi Division.
	Bhawulpur.

health, and where the period of maintaining the full working strength varies so greatly both from physical and local causes.

N. W. Provinces	Moradabad.
	Bareilly.
Oudh.	Gonda.
Central Provinces.	Chindwarra.
	Ryepur.
	Chanda.
Lower Provinces, Bengal	Luckimpur. (Assam.)
	Nowgong. (Assam.)
	Seebsagur. (Assam.)
	Hazaribag.
	Hoogly.

28. The mean average cost of effecting this description of work is about Rs. 45 or £4 10*s.* per square mile. The average area surveyed annually by a full and complete revenue party is from 1,000 to 1,200 square miles on the traverse system of land survey by theodolite and chain periphery measurements of boundaries of villages and estates, all perfectly identified and susceptible of incorporation with the Great Triangulation, forming a complete topographical delineation of the country, useful alike for fiscal and for geographical purposes.

29. The village system or definition of revenue boundaries and ascertainment of areas forms again the basis for the more minute record of the measurement of "fields" on a scale four times larger, or an approach to the cadastral system, for the record of every holding, which has heretofore been conducted, according to the primitive native system, of measuring land in conformity with the knowledge and experience of the native landowners and cultivators of the soil, with and on which operation, checked and confined by the professional or English survey, the settlements with the people have heretofore been conducted. This rough and antiquated process by native agency, and according to native ideas and system only, it is now in contemplation to exchange for the more reliable and correct method of a regular cadastral survey on an adequate scale like that of the Ordnance survey of Great Britain on the 25 inch = 1 mile scale, which, it is believed, will be found more worthy and reliable as a basis for the revenue assessment and Government demand of an empire depending so entirely almost on its land revenue.

30. There is still much remaining to be accomplished by this description of survey, *viz.*, the greater portion of the North-Western Provinces, a proper resurvey of which has only recently been commenced, to supply the loss caused by the mutiny, and in order to meet the requirements of a new settlement. The Dehli Division west of Jumna River, transferred to the Punjab, together with the Derajat west of the Indus up to British Frontier, now ripe for revenue or fiscal investigation. Also a few remaining districts in the Central Provinces, as well as some in Assam of the Lower Provinces. The above will occupy existing establishments many years. The total expenditure for this Branch of the Department for the season under report amounts to Rs. 8,89,433, including the Revenue Administrative Office.

31. With the above general explanation of the nature of, and the reasons for, the expenditure on account of the revenue or fiscal surveys of this side of India, as conducted under the Imperial Government, further details as to progress and cost with the budget actual expenditure will be found in the annexed report of the Superintendents of that Branch of the Departments, dated 21st December 1872, Appendix A.

32. The Administrative Branch of the Department consists of the following establishments at Head-Quarters, Calcutta, under the immediate direction of the Surveyor General, aided by three Assistants Surveyor General.

Administrative Offices, Surveyor General's Department.

ADMINISTRATIVE DEPARTMENT.

	Rs.	Rs.
1. Administrative Officers, including correspondence office		82,500
2. DRAWING BRANCH.		
Compiling and drawing of maps, plans, charts, &c.	53,922	
Travelling of Field Office while on tour	4,969	
CONTINGENCIES.		
Rent of offices, postage charges, service telegrams, presidency house-rent of graded assistants, miscellaneous, &c.	20,112	
Total Surveyor General's Office, Rs. ...		1,61,403
3. ENGRAVING BRANCH.		
ESTABLISHMENT.		
European engravers and plate printer, Native engravers and apprentices, writer, Native printers, pressmen, servants, &c.	29,406	
CONTINGENCIES.		
Presidency house-rent for European establishment, repairing tools, machinery, &c., purchase of chemicals, office furniture, &c., and miscellaneous ...	4,879	
Total Engraving Branch, Rs.		34,284

4. PUBLIC OBSERVATORY.

ESTABLISHMENT.

Superintendent, computers, observers and servants	6,029	
CONTINGENCIES.		
Miscellaneous	255	
Total Public Observatory, Rs.		6,284

5. LITHOGRAPHIC BRANCH.

ESTABLISHMENT.

Superintendent and chief draftsman, chromo-printer, draftsmen, writers, Native printers, pressmen, servants, &c.	27,774	
CONTINGENCIES.		
Purchase of type-printing materials, presses, &c., rent of office, purchase of oils, chemicals, ink, &c., repair of furniture, packing charges and miscellaneous	5,727	
Total Lithographic Branch, Rs.		33,501

6. PHOTOGRAPHIC BRANCH.

ESTABLISHMENT.

Photographers, zincographers, printers, pressmen, servants, &c.	18,096	
CONTINGENCIES.		
Cost of photographic chemicals, rent of office, purchase and repair of racks, shelves, presses, &c., and miscellaneous	10,734	
Total Photographic Branch, Rs.		28,830

7. MATHEMATICAL INSTRUMENT MANUFACTORY.

Salary of Officiating Superintendent and office establishment	5,216	
MANUFACTORY ESTABLISHMENT.		
Instrument-maker and assistant, mechanics and laborers	21,584	
STORE ESTABLISHMENT.		
Store-keeper, clerks and others	2,280	
CONTINGENCIES.		
Purchase of tools, stores and materials for work-shops, purchase of new and second-hand instruments, rent of office and miscellaneous	22,434	
Total Mathematical Instrument Manufactory, Rs.		51,514
Total administrative offices		3,15,816
Total Executive Field Establishments		3,45,242
Grand Total Topographical Surveys, and Surveyor General's Department, Rs.		6,61,058

33. The specific purposes for which these several establishments are required are as follows—No. 1 is for the conduct of the general business, correspondence and accounts, entailed by the control and supervision of the department,—the custody and maintenance of the records,—the issue of published maps, and various miscellaneous duties. It is the geographical depôt for the whole of India.

Clerical Office.

34. No. 2 is for the geographical business connected with the examination, compilation, drawing, and reduction of maps on all scales, as rendered by the executives, and geographical materials derived thereon, preparatory to publication,—for the revision of the proofs from the several printing presses—and the construction of the sheets of the Atlas of India, in manuscript, to be put into the engravers hands, as well as the coloring of all printed maps and meeting the wants of the several local Governments. This branch is under the immediate superintendence of J. O. N. James, Esq., Assistant Surveyor General, a Departmental Officer of great experience.

Geographical Drawing and Compiling Branch.

In 1870-71 *the work completed was as follows*:—

General maps and extensive compilations on various scales	14
Quarter sheets of the Indian Atlas, 4 miles = 1 inch	32
Sheet maps of old topographical surveys, 1 inch scale, redrawn for photozincography	29
Miscellaneous maps, charts, and extracts	20
Maps colored, corrected, &c.	23,321

35. No. 3 is for the copper plate engraving of the final results of the survey on the sheets of the Indian Atlas, as well as other provincial and miscellaneous maps on various scales, as only very

Copper plate Engraving.

lately etablished in India and transferred from the geographer to the Secretary of State at the India Office. The European staff sent out from England is now training the Native agency largely. Great advantages have already resulted from the conduct of this most important part of the work, so intimately connected with the survey of India, under proper professional supervision and instruction at the head-quarters of the Department in India. This work in India commenced with a staff as per margin, and has been very recently increased by a small number of Europeans and a considerable addition of native apprentices, who prove apt scholars, and will in time form a valuable class, capable of executing first class engraving.

European	Hill Etchers	...	2
Do.	Outline, writing, and ornamentation	...	4
Native	Hill Etchers	...	2
Do.	Writing and outline	...	2
Do.	Apprentices	...	4
	Total	...	12

36. No. 4 is for the purpose of showing mean time to the Shipping of Calcutta, by observation of the sun's transit at noon, and dropping of the mean time Ball for rating chronometers, as well as for taking meteorological observations hourly, day and night, the results of which are published monthly in abstruct form and weekly in the Government Gazette.

Observatory.

37. No. 5 is for copying and printing maps for each branch of the Department by the lithographic process, and issue for all subjects requiring revision and recopying, and which are not adapted for reproduction by the photographic process. It is also necessary for the speedy publication of the maps on both the 1 inch and $\frac{1}{4}$ inch scales, urgently demanded by all local officers, as preliminary productions before the engraving of the latter can be executed. All general and useful maps of Provinces or Districts are treated in this manner. An average of 100,000 copies of maps of various sorts are struck off annually by this process. The details of work produced in this branch of my office are given in a report by Captain W. G. Murray, Assistant Surveyor General in immediate charge.

Lithographic Press.

Appendix B.

38. No. 6 is of modern adoption and enables us now to produce all the results of the current surveys, prepared expressly for this object rapidly and effectively, which before were never printed or published in any form prior to the engraving on the small scale. By a combination of system in the preparation of the manuscript maps, they are now susceptible of immediate photographic reproduction and transfers to zinc without any hand-copying at all, and the public service is immensely benefited thereby. The perfection to which this art is now brought, and the great facility with which the transfers are effected, owing materially to the beauty of the original drawings, but also in a measure to superior manipulation of the process, has proved of immense value to the Department and to all administrative officers interested in getting the results of good surveys for all local purposes. About 100,000 copies of maps are now turned out by this process alone annually.

Photographic Department.

Appendix C.
See also Captain Waterhouse's excellent work on the "Cartographic applications of photography," published in 1870.

39. The general results achieved in this branch of my office, with the details of expenditure, are well described in the separate report appended by Captain Waterhouse, Assistant Surveyor General.

40. *No. 7, under the immediate superintendence of the Deputy Surveyor General, this establishment is a valuable adjunct to the Survey Department for the repair of all the instruments in use, as well as for the manufacture of many of the simpler instruments and implements required for survey purposes, and which can be made better in this country. It also forms a depôt for the safe custody of all the instruments sent out from England on indent, from which all the supplies are drawn by executives under due control by Heads of Departments. It is likewise largely made use of by the Public Works Department and other branches of the Public Service, both Military and Civil. The details of work performed and cost of the same are fully accounted for in the separate report by the Officiating Superintendent of that Department annexed.

Mathematical Instrument Workshops and Depôt.

Appendix D.

41. The administrative printed annual reports fully show in what manner and to what extent the results of all the surveys are put to proper account and treated by the several processes of photo-zincography for the immediate reproduction and issue of the standard sheets of both topographical for Native States and revenue surveys for British Districts and Provinces. Also by lithography for those older materials, all colored and not adapted for photography, but which form admirable avant couriers, as preliminary productions, to satisfy the reasonable and pressing demands of local administrative officers, and again by engraving for the final reduced maps for incorporation in the great atlas of India.

Cartography.

42. The great object is to supply every local officer and administration with some sort of printed results of the surveys, and no time is lost in the Surveyor General's Department in producing the maps as called for, either as preliminary or temporary issues by either of the

two former processes, according to the capability of the establishments, as well as in taking the final step of engraving for all the really disposable surveys which are ready in every way for that treatment. As shown above, 200,000 impressions of maps are turned out annually, independent of the atlas sheets, the preparation and issue of which have up to the present time been lamentably slow from various conflicting causes unconnected with the administration of the Survey Department in this country.

43. The above extensive issues showing an immense increase over former years, before the introduction of the photozincographic or carbon transfer process, may be said to be remarkable.

44. Every effort has been made for some years past to deal with the enormous outturn of all the surveys on this side of India, and great success with small means has been achieved. All the published maps are now regularly sent to the India Office for inspection at the new Geographical Department there, and for sale through London agents. There is no part of the executive field of our operations which is not published in some form or other for distribution to officials and sale to the public.

The London Agents are Messrs. W. H. Allen & Co., Waterloo Place.
Mr. Stanford, Charing Cross.

45. The general results of the utilisation of the survey materials, and their final embodiment into the Atlas of India, are given with much detail in my two printed special reports, cited marginally, showing the precise sheets already published, both full and only partially complete; those in course of engraving both in England and in India; those for which surveys were partially available, and the entire blanks, as well as regarding the nature and extent of the materials available towards the preparation of a complete Map of all India, and the filling up of the remaining sheets of the atlas now blank.

State of this Atlas of India on the scale of ¼-inch=1 mile.

No. 188F, dated 13th June 1871.
No. 809F, dated 28th October 1871.

46. Of the total number of sheets composing the Atlas, according to the published index map, the numbers of those already engraved in hand or remaining are abstracted marginally. Much has been done of late years, but very much still remains to be done, and of that already published much is now obsolete and will be superceded by better surveys, and require fresh editions of the sheets to be engraved.

Complete full sheets	...	40
Do. quarter sheets	...	13
Incomplete sheets (published)	...	48
Entirely blank unpublished sheets	...	28
Extra sheets belonging to Martaban and Tenasserim, all blank yet	...	11

47. The last printed catalogue of maps published and available at the Surveyor General's Office, gives the best idea of what is done with the survey materials. The Government Gazettes likewise notify the outturn of our several printing establishments monthly. Agents are appointed in several large stations for the dissemination and sale of all available maps, to which very moderate prices are affixed, and the object is to afford every possible facility to the public to obtain any and all of our publications.

48. In like manner a catalogue has been published of the maps available at the Geographical Department at the India Office, which affords further facilities to persons in England desirous of procuring any of the maps of the Indian Surveys.

SURVEYOR GENERAL'S OFFICE,
Calcutta, the 27th December 1872.

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

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APPENDIX C.

COMPILING, DRAWING AND GEOGRAPHICAL EXAMINING BRANCH, SURVEYOR GENERAL'S OFFICE.

STATEMENT showing the nature of the work performed and the progress made from 1st January to 31st December 1872.

Maps, &c.,	Scale.	Progress and Remarks.
	Miles. Inch.	
India.—Standard Map in 6 sheets. ... Sheet 3, Central India, Rajputana, Sindh, &c.,	32=1	Portions of Sindh, Rajputana States and Districts in the Central Provinces added. Laid aside for compilation of Atlas Sheets.
Sheet 4, Nepal, Bhutan, Bengal and part of the Central Provinces, &c.,	Ditto	Portions of Jeypur and Bustar added. Awaiting further materials from surveys in progress.
India.—Reduced from the above Standard Map, in 4 Sheet.	64=1	Inked in outline, rivers and roads; names of chief Towns, Civil and Military Stations written out lines engraving.
India.—For a General Map of the world; Estern Punjab Section; Latitude 30° to 35° Longitude 74° to 98°.,	10=1	Portions of districts Amballa, Loodianah, Hushiarpur and of the protected hill states compiled and partly inked. Laid aside for the compilation of Atlas Sheets.
India.—No. 2, (Hand Maps) 3rd edition ...	128=1	Hills being drawn for engraving in progress.
Bengal.—Jurisdiction of the Lieutenant-Governor, Standard Map in outline in four Sections.	16=1	Completed in outline; names written, Assam added from the best available sources; Map Photozincographed.
Bengal, Behar and Orissa.—2nd edition ...	32=1	Various additions and corrections.
Chota Nagpur Division.—S. W. Frontier of Bengal; Office copy General compilation.	4=1	Survey results 1879-70-71, added; Hill shading in progress.
North-West Provinces and Oudh.—Out line Map	32=1	Various additions and corrections. Map published for administration reports.
Preliminary Compilation Map of the Garo Hills.	4=1	Compiled in outline as far as Survey results were available; awaiting further Survey.
Hushangabad District.—2nd edition ...	4=1	Revisions and addition of the hills portion from Topographical Survey to complete the district according to its present limits; finished.
Sheets of the Atlas of India.		
Sheets 2, Quarters S. E., S. W,, N. E. ...	4=1	Province of Sindh; Quarter S. W., compiled and Hills drawn; N. E., only hills drawn; S. E., hills in progress.
Sheet 9, Quarters N. W., S. E., S. W. ...	Ditto	Province of Sindh; Quarter N. W., completed; S. E completed Hills drawn; S. W. only hills drawn.
Sheets 50, Full plate (old) Proof received from England for additions to complete blank portions.	Ditto	Jeypur, Alwar and Kerowli States in the Rajputana Agency; added from recent Topographical Surveys, nearly half the sheet was blank completed and returned to England.
Sheet 52, Quarters S. E. ...	Ditto	Part of Gwalior state, compilation in progress.
Sheet 53, Quarters S. E. ...	Ditto	Parts of Hooshangabad, Baitool and Chindwara in the Central Provinces. Completed as far as Survey results were available sheet engraving.
Sheet 54, Full plate (old) Proof received from England for additions and completion of blank portions.	Ditto	Fully two-thirds of this large sheet is quite blank; Districts Nimar, Baitool, &c., under compilation in progress.
Sheet 72, Quarters N. E., N. W., S. E. ...	Ditto	Central Provinces, Portions of districts Chindwara, Seoni and Bhandara under compilation.

STATEMENT showing the nature of the work performed and the progress made from 1st January to 31st December 1872,—continued.

Maps, &c.	Scale.	Progress and Remarks.
	Miles. Inch.	
Sheet 73, Full plate (old) ...	4 = 1	Heavy additions necessary to complete the blanks. The greater portion of the Chanda district compiled. Engraving of outlines in progress.
Sheet 89, Full plate (old) Proof received from England for completion of blank portions.	Ditto	Rewah, Southern portion, and some Bundela States added. Heavy additions completed and proof returned.
Sheet 104, Full plate (old) Proof received from England for completion of blanks.	Ditto	Parts of districts Hazaribagh and Lohardugga. Compilation of district Hazaribagh in progress.
Sheet 105, Quarters N. W. and S. E. Proofs received from England for completion of blanks.	Ditto	Gurjat States in the Chota Nagpur Division. Completed and hills drawn; proofs returned to England
Sheet 124, Quarter N. W. ...	Ditto	Assam. Part of district Kamroop and East Dooars completed. Sheet engraving.

N. B.—Except where it is specified in the column of remarks, the hill shading remains to be done on all the above drawings of Atlas Sheets.

Standard sheets of the Topographical Survey re-drawn for Photozincography.

	Miles. Inch.	
Chota Nagpur Division sheets 24, 25, 26, 33, 34 and 43.	1= 1	Projected and re-drawn from the original field sheets.
Sheets 12, 13, 14, 21, 22 and 23... ...	Ditto	In progress in various stages.
Ganjam and Orissa (old series) sheets 2, 3, 4, 5, 6, 10, 16, 17, 18	Ditto	Projected and re-drawn from the original field sheets.
Sheets 7, 8, 9, 11, 19, 35, 36, 37, 59, 60, 84, 86	Ditto	In progress in various stages.
Central Provinces and Vizagapatam Agency (new series) sheets 1 and 4.	Ditto	Additions to complete the sheets for publication in a complete form.
North-East Division, Central Provinces sheets 3	Ditto	Re-drawn from Chota Nagpur Division Survey sheet 62.
Sheet 6	Ditto	Additions to complete the sheets.
Rewah Survey sheets 3, 11, 13 and 15 ...	Ditto	Projected and re-drawn from the original field sheets.
Sheet 10	Ditto	In progress.
Khasia and Garo Hills' sheets Nos. 16 and 17 (in one).	Ditto	A larger portion re-drawn, hill drawn in progress.

Miscellaneous Maps, Charts, Tracing, and Extracts.

	Miles. Inch.	
Map of Bengal	64 = 1	For the Bengal Census Report.
Trans-Indus Frontier, 2 sheets ...	2 = 1	Copied for the Superintendent, Geological Survey.
Survey of the British boundary on the Northern Frontier of Zillah Purneah, North Behar	Ditto	Extract for J. G. Charles Esq.
Skeleton Map of the frontier between Holkar's State and Khandesh ...	Ditto	Fair copy for the Foreign Department.
Tracings of the Salween River in Burmah and of routes between Burmah and China	15 large sheets.	For Mr. Coryton, Recorder of Moulmein; most of these were rough Burmese maps.
Plan of the cantonment of Sekandrabad ... including the Residency	1 = 4	For the Garrison Instructor.
Extracts from the sheets of No. 3, Ganjam and Orissa Survey, seasons 1862-63 and 1868 to 62.	1 = 1	Tracings of the boundary between the Ganjam Agency and Central Provinces for the Superintendent of Revenue Survey, Madras.

STATEMENT showing the nature of the work performed and the progress made from 1st January to 31st December 1872,—continued.

Maps, &c.	Scales.	Progress and Remarks.
	Miles. Inch.	
Extracts from unpublished Charts of the Great Trigonometrical and Topographical Surveys	4 = 1	Eleven extracts with numerical data added for various departments.
Simoms' plan of Calcutta	.. ...	Various additions and corrections to complete the plan up to date 1872.
Corrections and additions to Topographical Survey sheets	1 = 1 2 = 1	Fifty-two sheets examined and corrected.
Corrections and additions to engraved, lithographed, and photozincographed maps ...	Various.	Railways, boundaries, territorial names, &c., inserted on 1,905 sheet maps.
Lithographed and photozincographed maps and plans colored	Ditto.	Thirty thousand, one hundred and sixteen sheets colored.
Atlas sheets and engraved maps colored ...	Ditto.	Four thousand, two hundred and thirty-six sheets colored.
Proofs examined of maps, charts and plans	Ditto.	Four hundred and sixty-six sheets.

Surveyor General's Office,
Calcutta, the 1st January 1873.

J. O. N. JAMES,
Asst. Surveyor General,
In charge Drawing and Compiling Branch.

Dr. *Abstract Cash Accounts from 1st January to 31st December 1872* Cr.

Items.	Amount.	Total Amount.	Items.	Amount.	Total Amount.
	Rs. A. P.	Rs. A. P.		Rs. A. P.	Rs. A. P.
To Cash Account.			*By Transfer Account.*		
Balance in Bank of Bengal as per printed Report for 1870-71 ...	2,623 0 2		Amount paid to Government by Cheque No. 365, dated 19th February 1872, as per Comptroller General's receipt No. 6598, dated 23rd February 1872	6,000 0 0	6,000 0 0
„ in hand ditto ditto ...	269 10 6		Ditto ditto No. 366, dated 11th May 1872, as per Bank of Bengal receipt sent to the Comptroller General under cover of this Office No. 869, dated 15th May 1872	800 0 0	
„ on account of sale of maps since realized ditto ...	7,625 12 9		Amount paid to Bank of Bengal, No. 949, dated 10th June 1872 ...	173 10 9	
		10,518 7 5	Ditto ditto No. 1023, dated 2nd July 1872	90 4 0	
To Map Sale Account.			Ditto ditto „ 1093, „ 26th „ „	3,036 9 0	
Amount received from Sundries	584 14 3		Ditto ditto „ 1096, „ 29th „ „ ...	212 0 0	
Sales by Curator of Government Books N. W. P.	212 0 0		Ditto ditto „ 1196, „ 24th August 1872 ...	50 0 0	
„ by Punjab Printing Company	159 3 2		Ditto ditto „ 1418, „ 8th November „ ...	50 12 0	
		956 1 5	Ditto ditto „ 1578, „ 21st November „ ...	728 0 8	
			Ditto ditto „ 1743, „ 17th December „ ...	162 0 2	
			Ditto ditto „ 1779, „ 19th December „ ...	20 15 0	
					5,324 3 7
					11,324 3 7
			By Sundries.		
			Amount paid on account of Stores Commission, &c., to the map sale Agents	150 5 3	150 5 3
Total ...	.....	11,474 8 10	Total ...	.....	11,474 8 10

H. L. THUILLIER,
Surveyor General.

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APPENDIX D.

Statement of work completed and in progress in the Engraving and Copper-plate Printing Branch Surveyor General's Office, during the year ending 31st December 1872.

Plates of the Indian Atlas.

10 N-W; 11 N-W; 11 N-E; 32 S-E; 32 N-E. Completed and published.

9 S-E; 11 S-W; 33 N-E; 86 S-W; Completed, will be published shortly.

34 N-E; 68 Full plate (old) 124 N-W; 125 N-E. Engraving completed. Some corrections and additions needed. The additions to plate 68 (Oudh) cover nearly one-third of the plate.

2 S. E.—Outline finished; writing well advanced.

2 N. E. Ditto ditto ditto.

2 S. W.—Outline and writing completed; hill etching commenced.

3 N. E.—Outline completed; writing commenced.

9 N. W.—Plate partly engraved in England. Outlines of additions completed; writing in progress.

9 S. W.—Outline and writing completed.

33 S. E.—Outline completed; writing in progress.

34 S. E.— Ditto; writing commenced.

51 S. W.—Outline and writing completed.

58 Full plate (old) —Railways added.

61 Ditto ditto

72 S. E.—Outline commenced.

73.—Full plate (old) portion of old work cleaned off. Outline of additions completed; writing commenced. The work on this plate is heavy.

78.—Full plate (old), repairing the work throughout; writing completed; hills half retouched, plate put down for other work.

87 N. E.—Outline completed; writing nearly finished.

88.—Full plate (old) outline done; writing in progress; additions very heavy.

93 N. E.— Ditto writing commenced.

120 and 121.—Full plates (old), Railway and small corrections and additions completed.

124 S. E; 124 S. W; 124 N. E.—Plates put down for other work.

125 N. W.—Outline and writing completed; hills in progress; plate put down for other work.

131 N. W.—Outline completed; plate put down for other work.

131 N. W.—Outline completed.—Plate put down for other work.

Miscellaneous Maps, &c.

Map of the Punjab in outline, 32 miles = 1 inch completed and published.

Maps of Oudh, 16 miles 1 inch outline completed.

Simom's plan of the city of Calcutta numerous corrections, additions to 4 large plates in progress.

Additions and corrections to maps of India, No. 2.

Ditto to Index Chart, Great Trigonometrical Survey.

Small Index to 10 mile map of India.

Headings for Topograpical Survey sheets.

Altering plates of office imprimatur.

Scale 16 inches = 1 mile (in chains) for the Mathematical instrument Department.

Ruling tints for the Lithographic Branch.

Specimen slips of writing for apprentices and Native Draughtsmen.

Copper plate printing.

Proofs of various kind	...	...	..	521
Transfers for stone ...	...	..	...	357
Impressions of various kinds	...	...	...	12,080
		Total impressions	...	12,958

Surveyor General's Office,
Calcutta;
The 1st January 1873.

(Sd.) C. W. COARD,
Supdt., Engraving Branch.

APPENDIX E.

Abstract of the Drawings executed in the Surveyor General's Office, Lithographic Branch, from 1st January to 31st December 1872.

Scale, &c.	New Maps, &c., the Lithographic Drawings of which were completed during the present year.	Size.	No. of Sheets.
	General Maps.		
8 Miles = 1 Inch ...	Eastern Bengal Sheets, Nos. 7, 8, 9, and 10	Imperial ...	4
16 „ = 1 „ ...	Afghanistan Map Sheets, Nos. 1 and 2, Chalk hills, on stone and Persian names on transfer paper	Special	2
32 „ = 1 „ ...	Eastern Bengal, Burmah, parts of China and Siam, a portion added in 4th Section...	Imperial ...	1
	District Maps.		
2 Miles = 1 Inch ...	District Shahabad	Atlas	4
8 „ = 1 „ ...	Burdwan Division Skeleton Map (re-drawn)	Double Elephant ...	1
8 „ = 1 „ ...	Bhagulpur ditto ditto (ditto)	Do. ...	1
4 „ = 1 „ ...	Sindh Compilation Map Sheets, Nos. 1, 2, 4, Chalk hills, on stone	Imperial ...	3
	Revenue Survey Maps.		
1 Mile = 1 Inch ...	Sindh Revenue Survey Sheets, Nos. 43, 45, 46, 47, 48, 57, 58, 59, 60, 61, 70, 77, 80, 81, 84, 88, 89 and 91 ...	Double Elephant, &c.	18
1 „ = 1 „ ..	Oudh Sheets, Nos. 25 and 26	Do. ...	2
1 „ = 1 „ ...	District Lohardugga Sheets, Nos. 7, 8, and 9	Double Royal ...	3
1 „ = 1 „ ...	District Bijnour Sheets, Nos. 5 and 6	Do. ...	2
1 „ = 1 „ ...	Do. Kooch Behar Sheets, Nos. 1, 2, 3 and 4 ...	Do. ...	4
1 „ = 1 „ ...	Do. Chanda Sheets, Nos. 2, 3a, 3c, 7a, 15 and 17 ...	Do. ...	6
	Plans of Cantonments and Civil Stations.		
1,000 Feet = 1 Inch ...	Town and Suburbs of Rangoon	Atlas	4
	Town and City of Delhie	Do.	12
	Thannah Maps.		
¼ Mile = 1 Inch ...	Thannah Nakassie P'arah, Sub-division Kissenaggur, District Nuddeah...	Double Royal ...	6
¼ „ = 1 „ ...	Thannah Kaligunj, Sub-division Kissenaggur, District Nuddeah	Do, ...	6
¼ „ = 1 „ ...	Thannah Kutwallee Kissenaggur, Sub-division Kissenaggur, District Nuddeah	Do. ...	6
	Barrack Plans.		
	New and old Royal Artillery lines and old Entrenchment, Ferozepur	Various sizes ...	24
	Ferozepur Arsenal	Do. ...	8
	New lines for 1st and 2nd British Infantry Regiment at Trimulgherry	Do. ...	32
	New lines for European Artillery at Trimulgherry ...	Do. ...	12
	Proposed position of the European barracks and subsidiary buildings at Bolarum	Do. ...	28
	New and old European Infantry and Royal Artillery barracks at Neemuch, Sheets Nos. 1, 2, 3, 4, 4A, 5, 5A, 6 and 7	Double Royal ...	22

Abstract of the Drawings executed in the Surveyor General's Office, &c.,—continued.

Scale, &c.	New Maps, &c., the Lithographic Drawings of which were completed during the present year.	Size.	No. of Sheets.
	BARRACK PLANS,—*continued.*		
	Nusseerabad European Infantry and Royal Artillery lines and Garrison cells	Various sizes ...	17
	European Cavalry barracks and out-houses at Secundrabad ...	Do. ...	10
	Agra Artillery and Infantry lines and Garrison in Fort Sheets, Nos. 1, 2 and 3	Do. ...	9
	MISCELLANEOUS.		
	Geological Map of portion of the Madras Presidency, including Kunoor and Caddapah, 8 tint stones prepared ...	.....	1
	Geological Map of sketch plan and section of Bhojia hills, 5 tint stones prepared	½ Sheet Foolscap ...	1
	India showing the sheets of the atlas and present state of the progress of the Geological Survey, 3 tint stones prepared...	Do.	1
1½ Inches = 1 Mile ...	Geological sketch plan of the head-water of Mhur Valley, 3 tint stones prepared	Do. ...	1
4 Miles = 1 Inch ...	Geological Atlas quarter Sheet, No. 77 S.W. Geological lines inserted, and 11 tint stones prepared	¼ Sheet Atlas ...	1
4 ,, = 1 ,, ...	Geological Atlas quarter Sheet, No. 78 S-E. Geological lines inserted, and 9 tint stones prepared	Do. ...	1
4 ,, = 1 ,, ...	Geological Map of the vicinity of Nagpur, 6 tint stones prepared	½ Sheet Foolscap ...	1
1 ,, = 1 ,, ...	Geological Map of Sirban hills in Abbottabad, 7 tint stones prepared	Do. ...	1
Various scales ...	Medical Department maps	Various sizes ...	2
,, ...	Railway Sections	Do. ...	32
,, ...	Sanitary Commissioner's maps	Do. ...	1
,, ...	Foreign Department maps	Do. ..	20
,, ...	Archæological Survey maps	Do. ...	30
,, ...	Public Works Department maps	Do. ...	8
,, ...	Bengal Government maps and plans	Do. ...	21
,, ...	Miscellaneous maps, plans and drawings	Do. ...	107
			476

J. WATERHOUSE, *Captain,*
Assistant Surveyor General,
In charge Lithograhic Branch.

CALCUTTA,
The 23rd January 1872.

ABSTRACT of the printing executed during the year, showing value or selling price of the same.

Subjects.	No. of sheets.	No. of copies.	No. of pulls	Value or selling price.
				Rs. A. P.
District and general maps on various scales	31	8,026	15,883	9,779 8 0
Index maps	8	1,860	1,860	Gratis
Revenue survey sheet maps, 1 mile=1 inch	25	5,676	7,548	8,514 0 0
Thannah maps	20	225	1,500	562 8 0
Plans of cantonments and civil stations	12	714	2,856	2,856 0 0
Block plan of barracks, &c., for Secretary of State	182	2,208	16,744	4,531 0 0
Reprints of old maps	109	9,556	30,946	13,114 10 0
Printed tints on engraved atlas sheets	4	4,033	5,167	631 11 3
Miscellaneous maps	73	20,631	24,431	12,767 3 0
Do. plans and sketches, &c.	230	1,19,497	1,40,744	13,866 12 0
Geological maps and plans	8	5,560	38,512	3,444 12 0
Estimated cost of transfers of headings and foot-notes to the published maps to this department	...	...	...	600 0 0
	702	1,77,986	2,86,191	70,668 0 3
Departmental orders, &c.	...	4,282	4,282	80 0 0
Memoranda and forms for the use of the department	...	1,01,489	1,15,733	1,640 0 0
Forms for Topographical and Revenue Survey orders	...	50,364	1,19,630	1,769 10 0
		1,56,135	2,39,645	3,489 10 0
Cost of Lithographic Branch.				
Permanent establishment	35,926	1	5	
Contingent expenses	1,445	9	2	
Extra contingencies	1,770	8	2	
Actual cost of papers	10,307	5	2	49,449 7 11
Lithographic papers of all sorts, 123 reams	...	...	...	
Proof „ „ 124 „	...	...	...	10,307 5 2
Printing „ „ 214 „	...	...	...	

The 23rd January 1873.

J. WATERHOUSE, *Captain,*
Assistant Surveyor General,
In charge Lithographic Branch.

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APPENDIX F.

REPORT by CAPTAIN J. WATERHOUSE, *Assistant Surveyor General, in charge* PHOTOGRAPHIC BRANCH, *Surveyor General's Office.*

AMOUNT OF WORK.—The amount of work may briefly be stated as follows—1,428 original subjects have passed through the office, of which 1,17,320 complete copies have been struck off, besides 4,200 silver prints.

PROGRESS.—The difference in the amount of work turned out during 1872, as compared with 1871, is shown in the table below, from which it will be seen that though some items show a falling off, which may be accounted for by the large size of the negatives now taken, there has been a considerable increase both in the amount of originals received and in the number of complete copies supplied. The increase in the number of silver prints has been very large, owing to the demands of the Archaeological Survey, the International Exhibitions, and also to an increased demand for silver print reductions from maps for the use of the Engravers.

Subject.	1871.	1872.	Difference.	Difference in dec. sq. feet.*
Originals	1035	1428	+ 393	
Negatives	1616	1760	— 56	
	(4892·1 d. s. ft.)*	(4481·69 d. s. ft.)*	.....	— 410·41
Silver prints	2561	4200	+ 1639	
	(2510·57 d. s. ft.)	(5230·39 d. s. ft.)	.....	+ 2719·82
Carbon prints	1827	1892	+ 65	
	(5017·19 d. s. ft.)	(4710 d. s. ft.)	.....	— 307·19
Transfer to Zinc or Stone ...	549	635	+ 86	
Number of Pulls	96,725	88,959	— 7766	
Ditto of complete copies ...	1,11,503	1.17,320	+ 5817	

* Decimal square feet of 100 square inches.

PROCESSES AND PERSONNEL.—There have been but few changes in the processes used, or in the personnel of the Office. Mr. W. Maher, the Assistant in charge of the Silver Printing Department, resigned his appointment in July 1872, and his place has not yet been filled up, though application has been made to secure the services of Sergeant John Harrold, R. E., an experienced photographer, from the school of Military Engineering, Chatham, and news of his appointment is daily expected.

The only improvement of importance in the processes is the use of albumen as a preliminary coating for glass plates, which have become old and stained by use, before using them again. The method has been found very valuable, and enables us to use glasses over and over again, whereas formerly they could seldom be used more than twice or three times.

EXPENSES OF WORKING.—The total expense of working the office during the year, including Superintendent's salary, has been Rs. 50,441-5-5 or Rs. 167-7 less than the expenses of last year. The decrease in expenditure is partly accounted for by the saving of Rs. 870-0-0 of Mr. Maher's salary from the month of July last.

The approximate sum to credit of the department is Rs. 77,928-12, showing a profit of Rs. 27,487-6-7.

PHOTOCOLLOTYPE PROCESS.—Though the hope, expressed in my last report, that this valuable process might be fairly introduced into the office during the year, has not been fulfilled owing to the want of material, and of a skilled printer, considerable progress has been made in working out the process experimentally, and in ascertaining the conditions of working it successfully in this climate. The accompanying specimen will give a good idea of the degree of success already attained in the reproduction of subjects in line, and I now only await the arrival of Sergeant Harrold and the requisite presses and apparatus to fairly start the process, and

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render it available for the practical production of copies of maps and drawings in which extra sharpness, delicacy and finish are required, as well as for replacing the slow and costly process of silver printing for ordinary photographs, required for the illustration of reports or other purposes.

The accompanying description of the working of the process embodying all the latest improvements, may be of interest.

Description of the Photocollotype process in use in the Surveyor General's Office, Calcutta.

The process I have worked out for use in this country, is similar to the processes now well-known in Europe as Heliotype, Lichtdruck and Albert-type, all of them modifications of the original process described by Tessier du Mothay some years ago, and which I saw being worked in 1868 in the establishment of MM. Maréchal at Metz. The printing film is a layer of insoluble gelatine which has been acted upon by light through the agency of an alkaline bichromate, in such a manner that the parts exposed to light become non-absorbent of water in proportion to the amount of exposure, while the protected parts absorb water in proportion to the amount of protection they have received, and consequently, if such a film be wetted and a roller charged with printing ink be passed over its surface, the exposed parts will attract the ink exactly in proportion as they are non-absorbent of water, while the unexposed and fully absorbent parts will repel the ink entirely, in the same manner as the wet parts of the stone in lithographic printing. It will thus readily be seen that from an ordinary photographic negative a print may be obtained, which will reproduce every gradation of tone in the original. Great success has been attained in the production of photographs of this kind, little, if at all, inferior to the ordinary silver prints, and this application of the process will be of immense value in replacing lithography for making copies of drawings for the illustration of scientific papers or reports, as the most delicate gradations of tone can be reproduced with a perfection quite unattainable by the best chalk drawing. Its value for this purpose is further enhanced by its extreme cheapness and rapidity, as may be judged from the fact that a drawing which might take a month to draw in chalk on stone at an expense of at least Rs. 80 or 100, for even a native draftsman, could be reproduced more perfectly in the course of 2 or 3 days at an absolutely trifling expense, not exceeding Rs. 5 for a comparatively large plate. A process of this kind is even more useful in this country than in England on account of the difficulty of obtaining trained skilled draftsmen, and is much required to supply the growing want of a practical and cheap mode of reproducing much of the miscellaneous work of the office in the same manner as photozincography has served us for the rapid reproduction and issue of the original manuscripts maps of our surveys. For reproductions in line also, the process surpasses most of the known processes of photo-engraving, photozincography, or photolithography in the delicacy, clearness and sharpness of the results, as well in accuracy of scale, owing to there being no intermediate process of transfer, and the plate being printed by vertical pressure.

The practical working of the process may best be considered under four heads; 1st, the original drawing; 2nd, the negative; 3rd, the preparation of the printing film; 4th, the printing.

THE ORIGINAL DRAWING.—The great advantage of the photocollotype process over the ordinary process of photozincography, is that any original drawing, whether drawn in lines only or coloured in washes that will give a *good photograph*, may be reproduced by it, while photozincography is only adapted for the reproduction of subjects in line, which even cannot be successfully reproduced unless drawn in black and white in a style specially suitable for the purpose. At the same time it must be borne in mind that the conditions as to necessity for drawings intended for reduction being drawn in a suitable style relatively to the scale of reduction, and as to the effect of photographing certain colours, are of the same importance in the photocollotype as in other photographic processes, and that, therefore, in order to secure the best results, drawings in line must be clearly and firmly drawn in black ink on clean, white, smooth paper and in a style suitable for the scale of the reproduction, while shaded or tinted drawings should be on as smooth paper as possible, and executed in monochrome, either with Indian ink, sepia, neutral tint, or some similar dark colour. These precautions should be particularly observed when preparing drawings specially for reproduction by the process, but in practice many cases arise in which drawings not specially prepared for reproduction by photography, and therefore unfit for reproduction by photozincography, have to be reproduced, and for this purpose the process will be a most valuable aid. Another point of the greatest importance is the necessity for the drawing being complete in all respects before it is given to be reproduced, as, though possible to a certain extent, it is not easy nor desirable to make alterations on the printing plates.

THE NEGATIVE.—As the printing surface receives the image direct from the negative and not by transfer as in photozincography, the necessity for the negative being *reversed* will readily be understood.

There is no great difficulty in obtaining reversed negatives by either of the three following methods.

(1.) By the use of a reversing mirror or prism.

(2.) By taking the negative through the glass plate instead of on its surface, *i. e.*, by turning the glass in the camera so that the collodion film may be turned away from the lens instead of facing it, as usual.

(3.) By coating an ordinary negative with gelatine, or transfer collodion, and stripping it off the glass.

The first and most simple of these methods has not yet been tried in the Office, but a silvered glass reversing-mirror has been indented for from England, and will probably prove the most useful means for the purpose.

The second plan has been tried with some success, and was, until quite lately, the only method employed for the purpose. There are, however, several disadvantages connected with it, of which the principal are the difficulties of obtaining photographic glass free from bubbles and other defects which leave their mark upon the sensitive film, and of accurately judging the time necessary for the exposure through the glass, owing to some glasses being thicker than others or deeper in colour; there is also the uncertainty of the focus being exactly sharp, and the impossibility of taking sharp pictures beyond a certain size, owing to the refraction of the glass causing a divergence of the more oblique rays, and thus throwing out of focus the details at the corners of the plates. On account of these difficulties I have lately made a trial of the 3rd, or transfer method, with success, and this plan would answer all purposes perfectly well, were it possible to prevent the gelatine film from contracting after it leaves the glass, but this serious defect seems likely to render it useless for map work, unless the usual amount of contraction can be estimated and allowed for. In other respects the collotype process is capable of giving most accurate reproductions to any desired scale, and it is therefore highly important that the reversed negatives of maps should be absolutely true to scale. For transferring ordinary negatives or others in which scale is of no consequence, the contraction is unimportant and the method may be used with advantage.

The *modus operandi* is as follows :—

After the negative has been taken by the ordinary method, it is carefully levelled and surrounded by a wall of putty or dough. A solution of gelatine composed of—

Gelatine	1 oz.
Water	8 ozs.
Glycerine	1 dram

is poured on it and left to dry in a place free from dust ; as soon as the film is dry, a knife is run round the four sides and the film instantly peels off the glass. Sometimes the gelatine film receives a coat of collodion to which a little castor oil has been added, and is thus better protected from atmospheric influences.

It is probable that the use of transfer collodion instead of gelatine would obviate many of the disadvantages caused by the contraction of the latter, but the method is much more expensive, and in a few trials made with it has not proved a success in this climate. The best means of making these reversed negatives absolutely accurate requires further experiment.

THE PREPARATION OF THE PRINTING PLATE.—It has been before stated that the printing plates are of glass. The ordinary plate glass about $\frac{1}{8}$ inch in thickness is the kind we have hitherto used, and seems to answer very well. The plates are ground on one side with very fine sand. When required for use they are thoroughly cleaned in the usual manner and carefully levelled by means of tripod levelling screws placed so as to form an isosceles triangle corresponding to the size of the plate; this method is much more convenient than using the ordinary levelling stands.

While the plates are being levelled, the gelatine solution is prepared as follows—

A	Gelatine	1 oz.
	Sugar	1 dram
	Distilled water	6 ozs.

heated in a water bath till the gelatine is dissolved.

B	Honey Soap	30 grains
	Distilled Water	1 oz

boiled till the soap is dissolved.

C	Tannin	10 grains
	Water	1 oz.

The above quantity will be found sufficient for two square feet of plate.

As soon as the gelatine solution A is quite ready, solutions B and C are mixed together hot and poured gradually, with constant stirring, into A. The whole is then strained through two thicknesses of coarse cotton cloth, and poured evenly over the plates, any bubbles being removed with the point of a penknife. The plates are then covered over with a light paper cover to prevent dust falling on them, and in the cold months will *set* firmly in about an hour, when they may be removed into the open air and turned face downwards upon small blocks of wood at their corners to remain till quite dry, which will be in from 12 to 24 hours. In the hot weather and rains, however, they will neither set nor dry so readily, and it will be advisable to increase the setting power of the gelatine by substituting one ounce of spirits of wine in place of the water used in dissolving the tannin, and in the rains a drying box must be used for drying the plates.

When the plates are dry, they may either be put away till required, or sensitised at once in a bath of—

Bichromate of potash	1 part
Water	20 parts

They are allowed to remain in this for about 5 minutes, and are then removed to a drying box and dried with a gentle heat. When dry, the deposit at the back of the plates, as well as any inequalities at the corners of the gelatine film, are removed, and the plates are ready for exposure to light under the negative.

This operation is performed in a pressure frame in the same way as for ordinary photographs. It is advisable, however, to secure clean margins by shielding the borders of the negative by means of a mask, cut out in yellow or brown paper, which should well overlap the edges of the printing plates. The mask is laid on the glass of the pressure frame, then the negative in its proper position (should this be a transferred film, it is advisable to place a glass plate between it and the mask, in order to secure the most perfect contact); the sensitive plate is then rubbed over with a little powdered soapstone (called in the bazars *Tel Khurri*), to prevent its adhesion to the negative, and adjusted in its place over the negative, covered with a sheet of black velvet or brown paper over which a thick glass plate is laid, and, if necessary, a few sheets of thick paper to give a good strong pressure, when the bars are shut down. The thick plate of glass has been found to give much sharper and more even contact than the usual back board.

The amount of exposure to light varies from about 10 minutes in the sun for a clear line subject to from 25 to 50 minutes for a subject in half tones according to the subject and intensity of the light, but, as it is impossible to judge of the progress of the printing by inspection, it is necessary to use an actinometer as a guide to the exposure, and nothing of the kind being available in India, I have made up an instrument which seems to answer the purpose very fairly. It consists principally of a box, in the lid of which is fixed a translucent scale divided in 14 squares of different densities; No. 1 being almost quite transparent while No. 14 is almost perfectly opaque, numbers corresponding to the densities being painted in opaque colour on the scale.

The body of the box contains a grooved block for carrying the sensitive film, whether on paper or on a glass plate and a strip of vulcanite for pressing it into close contact with the scale.

As it is advisable that the composition of the sensitive film used with the actinometer should be exactly the same as that of the printing plates, strips of glass are coated with the gelatine mixture, sensitised, and dried at the same time and in the same manner as the printing plates, and thus the progress of the action of the light can be watched and timed very closely.

The mode of using the actinometers is very simple. The sensitive test plate, having been inserted in its place in the instrument, is exposed to the sun at the same time as the printing plate, and when the necessary time of exposure is about expired, is examined, when if an inspection of the scale shows that the action has gone far enough, the printing plate is removed from the light, but if not sufficiently printed it remains longer. It is a good plan when the exposure appears to have been sufficient, to plunge the test plate into water when the full effect of the light will immediately become visible, and, if necessary, more exposure may be given to the printing plate.

When the exposure to light is considered sufficient, the negative and mask are removed and the *back* of the sensitive plate is then exposed to light for about 5 or 10 minutes to thoroughly harden the gelatine, and prevent it from swelling too much in the after processes. It is as well to carry on this second exposure under a piece of ground glass, otherwise if there should be any scratches on the back of the sensitive plate, or on the glass of the pressure frame, they will show as white lines on the print; after this the plate is taken out of the frame, a little tallow is rubbed round the edges to prevent water getting underneath and stripping the film, it is then plunged in water and thoroughly washed till all traces of bichromate have been removed, and is ready for printing.

I have tried several other compositions for preparing the printing films and most of the other published processes, but though the dark colour of the tanno-gelatine film prevents the action of light being easily seen, and is also objectionable when rolling up in the press, I have found it the most manageable in the climate of Calcutta, and in some respects better than any other I have experimented with.

Up to the present time the work done has been of comparatively small size, not exceeding 20 × 15, but it is most desirable that the advantages of the process should be extended to the reproduction of our large standard maps of the Topographical and Revenue Surveys. When the process is once fairly started, and the conditions of successful working better known, this subject will receive my full attention.

THE PRINTING.—The plates may be printed in the lithographic press, and then require to be fixed on a level stone with plaster of Paris. It has been found, however, more convenient, and in other respects better, to print them with vertical pressure in the ordinary Albion press,

and, in order to prevent their being broken, the bed of the press is fitted with 2 or 3 thicknesses of kamptulicon, besides a sheet of vulcanised Indian rubber on which the plate rests. It is also desirable to place a sheet of white paper over the bedding in order to enable the state of the plate, when it is being inked up, to be better seen.

The plate having been well soaked in water is laid on the press, and, after being wiped, to remove the excess of moisture is inked in, if a line subject, with an ordinary lithographic roller charged with an ink composed of lithographic chalk ink thinned with a little olive oil, followed by a rolling with a smooth roller to clean away the superfluous ink; a mask of the required size is laid on the plate, over this comes the printing paper covered with a piece of soft felt to drive the paper well into the hollows of the plate, the tympan is lowered, and the impression pulled in the ordinary way. The plate is then damped, and the work goes on in the same manner without difficulty.

For printing in half tones, however, the process is somewhat different, and to obtain uniformly successful results, requires considerable skill and experience. As far as we have gone the following procedure has given the best results.

The plate is first inked in by means of a small leather hand-roller charged with stiff ink (rendered stiffer, if necessary, by the addition of a little Canada balsam) which takes only on the deeper shadows, the half tones are then brought out by rolling in with a smooth lithographic roller charged with a lighter and softer ink. Rollers composed of glue, treacle, soap and catechu have been found useful in certain cases for inking in the plates, but, on the whole, the lithographic rollers are preferred. The impressions are best when printed on enamelled paper, but a smooth glazed printing paper also seems to answer well.

Before putting away the plates after printing, they are washed with turpentine, followed by a very weak solution of caustic potash, to remove all traces of the greasy ink; they may also be treated after this with a mixture of gum and glycerine with advantage.

Corrections.—A point that seemed likely to greatly interfere with the extended use of the process in this office, was the difficulty of making corrections on the plates. I am glad to say that some experiments lately tried have shown that it is practicable both to insert and to take out or clear up details on the gelatine films.

The insertion of details may be accomplished by two or three methods. The first is by writing in the required additions on the dry plate with a pen or fine brush, using an ink composed of bichromate of potash, used alone, or slightly coloured with Indian ink or Indigo. After the additions are completed, the plate is exposed to the light for 10 minutes or ½ of an hour till the bichromate is thoroughly reduced, and may then be washed and printed as usual. In some cases the same object may conveniently be accomplished by brushing over the part with solution of bichromate of potash, allowing it to dry, and then printing in the required details from another negative.

A third method which recommends itself by its simplicity, is to draw in the additional details with an ink composed of solution of chrome alum, this acts instantaneously and requires no exposure to light. It has, however, been found not quite so easy to use as the bichromate solution, but further experiment in this direction is still required.

The use of these methods of drawing upon the gelatine film, opens up a large and very important field of research as to their applicability in many cases as a substitute for lithography. I know that it is possible to produce line drawings in this manner, and believe that it would be quite possible to produce tinted drawings also, and, if possible, shall give my attention to the subject during the coming year.

Experiments have shown that details may be taken out by the aid of a solution of caustic potash or cyanide of potassium, and, should a plate print dirty, it may be cleaned up and greatly improved by the use of a weaker solution of the same substance.

Such are the details of the process as far as they have been worked at present, there is however much to be done; but with the large amount of current work constantly on hand, it is most difficult to find time to devote to working out an entirely new method of printing; and nothing much can be done till my full establishment is completed by the arrival of a photographer from England who will be able to take the work in hand. I trust, however that next year I may be able to report considerable progress in the usefull application of this valuable system of photographic reproduction.

Sergeants J. and B. Mackenzie have rendered great assistance in the working out of the process, the first in making the reversed negatives, the latter in bringing his skill as a printer to bear on the difficulties experienced in printing by the new system.

(Signed) J. WATERHOUSE, *Captain*,
Assistant Surveyor General.

ABSTRACT of work performed in the Photographic Branch of the Surveyor General's Office from 1st January to 31st December 1872.

Maps Photographed.	No. of Sections or Sheets.	No. of Negative Plates.	Prints.		Transfers to Zinc.	No. of Pulls.	No. of complete copies.	Remarks.
			Silver.	Carbon.				
Topographical Survey Maps	203	194	110	160	79	18,095	18,095	
Revenue Survey Maps ...	646	705	29	908	215	18,134	*16,674	*3,700 Anastatised.
District Maps ...	16	61	97	87	31	8,267	† 4,682	†1,230 Ditto.
General Maps ...	56	203	36	271	85	16,897	11,240	
City and Cantonment Plans	28	53	...	37	9	2,955	1,025	
Miscellaneous Maps ...	479	544	3,928	429	145	22,659	‡65,604	‡85 Ditto. 2,216 Zincographed.
Zincographic and Anastatic Transfers	...	...	...	...	71	...	...	
Proofs	...	...	...	...	...	1,952	...	
Total ...	1,428	1,760	4,200	1,892	635	88,959	1,17,320	

STATEMENT showing the cost of working the Photographic Branch of the Surveyor General's Office from 1st January to 31st December 1872.

Dr.	Number of complete copies.	Rs. A. P.	Cr.	Rs. A. P.
Topographical Survey Maps ...	18,095	17,417 8 0	Superintendent's salary from 1st January to 31st December 1872	9,561 14 0
Revenue Survey Maps ...	12,974	21,844 4 0		
District Maps	3,452	5,244 0 0	Sanctioned Establishment and house rent from 1st January to 31st December 1872 ...	21,990 14 2
General Maps	11,240	12,661 4 0		
City and Cantonment Plans ...	1,025	2,557 8 0		
Miscellaneous Maps	63,303	4,310 14 0	Contingencies, inclusive of chemicals received from the Government Medical Store Department and England ex "*Yeddo*," "*British Army*" and "*Agra*"	8,141 15 9
Anastatised Maps	5,015	8,098 12 0		
Zincographed	2,216	192 8 0		
Silver Prints	4,200	5,602 2 0		
			Cost of Paper	10,746 9 6
			Balance in favor of the Department ...	27,487 6 7
Total ...	1,21,520	77,928 12 0	Total Rupees ...	77,928 12 0

J. WATERHOUSE, *Captain,*
Assistant Surveyor General,
In charge Photographic Branch,
Surveyor General's Office.