GENERAL REPORT

ON THE

Topographical Surveys of India,

AND OF THE

SURVEYOR GENERAL'S DEPARTMENT,

FOR SEASON

1872-73.

BY

COLONEL H. L. THUILLIER, C.S.I., F.R.S., &C.,

SURVEYOR GENERAL OF INDIA.

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

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GENERAL REPORT

OF THE OPERATIONS OF THE

Topographical Surveys of India,

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FOR SEASON

1872-73.

Dated Calcutta, 20th January 1874.

THIS review of the operations of the Topographical Surveys of India for the professional season of 1872-73, and of the work performed in the several branches of the Surveyor General's Head-quarters Office for the year ending 31st December 1873, continues the narrative as detailed in the general report dated 15th January 1873. The nature and results of the entire operations are pretty much the same as previously reported on, and which have been before the Government of India in detail to a very considerable extent, during the period under review.

2. The seven survey parties constituting the existing sanctioned strength of this branch of the department (as detailed in paragraph 3 of the last report), were employed, in continuation of the work of the previous season, in the field of operations allotted to each, and regarding which full particulars are given under the head "Executive establishments," in which the work of each survey party is separately reviewed.

Results of the season's operations.

3. The general results of the season's operations and the cost of each survey party for the *professional* year commencing 1st October 1872, and ending 30th September 1873, are given in the Statement A in Appendix, showing the total outturn of the seven surveys to amount to 25,327 square miles of final topography, of which 14,054 square miles were accomplished on the usual scale of 1 mile to the inch, 670 square miles of the Naga Hills, (not requiring a larger scale,) on two miles to the inch, and 10,603 square miles, in the Northern and Eastern Chittagong, Tipperah, Lushai, and Munnipur Hills, on the geographical scale of four miles to the inch, which was as large as the objects and the nature of the country warranted. The average mileage rate of the whole comes to Rs. 17-12, including the cost of triangulation in advance, which, if taken one year with another, does not disturb the mode of reckoning the cost of the general operations, the same system having been observed from the beginning, and therefore if continued, will yield precisely the same results as if a separate allowance were made for the triangulation only, which, as a matter of partial detail, is quite unnecessary.

Apportionment of surveyed area in British and Native States.

4. It is estimated that, of the large area of 25,327 square miles which has been surveyed during a single season, only 6,136 square miles were in British territory and the remaining 19,191 square miles were in Native States and Independent territory. Of the 6,136 square miles surveyed within British districts, the ground in Belaspur, Mandla of the Central Provinces, the Garo, Mekir, Naga, and Northern

Chittagong Hills of the Eastern Frontier was of the wildest and most inhospitable nature, forest clad, unhealthy, and in parts totally uninhabited and never before entered by Europeans; whilst a very considerable portion of the Native States in Rajputana and Central India, Bustar of the Central Provinces, and Jeypur of the Vizagapatam Agency, were although not so bad, yet very hostile to health and most difficult for survey.

Survey and exploration beyond the Eastern Frontier of Bengal.

5. In Independent territory beyond the Eastern Frontier of Bengal, *viz.*, in the Lushai, Kuki, Tipperah, Naga, and Munnipur Hills, 6,423 square miles were during this season explored and mapped on the smaller scale, making, with the area obtained during the previous season (6,500 square miles), a total of 12,925 square miles of exceedingly intricate territory, chiefly beyond the British possessions, of which reliable geography has been for the first time obtained, together with much interesting and valuable information regarding the semi-civilized tribes along our frontier. Further exploratory surveys are now in progress along the southern frontier of Upper Assam, in the hills north and south of the Patkoi range, inhabited by various Naga tribes, who, though politically within the British frontier, are only known to us by the name of their race. The Patkoi pass (Lewe-Pet-Kui) crossed over by Drs. Bayfield and Griffiths in 1837, but the position of which was not geographically determined at the time, will, it is hoped, be visited and correctly fixed in due course. This pass is said to be on one of the most practicable routes from Assam into Burmah passing through the Hookoong valley.

Comparison of the professional results and cost of seasons 1871-72 and 1872-73.

6. In the Table B (Appendix) the professional results and cost of the season 1872-73, now under report, and those of the previous season (1871-72), are given, with the view to the comparison of one with the other, showing a very satisfactory reduction by 2 rupees and 14 annas in the average mileage rate in favor of the season under review, and the attainment of a very extensive area, below the mean general average cost of such operations, as explained in several previous reports.

7. During the season 1872-73, an increase of no less than 7,417 square miles of topography, and 2,594 square miles of triangulation, over the returns of the previous season have been obtained for an outlay of Rs. 4,49,826. The increase in cost of Rs. 78,280, is chiefly due to the addition of No. 2 Survey, Khandesh and Bombay Native States, and its expansion to full strength, whereby additional area was obtained. The expenses, however, have been raised by the very exceptional nature of the expenditure for special porters or coolies, and food depôts for the exploratory surveys along and beyond the Eastern Frontier by No. 6 party, for which the Government was pleased to allow a special additional grant to the sanctioned estimates of this branch of the department.

8. For the increased outlay an excellent return has been obtained (1), by a very much larger amount of topography and triangulation at a lower average rate, and (2), by the knowledge gained of the country and people along our Eastern Frontier.

9. With regard to the progressive annual outturn of area, I may remark that we are still engaged on a first survey of the non-revenue-paying, forest-covered, and unprofitable portions of British territory, which, during the past occupancy of more than a century, has never yet been mapped, and of extensive areas in Native States, which have scarcely been visited or explored. In the present day the requirements of the public service, owing to local and imperial public works, are accurate large-scale maps full of detail, in yearly increasing numbers. These requirements have been fully met by increased and vigilant supervision in the field work, more details and increased accuracy in the topography rendered, and by the yearly publication of all mapping produced by Executives on the full scale of survey with the aid of the photozincographic process.

10. With the increased cost of labour, supplies, carriage, &c., throughout India, and the more rigorous procedure necessarily adopted for several years past in the conduct of surveys, it is entirely a question between time and cost as to what the future results and progress of this department may be. Larger scale surveys, and the more accurate and complete delineation of every minute feature of the country, can only be obtained by a moderate and reasonable rate of progress at the fixed sanctioned present expenditure. To secure the present exceedingly moderate cost of survey, and to maintain both the quality and the quantity of the outturn, is the main object now, and I desire, in these remarks, merely to place before Government the very apparent causes which affect the outturn, expenditure, and mileage rates of surveys in progress in the worst parts of India now remaining to be entered.

Value of the season's Triangulation.

11. In Table C (Appendix) the results and value of the season's triangulation, and the average number of plane-table fixings per square mile, in topography delineated, are shown. The value and accuracy of the work in every stage has been fully maintained, and there is a marked improvement in the number of plane-table fixings per square mile, on which the accurate delineation of the ground and completeness of details so materially depends.

12. The fair drawings* of 14,113 square miles on the inch scale, 500 square miles on ½ inch, and 10,773 square miles on the ¼ inch have been rendered, making in all a total of 25,386 square miles, nearly all of which has been reproduced by photographic transfers to zinc, and is further now being reduced and compiled for incorporation on the sheets of the Indian Atlas. The area above described will furnish materials for portions of the following Atlas Sheets, 34 S.W., 37 N.E. and S.E., 52 S.E., N.E. and N.W., 53 N.E., 90 N.W. and S.W., 93 S. E. and S.W., 119 N. E., 130 N.W., S.W. and S.E., 131 N.E. and S.E.

Season's fair maps.

* 28 Standard Sheets 15′ of Lat. by 30′ of Long. 1 inch scale.
2 Standard Sheets 15′ of Lat. by 30′ of Long. ½ inch scale.
3 Sheet maps, 4 miles = 1 inch.

13. Six large sheets of the Simla and Jutog Survey, (scale 24 inches to the mile), and the plans noted on the margin, have been rendered, all of which have been published.

PLANS.

Bhopal Fort, City and Environs, Scale 24 inches = 1 mile.
Tura Station (Garo Hills) „ 24 „ „
Samaguting Station (Naga Hills) „ 12 „ „
Raisen Fort (Bhopal Territory) „ 12 „ „
Goona Cantonment (Central India) „ 8 „ „

14. The execution and finish of all these fair maps and plans are excellent, and no pains have been spared by Executives to render them as perfect as possible.

15. The total area produced by the Topographical and Revenue surveys in progress, with the cost of the same during the season, is given in the margin. The combined area amounts to 41,839 square miles obtained at a total cost of Rs. 14,48,780. In the Upper Circle Revenue operations, the Cadastral Survey of the North-Western Provinces, or measurements of fields on the large scale of 16 inches = 1 mile, or 330 feet = 1 inch, to the extent of 1,870 square miles, equal to 1,196,588 acres, contained in 1,469 villages, have been prosecuted, in which no less than 1,269,882 fields were separately measured and mapped. This system of survey of course greatly increases the cost and time of execution, relatively with the scale employed, as referred to in paragraphs 36 and 37 of the last report. In estimating, therefore, the general rate of the Revenue Surveys, which are now of so diversified a character, it is necessary to separate the tedious and expensive process of laying down the "fields," which cannot be calculated by the square mile, but by the acre. As far as at present advanced with this new system, the cost is stated to be about 4 annas 2 pie per acre, say @ 6¼*d.* in English money. The whole of the details will be found fully discussed in the report of that branch of the department.

Combined results of Topographical and Revenue surveys.

Topographical Survey ...	Sq. Miles ...	25,327	Cost Rs. ...	4,40,806	Rate per Sq. Mile ...	Rs.	17 12
Revenue Survey ...	Ditto ...	14,642	Ditto ...	6,51,370	Ditto ditto ...	„	44 8
	Ditto ...	39,969	Ditto ...	11,01,266	General average rate of combined Topographical and Revenue Surveys	„	27 9
Add Cadastral ...	Ditto ...	1,870	Ditto ...	3,47,514			
Total ...	Ditto ...	41,839	Ditto ...	14,48,780			

16. The aggregate results of the more modern Topographical and Revenue surveys brought up from previous reports from the year 1847, as specified in paragraph 31 of the last narrative, are as follow :—

Aggregate results brought up to date.

	Sq. miles.	*Cost Rs.*
Total up to 1872	701,963	1,85,79,549
Add for 1873	41,839	14,48,781
Total up to 1873 ...	743,802	2,00,28,330

The disposition of all these surveys, both completed and in progress, is described in the map of India attached.

17. In the Drawing and Geographical compiling branch of the Head-quarter Office, great progress has been made under the energetic immediate superintendence of Mr. J. O. N. James, Assistant Surveyor-General, in reducing, compiling, and incorporating the latest survey results on the manuscript or original sheets of the Indian Atlas. Nine new quarter-sheets, as per margin,* have been taken up, and very considerable additions have been made to 11† of the old full-sized double elephant sheets, several of which were nearly half blank; additions have also been made to the drawings of 23 quarter-sheets from the results of Topographical and Revenue surveys, in progress or completed, during the past two seasons.

Cartography.
Sheets of the Indian Atlas.

* 9 N. E.; 93 N. E.; and S. E.; 131 N. W.; 52 S. E.; 53 N. E.; 93 S. W.; 105 S. W.

† Sheets 54, 61, 67, 73, 104, 107, 108, 113, 118, 119, 121.

18. Proofs of the following sheets, the plates of which are engraving in England, were received during the year from the Geographical Department, India Office, to several very heavy additions from new surveys have been made to complete them up to margins,

or to date; 44 S.E.; 46, old full-plate; 51 N.W.; 54, old full-size plate; 63 N.W.; 64 S.W.; 69 S.E.; 70 S.W., N.W., N.E.; 71, N.W. and S.W.; 89, old full-size plate; 90 S.E., N.E., and N.W.; 92 S.E.; 104, old full-size plate; 118 old full-size plate; with the exception of three quarter-sheets all have been completed and returned to the India Office for the guidance of the engravers at home.

19. In all, 47 old and new sheets (full and quarter-plates) have either passed through the hands of the compilers and draftsmen or are now being dealt with. The additions to the old plates and fresh materials for new quarter-plates have necessitated the reduction and fair drawing of no less than about 115,000 square miles on the $\frac{1}{4}$ inch scale, or what would cover a superficial area of nearly 7,188 square inches. All this represents final and complete survey in portions of Bengal and Assam, the Central Provinces and Oudh, and in the Native States within the Rajputana and Central India Agencies.

Geographical and Miscellaneous maps and compilations.

20. In addition to the above, several valuable and useful maps, too numerous to detail here, but which are described in full in the appendix of this Report,* have either been completed or are in progress, the most important of which are as follow :—

* Report of progress in the Drawing Geographical compiling, and Engraving branches by J. O. N. James, Esq., Assistant Surveyor-General.

21. The standard map of India, scale 32 miles=1 inch, and the reduction on 64 miles to the inch, have been further advanced. It is most desirable to replace the old six sheet Sketch map of India, on which much of the information is now replaced by better and later material, and the old map, which has been on the stone so many years is so much worn from the very large number of copies taken from it that further corrections and additions are impracticable.

22. The great obstacles to progress with these maps, are the doubts and uncertainty which still exist, owing to the perpetual changes in the boundaries of districts and sub-divisions, more especially in Bengal, and to the various systems of spelling of names, subjects already fully discussed, and which seriously affect the progress, systems and completion of all geographical publications. No sooner is a map ready for issue than numerous corrections are required in boundaries, head-quarters, and names of sub-divisions, police stations, &c., and alterations and delays are thus occasioned, which are perfectly fatal to the style and finish of our best maps, and numberless valuable and useful publications are thus delayed and deteriorated.

23. The standard map of Bengal, Behar, Orissa, and Assam, scale 16 miles = 1 inch, has been greatly added to, and preliminary skeleton photozincographed copies have been taken for immediate purposes. It is intended to publish this map in two parts as soon as the internal civil and criminal jurisdiction boundaries are settled, and the final decision of Government regarding the separation of the province of Assam from the jurisdiction of the Lieutenant-Governor of Bengal and the limits of the new province are made known.

24. Considerable additions have been made to the map of the Eastern Frontier of Bengal, scale 4 miles = 1 inch, from the last exploration. This map will soon be ready for lithography.

25. The general map of Western Bengal, scale 8 miles = 1 inch, has been completed in manuscript from all the latest surveys, and the sheets of the western division are now in course of publication by lithography, to assimilate with the sheets or sections of Eastern Bengal already published.

26. A map of Oudh for the *Local Gazetteer*, scale 16 miles = 1 inch, has been completed, and a similar map of Sindh is under compilation.

27. A new district map of Darjeeling, showing territorial additions, scale 4 miles = 1 inch, has been compiled; maps on the same scale of the Garo Hills (Assam), Hazara (Punjab), and Chindwara (Central Provinces) are under compilation, also a new map of Bhootan, scale 8 miles = 1 inch, to illustrate a report under publication by the Bengal Government. Small skeleton maps on the scale of 16 miles=1 inch of the Presidency and Burdwan Divisions have been drawn for the *Imperial Gazetteer*, and skeleton district maps of Banda, Jhansi, Jaloun, Humeerpoor, and Lallatpoor, scale 8 miles=1 inch, are under publication for the *North-Western Provinces Local Gazetteer*.

Chota Nagpore Division, Ganjam, and Orissa, Rewah, and Bundelkund.

28. Of the earlier maps of the old Topographical surveys marginally noted, referred to in paragraph 49 of the last report, 18 sheets on the 1-inch scale have been redrawn at Head-quarters in uniform sheets specially for photozincographic reproduction, and 14 more are in various stages of progress. The publication of these older materials on the new system is of the utmost importance for the use of local authorities, and occupies my full attention.

29. The above, including the compilation and drawings for Atlas sheets, represents a very large amount of tedious compilation and fair manuscript drawing, in addition to which a great deal of miscellaneous and petty work has been accomplished. Mr. James remarks favorably on the very efficient aid rendered by Messrs. Baness and Chamarett in the drawing

and geographical compiling branches; both these assistants are experienced surveyors, and are now most essential aids for dealing with the greatly increased influx of work caused by the transfer of the geographical duties of the India Office to this department in India.

30. The old tables for the projection of the sheets or plates of the Atlas of India, as delivered over by the late Mr. John Walker, to myself in November 1868 at the India Office, were very incomplete, and in some instances the values were altogether wanting. It became necessary, therefore, to recalculate and revise the whole, and to elaborate the values for more points of the intersections of the lines of latitude and longitude. This duty has been very satisfactorily and efficiently performed by Mr. D. Atkinson, Surveyor, 2nd Grade, employed as First Draftsman at Head-quarters. This laborious work was accomplished during leisure hours, and great credit is due to Mr. Atkinson for the patience and mathematical ability which he has displayed. These complete revised tables are invaluable for the projections of the Indian Atlas sheets, and have been in constant use for all the plates started in India.

Engraving.

31. Excellent progress has been made in the Engraving branch, notwithstanding many difficulties, caused chiefly from the want of a larger staff of experienced European agency, capable of imparting instruction to native engravers and apprentices, and of guiding and helping them through the more advanced and artistic steps of the art of engraving and hill etching on copper. The small European staff has lately been further reduced by the resignation of Mr. J. F. Walsh, hill etcher, who completed his term of service of five years on the 7th January, and embarked for Europe on the 15th, and the departure of Mr. J. M. Dalziel, engraver, on medical leave to Europe for a year from the 12th November 1873. It not being possible to find substitutes in India for such skilled work, the loss falls temporarily on the office. It is found to be exceedingly difficult even in England to replace such a hill etcher as Mr. Walsh, whose qualifications were of a very high order.

Indian Atlas Sheets completed.

32. No less than 14 new quarter-plates, and one old full-size (double elephant) plate, marginally noted, have been completed and published during the year; of these, five plates will require further additions from surveys now in progress, and one (the Kurrachee sheet, Sindh) contains a portion of Khelat beyond the British western frontier, for which no materials from either survey or exploration are at present available. These will be separately submitted to the Government to show the style and extent of the work turned out. In addition, 18 new quarter-plates are in various stages of progress, and considerable additions are engraving to 14 different quarter and full-size old plates to complete them to the date of our latest surveys.

Quarter-plates Nos. 2 S. W.*; 3 N. E.; 9 S. E.* and S. W.; 11 S. W.; 33 N. E.* and S. E.*; 34 N. E.*; 51 S. W.; 53 S. E.*; 68 (full plate (¼ of it). Total 15 plates. Those marked* are not full up to margins, and some of them await the results of further survey.

33. The outlines of the new 64 miles = 1 inch map of India (in four sheets) have been completed, the cutting of the names is in progress. Names on the map of Oudh (16 miles = 1 inch) and corrections to the plates of Simm's plan of Calcutta are well advanced. Outlines and names completed of the small scale (16 miles = 1 inch) divisional map* of the Presidency and outlines only of the Burdwan Division.* Outlines completed of the small map of Bengal* (64 miles = 1 inch). A highly finished plan of the hill and fort of Kalinjar (in Bundelkund) has been completed for the *North-Western Provinces Gazetteer*, and a large chart, containing heavy numerical details, to illustrate the Great Trigonometrical Survey professional report volume, on the reduction of the north-west quadrilateral, has been well advanced, all of which are mentioned in detail in the statement attached to the report of work completed and in progress in the Drawing, Geographical compiling, and Engraving branches.

* For the *Imperial Gazetteer*.

Plate Printing.

34. In the Copper-plate Printing branch 9,508 impressions (some of them transfers for stone) have been taken of Indian Atlas sheets and other maps. The original plates are not used more than is absolutely necessary, all the ordinary copies being taken from transfers to the stone, which yield sufficiently fine impressions for general purposes. The plate printer, Mr. Martin, referred to in paragraph 53 of the last report, joined on the 20th February 1873, and gives much satisfaction.

35. The staff of native engravers and apprentices continue to make excellent and steady progress; those originally entertained are now kept fully employed on outlines, writing, and hill etching; two of them give very encouraging hopes of turning out fair hill etchers. The others give good promise of learning. In all 30 native incumbents and apprentices are at present employed.

36. The European staff, ten in number, are zealous and painstaking, and they have attained much skill in imparting instruction to the natives, to which I attribute much importance. Mr. C. W. Coard continues to give me the highest satisfaction, by the skill and energy he displays in training the large number of native youths and by the vigilant supervision and management of all the work in progress. It was my pleasing duty to recommend to the Government of India the conditions on which the engravers, whose

terms of agreement with the Secretary of State expired during the present month, were willing to continue to serve on, and Messrs. Coard, Dalziel, and Donaldson have been retained in conformity with the orders conveyed in letter as per margin.

Government of India, Agriculture, Revenue, and Commerce Department, No. 746, dated Simla, 4th November 1873.

37. This is highly satisfactory, and will, I trust, enable me to continue to work this important department of the Survey of India with the same good effect as during the preceding years. The value of the engraving to us in this country, cannot be overestimated, and with such a Superintendent as Mr. Coard the best results may be relied on.

Copper-plates of the Indian Atlas transferred from England to India.

38. The following engraved copper-plates of the Indian Atlas were received during the year from the Geographical Department of the India Office. Old full-size double elephant plates, sheets Nos. 4, 7, 24, 25, 38, 39, 40, 41, 42, 43, 55, 56, 62, 63, 74, 75, 80, 81, 94, 95, 106, 107, 108, 109, 111, 115, 116, 119. New quarter-plates, 5 S.E. and N.E.; 6 S.E. and N.E.; 92 N.E.; 105 N.E. and S.W.

Photographic Branch.

39. In this branch the work steadily continues of increasing importance. Captain J. Waterhouse, Assistant Surveyor General in charge, reports that during the year, 1,611 original maps or subjects passed through the office, of which 105,753 complete copies were printed from zinc, besides 2,010 silver prints and about 3,000 photo-collotypes.

40. The following abstract shows the nature and amount of the work performed by this process and comparison of the outturn with that of the previous year, 1872:—

Maps or subjects.	Number of sheets or sections.	Number of complete copies printed.	Number of zinc printings.
Topographical survey maps	189	18,421	17,785
Revenue survey maps	967	26,356	30,691
District maps	8	2,765	6,250
General maps	38	6,281	9,986
City and cantonment plans	145	4,892	11,463
Miscellaneous maps, &c.	264	47,038	35,499
Proofs	...	...	1,202
Year 1873, total ...	1,611	1,05,753	1,11,876
Work performed during 1872	1,428	1,17,320	88,959
	+ 183	— 11,567	+ 22,917

41. There is a very marked increase in the number of subjects dealt with, *viz.*, 183, and also in the number of sheets or sections printed, *viz.*, 22,917 more than in the previous year, and these actually represent the real labor and work performed. The number of complete copies of maps obtained, in which a decrease is shown when compared with the number of pulls taken, explains that more sheets or sections were required to complete each map or plan, and this further shows that the superficial area of the work performed in 1873 exceeds that of 1872.

42. This is further and better explained by the following table:—

	Original subjects.	Negatives.	Superficial area in decimal square feet.*	Photo-transfer prints.	Superficial area in decimal square feet.*
1873	1,611	1,969	5110·72	1,949	5157·88
1872	1,428	1,760	4481·69	1,892	4710·00
Excess in favor of 1873...	+ 183	+ 209	+ 629·03	+ 57	+ 447·88

* Decimal square feet of 100 square inches.

The comparison of results, as above shown, is clearly in favor of the year 1873 in all respects, and exhibits the outturn of one printing branch only. The subject as here discussed is intended merely to exhibit the real working power of this branch of the office and the wonderful facility with which a vast increase in its outturn can be obtained to cope with the demand in this country, which appears daily to increase.

General Remarks.

43. The process of steel facing the engraved copper-plates under the superintendence of Captain Waterhouse with the apparatus selected in England by Colonel Walker, Superintendent Great Trigonometrical Survey, and from the instructions brought out and introduced here by

that officer, has been worked with fair success, but it has been found that the steel surfaces of some plates have shown symptoms of incipient rust in spite of every precaution. It is therefore considered unsafe to practice it further at present, lest the surface of some of the engraved plates should be seriously injured. This difficulty in the Indian climate was originally foreseen and represented. The object of steel facing the plates of the Atlas of India to prevent undue wear and tear, is not of so much consequence, now that our impressions are taken from the stone.

44. Captain Waterhouse has, with most praiseworthy perseverance, further developed the working of the photo-collotype process, and fair prospects are entertained of its application for the reproduction of engraved, brush-shaded and pencil or chalk drawings, maps, and plans. The advantages to be derived by this process were explained in para. 67 of the last report. Captain Waterhouse mentions the obligations he is under to Captain Abney, R. E., of the Military School of Engineering at Chatham in the furtherance of this very useful process now being carried on in this branch of the department, and my cordial acknowledgments are tendered to that officer for the same.

45. A method of correcting copper-plates for erasures or additions with the aid of the galvanic battery, has been successfully carried out by Captain Waterhouse from his observations on the Continent during his visit to Europe in 1868. It is similar to the process employed in the Engraving Department of the Depôt de la Guerre, Paris, and the Military Geographical Institute at Vienna (as described at pages 2 to 6 and 152 to 154 of that officer's "report on the Cartographic Applications of Photography," &c., printed in 1870), and is fully described in the interesting report submitted by Captain Waterhouse on the working of the Photographic Branch in the Appendix. Its advantages are undoubtedly great, for it is simple and cheap in application, and a great saving of labor is secured in obtaining a fresh surface, while the risk of injury to the plate by the old process of "knocking up" the copper is entirely obviated.

46. The European assistant photographers and printers, in this branch, have worked well and zealously, and have given much satisfaction.

47. Captain Waterhouse's well directed labors continue to yield excellent results, and I am greatly indebted to him for the skill and energy he brings to bear on every duty entrusted to him. He neglects no opportunity or pains to render the working of the Photographic Branch of this office generally useful to every branch of the public service and its great uses are undeniable.

Lithographic Branch.

48. The duty of superintending the Lithographic press establishment devolved on Captain Waterhouse in addition to his other duties in consequence of the departure on furlough, under medical certificate, of Captain W. G. Murray* from the 5th February 1873, and owing to the impossibility of removing another officer from the Executive Branch in the present weak state of the department, for administrative duties at Head-quarters. During the year, 481 subjects (new maps, plans, charts, diagrams, &c.,) passed through this office, and were reproduced, either by transfer-paper drawings, or drawings direct on stone. From these 159,652 copies were printed, to obtain which 238,712 pulls or printings were necessarily made.

* Vide para. 63 of last report.

49. Thus between the two presses no less than 271,528 copies or sheets of maps, diagrams, and sketches have been struck off during the year. The issues from the large outturn of maps published, both to officials and to agents, have involved a vast extent of coloring and mounting, and given rise to an immense business, difficult to meet, as it increases year by year, but the results of which are believed to be highly beneficial to the public service.

Photographic	...	...	...	111,876
Lithographic	...	...	...	159,652
Total	...	...	...	271,528

50. Great progress has been latterly made in color printing on the stone, which is of great value. The sheets of the Atlas of India are thus tinted as well as many Geological maps for that Department. By the recent procurement from England of a better sort of paper, the registering or indexing for color printing is now better carried out, and the specimens turned out here may compete with similar work produced in England. The map attached to this report is a specimen of copper-plate transfer to the stone, tinted by Chromo-lithography.

51. Amongst the many maps treated by the lithographic process, two very fair preliminary maps, one of the Bombay Presidency and the other of the North-West Provinces, scale 32 miles=1-inch, to illustrate Administration Reports, have been published from the best materials available, and with such additions and corrections up to date as were obtainable from the local Governments. Of the Bengal administration map 1,000 copies have also been printed in colors, equal to 5,000 printings; 33 new 1-inch sheets from the results of Revenue Surveys completed in Sindh, in Rohilcund of the North-West Provinces, Oudh, Central Provinces, and Bengal; two District maps, scale 4 miles = 1-inch; a Forest map, as well as a Geological map of the Province of Pegu (both chromo-tinted), scale 8 miles=1-inch

61 geological chromo-tint stones, and 81 sheets of large-scale Barrack plans for the Public Works Department were completed and printed, together with the usual large amount of miscellaneous work for various Government departments, complete details regarding which will be found in the report on the Lithographic branch in the Appendix.

52. The assistants of the Lithographic department, and Mr. Niven particularly, have earned commendation for the zealous attention to their duties, which are of an arduous nature, and most trying in the hot weather.

Issue and sale of maps.

53. The usual quarterly despatches of all the publications of this department up to date have been made to the Geographical Department of the India Office, London, to the extent of 5,090 maps. To Government officials in India *bonâ fide* on the public service 25,817 maps, plans and charts have been issued from this office alone, representing, in money value, at the ordinary fixed selling price, Rs. 40,530. To the several local agents 5,384 maps have been issued, value Rs. 13,435, making a total of Rs. 53,965 to the credit of this department. Of these latter, 203 have been issued to Government officials on service and 2,405 have been sold for Rs. 4,355, but the money has not yet been realised from the agents.

54. During the year several interchanges of maps and publications have taken place with the Australian Colonies, which doubtless will be of much benefit to this department; complete sets of the Ordnance maps of England, one-inch scale, have likewise been received, and form most excellent studies for members of the department who visit Head-quarters. A valuable collection of Swiss maps has likewise been received, which are highly appreciated, and for which special acknowledgments have been tendered through the proper channel. A small collection of our new maps, sent to the Vienna Exhibition, was presented to the Imperial Geographical Institute, and the photographs of Indian antiquities, jewellery, fabrics, &c., were sent to the Imperial Museum of Science and Art.

55. The question of Office Accommodation has been materially advanced during the year by the purchase of the premises No. 9, Park Street, and No. 13, Wood Street, for the purpose of building suitable offices, printing press rooms, and workshops, for the several branches of this department, and the necessary plans and specifications have been drawn out and submitted to the Public Works Department, with a view to the approval of the Government and the inclusion of a part of the cost in the ensuing financial year's budget estimates. More ample space and accommodation is every day becoming a greater and pressing necessity, to meet the increasing wants and due supervision of the various Head-quarters Offices.

56. As in former years, and as acknowledged in paragraph 47 of my last report, the services of Mr. J. O. N. James, Assistant Surveyor-General, have been conspicuous, and during the period under review, the labors of this excellent officer have been most arduous, but rendered in such a way as to call for the expression of my warmest thanks. Mr. James' knowledge and efficiency in every branch of his profession, and in the multifarious duties at Head-quarters, are well known and appreciated, but the services he renders are such as to demand the highest encomiums on my part.

57. The usual cash account connected with map sales is given in the Appendix. During the year ending 31st December 1873, Rs. 4,943-3-7 have been paid into the treasury. No cash balances are at credit in the Bank of Bengal, and all monies realised by this office are at once paid into the Treasury, for which receipts are obtained and forwarded without delay to the Comptroller General. As a rule, no maps are sold at this office.

58. The several results of the Topographical Surveys and the progress of work in the several branches of my Head-quarters Office having been thus described, the detail operations of each executive establishment or survey party follow.

EXECUTIVE ESTABLISHMENTS.

No. 1.—TOPOGRAPHICAL SURVEY.

GWALIOR AND CENTRAL INDIA.

59. After arrival at Agra, the usual rendezvous for the field, the party started under the command of Lieutenant Holdich, R. E., Officiating Deputy Superintendent, with Lieutenant Leach, R. E., as Assistant Superintendent, on the 3rd November 1872, for the ground due west of Goonah extending from the Parbutty to the Chumbul river, and between the meridians of 75° 30′ and 77°, and the parallels of 24° and 25°, within which area lay both the detail operations and triangulation in advance for the season, embracing portions of the Native States marginally named situated within the Indore and Rajputana Agencies respectively.

Detached portions of Scindhia's and Holkar's territory, portions of Tonk, Kotah, Jhalawar, Rajgarh, and Kilchipur.

60. Towards the end of November, the several detached parties commenced their plane tabling and triangulation, and the total outturn of field work accomplished by the end of April 1873 was 3,000 square miles of final topography, with 2,320 square miles of triangulation in advance of topography, by which 316 points were fixed by observations at 45 stations, or on an average one point to every 7·3 square miles of ground, and 117 heights were trigonometrically determined, yielding on an average 1 elevation for nearly every 20 square miles of the ground triangulated, which is below the average allowed, but amply sufficient for the nature of the country. The outturn is detailed in the margin. In addition to the above, a survey on the scale of 12 inches to the mile of the cantonment of Jhalra Patan was completed.

Area finally surveyed, and Triangulation completed in advance of detail survey.

Strength of the Party.	Final Topography: square miles.	Triangulation: square miles.
Lieutenant T. H. Holdich, R. E., Officiating Deputy Superintendent, in charge	105	and running test or check surveys. 2,320
Lieutenant E. P. Leach, R. E., Asst. Supdt., 2nd Grade ...	...	
Mr. H. J. Bolst, Surveyor, 1st „ ...	263	
„ R. D. Farrell, Surveyor, 4th „ ...	285	
„ C. A. R. Scanlan, Assistant Surveyor, 1st „ ...	270	
„ W. J. Cornelius, ditto 2nd „ ...	314	
„ C. T. Templetou, ditto 3rd „ ...	292	
„ J. H. O'Brien, ditto 4th „ ...	190	
„ W. M. Kelly, ditto 4th „ ...	180	
Sub-Surveyor, Abdul Samad	262	
Ditto Joala Pershad	225	
Ditto Abdul Subhan	225	
Ditto Abdul Gufar	319	
Ditto Gridhari Lall	70	
Total square miles ...	3,000	2,320

61. The country brought under final survey is crossed from south to north by the Parbutty, Newaj or Parwan, and the Kali Sind rivers in the districts or soubahs of Mangaoli and Bujrunghur east of the Parbutty, and in the neighbourhood of Nahargarh; it is flat, stony, jungly and barren, but to the west, between the Parbutty and Newaj, and extending on to the Kali Sind river, the country is well cultivated and only occasional small strips of jungle occur. The most marked feature of the country is a double range of hills steeply scarped on the south-west side, but sloping gently into the plains on the north-west, with a general south-easterly run till it meets the Newaj river, where it is lost in a confused mass of rocky hills. The double scarp of this range are barely a mile and a half apart and run almost truly parallel; the valley between is in parts covered with dense jungle, with occasional patches of cultivation round small sheets of water, and the scenery along this valley, and more especially in the vicinity of a hamlet named Rata Devi, nearly due east of Jhalra Patan, is described by Lieutenant Holdich as very beautiful. For a complete description of the country, plane tabled and triangulated, see Appendix, (Extracts from the Narrative Report of the officer in charge).

Description of country visited during the season's operations.

62. The results of the test in the field both *in situ* and by check routes across each plane-table, are described by Lieutenant Holdich as most satisfactory. The average rate of plane-table fixings per square mile was 10; the maximum number in some plane-tables being 15, and the minimum 8 fixings per square mile.

Test applied to the final survey.

Cost of the season's operations.

63. The total cost of the season's operations, *viz.*, from 1st October 1872 to 30th September 1873, was Rs. 62,480-6-0.

The combined results, as above described, are a very fair return for the season, at a moderate cost, and fully proves the efficient and economical management of the party by Lieutenant T. H. Holdich, R. E., officiating in charge.

Recess work.

64. Fair copies of the Field Books and the computations in duplicate have been duly completed, and the standard sheets Nos. 54, 55, 56, 58, and 59 of degree No. X of this series have been fair drawn in the usual good style, fit for immediate reproduction by the photo-zinco: process, and lodged in the Head-quarters Office. Lieutenant Holdich reports that no arrears exist.

65. Towards the close of the recess some of the assistants of this party were employed in rendering aid towards the completion of a large-scale survey of part of the military sanitarium of Laudour, undertaken at the request of His Excellency the Commander-in-Chief.

66. Lieutenant Holdich reports in very favorable terms of the good aid he has received, both during the field season and in recess duties, from Lieutenant E. P. Leach, R. E., Assistant Superintendent, 2nd grade, attached to the party, who has, during the short period of two years' departmental service, acquired a good knowledge of all his professional duties, and proved himself a most promising and useful officer. I have every reason to be well satisfied with this officer's exertions, and record with pleasure my reliance on his ability and zeal.

* From 3rd November 1873.

67. Mr. H. J. Bolst, Senior Surveyor attached to the party, has recently obtained two years'* furlough to Europe, with the object of recruiting his health, which had been impaired from long exposure and hard service in the field during several past seasons. He is deservedly highly mentioned by Lieutenant Holdich, whose opinion also of the zeal and general efficiency of the rest of his assistants is most favorable.

Programme of operations for season 1873-74.

68. During the now current season of 1873-74, the detail survey will be continued west of the area completed during the past year, extending south to a little beyond the Chumbul river near Mundesor, or from about longitude 76° 30′ to 75° 30′, and between the latitudes of 24° and 25° in the Neemuch district. The triangulation in advance of details will be extended over the area enclosed in the square or section of the index map formed by the meridians of 74° 30′ to 75° 30,′ and the parallels of 24° and 25,° covering Neemuch, Pertabgurh, and Mundesor, being the halves of the two degree sheets Nos. 11 and 12.

Change of Executive Officer.

† As reported in letter No. 63 A., dated 2nd December 1873.

69. By the return of Captain Charles Strahan, R. E., Deputy Superintendent, 3rd grade, from furlough,† Lieutenant T. H. Holdich, R. E., was relieved of his officiating charge at Agra on the 3rd November 1873, and the latter officer has been transferred to No. 3, Central Provinces and Vizagapatam Agency Survey, with the object of assuming charge of that party on the occurrence of a vacancy. During the current season the party is under the command of Captain Charles Strahan, as before. The return of this officer was most opportunely arranged.

Inspection of the party.

70. This party was inspected by myself immediately on its return to recess quarters at Mussoorie in May last. I was well satisfied with its general efficiency, the style of the work turned out in all respects, and with the mode of effecting it in the Field. Lieutenant Holdich has well and ably performed the duties of his officiating charge during the absence of Captain Charles Strahan on two years' furlough.

71. The chief portion of the Maharajah Scindhia's territory has now been surveyed from the north on the Agra and Dholpoor frontier, down to the parallel of 24°, near Sironj, and as far west, as the Jhalra Patan and Neemuch districts boundary, comprising 10 square degrees. The programme of this party is now, to advance westwards into Rajputana as previously reported, between the parallels of 24° and 25° latitude, through Neemuch, Mundesor, Meywar or Udeypoor, &c. There are other outlying portions of Scindhia's territory below the parallel of 24°, such as the tehseels of Basoda and Bhilsa of the soubah Mangaoli, as well as Ujein, Augur, Amjhera, and Shahjehanpoor soubahs, but these being situated within the Political Agency of Bhopal are under survey by No. 5 party.

72. To supply a vacancy Mr. G. A. Knight, a qualified candidate, was appointed a probationary Assistant Surveyor from the 11th August 1873.

No. 2.—TOPOGRAPHICAL SURVEY.

KHANDESH AND BOMBAY NATIVE STATES.

73. This party, as per margin, started from Bhosawul, the rendezvous depôt on the Great Indian Peninsula Railway, on the 15th, and arrived at Khargoon, the chief town of Holkar's territory, south of the Nerbudda, on the 23rd November 1872; vakeels or agents and escorts having here been provided, work was commenced in the Nerbudda valley within a portion of the ground which had been triangulated during the previous season, as described in paragraph 93 of my last printed report. Two detachments were employed on the triangulation in advance, to the east (from the meridian of 76° up to the boundary of British Nimar) and north of the Nerbudda river, between the parallels of 22° 15′ and 22° 30,′ to work in continuation of the triangulation completed during the preceding season.

Portions of Holkar's and Scindhia's territory, Dhar and Burwani in the southern portion of the Indore or Central India Agency.

	Triangulation: square miles.	Topography: square miles.
Mr. F. B. Girdlestone, Deputy Superintendent, 3rd grade, in charge, employed throughout the field season in reconnoitering in advance, training and instructing newly appointed Assistants and Sub-Surveyors, inspecting and testing the triangulation and detail work.		
„ N. A. Belletty, Surveyor, 1st Grade	1,068	...
„ R. W. Chew, „ 3rd „	...	309
„ A. G. Wyatt, Asst. „ 1st „	...	369
„ T. D. Ryan, „ „ 2nd „	...	164
„ W. C. G. Barckley, „ „ 4th „	945	96
„ G. T. Lambert, „ „ 4th „	...	166
Sub-Surveyor Sheik Omer	...	299
„ Churaman	...	228
„ Ganesh Waman	...	113
„ Keshaw Waman	...	93
„ Abdoor Rahman	...	35
TOTAL SQUARE MILES ...	2,013	1,872

74. The ground topographically delineated in the States marginally noted covers an area of 1,872 square miles, inclusive of 33½ square miles of overlap survey, all of which was carefully tested in the field, both from fixed trigonometrical points and by 165 linear miles of check measurements with the chain, run from end to end of the work of every detail Surveyor. The average number of plane table fixings for every square mile of final survey was 7½, the minimum number was 4, and the maximum 15 per square mile. The greatest discrepancy found in any portion of the topography never exceeded $\frac{1}{16}$th of a mile, and this only occurred rarely in difficult and intricate ground.

Season's outturn. Topography.

Holkar's Territory.—Pergunnahs Amtalla, Kasrod, Dhargaon, Mardana, Sonawad, and portions of Jellalabad, Nagalwari, Khargoon, Barur, Un, Mahomedpur, Balakwara, Sangwi, Dunla, Mahesar, Barwai, Cheinpur, Bhikangaon, Bhamnala, Sendwa, Bamangaon.

Dhar State.—Pergunnahs Bhalkhar and Dharampuri, with a portion of Tikri.

Burwani State.—Portions of Pergunnahs Rajpur, Burwani, Pati, Anjer.

Scindhia's Territory.—Portion of Bakanir Pergunnah.

Nimar (British).—Portion of Beriaon Pergunnah.

75. The season's triangulation in advance of detail survey was extended over 2,013 square miles of ground by observations at 87 stations, determining the positions of 383 points and 375 elevations. The average error in common sides of the 1st and 2nd class secondary triangles is 7·8 inches per mile, and of the tertiary triangles and intersected points 16·2 inches per mile, differences which are quite inappreciable on the scale of the survey.

Triangulation.

76. During the two seasons this party has now worked, the total area of triangulation completed covers 6,953 square miles of country, in which no less than 1,214 points have been fixed trigonometrically, giving an average of one point to every 5·7 square miles of ground, and 964 elevations have been trigonometrically determined, giving 1 height on an average for every 7·2 square miles. These results need no comment, as nothing better could be desired, but owing to the natural difficulties of the ground they have been attained at a somewhat higher cost than usual; but in this early part of the operations, it is scarcely fair to estimate the exact cost of partial work.

Cost of final Topography.

77. During the season under review, the actual total cost of the survey amounts to Rs. 56,825-4.

Opinion on the general results and expenditure.

78. For a party which has worked only two seasons in new and difficult ground, the general outturn of the season is very fair. The country has been well and closely triangulated, affording a splendid basis for the detail survey, all of which, as stated by the Deputy Superintendent in charge, has been rigorously tested and proved to be satisfactory. The

three fair standard sheets submitted are well drawn, delineate the ground very clearly, and, as far as can be judged, faithfully. Mr. Girdlestone's management has been marked by great energy and success.

79. For the results obtained, the expenditure, though in excess of other surveys, is not higher than might under the circumstances be expected. As the work progresses, it is hoped the mileage cost will proportionately decrease. The field establishment is newly organised, and the cost of training and instructing newly appointed Assistants and Sub-Surveyors adds to the expense at present without any immediate compensating return. Again, the country is very wild and difficult, the prevailing rates for carriage and labour are much higher than in other parts of India, and throughout the Sathpoora Hills it has been found necessary to carry about provisions for the detached parties.

80. A very complete and interesting description of the country, with geographical and statistical notes by Mr. F. B. Girdlestone, as well as by Mr. N. A. Belletty, Surveyor, 1st grade, will be found in the Appendix, (Extracts from the Narrative Report).

Programme for the field season of 1873-74.

81. The triangulation in advance will be carried on north of the Nerbudda along the Vindhya range, in continuation of the work of the two previous seasons, up to the parallel of 22° 30′. The topography of the ground north-east and south of the area completed during the season under review, in detached portions of Holkar's and Scindhia's territory, north and south of the Nerbudda river, and in portions of the petty States of Burwani and Dhar, will be taken up.

* Topographical Survey of the plains portion of Khandesh.

No. 780, dated 25th September 1873.

82. With reference to the orders of Government for a complete topographical delineation of certain portions of the Bombay Presidency, I had the honor to refer under cover of my letter as per margin,* certain proposals made by the Officer in charge, No. 2 Khandesh and Bombay Native States Topographical Survey, regarding the scale to be adopted for the survey of the plains portion of Khandesh and the erection of permanent and easily distinguishable village triple junction boundary or other marks. The question, with a recommendation in support of the proposals, was referred to the Government of Bombay, and this Department now awaits the action of the Bombay authorities towards the erection of village tri-junction boundary marks, to break ground in the plains of Khandesh, a measure much to be desired, as No. 2 Topographical Survey is at present restricted to only the hilly, wild, insalubrious, and unprofitable portions of British territory and to Native States immediately north and south of the Nerbudda river, leaving no scope for any arrangement whereby the party might be employed with safety and profit, in healthy and open ground, during such months of the field season in which the bad and jungle-clad country is almost deadly.

Vide Agriculture, Revenue, and Commerce Department letter to Bombay Government, received under cover of that Department No. 677, dated 7th October 1873.

Health of the party and casualties.

† No. 87, dated 10th January 1874.

83. Nearly every member of the party has suffered more or less from the effects of malarious fever along the low ground and hills skirting the Nerbudda valley and in the bad parts of the Sathpooras. I regret to record (as already reported to Government†) that Mr. T. D. Ryan, 2nd grade Assistant Surveyor, shortly after taking the field, began to suffer in health. He obtained leave on medical certificate early in March, and died at Bombay on the 3rd May 1873. Another promising Assistant, Mr. George Lambert, in November last, was suddenly prostrated at Bhosawul, and compelled to take leave on medical certificate. He died, I much regret to add, at Calcutta on the 21st November 1873, a few days after arrival, from typhus fever.

84. The Deputy Superintendent has had a most difficult and trying task to perform in training and employing a number of newly appointed Assistants and Sub-Surveyors in a very bad tract of country, but with the aid of his old assistants has well performed this duty. Mr. Girdlestone reports very favorably of the good support he received from his assistants throughout the season.

Mr. E. Graham, Assistant Surveyor, 4th grade, transferred from No. 7 Rajputana Survey, 11th August 1873.

Mr. F. Rosario, Sub-Surveyor, 28th May 1873.

Mr. H. M. Holtham, Sub-Surveyor, 7th November 1873.

85. To increase the strength of the party and replace casualties, the appointments marginally noted were made from the dates specified.

The senior Surveyor of this party, Mr. N. A. Belletty, not being immediately required for carrying on the triangulation more in advance, has been transferred for duty at Head-quarters, in order to reduce the very heavy expenses incidental to keeping up so much native field establishment, for which the budget is insufficient. The expenses of working in the Bombay Presidency, with the addition of local allowances at Poona, are extremely heavy, and the Deputy Superintendent in charge of this Survey was anxious to reduce this description of agency temporarily whilst employed in particular parts of the Bheel country.

No. 3.—TOPOGRAPHICAL SURVEY

CENTRAL PROVINCES AND VIZAGAPATAM AGENCY.

86. This party, after recessing at Ootacamund, where the state of health of the several assistants was brought back to ordinary physical powers, started from Vizianagram—their rendezvous station—for the ground due west of it by the 15th December 1872. The detail survey was taken up in continuation southwards of that of the previous season, from the parallel of 18° 15′ to 18° 0′, with a small piece on the extreme east below 18°, and bounded on the east by the meridian of 82° 50′, and on the west by that of 81° 30′, or through a long strip of country, described marginally, measuring about 17¼ miles by 89 miles. The triangulation in advance was extended southwards from the parallel of 17° 45′ through the Rampa talook of the Rajamundry or Godavery district.

Portions of the Duslar and Rakapili States in the eastern portion of the Central Provinces of Pandchpenta, Jeypoor, Mudgul, and Golgonda in the Vizagapatam Agency and Talooka Rampa in the Rajamundry district, Madras Presidency.

87. The season's total outturn was 1,636 square miles of final topography and 1,500 square miles of triangulation in advance of detail survey in country never before visited, besides the interpolation of a good many additional points in some of the ground triangulated during previous seasons.

Season's outturn.	Triangulation. Square miles.	Area surveyed. Square miles.
Colonel G. H. Saxton, Deputy Superintendent, 1st grade, in charge	1,500	47
Mr. J. Harper, Surveyor, 3rd grade	...	227
„ J. A. May „ 4th „	...	210
„ F. Adams „	...	246
„ T. E. Claudius, Assistant Surveyor, 2nd grade	...	301
„ W. F. Pettigrew „ „ 2nd „	...	234
„ A. Cooper „ „ 3rd „	...	282
„ G. Vander Beek „ „ 4th „	And assisted in triangulation.	47
„ Duncan Campbell, Sub-Surveyor	...	10
„ Donald Campbell „	...	32
„ W. Chapman „	...	...
Total square miles ...	1,500	1,636

Colonel Saxton, Deputy Superintendent in charge, reports that he passed through the work of each plane table and was well satisfied with the results of his examination. The ground surveyed is described as, with but rare exceptions, extremely difficult, in parts almost destitute of villages and inhabitants, and frequently no labor was procurable. By the season's triangulation 237 points and 230 heights were trigonometrically determined by observations at 58 stations, and the errors of common sides was within 12 inches per mile.

88. The greater portion of the ground taken up by the season's detail survey has been described in previous reports. It is throughout wild, inhospitable, and over-run with jungle, but the Deputy Superintendent states that portions only require inhabitants to become richly cultivated. The soil is in most parts good, and there is no want of water. On the extreme east of the ground surveyed, along the Eastern Ghâts, and within the meridians of 82° 30′ to 82° 45′, and the parallels of 17° 50′ to 18° 10′, Colonel Saxton remarks that there are "several tracts of country (the best hitherto unnoticed by Europeans) incomparably, superior as respects climatal and sanitary characteristics to anything on the Eastern Ghâts, of which I know personally every part." The finest amongst these is the "Acula Mootah of Hill Madgul," a strip of country running from north-east to south-west for some 8 or 10 miles, and about 2 miles wide. To this tract Colonel Saxton desires to direct special attention, as it is in every way well suited for a sanatarium and is easily accessible from the plains, being only 50 miles west, north-west of Vizagapatam, with a level road nearly to the foot of the ghât. The hills surrounding rise to an elevation of 5,000 feet above sea level, and large villages were found at 4,000 feet. Water is abundant, and the scenery beautiful.

Description of country visited during the season's operations.

89. For a complete description of this ground, and also of the country triangulated in advance, see Appendix extracts from Colonel Saxton's Narrative Report.

90. Although Colonel Saxton is generally obliged to leave this insalubrious tract of country by the early part of April, it was not until the 3rd June 1873 that the whole patry had returned to recess quarters at Ootacamund. The season's computations were unusually heavy, but with such a long recess, these, together with the fair mapping, were completed, and Colonel Saxton reports that no arrears exist in his office—an important consideration at a time of delivering over charge of a party.

Recess duties.

91. The total cost of the season's operations, *viz.*, for 1,500 square miles of triangulation and 1,636 square miles of final survey amounts to Rs. 63,614-12.

Cost of the season's operations.

92. By the transfer of the Senior Surveyor (Mr. Chew) to recruit No. 2 Topographical Survey last year, this party had been somewhat weakened in the higher trained agency; and at the same time a newly-appointed assistant surveyor and three sub-surveyors had to be trained in very difficult country; progress was thereby retarded. Owing to these causes the expenditure of the party was increased. Due allowance, however, being made for the above circumstances, and, for the very short duration of the field season, owing to the very unhealthy and in fact malarious character of the country, the season's progress is as fair as could be expected, and Colonel Saxton, Deputy Superintendent in charge, and the older hands attached to the party, deserve well, for their perseverance under great difficulties and obstacles to progress.

Opinion on outturn of work.

93. The Deputy Superintendent reports in high terms of praise of the exertions of all his surveyors and assistants, both during the field and recess seasons.

94. During the ensuing season the final survey of the country south of that here reported on, and extending up to the limits of the old surveys of Vizagapatam and Rajamundry districts on the east and south, and closing on the south-west upon the Rakapili talook of the Upper Godavery district, surveyed by No. 2 party, Hydrabad Topographical Survey, in 1865-66, will be taken up. This area embraces all the portions of the eastern ghâts, at present utterly unknown and unvisited, remaining for topographical delineation now, and is described to be a very unhealthy and difficult portion of country. It is within the parallelogram formed by the meridians of 81° 30′ and 82° 30′, and the parallels of 17° 15′ and 18′, close on the Rajamundry district of the Madras Presidency and the Godavery talooks, and is well covered by the Coast and Beder longitudinal as well as the Belaspur series of the Great Trigonometrical Survey.

Future operations.

95. The triangulation in advance of details will be extended into some of the south-western zemindaries dependent on Bustar or of the Central Provinces extending westwards as far as Aheree of the Chanda district; but as no less than 3,000 square miles of ground in advance of topography is already prepared, it is not of immediate importance whether any more triangulation is executed during the now current field season, due care being taken to advance the reconnoissance of the country, and to fix proper marks on well selected and commanding elevations, so that the observer may experience no delay in these respects when he visits the ground. The officer in charge is well alive to the requirements of his survey.

96. Colonel G. H. Saxton, Deputy Superintendent, 1st grade, who has been in charge of this party since the year 1849, having obtained furlough to Europe,* will be relieved by Lieutenant T. H. Holdich, R. E., Assistant Superintendent, 1st grade, who has so well and ably fulfilled the duties of his late officiating charge of No. 1 Gwalior and Central India Topographical Survey during the absence on furlough of Captain Charles Strahan. Lieutenant Holdich was recommended to take charge of this party, and, with the approval of the Government of India, joined it at Ootacamund on the 20th November 1873. The arrangements necessary for conducting the party, owing to the peculiar difficulties of the country, needed much forethought. Colonel Saxton therefore proceeded to Vizianagram and there made over charge to his successor, where the proposed operations of the party were determined on. The information which his long and matured experience so well qualified him to render Colonel Saxton has fully afforded, and I trust that the programme may be carried out without much difficulty.

Change of Executive Officer.

* Madras General Order No. 309, dated the 16th December 1873, received with Agriculture, Revenue, and Commerce Department, No. 854, dated 30th December 1873.

97. After a service, departmentally, of nearly 25 years (joined the department on 24th April 1849), and the whole of it employed on one continuous tract of country, embracing the whole of the Ganjam and Orissa Tributary States, as well as Jeypur of the Vizagapatam Agency and the other minor Native States, of late years formed into the Central Provinces, or all that wild and little known country extending nearly from Cuttack and Ganjam down to the Godavary river, and covering an area of no less than 50,193 square miles, which have been completed under his sole superintendence, Colonel Saxton is now proceeding to Europe, with the prospect of not returning again to the scene of his old labors. I am anxious therefore to place on record my full appreciation of the long and useful services he has thus rendered. This officer has conducted his operations during all the above years with great judgment and discretion, and has been able to remain at his post and produce a fair outturn year after year, when few other officers could have done so. Very great improvements have been made of late years in the style of the topography laid down, and the mode of rendering it on the standard sheets of this survey, which are now re-produced and published regularly immediately on receipt in this office. Colonel Saxton has my best wishes for his future prosperity.

Colonel G. H. Saxton's services.

98. The whole of the above area has been published in the Atlas of India on the 1-inch scale, whilst the older one inch sheets are being now re-drawn with a view to early publication.

No. 4—TOPOGRAPHICAL SURVEY.

NORTH-EASTERN DIVISION, CENTRAL PROVINCES.

99. The ground allotted to this survey, and the difficulties and obstacles to fair progress against which the surveyor has to contend in it, have already been described in the printed reports of seasons 1870-71 and 1871-72. During the season under review, some of the worst portions of the country along the south-west side of the Sohagpur talook of the Native State of Rewah, and along the north-east border of the British district of Mandla in the Central Provinces, came under detail survey, together with portions of the zemindaries or estates along the north-western side of the Belaspur district, also in the Central Provinces as described in the margin. The triangulation in advance of detail survey embraced nearly the southern half of the Mandla district, and a good portion along the northern extremity of the Balaghat district. All this ground is notoriously unhealthy, very wild and rugged, and the difficulties of traversing it are greatly increased from the want of proper carriage, as camels are of no use; pack bullocks and tattoos, which are obliged to be employed, are liable to become foot or back sore, and porters or coolie labor cannot be obtained in the country, the population being extremely limited.

Portions of the pergunnahs of Sohagpur and Singwara in Talook Sohagpur of Rewah, portion of Rampurh in district Mandla and parts of the zemindaries of Lafa, Kenda, Pendra Kori and Lurmi, attached to the Belaspur district.

100. The area surveyed topographically covers 2,571½ square miles, and within this, in standard sheet 16, is situated the "Mekal pat" or Amarkantak plateau, from which, and within only a few hundred yards of each other, rise the rivers Soane, Nerbudda, Johilla, and the Hab, one of the principal feeders of the Mahanuddi, which flows through Orissa into the Bay of Bengal. All this ground the Executive Officer, Major Depree, states was very carefully mapped, and the average number of plane-table fixings for the season's work is 10¼ per square mile, while the minimum in the work of only one assistant was 3¾th. Every plane-table was tested, both in *situ* and by check routes, by the Deputy Superintendent and the senior surveyors of the party, Messrs. McGill and Vanderputt.

Season's outturn.		Triangulation.
Major G. C. Depree, Deputy Superintendent, 1st Grade, in charge	... ...	2,900 sq. miles.
		Topography.
Mr. G. A. McGill, Surveyor, 2nd Grade	...	323 sq. miles.
„ J. Vanderputt „ 3rd „	...	294 „
„ A. James, Assistant Surveyor, 1st Grade	...	325 „
„ J. A. Barker „ 2nd „	...	259 „
„ J. H. Wilson „ 3rd „	...	303 „
„ M. Rourke „ 4th „	...	91 „
„ G. Read „ 4th „	...	18½ „
Sub-Surveyor Dutt	... ...	274 „
Sub-Surveyor Rusof Shariff	... ...	360 „
„ Imam Shariff	... ...	265 „
„ Shere Shah	... ...	24 „
„ Mitter	... ...	35 „
Total	...	2,571½ sq. miles.

101. The triangulation in advance of the detail operations was carried over an area of 2,900 square miles. Observations were taken at 49 stations, by which 320 points and 208 heights were trigonometrically obtained, or on average one fixed point for every 9 square miles, and one height for every 14 square miles.

Triangulation.

102. The remarkable uniformity in the height of the hills throughout this ground, and its forest-clad nature, greatly increased the difficulties of triangulating it. A few extracts from the Deputy Superintendent's narrative report, descriptive of the country through which the operations passed, and a tabular statement of area, number of villages and houses in the zemindaries or estates, marginally noted, belonging to the Belaspur district, are given in the Appendix.

Chori, Kenda, Korba, Lafa Mahtin, Pendra, Uprora.

103. The total cost of the season's operations under all heads for the professional year, *viz.*, from 1st October 1872 to 30th September 1873, amounts to Rs. 57,639-15.

Total cost of the season's operations.

104. This party was inspected by myself immediately on its return from the field, at Mussoorie on the 7th May last, and again in camp at Jubbulpore in November last, just prior to its taking the field. The efficient state of the party, and its equipment in all respects, was highly satisfactory.

Inspection of party and opinion on the season's results.

105. The season's outturn of work, *viz.*, 2,571 square miles of final survey and 2,900 square miles of triangulation in advance, at a total cost of Rs. 57,639-15 annas, is excellent; and Major Depree, Deputy Superintendent, well merits praise for the very efficient and economical management of the party and the zeal with which he performs his duties. The season's fair mapping will bear favorable comparison with that of any other survey. All the ground is well and clearly delineated, and the maps well prepared for immediate reproduction by photography.

106. Two probationary Assistant Surveyors, Messrs. Rourke and Read, and two sub-surveyors*, were trained to field work during the season; of these, Mr. Rourke, as already reported to Government, I regret to say, died at Dehra Doon on the 5th May whilst returning from the field.

Training of new hands, &c.

* Shere Shah and Sripati Mitter.

107. Mr. Rourke was a remarkably hale and strong man, but succumbed to the climate and over zeal in his work, whilst in a feeble state, before time could be obtained for him to recruit at a hill station.

108. The programme for the now current field season of 1873-74 is as follows: the triangulation is being extended through the small remaining area on the western side of the Mandla district and the north-western and eastern portions of the Balaghat district. The topography will be carried on in continuation of that of the season under review in the south-eastern, northern, and central portions of Mandla district, and in the estates of Larmi and Pandaria attached to the Belaspur district.

Future operations.

109. Major Depree reports very favorably on the continued good services of his senior surveyor, Mr. McGill, recently promoted* to 1st grade to fill a vacancy, and I have pleasure in recording my concurrence in the opinions he expresses regarding the merits of all his assistants, who have ably supported him during the season.

* 1st January 1874.

110. To fill the vacancies caused by the death of Mr. Rourke, and the resignation of Sripati Mitter, sub-surveyor, who failed to give promise of qualifying, the postings of new appointments marginally noted were made.

Mr. G. L. Flemming, Probationary Assistant Surveyor, 4th Grade, from 11th August 1873.
Atma Sing, Sub-Surveyor, from 1st September 1873.

111. In consequence of the low state of the senior department of executive officers, I urged the appointment of a young military officer, with the required qualifications, to be attached as a probationary, assistant superintendent to this party, in my letter as per margin; but I regret to find that owing to the difficulties of obtaining the services of a subaltern officer from the Military Department, the chance of the present field season's training has been lost. I may state that it is of very serious importance that this Department should be recruited and maintained by young military officers, who have gone through a course of military drawing and topographical instruction at college, and who evince special aptitude and physical powers for a very arduous profession, and without this can be done with the existing state of the Indian Army, I do not see how it will be possible to keep up efficiency in a peculiar and important department, which in all European countries is deemed to possess a military organisation and element. I therefore trust that the services of the officer applied for may be granted, as soon as the exigencies of the Military Department service will permit.

No. 709F, dated the 18th September 1873.

No. 5.—TOPOGRAPHICAL SURVEY.

BHOPAL AND MALWA NATIVE STATES.

112. The programme for the field season's operations described in paragraph 141 of my previous season's report was, as regards the detail survey of the Bhopal Agency, fully carried out, and the eastern half of degree No. III, working from east to west, or the standard sheets Nos. 10, 12, 14 and 16 within the parallels of 23° and 24° and the meridians of 77°30′ and 78°, together with the large scale survey (12 inches =1 mile) of Bhopal City and Environs, were completed. In the proposed plan for the triangulation, owing to the difficult character of the ground, some modification was necessary, and in consequence the proposed series of triangles along the parallel of 23° was abandoned and a net-work extended over the south-west quarter of degree No. III and the north-east quarter of degree No. IV.

113. The season's operations, final survey and triangulation in advance, embraced portions of the several Native States marginally noted, all within the political superintendence of the Agent at Bhopal, subordinate to the Indore or Central India Agency.

Part of Bhopal territory under the Nazims of Raisen and Kalakhierce. Detached portions of Sindhia's territory intermixed with portions of Rajgarh, Tonk, Narsingarh, Kilchipur, and Dewas.

114. Of the triangulation in advance of topography, 2,264 square miles were completed. Observations were taken at 49 stations, from which 299 points were fixed, or 1 to every 7½ square miles of country, and 242 heights were trigonometrically determined, giving 1 height to every 9¼ square miles; 68 additional heights were also determined in standard sheets 10 and 12, for which the triangulation had, during a previous season, been executed by No. 1 Topographical Survey.

Season's outturn.				Triangulation square miles.		Topography, square miles.	
Captain R. V. Riddell, Deputy Superintendent, 2nd grade, in charge.				652	Also Bhopal City triangulation, &c.		
Captain J. R. Wilmer, Asst. Supdt., 1st grade				1,612	Also test routes, &c.		
Total Triangulation				2,264			
Mr. A. J. Wilson, Surveyor, 4th grade				...	...	274	
,, C. F. Hamer, Assistant Surveyor, 1st grade				...	...	322	
,, E. A. Wainright,	ditto	2nd	,,	...	...	288	Assisted on the Bhopal City survey.
,, H. T. Kitchen,	ditto	3rd	,,	...	...	273	
,, W. H. Lilley,	ditto	3rd	,,	...	...	273	
,, J. Murray,	ditto	4th	,,	...	...	137	
,, A. Kitchen,	ditto	4th	,,	...	...	88	
Sub-Surveyor Prem Raj ...		...		...	...	288	Ditto
Ditto Abdur Rahim		...		...	...	272	
Total Topography					...	2,215	Square miles.
Bhopal City survey, 12 inches=1 mile scale ...					...	18·5	Ditto.

115. The area brought under final survey covered 2,215 square miles immediately south of Sironj, round Basoda, Bhilsa and Raisen, down to the village of Deep, or the parallel of 23°, all of which the Deputy Superintendent reports was duly checked *in situ* and by test lines of traversing with very satisfactory results. The average number of plane-table fixings per square mile were 6·7; the maximum fixings per square mile were 8·2, and the minimum 5·3.

Topography.

116. A survey based on close triangulation, on the large scale of 12 inches=1 mile, was made of the City, Fort, and Environs of Bhopal, covering 18½ square miles. The ground around the City and Fort has been very carefully and artistically delineated. The method of survey adopted for a correct delineation of the ground is thus described by Captain R. V. Riddell, R. E., Deputy Superintendent in charge :—

Large scale survey of Bhopal City and Environs.

"Each of the Assistant Surveyors engaged on the delineation of the hilly portions was provided with a rough instrument, made on the principle of the 'clinometer,' but at the moderate cost of four annas each. The staff of this instrument was 5 feet in height. The outline, *viz.*, roads, water-courses, walls, buildings, &c., having first been laid down, the slopes of the hills were traversed at numerous points and in various directions, with the help of the clinometer, and the distances between the various points at a difference of level of 5 feet were measured. The points having been plotted on the plan, the contour lines were joined by eye on the spot; the plan may consequently be looked on as *very nearly* contoured, the space between any two contour lines representing a difference of level of 5 feet."

117. This plan has been photozincographed on the full scale (12 inches=1 mile) and also reduced to the half scale (6 inches=1 mile), and copies have been presented to Her Highness the Begum.

118. The total cost of the season's operations, for triangulation in advance and final topography, for the professional year, *viz.*, from 1st October 1872 to 30th September 1873, amounts to Rs. 57,898-14.

The total cost of the season's operations.

119. The general results, *viz.*, 2,264 square miles of triangulation and 2,215 square miles of topography, are good, and the expenditure moderate.

Opinion on the season's result.

120. All the season's fair mapping has been executed in excellent style, and the standard sheets, as also the plan of Bhopal City, have been reproduced by photozincography.

121. The party was inspected by myself on its return to recess quarters in May last, and also in the field at Bhopal and Sehore during the early part of the present current season of 1873-74. Its state of efficiency in all respects, both in recess and in the field, met my full approval, and is highly creditable to Captain R. V. Riddell, R.E., Deputy Superintendent in charge. The negotiations with Her Highness the Begum, for the satisfactory prosecution of the operations, were of the most satisfactory kind, and the co-operation and aid afforded by Colonel Osborne, Political Agent, all that could be possibly desired. The best results may be anticipated from the ready and cheerful assistance rendered by the people of this State, and this Department is under great obligations to Colonel Osborne, and to the Begum, for the same. A suitable atlas has been made and forwarded to Her Highness the Begum, containing all the standard sheets as published.

Inspection of Party.

122. Captain J. R. Wilmer, S. C., Assistant Superintendent, who for several years past has rendered excellent service with this survey, was transferred to No. 7 Rajputana and Simla Survey under Captain George Strahan, with the object of extending his experience and training under different officers, as well as of allowing him the opportunity of acquiring a knowledge of topographical sketching on a large scale in hilly ground, at high elevations. He was therefore relieved by Mr. H. Horst, Assistant Superintendent, from No. 7 survey at the close of the recess season.

Transfers and postings.

123. Mr. A. J. Wilson, Surveyor, 4th grade, requiring a respite from incessant field duties in bad climates, was transferred to the Head Quarters Office, in the place of Mr. E. S. P. Atkinson, Surveyor, 4th grade, and 2nd Geographical Examiner employed on the re-drawing of all the old sheets of the Ganjam and Orissa Survey, with a view to publication to complete the series uniform with the modern results and returns of the surveys, and who has been re-posted to No. 7 Topographical Survey for field duty, from which he was temporarily withdrawn.

Mr T. Downes, Mr G. R. Copping, } 11th August 1873.

124. Two newly-appointed Assistant Surveyors were posted to this party to fill vacancies from the dates specified opposite their names.

125. The triangulation will be advanced in continuation westwards and southwards of that executed during the season under review, into the degree sheets marked IV, V and VI on the index of this survey, and the final topography will be taken up of the western half of degree sheet III (between latitude 23° to 24° and longitude 77° to 77° 30'), together with the ground north of the Nerbudda river immediately above the station of Hoshungabad in standard sheet 26, which is much wanted to fill up the sheet of the atlas No. 53 S. E., containing a large portion of the Hoshungabad District which came under the Revenue Survey of the Central Provinces some years ago.

Programme for the ensuing field season.

126. Extracts from the Deputy Superintendent's Narrative Report descriptive of the country through which the season's operations have passed, together with a memorandum on the Forts of Raisen, Bhilsa, and Bhopal, are given in the appendix.

127. Captain Riddell, Captain Wilmer, and the assistants of this party, are entitled to commendation for the satisfactory outturn realised each succeeding year. Captain Wilmer, Assistant Superintendent, and Mr. A. J. Wilson, Surveyor, 4th grade, are honorably mentioned.

No. 6.—TOPOGRAPHICAL SURVEY.

KHASIA, GARO, AND NAGA HILLS.

128. In order to meet the pressing demands of the Government of Bengal for the further exploration and completion of the surveys on the Eastern Frontier in the Northern Chittagong hill tracts, the Tipperah, Lushai, and Cachar hills, the Garo hills and in the Naga hills district and along the Northern Munnipore Frontier, special arrangements, as referred to in paragraph 153 of my last report, were necessary to enable this party to operate in the extensive and detached portions of country above described.

Geographical explorations and reconnoissance along the Eastern Frontier of Bengal in the Garo, Naga, Munnipore hills, as well as in the South Cachar, Tipperah, Lushai, and North Chittagong hills.

129. By the return of Major Godwin-Austen from furlough on the 28th October 1872, and the addition of Mr. G. H. Cooke, Assistant Superintendent, Revenue Survey, the four several detachments, as per margin, were formed to act independently in the ground assigned to each, which lay widely apart. The reports of these special operations of the detachments under Major H. H. Godwin-Austen, Captain W. F. Badgley, and Mr. G. H. Cooke, having already been fully commented on and submitted to Government, with my letters marginally noted* and printed, it is unnecessary to review them again in full, but the professional details will be briefly recapitulated, in connection with the work of No. 4 detachment in the Garo hills, under Lieutenant R. G. Woodthorpe, R. E., Assistant Superintendent, so as to keep the history of the operations of this party together, and to render the general results of the topographical operations complete for the season under review.

Detachment No. 1, under Major Godwin Austen—In the Naga and Munnipore hills.
Detachment No. 2, under Captain W. F. Badgley—In the Tipperah, Lushai, and Cachar hills.
Detachment No. 3, under G. H.Cooke, Esq.—In the Northern and Eastern Chittagong hills.
Detachment No. 4, under Lieutenant R. G. Woodthorpe, R. E.—In the Garo hills.

* No. 313F, dated 27th June 1873.
„ 408F, „ 15th July „

130. The special objects which it was desired by the Bengal Government to secure, and which led to the dispersion of the party from its continuous course, and the systematic prosecution of the Naga hills survey, were as follow:—

Objects of the several detached surveys.

1*st.*—The demarcation and survey of a portion of the Naga hills boundary conterminous with the Munnipoor Native State boundary, and the exploration of the extreme frontier along the Patkoi range as far eastward as could be reached.

2*nd.*—The continuation of the survey and exploration of the Tipperah, Cachar, and Lushai hills, as pursued in the previous season with the military expedition under the two columns, which advanced from the north and south respectively, with the object of fixing on a suitable defensive line of boundary along the entire British Eastern Frontier and country inhabited by several Lushai and Kuki tribes, extending from the southern boundary of the district of Cachar in latitude 24°15′ to a point on the eastern boundary of district Chittagong in latitude 22° (Keokradong hill peak), and also to complete the geographical reconnoissance of the blank area in the Tipperah and Lushai hills between the parallels of 23° 30 and 24° 15 and the meridians of 91° 45′ and 93°.

3*rd.*—A military reconnoissance of the unsurveyed portion of the Garo hills inhabited by refractory tribes against whom a military demonstration was about to be made.

131. All these objects were fully attained, except the exploration of the Patkoi range further east than longitude 94° 15′, which owing to opposition on the part of the Munnipoor Rajah, as already reported to Government (*vide* correspondence marginally noted), caused the diversion of the operations under Major Godwin-Austen to the south or Munnipoor side, and led to the survey of a large portion of the Munnipoor State, between its disputed northern boundary and the capital, as the only means of utilising the establishment during the interval.

Results obtained.

Surveyor-General's No. 321F, dated 1st July 1873. Agriculture, Revenue, and Commerce, No. 669, dated 4th October 1873.

132. The extent of work effected by each detached party are given in the margin, yielding in all an area of excellent geographical survey over 11,273 square miles inclusive of 673 square miles of overlaps and margins, or 10,600 square miles of survey over entirely new ground with 9,433 square miles of triangulation, a portion of which is covered by the season's topography. All this work, both topography and triangulation, is well connected with the work of previous seasons and with the principal Great Trigonometrical Survey triangulation of the Eastern Frontier.

	Topography, square miles.	Triangulation, square miles.	
Major H. H. Godwin Austen, Deputy Superintendent, 2nd grade, in charge	1,580	3,650	In the Naga hills district and Munnipoor State, a small portion on ½-inch; 30 square miles of boundary survey on 1 inch; the rest on ¼ inch.
Mr. M. J. Ogle, Surveyor, 4th grade ..	755	....	
„ J. McCay, Assistant Surveyor, 4th grade ..	670	....	In the Mekir hills, on ½-inch scale.
Captain W. F. Badgley, Officiating Deputy Superintendent, 3rd grade ..	2,574	2,433	In the Tipperah, Lushai, and North Chittagong hills, all on ½ inch.
Mr. A. W. Chennell, Assistant Surveyor, 1st grade	1,514		
G. H. Cooke, Esq., Assistant Superintendent, 2nd grade	1,500	1,500	
Lieutenant R. G. Woodthorpe, R.E., Assistant Superintendent, 2nd grade.	440	1,650	In the Garo hills, on ½ inch; also a plan of Turn on scale 24 inches = 1 mile.
Mr. W. Robert, Assistant Surveyor, 3rd grade	1,380	....	
Sub Surveyor Shah Nasiruddin ..	790	....	
Ditto Shaik Daliludin ..	70	....	
TOTAL SQUARE MILES ..	11,273	9,433	

133. Observations were made at 86 stations, from which 305 points and 193 elevations were determined, and thus a sufficient knowledge of a very large tract of wild and hitherto untrodden and unknown country was obtained, which adds very materially to the map of India.

134. The reports furnished by the officers in charge of the several detachments furnish a great variety of very valuable and interesting information connected with the Eastern Frontier, descriptive of the country, tribes inhabiting it, climate, geology, &c.; these are given in full in the appendix and are well worthy of perusal, as they furnish reliable information, from personal observations, of an important frontier which has now for the first time been visited, explored, and mapped by British officers.

Geographical and statistical notes and information furnished by Executives.

135. The total cost of the season's operations amounts to Rs. 86,738-6*, exclusive of charges incurred by local civil officers for transporting provisions to the various depôts in the interior of the Lushai country for the use of the survey establishments and the military or police escorts which accompanied. The nature of these special surveys beyond the British Frontier and into totally unexplored and unknown ground very sparsely inhabited by unfriendly and semi independent hill tribes, necessitated arrangements of a very exceptional kind. The cost of providing commissariat stores, porterage or transport for the same, guides and interpreters, &c., form a heavy additional charge, which under ordinary circumstances, and in the regular course of survey operations, are never incurred by any survey party.

Cost of the season's operations.

* Of this sum, Rs. 76,862-8 was provided from the sanctioned estimates of the Topographical Survey Branch, (supplemented by the additional grant of Rs. 23,000 allowed to meet the exceptional nature of the charges for survey and exploration beyond the British Frontier, *vide* Agriculture, Revenue, and Commerce Department, letter No. 128, dated 20th February 1873), and Rs. 9,875-14 was provided from the Revenue Survey Branch estimates, for the deputation of an Assistant Superintendent and his field establishment employed on the Northern Chittagong hills.

136. More complete and successful operations over an extensive and widely scattered area have never before been conducted at a more moderate cost in similar ground and similar difficulties. The topography of no less than 10,600 square miles of hitherto unknown country, based on good triangulation, has been obtained, besides much valuable information regarding frontier tribes who have long proved troublesome neighbours, and who previously baffled all efforts to approach them. Geographically and for political and administrative purposes, the Eastern Frontier of Bengal from latitude 22° to 26° or from a point on the extreme south-eastern boundary of Chittagong to the northern boundary of the Munnipoor State, touching on the Naga hills district in Assam, a total direct distance of 275 miles, is now perfectly known, and all the Lushai, Kuki and Garo hills, together with a good portion of Northern and Central Munnipoor and part of the Naga hills, have been surveyed.

Opinion on the results obtained.

137. In my report to the Bengal Government, I brought to notice the satisfactory completion of the remaining portion of the Garo hill survey on the ¼ inch scale under Lieutenant Woodthorpe, R.E., in connection with the military expedition. The whole of these hills including the portion hitherto termed independent and never before entered, have now been delineated, and the long existing blank filled up, which will make a marked difference on the map. Lieutenant Woodthorpe's excellent services were at the same time brought to notice, as well as the appreciations felt by this Department of the great assistance and support so freely rendered by Captain Williamson, the Political Agent, accompanying the expedition, and aiding the survey on all occasions.

No. 632F, dated 3rd September 1873.

138. These highly important results have been attained under considerable risks to life and health, and under many difficulties and privations. Major Godwin-Austen and Mr. Ogle in the Naga hills, and Lieutenant R. G. Woodthorpe and Mr. Robert in the Garo hills, were, in the performance of their professional duties, placed in the position of combatants, and were under fire; whilst Captain Badgley and Mr. Cooke on several occasions suffered severely from the want of water and provisions, and had to endure much anxiety and overcome no ordinary difficulties, in the course of their exploration.

139. All the above named officers have very ably performed their duties, and I am greatly indebted to them, and especially to Captain Badgley, for his continued valuable services in the Lushai country, (where the obstacles and difficulties were the greatest,) for the satisfactory results above recorded. The Government of India has already acknowledged the good services of Captain Badgley and Mr. Cooke as specified in the Agriculture, Revenue, and Commerce Department letter No. 756, dated 7th November 1873, and in the Foreign Department letter to Government Bengal, No. 7 P, dated 2nd January 1874, the favorable opinions contained in which I had much pleasure in communicating, as being richly deserved. Lieutenant Woodthorpe is a most promising young officer and has fully realised my expectations.

140. In consequence of Major H. H. Godwin-Austen, Deputy Superintendent in charge, having again obtained leave to Europe on private affairs for six months under Section XI of rules of the 1868, Captain W. F. Badgley, Officiating Deputy Superintendent, succeeded again to the charge of the party from the 11th August 1873. As represented at the time, the sudden departure of this officer again to England on private affairs so very soon after his return from long furlough, caused exceeding inconvenience to this Department. The loss of an officer employed as Major Austen was on a special political mission before his field work could be properly brought up, computed, mapped and rendered, is of such serious consequence that I trust the present case may form no precedent for future practice or guidance in the Survey Department.

141. The programme for the current season of 1873-74 is as follows:—Captain Badgley and Lieutenant Woodthorpe will accompany the Political Agent, Naga Hills, (Captain J. Butler), on the survey and exploration of the Patkoi range, forming the British North-East Frontier, east of longitude 94°-30', and will reconnoitre the ground north and south of it in the Naga hills, Munnipoor and bordering on Burmah. The hills east of the Doyang river, and the valley of the Lanier river, will also be explored and mapped as far as possible.

Future Operation.

142. These officers are engaged on a very important and harassing duty, requiring great tact and judgment, as well as powers of endurance, in very elevated regions and amongst people who have never before come in contact with Europeans. Under the auspices of the Political Agent, Captain Butler, I have every expectation and hope of full success attending their energetic exertions.

143. Messrs. Chennell and McCay with one Sub-Surveyor will be employed in the Naga hills district from the Doyang River westwards to longitude 93°, and will complete all the unsurveyed portion of the district between the limits of the Revenue Survey of the Seebsaugor and Nowgong districts, and the Naga hills work of the previous season by this party.

144. Messrs. Ogle, Robert, and a Sub-Surveyor, will fill up the portion lying in western Munnipoor between the Barrak river, and the work of Major Godwin-Austen of the season under review, in about longitude 94°, and, if practicable, join on towards the south-west with the survey in the Lushai hills executed during the military expedition of 1871-72. A Sub-Surveyor has been also detached to complete a small portion of the hills on the western flank of the Garos along the Goalpara and Mymensingh district boundaries, which could not be completed by Lieutenant Woodthorpe during the past season.

145. All these operations are now in progress, and from the latest accounts received are advancing steadily and satisfactorily. They are special works of the utmost interest and importance, and by the manner in which they are being carried out by the persevering efforts of the able officers employed, will no doubt add to the great advantage of geographical research, as well as to the reputation of the Department.

No. 7.—TOPOGRAPHICAL SURVEY.

RAJPUTANA AND SIMLA.

146. With the object of forwarding as much as possible the large-scale survey of the Station of Simla and Jutog, the whole month of October at the close of the recess was devoted, with great effect, to the completion of fresh triangulation, lines of traverse and field sketching, within and around the limits of the sanitarium, and the party did not in consequence commence work in Rajputana before the beginning of December.

147. For the reasons given in paragraph 181 of my last report, no triangulation in advance was attempted during the season under review, but the Deputy Superintendent found it necessary to observe at five stations with the object of securing some additional fixed points in a difficult portion of ground. The whole strength of the party was, therefore, employed on final topography within the degree sheet VIII, formed by the parallels of 25° and 26° and the meridians of 73° and 74.°

148. The area topographically delineated embraces about $\frac{5}{8}$ths of the degree sheet VIII, covering 2,760 square miles of ground, in the Native States of Meywar, Marwar, Godwar, and Shahpura, and in the southern portion of Mhairwara, south of the British district of Ajmere. Captain George Strahan, R. E., Deputy Superintendent, reports very favorably on the results of tests applied to the work of the plane-tablers. The average number of plane-table fixings were 10·5 to every square mile, the maximum being 21 and the minimum 4 per square mile. In several plane-tables the average number of fixings per square mile ranged from 17 to 9, and it may safely be said that every precaution has been taken to ensure the accurate and faithful delineation of the ground under survey, which was of a most intricate character.

SEASON'S OUTTURN.

Strength of party.	Topography, square miles.	
Captain George Strahan, R. E., Deputy Superintendent, 2nd grade, in charge	176,	also test routes.
H. Horst, Esq., Assistant Superintendent, 1st grade	210	"
Mr. R. Todd, Asst.-Surveyor, 1st grade	159	
" C. Tapsell " 2nd "	120	
" H. T. Kitchen " 2nd "	120	
" W. Stotesbury " 2nd "	135,	also boundary traverse.
" W. W. McNair " 2nd "	240	
" F. E. Warde " 3rd "	120,	also boundary traverse.
" P. White " 4th "	160	
" G. R. Copping, Apprentice ...	180	
" T. Downes, Sub-Surveyor ...	139	
" E. Graham " ...	160	
" J. Noah " ...	290	
Baboo Kalka Pershad " ...	231	
" Harlall Singh " ...	300	
Total ...	2,760	

149. Of test routes 156 linear miles, and of a boundary traverse 275 linear miles were run, in addition to such ordinary traversing within the detail survey as was necessary in difficult and intricate broken ground.

Nature of the country.

150. The country through which the season's operations passed has already been described (see paragraphs 165, 166 of my last report, and the extract in the appendix, pages 13 and 14, from the Narrative Report of Captain George Strahan, R. E.,); a few additional notes are also given in the appendix of this report. Nearly all the ground was intricate and extremely difficult of delineation, and some of the ridges of the "Arabulla or Aravulli" range, which lay in the work, exceeded 4,000 feet above sea level. Supplies were procured and conveyed with difficulty, owing to the hills in these parts being uninhabited. In consequence of the peculiar intricacy of the ground all about the Arabulla range, which has been delineated with the utmost care and truthfulness, the progress of several of the plane-tablers was necessarily extremely slow.

151. Standard one-inch sheets have been rendered in the usual excellent style of this party, which have already been published, and proved well adapted for reproduction by photography. They are very valuable records, and fully show the extraordinary detail of the ground pourtrayed.

Simla and Jutog survey.

152. On the return of the party to recess quarters early in the year, but not until a very fair amount of work in Rajputana had been completed, the survey of Simla and Jutog was again taken up, and throughout the months of April, May, June and September field work was pushed on with great rapidity and vigor without detriment to the office work in bringing up the Rajputana records. By triangulation 102 points and 108 elevations were determined, 21·6 linear miles of close traversing of roads was completed, and the topography, on a scale of 24 inches to the mile, of 3,783 acres was obtained.

153. Since the commencement of this work in April 1871, and during the dry months only at the beginning and close of the recess season, this survey has been vigorously

and ably pushed on, and the following is an abstract of the results obtained during two seasons :—

By triangulation—303 points and 191 elevations determined.

By traversing—1,714 points fixed over 52·632 linear miles of roads, &c.

Topography—7,582 acres surveyed, on scale 24 inches = 1 mile, or natural scale 1:2640.

Estate boundaries completed for nearly 5 sheets.

Fair drawing completed of 11 sheets, measuring 31·8 inches by 22·7 inches.

Every house, out-office, road, foot-path, garden, stream and water-course, and in fact every feature, natural or artificial, which could be described on the scale of survey which is unusually large, has been inserted.

154. The sheets published up to date on the scale of survey, and also on two-third scale, as a preliminary issue prior to the insertion of estate boundaries, are shown in the margin. They are admirably executed drawings, in every respect likely to enhance the credit of the Department.

Full scale, 24 inches = 1 mile.
Nos. 1, 2, 3, 4, 5, 8, 9 and 10.

155. It is expected that nearly two more recess seasons will be occupied in the completion of the topography of Simla and Jutog on the large scale, but the boundaries of estates cannot be finished until they are clearly marked by the proprietors, and all disputes connected with boundary marks have been settled by the civil authorities, with the aid of the preliminary maps furnished for that purpose. The two roads from Simla to the plains will then be commenced to be laid down on a smaller scale, with the view of connecting the other military stations, and of producing a reliable map of the country between Kalka and the Thibet road, north of Simla, which does not exist at present.

Probable time of completion of the Simla and Jutog survey.

156. The total cost of the season's operations both in Rajputana and Simla amounts to Rs. 66,699.

Cost of the season's operations.

157. As explained above, the party has been employed in field, or out-door work, for fully nine months. The additional work imposed on it by the Simla survey has necessitated much extra labour both in field and office. Captain George Strahan and his assistants have cheerfully and ably responded to this extra tax on their time, and the results of the whole year's labors have been most successful, and are highly creditable to all.

Opinion on the season's general results.

158. The triangulation in advance of detail survey in Rajputana will, during the now current season (1873-74), be extended northwards into the degree sheets IX and X in Jodhpoor and Ajmere. The Deputy Superintendent will run a first class secondary series of triangles along the meridian of 73° until the parallel of 27° is reached, and then will continue this series eastwards to connect with the stations of the principal triangulation of the Gurhagurh series (Great Trigonometrical Survey). The Assistant Superintendent, Captain J. R. Wilmer recently transferred, and Mr. E. S. P. Atkinson, Surveyor, will triangulate within the area thus enclosed in the two degrees formed by the meridians of 73° and 75° and the parallels of 26° and 27°. The final detail survey will be taken up in continuation of the work of the previous season in the western portion of degree sheet VIII, and the southern portion of the degree sheet X, and the future operations in Rajputana will aim at completing the sections required for the several atlas sheets, west of and along the meridian of 75° east of which has already been finished. The Simla and Jutog survey will also be continued as usual from April to October next.

Programme for the ensuing season.

159. Mr. H. Horst, Assistant Superintendent, was at the close of the recess transferred to No. 5 Survey, Bhopal and Malwa Native States, and was relieved by Captain J. R. Wilmer, Assistant Superintendent, from No. 5 Survey. The transfers and postings marginally noted, were effected in the junior establishment to fill existing vacancies.

Changes in personnel of party.

Mr. G. Copping, Apprentice, promoted to 4th grade Assistant Surveyor and posted to No. 5 Survey from the 11th August 1873.

Mr. T. Downes, Sub-Surveyor, promoted to 4th grade Assistant Surveyor and transferred to No. 5 Party from 11th August 1873.

Mr. E. Graham, Sub-Surveyor, promoted to 4th grade Assistant Surveyor and transferred to No. 2 Party from the 11th August 1873.

160. Captain George Strahan, R. E., Deputy Superintendent, reports in terms of high praise of the very efficient and able manner in which Mr. H. Horst, Assistant Superintendent, has always performed his duties. His zeal, devotion to work, and excellent example in all respects, have had a most beneficial effect on all the junior members of the party. Mr. W. W. McNair, 2nd grade Assistant Surveyor, continues, by his good exertions both in the field and recess, to give unqualified satisfaction, and excelling in all the duties entrusted to him to deserve special mention.

161. During the season this party came under my personal inspection on several occasions, and I watched the work carried on in the field of the Simla Survey with the greatest interest and approval. I have on so many occasions had the pleasing duty of commending the labors of Captain George Strahan, that I find it difficult adequately to express again the high sense I entertain of his attainments and admirable management. This talented officer is an ornament to his profession and the corps to which he belongs, and this Department owes him much for his successful prosecution of surveys of varied character of the highest order of merit. The whole party under this officer's able direction is in the highest state of efficiency and deserving of my warmest commendation.

162. There is still a very extensive area remaining for this party to accomplish in Western Rajputana, which must necessarily occupy several years. This has been alluded to more specifically in my report prepared for the Financial Committee of the House of Commons, printed in last year's operation report. The Native States in the Rajputana and Central India Agencies have progressed well of late years, and have still three very efficient Parties or establishments employed in them; those in the Bombay Presidency are now in hand, and comparatively speaking a very few more years will see the completion of a very practical, useful, and economical first survey of all these important parts of the empire, on the scale of one inch to the mile, as so greatly needed and desirable.

(Signed) H. L. THUILLIER, *Colonel*,
Surveyor-General of India.

SURVEYOR GENERAL'S OFFICE,
Calcutta, 20th January 1874.

APPENDIX.

STATEMENT A.

Showing the progress and cost of each Survey during season 1872-73, *with general mileage average rate.*

DESIGNATION OF SURVEY.	Final topography completed, square miles.	Triangulation completed, 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 mapping rendered.	Total cost of survey.	REMARKS.
									Rs.	
No. 1 Survey, Gwalior and Central India ...	3,000	2,320	45	316	7·3	117	19·8	2,727	62,480	
No. 2 Survey, Khandesh and Bombay Native States ...	1,672	2,013	97	383	5·3	375	5·4	1,685	56,825	
No. 3 Survey, Central Provinces and Vizagapatam Agency ...	1,636	...	58*	237*	...	230*	...	1,636	63,615	* Points interpolated in the triangulation of previous seasons.
No. 4 Survey, North-Eastern Division, Central Provinces ...	2,571	2,900	49	320	9·1	209	13·9	3,918†	57,640	† This includes 1,337 square miles re-drawn of the Chota Nagpore division survey.
No. 5 Survey, Bhopal and Malwa ...	2,215	2,264	49	299	7·6	242	9·4	2,215	57,599	
No. 6 Survey, Khasia, Garo, and Naga Hills ...	11,273‡	9,433§	66	305	30·9	193	48·8	11,273	84,736	‡ Of this area 670 square miles were surveyed on 2 miles=1 inch, and the rest on the scale of 4 miles=1 inch. § This triangulated area does not include distant peaks far beyond the limits of survey, of which a considerable number have been fixed.
No. 7 Survey, Rajputana and Simla ...	2,760	...	5	25	...	...	...	2,032	66,699‖	‖ This sum includes the cost of the large scale survey, (24-inch=1 mile) of Simla and Jutog, of which 3,783 acres were completed during the season.
TOTALS ...	25,327	18,930	379	1,885	...	1,365	...	25,366	4,49,896	Average rate of final survey, inclusive of cost of triangulation in advance of details, Rs. 17-12 per square mile.

APPENDIX.

TABLE B.

Comparative results and cost of seasons 1871-72 *and* 1872-73.

	Final topography, square miles.	Triangulation, square miles.	Number of stations observed at.	Number of points fixed trigonometrically.	Heights determined trigonometrically.	Cost Rupees	Rate per square mile.			REMARKS.
							Rs.	A.	P.	
Season 1871-72	17,910	16,336	459	1,856	1,216	3,71,616	20	10	0	Practically, six executive parties were at work.
,, 1872-73	25,327	18,930*	379	1,885	1,365	4,49,896	17	12	0	* No triangulation executed by Nos. 3 and 7 surveys. The number of parties was brought up to seven, full working power.
Difference ...	+7,417	+2,594	— 80	+ 29	+149	+78,280	— 2	14	0	

TABLE C.

Professional results and value of the season's triangulation and average number of Plane Table fixings per square mile of detail survey (*Season* 1872-73).

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.	3rd class.	4th class.		
No. 1 ...	...	98	35	492	...	5·2	...	1·75	3·46	5·13	10·1	
„ 2 ...	13	164	21	462	3·6	12·0	4·3	6·7	16·7	15·7	7·5	
„ 3 ...	...	616	...	...	...	about 15	...	within 12	...	...	5·5	A few more remain to be computed interpolated points in the triangulation of previous years.
„ 4 ...	...	30	67	458	...	5·5	...	1·0	7·9	22·1	10·0	
„ 5 ...	5	87	559	...	5·9	11·7	0·025	2·3	3·2	...	6·7	
„ 6 ...	...	...	140	394	...	15·8	...	...	7·4	44·7	.....	This does not include the results of Mr. Cooke's triangulation in the Chittagong hills.
„ 7 ...	...	...	...	...	...	...	...	—	...	...	10·5	

APPENDIX.

DR. *Abstract Cash Accounts from 1st January to 31st December 1873.* CR.

ITEMS.	Amount.			Total Amount.			ITEMS.	Amount.			Total Amount.		
TO MAP SALE ACCOUNT.	Rs.	A.	P.	Rs.	A.	P.	BY TRANSFER ACCOUNT.	Rs.	A.	P.	Rs.	A.	P.
Amount received from sundries	1,015	3	9				Amount paid to Bank of Bengal, No. 237, dated 28th January 1873	45	14	0			
Sales by Curator of Government Books, N. W. Provinces ...	118	9	7				Ditto ditto, No. 352, dated 10th February 1873 ...	190	4	0			
„ by Ditto ditto, Central Provinces ...	504	14	0				Ditto ditto „ 459, „ 25th „ „ ...	236	3	3			
„ by Punjab Printing Company	235	3	3				Ditto ditto „ 746, „ 1st April „ ...	2,921	7	0			
„ by Thacker, Spink & Co.	2,921	7	0				Ditto ditto „ 848, „ 8th „ „ ...	196	5	6			
„ by T. H. Williams	147	14	0				Ditto ditto „ 1105, „ 28th May „ ...	537	14	0			
„ by Controller, P. W. Accounts, Bombay	100	0	0				Ditto ditto „ 1192, „ 30th June „ ...	126	9	7			
				5,043	3	7	Ditto ditto „ 1302, „ 30th July „ ...	34	0	0			
							Ditto ditto „ 1636, „ 18th October „ ...	502	2	9			
							Ditto ditto „ 2104, „ 30th December „ ...	152	7	6			
							Ditto credited to Government of Bombay, as per Controller of Public Works Accounts No. 405A, dated 30th September 1873	100	0	0			
											5,043	3	7
TOTAL				5,043	3	7	TOTAL				5,043	3	7

(Sd.) H. L. THUILLIER, *Colonel,*
Surveyor-General.

APPENDIX.

REMARKS, PROFESSIONAL, GEOGRAPHICAL, AND STATISTICAL, &c.,

BY EXECUTIVE OFFICERS.

Extract from the Narrative Report of LIEUT. T. H. HOLDICH, R. E., *Officiating in Charge, No.* 1, *Topographical Survey, Gwalior and Central India.*

Scindiah's territory, Gwalior, &c.

The peculiar conformation of the country north of Nimthur rendered the work of reconnoissance rather difficult. The general level of the Central India plateau is broken into by narrow valleys intersecting it, invariably flanked by steep scarped cliffs, and affording no prominent hills or eminences suitable for trigonometrical stations. The edges of the scarped cliffs, while they afforded an excellent view of the valleys in front of and below them, were usually slightly below the level of the plateau which was covered with tree jungle behind them, so slightly however that a few yards from the edge the view of the valley was shut out. It was clear that stations would have to be selected along these scarps in order to fix points in the valleys below; so they were carefully examined, together with a strip of the plateau adjoining them, observations being every now and then taken from trees to hit off, if possible, some point a few feet higher than the general level from which rays might be cut through the jungle to carry the triangulation across the plateau to its opposite edge where another valley might intersect it. This was very laborious work. Every yard of ground had to be examined, and in this way I proceeded with Lieutenant Leach northward from Nimthur *viâ* Khetholi, Hinglazgarh and Jhun-jhunu to the neighbourhood of Bhynsrorgarh, and from that point, eastwards to Mandalgarh Station, Great Trigonometrical Survey, of the Rahoon Series.

Gwalior Kotah: description of country.

The country brought under detail survey this season has already been generally described in previous reports, and varies so much in character that it is difficult to describe it systematically. It consists of the eastern half and a portion of the north-western quarter of Degree Sheet X. East of the Parbati, in the neighbourhood of Nahargarh, the country has already been described as flat, stony, jungly and barren of cultivation. The wealth of the scanty population consists chiefly in cattle, the small scattered villages and the frequent ruins surrounding all large places point to a decaying people. There are, however, very few traces of former cultivation, and formerly, as now, the breeding of cattle must have afforded the best chance of subsistence to the population of the country. The bed of the *Parbati* River is very peculiar at this point. It has worn its course into countless narrow channels, which wind and twist amongst islands with banks so steep that it is impossible to scale them, and covered with jungle and grass so dense, that it is impossible to penetrate them. Once involved in the curious net-work of these channels it is no easy matter to get clear of them. Tracks of tigers, sambar and pig, may be found in abundance, but the cover these animals find in the islands is too good to afford much chance to the sportsman. West of the *Parbati* the nature of the country changes completely. The Neewaj or Parwan from the point where it issues from the hills at Shergarh flows through a richly cultivated open plain. The Kalisind too, north of the Makandara and Rata Devi Range, flows through similar country with but a small strip of jungle here and there on its banks. All this part of Kotah must be valuable land, but it is parcelled out into small jaghirs, and further split up by small local rulers whose contempt of the Kotah durbar and belief in their own importance sufficiently attests to the want of a ruling power at the capital.

From the north-west corner of Degree Sheet X (Mandalgarh), there extends a curious double range of hills, steeply scarped on the south-west side and gently sloping to the plain on the north-west with a general south-easterly run till it meets the Neewaj River east of Dilanpur, and becomes lost in the confused mass of rocky hills which constitute the south-eastern portion of this Degree Sheet. The scarps of these two ridges are barely a mile and a half apart running almost mathematically parallel, the narrow valley between being here and there filled up with dense jungle, and here and there with cultivation round the margin of a sheet of water, affording scenes of most wonderful beauty, particularly in the neighbourhood of Rata Devi, a small hamlet on the edge of a lake in this range about due east of Jhalra Patan. At the end of this range the south-east corner of the Degree Sheet is covered with low stony jungle-covered hills, massed together without any apparent system, extending over the country south of Dilanpur to Kalchipur and eastwards of Rajgarh and Manohor Thana; then northward again very nearly to Chapra. On the north these hills are broken up into a mass of small detail, but on the south they open out into a plateau, still stony and unprofitable, but tolerably level and open. There are few, if any, objects of interest in this part of the country. The extraordinary mass of boulders and stones scattered evenly over the face of the land in the Kalchipur and Rajgarh districts is the feature that most prominently strikes the traveller. Yet a good deal of cultivation has been attempted, principally jowar, with a few small patches of opium, and here and

there a field of gram. The country triangulated in advance is the eastern half of Degree Sheet XI, and is thus described by Lieutenant Leach :—

The curious double range of hills noticed in the previous paragraph extends in a north-westerly direction through the northern portion of the ground under triangulation, the inner and higher range eventually forming an approximate boundary to the Udeypur State, and increasing gradually to a height of about 2,000 feet, the lower bending round nearly south, as far as the large town of Banpura in Holkar's territory, and afterwards pursuing a westerly direction towards Nimach ; Rampura, a station of the Great Trigonometrical Survey, forming the western limit of the season's triangulation, situated on this scarp, is a little over 1,900 feet, and the precipitous sides of the rock rising perpendicularly above an old ruined town of the same name, formerly of some celebrity, are visible for miles in every direction. The whole tract of country, embraced between the Chumbal and this lower range, is almost continuous jungle, except where a patch of ground has been cleared in the vicinity of the sparsely populated Bheel villages. During the greater portion of the year the tops of these hills are covered with long grass, and it is only during the months of February and March, when the whole tract is annually burnt, that detail works can be attempted. At other times the labour of dragging a chain (for the uniform height of the ground and the heavy tree jungle would entirely preclude any other method of detail work) through the rank vegetation would be but ill-repaid by the outturn obtained. On the left bank of the Chumbal, intermediate between the two main scarps above-mentioned, a third rises at a somewhat lower level, and follows a direction almost parallel to the other two. The peculiarity before noticed of the main streams running at right angles to these scarp lines is again remarkably exemplified at Chorassagarh, a place of great antiquity, and Bhynsrorgarh, some 30 miles further north, where the Chumbal breaking through each scarp in succession runs for several miles through a rocky channel, bounded by high precipitous sides, and quite impassable.

The nature of the country in the southern half of the season's work by no means accords with the above description. The greater portion is well cultivated, and although very much broken up in the immediate vicinity of the Chumbal and Abor Rivers, and studded here and there by long low ranges and small detached hills, villages are very numerous, and a large area is annually devoted to the production of opium. Holkar, Gwalior, and Jhalra Patan, are nearly equally represented, but the boundaries between the various states are well demarcated. Throughout the northern portion of the ground on the other hand, under the respective rules of Bhynsrorgarh (a dependency of Udeypur), Holkar and Kota, several disputed boundaries were met with, and the correct demarcation of these will no doubt be a subject of reference to the various political agentsd uring the coming season. The water, with but few exceptions, was good and plentiful, and the party employed upon the triangulation singularly exempt from sickness of every kind. As regards supplies, no difficulty was experienced as long as the party worked in the Gwalior and Jhalra Patan States, but, although invariably forthcoming in the Holkar territory, considerable difficulties were raised on every occasion, and excessive prices demanded for everything supplied. As far as can be judged from the preliminary reconnoissance thus made, the area to be brought under detail survey during the coming season may, with the exception of three of the northern plane tables (including the greater portion of the jungle-covered tract before alluded to), be considered of a fairly open nature, and even in the case of the high-lying land, by deferring all detail work till the latter months of the field season, when the greater portion is laid waste, no difficulty need be anticipated.

Notes, historical and statistical, on the Chapra District in Tonk Territory, by Mr. Charles A. R. Scanlan, *Assistant Surveyor.*

Tonk.

The District of Chapra is one of those portions of Tonk territory which is split up into six sections, namely, Tonk, Alligarh-Rampúra, Nimbhera, Gugor-Chapra, Sironj, and Peraia; these six divisions being scattered over the dominions of the Jeypúr, Bundi, Kotah, Jhalawar, Peraia, Holkar, Sindiah, and Mewar Princes. The area of Chapra is about 320 square miles, and is bounded on the east by the River Parbati, from which, in latitude 24°31′ and longitude 77°6, breaking off to form its southern limits, there runs a tortuous line over the broken up and hilly ground common and peculiar to this portion of Rajpootana ; this line then joins the small stream, Retri, about 10 miles below its source, and runs 4 miles in a direction due north, and then again erratically turning to the west joins the Anderi, which now forming the western limits of the district courses north-west till its confluence with the Parbati; both making in their extreme northern demarcation the apex of a triangle. The nature and aspect of this district has already been fully described, so that it is quite unnecessary for me to add more than saying it is well drained and watered, in the east and south, by hills, from which emanate many little streams, and with an open and well cultivated tract in the west and north. The heights of the hills vary from 1,300 to 1,500 feet above sea-level, while the low ground rises to an elevation of 1,000 to 1,100 feet. I shall now proceed to a brief historical and statistical report of the district.

When the towns of Chapra and Gugor first sprang into existence is a subject of doubt, and so with the precise origin of their names; but one fact appears to be established, that Chapra was built before Gugor, which town is now in rapid decay; the fort being used as a jail for life prisoners. From documents still extant I find that this district first held the name of Gugor. It is related that some members of the Chipa caste were the first founders of the town of Chapra; there exists still a temple of theirs which is the only landmark to verify this tradition. The town by them was called Chira, which means scattered, and in the process of time it came to be called Chapra. Again it is related that when the Makronat Gujars and the Rana of Udeypúr fought the battle of Ran-bania-ki, all the wives and children of the former were slaughtered, with the exception of one woman and her child of very tender years. This woman came to this spot, bringing the child in a basket, which in Hindi is called Chapra, and established the town; hence its name from the basket in which she had carried her child. But the latter appears to be quite a mythical tale, and the former the true version. The fort of Chapra and the temple were built by Rattan Singh, by caste a Khichi, and in Sammat 1818 (Vicramajithi) or 1178 (Hijri), Ambaji and Khundiji, by caste Inglia Maharattas, built the second fort, dug pucca wells, girded the town with a fortified wall, and built a bazar. At about this period Gagron was the stronghold and apparently the head-quarters of the Chouhan Thakur or Khichi chiefs; one of them, Dharaji or his father, founded Gugor at the base of a hill on the banks of the Parbati in Sammat 1343 (V.); he here took up his residence, set aside a plot of ground called Char-bag for the purposes of cremation, and from some alliteration peculiar to their language called this place Gugor after Gagron; he subsequently annexed a number of parganas, and among them Chapra came under his rule. In Sammat 1615 (V.) Raja Chattarsal Khichi founded Chattargurh to the east of Gugor, on one of the islands of the Parbati; he utilized the wood of the trees he had cut down in clearing the jungle to build his palace and houses with. Since then the river has considerably encroached on the southern lands and now washes the base of the hill on which the fort of Gugor stands. In this locality it used to discharge its waters over a very high fall, the sound was so great that all the men and cattle began to grow deaf! On this account the Raja left the place and re-entered his old town.

The building of Chattargarh dates back to about Sammat 1712 (V.) or 1072 (H.), because Chattarsal's wife's satti (tomb) still bears the above date engraved on it. Chattargarh itself is now in complete ruins, the habitation of birds and wild beasts. The site of the waterfall is called Bharka, and the sheet of deep water below Raindeh from the circumstance of one of the Raja's queens having been drowned in it. Here are also situated on a knoll hard by, the site probably where the queens bathed, some stones on which are spots of a whitish color, and when the hand is rubbed over them it retains an odour similar to that of certain ingredients which the natives of this country use for the hair in their ablutions; it is accordingly supposed that it was on these stones that the queens had the paste prepared. The Amil of Chapra narrates that he has come across the same species of stone in Ulwar, and to have his tobacco scented, he used to have it pounded on one of them. Although I have not seen this product of nature myself, yet from the earnest manner in which I was assured of its existence, I am inclined to think it is no delusion, for when one reads of the musical-sound-emitting sand which Dr. Bellew came across whilst in his mission to Seistan, the existence of a pleasant-odour-emitting rock does not strike one as an improbability nor yet as an impossibility. This gentleman, Irshad Hussen, Amil of Chapra, also told me that in Hammerpur (Ulwar State) there is on a hill a site which, during the rains, produces a most wonderful ear of grass called Khosha; it yields four different kinds of grain, makka, bajra, mot, and jawar. This Khosha is used by the zemindars as an omen; for accordingly as the number of seeds of the one preponderates over those of the others, so will that species of corn yield grain more prolifically during the season than others!!

During about the middle of the reign of the Khichis, who were themselves a turbulent and depredatory race, there were two tribes, Bheels and Dundhs, who committed all sorts of outrages. The former had built for themselves in wild localities two forts, the one at Kotra surrounded by jungle and deep ravines; the other on the hill of Megnath; the former is still in very good condition, but the latter is in a howling wilderness, and has all crumbled to pieces. At Pali, Dailod, and some other villages the Rahotors had erected their strongholds; these also are all now in ruins. Gradually the Dundhs began to acquire a formidable strength, and made the whole district desolate. It now only contained a few villages; and the revenue of the country from all sources amounted to Rs. 25,000, the zemindars saving just a sufficiency for their own consumption, subsisting on the produce of their cattle and with a common spirit freebooting. In fact, the greatest anarchy under this rule appears to have been the order of things. Every man's hand was against his neighbour, and the essence of a Philistine spirit pervaded the whole country. At last matters reached such a crisis as to lead to an imperial ukase being issued from the Court of Delhi to Dharoji Khichi, a resident of Gugor, with instructions to summarily punish these desperate Dundhs. It was in Sammat 1515 (V.) that he received his orders, but it was not till a long series of thirty years after (in Sammat 1545) that he succeeded in reducing the strength of the Dundhs and another allied tribe, the Sarangs, to two villages, Phul-Barod and Gorakpur, where he completely, after so long a struggle, overcame them. For these services he was constituted lord of forty-five parganas. He had two sons, Senduji and Gokalji. The latter in Sammat 1555 (V.) built the fort now extant and still in good repair (it has ever since been known by the name of Gokal-Ambaji), added a kot or fortification round the city, and around all he had a moat dug,

which he had arranged to be filled with the waters of the Parbati. So long as the Khichis swayed their power, wherever the kings and their family happened to die, it was always a rule with their queens to commit Satti in Gugor, whilst the corpse of the defunct king was also conveyed thither. There were in all eight Khichis who were the legal rulers of Gugor. In Sammat 1515 (V.) or 915 (H.), whilst Sikandar Shah Lodi was emperor at Delhi, one of them, whose name I have not been able to ascertain, died; in 1675 (V.) or 1035 (H.), Sal Pain died; in 1712 (V.) or 1072 (H.), Chattar Sal; in 1724 (V.) or 1084 (H.), Karansahi; in 1750 (V.) or 1110 (H.), Bakht Singh; in 1754 (V.) or 1121 (H.), Lal Singh; in 1771 or 1131, Kok Singh; in 1774 or 1141, Kalian Singh died.

In Sammat 1661 (V.) Raja Lal Singh went out on a shooting excursion to the Ragogarh Hills; he was enchanted with the locality, and forthwith issued orders for a fort, palace, and accommodation for his retainers to be erected. At this time Ragogarh was in the Balabent Pargana, of which the Nandbansi Ahirs were sole masters. There is no mention made of any struggle between these two powers ere Ragogarh was occupied by Lal Singh, nor still is there any record of negotiations having been entered into by them by which Raja Lal Singh was allowed to set up his household gods in this place of his choice—the simple and abrupt fact is stated that as soon as the fort and palace were ready, he transferred himself and all his belongings to them. Gugor still continued to be the head-quarters of his army, whilst all the revenues were collected at Chapra and regularly sent on to Ragogarh. When Raja Lal Singh died, his younger son Vicramajith usurped his father's sceptre, and drove his brother Ganj Singh a fugitive to the Court of the Rana of Udeypúr. He died there in 1800 (V.). His son, Indar Singh, having reached the state of manhood, contended for his father's share of the Ragogarh crown, and forthwith began beating about for an alliance by which he could effect his desires. Just then he, together with the Rana, visited the shrine of Nathdwara, where they met Chattar Sal, King of Kotah. After a conference he gave his cordial assent to assist the young claimant, and promptly dispatched an army of 25,000 men to invest Gugor. He was confronted by the Killedar of that place, and at the same time there came up to his support from Ragogarh a force of 27,000 men under the command of the Bakshi Pirthi Singh. For six months the opposing forces were continually engaged, and when neither side could establish a decided advantage, the usurper Vicramajith came in person himself with another subsidiary army.

When the Kotah commanders found this out, they held a consultation, and as their orders were to establish Indar Singh on the Ragogarh throne, and as the fort there was now empty, they resolved to make all haste and speed to capture the deserted capital. Immediately this move of theirs was discovered, they were followed by the army from Gugor, which entrenched itself on the banks of a nala near the village of Shani Mirgwas, about 20 miles south-east of Chapra in the Kamarj Pargana of Gwalior territory. The Kotah soldiers coming up, a fierce and bloody battle was fought, and here it was that Indar Singh was killed. There was no object in continuing the struggle, a truce was called, and the invading army retired from the scene of action. Indar Singh died without issue, in fact, in very bad circumstances, if I may be allowed to so judge from the fact of his widowed queens having had bestowed on them in perpetuity, in 1845 (V.), a jagir of 10,000 Rupees, which to this day is held by members of their family. From the date of the battle in which Indar Singh fell, Chattar Singh enjoyed full and undisputed possession of the throne, which was handed down in succession to the heirs of his line.

In Sammat 1846 (V.) or 1206 (H.), the reigning Maharaja of Gwalior demanded from Balwant Singh, the prince regnant at Ragogarh, a tribute of six annas in the rupee with the alternative in case of his refusing of having his fort stormed and his lands wrenched from him. As he could not contest the question with a power so superior as that of Sindiah, he yielded and ceded the pargana of Arown in lieu of the annual tribute. The wily Holkar, who appears to have bequeathed to all his descendants his cunning proclivities, no sooner heard of poor Balwant Singh's acquiescence to Gwalior in the matter of the tribute, than he made a similar demand on him, and commissioned one Dadha Ragoji to convey his requisition to the unfortunate prince, who forthwith presented him with the district of Chapra. Ambaji Khundiji was appointed soubah or governor, whilst Mirbaz Khan was appointed Killedar of Gugor.

After a certain time, Balaron Inglia requisitioned of the Killedar a certain grant of money, (for what purpose is not quite clearly stated,) but the fact is mentioned that he was a sort of go-between between Holkar and Sindiah, and accordingly a most unreliable character. On this grant of money being refused, he left Gugor with the ostensible purpose of bringing up reinforcements, as an attack from the Tonk Nawab was imminent. Nawab Amir-ud-dowlah Bahadur was encamped with an invading force at the citadel of Shergarh, and the time being opportune to do so, he despatched his general Mahammad Munawar Khan *alias* Munna Mia with an army, accompanied by two regiments from the Kotah Principality, with instructions to seize the fort of Gugor. Here we find the first mention made of the dynasty which now holds Chapra under its regimé. The struggle lasted for six months; and Balaron, who, as before stated, had gone on the pretence of bringing up help, being honest, the men in Gugor, who had no money nor provisions, began to see starvation staring them in the face. A general demoralization

seized them, and they resolved to capitulate, and did so immediately they were called on to surrender by Munawar Khan. Tonk supremacy was now established, and our government gave its approval to the Nawab adding this portion to the others of his territory. Mahammad Munawar Khan was appointed the first Amil, and began to administer the country with the ability of a clear-headed statesman; he made every endeavour to make the people happy and contented, he gave them takavi advances, and succeeded in raising the revenues of the country.

In Sammat 1893, Vazir-ud-doulah succeeded Amir Khan, but he had not been long in possession of the throne ere dark plots began to thicken around him. A relation of his Sahib Zada Karun Khan plotted with Munawar Khan to seize Chapra, and make themselves despotic rulers over it. Clandestinely they began levying their forces, but Vazir-ud-doulah, discovering their machinations, despatched a general Mukhtara Doulah, in hot haste with an adequate army to quell the mutiny, which by this time had become quite open. After a few days' fighting he succeeded in wresting the forts of Chapra and Gugor from the insurgents. At once Ahmid Alli Khan was appointed Amil, and Gulam Haidar Killedar, in Sammat 1897. They were subsequently attacked by the rebel Prince Shah Jada Abdul Karun Khan, who had not yet surrendered all hope of gaining a footing and creating an independent principality. The Amil was treacherously murdered, but the Killedar Gulam Haidar routed the prince, and so fully made his master's power to be felt, that since that day no one has dared to oppose it. This Haidar appears to have been formerly a Hindu, for we find mention made of his brother Narpat Singh building a temple in the fort. Under Haidar, peace smiled on the country, commerce was encouraged, and there was an increase to the revenue year by year.

In Chapra there are one hundred and sixty villages, and the revenue now stands over a lakh and eighty thousand. In Sammat 1865 (V.) it was about Rs. 70,000, and in 1872 (V.) sank so low as Rs. 28,000, and then till 1886 (V.) we have a constant fluctuation between Rs. 84,000 and Rs. 1,04,000. After that year there has been a considerable rise, and now it draws the very decent amount of Rs. 1,83,000. The district yields 600 maunds of opium, from which alone the revenue is considerable; the soil is black and fertile—all kinds of fruit, vegetables and grain are sown with advantage. The pargana is divided into two sections called Agwara and Pichwara. The soil in the latter is pronounced to be inferior to and less productive than that of the former. The reason assigned is that the villages here situated are in the jungles, where continued raids are made on them, cattle-lifting is rife, and although the strictest preventive measures are adopted, and heavy fines and punishments inflicted, the sober truth is that the zemindars prefer that code of morals which draws no distinction between meum and tuum; so they only cultivate the land to an extent which yields them enough for their wants. The area of this division is estimated at about 400,000 beegahs (acres), and it may fairly be portioned off into three sections, one hilly, one jungly, and one cultivated. The population numbers 35,074 persons, of which 11,625 are men, 10,591 women, 12,858 children. In this district there is nothing which calls for especial comment beyond this, that the saddlers and goldsmiths are pronounced to be very expert. There is also a tree called angol, the oil of which jugglers use in their avocations, and this oil is pronounced to make them more deft in their juggling arts. The peculiar stone on the Parbati I have already alluded to.

The following is a list of the nawabs of Tonk to the present day:—Amir Khan, (Shamsher Jang he had been prior to his assuming the title of nawab), a Pindari chief in Holkar's pay; Vazir Khan, Amir-ud-doulah, Nasrath Jang; Imin-ud-daulah, Mahammad Ali Khan Bahadur, Soulath Jang, the present exiled nawab of Tonk; Amin-ud-doulah, prince regnant, bears his father's titles as above. It will be remembered that the father of the present nawab was dethroned and exiled by our Government under a suspicion of his having had something to do with the Lawa tragedy.

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

This triangulation is based on the side *Argaon* to *Jellalabad*, a side on the eastern flank of the Khanpisura series, Great Trigonometrical Survey. It consists of 7 symmetrical single triangles, with sides averaging 19·4 miles in length, and supplies Trigonometrical points for an area of 2,020 square miles. These 7 large triangles are again broken up into 104 secondary ones, with sides of 6 to 10 miles in length. This triangulation supplies on an average one Trigonometrical Station for every 5·5 square miles, or 50 points for each Plane Table, which is a ratio more than ample as a basis for all topographical purposes.

Basis and object of the Sathpura series of triangles.

This triangulation emanates from Gumanpur to Mograba, a side of the Mograba Polygon of the Khanpisura series of the Great Trigonometrical Survey, and is intended to run along the Nerbudda Valley as far east as the Nimar Boundary, supplying points for Plane Tables Nos. 13, 12, 11, 10, and 1. It is necessary also as a check on the intricate net-work of triangulation carried on during the previous season. It is proposed to continue this series up to the meridian of 76,° and eventually to connect it with the Sathpura series of triangles, so that there may be a net-work of large triangles over the whole block of country between lat. 22° 30′ and long. 75° 0′ 76° 15′.

Basis and object of the Vyndhia series of triangles.

Mr. Belletty has submitted the following notes on the new area triangulated by him:

Remarks on the country triangulated by Mr. Belletty, Surveyor, 1st grade.

"The series runs generally parallel to the Vyndhia Mountains, the Great Trigonometrical Survey Stations of Gumanpur, Mograba, and Singarchaori being situated on them, while Bawangaz, another Great Trigonometrical Station, is on the highest part of a north-westerly projecting range of the Sathpuras. The two ranges approach one another so closely at a place called Haran Phal, where the Nerbudda flows between them, that there is a legend, that a deer, when hotly pursued by some Bheels, out hunting, managed to escape by leaping the river, and hence the name.

Rivers.

"The chief rivers are the Nerbudda, flowing east and west the Khuj, Man, Mandaodi, Uri and Gandarwi. Those last named have a general course from north to south, rising in the Vyndhias and flowing into the Nerbudda. The Mahi rises near the village of Mendha, on the northern face of the Vyndhias, and flows into the Chumbal.

Villages.

There are few villages of any note in the tract triangulated; many of those met with consisted of only a few straggling Bheel huts. The following are the principal ones falling within the work: Gandwani, Tanda, Talwara, Lawani, and Nalcha. The last two were places of note when Mandoo was flourishing, but since its decay have become mere villages. The local traditions regarding Mandoo are numerous, and among others, that the trade carried on in it, was so extensive and lucrative that one bazar extended from the present city of Dhar to Mandoo, a distance of about 17 miles, and that a foot passenger could travel the entire distance sheltered from the sun by the canopies extending from one side of the road to the other.

"The tract triangulated is very similar in soil and climate to that of season 1871-72, of which a report was submitted at the time; the products, animal and vegetable, are also identical. On the Vyndhia plateau much opium is grown, and this forms the main stay of the cultivator. Wheat also of excellent quality and known as 'Daodigahun' is extensively cultivated and exported to the Deccan.

Minerals.

"Near the village of Nimkhera in the Vyndhias in latitude 22°25′ longitude 75°16′ the following minerals are found: sandstone, red and grey. The grey is calcareous, and is used for making lime. Both descriptions are sent long distances for building purposes; also slate of fine quality is obtainable in large slabs at Parbatpura. Limestone near the villages of Ukala and Chirakhan, and honestone at Kachaoda."

Description of country surveyed. Holkar's and Sindiah's territory, Dhar. Burwani.

The area finally mapped during the last field season lies between latitude 21°45′ and 22°19′ longitude 75° 0′ 0″ to the north of the Sathpuras. It comprises the entire pergunnahs of Amtala, Kasraod, Dhargaon, Mardana, and Sonawad, with portions of Jellalabad, Nagalwari, Khargoon, Barur, Un, Mahomedpur, Balakwara, Sangwi, Diula, Mahesar, Barwai, Cheinpur, Bhikangaon, Bhamnala, Sendwa, and Bamangaon in Holkar's territory; also the entire pergunnahs of Bhalkar and Dharampuri and portions of Tikri in the Dhar territory; also portions of Rajpur, Burwani, Pati and Anjer pergunnahs in Burwani State; also a portion of Bakanir pergunnah in Sindiah's territory, and a portion of Beriaon pergunnah within British Nimar.

Hills.

The block of country may be described as a series of undulating plateaux, with 3 distinct falls or ledges between the Sathpuras and the Nerbudda which forms the northern boundary of the work. Thus the northernmost ridge of the Sathpuras, which is 15 miles to southward and outside of the above area, extends from Mahadeo H. S. in latitude 21° 30′ 12″ longitude 76° 11′ 36″ and 2,146 feet above sea level, in a west north-westerly direction to Abapuri H. S. in latitude 21° 52′ 34″ longitude 75° 5′ 37″ and 1,927 feet above sea level. Midway on this ridge are the higher plateaux of Huri and Jellalabad, 3,073 and 2,608 feet respectively above sea level. The above ridge keeps near the parallel of 21° 30′. The fall from it to the plains, or first plateau immediately to its north, ranges from 600 feet underneath Mahadeo to 1,200 feet under Abapuri. The next distinct fall extends along the parallel of 21° 45′ from Agassia H. S. in latitude 21° 4′ 25″ 75° 59′ 6″ and 1,114 above sea level to Rakniabari H. S. in latitude 21° 45′ 51″ longitude 76° 29′ 59″ and 1,178 feet above sea level. This level takes a more northerly direction as it extends westwards. The actual drop from it to the country immediately to its north averages 200 feet. Between latitude 21° 55′ 22° 5′ and longitude 75° 0′ 76° 15′ there is a confused mass of flat-topped hills covered with undersized jungle, the highest of which averages 950 feet above sea level; from the northern edge of this broad belt is a third distinct drop of 150 to 250 feet, and the ground from thence gardually slopes down to the Nerbudda.

Within a few miles of each side of this river there is a strip of tolerably flat ground, but even in this are many isolated small hills, rising 100 to 120 feet above it and about 650 above sea level. With the exception of this strip and others along the Beda and Kundi valleys in P. Ts. 18 and 19 there is hardly any level ground in the block of detail work. It consists of a succession of undulating plains, with a constant fall towards the north to the Nerbudda.

The Abapuri range in P. T. 21 was the highest, falling actually within the area of the detail work. The temple on its highest part, which is about six miles to south-west of Rajpur, is 1,927 feet above sea level. This range is exceedingly precipitous on the north-eastern face, but falls, on the south-west side, by a succession of long gradual spurs to the Goi river, which there runs through an exceedingly wild and totally deserted tract of country. The jungle and grass in that portion are very dense and proved great obstacles to the proper delineation of the ground.

Nerbudda river.

The Nerbudda enters the season's work in P. T. 14, at a height of about 495 feet above sea level, and leaves it at western edge of P. T. 16 at about 418 feet. Thus there is a fall of about 77 feet in 46 miles, or 1·6 feet per mile. This accounts for the great rapidity of the stream, and together with the numerous rocky barriers, for the very small traffic in boats along it. In February, when no rain had fallen, there was eight feet in the deepest and two feet in the shallowest part opposite Mahesar. The river within the above limits averages 1,030 yards in width between the banks, but contracts to 633 yards near Mahesar.

Ferries across Nerbudda.

Good and commodious ferries are kept up by Holkar and the Dhar States for the conveyance of men and cattle at the following places: In P. T. 16 from Chichli to Kotra, Bamangaon to Surgaon, Kathora to Dharampuri. In P. T. 15 Akbarpur to Morgam, Dalkhera to Jalkuti, Naoratori to Mahesar, Markarkher to Mandlesar, Garhi to Jalud.

In P. T. 14 Bhatian to Gogaon, Thelia to Sulgaon, Mardana to Baigaon, Bakawa to Pitamli, Pitnagar to Kapastar, or about every 4 miles along the river. The charges made average 1½ pies per man; ½ anna for cattle and 4 annas for a cart. There is also a ford near Chichli and a bridge-of-boats at Khal Ghat in P. T. 16. The banks of the Nerbudda vary from 20 to 100 feet in height above the river bed. There is a large fishing business carried on all along the river, there being a great demand for this article at the Mahesar and Kasraod weekly bazars.

Beda River.

The Beda or Yeda where it joins the Nerbudda opposite Mandlesar in P. T. 15, is a stream of 300 yards in width. It rises near Asirgarh fortress in P. T. 4, and flows from thence in a north-westerly direction; along its valley are the large and important villages of Bamnala and Gogaon. Throughout the last 25 miles of its course, this river runs through a highly cultivated and populous tract.

Kundi River.

The Kundi River rises near Lanka Hill in P. T. 23, and is a stream of 150 yards in width, when it joins the Beda River near Sirptan in P. T. 18. It runs under the walls of Khargun and drains a very large tract of the Sathpuras.

There are also the smaller rivers called the Deb and the Goi, into which all the drainage of P. T. 20 and most of P. T. 21 falls, and which eventually themselves flow into the Nerbudda. But all these rivers are merely mountain torrents, and present little more than a large expanse of rock and sand-banks during the cold and hot seasons. The fall in most of them is, I imagine, too great to allow of the water being stored by bunds, though I noticed ruins of old masonry ones in the Beda 2 miles north of Gogaon village, and also in a smaller stream near Dhargaon village. The cultivators are chiefly dependent on wells, which are very numerous, and the water from which is drawn by the ordinary bucket and bullock apparatus. The level of the water being very low, these wells are very costly. But little inducement in the way of advances appears to be made by any of the Native States to their ryots to open out new ones.

There are three very large tanks, each covering 200 to 300 acres, at Choli in P. T. 14, Talakpura in P. T. 20, and at a spot in the hills, 2 miles to south-west of Beriaon, in P. T. 14, from whence the water is conveyed by a masonry aqueduct to that village. These tanks are all protected by strong masonry dams. The sites are singularly well chosen, and the arrangements for outlet and escape of surplus waters very ingenious. They were all designed and constructed by natives.

Chief Towns. Khargun.

Khargun in $\frac{\text{latitude } 21^\circ\ 49'\ 33''}{\text{longitude } 76^\circ\ 39'\ 0''}$. Height above sea level 898 feet. Number of houses 1,997. Number of inhabitants 10,887. This town, situated on the east bank of the Kundi River, is the largest and most important one in Holkar's territory, south of the Nerbudda; it is the head-quarters of the Soubah, under whom are 32 Kamasdars, each in charge of one of the 32 pergunnahs. Though each of these officers is invested by the Durbar with small magisterial powers, all important cases, both civil and criminal, are referred to the Soubah. At Khargun there is a katchery, jail, and dispensary. The town is surrounded by a mud wall, and there are the ruins of a fort at the south-wets

corner. There are 5 schools, *viz.*, a Mahratta one with 65, a Hindoo one with 60, an English one with 12, a Sanscrit one with 24, and a Mahomedan one with 35 scholars. An epidemic of cholera in June 1872 swept off many hundreds of the population, and this probably accounts for the present dilapidated and miserable appearance of the place. There is a thriving trade, however, between Khargun and Khandwa, besides a large local one in grain, timber, and forest produce. There is also a great deal of native saddlery, manufactured at Khargun, and an extensive business done in cloth-dyeing with the root of a small shrub called "al."

Maheswar.

Mahesar, pronounced by the pundits Maheswar, is situated in Lat. 22° 10′ 14″.
Long. 75° 37″ 45″.

Height above sea level	...	577 feet.
Number of houses ...	...	2,815
Number of inhabitants	...	10,090

The town is beautifully situated on the northern bank of the Nerbudda, and surrounded on all other sides by extensive gardens and topes of mango and tamarind trees. It is a very important place, from the fact of its being the summer residence of H. H. Holkar, and, also, owing to a small temple of Mahadeo, situated on a rocky bank in midstream, to which there is a daily and constant stream of pilgrims from all parts of India. The Raja's palace and temples attached thereto occupy a great length of the river frontage. The former is a handsome stone building about 80 years old, with immense courts and verandas, right round, supported by sculptured pillars, and having paved floors. There is a fine flight of terraces and steps down to the water's edge; to the north-east of this place is a partially built fort. As one-third of the walls have still to be built (where it faces the river) it is not of much use as it stands at present. There is a very large straggling town to the north of these buildings, where the chief manufactures are those of copper vessels, also "dhoties," and silk "saries," as worn by Brahmins, the weavers of which are "Guzeratis," and more strict in their lives even than their customers. The town has a busy and thriving appearance, and from the number of temples, large pucca buildings, and well dressed people in the streets, there must be considerable wealth in the place. There are jails, police, lines, schools and a katchery: a squadron of Holkar's cavalry is also stationed there. Looking from the southern or right bank of the river, of an evening, when there are numerous bathers on the shore, and along the steps of the palace, and many boats, flitting about filled with pilgrims, making their rounds to the various temples, from which gongs and all kinds of musical intruments are constantly sending forth strange and curious sounds, the scene is most picturesque. The fine sheet of water with well-wooded banks, stretching between this and Mandlesar, seems to be much appreciated by the travellers, for crowds of them in all sorts of colored and most picturesque garments are always to be seen in the large flat river boats which are constantly plying up and down the same.

Kasrod.

Kasroad, situated in $\frac{\text{latitude } 22° 7' 42''}{\text{longitude } 75° 39' 10''}$ at a height above sea level of 713 feet, is another large village on the south side of the Nerbudda River, with 3,234 inhabitants. This, and the pergunnah of which it is the capital, formerly belonged to the British Government, but were exchanged some 15 years ago for territory then belonging to Holkar within Nimar. The village stands just underneath the third ridge of hills as described before, and in the midst of a well-wooded and highly cultivated tract—

Mandlesar.

Mandlesar in—

Latitude	22°	10′	27″.
Longitude	75°	4 ≈	13″.
Height above sea level ...	604 feet, with a		
Population of... ...	2,486 souls		

has greatly decreased in importance, since it was given up as a British Cantonment. As it is now again however to be the head-quarters of the Soubah, instead of Khargun, it will probably soon regain its original size; at present the town consists of a long straggling number of houses on the north bank of the Nerbudda—

Dharampuri.

In Latitude ... 22° 8′ 54″.
Longitude ... 75° 23′ 7″.
Height above sea level 445 feet,

is a rising village of 2,195 inhabitants, situated on the north bank of the Nerbudda and the head-quarters of a sub-division of Dhar, consisting of the four pergunnahs of Tikri, Dharampuri, Balkhar, and Gujri, in charge of a Kamasdar, who generally resides at Dharampuri. The Nerbudda is here split into two streams by a large jungle-covered island, extending from Dharampuri 2 miles to the east. The country to the north and north-east is a sheet of grain cultivation, undulating and beautifully wooded.

Rajpur.

The last large village in the season's work is Rajpur in

Latitude ...	21°	56′	23″.
Longitude ...	75°	10′	39″.
Height above sea ...	705 feet.		

It contains 624 houses and 3,182 inhabitants. It is situated at the northern and outer curve of a horse shoe of hills under the Abapuri Range, in exceedingly rich soil on the west bank of the Rupa or Pakalia stream. The Rajah of Burwani has lived here since his country has been placed under British administration. There are schools, a dispensary, and a cutchery within the village.

Roads.

The only metalled bridged road is the Agra and Bombay one, which enters the work at Dudha Village in P. T. 15, and leaves it at Jamli Village in P. T. 21. There is a branch of this road also metalled and bridged from Jalwani to Rajpur. The trunk road crosses the Nerbudda at Khalghat by an excellent and well managed bridge-of-boats. The leading fair weather roads are those from Khandwa *viâ* Bhikangaon and Mahomedpur to Khargun, and thence on *viâ* Likhi Lonara, and Ghegaon to Rajpur. From Sendwa *viâ* Nagalwari to Un and on to Khargun. From Khandesh *viâ* Newali and the Limsarwar Pass to Rajpur and Khalghat. There is also another fork of the same road *viâ* the Chatropani Pass over the Abapuri Range to Rajpur. There are also fair roads from Khargun *viâ* Kasraod to Mahesar and from thence to Choli and Dhar; also from Mandlesar *viâ* Dhargaon to Kherighat on the Nerbudda. The country is, however, completely intersected by rough katcha and fair weather cart tracks. Except where they cross black cotton soil, these are quite good enough for all the ordinary country cart traffic.

Traffic.

The traffic chiefly consists of grass between the jungles and large villages, and salt from Guzerat *viâ* Alirajpur; dates, gur, and sugar from Khandesh; piece goods and iron from Khandwa *viâ* Kherighat; timber from the Sathpuras within Barwani, from whence it is floated up the Nerbudda to Khalghat. The exports are ghee, opium, and til seed.

Crops.

The crops mostly cultivated are cotton, wheat, rahar or tur, gram, kulti, sugarcane, al (a small shrub, the roots of which produce a fine red dye), til, jowari, and poppy (opium).

Police Station.

There are police stations kept up by the different States, at Balakwara, Mahesar, Kasraod, Mandlesar, Dhargaon, Mardana, Barur, Khargun, Balakwara, Un, Mahomedpur, Bamnala, Segaon, and Lonara in Holkar's territory; at Dharampuri, Balkhar, and Khalghat in Dhar; at Rajpur in Burwani; and Kanapur and Beriaon in British Nimar.

Bazars.

Bazars are held weekly at Kasraod, Tembha, Balsamand, Mahesar, Un, Segaon, Lonara, Mandlesar, Moti, Thibgaon, Gogaon, Khargun, Dhargaon, Amlata, Mardana, Kanapur, Rajpur, and Beriaon.

Deserted tracts.

Owing to the constant raids made by Bhima, the Bhil Naik, in 1858, large portions of the Jelalabad, Cheinpur, Sendwa, and Nagalwari Pergunnahs of Holkar's territory are totally deserted. Every inducement is offered to ryots to again take up land in these parts, but malaria and wild beasts appear to take off both men and cattle just as quickly as the fresh emigrants settle down.

Un Temples.

At Un are the ruins of what must have been four magnificent temples dedicated to the worship of Mahadeo, Mahaluxmi, Parasnath, and Goaleshwar. They are prominent objects in the landscape for miles round the village, and are well worth a visit from travellers. Much of the sculpture on them is still sharp and clear. There are many local legends connected with these splendid ruins. They are said to be of great antiquity, but on the spot I could gain no real information whatsoever about them, though I met several intelligent pundits.

Game.

Of game, nilghai, pigs, hyœnas, and hare are most numerous. The two former roam about all over the country in large herds of ten to twenty, and 60 to 100 respectively, and do great damage to the crops. Panthers, leopards, gazelle, wolves, wild dogs, bears, sambar, porcupine and otters (in the Goi River) were constantly seen by myself as well as by every other member of the party. Tigers are rare, but in the Boraon River Valley, 4 miles to east of Tikri in P. T. 16, also in the Amba River Valley, 3 miles to north of Chondi Village in P. T. 14, one or two pairs seem to be heard of regularly as the hot season approaches. These places afford plenty of game and water. The jungle near them is very thick, and the locality is in every way suited as a residence for large beasts.

Game birds.

Black and brown partridge, blue and green pigeons, of several sorts, pea fowl, snipe, quail, wild geese, kulang, saras, bustard, and florican, were all met with, the seven first named being very numerous.

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

Country triangulated.

The country triangulated in advance includes the unsurveyed portion on the north of the Rajahmundry District, chiefly the Rampa Taluq, an extremely wild mass of jungly hills inhabited by a tribe, until quite recently, a very troublesome and rebellious lot. In sheets 27 and 54 the hills are very high, rising to nearly 5,000 feet, the highest are entirely without jungle on the summits, but further south the fall is gradual (though the hills are rugged and impassable except by one or two routes taken by Brinjaries) into the valley of the Godavery, where the hills entirely cease, at some distance above the town of Rajahmundry where that river enters the cultivated plain after passing through a great gorge through the hills. The country to north-west shown in sheets 52 and 50 is only 200 or 300 feet above sea level, with detached hills abundant everywhere. The considerable tributary of the Godavery River, named the Kolab, which has from its source to this part been a chief feature in the maps of this party for the last several years, in sheet 52 enters the Rakhapili Taluq of the old Hydrabad survey (since ceded by the Nizam to our Government) and a few miles lower falls into the Godavery. When encamped on the bank of the Kolab just at the extremity of my unsurveyed field, I was told that one of the river steamers had during a time of flood come up as far as that point.

"Arula" a mootah of hill Madgul.

In sheet 26, now being sent in, is a remarkably fine piece of country; it extends from north-east to south-west for some 8 or 10 miles, with a width of a couple of miles or so, with several large villages at an elevation of very nearly 4,000 feet never visited by any European, except the officers of this survey. The low portions of this tract (very little below the village sites) are cultivated with rice, &c., the higher portions being clear undulating waste land, very little higher than the village sites. The surrounding hills on all sides rise to about 5,000 feet, and are without much jungle, except in the ravine slopes, and hold an abundant supply of water. The Machieru has its source in the south hills and runs through this beautiful country in a northerly direction, and is the same river alluded to in paragraph 12 of this report under the name Sileru. At the beginning of April this stream has considerable flow of water, where close to its source it enters the valley now alluded to, and it receives constant streams from all sides. This fine country extends into sheet 24, where there are still larger villages, and greater extent of wet cultivation, but at a gradually decreasing elevation. With my experience and personal knowledge of every portion of the hill countries on the eastern side of the peninsula, I can affirm that nowhere is there anything approaching in extent, elevation, and other sanitary recommendations, to this Arula Mootah of Madgul. It is, though never visited, readily accessible from the coast being just 50 miles west north-west from Vizagapatam, with a well made level road nearly to the foot of the ghât, up which the difficulties are just as nature left them.

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

Mandla, Belaspur, and Sohagpur of Rewah. Difficult nature of the country.

The country comprised in sheets Nos. 11 and 16 is exceedingly wild, mountainous, and thinly populated. For instance, in sheet No. 16, covering an area of 549 square miles, there are only 1,116 huts, which represent about 5,000 inhabitants, or ten to the square mile, and these will be found to be congregated in one particular part of the ground, leaving other great tracts absolutely devoid of inhabitants. Mr. Barker especially met with great difficulties in finding men, who could tell him the name of rivers and other features, and who could assist him as jungle-cutters; and the difficulty of procuring supplies was also much felt; Sub-Surveyor Dutt met with difficulties of nearly equal magnitude.

North detachment.

The surveyors of the north detachment met with a more varied country, valleys fairly inhabited, being associated with difficult rocky hills. Messrs. James Wilson and McGill especially encountered some formidable ground, where the Johilla River cuts its way deep into the Mekal plateau, and escapes into the plain of Singwara below the ghât.

Physical features of the country surveyed.

The physical features of the country were described in my report No. 31 of 1st October 1872 at paragraphs 36 to 39. That remarkable hill, the Amarkantak plateau, has now been fully surveyed; it is found that the Rivers Nerbudda, Johilla, and the tributary of the Mahanuddy, all rise in the same plateau within a few hundred yards of one another. These rivers flowing as they do to the Bay of Bengal on one side, and to the Indian Ocean on the other, may be called the arteries, while Amarkantak may be likened to the heart of the peninsula of India.

The Nerbudda and Johilla both cut their way from off the high level of the Mekal plateau by abrupt gorges and rocky chasms, of hundreds of feet in perpendicular depth, and all the smaller streams partake of a like rugged character.

Inhabitants and cultivation.

In the Sohagpur Valley there are a few Hindu inhabitants, who are fair cultivators, but generally they are wretchedly poor, and heavily taxed and oppressed since the country has been transferred to the Maharajah of Rewah. On the Mekal plateau there are none, but aboriginal tribes, who cultivate in the rudest manner only. There is so much spare ground that the same area is covered with crops only for one or two seasons, and is then allowed to be fallow, other ground being taken up.

The following estates have been surveyed and the statistics of totals are given :—

District or Territory.	Estates.	Villages inhabited.	Villages deserted.	Number of houses.	Area in square mile.	Remarks.
Baloopore ...	Churi ...	151	13	+	329·5	The total numbers of houses of those estates marked + cannot be given, as small portions of them were surveyed by the Ganjam and Orissa Survey.
	Kenda ...	85	19	1,163	293·2	
	Korba ...	284	45	+	855·5	
	Lafa ...	72	10	+	355·7	
	Mahtin ...	49	53	576	542·6	
	Pendra ..	229	14	4,153	771·8	
	Uprora ...	45	36	384	451·4	
Rewah ...	Sohagpur ...	929	219	19,399	2457·7	

Area of Sohagpur calculated by Captain Wroughton, 1842, and by No. 4 party, 1873.

The area of Sohagpur District was calculated by Captain R. Wroughton in 1842, but this includes Singwara which contains 279,504 acres, equal to square miles 436·7. The Pargana of Sohagpur, as calculated by No. 4 party, does not include Singwara, which has not yet been re-surveyed completely. The totals are very accordant however, for—

By Wroughton—

Area of Sohagpur square miles	2895·842
„ Singwara	436·7
	2459·1

By No. 4 Topographical Party—

Area of Sohagpur	2457·7
Difference ...	1·4

Notes by Mr. G. A. McGill, *Surveyor, 2nd Grade, attached to No. 4 Topographical Party, for field season* 1872-73.

Religions and other ceremonies among the Baigas.

A description of these aborigines was given in my last report in season 1870-71. I had then no opportunities of collecting any information regarding their religion or private manners. As well as I could ascertain, they have no idea of a Supreme Being, nor of a life hereafter, they compare themselves to the animals, and pride themselves in the name of "banmanus," or men of the woods. They fear demons and imagine that the woods are full of them, and to propitiate them, whom they imagine to have disturbed by hewing timber and clearing jungle, they set up long slabs of stones on which offerings of a few grains of rice and flowers are made.

Their marriage ceremony is very simple. The bride, as a rule, is always selected from another village; a few gifts, such as grain, honey, &c., are carried to the house of the parents of the girl, and a day is named, when a few friends gather together. A loud tom-toming proclaims to the Baiga world that some of their brotherhood is to be married. By evening all is over, and the young husband leads his blushing, or I might more truly say, sorrowing bride, for she goes crying to his hut in some sequestered spot close to his fields. If the young man's parents are in good circumstances, they send to the closest Gond Village and get some mowha liquor, of which they all partake.

A Gond dance.

Of all the strange sights I saw during this season, was the Gond dance performed at the village of Saria on the occasion of the first setting up of a weekly bazar. The performers came in pairs, preceded by standard-bearers, the standards most fancifully decorated with peacock's tails and crowned on the top with a live domestic cock. On the planting of the standard, a conchshell is sounded and the dance is struck up to the beating of brass "thalies," and blowing on shells. The whole performance might well be compared to a war-dance of the American Indians, familiar almost to every one from Mayne Reid's descriptions. The resemblance to it is striking, as the men are most fancifully dressed in strips of cloth of all colours, and plumed with feathers of the sarus and peacock, they also carry shields and swords in their hands. One of the dancers was dressed from head to foot with leaves and creepers, and hooted and bounced about much to

our amusement. A "bukshish" quite delighted the poor fellows, which was at once laid out in the purchase of mohwa liquor, the effects of which set them off in right good earnest, and the dance was kept up till late in the evening.

Nerbudda Valley.

The morning march had to be put off, started in the afternoon and crossed over into the Nerbudda Valley. This valley is a most striking geographical feature in the country, as it forms a most magnificent plateau, its average height from the source of the river to some 20 miles is about 2,300 feet above sea level, and it enjoys a most beautiful temperature, perfectly free from hot winds.

A strange peculiarity in it is, that it is quite devoid of trees, this is owing to the heavy hoar frost that falls here during the months of January and February. It is, in fact, an extensive prairie and makes a rich pasture ground for cattle. The uniform width of the valley is from 6 to 8 miles, and on either side are pretty ranges of hills thickly wooded. There are numerous small Gond hamlets spotting it, together with flat fort-like mounds, and of a morning, just as the sun is rising, a most beautiful panorama is presented to the traveller as he descends into it from over the hills already referred to by me. Here and there the Nerbudda—"mai" or mother, as the natives call this sacred stream, is seen sparkling out, its waters lit up by the rising sun. Gond hamlets can be distinguished by the curling smoke rising like incense in the early morning. Nature too is alive, the musical lowing of the cattle, the sweet song of the lark, the clear metallic ring of the partridge and the sharp shriek of the pea fowl, all make themselves heard, but the sun's rays, soon make themselves felt, as there are no trees whose cool shade one might go and partake of: so that by 10 o'clock all become still, and the wide extensive plain bright with the rich golden beams of the sun reflected on the variegated coloured pass becomes quite still, and remains so till the declining course of the sun in the west makes life once more spring up. Antelope are met with in numbers, but they are difficult to get at, as the sportman has no cover, and must only trust to his steady hand and trusty rifle.

Deflection of the magnetic needle.

While surveying section latitude $\frac{23^\circ\ 0'}{15}$ longitude $\frac{81^\circ\ 15'}{30}$, a very strange deflection of the magnetic needle took place; these variations were carefully measured by me and were found to be irregular. At times the needle would be attracted to the right, and at others to the left, and very often these attractions differed at short distances of half a mile and a mile. At a place called Suriadand on the banks of the Johilla River, the needle was drawn 65 degrees to the right of true north, and at Dongrigar to the east of this place, the needle was attracted 15 degrees left of true north. There was no visible cause for this, certainly it could not have been put down to local attraction caused by iron ore, for, although the ore does exist, it is not so plentiful as in other places, when the needle remained almost unaffected by it. The greatest attraction I observed was found to exist where the ground was most broken up, and this was close to the Johilla River. The banks of the river are precipitous, at times, several hundred feet high, and its confluents before they can empty themselves into it take some extraordinary bends so unlike anything I have ever seen, that I feel myself quite unable to describe the chaotic appearance of the ground. It was in these particular parts that the most attraction was met with.

The "kaia" or wild dogs.

It was in such another place as the one above referred to, that I had a fine opportunity of seeing the wild dog called by the natives "kaia or bunkuthra." This animal is about the size of a setter, but bears resemblance more to a wolf than a domestic dog from close, although from far, one is apt to take them for dogs. It has a beautiful glossy coat of a rich burnt umber colour, with a rather long tail. They go about in large packs and hunt down sambar and spotted deer. These that I had the opportunity of seeing, had just brought down a sambar, and although the animal was still alive, they had torn its stomach open and were devouring it. The sight of me and my coolies frightened them all away, when we went up and put the poor animal out of pain; my men bore away the carcass to camp and had a fine feed on it. The natives say that they have never been known to molest man, and that the appearance of a single man is sufficient to put to flight a whole pack of "Kaias," and that, occasionally, tigers even are attacked and killed by them.

A legend.

In the south-west portion of section latitude 22° 47′ longitude 81° 4′ and about 14 miles east of the well known village of Ramghar, one sees a fine elevated range of plateau shaped hills, and distinguishable from all the others round-about is one well known as Athariadadar. A strange legend is given in connection with it, and like all legends, whether European or Indian, it dates back to the good old times, beyond the memory of man. Many, many years ago, I really can't tell you how many, there were "Bhooths," giants, living in all these parts, and among them was one Atharia; he had, however, earned for himself so bad a name, that the other *bhooths* to support their own respectability banished him from their society. Atharia driven from his home and country, came and settled down on this mountain. A large cave is pointed out where Atharia is said to have lived, and on the south face of the hill in a narrow valley there is a natural lake formed by a ledge of rocks damming up the course of a stream. The natives declare that Atharia built this dam, and that he used to cultivate the slopes of the hills on either side. A large grove of mangoe trees is all that remains of Atharia's garden.

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

Bhopál & Scindhia's territory. Country plane-tabled.

The country plane tabled was in the northern half consisting mostly of Gwalior territory, chiefly well cultivated open country, section 20 being the exception; the southern four sections were mostly Bhopál territory, and the greater proportion of this was hilly and covered with jungle; of the season's outturn—

1191·56	square miles were in	Bhopál territory,	of which	498·8	were cultivated.
922·80	ditto	Gwalior	ditto	527·9	ditto.
47·70	ditto	Tonk	ditto	2·4	ditto.
15·00	ditto	Kurwai	ditto	12·0	ditto.
3·00	ditto	British	ditto	2·0	ditto.
31·60	square miles were overlaps into work of No. 1 party,			8·0	ditto.
3·20	ditto	were disputed territory.			

which shows a general proportion of 46 per cent. of the whole as cultivated ground; this proportion is less than that of last season which was 60 per cent. The chief difference was found in the Bhopál territory, the rich heavily cultivated tract in the valley of the Nerbudda being this year out of the work.

The total outturn of 2214·87 square miles on the standard scale of one mile = one inch is less than usual, but then, it must be remembered, that the survey of the city and environs of Bhopál on the scale of 12 inches = one mile occupied as much time as the survey of 545 square miles on the standard scale; were this area added to that completed, the outturn would have been 2,760 square miles, which I should have considered a full season's outturn.

The area of the city of Bhopál surveyed on the scale of 12 inches = one mile was 18·5 square miles. Some parts of the city and suburbs are most intricate, and the detail was worked up very closely.

Description of country surveyed. Hills.

The Vyndhia range crosses this season's work, at about the parallel of 23° 15′ north latitude, but there is no well defined crest to mark the chief watershed. This watershed, on the east side of this year's work, lies over the hill (height 1,952) immediately south of the village of Khandera, sheet 14, thence over the hill, north-west of Chilwa, but between these two hills there is a pass some 400 or 500 feet lower than their crests. Thence for about two miles the watershed runs in a southerly direction until it reaches the ridge south of Surei H. S., then along through sheet 16 past the villages of Banni, Manpur, and Chandpur in a valley 400 and 500 feet below the crests of the surrounding hills; from Chandpur the watershed passes over the crest of a hill 1,963 feet in height, and down its south-western slope to the village of Barbatpur near Chiklod. Thence across the hills south-east of Kaliakeri, and out of this year's work, but it runs, I think, not far south of the parallel of 23° north latitude for the next 15 miles.

The run of the ridges or spurs forming the main range is very irregular, and the ridges themselves in many places have almost the appearance of separate groups of hills very slightly connected together. This is more especially noticed in sheet 14, then in sheet 12, excepting in the south-west portion where there are a few groups of hills rising up to 300 feet above the surrounding country; there are little more than one or two isolated hills. In sheet 10, the eastern half is devoid of any mass of hills, but the western half is almost entirely covered with hills forming no regular ranges or ridges, nor of any similarity in shape or size; then hills rise up to a height of about 350 feet above the average level of the surrounding country, which is cultivated to a small degree, but is chiefly covered with thick "Khair" and "Behr" jungle; towards the north these isolated hills are nearer to each other, and about the parallel of 24° north latitude they lose their isolated character and assume a more massive appearance.

In sheet 14 (the eastern portion) the ridges present a much more uniform character, they almost all have a gentle rise to the west of about 1 in 10 to 15, and present to the east an abrupt slope sometimes terminating in a precipice at the summit. In the western portion there is a great deal of this formation in the hills, but it is not so marked, the direction of the ridges is less regular, and the westerly slopes much less inclined. The most prominent hills in this sheet are that immediately north of the village of Ander on which the principal station Ander Great Arc Meridional Series is situated; Raisen Hill, on the top of which is the fort of the same name; Bangama Hill, a peak south of the village of Surei, on which the station of Surei is situated, and the hill south of Khandera near Narwar, all these rise to between 1,950 and 2,000 feet above the sea level, and from 450 to 500 feet above the plains. In sheet 16, the wildest and most irregular formations appear, the characteristic of each individual hill is chiefly that of a triangular pyramid, two of the lateral slopes of which are steep and precipitous, the third a gentle incline, but the way these are massed is most irregular; in the northern portion of the eastern half of the sheet, the precipitous slopes face the north, and in the southern portion they face the south. The crests of the main or more prominent points rise to about 2,000 feet above the sea, and from

two masses or ranges of about 10 miles in length the gentle slopes of which face each other, and between which the Banna and its tributary feeders take their rise. The most prominent peaks are Khamaria H. S., 4 miles north of Chandpura, which rises to a height of about 680 feet above the plain in which Chandpura is situated; the peak west of Karaghate which rises to a height of 700 feet above the Banna. Katao H. S., north of the village of Kasia, which rises to a height of 2,027 feet, this is the most prominent hill in the sheet; Hardal H. S., 2,008 feet; and in the south-east corner of the sheet, the ridge immediately north of the Jamner on which Dantko H. S. is situated, rises to 2,021 feet.

Rivers.

The principal river met with in this season's work was the Betwa, which springs a few miles west of the south-west corner of standard sheet 16, and winds northwards through all the four standard sheets, with the exception of the south-eastern portion of sheet 16, the whole country surveyed in detail is drained into the Betwa. The first feeder of any consequence is the Kaliasot which springs amongst the hills south of Bhopál, and winding in a south-easterly direction towards the south-east, joins the Betwa about 10 or 12 miles from its source, about half a mile above Bhojpur or Bhojnagar, and 2 miles below the junction of the Betwa and the Gogra: neither stream is here more than 30 or 40 yards in width. The Kaliasot was said by the inhabitants to spring from the Bhopál Lake. I could not believe this, as the drainage from the lake lay in an opposite direction to that taken by the Kaliasot, but after tracing up this stream I found that there was a connection between the west end of the lake and the Kaliasot, but on enquiry at Bhopál I was informed that this had been made artificially; it is an excellent escape for the waters of the lake, directly they rise beyond a certain point during the rains; during the dry months or from March to June, I should think that a considerable portion of the channel connecting the lake with the Kaliasot must be dry.

The next feeder of any note which joins the Betwa is the Hatali or Bes, which meets the Betwa about a mile and a half north of Bhelsa in sheet 12, and springs from sheets 15 and 17, which will come into the work of the following season, and winds over a course of about 33 miles in this year's work. Then the Neon which takes its rise near the Rajghati Pass in sheet 5, in which sheet about 12 miles of this stream were laid down, and about the same length appears in sheet 12 where the junction with the Betwa is effected west of the village of Sumer. For some miles before it joins the Betwa, the Neon is a river of 120 yards in width, more or less, running between banks from 30 to 40 feet above the water very little broken by ravines.

The next tributary of any size is the Baha, which enters sheet 12 near the north-west corner, and winds along, sometimes in that sheet, sometimes in sheet 10, until it eventually falls into the Betwa just below the Satalara ford, between the villages of Kanari and Nongain.

The Baha where it meets the Betwa and for some miles higher up, is a stream about 160 yards in width. When it enters sheet 12, it is not more than 30 or 40 yards in width. In the western portion of sheet 12, its banks are broken up by ravines, amongst these the shrub jungle is in places heavy, and mixed with it, but far more conspicuous, are quantities of date trees; the date trees are characteristic of almost every stream in the open tracts of this part of the country; from any slight eminence the water-courses can be marked out by the date trees. Then the Sagar enters the west side of sheet 10, near a small village called Kalna and runs from there in a general direction, a little south of easterly, until it falls into the Betwa, about a mile above the Barighat ford west of Ganj Basoda. The Sagar when it meets the Betwa is a stream of about 120 yards in width. The Sagar for the greater part of its course runs through broken ground, the banks are chiefly steep, the bed of the river rocky, and the adjoining ground is mostly covered with grass and Khair jungle.

There are other streams which have names, feeders to the above, but they are insignificant water-courses not known beyond their own immediate courses. The Betwa itself, although only about 240 yards in width, where it leaves this season's work, is in many places nearer its source nearly double that width.

Very nearly the whole of the eastern half of sheet No. 16 is drained into the Nerbudda by the Jamner and the Banne which rise within a quarter of a mile from each other near the village of Bandarchua, but before they meet, they run in courses nearly 10 miles apart; the Banne goes over a course of 24 miles in sheet 16, making its course altogether 57 miles in length.

Bhopál and Rajgurh. Country triangulated.

The country triangulated during the past season embraced an area of 2264·1 square miles, of which 651·8 were done by myself in degree sheet III at the south-western corner, and 1612·3 square miles partly in degree sheet III and partly in the north-eastern quarter of degree sheet IV, were done by Captain Wilmer. The ground triangulated by myself presented scarcely any difficulties except at the junction line between degree sheets III and V, or near the parallel of 23° north latitude, where the southern edge of the high table-land, on which the cities of Bhopál and Sehore are situated, is approached. The slope from the edge northwards is very slight, and the ground being in that part covered with thick forest jungle, and being moreover singularly wanting in peaks or small hills rising above the general run of the crest of the watershed forming the Vyndhia Range; a sufficient number

of properly connected stations of observation will not be found without a great deal of trouble and careful reconnoissance. It was for this reason that I was obliged to give up (for the present at any rate) my idea of connecting the Khanpisura and Great Arc Meridional Series by a chain of principal triangles. I may find it necessary to carry on the triangulation from north and south independently, with perhaps a junction here and there. The whole of the triangulation of degree sheet III emanates from the Great Arc Meridional Series. The triangulation in degree sheet IV was carried on over ground reported by Chaptain Wilmer to be easy for plane tabling, but troublesome for triangulation; in an area of about 1,200 square miles there were but seven or eight hills, the general character of the ground being a succession of broad low spurs running from south to north. These spurs are almost all of the same height in the same latitude, so that, it was generally impossible to obtain a platform on one which could be seen from the next spur, but one to the east or west, and if the stations had been built on each successive spur, the triangles would have been so small that trouble in other ways would have ensued. Then, too, the whole of this kind of ground is covered with high crops, until about the middle of December, and the trees, &c., around the villages enhance the difficulties for triangulation.

Memorandum on the Forts of Raisen, Bhopál, and Bhelsa, by MR. F. HAMER, *Assistant Surveyor.*

Raisen Fort.

The fort of Raisen is situated on the most prominent hill within an area of 200 square miles. Its summit stands about 500 feet above the surrounding plain, and is about ¾ths of a mile in length from south-west to north-east, and ⅓rd of a mile from north-west to south-east at its greatest width, with a precipitous ledge more or less all round the hill, and a wall varying from 20 to 30 feet in height, built above the perpendicular sides of the hill. The highest wall is at the western end of the fort (which there stands considerably lower than the north-east end), and at which end the slopes of the hill are less steep, and access more easy than at the northern side.

There are only two roads up the hill, one by the south face of the hill, and the other by the north, with three gate-ways on each road. The lowest gate-ways are about half way up the hill; they are connected with the precipitous sides of the rock by walls, so that the lower gates or wall being forced, would only be the first step towards gaining an entrance to the fort. The gate-ways on both roads are about 50 yards apart; they rise about 15 feet above the wall which is built, connecting the precipice with the lowest gate-way. Between the lower and upper gate-ways, the roads therefore pass through enclosures. Each gate-way has a massive wooden door with iron spikes, and now has a guard of three men. The way up on both sides is very steep, but broad and practicable for horses. There are 14 guns on the walls, but all in a very rusty and unserviceable state. I have been told that as many as 10,000 men occupied the hill under Aurungzebe (by whom the ramparts and buildings on the hill were built) for twelve years.

At the southern end of the fort, from the southern gate-way to nearly abreast of the northern gate-way, there is a second wall about 15 feet in height, but this wall does not entirely cut off the northern end of the fort from the southern, for there is a disconnected portion of about 150 yards near the northern gate.

There are two tanks on the hill with very good water, which never dry up. The water in the largest tank has a wide-spread repute, and I have been told that the Nawabs of Bhopál would lay a dák of runners simply for the carriage of this water to Bhopál, a distance of 24 miles. The hill, on which the fort is built, extends in a south-westerly direction for about a mile beyond the south-west corner of the fort. This portion of the hill is comparatively easy of access; guns could be brought up to the summit of the ridge without much difficulty.

This hill fort presents a very picturesque appearance, especially from the northern side, and from its height and position is capable of offering a stout defence. This would, however, be much decreased by the existence of a ridge, to which access is tolerably easy from the village of Bilour on the north-west side. This ridge is parallel to the run of the hill on which the Raisen Fort is built, and is not further than 1,400 or 1,500 yards from it, crest to crest; it is about 200 feet lower than the summit of the fort. Its value, as an availing point, would depend on the comparative value of the arms of the attacking and defending forces.

BHOPÁL FORT.

The fort of Bhopál is about 320 yards in length from east to west, with a mean width of 300 yards from north to south. It is divided into two portions separated by a thick wall, having one gate-way through it, the upper or western end being known as "Bala Killa," and the larger and eastern portion as "Fattehgarh."

The entrance to the fort is from the eastern wall of the "Fattehgarh" portion, adjoining the western side of the city within the city wall. There is another exit from the fort near

the south-east corner facing the lake, probably made to allow the garrison to get at the lake without being obliged to go through the city. Nine of the bastions or turrets have guns mounted on them; those on the northern face admit of the heaviest battery. The outer walls are about 30 feet high, and are continued round a large portion of the city. In this city wall there are seven turret gates; the fort overlooks the city, and in olden times may have been an useful stronghold; and the city (within the walls) might have been capable of strong resistance to an invader; but considering the near neighbourhood of hills on three sides of the city, and that all these hills are easy of access, the place can be looked on as imposing in appearance from a picturesque point of view only.

The survey of this city and fort, with a considerable extent of the surrounding country, having been made by this party on the scale of 12 inches to the mile, and as all the buildings of any note are specified on the plan, and also a very good idea of comparative levels can be obtained from an inspection of the plan, I do not think that any further description of this place is necessary here.

Bhelsa Fort.

At Bhelsa there is a fort, or what the natives call one, at the western side of the town, but joined to it. This fort is more strictly speaking merely a walled city of about 1½ mile in circumference, the walls being 25 to 30 feet in height. Inside the walls the Bhelsa Tehsil and Thana buildings are located, with the troops belonging to the establishment. The only hill close to Bhelsa is that of Lohangi, to which there is but one ascent from the southern side; this ascent is up a succession of steps, and passes through a tolerably massive gate-way at the crest of the hill. The Lohangi Hill touches the eastern end of the town, and overlooks the town and so-called fort completely; its summit being about 150 feet above them; there are hills 2 miles away from the western edge of the fort, between the Betwa and the Bes.

Extract from the Narrative Report of Captain G. Strahan, R. E., *in charge of No. 7 Topographical Survey, Rajpootana.*

Rajpootana, Udeypur, and Jodhpur.

Within the season's work falls the well known lake at Kankraoli on the eastern flank of the Arabulla Range, celebrated for the immense size and numbers of its fish. This lake is about 3½ miles long, and 1½ broad, and is artificially formed by a marble bund on the southern side. This bund is nearly 200 yards long and about 70 thick, and exquisitely decorated with marble arches and temples. It is, I believe, a comparatively modern work, but I was unable to obtain any authentic history of it.

Arabulla Range.

These hills are almost uninhabited, and great difficulty was found in obtaining supplies or suitable encamping ground. An important pass (or Nal in the language of the district) passes through here, called the Ganerao Nal, but so frequent are the dacoities committed in it, that twice a week the Jodhpur and Udeypur authorities send a strong guard to escort traders and travellers through it, and at all other times it is practically closed. The Bheels infesting this pass appear to have no fire-arms, but attack travellers simply with stones in the narrowest places on the road, and generally succeed in plundering them. Mr. Tapsell reports, that wild custard apples flourish here in considerable abundance. The chief trees are the Sālar and Katila. Wild animals do not seem to abound, a few bears are met with, deer of different sorts, and wild dogs; tigers are very rare.

REPORT OF THE SURVEY OF THE EASTERN FRONTIER OF BENGAL BETWEEN CHITTAGONG AND CACHAR, EMBRACING PORTIONS OF HILL TIPPERAH, AND THE LUSHAI AND NORTH CHITTAGONG HILLS, SEASON 1872-73.

From Colonel H. L. Thuillier, C. S. I., *Surveyor General of India, to the Secretary to the Government of India, Department of Agriculture, Revenue and Commerce,—No.* 4084, *dated* 15*th July* 1873.

No. 557, dated 9th September 1872.
No. 787, dated 14th December 1872.

With reference to the orders of the Government of India, conveyed to me in the correspondence received under cover of your office endorsements marginally noted, directing the completion of the exploration and survey of the eastern frontier of Bengal between Chittagong and Cachar, and embracing portions of Hill Tipperah and the Lushai and North Chittagong Hills, I have the honor to submit, for the information of the Government India, copies of the reports, as per margin, by Captain W. F. Badgley, Officiating Deputy Superintendent, Topographical Survey, employed in the Tipperah and Lushai Hills, and by Gordon H. Cooke, Esquire, Assistant Superintendent, Revenue Survey, employed in the North Chittagong Hill Tracts.

No. 199, dated 17th May 1873, by Captain Badgley.
No. 86A, dated 27th June 1873, by G. H. Cooke, Esq.

2. Captain Badgley, assisted by Mr. A. Chennell, Assistant Surveyor, after some detention in making the necessary arrangements for an expedition of such a peculiar character, entered Hill Tipperah from the Sylhet side on the 19th of December, with the object of laying down as much of the interior of the Rajah of Tipperah's territory, left unexplored by the old survey party under the late Mr. O'Donell, as could be effected, together with the north-east corner of the Chittagong Hill District, down as far as Demágiri southwards, and the Lushai country between Hill Tipperah to the west, Peak Z to the east, a well known and conspicuous hill previously fixed and determined, and the completed surveys of the previous season to the north and south, with the special view of a correct definition and demarcation between Hill Tipperah and the Lushai country, by the exploration of the Jampui and Hachik ranges of low hills.

3. By the programme sketched out and sufficiently detailed in Captain Badgley's narrative, the triangulation was carried across the abovenamed ranges of hills down to Sirthe, a point about twenty miles north of Demágiri on the Kurnafulee River in the Chittagong Hills previously well determined, and from thence the return route was made cross the Lushai Hills to Peak Z, Jalnacharra, and the Chaturchura Hill in south Cachar.

4. In this manner, and under the instructions given for the conduct of the operations founded on the experience of the former seasons in similar ground, an area of about 2,432 square miles of triangulation, and 3,587 square miles of reconnaissance with the plane table, has been accomplished on a scale of 4 miles to the inch, exclusive of necessary overlap survey on the work of the previous season, amounting to about 500 square miles.

5. This area, explored and mapped, fills a large blank extending from the Atermura Range in Hill Tipperah (longitude 91° 48′) to the Chal Fil Range (longitude 93°), and from Sirthe, a depôt station in latitude 23° 12′ to the Chaturchura Hill, latitude 24° 15′. It contains the head waters of the Dolai, Menu, Deo, Lungai, Pakwa, Gutar and Sonai streams, which flow northwards into the district of Sylhet and Cachar, the Gumti stream which flowing westwards passes into the plains near the station of Comillah, and of several feeders of the Kurnafulee River draining southwards into the Chittagong district.

6. By the combined operations of the north and south column parties of the past season, and the work now executed by Captain Badgley, we have the means of checking certain places which were doubtful on the maps previously published. The position of Bepari Bazar, on the Dellesar River, west of, and just below the well known Peak Z. which has for a long time been the cause of considerable doubt and embarrassment in reconciling conflicting authorities, has now been well determined, and is sufficiently proved that the value assigned to it by Major Macdonald, marked on the map "approximate," is considerably out of its proper place, because he did not visit it from his southern exploration, and merely fixed it by approximation derived from information, whereas Captain Badgley having visited the spot and sufficiently proved his route by careful comparisons and observations, which are wanting in Major Macdonald's results, I have no further doubt whatever of the value now assigned to it on the present compilation map.

7. The elevations of the principal ranges crossed by Captain Badgley will be furnished on his final map, and after the completion of the computations for his season's triangulation, which must take time to work out. The present report is merely preliminary.

8. Captain Badgley was well supported throughout by Mr. Chennell, Assistant Surveyor, who performed the share of work allotted to him, both triangulation and topography, with great zeal and success.

9. Mr. Gordon Cooke's party started from Demágiri on the Kurnafulee River in the north Chittagong Hills on the 3rd December, and worked southwards along the Oheepoom and Saichal Ranges to the hill of Keokradong on the Arracan frontier, about ten miles south-east of the frontier guard station of Polytai. He was quite unassisted, as the native sub-surveyor who started with him was found unfit for the arduous nature of the duties and personal risk required on this frontier, and he was able to accomplish little or nothing, having to be left behind at Demágiri.

10. The area triangulated and mapped by Mr. Cooke covers about 1,500 square miles, and forms a good connection with both Captain Badgley's work of the present season, as well as with the old survey of the north Chittagong Hill District by the late Mr. O'Donell, and with the survey by Major Macdonald of the previous season. It is drained by the Tui-Chong and Thega Khal stream. The former (Tui-Chong) flowing between the Kansaong and Oheepoom Ranges, the head waters or source being in latitude 22° immediately below the hill of "Keokradong" (north), where the ranges unite; and the latter (Thega Khal) flowing between the Oheepoom and Saichal Ranges, having its source near the Weyboong-tong hill station, at which point the Oheepoom Range connects with the Saichal Range.

11. The combined area mapped by Captain Badgley, Mr. Chennell, and Mr. Cooke covers about 5,087 square miles, and the secondary triangulation carried on from the north and from the south in previous seasons has been satisfactorily connected, so as to give a good basis to the whole of the topography laid down. The whole of this country was a perfect *terra incognita* hitherto; fully three-fourths of the area visited by Captain Badgley and

Mr. Chennell in Hill Tipperah, and on the western border of the Lushai Hills, is altogether uninhabited, and the same may be said of all the ground visited by Mr. Cooke.

12. Very interesting and full descriptions of the country and its climate, together with notes on the most suitable positions for frontier posts, are given in Captain Badgley's and Mr. Cooke's reports, to which attention is invited.

13. Both the survey parties have had to penetrate through very dense jungle, and often to cut their way step by step, and on several occasions suffered severely from want of food and water when they failed to reach the depôts of food placed at certain points at considerable expense and with great difficulty by the civil authorities; and it is due solely to the energy and fertility of resource displayed by Captain Badgley in his more difficult task, and by Mr. Cooke in his comparatively easier sphere, that the season's operations on the frontier have terminated so successfully and happily. From Captain Badgley's report it appears that Sukpilal's guides did all in their power to mislead the party when they could, and the Chief, although passive, was not deemed very friendly at any time.

14. The Commissioners of the Dacca and Chittagong Divisions rendered all possible aid to the respective surveys, and this department is much indebted to those officers for the prompt measures adopted to provide for the wants of the survey establishments and for the courtesy and promptitude with which information relating to the progress of Captain Badgley and Mr. Cooke, when they were beyond the reach of postal communication, was rendered to this office.

15. Captain Badgley was accompanied by Mr. Power, the Political Agent, Hill Tipperah, and I am much indebted to this officer for the valuable assistance he rendered, and which Captain Badgley fully acknowledges. Mr. Cooke also received ready and cordial aid from Captain Lewin, Deputy Commissioner of the Chittagong Hill Tracts, from Mr. A. V. Knyvett, Superintendent of Police, Rungamuttea, and from Lieutenant Gordon, Assistant Commissioner, Sungoo Sub-division, and for which my best thanks are tendered.

16. But the main success of the whole expedition must be attributed to the admirable measures taken by the Government of Bengal and to the energetic action insisted on by His Honor the Lieutenant-Governor, and so ably carried out in every emergency which arose during the conduct of these survey operations on the Eastern Frontier, and I have gratefully to express my sense of the very efficient and thorough manner in which I have been supported in securing aid and co-operation from local officials for these survey parties under very exceptional circumstances by the Bengal Government. The personal interest evinced by His Honor the Lieutenant-Governor in the success of the survey operations was most cheering to all concerned, and I trust the results obtained will be found fully satisfactory both to the Government of India and the Government of Bengal.

17. During the past two seasons, 1871-72 and 1872-73, the whole Eastern Frontier extending from Cachar on the north, or from latitude 25° to the frontier of British Burmah in latitude 22°, a direct distance of 206 miles, and representing a total area of 11,587 square miles, of the most difficult and inhospitable hilly country, has been geographically mapped on the scale of 4 miles to the inch, based on triangulation depending on the operations of the great triangulation of India. These materials will now enable me, I hope, to complete an entirely new map of the whole frontier, on which my establishment is actively engaged at present. This compilation will soon be available for the Government to decide on the actual line of boundary which it may be pleased to adopt on this frontier between Munnipur and Arracan.

18. In conclusion, I beg to bring prominently to the notice of Government that this is the second year during which Captain Badgley and Mr. G. H. Cooke have rendered excellent service* on these difficult frontier exploratory surveys, and they have both had to undergo exposure and hardships of no ordinary kind. They have suffered greatly from the incessant fatigue and exposure which they have had to undergo in traversing such inhospitable and hitherto untrodden ground, their labors well deserve therefore recognition on the part of the Government of India; they are both officers of known ability, conspicuous for their zeal, energy, and professional attainments, and what has been achieved will, I am satisfied, uphold the character and prestige of the Survey Department in whatever operations they undertake, or in whatever description of country they are employed.

* *Vide* No. $\frac{F}{160}$, dated 22nd June 1872, paras. 7 and 10.

19. The following maps are attached to illustrate this report :—

(1.) Captain Badgley's "preliminary map of the Tipperah and Lushai Hills." Scale, 4 miles=1 inch

(2.) Mr. Cooke's preliminary map of a portion of the hill tracts. Scale, 4 miles=1 inch.

(3.) Compilation of a portion of the Eastern Frontier of Bengal to illustrate the combined results of the survey operations and explorations in the Lushai and Tipperah Hills, South Cachar, North Chittagong Hills, and Munnipur Frontier, during seasons 1871-72 and 1872 73. Scale, 8 miles=1 inch. Colored, to show the area accomplished each season.

(4.) Ditto ditto uncolored.

20. I beg to recommend that the reports of these explorations and successful attainment of entirely new geographical materials of a highly interesting and important frontier of the British possessions in India, be published in the supplement to the Government Gazette.

21. A copy of the entire report has been furnished for the information of His Honor the Lieutenant-Governor of Bengal.

NARRATIVE REPORT OF THE HILL TIPPERAH, NORTH CHITTAGONG AND LUSHAI HILLS, TOPOGRAPHICAL SURVEY FOR THE FIELD SEASON OF 1872-73.

By Captain W. F. BADGLEY, *Officiating Deputy Superintendent, 3rd Grade, No. 6, Topographical Party,—No.* 199, *dated Shillong, the 17th May* 1873.

I have the honor to submit a report of the operations of the small party under my charge, detached from No. 6 party for the survey of parts of the Hill Tipperah, North Chittagong and the Lushai Hills.

Strength of Party.

2. The party was as follows :—

Captain W. F. Badgley, B. S. C., Deputy Superintendent in charge ; Mr. A. W. Chennell, Assistant Surveyor, 1st Grade ; Moung Hay, Sub-Surveyor, 3rd Grade.

Plan of operations.

3. The work proposed to be done by the party was the survey of as much as they could finish of the unsurveyed interior of Hill Tipperah, the north-east corner of Chittagong to near Demágiri southwards, and Lushai country between Hill Tipperah to the west, Peak Z to the east, and the finished surveys of the previous field season to the north and south ; and besides, with a view to a correct demarcation of the boundary between Hill Tipperah and the Lushai country, to furnish a special report on the Jampui and Hachik Ranges. In consultation with Mr. Abercrombie, the Commissioner of Dacca, a plan of operations was drawn up, which met with approval both by yourself and His Honor the Lieutenant-Governor of Bengal, by which the work was distributed as follows :—Mr. Chennell to fill in the gap in Hill Tipperah, clearing stations and plane-tabling southwards, from South Sylhet to North Chittagong, and then to return triangulating. Captain Badgley to visit the Jampui and Hachik Ranges, carrying the triangulation across them, to work southwards to Sirthe, twenty miles north of Demágiri, and then from thence to cross the Lushai Hills to Peak Z and Jalnacharra in South Cachar. In this way it was hoped to sketch in the whole gap of unsurveyed country above detailed, and also to cover it with a series of trigonometrical points for the after-verification of the sketch maps, in doing both of which the party has been very successful. Depôts for the storing of provisions for the party were to be formed on the Deo River at Sardeng, at Sirthe, and at Bepari Bazar.

Party breaking ground.

4. The party left Shillong on the 16th of November, and marching by Sylhet to Koilashur on the frontier of Hill Tipperah, after some little delay, on account of provisions and coolies to carry them, began work, Mr. Chennell on the 5th, and Captain Badgley on the 19th of December.

Plan of triangulation.

5. From the side Batchia to Komanatah of the Great Trigonometrical Survey, eastern frontier series, the triangulation was to be extended south and south-eastwards to meet the triangulation of former surveys in Chittagong, tertiary points being observed to as far eastward as could be from the Hachik Range, beyond which the secondary triangulation could not be carried, for which fortunately there was no absolute necessity, as there were several correctly fixed and prominent points in and round this part which were quite sufficient for plane-table work, with the addition of those to be observed from the Hachik stations.

Exertions of Members of the Party.

6. After finishing the arrangements for the equipment of the several detached parties into which No. 6 was broken up, that is, to the Naga Hills, Garo Hills, and his own detachment to the Lushai Hills, and after making over the office to Major Godwin Austen on the 12th November, Captain Badgley marched to Sylhet to meet the Commissioner of Dacca, and then on to Koilashur, arriving on the 3rd December. Here Mr. Power was making arrangements for storing a godown in the interior on the Deo River, and as soon as it was thought there would be sufficient stores at that depôt for Captain Badgley's party on its arrival, he went to the Komanatch and Sipir Hills, which he cleared and marked with signals, and from the latter through the Deo depôt to the Jampui and Hachik Ranges, the whole length of each of which he marched over, and on them cleared and marked five stations. During this time stores were being carried further up to Deo, and no

to the southern end of the Jampui Range, from which, when sufficient had been collected for the southern march with Mr. Power, he left for the Chittagong depôt at Sirthe. Thence, after a few day's rest, he crossed to the Hachik Range, and then on to Bepari Bazar and Peak Z, and thence *viâ* Jalnacharra to the Chaturchura Ridge, having finished which, he marched into Cachar on the 10th April, and arrived at recess quarters at Shillong on the 19th April. Captain Badgley cleared seven and observed at five stations, and completed about 807 square miles of triangulation and 2,574 miles of topography.

7. Mr. Chennell left Koilashar on the 5th December for Komulpoor, where he was delayed about a week engaging coolies and taking in supplies for his trip to the Lonktharai range; he cleared and marked the peaks Batchia, Sim Basia, and Feing Pui; reconnoitred the ridge southwards to its termination, and returned to Koilashar on the 28th. He left the following day for the Sakkan Klang Range, selected and cleared two stations, and marched westwards to Sardeng, cleared a station there, and *en route* the intermediate points Kohoisib X and South Lonktharai. At Sardeng Mr. Chennell having got fresh supplies started for the Dolajeri ridge, on which he put up a mark and returned, observing to South Sylhet on the 1st April, and arrived at recess quarters, Shillong, on the 9th April. Mr. Chennell cleared ten and observed at thirteen stations, and completed about 2,117 square miles of triangulation and 1,513 square miles of topography.

8. Moung Hay, Sub-Surveyor, a very promising young fellow, accompanied Captain Badgley to study surveying practically and to keep the ration accounts, for which purpose also the Jemadar of the party went with Mr. Chennell.

9. Mr. Power, the Political Agent at Hill Tipperah, accompanied Captain Badgley, taking charge of the commissariat for the party and its carriage; and the department owes him much for his active assistance and thorough management, without which the undertaking could not have been carried through. It was by his exertions that a sufficient number of the Kuki coolies who were employed to carry provisions for the party through these uninhabited or unfriendly tracts were kept to their work, and he had the storing of the depôts on the Deo, which formed the basis of the provisioning arrangements. The depôts on the Deo were supplied from Sylhet and Dacca, and others at Sardeng and Sirthe stored from Chittagong, and that at Bepari Bazar from Cachar; in these provisions were collected for the party for the season, an expensive arrangement, necessitated by the desolateness of the greater part of the country, and because the Lushais in the inhabited part could not be depended on for supplies.

Remarks on the country triangulated.

10. The hills running in parallel ridges, it was easy to lay down a plan of triangulation, and but little difficulty was found in selecting peaks on the ridges which answered the plan. Three points, Komanatah, Sipir, and Jampui, were cleared or nearly cleared for us by Kukis sent in advance, all other points by the Surveyors, parties (Captain Badgley and Mr. Chennell having each twelve khalasees and thirty Khasia coolies) and as many Kukis as happened to be in camp at the time. On the Chittagong side, poles were put up for us at Kuchet, Koteer, and Gopasuri; but these did not come into the triangulation. Mr. Chennell found no points cleared for him in his part of the work, except those already mentioned, but he met a party who had travelled down the Lonktharai Ridge, after he himself had cleared what points he wanted, who had at short intervals along it fastened slips of wood, about ten inches by two, with the word "mark" on them, to the tops of the most convenient trees for climbing up. Till January the weather was favorable for triangulation; it afterwards became so misty that no heliotropes could be employed as to make the accurate intersection of the signals,—a matter of difficulty, and very trying to the eyes of the observer.

Duration of the field season.

11. The party left Shillong on the 16th November and returned on the 9th, and 19th April.

Cost.

12. The cost of the party for the field season from November to April is about Rs. 14,940; this, however, does not include expenses on account of provisions and their carriage. The country in which the work lay being uninhabited, or inhabited by Lushais on whom we could not depend for assistance of any sort, our provisions and those for our military guards had to be carried with us throughout, thereby necessitating the employment of a large number of Kuki coolies at a great but unavoidable expense. These, with the guards, military and police, boatmen, overseers, provisions and other incidental expenses, will amount at a guess to about Rs. 25,000.

Total area surveyed.

13. The triangulation amounts to 2,432 square miles, and the topography to about 3,587, exclusive of overlap, which is 500 square miles.

Health of the Party.

14. Though two men died of jungle fever, the health of the party was generally good during the season, but unfortunately just at the close cholera had begun to show itself in the plains, and I am sorry to say that the Khasias, who appear to be peculiarly liable to this disease, lost six of their number

on the day they reached their hills. I had sent them unladen from Jalnacharra, carrying the baggage by boat, and had warned them against eating certain things and drinking too much; but precautions did not avail, seven were taken, and one only recovered; most of the cases were fatal in three hours. The Europeans of the party all suffered from disagreeable ulcers on the legs, like Delhi boils, which broke out after the first rains, which set in about the middle of March, and were probably caused by impurities in the water, the products of decaying vegetation washed into the streams by the rain.

Supplementary Report.

15. As soon as the computations and mapping of the surveys in the field have been finished, an accurate report of the areas and other points which are approximately entered or omitted in this report will be furnished. I have thought it better to make this report as full as can be, sending it, as you desire, out of the regular course, which would detain it till October next, as much of it refers to matters which Government would probably wish to decide on at once.

Description of the Lushai country.

16. The country surveyed is crossed by parallel ridges running north and south, which increase in height from west to east, gradually narrowing the valleys between them, till from a broad flat swamp of some seven miles wide between Atarmura and Batchia the ends of the spur ranges from cliffs on the sides of the Dallesar under Durklang, the peak Z ridge. These ranges also increase in height southwards from the plains of Sylhet, and northwards from the Chittagong District, till they reach their highest near the water-shed line of the rivers, running north and south, a line which west of the Ainkung makes an irregular zigzag between 23°30′ and 123°45′, not marked by any east and west cross-line range, but merely by the level of the valleys, like the level of the ridges, being a little higher than to north and south. The ranges do not join to make continuous lines from one district to the other, but lose themselves at the water-shed, the ends of the northern ranges coming in between the ends of those from the south. The hills are narrow ridges, sometimes so narrow at top as to be only knife-edged rocks dangerous to walk along, covered with forest, thinner along the edges of the ridges and spurs, and close and tangled, and often impenetrable in the ravines and the valleys, which from the hills appear as undulating plains, into which the sides of the ranges dip abruptly, and puzzling net-works of ridges of very little height, the main lines of which run in the same north and south direction as the high hills, and which are joined like them, where they do join, by low saddles not to be distinguished from these little valleys between. These tilas are higher, steeper, and more irregularly disposed near the water-sheds, becoming low, long ridges as they recede from it, and disappearing—that is, those to the north—in the swamps of South Sylhet.

Rivers.

17. The western rivers I will leave to Mr. Chennell to describe. The Deo is navigable for ten-maund boats all through the year to latitude24°. The Lungai, a clear stream with a sandy bed and good current, where I crossed it at the same latitude, had an average depth of 18 inches, and would therefore hardly be navigable so far. This stream runs directly northwards through Sylhet to the Kuseara. The other streams to the east of the Hachik Range pass through Cachar to the Barak. The first of these is the Pakwa; this is probably navigable for canoes to 23° 53′ till December. Some Lushais sent out to meet me on the Hachik, came by boat from Cachar to nearly this latitude. The next, the "Gutar," where I saw it under Raick-klang, had a rocky bed, and was quite a small stream at that season, but I am told is navigable for eight miles from its mouth. Both the streams run north, the first between the Hachik and Ainkung, and the other between the Ainkung and Rulpui, and fall into the Dallesar. This large stream, which comes from the south in the Howlong country, runs northward between the Rulpui and Durklang Ranges, bends slightly to the west to receive the Gutar and Pakwa, and then passing through South Cachar falls into the Barak. It is not navigable much above Bepari Bazar (latitude 22° 52′) on account of falls and rapids, but so far for small boats of 10 maunds throughout the year. About Bepari Bazar it is deep, narrow, and slow, running through dark pools with high rocks or steep banks on either side; further down, the hills receding further from the river, it gains in breadth, the bottom is sandy, and the banks are more open, but throughout its course are steep and not less than thirty feet high, (as is the case with all these rivers) to which or above which the stream rises during the rains, while in the dryer months it is fordable in many places along its entire course. The Sonai, which I have not seen, is not, I am told, navigable beyond Lushai Hat, about latitude 23° 55′. The Tulenpui, called in late maps the Sajjak, falls into the Karnafulee above Demagiri, and is navigable probably to where the Mar falls into it, latitude 23° 15′; all these streams are much obstructed by snags, which collecting cause banks and rapids, which make the navigation difficult by day and impossible by night. The Dallesar, again, is almost spoiled for traffic in the dry months by rapids near Kuchila.

Mr. Chennell's notes.

18. The following is Mr. Chennell's report of the country he visited, which lay between the Jampui and Atarmura Ranges and latitudes 23° 25′ and 24° 10′:—

"The whole of the area is quite uninhabited and densely covered with high forest and "bamboo jungle, with entanglements of thorny scrub, canes, creepers, and nettle, through "which it is impossible to force a passage without much cutting and clearing, excepting along

"the regularly used tracks of wild elephants, which are numerous and afford great facilities "for moving about the country, which otherwise would be almost impenetrable.

Village sites.

"I have met with many sites of old villages on the higher positions and summits "of the ridges indicated by broken pieces of pottery and "rough slates erect and prostrate, which leads one to "suppose that the country was once fairly populated; these sites are now overgrown with "high grass, bamboo, and forest trees, among which a few mango and lemon are still to be seen.

Hill ranges.

"The principal hill ranges beginning from the east are the Jampui, Sakkanklang, "Lonk-tharai, and Atarmura, presenting remarkably straight "lines north of latitude 23° 40′; while south of it they are, generally speaking, more broken and irregular; these ranges, without exception, con- "tinue from Chittagong in the south, running in a northerly direction, almost parallel "into the plains of Sylhet, where they gradually disappear. Numerous peaks stand "out above the general level, the most conspicuous being the Jampui, Sakkan, "Kohoisib, and Klang-bong-sib; the three former have been selected as stations of obser- "vation, and command an extensive view of the country. From Kohoisib, the most "southerly, the plains of Sylhet and peaks far away into Lushai are distinctly visible on a "clear day. Klang-bong is said by the Kukis to be the abode of the Great Bong, the evil "spirit of the forest, whose displeasure the ancient inhabitants had incurred, and were turned "by him into wild animals, thus accounting for their numbers in the forest. The northern "portions of the valleys between these ranges are for the most part flat, swampy, and covered "with rank vegetation, while to the south they are of a wild and broken character, intersected "by an infinity of deep-cut ravines and low, intricate, narrow-topped ridges.

Rivers.

"The drainage of the northern half of the country is effected through the Manu and "its tributaries, the Deo and Dolai. The Manu takes its "rise from the Kohoisib peak of the Sakkan-Klang range, "and for some distance passes through various narrow gorges with escarpments of naked "rock rising often 100 feet and more, and cutting into deep and clear pools swarming with "fish; as it descends into the more level country, it becomes a broad sluggish stream, "with a tortuous course, sandy bed, and low banks, covered with high coarse grass, clustered "here and there with wild plantains and dwarf palms, which furnishes a very pleasing sight; "its course is north, until it reaches the Sylhet plains, when it changes to north west.

"The Deo has its rise on the Jampui Range, 12 miles south of the Betleing Sib Peak; it "continues on a northerly course for nearly 30 miles, makes a detour to the west, cuts "through the Sakkan-Klang range of hills, and joins the Manu 10 miles north-west of the "G. T. station of Komanatah. The Dolai has its rise on the Dolajeri Ridge, from which it is "named, runs due north for nearly 50 miles, and joins the Manu near the village of Kudam- "hata in the plains of Sylhet. These rivers are all navigable up to latitude 24° 0′ for small "boats carrying about ten maunds (a couple of feet of water being sufficient to float them), "and are also utilised by the people of Sylhet during the rains, when they become roaring "torrents for floating down bamboos, thatching grass, and timber for boat-building purposes. "The country to the south is drained by the Keslong and its affluent, the Miani, which flow "southwards to Chittagong, and the Gumti, so called after the junction of its two main "feeders, the Sima and the Rima, the former taking its rise on the Atarmura, and the latter "on the Lonktharai Range. The Gumti flows in a south-westerly direction for 20 miles, and "then swerves round due west, cutting through the Atarmura Range of hills, where it passes "over a succession of rapids and falls, the most noteworthy being those at Doomra, the site of "the ancient capital of Tipperah; here it becomes a considerable stream with a large volume "of water, and navigable for boats of a large size.

Rainfall and climate.

"The rainfall here must be very great, as during March it rained almost every day, "while out of the belt of hill and forest in the plains of "Sylhet, where the average for the district is given at 120 "inches, there were but a few occasional showers. The climate was very pleasant through- "out, a couple of blankets being very acceptable at nights. As a rule, it is much colder "in the valleys than on the high ridges, owing, I fancy, to the dense foliage, through which "the sun seldom penetrates, and heavy fogs which settle down after nightfall, from which "the ridges are quite free. I found a marked change on returning to the open plains in "April, there being, I should say, a difference of at least 10 degrees in temperature.

Water.

"Water, which is to be had in abundance in the valleys, is very scarce on the "ridges. One occasionally meets with a clear spring oozing "out of the side of the hill, but, generally speaking, is only "to be found in small stagnant pools choked with decayed vegetation.

Salt springs.

"There are several saline springs in the valleys, round which are spaces trampled "down and kept clear of vegetation by wild elephants, "bison, and deer, which frequent them in great numbers "to drink the water.

Wild animals.

"Of the wild animals, elephants and bison are the most numerous; tigers, bears, samber, "and hog-deer are also to be found, and I have met with "frequent traces of rhinoceros, but never came across one. "Of the monkey tribe, there are the huluk, or black tailless howling monkey, the

"grey and common brown monkey. Of the lesser animals, a black squirrel with long "velvetty hair, measuring more than forty inches from nose to tip of tail, hedgehogs, and "land turtles, some of enormous size.

Game and other birds.

"Of game birds, there are the argus and kalidge pheasant, wood and green pigeon, "and jungle fowl, in abundance. Three distinct species of "the horn-bill are to be met with, as also a variety of singing "birds, and birds of beautiful plumage.

Serpents and insects.

"Four huge pythons, the longest measuring 18 feet, were killed and eaten by the "Kukis. Mosquitoes, ticks, leeches, and a large fly, called "the *das*, are the curse of the forest, making it almost "untenable after the first few showers of rain. The coolies from want of *proper* clothing "suffered considerably from them, and were only too glad, when the work was completed, "to get out of the country."

Botanical.

19. The entire country, except where cultivated by Lushais, is covered with forests of timber and bamboos, with undergrowth of canes and thorny plants, which tangle into impassable belts in low and swampy place, which are the favorite cover of the larger game during the winter, when they desert the hills for want of water, to return when the rains have well set in. Of timber trees and bamboos, there are many varieties, of which it is useless attempting to give a list, as doubtless the district officers of Sylhet and Cachar could furnish much better ones. Nearly all the hills west of the Ainkung and Hachik ranges are below the limit of bamboos, but there are one or two points above the line, and the tops of all the ranges to the east are so, where my men were often put to shifts to carry their water for want of bamboo "choongas" the best substitute being a water-proof sheet tied like a bag. The timber floated down during the rains is mostly used for boat-building, for which it is excellent. On deserted village sites we found lemons, with abundance of fruit of a large size, one which I measured being 5½ inches long by 13 round. In the low ground there is a harmless looking plant with large green leaves, the edges of which give a burning nettle-like sting, which lasts for two days, and is felt even on the fourth, if the part be rubbed. Water makes it worse, and nothing tried alleviated it. There are several roots for edible purposes to be found in the jungles, and the shoots of a species of cane and a small palm; the inside of the plantain flowers are good for food; it was on these that the Kuki coolies subsisted when they deserted. Mr. Power has written of our difficulties with these people, whom it was impossible to keep if they would not stay. Money was no inducement, and no amount of vigilance could keep men who brought nothing with them but the cloth on their backs.

Marching.

20. Although there are elephant tracks along every ridge, both large and small, still travelling is most difficult, even in the easiest, the north and south directions, till once the path has been well cleared and marked, when it becomes a mere matter of muscle and daylight. It took me three marching days from Jalnacharra to a point between the Chaturchura, and Hachik Hills, a distance in straight lines of about fourteen miles; but having seen the path and avoiding our blunders in going out, we returned in one day; this, however, was a most difficult bit among the low "tilas" between the two ranges. Six miles, as the crow flies, is the average which can be done on any unexplored line, and in the most favorable places that are along the ridges. In marching from the southern end of the Jampui to Sirthe, we took this rate to calculate the length of our journey, and having some heavy clearing to do in one or two places, we did less. We had only seven days' provisions and no guides, as no one had lived in the country for more than a generation, and I had to pioneer the party across. No view could be got without clearing or climbing; every spur had its misleading path; the ridge itself zig-zagged in many places in a very confusing way, and a site for the camp had to be selected wherever there seemed a chance of finding water while daylight lasted to search for it. On the morning the provisions were finished, we reached Sirthe, and found nothing there, the country was a jumble of low hills between the ends of the two ranges, Lungsir and Sirthe, and it took two days of blundering along blind-paths, searching for marks, and tree-climbing before we found the depôt, which was not five miles off, the camp starving the while; for though we got what game we could and distributed it with our live-stock, what were they, two goats and a dozen birds among two hundred empty stomachs. I think that I was right in taking the task of direction on myself, but I found it a great strain; the Kukis invariably replied—"We know nothing" to any question about the road, and I hear that Mr. Chennell, who at first trusted to them, gave them up, in favor of a pocket compass, after making a long three days' march under their guidance, and finding himself at the end only seven miles from his starting point. We were never again so hard-pushed for food as on this occasion, but four times my camp went to bed starving for want of water, and had to march next morning thirsting to search for it. In crossing from one range to another, one has either to try for the connection between the "tilas" or wade along the stream, both very crooked routes, or to push straight across over everything, which, though harder work, takes less time. The wading along stream is most fatiguing; our shortest and most difficult march was on the Gutar under Raiek-Klang, where we only managed three miles in the day.

21. Throughout the uninhabited part of the country there may be said to be no scenery, as the jungle obstructs the view entirely beyond a few yards, and from such hills as were cleared, the landscape was a mere monotonous repetition of unpicturesque, unbroken ridges. In the inhabited and higher ranges there were many points whence the views were magnificient, though the most extensive, that westwards from Hachik, which, with the range south, rises like a gigantic wall to bound the Chittagong District, was, except in extent, not at all so; it was most tame; from this greater height the hills in Chittagong and even in Hill Tipperah looked insignificant, the valleys seemed level, and the rivers were quite hidden in the jungle, the view conveying no idea of how difficult a country it was to march over. In the valleys on the streams there were some lovely bits of scenery, especially on the Dallesar. During the cold weather, and until the rains set in, in March, the climate is very pleasant; the temperature is lowest about the middle of January. During the dry weather there is a marked difference between the temperature of the hills and valleys, being in the valleys colder at night and warmer during the day than on the hills, the cold being due to heavy fogs which fill them from 10 at night to 10 in the morning. After the first rains set in about the 15th March, the valleys are clear at night, and are then hotter than the hills both by day and night, that is, in the shade, the sun in open places on the hills being fiercer than in opens in the valleys. From a few observations I found a difference of 29° between the maxima in sun and shade on the hills, but only of 23° between like observations in the valleys. The following maxima and minima are from such observations as I was able to take; minima were taken every night, but maxima could seldom be taken except during halts of camp.

Scenery and climate.

	On the hills.		In the valleys.	
	Max.	Min.	Max.	Min.
From 22nd to 31st December	72·5	59·4	80·0	48·8
During January	69·1	54·4	75·5	46·3
„ February	77·9	59·4	.....	54·1
From 1st to 14th March	85·0	60·0	85·2	52·0
„ 15th to 31st „	.....	58·2	.....	61·0
„ 1st to 6th April	86·0	68·5	.....	.....

The greatest cold we experienced in the valleys was 41°, and on the hills 48°.

22. The ridge of which Hutchet (Kuchet of the last map) is a peak, is the true Sorphuel ridge, and Sorphuel hill is at its northern end. The Kukis have transferred the names of all the ranges a range westwards, and having no names, but these traditional names which they have given to the wrong hills, it is somewhat difficult to know what to call them. This Sorphuel is the Sorphuel of Mr. Baker's expedition. He encamped on the site of the village "Arta" on a spur of Raiek, the people of which turned out to attack him, his camp being then on the Gutar, just below the village. His force had to return for want of provisions, but unfortunately left their cooking pots behind, which, with the intrenching tools, were taken by the Lushais, who considered them a magnificent prize, valuing, as they do, iron more than anything; and Sukpuilàl, to whose tribe the men belonged, and to punish whom the expedition was sent, having been after this let alone and made much of, has naturally been insolent ever since. His treatment of us was very different from that of Von-Kunga and the Howlongs (Von-Kunga, by the way, is not a Howlongs, but a Savalongs; the tribes to the east are Howlongs, those on the Chittagong border Savalongs). Von-Kunga made much of us and took us into his house. Sukpuilàl surrounded us with armed men to see that we did not come near him. Single policemen can go where they like among the Howlongs, while with a smaller guard than the thirty men we took with us, I doubt not we might have been robbed by Sukpuilàl's people. However, as he is going to move his villages. Captain Lewin, on the borders of whose district the new village is to be, will have an opportunity of putting his thumb on him. Sukpuilàl did what he could to mislead us throughout. The men sent by him to us as guides invariably tried to misguide us, and it was only by taking routes which seemed to us the best, and not those recommended by them, that I managed to lead the party to Bepari Bazar before the provisions gave out. Fortunately they had pointed out to me, while on the Hachik, the position which they said Sukpuilàl's village occupied, many miles north of where it really was, and finding out this deceit soon after, I was always prepared to disbelieve them. Mr. Baker's route can now be clearly traced from the corrected position of Sorphuel The place chosen for our godown, first set up on the Deo, was also the site of his godown.

Mr. Baker's route.

23. The hills are of sandstone, overlying a saliferous arenacious shale. The dip in the strata of the hills north of the Chittagong and Sylhet water-shed line is to the east; south of that line, where the direction of the ridges changes somewhat from direct north and south, it is inclined a little north of east, and throughout varies from 30° to 60.° There are several salt springs in different places; some of them warm. On either side of the ridge between Kanàtah and Sipir there rises a stream; both are called Nuncharra, and both at their sources are salt and slightly warm; at the southern end of the Jámpui range there is a salt spring (lat. 23° 41′) which has a temperature of 72°; at lat. 23° 28′ and lat. 23° 17′ from the Lungten range, there flow two salt springs, both cold; and about lat. 23° 37′ just

Geological.

under the true Sorphuel, I am told, there is another. That at the south of the Lungten and this last are much used by the Kukis. Sukpuilál and the more northerly Howlongs use the second, and the western Howlongs (or Savalongs) the other. The salt is manufactured by boiling down the water in cone-shaped earthen pots, made on the spot with a mixture of earth, and the clay washed out by the spring, arranged in rows over a low flat fire-place of stones and mud; it is always of a dull grey color, and from the shape of its crystals appears to have an admixture of other salts.

24. Game and fish abound.

Game, &c.

Elephants, rhinoceros, buffalo, samber, scrow, kakar, bear tiger, leopard, and pigs, among four-footed game; and for birds, kalij and polyplectron pheasants, jungle fowl, hill partridges, green pigeon of four or more varieties, and imperial and blue pigeons. There are three species of hornbill, and two of land tortoise,—all, I believe, good eating; and besides snakes—the python, a cobra, and the bamboo snake, and iguana, and two sorts of others; squirrels, porcupines, and field rats, all eaten by the Kukis. There are four monkeys, two red (one long-tailed, and one with a naked stump about 1½ inch long), a lungoor, and the howling monkey. Honey is occasionally to be found in hollows in trees, or in nests hung on bushes, the bees who build the latter being about the size of a house-fly, and stingless. The fish are all, so far as I have seen, varieties of carp; at the depôt on the Deo in three days, working for a few hours each day, 360 lbs. of fish were caught with one small cast-net, all the fish of fair size, the largest 38lbs. weight. There are many lovely birds and many lovely butterflies, and a superfluity of insects of other sorts; some of these and leeches are distracting nuisances. Not in the cold weather, but about March, there appear five varieties of horse-fly, which are almost as numerous as the mosquitoes, which also come out about the same month; one is bitten by the first all day, and stung by the other all night. Ticks attack one the season through; grass-seed and cobwebs also trouble one, and in wading in the streams a species fo scabies attack the legs. For drinking, the water should either be boiled or filtered, to rid it of the larvæ of intestinal worms.

25. There are no inhabitants in the western half of the country mapped; beyond the edges there are small scattered Kuki villages. These Kukis are not different from the other tribes, unless in being smaller, weaker, and diseased—degenerate in fact. They keep their villages clean, but are dirty themselves, wear very little clothing, or none, while in their houses, keep pigs and fowls, but no metna or other cattle. All the children I saw (and compared with the crowds of youngsters in a Lushai village, there were very few) were covered with sores, some so wretchedly so as to be scarcely able to move; all were so, from those at the breast to those of seven or eight. This comes, I dare say, from the bad position of their villages, which are on low *tilas* hardly above the line, to which the rivers must rise during the rains, and usually surrounded with swamp and approached by bamboo causeways. We had men from three tribes with us as coolies, Tipperahs, Hálams, and those we call Kukis, each speaking their own dialect, as do the other tribes (the Howlongs differing from the Lushais, and these from the Manipuris, and so on). Though they have degenerated, they still, however, retain their hardy habits, and can sleep on a hill-side on the coldest nights with a few leaves under them and a single sheet, the sheet which is their only clothing by day to cover them, and they are wonderful hands at cutting bamboo jungle, which falls before their little *dhows* like wheat before the reaper. They work well with bamboos in many ways; a dozen will build a roomy hut, raised from the ground, floored, and thatched, in a day; and on one occasion two of them, with half a dozen of my men to help, built a make-shift bridge across a stream 4 feet deep and 60 wide in forty minutes. The Haláms are the finest among these men.

Inhabitants.

26. At the bazars in the Lushai country, Bepari Bazar and Lushai Hat, a trade is carried on in India-rubber and wax from the Lushais for cornelian and glass beads, cloth, brass, and iron-pots to cook their pigs' food in (they will not use them for their own), axe-heads, dhows, &c. Bepari Bazar is a much larger place than we supposed; there must be forty houses in it, and the trade must be profitable, though the shop-keepers complain that it is falling off, and that the Lushais are getting too sharp for them. Sukpuilál has also raised his levy of black-mail. This summer he wanted a thousand rupees to buy an amber necklace, and demanded twenty-five rupees from each house; the shop-keepers remonstrated, but had to pay up, as he threatened to burn and plunder the place, unless the money was given in a week. Lushai Hat is, I believe, a much smaller bazar. They will, both of them, probably fall off soon, as the rubber trees are being rapidly destroyed.

Trading.

27. The Jampui runs directly north and south upon longitude 92° 19′, between the rivers Deo and Lungai, and, beginning at latitude 23° 40′ ends at latitude 24° 10′. Its highest point, Betleing-Sib (Sorphuel of the old maps), is about 3,200 feet above the sea by barometer; thence it decreases in height both ways. To the north it is joined by small *tilas* with a low ridge which runs into Sylhet, and to the south with the Lungtein Range of Chittagong. The Hachik, on longitude 92° 25′, between the rivers Lungai and Pakwa, begins at latitude 23° 40′, and ends at latitude 24° 5′. Its highest

The Hachik and Jampui ranges; special report.

point, opposite Betleing-Sib, is almost 3,000 feet. It is joined by low hills to the Chaturchura ridge, the boundary between Sylhet and Cachar, and to the south joins the Sorphuel range, which runs on longitude 92° 28′, and is the eastern boundary of Chittagong. The ridges are precipitous to the west, and steep to the east, generally narrow at top (from 5 to 50 feet broad), expanding a little in one or two places, where, especially if they are at the foot of a peak, there is usually some stagnant water. I found three such places on the Hachik—(latitude 23° 51′ 0″, 23° 56′ 30″, 24° 0′ 30″)—and one on the Jampui (latitude 23° 56′ 30″). Usually water cannot be found nearer than half a mile from the top, and then more certainly to the east side; in some places the springs do not show till half-way down the slope. But for the scarcity of water, stockaded posts, easy of defence, might be built on any part of the ranges. Elephant tracks run along both ranges and connect them with the others north and south of them. Water can be found sufficiently near the top to supply a camp at Chaturchura Peak, and in two places between it and the present police post on that range, and also at its south end; but there is none on the Sorphuel range, except at its north and south ends. Water is also scarce about the middle of the Lungten Range. All these ranges are thickly wooded.

28. If a line of outposts was placed on the Hachik, and if the men holding them could be depended on to do their duty, patrolling daily to meet patrols from the posts on either side some good would doubtless be done, as the best route to the South-Western Cachar tea gardens would be closed to raiding parties of Lushais, and Sylhet guarded; but as patrolling would not be kept up, and as the forest is so heavy that armies might encamp in the valleys (burning fires night and day), or pass close to a post without being seen, such a cordon would be of little use, except as keeping men near at hand to make reprisals, and the expense for carriage of provisions alone would be enormous, besides, such a system (for native officers cannot be trusted, as I found by experience at Chaturchura) would be as bad as could be devised as regards maintenance of discipline and efficiency of the men, to say nothing of exposing them and their arms to considerable and perhaps useless risk. There is a plan, if I might be allowed to give an opinion, whereby that part of the frontier would be protected, which, whatever objection there might be to it, would at least be economical. There has been and is still going on a movement westwards among the Lushai Kukis. Sukpuilál intends moving his village next autumn to the borders of Chittagong; Lallei has left Vanvong for Senvong; Poiboi has occupied Vanvong and part of Chalfil; Lal Bur and his relations are on the ranges south of Chalfil, and the whole country through which the expedition from Cachar passed last year is deserted, except Lal Bur's village of Lungvel, which is occupied by his enemies, the Sukties. All these families are now crowding on to the hills south of Cachar; and as Joom cultivation must soon exhaust these hills, they must soon again move on elsewhere. If one clan was invited to occupy Hachik and Chaturchura, and obliged, as a return for such permission, to feed a police guard on each range, I imagine that raids westwards of these ranges would be impossible, and that news of intended attacks on South Cachar would be obtained in time to prevent them. A still more effective plan, however, would be to keep a guard at Bepari Bazar. It is near the larger villages, and a strong party under an officer might be sent there at once to protect our shop-keepers; this, with another at Sukpuilál's new village, would entirely stop any aggressive acts on the part of the inhabitants.

29. If either of the ranges is chosen as the boundary between Hill Tipperah and the independent tribes, and should eventually be inhabited by the latter, there would certainly be disputes as to the ownership of the western slopes, which could not occur if a river was taken as the boundary, as the valleys would not be inhabited, nor cultivated, for many years to come; the present race of Kukis using the ridges and their spurs only, a road along either range would not be used by native merchants as long as they are now uninhabited, on account of the distance for which goods and provisions must be carried by land only. From our depôt on the Deo, which is almost as far as boats can go on that river along the Lungten and Jampui Ranges, to the river south of Pukzing (the Sajjak River of last map) is 65 miles, and from Jalnacharra (the Pakwa is practicably unnavigable), along the Chaturchura, Hachik, and Sorphuel ranges, to the same point is 75 miles, both measured as the crow flies, the marching distances being almost double.

Concluding remarks.

This country (that surveyed during the season) was not so interesting as that we saw in 1871-72. The hills were lower, the jungle too dense, and there was nothing new to see in the way of people, for even in the part inhabited they were too suspicious to allow us even to pass through their villages, except at peak Z, where there are the villages of Sukormur and Mintang's. At the former they were very friendly when I first came up, allowed me to go into the village, and gave me a place to encamp on inside their stockade, but they turned suspicious when some of my men came up late with provisions, and surrounded us with some two hundred men, armed with flintlocks, through the night. I had no one to talk to them, as both my interpreters had gone to drink in the villages, and my unfortunate camp-followers and guard, only fifteen sepoys, neither ate nor slept till I moved to my next camp next day. Should you desire a preliminary map of the survey, I request the favor of your telegraphing to me to that effect, when I will send one, though it must be a rough one, as our best draughtsmen are still in the field.

NARRATIVE REPORT OF SURVEY OPERATIONS TO THE SOUTH OF DEMAGIRI, CHITTA GONG HILL TRACTS, 1872-73.

By G. H. COOKE, Esq., *Assistant Superintendent,—(No.* 86 *A, dated* 27*th June* 1873*).*

I have the honor to submit for your information a brief report of the results of the survey operations on our Eastern Frontier, south of Demágiri.

2. Having received orders from the Superintendent of Revenue Surveys, Lower Circle, at the end of October, to proceed to join Captain Lewin, the Deputy Commissioner of the Hill Tracts and Chittagong, at Rungamuttee, with as little delay as possible, for the purpose of demarcating the boundary on the Eastern Frontier, the notice being very short, I made all speed in getting together the necessary instrumental equipment and native establishment, and started by the first out-going steamer, reaching Rungamuttee, the Deputy Commissioner's head-quarters, on 9th November. Here I found that no preparations of any kind had been made for a Surveyor to accompany the Political Officer, and was in consequence delayed some two or three weeks on account of the Deputy Commissioner being unable to supply me with provisions and necessary carriage for the whole of my party. Captain Lewin's *locum tenens* informed me that he had not received sufficient notice, and that he had only heard a short time previously that a survey party was to accompany Captain Lewin in the exploration of the country for the purpose of establishing a boundary line between British and foreign territory to the south of Demágiri.

3. The Deputy Commissioner being away from Rungamuttee at the time of my arrival there, I proceeded up the Kurnafulee River and met him at Burkal on 13th November, and from what passsed between us I saw that no preparations had been made for my party, and that it would not be possible or safe for the present to take even the small number of men who were told off to accompany me into a country where no provisions of any kind were obtainable. I decided therefore on pushing on myself with as few men as possible, leaving a Sub-Surveyor and the remainder at Rungamuttee. These were placed at the disposal of Mr. A. V. Knyvett, Assistant Commissioner, for the survey of some village lands for the resettlement of the revenue. They were engaged at this work until the middle of December, when they were ordered to join me at Demágiri, but did not reach that place until the beginning of January.

4. The actual field operations commenced on the 3rd December, when Captain Lewin and myself with a hundred men, all told, including survey party, police guard, coolies and followers, started from Demágiri on our southward course, commencing from Major Macdonald's triangulation of last year. The field work continued (with the exception of two interruptions from want of carriage) until the end of April, when heavy rain set in for several days continuously, making the mountain torrents impassable and cutting off our party from all communication.

System of survey.

5. As the country over which the survey had to pass was precisely similar to that traversed by the right column of the Lushai expeditionary force, where the triangulation and plane-tabling have to keep pace with one another, and be carried on at one and the same time, I adopted the method practised by the survey party under Major Macdonald in the late Lushai expedition, of plotting the points as soon as observed by working out their values by rectangular co-ordinates on the meridian of the nearest Great Trigonometrical Station—a most speedy and simple way, compared with that of computing points by deductions of latitudes and longitudes. By this means, starting from a given base and azimuth, I was enabled to provide myself with a sufficient number of plotted points on my board for interpolation, and taking up the detail and drainage of the country by plane-table at the same time that the triangulation was being carried on, saving me an immense deal of time, labor, hard marching, and going over the same ground twice. No method could be better adapted for a small scale survey of such a wild and difficult country.

Traingulation.

6. Acting on your letter of instructions, No. 1601, dated Calcutta, 25th November 1872 (to every clause of which I adhered as strictly as possible throughout the field season, and which was of constant service to me as a reference in all cases of difficulty), I based the whole of the topography of the country on triangulation; starting from the given base between Oheepoom No. 2 and Phooka-muin of last year's triangulation, I extended it for about 90 miles due south along the two ranges of Oheepoom and Saichul, and closed on the Great Trigonometrical base of Bhatti-tong and Lurain-tong, covering an area of 1,500 or 1,600 square miles, and giving a very fair value for the common side connected from the northern to the southern base, thereby proving the accuracy of the work both of this and last year.

7. Observations were made from 23 different stations, giving about 48 second-class triangles and about 20 minor triangles, observed merely for the purpose of fixing the position and heights of distant hill peaks to the east in the North Arracan and Shendoo country.

Heights.

8. The height of 20 points were determined by two or more observations to each station. The common value of two deductions to the same point is very fair, considering the size of the instrument used and the impossibility of clearing thoroughly the immense forest jungle that covers these vast mountain ranges. The average discrepancy between two observations to the same hill is 5 feet. In many case gaps merely were cut in the direction of the stations to which observations had to be made, the clearing of the whole hill of trees, 12 and 14 feet in circumference, being quite an impossibility with the means at my disposal. The heights of valleys, rivers, and saddles, were carefully recorded by a compensated aneroid barometer, giving very true heights, and these are shown on the map.

Description of country.

9. The country over which the survey extends comprises the three hill ranges of Saichul, Oheepoom, and Kansa-tong, with the two large rivers of Thegakhal and Tuichong, flowing northwards and draining the whole of that part of the country up to the borders of the Arracan district, and eventually emptying themselves into the Kurnafulee River. The two ranges of Kansa-tong and Oheepoom run almost parallel with the Saichul range, gradually approaching each other towards the south, until they both connect and become spurs of the Saichul Range, which is the backbone or main ridge, extending south far down the Arracan border and in those parts known by another name. The Saichul has a more gentle slope to the westward, the opposite face being very precipitous and descending several hundred feet perpendicularly; this feature extends many many miles further south. The Oheepoom range, on the other hand, is generally precipitous to the west, with a more gentle slope on the eastern face, as is also the case with the Kansa-tong range.

10. The formation of the hill ranges of this part of the country consists of sandstone and schistous clay; not a hard rock of any kind is ever met with. The Kansa-tong and distant ranges to the east are composed of a harder rock, of a dark-brown color, and evidently of an igneous formation. The valleys of the Tui Chong and Thega-khal rivers consist of a rich alluvial soil covered with immense timber. The "gurjun," several varieties of the ash, the oak, and the lance-wood, abound on these ranges; several specimens of the sandal-wood tree were also met with. The most useful and the one most valued by the hill men is the "gurjun" tree, from which a kind of black wood oil is extracted, and it is also extensively used by the Chukmas and hill men, on account of its close grain and oily nature, which enables it to withstand the heat of the sun, for making their country boats or canoes. I met several parties of the Chukma wood-cutters on the Thega-khal engaged at their trade; they all appeared to be in mortal fear of being carried off by the much-dreaded Kukis, who are said to be in the habit of coming over into these valleys for the purpose of taking captives, and many a tale they told me of how their friends had been surrounded and carried off into captivity whilst engaged at their trade of boat-making.

Outturn of work.

11. The actual ground mapped and triangulated covers an area of fifteen hundred (1,500) square miles, including the portion, to the north of Demágiri, of the valley of the Bur-Hurin-khal, which I surveyed at Captain Badgley's request. The difficulties of this country, almost destitute of inhabitants, are too well known for me to enlarge on them; and yet few people know the real extent of the hardships a Surveyor working in this country has to suffer from hunger, thirst, and weary marching, having to cut every inch of his way through the densest of forest jungle; and, perhaps, coming to the end of his "tether," miles away from his nearest goal, he finds himself and his party reduced to the shortest commons and on the brink of starvation for days together.

Routes from Demágiri to the southward.

12. The road along the Oheepoom Range, starting from Demágiri and commencing at an elevation of 1,200 feet, continues at about the same level with a very slight incline as far as Rutton Poyas Village, which is 1,300 feet and about four hours' march from Demágiri. The road from here to No. 2 Oheepoom rises by a steady incline and an easy path to a little over 2,000 feet, again gradually descending to 1,100, and, leaving the ridge about a mile to the east, crosses a small stream where a provision godown has been erected, and is about one and a half or two days' march from Demágiri. The road, now again mounting the ridge by a rather stiff ascent, from this point becomes more hilly, the inclines sharper and shorter, but more difficult, and the general features of the country precipitous, ascending and descending some 200 or 300 feet, until it reaches an elevation of over 2,400 feet.

13. At this point, a survey station, called on the map Oheepoom No. 4, has been fixed and cleared on a very sharp and prominent peak, commanding a view of the whole of the two valleys on either side and the distant hills for miles to the south. A beacon fire or the flash of a heliotrope from this station can plainly be seen from either Wey-boong-tong, Keokradong, or Polytai Guard, although the distance between the hills is not less than 50 miles in a direct line, the distance from Demágiri not being more than three or three and a half days' march. This station is also plainly visible from all the points on Sirte and to the north of Demágiri. A constant through communication could therefore be kept up by means of the heliotrope or

fires from the northernmost outpost of the Arracan frontier (*viz.*, Keokradong) to Sirte No. 1. From Oheepoom No. 4 the ridge suddenly dips, and 1½ mile to the south of that station the elevation decreases to 1,200 feet, and from this point I would recommend the boundary to cross the valley of the Thega-khal in a south-westerly direction towards a high and prominent hill feature called on the map Saichul No. 2.

14. Although the country is a good deal broken and inclined to be precipitous at this point, by following a wild elephant track which leads off the ridge, I found the descent to the Thega-khal and across to the Saichul Range anything but difficult for laden coolies. From No. 4 to No. 5 Oheepoom, a distance of some 5 miles as the crow flies, the road is good and water moderately plentiful on the hill sides, but the elevation not more than 1,600 feet, and gradually lowering towards the south. From this point, which has also been cleared for a survey station, the road becomes intricate, crossing and re-crossing small streams with high and steep banks, difficult for coolies and almost impracticable for elephants, continuing at an elevation of not more than 1,200 or 1,300 feet. This low country is completely commanded and overlooked on either side by the two ranges—on the east the Kansa-tong, lying on the borders of the Shendoo country, and on the west by the precipitous face of the Saichul Range, at this point over 2,000 feet high. Several other stations have been cleared further to the south on this same range, but there being nothing further of note to be mentioned about the remaining portion of the Oheepoom Range, except that the ridge becomes intricate and tortuous, and almost entirely disappears, and is lost to the eye in long low level spurs, shooting out for several miles in all directions (in utter confusion), and covered with immense primeval forest jungle and impassable undergrowth, and the whole of this intersected by a complete net-work of tracks of elephants and wild beasts of every kind.

15. This description of country continues until the Oheepoom range, narrowing towards the Saichul as the watershed of the Thega-khal is reached, disappears altogether and becomes connected by a low saddle with the Saichul Range, about 3 miles due east of Wey-boong-tong. The Saichul Range is easiest reached from Burkur, by going along the old road made during the Lushai expedition, until reaching a small stream called the Aibur-surra, which has to be waded about 2 miles up stream, when a Bunjoogee village, named after the stream, is reached; from here the path ascends by some sharp inclines until it mounts the ridge at about 1,200 feet, and becomes comparatively level until it reaches Saichul No. 1 (see map). Still south, for about 2½ miles, the path leads off the ridge, descends 300 or 400 feet, and crosses a small stream running south-west; then again re-ascends about the same height in a south-easterly direction, on to a flat ridge for about 3 miles, when the path, taking a turn to the westward again and lowering the elevation to 800 feet, crosses a horse-shoe formed by the junction of three small streams, all tending away to the west; this being crossed, the path ascends a spur shooting out due north from a high and prominent hill called Saichul No. 2, which is about 2½ days' march from Burkul.

16. From this station the features of the range become changed, the eastern face of the hill becoming very precipitous, and in most parts impassable for laden coolies, the slope on the western face of the ridge being more gradual. Saichul No. 2, over 2,000 feet, a cleared survey station, is situated on a round hill, the highest and most prominently marked feature of the northern part of the Saichul Range; and it is at this point that I before mentioned I would recommend the boundary to cross the Thega-khal from the Oheepoom to the Saichul Range. Water is to be found on the ridge at the foot of this hill, a short distance to the north of the station, and a small encamping ground was cleared on the spot by my party. From here the path gradually descends for 2 or 3 miles, and runs along the ledge of the scarp, on the eastern face, overlooking the valley of the Thega-khal. Water generally is plentiful, and invariably to be found in the ravines on the eastern face of the hill, which has an easy gradient. From No. 2 to No. 3, a distance of about 8 miles, the path is somewhat rougher and more broken.

17. From this point the road continues about S. S. E., with little change, excepting that one or two sharp ascents are met with, but quite practicable for laden coolies or even elephants the whole way from Burkul. The ridge from here still continues at an elevation of about 2,000 feet, until it reaches a hill two miles N. E. of Wey-boong-tong in lat. 22° 11′ N., long. 92° 36′ E., about eight marches from Burkul, and it is between this point and Polytai Guard, the easternmost police outpost of the Sungoo Sub-division, where any difficulty is experienced in the route. The country about here becomes exceedingly precipitous and wild, and the marches from Wey-boong-tong H. S. to Polytai Guard Station, crossing the valley of the Ryug Kheong, are very trying, and the ground in some parts dangerous and practicable only for hill coolies.

18. This portion of the road, which must necessarily be crossed to make the communication with the Sungoo Sub-division complete, is of no great distance, and might, with a little labor, be very much improved. From Wey-boong-tong No. 1, which is a continuation of the Saichul Range, the road still follows the ridge due south, descending 1,200 feet in a distance of a mile and a half to a low saddle which connects the northern end of the Keokradong Range with the Wey-boong-tong hill. From this point the road again ascends to an elevation of 2,300 feet, and keeping along the ridge and following a broad flat elephant path gradually rises to a height above sea-level of over 3,000 feet, where a survey station has been cleared and a prominent single tree left standing as a mark; keeping to the ridge, the road still traverses along the eastern ledge of the scarp with a comparatively gentle

slope to the west, increasing the height to over 3,500 feet until Keokradong hill is reached. To the east of this hill the Karama Kheong takes its rise, and flowing in a south-easterly direction, joins the Kola Khal, which again joins the "Koladyne" and flows down past "Tulukmai." The difficulty of opening a line of communication from the junction of the Kurama-kheong above-mentioned to the Keokradong hill would not be great, and by establishing a post at Keokradong the line of communication betweeu Demágiri, Tulukmai, and the Sungoo valley, would be complete.

19. With regard to the qualification of the different hill peaks on the Oheepoom and Saichul Ranges as to water, commanding position, natural features of the country, and facilities for telegraphic communication, I would recommend the following:—

Outposts.

Principal Posts.		Direct distance from Demágiri.		Approximate distance by the road.		
1	Oheepoom ... ... No. 2	8 miles	...	14 miles	...	Chittagong District.
2	Oheepoom ... ... „ 4	21½ „	...	34 „	...	
3	Saichul ... ... „ 2	30 „	...	50 „	...	
4	Saichul ... ... „ 3	37¾ „	...	62 „	...	
5	Ryungtong*	47 „	...	77 „	...	
6	Weyhoongtong	56 „	...	92 „	...	
7	Keokradong	65 „	...	107 „	...	
	Kurama river	Arracan	...	16 „	...	
	Tulukmai	26	...	20 „	...	
	TOTAL ...	91		143		

20. The wild and trackless country between the north-east and south-east of Polytai Guard has, no doubt, been the "rendezvous" of all the raiders of the Sungoo valley, and it is at this point that the strongest and closest outpost would be required, both on account of the difficulty of that part of the country, and on account of its being the nearest approach to some of the most prosperous villages on the Sungoo river.

21. The two principal rivers are the Thega Khal and the Tui Chong; the former, flowing northward between the Saichul and Oheepoom ranges, drains the whole of that valley, an area of some 300 square miles, and empties itself into the Kurnafulee, 3 miles south of Demágiri. This river is navigable for the smallest kind of boats for about 30 miles from the junction, and should outposts be established on Oheepoom, might be utilised for the carriage of provisions at least as far as station No. 4, where the boundary should cross the valley of the "Thega Khal." The Tui Chong is another large river flowing towards the north, and carrying off the drainage of a valley of some 400 square miles between the Oheepoom and Kansa Tong ranges, and joining the Kurnafulee a few miles north of Demágiri. This river has many rapids, and the smallest kind of boats cannot be taken more than two days' journey up its source. Elephants, rhinoceros, deer, pigs, and other games abound in these valleys. There is also another large river called the "Phyrang," flowing between the Lungman and Lung-Siu ranges, and from its size appears to drain a considerable area of country, but its source has not been explored nor is it navigable.

Rivers.

22. The following documents and maps will be submitted with the report:—

1. Preliminary map, showing the routes marked and outposts.
2. Fair map of the country, adapted for photography, for final record.
3. Chart of triangulation.
4. Angle book.
5. Computation of triangles and deduction of latitude and longitude.
6. Computation of heights.

23. The coolie carriage I was able to obtain was exceedingly limited, and I can safely say that my area would have been at least 500 square miles more, had I obtained sufficient hill coolies to enable me to extend my tours to a greater distance.

Carriage.

The difficulty of obtaining free coolie labor in the Chittagong hill tracts is immense, and unless men are pressed they refuse to serve as coolies. For any future survey operations that may have to be carried on in these parts, I would strongly recommend the officer in charge, if possible, to import his coolies from another district, and not rely on the local labor.

Elephant carriage in these hills, except on made-roads and at the base of operations, is useless.

24. In conclusion, I must gratefully acknowledge the kind and cordial assistance I received from Captain Lewin at Demágiri and from his *locum tenens*, Mr. A. V. Knyvett at Rungamuttee. I had necessarily to rely on the local authorities for everything, and it

* Ryungtong station is situated about a mile to the west of the road, but there is a cleared Survey Station about three miles to the south of it, which would perhaps be better adapted for an outpost, as it is situated on a more commanding position.

is solely due to the ready assent they gave to my numerous requisitions that the survey operations were so successfully carried on.

25. I must also especially bring to your notice the willing help that I received from Lieutenant Gordon, the Assistant Commissioner of the Sungoo Sub-division, who spared himself no personal inconvenience in his zeal to forward the wishes of Government with regard to the survey operations.

REPORT ON SURVEY OPERATIONS IN THE GARO HILLS DURING FIELD SEASON 1872-73.

By LIEUTENANT R. G. WOODTHORPE, R. E., *Assistant Superintendent, Topographical Survey, on special duty.*

I have the honor to forward my report on the operations connected with the survey of the Garo Hills.

2. It is unnecessary in this report to enter into any historical account of the causes which led to the sanction by the Indian Government of a small expedition against the lately independent Garos; suffice it that such sanction was given in August 1872, and orders were in consequence received by the Officer in charge of No. 6 Topographical Survey Party to tell off a detachment to accompany the police, and, taking advantage of their protection, to penetrate into the hitherto unexplored portions of the Garo Hills and fill up the ugly gap existing in all the maps of the North-Eastern Frontier.

3. The party told off for this work was composed of the officers and surveyors mentioned in the margin, with a small establishment of Hindustani kalassis.

Lieutenant R. G. Woodthorpe, R. E., Assistant Superintendent in charge.
Mr. W. Robert, Assistant Surveyor.
Shah Nasirudin, Sub-Surveyor.
Dahludin, ditto.

4. To relieve Captain Williamson, whose resources would be taxed to the utmost to provide carriage for the police, &c., I was directed to provide a sufficient number of coolies from the Khasi Hills for the carriage of the baggage and supplies of the whole party, which I accordingly did, and we were ready for a start by the 23rd October.

5. Just before leaving Shillong, I received a letter from the Deputy Commissioner of the Garo Hills, giving a sketch of the proposed movements of the police. This force was to be divided into three columns—one, under Captain Davis, to proceed into the hills from the north, starting from Goalparah and entering the hills at a place called Nibari, immediately south of which the independent territory commenced, and working south and south-east to a village on the Semsang river called Rongrongiri; the second, under Mr. Daly, starting from Shooshung Doorgapoor, in Mymensing district, was to be employed at first in passing up supplies to Rongrongiri, where it was proposed to form a central depôt for russud, and where all three columns also were to effect a junction; the third or main column, under Captain Williamson, was to start from Tura, and, working slightly north-east and east, also make for Rongrongiri. Captain Williamson recommended that a surveyor should be sent with Captain Davis from Goalparah, and though he supposed that in the first advance, *i. e.*, till the junction was effected, but little more than route surveying could be carried on, yet the advantages of sending a surveyor with this column were obvious, as he would be able to give me an idea of that part of the country, and find out what hills were likely to prove suitable for triangulation, and at the same time avail himself of any halt or check to use his plane-table when practicable; I therefore deputed Mr. Robert to accompany the Goalparah force, intending to go myself with Captain Williamson, in order that I might make with that officer, in person, all the necessary arrangements for the prosecution of our work. The Shooshung column, working at first through country already finally surveyed, did not require a surveyor with it.

6. The party left Shillong on the 23rd October for Gowhatty, where I expected to find boats to take us on at once. A certain number had been collected by the Deputy Commissioner in accordance with a request I had sent to that officer, but before our arrival some of them had decamped, others had been bored by their boatmen to render them unfit for transport of human beings. Few boats comparatively go up to Gowhatty, and these not very large, and notwithstanding our efforts we were unable to get together a sufficient number. However, a steamer coming in on the 3rd November, I determined to take the party down in her, and we left Gowhatty on the 5th, arriving at Goalparah the next day. Here I learnt that Captain Davis was not expected for some time; so that Mr. Robert would thus be enabled to visit at least two, if not three, of the G. T. S., *viz.*, Ajaghar, Dabli, and Gorkhar, which are situated in the Goalparah district, along the northern boundary of the Garo Hills, and which it would be safe to visit with only two or three policemen as a guard. Mr. Robert was detained in Goalparah for a few days making the necessary arrangements for a start, and then in the next fortnight he succeeded in visiting and erecting signals on all three points, at the same time fixing several points within the hills which afterwards proved very useful, and enabled him to carry on his plane-tabling simultaneously with the advance of the column. He had to wait some time at Nibari before the arrival of Captain Davis, and he employed this interval in getting in as much of the country around from the low hills in the neighbourhood as he could without risk to himself or party.

7. In the meantime I continued my journey down the river to Singmaree, a steamer station on the right bank of the Brahmaputra, where we arrived on the afternoon of the 7th November, and the next day, procuring boats, we started for Mankarchar, a police thannah on the banks of the Kalu, a tributary of the Brahmaputra, which rises not far from Tura in the Garo Hills. Owing to the large number of sand-banks, called "churs," in the river, the course taken by boats proceeding to Mankarchar from Singmaree and *vice versâ* is very circuitous, and we did not reach the former place till midday on the 9th. While at Goalparah I heard from Dr. Briscoe, the officer charged with the medical arrangements of the expedition, that cholera had broken out among the Nepalese coolies assembled at Tura, and I was unwilling to take my large camp up there till I had communicated with Captain Williamson, especially as sickness had appeared among my Khasias owing to the, to them, unaccustomed heat of the plains and confinement on the steamer, aggravated probably by the temptations of the bazar, which they were not able to resist during the unavoidable delay in Gowhatty. I therefore despatched a messenger to Captain Williamson immediately on landing, and fixed my camp at Mankarchar to await his reply. While waiting here, I went with Nasirudin to the old H. S. of Rambola Tari, about five miles away. It is a very low tila, but we were able to identify from it many of the points given us, such as Rangira, Durama, &c., previously fixed by triangulation, and also to determine the compass variation. During the interval I also made a route survey of part of the road to Tura.

8. Early on the morning of the 13th Captain Williamson arrived from Tura, having ridden in a distance by road of about thirty-three miles, and he then detailed his proposed plan of operations, and we discussed the best means of furthering the objects of the survey during the first part of the season, subservient as they then must needs be to political or military exigencies. He also assured me that cholera had left Tura, and that I might safely proceed there, and then went on to Roohoomari, a place on the left bank of the Brahmaputra, about six miles north-west of Mankarchar, to catch the Government steamer taking up Captain Davis's police, and to go in her to Goalparah. On the 14th I started for Tura, leaving behind Daliludin and a few men who were unable to march, and arrived the first night at Putimari, one of the great hâts or market-places which encircle the Garo Hills at their foot.

9. The next day I made a short march to Harigaon, intending to visit Rangira H. S. I sent for the Lukma (headman) of Buripara, the village nearest to the mark, but hearing from him that the pathway had been choked up and the old clearing overgrown with low jungle, I determined to continue the march to Tura, and reached that place on the afternoon of the 16th. Here I found Mr. Cawley, Deputy Superintendent of Police, who at once sent off instructions to the Lukma of Buripara to clear Rangira, and erect a signal over the old mark without delay. The 17th was devoted to office work and on the 18th I visited Durama H. S., but found that it would be of very little, if any, use for the triangulation, owing to the long level spurs and high knolls, all densely covered with large forest trees, which surrounded and even rose above it on three sides; the fourth being that looking towards the plains. Long rays of a mile each would probably have to be cut through these trees to make the station visible from the north. I erected a high platform on the old spot, but even this was of no avail,

10. As Captain Williamson did not meditate a start from Tura before the first week in December, I determined, if possible, to visit the hill stations of Nokrek and Mimanram, and left Tura for that purpose on the 19th. We crossed over a very high spur from Durama, a point which (afterwards called Duragiri H. S.) at once presented itself as a favourable spot, from which, and also from Rangira, I should be able to fix a few prominent features of a hill range running east and west, which for convenience' sake may be called the Watrigiri Range, no special name being given to it by the Garos. This range ran parallel to, and north of, the proposed line of march. I would also fix points on the Arbela Range from the same two stations; this was a high range we should have to cross. The first night we stopped at a village called Macholgiri, situated on the Kalu river not far from its source, but which owing to the many rivulets which flow into it from the steep spurs of the Tura range, is here a considerable stream flowing noisily over rocky boulders. Most of the male inhabitants turned out on our arrival and cleared a large space on the bank for the camp, bringing firewood, &c., with ready cheerfulness; and the next day Sollunga, the Luskur, accompanied us to Ramphagiri, a village on the west bank of the Semsang, about three hours' march from Macholgiri. The path wound about considerably through thick and high grass jungle and along the beds of small water-courses, a favourite pathway with Garos, coming out occasionally on to patches of cultivation on small rounded hills, on each of which I was able to fix myself and do some work. I found, to my surprise, that my fixings of Macholgiri and Ramphagiri were each more than six miles north of the positions assigned to them in the published reconnoissance map of the Garo Hills; and hearing that the independent villages were on the Arbela Range, thinking also that perhaps I might have got further north owing to the error in the maps than had been anticipated when I started from Tura, I hesitated, in the face of the expedition, to precipitate matters and risk a collision (though my guard would have been quite strong enough) by ascending the Arbela hill which was within easy reach from Ramphagiri, and remained in that village, proceeding the next day to Mandalgiri. The path, rising suddenly above Ramphagiri, runs along a high spur, from which I was able to get several fixings, and also from a favourable patch of cultivation near Mandalgiri.

11. I now found that the route we had taken, being so different from what it appeared on the map, had occupied more time than I had expected; also, that Mimanram and Nokrek would be invisible from Rangira and Duragiri, and that the rest of my time before the Expedition started would be best employed in fixing as many points as possible from these two latter stations. No path exists by which Nokrek may be approached from the north, and, as in the case of Durama, and for the same reasons, it was useless for my triangulation. The next day therefore, starting from Mandalgiri early in the morning, we crossed the Semsang near its source, and ascending a very steep spur, our path followed up the ridge to a dip in the Tura range. This path the Luskur of Ramphagiri, Toza, who was our guide, informed me was a road much used by the Garos proceeding to the hâts in the plains; but threading its way through a maze of mighty trunks and tangled creepers, and covered with fallen leaves, it was almost imperceptible to me, and even Toza himself hesitated occasionally as to its direction. The gloom of the forest was very great, and it was not till late in the afternoon, when we crossed the range and began to descend its southern face, that we got a glimpse of anything more than sky. We did not arrive at a favourable camping place till late; we were marching nearly the whole day without meeting any water; the heat was very great, and the coolies rather distressed in consequence. The next day, at noon, we reached Tura, and I saw that the signal had been put up on Rangira. The platform had also been erected on Durama, and on the 24th I visited the latter with the result already mentioned. On the 25th I sent heliotropers and coolies, with a blanket and some provisions, down to Mankarchar, and went out myself to Duragiri and erected a signal there; and the following day, Captain Williamson (who had returned to Tura on the 23rd) having kindly laid a dâk for me, I rode down to Mankarchar, and the next morning, going out early to Rambola Tari, I tried to observe at Rangira and Duragiri.

12. Unfortunately clouds hung over the hills all day, preventing the heliotropers working, and the distances were too great to make out the signals with the small theodolite. I would not spare more than a day at this place, and in the evening rode back to Harigaon, where I found my camp, and very glad I was, for owing to the carelessness of a kalassi at Mankarchar, the rats during the night had eaten up what should have been my breakfast and tiffin. On the 28th I observed at Rangira, and returned to Tura on the 29th. The column could not start from there till Captain Williamson had received intimation that Mr. Daly had got well on with the stores towards Rongrongiri. This intimation arrived about 3rd or 4th December, I think, and a start on the 7th was decided on. In the meantime I was employed in observing at Duragiri, Tura, and N. W. Tree, and in improving and extending my plane-tabling in the neighbourhood of Tura; also in arranging for guards, &c., for Nasirudin, and starting him on his half-inch scale work.

13. I left Tura with my party on the 6th December, preceding the police as far as Selbalgiri, working along the road. Captain Williamson, with Mr. Cawley and the police, arrived on the 7th, and the 8th was spent in visiting certain independent villages within reach from Selbalgiri, and the whole camp moved forward on the 9th to Kiragiri, passing through Alogiri and Gondengiri, two villages which submitted on our approach. In the latter we were told that the Garos were ahead in force intending to oppose our progress. We, however, arrived at Kiragiri without seeing anything more formidable than some fine peafowl, several of whom died a violent death. On the 10th we proceeded to Tongbolgiri, and arriving early we explored the country south and east towards the valley of the Semsang. The next day we reached Dilmagiri (dilma, "big or principal;" giri, "village"), the great stronghold of the independents, which was supposed to have given the signal for all the raids, and where it was expected the Garos would make a desperate stand. Not a Garo was visible on our approach however, and our entrance was peaceably effected. The village is prettily situated on the banks of the Rongrete, an affluent of the Semsang, wooded hills rising up on either side, and the houses scattered up and down most picturesquely among the trees. No stockade defended the approaches, and they were but slightly "*panjied.*" At the principal entrance, however, was a remarkable erection of symbols, by means of which oracles had been consulted as to the success which should attend any attempt at opposition the Garos might make. A tall forked post bore a decapitated goat crucified tail upwards; below this, one on either side of the path, stood two bamboo machans, on each of which reposed a life-sized figure of a man, made of brushwood enclosed in bamboo basket-work, with a small crown of bamboo round the forehead. The figures were well constructed, the different parts of the human form being fairly represented. Many large sharp-pointed stones, having small circlets of bamboo round the tops, stood upright in the ground close by. An immense number of bamboo spears, intended originally for defence, were planted round the symbols. In default of more formidable enemies, the Garo constables and tame Garos with us cut up the symbols, especially the figures, with great fury.

14. A halt of one day was made at Dilmagiri in order to explore the fields in its immediate neighbourhood. Captain Williamson was anxious not to delay too long on the way, as he expected to meet both Captain Davis and Mr. Daly at Rongrongiri about the 17th, and considered that after a junction had been effected and a consultation held, a better course of action could be decided on than by each column moving about independently of the others. While we were foraging about among the Dilmagiri fields we suddenly came upon a body of Garos, who were so astonished at our unexpected appearance that they retreated precipi-

tately with hardly any show of resistance. A few "*joom*" houses were burnt, and their store of grain destroyed as a warning, a certain amount of rice being carried away; and a large number of pigs were caught by constables and coolies.

15. A large consumption of pork took place that evening with the saddest results, as cholera broke out among two coolies who had gorged themselves with the half-raw flesh; two of the friendly Garos, of whom about 150 were with Captain Williamson, being among the victims. This had a dispiriting effect on the rest, many of whom returned to their villages. Fortunately the outbreak did not last long, and few men were lost. On the 13th we reached a place called "*Sarramphang Hât*, a level piece of ground on the Semsang, where a large market is annually held under the trees called by the Garos "Sarram" tree; hence the name, "the hât under the Sarram trees." It was reported in the evening, when the rear guard had come in, that a Goorkha cooly having found some Garo liquor in a village, Ronghakgiri, on the road, which had evidently only been deserted that morning, and having succeeded in concealing himself in the long grass jungle which bordered the narrow path on either side, had been left behind. It was no use to send back for him that night, and no doubt was entertained as to his fate, which we afterwards learnt was this. Having separated himself from his comrades, and allowed the whole line to pass him, he apparently had some idea of proceeding towards Tura, or probably in any direction rather than that taken by us; but overcome with drink he lay down in an open place. Here he was found by some Garos, who at first imagined it was some trap on our part, and, suspecting an ambush, ran away; again they came back, again retiring, till at length, satisfying themselves that all the other invaders had passed on, they rushed on him as he was resuming his journey, and despatched him with a blow of a "*dao*." His skull was brought in to Rongrongiri; when the Dilmagiri men submitted it to Captain Williamson, and it bore the mark of a severe cut inflicted from behind. Other coolies tried to run away at various times (none of my Khassias I am happy to say), some succeeding in returning to Tura; but no others met with similar fate.

16. To return, however, to the camp. During the evening several elephants attempted to enter it, the place being apparently a favorite resort of theirs; and several shots were fired before they could be induced to retire. On the 14th I accompanied Captain Williamson to Rongrongiri, which proved to be about three miles from our camp. Here we found Mr. Daly encamped in an open cultivation commanding the river; a rough stockade surrounded the huts and russud godowns. His column had reached Rongrongiri on the 9th, and found the village deserted. The next night the Garos burnt it, but made no demonstrations against the camp till the 12th, when at midday, after great shoutings, intended to instil fear into the minds of the police, they rushed from out the cover of the forest towards the camp; the police received them with a volley which knocked over three of them, and they retired behind some breastworks of wild plantains they had erected, but which hardly proved bullet-proof. They made one more assault, which was, of course, equally unsuccessful, and retired across the river, threatening to bring reinforcements; they did not return however. We returned to Sarramphang Hât in the afternoon, and there the camp remained till the 17th, to allow of a good path being opened to Rongrongiri, and to give time for a space to be cleared for us adjoining Mr. Daly's camp.

17. When we arrived at the latter place, we expected to get tidings of Captain Davis, or to see him there. I was very anxious to hear of Mr. Robert, of whom I had no news since I left him in Goalparah. No tidings, however, had been received by any one, and the independent Garos, who came daily, knew nothing about the movements of the Nibari column. So on the 19th I accompanied Captain Williamson to Samshangiri, which he wished to visit *viâ* Bongongiri. About 12 noon, just as we were leaving the latter village, a violent earthquake, which must have lasted quite half a minute, occurred, the severest I have ever felt, and second only in violence, as every one declared, to the shocks of the great earthquakes of 1869. I managed to get some work on the road, and on the 20th, getting some "*dugouts*" from the village, we explored the river southwards, returning by river the third day to Rongrongiri. I found that Daliludin had arrived from Tura, where he had been left when the force started on account of continued illness, We learnt that the guard taking the dâk into Tura had been attacked passing through Dilmagiri, but had beaten off the Garos. At the entrance to this village the unfortunate Goorkha coolie before mentioned had been sacrificed, and the guard saw hanging up on a pole the lower jaw of the wretched man and also his scalp.

18. Captain Williamson was meanwhile employed in receiving the submission of the chiefs of the surrounding villages, and huts, godowns, &c., surrounded by a slight stockade, were erected on the site of the burnt village of Rongrongiri, a most admirable defensive position on the top of a rocky mound overlooking the view, with a precipitous fall on the waterside and descending steeply on the other three sides, which were cleared of jungle and thickly "*panjied*," rendering sudden assault impossible, and in the remarkable absence among the Garos of any missile weapons beyond stones or bamboo spears, no other danger was to be feared.

19. On the 1st January, receiving tidings of an attack by Garos on the russud depôt at Bengal Katta, a post on the extreme north-west of the Garo Hills, in which it was re-

ported the police guard had been cut up, Captain Williamson despatched Mr. Daly in that direction *viâ* Dilmagiri, Kiragiri, Watrigiri, Baljekgiri, &c., and I detained Daliludin to accompany him to erect a signal on the hill above Watrigiri, and fill up as much as he could of the country till he came into the moonshi's work, when he was to rejoin me at Tura. On the 2nd Captain Davis and Mr. Robert came in. The latter had managed to get in about 400 square miles of country in spite of many difficulties. Captain Davis had also done very good work in the reduction of some twenty-five or thirty villages. In the course of his wanderings he had been twice attacked, once at night when encamped in a village called Dukhigiri. Having failed to induce the villagers to go in during the day, he sent out the police, who found and made prisoners of several women. The Garos, resenting this proceeding, assembled at night and attacked the camp by throwing in stones; some of them tried to creep up to the sentries and others under shadow of the houses, with the view of cutting them down, but they were detected and made prisoners. Among them was the headman who afterwards submitted.

20. The next morning the villagers were dispersed, the police capturing two small cast-iron guns, curious little things, the bore being about 12 inches long and say ¾-inch diameter, each furnished with a long iron tail and sharp end. This is stuck in the ground at the required angle and the gun fired off. These are only used at festivities, not being intended, as indeed they are utterly unsuited, for offensive purposes. Again, on leaving Sinai one morning, the Garos suddenly attacked the coolies, but a volley or two dispersed them. On this occasion Mr. Robert had a narrow escape, as he remained behind working in the village, to which the police had set fire, and into which they were also firing. Mr. Robert thus found himself in a critical position, cut off from the column by the burning houses and shots of his friends, and surrounded by the Garos; he, however, managed to rejoin the former by creeping cautiously through the jungles which encircled the village.

21. It is principally owing to delay in the early part of the season that the survey party did not return to Shillong early in May, instead of the middle of June, by which additional expense was incurred to the Government. The 2nd, 3rd, and 4th January were spent in inspecting Mr. Robert's work and in making the necessary arrangements, in consultation with Captain Williamson, for carrying on the work. Captain Williamson also wrote out some instructions concerning the survey for Captain Davis's guidance, as that officer told us that when he first saw Mr. Robert at Nibari he wondered who he was, never having received any instructions about him, a statement which took us all by surprise.

22. The future plan of operations decided on was as follows. Captain Davis was to proceed leisurely towards Gahal, another russud depôt north-east of Rongrongiri, allowing Mr. Robert time to erect signals at Moungrhi and Sokadam, as he had said on arrival that he had twelve days' supplies with him. On the 4th, however, Captain Davis said he had no russud whatever, and that he should be obliged to go into Gahal at once. He allowed Mr. Robert a guard to go to Moungrhi, but directed him to join his column at Nokrek on a certain day, which did not allow time for him to superintend all the clearing himself which he left to the Garos to complete, and thereby necessitated two visits for me later on.

23. Mr. Robert having managed to get about 90 square miles of country in, rejoined Captain Davis on the 10th, and was informed that scarcity of russud would necessitate a hasty march to Gahal; and he was not allowed a day's halt nor an independent guard in order to ascend Sokadam Hill, from which he could have intersected points already seen from Moungrhi in the direction of Gahal; the consequence was that the march to that place lying through low ground, and the high range of Sokadam shutting out all previous points, Mr. Robert was obliged to close work as soon as he left Nokrek, instead of getting in about 250 square miles by the way. It took the column five days to reach Gahal, the last march, notwithstanding the necessity for haste, being only two miles; and on arrival there it was discovered that there were still three days' provisions for the whole force. Had Mr. Robert had a few points fixed in advance, he would therefore have had ample time for sketching country at each halting place. A good ten days' work was thus lost. Through Mr. Scanlan, the police officer with Captain Davis, Mr. Robert got detached for eleven days, and did about 160 square miles in the direction of Gahal, Jeera, and Moungthrim, clearing and erecting a signal on this latter hill, which proved admirable point for the triangulation. Here for the present we may leave Mr. Robert.

24. On the 5th January, having seen Mr. Robert in a fair way for starting to Moungrhi, I left Rongrongiri for Mimanram with Captain Williamson and Mr. Cawley, and encamped about two miles from the old H. S., to which no path existed; fortunately the Garo interpreter had some idea of its whereabouts, and the next morning, sending on the camp to Farrangiri, we tried to cut our way up to the mark. Tall trees shut out all view of anything beyond them, and it was not till after three hours of dispiriting tramping about steep hill sides that at length a man, who had been sent up a tree, discovered some signs of the old signal, and another hour's cutting through a most tangled mass of creepers, long glass, and very small bamboos, brought us to the point. The signal had fallen down and the old poles were too rotten and bamboos too far to think of erecting another there, and as none of points I wanted in the inner hills had been cleared, we descended to Farrangiri. The next day I visited Emangiri with Captain Williamson, who wished to have a route survey from that

place through to Rongrongiri, this being part of the intended road to be carried from Shoo-shung Doorgapoor, through the Garo Hills *vid* Sokadam, and Thapa to Goalparah.

25. I found a very satisfactory way of conducting route surveys when accompanying a line of march. It was as follows. Just before starting I compared the direction of my shadow with several bearings of a prismatic compass, and on starting took the general direction of the road with a compass, and also all great changes which afterwards occurred during the march, as well as rays to any known points. All minor changes I obtained by watching my own shadow when the sun was behind me, and that of the man in front when the sun was before me, and whenever a halt was made, I checked the direction of my shadow again to find the variation due to the sun's motion at different periods throughout the day. A little practice soon renders one almost independent of the compass, and I would generally guess a bearing within 2° or 3°. This difference in short distances when plotted on a small scale, say one inch = one mile, is of no importance. Of course for long distances, for instance anything over 200 or 250 yards (which, however, seldom occurs in jungly country), compass bearings should he taken to ensure accuracy. To find the distances, I noted the times of traversing each by a watch with a second's hand, occasionally pacing 100 yards to find the rate of going, all halts or checks of course being noted also.

26. By this system a frequent stoppage of the whole line in rear in a narrow path, from which it is perhaps impossible to step aside while taking compass bearings, is avoided. The compass is much affected often by the proximity of riflesand bayonets; this difficulty is also got rid of. The changes in the direction of a jungle path are very frequent, and observations of shadows enable one to determine whether the direction of a path really changes or only alters for a few yards, resuming the old course again. Accurate measurements by pacing can only be obtained by keeping up a continuous steady walk, which it is impossible to do on a line of march; but I found by repeated trials that the rate of a column does not vary nearly so greatly as the pace of any one individual in it, A good deal of practice is necessary to get accuracy in steep ground, but in tolerably easy country, I found I could obtain a very fair amount of accuracy without much difficulty. That this method cannot be practised when the day is cloudy, is not a serious objection, as during the cold season sunny days are in the majority, and jungle is seldom so thick as to prevent all indications of one's shadow.

27. This is, however, a long digression, and I return to Farrangiri, which we again left on the 8th, and visiting Mimanram on the way to point out to a Garo from a neighbouring village the position and kind of mark which Captain Williamson had ordered the Garos to erect for me, we reached Rongrongiri that evening. Here we heard that Colonel Haughton was very ill at Tura, and wished to see Captain Williamson as soon as possible; also, that there was no truth in the report concerning the Bengal Katta raid, no unfriendly Garo having been seen near the place. It seems to have originated in the Doobree Bazar, and coming to the ears of the native assistant commissioner, he at once, without any inquiry, apparently telegraphed to Colonel Haughton that the raid had actually been committed. Captain Williamson left next day for Tura, and I started the day after to explore the valley of the Semsang, and to clear and erect a signal on Arbella, and thence to Tura, where I arrived on the 13th January.

28. The next few days were devoted to office work, and visiting Rangira again, as Daliludin had erected the signal at Watrigiri; and on the 23rd Captain Williamson started for Goalparah, and I left Tura with him, taking with me Daliludin, in order to visit and clear Tingrith, Dalmung, and Jeera points. All these were ready by the 6th February, but unfortunately, with the exception of the day I was on Dalmung, the weather was so hazy that I could not observe a single angle, and as many other points still remained to be cleared, I could not then afford to wait anywhere for a chance of clear days. A great disadvantage in putting up stations in that weather was the uncertainty of the signal being put up in the best position with regard to the other points, some of which might be obscured by an intervening tall tree. Captain Williamson wrote to me at Nibari on the 1st February that while he was at Damra, where he had been inspecting schools, Captain Davis had ridden in to see him from Chima, and hearing that no mark had been put up at Sokadam, he had directed that officer with his column to proceed to Rongrongiri *vid* Sokadam, to enable Mr. Robert to erect the signal and finish off a little bit unsurveyed near Nokrek, proposing that he and I should meet Captain Davis and Mr. Robert at Sokadam on the 9th, when an independent guard would be given to the latter to go wherever he wished, the former taking his column to Tura previous to leaving the hills. I was very glad to receive tidings of Mr. Robert once more, as I had not heard from him for a month; he had written to me twice it appeared, but through some mismanagement the letters which had been sent to Rongrongiri to be forwarded, had been returned from that place to Captain Davis, who then sent them to Goalparah to be posted. I left Jeera with Captain Williamson on the 7th, arriving at Sokadam in two days. Instead of finding Captain Davis there, the Garos told us he had gone straight on and that no signal had been put up; we therefore went up ourselves next day, taking coolies and Garos with us, and fortunately, finding an excellent point which would require but little clearing while the coolies were collecting and preparing bamboos, &c., I got a goodly number of angles. The afternoon being very clear by 5 P. M., and a brilliant moon favouring us, we got the signal up before returning to camp.

29. The next day, the 10th, we arrived at Rongrongiri, where we saw Captain Davis and Mr. Robert. The former said, being in a hurry to get to Tura he had not allowed the latter a halt to put up the signal, the same old tale! but Captain Davis left for Tura on the 11th, and Captain Williamson gave Mr. Robert a guard to go whither he would. Unfortunately this boon came a little late, as the weather was henceforth very hazy, and in March the joom fires further impeded his progress, so that it was not till the middle of May that he had finished the portion of hills assigned to him. Mr. Robert's reputation as a surveyor is well established, and you have yourself acknowledged his services on several occasions; I do not fear therefore that you will attribute to any want of zeal or energy on his part the delay in completing his work.

30. At Rongrongiri Captain Williamson received orders to proceed as soon as possible with the settlement of the boundary between the Khasi and Garo Hills, taking a surveyor with him. He could not go before the beginning of March himself, and I hoped to have had a good deal of the triangulation done by that time, as I was the only surveyor who could accompany Captain Williamson on the boundary, both Mr. Robert and Nasirudin having as much as they could do of their own work. I agreed to be in Tura towards the end of February, to make arrangements there for proceeding to Shooshung Doorgapoor, where it was proposed we should meet Colonel Bivar, Deputy Commissioner, Khasi Hills.

31. I had intended that Daliludin should have plane-tabled all the Tura range south of the Semsang river, but he was seized with a fresh attack on the 11th February, and was unable to do any more work, and I sent him away on sick leave on my return to Tura. On the 12th February I left Rongrongiri for Moungrhi. Unfortunately the weather, which had been very clear for a few days, again became hazy, and I did not get all I wanted; the Lukma of Dawa had not cleared as much as was necessary moreover, so leaving instructions with him as to the necessary clearing, I left for Mimanram *viâ* Semsanggiri and Bowigiri, plane-tabling by the way. I found a very excellent signal on Mimanram, but the breeze was too great for me to get any angles. I managed to get some country done, and returned to Rongrongiri on the 16th. Taking in supplies there, I proceeded to Dilmagiri and Watrigiri, correcting (now that I had the well-defined points of Sokadam, Moungrhi, &c., to go by) and improving the reconnoissance made during our first march in December.

32. The weather still continued bad, and I failed in obtaining angles either at Watrigiri or Arbela, notwithstanding that heliotropers were at Mimanram, Sokadam, and Moungrhi. I tried also to observe by night. I directed the heliotropers to light fires over the mark, the bamboo signal above being protected from the flames by a machan of bamboo matting covered with damp earth. I repeated the experiment several times, but without success. The telescope of the 6-inch theodolite is not powerful enough to make out these fires without a strong reflector behind them at greater distances than six or eight miles. Up to that distance fires were thoroughly successful, but unfortunately objects were generally visible by day, also at the same distance even in the haziest weather.

33. I encamped in Ramphagiri rather disheartened on the night of the 21st February. About 2 A.M., a strong breeze blowing through my water-proof sheet, which was pitched as a tent, aroused me, and directly after a heavy shower, lasting for some time, came pattering down, leaving, as it passed off, a clear and beautiful starlit sky. My spirits rose, for from past experience I knew that the next day would be clear, and I thought I should probably be able to observe at both Arbela and Watrigiri in the same day. In case of any delay occurring, as my supplies were running short, I determined to take only a few coolies with me and a small guard, sending the rest of the camp at once into Tura, taking all the russud I could with me. As soon as it was light I ascended Arbela, and found, as I had expected, that the whole country was distinctly visible even to the snowy peaks of the Himalayas. I at once sent my little camp on to Watrigiri, and by 11 A.M., having completed my observations, I started for that place myself. Another heavy shower came down by the way, but I reached the village about 4 P.M., and taking the theodolite, &c., from my tired men, made some Garos carry them up to the mark. A heavy cloud obscured the view to the north, but I got some angles, and the next day, during a few clear intervals, I managed to get all angles I wanted, and in the evening went on to Rengigiri, and into Tura on the 24th.

34. The triangulation was much less advanced than I had hoped, and I telegraphed to you through Captain Williamson concerning its postponement till after the boundary survey had been completed, the reply being that the Bengal Government were very anxious to have this work completed then, and that the triangulation might be postponed. This reply came about the 5th March, and business connected with the expedition detained Captain Williamson at Tura till the 9th. I employed the interval in transferring points required for the boundary, revisiting stations near Tura, &c. Meah Nasirudin had finished his work on the $\frac{1}{2}$-inch scale as far as the supposed boundary between Goalparah and Garo Hills, but wishing to examine the old revenue survey maps, I sent him to do as much as he could of the low tila country outside this boundary. Captain Williamson was anxious to have all the villages under his jurisdiction which lie without this boundary shown, and sent his surbarakar with Nasirudin to point them out. They left about the 12th March, up to which time Nasirudin was employed in making a plan of Tura on the scale of 24 inches = 1 mile. My Hindustani kalassis had proved, with one or two exceptions, a most useless set

of men, never being able to keep up with me on the most level ground, always forgetting something, and requiring coolies for their baggage and food. As it was necessary, considering the lateness of the season and the amount of work still remaining, that I should be able to move about rapidly and carry as many days' supplies as possible, I determined not to take any but Khasias with me, and discharged ten of the most incapable Hindustanis. My experience of these men is that they are unfit for work in the hills, which seem to try them too much; Goorkhas are better, but those I had with me did not come up in strength or activity to the Khasias.

35. I left Tura with Captain Williamson on the 9th, and arrived at Shooshung Doorgapoor on the 12th, carrying on a route survey the whole way. In passing from Daloo to Doorgapoor, where the boundary between the Garo Hills and Mymensing has already been laid down, I noticed that it was only occasionally that we saw the boundary pillars, the others being placed in the jungle which covers the low hills, forming the southern boundary of the Garo district. In continuing the boundary, which it is proposed to do next year, I believe, by the revenue survey, I venture to suggest that it would be better to keep the whole of the pillars out in the open. I should not imagine that there would be any difficulty in this, and the boundary line would be much more easily found at any time. At Shooshung Doorgapoor we found Colonel Bivar waiting for us, with the Khasia "*Siems*," whose interests were affected by the boundary about to be laid down. On our arrival these men were called up and stated their claims.

36. The "*Siem*" of Nongstoin laid claim to all the country east of the Damreng river on the north and of the Semsang on the south; and the "*Siem*" of Ramrye also laid claim to many villages, to which clearly they had no right, neither possessed any local knowledge of the places they claimed, and as they did not seem inclined to abate any of their claims, it became evident to the Commissioners that the only thing to be done was to lay down an authoritative boundary, starting from the Moheshkali river, which Colonel Haughton had declared to be the west boundary of Nongstoin's territory, and taking, as far as practicable, natural features for the line of demarcation. As the Moheshkali was well known and had been surveyed already, it was not necessary to explore that river; and the hills were entered by the valley of the Mahadeo river, a much easier route, on the 15th, encamping near the old survey station of Balpukram, a fine open elevated rocky plateau. The path up to it led through and over masses of sharp limestone rocks, which, by the action of water, had assumed the most fantastic shapes—now like the ruined and moss-grown battlements of some huge keep, now standing up in clusters of long sharp pinnacles among the trees, or again presenting the appearance of fallen columns. From the summit of Balpukram a long well-defined spur running down to the Umram river was chosen as a good line for the boundary to take to that river, whose course as far as Semsang it was afterwards intended to follow, and thence up the Semsang to Nongsram, at which place the inquiries previously made by Captain Peet, who officiated for Captain Williamson during the latter's absence on furlough, had ceased. This much was decided on at starting, and we proceeded to Nongsram *viâ* Nongmeng (where a halt of one day was made to enable me to get in the surrounding country and source of the Umram), Rengdini, Sudugiri, and Swangiri.

37. The country here is very intricate, densely wooded, and much cut up by small streams, and it was with great difficulty that I was able to get any fixings. At Nongsram we learnt from the Garos that Mr. Robert was at work close by, and I at once despatched a messenger to request him to join us, which he did the same afternoon. It was very fortunate that we fell in with him, as I found he had surveyed most of the country through which the boundary was to be carried; and an inspection of his plane-table materially assisted the Commissioners in deciding on the line. Captain Peet had recommended that the Rungdi should be taken, but Mr. Robert showed us that the Rungdi ran in too easterly a direction into the Khasi Hills, but that its largest tributary, the Ronga, was admirably adapted for a boundary, and it was finally chosen. Another advantage from seeing Mr. Robert was that he gave me the positions of several points he had prepared for triangulation, which lay close to our course, and which I was able to visit by the way. On the 22nd, leaving Nongsram, we marched to a small village, Mansung, on the right bank of the Ronga, nearly half way to Parmiap. We arrived about 11 A.M., and after a slight halt, I went with Captain Williamson to Hashlong and observed there. The afternoon was too hazy to get all the points, so the next day Colonel Bivar preceded us with the camp to Parmiap, while we returned to Hashlong and finished the observations, going on in the afternoon to Parmiap, a village which is situated near the source of the Ronga.

38. The next day we visited Nongbak; the weather was unpropitious, and joom fires lighted in all directions still further obscured the hills; and I returned there again the following day, while the Commissioners were employed in camp conducting examinations of the surrounding villages. They determined to carry on the boundary by means of the Radiac or Ildek river (called also in the plains Dopsilo), a small tributary of which, the Umpai, rises near Parmiap, and on the 26th we followed up the Parmiap stream to its source, whence a short line connected it with the source of the Umpai, and the next day started for Hadaogri. Here it was discovered that if the Radiac were taken from this point as the boundary, several Garo villages paying revenue to Captain Williamson would be included in the Khasi Hills,

and it was therefore necessary to find another line. After a careful examination on the 28th the village boundaries of Hadaogri were taken.

39. This part of the country is most difficult to get about in, swamps and muddy streams, through which we waded knee-deep, affording the only means of passage through the otherwise impassable jungles; but the line of boundary was here brought to a satisfactory termination, and on the 29th the Commissioners separated, Colonel Bivar returning to Shillong, Captain Williamson proceeding to Goalparah. I accompanied the latter for two days till we reached Dabli. On the 29th, at noon, we reached a village, Madung, about two miles from Gorkhar, Great Trigonometrical Survey, which I was thus enabled to visit the same day, and secured all my angles. I found that the joom fires had reached as high as the signal and destroyed it. I put up a pole and brush after observing, and a few days later the villagers put up another signal. On the 30th I went on to Dabli, and thence saw that the signal on Rajung had also been burned. It was necessary to re-erect it before I could observe from Dabli, so the next day I went there, and as, in consequence of heavy rain which we had had for several days, the weather was very clear, I was fortunate enough to get all my angles early, and having sent for the villagers, made them put up a new signal before nightfall. The following day, sending my camp across to Nibari, I returned to Dabli, and observing there, proceeded afterwards to Nibari, where I arrived at 6½ P.M., after a long march of 32 miles in the Goalparah plains under a very hot sun. The Khasias, with the theodolite, &c., arrived about an hour later than I did. Not one of the Hindustanis, and very few of the Goorkhas, could have done the distance in less than a day and a half. The two Garo policemen who were with me did not reach Nibari till noon the next day.

40. A simple diary of my marches and observations would be neither interesting nor instructive, and it is enough to say that by the 12th April I had, by dint of marching about 20 miles daily, with the exception of a three days' detention on Ajaghar, succeeded in observing at Ajaghar, Pandpar, Tingrith, Dalmung. I was fortunate in other weather, for though we were visited by heavy storms each night, they generally passed off before dawn, leaving the days tolerably bright and clear. Returning to Nibari, I laid in fresh supplies and started on the 13th for the eastern triangulation, and observed at Moungthrim, Megam, Duragiri (where I was detained one day putting up the signal which had been blown down), Sokadam, Mimandram, and Moungrhi, returning to Rongrongiri on the 31st April. On the 1st May, sending off to Tura all my sick men (of whom I had then a daily increasing number) owing to the unhealthiness of the jungles and daily drenchings we got during the latter half of April, I left myself to finish off the Tura range, which was to have been done by Daliludin, and also a small piece of country near Delkrangiri and Alogiri, and arrived in Tura on the 8th May.

41. I remained there one day for office work, and then set out on the 10th to observe at Rangari, Borchi, Dadok, and Shikarpara, returning to Tura for the last time on the 16th. Nasirudin had arrived and Mr. Robert joined me on the 20th, and after settling up all russud accounts, &c., with Captain Williamson, Mr. Robert and the camp left for Roohoomari, where Captain Williamson had established a convalescent depôt, and whither he had previously sent all my sick on elephants. I followed a few days after, riding straight through in one day with Captain Williamson, and after waiting a few days, we were picked up on the 31st by the Steamer *Rajmehal* and conveyed to Gowhatty. Here another delay of a few days occurred in procuring coolies and baggage ponies to supplement my sick men, and the camp left on the 7th June. Unfortunately cholera broke out on the road, and most of the men and baggage were detained in "quarantine," about 15 miles from Shillong till the 30th June. In consequence of my office and angle-books being also detained, I was much hindered in commencing the work of the recess.

42. *Individual exertions of assistants.*—This Assistant Surveyor has sustained his reputation for zeal and energy, completing 1,380 square miles of topography on the ¼-inch scale, and clearing several points for triangulation, which he selected himself with great judgment. A practical knowledge of the theodolite would greatly increase his efficiency as an assistant in the field. Had he possessed this knowledge, the triangulation could have been completed much sooner. I have already noticed the difficulties he had to contend against, and need not again refer to them.

Mr W. Robert, Assistant Surveyor, 3rd grade.

43. This Sub-Surveyor has done good and reliable work. Wherever I had opportunities of testing it I found it very accurate. He erected several signals over the old marks of Mr. Doran's triangulation, and completed 139 square miles of topography on the ¼-inch scale, and 651 on the ½-inch scale, besides making a large plan of the station of Tura for the Deputy Commissioner. He suffered a good deal from fever during the last six weeks, but continued working in the field notwithstanding.

Shah Nasirudin, Sub-Surveyor, 1st grade.

44. This Sub-Surveyor was ill nearly the whole season from the date of leaving Gowhatty to the 1st March, when he went on sick leave, with the exception of a few days, when he accompanied Mr Daly and got in 70 square miles of topography on the ¼-inch scale. His work was satis-

Dalilodin, Sub-Surveyor, 3rd grade.

factory so far as it went; it was but a drop in the ocean though, and his illness threw a great deal of topography on to my hands at a time when I should have been triangulating.

45. *Area surveyed, and triangulation.*—The total area surveyed is 2,579 square miles, including 138 on the ½-inch scale and 170 square miles of overlap. The area of the triangulation is 1,940 square miles. The stations were observed at, and about 40 points determined from them. It was impossible to fix more tertiary points in the lower hills, which were very jungly, all very similar in appearance, and of the same general level, and without erecting conspicuous marks, for which there was no time; it was impossible frequently to recognize the same hill from two stations. I had hoped to have connected on to the Khasia series on the east, but the delay at Rongrongiri, and the interruption to the triangulation caused by the boundary survey, prevented this, as the station of Ladomai was invisible from any point to the west, and another would have had to be chosen. This part of the country was very difficult, and though Mr. Robert attempted to erect a signal for me near Swangiri, he found it impossible, even when mounted on a machan 80 feet high, to see any distance across the level and wooded hills. The triangulation, however, starts from three good bases of the Great Trigonometrical Survey.

46. The cost of the party in the Garo Hills up to the end of September 1873 will have been about Rs. 21,164, or about Rs. 8-3-0 per square mile.

47. *Health of the party.*—About ten per cent. of the party were sick with fever or diarrhœa almost from the commencement of the season. Several men died at various times from jungle fever, cholera, or dysentery, but the general health of the party was pretty good till towards the end of March, when a great many, both Khasias and Hindustanis, were attacked with bad ulcers (some of the sores being 3 inches in diameter), which broke out on their legs and feet, utterly incapacitating them; the constables and Gorkhali coolies also suffered much in this way. In the sad outbreak of cholera, which occurred on the road up from Gowhatty, eleven coolies at the end of a long and trying season died almost within sight of their homes.

48. With one or two exceptions, the native doctors with the expedition were almost useless. The one with the Tura column treated a coolie of mine for cholera, when, I firmly believe now, he had jungle fever, a disease I had not seen before. I adopted a saline treatment after the doctor's had failed, and the man rallied for a day or two, but eventually died. The Khasias had no faith whatever in the native doctors, and if I could not treat them, preferred going without medicines. They said, "Men die at once under the native doctor, but you keep us alive at least three days longer." The native doctors were certainly not well supplied with medicines; I could very seldom get even necessary articles from them; and but for my receiving a good assortment of medicines from the Medical Department, Calcutta, in January, I should probably have lost the services of many of my coolies. Native doctors, especially the younger ones, seem to me to be worthless, unless they are under the superintendence of a European doctor; and this does not seem to be my opinion only, as a European Medical Officer has lately been appointed to take charge of Tura, certainly not before such an appointment was necessary.

49. *Physical aspect of the country, &c.*—The Garo Hills, the westernmost of the girt of hills forming the southern boundary of the valley of Assam, are also the lowest descending ranges to the plains on three sides. The highest range in the Garo Hills is the Tura range running east and west, the highest point of which does not exceed 4,700. This range descends precipitously on the south for nearly 3,000 feet, thence sending out long and very gradually descending spurs down to the Brahmaputra on the east and into the plains of Mymensing on the south, these spurs being separated by deep ravines through which numberless streams thread their course. The southern face of this range presents an almost unbroken mass of fine dark-green foliage of huge forest trees; from this the yellow patch, which marks the position of Tura, stands out in bold relief. To the north the range sends out a series of long, lofty, and almost parallel spurs, the steep and well-wooded sides of which feed, with many streams and rivulets, the principal river of these hills, which cuts through this range to the east between Dorengo and Kylas, and is called by the Garos "Semsang" or "Shemshang," and by the inhabitants of Mymensing the "Sumasery." The lower slopes of these spurs are well cultivated, and dotted over with a tolerable number of villages. The next ranges in height and importance are the Arbela and Watrigiri, which possess somewhat similar features, being steep and well marked on one side, and fading away on the other in long spurs and a succession of rounded knolls.

50. The Sokadam and Moungrhi are the next most clearly marked, the remainder of the Garo country being a confused mass of low hills (gradually rising in general level towards the Khasi Hills) and narrow valleys watered by numerous small streams. Out of this mass a few detached hills stand up prominently, such as Tingrith, Dalmung, Moungthrim, &c. The level of all these lower hills being so nearly the same, and the absence of any well-defined watersheds showing clearly the course of the various large rivers, were among our principal difficulties, necessitating much closer working than is usually, I believe, adopted in this small scale; and I am of opinion that a survey on the ½-inch scale could easily have been made in the same time and with the same amount of labour.

51. *Rivers.*- An inspection of the map will show how in many cases two rivers, rising within half a mile of each other, take an entirely different direction. Take, for instance, the Jeugial and Damreng rivers, which rise close to each other in the Arbela Hill, the former near Kiragiri, the latter at Tongbolgiri. At the northernmost of the Boldamgiri villages the Jengial takes a bend as if it would join the Damreng, and there is nothing in the formation of the low country to prove from a little distance that it does not, yet it goes to Bengal Katta, while the Damreng flows out into the Goalparah plains by Jeera. It was often only by actually following the rivers themselves that their courses could be determined.

52. The Semsang is a very rocky stream, a succession of falls and rapids, as far as below Kylas, whence it flows gently onwards by Doorgapoor; it is navigable for small "*dugouts*" for a few miles between Rongrongiri and Shongmagiri. The rivers on the west, and the three principal ones on the north—the Jinjeram, the Damreng, and the Manda—are rocky for the first few miles of their course, when they become sluggish streams flowing slowly over sandy beds. The eastern tributaries of the Semsang are generally rocky, with rather a rapid flow.

53. *Cultivation.*—The Garo Hills, as will be seen, are very thickly populated, and the numerous patches of cultivation pleasingly break the monotony of the dense tree and long grass jungle which covers the remainder. The principal object of cultivation is, and has long been, cotton. Indeed, even under the Mogul rule, the Garos were large suppliers of the demand for cotton. The soil is a stiff red soil, and in the same field, cotton, summer rice, a kind of millet, with various other crops, as chillies, squashes, sweet potatoes, &c., all flourish together. Cotton can only be grown the first year, rice for two years, and then the field is allowed to lie fallow for a few years (five I think), during which it becomes overgrown with long grass and a tall weed with a lilac flower resembling heliotrope. When the five years are up, all this is burned and cultivation resumed. The burning never commences till they are sure of rain, the action of the rain on the ashes being necessary to perfect the soil. The fields in the flat valley towards Nibari are ploughed roughly and yield heavy crops of rice.

54. In every field are two or three joom houses constructed of bamboo, with grass-thatched roof, in which the crops are first stored, and in which live the men who look after them. These are raised to a great height, sometimes as much as 50 or 60 feet from the ground, as a protection against wild beasts, and also answer as watch-houses. They are built among the branches of strong trees, the trunk forming the principal upright; the floor is additionally supported by long bamboos either planted in the ground or secured at their lower ends to the trunk of the tree. One I saw, of which the outer ends of the floor were supported only by cane ropes from the top of the tree—a suspension house. Long frail ladders of bamboo give access to these houses, which, nestling in the foliage of the trees, and often covered by some large vine, have a very pleasing and picturesque appearance.

55. The scenery in the Garo Hills is not striking as a rule, but some of the most beautiful effects of colour and light and shade are to be seen there at sunrise or sunset from the top of some high point overlooking the low hills; and to those who can admire the smaller works from the Great Master's hand, the "Semsang" and its affluents present, in combinations of wood, rock, and waterfall, many most exquisite little pictures which linger long in the memory. Here the strong rapids carry the angler's bait spinning away down into the deep green and purple pools, flecked here and there with sunlight, where beneath the tall grey rocks, made glorious with orange lichens and ferns, and crowned by graceful trees, lie the big fish, who yield themselves ready victims to the tempter.

56. Tura itself, so called from the high range rising above it to the north, was first established as a station by Captain Williamson in 1867 on his appointment as Deputy Commissioner. It has an elevation of about 1,300 feet, and is situated on a long forked spur running down from one of the western peaks of the range, and commands a fine view over the low spurs to the Brahmaputra, visible some 30 miles off, where steamers going up and down can easily be made out with binoculars. The station itself is rather bare, owing to injudicious felling of trees by Captain Williamson's *locum tenens*. Good water is plentiful and flows in little aqueducts past the sepoys' huts, which are ranged in long parallel lines down the slope. Captain Williamson was exerting himself to improve the place when I left, and had already achieved considerable success. On a fine morning the view from a point above Tura is very fine. The tops of the low spurs and the high hill of Rangira are lighted up by the rising sun with many delicate tints, blended and harmonized by the soft grey mists still floating in the valleys.

57. The Brahmaputra glitters golden in the morning haze, and, beyond the low country of Rungpore and Cooch Behar, is faintly visible, while above the brown obscurity of the distant plains, rising sharp and clear in the far off horizon, the rosy peaks of the Snowy Range close the scene. But by far the most striking of any is the view obtained from Bulpakram, looking south down the valley of the Mahadeo, as we saw it on the 15th March in the early morning. To the left a long, jagged ridge sending down large spurs; beyond, the Pandengru Hill, precipitous to the north, extending southwards—a long level hill behind which rises a high conical peak; to the right, a series of steep, rocky spurs, crowned by a

wide level plateau; between this and Pandengru, in front, stretching away in perspective, the valley of the Mahadeo, affording a distant view of the plains of Sylhet; the head of the valley immediately before us, a semi-circular precipice of some 800 or 900 feet, displaying strata of limestone, coal, and igneous rocks, the black, orange, and brown colours of which contrast beautifully with the dark-green trees and clumps of cactus. The sun, rising behind Pandengru, casts its foliage-covered sides and ravines into deep shadow, which extends half-way up the opposite side of the valley, in which, through the mist, we get faint glimpses of the stream, and lights up the upper half of the right hand slopes with most glorious green and golden tints, and far away in the distance the twinkling plains delude us into the belief that we are gazing upon "the countless smilings of the ocean wave."

58. The Garo Hills consist principally of granite and highly talcose rocks. In the fields immense quantities of talc are to be found, some of the flakes being of very great size. In many instances, the silvery scales glistening in the sun on the red soil of the fields give the latter the appearance of being frosted. At Mering, a large mass of granite, standing apparently about 150 feet above the level of the surrounding country, is a landmark for many miles. I was obliged, much to my regret, to give up the idea of inspecting it, as it would have taken me too far out of my way, but I imagine it must be another exhibition of the geological fact thus mentioned by Dr. Oldham, *viz.*, "the occurrence of those huge blocks of rock imbedded in, and of a similar character to, the mass, though much more highly indurated," and, like the Kullong rock in the Khasi Hills, though in a smaller scale, "no human hands have exposed the Mering stone, but the action of natural causes, continued for ages, has laid it bare."

59. From a distance it appears to be a huge conical mass, but Mr. Robert, who visited it, states that, like the Kullong, it is accessible from one side, though not easily so, but perpendicular on the other, overhanging a cave. This rock is supposed by the Lengams (the men who inhabit the border country between the pure Garos on one side and pure Khasias on the other) to be the abode of a very powerful and malicious demon, and the men who were with Mr. Robert deserted in the night when they heard he was going there the next day. At one place on the Arbela Range, near Makragiri, I noticed large masses of granite lying in the small furrows between the tilas and on the hill sides, as if thrown down from a height above—just as is the case at Nongkrem and elsewhere in the Khasi Hills.

60. The southern face of the hills at Pandengru, Balpukram, &c., seems to be a continuation of the limestone beds of the south Khasi Hills. Limestone and chalkstones are also found near Tura and in the Rangira Hills, and, as before mentioned, well-marked beds of good coal are found at the head of the Mahadeo valley. Another large bed of coal is said to exist in a hill near Gare Gittom. Unfortunately Mr. Robert was unable to visit this hill. Iron exists in very large quantities in these hills, as evidenced in the streams both to the taste and vision, especially in those south of the Tura Range. Mr. Eliot, who visited the hills in 1788-89, describes a mode the natives of the Mahadeo valley employed for extracting oil from the coal, which they applied as an ointment for cutaneous diseases. A large earthen vessel *(ghurra)* was filled with coal, and the mouth stopped with grass; this was placed, inverted, in a shallow pan, the neck protruding through a hole in the bottom of it; this pan was supported at a sufficient height from the ground by bricks, to allow of a receiver being placed beneath the neck of the *ghurra*. Cowdung fuel being placed in the pan and lighted, the oil from the coal distilled through the grass into the receiver; the oil was extracted in the course of an hour.

61. *Natural History.*—Elephants abound in those hills, and very profitable khedda operations might be established there. Tigers are also found in the lower hills. Leopards, barking deer, and sambur have their home here, and I believe, though I never saw them, that there are many wild dogs in the inner hills. Of birds, there are an immense number of peafowl, Kalej pheasants, jungle fowl, a few partridges, and several varieties of green pigeons. Of small birds there are over one hundred varieties. Mr. Robert succeeded in obtaining two varieties of thrush and cuckoo, which are supposed to be quite unknown. The Hoolook monkey is heard nearly all over the hills. Captain Williamson, when out in the districts during the rains last year, discovered two entirely new tortoises, which are now in the museum at Calcutta, I believe.

62. *Climate.*—The climate of the Garo Hills is very fine from November to January and of a very pleasant temperature, though rather warm in the middle of the day. The lower valleys are, however, generally visited at night by heavy mists, from which the upper ranges are entirely free. In January, in the valley of the Semsang, the houses were generally covered in the early morning with thick hoarfrost, and ice was found in our "*chitumchees*." From the middle of October to the middle of January the atmosphere is singularly clear and favorable to triangulation; later it gets hazy, and the smoke of field fires covers the country as with a veil during the last half of March and beginning of April, when the rains have generally commenced, and triangulation is then a work of great anxiety and uncertainty. The weather also becomes very hot. In the lower hills and plains of Goalparah the average maximum height of the thermometer in the shade was 88°, seldom sinking below 74° even after sundown. Mosquitoes, midges, and leeches abound in almost incredible numbers from the beginning of April.

63. Tura enjoys the advantage of a clear look-out across the Brahmaputra, is above the nightly fogs, and is easily accessible from Mankarchar or Roohoomari. I have not seen another site further in the hills to which it would be advisable, in my opinion, to move the station. The argument that it should be more centrally situated is of little weight while the present Deputy Commissioner remains in charge, as paths have been opened out all over the country, and the ideas of the Garos with respect to the distances and inaccessibility of their villages from Tura have undergone a great change, and they now attribute even exaggerated powers of speed and endurance to Captain Williamson.

64. *The Garos themselves.*—Colonel Dalton divides the Garos into three tribes. The Nunyas (or Lengams, the name we heard on the boundary) are the most easterly, the Lyntcas occupying the central hills, and the Habengs the western portion of the country. These two latter differ in nothing except physique, the Garos in the inner hills being finer and better made men than those living near the plains; they are also better looking. Like many hill tribes, the Garos do not, as a rule, attain any great stature, but are generally of the middle height, active, and muscular, with a tendency to obesity in middle and old age. They have broad faces, with high cheek bones, and rather flat noses, almond-shaped eyes set obliquely. Their hair is tied in a knot at the back, and frizzed up above the small turban or fillet of cloth, which they almost invariably wear round the forehead; this latter fillet is often ornamented with a band of brass foil and rows of white beads. Their dress is very simple, consisting solely of a long strip of cloth about 6 inches wide. This is passed tightly round the waist and tied in a knot at the back; the long end, being passed between the thighs and drawn up under the waistband, falls in a flap of about a foot in length: this flap is decorated very often with rows of white cylindrical beads. They are very fond of small brass rings, which they wear in the lobe of the ear, to the number of eighteen or twenty in each ear, from the upper portion of which hangs also a small string of coloured beads; large strings of beads and rude steel ornaments adorn their necks and chests.

65. The women are decidedly wanting in personal attractions, with the exception of a few younger ones whose appearance was certainly pleasing, though none could be called beautiful, scarcely even pretty. They wear their hair braided and tied in a knot at the back; the younger women frequently bind a fillet of cloth round the forehead. They also load their ears with brass rings 4 inches in diameter, and twenty or thirty in each ear: these stretch the lobe to a great extent, and would inevitably tear it, but that part of the weight is taken by a string passing over the head and through all the rings on each side: this string is removed on state occasions. These rings give them a very stiff carriage of the head, which does away with all idea of grace. They wear a large number of bead or steel necklaces; the latter are formed of several strings of small bill-shaped steel ornaments, fastened at the ends behind the back of the neck, and in front the lowest string hangs down to the waist, the uppermost just below the collar bones, the whole forming a sort of crescent-shaped breast-plate, and weighing about eight or nine pounds. A small strip of cloth, about a foot broad, and just long enough to meet round the hips, and fastened by the upper corners only to the right side, completes the female attire, the more fastidious weight the lower hem of this small petticoat with four or five rows of white beads. They carry their babies in a small cloth tied over one shoulder. Their waist cloths, both men's and women's, are home-made, of a coarse cotton, striped maroon, purple, and white; they manufacture their dyes themselves.

66. The Lengams are a mixed race, possessing some characteristics both of the Garos and Khasias; their dress is a compromise between that of the Garos and that of the Khasias, consisting of the waistband of the former, but worn broader, and ornamented at the end with the fringe, which forms a conspicuous part of a Khasia's dress, and also of the Khasia fringed shirt. The women are more decently clothed, adding a large cloth to the scant Garo petticoat. Colonel Dalton says the Khasias are superior to the Garos in carriage and natural dignity. This did not strike me as being the case, at any rate with the independent Garos, while the almost utter absence of clothing rendered their movements singularly easy and graceful.

67. I may perhaps be allowed here to explain the system of government introduced among the Garos by Captain Williamson, or rather revived by that officer, David Scott having the merit of first proposing it. As the police force at Tura could never detect and punish each crime in the hills, the Garos themselves, through the heads of villages and communities, are made responsible for the preservation of order. The head of a village is called the Lukma, or Nukma, his duties being to collect the revenues of his village, to maintain order in it, to report all crimes to the Luskur, and arrest the offenders. The Luskur is the head of a circle of villages, ten or twelve; he receives the revenue from the Lukma, and remits it to the Deputy Commissioner; he disposes of all petty cases occurring within his jurisdiction by punchayet, appeals from which, as well as all grave cases, are heard by the Deputy Commissioner. Great success has attended the adoption of this system; the presence of a force at Tura giving great moral support to the Luskurs in carrying out their duties.

68. The Garos are singularly wanting in any missile weapons beyond bamboo spears and stones;—a spear and sword are their only weapons with which they lie in wait for their enemies, springing on them suddenly from ambush. The blade of the sword is about twenty inches long and two broad, two-edged, with a hilt about 8 inches long. The blade and hilt

are formed from one piece of iron, a cross piece, ornamented with tufts of goat-hair being let into the latter near the blade. They carry shields made of thin pieces of soft wood, covered on each side with fine cane-work, oblong in shape, and also ornamented at the upper corners with tufts of goat-hair.

69. In consequence of possessing no missile weapons, not even bows and arrows, the Garos are obliged to resort to traps for securing every kind of game. Large square pits are dug by the side of the paths, and the bottoms filled with sharp bamboo spikes; into these fall elephants, tigers, deer, &c., Another contrivance for killing an elephant is as follows: a short spear fixed in a small inverted basket to steady it in its descent, and weighted with stones, is suspended from the thick bough of a tree; the elephant is forced to pass under the spear by panjying the ground all about, leaving only a narrow path. A Garo sits up by the spear and cuts the ties at the moment of the animal's passing beneath. They have an ingenious deer-trap which they construct in their fields at the gaps in the surrounding jungle which marks the deer's path. A long flexible pole is fixed at its butt end between two stout posts, the line joining the centres of which is not at right angles to the axis of the pole, to which a spring action is thus imparted when pulled out of its normal position of rest to the thin end of the pole, and at right angles to it is fixed a long bamboo spear. The trap is set by drawing back this spear to a post in the hedge, where it is held by a simple trigger, to which is attached a thin creeper passing across the gap; the deer coming from the jungle does not see the creeper, and pushing against the latter, releases the trigger and is transfixed in the side by the spear.

70. An unfortunate kalassi of mine at Rongrongiri, returning to camp with an armful of bamboos, pushing his way sideways through the jungle, came across one of these, and was pierced in the stomach, dying within nine hours. Large bamboo traps for peafowl are constructed on the principle of the sieve trap at home, and a somewhat similar one to the figure of 4 trap is adopted for smaller birds.

71. The Garos eat almost anything, but I believe the tale of their mode of cooking puppies by making them first eat as much rice as they can, and then roasting them alive, is an exaggeration, as the Garos whom I questioned about it denied it, and Captain Williamson tells me he has never seen this method of cooking practised anywhere. They are very fond of blood, which they boil till it assumes a green colour and then drink it; but milk they abhor, considering it an unclean excretion.

72. An intoxicating liquor* is made from rice and millet pounded and pressed into cakes, with some pounded vegetables. These cakes are broken and put into earthen vessels, a small well being kept free in the centre by a basket-work cylinder. Water being poured over the rice from time to time, drains through into the well, and when it has acquired sufficient strength, is removed to other jars, and either drunk through a reed or from a small long-necked gourd.

73. The Garos build large substantial houses, very similar to those of the Lushais; the framework and principal posts are of sâl (which valuable tree flourishes abundantly in some parts of the hills), the walls and floor of bamboos, and the roof thatched with grass or palm leaves. The houses are sometimes raised entirely from the ground, but generally one end, which is left unfloored, rests on the ground, the other supported on long posts. As the houses are often over 100 feet in length, and sites are seldom levelled on a steep hill side, the outer end of the house will be 25 feet or more from the ground. The hearth is frequently built in the unfloored portion, but if built in the inner part of the house, is formed of large flat stone and mud. The eaves are very wide, and the roof projects to form an open verandah. Sometimes the house is divided off into several little rooms. A portion of the space below is enclosed to form a fowl and pig-house. Raised platforms at one end or side of the house enable occupants to sit out and see what is passing around. The women also sit here to weave, pick cotton, &c. Where there are small children, these platforms are railed.

74. The villages, unlike the Lushais, are seldom built on elevated sites, but down on the banks of streams, and in all there is one large house (in big villages two or three) called the "nokphante," or bachelor's house, in which all the unmarried men sleep, and where strangers are put up. It is entirely raised from the ground, the front forming a large partially enclosed verandah and the back part a long room, round the sides of which are sometimes ranged raised bamboo sleeping places like the berths of a steamer. The Garos' bedding is made from the bark of a tree, of an open fibre resembling the texture of a very thin native blanket; it is sewn together in several thicknesses and forms the mattress. In these nokphantes are seen hanging up the drums and other musical instruments of the village; in some were triangular slabs of stone about 2 inches thick, which, when suspended from a beam and struck with other stones, gave forth musical notes like those of a sweet-toned gong. These rocks are found in the bed of the Semsang and its affluents. The drums are long wooden cylinders, varying from 2 to 4 feet in length and about 1 in diameter; deer skin being stretched over the ends. Bamboo flutes and buffalo horns are among their musical instruments, and, instead of gongs, they have bowls of bell metal called "rangs" of various kinds, the names of which are known only to Garos, and the differences between which can only be appreciated by them. These are used as objects of barter, and are supposed to gain immensely in value with age.

* Called *châ*, compare *ju*, the Lushai name for the same beverage.

75. Few villages are surrounded by any defences; those that are, are enclosed in a stiff double wall of strong bamboo matting, the principal upright webs forming long spears; the approaches are, however, thickly panjied. At Gokulgiri a watch-house was built in a tree just outside the stockade and overlooking the gate, after the manner of a Machicouli gallery, whence spears could be thrown on the assailants. A long ladder from the interior of the stockade communicated with it. The western villages near the plains, buried in groves of mango trees, present a very picturesque appearance. Water is brought into villages, which are at a little distance from stream, by long aqueduct of bamboos from some point above the village. These bamboos are notched on the top at intervals to provide for any sudden increase in the flow: a small pool is formed under the end of the aqueduct. The Garos, men and women, bathe under the stream, removing their cloth most dexterously as they squat, whipping it on again as they rise without any exposure whatever.

76. The Garos people every place in their imagination with demons and spirits, whom they suppose to be continually exerting an influence for evil over them if not propitiated by sacrifices. For this reason little propitiatory erections of bamboos, smeared with blood and decorated with feathers or egg shells, are seen in their fields, paths, streets of their villages, under the trees, or by the river side. At the time of commencing agricultural operations, I saw a monkey crucified at the entrance to each field. At Sarramphang Hât a boy belonging to Sibchurn, the interpreter, fell ill and was dying. Sibchurn, with another boy of his, went down to the river's edge, carrying with them a fowl, arrived at the place where a rapid made a melancholy murmuring over the water-worn stones; they fixed two forked uprights in the ground, placing across them a stick carrying a basket-work cylinder. Sibchurn then took a grass brush, and dipping it in the water, sprinkled the fowl, the basket, and its supports, exorcising any evil spirit in them, and muttering rapidly a long formula. This finished, the bird's throat was cut, and holding it by the neck and legs, the man smeared its blood over each component of the structure, small handfuls of feathers being plucked out and stuck to the blood spots, another incantation being muttered meanwhile; some cooked rice in a plantain leaf was then placed in the cylinder as an offering to the demon who had smitten the boy, but the fowl was taken back and eaten.

77. At Tura in May this man's daughter died early one morning. Invitations were at once sent out to friends to attend the funeral ceremonies that day. All day rangs were beaten in front of the house, and in the afternoon a bull fight took place. Two bulls were brought out, a Garo holding each in a strong rope, and endeavours were made to excite the bulls to combat by pulling their heads together. As soon as they exhibited the slightest inclination to fight, the Garos took a round turn of the rope on a strong post and held on, to prevent hostilities being carried among the audience. After two or three hours of tugging and false alarms the idea of a fight was abandoned, the bulls being evidently of a very friendly disposition towards each other. We were told that the body was to be burned at midnight, but about 9 P. M. we heard that the pile had been lighted some time, and when we arrived on the spot but little remained of the body, a very fierce fire being kept up. My Khasia sirdar was much shocked at the way the body had been placed on the pile, saying it had been put there perfectly naked, instead of being decently covered up after Khasia fashion. A large circle of Garos sat round the fire at a little distance beating rangs and drums and blowing horns. When the body was quite burned these men rose, and forming a procession, marched round the fire, each, as he arrived at a certain point, tossing into it the stick he had used in beating the rang or drum; they then retired to the interpreter's house to spend the night in eating and drinking.

78. The next morning the ashes were collected and buried with some rupees in front of the house. The ashes are usually buried where the body has been burnt, but as this heath occurred in the station, the pile was erected some little distance off. The burial place was covered by a bamboo structure about six feet long, three high, and four broad; from four poles at the corners several canopies of white and violet cloth were suspended; gourds and other vessels being affixed also to them; grotesque carvings in wood of horned animals, painted with black, brown, and white designs, decorated the structure, in which a live fowl was placed with food to last for two months; at the end of this time it was to be sacrificed and the whole structure burned. A large wine jar was one of the offerings, and to prevent its exciting the cupidity of any light-fingered Garo, it had a small hole broken in the bottom. Outside the door of the house, in the verandah, a post rudely carved and painted to represent the diseased, was planted in the ground, decorated with her earrings, turban, and cloths, a bunch of white cocktail feathers being stuck in the head. A post close by carried the horns of the animal slain in her honor and a couple of rangs also damaged.

79. Nearly every house in a Garo village has a monument similar to the above in front. These monuments vary, however, greatly in shape or size, according to the taste and fancy of the bereaved, but the one described may be taken as a type of general form. At certain seasons the inhabitants of a village, with their neighbours, assemble together, and amid much feasting all these monuments are burned; the villages are thus prevented from becoming overstocked, and are free to start afresh after each clearance. In the case of persons of importance, figures to represent the departed are always placed in the verandah of their houses, the effigy of a Luskur being frequently clothed in an old red uniform coat. I was

surprised at the number of effigies collected in some of the verandahs of the eastern villages; often there must have been at least a dozen. In some descriptions of the Garos I see it stated that they keep their corpses four days; I fancy this is a mistake. The Garos I asked about it told me that they were invariably burned on the evening of the day on which they died. Passing through one village, while talking to the Luskur, suddenly a most fearful noise broke out from one of the houses; at first it sounded like the hysterical laughter of two or three women, but soon men's and children's voices swelled the din, which now resembled the cries of jackals, occasionally dying away, only to be renewed with greater vigour as if the people were inciting each other to grief. I heard that the cause of this noise was that a man who had been ill some time had that moment died; and asking when he would be burned, the answer was, "that night." On another occasion, passing through a village just after a man had died, his funeral pyre was being built, and again they told me he would be burned that night; and we have seen that Sibchurn's daughter was only kept one day. Among the Lengams the monuments differ very slightly from those of the Garos; but near Parmiap we saw the Khasia element in two sets of monumental stones arranged in the usual Khasia manner, but on a small scale.

80. Among the Garos property does not descend from father to son, but the son-in-law; if the latter's wife dies before her father, though he has no claim to it unless he marries the "deceased wife's sister"—a state of society worthy of the notice of the common sergeant, Sir T. Chambers. Thus, the day after the funeral ceremonies had been performed for Sibchurn's daughter, her husband, a constable, showed me a little girl of about seven, his late wife's sister, whom he had adopted and would eventually marry. He also explained to me that as soon as a little girl has been betrothed her hair is allowed to grow, but unless she has, it is kept cut close except one little tuft, till she is 13 or 14, when it is allowed to grow in either case.

81. Wedding ceremonies I did not witness, so to describe them would be merely to do so second hand; but on my first visit to Mandalgiri I was fortunate to arrive in the midst of some festivities and witnessed their dancing, which is peculiar. The women were more dressed than usual, wearing their gaudy Bengali shawls over their shoulders, and tall crowns made of broad stripes of cloth entirely covered with white beads, while plumes of white cocktail feathers sprung from their back knots of hair. Some carried in their hands small brass cymbals with which they assisted the music of the drums and flutes. The dancing consists in simple jerky motions of the knees and elbows, with an occasional walks round, in which three or four women follow each other in a certain direction, with curious little hops for a few bars of the music, when the last one, lifting a finger, taps the one in front, and the signal being passed on, the whole jump round and hop gravely back again. The men's dancing is similar, but they hold on to each others waist and belts. Dancing went on till about 12 noon or 1 P. M., when the women resumed their household garb and duties, and the men went in procession from house to house, remaining about an hour to feast in each one, and keeping it up till a late hour, by which time few (if any) had a spark of sobriety left.

82. Schools have been established by the missionaries along the foot of the northern hills: they are presided over by Native Christian school-masters. The pupils are taught reading and writing in Bengali at present; but, in my humble opinion, it would be better primarily to establish industrial schools, by which the Garos would learn some useful arts and improve their condition, before learning reading and writing, which cannot be of much use to them, and cause them probably to become discontented with their surroundings, so that instead of trying to improve their own homes and people, their sole idea will be to better themselves by going away and getting employment elsewhere. The desire to learn Bengali at present, evinced by these border villagers, is probably due to the fact that they transact business largely with Bengali-speaking tradesmen at the weekly hâts.

83. The Garos possess many curious traits: they are slow to move, but when once they have committed themselves to a promise, they, as a rule, fulfil it to the letter; but if it is a work to which they are disinclined, before binding themselves they will make use of every misrepresentation or excuse to get off. At first I almost believed their tales about no roads existing between certain villages or to certain hills, &c., &c., and sometimes felt inclined to give up a project I had formed, but I soon found that when they saw I was certainly bent upon it they yielded, and then were anxious to do their best for me, and, like some people we meet in more civilized society, they only require pressing to do what is required of them. I have said that the Rongrongiri men burned their village on Mr. Daly's approach in December, nevertheless a fortnight after, when they had submitted, they assisted to clear the site, and erect on it godowns, barracks, stockade, &c., with the utmost cheerfulness.

84. When a Garo is killed by a tiger, his father, mother, brothers, and sisters all change their names; a man who has been attacked by a tiger, but escaped, changes his name to prevent the tiger knowing him again. A Garo constable, Rungsen by name, who went with me as guide and interpreter, and used to perform war dances, &c., by the camp fire at night, became widely known among the Garos, and was hailed as we pass them during the day by men, women, and children. I said, "you know a great many people," to which he replied, "I don't know them, but they know me somehow. I must throw away the name of Rungsen and take another. I don't care to be recognised and shouted at by every *sala* Garo I meet."

85. I cannot better close this account of the Garos than by giving Colonel Dalton's summary of their character, in which, with this exception, that I did not find their love of truth very conspicuous, my experience of them enables me most cordially to agree. Writing in 1847 Colonel Dalton says: "The Garos are lively, good natured, hospitable" (I was generally well received, even in the lately independent villages, and when I visited any a second time, I was always met with a smiling welcome), "and honest in their dealings, till contaminated by their intercourse with Bengalis, and they possess that pearl of great price so rare among eastern nations,—a love of truth. They do not readily make engagements, because when they do they really intend to keep them. They are affectionate fathers, kind husbands, and their conduct towards women is generally marked by consideration and respect; very industrious. The women, notwithstanding their lavish exposure of the person, are chaste, and make good steady wives, sharing all the toils and enjoyments of the husband. They appear to me to be easily won by kindness, and that they are susceptible of emotions of gratitude, is shown by the veneration and respect they pay to the memory of David Scott. That the same feelings could be again engendered in them by kindness, attention to their habits, and perseverance, I fully and firmly believe." The truth of this last sentence has been proved, I think, by the success which has attended Captain Williamson's administration.

86. In concluding this report, I must mention that the thanks of the Survey Department are due in a very special manner to Captain Williamson for the valuable assistance he rendered the party under my orders on all occasions. Thoroughly appreciating the value of our work, and possessing some knowledge of our *modus operandi*, he frequently anticipated our wants, and to him I owe many valuable suggestions for carrying on the work, while his personal kindness to every member of my party never failed. Thanks are also due to Mr. Cawley for the ready help he invariably afforded me when I required it, especially during Captain Williamson's absence from Tura at the very commencement of our season's work.

87. I must also record the obligations I am under to Mr. M. T. Ogle of this party for the great trouble he gave himself before I left Shillong in October in hunting up and supplying me with all the information which his knowledge of the work already done in the Garo Hills and his experience in the Department suggested to him as likely to help me. I may add that none of this information proved superfluous.

From C. J. LYALL, ESQ., *Under Secretary to the Government of India, Department of Agriculture, Revenue and Commerce, to the Surveyor General of India,—No. 756, dated Simla, the 7th November* 1873.

I am directed to acknowledge receipt of your letter No. $\frac{F.}{408}$, dated the 15th July last, submitting reports by Captain W. F. Badgley of the Topographical Survey, and Mr. G. H. Cooke of the Revenue Survey, on the survey work done by them during the season of 1872-73 in the Tipperah and Lushai Hills and the Northern Chittagong Hill Tracts respectively.

2. I am to request that you will convey to Captain Badgley and Mr. Cooke the acknowledgments of His Honor the President in Council for the excellent and efficient manner in which they have carried out the difficult work allotted to them.

Extract from a letter from C. U. AITCHISON, ESQ., C. S. I., *Secretary to the Government of India, Foreign Department, to the Secretary to the Government of Bengal, Political Department,—No. 7 P., dated Fort William, the 2nd January* 1874.

PARA. 1. In acknowledging receipt of the several letters from the Bengal Government marginally noted, relative to the defence of the Eastern Frontier, I am instructed to convey the cordial acknowledgments of the Government of India to Captain Badgley, Mr. Power, and the other officers whose services in connection with the recent survey operations on the frontier have been specially brought to notice by His Honor the Lieutenant-Governor.

No. 1756, dated 7th May 1873.
" 3149, dated 19th August 1873.
" 3150, dated 19th August 1873.
" 3152, dated 19th August 1873.
" 3530, dated 11th September 1873.
" 3934, dated 10th October 1873.
" 4112, dated 22nd October 1873.

3. The next point for consideration is that discussed in your letter No. 3149, dated 19th August 1873, *viz.*, the definition of the eastern boundary of Tipperah and the measures to be adopted for its defence. His Excellency in Council approves generally of the eastern and south-eastern boundary of Hill Tipperah as proposed by the Lieutenant-Governor, *viz.*, the Sungai river between the Hachik and Jampui ranges to its source, then across to the Dalajeri peak, and then by the recognised southern boundary to the Fenny. The Survey Department should work out the details at convenience.

Endorsed by the Government of Bengal, No. 341, dated 24th January 1874.

Forwarded to the Surveyor General, with reference to his letter No. 409 F., dated the 15th July 1873, with a request that he will be so good as to make the necessary arrangements for working out the details of the eastern boundary of Hill Tipperah next season, and that he will communicate to Captain Badgley the approval expressed by the Governor General in Council of his work last season.

REPORT ON THE SURVEY OPERATIONS IN THE NAGA HILLS AND MUNIPUR DURING THE FIELD SEASON 1872-73.

From COLONEL H. L. THUILLIER, R. A., C. S. I., *Surveyor General of India, to the Secretary to the Government of India,—No. 313F., dated Simla, the 27th June* 1873.

Adverting to my letters as per margin, relative to Major Godwin-Austen's application for permission to resign his appointment in this Department, as well as for six months' leave to Europe, with one month's subsidary leave to port of embarkation, I have the honor to submit, for the information of the Government of India, the narrative report on the survey operations in the Naga Hills and Munipur Boundary executed by that officer during the past field season, together with a copy of the map of the ground surveyed, showing the Munipur Boundary.

No. 84F., dated 13th May.
No. 297F., dated 25th June.

2. The Deputy Superintendent's report is very full and complete, giving a succinct history of his proceedings in company with the Boundary Commissioners. It also contains much valuable information on the physical aspect, geology, scenery, climate, races, tribes, &c., of that portion of the extreme North-Eastern Frontier.

3. The survey results are extremely satisfactory, and, when put into proper shape, will, no doubt, prove highly interesting; the professional details will take time to work out, and will more properly be noticed in the annual administration report. They are very creditable to the energy, skill, and perseverance of Major Godwin-Austen and his excellent Assistant Surveyors specified in the margin, whose labors form an entirely new and valuable addition to our geographical knowledge of that frontier.

Messrs. Ogle and McCay.

4. In consequence of an urgent requisition* from the Foreign Department, through the Government of Bengal, for the submission of this report at an early date, it is forwarded in original, directly as received, to the Government of India, in consequence of Major Godwin-Austen's existing unusual position, with a recommendation that it may be printed, or such portions of it as may be deemed necessary, and supplied to the Foreign Department as well as to the Bengal Government with all practicable expedition.

* Foreign Department, to Bengal Government, No. 1096P., dated 29th May 1873.

5. The return of the report, together with the map, to this office is particularly solicited. The map, although only a copy, is valuable, and should be carefully preserved.

From MAJOR H. H. GODWIN-AUSTEN, F. R. G. S., *&c., Deputy Superintendent, Topographical Survey, to the Surveyor General of India,—No. 42A., dated Shillong, the 14th June* 1873.

I have the honor to forward report on the operations connected with the Munipur and Naga Hills Boundary Survey.

2. I left Calcutta on the 20th November, and proceeded to Khústia and thence by steamer up the Bráhmáputra to Dunsiri Múkh, where I found Mr. Ogle and Mr. McCay, with establishment told off for the Naga Hills, awaiting my arrival; they had preceded me from Gowhatty a day or two by another steamer. Leaving Mr. McCay to proceed to his ground in the Mikir Hills close by, I took the remainder of the party on the Nuigri Ting, arriving there on the 10th December. Golaghat was reached on the 12th, delayed there five days while 35 coolies were being collected, and marched on the 18th for Sámágúting. Captain Butler met me that day at the Namba hot-spring, and rode back the same evening to Borpathar after we had discussed our plans for the season's survey.

3. Sámágúting was reached on the 24th, and everything was ready for a final start into the hills on the 27th, when I left with Mr. Ogle to take up the preliminary triangulation. Captain Butler started the same day (27th December) for Kenoma or Poplongmai, to meet the Political Agent of Munipur, and we were all to meet again at Kohima. On the 28th visited the trigonometrical station of Kadiuba with Mr. Ogle to fix the plane-tables and build the mark, and commenced work selecting trigonometrical stations, &c. As, prior to an advance eastwards, it was very necessary to extend the triangulation, and fix as many points as possible on the distant ranges, the plan of operations was as follows. Mr. Ogle was to visit and observe at the stations of Rékromah, Nidzúkrú, and back to Kadiuba, and at the same time to sketch in as much of the country he passed over as possible on the ½-inch scale, and thus fill in sheets Lat. 25°-30′ to 26°-0 Long. 94°-0 to 94°-30′ portions of which he had already done in a previous season. I was to

proceed to Japvo Peak, the highest point on the Burrail, clear it, and connect with the old stations of Paona and Kadiuba, observe angles to Mr. Ogle's new stations, then go on to Tellizo Peak, and, after fixing a few points on the disputed boundary line near the Sopvomah group, be ready to take up, in unison with the Political Agents, the survey of such boundary they might agree upon on a larger scale, and thus complete that portion of the work the Government were so anxious should be completed before any further advance was made.

4. Owing to a bad fall Captain Butler met with on march near Jotsomah, the Political Agents did not reach Kohima until the 3rd January 1873, but the intervening time was well spent in plane-tabling the country around. The same day (3rd), after arranging that the whole party should rendezvous at the village of Kidimah in about 14 days' time, Mr. Ogle marched for Rékromah with a guard of 15 constables of the Naga Hill Police, and, accompanied by another party, I left for Kigwémah, situated under the Burrail, and whence the ascent of Japvo was practicable. On the 4th, leaving tents and heavy baggage below, we made the ascent, starting at 9 A. M., and reaching the summit at about 4 P. M., a most laborious climb through forest, the path requiring to be cleared in many parts. Camp had to be formed 1,000 feet below the peak, as the last portion of the way led over rocks where men with heavy loads could not well make their way; water would have been also too far off; it was already a two hours' ascent distant. The weather was very unpropitious; for four days driving cloud hid everything. The cold at this elevation, just under 10,000 feet, was very great all day, falling to 22° at night. During this time the clearing was in progress, and some 40 Nagas of Kigwèmah came up and took a share in it with the Khási coolies.

5. After a heavy fall of sleet and snow on the night of the 9th January, there was a sign of a break in the weather, and it was clearing fast, when early next morning I reached the summit. By working very hard, the Khásis and Goorkha Kalasis cleared the way to Paona through the forest, and that station could be well seen by the evening. Mr. Ogle's marks were also up. The fine peak we had just seen the apex of from Kadiuba H. S. came into view the last thing about sunset, then a fine snow-capped cone (since found to be 12,600 feet high), the highest yet observed south of the Bráhmápútra. It was too late that day to commence observing, but much work was done on plane-table. On the 10th January, all the angles, vertical and horizontal, were observed; it was punishing work, for the wind blew very cold, and at times my hands were powerless to clamp or unclamp the instrument. During the previous bad weather, the moisture-laden clouds meeting the cold air of the ridge, precipitated their moisture in hoar frost on the trees, which were covered with ice spicules two inches in length having a beautiful effect, when a gleam of sunshine broke out, and as the clouds now and then cleared, the whole range appeared as if covered with snow. True flakes of snow seldom fell, but heavy falls of sleet occurred several times, leaving the ground quite white.

6. The view from Japvo was superb, one of the finest I have ever seen. On the north, over the valley of the Bráhmápútra, covered with a pall of white sea-like fog, out of which at 100 miles distant rose the snowy peaks of the Western Bhútan Himáláyá. East, over the gradually ascending main range, beautifully broken into well-marked peaks, all over 11,000. The main ridges trending to the north, and ending in the low intricate hills, upon the plain of Assam near Nazirah. To the south, a low depression in the mass of the hills allowed a portion of the valley of Munipur to be seen with the higher hills beyond in the Kamhow Kúki country. On the south-east, the peak of Japvo falls almost perpendicularly into the valley below 4,000 feet, and the eye follows this lateral valley to its junction with the Zúllo, the large Naga villages showing clear on all the commanding points of the many spurs thrown off from the Burrail. On the 12th I joined the Political Agents at Kidimah, and commenced the survey on one inch-to-mile scale of the line of boundary they had determined on. This leaves the line of main watershed of the Peak of Khúnho, takes a sweep round to the north, and again rejoins the watershed at the Peak of Tellizo, thus giving over the Sopvomah or Mao group of villages to Munipur.

This, I may remark, as it fell under my immediate observation very frequently, has caused a very dangerous amount of dissatisfaction among the inhabitants, who always considered themselves, like Kohimah and other villages to the north, if under any rule, to be subservient to the Indian Government. Such I believe to be the case, confirmed after reading through the old correspondence about 1835 in time of Captains Pemberton and Gordon in the Munipur office of the Political Agent, where the latter officer clearly states that in time the *Barak* was considered the northern boundary of Munipur, alluding to the Anghami Naga side, across which they never then asserted any authority.

7. I cannot but notice that in all the past correspondence relative to this boundary all matter in favor of the claims of Munipur appears to have been very carefully extracted and put forward, while much having a contrary tendency has escaped notice. Nothing can be stronger or plainer than what is stated by Captain Gordon, and no question simpler than the settlement of this northern boundary. The claims of Munipur on the Mao villages she has now got, rest solely on marauding expeditions, like that of the present year.

While working in this part, Munipuris under Major Romah Sing were in our camp. They could neither collect supplies in the Mao or Sopvomah group, or even in villages like Sikhámi

on the watershed, yet Captain Butler could obtain any amount; this was partly owing, no doubt, to the fact that the Munipuris never pay for any supplies they obtain, partly to the determination on the part of the villagers to show they were not in any way under Munipuri authority, although they were repeatedly told they were to be in future under that State.

8. If I may be allowed to express an opinion, I consider that Government have been led to make a grave error in giving up villages north of the watershed.

Boundary pillars were set up to mark the new line at both its extremities, and across the spur between the Zullo and Sijjo rivers; three of these are trigonometrical stations. On the 17th, Major Romah Sing (the Raja not being satisfied with this new line) announced his intention of knocking them all down; this would have at once brought matters to a crisis, and completely stopped the progress of the triangulation and survey of the line. However, owing to the firm attitude assumed by Captain Butler, the Munipuris did not carry out their design, and the survey of this part of the ground, 30 square miles on the inch scale, was completed, and the original submitted to your office on the 24th January. The Major then, by orders to the guard and coolies supplied to Colonel Mowbray Thomson by the Raja, tried to prevent that officer moving with us to the extreme point of this new line of boundary, but eventually they were allowed to go as far as Kezakenomi just below Telizo; the reason for this action was soon apparent. The day we arrived in that village, news from the other side of the high range was brought in that a Munipuris force of 400 sepoys, Kukis, &c., was encamped on the Lanier, and were threatening certain villages on that side; this news was confirmed on our return to Kezakenomi a few days afterwards. The anxiety of the Munipuris and attempt to prevent our moving in this direction was now apparent, but this act of Munipur was the more glaring from the fact of the Raja having lately declared in letter his inability to provide a proper escort for the survey of the watershed line, owing, as he stated, to financial difficulties brought about by the late Lushai expedition.

9. As neither guard nor coolies with Colonel Thomson would go any further, it became necessary to return to Sikhami, give the Munipur Major another chance, or arrange in some way for that officer's advance with us. Before leaving, the village of Kezakenomi promised to send up and clear the Kopamedza Peak, and I left two Goorkhas with them to assist and show how to build the mark. This was up by the 26th, and that day Thizami must have been burnt. Gaziphimi had been destroyed on or about the 23rd. The trigonometrical mark over Razami showed the raiding force we were close by, and they retired without making attempt to take it, as they had intended. The return to Sikhami was of no avail, and we only lost three good days by doing so. Neither Romah Sing, guard, nor coolies would proceed with the Political Agent, and that officer then decided to leave everything behind and go on with us, and by reducing, we were enabled to supply the coolies. We returned to Kezakenomi on the 25th, crossed the Kopamedza Range on the 28th to Razami, and found that all the Naga information regarding the Munipuri force was correct.

10. The next day ascended to the peak which had been cleared by the men of both Kezakenomi and Razami, and observed all the angles, assisted by Mr. Ogle, who was sketching this part on the ½-inch scale; the weather was extremely fine, and the distant ranges all in view. On the 30th we marched through the site of Thizami to Gaziphimi, where the people were living in hurriedly-constructed huts of boughs and the few mats they had saved. The stockaded camp of the Munipuri force was seen on the banks of the Lanier below the village; we heard all the details of the attack, and it appeared they had never visited these villages before. It was a trial expedition to see whether they could bring these villages to pay up their demands, and, had it succeeded, it would have been brought forward to establish their claim of long occupation and attachment.

11. On the 31st, Mr. Ogle and myself proceeded to the east, plane-tabling, and on the 1st February marched towards the westward along the ridge, intending to encamp at Shipvomi. Mr. Ogle and myself remained behind, plane-tabling as we came along, so that it was not until 3 P. M. that we got to the stream at the bottom of the valley below the village, where breakfast had been prepared. Captain Butler and Colonel Thomson having finished theirs, were waiting for us; the latter did not wait long, but started on to look after the camp. Captain Butler remained with us until breakfast was nearly over, but started a few minutes in advance. I had not got up the hill side more than 200 yards, when Captain Butler shouted out to come on quickly, as there was a row in front. We pushed on as hard as the steep path would let us (the ascent from valley to village was about 1,500 feet), and it seemed an age before we came up with the advance guard, and hearing shots fired far up the slope only made the time appear the longer and the path the steeper, struggling, as we believed we were, against time. On getting to the front there was naturally a little confusion among the coolies, but it soon subsided, and the rear guard having come up with us, line was extended on both sides of the path, and we slowly advanced through the jungle up the spur towards the village. The Nagas, who we could hear in front, retired, and as we entered the village defence at two points, only a few showed themselves on the highest part, and they bolted on, a few shots being fired. Two of their number had already been hit when they charged down on Thomson and the advance guard; another was now hit and carried off. It appeared that that officer had come up with the advance guard just in time; some fifty or more were assembled up the hill with spears and shields; after a parley, and failing to make Thomson leave the path, they charged,

but a volley from the police caused an immediate retreat. Just after dark they came in and fired the south-east end of the village. We had, however, selected a strong position near a fine large shingled house on the highest part, and, by pulling down and firing the houses in our vicinity, and stockading the north side, made our position very secure.

12. However, contrary to expectation, we were not annoyed by the Nagas during the rest of the night, and all kept watch in turn; to the burning houses in the village we probably owed this quiet, for they lit up the whole place as bright as day. Villagers of Yemai, the next village on the east, came in next day and tendered their submission, and promised supplies should we proceed their way; these men were detected about noon firing the few houses that were left standing, and were much to their surprise immediately put in charge of the guard; we, however, let them go back to their village late in the evening. The second night the Nagas were heard about, and some seen passing to the side we had come in by; the night was dark, but by keeping up large fires in advance of the sentries the ground could be seen for some distance. They began surrounding our position about 8 A. M., numbers of them coming up the spur from the south-east, fully armed, many helmeted in their peculiar way. They were not allowed to come near, and a shot was fired now and then, on which they got under cover behind trees and rocks at about 400 to 500 yards.

13. Captain Butler with the interpreters went out towards the other end of the village, and shouted to them to come in without their arms, and after about an hour, two of the chiefs did so. The first parley did not end in anything satisfactory being done; they were told if they wanted to fight to do so, but if they wanted to make peace we were willing to leave the place. They left saying they would confer with the other men of the village. After the lapse of an hour they returned ready to make peace, and this was duly ratified by the sacrifice of a fowl. We marched out as they came in, and began collecting the remains of their burnt property, and had it not been for their old enemies, the men of Yemai, a great many more houses would have been left standing, and much more of their grain would have escaped destruction, for these men even fired the pits in which it was stored. We took the road to Yemai, and halted there one day to sketch the country towards the head of the Lanier, and I was able to fix the position of the village where the Munipuris had located themselves, Mezimah of the Nagas, the Provi thanna of the Munipuris, as we afterwards discovered.

14. The next day we crossed the watershed into the Iril valley and *vid* Unromai over the high south extension of the Kopamedza ridge to Mehulmai, and thence back to Sikhámi. The wildest rumours had been circulated about the country, with the addition that we had all been cut up; this led the Nagas of Sikhámi to actually make a demonstration against the small Munipur guard left there with Colonel Thomson's baggage, whom they surrounded in a threatening way, and were only kept at a distance by being fired at, and not a man in camp slept that night. Romah Sing joined this camp the next day, and the news came in the interim that Shipvomi had been burnt. This affair only showed how small a spark would kindle a rising, and had we, by any possibility, suffered a reverse, commencing in a general stampede of the coolies, and loot of the baggage, I think it not improbable Sámágúting might have been threatened, where but very few men had been left. I therefore consider it would be a wise precaution, when such expeditions are on foot, which denude the Head-Quarter station of its best men, that a reserve of the Native Infantry be moved up to some convenient place, ready as a reserve in case of accidents, yet more to show the hill people we have plenty of men to fall back on, and that any falseness on their part would be followed by retribution.

15. It must not be forgotten that, although the larger Naga villages have been severely handled by us on one or two occasions, yet this is only remembered by the old men; all the youngsters, who will have it soon their own way, and have it in some villages, scarcely believe the tale, and make light of it. Arms and ammunition they are greedily anxious to obtain, and, undoubtedly, do so every year despite all precautions we may take to prevent it. A very close watch should be kept on the side of Munipur; they will soon have a large number of old muskets to get rid of in some way or other, the only incentive being the turning of them into money. Packages of cartridges made in Munipur we saw in the hands of Nagas, the paper used in one case being some journal on photography.

16. As it had been ascertained without doubt that the Munipuris had crossed the main watershed, in direct disobedience to the orders of the Government of India, and that the Raja was able to send a marauding force beyond it, while at the same time he was stating his inability to aid the Political Officers and survey in making a map of the country, the Political Officers resolved to go into Munipur itself, and see the Raja in person, after which Captain Butler hoped that he would enter into our plans, and give the required assistance on his north-east frontier. This arrangement did not interfere with my own particular work, for, having discovered that the sources of the Lanier lay so far to the south-east, it was quite as easy to get into that quarter from the side of Munipur, up one of the main valleys, as from the Naga Hill district side. Moreover, it was very questionable what the Munipuris would have done had we pushed on into the Tangkol Naga country by ourselves. Even with regard to the attack made on us at Shipvomi, suspicion was not altogether removed from Major Romah Sing's camp, although we were willing to attribute the action of that village to the fate that had but lately attended Gaziphimi, &c. This the villagers of Thiwa did say, that men of Mekribama had come over the ridge, sent by the Munipuris, to tell the men of Ship-

vomi to put their spears into us, should we attempt to pass that way; this was on the direct road to Prowi, where the thanna had been established; and to prevent our seeing or getting to Prowi was the point they had all along endeavoured to gain. Before we learned the geography of that part of the country, the Munipuris always stated Prowi to be on the Munipur side of the watershed.

17. It then being decided that it was politic to go to Munipur, new plans for the survey had to be formed, and I decided on a secondary series of triangulation extending from the base Khúnho to Tellizo, due south, as far as we could carry it into the Munipur valley and to carry on a sketch of the country on the ½-inch scale. As the regular marches were made, this became very heavy work, and for the four days we were marching into the valley neither myself nor Mr. Ogle got into camp until between 9 and 10 o'clock. Very fortunately we had fine moonlight nights, thus a good survey of this route was made and hills were selected and marks set up. Major Romah Sing at once objected, and the villagers were warned not to assist; this did not, however, prevent the plane-tabling. After arrival at the Residency at Imphall, and meeting the Raja in Durbar, who refused most distinctly to give any assistance, I desisted from all survey work. It was very apparent that the Raja, by putting off the survey as long as he could, hoped the season would get so advanced we should perhaps be unable or at last unwilling to proceed with it, and more time would be gained. Hints were often thrown out by the Tangal Major "of the increasing heat of the weather," "the approaching rains," &c., and they were not without hopes in a change of the Political Agentship before the survey could be accomplished. However, after ten days of inactivity (but during which interval I marched south as far as the Logtak Lake to look at the country), a change seeming to have come over the officials, I sent a letter through the Political Agent to the Raja, asking for purwanas on the villages in the valley, and that I desired to visit certain hill-tops. After a delay of two days the permission was accorded, but nearly all the hills mentioned were barred, as being the abode of certain deities. However, this matter was adjusted with Tangal Major, and men were sent off at once to pole up the selected points. Mr. Ogle proceeded to the north-west and myself to the north-east, working back east to south.

18. We were soon engaged at the triangulation and sketching of the valley; in the last we were much aided by the points I had fixed in 1868-69, and by Mr. Ogle in 1869-70 from stations on the Burrail, near Ossalee. All the clearing and mark-building was done by our Khási coolies, and I am sorry to add that several of these marks, which took hours to collect materials for and build, were wantonly cut down, and the mark-stones dug up; as they were not touched for many days, and the villagers were certainly not inimical, and that they were cut down about the same day, I have reason to suspect that some order was issued. However, all the triangles were finished in neighbourhood of the capital by the time the peremptory orders of Government came up from Calcutta, and before all was arranged for final start up the Iril valley. Mr. Ogle and myself started ahead, and the former surveyor eventually went off by himself to the north-west to carry on the triangulation, and I, after observing at one other station—Laisen—marched on with the Political Agents up the Thobal valley, in the direction of Prowi, sketching all the country *en route* to the source. Here we crossed the main watershed, and were again in sight of the above place. Before going there we proceeded to the south-east to Shirúi and the peak above Shiruifúrar, whence I got a magnificent view of all that side of Munipur, and erected a trigonometrical mark on it. We reached Prowi on the 31st March. The Munipuris burnt their stockade on the 1st April, and all their store of rice laid in at the expense of the villagers, to whom they gave the significant warning,—"The Sahibs are here *to-day*, but we are here *always*." As it was now late in the season, and the triangulation still to be connected, we left Prowi the next day to finish the intermediate piece of watershed on the west, near Kachai and Thiwa, crossed the Iril below Gnamchow, and the Kopamedza Range above that village, and again descended on the Barak river at Maithaiphum.

19. Mr. Ogle had made great progress, had not been impeded, and joined us on the 8th April. We remained there to observe at the last stations in the neighbourhood; only Tellizo and Khúnho now remained to be visited. Mr. Ogle proceeded to the first, Colonel Mowbray Thomson returned to Munipur, and Captain Butler and self left for Sopvomah below Khúnho. On the ascent to this peak I met with what might have been a very nasty accident by falling into a concealed pitfall in middle of the path; fortunately the pit was not spiked, so that I escaped with a severe shaking and a bad cut on joint of forefinger, which has caused a permanent still joint, but I was able to go on fortunately and finish the angles, and closed the work for the season. Halted two days at Sopvomah, as the fall had left me so stiff and bruised. We reached Sámágúting *vid* Jotsomah on the 15th April, and left again on the 21st. At Dimapur we waited a day for Captain Butler to come up. I took the opportunity of exploring the old ruined temple there, which is very curious and interesting; we made a plan of the place, and I was able to make several drawings of the pillars and the sculptured stones. Reached Golaghat on the 26th, and thence we came on by boat down the Dunsiri to the Múkh on the Bráhmapútra, and by steamer to Gowhatty, arriving at recess quarters here (Shillong) on the 8th May.

Individual exertions of Assistants. Mr. M. T. Ogle, Surveyor, 4th grade.

20. This surveyor has worked with his usual zeal, and seconded me in every way. It is mainly to his efforts that the connection of the triangulation commenced in Munipur was carried successfully and closed on the base of the first work at Khúnho and Tellizo. Mr. Ogle also filled in the topography at same time between the base of the Koupru range and the

River Iril. I brought this Assistant's services to your notice in February, and you were good enough to promote him at once to the rank of surveyor; he completed 295 square miles on ½ inch, and 460 square miles on ¼ inch.

Mr. J. McCay, Assistant Surveyor, 4th grade.

21. Has turned out very well 670 square miles on the ½-inch scale of a portion of the Mikir and Rengma Naga Hills, working the whole time in most difficult ground, covered, I may say the whole of it, with dense forest jungle. This is a great addition to our topography on the Assam side. The extra points supplied by the Great Trigonometrical Survey under Mr. W. Beverley proved most valuable in getting an accurate map of this little-known tract. I have much pleasure in being able to report so favorably of this young Assistant.

Area surveyed and triangulation.

22. The total area surveyed is 3,005 square miles, of which, including the 30 square miles of boundary survey on the 1-inch scale, 172 is re-survey and overlap, giving a total of fresh topographical detail 2,833 square miles. The area of triangulation is 3,850 square miles. Twenty-four stations were observed at, and about 105 points will have been laid down from them on completion from the computations.

The cost of the detached party on the Naga Hills side was Rs. 23,643 up to the end of May, or about Rs. 7-14-0 per square mile.

Health of party.

23. The Khásis, who marched early in season from Gowhatty to Golaghat, suffered many of them from fever, and two died, but they soon threw it off in the fine climate of the Naga Hills, and returned to Sámágúting in capital health, as well as the rest of the native establishment. From Dunsiri Múkh I brought them out to Gowhatty by steamer, and thus they arrived in the same good health in Shillong. The welfare of the Khásis is important; they have done excellent service as coolies for years with this party, but they would naturally be chary of proceeding into more remote parts of the frontier if they found many of their number lost their health and lives in the expedition.

Physical aspect of the country, geology, &c.

24. Proceeding from Golaghat towards Sámágúting, crossing by the ferry to the left bank of the Dunsiri, the road keeps close to its winding courses the whole distance. At five miles from Golaghat the forest is entered, and this is continuous to the foot of the hill for a distance of 44 miles. Only one open piece of ground occurs, called Borpather, which is under rice cultivation, and is the site of a village inhabited by Assamese and Aitonias, descendants of Shan Burmese by Assamese women; this open bit is not more than 1½ miles long by 1 mile broad. This valley of the Dunsiri stretching from the base of the Mikir Hills on the west to the base of the Lhota Naga on the east, with a breadth of some 15 miles, is a dead level, only just raised above the inundation level of the streams. The Doyong flows through the eastern side to join the Dunsiri just above Golaghat. On the Golaghat side of the Namba stream, which comes in on the left bank, the road rises and passes over a low terrace of older river conglomerate, a remnant left abutting against the low hills. In the bed of the Namba rock *in situ* is seen thin-bedded sandstones nearly horizontal, which abut against gneiss where the river falls suddenly from a higher level of this rock. One of the highest beds exposed here is a fossiliferous limestone, which has been burnt for lime in small quantities; it is, however, not pure enough to be used for white-washing, though making a good mortar. Mr. H. B. Medlicott, of the Geological Survey, reports on this section in his "Coal of Assam," and considers these rocks of cretaceous age. Coal has been found by Captain Butler higher up the Namba, and the specimen which I have from that officer is similar to the cretaceous coal.

25. The dead level portion of the Dunsiri valley comes to an end a few miles to the westward of Dimapur; and at a very short distance towards Sámágúting the surface gradually rises over the broad conglomerate deposits swept down out of the gorges of mountain streams like the Diphúpáni. The first line of hills rises abruptly to 2,000 feet, with a strike with the strata north-east and south-west, dipping south-east, towards the main range at about 30° on the crest, the dip increasing rapidly northwards until nearly perpendicular at the very base, probably making a great meridional bend in the rocks. These consist of sandstones, very thick bedded in the upper portion of red and ochrey color, interstratified with thinner beds of an indurated, light colored clay, nodules of which are very numerous and conspicuous in some of the soft sandstones. In exposed sections, such as that near the new tank, the strata are seen to be closely faulted in direction of the strike, the upthrow never exceeding a few feet. These beds I should refer to the Siwalik series; no mammalian remains have as yet been found in the neighbourhood.

26. Nowhere is a better and more comprehensive view obtained of the broad alluvial valley of the Dunsiri and its great forest than from Sámágúting; mile beyond mile of this dark forest stretches away, and is lost in the distant haze. During the cold weather this is usually in the early morning covered with a dense woolly fog; this about 10 o'clock begins to roll up from the Bráhmápútra against the northern slope of the Burrail, and often hangs over Sámágúting and all the outer belt of hills late into the afternoon, when the increasing cold dissipates it. This makes Sámágúting even in the cold weather such an undesirable residence.

27. The sandstone ridge on which Sámágúting is situated runs parallel with the Burrail at a distance of 15 to 16 miles, measuring from crest to crest, respectively. The Burrail rises very suddenly on its northern face, and the intervening country for a breadth of 8 miles is very low, forming a miniature "Dhún;" this intermediate depression continues westward for many miles, the outer range marked by the hills of Phegi H. S. and Laikek H. S. It terminates to the eastward on the Kadiuba, spur thrown off from the high north-east extremity of the Burrail, and this spur coincides with the great east upthrows of the Sub-Himalayan rocks composing the highest parts of that range, and this, I believe, is a great north-north-west—south-south-east dislocation in the mountain mass, marked by the course and the gorge of the Zubza. This dislocation is, I think, intimately connected with the change in direction of the main axis of elevation, which has thrown the line of main watershed away to the south-east from its normal south-west—north-east direction which it assumes at Asálu. The dip of these tertiary rocks of the Burrail is steadily to the south-eastward throughout the whole distance, but it gradually changes round to due west, the beds on the highest part, Japvo, turning up at an angle of 35° west, being fine slightly-micaceous ochre-grey sandstones, very massive and weathering pinkish grey. From this the elevated outcrop of these sandstones trends to the south, and is continued south of the Barak in that direction right away into Munipur, conforming with the change in the strike of all the ridges, the parallelism of which is such a conspicuous feature of the physical geography. To the north-north-west the great change in this mountain system is marked by the broad re-entering arm of the Dunsiri, and the sudden appearance of the granitic series in force in the Mikir and Rengma Naga Hills, seen in the bed of the Namba, and which becomes the principal feature eastwards as far as the Garo Hills. Extensive and thick-bedded deposits of clay and conglomerate are seen in the Sámágúting Dhún, forming broad plateau-topped spurs. I had no time to examine these closely; they appeared to be nearly horizontal, and may belong to the highest beds of the Siwalik formation, or the remains of deposits formed prior to the cutting through of the Diphúpáni gorge. Analogous deposits to the last occur in the Dhúns of the North-West and Punjab Himalaya.

28. At the base of the Burrail, proceeding to the depression at the sources of the Zullo and Sijjo, the Sub-Himalayan rocks pass downwards into thin-bedded sandy shales, with the steady westerly underlie. Whether the lowest beds represent nummulitic or even cretaceous rocks it is impossible to say; the thickness is very great, at least 3,000 feet; they rest on an older series of rocks, with a totally different lithological aspect. There is unconformability not always apparent, for they partake of a general westerly dip. The strong-bedded younger rocks are but little disturbed, and on the east of the Sijjo come in again at Tellizo, nearly horizontal, with a slight dip to east on main ridge towards Kopamedza, making an anticlinal axis; their horizon is, however, lower. The older beds, on the contrary, are much crushed, and change their dip and strike very frequently, the result of prior disturbance. They are composed of clay slates and very dark blue friable shales alternating with others of pale ochrey tint; they are saliferous, and veins of milky quartz occasionally occur. Several salt springs occur near the bottom of the Zullo valley under Visvemah, where the Nagas evaporate the water to obtain it; a warm mineral spring also occurs here.

Nomenclature of the different range, &c.

29. The natives of the country have no general term to express a range, and only distinguish by name certain of the peaks. In writing of their run and physical features, a nomenclature must be supplied. I have adopted the name of the highest peak, or best-known peak on a range, to discriminate one from the other. The Burrail is a well-established name for the mountain range up to 94°10′ longitude, its highest part at Japvo and Tennepú, where it terminates. It is quite unsuited to the main range east of this, and I shall designate the whole mountain mass east of the Doyong and its tributaries up to the neighbourhood of the Patkai pass as the "eastern Naga range," in contradistinction to the western Naga or Burrail; beyond the above pass it is already well known on our maps as the "Patkai" up to the sources of the Dihing on longitude 97° east. A glance at the map will show that east of the Burrail the hill region is a component of many parallel ridges alternating high and low, with a general north-east south-east strike, given off from a watershed considerably lower than these ridges, having a more or less north-east—south-east run.

30. The first of these ridges, commencing on the west under the Burrail scarp, I call the Sopvomah, from the group of villages situated near where it is given off from the main watershed. It separates the Zullo and Sijjo, and runs north north-east for 24 miles, the two streams there uniting to from the Doyong. Orographically this ridge, still a subordinate one, is continued south of the Barak by the Khiba ridge to Yangbalang Khong and the Langol Fila close to Munipur; the high Koúpru ridge rises above it on the west. The next ridges or rather range on the east is of considerable elevation, some 8,000 feet, and a principal feature in the landscape, shutting out the view of all the country to the eastward, and separates completely the Naga tribes of the respective sides. This I name the "Kopamedza ridge," from the name of a high point and trigonometrical station. It commences with the gradual rise to Tellizo peak, and continues to the north north-east into the Lhota Naga country for 45 miles, and to the south-east for 34 miles to the junction of Ihang and Iril. On its western face are the main sources of the Barak or Kwedzú, and on it are the peaks of Chinghú, Laisom, and Khamjom, the two last being trigonometrical stations.

31. The lowest point on the watershed occurs just under and to the east of this range close to the village of Yemai in $\frac{\text{Lat. } 25°24'}{\text{Long. } 94°20'}$ and the source of the Iril; it is here only 5,000 feet above the sea. From this point the line of main watershed has a direction due north and south for 10 miles to the source of the Ihang, a second low depression in the range. This north and south line is continued by a ridge between the Ihang and Iril, which, from being very low, rises suddenly to the hill of Laisen, about 5,000 feet; it ends on the sharp bend of the Ihang, but the strike of elevation is taken up again south by the Mungching ridge. At Kachai, south of the Ihang depression, the Padhai ridge is given off south south-west, and runs parallel to the valley of the Thobal for 36 miles north north-east, by the village of Humi, to the Lanier 10 miles, and can be traced by the subordinate features on west face of the Swemi ridge. The main watershed, again, takes a southerly direction for three miles on the ridge of Toroikáchu, turns sharp to the east under that peak, and is connected by another low saddle of 5,500 feet with the Rapfo ridge, another line of elevation remarkably straight cut through by the Lanier on the north and Thobal on the south. From the peak of Rapfo it is continuous north 15° east by Swemi peak and ridge for 34 miles, and south 15° west, *vid* Lamlang, to the Maphitel ridge, the eastern boundary of the Munipur valley for 28 miles. The main watershed follows the Rapfo ridge southward for five miles, turning sharp east again and heading the sources of the Lanier near Ukrul, and thence to the peak of Shirnifúrar. The ridge, which I name after this peak, continues north for 35 miles, the river Nongtum washing its eastern base; south it extends for a long distance with an easterly inclination, the valley of the Tuyungba on one side and the Jatrik valley on the other.

32. A minor ridge of 15 miles extends north from the watershed at three miles east of Shirinfurar and at seven miles the main watershed, having attended a height of about 10,000 feet, turns north north-east towards Sárámethi; this high portion I shall name the "eastern Naga range." Turning to the lines of lowest depression, and the lowest points on main watershed and ridges, it is interesting to note how exceedingly straight such lines are, and how, eastward, they regularly change direction a few degrees. A slight shift of these lines to the eastward takes place on a line north-west south-east drawn through the peak of Kabalong parallel also to the mean direction of the watershed, and upon this line we find the courses of all the rivers to take a sudden change of direction, and break through what would otherwise be continuous ridges from northward to southward. At this break we also find a change of about 10° in the strike of the valleys and spurs, conformable to that of the rock masses. These features are not accidental, but it is a beautiful example of how present geographical features are subservient to a system of dislocations, due to forces of upheaval and compression, in a past state of the earth's crust. On all the ridges abovementioned the newer deposits, all sandstone, dip to the west at moderate angle, and strike with the ridge, while the stratified rocks at the base do not always follow the same strike, and are often seen with a north-west south-east one, and dip at high angles. Only at Yemai did I find any fossils in a transported block from the high range, and at Laisen carbonaceous shales occurred, both in favor of the cretaceous rocks being represented. In the above shales indistinct fern remains were noticed, but there was no time with so much triangulation to get through to search for good specimens.

33. On the ridge to Rapfo coarse crystalline sandstone caps it, and altered sandstones also occurred associated with a bed of pure limestone at Phunggum.* Here it was interesting to find just below the village to the south a larger boss of injected trap projecting out of the side of the spur, its western face perpendicular and perfectly flat. It accounted for the altered state of some of the rocks. In the bottom of the Lainer valley, a great thickness of hard thin-bedded shaly rocks dipped 75° high to east south-east. The boulders in bed of this stream are nearly all of dark green trap, a few of clay slate veined with quartz, and others of white quartz. These last were the stones good for striking a light, which the Kézakenomah men had mentioned when describing the Lainer, good quartz being very rare on their side. Coarse, pale and bluish sandstones, so like the base of the cretaceous, are seen capping the spur as an outlier dipping west 30°, and resting on the older series, which in ravine east of Shirni village are 80° south south-east, sharp up against the trap, of which I found the whole mass of the Peak of Shirinfúrar to be for 2,500 feet. Much of this trap is composed of large and small nodular lumps of harder greenstones in a full-green matrix, giving it a very lava-like appearance, and the color of the harder rolled boulders in the streams is a very rich tint of green. It appears to be the base of all the rocks, and I expect will form the main axis of the high range, probably associated with granite towards Sárámethi. It is highly magnetic, the compass being deflected about 10°, so that I found it useless in setting the plane-table.

34. There can be no doubt but that the highly-inclined shales (age unknown) that first come in with the anticlinal axis east of the Burrail are the same as those out of which the low Tilasin Munipur have been formed, and subsequently silted round with the valley alluvium. Beds containing nodular concretions are very characteristic, the nodules having a crystalline nucleus, probably originally in organic matter. Veins of quartz are, however, very common in the valley beds, particularly so in the south towards the Logtak, generally running across the bedding east and west; these veins are often very crystalline, and pure isolated crystals of the same an inch or two in length are seen in these lowest rocks all round the valley.

* Which was again seen at Prowi in greater quantity, extending along the spur from Rapfo.

Sandstones showing signs of metamorphism dip at about 30° on the Tila of Nungshigum, probably cretaceous. In unaltered state, sandstone caps the hill of Mungching, which is on the same axis as Laisen, and dip in same direction. The highest beds on Nongmaiching also appear to belong to this series. The Koupru range bounds the valley on the west with a mean height near peak of that name of 8,000 feet; this is gradually reduced on the south: the strata have a uniform dip to the westward. The Maphitel ridges on opposite side of valley separates the Munipur drainage from that of the Kubbu valley, the strata dipping easterly, apparently the younger sandstones leaving out minor kinds in the rocks. The Munipur valley lies along a great anticlinal curve first noticed between the Burrail and Tellizo.

35. About the very centre of the valley, as at Chingamukka, Langol, Langthabal Tilas, and those in the south, the lower shales are formed tilted at angles near the perpendicular, and shew an apparent great thickness; but on the east extremity of the Langol Hill sharp folding is apparent; they are also very closely jointed generally in planes at right angles to dip; and on the Langol ridge this sructure has broken up the harder indurated shales into long pencil-shaped pieces. Interstratified with these clay shales are thicker beds of very hard dark-green and grey altered sandstones, quite quartzitic in appearance. Between the topmost beds of the Burrail and the lowermost shales it is not impossible, both the nummulitic and cretaceous are represented, but the actual lines of separation will be difficult to fix, as is the case in the scarp at Cherra. The limestone seen at Prowi is very likely to be nummulitic rocks, so very similar to the lowest cretaceous occurring on the flank of Shirinfúrar. We have evidence in this mountain area of very old (geologically) original elevation and compression acting on a north-west south-east bearing, which took place prior to a later elevation of the mass into its present horizon, producing the north north-east—south south-west features, and that this last change was accompanied by local trap intrusion, altering the cretaceous rocks, as at Phunggum, and on a still greater scale at Shillong in the section presented at the falls of the Umshirpi, where much altered conglomerates and sandstone abut up against a great development of trap rock.

Old glacial action.

36. Evidence of past glacial action is very marked on the north-east side of the Burrail, where its elevation is close under 10,000 feet. Small moraines project beyond the gorges of the lateral valleys. These moraines originally consisted of much earthy matter due to the soft sandstones out of which they were derived; this and long surface weathering has led to the surface being well cultivated and terraced, but the original lines of larger angular blocks are still apparent. Through these moraines the present stream has cut its channel down to the solid rock, leaving the slopes at an angle of 45½, out of which project great masses of the sub-angular sandstones. The thickness of the moraine at Kigwema is quite 300 feet at the terminal slope, and the length of the former glacier 4 miles to the west of range at Japvo. At the head of the Zullo traces of this former state of things are shown by the even height at which large transported blocks of the tertz sandstones lie up against the sides of the ravine, resting on patches of rubble.

Physical aspect, scenery, &c.

37. No part of the Burrail is more beautiful than that between Kigwema and Sopvomah, looking up the lateral glacial gorges with their frowning, steep sides, running up to the crest of the Burrail, which is for the greater part a wall of grey rock and precipice. Dense forest covers the slopes, but from their steepness many parts are bare, breaking the usual monotony of the dark-colored mountain scenery. Where the steep rise in the slope commences, the spurs are at once more level, and are terraced for rice cultivation; not a square yard of available land has been left, and the system of irrigation canals is well laid out. I have never even in the better-cultivated parts of the Himalayas seen terrace cultivation carried to such perfection, and it gives a peculiarly civilized appearance to the country. The rice raised is exceedingly fine and very nourishing, containing much sugar and gluten; it appears coarse when compared with the table rice of Assam and Munipur, but we always preferred it to the latter, and it can be cleaned to boil quite white. While on the subject of rice, I may mention that the kind grown by the Kukis is remarkably fine and nutritious, no doubt due to their system of joom cultivation, the crop being taken year after year off virgin soil. The Naga rice owes its fineness to the natural richness of the decomposed clay shales, but they also manure at the time of breaking up the soil and before the first water is let in upon the fields. The rice is sown in nurseries and planted out just before the rains. In April these nurseries were just up, and the water was being run into the terraces. A great deal of other cultivation is carried on upon the hill slopes, dependent on the natural rain-fall, and jooming is also adopted; this is the sole method practised by the Nagas living on the outermost slopes upon the north.

38. Leaving the valleys of Zullo and Sijjo, and crossing into the upper Barak, a great change takes place in the appearance of the country. The opposite range (Kopamedza) is above forest-clad to about half way down, thence all the slopes falling to the river are quite bare, and covered with grass, much of it spear grass. This is also the state of all those spurs that are thrown off from the low part of the watershed on the right bank. A few pines of the Khasi hill species are scattered here and there. The river Barak flows with a very serpentine course through a broad alluvial belt, 500 to 700 yards broad; this commences under the village of Gnámi. Here extensive development of water-worn material, which above closes on the

stream, comes to an end, and it is continuous in narrow terraces on either side here and there down the valley, and up into the larger lateral valleys, quite into the narrow gorge of the Barak. It is often as much as 120 feet thick. It points to a time of former lake conditions here, and probably is coeval with the glacial period on this southern latitude. The level round on either side of the river is mostly under rice cultivation, but near Maithaiphum, which has dwindled down to a very small village, hundreds of acres of fine land have been given up.

39. The gorge of the Barak commences where it takes a great bend in a loop of seven miles long round the narrow spur of Itahmi, and thence away through a great and deeper gorge towards Togwemah. The next valley on the road to Munipur from the Naga Hills district is the Ngordui, or Koimaru, broad and open; here again thick-bedded gravel and boulders are seen on the flanks of the valley; and at somewhat higher level than the last of these accumulations seen in the gorge of Barak, and gave rather the idea of a change in surface-level since their deposition. On crossing the low pass at head of this valley, the drainage area of the Irrawaddy is entered, and the road passes through an old lake bed about four miles long by a little more than a mile wide, its edge well marked on the west. It was evidently formed by the detritus brought down by the stream from the Koupru peak, extending right across the valley and damming it up. With the present conditions the Koupru stream now washes this terrace of detrital matter, and combined with the main stream has cut a channel through it on the east side of the valley. The road runs over the plateau, and thence at the base of the spurs from the Koupru range through very pretty wooded scenery, leading out into the valley above Sengmai, which is well out into the alluvial flat of the Munipur valley. These Munipuri villages have a very great resemblance to those in Cachar, and seen from a distance stand out like in black patches against the ochre coloring of the dried-up grass and rice-fields.

40. The valley of Munipur was no doubt at one time to a great extent under water, and has gradually silted up, and is even now, by the annual overflowing of the rivers, heavily laden with mud; this gradual silting up is well shown in the small patches of water and marsh that invariably occur under the lea of the low spurs, given off from the parallel ridges north of the valley, and in the re-entering angles of such spurs, where the gradual flow of the sediment south is arrested, and can only enter in smaller quantity. The piece of open water and swamp of Lamphel, under Langol, and under Phunan, towards Thobal, are the best illustrations of this action. Down in the south end of the valley the lake Loglak must have long existed, and no doubt extended much further to the north, gradually but very gradually silting up, yet this entirely depends on the width and depth of the exit channel below, and not so much on the amount of silt brought down and yearly deposited in an equal way over all the inundated portion of the valley. But the extent of this lake has been, I fancy, altered by earthquakes; even that of 1869 (January 10th) produced in a short time great changes, and the fishermen say it has never recovered its former state. The water then retired off a large area, showing the fish at the bottom, and returning swept immense numbers up high and dry. Such earthquakes, and no doubt many worse, have occurred at longer and shorter periods of past time over this area, and would as often tend to increase a lake of this sort as to drain it. In fact, the original formation of this mountain valley, 2,500 feet above the sea, may be due to a present tendency to depression. The sedimentary deposit extend away in broad belts up the northern valleys like arms of the sea, gradually narrowing. The limit of deposit is shown to be attained by the very great depth the Iril above Imphal has cut down below the surface; in the cold season it is 35 feet below the bank, and its present course is much straighter. On looking down upon the valley here an older and more winding course can be just made out.

41. There is no reason for supposing that the alluvial deposits in the valley are of immense depth, as stated by Pemberton, nor can they possibly rest on limestone rock, no limestone rock occurring anywhere round and in the valley. All lime is made from a travertine or calcareous tufa, obtained near the banks of streams, often showing casts of leaves, &c. It occurs at the head of the Loimakhong valley and in some other spots under the Maphitel ridge.

42. Imphal or Munipur is a straggling large place extending along the rivers that flow through it for a distance of five miles with a mean breadth of about one and a half mile. There is no arrangement of the houses into streets or bazars; the mainroads, however, have been regularly laid out, leading away into the country from the Raja's residence and the great market place near the entrance gateway. The houses are situated in small compounds having a low mud wall round them, by the side of which bamboo is planted, and grows into luxuriant clumps, hiding completely the houses in the place. These bamboo clumps, fruit trees of the usual kind in Lower Bengal, pepul, &c., give the place at a distance and from the surrounding hills the appearance of an extensive wood. Thobal has also the same character. The river Iril is navigable for small canoes up as far as Kaibikunas, and a canal, fed partly by water from the marsh under Langoltila, passes along the western side of the place, and by both streams the Logtak Lake can be reached. The great institution of the place is the daily market; this is largely attended by buyers and sellers, the latter nearly all women, and it does not break up until past 8 P. M. There every tribe from the surrounding hills is represented. Burmese, Cacharis, and Sylhetias, even the tall Sikh, a few of whom are in the Raja's service, make up a busy, most picturesque scene.

43. This portion of the north-east frontier hills is extremely rich in its avi fauna; we have a great mingling in this direction of the Indian with Indo-Chinese forms. Many birds, extremely rare in collections,

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and only represented by a few solitary examples described by Hodgson and Blyth from Nipal, &c., were obtained here again, and a large number have yet to be either identified or compared with specimens from other distant quarters. To enumerate them is not in the scope of this report (already too long); some 280 species were collected. Other families of Natural History are equally rich, none more so than the insects; and interesting forms of land mollusca are numerous. The great forest of Dunsiri swarms with insect life, the lepidoptera conspicuous by their numbers and colouration. Leaving this, and ascending the spurs of Burrail, with the changing flora, new forms are constantly appearing, and I could point to few areas where a naturalist can find more rare objects for his search than the slopes of this range. The larger wild animals are those common to Assam in general, and to enumerate the more common is only repeating the usual report formula, "Elephant, rhinoceros, &c., &c." It may be worth mention that the latter animal is not now found in the Munipur valley, not even on the Logtak. Driven out by the presence of man and the extensive fires, he is annually the cause of.* The Hulook (Hylobates) is found as high as 8,000 feet in January, showing that they can stand very considerable changes of temperature.

Climate.

44. The climate of the Naga and Munipur Hills is almost perfect during the cold weather. The minimum temperature during January in the vicinity of the high range was 32° to 37°. In the valley of Koimaru in camp Maiyangkang it fell as low as 25° from 12th to 14th February. Rising early before sunrise, as we did to be off to work, the heavy frost on the ground gave the whole country a wintry look one seldom sees in this part of India. Munipur was very hot and dry in March, the maximum in shade being about 74° mean, of minimum 47°. The climate of the northern base of the hills is, on the contrary, very unpleasant and unhealthy, owing to the fog that so often hangs over it. When clear, Sámágúting is hot and dry, but succeeded in a few minutes by cold damp wind and driving mist; these changes cause much sickness among the natives, and Goorkhas cannot be prevailed on to stay there. Fine sites for a station at 5,000 or 6,000 feet are to be found on the Nidzukru ridge, between that and the peak of Thebzuthu close over Sonurigam and 36 miles (direct as crow flies) from Golaghat. An examination of the country here would, I think, lead to the discovery of a shorter line of road to Golaghat, avoiding the long unhealthy valley of the Dunsiri, while the station would be in the immediate neighbourhood of the Lhotah Nagas, keeping them effectively under control. A road along the ridge south leads direct into Kohima and the very heart of the largest Anghámi villages, and is a far easier line than that at present in use from Sámágúting, which leads up and over every lateral spur from the Burrail, and a large stream like the Diphúpáni cutting off all communication during the rains.

Races and tribes.

45. The Naga race is broken up into many large and small communities, some consisting of many large villages, others of no more than two or three; the best term in speaking of them is that of tribe. The villages are again sub-divided into clans, which are not always living on terms of amity, although within the same defences. This collection of different clans is no doubt the result of the lawless state they have for ever lived in, but it tends to prevent the utter extermination of a clan when worsted by a superior enemy; they would then join some other community. The Sopvomah tribe has been the subject of official correspondence and report for some years, so I shall not allude to them.

46. To the east of the Sijjo and under the Kopamedza ridge are the Kézámis, inhabiting the seven villages of—1, Kézá Kenome; 2, Chéromi; 3, Téphimi-júmi; 4, Nizani; 5, Kálúmi; 6, Nekromi; and 7, Tekhunubámi; they are very like the Anghámi, use the same form of spear, long, narrow, ornamented shield, and showy ornaments of hair, but, like the men of Sopvomah, wear more constantly the fine cane-plaited short leggings. Here we saw shingle-roofed houses for the first time, the shingles cut into oblong form. This tribe is a large and powerful one, and at feud with Kidima across the Sijjo on one side and with Megwimi on the Munipur side. To the east of the Kopamedza we have another tribe, the Zami Nagas, consisting of five villages.—

Called by themselves.	*By the Nagas on the west.*
1. Zámi	1. Rázámi
2. Zallomi	2. Thizámi
3. Tilomi	3. Thetcholumi
4. Vaphomi	4. Gaziphimi
5. Zemi	5. Khiphimi

of which numbers 2, 4, and 5 were burnt by the Munipuris for refusing to pay revenue. These Nagas differ somewhat from the last described; they carry very long spears, 10 feet long, and oblong short leather shield, and are not so smart in their dress.

47. Rázámi is a fine village of some 300 houses, many of which were very old and large, the front portion covered with the heads of animals killed at feasts. Gaziphimi was of equal size, and extended some way along the ridge. Just before entering the village, we passed the place where heads taken in their constant fights were set up on poles about ten feet high, each skull fixed on the top by a pointed peg of hard wood driven through the centre. There were fifty-two of these, skulls were lying on the ground, others still in position; hands were tied on small sticks stuck up at the base of the posts; much might be said and written on these heads, and why cannot the custom be stopped? It is widespread. In villages within twelve miles of Imphál skulls and scalps are to be seen stuck on spikes near the villages; and how are many

* Sic in original.

procured? only by the misused strength placed in hands of Munipur by arms the Indian Government have given and are now giving in improved form. Munipur does no good for the tribes over whom she rules and those she is so desirous to rule; her expeditions are mere forays made for plunder, when Kukis and Nagas of the valley, aided by well-armed sepoys, are able to collect and carry back to their villages the heads we saw. Munipur thus, in fact, fosters the system where it could best be checked.

48. The villages Munipur attacked on the north, and those again the expedition went against into the Jatick valley, had given no provocation, certainly no information of such was given to the Political Agent, and the former certainly was despatched without his knowledge. In what way has Munipur acted towards the Ramhows? the seizure of the chief was a most treacherous act, and yet this is a Native State to whom a late Political Agent recommended that the Indian Government should give a present of field-pieces; a Native State with an army undrilled and undisciplined, and not particularly respectful to European officers, is no source of strength on this part of the frontier should we ever be involved again with Burma; officered and drilled by us in a reduced form, it might be of some use, and its movements would always be known. The least we can do is through our Political Agent prevent Munipur advancing her boundary and attacking tribes without a full knowledge of the circumstances examined into by the Political Agent on the spot.

49. To return to the tribes. There is one custom of the Zami Nagas that must not be overlooked, that is, smoking of pipes made on same plan as those used by the Kúki women; the water in the bowl through which the smoke passes being put by in small bamboo vessels and afterwards sipped, the liquor being held in the mouth for some time and then rejected. Neither the Sopvomah nor Tengimah nor any of the western Nagas smoke these pipes. I have already mentioned their very different armament to the tribes on the west.

50. The next tribe we came across was a section of the Tangkúl Nagas, a very distinct race from those on the north; this section has been discriminated by Colonel McCulloch as the Lahúpoh (from "Lahup," a hât in Munipur), from the large helmet they wear; there is certainly much that is different in their appearance, especially the way of cutting the hair. The Tangkul nearer Munipur shaves all except a narrow high ridge extending from the sinciput to occiput, and terminating in a little tail tied in a knot. The men of Shipvomi, Swemi, Yemai, and Aphomai trim the hair down to about 1½ to 2 inches all over the head, and by shaving all round over the ears, leave it somewhat like an inverted basin-shape cut. Many wear large circular ear-rings of brass-wire and a circular neck-piece of cane stained red and ornamented with cowries; from the fastening at the back hang long cotton tassels; these are sometimes of hair. This ornament I noticed is worn by the Tangkúls as far into Munipur as Laisén.

51. The changes that take place in the different tribes are very gradual one into the other, but at last these accumulating one finds the Anghámi and the Tangkúl differing most widely; some of these differences one can hardly describe on paper, for the eye alone can detect the slightest difference in cut of hair, manner of putting on their dress, and particularly expression. Thus the Gaziphimi men, although belonging to the Zami community, had an affinity to those of Shipvomi, and these again with Yemai, and so on into the Tangkúl of the south. Customs peculiar to the Anghámi would now and then re-appear, such as the building of platforms over graves and mode of decorating them. All Nagas wear the cane rings round the leg, just below the knees, and the more they can get on the better style it is with them. The Nagas of the north always dye theirs black, while to the south, commencing with the Máráms, they are generally uncolored. Certain Tangkúls wear a plaited kind, dyed yellow and red, in keeping with a narrow flat fillet of same coloring round the head, and the spear handle also ornamented with plaited cane work laid over it.

52. The great distinguishing social custom of the Tangkúl, however, is the wearing of a small ring of bone, ivory, or wood, into which the foreskin is drawn. When employed in their fields during the heat of the day, they are generally stark naked, and hundreds were to be seen working thus on a new line of road the Raja was constructing. The women, however, dress much as those of other tribes, the petticoat usually in broad alternate stripes of black and white, the body to over the breast wrapped round with a white cloth. The chudder or cloth of the Tangkúl is of home manufacture, and very stout and strong, in stripes of a maroon red and indigo, with narrow lines of white, the red predominating; and these colors blend most harmoniously.

53. In the Tangkúl villages, visited east of the Laimakhong valley, the women wear a coarse cotton kerchief on the head, which is folded and brought back and tied with string behind to the knot of hair. These Tangkúls differ by their using the bow and arrow; the arrows are very short, barbed, and poisoned. The helmet is worn by all the Tangkúls from Shipvomi south to Kúntúck and Laisén; it is strongly made of plaited cane, rather conical in form in front, and on each side is fixed securely one or two (generally two) round discs, ornamented with concentric circles of white and red beads; between this hangs loosely a circular polished disc of bell metal or brass flatly conical in the centre, and which flashes in the sun with every movement; rising from the top of the helmet is generally a long white plume of feathers, and hanging from the two side discs a broad band, covered with red seeds, and from which and from the side ornaments hangs a quantity of black hair; with this on, his long spear, shield, and dâo, he looks most formidable.

54. The Tangkúls of the villages of Mézimeh or Prowi, Phunggum, and Shirai have characteristics which link them on to tribes who tattoo on the east, as the Shans. The women of these villages are all tattooed in a pattern of three parallel lines extending from under the lip to chin, down centre of neck and bosom to the navel, from the shoulders down to the breasts, and again down to outside of the arm and occasionally on the back. They are perhaps less particular in covering the upper part of their body than the other women we saw when at work. A broad semi-circular collar or neck-piece of brass is very frequently worn by the men, and is no doubt worn as a piece of armour against a dâo cut. It is very evident that these Láhúpahs, in Colonel McCulloch's time, were not under Munipur, for he distinguishes them from other Láhúpahs, *vide* page 68 in his "account of the valley of Munipur." "The Láhúpah in the far north being more warlike, are much feared by those south of them. The women of the former are tattooed, &c.," and again read the paragraph commencing at foot of page 66.

55. The Marams are located on the Barak and its sources, and scarcely differ from the Anghámi, wearing like them the short kilt; they are not so fine a race of men; in build none carry away the palm from the men of the large villages like Kohimah, Mozamah, &c. The Láhúpah, although so highly praised for his superior stature by Colonel McCulloch, I did not notice, was particularly tall. The roofing of houses with shingles is mainly dependent on the proximity of pine woods, and is not a custom peculiar to the Tangkúl or Láhúpah. The dog of the Láhúpah is, as Colonel McCulloch justly remarks, a very fine animal, quite a different breed; when young they have long thick soft hair, but they lose this to a great extent as they become adult.

56. The Kúki colonies in Munipur are gradually moving away north to the Burrail, and will many of them settle there eventually.

Those in the northern valleys are Thados, or, as they are called in Munipur, "Khongjais." The most flourishing colony I saw was at Aimulkún, west of the Koimárú valley, and close to the Barak; it is also the most northerly.

Stone monuments.

57. I was much interested to find, on entering the Anghámi country, that they and other Nagas also erect monolithic monuments like the Khásis, and that the custom was still in force. The finest slabs are to be seen near Sopvomah and Togwema; they are quite equal in size to those in the Khási Hills. Large stones are also set up on three or more supports in dolmen form. These on the Sopvomah ridge were all of sandstone, which must, at the cost of very great labor, have been dragged up out of the bed of the Zullo, the ridge being of friable shales. They move the stones on wooden sledges constructed for the purpose, dragged by ropes, and rollers used where necessary. The Tangkúls do not greet these larger monuments, but in the villages of Prowi and Phunggum I noticed long lines of small stones, generally the white weathered lime-stone, sunk nearly flush with the surface, and extending for many yards along the sides of the paths leading from the village; and rows of small stones, two or three feet high, were here and there noticed.

58. Among the Anghámis they are set up by individuals during their life time to perpetuate their own memory and that of the feast given at the time; after a day or two of feasting the men assembled, all go in a body and drag in the stones, which are set up on the side of the principal road near the village or on a conspicuous knoll. The number set up is apparently unlimited, and they are arranged differently to the Khási stones, the largest and highest on the right, the others in gradation of size. I have seen as many as twelve to fifteen in a row, but one to three is the most usual number.

On the line of boundary, &c.

59. East of Tellizo the villages on the main watershed are 1, Yemi or Yemai; 2, Aphomai; 3, Káchai or Achámi; 4, Humi; 5, Taloi; 6, Langthang; and 7, Siarhi. North of and near the watershed we have 1, Rázámi; 2, Thizámi; 3, Khiphimi; 4, Shipvomi; 5, Raimeh; 6, Thiwa; 7, Phunggum; 8, Hwining; 9, Ukrul; and 10, Nungvar. Of these I am of opinion Munipur has had for some years a certain kind of intercourse and influence; they are 1, Yemi; 2, Aphomai; 3, Káchai; 4, Humi; 5, Taloi; 6, Hwining; 7, Phunggum; 8, Ukrul; 9, Langthang; and 10, Siruhi. On Gaziphimi a raid was made by the Munipuris some years back, and that village bought its safety by a payment of cloths and other things, but this village and certainly Rázámi and the others composing the Zámi group have never been under Munipur or paid annual tribute. This year certainly Swemi and Mezimeh assisted Munipur at the destruction of Gaziphimi, but this was solely due to the existence of old blood feuds. Shipvomi had not paid tribute. It is not many years since Munipur has established any kind of influence over Yemi; it was formerly a very large village; the refusal to pay tribute had led to its being burnt, and a number of the men were killed; the village yet shows this in the badly-built houses and partly burnt timber put into them. Raimeh and Thiwa openly declared their independence in our camp at Káchai, and I do not believe pay tribute yet.

60. After the establishment of the Thanna at Prowi late last autumn, the Munipuris penetrated down the river east of Swemi, and over the next ridge to the Nongtum river, up to the villages of Vumé or Thusum, and Láphumeh or Wahong; they know but little of the villages of Chullo and Kuhsom; all their information is supplied by the headman of

Ukrul, who attended Thangal Major to the top of Shiruifúrar; but the Munipuris were quite in the dark concerning the villages on that side, and their map had evidently been put together by the aid of this man in Munipur. The line of main watershed would, I think, be the best boundary, leaving to Munipur all villages situated on it, who would continue their cultivation on both sides as usual, but would give the Munipuris no excuse for crossing the boundary at that point, or interfering in any way with other villages. To throw in Hwining and Ukrul a very simple modification can be made.

61. By following the main watershed east of Toloi, to where the road turns north to Rapfo Hill, where a Trigonometrical Station has been built, thence down the very marked ravine to the Lanier and junction of the Shirni stream up to the peak, where it would follow the main watershed again by the peaks known in our triangulation as Far Blue Range, Nos. 4, 5, 2, and 1. To more than the villages such boundary would give Munipur has no claims in the strict sense of the term.

62. It might have been expedient to have made other modifications, but this, if I may be permitted to express an opinion, would now be most impolitic, after the manner in which the officers deputed by Government to settle this line of frontier were thwarted, and even opposed by servants of the Raja like Major Romah Sing, and the double-dealing game the Munipur durbar was playing up to the middle of March, which very nearly caused the failure of the expedition; nor was the bearing of the Raja towards the Political Agent of the Naga Hills of the nature it should have been, plainly shown by the long interval of 26 days which were allowed to elapse before any notice was taken or a return made of our friendly visit upon him.

Assistance of Political Agents.

63. I cannot close this report without recording the truly zealous aid afforded to the survey operations by Captain J. Butler, Officiating Political Agent, Naga Hills. Having a knowledge of survey work, he well understands its requirements, and can allow for the changes of weather and unforeseen difficulties that so often entail delay and retard work. His knowledge of the people, energy, and physical powers make him just the man for such work as we were employed on. To Colonel Mowbray Thomson my thanks are also due for the assistance he rendered us on the Munipur side, first, in obtaining the Raja's sanction to our taking up work in the valley, and secondly, the aid afforded to Mr. Ogle when working alone. This officer, I may mention, is very anxious that this survey party should take up the remaining unsurveyed part of Munipur, and that, should he remain in political charge, an officer be deputed to proceed with him and lay down the eastern boundary in the Kubbu valley, and also visit the valley of Jatrik, lately invaded by the Munipuris, a question that certainly should be looked into, or difficult questions may arise regarding the boundary of Burmah in that quarter.

Report of progress in the DRAWING, GEOGRAPHICAL COMPILING, *and* ENGRAVING *Branches, Surveyor-General's Office, Calcutta, during the year 1st January to 31st December 1873, by* J. O. N. JAMES, ESQ., *Assistant Surveyor General.*

The usual tabular statements of work completed and in progress in the drawing, geographical compiling, and engraving branches during the year 1873 are herewith submitted.

2. Under the Surveyor General's instructions, my attention has been chiefly directed to the compilation of geographical materials from the results of final survey for the sheets of the Indian Atlas, as it was found on the transfer of the engraving to India in 1868-69 that heavy arrears representing the completed surveys of at least eight years had accumulated, while the combined outturn of the topographical and revenue surveys of nearly 40,000 square miles annually was being added to these arrears.

3. Great efforts have, therefore, been made during the past five years to complete fair drawings for new sheets and to fill large blanks on the old ones, so that the engraving might be pushed on, and the publication of the sheets of the Great Indian Atlas be kept more closely up to the date of surveys completed and in progress than has hitherto been usual.

4. All that has been done from 1869 to 1872 to further this very desirable object, has been fully described in the printed Annual Administration Reports of previous seasons, and I shall now report only on the progress during the year 1873.

5. No less than 115,000 square miles of topography have been reduced from the scale of 1 inch to ¼ inch to the mile and fair drawn for various sheets of the Atlas, as detailed in the statement attached. This large area covers 7,188 square inches of paper, and represents the contents up to margin of thirty and a half quarter sheets of the atlas, but as much of it went to fill blanks on the old full size plates and on several incomplete quarter plates, it is distributed over 47 plates, and embraces portions of various British districts in Bengal, the Central Provinces, Oudh and Sindh, and in the Native States within the Indore and Rajputana Agencies, and in the Vizagapatam Agency of the Madras Presidency.

6. In addition to the above the ¼ inch district maps of Darjeeling, Hazara, and Chindwara, have been compiled, and the drawing (outlines and names) of District Darjeeling has been completed. Considerable additions have also been made to the standard 32 miles=1 inch map of India, to the smaller map on 64 miles = 1 inch, to the standard 16 miles = 1 inch map of Bengal, and to various other general maps (*vide* statement).

7. A map of the Bombay Presidency, scale 32 miles = 1 inch, to illustrate the Administration Report, has been compiled. Additions have been made to the map of Oudh, 16 miles=1 inch.

8. Of the 1 inch =1 mile sheets of the early portions of the Ganjam and Orissa, Chota Nagpore Division, Rewah, and Khasia, and Garo Hills Topographical Surveys, 34 were taken in hand and 12 sheets have been completed; of the remaining 22 sheets the hill drawing is in progress. Of the first portion of the Orissa tributary state's topographical survey, 9 sheets on the scale of 2 miles to the inch (actual scale of field survey) are in hand.

9. A map showing the country around Kirwee and Kalinger, in the Banda District, scale 1 mile=1 inch, and one of the country round Roorkee and Hurdwar, scale 2 miles=1 inch, were compiled for the military camps of exercise.

10. A preliminary map, to illustrate the Surveyor General's report to Government on the survey operations on the eastern frontier of Bengal, in the Lushai, Tipperah, North Chittagong, and South Cachar Hills, was fair drawn for reproduction on half scale by photozincography. The final compilation map of the Eastern Frontier, scale 4 miles=1 inch, has been well advanced. A final map of the Garo Hills, scale 2 miles=1 inch, for reduction to the ¼ inch scale is in progress.

11. A map of Sindh, scale 16 miles=1 inch, and several district and division maps for local and imperial gazetteers on small scales have either been completed or are in various stages of progress. Of miscellaneous work, such as transcripts of portions of maps, charts, plans, &c., details are given in the statement attached.

12. Of proof sheets of engraved, lithographed, and photozincographed maps, 730, were examined, 24,569 sheet maps were colored, and various additions and corrections by hand were made on 213 sheet maps.

13. To Government officials 25,817 maps were issued on service, 5,090 maps were forwarded to the India Office, Geographical Department, and 5,384 maps were despatched to local agents for sale.

14. In the above paragraphs I have endeavoured to describe briefly the work completed and in progress, but the details connected with each description of work, *viz.*, reducing compiling, fair drawing, copying, &c., are very numerous and could not possibly be described without the limits of a professional report.

15. I have much pleasure in stating that the greater portion of the arrears of drawing connected with the progress of the Indian Atlas sheets have been cleared, and what remains

can easily be dealt with *without* detriment to the advancement and completion of many useful district maps and general compilations, which shall have due attention now.

16. Since 1869 it was arranged that this office should undertake the compilation on the 1 inch scale of all the results of the revenue surveys. The usual geographical maps of districts are therefore completed here now for publication. The 1 inch maps of each season's work, or degree sheets, which were formerly rendered to this office by the topographical survey parties, have for various seasons been discontinued, and these changes have very considerably increased the work of this office. But for the good aid rendered by photography, such as reduced silver prints, blue prints to scale, &c., it would have been impossible for *this office* to have kept pace with the demand for fair drawings for atlas sheets, now engraving both in India and England, or to have completed one-half the fair mapping of different descriptions that have been finished during the year; and I am greatly indebted to Captain J. Waterhouse, Assistant Surveyor General in charge of the Photographic Branch, for the ready help he renders me at all times.

17. I beg to bring to your favorable notice the excellent services rendered by Mr. J. F. Baness, surveyor and chief draftsman. His zeal and ability are well known to you. He is devoted to his work and seconds my efforts at all times with great promptitude and skill. Mr. A. Chamarett, surveyor and geographical compiler, has worked well and steadily. He is a skilful compiler, very quick and accurate, and his professional knowledge and experience are of great value in this office. Mr. D. Atkinson, surveyor and officiating 1st draftsman, continues to render good aid at all times; his services have already been specially brought to the Surveyor General's notice in connection with the complete revised set of tables for the projection of the sheets of the Indian Atlas. Mr. T. W. Babonau, record and store keeper, is very attentive to his duties, and after much labor has succeeded in arranging systematically all the publications of this office.

18. ENGRAVING BRANCH.—In the engraving branch, 14 quarter-plates and nearly one-third of an old full plate (double elephant size) have been completed and published 23 quarter-plates are in hand in various stages of progress, and additions and corrections have been made in 9 of the old full-size plates. Several of the new sheets await the completion of the hills.

19. The map of India, 64 miles=1 inch (in four sheets), has been well advanced in outline maps of the Presidency and Burdwan divisions, scale 16 miles=1 inch; and a map of Bengal and Assam, 64 miles=1 inch, has been completed in outline for the imperial gazetteer. Considerable additions and corrections have been made to the copper plates of Simm's plan of Calcutta, but much more is yet needed to render this plan a fine representation of the present state of the capital of India and its suburbs.

20. Various other jobs have been executed, which are detailed in the statement attached; 9,508 impressions in all (including proofs and transfers for stone) have been taken during the year.

21. With the limited amount of trained European agency at our disposal, aided by partially trained natives, a very good return of work has been completed. Better progress would have been made with the sheets of the Indian Atlas, if the engraving establishment had been stronger in European hill etchers. By the succession of Mr. J. F. Walsh the establishment has been still further weakened in this most necessary element; but the Superintendent, Mr. C. W. Coard, has devoted much careful attention to training some natives to this description of work, and two of them are now employed in hill etching on atlas sheets.

22. All the native engravers and apprentices engaged in 1869 are now fully employed on the sheets of the Indian Atlas and other small maps; but they are still greatly dependent on the European engravers for constant help.

23. Mr. Coard's labors and exertions cannot be too highly commended. He possesses great tact in dealing with and training natives, and his watchful supervision over all the work in progress is very apparent in the finish of every sheet or map executed under his management.

J. O. N. JAMES,
Assistant Surveyor General,
In charge, Cartographic and Engraving Branches,
Surveyor General's Office.

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 1873.

Maps, &c.	Scale. Miles. Inches.	Progress and Remarks.
India—Standard Map, in 6 sheets ...	32 = 1	New materials from the several surveys in progress inserted. Suspended, awaiting further survey.
India—No. 3, reduced from the above, 4 sheets.	64 = 1	Fresh additions made in original and dry proofs from recent surveys, and also of the countries bordering on British frontiers, from the best authorities, *viz.*, Burmah, China, Cashmere, Afghanistan, Turkistan, &c. Names written on sheets 3 and 4. Engraving.
India—For a General Map of the World.	10 = 1	Sheet 7. Portions of the protected hill states inked in. Suspended.
Bengal—Standard Map in outline, 4 sheets, provinces under the Lieutenant-Governor of Bengal.	16 = 1	New district and sub-divisional boundaries and names inserted; province of Assam and the surrounding country, from best available sources; the Lushai country recently surveyed; also the Garo Hills. Compiled and drawn for publication.
Bengal—North-Eastern Frontier of, 3 sheets.	4 = 1	Additions made from surveys to date, in Assam, the Garo, Naga, and Lushai Hills. In progress.
Bengal—North-Eastern Frontier of, 3 sheets.	8 = 1	To illustrate the survey reports on the Eastern Frontier. Preliminary Map.
Bengal—Western, in 10 sheets ...	8 = 1	Sheet 13. Parts of Hazareebagh, Manbhoom, Lohardugga, Sonthal Pergunnahs, Beerbhoom, &c., compiled and drawn in outline. In progress.
Bengal—Western, in 10 sheets ...	8 = 1	Sheet 11. Compilation of Nepal, showing the recent explorations, routes, &c., from the best available materials. In progress.
Punjab—Outline Map (engraved) ...	32 = 1	Portion of Turkistan and countries on northern and western frontier reduced, and added on a dry proof. Engraving.
Oudh—Outline Map (engraved) ...	16 = 1	Additions made on a dry proof of a portion of Nepal, and various other additions. Names written in—For "Gazetteer". Engraving.
Sindh—Outline Map for "Gazetteer"	16 = 1	Compiled and drawn in outline. Writing of names in progress.
Bombay Presidency—Preliminary Map of.	32 = 1	Compiled and drawn for the Bombay Government Administration Report. Being printed.
DIVISIONAL MAPS.		
Chota Nagpore Division—2 sheets	4 = 1	General office compilation. In progress; nearly finished. Suspended.
Bhaugulpur Division	4 = 1	Skeleton Maps, to illustrate the famine relief operations and other projects.
Rajshahi Division	4 = 1	
Presidency Division	16 = 1	Drawn for the "Imperial Gazetteer" of Bengal. Engraving.
Burdwan Division	16 = 1	
Dacca Division	16 = 1	In progress. Outlines finished.
DISTRICT MAPS.		
District Banda	8 = 1	Drawn for the "Gazetteer" of the North-Western Provinces. Engraving.
District Jhansi		
District Jalaon		
District Hameerpur		
District Lallatpur		

Statement showing the nature of the work performed, and the progress made, from 1st January to 31st December 1873,—continued.

Maps, &c.	Scale. Miles. Inches.	Progress and Remarks.
DISTRICT MAPS—*continued.*		
District Sirsa	4 = 1	Prepared for the Settlement Report.
District Hazara	4 = 1	Reduced from sheets of the Revenue Survey. Outlines finished. Names in progress.
District Chindwara	4 = 1	Reduced from sheets of the Revenue Survey. Outlines in progress.
District Darjeeling	4 = 1	Reduced from sheets of the Revenue Survey. Outline and names finished. Hills to be drawn.
Bhootan	8 = 1	A new Compilation Map of Bhootan, from the best available information. In progress.
Garo Hills	4 = 1	Final compilation. In progress.

Sheets of the Atlas of India—Engraving in India.

Maps, &c.	Progress and Remarks.
Sheet 2 quarters, S. E., N. E. ...	Part of Sindh.—Hills drawn on a dry proof.
„ 3 „ N. E. ...	Part of Sindh.—Hills drawn on a dry proof.
„ 9 „ S. W., N. E. ...	Part of Sindh.—S. W. Sand Hills drawn on a dry proof, N. E. compiled, and hills drawn.
„ 34 „ N. E. & S. W. ...	Parts of Jeypoor, Udepoor, and Boondi Native States, and Ajmere.—Additional material from recent surveys to date compiled and drawn in outline on dry proofs. Hills to be drawn. S. W. in progress.
„ 51 „ S. W., S. E. ...	Parts of Kotah, Boondi, and Gwalior Native States. Hills drawn on dry proofs.
„ 52 „ N. E., S. E. ...	Parts of Gwalior and Tonk Native States. Additional survey results to date, compiled and drawn in outline on dry proofs. Hills to be drawn. S. E. in progress.
„ 53 „ N. E., S. E., S. W.	Parts of Bhopal Native State, and Districts Hoshungabad, Baitool, and Chindwara, of Central Provinces. Additional survey results to date, compiled and drawn in outline on dry proofs. N. E. in progress. Hills to be drawn
„ 61 Full Plate	Gap in the Kondah Hills, south of the Neilgherries. Compiled and drawn to complete the plate.
„ 67 ditto	Parts of Oudh and Nepal required, to complete the plate under compilation from recent surveys and best available information. In progress.
„ 72 „ „ S. E., N. W., N. E.	Parts of Districts Chindwara, Seoni, and Bhundara, of Central Provinces. S. E. compiled and drawn. N. E. Hills drawn on dry proof. N. W. under compilation. In progress.
„ 73 Full	Part of District Chanda of Central Provinces compiled and drawn in outline on dry proof.
„ 87 quarter, N. E. ...	Part of Oudh. Hills drawn on a dry proof.
„ 93 „ N. E., S. E., S. W.	Parts of Jeypoor, Bustar, and Godavery talooks, Vizagapatam agency. N. E. and S. E. compiled and drawn. S. W. under compilation. In progress.
„ 105 „ S. W. ...	Parts of Belaspur and Sumbulpur, Central Provinces and Gurjat States, Chota Nagpur Division, under compilation. In progress.
„ 107, „ 108 Full Plate	Jeypoor, Kolahandy, Panchpetta, &c.; Vizagapatam Agency, and the portion known as the "Saora gap," compiled and drawn in outline on dry proofs, to complete the plates. Hills to be drawn.
Sheet 113 Full Plate	Parts of Hazareebagh, Beerbhoom, and Manbhoom. Hazareebagh under compilation on dry proof, to complete the plate. In progress.
„ 119 „ „	Part of the Garo Hills required, to complete this plate. Under compilation from recent surveys. In progress.

Sheets of the Atlas of India—Engraving in India,—continued.

Maps, &c.	Progress and Remarks.
„ 124 quarter, S. W. ...	Parts of Goalpara, Durrung, Kamroop and Garo Hills, compiled and drawn with hills. A small portion of the Garo Hills on the west under compilation from recent survey. In progress.
„ 131 „ N. W. ...	Part of the Naga Hills from recent surveys to date. Compiled and drawn with hills on a dry proof.

Sheets of the Atlas of India—Engraving in England.

Sheet 51, quarter N. W. ...	Parts of Jeypur and Kerowli, compiled and drawn with hills to complete the plate. Proof returned to England.
„ 54 Full Plate. To complete blank portions.	Districts Hoshungabad and Nimar, Central Provinces, compiled, and drawn with hills, complete, on a dry proof, from England, and returned. District Baitool wanting to complete the plate.
„ 69 quarter, S. E. ...	Parts of Punnah, Churkaree, &c., compiled and drawn with hills up to the boundaries of Banda and Hameerpoor, (now under survey,) and proof returned to England.
„ 70 „ N. W., N. E. ...	Parts of Bijawar and Punnah, compiled and drawn with hills to complete the plates. Returned to England.
„ 71 „ N. W., S. W. ...	Part of Bhopal, compiled and drawn with hills to complete the N. W. plate. Proof returned to England. Plate S. W., Chindwarra portion, under compilation. Nearly ready.
„ 89 Full Plate	Rewah, compiled and drawn with hills to complete the plate. Proof returned to England.
„ 90 quarter, S. E., N. E., N. W.	Parts of District Belaspur, Central Provinces, and various Gurjat States in Chota Nagpur Division, with parts of Rewah and Sohagpur. S. E. compiled and drawn with hills and returned to England. N. E. and N. W. compilation in progress.
„ 92 „ S. E. ...	Parts of Jeypur and Bustar, compiled and drawn with hills. The plate completed and returned to England.
„ 104 Full Plate	Hazareebagh, Lohardugga, and Sirgooja, of Chota Nagpur Division, compiled and drawn in outline. Old and new work adjusted. Plate completed and returned to England. Hills to be drawn on fresh dry proofs.
„ 118 „ „	The Western Dooars and part of Bhootan, from best available sources, compiled and drawn with hills. Old and new work adjusted. Plate completed and returned to England.

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

Maps, &c.	Scale. Miles. Inches.	Progress and Remarks.
Chota Nagpur Division, Survey Sheets 9, 10, 11, 12, 13, 14, 16, 21, 22, 23.	1 = 1	Projected and in progress in various stages.
Ganjam and Orissa Survey.—Old series, Sheets 1, 8, 19, 34, 35, 36, 37, 68, 84, and 86.	1 = 1	Projected and re-drawn from the original field sheets.
Sheets 21, 38, 45, 61, 70, and 72, 7, 9, 11, 59, 60.	1 = 1	Projected and in progress in various stages.
Sheets 12, 13, 14, 15, 15a, 26, 27, 28, and 29.	2 = 1	Ditto ditto.
Khasia and Garo Hills Survey, Sheets 16 and 17 in one.	1 = 1	Re-drawing the hills of half sheet.
North-East Division—Central Provinces Survey, Sheet 11.	1 = 1	Projected drawing in progress.
Rewa and Bundelkund Survey, Sheet 10.	1 = 1	Projected and re-drawn from the original field sheets.

Miscellaneous Maps, Charts, Tracings, and Extracts.

Maps, &c.	Scale.	Progress and Remarks.
	Miles. Inches.	
Country between Kirwee & Kalinger	2 = 1	Drawn for use of the camps of exercise, 1873-74.
" " Roorkee & Dehra ...	2 = 1	
" "	4 = 1	
District Banda	1 = 1	Extracts on vellum cloth made from original field sections, for
Hyderabad Topographical Survey, Seasons 1861-62-63-64-65.		
Lucknow.—City, Civil Station, and Cantonments.	2 = 1	Triangulation charts projected and drawn, and tracings made of the same on vellum cloth, with trigonometrical data inserted.
Agra,—City, Civil Station, and Cantonments.	1 = 1	
Hyderabad—(Nizam's Dominion) and Berar, Ceded Districts.	4 = 1	Boundary adjusted and drawn from surveys of Settlement Officers.
Ganjam and Orissa Survey.—Season 1850-51.	2 = 1	Tracings made on vellum cloth from the original field sections, for
Hyderabad.—Topographical Survey, Season	4 = 1	Tracing made on vellum cloth of chart of triangulation, for
Ghazeepoor.—City and Station ...	ft. in. 400 = 1	Tracing made on vellum cloth.
	Miles. Inches.	
Bengal, Behar, and Orissa, with Assam.—	64 = 1	Revised for the "Imperial Gazetteer."
Rajshahye Division.—On vellum cloth.	4 = 1	For Bengal Government for famine works.
Bhaugulpur Division.—Ditto.		
Trigonometrical data	...	Extracts for various Government Officers.
Corrections and additions to Topographical Survey Sheets.	1 = 1 2 = 1	49 sheets examined and corrected.
Corrections and additions to engraved, lithographed, and photozincographed maps.	Various.	Railways, boundaries, territorial names, &c., inserted, examined, and corrected, 213 sheets.
Lithographed and photozincographed maps and plans colored.	Ditto ...	21,707.
Atlas sheets and engraved maps colored	Ditto ...	2,862.
Proofs examined of atlas sheets, maps, charts, and plans.	Ditto ...	730.

Numerous other small tracings, extracts and copies of maps, charts, and plans, have been prepared, which cannot be specified in detail.

J. O. N. JAMES,
Assistant Surveyor General.

Statement of work completed and in progress in the Engraving and Copper-plate Printing Branch of the Surveyor-General's Office during the year 1873.

Atlas Sheets completed.

Quarter Sheets ...	2 S. W.*	Kurrachee Collectorate, Sindh, finished.
	3 N. E.	Portions of Shah Bunder and Mahomed Khan's Tanda, Sindh, finished.
	9 S. E.*	Small portion of the Khyrpoor State, Sindh, finished.
	9 S. W.	Khyrpoor State, Sindh, finished.
	11 S. W.	Small portion of Shah Bunder and Runn of Cutch (Sindh), finished.
	33 N. E.*	Portions of Jeypoor, Jodhpoor, Shekawati, &c., in the Rajputana Agency, finished.
	33 S. E.*	
	34 N. E.*	Portions of Jeypoor, Tonk, Kotah, &c., Rajputana Agency, finished.
	51 S. W.	Portions of Gwalior, Kotah, &c., in the Indore Agency, finished.
	53 S. E.*	Hoshungabad District of the Central Provinces, finished.
	68	The old full plate containing a large portion of Oudh, a very heavy sheet, finished.
	86 S. W.	Portions of Oudh and Nepal, finished.
	87 N. E.	Ditto ditto ditto.
	124 N. W.	Portions of the Districts of Goalpara and Kamroop, Assam, finished.
	125 N. E.	Khasia and Jynteah Hills, Assam; a very heavy sheet.

Atlas Sheets in progress.

Quarter Sheets ...	1 N. E.	Plate engraved in England; hill work had to be made much darker.
	1*a* S. E.	Ditto ditto ditto.

Plates in progress.

Quarter Sheets ...	2 N. E.	Small portion of hill work done; plate put down for other work.
	2 S. E.	Additions and corrections to outline and writing done; hill work just commenced.
	9 N. W.	Outline and writing additions done; hills in progress. This plate was partly engraved in England by Mr. John Walker.
	10 N. W.	Additions completed; plate published 1872.
	31	Sheet additions and railways finished.
	34 N. W.	Plate projected; border line cut; plate put down.
	34 S. E.	Outline and writing finished; waiting orders before commencing the hills.
	34 S. W.	Plate projected; border line in hand.
	51 N. E.	Plate engraved in England; small portion had to be taken out on account of having been engraved wrong; re-engraved finished and sent to press.
	51 S. E.	Additions and corrections finished; plate published 1871.
	52 N. E.	Outline finished; writing just commenced.
	52 S. E.	Outline finished as far as drawing.
	53 N. E.	Outline done; writing in progress, only a small portion.
	53 S. W.	Outline finished as far as drawing.
	61	Sheet plate engraved in England; additions finished.
	67	Ditto ditto additions and railways finished.
	72 N. E.	Outline and writing finished; hills about to be commenced.
	72 S. E.	Ditto ditto sand dotting, &c.
	73	Sheet; full plate old portion has been cleaned off for new work. Outline done; writing well advanced. This is a heavy sheet.
	88	Outline done; writing in progress. This is an exceedingly heavy sheet, one of the old sheets.

* These plates are not full up to margins.

Plates in Progress,—contd.

93 N. E.	Outline and writing finished; waiting orders before commencing the hills.
93 S. E.	Outline done; writing in progress.
Quarter Sheets ... 112	Sheet additions and railways done.
113	Ditto ditto ditto.
124 S. E.	Hill work etched; writing finished; plate put down for want of hands.
124 S. W.	Outline done; waiting orders to commence the writing.
125 N. W.	Outline and writing done; hills in progress.
131 N. W.	Ditto ditto. ditto.
107	Sheets; tracing commenced.
108	
Total 32 Plates.	

Miscellaneous Maps, &c.

	Map of the Presidency division, comprising the districts of 24-Pergunnahs, Nuddea, and Jessore, finished.
	Map of Oudh; outline completed; writing about one-eighth done; plate put down.
	Plan of the town and fort of Kalinjar, in the Banda District; outline and writing done; hills nearly finished.
	Map of the Burdwan division; outline done; writing in progress.
	Map of Bengal; outline finished; writing in progress.
	Map of the Punjab; the north portion re-engraved from new drawings.
	Chart of the north-west, quadrilateral; writing in progress. This is a heavy sheet.
	Simm's plan of the town of Calcutta; heavy corrections to all four sheets; shading water tanks in progress.
	Index chart to the Great Trigonometrical Survey; additions completed.
	Map of India, 64 miles = 1 inch, four plates; outline done; writing in progress; three plates put down.
	Four beautifully engraved alphabets of open letters, of four different sizes.
	A large plate of specimen slips of writing for copies for native engravers to copy from.
	A plate of sizes of specimen of sizes writing—specimen to be used for the four sheet map of India, scale 64 miles = 1 inch.
	A plate of specimen of writing of sizes to be used for the map of Oudh.
	Cleaning surface of the plate; small index to the Indian atlas and re-engraving the work, plate damaged by the new process of steel facing.
Total 16 Plates.	A large tint ruled for the use of color tinting of the atlas sheets.

Copper-plate Printing.

Proofs of various kinds	1,330
Transfers for stone	450
Impressions of various kinds	7,728
Total impressions ...	9,508

Report by CAPTAIN J. WATERHOUSE, *Assistant Surveyor-General, in charge, Photographic Branch Surveyor-General's Office, dated Calcutta, the 1st January* 1874.

AMOUNT OF WORK.—The amount of work executed during the past 12 months, from 1st January to 31st December 1873, may be briefly stated as follows: 1,611 original maps have passed through the office, of which 105,753 complete printed copies have been printed off, besides 2,010 silver prints and about 3,000 photocollotypes.

PROGRESS.—The difference of the amount of work turned out during the year under review, as compared with that of the previous year, is shown in the table below, from which it will be seen that there has been a large increase in the number of the originals received and in the outturn of printed maps, as shown by the number of pulls or actual work done. The number of silver prints shows some falling off, as there has not been the same demand for Exhibitions or for the Archæological Survey as was the case last year. The number of collotype prints is only approximate, as a great deal of the work done during the year has been for the purposes of instruction.

SUBJECTS.	1872.	1873.	Difference.	Difference in Decimal square feet.*
Originals	1,428	1,611	+ 183	
Negatives	1,760	1,969	+ 209	
	*4,481·69 d. s. ft.**	*5,110·72 d. s. ft.**		*+629·03 d. s. ft.*
Silver prints	4,200	2,010	− 2,190	
	5,230·39 d. s. ft.	*3,553·84 d. s. ft.*		*−167·55 d. s. ft.*
Photo-transfer prints	1,892	1,949	+ 57	
	4,710·0 d. s. ft.	*5,157·88 d. s. ft.*		*+447·88 d. s. ft.*
Photocollotypes	.....	3,000	+ 3,000	
Transfers to zinc	635	1,413	+ 778	
Number of pulls	88,959	1,11,876	+ 22,917	
Ditto of complete copies ...	1,17,320	1,05,753	− 11,567	

* Decimal square feet of 100 square inches.

EXPENSES OF WORKING.—The approximate expense of working the office during the year, including Superintendent's salary, has been Rs. 50,868-15-1.

The approximate sum to credit of the department is Rs. 85,850-6-1, showing a nominal profit of Rs. 34,981-7-0.

PERSONNEL.—I have again great pleasure in reporting on the steady good conduct and zealous attention to their duties of my European assistants, Sergeants J. Mackenzie, B. Mackenzie, and J. Watson. Sergeant J. Harrold, whose appointment was noticed in my last report, arrived from England in March, and has since been busily occupied in working out the collotype process, and training native assistants in the work. Mr. W. Crossley, whose conduct for some time past had been very unsatisfactory, was dismissed under the orders of Government in the Department of Agriculture, Revenue, and Commerce, No. 401, dated Simla, the 16th JUNE 1873, and his place has been filled up by the appointment of Corporal Marshall from the School of Military Engineering, Chatham, who is expected to arrive immediately, and it is hoped that on his arrival several improvements may be introduced into the working of the collotype and photo-transfer printing, in both of which branches, I understand, he has been under special training for some months past.

Syud Ishmael and the native assistants have conducted their duties very satisfactorily. I may particularly mention Hubeebul Hussun, who has conducted the photo-transfer printing since Mr. Crossley's dismissal.

PROCESSES.—There have been no important changes in the processes ordinarily used in the office, but a few minor improvements may be noticed. It has been found that a weak solution of citric acid may be advantageously used for clearing up photo-transfers that print dark either from defects in the originals or by over-printing from weak negatives. Sergeant B. Mackenzie has discovered that ordinary lithographic chalk printing-ink may be used for inking in the photo-transfers instead of the retransfer-ink we have ordinarily used. It works well and seems particularly good for fine work. The only objection to it appears to be on account of the tendency of the printing-ink to dry, so that the transfers cannot be kept so long as when inked with the usual transfer ink. If it were found to answer well throughout the year, some trouble and expense would be saved, with equally good results. Sergeant Mackenzie has also found that an etching of dilute nitric acid (1 to 6) applied to the zinc plates, in parts where the work is very close and thick, followed by the application of the ordinary etching liquid, has an excellent effect in clearing the lines and preventing their blocking up in the printing. This method will be very valuable in many cases.

8. PHOTOCOLLOTYPE PROCESS.—The working of the photocollotype process has made considerable advance under Sergeant Harrold. It had previously only been carried on experimentally by myself and at first many difficulties, due to the climate and to the

RUINS OF DIMAPUR, NAGA HILLS.

Photocollotyped at the Surveyor General's Office, Calcutta, from a pencil sketch by Major H. H. Godwin-Austen.

want of proper appliances and materials, were experienced, but the latter have now nearly all been received from England, and all that is required is the increased establishment to work two more presses. Sergeant Harrold has been training two native assistants who will be able to take charge of these presses. There is considerable field for the use of the process, and there is no doubt that the three presses will find ample work as soon as its value is better known. The accompanying reduced copy of a pencil drawing by Major H. H. Godwin-Austin of a view of the Temple of Dimapúr in the Nágá Hills printed by the process will give an idea of the success with which such drawings can be copied, and of the value of the process for copying drawings, &c., not susceptible of reproduction by photozincography.

I have to record several improvements made since my last report.

We have now succeeded in obtaining very perfect reversed negatives by the method practised by Captain Abney, at Chatham, of taking a negative in the ordinary manner, coating it with thin solution of Indian-rubber in benzole, and when dry again coating it with transfer collodion containing a little castor oil. As soon as this is dry the compound film may easily be removed from the glass and either laid down reversed on the same glass or transferred to the printing plate as described below.

A reversing mirror has been received from England during the year, and will prove of great use in making the reversed negatives of many subjects without extra trouble or expense.

The formula for the preparation of the sensitive film has been slightly modified, and it now stands as follows:—

A	Gelatine	...	1 ounce.
	Glycerine	...	1 dram.
	Distilled water	...	6 ounces.
B	Albumen	...	1 ounce.
	Water	...	1 „
C	Tannin	...	10 grains.
	Water	...	1 ounce.

The use of the albumen has been found to give toughness to the gelatine films and to help their firm adherence to the plate.

During the hot weather the use of carbolic soap instead of honey soap was found to be advantageous in preventing the decomposition of the gelatinous mixture while drying, but the introduction of improved means of drying the plates and the substitution of albumen have led to the abandonment of the soap; the best formula for the mixture has, however, yet to be decided, and much seems to depend upon the time of the year, so that the compositions may have to be modified according to the dryness or dampness of the air and the heat of the weather.

The principal improvement introduced is in the transfer of the negative film on to the printing plate, whereby perfectly close contact between them is secured and the sharpest possible results obtained. In working from the ordinary glass negatives, and more particularly from negatives that have been reversed and transferred to a glass plate, it was found very difficult to make sure of perfect contact between them and the printing plate owing to inequalities on the printing films from uneven drying of the gelatine or dust, &c., on the surface of the transferred negatives. After many failures from this cause it struck me that it might be possible to transfer the negative on to the gelatine surface of the printing plate, so that it might be in the most perfect contact with it during the exposure to light and afterwards be removed without damage for further use. After several trials, in which the only difficulty experienced was in the removal of the thin collodion films from the printing plates after exposure, the following method was found to give satisfactory results.

The sensitised and dried gelatine surface of the printing plate is covered with an extremely thin coating of wax dissolved in turpentine or benzole, applied in the same manner as in waxing glass plates from which a gelatine film is to be stripped. The plate is then placed in a dish containing sufficient strong spirit of wine to cover it. The thin negative film having been removed from its glass support, as above described, is laid down upon the gelatine surface in its proper position, the plate is then removed from the spirit and the negative carefully pressed into close contact with the gelatine by means of a squeezee. The collodion surface is covered with a few thicknesses of blotting paper under a thick glass plate and allowed to dry. When dry any stopping out that may be necessary is easily done on the negative, and the plate is ready for exposure to light. The negative film may be removed again, immediately after exposure or after the back of the plate has been sunned. If the gelatine surface is well coated with wax, and the negative tissue sufficiently tough, there is no difficulty in removing the film, which may then be laid aside between sheets of blotting paper for future use. Should the film tear, or be difficult to remove, it should be dissolved off at once with ether or other solvents, otherwise there will be a continuating action of light under the parts protected by the films, so that they will print darker than the rest of the plate. Before the printing plates are put to soak the wax should be removed with turpentine. Negative films strengthened with a coating of gelatine, as described in my report for last year, may also be transferred in the same manner.

The object of effecting the transfer in a bath of spirit of wine is that neither the gelatine nor the bichromate of potash are dissolved by it. The spirit may be used over and over again.

This method is of course not applicable in the case of valuable and unique negatives which could not be replaced, but for making perfect copies of maps, drawings or other subjects, of which the originals are available in the case of the accidental destruction of the negative, it seems likely to prove most valuable.

In the course of a series of experiments upon the action of various reagents upon collotype films, I discovered that, among other substances, citric acid had an excellent effect in clearing up plates that printed dirty, and at the same time facilitated the inking in.

This valuable property has been most usefully applied in the working of the process, and almost supersedes the use of cyanide of potassium, except in extreme cases, when the two may be employed together with advantage, the cyanide to clear and the citric acid to enable the plate to be inked up again after the clearing.

In the present state of the process, I have not yet been able to apply it to the improvement of the reproduction of the 1-inch maps of the Revenue and Topographical Surveys. There are many practical difficulties to be overcome, due to the large size of the maps and the necessity for alterations and additions to the originals before they are fit for publication, but the subject is borne in mind, and will be dealt with at the earliest possible opportunity.

As soon as the requisite establishment is sanctioned, it is proposed to publish by the collotype process a reduced series of the quarter-sheets of the Atlas of India on the scale of 6 miles to the inch. In this manner small portable atlases of provinces could be got up, which would prove of great use to all persons requiring such maps, particularly to travellers. The process might also be usefully applied in producing reduced copies of the 1-inch maps of the Topographical Surveys on half scale, or 2 miles to one-inch ; these would be portable and convenient, and, if required, could easily be joined up into larger sheets.

I have to bring to your notice and to warmly acknowledge the great assistance I have received from Captain W. de W. Abney, R. E., of the School of Military Engineering, Chatham, who has very kindly procured and sent out through the Secretary of State for India all the apparatus and other materials required for working the process, besides selecting and training two non-commissioned officers of the sappers for service in this office.

AUSTRALIAN PHOTOLITHOGRAPHS.—During the year I have opened communications with the Photolithographic Departments of the Surveyor General's Offices at Melbourne and Adelaide, in Australia, and in both cases I have received some excellent specimens of the Australian photolithographed maps. The Surveyor General of Victoria has further favoured me with a valuable and interesting account of the photolithographic process used in the Melbourne Office, drawn up by Mr. J. Noone, the Government Photolithographer.

I am indebted to Mr. Frazer S. Crawford in charge of the Photolithographic Department of the Surveyor General's Office, Adelaide, for a description of his photo-tracing transfer process which is likely to be of great service in the office for lithographing maps or plans on a reduced scale, in cases where the originals are not suitably drawn for photozincography. The method consists in making a print from the negative on paper prepared with bichromate of potash and gelatine precisely in the same manner as for the ordinary photo-transfers in greasy ink. After exposure to light, which should be much more prolonged than is usual for photo-transfers, the print is washed to remove the bichromate, and is then coated with the ordinary lithographic transfer composition. When dry, it is passed through the press to smooth the surface, and is then ready to be handed over to the lithographic draftsman, who has only to draw in the details required on the print, which is then transferred in the usual way.

Mr. Crawford has also very obligingly sent me descriptions of his mode of working and of his apparatus and glass-house accessories, some of which may be adopted here with advantage.

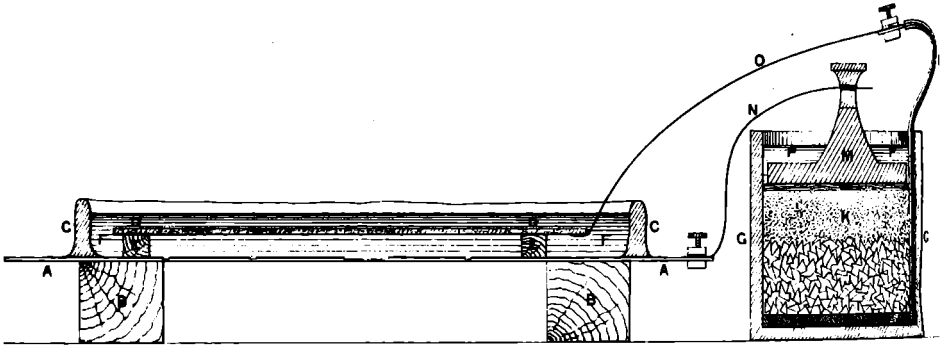
This interchange of communications with similar offices in other countries is very desirable, and cannot but be attended with a good effect, especially considering the complete isolation in which one has to work such special subjects in India.

AWARD OF MEDALS.—I am happy to report that at the last exhibition the silver prize medal of the Bengal Photographic Society for Indian subjects, was awarded to this office for a collection of photographs of jewellery, &c., originally prepared for the London International Exhibition; and I have also been informed that the collection of specimens of maps, &c., forwarded to the Vienna Exhibition, gained a medal, but have not yet received an official announcement of the fact.

STEEL FACING OF ENGRAVED COPPER PLATES.—Although this process has strictly no connection with the operations of the Photographic Office, it is carried on here under my charge, and a notice of what has been done is, therefore, not out of place.

CORRECTION OF ENGRAVED COPPER PLATES BY ELECTRO-DEPOSITION,

As proposed by Captain J. Waterhouse, Assistant Surveyor General.



Scale One-Fourth.

REFERENCES.

A A. Engraved Plate
B B. Wooden blocks supporting the Plate
C C. Wax Wall
D D. Copper Anode
E E. Blocks supporting do.
F F. Solution of Sulphate of Copper.
G G. Stone Jar of Battery
H. Disc of Copper
I. Insulated wire attached to Disc of Copper
J. Crystals of Sulphate of Copper (about 1 lb.)
K. Saw-dust
L. Felt
M. Disc of Zinc with Brass Binding-screw.
N. Copper band from do., attached to Engraved Plate.
O. Copper band from Copper, attached to Anode
P P. Water.

The thick line on the surface of A A represents the coating of Brunswick black, and the breaks in it the cuts or erasures in which copper is to be deposited.

The apparatus arrived from England in a very damaged state, the two sides of the large slate depositing-trough, and nearly the whole of the battery jars, being broken and useless. Endeavours were made to replace them as soon as possible, and it has since been done, but it was necessary to provide makeshifts for the trough and jars, in order that Colonel Walker, R. E., Superintendent of the G. T. Survey, who had learnt the process as practised by Messrs. Malby & Co., the well-known geographical engravers in London, might instruct me in the manipulations. A trough was made of a double casing of teak-wood filled in with pitch, and battery cells were made by cutting the necks off some large stone jars. These answered very well, and, under Colonel Walker's supervision, the process was started with success on the 11th March, since which time 4 full-size, double elephant plates, of the Indian Atlas, 10 quarter-size plates, and 21 plates of tints, &c., have been steel-faced. Latterly, the apparatus has not worked so successfully, and though many experiments have been made, it is difficult to ascertain the reason of the failures. I have, however, forwarded proofs illustrating the failures to Messrs. Malby & Co., who have kindly favoured me with information on the subject, by the help of which, it is hoped, the process may again be successfully worked. It has also been found lately that the plates cannot be kept steel-faced without danger of being attacked by rust, even though the most careful precautions are taken for their preservation, and they are well coated with Brunswick black. These dangers may, however, be obviated by making it a rule only to steel-face the plates as required for printing, and to remove the coating again as soon as the requisite number of impressions have been struck off.

CORRECTION OF ENGRAVED COPPER PLATES.—During the past year my attention has been drawn to the way in which valuable engraved plates were damaged by the process of making corrections by "knocking up." Having learnt when I was in Paris in 1868 a method of correcting copper plates with the aid of the galvanic battery, invented by M. Georges, Superintendent of the Engraving Department of the *Depôt de la Guerre*, and seen a similar process in work at the Military Geographical Institute at Vienna, I made some experiments with the view of ascertaining whether such a process could be introduced here. After several trials I succeeded perfectly by the following method, which is a combination of both the Paris and Vienna systems,* and, as far as present experience goes, appears to have the advantage of being more regular in action than the former, and more simple and economical than the latter. The general arrangement will be seen from the accompanying sectional diagram :—

The engraved plate is first of all coated with a thin asphaltum varnish, which is allowed to dry thoroughly. The parts to be corrected are then carefully cut out so as to leave clean square edges, especial precautions being taken that no trace of grease or other substance which might hinder the perfect adherence of the deposit remains in the cuts.

The whole surface of the plate, with the exception of one corner, is then coated with Brunswick black, taking care to avoid getting any in the cuts, (this is done to prevent any damage being done to the plate by leakage of the acid solutions used in the after-stages of the process). When this is dry, the parts of the plate surrounding the cuts to a distance of about 4 or 5 inches are again well coated with the black in order to prevent any chance of the deposited copper adhering to the plate elsewhere than in the cuts. When the varnish is thoroughly dry, a strip of bordering wax about $1\frac{1}{2}$ inch wide and $\frac{1}{4}$ inch thick is firmly pressed down at a distance of about 3 inches round the cuts so as to form a water-tight trough, and the plate is now ready for connection with the battery.

The battery is one of those generally used in the Government Telegraph Department, known as Menotti's modification of Daniell's battery, and consists of a stone-ware jar, containing at the bottom a disc of copper or lead, to which is attached an insulated copper wire running up the sides of the jar. The copper disc is covered by a quantity of crystals of sulphate of copper, over which is a layer of sawdust covered by a piece of felt and then a thick disc of zinc to which a binding screw is attached. To set the battery in action, it is only necessary to pour water into the jar till the zinc disc is covered. The action is very constant, and the battery remains in good order for a long time.

The bare corner of the plate to be corrected, and all the connections of the battery having been carefully cleaned, the plate is supported on blocks of wood and the bare corner connected with the zinc pole of the battery by means of a thin band of copper. A solution containing—

Sulphate of copper	5	parts
Sulphuric acid	1	,,
Water	30	,,

is poured into the trough to the depth of about an inch, any air bubbles that may form in the cuts being carefully removed with a soft camel's hair brush. A plate of copper large enough to cover the whole extent of the parts to be corrected, having been attached to the copper pole of the battery by means of a copper band previously soldered to it, is laid down horizontally over the cuts at a distance of about $\frac{1}{2}$ an inch, and is supported at the proper distance by means of pellets of wax or pieces of wood fastened down to the plate with a little wax. The deposition of copper in the cuts now commences, and in the course of 20 to 24 hours completely fills them up, forming a ridge of copper round them. The

* For full details of these methods, see my "Report on the Curtographic Applications of Photography," pp. 2 and 91.

proper thickness of the deposit is ascertained by a means of a small copper fork having three prongs of equal length, so that if the middle prong is placed in the hollow formed above the cuts, it is easy to see by the distance of the side prongs from the plate whether sufficient metal has been deposited to enable the surface to be perfectly restored. When this is ascertained to be the case, the solution is poured off, the wax wall removed, and the plate cleaned with turpentine. The deposited copper will then be found to be in the form of a hollow between two ridges extending beyond the original limits of the cut. There may also be several knobs and accretions of copper round the ridges and in other parts of the plate. These can easily be removed with the point of a burnisher or a wooden scraper. The ridges of superfluous copper have now to be filed down, and in order to protect the surface of the plate from injury during this operation, a piece of stout paper is fastened down with Brunswick black on the plate all round the ridges. When this is dry the deposit is carefully filed down with a bent flat file till it is no higher than the thickness of paper on each side. The paper and varnish are then removed, and the remaining deposit is carefully scraped away till the original level of the plate is restored, care being taken to turn the plate constantly to prevent the parts being worked into a hollow. The surface of the plate is then brought up with charcoal, and it is ready for re-engraving. If the operation has been skilfully performed, there should not be the slightest trace of it on the plate, except perhaps a little difference in the color of the copper in the parts filled in.

This process is likely to prove of value to the Engraving Department as a means of avoiding the extensive damage done to valuable plates by the old process of "knocking up." Instead of the plates being full of hollows, or bent and distorted, they retain their original even thickness throughout. Instead of an immense amount of labour being required to repair the good work damaged all round the corrections, not a line of the surrounding work need be injured in the least degree, and it is only necessary to re-engrave the new details. Mr. Coard, the Superintendent of the Engraving Department, has testified strongly to its efficiency in these respects and considers it most satisfactory. The method has already been applied to the correction of two very valuable plates, on one of them for the removal of a line of boundary running through fine hill work, which would have been almost irretrievably damaged by the old process.

As regards the time required for the operation, the new method has the further advantage of being quite as quick as knocking up for at all extensive corrections, more on account of there being no need to repair work already on the plate than from the actual time spent on the operations. A great saving of time is effected by working at night, *i. e*, the plate can be connected with the battery at the close of the day's work and may be ready for filing next morning.

The expense is very trifling, as will be readily understood when it is stated that the cost of a complete battery as supplied by the Telegraph Department is only Re. 1-2, and this will serve for a very large number of plates, while the copper bath once made requires no alteration.

The manipulations are very simple, and could easily be learnt by any engraver, European or Native.

General Experimental Work.—The charge of the Lithographic Branch in addition to my other duties has prevented my giving much time to experimental work, but nevertheless several trials of new processes and methods in connection with the working of the collotype processes have been made, and much useful experience acquired. A series of observations on the solubilities of chrome-gelatine compounds and of the action of reagents upon collotype films have also been partly recorded. I hope to complete them during the present year, as they are likely to prove of practical utility in facilitating the working of all the photo-mechanical processes dependent on the use of gelatine and salts of chromium.

At the request of the Quarter Master General of the Army, trials have been made of Herschel's Cyanotype process which has been suggested by Lieutenant-Colonel M. Hunter as an easy method of reproducing facsimile copies of sketches, intricate calculations, &c., of which a few copies might be required in a hurry, or in cases where the appliances for photozincography might not be available. The process was found to be easily worked, but to possess the disadvantage of giving prints with white lines on a dark blue ground and thus unsuited for general purposes.

More useful results were obtained from trials of Poitevin's process of printing with a mixture of perchloride of iron and tartaric acid, by which copies with the lines in black on a white ground may be made direct from manuscript writings or drawings on tracing paper, vellum cloth, or other thin transparent material. Trials were also made to apply the same process to photozincography, but without success; further experiment may prove its possibility. If it could be done, the value of such a process would be very great as enabling facsimile photozincographic copies to be made from any drawing or thin paper or cloth without the necessity of making the negatives in the camera, and thus a great saving of time, labour, and expense would be effected.

During the year my attention was drawn by Colonel Gastrell, Superintendent, Revenue Surveys, Upper Circle, to the subject of a quick and cheap method of reproducing

he original sheets of the Cadastral Surveys of the North-Western Provinces, and several trials were made with this object in view. The question is not yet definitely settled, but excellent results were obtained from drawings on vellum cloth with a liquid lithographic transfer ink introduced by Captain Abney, R. E. The drawings were prepared in recess quarters at Nynee Tal and sent here for transfer to zinc. The method was found to be simple, and the results fairly accurate to scale. It also has the advantage of reducing to a minimum the errors incidental to copying maps by hand.

Abstract of work performed in the Photographic Branch of the Surveyor General's Office from 1st January to 31st December 1873.

Maps photographed.	Number of sections or sheets.	Number of negative plates.	Prints.		Transferred to zinc or stone.	Number of pulls.	Number of complete copies.	Remarks.
			Silver.	Carbon.				
Topographical Maps ...	189	322	206	307	117	17,785	18,421	4 stone.
Revenue Maps ...	967	748	10	786	223	30,691	26,356	2,425 anastatic.
District „ ...	8	24	16	36	8	6,250	2,765	1,610 do.
General „ ...	38	184	151	162	51	8,986	6,281	
City and Cantonment Plans	145	306	...	346	85	11,463	4,892	770 do.
Miscellaneous Maps ...	264	385	1,627	310	100	35,499	47,038	1,124 do.
Zincographic and anastatic transfers ...	...	...	...	...	829	...	...	
Proofs ...	...	...	...	...	...	1,202	...	
Photocollotypes ...	...	...	...	...	...	3,000	3,000	
Total ...	1,611	1,969	2,010	1,947	1,413	1,14,876	1,08,753	

Statement showing the cost of working the Photographic Branch of the Surveyor General's Office from 1st January to 31st December 1873.

Dr. Cr.

Maps photographed.	Number of complete copies.	Rs.	A.	P.		Rs.	A.	P.
Topographical Maps ...	18,421	17,991	4	0	Superintendent's salary from 1st January to 31st December 1873	9,659	6	0
Revenue Maps ...	23,931	31,374	0	3				
District „ ...	1,155	3,030	0	0	Sanctioned establishments and house-rent from 1st January to 31st December 1873	23,223	12	9
General „ ...	6,281	7,455	10	3				
City and Cantonment Plans	4,122	8,514	10	6				
Miscellaneous Maps ...	45,914	5,567	7	1	Contingencies, inclusive of chemicals received from the Government Medical Store Department on emergent indents and stores from England (as far as invoices have been received)	6,487	2	2
Anastatised Maps ...	5,929	8,107	9	0				
Silver prints ...	2,010	3,434	13	0				
Photocollotype (approximate)	3,000	375	0	0				
					Cost of paper	11,498	10	2
					Balance in favor of the Department	34,981	7	0
Total Rs. ...	1,10,763	85,850	6	1	Total Rs. ...	85,850	6	1

(Signed) J. WATERHOUSE, *Captain,*
Asst. Surveyor General,
In charge, Photographic Branch,
Surveyor General's Office.

Calcutta, 1st January 1874.

Report by CAPTAIN J. WATERHOUSE, *Assistant Surveyor General, in charge, Lithographic Branch.*

During the past year, extending from 1st January to the 31st December 1873, the amount of work may briefly be stated as below :—

240 new drawings have been executed.
139 colour stones prepared.
481 sheets have been printed, giving 159,652 complete copies, for which 238,712 pulls were required.

2. The cost of the establishment and contingencies has amounted to Rs. 40,573.

3. The work of type printing for departmental forms and circulars, headings and foot notes of maps, &c., is largely increasing and getting beyond the capabilities of the small staff at present allowed for the purpose. A proposal for strengthening this branch is under preparation, and will be submitted at an early date.

4. The color printing has made good progress during the year, and has been availed of to a considerable extent for colouring departmental maps and for much miscellaneous work for other departments.

5. I am glad to report that attention has been given during the year to the superior advantages of drawing on the stone, and that several apprentices show a great aptitude for learning this method, which will hereafter be adopted as far as possible for the one-inch maps and other work of a superior class.

6. I have again to report with pleasure on the good service and zealous attention to their duties of Messrs. Jevezy, Niven, and Lepage.

Abstract of the drawings executed in the Surveyor General's Office, Lithographic Branch, from 1st January to 31st December 1873.

Scale, &c.	New Maps, &c., the lithographic drawings of which were completed during the present year.	Size.	No. of Sheets.	
	General Maps.			
32 miles = 1 inch	Preliminary Map of Bombay Presidency ...	Antiquarian ...	1	
32 „ = 1 „	Map of North-Western Provinces for Administration Report.	Imperial ...	1	
8 „ = 1 „	Punjab Compilation Map, Sheet No. 6, only hills drawn on stone.	Double Elephant ...	1	
8 „ = 1 „	Map of Western Bengal, Sheet No. 11, partly drawn ...	Imperial ...	1	
4 „ = 1 „	„ Soonderbuns.	Double Elephant ...	2	
	Index to the Sheets of the Ganjam and Orissa Topographical Survey.	Foolscap ...	1	7
	District Maps.			
	Scale 4 miles = 1 inch.			
	District Dumoh, (2nd edition)	Double Elephant ...	1	
	„ Sirsah	Ditto ...	1	2
	Revenue Survey Maps.			
	Scale 1 mile = 1 inch.			
	Sindh Revenue Survey, Sheets Nos. 44 to 46 ...	Ditto ...	2	
	Oudh „ „ „ Nos. 27, 39, 40, and 41	Ditto ...	4	
	„ „ „ „ Nos. 23 and 24, (2nd edition).	Ditto ...	2	
	District Lohardugga, „ Nos. 10, 12, and 13 ...	Double Royal ...	3	
	Kooch Behar State, „ Nos. 5, 6, and 7 ...	Ditto ...	3	
	District Bijnour, „ Nos. 1, 2, 3, and 7 ...	Ditto ...	4	
	„ „ „ No. 6 redrawn ..	Ditto ...	1	
	„ Chanda, „ Nos. 3B, 3 to 11 ...	Ditto ...	3	
	„ „ „ Nos. 10 to 14 (2nd edition) a portion drawn.	Ditto ...	2	
	„ Bareilly, „ Nos. 1, 2. 3, 4, 7, 10, 11, and 12.	Ditto ...	8	
16 inches = 1 mile	Cadastral Survey Map, Village Mandour, Pergunnah Sadabad, District Muthra, Sheet No. 5.	Ditto ...	1	33
	Thannah Maps.			
4 „ = 1 „	Thannah Doulutpoor, Sub-Division Kooshteah, District Nuddeah.	Ditto ...	12	12
	Plans of Cantonments and Civil Stations.			
10 chains = 1 „	Plan of the City and Cantonments of Hosungabad ...	Super Royal ...	1	1
	Carried over ...	...	...	55

Abstract of the drawings executed in the Surveyor General's Office, Lithographic Branch, from 1st January to 31st December 1873—continued.

Scale, &c.	New Maps, &c., the lithographic drawings of which were completed during the present year.	Size.	No. of sheets.	
	Brought forward ...	...	...	55
	Barrack Plans.			
	Plan of European Infantry lines at Fyzabad, Sheets Nos. 1, 2, 3, 4, 5, 6, and 7.	Double Elephant ...	7	
	Plan of Royal Artillery lines at Fyzabad, Sheets Nos. 1, 2, and 3.	Double Royal ...	3	
	Index to the Sheets of European Infantry and Royal Artillery lines at Fyzabad.	Super Royal ...	1	
	Plan of Military Buildings at Dum-Dum, Sheets Nos. 1, 2, 3, 4, 5, 6, 7, 8, and 1 Title Section.	Double Royal ...	18	
	Index to the Sheets of the Plan of Military Buildings at Dum-Dum.	Super Royal ..	1	
	Plan of Fort William, Sheets Nos. 1, 2, 3, 4, 5, and 6	Double Elephant ...	9	
	Native Infantry lines at Alipore, Sheets Nos. 1 and 2.	Ditto ...	2	
	Plan of Ballygunge	Double Elephant ...	2	
	Plan of Hastings, Sheets Nos. 1, 2, 3, and 4 ...	Double Royal ...	8	
	Chinsurah Cantonment	Ditto ...	4	
	Cawnpoor European Infantry Barracks, Nos. 1, 2, 3, 4, 5, and 6.	Ditto ..	8	
	Cawnpoor Artillery Barracks, Nos. 1, 2, 3, 4, 5, 6, 7, 8, and 9.	Ditto ...	9	
	Plan of Military Buildings at Barrackpoor, Sheets Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13.	Ditto and Double Elephant.	13	85
	Drawing of Geological Survey Maps.			
8 miles = 1 inch	Geological Map of Pegu Province, British Burmah ...	Antiquarian ...	1	1
	Miscellaneous Maps.			
Various Scales ...	Railway Maps	Various sizes ...	2	
" " ...	Foreign Department Maps	Ditto ...	16	
" " ...	Archæological Survey Plans	Ditto ...	18	
" " ...	Public Works Department Maps and Plans ...	Ditto ...	16	
" " ...	Bengal Government Maps and Plans	Ditto ...	7	
" " ...	Miscellaneous Maps, Plans, and Diagrams ...	Ditto ...	99	158
	Coloring.			299
128 miles = 1 inch	India No. 2, 3 tint stones prepared	Imperial ...	3	
64 " = 1 "	The Territory under the Lieutenant-Governor of Bengal, showing boundaries, 3 tint stones prepared.	Super Royal ...	3	
32 " = 1 "	Maps of Bengal, Behar, and Orissa for Administration Report for 1872-73, 3 tint stones prepared.	Double Elephant ...	3	
32 " = 1 "	Central Provinces, 3 tint stones prepared ...	Atlas ...	3	
32 " = 1 "	Map of North-Western Provinces for Administration Report, 3 tint stones prepared.	Imperial ...	3	
16 " = 1 "	Forest Map of British Burmah, 4 tint stones prepared	Ditto ...	4	
8 " = 1 "	Punjab Compilation Map, Sheet No. 6, 4 tint stones prepared.	Double Elephant ...	4	
4 " = 1 "	Indian Atlas Quarter Sheets, Nos. 9 S. W., 10 N. W., 11 N. E., 32 N. E., 32 S. E., 33 N. E., 51 S. W., 78 N. E., and 86 S. W., 29 tint stones prepared.	¼ sheet Atlas ...	29	
4 " = 1 "	District Bahraitch, 4 tint stones prepared ...	Imperial ...	4	
1 " = 1 "	District Bijnour, Sheets Nos. 2, 3, 6, and 7, 4 tint stones prepared of lines of levels.	Double Royal ...	4	
	Index Map illustrating proposed plans for supplying water to the City of Jeypoor, 2 tint stones prepared.	½ sheet Imperial ...	2	
	Plan of Head Works on the Emanishah River, Jeypoor, 2 tint stones prepared.	Ditto ...	2	
	5 Diagrams of Tubular Brackets, 2 tint stones prepared	Various sizes ...	2	
	India Skeleton map showing Inland Customs lines and salt sources in the Punjab, North-Western, and Central Provinces, 1 tint stone prepared.	Foolscap ...	1	
	Wreck Chart of the Coast of India for 1872, 1 tint stone prepared.	Double Elephant ...	1	
	Settlement Map of District Pertabgurh, 3 tint stones prepared.	Antiquarian ...	3	
	Sketch Map showing the cold weather channel of the River Sutlej in different seasons, 6 tint stones prepared.	Foolscap ...	6	
	Map of India to illustrate the Annual Report of the Sanitary Commissioner for 1872, 1 tint stone prepared.	Imperial ...	1	78
	Carried over ...	...	...	78

Abstract of the drawings executed in the Surveyor General's Office, Lithographic Branch, from 1st January to 31st December 1873—continued.

Scale, &c.	New Maps, &c., the lithographic drawings of which were completed during the present year.	Size.	No of sheets.	
	Brought forward ...	...	...	78
	COLORING GEOLOGICAL SURVEY MAPS.			
4 miles = 1 inch	Geological Map of Indian Atlas, Quarter Sheet, No. 77 N. E., 8 tint stones prepared.	½ Sheet Atlas ...	8	
4 „ = 1 „	Geological Map of Indian Atlas, Quarter Sheet, No. 78 N. E., 6 tint stones prepared.	Ditto ...	6	
1 „ = 1 „	Geological Map of District Dumoh, Sheets Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12, 44 tint stones prepared.	Double Royal ...	44	
	India No. 1, showing present state of progress of the Geological Survey of 1872, 3 tint stones prepared.	Foolscap ...	3	
				61
				139

Abstract of printing executed at the Surveyor General's Office, Lithographic Branch, during the year 1873.

Subject.	No. of Sheets.	No. of Copies.	No. of Pulls.
Lithographic Branch.			
District and General Maps on various scales	21	4,242	11,111
Index Maps	5	935	935
Revenue Survey Sheet Maps, 1 mile = 1 inch	35	8,478	13,256
Thannah Maps	18	150	1,350
Plans of Cantonments and Civil Stations	13	327	2,252
Block Plan of Barracks, &c., for Secretary of State	56	3,220	5,144
Reprints of Old Maps	62	10,352	16,245
Miscellaneous Maps	27	6,921	14,451
Ditto Plans and Sketches, &c.	225	1,19,342	1,53,206
Printed tints on Geographical Maps and Plans, &c.	19	5,685	20,763
	481	1,59,652	2,38,712
Type Department.			
Departmental orders, &c.	22	3,226	3,226
Memoranda and forms for the use of the Department	497	1,79,033	1,98,440
Forms for Topographical and Revenue Surveys	75	87,315	1,73,267
Transfers of headings, foot-notes, and references, &c., to the published Maps	.....	5,760	5,760
TOTAL ...	.....	2,75,334	3,80,693

Statement of Cost of Lithographic Branch.

	Rs. A. P.
Permanent Establishment	34,790 8 2
Contingent expenses	4,408 8 2
Extra contingencies	1,374 12 0
TOTAL RUPEES ...	40,573 12 4

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

SURVEYOR GENERAL'S OFFICE,
LITHOGRAPHIC BRANCH,
1st January 1874.

O. S. G. P.—No. 6 S. G.—24-3-74.—300.