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GENERAL REPORT

ON THE

OPERATIONS

OF THE

Survey of India Department

ADMINISTERED UNDER

THE GOVERNMENT OF INDIA

DURING

1898-99.

PREPARED UNDER THE DIRECTION OF

COLONEL ST. G. C. GORE, R.E.,

SURVEYOR-GENERAL OF INDIA.



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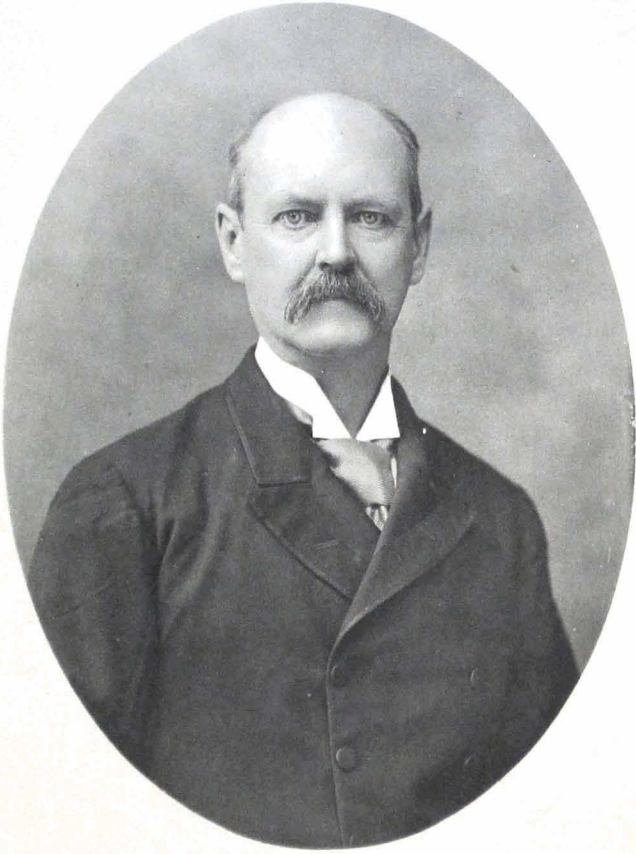
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OF THE
Survey of India Department

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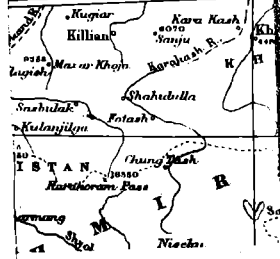
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GENERAL REPORT
ON THE
Operations of the Survey of India

DURING THE SURVEY YEAR

1898-99.

PART I.

SUMMARY.

ADMINISTRATION.

1. The operations of the department that are now reported on are for the survey year ending 30th September 1899.

2. The general administration of the department and the superintendence of the Topographical Branch remained throughout the year in the hands of Major-General C. Strahan, R.E., Surveyor-General of India, who on the 30th September retired from the Department in which he had served for 36 years.

Throughout the year Lieutenant-Colonel J. R. Hobday, I.S.C., Deputy Surveyor-General, held charge of the Revenue Branch.

Major S. G. Burrard, R.E., officiated as Superintendent, Trigonometrical Surveys, until the return of Lieutenant-Colonel St. G. C. Gore, R.E., from special leave on the 31st October, when the latter resumed charge of the Trigonometrical Branch, which he held until the end of the year.

Captain R. T. Crichton, I.S.C., continued to be Superintendent, Settlement Surveys, Bengal, until he proceeded on furlough on the 26th April 1899 when Captain C. W. H. Symonds, I.S.C., was appointed in his place.

Mr. G. B. Scott, the Superintendent of Land Records Surveys in the North-Western Provinces, attained the age of 55 on 31st July 1899, but the Government has been pleased to grant him an extension of service for a period of two years.

Inspection Tours of the Administrative Officers.

3. The Surveyor-General left Calcutta on the 15th April and proceeded to Dehra, when he was summoned by the Government of India to Simla where he remained on special duty till the 27th. On the 28th he left Simla and returned to Dehra, to inspect the Trigonometrical Office and the field parties recessing at Mussooree, and again returned to Simla on the 10th May. During his stay at Simla he visited the office of No. 18 Party (Himálayas). On the 16th July Major-General Strahan left Simla and returned to Calcutta, again visiting the Trigonometrical Branch Office at Dehra and the field parties recessing at Mussooree. On the 11th September he left for Bangalore and Poona, where he inspected the recess offices of Nos. 10, 11, 17 and 21 Parties, till the end of the month, when he handed over charge of the department to Colonel St. G. C. Gore, R. E.

4. Lieutenant-Colonel J. R. Hobday, Deputy Surveyor-General, left Calcutta on 5th December for Burma, and inspected the following survey parties at work in the field, *viz.* :—No. 20 Forest Party at Pegu, No. 7 Cadastral Party at Toungoo, Mandalay and Myingyan, and No. 3 Lower Burma, Topographical Party at Prome, returning to Calcutta on 22nd *idem*. He then again left head-quarters on the 29th January to inspect the Bengal survey party in the field at Darbhanga and returned to Calcutta on the 8th February. At the request of the Government of India, he started again on the 12th February to

inspect and report on certain traverse operations in the Dera Gházi Khan district that were being conducted by Mr. R. B. Smart, Extra Assistant Superintendent, at the instance of the Punjab Government to help the local *patwári* surveys. He met Colonel Montgomery, the Settlement Commissioner at Sinánwán, and conferred with him regarding the work in progress under Mr. Smart, and the square system of surveying adopted by the Punjab Government. He left Bhakkar in the Dera Ismail Khan district on the 24th of February and proceeded to Tezpur to inspect No. 6 Survey Party in Assam, and finally returned to Calcutta on the 17th March.

He again left Calcutta on the 17th of April and inspected the Bengal Surveys recess office at Dígha near Dinapore, and continued on to inspect three of the field camps of the Land Records Surveys in the North-West Provinces and Oudh, at Gonda, Fatehgarh and Bareilly. He then proceeded to Mussooree to inspect Nos. 2 and 8 Traverse Parties, and continued on to Naini Tal to confer with His Honour the Lieutenant-Governor and the Board of Revenue regarding the transfer of Nos. 2 and 8 Traverse Parties and Drawing office to the control of Mr. G. B. Scott, the Superintendent, Land Records Surveys, North-West Provinces and Oudh, and other matters connected with the surveys in those Provinces, and finally returned to Calcutta on the 16th June. On the 2nd July he again left head-quarters to inspect the traverse detachment working in the Central Provinces and recessing at Jubbulpore, and then proceeded to Pachmarhi to confer with Mr. Ibbetson, the Chief Commissioner, regarding survey matters connected with those Provinces.

In August he inspected Nos. 3, and 9 and 19 Parties at their recess quarters in Bangalore.

5. Colonel St. G. C. Gore, R.E., Superintendent, Trigonometrical Surveys, visited Mussooree in June and inspected Nos. 22, 23 and 24 Parties recessing there, and in July he proceeded to Simla where he inspected No. 18 Party.

In September he left Dehra Dún for Karáchi and inspected No. 12 Party.

FIELD PARTIES.

6. The field operations of the year were carried on by two double and 17 ordinary parties. Of these, one party was employed on trigonometrical surveys; eight parties on topographical surveys; one double and two ordinary parties on forest surveys; two parties on cadastral surveys; one double and one ordinary party, and a detachment, on traverse surveys; and three parties on scientific operations. The operations of the Forest Survey Branch were continued during the year in addition to the above. The Land Records surveys carried on by local agency in the North-Western Provinces and Oudh, which are under the general superintendence of the Deputy Surveyor-General, Revenue Branch, have been included in this report under the head of Cadastral Surveys.

7. The following tabular statement shows the whole of these operations grouped according to the scope and nature of the work on which the parties were severally employed:—

Statement of Survey Operations and Parties.

| No. of Party. | Nature and locale of operations. | Page in this Report. | Executive Officers. | Scale of Survey. | Administrative Superintendent. |
|---------------|----------------------------------|----------------------|---|-----------------------------------|--------------------------------|
| 24 | <i>Trigonometrical Survey.</i> | 17 | Captain H. A. D. Fraser, R.E. Lieutenant H. H. Turner, R.E. Mr. J. Hickie . . . | | Supdt., Trig. |
| | Indian Triangulation . . . | | | | |
| | <i>Topographical Surveys.</i> | | | | |
| 6 | Assam | 57 | Captain C. W. H. Symonds, I.S.C. Mr. W. H. Penrose . . . | 2 inches = 1 mile for reduction. | D. S. G., Rev. |
| 3 | Lower Burma | 19 | Mr. T. E. M. Claudius . . . | 1 inch = 1 mile for reproduction. | Ditto. |

Statement of Survey Operations and Parties—contd.

| No. of Party. | Nature and locale of operations. | Page in this Report. | Executive Officers. | Scale of Survey. | Administrative Superintendent. |
|--|-----------------------------------|----------------------|---|---|--------------------------------|
| 10 | Upper Burma . . . | 20 | Lieutenant W. M. Coldstream, R.E. Captain F. W. Pirrie, I.S.C. Mr. G. D. Cusson . . . | 1 inch = 1 mile and 16 inches = 1 mile for reproduction. | D. S. G., Topo. |
| 11 | Ditto . . . | 21 | Mr. P. J. W. Doran . . . | 1 inch = 1 mile for reproduction. | Ditto. |
| 21 | Ditto . . . | 22 | Captain C. H. D. Ryder, R.E. Captain H. J. Hare, R.E. Mr. A. J. James . . . | Ditto . . . | Ditto. |
| 12 | Sind . . . | 23 | Mr. C. F. Erskine . . . Mr. J. A. Barker . . . | 2 inches = 1 mile for reduction. | Supdt., Trig. |
| 14 | Lushai . . . | 25 | Captain C. L. Robertson, R.E. Mr. J. Keating . . . | 1 inch = 1 mile for reproduction. | D. S. G., Rev. |
| 15 | North-Western Frontier | 27 | Colonel R. A. Wahab, C.I.E., R.E. Lieutenant G. A. Beazeley, R.E. | 1 inch = 1 mile, 2 inches = 1 mile and 6 inches = 1 mile for reproduction. | Ditto, Topo. |
| 18 | Himálayas, Punjab . . . | 28 | Major W. J. Bythell, R.E. Mr. L. J. Pocock . . . Mr. C. D. Potter . . . | 4 inches = 1 mile for reproduction and reduction to half scale, and 2 inches = 1 mile for reproduction. | Supdt., Trig. |
| <i>Forest Surveys.</i> | | | | | |
| 9 & 19 | Madras Presidency . . . | 31 | Captain A. H. B. Hume, R.E. | 4 inches = 1 mile for reproduction. | D. S. G., Rev. |
| 17 | Bombay Ditto . . . | 33 | Captain P. J. Gordon, I.S.C. Mr. C. E. Tapsell . . . | 16 inches = 1 mile, 8 inches = 1 mile and 4 inches = 1 mile for reproduction. | Ditto, Topo. |
| 20 | Lower Burma . . . | 35 | Mr. L. J. Pocock . . . Mr. T. E. M. Claudius . . . Mr. C. W. Wilson . . . | 4 inches = 1 mile and 2 inches = 1 mile for reproduction. | Ditto, Rev. |
| <i>Forest Survey Branch.</i> | | | | | |
| | Central Provinces . . . | 39 | Mr. W. H. Reynolds . . . | 4 inches = 1 mile for reproduction. | I. G. Forests. |
| | Punjab . . . | 40 | Ditto . . . | | |
| | North-Western Provinces. | 41 | Ditto . . . | | |
| | Burma . . . | 41 | Ditto . . . | | |
| <i>Cadastral Surveys.</i> | | | | | |
| 4 | Bengal . . . | 42 | Captain R. T. Crichton, I.S.C. Captain C. W. H. Symonds, I.S.C. | 16 inches = 1 mile . . . | S. S. S., Bengal. |
| 7 | Lower and Upper Burma | 48 | Mr. T. E. M. Claudius . . . Mr. E. J. Jackson . . . Mr. E. G. Little . . . | 16 inches = 1 mile . . . | D. S. G., Rev. |
| Land Records Surveys. | North-Western Provinces and Oudh. | 51 | Mr. G. B. Soott . . . | 16 inches = 1 mile . . . | Ditto. |
| <i>Traverse Surveys.</i> | | | | | |
| 2 & 8 | North-Western Provinces and Oudh. | 53 | Mr. B. G. Gilbert-Cooper . . . | 16 inches = 1 mile (skeleton plots). | Ditto. |
| 6 | Assam . . . | 57 | Captain C. W. H. Symonds, I.S.C. Mr. W. H. Penrose . . . | | Ditto. |
| Central Provinces Detachment. | Central Provinces Detachment | 59 | Mr. W. C. Price . . . | | Ditto. |
| <i>Geodetic.</i> | | | | | |
| 22 | India . . . | 60 | Lieutenant E. A. Tandy, R.E. | | Supdt., Trig. |
| 23 | Ditto . . . | 62 | Captain G. P. Lenox-Conyngham, R.E. | | Ditto. |
| <i>Tidal and Levelling Operations.</i> | | | | | |
| 25 | India . . . | 64 | Lieutenant H. L. Crosthwait, R.E. | | Ditto. |

OUTTURN.

8. The total outturn of survey during the year amounts to 95,934 square miles, including 66,883 square miles of reconnaissance. During the previous year the area surveyed amounted to 36,199 square miles which is considerably less than this year's outturn. The increase this year is due to the large amount of reconnaissance in Yunnan and along the Burma-China boundary, etc., on the $\frac{1}{2}$ inch and $\frac{1}{4}$ inch scales, the former amounting to 2,043 square miles, and the latter to 64,840 square miles. The total area of rigorous survey on all scales is 29,051 square miles as compared with 26,223 square miles done last year. The traverse operations in the North-Western Provinces and Oudh, Assam, and the Central Provinces which were carried out for Cadastral purposes—to furnish the Settlement Department with skeleton plots on which field surveys are based—amounted to 4,334 square miles against 5,128 square miles done last year.

9. The operations are summarised in the following pages of Part I, and a more detailed report on the operations of each Field Party will be found in Part II.

TRIGONOMETRICAL SURVEYS.

10. Owing to the continued disturbed state of Makrân alluded to in paragraph 11 of last year's report the opportunity was taken to shift the *locale* of the triangulation party to Burma, to complete the connection between the Burma and Assam triangulation which had to be postponed at the close of the field season of 1895-96. By having two observers, Captain H. A. D. Fraser and Lieutenant H. H. Turner, observing simultaneously the Manipur Longitudinal Series was successfully completed and the Burma Triangulation linked up with the other Principal Triangulation in India. Opportunity was taken to have the angles at some of the stations of season 1894-95, re-observed, and the results proved that there had been no displacement in that part of Assam, from the great earthquake of 1897.

TOPOGRAPHICAL SURVEYS.

11. Eight parties have been engaged in topographical surveys during the year—an increase of one over those employed in the previous year due to the transfer of No. 3 Party from cadastral to topographical work.

Of these, four parties, *viz.*, Nos. 3, 10, 11 and 21 have been employed in Burma, and the remainder, *viz.*, Nos. 12, 14, 15 and 18 in various parts of India.

12. Two of the parties employed in Burma, Nos. 11 and 21, were again occupied in mapping the Shan States. The ground under survey was similar to that of the previous year, hilly and intricate and covered with scrub jungle. These two parties were much weakened by calls on them to supply surveyors for the Burma-China Delimitation Commission, and consequently the outturn of the parties is lower than it would otherwise have been. The aggregate area surveyed by the two parties on the scale of 1 inch=1 mile amounted to 3,658 square miles, 6,650 square miles of triangulation being also completed.

The average cost rate for the topography is ₹15 per square mile, which compares very favourably with the previous year.

13. Of the other two parties employed in Burma, No. 10 has had the country west of the longitude of $96^{\circ} 30'$ in Upper Burma allotted to it, while No. 3 Party is employed in Lower Burma. A good deal of the work of the former consists in filling in topographical detail omitted by the surveyors when the districts were under cadastral survey.

The party completed an area of 2,338 square miles of topography on the 1 inch scale at a cost of just under ₹20 per square mile. In addition 2,798 square miles of triangulation in advance of detail survey was executed.

A large scale survey on the scale of 16 inches=1 mile of the station of Maymyo was also commenced which will be completed during the coming year.

No. 3 Party which was converted from a cadastral into a topographical one was employed in Lower Burma on the detail survey, on the 1 inch scale, of the ground lying between the crest of the Arakan Yomas and the River Irrawaddy.

The greater portion of the area under survey was uninhabited hilly country covered with dense forest, and with very few roads, and considering that this was the first year in which this party had worked as a topographical one, their outturn of 1,963 square miles of topography and 3,512 square miles of triangulation is very creditable. The cost rates, ₹28·8 for topography and ₹5 for triangulation, are low for the class of country under survey. The party unfortunately suffered a good deal in health owing to the malarious nature of the country.

The total result of the season's work in Burma is an addition to our topography of 7,959 square miles.

14. No. 12 Party continued the topography of Sind on the scale of 2 inches to a mile. An area of 2,813 square miles was surveyed and mapped on the 2-inch scale at an average cost of Rs. 13·1 per square mile, while the larger scale city survey cost ₹ 140·1 per square mile; this last rate includes the cost of the extra triangulation and traversing which had to be carried out in order to give the topographers a sufficiency of points for their work. An area of 3,850 square miles was prepared for future topography by the usual triangulation and traversing and some additional bench-marks laid down by the Irrigation and Railways were connected with the triangulation and their heights fixed.

15. The survey of the Lushai Hills, which was commenced last season, has been carried on with fair success.

The secondary series of triangles which will form the backbone of all future triangulation in this part has been carried through and completed, and in addition minor triangulation has been extended over an area of 1,423 square miles.

Owing to all absence of data on which to found a fair estimate of the rate of progress in such country, the actual outturn of topography did not quite come up to what was expected, an area of 649 square miles having been completed.

On account of the great physical difficulties of the country and the necessity of importing all food supplies, it is impossible to work a large party on this survey and a comparatively high cost rate will be inevitable. That of the present season is ₹64 per square mile for topography alone. It is not fair, however, to judge this by the result of a first season's work in new and difficult country, and no doubt the rate will be considerably reduced in future years.

16. No. 15 Party as usual was employed on various surveys required by the Military Department mainly in the Ráwalpindi district and in Kashmir, a special survey of the coal-bearing area on the Sor Range near Quetta having been also made. A detachment of this party was, as heretofore, employed on the 1 inch survey of the western hilly portions of Sind.

17. No. 18 Party completed a total area of 778 square miles in the Kángra and Hoshiárpur districts, and in the Sirmúr and Simla Hill States. This area included 156 square miles of the Kángra district surveyed on the 4-inch scale and 622 square miles surveyed on the 2-inch scale. Classification of forests and soils was carried out in 312·4 square miles.

The survey of the town of Náhan on the scale of 48 inches=1 mile, which was begun last year, was completed, and at the special request and expense of the State the Cantonment at Náhan was surveyed on the same scale.

18. The total area of country topographically surveyed during the year, on various scales, from 1 inch to 1 mile upwards, amounted to 18,280 square miles against 15,109 square miles completed the previous year.

The total is made up as follows:—

| | scale. |
|---|----------|
| 13,096 square miles surveyed on the | 1-inch. |
| 4,849 " " " " | 2-inch. |
| 104 " " " " | 4-inch. |
| 223 " " " " | 6-inch. |
| 8 " " " " | 16-inch. |

FOREST SURVEYS.

19. The special surveys of Government forests on various scales are carried out in part by the Forest Survey Branch and partly by the Survey Department. From the 1st April of the year under report the Imperial Survey Party working in the forests in Burma (No. 20) was transferred to the Forest Survey

Branch, and eventually it is hoped that these surveys will be all carried out under one administrative officer of the Imperial Branch of this Department, thus giving the Surveyor-General greater professional control over them, in addition to securing more uniformity of procedure.

During the year surveys were carried out in Burma, Madras and Bombay and in part of the Himálayas by the Imperial Parties, and in the Central Provinces, Punjab and Burma by the Forest Survey Branch.

20. In Madras the two parties, Nos. 9 and 19, which had been amalgamated into a single one last year, were further reorganised and put under charge of a single Imperial officer.

Surveys of reserved forests were carried on in the Kurnool, Cuddapah and North Coimbatore districts.

The reorganisation and further familiarity with the work had the effect, notwithstanding the difficulties of the country under survey, of largely increasing the outturn and diminishing the cost rate: 1,350 square miles of 4-inch survey having been completed at a total cost rate of ₹74 per square mile, which is very satisfactory. The health of the party was somewhat better than in the previous year.

21. In Bombay the Forest Surveys were carried on as heretofore on three different scales. The bulk of the topography, that of the ordinary forest reserves, is mapped on the 4-inch scale, that of the special teak reserves on the 8-inch scale, while small areas of *bábul* reserves are surveyed on the 16-inch scale.

During the year surveys on the two smaller scales were carried on in the Thána, Násik, Kolába and North Kánara districts, and on the 16-inch scale in Ahmednagar and Sholápur districts.

The areas surveyed were, on the 4-inch scale 429 square miles, on the 8-inch scale 254 square miles, and on the 16-inch scale 55 square miles. The cost rates are very satisfactory, that for 4-inch work being about the same as for the last year, while those for the 8-inch and 16-inch work are very considerably less.

The health of the party during the field season remained good, though during the recess they suffered somewhat from the ravages of plague.

22. In Lower Burma, No. 20 Party continued the survey of the forests located there, the work being carried on in the Pegu, Shwegyin, Thayetmyo and Rangoon Forest divisions. The country met with was very difficult for survey work, the hills being very intricate and densely jungle covered. As usual food depôts had to be established and provisions distributed from them to the various squads. The area surveyed comprised 472 square miles on the 4-inch scale and 87 square miles on the 2-inch scale, the latter scale being employed for unreserved forests which were surveyed to fill up gaps in the sheets. In addition 1,200 square miles of triangulation and 186 square miles of traversing were completed. The cost rates were satisfactory, that for the 4-inch detail survey and for triangulation being the lowest recorded by this party as yet, though the cost of traversing was considerably higher than of late years, the enhanced rate being in part owing to the fact that the officer in charge had himself to undertake the traversing. The health of the party was on the whole good, though unfortunately three *khalásis* were carried off by tigers.

23. The Forest Survey Branch continued its operations in the Central Provinces, the Chamba State and Montgomery district of the Punjab, in Oudh and in Upper and Lower Burma.

In the Central Provinces an area of 1,780 square miles was surveyed, of which 1,454 square miles were mapped on the 4-inch scale and 326 square miles on the 16-inch scale, the latter comprising work along the forest boundaries.

In the Punjab, with the exception of some boundary traversing in the Montgomery district, work was confined to the Chamba State where a number of forests are leased by Government from the Raja. One hundred square miles of these leased forests were surveyed on the 4-inch scale and 953 square miles of the outlying portions were mapped on the 1-inch scale in order to complete the topographical map of the State.

In Burma work was carried on in the Ruby Mines, Pyinmana and Salween-Ataran Forest divisions, and an area of 377 square miles of survey completed.

24. The total outturn of Forest Surveys executed on various scales during the year amounts to 5,217 square miles, of which 2,257 square miles were surveyed by the Forest Survey Branch. The area surveyed by the Imperial Survey Parties amounts to 2,960 square miles, being an increase of 563 square miles over that completed last year.

Classed by scales the figures are as follows:—

| 347 square miles surveyed on the | | | | | scale. |
|----------------------------------|---|---|---|---|----------|
| 4,234 | " | " | " | " | 2-inch. |
| 255 | " | " | " | " | 4-inch. |
| 381 | " | " | " | " | 8-inch. |
| | | | | | 16-inch. |

CADASTRAL SURVEYS.

25. During the year under report there was one cadastral survey party in Burma administered directly by the Deputy Surveyor-General, one in Bengal, and one in the North-West Provinces. The two latter are under the general professional superintendence of the Deputy Surveyor-General, whilst the programme and cost of operations are entirely under the control of Local Governments.

26. The Burma party completed an area of 711 square miles in Lower Burma (Toungoo district) and 109 square miles in Upper Burma (Myingyan district). No traverse operations were undertaken by this party, since there was a sufficiency prepared in advance of detail survey in Upper Burma, *vis.*, in the Lower Chindwin district. No writing of records is done by the Survey Department in Burma. The survey operations in Upper Burma having advanced so far ahead of the settlement, it is considered that an annual outturn of about 800 square miles by the cadastral party will suffice for the next few years to enable the settlement to overtake the survey. A separate establishment is kept up in this party to complete the mapping of the districts cadastrally surveyed, and to assist the Settlement Department in many ways as their work progresses.

27. The Bengal party completed an area of 607 square miles in Sárán, and 684 square miles in Darbhanga district. In addition, 267 square miles were traversed in Sárán, 619 square miles in Darbhanga, 95 square miles in Champáran and 726 square miles in Sonthal Parganas.

The cities of Darbhanga and Chapra were traversed and surveyed, the former on the scale of 64 inches = 1 mile, and a portion of the latter on the scale of 16 inches = 1 mile. Minor miscellaneous work, topographical and traverse, was carried on, in districts Champáran and Sháhabad of the Patna division, and for the rectification of boundaries in Kachnar and Banskati *mahals*, the Nepál Frontier, etc., etc.

In Bengal the work of the record-writing is done by the Survey Department, and there is nothing remaining for the Settlement officers to do but the attestation. The detail survey is carried on entirely with *amins*.

28. The cadastral survey and writing of records were continued in the North-West Provinces.

29. The total area cadastrally surveyed was 3,314 square miles in the following districts:—

| | Square miles. |
|-------------------------------|---------------|
| Bareilly | 345 |
| Kheri | 284 |
| Pilibhít | 425 |
| Do. Bisálpur Tahsil | 162 |
| Farrukhabad | 867 |
| Azamgarh | 587 |
| Gonda | 623 |
| Naini Tal | 21 |

Districts Bareilly and Kheri and the hill *parganas* of Naini Tal were completed during the season under report.

30. The detail survey was conducted entirely by *patwáris* except in Naini Tal, where there are no *patwáris*, and in portions of Farrukhabad and Pilibhít districts where it was required to complete certain small areas expeditiously or where they were situated in difficult and scattered localities.

31. The total areas cadastrally surveyed during the year in the different Provinces are as follows :—

| | Square miles. |
|---|---------------|
| Bengal | 1,420 |
| Burma | 820 |
| North-West Provinces and Oudh | 3,314 |
| TOTAL | <u>5,554</u> |

TRAVERSE SURVEYS.

32. During the year under report there was one double party in the North-West Provinces and Oudh, one party in Assam, and a detachment in the Central Provinces.

33. The party in the North-West Provinces completed an area of 3,800 square miles in districts Farrukhabad, Etáwah, Mainpuri, Etah, Azamgarh and Gonda, also an area of 164 square miles of topographical survey, in districts Sháhjahánpur and Kheri, and the Lalitpur sub-division of Jhánsi district.

34. The Assam party traversed an area of 1,076 square miles in the Assam and Surma Valleys and topographically surveyed an area of 1,144 square miles on the 2-inch scale of the Brahmaputra Valley, in districts Nowgong and Sibságar. This party ceases to exist from 1st November 1899, but a detachment will remain in the Province to undertake the traversing of extensions of cultivation and the upkeep of topographical maps and other miscellaneous work that may be needed by the Local Government.

35. The detachment in the Central Provinces completed the traversing of 147 square miles of *raiyatwári* excisions in districts Chhindwára and Betúl, 300 square miles in the Chhindwára *Jagirs* and 31 square miles in the Biláspur district.

36. The areas traversed during the year, excluding the traversing done by the cadastral parties for their own surveys, are as follows :—

| | Square miles. |
|---|---------------|
| North-West Provinces and Oudh | 3,800 |
| Assam | 1,076* |
| Central Provinces | 478 |
| TOTAL | <u>5,354</u> |

SPECIAL OPERATIONS.

37. The two Astronomical Parties Nos. 22 and 23 were employed in continuing the latitude observations. No. 22 Party worked along the East Coast Series. Observations having been taken at 8 stations.

Captain G. P. Lenox-Conyngham who was in charge of No. 23 Party continued the system of determining latitudes in groups, referred to in paragraph 32 of last year's report. Observations for latitude and azimuth were taken at 8 stations forming a group round Kaliánpur H. S. the origin of the Indian Survey. Owing to the increased amount of computations the observations could not be sufficiently analysed to draw any conclusion from the results.

38. The tidal observations have been continued as usual. Automatic registrations with self-registering tide-gauges were continued at 13 stations in India, Burma, the Andaman Islands, the Persian Gulf and the Red Sea, and in addition a series of personal tidal observations to graduated staves alluded to in paragraph 33 of last year's report, was continued at 6 stations with the object of comparing the actual times and heights of high and low water with those predicted in the tide-tables. The observations at Diamond Island having been completed, it is proposed to close this station and to start work at Port Albert Victor during the ensuing season.

39. The levelling operations, suspended last year, were resumed and the line of levels was continued from Katni to Allahabad, thus completing another chain from Karáchi on the west to Vizagapatam on the east. In addition, a branch line was run from Katni along the Indian Midland Railway to Kethora and from thence to the two ends of the Sironj Base line. The total outturn amounts to

* Of this area 1,020 square miles was for topographical survey on the 2-inch scale.

378½ miles of double levelling, fixing the heights of 33 embedded bench-marks, 331 ordinary bench-marks, 94 Railway bench-marks, 11 P. W. D. bench-marks and 8 stations of the Great Trigonometrical Survey.

40. The Government of India having decided to undertake a magnetic survey of India, Captain H. A. D. Fraser, R.E., who had gone home on furlough was deputed to consult Professor Rücker on the matter, to proceed to Kew and to make a study of the subject, and to arrange about providing suitable instruments.

As these have to be made especially to order, there is no probability of the actual survey commencing before the end of the year 1900.

GEOGRAPHICAL SURVEYS AND RECONNAISSANCES.

41. Under this head are included surveys and reconnaissances which are executed on the scale of $\frac{1}{2}$ inch to 1 mile or smaller scales. During the year an area of 2,043 square miles of survey on the scale of $\frac{1}{2}$ inch=1 mile was completed in Kashmir and Gilghit, and a very large addition made to our knowledge of the geography of our frontiers, amounting to some 65,000 square miles of geographical reconnaissance on the $\frac{1}{2}$ inch scale.

HEAD-QUARTERS OFFICES.

42. The details of the work done in the various offices at head-quarters are given in Part III of this Report.

43. The offices in Calcutta were supervised by three Assistant Surveyor-Generals: Mr. A. E. Spring remained in charge of the Drawing, Engraving and Map Record and Issue Offices and also held charge of the Bengal Provincial Drawing Office, and Mr. T. A. Pope continued to supervise the Photographic and Lithographic Offices. The Correspondence Office was, at different periods in the year, under Captain H. A. D. Fraser, R. E., Lieutenant G. A. Beazeley, R. E., Major S. G. Burrard, R. E., and Captain P. J. Gordon, I. S. C., and the Mathematical Instrument Office was in the hands of Lieutenant-Colonel J. R. Hobday, I. S. C., Major W. J. Bythell, R. E., Captain H. A. D. Fraser, R. E., Lieutenant G. A. Beazeley, R. E., and Major S. G. Burrard, R. E.

44. The Geographical Section of the Drawing Office has as usual been employed on the work of completing and keeping up to date the maps of the North-Eastern and South-Eastern Frontiers. Sheets No. 15 S. E. (6th edition), 22 S. W. (2nd edition) on the 4-mile scale, were brought up to date and published, and sheets No. 22 (6th edition) and 23 (2nd edition) on the 8-mile scale were also corrected, brought up to date and published. Of the South-Eastern Frontier Series, sheets No. 2 S. E. (5th edition), 2 S. W. (2nd edition), 4 N. W. (6th edition), 5 S. W. (6th edition), 6 N. W. (7th edition) were added to and published. Upper Burma sheets Nos. 305, 306 (2nd edition), 307, 315, 351, 352, 353, 358, 360, 361, 362 on the 1-mile scale were completed and published, and sheets Nos. 304, 350, 398, 399, 402, and 458 are now under publication; sheets 260 (2nd edition), 316, 400, 401, 403, 404, 405, 406, and 407 are very nearly completed and will be published early next year; sheets 313 and 314 of the same series had their boundaries revised and brought up to date. The general maps of India on various scales have been corrected and brought up to date; the 32-mile map of India (3rd edition) was published early in the year; the new Railway map of India on the 32-mile scale showing railway and steamer stations was completed and sent to press and will be published shortly. The Military map of India on the 32-mile scale is still under preparation and will be completed early next year. The provincial maps on the 16-mile scale were all more or less corrected and brought up to date; those of the Bombay Presidency, the Madras Presidency and of the Punjab, had the hills brush-shaded and sent for engraving. A large number of maps were prepared for the Military and other Departments, among them a series of maps to illustrate Mr. Grierson's work in connection with the Linguistic Survey and some for Mr. Forrest's work on the Indian Mutiny of 1857.

45. The work of the Revenue Section has been mainly of the usual routine nature. The map of "City of Calcutta and Suburbs" (in two sections), on the scale of 6 inches=1 mile is at press. Five standard sheets of district

Pesháwar, a map of Calcutta and 10 miles of surrounding country on the 1-inch scale, and a map of the Civil station of Basti on the scale 8 inches=1 mile, have been compiled and published. The 2-inch map of Calcutta and 10 miles of surrounding country was also compiled and is in press. Six standard sheets for the North-Western Provinces and Oudh, (two sheets on the 1-inch scale and four sheets on the 4-inch scale), and four standard sheets for the Bombay Presidency, have been published. Sheet No. 389 of the Bengal series has been compiled from the old main circuit maps. One district in the Punjab and three in the Central Provinces have had the office copies on the 1-inch scale corrected from tracings supplied by the Settlement Department. Of the large scale maps press order was given on 19 sheets on the scale of 1 inch=50 ft. of the Moulmein Town maps, and for 191 sheets on the scale of 1 inch=50 ft. of the Rangoon Town maps: 154 originals of the Rangoon Town maps on the scale of 1 inch=100 ft. were sent to press for reproduction. Of the office copies 17 standard sheets and 26 *pargana* maps of Bengal, 9 standard sheets and 7 *pargana* maps of the Central Provinces, 2 standard sheets of Bombay, 7 *pargana* maps of Assam, 2 standard sheets of the North-Western Provinces and Oudh, and 16 Cantonment maps, on various scales, were revised and corrected as to their boundaries and brought up to date; twenty (old) standard sheets of the Punjab, 45 *pargana* maps of Bengal and 7 of the Central Provinces were touched up, corrected and brought up to date for republication. Of the district maps on the $\frac{3}{4}$ -inch and $\frac{1}{4}$ -inch scales, 4 districts of the Punjab, one of Bengal, and 2 in the Central Provinces were corrected and brought up to date from information supplied by the local authorities.

46. In the Cadastral Section 4,609 sheets were published of which 633 belonged to the North-Western Provinces, 3,431 to Burma, 289 to Bengal (Tikári Ward's Estate, District Gaya) and 256 to Assam.

47. The Bengal Provincial Drawing Office continued to be employed on the compilation of standard sheets on the scale of 2 inches=1 mile for reduction to half scale, by photography, from the cadastral maps of Bihar, Orissa and Chittagong. The outlining of 6 standard sheets in 24 sections of Bihar was completed and 32 sections were sent to the Photographic office for reduction to the scale of 1 inch=1 mile. The outlining and examination of the Orissa standard sheets was completed and 4 sheets in 16 sections were sent to the Photographic office for reduction to the scale of 1 inch=1 mile. The whole of the cadastral maps of Chittagong have been reduced by pantagraph to the scale of 2 inches=1 mile, and the outlining of 4 standard sheets in 16 sections was completed during the year under report. Of the special publication of 26 standard sheets of Orissa on the scale of 2 inches=1 mile called for by the Government of Bengal showing the irrigated areas, 9 sheets were published during the year under report.

48. In the Engraving Office the work has been steadily pushed forward. The quarter sheets of the Atlas of India being principally worked upon; eight new sheets have been published, 63 new quarter sheets in various stages of progress have been added to with the most recent surveys. Fifty published quarter sheets and 15 full sheets have been corrected and brought up to date for printing, while 29 plates have been projected or had the borders cut on them. A new map of India on the 64-mile scale has been projected; the published map on the same scale, the 80-mile and the 96-mile maps have been in hand to bring the railways up to date; the hills have been well advanced on the 128-mile map and have just been started on the 256-mile map of India. Of the 16-mile provincial maps, Bengal in 2 sheets and the Bombay Presidency, have had some new materials added to them; Central India, Central Provinces, and Rájputána, all in 2 sheets, Gujarát and Madras in 6 sheets have all been in hand for corrections and additions. The four sheets of the map of the Punjab and Kashmir both with and without hills have been in hand and large additions are in progress in sheets 1 and 3. Thirteen district maps for administration reports have been completed and published, while fifteen others, 6 Index maps, 5 charts, 4 imprint and note plates have been in hand for correction. Three new tint plates have been completed and 53 plates have had titles and footnotes cut on them for the Photo-Litho. Office. The Copper-plate Printing Section pulled 18,624 impressions and the Steel-facing Section dealt with 236 plates.

49. The scheme for the reorganisation of the Photographic and Lithographic Office, having received the sanction of the Secretary of State for India, came into effect on the 1st December 1898, and has been found to work smoothly and well during the past year. The technical sections of the Trigonometrical Branch Office at Dehra Dún have now been amalgamated with this Office for the purposes of promotion, and all posts carrying progressive salaries have been abolished, with the exception of a few which will, as a rule, be filled by men trained and appointed in Europe. Under the new arrangements every man in the Office knows precisely what amount of promotion he may reasonably expect during his term of service, and the feeling of uncertainty as to their future prospects felt by all the assistants while under the old rules has been entirely removed. The financial result of the scheme is a small saving to Government, effected by the abolition of one of the more highly paid posts and the substitution for it of several posts in the lower grades.

The amount of work received for reproduction during the year is considerably in excess of that received last year. The work sent in by other departments and Government officials has increased very largely, and it has been found impossible to fulfil these heavy demands, and at the same time to keep the current departmental work from falling into arrears. The publication of a large number of the standard sheets of the Topographical and Revenue Surveys has been seriously delayed during the past year by the urgency of the demands made upon the Office by other departments; and as it is not to be expected that these demands will lessen in the future, but rather that they will continue to increase, the question of strengthening the establishment in certain sections of the Office, which are undermanned, will shortly require consideration. It is impossible to allow the publication of departmental maps, which forms the legitimate and most important work of the Office, to fall into arrears, in order that other work, however urgent, may be undertaken. At the same time it is undesirable to decline work sent in from outside, such as military maps for manœuvres, weather charts for meteorological purposes, administration report maps, railway maps and diagrams, etc., which cannot be executed elsewhere, and are useless if not supplied within a given time. The printing power of the Office has been increased of late years, and is now equal to any demands that are likely to be made upon it, but the establishment has remained practically the same for many years past, and a small increase to it is now absolutely necessary if arrears are to be avoided.

The number of original subjects dealt with during the year was 6,873, as against 6,364 last year. Of these the number of departmental subjects (normal and cadastral) is slightly more than last year, *viz.*, 5,349, as against 5,262, while the number of extra-departmental subjects increased from 1,102 to 1,524. The printed outturn, excluding type work, amounted to 965,453 copies, of which 135,094 were of ordinary departmental maps, 136,630 of cadastral maps, and 693,729 of extra-departmental maps and plans. Nearly three-fourths of the whole outturn of the presses and machines was thus executed for other departments. Last year the total number of copies printed was 695,812, of which 156,155 were departmental maps, 94,328 cadastral maps, and 445,329 extra-departmental subjects. The increase of cadastral work is owing to the fact that the outturn consisted of Burma and Assam sheets, of which more copies are required than of the North-West Provinces sheets, which formed the bulk of last year's outturn. The number of pages or items set up in the Type-printing Section was 13,932, or 113 in excess of last year. The number of pulls was 1,277,949, or 101,112 more than last year and of copies, 684,039, or 16,717 less than last year. The Heliogravure Section again shows a considerable increase; 128 plates were etched, yielding 86,514 prints or 27 plates and 12,713 prints in excess of last year's outturn. The number of blocks made by the Enamelline process was 78, yielding 12,100 prints, as against 82 blocks and 8,100 prints last year. The total value of the work done in all sections amounted to ₹2,17,622, which is ₹24,696 in excess of the value of last year's outturn.

The more important publications of the year are referred to in Part III, and full details of the work done in every section will be found in the Appendix.

50. In the Map Record and Issue Office the number of new maps and editions of departmental subjects received during the year amounted to 4,591, of which 4,239 were cadastral maps. The total number of maps issued was

1,94,848, and their value ₹2,15,195, which shows an increase of 38,325 in number and ₹97,253 in value, on those of the preceding year. The cash sale of maps amounted to ₹20,916, which also shows an increase of ₹1,602, over the cash receipts of the past year.

51. In the Mathematical Instrument Office the total number of instruments issued was 72,514, and their value ₹2,59,435 against 59,100 and ₹2,83,857, for the previous year. The number of instruments received into store was 61,407, and their value ₹2,84,208, against 54,256, and ₹2,61,816 last year. There has been an increase in the number of instruments issued during the year, but their value is less; there has also been an increase both in the number and value of instruments received. The number of instruments taken from the repairable stock and rendered serviceable was 4,118, and their value ₹1,07,967, against 5,250, and ₹1,06,055 last year. This shows an increase in value though a decrease in number.

The conversion of old pattern levels and theodolites has been steadily continued and 71 levels, obsolete patterns, have been converted into serviceable instruments and issued. Since the increased establishments for the repair of instruments have been sanctioned, 487 levels and 192 theodolites have been converted and issued and, except in the case of special patterns for definite purposes, indents for such instruments have been discontinued. The value of instruments indented for during 1899-1900, from England amounted to £5,174. This shows a small increase over last year's figure.

52. In the Trigonometrical Branch Office at Dehra Dún a commencement was made with the preparation of the North-East Longitudinal Series for the press. The reduction of Captain Deasy's and other exploration work entailed heavy computations. A catalogue of circumpolar stars was computed for the use of the Trigonometrical Parties.

The usual meteorological and solar photographic observations were continued. The results obtained with dry plates in the photoheliographic work have been so successful that it is expected they will, in time, supersede the wet plates. This is all the more satisfactory, as on cloudy days during the monsoon many a negative was spoiled by the quick drying of the wet plates.

The reproduction of maps for the forest department in various colours has entailed a heavy pressure of work on the small photozincographic section.

The Training School has continued to do good work and the class just passed was the largest the school is likely to have for some years to come. Seven officers of the Imperial Service went through a practical course of trigonometrical, topographical and astronomical work. Thirteen of the Provincial officers were put through a course extending over the whole year and were then posted to field parties. In addition fifteen Sub-Surveyors satisfactorily passed through a course fitting them for topographical surveyors.

53. The head-quarters offices of the Forest Survey Branch at Dehra Dún were under the supervision of Mr. W. H. Reynolds, Superintendent of Forest Surveys, and were employed as usual upon correspondence and accounts, and final computations in connection with the work of the several field detachments of the Forest Branch; the maintenance of Forest records; the compilation and drawing of special maps and other miscellaneous work for the Forest Department; and on the training of men for forest survey work. During the year 5 index maps on various scales, 169 standard sheets on the 4-inch scale and 29 standard sheets on various scales were published. In addition to the above 3,274 printed maps were coloured, 440 tracings were prepared and 2,230 printed maps were mounted in book form for the Forest Department and District Officers.

ESTABLISHMENT.

54. During the year the Department has lost the services of two officers of the Imperial Service.

Major-General C. Strahan, R. E., Surveyor-General of India, retired from the Department in which he had served for the last 36 years, on the 30th September 1899, the close of the survey year.

General Strahan, who was the last of the Bengal Engineers, received his first commission from Addiscombe, on the 8th June 1860 at the early age of 17. He came out to India in 1862, was appointed to the Survey Department on the

26th September 1863 and posted to the Central India Topographical Survey in which he remained nearly 17 years, when he was transferred to the Rájputána Topographical Survey for 3 years. In 1883 he was appointed Assistant Surveyor-General and rose through the post of Deputy Surveyor-General, Revenue Branch, to be Surveyor-General in 1895 from which position he has now retired.

General Strahan had a very wide grasp of general scientific matters as well as great administrative ability and a thorough mastery of Topographical Surveying and his loss will be greatly felt by the Department in all its branches. The Government of India have been pleased to place on record their appreciation of the professional reputation and eminent service rendered to the State by the Department during the period it was under his control.

Mr. G. W. E. Atkinson, Officiating Deputy Superintendent, 1st grade, retired from the service on superannuation on the 11th October 1898. He joined the Junior Division (now the Provincial Service) of the Trigonometrical Branch on the 1st August 1859, and after varied service was promoted to the Senior Division (now the Imperial Service) on the 8th November 1892.

Mr. Atkinson was for many years in charge of the Trans-frontier Geographical mapping, and had acquired a very considerable knowledge of the subject.

55. In the Provincial Service the Department has lost the services of five officers during the year, *viz.*, three by the retirement of Messrs. L. J. Pocock, W. S. Buttress and P. White and two by the deaths of Mr. A. H. Peychers and Rai Bahadur Hira Singh.

RETROSPECT.

Remarks on the progress of the Operations since March 1895.

56. Major-General C. Strahan, R.E., the late Surveyor-General, having been unable to draw up the report on the operations of the department during this the last year of his tenure of office, requested that the following might be included in it.

"A few remarks on the progress made in the different branches of the department since March 1895, when Sir H. Thuillier retired, and the work remaining to be taken up may be of interest.

"In 1896, Colonel Sandeman submitted to Government a scheme by which the different Local Governments and Administrations of India should be allowed to prosecute their own cadastral and other surveys under the management of officers trained in the Survey Department, who were to be lent to them: this system had already been introduced into Bengal with success and a few months before Sir H. Thuillier left, an officer was deputed to carry on similar operations in the North-West Provinces; during the coming field season he will have under him a staff consisting of a Royal Engineer officer and 16 Provincial officers and the outturn will be about 4,000 square miles a year. In addition to these there is a Drawing Office, the duty of which is to prepare the 1-inch standard maps from the 16-inch settlement maps of the cultivated areas and to fill in the gaps by topographical survey. To the Central Provinces an experienced Provincial officer has been deputed to supervise the traverse operations and to otherwise assist the Local Administration in carrying out their local surveys on a correct basis.

"Another Provincial officer has been nominated for the same purpose in the Punjab, and a third officer is now on deputation to Assam. For all of these Drawing offices must be organised; one for the Central Provinces is urgently wanted.

"The duty of these Drawing offices will be not only to prepare in the first instance the 1-inch standard sheets as already mentioned, but also to bring those already published up to date and hereafter to continue keeping all maps of the Province up to date. For this most important duty no proper provision has ever been made, and if not dealt with, will in years to come necessitate great expenditure in making entire resurveys. Arrangements have been made with the sanction of the Bengal Government by which at a trifling annual cost, the map of Calcutta on the scale of 50 feet to the inch, which was published about 1893, will be always kept up to date and no resurvey will ever be required until one on a still larger scale is found to be necessary. This is what is wanted for the whole of India, but which it is quite impossible for any one Central Office to attempt to carry out; it can only be done by some system of dividing the labour, such as is

being done by these Provincial Survey establishments with their attached Drawing offices.

"For many years the Topographical Parties had complained of the difficulty of training new hands in the field and of the time wasted by the older men in training them; moreover, it was said and with truth that at best the men were not well trained. To remedy this a training school for native surveyors was organised at Dehra Dún and this has since been enlarged, until it has now become an important institution under the Superintendent, Trigonometrical Surveys, at which all Imperial and Provincial officers, as well as native surveyors, go through a course of instruction. It is doing admirable work, but is unable to train native surveyors fast enough to supply the demands of our Topographical Parties and those of foreign countries.

"During the last 3 or 4 years the calls on the Department to provide trained surveyors for work out of India have been increasing and are now so many that we cannot supply them without detriment to our own work. In addition to surveys for Boundary Commissions and Military Expeditions, which may be looked upon as part of our legitimate work, we have been asked for and have furnished surveyors for Africa, China, Zanzibar, and a detachment under two European officers is under orders to survey the added area in Kwang Tung. It is not only on the topographical branch that such demands are made, but they extend also to the cadastral and trigonometrical branches; for we have supplied four Provincial Officers to Siam and a retired Survey Officer who has taken service under the Siam Government is now in India recruiting native Surveyors for that country; and again not long ago I was obliged to refuse to send to the Straits Settlement some natives experienced in trigonometrical work, for want of men to spare. In consequence of these increasing demands I consider that the department should at all times be kept up to its full strength in both the Imperial and Provincial Services.

"The scientific branch has not been idle; the electric determination of the difference of longitude between Karáchi and Greenwich has been finally determined with a probable error of about $0^{\circ}.33$; the principal series of triangulation through Makrán to Persia was started, but owing to the political rising in those parts during which our officers narrowly escaped with their lives and several natives were killed, it came to an abrupt conclusion and has not yet been started again. A junction has been made between the principal triangulation in Burma and that in India, the result of which has been to prove that the most eastern stations, near Manipur, to which the Indian work had been carried, had not been disturbed by the earthquake in Assam. It had been previously ascertained by means of some carefully executed secondary triangulation that the hills to the west of Shillong had been perceptibly thrown out of position, both horizontally and vertically, but neither the actual amount of the displacement nor the area over which it extended could be ascertained, as it was evident that all the stations visited lay within the affected area. This being so, the Superintendent, Geological Survey, asked for sanction to have the whole of the triangulation in that part of Assam rigorously revised; as however the junction now made has proved that such revision is not necessary for geodetic purposes, the Government of India have decided that it is not worth incurring such a heavy expense. I still hope, however, that this may some day be sanctioned, when the finances are in a more favourable condition, as I believe it is almost the only case in which it is possible to determine with accuracy the actual displacement of the earth's crust over a large area due to an earthquake. Tidal observations have been extended to the Red Sea and observatories have been established at Perim and Suez.

"Arrangements have been made to start the first magnetic survey of India, and it was hoped that a commencement would have been made this field season, but this is now impossible as the necessary instruments cannot be procured till October 1900.

"Great progress has been made in topographical surveys, more especially in Burma, where four topographical and one forest survey party are at work, besides yet another small party in the Lushai Hills. The whole of Burma and the countries between Burma and Bengal have now been allotted to some one of these parties. The resurvey of the whole of Sind was commenced in 1895-96, and about 4,000 square miles a year are being mapped.

"Only one cadastral party is now being carried on, on the old lines, and that is working in Burma. The survey of the cultivated areas in the Assam valley

and in Cachar of which the Local Government wanted cadastral maps has been finished, but there are large permanently settled tracts in Cachar which have not been mapped since the original survey 40 or 50 years ago. Portions of the North-Western Provinces were cadastrally surveyed on the old system previous to 1895, but as already mentioned the remaining districts are being surveyed by local agency under our officers.

"The areas completed since 1895 by the topographical, forest and cadastral surveys are as follows :—

| | Square miles. |
|---|---------------|
| Topographical Surveys | 89,235 |
| Forest Surveys | 23,314 |
| Cadastral Surveys | 35,263 |
| Traverse Surveys | 29,704 |
| Geographical Surveys or Reconnaissances | 278,456 |

"No allusion so far has been made to the large Head-Quarters Offices, in Calcutta nor to the Trigonometrical Branch Office in Dehra Dún. The actual number of maps examined, printed and issued, the number of instruments manufactured or repaired and issued, and all the other work performed in Calcutta can be seen in the annual reports. In almost all the different branches work is steadily increasing and it is almost certain that not many years hence an enlargement of the office will be required. The copper-plate printing establishment is much below the strength it should be and it is accumulating arrears at an alarming pace, but it is impossible to strengthen it for want of space. We have been forced to take a house in which to accommodate the Bengal Drawing Office for want of room. The Trigonometrical Branch Office is also much too cramped and some addition to that is urgently wanted, and I hope Government will carry out my successor's proposal when he submits it. The clerical and other establishments of these different offices, which up till now have always been in separate cadres, and difficult to deal with in respect to promotions, etc., have all been remodelled and amalgamated like to like, which much simplifies such questions and greatly accelerates promotion in the smaller offices.

"As the question is sometimes asked as to when the Survey of India will be completed, it will not be amiss to mention some of the areas still remaining to be surveyed for the first time, as well as those which have been reconnoitred only, and require resurvey or of which the maps have become out of date.

"In the North-Western Provinces there are nine districts aggregating an area of over 17,500 square miles, which have never been accurately surveyed at all; the existing maps are based on rough settlement surveys made many years ago, of other parts the maps require revision. All this has been provided for by the local survey establishment.

"The maps of, by far the greater part of, Bengal and Cachar are so old as to be of but little use now; the changes of rivers in many places are so great as to make it impossible to trace the rivers along which the steamers ply. No provision has been made in either Bengal or Cachar to resurvey these areas.

"Of upwards of 35,000 square miles in the Punjab, we have no reliable maps; arrangements have quite recently been made with the Local Government by which it is hoped new maps of the Punjab will be gradually produced; at present the scheme is in its infancy, but I trust it will shortly be organised on a proper footing, with a strong drawing office.

"In Sind a topographical party is at work and should complete the province in nine or ten years, it will then take up the survey of 18,000 square miles yet un-surveyed in Rájputána.

"There are hilly portions of Madras of which we have no maps worthy of the name. A topographical party was provided for the survey of these on the 1 inch scale, but it was directed to take up the special surveys of the forest reserves. on the scale of 4 inches to the mile, and of course its progress, though it is a double party, is slow. There are upwards of 26,000 square miles in this Presidency still to be topographically surveyed.

"It is difficult to say what area still remains for survey in Burma, the Lushai Hills, Hill Tippera and the Chittagong Hill Tracts, but it cannot be less than 150,000 square miles, which will occupy the present parties for some 15 years.

"The above are in British Territory or Tributary States, but besides those we have 80,000 square miles in Hyderabad of which we have maps formed from rough

reconnaissances ; and a very large area in the eastern Himálayas, including Nepál of which we know but little more than can be gathered from native information.

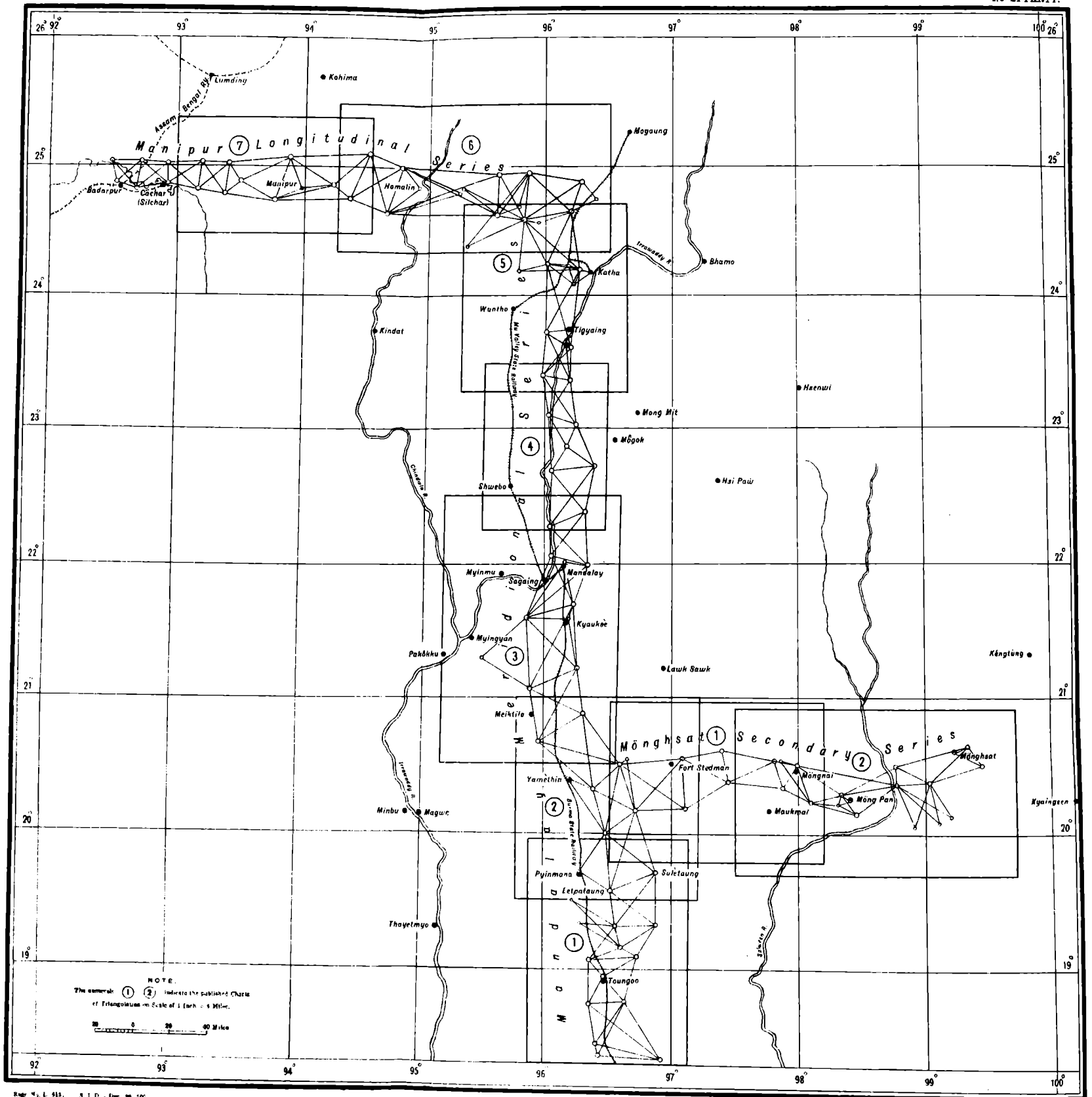
“ Without pretending that the above embodies all that remains to complete the first survey of India or that the figures quoted are more than approximate, I think I have shown that there is work enough to employ the topographical branch for many years to come, without taking into account resurveys on a larger scale which will assuredly be hereafter required in special places.

“ The future of the cadastral surveys has been or will be provided for provincially ; they can never end, as the fields and other details are constantly changing, and in many cases resurveys will be necessary when new settlements are required.

“ In the scientific branch there is still a large amount of work to be done. Owing to the extension of our surveys and reconnaissances to the west and north-west in Balúchistán and Persia, and to the east and north-east in Burma, it has been found absolutely necessary to extend the principal triangulation ; in Burma several base lines will have to be measured, and probably some telegraphic determinations of longitude will be desirable. The observations for latitude and azimuth, which have been constantly put aside for other more urgent work, have yet to be finished in India and they must be made in Burma also. The magnetic survey has not yet been even commenced. The observations at many of the tidal stations will not be completed for several years, and the levelling operations are still going on in India, whilst Burma has only one line of levels—that from Elephant Point to Mandalay.”

INDEX TO THE CHARTS OF THE PRINCIPAL TRIANGULATION
OF THE
MANDALAY MERIDIONAL AND MANIPUR LONGITUDINAL SERIES.

No. 24 PARTY.



PART II.

THE OPERATIONS OF THE SEVERAL FIELD PARTIES.

TRIGONOMETRICAL SURVEYS.

INDIA TRIANGULATION.

No. 24 PARTY.

57. This party under Captain Fraser, R. E., started from Calcutta on the 14th October, arriving in Rangoon on the 17th October and in Mandalay on the 19th October.

Personnel.

Captain H. A. D. Fraser, R.E., Officiating Deputy Superintendent, 1st grade, in charge from 14th October 1898 to 12th May 1899.

Lieutenant H. H. Turner, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 1st to 13th October 1898, from 13th May to 28th June 1899, and from 22nd August to 30th September 1899.

Mr. J. Hickie, Extra Assistant Superintendent, 4th grade, in charge from 29th June to 21st August 1899.

Mr. D. J. Hunter, B.A. }
 " H. R. Hunter } Sub-Assistant Superintendents, 3rd grade. Joined the party on 1st October 1898.

58. After a halt of two days the whole party embarked on board, one of the Irrawaddy Flotilla Company's boats, and proceeded down the river as far as Pakòkku, where the party changed into the Chindwin steamers. The journey up the Chindwin occupied 7 days, and Homalin was not reached until the 30th October 1898.

59. A halt of seven days was made at Homalin, the time being employed in adjusting instruments and lamps.

60. Actual work was commenced by Captain Fraser at Tonsakah on the 12th November, the idea for the season's work being to connect up the India and Burma triangulations. Great difficulty had been experienced by Captain Fraser in 1895-96 in observing across the Chindwin Valley. These difficulties had led him to consider whether the lamps could not be considerably improved, with the result that the party took the field with not only a very much improved lamp but they also had with them a stock of acetylene, some of the lamps having had special fittings made to allow of either acetylene gas or Duplex oil lamps being used in them. The lamps had previously been thoroughly tested by being observed at Roorkee from Mussooree.

61. As a result of the improved lamps very little difficulty was experienced in observing across the Chindwin Valley, and the great quadrilateral was finished by the 17th December, acetylene gas being used for all the longer rays. The longest of these rays was 61.4 miles.

62. Owing to bad weather being experienced the season's work was not completed until the 19th of March 1899. In addition to joining on to Captain Burn's work of 1894-95, several of his angles were re-observed, in order that it might be ascertained whether the great earthquake of 1897 had caused any movement of the earth's crust in this neighbourhood. The result of these observations given below, tended to prove that there had been no movement whatsoever.

Comparison table showing the angles observed at Kanpru, H. S., Loiijing, H. S., and Pangkibot, H. S., during the seasons 1894-95 and 1898-99.

| ANGLE BETWEEN STATIONS. | OBSERVED BY | | | | | | | | |
|-------------------------------------|--------------------------------|---|-------|----------------------------------|---|-------|-------------------------------------|---|---|
| | Captain Burn, R.E. 1894-95. | | | Captain Fraser, R.E. 1898-99. | | | Lieutenant Turner, R.E. 1898-99. | | |
| <i>At Kanpru, H. S.</i> | ° | ' | " | ° | ' | " | ° | ' | " |
| Loiijing, H. S. and Pangkibot H. S. | 41 | 5 | 50.18 | 41 | 5 | 50.60 | | | |

Comparison table showing the angles observed at Kaupru, H. S., Loijing, H. S., and Pangkibot, H. S., during the seasons 1894-95 and 1898-99—contd.

| ANGLE BETWEEN STATIONS. | OBSERVED BY | | | | | | | | |
|-------------------------------------|--------------------------------|----|-------|----------------------------------|---|---|-------------------------------------|----|-------|
| | Captain Burn, R.E. 1894-95. | | | Captain Fraser, R.E. 1898-99. | | | Lieutenant Turner, R.E. 1898-99. | | |
| | o | ' | " | o | ' | " | o | ' | " |
| <i>At Loijing, H. S.</i> | | | | | | | | | |
| Khaojing, H. S. and Pangkibot H. S. | 25 | 19 | 56.91 | | | | 25 | 19 | 56.71 |
| Pangkibot, H. S. and Kaupru, H. S. | 81 | 26 | 20.57 | | | | 81 | 26 | 20.78 |
| Kaupru, H. S. and Maphitel, H. S. | 53 | 38 | 29.41 | | | | 53 | 38 | 29.25 |
| Maphitel, H. S. and Khambiching | 11 | 16 | 19.54 | | | | 11 | 16 | 19.25 |
| <i>At Pangkibot, H. S.</i> | | | | | | | | | |
| Kaupru, H. S. and Loijing, H. S. | 57 | 27 | 52.48 | | | | 57 | 27 | 52.01 |

63. Two observers (Captain Fraser and Lieutenant Turner) were working throughout the season; it was considered better for both observers to start work from the Burma side.

64. Captain Fraser observed at Tonsakah, Thyoliching, Sirohifurar, and Kaupru and re-observed the angles at Khambiching; Lieutenant Turner observed at Tamunja, Khambiching, Maphitel, and Loijing and one angle at Pangkibot. Owing to both observers working from the same side, there was occasionally a delay in waiting till the one had finished observations at one station, before the other could commence at the other end of the ray; a far greater cause of delay was the bad weather and thick haze, but fortunately the work required to be done was satisfactorily finished.

65. The season is a memorable one from the fact of the Burma triangulation being linked up with the Indian, the result being on the whole satisfactory.

In computing out the results the values obtained from the Burma side were carried on to the side Ramphan, H. S.—Tukbai H. S. of the Cachar Branch Series, the two figures of Captain Burn's work of 1894-95 being recomputed.

66. The instruments used were No. 2 and No. 3 Troughton and Simms 12-inch Micrometer Theodolites.

67. The method of observing was to measure angles on twelve zeros, two faces on each zero, and at least two swings on each face.

Towards the end of the season the body of the instrument was shifted through 120° at every 4th zero, in order to bring the female portion of the cone bearing, into different positions with reference to the zero station. The shifting was effected by lifting the instrument bodily from its stand and in replacing it; each footscrew was brought over a different leg.

No. 3 proved itself to be a very high class instrument, but No. 2, as in former years, proved very unreliable, and gave indifferent results.

68. The season's outturn of work is as follows:—

| | | | | | | |
|---------------------------------------|---|---|---|---|---|-------|
| Number of stations newly fixed | . | . | . | . | . | 5 |
| Do. figures completed | . | . | . | . | . | 3 |
| Length of series completed in miles | . | . | . | . | . | 111 |
| Area of triangulation in square miles | . | . | . | . | . | 2,540 |

The mean triangular error in seconds was 0.64. This rather large error was due to the unreliable results given by No. 2 Theodolite.

69. The health of the party during the first-half of the field season was not good owing to the feverishness of the districts in which the work had to be carried on, but later the general health decidedly improved, though a few men had to be sent back to their homes early.

70. The work was greatly facilitated by the kindness of the Political Agent of Manipur, and the Deputy Superintendent, Upper Chindwin, in rendering the Party every assistance on all possible occasions.

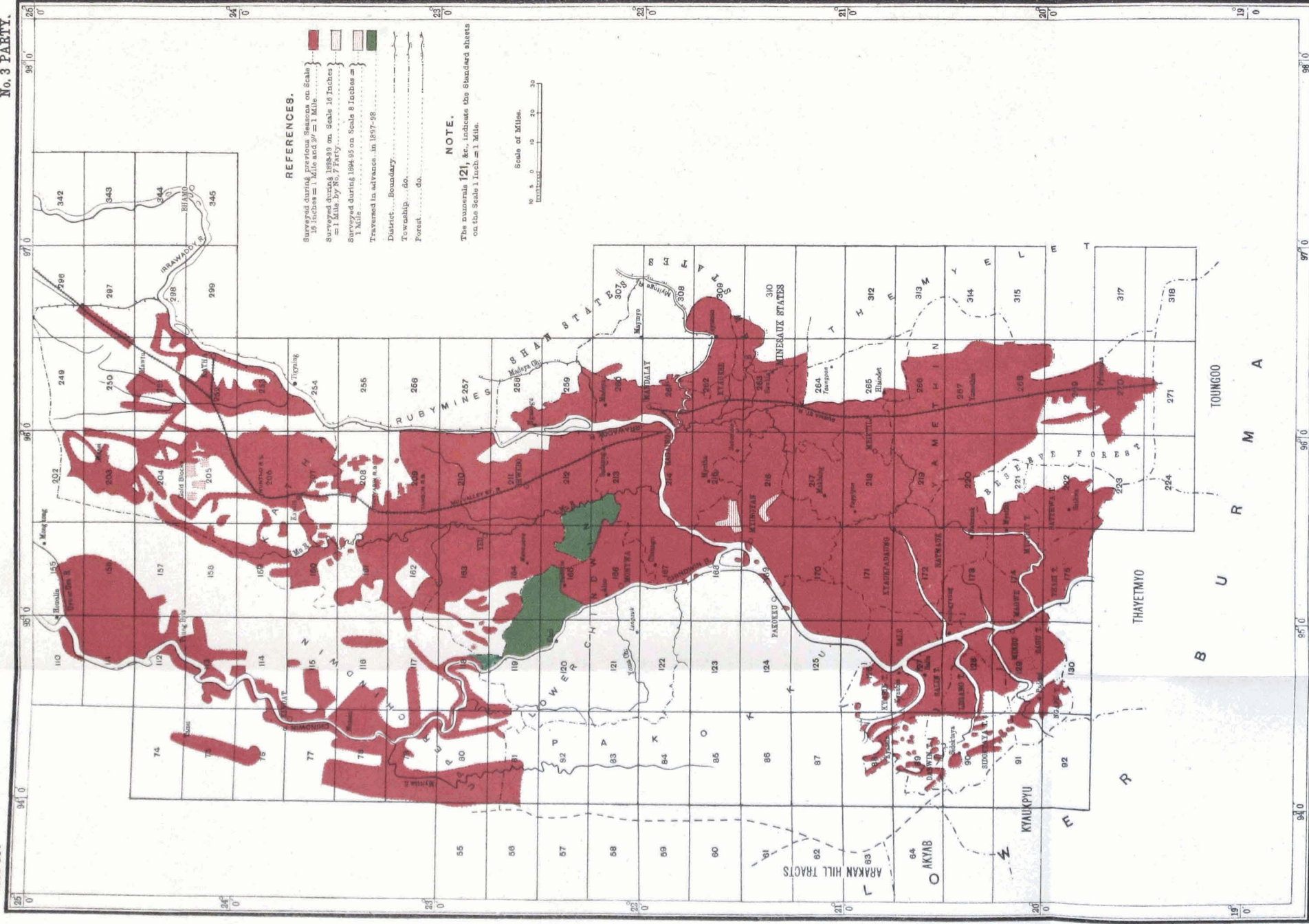
The officer in charge is well pleased with the work of his assistants.

BURMA SURVEY.

INDEX TO THE CADASTRAL SURVEY IN UPPER BURMA.

1898-99.

No. 3 PART.



INDEX TO THE TOPOGRAPHICAL SURVEY IN LOWER BURMA.

1898-99.

No. 3 PARTY.

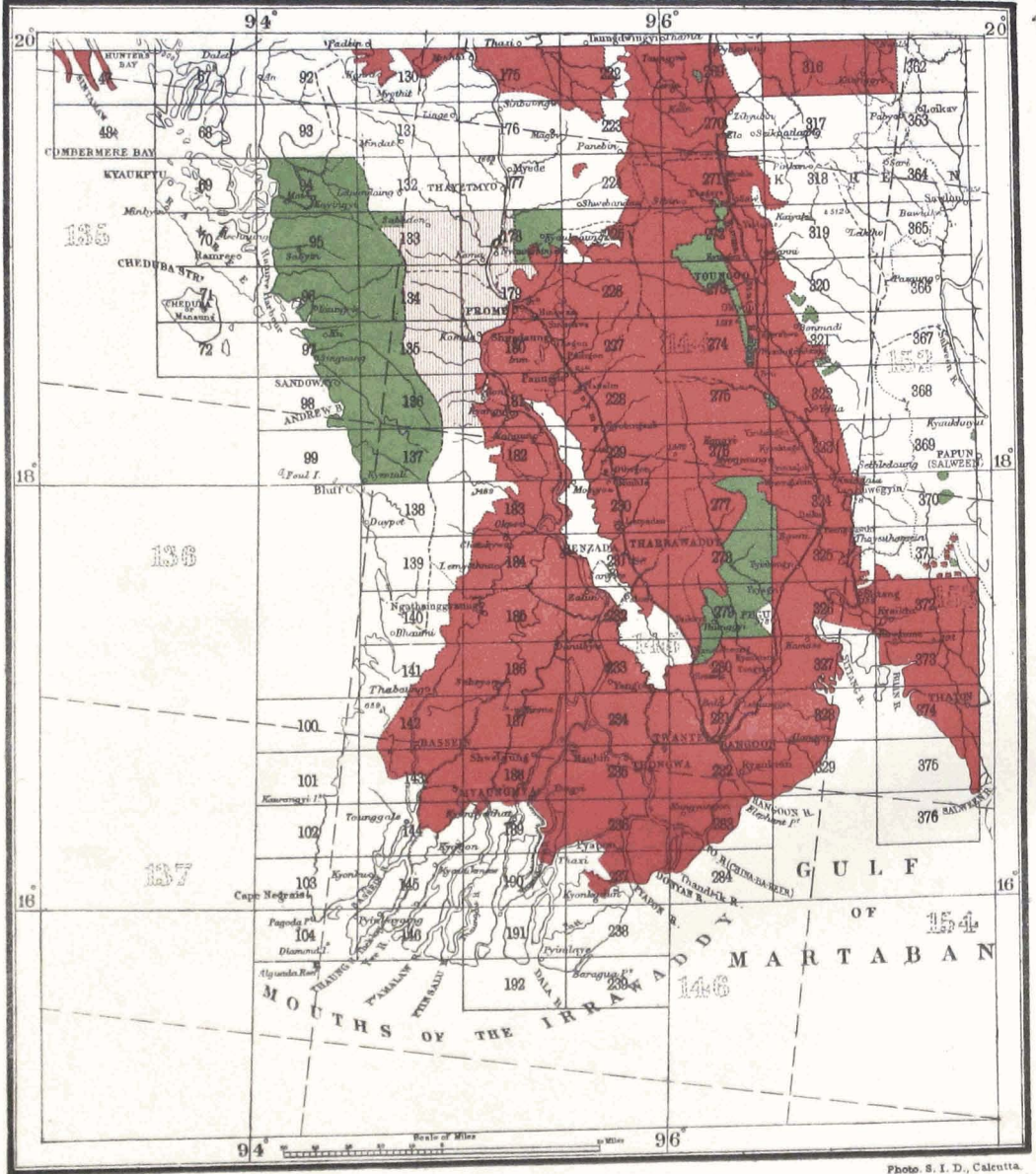


Photo. S. I. D., Calcutta.

NOTE.

The numerals **180, &c.** indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

The names of Cities surveyed on large Scale are underlined thus **RANGOON**

The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas.

REFERENCES.

- Area Surveyed by Forest & Cadastral Parties on 1, 2, 4 & 16 - Inch Scales. ■
- Do..... during 1898-99 by No. 3 Party. ■
- Do..... Triangulated & Traversed in advance.

LOWER BURMA.

NO. 3 PARTY.

71. On the 15th November 1898 Mr. T. E. M. Claudius made over charge of No. 7 Party (Cadastral) at Rangoon to Mr. E. J. Jackson, and on the following day assumed charge of No. 3 Party. In this capacity he remained till the 15th September 1899, when he was relieved by Mr. E. Litchfield, and received orders to proceed to Dehra

Personnel.

| | |
|--|--------------|
| Mr. T. E. M. Claudius, Extra Assistant Superintendent, 1st grade, in charge. | |
| Mr. G. C. Swiney, Extra Assistant Superintendent, 5th grade. | |
| " C. George, | ditto, 6th " |
| " M. Gastaud, | ditto, 6th " |
| " J. Donaghey, Sub-Assistant Superintendent, | 2nd " |
| " E. H. Corridon, | ditto, 3rd " |
| Sub-Surveyors Asmatulla Khan, Nizamudin, Rohan Lall, Ram Sarup and sixteen others. | |

Dún to take charge of No. 20 Party, Burma Forest Surveys. On the 20th April Mr. G. C. Swiney was transferred to No. 7 Party (Cadastral).

72. As No. 3 Party (Cadastral) was converted into a topographical one, assistants and surveyors accustomed to that style of work were posted to it from various parties. All assembled at Prome by the 15th November, and by the 25th idem had left for their respective ground of work. On the 10th May all the members reached recess quarters at Bangalore, with the exception of the triangulators, who did not return till the middle of June.

73. The plane-tying portion of the party was divided into two sections, the northern and the southern. Each consisted of nine plane tablers. The former was supervised directly by Mr. Claudius with Mr. Swiney's occasional assistance; and the southern was solely under Mr. George's supervision. Mr. Swiney supervised the traverse work in the Pegu district, whilst Mr. M. Gastaud and Sub-Surveyor Ram Sarup were deputed for triangulation in advance in the Sandoway and Kyaukpyu districts.

74. The programme for the field season was the survey in detail on the 1-inch scale of the ground lying between the crest of the Arakan Yomas and the river Irrawaddy and between the parallels of $18^{\circ} 15'$ and $19^{\circ} 15'$, including parts of the districts of Prome, Thayetmyo, and Henzada. A portion of detail work was also done on the left bank of the Irrawaddy in standard sheets 178 and 179. The triangulation was undertaken of the country between the sea coast and the Yomas, between the parallels of $18^{\circ} 0'$ and $19^{\circ} 30'$, and traverse work in the unfinished portions of sheets 278, 279, and 280 in the Pegu district. The whole programme was successfully accomplished.

75. The outturn of detail work on the 1-inch scale was 1,963 square miles. The triangulation comprised 3,512 square miles, and the traverse work consisted of 185 linear miles, a most creditable result, seeing that this is the first field season of the party as a topographical one.

76. The cost rates are as follow:—

| | <i>R</i> | <i>a.</i> | <i>p.</i> |
|---------------------------------------|----------|-----------|--------------------|
| Detail survey, 1-inch scale | . 28 | 12 | 1 per square mile. |
| Triangulation | . 5 | 0 | 11 " " |

77. In the country under survey the Arakan Yomas attain an altitude of from 3,000 to 3,800 feet, whilst the lower hills range from 300 to 2,000 feet. The inhabited area is confined to the plains, in the vicinity of the Irrawaddy river on the east of the Yomas, and the sea coast on the west. The remaining area, about two-thirds of the whole, is uninhabited and hilly, covered with dense forest, and infested with wild elephants, rhinoceri, tigers, bison, etc., etc. There are only three roads practicable for carts, one about 10 miles in length leading from Sandoway to Gaw on the sea coast, another about 4 miles long from Sandoway northwards. The third is a military road connecting Prome on the Irrawaddy with Taungup on the sea coast. After passing the large village of Padaung, it crosses the Yomas. Rest-houses exist along this road about 8 to 10 miles apart. There is telegraphic communication between Prome and Taungup, but none between the latter place and Sandoway. Taungup is, however, connected with Kyaukpyu. In the forests the surveyors moved about principally along wild elephant tracks, which were fairly numerous. The

inhabitants were mostly Burmans in the plains, but in the hilly tracts a few Chins were met with.

78. As was expected in such unhealthy ground, a good deal of sickness was experienced, mostly fever and dysentery. Of fifteen serious cases among the *khalásis*, three proved fatal. After returning to recess Sub-Surveyor Nizamudin, an able and experienced topographer, died from malarious fever contracted in the Yomas; and Sub-Surveyor Asmatulla Khan has been entirely prostrated from the same cause. Of the European assistants Mr. Corridon suffered most. His constitution appeared to be quite shattered when he reached recess quarters in May. The delightful climate of Bangalore has, on the whole, re-established the health of all the members.

79. The party was inspected by the Deputy Surveyor-General, Revenue Branch, in the field in January, and in recess quarters at Bangalore in August.

The Surveyor-General also visited and scrutinized the work and office in September.*

UPPER BURMA.

NO. 10 PARTY.

80. Lieutenant W. M. Coldstream, R.E., continued to hold charge of

Personnel.

Lieutenant W. M. Coldstream, R. E., Officiating Deputy Superintendent, 2nd grade, in charge from 1st to 28th October 1898.

Captain F. W. Pirrie, I.S.C., Officiating Deputy Superintendent, 2nd grade, in charge from 29th October 1898 to 31st May 1899.

Mr. G. D. Cusson, Extra Assistant Superintendent, 4th grade, in temporary charge from 1st June 1899.

Mr. G. T. Hall, Extra Assistant Superintendent, 5th grade, up to 14th October 1898.

Mr. P. J. Serrao, Sub-Assistant Superintendent, 1st grade.

" C. C. Byrne, Sub-Assistant Superintendent, 3rd grade.

" W. G. Jarbo, Sub-Assistant Superintendent, 3rd grade.

13 Sub-Surveyors and Apprentices.

1 Writer and 1 Hospital Assistant.

this party up to the 28th October 1898, when he was invalided home; the direction then devolved on Captain F. W. Pirrie, I. S. C., who remained in charge of the party up to the 31st May. He then left for England on a year's

furlough, handing over temporary charge of the party to Mr. G. D. Cusson.

81. The party left recess quarters at Bangalore on the 3rd of November, arriving at Mandalay on the 9th, and leaving again for its ground on the 21st idem. During the passage from Madras to Rangoon one of the apprentice Sub-Surveyors died of fever.

82. Captain Pirrie proceeded three times during the field season to Bhamo for longitude operations with Captain Ryder, R.E., between Bhamo and various points in Yunnan; and the results obtained were highly satisfactory.

83. Mr. G. D. Cusson with Messrs. C. C. Byrne and W. G. Jarbo, seven Sub-Surveyors and six apprentices, took up the one inch detail survey of sheets 261, 262, 263, 264, 265, 266, 267, 312, and 313.

84. Mr. P. J. Serrao triangulated in sheets 254, 255, 256, and also fixed points in sheets 253, 301, 302, and 303. On his return to Mandalay, he with four Sub-Surveyors was employed on detail survey in the western portions of sheets 265 and 267. In addition to the above, sheets Nos. 267 and 268 were triangulated in by an Assistant and a Sub-Surveyor.

85. The Maymyo survey, comprising an area of 25.3 square miles, on the scale of 16 inches to a mile, having the *basar* in the centre, was traversed by No. 7 Party; and the detail survey, which was started by a detachment of the same party, consisting of one *Inspector* and two *Amins*, was taken over by No. 10 Party from 1st December 1898. The cadastral survey was completed on 8th April 1899; and about seven of the sheets were contoured before the end of the field season. The method employed was that of traversing along each 50 feet contour, using the clinometer as a level; the initial points being given by Mr. C. C. Byrne from observations with a theodolite to three trigonometrical stations. A ten and a twenty-foot bamboo could sometimes be used with success in filling

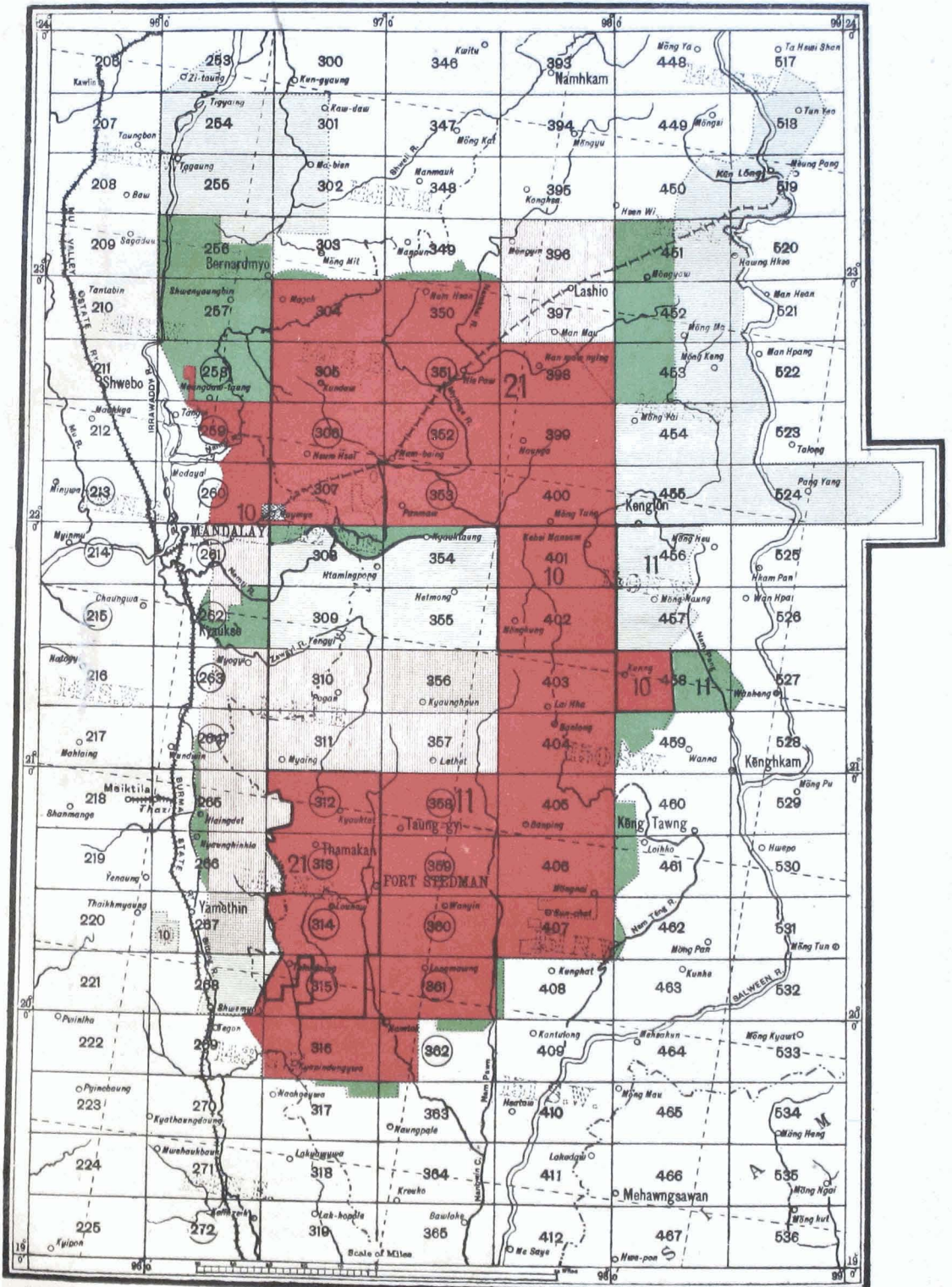
* Mr. Claudius reports very favourably of the services of Mr. George, who, throughout the year, has worked cheerfully and indefatigably. Messrs. Gastaud and Corridon have also given entire satisfaction. Of the Sub-Surveyors special mention is made of the good work turned out by Asmatulla Khan, Nizamudin, Mohamed Khan II. and Mulk Raj. Sub-Surveyor Ram Sarup has proved himself to be an exceptionally good triangulator. Writer Nisarali is reported as being quite competent in all his duties.

UPPER BURMA SURVEY.

INDEX TO THE TOPOGRAPHICAL SURVEY IN UPPER BURMA & SHAN STATES.

1898-99.

Nos. 10, 11, & 21 PARTIES.



Scale No. 605, S. I. D. - 450 - 550.

Photo. S. I. O. Calcutta.

No. 445-S. 00.

REFERENCES.

- Sheets published are shown thus..... (352)
- Area previously surveyed..... (352)
- Surveyed during 1898-99..... (352)
- Triangulated during previous seasons..... (352)
- during 1898-99..... (352)
- and Surveyed during 1898-99..... (352)
- Maymyo Survey, 10 Inches = 1 Mile, 1898-99..... (352)

NOTES.

The numerals 312, &c., indicate the Standard sheets on the Scale 1 inch = 1 Mile.
 The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas.
 The thick lines represent the areas surveyed by the different Topog. Parties, the large figures indicating the number of the Party.

in the intermediate 10 feet contours, when working down hill. Also Colonel Wahab's height indicator was often used and did a great deal to accelerate the work. The Maymyo topographical detachment was under the charge of Mr. C. C. Byrne, after the work was started by Captain Pirrie.

86. The outturn for the season is as follows :—

| | Square miles, |
|---|---------------|
| Triangulation for detail survey | 2,798 |
| Topography, one inch scale, including 276 miles overlap | 2,338 |
| Maymyo survey, scale 16 inches to 1 mile | 8 |

This outturn is an improvement both in quantity and quality, compared with the previous season's work, and is very creditable considering that the party lost a Sub-Surveyor through death just before the beginning of the field season, and another by transfer in January.

87. The health of the party was, on the whole, excellent throughout. One of the triangulators in sheet 267 suffered from fever, and a Sub-Surveyor died of debility in hospital after the close of the field season.

88. The whole party, except the Maymyo detachment, left for Bangalore on the 18th May, and arrived there on the 25th; the recess office being opened there on the 29th. The above detachment left Mandalay on the 15th of June and arrived at Bangalore on the 22nd.

89. During the recess the computations have been brought up to date; and sheets Nos. 461, 463, 464, 465, 466, and 467, have been prepared for publication in two colours. Sheets 312 and 313 have also been completed in the same style as the portions already published. Sheets 1 and 4 of the Maymyo survey have been prepared for publication; and the outlining of sheets 2, 5, 7 and 8 completed.

90. The total cost of the party for the year was R86,135-2-4, and the cost rates per square mile are :—

| | R | a. | p. |
|-----------------------------|----|----|----|
| For triangulation | 9 | 13 | 2 |
| „ topography | 19 | 15 | 9 |

These figures compare favourably with those of last year, the rates being less both for triangulation and topography.

91. The programme for next season is :—

The triangulation of sheets Nos. 268, 221, 220 and 219; the unsurveyed gaps in 210, 211, 212 and 213, and a network to connect the gaps falling in sheets Nos. 170, 171, 217, 218. In detail survey the completion of the large scale survey of Maymyo, and the one inch survey of sheets 257, 258, and 268, and the completion of sheets 259, 260, 261, 262, 263, 264, 265, 266, and 267.*

UPPER BURMA.

NO. 11 PARTY.

92. The services of Captain Renny-Tailyour, R.E., being again required

Personnel.

Mr. P. J. W. Doran, Extra Assistant Superintendent, 4th grade, in charge.

Mr. W. M. Kelly, Extra Assistant Superintendent, 5th grade

Mr. P. White, Extra Assistant Superintendent, 6th grade.

Mr. H. G. Shaw, Sub-Assistant Superintendent, 1st grade.

Mr. B. M. Berrill, Sub-Assistant Superintendent, 3rd grade.

Surveyor J. Sebastian and 12 Sub-Surveyors and Probationary Sub-Surveyors.

1 Writer.

1 Typist.

for the Burma-China Boundary Commission, Mr. P. J. W. Doran continued in charge of the party.

93. In addition to the surveyors transferred from the party during the previous year, there was a further reduction by the transfer of Surveyor Ram Sabad to the Yunnan Mission and of Sub-Surveyors Kudratulla and Mowni Ram to the Burma-China Boundary Commission.

Mr. Berrill, Sub-Assistant Superintendent, 3rd grade, joined the party at Rangoon

from the Dehra Training School, on the 8th of November 1898.

Mr. White unfortunately falling ill was unable to cope with the work allotted him and returned to head-quarters on the 5th of May. He has been invalided and pensioned from the 7th of July 1899.

* The officer in charge reports that Messrs. P. J. Serrao and C. C. Byrne deserve special mention for the excellence of their work; and among the Sub-Surveyors, Sakhawat Husain, Syed Ali Shah, Sheikh Abdulla, and Radha Krishen.

94. The party, with the exception of Mr. White, who had started a week earlier, left Bangalore, the recess quarters, on the 2nd of November 1898, sailed from Madras on the 3rd and reached Lawk Sawk, in the Southern Shan States, its head-quarters for the field season, on the 8th of December. Field work was commenced on the 7th of December and closed on the 18th of May 1899. The party, with the exception of Mr. White and Sadiq Hossein, returned by the steamer leaving Rangoon on the 2nd of June, and office opened at Bangalore on the 12th.

95. The programme for the season was the detail survey of sheets Nos. 310, 311, and 357, sheet No. 356 was also to be taken up, if possible. The triangulation to be taken up was that of sheets Nos. 308, 309, 354, 355, 356, 456, and 457 as "triangulation in advance."

Detail Survey.—The programme was completed, sheet No. 356 was not only planetabled but also triangulated.

Triangulation.—The sheets laid down for triangulation in advance were all completed except Nos. 456 and 457, of which only 250 square miles could be finished.

96. The outturn of work is as follows :—

- (a) Detail survey on 1 inch scale, 2,524 square miles, inclusive of an overlap of 306 square miles.
 (b) Triangulation, 3,234 square miles, inclusive of an overlap of 220 square miles.

The area surveyed, considering the nature of the ground and the reduction in the strength of the party, is very creditable.

97. The total cost of the party is ₹81,093-5-10.

The cost-rate, as noted below, compares favourably with the rates of previous season. Triangulation for 1 inch survey, ₹11-6-4. Detail survey on 1 inch scale, ₹17-8-0.

98. The health of the party during the field season was good. At the beginning and particularly at the close there were several cases of fever among the natives. During the recess, the malaria contracted in Burma has shown itself among the surveyors and *khalāsis*.

99. The detail surveyors were visited regularly during the season. The work after a rigorous test proved excellent.

100. The programme for the coming season will be the survey in detail of sheets Nos. 308, 309 and the western halves of sheets Nos. 354 and 355, and the triangulation of sheets Nos. 525 to 528 and the portions of 456 and 457 left unfinished during the season under report.

101. The Surveyor-General visited the party on the 19th of September, and after a careful examination into the working, expressed himself as "very well satisfied."*

UPPER BURMA.

NO. 21 PARTY.

102. The Party left recess quarters at Bangalore on 2nd November 1898,

Personnel.

| | |
|--|--------------------|
| Captain C. H. D. Ryder, R.E., Officiating Deputy Superintendent, 1st grade.* | Lashio in the |
| H. J. Hare, R.E., " " 1st " † | Northern Shan |
| Mr. A. J. James, Extra Assistant Superintendent, 2nd grade. | States, where the |
| W. F. E. Adams, Sub-Assistant Superintendent, 1st grade. | head-quarters |
| A. H. Peachers, " " 2nd " Died 20th | were established, |
| February 1899. | and returned to |
| P. Williams, Sub-Assistant Superintendent, 3rd grade. | recess quarters on |
| P. R. Anderson, " " 3rd " † | 18th May 1899, |
| Munshi Ikbaluddin, " " 3rd " † | regular office |

Surveyors and Sub-Surveyors.

Lachman Jadu,* Ram Sabad,* Ganu Mal, Natha Singh, † Mohamad Latif, ‡ Kudrat Ali, Jamna Pershad, Keshao Jadu, † Abdul Gaffor, Hazrat Ali, Permanand, Shamsuddin, and ‡ Probationary and Apprentice Sub-Surveyors.

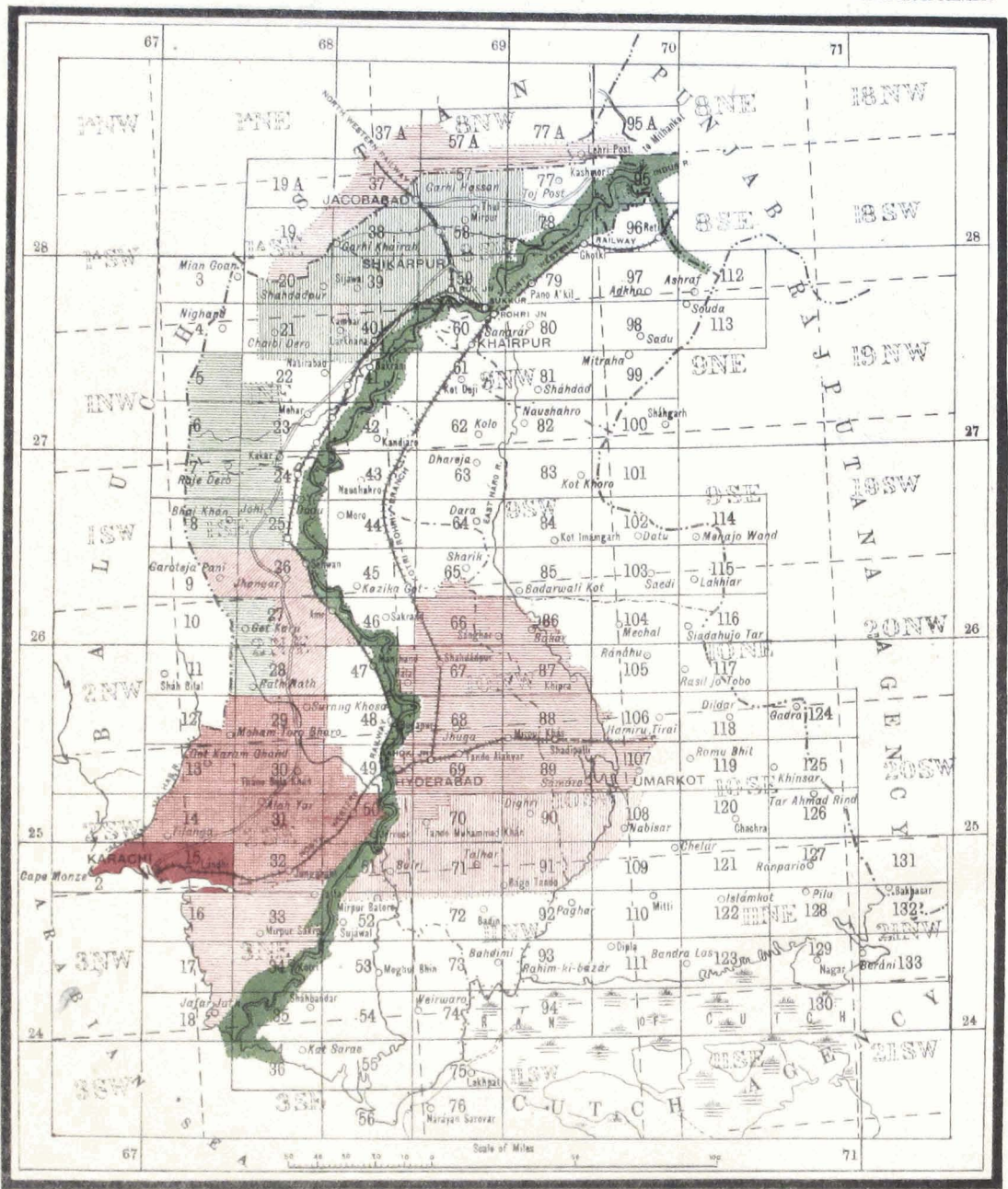
* Attached to Yunnan Survey throughout the season.
 † " to Burma-China Boundary Commission throughout the season.
 ‡ " to Yunnan Railway Survey throughout the season.
 § " to Tekm Syndicate.

* The officer in charge reports in high terms of the work done by Messrs. W. M. Kelly, H. G. Shaw, and B. M. Merrill

The surveyors and sub-surveyors with one exception have worked well.

103. Owing to the exigencies of

SIND SURVEY.



Leg: No. D. 187, S. I. D. - Reg. 55-100

Photographed at the Office of the Triangulation Branch, Survey of India, Dehra Dun, October 1895.

REFERENCES.

- Surveyed in previous Seasons Scale 1" = 1 Mile by No. 12 Party
- Do. do. do. 1" = 1 Mile do.
- Do. 1898-99 1" = 1 Mile do.
- Triangulated and Traversed in advance do.
- Surveyed in previous Seasons Scale 1" = 1 Mile by No. 15 Party
- Do. 1898-99 1" = 1 Mile do.
- Triangulated in advance do.
- Indus River Survey

NO. 252-S. 99.

NOTES.

The numerals 63, etc., indicate the Standard sizes on the Scale 1 Inch = 1 Mile.
 The figures and lines in circles represent the numbers and limits of the Engraver sheets of the India Atlas.

the Burma-China Boundary Commission the working strength of this party was considerably reduced during the field season, with the natural result that the outturn of work was considerably below that of a normal season.

The detail survey of sheets 396 and 397, with a small gap remaining in sheet 350, on the scale of 1 inch = 1 mile, was completed.

The triangulation in advance for 1 inch survey was carried out in parts of sheets 450, 451, 452, and 453; over the whole of 454, 455, and 524, and in parts of 518, 519, 520, 522, and 523.

The outturn of work is as follows: Triangulation for the 1 inch survey 3,416 square miles, Topography on the 1 inch scale 1,133.5 square miles, Topography on the ½ inch scale in Yunnan 26,850 square miles. The total cost of the party from 1st October 1898 to 30th September 1899, is ₹92,724-9-4, and the cost rates per square mile are as follows:—

| | Per square mile. |
|---|------------------|
| | ₹ a. p. |
| Triangulation for 1 inch survey | 11 9 8 |
| Detail Survey 1 inch scale | 11 12 3 |
| „ ½ inch „ | 1 8 0 |

which figures are as low as could be expected under the conditions of the smaller outturn.

104. A very regrettable incident occurred during the course of the field season, Mr. A. H. Peychers, Sub-Assistant Superintendent, having been murdered in cold blood by a sepoy of his escort, while at work on 20th February at Loi Hopong Hill Station. Mr. Peychers was a promising lad and his untimely death is much regretted. The murderer was duly tried and executed.

105. The health of the party, with a few exceptions, was uniformly good throughout the season, and no deaths occurred from sickness.

106. The country surveyed included parts of the Hsi Paw, and the Northern and Southern Hsinwi States. The ground is all very hilly and covered with heavy tree and scrub jungle. About four miles to the north of Lashio there are hot sulphur springs, more or less in the shape of a horse-shoe; the waters of which have the reputation of possessing healing properties for curing certain diseases if regularly bathed in for some time. The Shans of the country, as well as Natives of India living round about Lashio, make free use of them.

107. The Surveyor-General inspected the party on the 20th September 1899, and was generally satisfied with what he saw of maps, records, etc., of the party during his inspection.*

SIND.

NO. 12 PARTY.

108. The operations during the year under report were in continuation of those of the previous season.

Personnel.

Mr. C. F. Erskine, Deputy Superintendent, 1st grade, in charge from 1st October 1898 to 13th July 1899.

Mr. J. A. Barker, Extra Assistant Superintendent, 4th grade, in charge from 14th July to 30th September 1899.

Mr. G. G. Vander-Beeke, Extra Assistant Superintendent, 5th grade.

Mr. R. F. Warwick, Extra Assistant Superintendent, 6th grade.

Munshi Rahmatullah, Sub-Assistant Superintendent, 2nd grade.

Mr. E. C. J. Bond, Sub-Assistant Superintendent, 2nd grade.

Mr. C. J. Veale, Sub-Assistant Superintendent, 3rd grade.

Babu Dhani Ram, Sub-Assistant Superintendent, 3rd grade, and 55 permanent and temporary Sub-Surveyors, Computers and Draftsmen.

Mr. C. F. Erskine held charge of the party up to the 13th July 1899 when he proceeded on three months' privilege leave making over the temporary charge to Mr. J. A. Barker.

109. The programme, which was as follows, was completed:—

(a) A short series of secondary triangulation, about 35 miles in length, as a check on traversing, and another short series to supply points.

(b) Village boundary traverse survey in sheets Nos. 20, 21, 37, 38, 39, 40, 57, 58, 59, 77 and 78.

(c) The detail survey on the 2-inch scale of an area situated between the Indus river on the west, and the desert on the east, in sheets Nos. 70, 71, 90, portions of 50, 51, 91, 108, 109, and 40.

* The officer in charge is perfectly satisfied with the work of all his assistants.

110. The recess office at Karáchi closed on the 17th October 1898, and the party re-assembled at Tando Alahyar on the 20th idem, and each man was on his ground by the end of the month.

111. The traversing consists of a village boundary survey with offsets, and the area traversed is 3,887 square miles. There were 14 main circuits measured, 19 sub-circuits, and 791 village circuits. The angular work was checked by observations for azimuth at 99 stations on main and sub-circuits, and the average angular error is $1' 34''$, the angular error per station being $3''\cdot 7$. The linear measurements amounted to 4,118 miles, and were checked by 54 connections with principal stations of the Great Indus Series, and with stations of the secondary triangulation executed by Mr. Bond. The average correction per 1,000 links being $1\cdot 21$ links. No permanent marks were laid down at traverse stations, but the position of the marks used to demarcate the village boundaries have been fixed by offsets wherever possible.

In addition to the village boundary traverse survey 51 bench-marks laid down by the Irrigation and Railway Departments were connected with the traversing, involving observations at 66 stations and 44 linear miles of chain measurement.

112. The cost of the traverse survey amounts to $\text{R}8\cdot 5$ per square mile.

113. The area surveyed in detail on the 2-inch scale amounts to 2,813 square miles, giving 61 plane-table sections. It comprises the whole of sheets Nos. 70, 71, 90 and portions of Nos. 50, 51, 91, 108, and 109, and an area of 72 square miles has also been surveyed in standard sheet No. 40. In sheets Nos. 91, 108, and 109 the survey has been carried to the edge of the desert. Sheets Nos. 50 and 51 have been surveyed up to the work of the Indus Riverain Survey. The remainder of these sheets will be surveyed on the 1-inch scale by No. 15 Party. The detail survey was carried out almost entirely by interpolation, and was based mainly on the traversing; it was tested from 1,756 *in situ* fixings, and was done under the direct supervision of the officer in charge and three assistants. The cost of detail survey is $\text{R}13\cdot 1\cdot 0$ per square mile.

114. The country surveyed during the past season was generally of the same monotonous and uninteresting description as that dealt with during the previous year, the only hilly portion being the southern limit of the Ganj Takkar falling in standard sheet No. 50. In sheets Nos. 50, 51, and 70 the country was fairly well populated and cultivated, except in the north portion of sheet No. 70, where there is a considerable area of uncultivated land; this, however, in the event of sufficient water being available could, to a large extent, be brought under cultivation; in the west portions of sheets Nos. 50 and 51 on the east of the river Indus, there are large tracts of waste lands covered with *Kandu* (*Prosopis spicigera*) and *Lai* (*Tamarix Diwaa*); there are also considerable Forest reserves near the river, the most important being the Huderáni and Mulchand reserves. The greater part of standard sheets Nos. 71 and 91 are fairly well populated and cultivated, with the exception of the south-east corner of sheet No. 91, which is very sparsely populated, the greater portion being waste land covered with a growth of *babul* trees. In sheet No. 90 the southern portion, which is watered from the Nasir Wah, and the eastern portion, watered by the Mithrau Canal, are fairly well populated and watered, a very large percentage of the balance of the sheet being composed of uncultivated land, of which a very large area will be brought under cultivation when the Jamrao Canal, now under construction, is completed. In sheets Nos. 108 and 109, watered chiefly by the Nára river, both the population and cultivation are scanty, and both rapidly decrease journeying eastwards towards the Thar and Párkar desert.

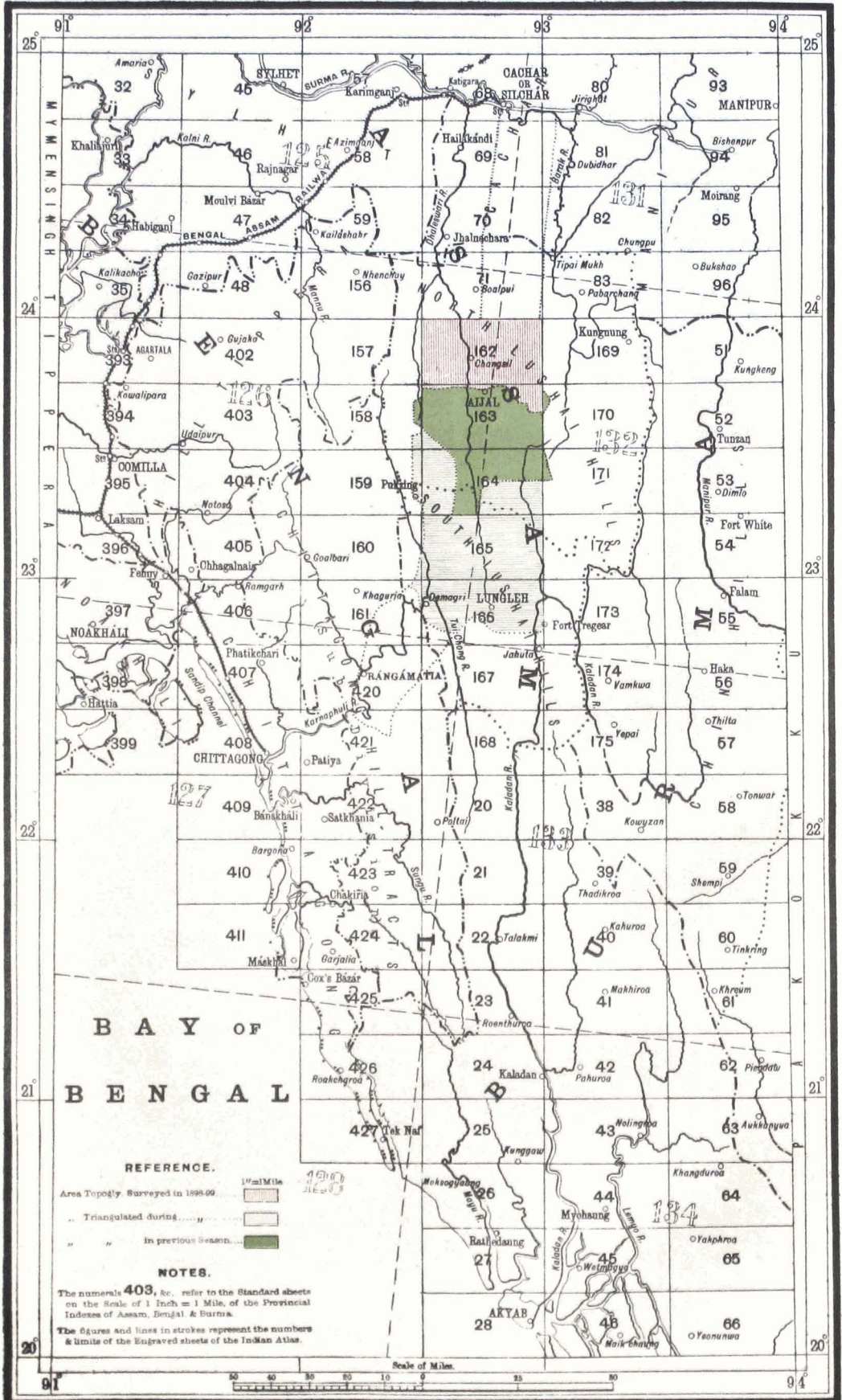
115. There was little or no sickness.

116. Field work closed early in April, and the party returned to Karáchi for recess. During recess the fair mapping of the entire area surveyed in detail on the 2-inch scale was completed, with the exception of the small portion surveyed in sheet No. 40; this sheet will be drawn next year when the survey is completed. The mapping was comprised in 30 quarter sheets, of which three were blank. They were drawn on the 2-inch scale for reduction by photography to one-half, and have all been despatched to the Trigonometrical Branch Office at Dehra Dún for publication. Sheets Nos. 50 and 51 have been drawn as far as surveyed. The remainder of these sheets will be mapped by No. 15 Party. Sheets Nos. 91, 108, and 109 have been mapped as far as they are to be surveyed

INDEX TO THE TOPOGL. SURVEY OF THE LUSHAI HILLS.

1898-99

No. 14 PARTY.



at present and will be published. The area surveyed in sheet No. 40 has not been mapped; the detail survey of the remainder of the sheet will be completed during the coming field season, and it will be fair drawn in due course.

117. The triangulation and traverse charts of sheets Nos. 19, 20, 21, 37, 38, 39, 40, 51, 57, 58, 59, and 71 have been drawn. All the charts with the lists of co-ordinates have been despatched to Dehra Dún.

118. Next season triangulation and traversing in advance will be taken up in sheets Nos. 41, 60, 61, 77, 78, 79, 80, 81, 95, 96, 97, 98, 99, and 112.

Detail survey will be carried on in sheets Nos. 19, 20, 21, 37, 38, 39, 40, 57, 58, and 59.*

LUSHAI HILLS, ASSAM.

NO. 14 PARTY.

119. Captain Robertson, on transfer from special duty in Simla, assumed

Personnel.

Captain C. L. Robertson, R.E., Deputy Superintendent, 1st grade, in charge from 6th October 1898 to 28th May 1899, inclusive, and from 25th September 1899, inclusive.

Mr. J. Keating, Extra Assistant Superintendent, 6th grade, in charge up to 5th October 1898 and from 29th May 1899 to 24th September 1899, inclusive.

Mr. R. Waller-Senior, Extra Assistant Superintendent, 6th grade.

Sub-Surveyors, etc.

Ram Singh, Mahadeo Daji, Abdul Haq and five others.

charge from Mr. Keating on the 6th October 1898 and remained in charge till the 29th May 1899, when he again proceeded to Simla on leave and special duty, making over temporary charge to Mr. Keating till the 25th September 1899, when he rejoined the party.

120. The party left recess quarters in Shillong on the 16th October 1898, and, with the exception of the assistant detailed to carry out the 1st class secondary series, proceeded to the Lushai Hills *via* Goalundo and Silchar. Field work was closed by the 15th April 1899, and the party returned by the same route by which they had taken the field to Shillong, where the office was opened for the recess on the 5th May.

121. The sanctioned programme of work for the season under report, included the completion of the 1st class secondary series commenced during the preceding field season, the extension of a net-work of tertiary triangulation in continuation of a similar triangulation of the preceding season over standard sheets Nos. 164, 165, and 166, and the execution of a detail topographical survey on the scale of 1 inch = 1 mile of standard sheets Nos. 162 and 163.

The programme of triangulation, with the exception of a small portion of tertiary work on the southern edge of sheet No. 166, has been completed.

The detail topographical survey, however, of only one complete standard sheet (No. 162) has been carried through, though a portion of sheet No. 163 has also been surveyed.

122. Mr. Keating, to whom was entrusted the completion of the 1st class secondary series commenced by him during the preceding season, proceeded with his squad to Chittagong, and starting work from a side of the Burma Coast G. T. series, worked northwards, completing his series by joining on to his previous work.

A net-work of tertiary triangulation, based on the sides of Mr. Keating's series, and in continuation of the previous season's work of the same kind, was carried out in standard sheets Nos. 164, 165, and 166, by two of the native sub-surveyors assisted, for the part of the season when he was not employed on the supervision of the plane-tablers, by Mr. Waller-Senior.

The remainder of the native sub-surveyors were employed on the detail survey on the scale of 1 inch = 1 mile of standard sheet No. 162 and a small portion of sheet No. 163.

123. The failure to complete the programme of topography has been due to an over-estimate of the capacity of the surveyors in a country presenting the difficulties, physical and other, which are encountered in the Lushai Hills. Owing to the absence of any previous experience in this district the programme had to be framed on utterly insufficient data.

* Mr. Erskine reports that all his assistants worked well and specially mentions Mr. Vander-Beek. The Native establishment with one or two exceptions, gave satisfaction. Ram Kinkar Pershad, Ishar Sing, Gormukh Singh, Maula Bakhs, Mohamed Akbar, and Alay Ahmad II, are deserving of mention.

A survey of Aijal on the scale of 24 inches to the mile was asked for by the Secretary to the Chief Commissioner of Assam in the Public Works Department, and this was commenced during the field season.

The programme for the ensuing field season will include the completion of the net-work of tertiary triangulation in sheet No. 166 and the execution of a similar net-work in sheet No. 170 and half of sheet No. 171 in extension eastward of previous triangulation, the completion of the detail topographical survey of standard sheet No. 163 and the execution of a similar detail survey of half of standard sheet No. 164.

The large scale survey of Aijal will also be taken up and completed.

Besides the foregoing a detachment consisting of one officer and one native surveyor will be detailed to accompany the military expedition operating about the 1st December 1899, against the Mishmi tribes to the north-east of Assam,

124. The outturn for the season was as follows:—

| | Square miles, |
|---|---------------|
| 1st class secondary triangulation | 1,050 |
| Tertiary triangulation (net-work) | 1,423 |
| Detail topography on the scale of 1 inch = 1 mile | 649 |

And the cost-rates for the different classes of work are as under:—

| | Per square mile. |
|---|------------------|
| | ₹ a. p. |
| 1st class secondary triangulation | 22 3 6 |
| Tertiary triangulation (net-work) | 31 13 4 |
| Detail topography on the scale of 1 inch = 1 mile | 64 6 9 |

As the net-work triangulation of the previous season (1897-98) is that on which the detail 1 inch survey of sheet No. 162 has this year been based, its cost-rate (₹50 per square mile) has been accepted in calculating the final cost-rate of that standard sheet and added to that of the detail survey of the season under report, thereby giving the outturn cost-rate as ₹114-6-9 per square mile exclusive of cost of publication. This rate will probably be considerably reduced in future years. The cost-rate of the 1st class secondary triangulation has not been included in calculating the final cost-rates of the topographical survey as the work is trigonometrical rather than topographical.

125. The health of the party during the field season under report has not been good. Out of a total native establishment of 11 native surveyors and clerks, 131 *khalásis* and 400 *Nepálese coolies*; 3 *khalásis* and 20 *coolies* died, and 4 *khalásis* and 11 *coolies* had to be invalided as permanently broken down in health, giving a proportion of deaths and breaks-down of 7 per cent. on the total number of natives employed in the field. Eighteen *coolies*, however, died of cholera which broke out among them during their journey from the Darjeeling district to Silchar. There were besides a large number of cases of sickness under treatment during the field season. Every care was taken of the health of the men, and the high rate of mortality and sickness can only be attributed to the unhealthiness of the country and the hardship inseparable from service in it.

126. The country surveyed is a difficult one, consisting of a series of densely wooded and very steep parallel ridges rising to a height of from 3,000 to 5,000 feet above sea-level with valleys between them whose elevation is but a few hundred feet above that of the sea.

Beyond the one Government mule road running through the country from north to south and one or two branch roads to police outposts, there are no communications other than native foot-paths, and in the uninhabited tracts of the country, considerable areas of which came under survey this year, not even these exist, and here the surveyors have had to cut tracks for themselves. Transport other than coolie was therefore out of the question, and as local labour was not procurable, the necessary number of men (400 *Nepálese coolies*) was obtained through the Deputy Commissioner, Darjeeling. These men, with the exception of a proportion who were of inferior physique, worked well throughout the field season.

As practically no food supplies are obtainable in the country, the food for the party had to be imported from Silchar. The difficulty of rationing the various squads in the field, very considerably added to the difficulties and cost of survey, and necessitated the establishment of intermediate ration depôts scattered about the country for the supply of such squads as were working more than four or five days' march from Aijal.

The smoke haze which sets in about the middle of February each year, and is due to the custom which obtains in these hills of clearing the forest for cultivation by burning it, was found to be another difficulty to the execution of survey operations, especially triangulation, as it renders the observation of the longer rays, even with the use of luminous signals, an absolute impossibility. Another characteristic custom of this district is that of moving the sites of every village every two or three years, a custom which renders the record of village sites and names on the map of very little permanent value.

Much assistance was rendered throughout the field season by the Superintendent of the Lushai Hills and other officers of the Civil Administration.

127. The party was inspected in recess quarters by Lieutenant-Colonel Hobday, I.S.C., Deputy Surveyor-General, Revenue Branch, at the end of September, and he expressed himself satisfied with the work done.*

NORTH-WESTERN FRONTIER.

NO. 15 PARTY.

128. Colonel R. A. Wahab, R.E., held charge from 1st October 1898 till the 12th July 1899, when he proceeded on privilege leave and was relieved by Lieutenant G. A. Beazeley, R.E.

Personnel.

Colonel R. A. Wahab, C.I.E., R.E., Superintendent, 2nd grade, in charge up to 12th July 1899.

Lieutenant G. A. Beazeley R.E., Officiating Deputy Superintendent, 2nd grade, joined the party on the 29th May, in charge from 12th July till the 9th October 1899.

Mr. E. A. Wainright, Extra Assistant Superintendent, 3rd grade.

" G. A. Knight, " " 5th "

" G. P. Tate, " " 6th "

Yusuf Sharif, Khan Bahadur, Sub-Assistant Superintendent, 1st grade.

Hira Singh, Rai Bahadur, Sub-Assistant Superintendent, 1st grade, died 17th September 1899.

Mr. M. C. Petters, Sub-Assistant Superintendent, 2nd grade.

" H. C. H. Cooper, " " 2nd "

Ahmed Ali Khan, Khan Bahadur, Sub-Assistant Superintendent, 3rd grade.

25 Surveyors, and Sub-Surveyors, etc.

The sudden death of Rai Bahadur Hira Singh at Quetta on the 17th September 1899 has deprived the party of one of its best known members. His excellent service on the Afghan Boundary Commission in 1884—86 gained him promotion to the Provincial Service, and his subsequent services in the North-Western Frontier party, both in military expeditions and in regular work, have fully justified his advancement.

129. The different detachments commenced work on or about the 1st November 1898, the field season terminating on dates varying with the different detachments.

130. The surveys in progress during the previous season in Sind and near Rawalpindi were continued, and a special survey on the 6-inch scale was made of the coal-bearing area on the Sor range near Quetta. Triangulation for 1-inch survey was continued in Sind.

131. During the summer months a detachment has been employed on ½-inch surveys in Kashmir and Gilgit, and in the Indus Valley near Chilas.

132. During the year the recess quarters of the party were moved from Quetta to Mussooree where the North-Western Frontier Drawing Office, hitherto at Simla, has also been transferred. The two offices have always formed one charge under the superintendence of the officer in charge of No. 15 Party, and the desirability of bringing them into closer connection has been obvious for some time. During the recess the fair drawing of the Sind 1-inch sheets has been continued and revised maps of the Quetta Cantonment Survey on the scale of 16 inches = 1 mile have been completed.

* The officer in charge reports highly of the assistants with the party and of the cheerful way in which all members performed their duties under exceptionally trying conditions.

Mr. Keating has shown himself an able triangulator and has administered the party during his (Captain Robertson's) absence to his entire satisfaction. Mr. Waller-Senior is especially mentioned for the energy and zeal he has displayed in carrying out his work, for much of the season, in spite of ill-health from malaria contracted in the country.

Sub-Surveyors Ram Singh, for his net-work triangulation, and Gurjan Singh, for his 1-inch detail topography, are especially mentioned, as also Syed Razi Hasan, the writer of the party, for the painstaking way in which he has performed his duties in office.

133. The total outturn of the party is as follows :—

| | Square miles. |
|--|---------------|
| Triangulation for 1-inch survey | 2,765 |
| " " 12-inch " | 21 |
| " " ½-inch reconnaissance | 16,000 |
| Detail Survey on 1-inch scale | 1,320 |
| " " 2-inch " | 271 |
| " " 6-inch " | 187 |
| " " ½-inch " | 2,043 |
| Reconnaissance and Survey ½-inch scale | 26,274 |

134. The programme for the ensuing season includes the extension of 1-inch detail survey in Sind, and the commencement of 12-inch survey at Secunderabad. The ½-inch surveys of Kashmir and the Gilghit Agency, and ¼-inch survey and reconnaissance will also be continued.

135. The health of the party has been excellent throughout the year, and with the exception of Rai Bahadur Hira Singh, who died of heart disease, there have been no casualties.*

HIMALAYAS, PUNJAB.

NO. 18 PARTY.

136. Mr. Pocock held charge of the party from the 1st October to the 4th November when

Personnel.

Major W. J. Bythell, R.E., Officiating Superintendent, 2nd grade, in charge, from 5th November 1898 to 1st May 1899.

Mr. L. J. Pocock, Extra Deputy Superintendent, 2nd grade, in charge, from 1st October to 4th November 1898.

Mr. C. D. Potter, Extra Assistant Superintendent, 3rd grade, in charge, from 2nd May to 30th September 1899.

Mr. W. Robert, Extra Assistant Superintendent, 5th grade.

" G. E. Parker, " " 5th "

" J. O. Greiff, Sub-Assistant Superintendent, 2nd "

" W. M. Gorman, " " 2nd "

" E. J. Biggie, " " 2nd "

" C. E. C. French, " " 2nd "

23 Sub-Surveyors, one Clerk, and 27 others.

he was relieved by Major Bythell, R.E., who continued in charge up to the 2nd May 1899 when he proceeded on special leave making over the party to Mr. Potter.

137. The party, as in previous seasons, was divided into detachments noted below, each working in different portions of the Himálayas, in the Kángra and Hoshiárpur districts, and also in the Simla Hill States and in Suket and Sirmúr. The detachments left, and returned to, recess quarters on various dates according to the description of work performed and the nature of the ground worked over, the climatic conditions, and the state of fair mapping. The detachments were as follows :—

- i. The Sirmúr detachment, for work in the Sirmúr State forests on the 2-inch scale and a 48-inch scale survey of the town and cantonment of Náhan, the capital of the State.
- ii. The Kángra detachment, for work in the Kángra district, on the 4-inch scale surveys.
- iii. The Simla Hill States detachment, for work in the Simla Hill States and Hoshiárpur district, on the 2-inch scale surveys.
- iv. A Triangulator, for triangulation in advance of topography, in the Hoshiárpur district.
- v. The Executive officer, to visit and examine progress of work in all the above detachments, left recess on the 23rd December and returned on the 20th April.

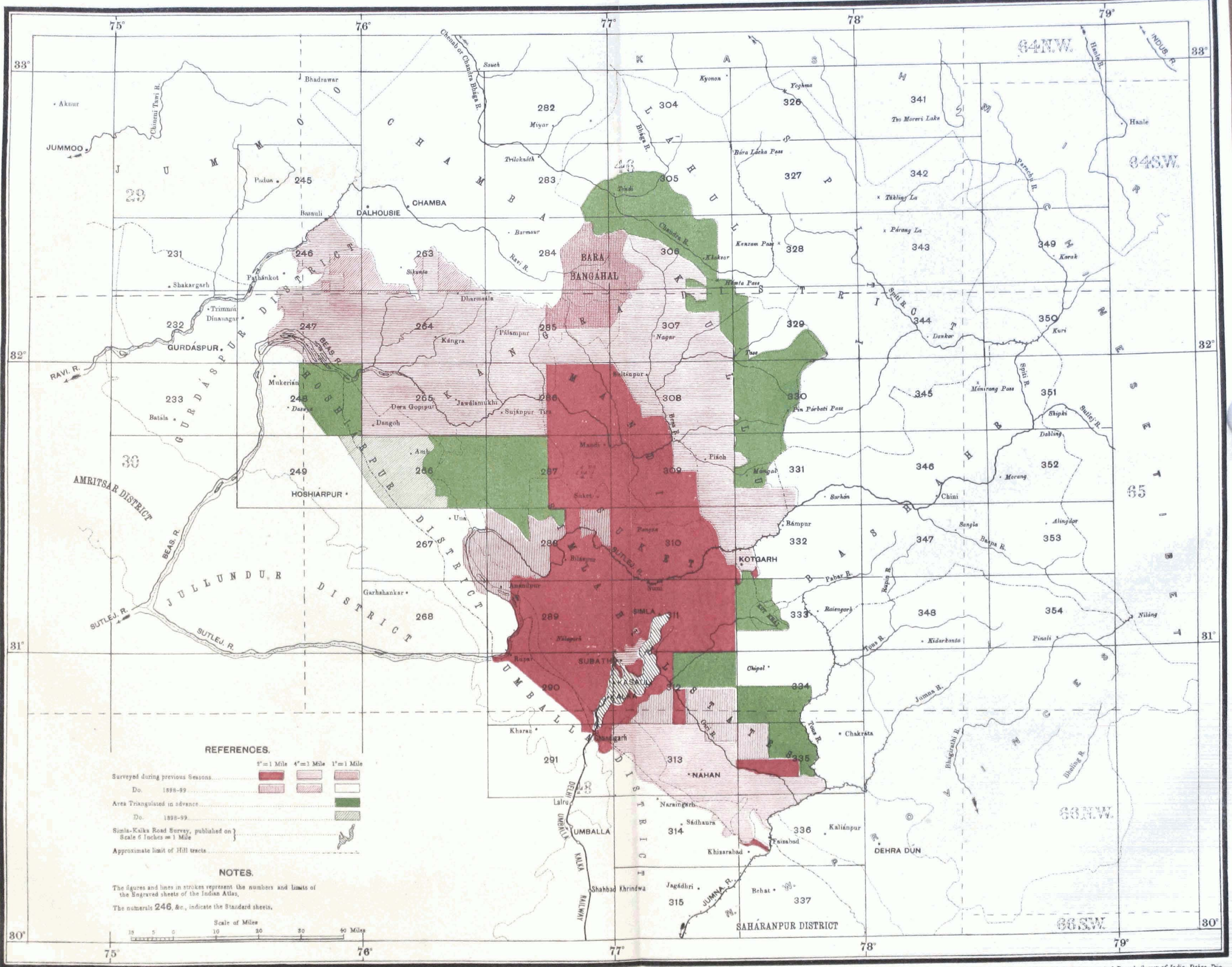
138. The Sirmúr detachment under Mr. Potter, with 7 sub-surveyors, continued the previous season's work of surveying and classifying the forests of the Sirmúr State, but on a reduced scale of 2 inches to a mile as noted in paragraph 138 of the General Report of 1897-98. The surveys were carried on in the northern part of the State on either side of the Giri river, from the main Náhan-Dagshai road to the ridges of the Chor. The highest point reached during the season's work was 11,134ft. above sea-level. The 48-inch survey of the town

* The officer in charge reports that Messrs. Wainright, Knight, and Tate deserve special mention and of the native establishment Surveyors Sher Jung, Lall Singh, and Jafar Ali have done excellent work.

PUNJAB SURVEY

1898-99

INDEX TO THE SURVEY OPERATIONS IN THE HIMALAYAS



REFERENCES.

- 2"=1 Mile 4"=1 Mile 1"=1 Mile
- Surveyed during previous Seasons:
 - Do. 1898-99: [Pink shading]
 - Do. 1899-00: [Light pink shading]
 - Do. 1900-01: [White shading]
 - Area Triangulated in advance:
 - Do. 1898-99: [Green shading]
 - Do. 1899-00: [Light green shading]
 - Simla-Kalka Road Survey, published on }
Scale 6 Inches = 1 Mile
 - Approximate limit of Hill tracts: [Dashed line]

NOTES.

The figures and lines in strokes represent the numbers and limits of the Engraved sheets of the Indian Atlas.
The numerals 246, &c., indicate the Standard sheets.

Scale of Miles
0 10 20 30 40 Miles

of Náhan, at the special request and expense of the State, as noted in paragraph 139 of the General Report of 1897-98, to which was added the survey of the cantonment, on the same scale, with spirit levels over both localities, was continued and completed during the season.

139. The Kángra detachment, under Mr. Greiff with Mr. French, and 7 sub-surveyors, continued the previous season's surveys on the 4-inch scale in the north-western portion of the Kángra district. During the winter months they worked on the low ground (about 2,000ft. above sea-level) bordering the high ranges that separate that district from the native state of Chamba, and during the spring months they moved up to the high ranges some 15,000 ft. above sea-level. The lower ground consisted, for the most part, of level stretches of land, richly cultivated and well inhabited, lying between detached hills and knolls and intersected by numerous streams with deep channels and precipitous banks. The higher ranges, of characteristic mid-Himálayan features, are uninhabited and destitute of cultivation above 7,000 ft.; and but for a few goat-tracks leading to the passes over the crests they are otherwise inaccessible. The survey of this ground was accomplished under the usual difficulties and hardships encountered by surveyors on high altitudes. All forests were also surveyed *parri passu* with the general survey of the locality, and a classification of forest growth and soils in them, was also prepared.

140. The Simla Hill States detachment, under Mr. Robert with Mr. Biggie and 8 sub-surveyors, continued the previous season's operations on the 2-inch scale in the native states of Suket and Kahlúr of the Simla Hill States, and contiguous portions of the Hoshiárpur district. The country surveyed was mostly along the valley of the Sutlej river, at an average height of 1,500 ft. above sea-level, including the remarkable loop some 55 miles long and 200 miles in area formed by the river. The survey of the Hoshiárpur district was commenced on the reduced scale of 2 inches to a mile in pursuance of the recent Government of India orders.

141. The triangulation, in advance of topography, was done by Mr. Gorman in the eastern portion of the Hoshiárpur district, along the Soán river, one of the tributaries of the Sutlej river, on either side of which run two parallel ridges, the western of Siwálik and the eastern of outer Himálayan formation rising to 2,200 ft. and about 4,000 ft., respectively, above sea-level.

142. A drawing office under Mr. Parker, with 19 draftsmen and apprentices, was left located at Simla to deal with the mapping work of the party.

143. The operations of the party were carried out in accordance with the proposed programme of the season, except the work in Kullu, which appertained to the Simla Hill States detachment, and had to be abandoned on account of the late snow falls during the spring, following a severe winter, which rendered work on high regions impracticable. Some triangulation to the north-east of Simla had also to be abandoned on account of the dense haze that enveloped the country prior to the setting in of the monsoon.

144. The outturn of the field season's work was as follows :—

| | Square miles. |
|---|---------------|
| (a) Triangulation in Hoshiárpur district | 315·0 |
| (b) Detailed survey on the 4-inch scale in the Kángra district! | 156·0 |
| (c) Detailed survey of the Sirmúr forests, on 2-inch scale with classification of forest growth | 259·8 |
| (d) Detailed survey on the 2-inch scale in Suket, Simla Hill States and Hoshiárpur districts | 362·2 |
| Detailed surveys on all scales = | 778·0 |

145. The surveys of the following number of forest blocks or compartments are included in the areas shown above :—

| | No. of blocks or compartments. | Area in square miles. |
|---------------------|--------------------------------|-----------------------|
| In Sirmúr | 78 | 259·8 |
| „ Kángra | 22 | 52·6 |

| | ₹ |
|---|------|
| The cost per square mile for triangulation is | 15·2 |
| The cost per square mile for 4-inch surveys including mapping and instruments | 99·9 |
| The cost per square mile for 2-inch surveys in the Simla Hill States including mapping and instruments | 68·7 |
| The cost per square mile for 2-inch surveys, in Sirmūr State, 2-inch scale, including mapping and instruments | 52·6 |

146. There was also good progress made in fair mapping as 40 sheets were sent for publication; 15 are in a very advanced state of preparation for publication; 28 and 35 proofs were examined and coloured respectively; 15 sheets of forest classification were prepared for ferrotypé reproductions, and 23 coloured, and despatched to district officers; besides the compilation of tabular statements and indexes supplied to the various offices connected with the party.

147. The instruction of Native Soldier surveyors, as noted in paragraph 143 of last year's report, still continues to form one of the duties of the party. One of them, Naik Madho Ram, 44th Gurkhas, completed his course with much credit to himself, and rejoined his regiment. Sepoy Manna Singh, 5th Punjab Infantry, joined the party on 8th October 1898, and has now completed a portion of his training; and another man from the 6th Punjab Infantry has just joined for his course.

148. This party has frequently been placed under contribution for sub-surveyors on special work, two men have been absent during the season on exploration duties, another man is on deputation with the Central Africa Protectorate, and a fourth is on deputation with the Pekin Syndicate in China; a fifth, Wahid Ali Khan, was also on deputation with the Central Africa Protectorate, but returned during the recess and obtained the distinction of "*Khán Sáhob*" from the Government of India for his services; but he has since resigned his appointment for a more lucrative one in the Protectorate. All these men have been trained in this party, inured to hardships on the Himálayas, accustomed to work on various scales and in the different descriptions of ground to be met with in the Himálayas and, almost all, have been favourably reported on wherever sent.

149. In future, in accordance with the orders contained in Government of India letter No. 351-95-18, dated 11th February 1899, the scale of survey in Kángra and the hilly parts of Hoshiárpur is to be reduced from the 4-inch to the 2-inch, with the exception of the Reserved Forests which are still to be surveyed on the larger scale; in the Simla Hill States, when the 2-inch sheets, at present in progress, have been completed, the scale is to be reduced from the 2-inch to the 1-inch; and what remains for survey in Kullu is to be surveyed on the 1-inch scale. It is also proposed to survey the small area still remaining in the Sirmūr State on the 2-inch scale, as the party is under an arrangement with His Highness the Maharaja to survey his forests on that scale, His Highness paying a contribution to their cost.

150. The party was inspected by the Surveyor-General on the 11th July, and by the Superintendent, Trigonometrical Surveys, on the 12th and 13th July 1899, and both expressed their commendation of the work and efficiency of the party.*

* Mr. Potter reports very favourably on the work done by Messrs. Robert, Parker, Greiff (specially), and Gorman in the management of their respective detachments; Messrs. French and Biggie promise to become good surveyors, the former especially.

Of the subordinate establishment the following are specially brought to notice:—

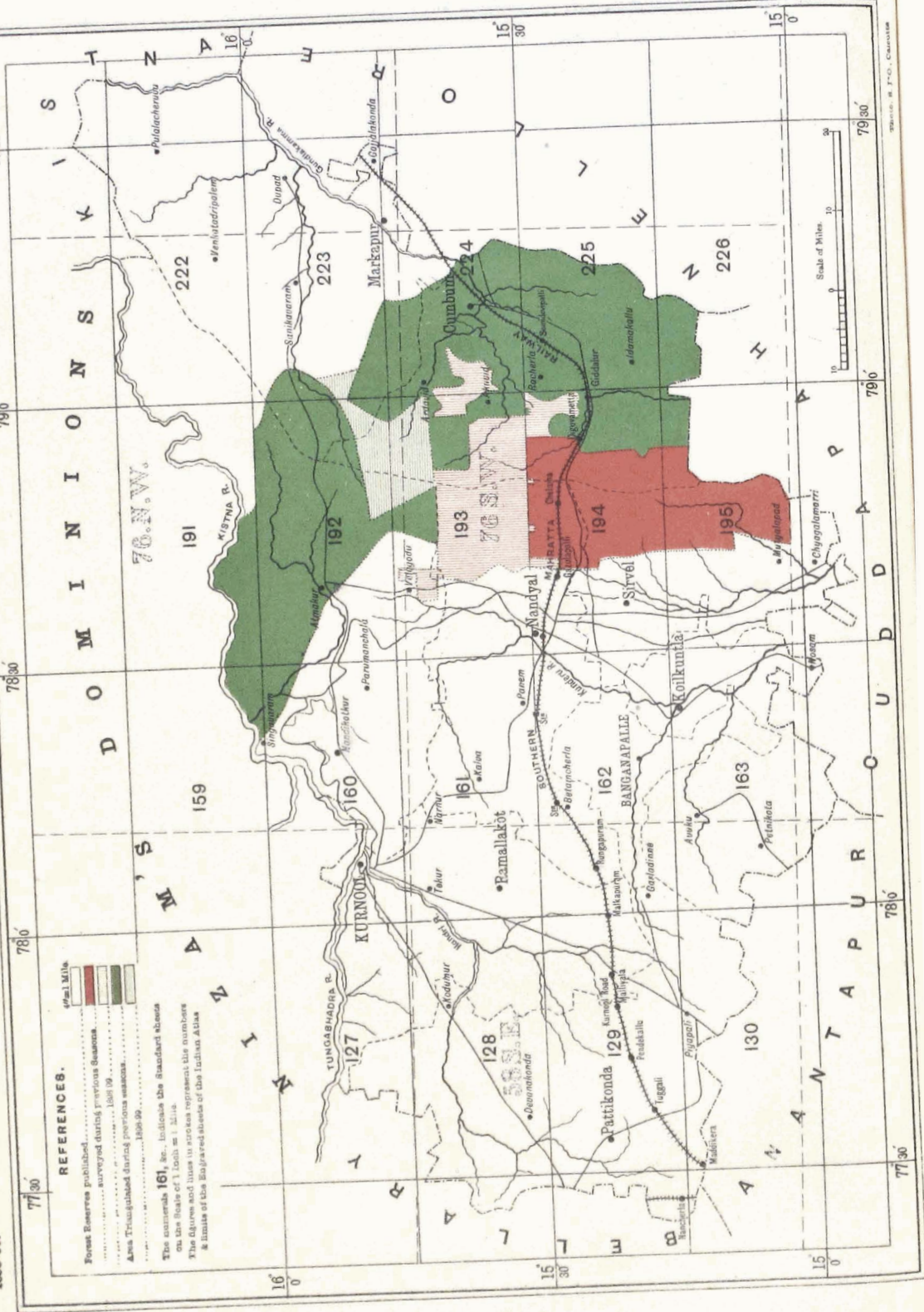
Amir Singh, clerk; Paras Ram, Sheopal Misar, and Amba Dutt, sub-surveyors; and Narain Dutt, draftsman.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE KURNOOL DISTRICT.

Nos. 9 & 19 PARTIES.

1898-99.



REFERENCES.

- Forest Reserves published..... 1891, M. 116.
 - surveyed during previous seasons.....
 - 1881-19.....
 - Areas Triangulated during previous seasons.....
 - 1861-69.....
- The numbers 161, &c. indicate the Standard sheets on the State of 1 inch scales represent the numbers. The figures and lines in squares represent the numbers & limits of the Bangalore sheets of the Indian Atlas.

Scale of Miles.

79° 30'

79° 0'

78° 0'

77° 30'

79° 30'

79° 0'

78° 30'

78° 0'

16° 0'

16° 30'

15° 30'

15° 0'

15° 30'

15° 0'

79° 30'

79° 0'

78° 0'

77° 30'

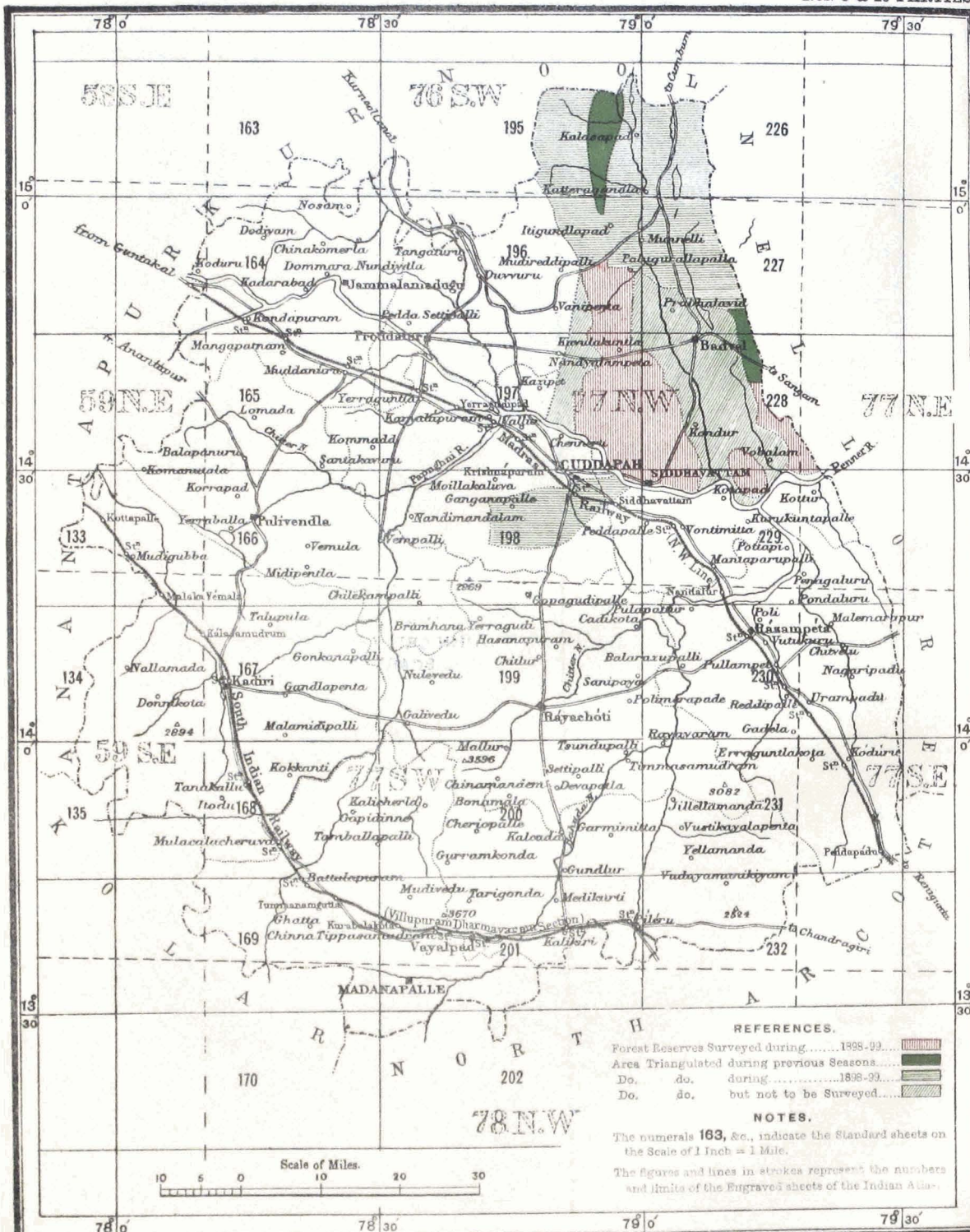
77° 0'

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE CUDDAPAH DISTRICT.

1898-99.

Nos. 9 & 19 PARTIES.

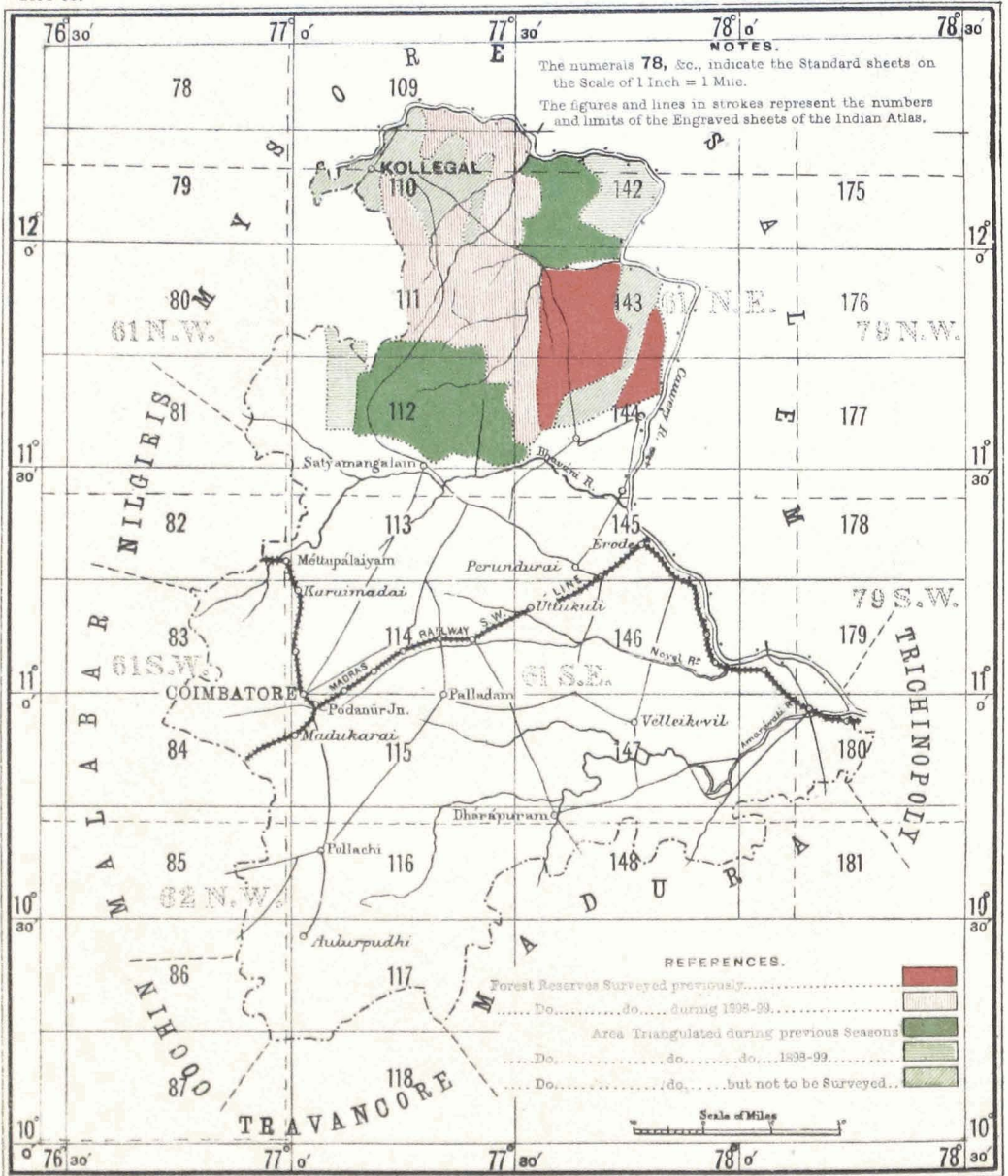


MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE COIMBATORE DISTRICT.

1898-99.

Nos. 9 & 19 PARTIES.



FOREST SURVEYS.

MADRAS PRESIDENCY.

NOS. 9 AND 19 PARTIES.

151. Under the orders of the Deputy Surveyor-General the parties were re-organized with the *personnel* reduced from that shewn in last year's report, the *personnel* is given as it was on taking the field after the reduction was completed.

Personnel.

Captain A. H. B. Hume, R.E., Officiating Deputy Superintendent, 1st grade, in charge.

Mr. C. F. Hamer, Extra Assistant Superintendent, 2nd grade.

Mr. H. Todd, Extra Assistant Superintendent, 3rd grade.

" R. Todd, Extra Assistant Superintendent, 4th grade.

" J. H. S. Wilson, Sub-Assistant Superintendent, 2nd grade.

Mr. M. J. Sheehan, Sub-Assistant Superintendent, 2nd grade.

60 Surveyors, sub-surveyors, and soldier surveyors and one writer.

152. The parties took the field on the 7th October 1898 and returned to recess quarters on the 11th May 1899.

153. Mr. H. Todd was placed in charge of the Northern Circle Camp, and Mr. Hamer, assisted

by Mr. Sheehan, of the Southern Circle Camp.

154. For triangulation Mr. R. Todd was employed first in Kurnool and then in Cuddapah. Surveyor Govind Raju and Sub-Surveyor Hilal Uddin, who was detached from the Southern Circle Survey towards the end of the season, worked in North Coimbatore. On Surveyor Govind Raju's falling sick Mr. R. Todd took up his work for the last month in North Coimbatore.

155. The programme for the Northern Circle was the continuation of the survey of the Nallamalai Hill reserves in the Kurnool district. An area of 303 square miles was completed. The triangulation was also the continuation of the same district to the north, and 150 square miles were completed and boundaries traversed for the current season and next.

For the Central Circle the programme was the mapping of the Nallamalai Hill reserves of the Cuddapah district, here 334 square miles were completed. The triangulation programme included 5 reserves south of the railway near Cuddapah, of which an area of 550 square miles was triangulated. The boundaries necessary for the current season and next were traversed.

In the Southern Circle 688 square miles were completed in the North Coimbatore district including the following reserves:—

| | |
|----------------|---|
| North Bargur | } (A strip remaining from last season). |
| South do. | |
| Hanur. | |
| Kaudhalli. | |
| Doddasampegai. | |
| Chikialur. | |
| Yedarhalli. | |

The triangulation programme included the Talamalai and Madeswaranmalai reserves, the latter were completed and 100 square miles out of the 250 of the former. The area not triangulated was reconnoitred and the East Nilgiri reserve also, but the surveyor, and afterwards an assistant, falling sick prevented its completion. The triangulation being well in advance in this district the loss is immaterial. Traverses as required for the current season and next, were completed.

156. A total of 950 square miles of triangulation was completed.

The traverse outturn was 717 linear miles, or about the normal amount.

The total detail survey outturn of 1,350 square miles is a very good one, showing an advance of nearly 30 per cent. on last season. It is decidedly the largest yet completed in a season, and 170 square miles more than the programme, the outturn in each district being above the estimate.

The Kurnool outturn was considerably the largest yet done in that district though the country was particularly difficult.

The work was checked by *partial* lines and *in situ* fixings and, with few exceptions, was found well and carefully done.

157. The state of the mapping is as follows:—

Of Kurnool 11 finished maps are to be submitted and 2 held over as incomplete.

Of Cuddapah 7 finished maps are to be submitted and 5 held over.

Of North Coimbatore 18 finished maps are to be submitted and 11 held over.

Those held over are fair drawn as far as the survey is done in them.

Besides the above, 19 fair sheets of last year's survey of Salem and South Arcot have been finished, and 2 part sheets of Madura surveyed this year.

All computations have been completed and bound, and traces made for the classification of soils and forest growth.

158. The programme for next season proposes continuing the survey on the same lines in Kurnool, Cuddapah, and North Coimbatore, and commencing the triangulation of the South Canara reserves in the Southern Circle.

159. The following table shows the progressive outturn and cost-rates of the party since 1888:—

Comparison of outturn and cost-rates.

| 1 | 2 | 3 | 4 | 5 | 6 | REMARKS. |
|---------------|--|-----------------------------------|--|-----------------------------------|---|--|
| SURVEY YEARS. | Detail survey completed in square miles. | Total cost of party for the year. | Triangulation and traverse combined cost-rate per square mile. | Detail cost-rate per square mile. | Cost-rate of party per square mile of finished work, cols. 3+2. | |
| | | ₹ | ₹ | ₹ | ₹ | |
| 1888-89 . . . | 168 | 56,608 | 24 | 138 | 337 | |
| 1889-90 . . . | 214 | 71,049 | 29 | 120 | 332 | |
| 1890-91 . . . | 465 | 75,492 | 31 | 81 | 162 | |
| 1891-92 . . . | 659 | 76,347 | 20 | 77 | 116 | |
| 1892-93 . . . | 788 | 81,840 | 7 | 71 | 104 | |
| 1893-94 . . . | 881 | 78,548 | 11 | 61 | 89 | |
| 1894-95 . . . | 971 | 76,692 | 10 | 56 | 79 | |
| 1895-96 . . . | 964 | 75,900 | 11 | 54 | 79 | |
| 1896-97 . . . | 1,027 | 88,921 | 18 | 66 | 87* | Above this line No. 19 Party. |
| 1897-98 . . . | 1,050 | 129,293 | 13 | 106 | 123 | Below this line Nos. 9 and 19 as combined parties. |
| 1898-99 . . . | 1,350 | 100,510 | 20 | 58 | 74 | |

* In season 1896-97 Kurnool district was commenced, which accounts for the increase in rate, and the same tends to increase the years following.

Column 6 shows that this has been decidedly the cheapest year since the work was commenced in the Presidency. The rate in column 4 appears larger than before and that in column 5 larger than in the two previous years, but these rates cannot be relied on for exact comparison as they depend on the allotment of supervision, and the larger or smaller amount of triangulation and traversing undertaken. From 1892 to 1896 easier country was under survey, and the detail cost-rate this year, if the Kurnool district figures be excluded, is ₹51 per square mile, or lower than it was in those years. Column 6 gives the fairest comparison by actual results and shows a highly satisfactory advance in the cheapness of the work. Comparison with last year's figures also shows the good effects of the re-organization that took effect from October last year.

160. Allowing for the ordinary percentage of fever, the health of the party was, on the whole, fairly good. One sub-surveyor and 2 *khalásis* died of fever. The assistant in charge of the Kurnool section suffered rather severely from fever in the field. The work of the surveyor triangulating in North Coimbatore was brought to a close mainly by ill-health, and the assistant sent there to carry on his work contracted bad fever, from which he has suffered throughout the recess. Besides the above, 5 apprentice sub-surveyors had fever at frequent intervals.

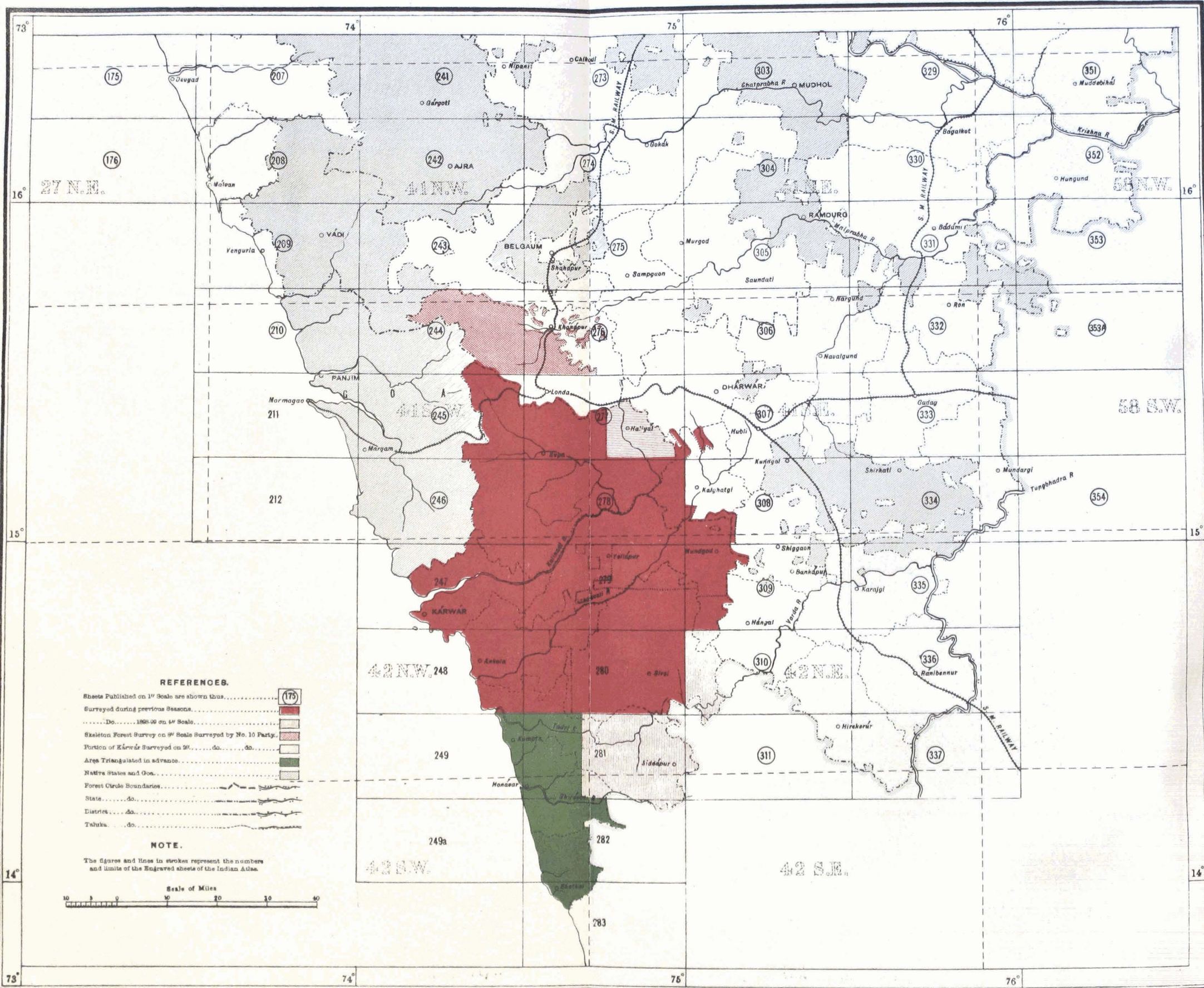
161. The country surveyed varied considerably. The Nallamalai Hill reserves of Kurnool are the most difficult on account of the thick jungle, and work has to be done mainly by traversing which is very tedious, owing to the thick thorny undergrowth. The south end of the same range of Nallamalais

BOMBAY SURVEY.

INDEX TO THE FOREST SURVEYS IN PORTION OF THE SOUTHERN CIRCLE

No. 17 PARTY.

1898-99.

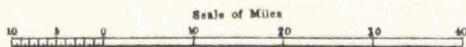


REFERENCES.

- Sheets Published on 1" Scale are shown thus..... (175)
- Surveyed during previous Seasons..... (Red shading)
- Do..... 1898-99 on 1" Scale..... (Light red shading)
- Skeleton Forest Survey on 2" Scale Surveyed by No. 10 Party..... (Dotted shading)
- Portion of Kárwár Surveyed on 2" Scale..... (White shading)
- Area Triangulated in advance..... (Green shading)
- Nátra States and Cos..... (Light green shading)
- Forest Circle Boundaries..... (Dashed line)
- State..... (Dotted line)
- District..... (Dashed line)
- Taluka..... (Dotted line)

NOTE.

The figures and lines in strokes represent the numbers and limits of the Engraved sheets of the Indian Atlas.

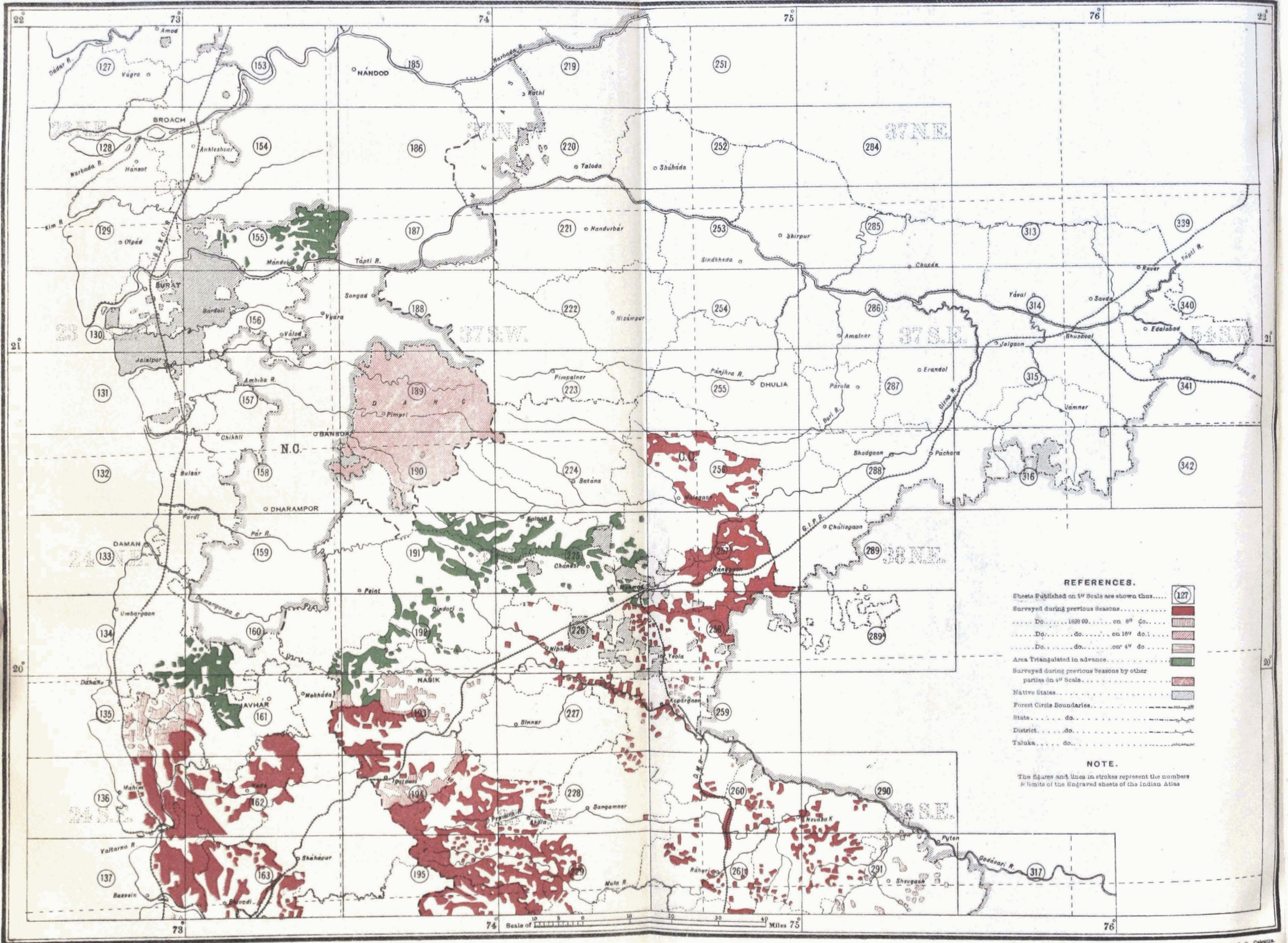


BOMBAY SURVEY.

INDEX TO THE FOREST SURVEYS IN PORTIONS OF THE NORTHERN & CENTRAL CIRCLES.

1898-99.

No. 17 PARTY.



- REFERENCES.**
- Sheets Published on 1" Scale are shown thus..... (127)
 - Surveyed during previous seasons..... (128)
 - Do. 1898-99. on 8" Co. (129)
 - Do. do. on 10" do. (130)
 - Do. do. on 4" do. (131)
 - Area Triangulated in advance..... (132)
 - Surveyed during previous seasons by other parties on 4" Scale..... (133)
 - Native States..... (134)
 - Forest Circle Boundaries..... (135)
 - State..... do. (136)
 - District..... do. (137)
 - Taluka..... do. (138)

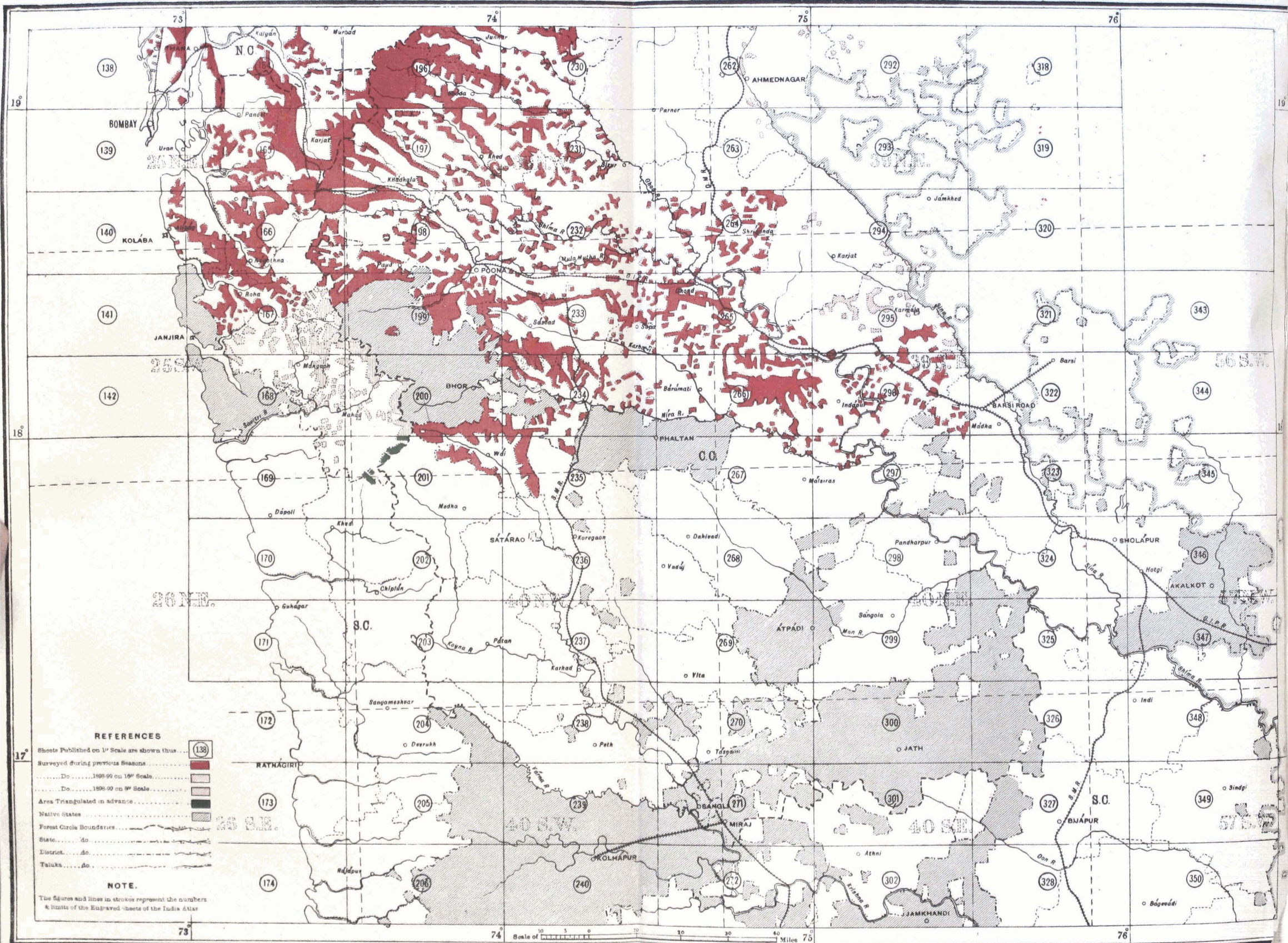
NOTE.
The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas

BOMBAY SURVEY.

INDEX TO THE FOREST SURVEYS IN PORTIONS OF THE NORTHERN, CENTRAL, & SOUTHERN CIRCLES.

1898-99.

No 17 PARTY.



REFERENCES

Sheets Published on 1" Scale are shown thus: (138)

Surveyed during previous Seasons: (139)

Do. Do. 1898-99 on 10" Scale: (140)

Do. Do. 1898-99 on 9" Scale: (141)

Area Triangulated in advance: (142)

Native States: (143)

Forest Circle Boundaries: (144)

State: (145)

District: (146)

Taluka: (147)

NOTE.

The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the India Atlas

in Cuddapah is rather more open. In parts of North Coimbatore the hills rise to nearly 6,000 feet and have areas of fine evergreen jungle.

162. Besides the work in the districts reported on above, 10 square miles were surveyed to complete the South Arcot district, and 2 square miles to complete Salem district, also the revision of some boundaries, wrongly demarcated in the previous season's survey. In Madura district, where the survey was completed some years ago, 13 square miles of new extensions were surveyed at the request of the Forest Department.

163. The Deputy Surveyor-General inspected the parties in recess on the 23rd August, and the Surveyor-General on the 26th September. Each District Forest Officer visited the recess office for several days for the verification of the maps with the notifications, and the Conservator of Forests, Northern Circle, inspected the maps on the 22nd August.*

BOMBAY PRESIDENCY.

NO. 17 PARTY.

164. Captain Gordon held charge of the party during the field season until the 20th May 1899, when he was transferred to Calcutta to officiate as Assistant Surveyor-General in charge, Surveyor-General's Office and Mathematical Instrument Office. He was succeeded by Mr. Tapsell who continued to hold charge during the recess season.

Personnel.
Captain P. J. Gordon, I.S.C., Deputy Superintendent, 1st grade, in charge from 1st October, 1898.

Mr. C. E. Tapsell, Extra Assistant Superintendent, 2nd grade, in charge from 20th May 1899.

Mr. S. F. Norman, Extra Assistant Superintendent, 6th grade.

Mr. C. A. Norman, Extra Assistant Superintendent, 6th grade.

Surveyors and Sub-Surveyors:

G. R. Bhopatkar, R. V. Joshi, Govind Gopal, and 36 others.

165. The first detachments left Poona in the middle of November and the last ones returned in the end of June, giving a working field season averaging six months in duration.

166. The party was divided as usual, for convenience of supervision, into three camps and a detachment as follows:—

- (1) No. 1 Camp consisting of 12 surveyors under Mr. Tapsell in North Kánara.
- (2) No. 2 Camp consisting of 12 surveyors under Mr. S. F. Norman in Násik up to the end of February, and afterwards until the end of the season, strengthened by 3 surveyors from No. 3 Camp, in Thána district.
- (3) No. 3 Camp consisting of 10 surveyors, afterwards reduced to 6, under Mr. C. A. Norman in Kolába district.
- (4) A detachment consisting of 5 surveyors under Sub-Surveyor Govind Gopal in Ahmednagar and Sholápur districts.

167. The party continued the survey on various scales, of the forest reserves in the Northern, Central, and Southern Circles of the Bombay Presidency, these operations comprising:—

- (1) *In the Northern Circle.*—Preliminary triangulation in Thána. Detail survey on the 8-inch scale of the Teak reserves in Thána (Máhim and Dáhnú *tálukas*).
- (2) *In the Central Circle.*—Preliminary triangulation in Násik (Násik Chándor, Kalvan, and Dindori *tálukas*). Detail survey on the 8-inch scale in Igatpuri *táluka* and on the 4, 8 and 16-inch scales in the Násik *táluka* of the Násik district, and on the 16-inch scale of the *Babul* reserves in Ahmednagar and Sholápur districts.
- (3) *In the Southern Circle.*—Traversing in North Kánara. Detail survey on the 8-inch scale of the Teak reserves in Kolába district (Mahád and Mángaon *tálukas*) and on the 4-inch scale in North Kánara district.

* The officer in charge reports favourably on the work of Messrs. Hamer, H. Todd, R. Todd and Wilson.

The surveyors, sub-surveyors, and soldier surveyors, with few exceptions, are favourably mentioned. The work of the writer, Taraprosunno Roy, is also commended.

168. The following table shows in detail the cost-rates and outturn for the year under report and the two previous years :—

| DESCRIPTION OF SURVEY. | COST-RATES. Per square mile. | | | OUTTURN. | | | |
|--------------------------|---------------------------------|----------|----------|----------|----------|----------|----------|
| | 1896-97. | 1897-98. | 1898-99. | | 1896-97. | 1897-98. | 1898-99. |
| | R | R | R | | | | |
| Triangulation . . . | 21'4 | 19'2 | 18'3 | (a) | 229 | 255 | 230 |
| Traversing . . . | 14'3 | 14'6 | 10'9 | (b) | 188 | 164 | 166 |
| Topography, 4-inch . . . | 77'6 | 49'4 | 53'2 | (c) | 522'0 | 444'25 | 429'15 |
| Ditto 8 ,, . . . | 135'7 | 155'7 | 136'6 | (c) | 168'0 | 203'81 | 254'02 |
| Ditto 16 ,, . . . | 156'1 | 176'3 | 122'9 | (c) | 33'0 | 28'97 | 54'74 |

Note.—(a) Stations of observation. (b) Linear miles. (c) Square miles.

The improvement both in outturn and in cost-rates, notwithstanding the increase in the cost of supervision for the year under report, is very marked. The trifling increase in the cost-rates for 4-inch surveys may be disregarded, as ₹50 per square mile may be considered the minimum possible for 4-inch Forest Surveys in Kánara, any slight increase or decrease being due entirely to local conditions.

Owing to a clerical error in the report for 1897-98, it has been found necessary to revise the figures for that year, the rates now given are, however, more favourable than those given in last season's report.

169. As was pointed out in last year's report, a just comparison of results can best be arrived at by forming a unit of survey which will include preliminary traverse and triangulation, actual survey, fair mapping, and all supervision. It may be assumed that a square mile of completed 8 or 16-inch survey is now equal to $2\frac{1}{2}$ square miles of 4-inch survey which may be taken as the normal scale of the party. The results, according to this scale of values, are for the year under report and the two previous years, as follows :—

| SEASON. | Number of units. | Cost per unit. | REMARKS. |
|-----------------------------------|------------------|----------------|----------------------------------|
| 1896-97 | 1024'5 | 80'8 | |
| 1897-98 | 1026'3 | 64'4 | |
| 1898-99 | 1201'1 | 58'1* | * Or an improvement of some 10%. |
| Average for three years | 1084'0 | 67'9 | |

These results, both as regards outturn and cost-rates, may be considered satisfactory.

170. A comparative statement of the total cost of the party for the past three years is given below :—

| Survey year. | Total cost. | | |
|-------------------|-------------|----|----|
| | R | a. | p. |
| 1896-97 | 82,818 | 4 | 11 |
| 1897-98 | 66,106 | 8 | 9 |
| 1898-99 | 69,287 | 9 | 6 |

171. It may be remarked that the increase in the cost for 1898-99, as compared with that for 1897-98, is principally due to an increase of ₹4,614 under the head of supervision. For this increase, however, there is a larger outturn at reduced cost rates.

172. The work was thoroughly examined and tested while in progress by the Superintendent and Camp officers.

173. During the recess, most of the fair mapping of the past season's work, has been completed. A small Drawing Office was left in Poona during the field season and brought up the arrears of mapping, and it is proposed to continue it in future for the purpose of keeping up with the increased outturn of field work.

174. All the fair maps for the Forest Department have been submitted to the Bombay Government Photo-zincographic Office and published, and the 2-inch sheets of the North Kánara district have been sent to the Head-Quarters Offices at Calcutta for reduction to one inch standard sheets.

175. The health of the party during the field season was exceptionally good, but during the recess the party did not escape the ravages of plague and two valuable surveyors and one *khalási* died from this cause. The party has thus lost the services of five thoroughly trained surveyors during the past 2 years, a severe loss in a small party of forty men, especially when it is considered that it takes several years before an apprentice can become a thoroughly qualified surveyor. The greatest credit is due to Mr. Tapsell, for the excellent arrangements he made in forming a segregation camp for the members of the party and thus minimising the risk of the disease spreading in a small community, the members of which were daily brought into close contact with one another.

176. The programme for 1899-1900 is a continuation of that for the past season; Belgaum is the only new district in which operations will be commenced, and it is hoped the work in Kolába and North Kánara districts will be brought to a close.

177. The party was inspected during September by the Surveyor-General.*

LOWER BURMA.

No. 20 PARTY.

Personnel.

Mr. L. J. Pocock, Extra Deputy Superintendent, 2nd grade, in charge, from 25th November 1898 to 25th September 1899.

Mr. T. E. M. Claudius, Extra Deputy Superintendent, 2nd grade, in charge, from 26th September 1899.

Mr. C. W. Wilson, Extra Assistant Superintendent, 5th grade, officiating, in charge from 3rd October, 1898 to 24th November 1898.

Mr. A. George, Extra Assistant Superintendent, 6th grade.

" A. Ewing, " " " 6th "

" W. C. Barkley, Sub-Assistant Superintendent, 1st grade.

" H. A. Charrier, " " " 1st "

54 Surveyors, Sub-Surveyors, etc.

178. Mr. L. J. Pocock was in charge of this party from the 25th of November 1898 till he retired on the 25th of September 1899, when Mr. T. E. M. Claudius assumed charge.

179. The work of the party, as in former years, comprised—

- (i) Detail survey of portions of the South Zamayi and Kadat reserves in the Pegu forest division, the Nyabwa Zaha Kowliya and Tongan reserves in the Shwegyin division; the Thayetmyo East Yoma, Tindow, and Setsuwa reserves in the Thayetmyo division and Hmawbi and Kyetpugon reserves in the Rangoon division, all on the scale of 4 inches=1 mile, except Kyetpugon which was done on the 8 inches=1 mile scale.
- (ii) Detail survey of portions of standard sheets 271, 274, and 323 of unreserved forests, to fill up gaps, on the scale of 2 inches=1 mile.
- (iii) Triangulation in advance of topography in the West Salween forest division.
- (iv) The classification of forest growth and soils *pari passu* with the topography of the reserved forests.
- (v) Theodolite traverses based on the triangulation, as a basis for the detail work in the Thayetmyo, Toungoo, Shwegyin, West Sal-

* Much credit is due to Messrs. Tapsell and S. F. Norman for the efficient way in which they performed their duties. Most of the surveyors worked to my entire satisfaction; G. B. Bhopatkar, Mah-sud Khan, Yemla Piraji, Hari Ramchandra, as plane tablers, N. R. Patwardhan as a triangulator, and Ganesh Balal as a draftsman are specially deserving of mention.

ween and Ataran forest divisions; in the last named the traverse work was based on Great Trigonometrical Survey points of the Eastern Frontier Series.

180. The party left recess quarters at Bangalore about the 10th of November and commenced field work in the first to third week of December, according to the distance of the field of operations from Pegu. The recess quarters of the party have been changed to Dehra Dún, and the party has been amalgamated with the Forest Surveys of the Bengal Presidency and has been placed under the administrative charge of the Superintendent of Forest Surveys, in keeping with the orders of the Government of India, in their Resolution Circular No. $\frac{6}{143.3}$ F. of the 6th March 1899, Revenue and Agricultural Department. The recess office was opened in the beginning of the first week of June.

181. The party was divided into six sections, the head-quarters and traverse camp being in charge of the Executive Officer. Three detail survey camps were under charge of Messrs. George, Ewing, and Charrier, respectively, while the triangulation was carried on by Mr. Barckley assisted by Surveyor Amjad Ali. All the detachments left Pegu on various dates between the last week of November and the first week of December.

182. The outturn of the field season's work was as follows:—

| | Square miles. |
|---|---------------|
| (a) Triangulation in the West Salween forest division | 1,200 |
| (b) Theodolite traversing for the 4-inch scale | 186 |
| (c) Detail survey on the 4-inch scale | 472 |
| (d) " " " " 2-inch " | 87 |
| (e) " " " " 8-inch " | 1'4 |

183. The usual test lines were applied to the detail work by the camp officers, who constantly visited the surveyors at work, which as a rule, proved of good quality; one case having been found otherwise, for which the surveyor's pay was reduced by the Deputy Surveyor-General.

184. The traverse work was conducted by Mr. Pocock, no assistant being available for this work. Considering the difficult and scattered nature of the reserves which entailed considerable loss of time in marching from one to the other, and sickness among the traversers, a good outturn was completed.

185. The outturn of 4-inch detail work is larger than ever before done by this party, but the 2-inch work has decreased.

186. The cost-rate of survey, as seen from the following table, shows—

| YEAR. | COST-RATE PER SQUARE MILE. | | | | |
|-------------------|----------------------------|-------------|----------------|---------------|---------------|
| | Triangulation. | Traversing. | DETAIL SURVEY. | | |
| | | | 4-inch scale. | 2-inch scale. | 8-inch scale. |
| | R | R | R | R | R |
| 1891-92 | 35'2 | 150'6 | 175'3 | 66'2 | ... |
| 1892-93 | 33'2 | 138'1 | 160'1 | 60'9 | ... |
| 1893-94 | 36'9 | 133'9 | 159'3 | 83'5 | ... |
| 1894-95 | 30'1 | 94'0 | 153'5 | 176'0 | ... |
| 1895-96 | 21'2 | 58'5 | 158'1 | 83'5 | ... |
| 1896-97 | ... | 83'5 | 173'2 | 50'5 | ... |
| 1897-98 | ... | 57'4 | 196'4 | 79'4 | ... |
| 1898-99 | 14'6 | 132'8 | 155'4 | 86'4 | 131'4 |

The cost-rate for traverse work is high, but the cost per square mile is not a fair comparison, as all the work done this year is for 4-inch survey only, embracing a much smaller area than if similar work had been needed for 2-inch survey.

The cost-rate for detail survey is lower than last year. The early beginning of the monsoon reduced the last month's outturn somewhat or the area finished would have been greater. The new hands which joined the party from the Dehra Training School required further tuition before they could take up independent work in the very difficult country operated in by this party.

187. The country was very difficult for survey work, consisting of intricate hills covered with dense jungle. The health of the party was on the whole good. Three *khalásis* were carried off by tigers, which caused some delay in the work, and one sub-surveyor and one *khalási* died from fever. Most of the surveyors were provided with guns and ammunition, which gave them some confidence.

188. No supplies, except small quantities of rice, being obtainable near the work, food depôts had to be established, and the supply and distribution of provisions was successfully done by the party. The elephants attached to the party were of the greatest use for transporting the provisions.

189. During the recess all the computations and 4-inch mapping have been brought up to date.

Thirty-five 4-inch sheets were submitted for publication, and three more sheets will be submitted during the field season.

190. The programme for next season comprises :—

- (1) *Eastern Circle*.—The survey of the Sinthe reserve in the Pynmana forest division.

The unsurveyed portion of the Ruby mines forest reserve will be triangulated and traversed for future topography.

- (2) *Tenasserim Circle*.—Survey operations in the Ataran division will be carried on in the Kyunchaung and Ye forests and teak-bearing tracts contiguous to the former. In the West Salween division, all the reserved forests will be topographically surveyed, (except Pachaung which will be prepared for topography during 1899-1900), and the balance of the unsurveyed forest reserves in the Toungoo and Shwegyin divisions.

- (3) *Pegu Circle*.—An area of about 157 miles will be topographically surveyed, comprising the Ohnezan, Thègôn, and Sinmadaung reserves in the Thayetmyo division, Wanetchaung in the Rangoon division, and Shwelaung Kodugwe and Salu in the Pegu division.

191. The party was inspected by the Deputy Surveyor-General, Revenue Branch, in the field, in December 1898.*

OPERATIONS OF THE FOREST SURVEY BRANCH.

192. Mr. W. H. Reynolds, Superintendent of Forest Surveys, held administrative charge throughout the year under the orders of the Inspector General of Forests and the professional control of the Surveyor-General.

During the year (*vide* orders marginally noted) No. 20 Party of the Survey of India Department has been amalgamated with the Forest Surveys of the Bengal Presidency, and has been brought under the administrative charge of the Superintendent of Forest Surveys.

Government of India, Department of Revenue and Agriculture (Forests), Resolution Circular No. 143-3 F., dated 6th March 1899.

193. The field operations of the year were carried on in seven districts of the Central Provinces, in the Chamba State and Montgomery district of the Punjab, in several districts in Oudh and in three districts in Upper and Lower Burma. No. 20 Survey Party was employed entirely in Lower Burma.

194. In addition to No. 20 Party, the field establishments comprised twelve separate detachments, each of which worked under European supervision or under reliable and trustworthy native assistants.

* Mr. Pocock reports very favourably of the work done by Messrs. George, Ewing, and Charrier, who, as heads of sections, supervised their camps efficiently. Of the subordinate establishment, Surveyors Awjad Ali and Sharifudin, and writer Muhammad Abdul Karim are favorably reported.

The total outturn of field work for the year is as follows :—

| NAME OF PARTY. | Triangulation. | Traversing (linear miles). | Levelling (linear miles). | DETAIL SURVEY IN SQUARE MILES. | | | | |
|-------------------------------|----------------|----------------------------|---------------------------|--------------------------------|-----------|--------------|-------------|------------|
| | | | | 1 inch. | 2 inches. | 4 inches. | 8 inches. | 16 inches. |
| Forest Surveys | 1,092 | 561 | 839 | 953 | ... | 1,931 | ... | 326 |
| No. 20 Survey Party | 1,200 | 201 | ... | ... | 87 | 472 | 1'44 | ... |
| TOTAL | 2,292 | 762 | 839 | 953 | 87 | 2,403 | 1'44 | 326 |
| | | | | 3,770'44 | | | | |

The detail survey on the 1-inch and 2-inch scales was done for topographical purposes.

The topographical work was tested by running 720 linear miles of *partal* or check surveys through it, and the instrumental contours which were run at fixed vertical intervals in the Central Provinces and Chamba Surveys, also afforded a further check on the detail survey, 220 miles of *partal* surveys were also run through the detail surveys done by No. 20 Party.

195. For purposes of comparison with the previous year's outturn, the following statement for 1897-98 is added :—

| NAME OF PARTY. | Triangulation (square miles). | Traversing (linear miles). | Levelling (linear miles). | DETAIL SURVEY IN SQUARE MILES. | | | | |
|-------------------------------|-------------------------------|----------------------------|---------------------------|--------------------------------|------------|--------------|------------|------------|
| | | | | 1 inch. | 2 inches. | 4 inches. | 8 inches. | 16 inches. |
| Forest Surveys | 2,617 | 395 | 672 | 200 | ... | 1,501 | ... | 236 |
| No. 20 Survey Party | ... | 724 | ... | ... | 118 | 406 | ... | ... |
| TOTAL | 2,617 | 1,119 | 672 | 200 | 118 | 1,907 | ... | 236 |
| | | | | 2,461 square miles. | | | | |

From the foregoing statements it will be seen that, except the 2-inch work, all the outturn of detail surveys, on the several scales, is in excess of what it was in the previous years and so also is the traversing and levelling against Forest Surveys, as well as triangulation against No. 20 Party. The triangulation against Forest Surveys is less than in the previous year, which is due to this branch of the work, both in the Himálayas and some of the districts in the Central Provinces, being sufficiently in advance of the detail survey.

196. The cost-rates per square mile, by Provinces, of the detail surveys, are as follows :—

| PROVINCE. | DETAIL SURVEY. | | | |
|---------------------------------|----------------|-----------|-----------|-----------|
| | 1 inch. | 2 inches. | 4 inches. | 8 inches. |
| | <i>R</i> | <i>R</i> | <i>R</i> | <i>R</i> |
| Central Provinces | ... | ... | 38'8 | ... |
| Punjab | 7'8 | ... | 41'3 | ... |
| Burma (Forest Survey) | ... | ... | 93'8 | ... |

The above cost-rates compare favourably with those of the previous year.

197. For all forest areas surveyed on the 4-inch scale the usual records of forest distribution and classification of soils were prepared.

198. During the field season Mr. W. H. Reynolds, Superintendent of Forest Surveys, visited in turn, each of the several field detachments in Burma, the

Central Provinces, and the Punjab, and satisfied himself that the field work was being efficiently conducted. Also, by special request, he inspected the field office of No. 20 Survey Party.

CENTRAL PROVINCES.

199. Six separate forest survey detachments were employed during the year on field operations in the Central Provinces. The forests operated on were those in the districts of (i) Biláspur, (ii) Chhindwára, (iii) Nágpur and Wardha with Chánda, (iv) Seoni, (v) Sambalpur, and (vi) Saugor. All the survey operations, except those in the Sambalpur and Chánda districts, were in continuation of the previous year's work.

Personnel.
 Mr. T. S. Marten, Extra Assistant Superintendent, 5th grade.
 „ J. Marten, Extra Assistant Superintendent, 6th grade.
 „ B. R. Hughes, Sub-Assistant Superintendent, 1st grade.
 „ J. H. Nichol, Sub-Assistant Superintendent, 1st grade.
 „ C. Litchfield, Sub-Assistant Superintendent, 1st grade.
 Babu Oodey Singh, Forest Surveyor.
 99 Native Surveyors.

200. The several survey detachments took the field about the middle of November and returned to recess quarters on various dates between the 10th June and 8th July.

201. The following statement exhibits the areas surveyed and the expenditure and cost-rate per square mile on each branch of the work :—

| FOREST DIVISION. | COST OF | | | | Total expenditure. |
|---------------------------------|---|----------------|-------------|------------|--------------------|
| | Detail survey 4 and 16-inch, including mapping. | Triangulation. | Traversing. | Levelling. | |
| | ₹ | ₹ | ₹ | ₹ | ₹ |
| Saugor | 17,328 | 2,770 | ... | ... | 20,098 |
| Biláspur | 10,276 | ... | 790 | ... | 11,066 |
| Seoni | 11,838 | ... | 497 | 1,246 | 13,581 |
| Chhindwára | 10,730 | 1,929 | ... | ... | 12,659 |
| Nágpur-Wardha with Chánda . | 9,360 | ... | ... | 2,832 | 12,192 |
| Sambalpur | 9,504 | .. | ... | ... | 9,504 |
| Total expenditure | 69,036 | 4,699 | 1,287 | 4,078 | 79,100 |
| Total areas, square miles . . | 1,780 | 825 | 53.5* | 827* | |
| Cost per square mile in Rs. . . | 38.8 | 5.7 | 24.1† | 4.9† | |

* Linear miles.
 † Cost per linear mile in Rupees.

202. The total area topographically surveyed in detail was 1,780 square miles; of this area 1,454 square miles were done on the 4-inch scale and comprised the interior survey of the reserved forests and 326 square miles were surveyed on the 16-inch scale. The larger scale survey comprises work along the forest boundaries and was done, as explained in previous reports, for the purpose of securing a large scale indisputable boundary record of the Government forest reserves. The outturn for the previous season was 902 square miles on the 4-inch scale and 236 on the larger scale, showing an increase, for the present year, of 552 square miles on the 4-inch scale, as well as an increase of 90 square miles on the 16-inch scale.

203. Triangulation was extended in the Chhindwára and Saugor districts; the work in the former district was done by Mr. J. H. Nichol, and in the latter district the triangulation was done by Mr. T. S. Marten. Some traversing was done in the districts of Biláspur and Seoni for the purpose of connecting the old revenue survey traversing with the triangulation of the province, with the object of reducing the traverse measurements to those of the triangulation. In the Seoni and Chánda districts where the trigonometrical stations were few and far part, and in the denser parts of the forests, it was found necessary to run lines

of spirit levels to afford a sufficient and ample basis for adding instrumental contours to the topographical work.

204. The detail survey was tested by running 501 miles of *partial* or check surveys through it and no serious errors were brought to notice, and the instrumental contours, which were run at 250 feet vertical intervals, afforded a further check on the topographical work.

205. A large amount of work has been completed in the way of mapping: 129 forest sheets, on the 4-inch scale, have been published during the year, 45 are in the press and 163 sheets are in different stages of progress.

206. The average cost-rate per square mile of the detail topographical surveys was ₹39, as compared with ₹41 in the previous year and ₹43 in 1896-97.

207. Mr. W. H. Reynolds, Superintendent of Forest Surveys, was in the Central Provinces from the 16th February to the middle of March, and inspected the field work of the several survey detachments whilst the work was in progress.

PUNJAB.

208. In the Punjab, survey operations were conducted in the Chamba State, as well as in the Montgomery Forest Division. The Chamba survey was in continuation of the previous year's operations, and the survey of the Montgomery reserves was commenced during the year under report.

Personnel.

Mr. J. Marten, Extra Assistant Superintendent, 6th grade.

Mr. B. R. Hughes, Sub-Assistant Superintendent, 1st grade.

16 Native Surveyors.

209. Triangulation was extended in the Chamba State over an area of 267 square miles situated in the north-east corner of the State touching on Zaskar and Lálul and at elevations of from 7,000 to 21,000 feet above sea-level. This branch of the work, which was an arduous undertaking, was done by Mr. B. R. Hughes, and this season's outturn completes the triangulation of the Chamba State.

210. Topographical operations were carried on entirely in the Pangí Valley and in the more elevated and sparsely populated tracts of Chamba. The leased forests which were brought under survey during the year, are situated for the most part on the Chandra Bhága river and its main tributaries, and were surveyed on the 4-inch scale; the tracts, beyond forest limits, were surveyed on the 1-inch scale for the purpose of completing the topographical map of the Chamba State. The 4-inch survey, as well as the western portion of the 1-inch work, was entrusted to Mr. J. Marten, and Mr. Hughes also assisted in the 1-inch topographical survey.

211. In the Montgomery district the survey was confined to the traversing of forest boundaries and the detail survey of a narrow tract on either side of the boundary lines.

212. The following statement gives the areas surveyed in the Punjab and the expenditure and cost-rate per square mile on each branch of the work:—

| FOREST DIVISION. | COST OF | | | | Total expenditure. |
|-------------------------------------|---|--|----------------|-------------|--------------------|
| | 1-inch detail survey, including mapping | 4-inch detail survey, including mapping. | Triangulation. | Traversing. | |
| | ₹ | ₹ | ₹ | ₹ | ₹ |
| Chamba | 7,436 | 4,128 | 3,249 | ... | 14,813 |
| Montgomery | ... | ... | ... | 1,681 | 1,681 |
| Total expenditure | 7,436 | 4,128 | 3,249 | 1,681 | 16,494 |
| Total areas, square miles | 953 | 100 | 267 | 380.2* | |
| Cost per square mile in Rs. | 7.8 | 41.3 | 12.2 | 4.4† | ... |

* Linear miles.

† Cost per linear mile in Rupees.

213. The total expenditure on account of survey operations in the Punjab was ₹16,726, of which ₹14,813 were spent on surveys in the Chamba State, and an expenditure of ₹1,681 was incurred for surveys in the Montgomery division, whilst ₹232 were expended on map drawing and the publications of maps of areas previously surveyed in the Bashahr State.

NORTH-WESTERN PROVINCES AND OUDH.

214. Nothing beyond forest boundary surveys was undertaken in the North-Western Provinces and Oudh. The final demarcation of many of the Oudh forest boundaries, by permanent marks, is still incomplete, and hence delays have occurred in issuing the new maps.

215. A small survey detachment was employed in the districts of Pilibhit, Kheri, Bahraich, and Gorakhpur in surveying the newly erected monoliths on forest boundaries, and a few surveyors will again have to proceed to Oudh during the coming field season to continue the survey of the boundaries, the demarcation of which was incomplete at the close of last field season.

216. A total length of 611 miles of boundary was measured and the details added to the existing 4-inch maps at an average cost of ₹3·4 per mile.

217. It was remarked in last year's report that the re-aligned Nepal-Kheri boundary would not be shewn on forest maps until the new boundary had been finally approved by Government. This boundary has now been approved, and it will, accordingly, appear on the new maps.

BURMA.

218. The forest surveys in Burma were in continuation of the previous year's operations. Three detachments were employed, and the forests surveyed were situated in the divisions of—

Personnel.

Babu Bhup Singh, Native Surveyor.
 „ Dalip Singh, ditto.
 „ Oodey Ram, ditto.
 and 30 other Native Surveyors.

- (i) Ruby Mines } in Upper Burma.
- (ii) Pyinmana } }
- (iii) Salween-Ataran in Lower Burma.

219. No. 20 Party was also employed on forest surveys in the Pegu and Tenasserim Circles.

220. The three forest survey detachments left Dehra on the 21st November and were again in recess quarters early in July. No. 20 Party left Bangalore about the 10th November; all the field squads were at work by the third week of December and the party returned to its recess quarters at Dehra Dún early in June.

221. On the 1st April 1899 Party No. 20 was brought under the administrative charge of the Superintendent of Forest Surveys, and is now amalgamated with the forest surveys of the Bengal Presidency, in keeping with the orders of the Government of India marginally noted.

The following statement gives the areas surveyed by the three forest survey detachments, as well as the expenditure and cost-rate per square mile on each class of survey:—

| FOREST DIVISION. | COST OF | | Total expenditure. |
|-------------------------------------|-------------|--|--------------------|
| | Traversing. | 4-inch detail survey, including mapping. | |
| | ₹ | ₹ | ₹ |
| Tenasserim | 3,372 | 13,800 | 17,172 |
| Pyinmana | ... | 7,044 | 7,044 |
| Ruby Mines | 3,592 | 14,503 | 18,095 |
| Total expenditure | 6,964 | 35,347 | 42,311 |
| Total areas, square miles | 127·6* | 377 | |
| Cost per square mile in Rs. | 54·6† | 93·8 | ... |

* Linear miles.
 † Cost per linear mile in Rupees.

From the above statements it will be seen that the cost-rates compare favourably with those of previous years.

222. The detail survey was tested, as usual, by running *partál* or check surveys through the topographical work after it had been completed. By the forest survey detachments 219 linear miles of test surveys were run and No. 20 Party measured 220 miles of *partál* lines.

223. The fair mapping has made good progress during the year; 17 sheets have been published, 36 are in the press and 34 are in different stages of progress.

224. Mr. W. H. Reynolds, Superintendent of Forest Surveys, was in Burma from 16th January to 6th February and visited, in turn, each of the survey detachments and, by special request, he also inspected the field office of No. 20 Party prior to its amalgamation with the Forest Survey Branch.

225. During the field season of 1899-1900 all the forest survey detachments in Burma will work under the Executive Officer in charge of No. 20 Party, and the combined establishments will be employed on surveying the forests in the Ruby Mines and Pinyinana divisions in Upper Burma, as well as the reserves in the Pegu and Tenasserim forest circles in Lower Burma.

226. The operations, in detail, of No. 20 Party are reported on separately.*

CADASTRAL SURVEYS, BENGAL.

No. 4 PARTY,

227. The survey programme in the Province of Bengal consisted of the following:—

Personnel.

Captain R. T. Crichton, I.S.C., Deputy Superintendent, 1st. grade (up to 26th April 1899).

Captain C. W. H. Symonds, I.S.C., Officiating Deputy Superintendent, 1st grade (from 26th April 1899).

Lieutenant A Mears, I.S.C., Assistant Superintendent, 1st grade.

Mr. H. Dowman, Extra Assistant Superintendent, 1st grade.

Mr. A. W. Smart, Extra Assistant Superintendent, 5th grade.

Mr. C. S. Kraal, Extra Assistant Superintendent, 6th grade.

Mr. E. P. Berkeley, Extra Assistant Superintendent, 6th grade.

Mr. T. W. Babonau, Sub-Assistant Superintendent, 1st grade.

Mr. C. S. Gasper, Sub-Assistant Superintendent, 1st grade.

Babu Nilmoni Chatterji, Sub-Assistant Superintendent, 2nd grade.

Mr. H. H. b. Hanby, Sub-Assistant Superintendent, 2nd grade.

Mr. P. L. Causley, Sub-Assistant Superintendent, 2nd grade.

Mr. E. G. Hardinge, Sub-Assistant Superintendent, 3rd grade.

73 Supervisors and Inspectors.

65 Surveyors and Sub-Surveyors.

30 Computers.

31 Estimators, Draftsmen and Writers.

246 Amins (local).

452 " (imported).

(a) In Sárán—

| | Square miles. |
|----------------------|---------------|
| Traverse survey | 143 |
| Cadastral survey | 535 |
| Topographical survey | 87 |

(b) In Darbhanga—

| | |
|------------------|-----|
| Traverse survey | 521 |
| Cadastral survey | 680 |

(c) In Backergunge—

| | |
|-----------------|-----|
| Traverse survey | 150 |
|-----------------|-----|

(d) In Champáran—

| | |
|----------------------|-----|
| Traverse survey | 125 |
| Topographical survey | 90 |

(e) In Burdwan—

| | |
|----------------------|----|
| Traverse survey | 88 |
| Topographical survey | 88 |

(f) In Darbhanga City—

| | |
|----------------------|---|
| Traverse survey | 7 |
| Topographical survey | 7 |

(g) In Chapra City—

| | |
|----------------------|---|
| Traverse survey | 7 |
| Topographical survey | 7 |

(h) In the Sháhábad Division—

| | |
|----------------------|----|
| Traverse survey | 15 |
| Topographical survey | 15 |

(i) In Sonthal Parganas—

| | |
|-----------------|-----|
| Traverse Survey | 631 |
|-----------------|-----|

In addition to the above the relaying of certain boundary marks on the Nepál and the Kachnar *mahal* boundaries was sanctioned.

228. The general principles which have been in vogue during preceding years have been fully maintained during the season under report.

All villages lying in the *diára* were treated as follows:—

(a) *Villages permanently settled.*—The external boundaries were mapped on the 16-inch scale, topographical features (*i.e.*, roads, etc.) being shown.

* Mr. Reynolds speaks in the highest terms of the officers of the Provincial Service; they have, one and all, co-operated willingly and cheerfully in the season's work, and the results of their labours are most creditable to themselves and have met with the Superintendent's entire satisfaction.

BENGAL SURVEY.

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1898-99.

No. 4 PART



- (b) *Villages temporarily settled but not belonging to Government* were dealt with in the same way as permanently settled villages, but references were made to the Collector, and in special cases, such as the impending close of an existing settlement, a detailed survey was made, if required.
- (c) *Villages belonging to Government* were surveyed cadastrally, *khasras* written and *khánápuri* done. The *khánápuri* Settlement Officer, in addition to deciding boundary disputes, passed, orders on all disputes entered in the list. The records were then made over to the Collector for any further action he deemed advisable.
- (d) *Villages partly belonging to Government and partly permanently or temporarily settled (but not the property of Government) or both* were treated in the same manner as villages entirely belonging to Government. Government villages, not on the river side of the *diára* line, were surveyed and settled under the Bengal Tenancy Act in accordance with Government orders. Lists were sent to the Collector, of villages proposed for treatment (1) as permanent, (2) as *diára*.

229. During the season, there were no serious complaints regarding the temporary demarcation of village boundaries, with the exception of villages lying in the *Sáran diára*. Here it was very defective. This is due to the fact that the *raiyats* were unable to point out their boundaries in waste land tracts. With a view to secure the better attendance of *raiyats*, a new form was introduced, which was supplied to each *amin*, who entered in the proper columns the numbers of the fields, and the names of those whose attendance was required for either survey or *khánápuri*. Each of the interested parties signed against those fields in which they had vested interests. The introduction of this procedure reduced the reports for non-attendance to $\frac{1}{3}$ th in the *Sáran* district. It was equally effective in Darbhanga.

All village sites were surveyed on a scale of 64 inches=1 mile which necessitated the use of 1,241 additional sheets.

No free labour was provided. The three coolies attached to each *amin* were paid at a uniform rate of $1\frac{1}{2}$ annas per diem, with the exception of those employed in the survey of the Darbhanga City where it was found necessary to pay them at a rate of annas 2 per diem.

230. The following civilians went through a course of survey and settlement work, in accordance with the rules drawn up by Captain Crichton and Mr. Stevenson-Moore. Messrs. Johnston, Woodman, Hignell, Strong, and Cornes in the *Sáran* district, and Messrs. Crump, Thomas, Salkeld, Cammiade, Mellor, and Gourlay in the Darbhanga district.

SÁRAN DISTRICT.

231. *Traverse Survey*.—The traverse section, which was under the supervision of Mr. H. Dowman, took the field on the 1st of November 1898 and returned to recess quarters at Mussooree on the 20th of April 1899.

The whole area traversed lies within the following *thánas*. *Mánjhi*, *Mashrak*, *Chapra*, *Sonpur*, and *Parsa*, and is contained in 6 river circuits, which were again sub-divided into 21 sub-circuits. The urban area of the *Chapra Municipality* was contained in one sub-circuit, sub-divided into 40 blocks.

The preliminary demarcation, which was carried out by the villagers themselves, was found to be satisfactory. No opposition was experienced, and willing assistance was invariably afforded.

232. *Cadastral survey and writing of Records*.—This section was under the supervision of Mr. A. W. Smart, assisted by Messrs. E. F. Berkeley (up to 12th November 1898), C. S. Gasper (from 1st July 1899), H. H. B. Hanby, P. L. Causley, and H. H. Taylor (up to 21st March 1899). The native establishment consisted of the following: 3 head-inspectors, 30 inspectors, 205 foreign, and 103 local, *amins*; 308 *moharrirs* and 490 *mirddhas* together with the usual office establishment. During recess the above strength was reduced to 278 *amins* and 255 *moharrirs*. Field operations commenced on the 5th of November and closed on the 20th of April, on which date the establishment returned to recess

quarters at Dígha. Owing to their being under water, three villages were not completed until the 16th of June 1899.

The programme in this district consisted of the completion of *thánas* Chapra, Parsa, and Sonpur. As usual the tenures were of a very intricate nature and the size of the fields extremely small.

The area is mapped on 1,825 sheets, which include 551 sheets of village sites which were mapped on a scale of 64 inches=1 mile. The average size of the field was the same as that of the previous season, namely $\frac{3}{4}$ of an acre.

In order to check the accuracy of the detail survey, 1,871 linear miles of *partáls* were run by European officers, and independently. The amount of *partáls*, run by inspectors was 1,645 linear miles, giving a total of 3,516 linear miles, which gives an incidence of 6.41 linear miles per square mile of survey. In the survey of village sites on the 64 inches=1 mile scale, portions of 330 were re-surveyed as an independent check and as a further check 1,522 chains of *partál* were run through the main streets and alleys. The results of these checks proved the work to be excellent.

Of the total number of fields, namely, 1,157,451; 9,689 entries were checked by European officers and 301,352 by inspectors, which brings the average number checked to 26.9 per cent. This check is exclusive of that done by Assistant Settlement Officers and *kanungos*.

The cost-rate for detail survey amounted to ₹72 per square mile, and for record writing, etc., to ₹59 per square mile.

The health of the establishment was excellent during the field season, but after returning to recess quarters at Dígha there were a few cases of cholera and dysentery.

233. *Topographical Survey*.—In accordance with the procedure laid down in 1896-97, a topographical survey on the 16-inch scale was made of all villages lying in the Ganges, Gogra, and Gandak rivers, which did not come under the provisions of the Bengal Tenancy Act.

The survey has been mapped on 105 sheets. All village sites have been surveyed in blocks and all topographical features of any importance have been accurately mapped with a view to their being utilized in the compilation of the standard sheets.

The check survey comprises 260 linear miles of *partál* which gives an average of 4.57 linear miles of *partál* to each square mile of survey. The cost-rate is ₹13 per square mile.

The areas of work completed will be found in the subjoined tabular statement.

| DISTRICT. | TRAVERSE SURVEY. | | CADASTRAL SURVEY, 16 INCHES=1 MILE AND RECORD WRITING. | | | TOPOGRAPHICAL SURVEY 16 INCHES=1 MILE. |
|-------------|---------------------|----------------------|--|-------------------|-----------------------|--|
| | Number of Stations. | Area in square miles | Number of Villages. | Number of Fields. | Area in square miles. | Area in square miles. |
| Sáran . . . | 7,745 | 267 | 1,066 | 1,157,451 | 548 | 57 |

234. *Badar Establishment*.—The *badar* section of the Bengal Drawing Office was transferred to North Bihar, each cadastral camp being allowed to entertain a small *badar* establishment which, during the season, undertook the completion of the *badars* of 1897-98.

The work completed was as follows: 877 villages, 1,180,871 fields with an area of 555.27 square miles. In the above area only *badars* effecting 582 villages were submitted by the Settlement Department. In these villages only 3,309 fields required corrections.

DARBHANGA DISTRICT.

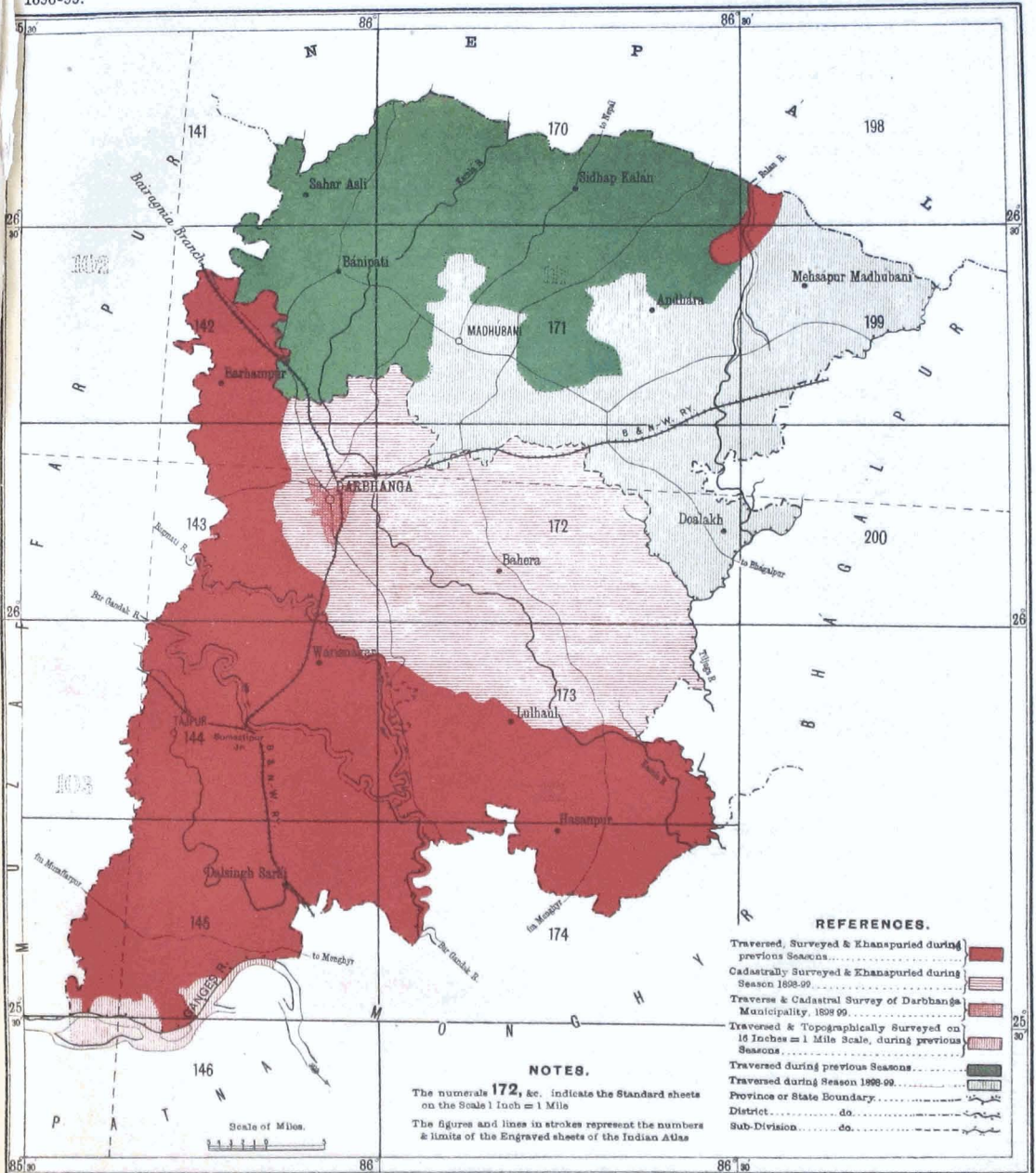
235. *Traverse Survey*.—As the traverse survey in the Sáran district neared completion, and as the services of the sub-surveyors became available, they were moved across to Darbhanga. By the 1st of February the whole traverse section was employed in this district. The area completed contains 596

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT DARBHANGA.

1898-99.

No. 4 PARTY.



REFERENCES.

- Traversed, Surveyed & Echanpuried during previous Seasons.....
- Cadastrally Surveyed & Echanpuried during Season 1898-99.....
- Traversed & Cadastral Survey of Darbhanga Municipality, 1898-99.....
- Traversed & Topographically Surveyed on 15 Inches = 1 Mile Scale, during previous Seasons.....
- Traversed during previous Seasons.....
- Traversed during Season 1898-99.....
- Province or State Boundary.....
- District..... do.....
- Sub-Division..... do.....

NOTES.

The numerals 172, &c. indicate the Standard sheets on the Scale 1 Inch = 1 Mile
 The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas



villages and 618.72 square miles. In addition to the above, 31 blocks comprising an area of 6.96 square miles, was traversed in the Darbhanga Municipality. The area traversed was divided up into 3 main circuits, which were again sub-divided into 35 sub-circuits.

During the season under report, 13,573 new stations were embedded, of these 1,054 were marked by stone prisms, 9,749 by clay cylinders, and 183 by wooden pegs. In the survey of the Darbhanga Municipality, 11 were marked by stone prisms, 175 by iron pins, and 2,401 by clay cylinders. The temporary demarcation was found to be excellent. The health of the establishment was exceptionally good throughout the season.

236. *Cadastral survey and writing of Records.*—This section was under the supervision of Mr. C. S. Krial, Extra Assistant Superintendent, assisted by Messrs. T. W. Babonau, E. G. Hardinge, Sub-Assistant Superintendents, and A. E. Le Franc and W. H. Babonau, Supervisors. The native establishment consisted of 4 head inspectors, 34 inspectors, 340 *amins*, and 340 *mirdhas*. In addition to the above there were 102 computers, draftsmen, tindals, etc.

The section commenced field work on the 3rd of November and after completing the entire programme (with the exception of 3 villages which were under water) and the Darbhanga Municipality, returned to recess quarters at Digha on the 21st of April.

The programme consisted of the survey with records of all villages lying within *thāna* Bahera, and a portion of *thāna* Darbhanga. The area which comprised 916 villages, 1,131,264 fields, and 683.82 square miles was mapped on 1,337 sheets and on 655 additional sheets on the 64 inches=1 mile scale. The Darbhanga Municipality has been mapped on 94 sheets on the 64-inch scale.

The total number of linear miles of check run in the detail survey amounts to 1,136.91 by Europeans and 1,577.72 by inspectors. The average size of each field is .38 of an acre. During the season 1.60 linear miles of independent *partāl* were run to each square mile of survey. In village sites in order to test the accuracy of the survey, 965 blocks were re-surveyed and 1,532 *partāl* lines run. The total number of entries in the *khassa* which were checked by European officers, amounted to 7,576 and by inspectors to 283,581, which gives an incidence of 26 per cent. on the total number of fields *khānāpuried*. The demarcation of village boundaries was fairly good. During the season the health of the establishment was excellent. There were four deaths from cholera and two from dysentery. Mr. W. H. Babonau, Supervisor, also died during recess from consumption.

The total expenditure incurred amounts to R1,01,535, of this sum R44,092 are debitable to detail survey, etc., and R57,443 to *khānāpurī*, completion of records, etc. The resulting cost-rates being as follows:—

Detail survey R64 per square mile; *khānāpurī*, etc., R84 per square mile.

The areas completed are given in the subjoined tabular statement:—

| DISTRICT. | TRAVERSE SURVEY. | | CADASTRAL SURVEY, 16 INCHES=1 MILE AND RECORD-WRITING. | | | TOPOGRAPHICAL SURVEY ON 16 INCHES=1 MILE SCALE. |
|------------|---------------------|-----------------------|--|-------------------|-----------------------|---|
| | Number of Stations. | Area in square miles. | Number of Villages. | Number of Fields. | Area in square miles. | Area in square miles. |
| Darbhanga. | 13,584 | 619 | 916 | 1,131,264 | 684 | Nil. |

237. *Badar Establishment.*—A staff of 3 estimators and 3 draftsmen were employed on the attestation *badars* of 1897-98. The work which has been dealt with during the season is as follows:—

Villages 965, fields 110,808, and area 732.54 square miles. In this area *badars* effecting 4,411 fields contained in 590 villages were submitted by the Settlement Department.

SONTHAL PARGANAS DISTRICT.

238. *Traverse Survey*.—This section, which was under the supervision of Mr. E. F. Berkeley, assisted by Mr. W. Newland, commenced field operations early in December. The work carried out consisted of the traverse survey of 1,936 villages, comprising 726 square miles. The greater portion of the work consisted of a compact block of 525 square miles lying to the N.-W. of Naya Dumka. Field work was completed on the 1st June 1899, on which date the detachment moved into recess quarters at Naya Dumka. The demarcation was fairly good and was carried out by the headmen of villages. Considerable opposition was experienced from the inhabitants of Tappa Manihári, who amused themselves by uprooting theodolite stations. During the season the following marks were embedded :—stones 2,335, cylinders 3,881, and pegs 14,764. A considerable number of stones still remain to be embedded. This is due to—

- (1) The number of stones required being under-estimated.
- (2) On the arrival of the additional stones great difficulty was experienced in obtaining carts at Deoghur.

The health of the Establishment throughout the season was excellent. The total cost of the season's operations amounted to ₹32,693, which gives an incidence of ₹45 per square mile.

CHAMPARAN DISTRICT.

239. *Traverse and Topographical Survey*.—This detachment was in charge of Mr. C. S. Gasper, Sub-Assistant Superintendent.

The original programme was approximately 172 square miles, this was reduced to 125 square miles and again, owing to the entire establishment being laid up with fever, to 95 square miles. Field operations commenced on the 20th January 1899, and on the 20th of May the detachment returned to recess quarters at Dígha. The topographical survey on a scale of 2 inches=1 mile has been mapped on 17 field sections. Mr. C. S. Gasper was greatly hampered owing to his having to employ ordinary *amins* who know nothing about hill surveying. This necessitated a good deal of time in training them. The total cost of the season's operations amounted to ₹9,545, which gives an incidence of ₹100 per square mile.

KACHNAR AND BANSKATTI MAHALS.

240. The survey of this dispute boundary was commenced in season 1893-94 under the supervision of Major (then Captain) G. B. Hodgson, but owing to none of the marks said to have been embedded by Sub-Surveyor Irfan Ali, being traceable, in 1897-98 Captain Crichton deputed Sub-Surveyor Sarju Pershad for the work, but apparently, the sub-surveyor misunderstood the orders sent to him. Mr. C. S. Gasper who was deputed to test the work during the season under report, reports, that all the stations laid down by Irfan Ali and Sarju Pershad have been marked with stones about 2' to 3' high; also with rocks and small stones piled round them. As Mr. Gasper's services were urgently required for the relaying of stations on the Nepál Frontier, he was recalled and the permanent marking of these stations postponed until 1899-1900.

NEPÁL FRONTIER BOUNDARY.

241. This work which was undertaken under the supervision of Mr. C. S. Gasper consisted of—

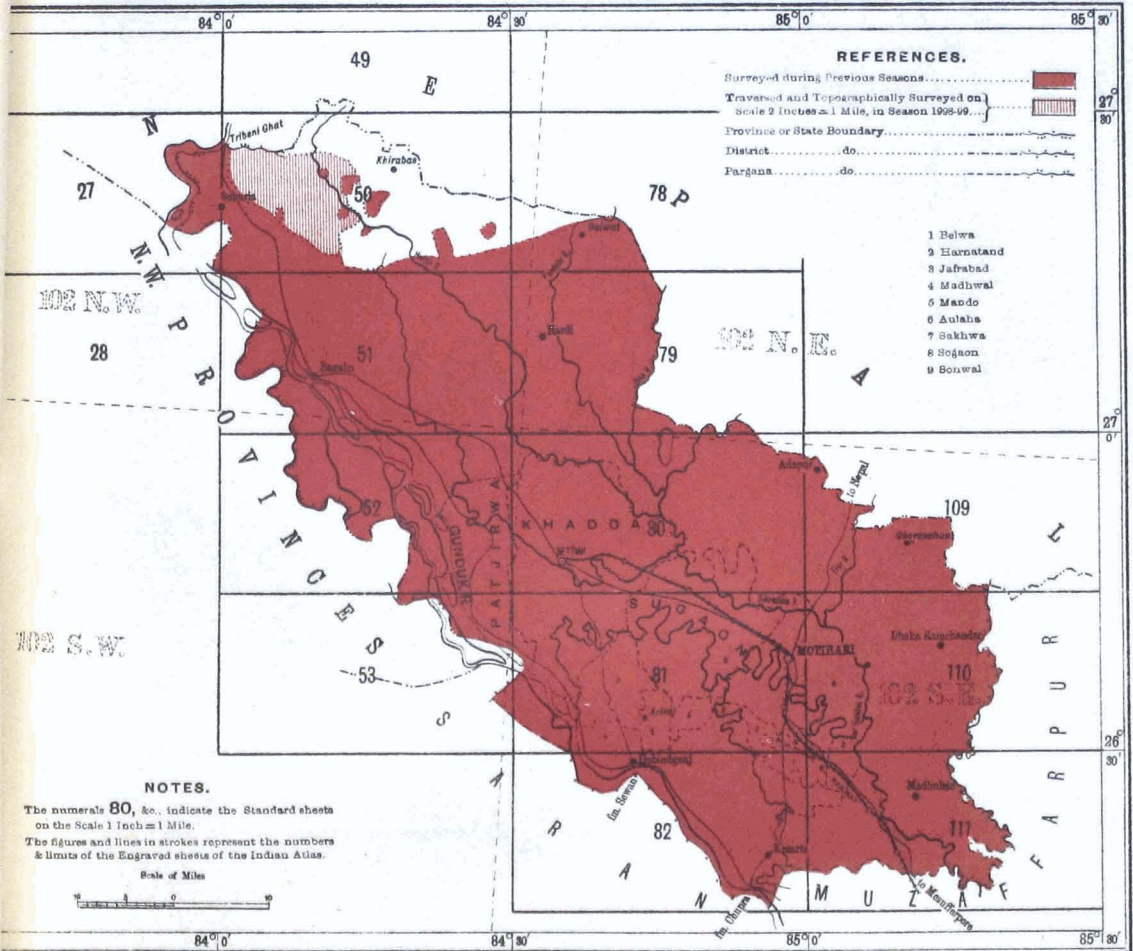
1. Examination and relaying any of the stations of the traverse survey done by Mr. E. F. Berkeley during the season 1897-98.
2. Refixing wooden posts Nos. 76 and 82 which had been washed away.
3. Removal of wooden posts from 67 to 71.
4. Survey of the Nuna river and refixing of wooden posts Nos. 23, 24, and 30.

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT CHAMPARAN.

99.

No. 4 PARTY.

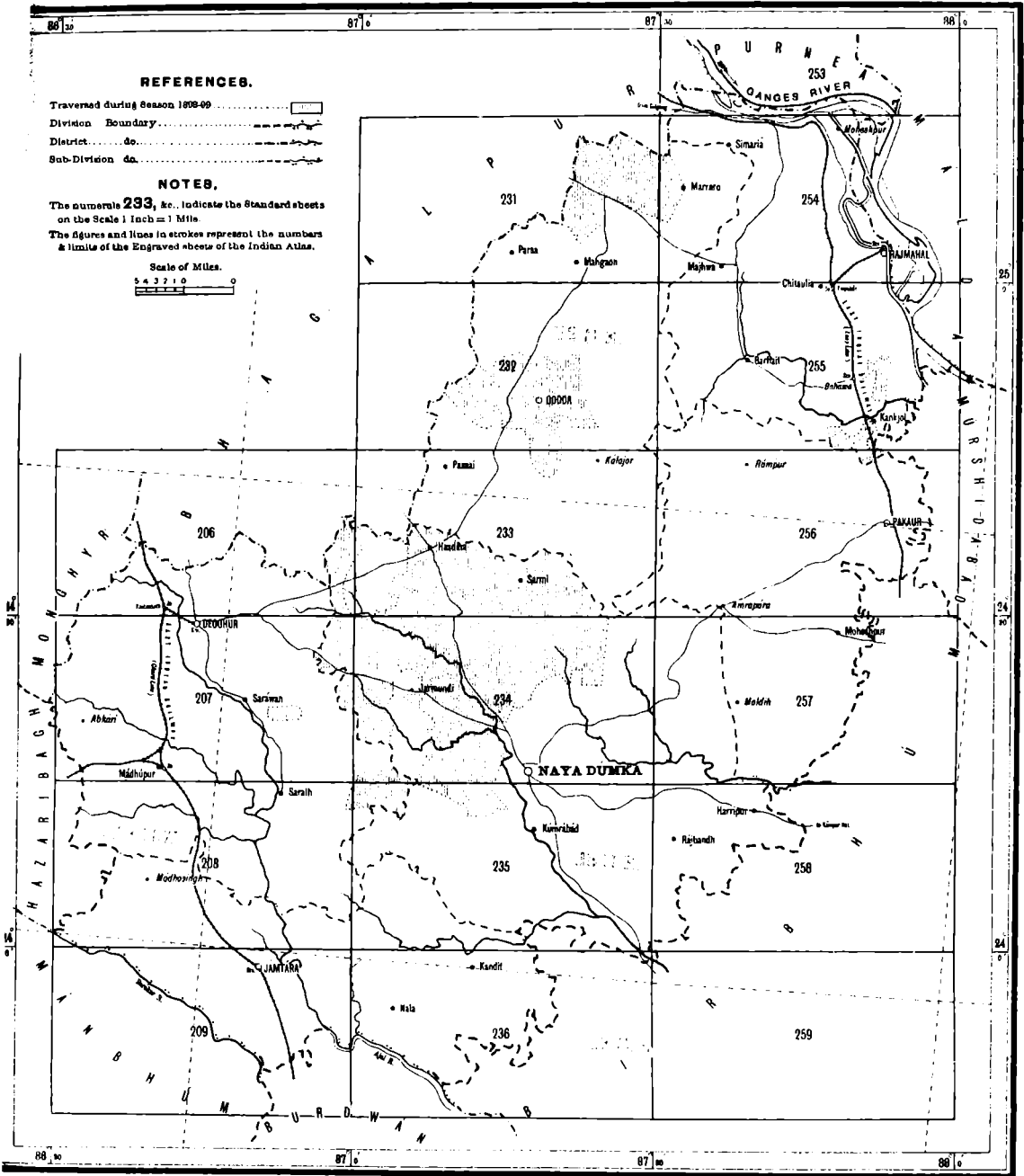


BENGAL SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT SONTHAL PARGANAS.

698-99.

DETACHMENT.

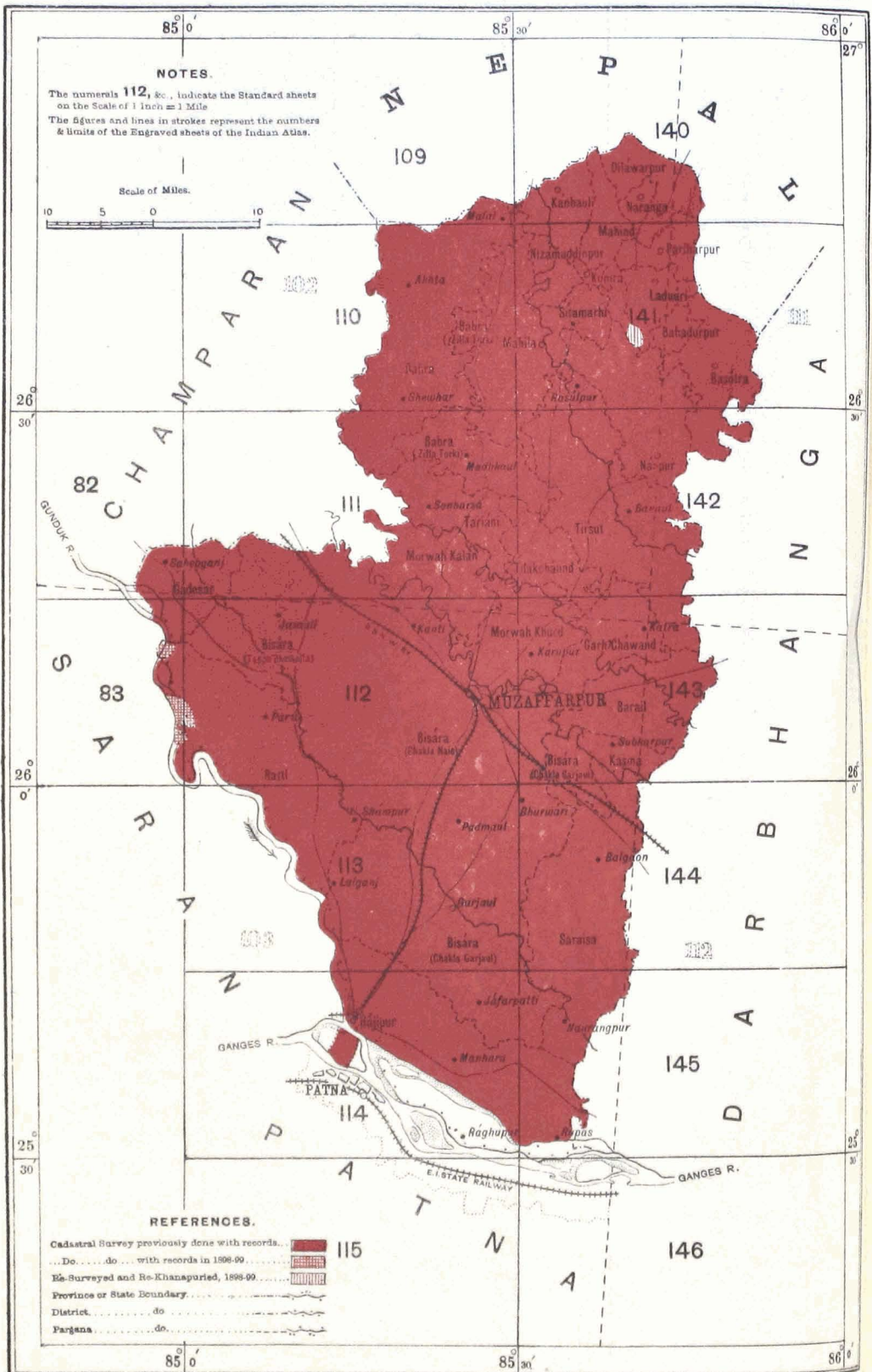


BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DIST. MUZAFFARPUR.

1898-99.

No. 4 PARTY.



Arrangements having been made between the Nepálese representative and the Sub-divisional Officer of Supaul, Mr. C. S. Gasper was deputed by the Superintendent, Settlement Surveys, Bengal, to proceed to Bírpur. The work was commenced on the 13th of December. Out of the 14 stations embedded by Mr. E. F. Berkeley between pillars 11 and 14, 9 were found to be intact, while 5 had been washed away by the river. The relaying of these 5 was completed by the 17th December. The rest of the work on the Nepál Frontier was completed on the 4th of January and Mr. Gasper returned to head-quarters.

MISCELLANEOUS SURVEYS.

242. In addition to the foregoing surveys, the following tabular statement shows the various minor operations carried out by No. 4 Party in Bengal, during the year under report.

| DISTRICT AND ESTATE. | Traverse Survey. | Cadastral Survey. | Record writing. | Topographical survey on 16-inch scale. | Topographical survey on 2-inch scale. | City survey on the 64-inch scale. |
|--|------------------|-------------------|-----------------|--|---------------------------------------|-----------------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | Sq. m. | Sq. m. | Sq. m. | Sq. m. | Sq. m. | Sq. m. |
| Muzaffarpur Diára | ... | 2'65 | 2'65 | ... | ... | ... |
| Revision of Bazidpur Village | ... | 2'63 | 2'63 | ... | ... | ... |
| Darbhanga City | 6'96 | ... | ... | ... | ... | 4'0 |
| Chapra City | 1'84 | ... | ... | ... | ... | 1'9 |
| Revelganj City | ... | ... | ... | 2'00 | ... | ... |
| Sháhahad Dumráon Ráj | ... | 25'86 | 25'86 | ... | ... | ... |
| Sháhahad Diára | ... | ... | ... | 25'08 | ... | ... |
| Ballia Sáran | ... | ... | ... | 13'08 | ... | ... |
| Patna Diára | ... | 29'33 | 29'33 | 10'61 | ... | ... |
| Sháhahad Dumráon Ráj Diára | 14'21 | ... | ... | 14'21 | ... | ... |
| Revision of Babu Ganeshar | ... | ... | 22'2 | ... | ... | ... |
| Pershad's area | ... | ... | ... | ... | ... | ... |
| TOTAL | 23'01 | 60'47 | 82'67 | 64'98 | ... | 5'9 |

243. According to the orders of the Bengal Government the programme for 1899-1900 is shown in the following table :—

| DISTRICT. | Traverse. | Cadastral Survey with records. | TOPOGRAPHICAL SURVEY. | | |
|----------------------------------|--------------|--------------------------------|-----------------------|---------------|---------------|
| | | | 16-inch scale. | 4-inch scale. | 2-inch scale. |
| | Sq. m. | Sq. m. | Sq. m. | Sq. m. | Sq. m. |
| Darbhanga | ... | 941 | ... | ... | ... |
| Monghyr | 655 | ... | ... | ... | ... |
| Backergunge | 600 | ... | ... | ... | ... |
| Dáman-i-koh | 700 | ... | ... | ... | ... |
| Champáran | 80 | ... | ... | ... | 80 |
| Nepál Boundary | Relaying | Stations. | ... | ... | ... |
| Kachnar Mahal | | | ... | ... | ... |
| Noákháli | 50 | ... | ... | 50 | ... |
| Jauhi Village (Ballia) | 7 | 7 | ... | ... | ... |
| TOTAL | 2,092 | 948 | ... | 50 | 80 |

N.B.—Captain Symonds reports well of all officers attached to No. 4 Party, especially of the services rendered by Messrs. A. W. Smart, C. S. Kraal, H. Dowman, E. F. Berkeley, and C. S. Gasper.

TOUNGOO AND MYINGYAN DISTRICTS, LOWER AND UPPER
BURMA.

NO. 7 PARTY.

244. Mr. T. E. M. Claudius was in charge of the party till relieved on 15th November 1898 by Mr.

Personnel.

Mr. T. E. M. Claudius, Extra Assistant Superintendent, 1st grade, in charge, till 14th November 1898.

Mr. E. J. Jackson, Superintendent, 1st grade, in charge, from 15th November 1898 to 10th April 1899.

Mr. E. G. Little, Extra Assistant Superintendent, 1st grade, in charge, from 11th April 1899.

Mr. J. Connor, Extra Assistant Superintendent, 3rd grade.

" G. W. Jarbo, Extra Assistant Superintendent, 4th grade.

" G. C. Swiney, Extra Assistant Superintendent, 4th grade, from 21st April up to 9th October 1899.

Mr. J. S. Swiney, Extra Assistant Superintendent, 4th grade.

" C. W. Wilson, Extra Assistant Superintendent, 6th grade, from 1st January 1899.

Mr. W. J. Baker, Sub-Assistant Superintendent, 1st grade, till 20th November 1899.

Mr. W. Newland, Sub-Assistant Superintendent, 2nd grade, till 1st January 1899.

E. J. Jackson, who continued in charge till 10th April 1899, when he proceeded on 6 months and 21 days furlough, making over charge to Mr. E. G. Little, who held it for the remainder of the year.

245. The cadastral survey of Upper Burma having of late years advanced too far ahead of settlement operations, it

was decided to reduce the establishment and the outturn to about 800 square miles annually. In accordance with this decision two cadastral camps were formed in Lower Burma for the survey of the area remaining in the Toungoo district, and were placed in charge of Messrs. Jarbo and J. S. Swiney; Mr. Jarbo was helped by Mr. Wilson from the date he joined the party. Both the above camps as well as the head-quarters one were located at Toungoo during the field season. Mr. Little, assisted by Mr. Baker, had charge of the only cadastral camp in Upper Burma for the survey of the small area remaining in the Myingyan district, on the completion of which the camp returned to recess quarters at Mandalay, whilst Mr. Little proceeded to Toungoo to relieve Mr. Jackson of the charge of the party when that officer proceeded on furlough.

246. The two cadastral camps in Lower Burma took the field on 1st December 1898, and returned to recess quarters towards the latter end of May 1899. The cadastral camp in Upper Burma also started for the field on 1st December 1898, and closed operations on the 8th April 1899.

247. The programme, as revised, was to survey cadastrally the areas remaining in the Toungoo and Myingyan districts so as to complete them, and this has been done. No traverse work was undertaken during the season under report, there being a sufficiency prepared in advance of detail survey for next field season.

248. The following statement gives the season's outturn and cost-rates:—

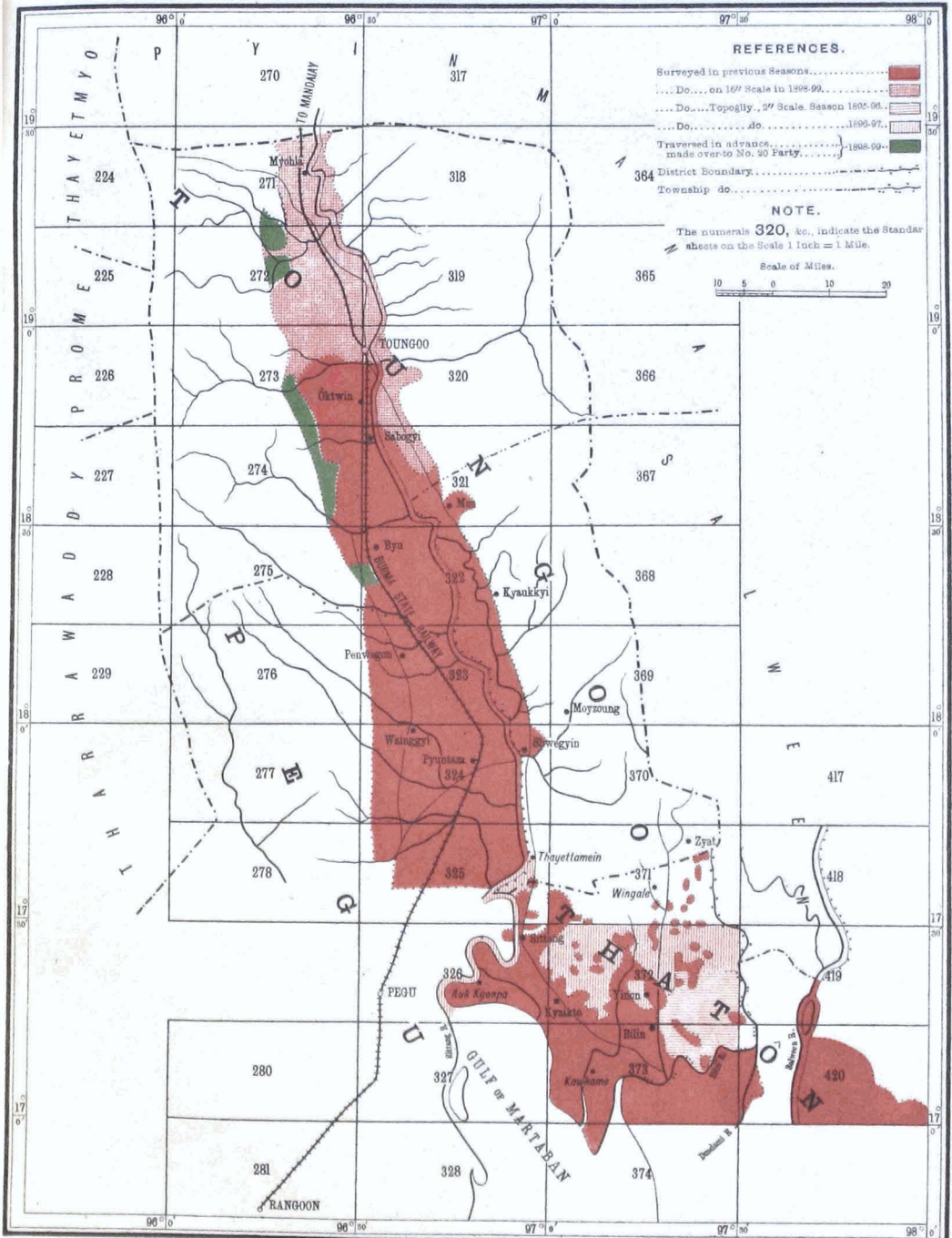
| DISTRICT. | CADASTRAL SURVEY, 16 INCHES = 1 MILE. | Total cost. | Cost-rates per square mile. |
|----------------------------------|---------------------------------------|----------------|-----------------------------|
| | Area in square miles. | | |
| | | <i>R a. p.</i> | <i>R a. p.</i> |
| Toungoo, Lower Burma | 665 | 90,406 2 10 | 135 15 2 |
| Ditto, Revision Survey | 46 | 9,945 14 7 | 216 3 5 |
| Myingyan, Upper Burma | 109 | 22,628 6 5 | 207 9 7 |
| Arrears Establishment | ... | 58,114 10 7 | ... |
| TOTAL | 820 | 1,81,095 2 5 | |

BURMA SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICTS THATON, PEGU, & TOUNGOO.

1898-99.

No. 7 PARTY.



The high rates of the revision work in Toungoo and of the survey in Myingyan are accounted for by the scattered nature of the work and the smallness of the areas operated on.

249. The detail survey in the Toungoo district comprised 1,169 sheets, and was checked by 1,712 linear miles of *partál*; 928 miles of which were undertaken by inspectors, and the balance 784 miles, by European assistants and independent *partállers*. The average size of the field is 0·38 of an acre calculated on the cultivated area only, and the proportion of jungle to cultivation east of the Sittang river is as seven to one, and on the west four to one. In Myingyan the work was mapped on 163 sheets and checked by 441 linear miles of chain measurements including those done by inspectors, independent *partállers* and European agency. The average size of the field is 1·38 acres.

250. Owing to the survey having advanced so far ahead of settlement operations in Upper Burma, a vast quantity of cadastral maps have accumulated, which cannot be published till the settlement has been completed. Again, in some districts, the original surveys were carried out by circles, which were subsequently divided up into *kwins*, entailing renumbering of the fields and re-drawing of the whole of the work together with the preparation of new Field area statements. In many districts all holdings had been surveyed and numbered; subsequently it was ruled that holdings, being of a temporary nature, should not have been surveyed, thus necessitating the re-drawing, retracing, and recasting the area statements of all such work. Numerous tracings and copies of Field area statements (sometimes in duplicate) have also to be supplied to Settlement Officers from time to time, and continuous corrections and alterations have to be made on the original maps, due to revision surveys by local agency as the settlement work progresses.

In addition to the preparation and completion of the 16-inch cadastral maps and Field area statements, the party was expected to compile 2-inch reductions of all cadastral surveys, for incorporation in the standard sheets of the Province.

It was found impossible to cope with all this amount of mapping and miscellaneous work, which has accumulated since 1892-93, without forming a separate establishment of draftsmen and others to deal with it. An establishment was therefore created for the purpose during the year under report, and supervised by Mr. J. Connor, and the following statements show the extent of this arrear mapping, and the progress that has been made in clearing it off:—

CADASTRAL SURVEY MAPPING—SCALE 16 INCHES=1 MILE.

| DISTRICT. | Sheets submitted for publication previous to 30th September 1898. | Sheets submitted for publication during 1898-99. | Sheets remaining in hand, awaiting settlement operations. |
|--------------------------|---|--|---|
| Meiktila | 1,825 | 21 | <i>Nil.</i> |
| Shwebo and Yeu | ... | 2,796 | 757 |
| Upper Chindwin | ... | ... | 790 |
| Katha | 146 | 1,459 | <i>Nil.</i> |
| Yamèthin | ... | ... | 2,407 |
| Myingyan | ... | ... | 3,964 |
| Minbu | ... | ... | 384 |
| Lower Chindwin | ... | ... | 501 |
| Magwe | ... | ... | 2,554 |
| TOTAL | 1,971 | 4,276 | 11,357 |

STANDARD SHEET MAPPING—2-INCH REDUCTIONS.

| DISTRICT. | Sheets submitted for publication previous to 30th September 1898. | Sheets submitted for publication during 1898-99. | Sheets remaining in hand. |
|--------------------------|---|--|---------------------------|
| Meiktila | ... | 24 | <i>Nil.</i> |
| Shwebo and Yeu | ... | ... | 70 |
| Upper Chindwin | ... | ... | 59 |
| Katha | ... | ... | 51 |
| Yamèthin | ... | 36 | <i>Nil.</i> |
| Myingyan | ... | ... | 38 |
| Minbu | ... | ... | 20 |
| Lower Chindwin | ... | ... | 11 |
| Magwe | ... | ... | 47 |
| TOTAL | ... | 60 | *296 |

In addition to the above, 1,979 tracings of 16-inch maps and 96 tracings of 2-inch reductions have been prepared and submitted to Settlement Officers.

251. The country to the east of the Sittang river in the Toungoo district is low and covered with *jheels* and swamps, having narrow strips of cultivation running along their edges, whilst about 49 square miles of country situated to the west of Dinnya-wadi and Yegyí Circles on the opposite side of the river is full of ravines, and hills ranging from 100 to 500 feet high, and sparsely cultivated. Most of the country under survey in the Toungoo district during the season under report, is only now being opened out, judging from the numerous indications of intended extensions. Many of the village sites along the Sittang river were large and intricate, and the irregular strips of fallow ground between fields, being covered with high grass, rendered the work very laborious.

The area surveyed in Myingyan this season contains scattered patches of wet cultivation, but the greater part of the district is rough and broken up into low undulating hills covered with thorny jungle interspersed with ill-defined upland cultivation.

252. No complaints were received regarding demarcation, which seems to have been well done, especially in Lower Burma.

253. The establishments both in Lower and Upper Burma kept in fairly good health, and only three deaths occurred.

254. The party was inspected on the 9th, 10th, and 11th December in the field by the Deputy Surveyor-General.

255. All the tracings and area statements of the season's work have been completed and submitted to the Settlement Department before the commencement of the field season.

256. The programme for the coming season comprises :—

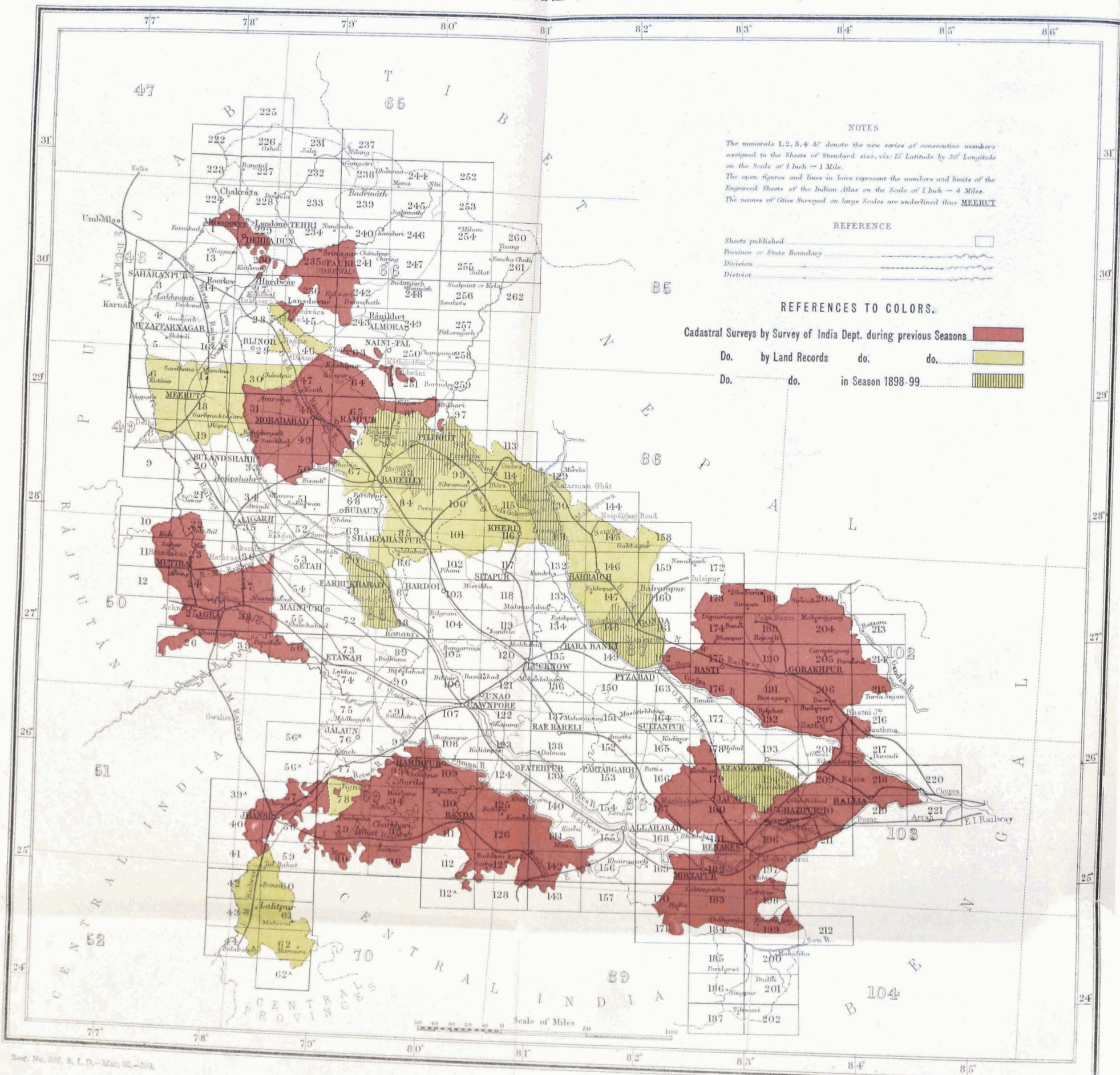
| TRAVERSING. | | CADASTRAL SURVEY. | | REMARKS. |
|-----------------------|----------------|-----------------------|------------------------------------|-------------------------------------|
| Area in square miles. | District. | Area in square miles. | District. | |
| 790 | Lower Chindwin | 762 | Lower Chindwin . | ... |
| ... | ... | ... | Katha | Re-survey five vil- lages. |
| ... | ... | 152 | Bawni (Toungoo) . | ... |
| ... | ... | ? | Toungoo town and civil station. | Large scale, 64 inches = 1 mile. |

* These are not all complete sheets.

NOTE.—The officer in charge reports that all the assistants have worked well, whilst Messrs. Connor, Jarbo, and J. S. Swiney are deserving of special mention. Of the native establishment Bhagobatti Charan Chakarabatti, Head writer, has, as usual, done excellent work, and most of the others have given satisfaction.

N. W. P. & OUDH SURVEY.

INDEX TO THE CADASTRAL SURVEY IN N. W. P. & OUDH,



NOTES

The numerals 1, 2, 3, 4 & 5 denote the new series of consecutive numbers assigned to the Sheets of Standard size, viz: 15' Latitude by 30' Longitude on the Scale of 1 Inch = 1 Mile.
 The open figures and lines in bars represent the numbers and limits of the Engraved Sheets of the Indian Atlas on the Scale of 1 Inch = 4 Miles.
 The names of Cities Surveyed on large Scales are underlined thus MEERUT

REFERENCE

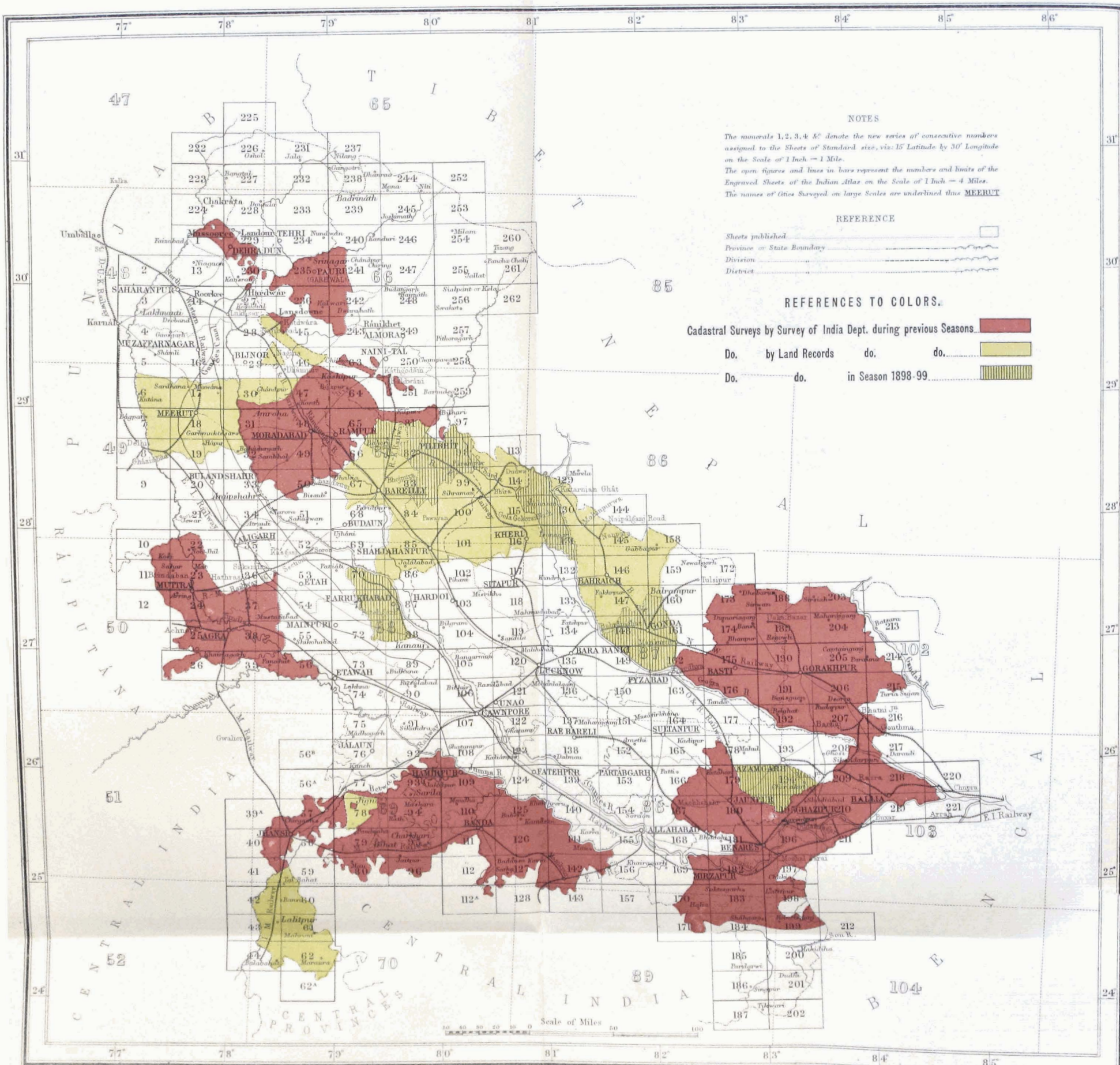
Sheets published:
 Province or State Boundary:
 Division:
 District:

REFERENCES TO COLORS.

Cadastral Surveys by Survey of India Dept. during previous Seasons:
 Do. by Land Records do. do.:
 Do. do. in Season 1898-99:

N. W. P. & OUDH SURVEY.

INDEX TO THE CADASTRAL SURVEY IN N. W. P. & OUDH,



NOTES

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 District 

REFERENCES TO COLORS.

Cadastral Surveys by Survey of India Dept. during previous Seasons 
 Do. by Land Records do. do. 
 Do. do. in Season 1898-99 

NORTH-WESTERN PROVINCES AND OUDH.

257. During the season under report the revision of village maps and records was completed in districts Bareilly, Kheri, and the hill *parganas* of Naini Tal, continued in Gonda and commenced in Farrukhabad, Azamgarh, and Pilibhít.

Personnel.

- Mr. G. B. Scott, Superintendent.
- „ T. F. Freeman, Deputy Collector, on survey duty.
- Mr. L. F. Berkeley, Extra Assistant Superintendent, 6th grade.
- Mr. P. C. H. Smart, Extra Assistant Superintendent, 6th grade.
- Mr. O. D. Smart, Extra Assistant Superintendent, 6th grade.
- Mr. N. Bedford, Extra Assistant Superintendent, 6th grade.
- Mr. W. Skilling, Sub-Assistant Superintendent, 1st grade.
- Mr. F. B. Powell, Sub-Assistant Superintendent, 1st grade.
- Mr. C. H. G. Johnson, Sub-Assistant Superintendent, 1st grade.
- Mr. G. Rae, Sub-Assistant Superintendent, 1st grade.
- Mr. J. H. Murphy, Sub-Assistant Superintendent, 1st grade.

258. The total area surveyed was 3,314 square miles, the number of villages 4,376 and of fields 41,88,949. Of these the record writing in the field was completed of 4,338 villages containing 39,91,364 fields. The average size of the fields ranged from .1 of an acre in Azamgarh (omitting Naini Tal as exceptional) to 1.6 in Kheri. The total number of *patwáris* in the tracts surveyed was 1,720, of whom 1,418 or 82 per cent. qualified and completed the survey and records of some or all of the villages in their circles. Of

these, who from old age or other physical incapacity, were unfitted for survey work, the greater number provided substitutes in the person of their own heirs, or other relatives, and a few substitutes were appointed by survey officers with consent of the district officers. In addition 59 *Kanungos* and 263 *Umedwar* (candidate) *Kanungos*, sent for training by the Officers of other districts, were trained, and the greater number qualified and assisted in survey work, also 18 scholars from the Agricultural School, Cawnpore. The average daily outturn by *patwáris* ranged from 4 to 10 acres of survey in December and January, rising to 20 acres in the later months of the year and 42 fields of record writing.

259. No village plan was passed till it had been carefully checked, first by the Inspector of the circle, and after completion of survey and deposit of the plan in office, by "independent *partállers*." These are native surveyors employed exclusively in running check lines over completed villages, having no access to the plans, and registering details in field books which are plotted in office and compared with field sheets by the survey officers. All plans, which on application of these tests, were found incorrect were rejected and re-surveyed. The total area thus rejected only covered about 10 square miles. This does not of course include small portions of sheets rejected while work was in progress. The average length of check lines run by Europeans on board plan was 289 linear miles, inspectors 6,932 linear miles, and by independent *partállers* 3,362 linear miles, giving an average of about 3 linear miles per square mile of survey. Of the records those of 6,63,799 fields or 12 per cent. were checked chiefly by inspectors. As these are attested by Deputy Collectors before settlement operations commence, there is not the same necessity for so large a percentage being checked by European Officers as was usual in the Survey of India Department, when records were passed on to settlement officers without further attestation. No *amins* were employed on survey work except in Naini Tal where there are no *patwáris*, and in a portion of the Farrukhabad district where the near expiry of old settlement rendered it necessary to complete the survey of the *Káimganj* and *sadar tahsils* in one year and in the alluvial tracts along the Ganges in Gonda. Some villages in Pilibhít, where annual settlements are made, and villages in the jungle, north of the Chaka river, were also surveyed by *amins* at the request of the Collector. The cultivation of these villages was scattered in dense jungle, and none but experienced surveyors could have done this work correctly, certainly not newly trained *patwáris*. The rest of the work being on the two years' system, the *patwáris* needed little or no assistance, according to the size of their circles, and where it was needed *Kanungos* and candidates fully met the want.

260. Cost rates on the two years' system must be in excess of those for work done on the one year system, owing to the large number of inspectors, and still more of *mirdahs* or chain men required over a double extent of country. On the other hand, the *patwáris* after two years are, as a rule, not only good

surveyors, but also good at record writing, area estimating, and drafting. Expenditure is largely increased also when the *patwáris* are called away from survey duties for long or frequent intervals, and to ensure the completion of records of certain areas *Moharrirs* have to be entertained to complete the work. This year owing to the necessity for reports on cattle, crops, etc., in connection with the threatened scarcity or famine, the *patwáris* were more often withdrawn from survey work even than in previous years. An examination of the records of attendance shows that every *patwári* was absent from survey work for an average of 3 months of the year, during which either the work had to remain unfinished, or when necessary, completed by outsiders at increased cost. This was specially necessary in Bareilly and Kheri, where the survey was completed and only records remained to complete, and in Farrukhabad where the papers of two *tahsils* were urgently needed for attestation this year.

261. Of boundary disputes, 259 were reported, most of which were settled on the ground with the aid of former settlement maps. A few are still unsettled and have been reported to the record officers.

262. Rewards for good work to *patwáris* amounted in all to ₹ 374-13-1.

263. Record writing has been much facilitated and uniformity ensured by the issue of the "Rules of Procedure" by the Board of Revenue. In accordance with these rules the demarcation of soils is now left to settlement officers. *Khatauni* or holding slips are prepared in the field simultaneously with *khasras*, and *khataunis* prepared from them subsequently in office. The preparation of *jamabandis* has been discontinued. The survey of districts Bareilly, Kheri, and Naini Tal having been completed, and the records made over to settlement officers, the permanent establishments of those parties have been transferred to Mainpuri, Etáwah, and Etah, respectively.

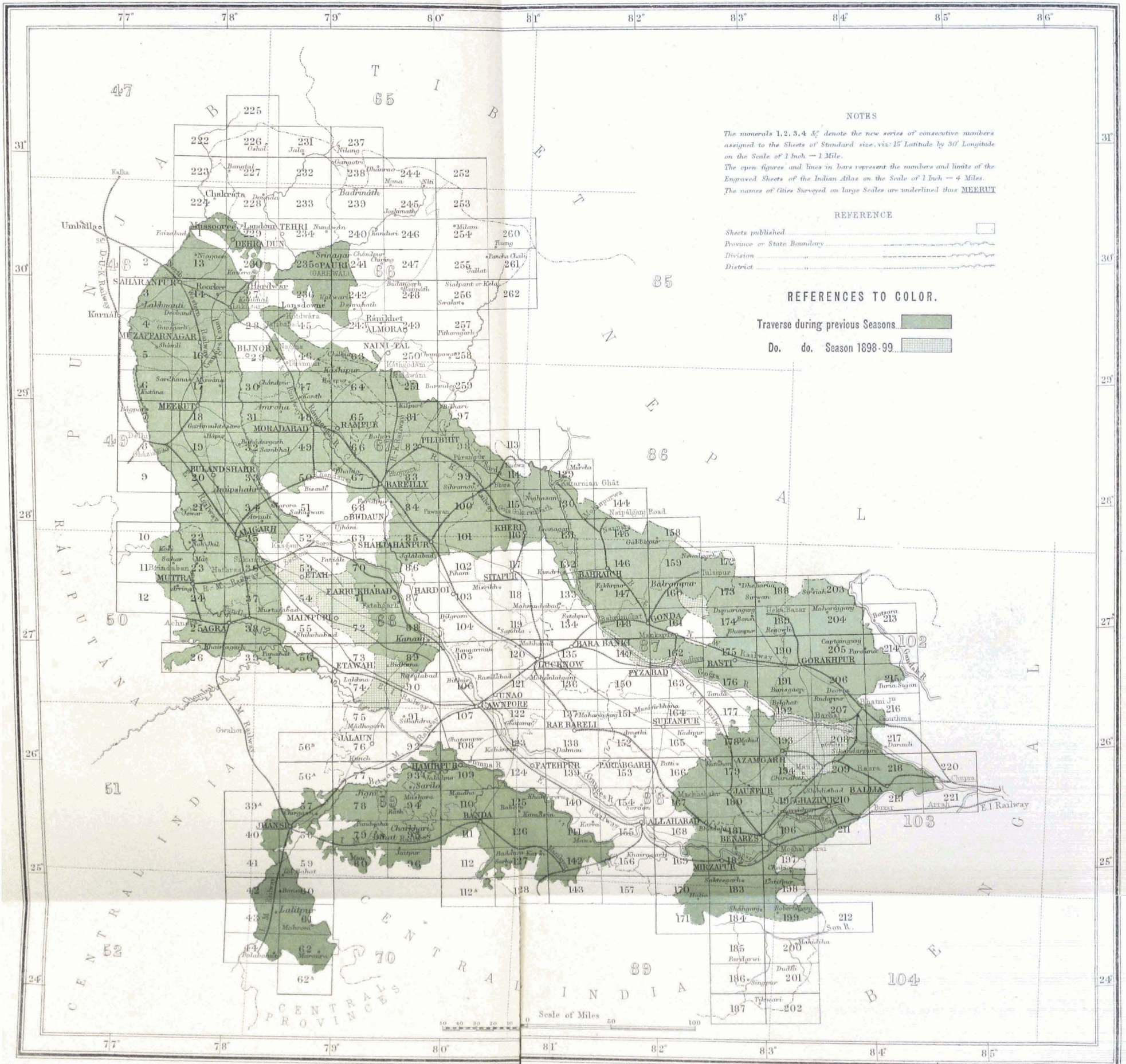
264. In district Bareilly only 344 square miles remained for survey, and in Kheri 284. When such small areas are supervised by the strength of a full camp, the cost per square mile must necessarily be heavy. In Bareilly, portion of the establishment was utilized in helping the Bísalpur section of Pilibhít, and the cost per square mile was therefore kept down to ₹69-2-8. This includes the cost of a small establishment employed in preparing plots for the Aligarh district. It was impossible to reduce expenditure, or increase the area to be done in Kheri. Moreover, the work remaining to be done was of the most difficult nature, consisting of numerous patches of cultivation scattered over a large area in heavy jungle and intersected by numerous water-courses. The cost for this year was ₹128 per square mile, but this rate does not apply to the entire area. The district is now completed, the area is 2,551 square miles, the cost from October 1895, ₹1,36,423-15-2, or an average of about ₹53-8-0 per square mile. The average cost per square mile for the year, of the remaining districts, is ₹52-12-4. This does not include cost of head-quarters establishment, which might add another ₹10 per square mile for expenditure under various heads.

265. The survey, and record writing of the cultivated area in the hill *parganas* of the Naini Tal district were completed. There is nothing to add to the remarks on this survey made in previous reports. The area surveyed this year was 21 square miles on the 64-inch scale, making the total surveyed in the district 101 square miles. Excluding carefully from this the area of all terraces and uncultivated land, the area under crop or lying fallow but held in occupation by tenants, is 61 square miles. The area according to previous papers in district office is 49 square miles, a difference of 12 square miles or 25 per cent. increase, although the actual cultivation appears rather to have diminished than increased since last settlement, owing to the tenants obtaining more valuable lands in the *Bhábar*. The cost of the 64-inch survey and record work, and of 4-inch index maps, (excluding cost of instruments transferred for use in other parties) was ₹426-6-9 per square mile. Mr. F. Powell, who has been in charge of this difficult work from the start, deserves credit for its success and full completion.

266. All the survey officers have worked with their usual zeal and ability. The work of Mr. Freeman (Deputy Collector, on survey duty) in Azamgarh was specially difficult and needed all his exceptional experience in survey and record work, together with his zeal and energy, to ensure correct results.

N. W. P. & OUDH SURVEY.

INDEX TO THE TRAVERSE SURVEY IN N. W. P. & OUDH.



267. The Superintendent visited the several districts under survey, and where time permitted personally examined the work of *patwáris* in the field, especially in Pilibhit and Farrukhabad, where work was commenced this year. He also completed the relaying of lost boundaries between Sháhjahánpur on one side, and Budaun, and Farrukhabad on the other, where the Rámᅡanga and Ganges rivers had swept away all old land-marks over a large extent of country.

268. The Superintendent also personally supervised a training class of 12 junior civilians from 1st to 20th November. After surveying a small block of cultivation each, these officers were posted to surrounding districts to gain an insight into the system of survey, and assist survey officers by checking the work of *patwáris*. At this time of year the *patwáris* are, as a rule, only commencing work, and it is not therefore a seasonable time for observing the full working of a party. The training class will, during the coming season, be held in January.

269. In the month of December, having no competent assistant available for the work, the Superintendent personally refixed the sites of lost boundary pillars and selected others on the Nepál-Almora and Nepál-Naini Tal (Tarái) boundaries. In March and April, he ran check lines over numerous villages in the Agra and Muttra districts to test the present accuracy of the village maps. The districts having been cadastrally surveyed by the Survey of India Department, the original maps were of course correct. The Superintendent found few changes as a rule, and where field limits had been changed these had been correctly recorded on the maps, a re-survey was considered unnecessary. Mr. Johnson at the same time ran check lines across the Jálaun district and found the old maps as a rule much changed and at times seriously incorrect. It is believed a re-survey will be ordered of this district.

270. The Deputy Surveyor-General visited the Survey Camp at Gonda, Farrukhabad, and Bareilly in April and expressed his satisfaction with the systematic way in which the operations were being conducted.

TRAVERSE SURVEYS.

NORTH-WESTERN PROVINCES AND OUDH.

NOS. 2 AND 8 PARTIES.

271. During the year under report, charge of these parties was held by

| | |
|---|---|
| <p><i>Personnel.</i></p> <p>Mr. B. G. Gilbert-Cooper, Deputy Superintendent, 1st grade, in charge.</p> <p>Mr. W. S. Buttress, Extra Assistant Superintendent, 1st grade, from 1st October 1898 to 18th February 1899.</p> <p>Mr. H. T. Hanby, Extra Assistant Superintendent, 1st grade, from 1st October 1898.</p> <p>Mr. R. B. Smart, Extra Assistant Superintendent, 3rd grade, from 1st to 31st October 1898, and from 1st April 1899.</p> <p>Mr. J. McHatton, Extra Assistant Superintendent, 4th grade.</p> <p>" T. Shaw, " " " 5th " up</p> <p>" J. Murphy, " " " 5th " up</p> <p>to 31st May 1899.</p> <p>Munshi Aulad Hossein, Sub-Assistant Superintendent, 2nd grade, up to 31st October 1898.</p> <p>Mr. O. C. Ollenbach, Sub-Assistant Superintendent, 2nd grade.</p> <p>Bahu Amar Sing, " " 2nd " up</p> <p>to 31st October 1898.</p> <p>Mr. Jagdamba Prasad, " " " " up</p> <p>to 31st October 1898.</p> <p>Mr. C. O'Donel, Sub-Assistant Superintendent, 3rd grade.</p> <p>" C. S. Littlewood, " " " "</p> <p>114 Sub-Surveyors, Computers, etc., etc.</p> <p>1 Hospital Assistant.</p> | <p>Mr. B. G. Gilbert-Cooper.</p> <p>Mr. W. S. Buttress was superannuated on 18th February.</p> <p>Mr. R. B. Smart's services were temporarily lent to the Punjab Government from 1st November until 1st April.</p> <p>Mr. J. Murphy was transferred to the Head-Quarters Offices, Calcutta, from 1st June, and Munshi Aulad Hossein, Babus Amar Sing, and Jagdamba Prasad were transferred to the survey training school at Dehra Dún, from 31st October.</p> |
|---|---|

272. The recess offices of the parties were closed at Mussooree on 25th October 1898, and field work started in districts, Farrukhabad, Mainpuri, and Azamgarh on the 1st November 1898, and in districts Etáwah, Etah, and Gonda, on the 1st December 1898, 14th January 1899, and 11th November 1898, respectively. The recess offices were re-opened at Mussooree on 1st May.

273. The programme sanctioned and the work actually carried out was as follows:—

- (a) Completion of district Farrukhabad, exclusive of the bulk of alluvial tracts, comprising 166 square miles in *tahsils* Kanauj and 22 square miles of alluvial lands in *tahsil* Farrukhabad.

District Farrukhabad was commenced on 1st November, and completed by the end of the month. In this, as in the other districts that came under survey this year, it was decided, at the instance of the Superintendent, Land Records Surveys, to exclude from traverse operations all alluvial tracts, and only take them in hand during the same season as the cadastral survey by local agency; as previous experience had shown that in the interval between traverse and cadastral survey, amounting sometimes to more than a year, many of the survey stations were washed away, owing to fluvial action, necessitating their being re-laid at considerable extra expense.

- (b) District Etáwah, about 700 square miles, in *tahsils* Bidhúna and Auraiya.

This district was commenced on 1st December, on completion of district Farrukhabad, and two whole *tahsils* Bidhúna and Auraiya, giving an area of 846·51 square miles, were completed in the order given, thus completing half the district. Some difficult country was here met with, lying along the rivers Jumna and Chambal, aggregating about 100 square miles, and consisting of formidable ravines, where it was almost impossible to use a chain.

- (c) District Mainpuri, about 700 square miles, in *tahsils* Bhongaon and Mainpuri.

Work was commenced in this district on 1st November and closed on 13th January, and one whole *tahsil* Bhongaon and a portion of Mainpuri were completed, comprising an area of 694·67 square miles, and leaving a balance of about 1,000 square miles for future traverse. The country was open and easy.

- (d) District Etah, 770·59 square miles, in *tahsils* Etah and Aliganj.

Work in this district was commenced on 14th January and closed on 6th April. *Tahsil* Etah was completed, and as much of *tahsil* Aliganj as was necessary to meet the requirements of the programme, comprising 770½ square miles and leaving a balance of about 911 square miles to be traversed.

- (e) Completion of district Azamgarh (exclusive of about 255 square miles of alluvial tracts), comprising 896 square miles, in *tahsils* Sagri and Muhammadabad.

Work in this district was commenced on 1st November and closed on 9th April. *Tahsils* Sagri and Muhammadabad were taken up, thus completing the district.

- (f) District Gonda; alluvial tract touching on districts Fyzabad and Bara Banki, comprising an area of 242 square miles, and a similar tract in *pargana* Utraula with an area of 162 square miles.

The work in this district was started on 11th November and closed on 9th April. A balance of 338 square miles remains to be traversed in this district.

In addition to the above sanctioned programme, the following work was done for the local Government, at the request of the Superintendent, Land Records Surveys, the cost of which will be debited to the Government of the North-Western Provinces, *viz.* :—

- (a) One Sub-Surveyor was deputed to district Kheri for 6½ months, to relay old stations or substitute new ones where they could not be found, also to traverse boundaries of newly-formed villages within forest areas and other miscellaneous work, at a cost of R742-11-5.
- (b) Another Sub-Surveyor was similarly sent to district Pilibhit to survey disputed boundaries of villages bordering on the Government Forests, also to run supplementary sub-traverses and take up boundaries of villages, which during the traverse survey of the district, were for some reason either omitted or were found to be too far away from the traverse lines, at a cost of R183-12-0.

(c) A Sub-Surveyor was deputed, to district Bulandshahr, to survey a boundary dispute, at a cost of ₹127-0-10.

274. The average size in square miles of village circuits in the several districts traversed is as follows:—Farrukhabad 0·76, Etāwah 0·93, Mainpuri 1·17, Etah 1·06, Azamgarh 0·36, and Gonda, in *pargana* Utraula 0·78; and alluvial tracts 8·07.

275. Azimuth observations were taken at 462 points on main and sub-circuits in the season's work. With very few exceptions, as in the case of alluvial lands, main and sub-circuit traverses have been run along *pargana* and *tappa* boundaries. In alluvial tracts, the practice is, for the main circuits, to follow the first line of village boundaries above the high bank of the river.

276. The usual prism-headed stones obtained from Chunar, and baked clay cylinders, locally made, were used to mark the stations. The former were used as before, in marking (a) village trijunction points, where settlement marks were non-existent, (b) one satellite station at every trijunction, and (c) two consecutive stations between trijunctions a mile or more apart; cylinders were used for all other stations. The total number of stones used was 11,113 and cylinders 41,225. The number left unused, and which will be utilized next season, are, stones 5,771, cylinders 12,913. The cost of 16,477 stones purchased during the year under report, amounts to ₹4,326-2-6, including railway freight, and that of 50,131 clay cylinders, to ₹955-2-10, excluding carriage. The local carriage for both descriptions of marks, cost ₹3,026-4-1. The cost for cylinders this year is less, owing to the price paid per hundred being considerably less than in previous years.

277. Traverse charts of every district under survey have been prepared, showing the run of main and sub-circuits, with their trijunction points, azimuth, and Great Trigonometrical Survey stations, and a table showing their co-ordinate values from origin was also prepared.

278. The plotting done on various scales is as follows:—

| | Scale. |
|---|----------------------|
| 2,656 villages and 121 river blocks on 55 sheets | . 2 inches = 1 mile. |
| 2,626 villages on 54 sheets | . 4 " = 1 " |
| 5,282 villages and 121 river blocks on 7,305 sheets, 16 " | = 1 " |

279. The parties were divided into one Drawing Office and three Traverse Camps. The former together with a small topographical section, being in charge of Mr. T. Shaw, and the latter of Messrs. Buttress, Hanby, and McHatton; Mr. Smart taking Mr. Buttress' place on the retirement of that officer on 18th February 1899.

280. The field work of the topographical section, consisting of two native sub-surveyors, under Mr. O. C. Ollenbach, was commenced on 1st November and closed on 16th May. This section completed the survey on the scale of 2 inches to the mile, of the gaps left in *parganas* Lalitpur and Bānpur, of the Lalitpur sub-division of district Jhānsi, between the areas cadastrally surveyed, and which were scattered over an area of 860 square miles. The area surveyed was 30 square miles which completed Lalitpur. Absolute heights were observed this year, so that in conjunction with the heights given by the Forest Surveys, there are now heights above sea-level for every sheet of the Lalitpur sub-division. On the completion of Lalitpur, district Shāhjahānpur was taken up, and an area of 94 square miles of flat waste-lands in 46 *mauzas*, was completed on the 2-inch scale. In district Kheri the area surveyed on the 2-inch scale was 40 square miles, situated in seven *mauzas*, and scattered over several *parganas*. The surveys were, in the case of each district, based on the traverse stations fixed for the cadastral survey. The Drawing Office continued the compilation of standard geographical maps from recent cadastral surveys; but no fresh districts were taken up during the year. The mapping of districts Lalitpur and Shāhjahānpur was proceeded with, and that of the former district was practically finished by the 30th September. The whole of the cadastral maps of district Meerut received from the Land Records Survey Department have been reduced by pantagraph to the scale of 2 inches = 1 mile, and a comparison has been made with Colonel Wilkins' survey on the 2-inch scale made in 1874-75. From this it appears that additions and alterations will have to be made to two-thirds of the villages examined, and as these changes require draftsmen

skilled in the correction of original maps, it is considered that it will be preferable to construct entirely new maps of the Meerut district, rather than attempt to doctor up the old ones.

281. The following table shows the particulars of outturn and cost-rates for the season :—

| DISTRICT. | Area in square miles. | TOTAL COST. | Cost-rate per square mile. |
|-------------------------------------|-----------------------|-------------------|----------------------------|
| <i>Traversing.</i> | | | |
| | | <i>R a. p.</i> | <i>R a. p.</i> |
| Farrukhabad | 188.18 | } 99,734 5 11 (a) | } 26 3 10 |
| Etáwah | 846.51 | | |
| Mainpuri | 694.67 | | |
| Etah | 770.59 | | |
| Azamgarh | 896.37 | | |
| Gonda | 404.06 | | |
| | 3,800.38 | | |
| <i>Topographical.</i> | | | |
| Lalitpur | 30 | } 6,322 7 0 | } 38 8 9 |
| Sháhjahánpur | 94 | | |
| Kheri | 40 | | |
| | 164 | | |
| Miscellaneous work for Land Records | | | |
| Surveys | ... | 1,053 8 3 (b) | ... |
| Drawing Office | ... | 13,447 0 2 | ... |
| | ... | 1,20,557 5 4 | ... |

(a) Includes R8,286-0-5 for stone embedding.

(b) Debitable to North-Western Provinces Government. Includes 4 per cent. for cost of instruments.

282. As during the preceding seasons, the *mausa* was the unit in the system of traversing adopted; each *mausa* being sub-divided by traverses averaging half a mile apart, the object being to supply the Land Records Department with skeleton plots on the scale of 16 inches to the mile, with a sufficient number of fixed points to form a good basis, on which *patwáris* could do their detail surveys.

283. The health of the parties was throughout the field season excellent, there being few cases of sickness.

284. The boundaries in all districts were well demarcated, and the attendance of *patwáris* was good. Messrs. R. P. Dewhurst, Collector of Farrukhabad, J. M. Wright, Collector of Etáwah, W. R. Partridge, Collector of Mainpuri, P. U. Allen, Collector of Etah, E. Rogers, Collector of Azamgarh, and R. L. H. Clarke, Deputy Commissioner of Gonda, are to be thanked for the very prompt and cordial assistance always afforded by them during the progress of survey operations.

285. The parties were inspected in the field by Lieutenant-Colonel J. R. Hobday, Deputy Surveyor-General, and in recess quarters by Major-General C. Strahan, R.E., Surveyor-General, and again by Lieutenant-Colonel J. R. Hobday.*

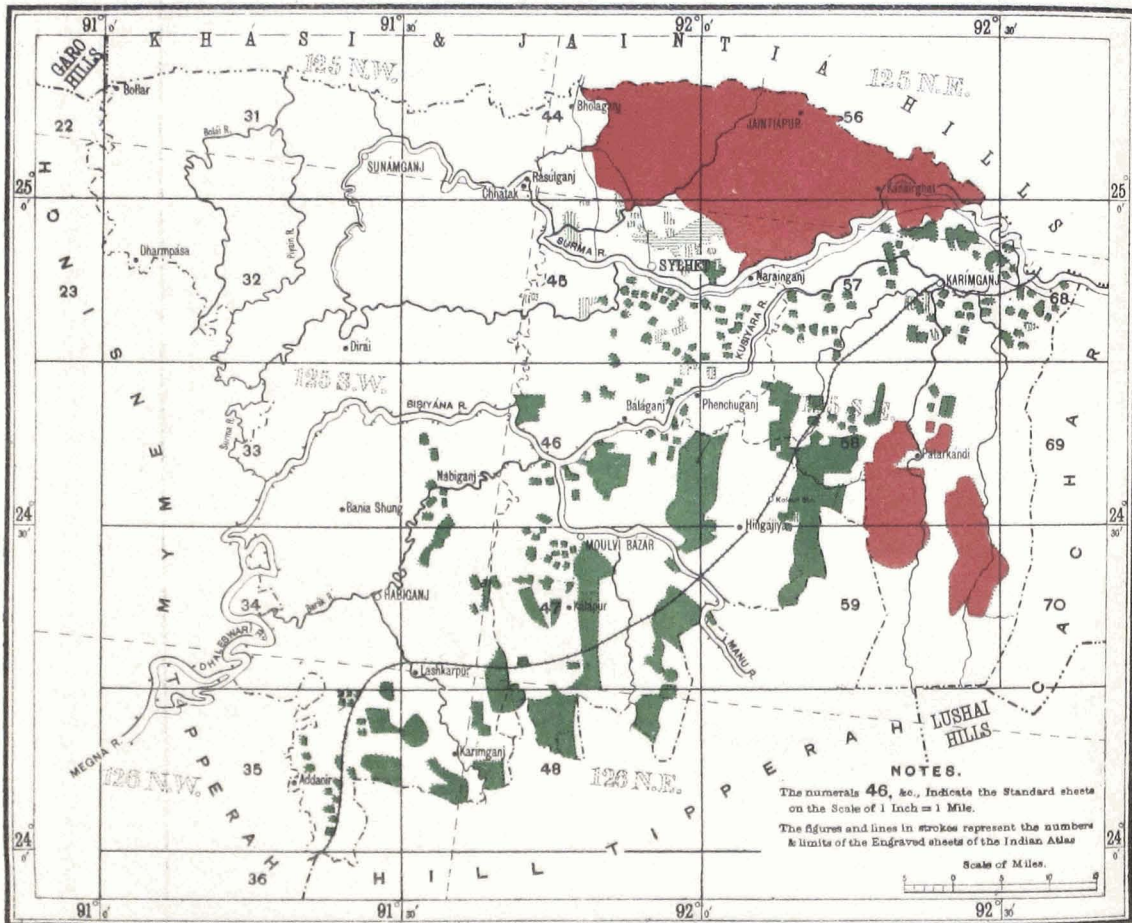
* The officer in charge reports that Messrs. H. T. Hanby, R. B. Smart, J. McHalton, and T. Shaw have conducted their duties in a most satisfactory and able manner; and that Messrs. O. C. Ollenbach, C. O'Donel, and C. S. Littlewood also rendered good assistance. Of the Native establishment the names of Monohar Lall, Latifulla Khan, Dharanidhar Mookerjee, Gokul Chand, Mahadeo Ram, Hasant Rai, Gouri Shanker, Sanat Kumar Chatterjee, Kanhya Lall, Enayetullah, and Krishna Prasad have been brought to special notice.

ASSAM SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DIST. SYLHET.

1898-99.








No. 6 PARTY.



Reg. No. 623. S. I. D. - Dec. 99. - 603.

Photo. S. I. D. Calcutta.

REFERENCES.

| | |
|--|---|
| Previously Cadastrally Surveyed |  |
| Traversed previously |  |
| Traversed Ham Lands Season 1898-99 |  |
| Traversed Boundary of Grants .do |  |
| State |  |
| District |  |
| Sub-Division .do |  |

No. 609-S. 99.

ASSAM.

No. 6 PARTY.

286. The charge of the party was held by Captain C. W. H. Symonds up to the 17th February 1899, when he was transferred and Mr. W. H. Penrose assumed charge.

Personnel.

Captain C. W. H. Symonds, Officiating Deputy Superintendent, 1st grade, in charge, up to the 17th February 1899.

Mr. W. H. Penrose, Extra Assistant Superintendent, 5th grade, in charge, from the 18th February 1899.

Mr. F. S. Bell, Sub-Assistant Superintendent, 1st grade.

25 permanent and 17 temporary Sub-Surveyors, Computers, etc.

287. The party left Shillong on the 22nd October 1898 and opened field office at Tezpur on the 1st November 1898. Field work was brought to a close in the Assam Valley on the 31st of May 1899, and in the Surma Valley on the 9th July 1899. Office re-opened in Recess Quarters at Shillong on the 10th June 1899.

288. Two traverse surveyors were deputed from Tezpur on the 11th November 1898 to complete the remaining areas in district Sylhet in the Surma Valley, and one Sub-Surveyor on the 9th November 1898 to execute a plane-table survey on the 2-inch scale, of the demarcation of certain boundaries in district Sylhet formerly under dispute and settled by a deed of compromise between the Maharaja of Tippera and the British Government.

289. The proposed programme and the areas actually completed are given in the following table:—

| | Approximate area to be completed. | Area actually completed. | REMARKS. |
|--|-----------------------------------|--------------------------|--|
| | Sq. miles. | Sq. miles. | |
| <i>Assam Valley.</i> | | | |
| (1) 2-inch topographical survey . | 1,045'00 | 1,144'45 | In addition 185.8 linear miles of railway lines, open and under construction, falling in the 2-inch standard sheets, were traversed in the Assam Valley. |
| (2) Traverse of villages for cadastral survey by local agency . | 30'00 | 56'04 | |
| <i>Surma Valley.</i> | | | |
| (3) Traverse of <i>ilam</i> and waste-land grants in District Sylhet . | 23'40 | 22'54 | |
| | 1,098'40 | 1,223'03 | |
| | Linear miles. | Linear miles. | |
| (4) Demarcation of boundaries between Sylhet and Hill Tippera in the Sâtgaon, Dinarpur, and Balisira Hills on the 2-inch scale | 35'18 | 35'18 | |

290. In the Assam Valley the area to be traversed was divided into two main and seven minor or river circuits. In the Sylhet district the areas being scattered, there were no main or sub-circuits. Each estate was traversed separately; the total number traversed being 58, with five sub-traverses. In the Assam Valley all co-ordinates for districts Sibsâgar and Lakhimpur were referred to the intersection of parallel 26° 30' with the meridian of 94° 30'. In the Sylhet district the origin of the Jaintia Survey was preserved, *viz.*, the intersection of parallel 24° 30' with the meridian of 92°. The traverse surveyors were provided with spare testing chains and these were again tested from time to time with the standard steel bars in camp, throughout the field season. In the Assam Valley the theodolite was set up at 6,120 stations and the aggregate length of the lines measured is 1,019 miles. In district Sylhet the theodolite was set up at 2,141 stations, and the aggregate length of the lines is 134 miles. Six stations of the Assam Valley Series and one of the Eastern Frontier Series have been connected with. The angular work was checked by azimuth observations, and the 2-inch detail survey by 110.73 linear miles of chaining, besides

examination *in situ*. In the Sylhet district the total number of new and old permanent marks (embedded by the Settlement Department) utilized as theodolite stations was 315. The remaining 1,826 stations were marked by wooden pegs with the usual mound and tree planned 5 feet to the magnetic north. In the Assam Valley the stations in the areas traversed for cadastral survey by local agency are marked as in Sylhet. The triple junctions of these villages will be permanently marked by the Settlement Department. In the traverse of the areas topographically surveyed on the 2-inch scale, pegs only were used.

291. A survey training class was opened on the 15th January 1899 at Tezpur under the supervision of Captain C. W. H. Symonds for the purpose of instructing the following officers:—

| | |
|--|-----|
| Mr. T. Emerson, Assistant Commissioner. | |
| „ J. Donald, | do. |
| Babu Uttam Chandra Dass, Extra Assistant Commissioner. | |
| „ Lakhesvar Surma, Sub-Deputy Collector. | |
| „ Ramkanta Barua | do. |
| „ Janakinath Dass | do. |
| Moulvie Abrar Hussain | do. |
| Babu Benudhar Rajkwa | do. |
| „ Ghanakanta Chalaha, Tehsildar. | |

These officers all passed after having done actual field surveying on the 16-inch scale aggregating 3,259 acres, or 5.10 square miles. This work was professionally tested by 14.07 linear miles of independent check lines. The school was closed on the 31st March 1899.

292. By the 30th September 1899 all the remaining 16-inch sheets of the cadastral survey of Cachar district were finally completed and sent to Calcutta for printing. The total number of these sheets is 1,354, falling in 15 standard 2-inch quarter sheets, in various stages of completion. Thirteen standard 2-inch quarter sheets of Jaintia and Pratábgarh, incorporating the recent cadastral survey of these tracts in Sylhet district, and which were previously reported as complete, were kept back on account of subsequent boundary surveys of the grants in the same district, and adjoining cadastral surveys in district Cachar. The work of incorporating the boundaries of these grants in 2-inch standard sheets, from 16-inch skeleton boundary plots previously supplied to the settlement officer and of which he has passed the boundaries, has been made over to the Assam Provincial Survey Detachment, together with four of these 2-inch standard sheets in which the new work falls, *viz.*, 45 N. E., 57 N. W., 58 N. E., and S. E. In the Assam Valley there are 127 standard 2-inch quarter sheets compiled from previous cadastral surveys and recent 2-inch topographical surveys. Twenty-four of these sheets have been completed and submitted for reduction and publication on the 1-inch scale. The remaining 103 sheets, all more or less incomplete, will be completed in the head-quarters' offices, Calcutta, by the end of May, but they will not all even then be ready for publication and will be eventually entirely completed in the drawing office of the Assam Provincial Survey Detachment as additional material becomes available.

293. On the 31st October this party ceases to exist, but from the 1st November 1899 sanction has been obtained for the retention of a Provincial Survey detachment under Mr. J. H. O'Donel, Extra Assistant Superintendent, to undertake all traverse operations in advance of local agency surveys, the topography of such areas as are required from time to time for the completion or revision of the standard sheets, and a drawing office for the compilation of topographical and other maps of the Province. The whole to be under the professional supervision of the Deputy Surveyor-General and the direct control of the Local Administration.

294. The health of the party was fairly good throughout the season, but a bad type of fever permanently disabled one and killed two computers on the temporary establishment. There were four deaths among the *khalásis*.

295. The Deputy Surveyor-General inspected the party both in the field at Tezpur in March and at Shillong in September.

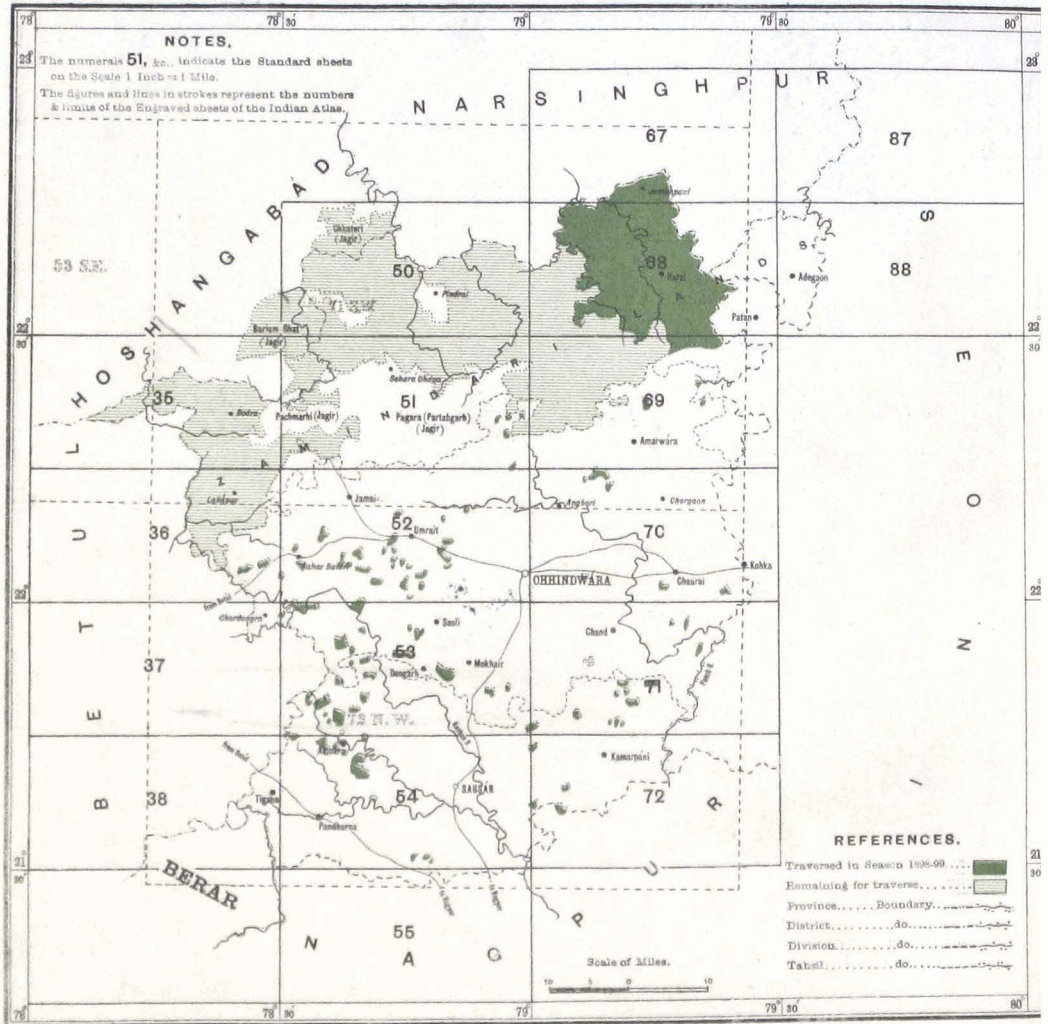
Note.—With some few exceptions the members of the party, both European and Native, have worked well during the field season and in recess.

CENTRAL PROVINCES SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT CHHINDWARA.

1898-99.

DETACHMENT.

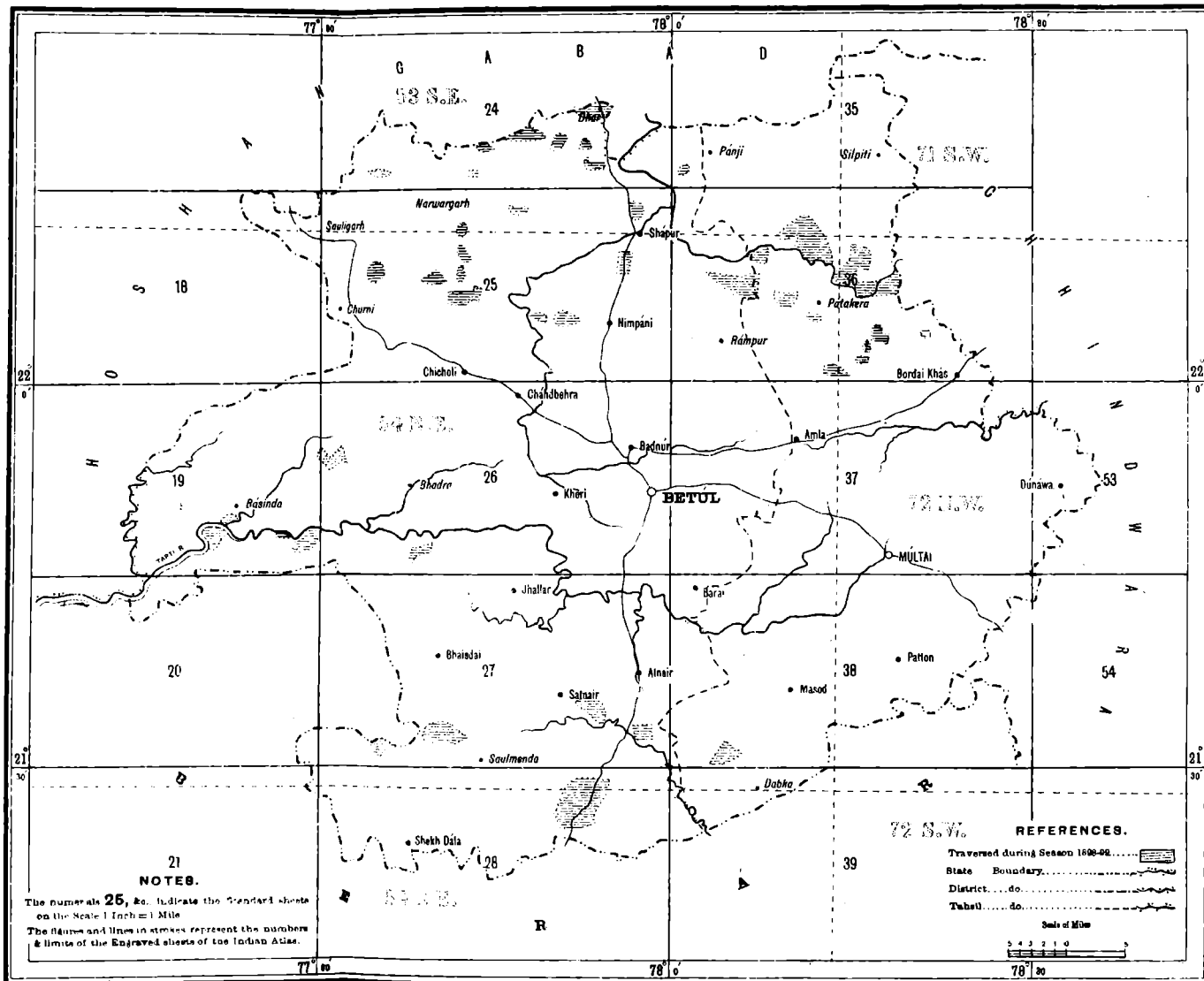


CENTRAL PROVINCES SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT BETUL.

1898-99.

DETACHMENT.



CENTRAL PROVINCES.

CENTRAL PROVINCES DETACHMENT.

296. Sanction was conveyed to the formation of this detachment, under orders of the Government of India, in their letter No. 1795, dated the 30th August 1898, for the conduct of traverse operations in the Central Provinces.

Personnel.
 Mr. W. C. Price, Extra Assistant Superintendent, 1st grade.
 8 Sub-Surveyors.
 6 Computers.

1 Draftsman.
 1 Writer.

297. The detachment assembled at Chhindwára on the 19th November 1898, and began traversing the excisions of that district on the 6th December, and of Betúl by the middle of January 1899, completing them, respectively, on 15th January and 31st March. From the 1st April to the first week of June the Chhindwára *jágirs* were traversed. The recess office was opened at Jubbulpore on the 12th June 1899.

With respect to the *locale* of operations, and the sequence in which they should be taken up, the detachment was placed under the direct orders of the Commissioner of Settlements and Agriculture, Central Provinces, to supply plots of *raiyatwári* excisions that were wanted promptly, irrespective of the distances apart, or districts in which they were needed, so that Settlement Officers could deal with them before they were transferred elsewhere. All traversing by local agency, with the prismatic compass and chain, a system which has been in vogue for many years past in these provinces, to supply data for the Land Record Surveys, was suspended.

298. The programme of work completed was as follows:—

- (a) The traversing of 56 square miles of *raiyatwári* excisions, in the Chhindwára District.
- (b) The traversing of 91 square miles of *raiyatwári* excisions, in the Betúl District.
- (c) The supply of 16-inch plots of the above, in the field.
- (d) The traversing of 300 square miles of villages, in the Chhindwára *jágirs*.
- (e) The traversing of 31 square miles of Sonákhán estate and supply of 16-inch plots of 14 scattered waste-land grants, in the Biláspur District.

Chhindwára District Excisions.—The whole of the sub-surveyors were employed on the Chhindwára excisions, completing them by the middle of January. The work was very scattered and the blocks, as a rule, small and troublesome. Going from one to another took up much time, and the delays in obtaining men to point them out considerably inconvenienced the work.

Betúl District Excisions.—The excisions in Betúl were next urgently called for, and by the middle of January four sub-surveyors were sent there, the rest following soon after, each marching an average distance of 100 miles. The traversing was practically completed by the end of March. This country, especially the part worked in, is very hilly and rugged: the forest ranges, where the traversing lay, is difficult and unhealthy, thickly wooded and covered with high grass. Three different kinds of survey stations were found on the ground; one the Revenue, another the Forest Topographical, and a third, the local agency survey; and these three were undistinguishable from each other, and could not be identified by *patwáris* and other local officials. Imperial Revenue survey data were only available, and the stations had to be identified and pointed out by computers, who accompanied the sub-surveyors in the field.

Chhindwára jágirs.—When the Betúl work was complete, the sub-surveyors had to march distances of 150 to 200 miles each, to the Chhindwára *jágirs*, in the north-east corner of the district, taking up on the way excisions that had, owing to the faulty nature of the index maps and the ignorance of the local men, been wrongly traversed. These mistakes were detected on comparing the reduced plots with the forest survey maps. When the men got into the compact block of the *jágirs*, they had better assistance, and although the country was as difficult as they had worked in before, the progress was very rapid, and the two *jágirs* of Harrai and Gorpáni were completed before the field work closed.

Biláspur District.—One estate, named Sonákhán, belonging to the Cash Company, Calcutta, was traversed in part during the recess, and plots of 14

waste-land grants which had been surveyed before by No. 2 Party were supplied to the Settlement Officer.

299. The mark-stones embedded were 8,517 in number. Dressed and undressed stones of suitable size, with crosses cut on them, were locally obtained and firmly buried in the ground, leaving about a foot above the surface, and subsequently covered over with cairns of stones for their preservation and identification. The traverse lines followed closely the excision and village boundaries. All the old boundary pillars that were suitably placed were utilised as traverse-stations.

300. The origin of the Chhindwára *jágir* traverses is the same as that adopted for the district before, *viz.*, Amliwára hill station of the Jubbulpore Meridional Series in latitude $22^{\circ}-0'-53''\cdot87$ and longitude $79^{\circ}-28'-54''\cdot65$.

301. The total expenditure for the year ending 30th September 1899 is ₹20,543, giving a cost-rate of ₹43 per square mile. These figures include heavy transfer, extra contingent, and transit charges, incidental to the organisation of a newly formed detachment; but this abnormally high cost-rate is chiefly due to the very scattered nature and small size of the blocks traversed, and therefore cannot be compared with the rates of former traverse-operations of large compact areas in these provinces.

302. Throughout the season the health of the detachment was fairly good. In the early part sickness was rife, mostly malarial fever and bowel complaints, and in April influenza was prevalent. A *khalási* of the establishment was badly wounded by a wild boar whilst out at work in the Betúl district, and was a long time under medical treatment in hospital.

303. The Government forests included a number of villages containing small patches of culturable land. The original demarcation of the forest boundaries was effected in a haphazard way, and the present excisions included existing cultivation with a proportion of culturable land, separated with the object of giving good forest boundaries, and of making them conterminous with villages.

The attendance of *patwáris* and others to show the boundaries of the excisions was very unsatisfactory, causing considerable delay and trouble.

Guide maps were not given for the Chhindwára excisions but only village lists. Rough copies of the forest officer's maps on the 1-inch scale had to be made by the sub-surveyors for their guidance. The *jágir* index maps, made according to a sample supplied, were good. The Betúl tracings, forwarded by the Settlement Officer with his lists, were fair approximations.

304. With regard to the outturn of work the Settlement Commissioner reports as follows:—

“ Having regard to the difficulties encountered in the nature of the country and the scattered character of the work, the progress seems to have been very satisfactory.”

305. The programme for the coming field season consists of—

Continuation of the traversing of *jágirs* in Chhindwára and Hoshangabad; 203 square miles of the Charwa tract in Nimár, and the carrying out of any miscellaneous surveys which may be required by the Local Administration.

306. The detachment was inspected by the Deputy Surveyor-General, Revenue Branch, early in July, at recess quarters in Jubbulpore.*

GEODETIC.

ASTRONOMICAL LATITUDES.

NO. 22 PARTY (ASTRONOMICAL I).

Personnel.

Lieutenant E. A. Tandy, R.E., Officiating Deputy Superintendent, 2nd grade.
Babu Hanuman Prasad, Sub-Assistant Superintendent, 3rd grade.
Babu Govind Balwant Joshi, Computer, and one temporary computer.
One Hospital Assistant.

307. This party under Lieutenant E. A. Tandy, R.E., was employed on latitude operations on the East Coast Series. The party left Mussooree on the 3rd October 1898 and returned on the 24th May 1899.

* The officer in charge commends the work of the following men of the native establishment: Preonath Banerji, computer; C. Paupiah, writer; and Ram Narain, Nathu Khan, and Maula Baksh, sub-surveyors; the rest worked well and gave satisfaction.

308. The instrument used was Troughton and Simms Zenith telescope No. 1, which was this year for the first time mounted with two levels instead of one.

The following eight latitudes were taken, and a special interest attaches to the results, as, several stations being on the sea coast, they will afford valuable data in elucidating the question of the existence or otherwise of oceanic attraction :—

| Station. | Number of pairs. | Number of observations. | Geodetic latitude. = λ_0 | Astronomical latitudes and p. e. = λ_0 | $\lambda_0 - \lambda_c$ Apparent deviation of plumb- line. |
|--------------------------------|------------------|-------------------------|-------------------------------------|--|---|
| Vizagapatam base line N. end . | 50 | 102 | ° ' " 18 1 2'91 | ° ' " 18 0 56'60 ± 0'057 (2) | " -6'31 |
| Ráwal H. S. | 46 | 92 | ° ' " 18 32 9'22 | ° ' " 18 32 4'64 ± 0'065 | " -4'58 |
| Mal H. S. | 49 | 98 | ° ' " 18 47 16'97 | ° ' " 88 47 6'75 ± 0'064 | " -10'22 |
| Khundáboló H. S. | 56 | 112 | ° ' " 19 51 12'90 | ° ' " 19 51 7'33 ± 0'050 (2) | " -5'57 |
| Cuttack Fort | 56 | 127 | ° ' " 20 29 0'68 | ° ' " 20 28 52'03 ± 0'046 | " -8'65 |
| Patna | 50 | 132 | ° ' " 21 47 20'83 | ° ' " 21 47 17'35 ± 0'039 (3) | " -3'48 |
| Chandipur | 50 | 101 | ° ' " 21 26 36'99 | ° ' " 21 26 33'93 ± 0'060 | " -3'06 |
| Dariápur | 52 | 107 | ° ' " 21 47 27'95 | ° ' " 21 47 28'80 ± 0'042 | " +0'85 |

309. Lieutenant Tandy states that these results can only be provisionally accepted, as an instrumental defect just recently brought to light may lead to the modification of some of them. The matter will be finally dealt with in his next annual report.

310. The persistent appearance of a northerly deviation of the plumb-line here shown is probably chiefly due to the attraction of the heavy masses of the Eastern Gháts lying on the North-Western flank of the series. It is, however, impossible to make deductions from the results of one series by itself; such discussions must be postponed until the astronomical examination of the whole triangulation of India is more complete.

311. Owing to the addition of a second level to the instrument, Lieutenant Tandy has been able to undertake a series of investigations, which promises to be of very considerable interest. In connection with these investigations about two months were spent in Dehra Dún in experimenting with a system of level calibration which entailed nearly 4,000 observations of each of the two levels examined, and Lieutenant Tandy has submitted a very complete report of the work for publication in the Professional Papers of the Survey of India. This report is now in the Press, and may be further discussed on publication.

312. The reduction of this large number of observations, and the exhaustive examination of several important questions arising from the investigations, have, together with some other enquiries, which Lieutenant Tandy is conducting,

thrown a large amount of extra labour on the party, which has accordingly been strengthened by the addition of a fresh computer on probation and a sub-surveyor.

313. Portions of the country traversed by the party were very malarious, and it suffered considerably from this cause. The *daftari* of the party who had served for 20 years in the department died on his return journey at Dehra Dún, and one *khalási* was incapacitated from all further Government service, from the effects of malaria. The officer in charge had one sharp attack of fever in Cuttack. Otherwise the health of the party was good.

314. The party was inspected by Colonel St. G. C. Gore, R.E., Superintendent of Trigonometrical Surveys, on June 7th.

ASTRONOMICAL LATITUDES AND AZIMUTHS.

No. 23 PARTY (ASTRONOMICAL II).

Personnel.

Captain G. P. Lenox-Conyngham, R.E.,
Deputy Superintendent, 1st grade.
Babu Lal Singh, writer and recorder.
Sub-Surveyor F. Kerr.

315. There were no changes in the *personnel* of the party.

316. The party left recess quarters for the field on October 17th, 1898, and returned on April 18th, 1899.

317. The programme of work consisted of the determination of latitudes and azimuths at stations forming a group round Kaliánpur H. S., the origin of the Indian Survey.

The experience gained during the last season, when observations on this principle were carried out near Agra, led to a modification of the arrangement. No new stations were built but existing stations of the Principal Triangulation were selected, forming two quadrilaterals, an inner and an outer, round the old Observatory at Kaliánpur.

In so doing some sacrifice of symmetry was unavoidable, but the compensating advantages were considerable.

318. Observations for latitudes were taken at all the eight stations forming the quadrilaterals, and at the centre, that is at nine stations in all.

Observations for azimuth were made at eight stations, the ninth had been destroyed and Captain Lenox-Conyngham found it impossible to re-determine its original position with sufficient precision to render an azimuth observed there of value.

319. The quantity of observing got through the season was much greater than has been done before, and as a result the computations have only been completed with great difficulty, though assistance was given by the computing office at Dehra Dún. It has not therefore been possible up to the present time to analyse the results, or to draw any conclusion from them, they are merely tabulated without comment.

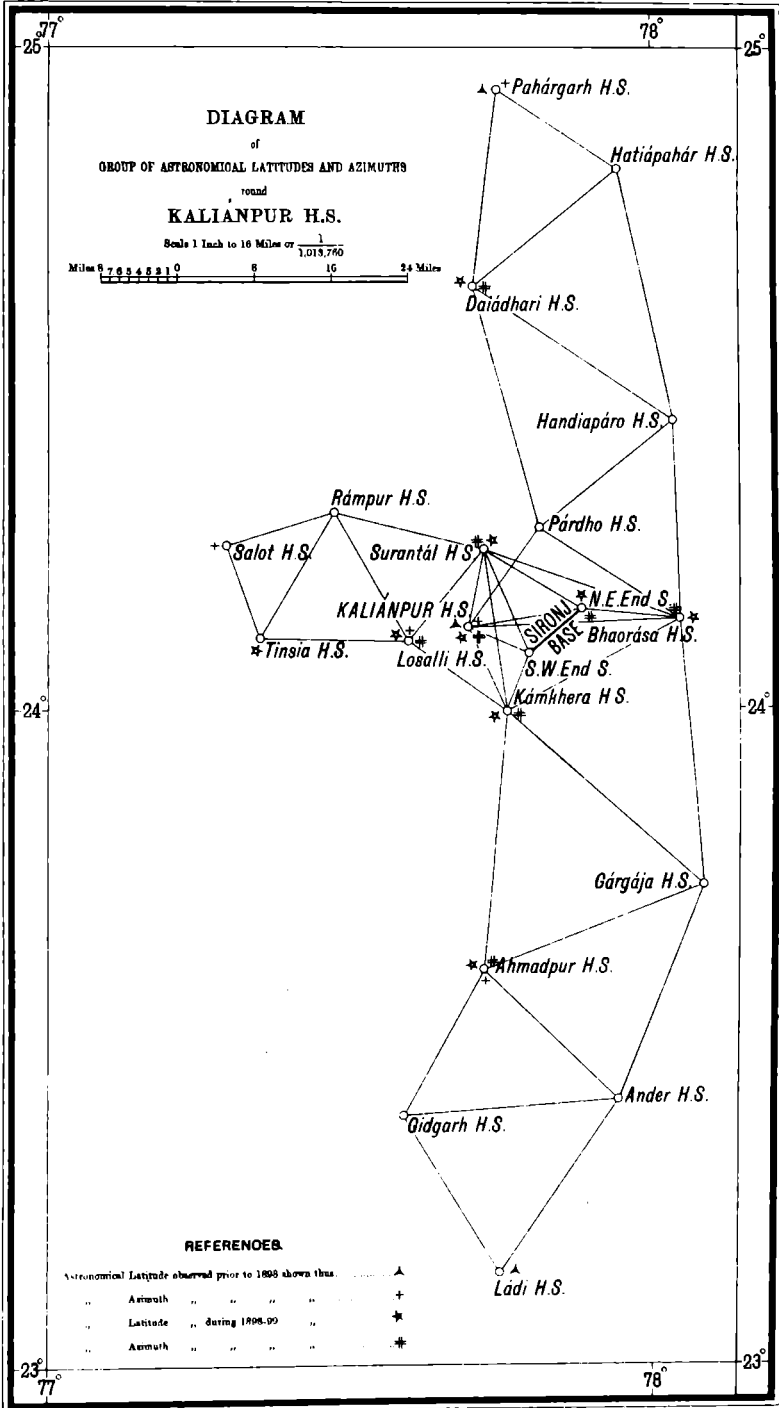
320. Should the system be extended to other places, it will probably be better to employ two observers, so that each may give undivided attention to one instrument in the field, and to the computation of his own observations in recess.

321. The officer in charge expresses his gratitude for ready and cordial assistance rendered by the officials of the Gwalior and Tonk States, within whose territories the whole of his work lay.

322. The health of the party was good throughout the season.

323. In the month of May, Captain Lenox-Conyngham took charge of the measurement of an experimental Base Line in Dehra Dún for instructional purposes.

324. The party was inspected by Colonel St. G. C. Gore, R.E., Superintendent of Trigonometrical Surveys, on June 6th.



ABSTRACT OF RESULTS.

Azimuths.

| Station. | Azimuths. | | | Observed -computed. | Station at other end of Ray. |
|------------------------------|----------------|-----|----------|------------------------|---------------------------------|
| | Observed | ° | ' | | |
| Daiádhari . . . | Observed . . . | 303 | 32 52'65 | +2'24 | Handiapáro. |
| | Computed . . . | | 50'41 | | |
| Bháorása . . . | Observed . . . | 95 | 12 39'38 | +1'30 | N.-E. end of Sironj Base. |
| | Computed . . . | | 38'08 | | |
| N.-E. end of Sironj Base. | Observed . . . | 80 | 46 35'03 | +3'42 | Kaliánpur. |
| | Computed . . . | | 31'61 | | |
| Kaliánpur . . . | Observed . . . | 190 | 27 7'35 | +2'25 | Súrantál. |
| | Adopted . . . | | 5'1 | | |
| Súrantál . . . | Observed . . . | 10 | 27 43'86 | +3'40 | Kaliánpur. |
| | Computed . . . | | 40'46 | | |
| Kámkhera . . . | Observed . . . | 154 | 45 36'58 | +1'27 | Ditto. |
| | Computed . . . | | 35'31 | | |
| Losalli . . . | Observed . . . | 305 | 52 55'71 | -1'59 | Kámkhera. |
| | Computed . . . | | 57'30 | | |
| Ahmadpur . . . | Observed . . . | 185 | 10 56'14 | +2'23 | Ditto. |
| | Computed . . . | | 53'91 | | |

Latitudes.

| Station. | Latitudes. | | | Observed -computed. | P. E. of ob- served Lati- tude. | Number of pairs of stars observed twice each. |
|------------------------------|----------------|----|----------|------------------------|---------------------------------------|--|
| | Observed | ° | ' | | | |
| Daiádhari . . . | Observed . . . | 24 | 38 18'83 | +1'26 | ±0'105 | 38 |
| | Computed . . . | | 17'57 | | | |
| Bháorása . . . | Observed . . . | 24 | 8 5'13 | +1'40 | ±0'132 | 38 |
| | Computed . . . | | 3'73 | | | |
| N.-E. end of Sironj Base. | Observed . . . | 24 | 8 55'46 | +1'89 | ±0'084 | 44 |
| | Computed . . . | | 53'57 | | | |
| Kaliánpur . . . | Observed . . . | 24 | 7 10'46 | -0'80 | ±0'083 | 44 |
| | Adopted . . . | | 11'26 | | | |
| Súrantál . . . | Observed . . . | 24 | 14 21'41 | +0'99 | ±0'073 | 39 |
| | Computed . . . | | 20'42 | | | |
| Kámkhera . . . | Observed . . . | 23 | 59 42'95 | -1'98 | ±0'068 | 42 |
| | Computed . . . | | 44'93 | | | |
| Losalli . . . | Observed . . . | 24 | 6 18'31 | -0'86 | ±0'093 | 43 |
| | Computed . . . | | 19'17 | | | |
| Tinsia . . . | Observed . . . | 24 | 6 29'11 | +1'14 | ±0'090 | 39 |
| | Computed . . . | | 27'97 | | | |
| Ahmadpur . . . | Observed . . . | 23 | 36 18'59 | -2'29 | ±0'073 | 35 |
| | Computed . . . | | 20'88 | | | |

TIDAL AND LEVELLING OPERATIONS.

NO. 25 PARTY.

325. The direction of these operations was in the hands of Lieutenant

Personnel.

Lieutenant H. L. Crosthwait R.E., Officiating Deputy Superintendent, 2nd grade, in charge, during the year.
 Mr. G. Belcham, Extra Deputy Superintendent, 2nd grade.
 „ E. J. Connor, Extra Assistant Superintendent, 3rd grade.
 „ J. Bond, Extra Assistant Superintendent, 3rd grade.
 „ J. P. Barker, Extra Assistant Superintendent, 6th grade.
 Syed Zille Hasnain, Sub-Assistant Superintendent, 3rd grade.

Surveyors, etc.

Dhondu Vinayek, Vinayek Narayan, 2 Native artificers, 15 Recorders, and computers.

H. L. Crosthwait, R.E., throughout the year. The head-quarters of the party was removed from Poona to Dehra Dún in March.

TIDAL OPERATIONS.

326. The automatic, recording of tidal curves by means of self-registering gauges, their reduction and the publication of Tide-Tables containing the predicted times and heights of High and Low water, have been continued during the year. The following is a list of stations at which tidal observations, have been and are still being taken: permanent stations are shown in italics.

| | STATION. | Automatic or Personal observations. | Date of commencement of observations. | Date of closing of observations. | No. of years of observations. | REMARKS. |
|-----|----------------------------------|-------------------------------------|---------------------------------------|----------------------------------|-------------------------------|----------------|
| 1 | Suez | Automatic . | 1897 | Still working. | 2 | |
| 2 | Perim | Ditto . | 1898 | Ditto | 1 | |
| 3 | Aden | Ditto . | 1879 | Ditto | 19 | |
| 4 | Muscat | Ditto . | 1893 | 1898 | 5 | |
| 5 | Bushire | Ditto . | 1898 | Still working. | 6 | |
| 6 | Karachi | Ditto . | 1881 | Ditto | 18 | |
| 7 | Hanstal | Ditto . | 1874 | 1875 | 1 | |
| 8 | Navánár | Ditto . | 1874 | 1875 | 1 | |
| 9 | Okha Point | Ditto . | 1874 | 1875 | 1 | |
| 10 | Porbandar | Personal . | 1893 | 1894 | 2 | |
| 10A | „ | Automatic . | 1898 | Still working. | 1 | |
| 11 | Port Albert Victor (Káthiáwádar) | Personal . | 1881 | 1882 | 1 | |
| 11A | „ „ („) | Automatic . | ... | ... | ... | To be started. |
| 12 | Bhávnagar | Ditto . | 1889 | 1894 | 5 | |
| 13 | Bombay (Apollo Bandar) | Ditto . | 1878 | Still working. | 21 | |
| 14 | Bombay (Prince's Dock) | Ditto . | 1888 | Ditto | 11 | |
| 15 | Mormugáo (Goa) | Ditto . | 1884 | 1889 | 5 | |
| 16 | Kárwár | Ditto . | 1878 | 1883 | 5 | |
| 17 | Beyypore | Ditto . | 1878 | 1884 | 6 | |
| 18 | Cochin | Ditto . | 1886 | 1898 | 6 | |
| 19 | Tyticorin | Ditto . | 1888 | 1893 | 5 | |
| 20 | Minicoy | Ditto . | 1891 | 1896 | 5 | |
| 21 | Galle | Ditto . | 1884 | 1890 | 6 | |
| 22 | Colombo | Ditto . | 1884 | 1890 | 6 | |
| 23 | Trincomalee | Ditto . | 1890 | 1896 | 6 | |
| 24 | Pámban Pass | Ditto . | 1878 | 1889 | 4 | |

| STATION. | Automatic or Personal observations. | Date of commencement of observations. | Date of closing of observations. | No. of years of observations. | REMARKS. |
|-------------------------------------|-------------------------------------|---------------------------------------|----------------------------------|-------------------------------|-------------------------------|
| 25 Negapatam | Automatic | 1881 | 1888 | 6 | The year 1884-85 is excluded. |
| 26 Madras | Ditto | 1880 Restarted . 1895 | 1890 | to } 14 | |
| | | | Still working . | 4 } | |
| 27 Cocanada | Ditto . | 1886 | 1891 | 5 | |
| 28 Vizagapatam | Ditto . | 1879 | 1885 | 6 | |
| 29 False Point | Ditto . | 1881 | 1885 | 4 | |
| 30 Dublat (Saugor Island) | Ditto . | 1881 | 1886 | 5 | |
| 31 Diamond Harbour | Ditto . | 1881 | 1886 | 5 | |
| 32 Kidderpore | Ditto . | 1881 | Still working . | 18 | |
| 33 Chittagong | Ditto . | 1886 | 1891 | 5 | |
| 34 Akyab | Ditto . | 1887 | 1892 | 5 | |
| 35 Diamond Island | Ditto . | 1895 | Still working . | 4 | |
| 36 Elephant Point | Ditto . | 1880 | 1881 | 1 } 6 | |
| | Ditto . | 1884 | 1888 | 5 } | |
| 37 Rangoon | Ditto . | 1880 | Still working . | 19 | |
| 38 Amherst | Ditto . | 1880 | 1886 | 6 | |
| 39 Moulmein | Ditto . | 1880 | 1886 | 6 | |
| 40 Mergui | Ditto . | 1889 | 1894 | 5 | |
| 41 Port Blair | Ditto . | 1880 | Still working . | 19 | |

327. No tidal observatory was closed during the year under report. The observatory at Port Albert Victor will be opened during the ensuing field season, the building work having been completed; and that at Diamond Island will be closed.

328. In addition to the automatic registrations made during the year at the 13 stations enumerated above, personal tidal observations on graduated staves were taken at Bhávnagar, Tuticorin, Colombo, Chittagong, Akyab, and Moulmein, with the object of comparing the actual times and heights of high and low water with those predicted in the tide-tables. No such observations have been made at any of the other closed stations since the automatic registrations ceased, and it is not known if the predictions continue accurate. The scheme for checking tidal predictions at closed ports as noticed in last year's report, was sanctioned and put into operation during the past year.

Surveyor Dhondu Vinayek is at present engaged in erecting tide-poles at the ports which were selected for this purpose, viz., Vizagapatam, Cocanada, Negapatam, and Cochin. It will be necessary to wait until all effects of the monsoon cease in order to get reliable observations at these ports.

329. All the tidal observatories in operation during the year were inspected, either by Lieutenant Crosthwait or by Mr. Belcham; portable meteorological instruments being taken by them for testing those working locally.

330. With one exception, Porbandar, the tidal observatories have worked satisfactorily. At Porbandar registrations ceased altogether from the 21st July, owing to the mouth of the pipe being covered with sand, brought in by the monsoon. This will be remedied during the ensuing field season.

331. The reduction of the tidal observations has been carried on steadily during the year: observations for the year 1898 at 13 tidal stations were reduced, and there are no arrears. The usual work in connection with the preparation of tide-tables for 1900 has been satisfactorily gone through; they will contain predictions, of high and low water times and heights, for 39 ports.

332. In the following statements, are summarised the percentage of error in the predicted times and heights of high and low water for the last nine years:—

PERCENTAGE OF ERROR IN PERIODICAL TIMES AND HEIGHTS AT OPEN COAST STATIONS FROM AUTOMATIC OBSERVATIONS.

| YEAR. | No. of stations. | IN TIME. | | IN HEIGHT. | | | |
|------------------------------|------------------|-------------------------------|-------|-----------------------------|-------|--|-------|
| | | Within 15 minutes of Actuals. | | Within 8 inches of Actuals. | | Within $\frac{1}{2}$ of mean range at Springs. | |
| | | H. W. | L. W. | H. W. | L. W. | H. W. | L. W. |
| 1890 | 13 | 69 | 70 | 95 | 93 | 91 | 91 |
| 1891 | 10 | 74 | 73 | 94 | 87 | 98 | 97 |
| 1892 | 8 | 75 | 74 | 91 | 85 | 98 | 98 |
| 1893 | 9 | 73 | 68 | 93 | 98 | 96 | 95 |
| 1894 | 10 | 65 | 62 | 95 | 92 | 97 | 95 |
| 1895 | 9 | 68 | 65 | 98 | 97 | 94 | 94 |
| 1896 | 9 | 71 | 70 | 97 | 97 | 97 | 93 |
| 1897 | 8 | 71 | 75 | 96 | 97 | 97 | 97 |
| 1898 | 9 | 74 | 70 | 96 | 96 | 95 | 95 |
| Average of 9 years | 9 | 71 | 70 | 95 | 94 | 96 | 95 |

PERCENTAGE OF ERROR IN PERIODICAL TIMES AND HEIGHTS AT RIVERAIN STATIONS FROM AUTOMATIC OBSERVATIONS.

| YEAR. | No. of stations. | IN TIME. | | IN HEIGHT. | | | |
|------------------------------|------------------|-------------------------------|-------|-----------------------------|-------|--|-------|
| | | Within 15 minutes of Actuals. | | Within 8 inches of Actuals. | | Within $\frac{1}{2}$ of mean range at Springs. | |
| | | H. W. | L. W. | H. W. | L. W. | H. W. | L. W. |
| 1890 | 3 | 53 | 55 | 64 | 63 | 90 | 86 |
| 1891 | 3 | 64 | 58 | 66 | 66 | 92 | 92 |
| 1892 | 2 | 61 | 60 | 72 | 65 | 94 | 95 |
| 1893 | 2 | 57 | 57 | 68 | 50 | 89 | 84 |
| 1894 | 2 | 56 | 55 | 66 | 42 | 88 | 80 |
| 1895 | 2 | 59 | 55 | 74 | 47 | 94 | 84 |
| 1896 | 2 | 56 | 55 | 63 | 42 | 87 | 74 |
| 1897 | 2 | 59 | 61 | 75 | 57 | 96 | 91 |
| 1898 | 2 | 53 | 59 | 71 | 61 | 90 | 91 |
| Average of 9 years | 2 | 58 | 57 | 69 | 54 | 91 | 86 |

333. A further investigation of the meteorological conditions, which prevail in the Persian Gulf, has been carried out. The records of wind velocity for three complete years have been analysed and compared with the errors of prediction for a corresponding period. It is conclusively proved that wind produces a considerable effect on tides in the Gulf. The diagrams prepared indicate that large errors of prediction are almost always accompanied by a high wind velocity. Though this is not an invariable rule, it is believed it would prove to be so were there sufficient observing stations, to judge of the wind's true force and direction over a large area. At present only the local record at Bushire is available. A slight variation from the normal in the strength of the wind produces a much larger effect in the Persian Gulf than at

other stations, due no doubt to the small depth of the sea. The large daily variations in mean sea-level at Bushire seems also to point to the abnormal influence of wind in the Persian Gulf. The wind exhibits no regular cycle, so far as can be judged from the three years under analysis. The following table shows the state of affairs as regards errors of prediction in times and heights :—

PERCENTAGE OF ERROR IN PREDICTED TIMES AND HEIGHTS AT BUSHIRE OPEN COAST STATION.

| YEAR. | No. of stations. | IN TIME. | | IN HEIGHT. | | | |
|---------------------------------|------------------|-------------------------------|-------|-----------------------------|-------|---|-------|
| | | Within 15 minutes of Actuals. | | Within 8 inches of Actuals. | | Within $\frac{1}{10}$ of mean range at Springs. | |
| | | H. W. | L. W. | H. W. | L. W. | H. W. | L. W. |
| 1895 . . . | | 45 | 41 | 80 | 54 | 69 | 45 |
| 1896 . . . | | 58 | 44 | 77 | 70 | 73 | 62 |
| 1897 . . . | | 57 | 37 | 85 | 88 | 78 | 81 |
| 1898 . . . | | 67 | 47 | 84 | 82 | 74 | 72 |
| Mean of 4 years. | | 57 | 42 | 82 | 74 | 74 | 65 |
| Average at Open Coast Stations. | 9 | 71 | 70 | 95 | 94 | 96 | 95 |

SPIRIT LEVELLING. OPERATIONS.

334. The regular levelling operations, which had been suspended last year, to permit of the detachment being employed on revisionary triangulation in Assam, were again resumed and carried on by Mr. Bond. The programme for the year, was to complete the great line of levels from Vizagapatam to Allaha-bad, and then to carry a branch line from Katni along the Indian Midland Railway to Kethora and thence to the two ends of the Sironj Base Line, connecting *en route* trigonometrical stations of the Calcutta Longitudinal, Amua Meridional and Karára Meridional, Series.

335. The detachment left Poona on the 30th October 1898 and returned to head-quarters at Dehra Dún on the 4th June 1899, after completing the whole of the programme.

336. The total rises and falls amounted to 11,634 feet and the outturn to 378½ miles of double levelling, in the course of which the instrument was set up at 3,727 stations and the heights of 33 embedded bench-marks, 331 permanent bench-marks, 94 Railway bench-marks, 11 Public Works Department bench-marks, and 8 Stations of the Great Trigonometrical Survey (including the ends of the Sironj Base Line) were determined.

337. During the next field season levelling operations will be commenced from Calcutta to Siliguri, which will be extended to Assam in after years. A detachment will also work on the branch lines of Eastern Bengal State Railway, Manihári Ghát, Achnera Ghát, Katihár-Bársoi, Bársoi-Kishanganj, Bársoi-Pár-batipur, Porádaha-Faridpur; this latter work will be undertaken at the request and expense of the Railway in question.

338. In addition to the regular departmental work of the tidal and level-ling party, a considerable amount of extra work had to be undertaken in order to furnish other departments and Local Governments with information applied for by them.*

*Lieutenant Crosthwait reports favourably of Messrs. Belcham and Connor, and Surveyor Dhondu Venayek of the Tidal Section, and of Mr. Barker and Munshi Syed Zille Hasnain employed with the levelling detachment. The staff of computers and mechanics is also well reported on.

Summary of the outturn of work of the

| SCALE OF SURVEY. | Number of Party. | LOCALS OF FIELD OPERATIONS. | TRIANGULATION. | | | | | | | | | | SPIRIT-LEVELLING OPERATIONS. | | | | | | | |
|---------------------------------|---|---------------------------------------|--------------------------------------|-----------------------|---|------------------------------|--------------------------|------------------------------|-------------------------|-----------------|------------------------------|-------------------------|------------------------------|-------------------------|----------------------|---------------------------------------|--|-----|-----|-----|
| | | | Instrument used. Diameter in inches. | Area in square miles. | Square miles to each point trigonometrically fixed. | Square miles to each height. | 1ST CLASS TRIANGULATION. | | | SECONDARY. | | | TERTIARY. | | Miles levelled over. | Permanent bench-mark stones embedded. | Trigonometrical stations connected with. | | | |
| | | | | | | | Stations fixed. | Triangular error in seconds. | Error per mile in feet. | Stations fixed. | Triangular error in seconds. | Error per mile in feet. | Intersected points. | Error per mile in feet. | | | | | | |
| Inches to a mile. 64 | 4 Land Records Survey | Darbhanga City | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| | | Naini Tal | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | TOTAL | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| 16 | 2 & 8 4 7 16 17 Land Records Survey. | Farrukhabad | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| | | Etawah | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Mainpuri | 5 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Etah | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Azamgarh | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Gonda | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Sáran | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Darbhanga | 10 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Muzaffarpur | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Patna | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Sháhabad | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Sonthal Parganas | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Ballia | 15 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Myingyan | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Toungoo | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Ditto Revisions | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Betul Excisions | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Chhindwára Excisions | 20 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Ditto Jagirs | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Biláspur Estate | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Maymyo Town | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Bombay Forests | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Biláspur | 25 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Chhindwára | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Nágpur and Wardha | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Chánda | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Seoni | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Sambalpur | 30 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Saugor | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Bareilly | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Pilibhit | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Do. (Bisalpur Tahsil) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Farrukhabad | 35 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Kheri | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Azamgarh | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Gonda | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| TOTAL | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| 12 | 15 | Attock | ... | 6 | 21 | 0'14 | 0'14 | ... | ... | ... | 11 | 13'9 | 0'22 | 146 | 0'55 | ... | ... | ... | | |
| 8 | 17 20 | Bombay Forests | 40 | 7 | 415 | ... | ... | ... | ... | ... | 193 | 11'5 | 0'28 | 1,468 | 0'41 | ... | ... | ... | | |
| | | Burma Forests | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| TOTAL | ... | ... | 415 | ... | ... | ... | ... | ... | ... | 193 | ... | ... | 1,468 | ... | ... | ... | ... | ... | | |
| 6 | 15 12 | Ráwalpindi | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| | | Quetta Sor Range, Coal Mines. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Sind | ... | 6 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| TOTAL | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| 4 | 9 & 19 17 | Kurnool | 45 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| | | Cuddapah | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | North Coimbatore | 7 & 5 | 950 | 1'6 | 1'6 | 11 | 12'5 | 0'32 | 79 | 17'2 | 0'34 | 261 | 0'50 | ... | ... | ... | ... | | |
| | | Salem | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | South Arcot | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| Madura | 50 | 6 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | |
| Bombay Forests | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | |
| Carried over | ... | ... | 950 | ... | ... | 11 | ... | ... | 79 | ... | ... | 261 | ... | ... | ... | ... | ... | | | |

Field Parties during the year 1898-99.

| | TRAVERSING. | | | | DETAIL SURVEY. | | | | | RECORD-WRITING. | | | REMARKS. |
|-----|-----------------------|--|---------------------------------------|------------------------|-----------------------|--------------------------------------|-----------------------------|-----------|-------------------------|-----------------------|-----------|--------------|--|
| | Area in square miles. | Number of Stations at which the theodolite was set up. | Angular error per station in seconds. | Linear error per mile. | Area in square miles. | Plane-table fixings per square mile. | Linear miles of test lines. | Villages. | Average size of fields. | Area in square miles. | Villages. | Fields. | |
| ... | 7 | 3,189 | ... | ... | 4 | ... | 5 | 37 | ... | 4 | 37 | 32,000 | 57 square miles = 61 villages surveyed topographically on the 16-inch scale. 2 square miles = 3 villages of Revelganj city survey. 2 square miles = 8 villages = 12,990 holdings of Chapra city survey. (b) Includes Revision of Khanapuri of 22 square miles = 24 villages = 23,462 fields. (c) Includes 11 square miles = 11 villages, surveyed topographically on the 16-inch scale. (d) Includes 39 square miles = 18 villages surveyed topographically on the 16-inch scale. (e) Topographical survey on the 16-inch scale. (f) Of cultivated area only. |
| ... | ... | ... | ... | ... | 21 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 7 | 3,189 | ... | ... | 25 | ... | 5 | 37 | ... | 4 | 37 | 32,000 | |
| ... | 188 | 3,790 | 10 | 0'31 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 846 | 14,515 | 9 | 0'30 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 5 | 695 | 10,950 | 0'5 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 771 | 11,716 | 0'5 | 0'13 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 896 | 19,028 | 11 | 0'03 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 404 | 5,206 | 17 | 0'03 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 267 | 7,745 | ... | ... | 609(a) | ... | 3,808 | 1,138(a) | 0'30 | 550 | 1,074 | 1,170,441(a) | |
| ... | 10 | 619 | 13,584 | ... | 684 | ... | 2,715 | 916 | 0'38 | 706(b) | 940(b) | 1,154,726(b) | |
| ... | ... | ... | ... | ... | 5 | ... | 14 | 4 | ... | 5 | 4 | 4,435 | |
| ... | ... | ... | ... | ... | 40(c) | ... | 162 | 21(e) | 1'67 | 29 | 10 | 11,238 | |
| ... | 14 | 181 | ... | ... | 65(d) | ... | 202 | 20(d) | 1'81 | 26 | 8 | 9,133 | |
| ... | 720 | 26,818 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 15 | ... | ... | ... | 13(e) | ... | 38 | 5 | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 109 | ... | 441 | 93 | 1'38 | ... | ... | 50,422 | |
| ... | ... | ... | ... | ... | 665 | ... | 1,645 | 361 | ... | ... | ... | 312,684 | |
| ... | ... | ... | ... | ... | 46 | ... | 67 | 90 | 0'38(f) | ... | ... | 52,956 | |
| ... | ... | ... | 7 | 0'9 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 20 | 91 | 2,225 | 11 | 0'9 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 56 | 1,437 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 300 | 4,602 | 5 | 1'0 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 31 | 253 | 14 | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 8 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 55 | ... | ... | 179 | ... | ... | ... | ... | |
| ... | 25 | ... | ... | ... | 15 | ... | 85 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 89 | ... | 255 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 10 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 36 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 86 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 145 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 30 | ... | ... | ... | 25 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 65 | ... | 110 | 156 | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 345 | ... | 1,550 | 430 | ... | 430 | ... | 392,944 | |
| ... | ... | ... | ... | ... | 425 | ... | 1,958 | 511 | ... | 494 | ... | 265,536 | |
| ... | ... | ... | ... | ... | 162 | ... | 762 | 298 | ... | 247 | ... | 130,748 | |
| ... | 35 | ... | ... | ... | 867 | ... | 2,897 | 976 | ... | 867 | 976 | 642,953 | |
| ... | ... | ... | ... | ... | 274 | ... | 1,158 | 151 | ... | 284 | 151 | 110,204 | |
| ... | ... | ... | ... | ... | 587 | ... | ... | 1,443 | 0'28 | ... | 1,223 | 1,016,674 | |
| ... | ... | ... | ... | ... | 623 | ... | 2,935 | 567 | ... | ... | 817 | 1,426,300 | |
| ... | 5,904 | 122,053 | ... | ... | 5,918 | ... | 20,508 | 7,209 | ... | 2,467 | 6,374 | 6,757,399 | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 40 | ... | 85 | 0'1 | 0'07 | 254 | 203 | 146 | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 174 | ... | 200 | ... | ... | ... | ... | ... | |
| ... | ... | ... | 85 | ... | ... | 255'4 | ... | 146 | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 158 | ... | 152 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 29 | ... | 98 | ... | ... | ... | ... | ... | |
| ... | 37 | ... | ... | ... | 36 | 83 | in situ. | ... | ... | ... | ... | ... | |
| ... | 37 | ... | ... | ... | 223 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 45 | ... | ... | ... | 303 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 334 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 688 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 2 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 10 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 50 | ... | ... | ... | 13 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | 1,236 | 0'05 | 0'09 | 429 | 101 | ... | ... | ... | ... | ... | ... | |
| ... | ... | 6,649 | ... | ... | 1,779 | ... | 276 | ... | ... | ... | ... | ... | |

Summary of the outturn of work of the

| SCALE OF SURVEY. | Number of Party. | LOCALE OF FIELD OPERATIONS. | TRIANGULATION. | | | | | | | | | | SPIRIT-LEVELLING OPERATIONS. | | | | | |
|-------------------------------------|--|--|--------------------------------------|-----------------------|---|------------------------------|--------------------------|------------------------------|-------------------------|-----------------|------------------------------|-------------------------|------------------------------|-------------------------|----------------------|---------------------------------------|--|-----|
| | | | Instrument used. Diameter in inches. | Area in square miles. | Square miles to each point trigonometrically fixed. | Square miles to each height. | 1ST CLASS TRIANGULATION. | | | SECONDARY. | | | TERTIARY. | | Miles levelled over. | Permanent bench-mark stones embedded. | Trigonometrical stations connected with. | |
| | | | | | | | Stations fixed. | Triangular error in seconds. | Error per mile in feet. | Stations fixed. | Triangular error in seconds. | Error per mile in feet. | Intersected points | Error per mile in feet. | | | | |
| Inches to a mile. 4 | 18 20 Forest Branch | Brought forward | ... | 950 | ... | 11 | ... | 79 | ... | 261 | ... | ... | ... | ... | ... | ... | ... | |
| | | Himálaya (District Kángra). | 7 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Burma Forests | 6 | 1,200 | 63 | 63 | ... | ... | 18 | 10 | 1'3 | 2 | ... | ... | ... | ... | ... | ... |
| | | Biláspur | 5 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Chhindwára | 55 | 7 | 425 | 5'1 | 4'7 | ... | ... | 9 | 3 | 0'23 | 75 | 1'0 | ... | ... | ... | ... |
| | | Nágpur and Wardha | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Chánda | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Seoni | ... | 7 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Sambalpur | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Saugor | 60 | 7 | 400 | 23'5 | 20'0 | ... | ... | 12 | ... | ... | 5 | 0'5 | ... | ... | ... | ... |
| | | Chámba | 7 | 267 | 2'8 | ... | ... | ... | ... | 39 | 10 | 0'7 | 257 | 1'0 | ... | ... | ... | ... |
| | | Montgomery | ... | 5 & 5½ | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | Lower Burma (Tenasserim). | ... | 4½ & 5½ | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Upper Burma (Pyinmana). | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| Upper Burma (Ruby Mines). | 65 | 5½ & 7 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| TOTAL | | ... | 3,242 | ... | 11 | ... | 157 | ... | 600 | ... | ... | ... | ... | ... | ... | ... | | |
| 2 | 2 & 8 4 6 12 15 18 20 | Jhánsi (Lalitpur Sub-division)-Sháhjahánpur | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Kheri | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Champáran | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Sibságar | 70 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Lakhimpur | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Nowgong | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Sylhet | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Sind | 8 | 761 | ... | ... | ... | ... | 45 | 47 | 0'4 | 70 | 1'3 | ... | ... | ... | ... | |
| | | Gilghit, Kashmir, and Landi Khel. | 75 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| | | Himálaya | 7 | 315 | 2'0 | 2'0 | ... | ... | 23 | 15'5 | 0'5 | 90 | 0'7 | ... | ... | ... | ... | |
| Burma Forests | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| TOTAL | | ... | 1,076 | ... | ... | ... | 68 | ... | 160 | ... | ... | ... | ... | ... | ... | ... | | |
| 1 | 3 10 11 14 15 21 Forest Branch | Lower Burma (Promé, Henzada, Thayetmyo, Sandoway, and Kyaukse). | 6 | 3,512 | 118 | 146 | ... | ... | 30 | 6 | 0'2 | 265 | 0'5 | ... | ... | ... | ... | |
| | | Upper Burma (Mandalay, Kyaukse, Meiktila, Yaméthin, and S. Shan States). | 6 | 2,798 | 6'2 | 7'5 | ... | ... | 41 | 8'6 | 0'22 | 470 | 0'7 | ... | ... | ... | ... | |
| | | Upper Burma (Myelat, Lawk Sawk, S. Shan States). | 80 | 6 | 3,234 | 7'7 | 8 | ... | ... | 64 | 15 | 0'36 | 341 | 0'7 | ... | ... | ... | |
| | | Lushai | 7 & 6 | 2,473 | ... | ... | 8 | 7 | 0'23 | 43 | 14 | 0'29 | 411 | 1'4 | ... | ... | ... | |
| | | Sind | 6 & 8 | 2,765 | 18 | 18 | ... | ... | 42 | 6'7 | 0'11 | 132 | 0'6 | ... | ... | ... | ... | |
| | | Upper Burma, North Shan States. | 6 | 3,410 | 11'3 | 15'7 | ... | ... | 47 | 8'9 | 0'32 | 344 | 1'1 | ... | ... | ... | ... | |
| | | Chamba | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | | South Section, Boundary Commission. | 85 | ... | 4,724 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| North Section, Boundary Commission. | ... | ... | 4,000 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| TOTAL | | ... | 26,922 | ... | 8 | ... | 267 | ... | 1,893 | ... | ... | ... | ... | ... | ... | ... | | |
| ½ | 15 | Gilghit, Kashmir, Dir, Chitral. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ½ | 15 21 25 | Siatán, Dir, Chitral, Upper Burma (Yunnan) India | 6 | 16,000 | 34 | ... | ... | 191 | 23'1 | 0'52 | ... | ... | ... | ... | ... | ... | | |
| | | South Section, Boundary Commission. | 90 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 378 | 33 | 8 | |
| | | North Section, Boundary Commission. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| TOTAL | | ... | 16,000 | ... | ... | ... | 191 | ... | 378 | 33 | 8 | ... | ... | ... | ... | ... | | |
| GRAND TOTAL | | ... | 47,676 | ... | 19 | ... | 887 | ... | 4,267 | ... | 378 | 33 | 8 | ... | ... | ... | | |

Field Parties during the year 1898-99—(contd.).

| | TRAVERSING. | | | | DETAIL SURVEY. | | | | | RECORD-WRITING. | | | REMARKS. |
|-----|-----------------------|--|---------------------------------------|------------------------|-----------------------|-------------------------------------|-----------------------------|-----------|-------------------------|-----------------------|-----------|-----------|--|
| | Area in square miles. | Number of stations at which the theodolite was set up. | Angular error per station in seconds. | Linear error per mile. | Area in square miles. | Planetable fixings per square mile. | Linear miles of test lines. | Villages. | Average size of fields. | Area in square miles. | Villages. | Fields. | |
| ... | ... | 6,649 | ... | ... | 1,779 | ... | 276 | ... | ... | ... | ... | ... | (g) Includes 32 square miles of Forest. |
| ... | ... | ... | ... | ... | 156(g) | 112 | in situ. | ... | ... | ... | ... | ... | |
| ... | 186 | 9,078 | 6'8 | 0'07 | 472 | 225 | 212 | ... | ... | ... | ... | ... | |
| ... | ... | 252 | 7 | 0'38 | 212 | 93 | 10 & in situ. | ... | ... | ... | ... | ... | |
| 55 | ... | ... | ... | ... | 253 | 280 | 112 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 26 | 173 | 46 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 270 | 254 | 35 | ... | ... | ... | ... | ... | |
| ... | ... | 286 | 12 | 0'17 | 263 | 187 | 36 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 184 | 241 | 50 | ... | ... | ... | ... | ... | |
| 60 | ... | ... | ... | ... | 246 | 110 | 56 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 100 | 146 | in situ. | ... | ... | ... | ... | ... | |
| ... | ... | 2,085 | 6 | 0'09 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | 1,431 | 7 | 0'1 | 198 | 82 | 131 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 48 | 273 | 16 | ... | ... | ... | ... | ... | |
| 65 | ... | 1,368 | 9 | 0'65 | 131 | 285 | 72 | ... | ... | ... | ... | ... | |
| ... | 186 | 21,149 | ... | ... | 4,338 | ... | 1,052 | ... | ... | ... | ... | ... | (h) Includes 260 square miles of Forest. |
| ... | ... | ... | ... | ... | 30 | ... | ... | 111 | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 94 | ... | ... | 46 | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 40 | ... | ... | 7 | ... | ... | ... | ... | |
| ... | 95 | 872 | ... | ... | 95 | ... | ... | ... | ... | ... | ... | ... | |
| 70 | 1,018 | 6,120 | 3'8 | 0'24 | 1,049 | 8 | 111 | ... | ... | ... | ... | ... | |
| ... | 35 | ... | ... | ... | 95 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 23 | 2,141 | 3'7 | 0'21 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 3,850 | 15,939 | 3'7 | 7'4 | 2,813 | 18 | in situ. | ... | ... | ... | ... | ... | |
| 75 | ... | ... | ... | ... | 271 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 622(h) | 34'5 | in situ. | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 87 | 141 | 9 | ... | ... | ... | ... | ... | |
| ... | 5,021 | 25,072 | ... | ... | 5,196 | ... | 120 | 164 | ... | ... | ... | ... | |
| ... | 291 | 2,936 | 4 & 5 | ... | 1,963 | 5'2 | 100 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 2,338(i) | 5'2 | 193 | ... | ... | ... | ... | ... | |
| 80 | ... | ... | ... | ... | 2,524(j) | 8'5 | 69 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 649 | 2'7 | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 1,320 | 5 | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 1,134 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 953 | ... | ... | ... | ... | ... | ... | ... | |
| 85 | ... | ... | ... | ... | 915 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 1,300 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 291 | 2,936 | ... | ... | 13,096 | ... | 362 | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 2,043 | 2 | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 26,274 | ... | ... | ... | ... | ... | ... | ... | |
| 90 | ... | ... | ... | ... | 26,850 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 4,216 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 7,500 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 64,840 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 11,446 | 174,484 | ... | ... | 95,934'4 | ... | 22,193 | 7,410 | ... | 2,471 | 6411 | 6,789,399 | |

several Field Parties during the year 1898-99.

| | COST-RATE PER ACRE. | COST-RATE PER SQUARE MILE. | | | Total cost, inclusive of charges for instruments to Provincial Governments. | REMARKS. |
|-----|---|----------------------------|----------------------|--|---|--|
| | *** Cadastral Survey, including traversing, detail survey, and mapping. | Stone embedding. | Records (Khanapuri). | Completion of Vernacular records assessment statistics, etc. | | |
| | Annas. | ₹ | ₹ | ₹ | ₹ | |
| ... | ... | ... | ... | ... | 81,915 | |
| ... | ... | ... | ... | ... | 61,736 (a) | (a) Includes ₹7,048 expended on completion of records; ₹1,993 on 2-inch mapping of local agency survey; ₹4,210 on field statistics; ₹2,500 on training of officers; and ₹50 on miscellaneous work for local officers. |
| ... | ... | ... | ... | ... | 7,514 (b) | |
| ... | ... | ... | ... | ... | 86,135 (c) | (b) Includes ₹4,595, cost of revision survey in District Cachar; ₹350 on 2-inch mapping; and ₹1,835 on demarcation. |
| 5 | ... | ... | ... | ... | 90,896 (d) | (c) Includes ₹11,925 expended on Maymyo Town Survey on 16-inch scale. |
| ... | ... | ... | ... | ... | 93,717 (e) | (d) Includes ₹9,803 expended on Burma-China Boundary Survey. |
| ... | ... | ... | ... | ... | 111,668 (h) | (e) Includes ₹8,814 expended on mapping. |
| ... | ... | ... | ... | ... | | (f) Rate of network triangulation. |
| ... | ... | ... | ... | ... | | (g) Rate of 1st class secondary triangulation. |
| 10 | ... | ... | ... | ... | 114,864 (i) | (h) Includes ₹1,228 expended on the Survey of Aijal on the 24-inch scale. |
| ... | ... | ... | ... | ... | | (i) Includes ₹7,415 expended on traversing. |
| ... | ... | ... | ... | ... | 71,700 (j) | (j) Includes ₹704 expended on Survey of Nahan Town and Cantonment; ₹14,407 for arrears of mapping, and ₹3,844 on instruction. |
| ... | ... | ... | ... | ... | 92,725 | |
| ... | ... | ... | ... | ... | | (k) Includes ₹1,635, cost of Survey in District Salem. |
| ... | ... | ... | ... | ... | | (l) Includes ₹232 expended on Bashahr mapping. |
| ... | ... | ... | ... | ... | 43,926 | |
| 15 | ... | ... | ... | ... | 31,299 | (m) Includes ₹719 expended on diara Topographical Survey; ₹4,478 on Chapra City Survey; ₹877 on Shitab diara village Survey; ₹9,545 on 2-inch Topographical Survey of 95 square miles in District Champaran, and ₹1,687 on badars, and ₹2,028 on Bihar badars. |
| ... | ... | ... | ... | ... | 24,548 (k) | |
| ... | ... | ... | ... | ... | 496 | |
| ... | ... | ... | ... | ... | 241 | (n) Includes ₹2,497 on arrears of work; ₹1,511 on badars; ₹5,925 on Darbhanga City Survey; ₹1,831 on revision of Khanapuri; ₹426 on Muzaffarpur work; ₹100 on Shahabad Cadastral work; ₹789 on demarcation in Kachna Mahal; ₹238 on Shahabad diara Topographical Survey; ₹1,647 on Patea diara; ₹611 on Ballia; ₹300 on Gaya arrears; ₹120 on Patna diara; ₹158 on Patna Ghat Survey; ₹1,034 on Orissa badars, and ₹575 on Roshnabad badars. |
| 20 | ... | ... | ... | ... | 69,288 | |
| ... | ... | ... | ... | ... | 123,260 | |
| ... | ... | ... | ... | ... | 79,100 | (o) Includes ₹716 on Bhagalpur-Nepal Boundary Survey; ₹48 on Bindadiara Village Survey; and ₹6,506 on Khurda badars. |
| ... | ... | ... | ... | ... | 16,726 (l) | |
| ... | ... | ... | ... | ... | 42,311 | (p) Includes ₹9,946, cost of Revision Survey of 46 square miles = 90 villages = 52,956 fields, giving a rate of ₹2162 per square mile. |
| ... | 270 | ... | 590 | ... | 101,248 (m) | (q) Includes ₹58,115 expended on arrears of work in Districts Shwebo, etc. |
| 25 | 241 | 17 | 840 | ... | 140,870 (n) | (r) Includes ₹1,055 debitable to North-Western Provinces Government for work done in Bulandshahr, etc., ₹6,325, cost of 2-inch detail survey of 164 square miles in District Jhansi, Shahjahanpur and Kheri giving a rate of ₹385 per square mile; and ₹13,447 cost of North-Western Provinces Drawing Office. |
| ... | ... | ... | ... | ... | 39,963 (o) | |
| ... | 340 | ... | ... | ... | 100,352 (p) | |
| ... | 519 | ... | ... | ... | 80,743 (q) | |
| ... | ... | 23 | ... | ... | 120,557 (r) | |
| 35 | ... | 12 | ... | ... | 20,543 | |

Particulars of Cadastral Surveys completed since 1897-98.

| DISTRICT. | Scale of survey. | Number of villages. | Number of fields. | Area surveyed in square miles. | Average size of fields in acres. | Cost, exclusive of demarcation and charge for instruments. | RATE PER SQUARE MILE. | | | By whom and when surveyed. |
|--------------------|------------------|---------------------|-------------------|--------------------------------|----------------------------------|--|-----------------------|-------------------|---|--|
| | | | | | | | Traverse survey. | Cadastral survey. | Cadastral survey with record-of-rights. | |
| Bareilly | 16" = 1 mile | 2,109 | 1,622,490 | 1,580 | 0.62 | R 1,59,331 | R a. p. 27 1 2 | ... | R a. p. 73 12 4 | Traverse survey done by Mr. J. S. Pemberton during 1895-97. Cadastral survey done by Land Records Surveys. |
| Kheri | " | 1,752 | 1,940,020 | 2,551 | 0.84 | 2,16,461 | 31 6 0 | ... | 53 7 6 | Traverse survey done by Captain J. M. Fleming and Mr. J. S. Pemberton during 1895-98. Cadastral survey done by Land Records Surveys. |

PART III.

THE OPERATIONS AT THE HEAD-QUARTERS OFFICES.

339. These offices comprise—

- (1) The Head-Quarters Offices at Calcutta.
- (2) The Trigonometrical Branch Office at Dehra Dún.
- (3) The North-Western Frontier Drawing Office.
- (4) The Forest Survey Branch Office at Dehra Dún.

A description of the work carried on in each office is given below :—

I.—HEAD-QUARTERS OFFICES, CALCUTTA.

SUPERINTENDENCE, CORRESPONDENCE, AND ACCOUNTS.

Superintendence.

Major-General C. Strahan, R.E., Surveyor-General of India.
 Lieutenant-Colonel J. R. Hobday, I.S.C., Deputy Surveyor-General, in charge Revenue Branch.
 Major S. G. Burrard, R.E., Assistant Surveyor-General, from 31st October 1898 to 4th February 1899.
 Captain P. J. Gordon, I.S.C., Officiating Assistant Surveyor-General, from 23rd May 1899 to the close of the year.
 Captain H. A. D. Fraser, R.E., Officiating Assistant Surveyor-General, from 1st to 13th October 1898, Lieutenant G. A. Beazeley, R.E., Officiating Assistant Surveyor-General, from 14th to 30th October 1898 and again from 5th February to 22nd May 1899.
 Mr. T. W. Babonau, Registrar, on leave, from 24th July 1899.
 „ T. A. Milne, Officiating Registrar, from 24th July 1899.

Correspondence.

Mr. T. A. Milne, Head Assistant.
 „ G. C. Walker, Head Clerk.
 Babu Kalipodo Banerji, Clerk.
 „ Beni Madhab Banerji, „
 „ Chuni Lal Dey, „
 „ Durga Narain Ghosh, „
 „ Ram Kristo Chunder, „
 Mr. H. E. D'Cruz, on leave.
 Babu Gopal Chunder Dass, Clerk.
 Babu Kali Kristo Chunder „
 and seven others.

Accounts.

Mr. C. O. Gray, Head Clerk.
 Babu Raj Krishna Mukerji, Clerk,
 Babu Hem Nath Dutt „
 and nine others.

340. The general direction of these offices remained in the hands of Major-General C. Strahan, R.E., throughout the year, and the Revenue Branch Section under Lieutenant-Colonel J. R. Hobday, I.S.C. The General and Topographical Branch Sections were under Captain H. A. D. Fraser, R.E., up to 13th October 1898, under Lieutenant G. A. Beazeley, R.E., from 14th to 30th October, and again from 5th February up to 22nd May 1899; under Major S. G. Burrard, R.E., from 31st October up to 4th February 1899, and under Captain P. J. Gordon, I.S.C., from 23rd May up to the close of the year.*

* The Assistant Surveyor-General reports as follows :—

The work of this office has been carried on satisfactorily under the respective heads of sections, amongst whom Mr. Gray is deserving of special mention for the willing way in which he has devoted himself to his work, both in and out of office hours.

DRAWING OFFICE.

341. The Drawing Office continued under the superintendence of Mr. A. E. Spring throughout the year.

SECTION I.—GEOGRAPHICAL, DRAWING, AND COMPILATION.

342. During the year, a few changes took place in the *personnel* of this section. Mr. A. J.

| <i>Personnel.</i> | |
|---|---|
| <p>Mr. W. Stotesbury, Chief Draftsman.</p> <p><i>Extra Assistant Superintendents and Sub-Assistant Superintendents on duty and European draftsmen.</i></p> <p>Mr. A. G. Wyatt, Extra Assistant Superintendent, 2nd grade.</p> <p>Mr. T. H. Rendell, Extra Assistant Superintendent, 3rd grade.</p> <p>Mr. J. A. Barker, Extra Assistant Superintendent, 4th grade, up to 5th October 1898.</p> <p>Mr. R. C. D. Ewing, Extra Assistant Superintendent, 4th grade, from 4th March.</p> <p>Mr. G. Campbell, Extra Assistant Superintendent, 5th grade.</p> <p>Mr. J. Murphy, Extra Assistant Superintendent, 5th grade, from 1st June.</p> <p>Mr. P. F. Prunty, Extra Assistant Superintendent, 5th grade, up to 12th June.</p> <p>Mr. S. O. Madras, Sub-Assistant Superintendent, 1st grade, up to 22nd April.</p> <p>Mr. P. K. Vaughan, Sub-Assistant Superintendent, 2nd grade, up to 26th May.</p> | <p>Mr. A. H. Psychers, Sub-Assistant Superintendent, 2nd grade, up to 31st October.</p> <p>Mr. C. C. Byrne, Sub-Assistant Superintendent, 3rd grade, up to 11th November.</p> <p>Mr. W. Green, Draftsman, up to 26th September.</p> <p>Mr. A. J. Musgrove, Draftsman.</p> <p>Mr. A. S. Bateman, Draftsman.</p> <p>Mr. A. J. Wilson, Draftsman, up to 3rd November.</p> <p>Mr. C. L. Green, Draftsman.</p> <p>" E. W. Stark, "</p> <p>" A. S. Nelson, "</p> <p>" J. Kitchen, " from 4th November 1898.</p> <p>Mr. E. B. West, Draftsman, from 27th September 1899.</p> <p style="text-align: center;"><i>Native Draftsmen.</i></p> <p>Babu Purna Chandar Sen.</p> <p>" Sarat Chandar Chatarji.</p> <p>" Narendra Nath Mukarji.</p> <p>" Subodh Chandar Sarkar.</p> <p>" Sarat Chandar Kumar and 28 others.</p> |

Wilson, a young and promising draftsman, died of malarious fever on the 2nd November 1898. Mr. W. Green retired on pension on the 9th September 1899, after a service of 37 years. He was a first class draftsman, and had for years been employed on drawing the sheets of the Atlas of India; he excelled in the art of hill shading by brushwork, and his loss will be very much felt in this section. Messrs. J. Kitchen and E.

B. West were appointed to the two last posts of draftsmen, which fell vacant by the death of Mr. Wilson and the retirement of Mr. W. Green.

343. The compilation, correction, and bringing up to date of the maps of the several frontier series was still carried on by this section, but during the year it was relieved of all work appertaining to the N.-W. Frontier, this work having been transferred to the N.-W. Frontier Drawing Office. The following sheets of the North-Eastern Frontier Series were taken in hand, brought up to date and published: 15 S. E. (6th edition), 22 S.-W. (2nd edition); all on the 4-mile scale, and sheets 22 (6th edition) and 23 (2nd edition), on the 8-mile scale, were also similarly treated, the first being published and the latter is having the hill drawing now completed. Of the South-Eastern Frontier Series sheets, 2 S.-E. (5th edition), 2 S.-W. (2nd edition), 4 N.-W. (6th edition), 5 S.-W. (6th edition), 6 N.-W. (7th edition) were also added to and published; and sheets 1 N.-E. (7th edition), 1 S.-E. (5th edition), 1 N.-W. (5th edition), 1 S.-W. (4th edition), 2 N.-E. (7th edition) were also taken in hand and are now ready for publication; all these sheets are on the 4-mile scale, those on the 8-mile which also had additions or corrections made thereto were, sheet 4 (2nd edition), sheets 5 and 6 (2nd edition), 7 (2nd edition), and 8 (2nd edition).

344. The standard sheets on the 1-inch scale, which were corrected and brought up to date as regards boundaries, railways, roads, etc., were of Assam, 4 sheets; Bengal, 6 sheets; Central India and Rájputána, 16 sheets; Central Provinces, 10 sheets; Hyderabad, 1 sheet; N.-W. Provinces 1 sheet; Upper Burma, sheets Nos. 305, 307, 315, 351, 352, 353, 358, 360, 361, 362, 306 (2nd edition), 304, 350, 398, 399, 402, and 458 were published during the year, and sheets Nos. 260 (2nd edition), 316, 400, 401, 403, 404, 405, 406, and 407 are now passing through the proof stage and will be published early next year. Sheets 313 and 314 had their boundaries corrected and brought up to date. Standard sheets on other scales which were examined and passed through to press, were 4 sheets, on the $\frac{1}{2}$ -inch scale of Assam; 4 sheets of Central India and Rájputána, on $\frac{1}{2}$ -inch scale; Punjab, 16 sheets on 2-inch scale, were completed and published and 6 sheets on the 2-inch scale are now under publication. Sheets on the 4-inch scale which were dealt with, added to and published, were Central Provinces,

1 sheet; Bombay, 1 sheet; Madras Forests, 54 sheets; N.-W. Provinces, 4 sheets, and Burma Forests, 26 sheets.

345. The sheets of the Atlas of India formed as usual a large part of the work of this section, as many as 123 of them had additions of railways, roads, canals or corrections to boundaries made to them, 14 of them having been brush-shaded and sent for engraving.

346. The General maps which were dealt with during the year are the 32-mile map of India (3rd edition) published; Afghánistán, 24-mile scale; Route map of the Western Himálayas, Kashmir, Punjab, and Northern India on the 32-mile scale, was brought up to date; Railway map of India on 32-mile scale, Railway map of India on 48-mile scale, India on 80-mile scale, India on 96-mile scale, and India on 128-mile scale were brought up to date and published. The Railway map of India on 32-mile scale, showing railway and steamer stations, mentioned in last year's report as having been put in hand, was completed and would have been published, but for the numerous additions made to it since it was in proof; these are now in hand and the map will be published early next year, the new Military and Canal maps of India on 32-mile scale are still under preparation.

Of the Provincial maps of India, mostly on the 16-mile scale, 41 were added to, corrected, and brought up to date, and those of the Bombay Presidency, Madras Presidency, and Punjab had the hills brush-shaded and sent for engraving. Of the Divisional maps 7 were brought up to date and 29 District maps on $\frac{1}{4}$ -inch and $\frac{1}{8}$ -inch scales were similarly dealt with, and 42 Administrative Report maps, mostly on $\frac{1}{8}$ -inch scale, were corrected to date, that of Kohát had the hills brush-shaded and sent for engraving.

Of the cantonment and city plans, 12 of them had corrections and additions made to them. The revision of the sheets of the Town of Calcutta, on the scale of 1 inch = 50 feet, was sanctioned by the Bengal Government, and during the year 18 sheets were revised and the new work tested by a Provincial Officer, 9 sheets were sent to press to have the zinc plates corrected and 2 sheets were published as 2nd editions. Of the index maps required to illustrate this report, 12 were prepared and 15 others were brought up to date. Besides this, 14 triangulation charts were examined and passed, 5 of them being published. As usual a large number of maps were prepared for other departments, 46 sheets were taken in hand, of these 6 being required by the Military Department for manœuvres; the postal map of Bengal being drawn on 4-mile scale for reduction to 8-mile scale, the postal map of Bihar also on the same scale: the Military Route map on 8-mile scale is also well advanced; 9 maps to illustrate Mr. G. A. Grierson's Linguistic Survey and one map for Mr. Forest's work on the Indian Mutiny.

347. The colouring of 1,986 maps as office copies and for other Departments was also accomplished. A large amount of professional data was extracted and supplied to various officers. During the year, all the clerical work in connection with the correspondence of this section, such as docketing, registering, recording, and copying was transferred from the correspondence section, Surveyor-General's Office, to this section, and this has been a very heavy job as 3,176 letters were received, replied to, and recorded during the past year.

SECTION II.—REVENUE.

348. The work of this section consists in examining and preparing for

Personnel.

Mr. E. P. S. Hill, Head Draftsman.

Extra Assistant and Sub-Assistant Superintendents on duty.

Mr. J. Murphy, Extra Assistant Superintendent, 5th grade, from 14th September 1899.

Mr. P. F. Prunty, Extra Assistant Superintendent, 6th grade, up to 3rd April 1899.

Mr. S. O. Madras, Sub-Assistant Superintendent, 1st grade, from 24th April 1899.

Mr. P. K. Vaughan, Sub-Assistant Superintendent, 2nd grade.

Native Draftsmen.

Munshi Abdul Aziz.

Abdur Razak.

Babu Tincowri Sen.

„ Bacharam Hanarji.

„ Ram Chandar Sen.

„ Harendra Krishna Gupta and 19 others

Sub-Surveyors, etc., on duty.

Babu Rhidoy Chandar Das.

photo-zincography, the fair maps received from the field parties of the Revenue Branch; in bringing up to date and republishing the old maps; in the preparation of the index maps for field parties, and for the General Report; in colouring maps on various scales, in tracing maps, furnishing plans and supplying data to Government officials and others. The examination of the field books, and azimuth computations, etc., on which the several Revenue Surveys are based, is also done in this section.

349. Of the maps of district Pesháwar (Punjab) reported on last year, in paragraph 373, the drawing of five sheets on scale 1-inch = 1 mile for reproduction to full scale was finished; two of them are

passing through press, the remaining three will be sent to press shortly. The compilation of sheets Nos. 108 and 134 which complete the district is in progress.

The maps of district Dera Gházi Khan (Punjab), in twenty sheets, were corrected from tracings supplied by the Settlement Officer. Similar corrections were carried out in the districts of Bhandára, Betúl, and Nimár (Central Provinces) from 16-inch tracings supplied by the Settlement Department.

350. Eighteen large scale plans of cities and cantonments on various scales were corrected, and additions made thereto, from information supplied by the Executive Engineer and Military authorities. The Bareilly Cantonment plan on the 12-inch scale is in 21 sheets and that of Murree on the 10-inch scale contains 6 sheets. The 19 sheets of the map of Moulmein Town on the scale of 1 inch=50 feet, referred to in paragraph 379 of last year's report, were published during the year under report. Of the Rangoon Town maps, 191 sheets on the scale of 1 inch=50 feet, were published during the year, and 154 originals on the scale of 1 inch=100 feet were sent to press for re-production.

351. Standard Sheets Nos. 15 and 221 of the North-Western Provinces and Oudh were published during the year; 28 sheets of districts Meerut, Moradabad, Saháranpur, Muzaffarnagar, Aligarh, Agra, Muttra, Gházipur, Benares, Mirzápúr, Basti and Gorakhpur were sent to press. The compilation of standard sheet No. 27 containing the parts of the districts of Saháranpur, Garhwál, Dehra Dún, and Bijnor is in progress. Of the Standard Sheets of Bengal 8 are in press after being corrected up to date, and sheet No. 389 has been compiled from the old main circuit maps. For the Bombay Presidency 4 standard sheets have been published during the year and 9 are in press, 6 standard maps of Lower Burma and 5 of Upper Burma are in press. In addition to the above 36 *Pargana* maps (Bengal) of districts Birbhum, Champáran, Cuttack, Dacca, Monghyr, Mymensingh, Nadia, Cooch Behar, Rájsháhi, and Tippera had corrections to roads, boundaries, etc., carried out.

352. A large amount of mapping has, as usual, been done for other departments. The special map of Narhan Estate referred to in paragraph 381 of last year's Report was published. A map of the Civil Station of Basti (N.-W P. & Oudh) on the scale of 8 inches=1 mile for the Commissioner, Gorakhpur division, was compiled and published. A military map of Calcutta and 10 miles of surrounding country on the scale of 1 inch=1 mile was compiled and published for the Commanding Officer at Fort William. A similar map in 2 sections on the 2 inches=1 mile scale for the same officer is in press. The map of Calcutta city with suburbs (in 2 sections) on scale 6 inches=1 mile, referred to in paragraph 379 of last year's Report, is passing through press.

353. A large number of original fair sheets together with computation volumes received from field parties were cursorily examined and reported on. The traverse computations of districts Magwe (Burma) and Sylhet (Assam) extending over three seasons each were thoroughly examined during the year. Traverse data, calculation of areas, and such like information has, as usual, been prepared in this office and supplied to field parties and district officials. Of traverse data 2,324 pages were copied and supplied. The spherical values of certain pillars along the Nepál boundary were computed. The area was calculated by *tálukas* of the Nizam's Dominions and sheet No. 201 Bombay. The *pargana* areas of sheets 307 and 347 of the Central India Agency were computed. The district areas of 24-Parganas and Ránchi (Bengal), and Gurdáspur, Jhelum and Ráwalpindi (Punjab), the Sámbar Lake in Rájputána, and of the Bunaili Raj estates in sheets Nos. 1, 3, 4, 8, 9, 10, 11, and 17, district Bhágalpur, were also computed. The revised areas of districts Cuttack, Puri, and Balasore were supplied to the Settlement Officer. The computation and plotting of 4 traverse circuits and 11 sub-circuits in connection with the map of Calcutta and 10 miles of surrounding country on the scale of 2 inches=1 mile was prepared. The traverses for a group of 13 villages were plotted for the Collector of Pabna. The traverse stations of one line of villages transferred from district Midnapore to district Hooghly were plotted. A statement detailing the areas by Imperial Traverse Surveys, Cadastral Surveys by local Agency, and by Forest Surveys in the Central Provinces was prepared.

Eighty-two tracings of sheets and twenty-one tracings of village plans were also made and supplied to district and other officers. Forty-six maps on various scales were coloured for office use. Twenty-two thousand four hundred

and sixty-five maps coloured in Map Record and Issue Office for stock were examined in this section.

Since April 1899 the entire correspondence has been carried on in this section. The total number of letters dealt with being 1,269.

Applications for manuscript copies of maps were also dealt with in this section. During the year 716 applications were received and disposed of. The correspondence in connection with this portion of the office reached 988 letters. Rupees 1,076-5-0 was received and deposited in the accounts section as Government Fees.

SECTION III.—CADASTRAL.

354. This section is employed in preparing the original maps of all cadastral surveys for photo-zincography and zincography. The maps to be examined are, on receipt of the originals, submitted to a cursory examination in order to see that the sheets are in every respect fit for reproduction.

Personnel.

Mr. W. H. D. Ewing, Sub-Assistant Superintendent, 1st grade.

Permanent Establishment.

6 Draftsmen. 1 Writer.

Temporary Establishment.

6 Tracers. 3 Moharrirs.

633 sheets of district Garhwál remaining to be published, and during the year these have been published.

In Burma the returns for the previous year showed 1,908 sheets remaining to be published, and during the past 12 months 4,217 sheets of district Katha, Magwe, Meiktila, Meiktila Town, Sagaing, and Shwebo of Upper Burma and Pegu of Lower Burma were received from Parties; out of these 3,431 sheets of the same have been published, leaving a balance of 2,694 sheets remaining to be printed; of these 700 sheets have been prepared for publication; 5 sheets of district Thatón have been reprinted.

In Bengal 289 sheets of district Gaya, Tikari Ward's Estate, have been published by the sanction of the Board of Revenue, Lower Provinces; the remaining 411 sheets will be printed during the coming season; of these 50 sheets have already been prepared for publication.

In Assam the returns for the previous year showed 64 sheets remaining to be published, and during the past 12 months 685 original sheets of district Cachar were received; out of these 256 sheets have been published during the year, leaving a balance of 493 sheets remaining to be printed; of these 100 sheets have been prepared for publication; 23 sheets of district Darrang and 1 sheet of district Lakhimpur have been re-published and 1 sheet of Index to the villages of district Jaintia, Sylhet, has been published. Those remaining incomplete, are districts Kámruáp (8 sheets), Sibságar (8 sheets), and Sylhet (45 sheets): these are mostly blocks and waste lands and under existing orders are not to be printed.

356. The total number of maps passed for publication during the year was 4,626, of which 4,609 were actually printed, 3,528 having been photo-zincographed and 1,087 zincographed. At the close of the year there were remaining to be published 3,659 sheets against 2,666 sheets in last year, showing an increase of 993 sheets.

357. The services of 3 *moharrirs* were engaged during the 12 months under report in *badar* corrections of district Tippera, 468 original sheets have been corrected in the Central and Southern divisions of districts Tippera and Noákháli, and 106 original sheets of the *chur* lands of district Noákháli. In addition to the above Field Area Statements have been corrected, and a good deal of miscellaneous work for Collectors, Settlement Officers, and others has been done.

SECTION IV.—BENGAL PROVINCIAL.

358. The cadastral maps dealt with during the year were those of Bihar, Orissa, and Chittagong.

Personnel.

Mr. A. B. Smart, Sub-Assistant Superintendent, 1st grade.

Permanent Establishment.

6 Draftsmen.

Temporary Establishment.

6 Computers, Writers, etc.

5 Draftsmen.

For Bihar, 1,062 cadastral maps, which were received during previous years, were reduced by pantagraph to the scale of 2 inches = 1 mile for the completion of the Standard sheets. There were received during the year 4,778 maps, of which 1,895

were reduced by pantagraph, leaving a balance of 2,883 to be dealt with during the current year.

359. The reduction of 2,144 cadastral maps of Chittagong, received during previous years, to the scale of 2 inches = 1 mile, was completed during the year under report.

360. The publication of the Orissa standard maps has been considerably delayed, owing to numerous unsettled boundary disputes and the non-return of the proof sheets from the Settlement authorities. The outlining of 6 sheets was completed during the year under report.

For Bihar, 24 sheets were outlined and completed. The interior details of 32 sheets were finally examined and forwarded to the Photographic Office for reduction to the scale of 1 inch = 1 mile. The outlining and completing of 32 sheets has yet to be dealt with.

The publication of 60 sheets of Chittagong was taken in hand during the year under report, all of which have been projected and plotted and the outlining of 16 sheets completed.

Of the special publication of 26 Standard sheets of Orissa on the scale of 2 inches = 1 mile, called for by the Government of Bengal, 9 sheets were published during the year under report.*

ENGRAVING OFFICE.

361. Mr. A. E. Spring held

Personnel.

Mr. A. E. Spring, Assistant Surveyor-General, in charge.

Mr. J. Fulford, Head Engraver, died 24th November 1898.

Mr. S. M. Coard, Head Engraver, from 25th November 1898.

Mr. A. R. Coard, Assistant Head Engraver, from 25th November 1898.

Mr. A. W. N. James, Engraver.

" E. Earle, "

" F. R. C. Scallan, "

" E. C. V. Ollenbach, "

" L. H. Musgrove, "

" A. T. Vieux, "

" A. E. W. Cann, "

" H. H. Green, "

" R. Rodger, "

30 Native Engravers

1 Apprentice

Copper-plate Printing Section.

Mr. W. T. Collins, Copper-plate Printer.

" A. E. Pilley, Assistant Copper-plate Printer and Store-keeper.

4 Native Copper-plate Printers and 12 pressmen.

completed.

364. Sixty-three unpublished quarter sheets in various stages of progress have had new material added to them; 50 published quarter sheets and 15 full sheets have been in hand for corrections and additions, bringing them up to date for printing and 29 new plates have been projected or had the borders engraved. In all 306 sheets have been in hand.

365. A new map of India on the 64-mile scale in four sheets has been projected and dry prints supplied to the Drawing Office for the latest material. It is intended that this map should replace the one now available, as it is becoming much worn and is beyond being brought up to date in recent surveys and

charge of this Office throughout the year. Mr. Fulford, the Head Engraver, who was on an extension of service, died on the 24th November 1898, having held the appointment for seven and a half years. Mr. Fulford was a most capable officer, and he took a share in starting the art of engraving in this country; his death is much to be regretted as he would have retired in a few months, he having completed 26 years' service. Mr. S. M. Coard has succeeded him as Head Engraver, and Mr. A. R. Coard appointed Assistant Head Engraver under the scheme of 1895.

362. The outturn of work for the year has been most satisfactory, the outline and writing both being in excess of last year, the hills only being slightly less.

363. During the year, eight quarter atlas sheets have been completed and published, 13 district maps for administration reports, 3 plates for the longitude volume, three tint plates, and one plate of scales have been

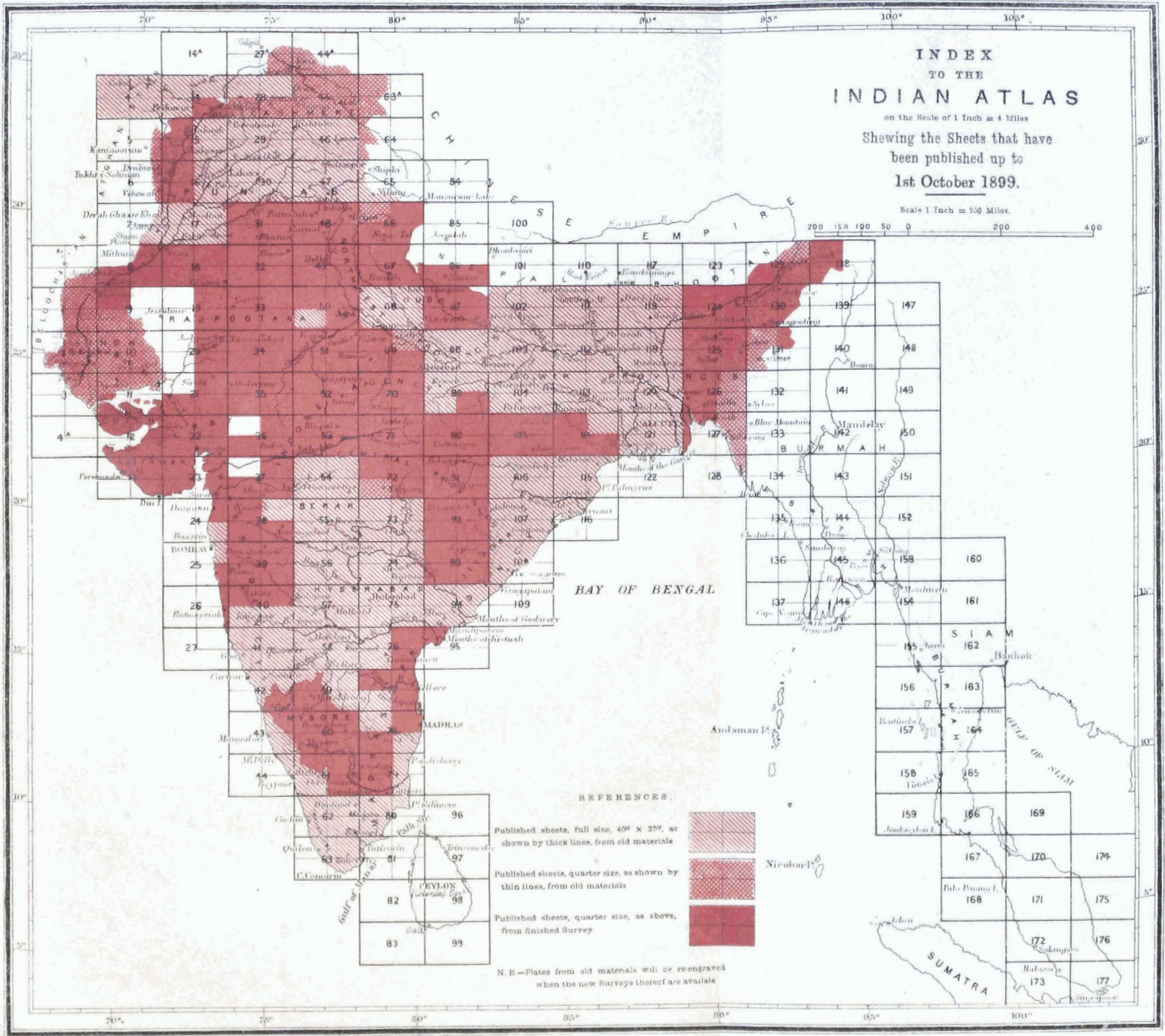
* Mr. Stotesbury and Mr. Hill, in their posts as Chief and Head Draftsmen, respectively, supervised their establishments very efficiently. Messrs. Wyatt, Smart, and Ewing have also done well as heads of the Examining, Bengal Drawing, and Cadastral Sections. Mr. Madras has also done good work. The European draftsmen have been well reported on, especially, Mr. Musgrove. Of the Native Establishment Babus Purna Chandar Sen, Sarat Chandar Chatarji, Narendra Nath Mukarji, Subodh Chandar Sarkar, Bepin Behari Ghose are especially commended and Munshi Abdul Aziz, Abdur Razaq, Babus Tincowri Sen, Bacharam Banarji, Ram Chandar Sen, Harendra Krishna Gupta, and Rash Behari Sen, amongst others, have rendered good service.

INDEX TO THE INDIAN ATLAS

on the Scale of 1 Inch = 4 Miles

Shewing the Sheets that have
been published up to
1st October 1899.

Scale 1 Inch = 200 Miles.

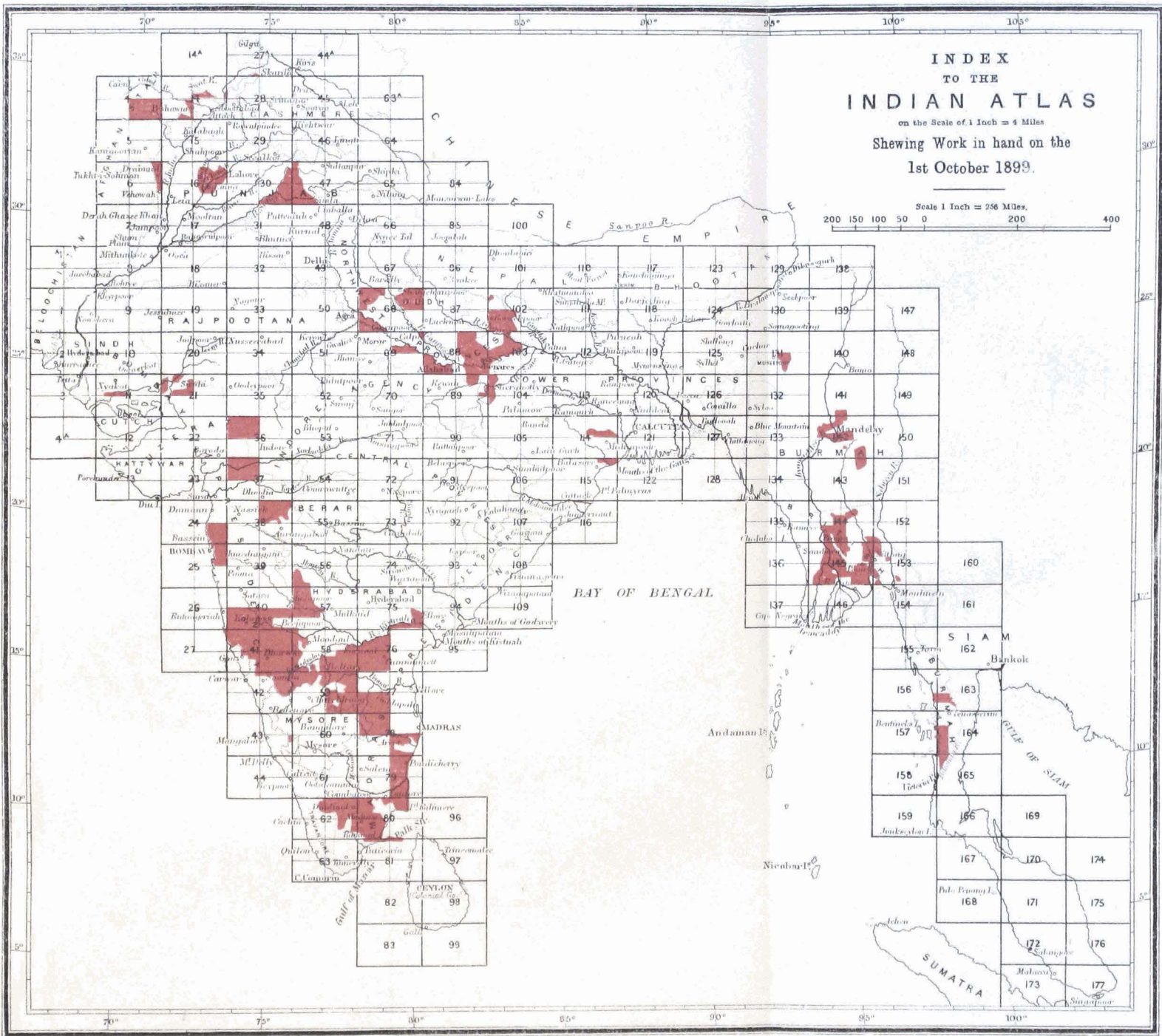


REFERENCES.

- Published sheets, full size, 409 x 259, as shown by thick lines, from old materials
- Published sheets, quarter size, as shown by thin lines, from old materials
- Published sheets, quarter size, as above, from finished Survey



N.B.—Plates from old materials will be re-engraved when the new Surveys thereof are available



INDEX
TO THE
INDIAN ATLAS

on the Scale of 1 Inch = 4 Miles
Shewing Work in hand on the
1st October 1899.

Scale 1 Inch = 256 Miles.
200 150 100 50 0 200 400

spelling, the four sheets of this map are in hand, being brought up to date in railways only. The hill-etching on the 128-mile map of India has made good progress. India 80-mile and 96-mile maps have had all the additional railways cut, to bring them up to date, and the 256-mile map has been put in hand for hills.

366. Of the 16-mile provincial maps, Bengal in 2 sheets, has had two portions of new material added, the outline of which is completed and the writing well advanced, the map of the Bombay Presidency has had some new material added. Central India, Central Provinces, Gujarát, Madras, and Rájputána have all been in hand for corrections and additions. The four sheets of Punjab and Kashmir without hills have been in hand and heavy additions are being carried out on sheets 1 and 3, the hills have been completed on the four hill sheets, but as the new material now being engraved on the duplicate sheets will have to be cut on the hill sheets, the publication of this map on copper must be held over; the map of the Punjab on the 32-mile scale is in progress with heavy corrections. Fifteen district maps for administration reports (besides those mentioned as published), 6 Index maps, 5 charts, 4 imprint, and note plates have been added to. Fifty-three plates have had titles and foot-notes cut on them for the Photo-Litho. Office.

367. The process of cutting out the corrections from the face of the plate, and filling the holes by electro-deposited copper, has been carried out on 12 plates, and has apparently been most successful; it is hoped by this process not only to save the copper-plate from being beaten out of shape, but that the plates will be brought up to date more effectively than by the process of beating out the corrections, as only a limited number could be carried out by the old process.

368. The Copper-plate Printing Section pulled 18,624 impressions: although this number is less than last year, the impressions were taken from larger plates, and thus more time was occupied in pulling them: the section was kept hard at work the whole year and is unable to cope with the demand for copies of engraved maps which is becoming very great. The Steel-facing Section has dealt with 236 plates.*

* The Head Engraver, Mr. S. M. Coard, has given great satisfaction in the discharge of his duties. Both the European and Native Engravers, and the Copper-plate Printer have given entire satisfaction.

THE PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE.

369. The charge of this Office was held by Mr. T. A. Pope throughout

Personnel.

Mr. T. A. Pope, Assistant Surveyor-General, in charge, up to 17th June 1899 and from 15th September 1899.

Major J. M. Fleming, S.C., Officiating Assistant Surveyor-General, in charge, from 18th June to 14th September 1899.

FIRST DIVISION.

Mr. R. Fogarty, Head Assistant, Litho. Branch.
Mr. H. Haward, Head Assistant, Photo. Branch.
Mr. A. W. Turner, Photo-Engraver.
Sergeant F. R. Vandye, R.E., Foreman Litho. Printer, up to 9th February 1899.

SECOND DIVISION.

Mr. E. A. LeFranc, Assistant.
" R. George, "
" D. Deas, "
" L. Lagnier, "
" T. Lloyd, "
" J. B. MacKenzie, "
" E. DePyvah, "
" C. J. Meade, "
" S. U. Ravenscroft, "
" P. Michael, "
" A. J. J. Rodrigues, "
Babu Ambica Churn Mukerjee, "
Mr. C. Andrews, "
" F. N. Murphy, "
Munshi Abdul Mujeed, "
Mr. N. J. Gonsalves, "
" J. Vieux, "
and 4 apprentices.

THIRD DIVISION.

Munshi Mohamed Yasin, Sub-Assistant.
Munshi Abdul Hakim, Sub-Assistant.
Munshi Abdul Rahman, Sub-Assistant.
Munshi Hyder Ali, Sub-Assistant.
Babu Dino Nath Dass, Sub-Assistant.
Munshi Azeezoor Rahman, Sub-Assistant.
Babu Srenibas Pattra, Sub-Assistant.
Babu Bhootnath Nath, Sub-Assistant.
Munshi Enayetullah, Sub-Assistant.
Babu Ambica Churn Bhattacharji, Sub-Assistant.
Babu Gossain Dass Nath, Sub-Assistant, and 45 Sub-Assistants.

FOURTH DIVISION.

49 Press-Assistants.
Correspondence, Stores, and Accounts Section.
Babu Kanny Lall Sen, Store-keeper.
Mr. A. B. Carville, Head Clerk.
Babu Khetter Mohan Dass, Clerk.
Babu Gopal Chundra Mukerji, Clerk.
Babu Surja Kumar Banerji, Clerk.
" Rajani Kanta Chatterji, "
" Ganoda Prosad Pal, "
and 6 clerks.

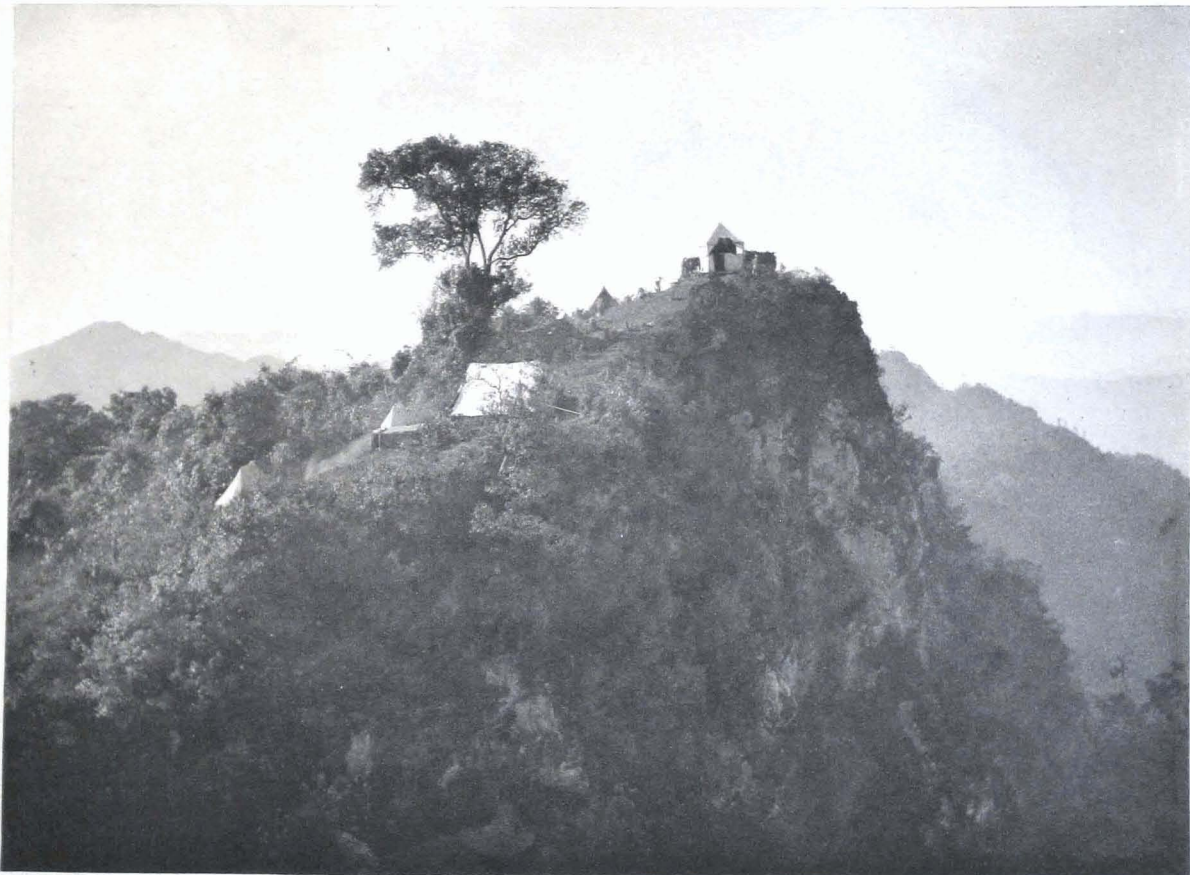
INFERIOR ESTABLISHMENT.
1 Fireman.
9 Machine men.
150 Spongemen, grainers, pressmen, etc.

the year, except for three months from the middle of June, when he proceeded on privilege leave to England, during which period the charge was held by Major J. M. Fleming, S. C. Sergeant F. R. Vandye, R.E., Foreman Litho. Printer, proceeded on furlough to England for one year in February 1899, and during his absence Mr. D. Deas, Assistant, 2nd Division, officiated for him.

370. An abstract of the work performed during the year in each section of the Office is given in the following statement :—

General Abstract of Work done during the year 1898-99.

| CLASSIFICATION. | Sheets or subjects. | Negatives and transparencies. | PHOTO-ZINCOGRAPHIC AND LITHOGRAPHIC PRINTING. | | | | | | | TYPE PRINTING. | | | SILVER AND OTHER PRINTING. | | HELIOGRAPHY AND ELECTROTYPING. | | VALU. | | | | | | | | |
|-------------------------------|---------------------|-------------------------------|---|--------------------------|----------------------|------------|----------------|-------------------|----------------|----------------|-----------------|------------------|----------------------------|----------------|--------------------------------|----------------------|---------------|----------------------|----------------|-----------------|----------|----------|--------|----|---|
| | | | Phototransfer Prints. | Zinc Plates transferred. | Zinc Plates printed. | Stones. | Fulls. | Number of copies. | | | Pages or items. | Fulls. | Copies. | Silver Prints. | Blue Prints. | Heliographic Plates. | | Heliographic Prints. | Photo. Blocks. | Electrotype. | | | | | |
| | | | | | | | | Coloured. | Uncoloured. | Total. | | | | | | | | | | | | | | | |
| Departmental Maps. | 651 | 846 | 913 | 216 | 201 | 58 | 165,485 | 14,565 | 120,529 | 125,094 | 12,932 | 1,277,949 | 684,039 | 47 | 1,416 | 17 | 4,292 | 1 | 8 | 58,350 | 4 | 9 | | | |
| Cadastral Maps. | 4,695 | 2,621 | 2,645 | 4,621 | 4,621 | ... | 145,312 | ... | 136,630 | 136,630 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 64,487 | 15 | 0 |
| Extra-Departmental Maps, etc. | 1,524 | 1,100 | 1,153 | 568 | 626 | 420 | 671,422 | 122,616 | 570,112 | 689,728 | ... | ... | ... | 73 | 215 | 111 | 82,222 | 77 | ... | ... | ... | ... | 94,812 | 14 | 0 |
| Total | 6,873 | 5,567 | 5,711 | 5,505 | 5,546 | 478 | 982,220 | 138,181 | 827,272 | 965,453 | 12,932 | 1,277,949 | 684,039 | 120 | 1,631 | 128 | 86,514 | 78 | 8 | 2,17,622 | 2 | 8 | | | |
| Totals of 1897-98 | 6,364 | 5,242 | 5,161 | 5,387 | 5,566 | 524 | 845,562 | 124,841 | 570,971 | 685,812 | 12,819 | 1,176,837 | 700,758 | 283 | 2,174 | 101 | 72,801 | 82 | 13 | 1,92,927 | 8 | 0 | | | |
| Differences | + 509 | + 325 | + 550 | + 118 | - 8 | 46 | + 136,658 | + 13,340 | + 256,301 | + 289,641 | + 112 | + 101,112 | - 16,717 | - 163 | - 543 | + 27 | + 12,713 | - 4 | - 5 | + 24,694 | + 10 | 6 | | | |



Capt. H.A.D. Fraser R.E. Photo.

Photo-gravure - Survey of India Office, Calcutta, December 1899.

THYOLICHING TRIGONOMETRICAL STATION.

A PRINCIPAL STATION OF THE MANIPUR LONGITUDINAL SERIES.

Height above sea level 6500 Feet.

The statement shows that there has been a large increase in the outturn of work of all kinds during the year under report, and that this increase is chiefly under the head of work done for other departments. The number of original subjects received for reproduction was 6,875, or 509 in excess of the number received last year. The printed outturn of maps, plans, etc., yielded by the machines and presses amounted to the large total of 965,453 copies, or 269,451 more than the outturn of last year. The departmental work done is somewhat less in quantity, except as regards copies of cadastral maps, of which the number rose from 94,328 copies printed last year to 136,630. This is due to the fact that the cadastral sheets dealt with principally comprised those of Burma and Assam, of which a much larger number is required than of the North-Western Provinces sheets, which formed the bulk of last year's cadastral outturn. The work done for other departments shows an enormous increase, and if it continues to increase, it will be a difficult problem to know how to deal with it in the future. Of the total outturn of 965,453 copies printed, 693,729 were copies of maps, plans, etc., received from other departments, or nearly three-fourths. The proportion of work done in colours remains about the same, but the number of copies printed of each subject still averages smaller than was formerly the case, where extra-departmental work is concerned. The outturn of type-printing, which depends principally upon the demands of the Survey Department for professional and other forms, is about the same as last year, though the work actually done, as represented by the number of pages set up and of pulls made, is larger. The Heliogravure Section also shows a satisfactory increase of work, both in photogravure and half-tone block work. The number of prints from photo-etched plates rose from 71,280 last year to 86,514 during the year under report, which is about as large an outturn as can be obtained from the printing power available. The total value of the work in all sections was R2,17,622, or R24,695 more than last year.

371. Of the departmental publications of the year, the following may be specially referred to:—

The third edition of the map of India, on the 32-mile scale, in six sheets, which had been held over for some years on account of frontier boundaries, was finally published in December 1898. As mentioned in paragraph 402 of last year's report, a considerable amount of work had to be done after the receipt of final press order before the map could be printed. Re-transfers had to be made from each of the six stones to zinc plates, and some of these required a great deal of touching up owing to the large number of corrections which had previously been made on the stones. Three hundred copies were printed off. Two skeleton maps of India, on the 32 and 48-mile scales, in six sheets and two sheets, respectively, were also published during the year. A map of Upper Burma, on the 64-mile scale, was photo-zincographed, and also a railway map of India on the 48-mile scale, corrected up to 31st March 1899. A new railway map of India shewing stations, on the 32-mile scale, in six sheets, was photo-zincographed but not printed off.

Of provincial maps, the map of Burma and adjacent countries, on the 32-mile scale, with hills in brown, was photo-zincographed, and 200 copies were printed off. Maps of the Bombay and Madras Presidencies, and of the Nizam's Dominions, including the Assigned Districts of Berar, were lithographed, and 200 copies of each printed.

The following district maps were printed off:—Monghyr (sheet No. 8) and 24-Parganas (sheets Nos. 3, 4, and 5) on the 1-inch scale, photo-zincographed; and Chittagong (in two sheets), Darbhanga, Darrang, Dinájpur, Hissar, Jhelum, Cooch Behar State, Malda, Monghyr, Ráwalpindi, and Singhbhum; all on the 4-mile scale, lithographed.

Two hundred and ninety standard sheets of the Topographical and Revenue Surveys, on the 4-inch, 2-inch, 1-inch, $\frac{1}{2}$ -inch, and $\frac{1}{4}$ -inch scales, were taken in hand either for re-printing or as new publications. Eighty plates were printed off, including 28 sheets, on the 1-inch scale, comprising three of Bombay, eleven of Upper Burma, seven of Central India and Rájputána, five of the Central Provinces, and two of the North-Western Provinces and Oudh. Two sheets of the Punjab Survey, on the 2-inch scale, and 20 sheets of the Lower Burma survey and twelve of the North-Western Provinces and Oudh, on the 4-inch scale, were printed off. Of the trans-frontier surveys, twelve sheets of the North-West

trans-frontier survey, on the $\frac{1}{2}$ inch scale, four sheets of the South-East frontier survey, and two sheets of the North-East frontier survey, all on the $\frac{1}{2}$ inch scale were also printed off.

The city and cantonment maps dealt with during the year comprised maps of the city and cantonment of Dacca, on the 12-inch scale; cantonment and environs of Jullundur, on the 6-inch scale, plan of Jabua and environs, on the 6-inch scale; plans showing the old entrenchment and the new position at Lucknow, and the entrenched position of the British garrison at Lucknow, on the scale of 1 inch=400 feet; and a plan of Ráwalpindi cantonment, on the 6-inch scale, all photo-zincographed.

The following technical charts were photo-zincographed:—Triangulation chart of the Khási Hills, chart to illustrate a report on the Assam triangulation, and a chart of the triangulation in the Northern Shan States.

Among miscellaneous departmental publications may be mentioned three maps pertaining to the Burma-China Boundary Commission, on the $\frac{1}{2}$ -inch and $\frac{1}{4}$ -inch scales, and a map to accompany the report of the Commission, on the $\frac{1}{4}$ -inch scale, all photo-zincographed. A map of the Eastern Nágá Hills and Manipur, with the adjoining portion of Burma, on the $\frac{1}{4}$ -inch scale, and a map pertaining to the Northern Party, Burma-China Boundary Commission, on the $\frac{1}{4}$ -inch scale, were photo-zincographed and proofs supplied. A large number of sheets of the various forest surveys were as usual photo-zincographed and printed off.

372. The number of extra-departmental subjects, received and put in hand during the year, amounted to 1,521, as against 1,102 last year, and the number of copies printed was 693,729, against 445,329. Much of this work was of a very urgent nature, and it has been found impossible to comply with the increasing demands for work received from other departments during the past year, without unduly delaying the reproduction of important departmental maps. The strain falls chiefly upon the compositors employed in setting up type-transfers of headings and foot-notes, and upon the zinc-correctors. The Office has for some years past been weak in these two sections, and it is now certain either that the establishment must be strengthened in these respects, or that a certain proportion of the extra-departmental work sent in must be declined. To enable the Office to comply with all demands upon it without accumulating arrears, at least seven new posts should be added to the lower grades of the Third Division, to be held by three compositors and four zinc-correctors; and the Head Zinc Printer should be given two more presses for transferring and proving, with the required extra printers, zinc grainers, and pressmen.

The largest and most important piece of extra-departmental work taken up during the year was the railway and canal map of India, in six sheets, on the 32-mile scale, which was undertaken at the instance of the Government of India, Public Works Department. It is intended that this map shall supersede the old 32-mile railway map. Considerable progress was made with it, but owing to several changes introduced in the manner of delineating the canals and irrigated areas, it will take some time to complete. It is hoped that the map will be published during the ensuing year. A map of India, showing railways sanctioned during the administration of the several Viceroys, from 1845 to 1895, was lithographed in four colours, and 1,750 copies supplied.

For the Government of India, Home Department, a map of India on the 102-mile scale, showing British Provinces and native states, was photo-zincographed, and 450 copies printed; also four maps illustrating the quinquennial review on education.

For the Government of India, Revenue and Agricultural Department, a map of Eastern Turkestan, to illustrate a report on Central Asian antiquities by Dr. Hærnle, C.I.E., was lithographed and 50 copies printed; this map was afterwards re-printed for the Journal of the Asiatic Society of Bengal. Four plans of the Paris Exhibition of 1890 were photo-zincographed, and 13,000 copies of each printed off.

For the Government of Bengal, Public Works Department, a map of Bengal showing railways, canals, and canalized rivers, was lithographed in colours, and 750 copies printed.

For the Quarter-Master General in India, a military map of India, in six sheets, on the 32-mile scale, was lithographed in colours and proofs supplied. The proofs have been returned with many additions which are now being carried

out. For various military authorities, maps of the country, 10 miles round Ráwalpindi, Karáchi, Calcutta, Pesháwar, Delhi, Attock, and Jhelum, were prepared and printed off, and also maps for manœuvre purposes of Goona, Attock, and Allahabad. For the Adjutant General, Bengal Command, a military map of the Bengal Command was photo-zincographed and 400 copies supplied. Also 29 sketches pertaining to a staff ride between Meerut and Delhi, and 12 similar sketches of a staff ride between Lucknow and Cawnpore, lithographed in colours, and 100 copies of each printed.

For the Secretary to the Plague Commission, Bombay, a number of charts pertaining to plague inoculation were lithographed, and 7,830 copies supplied; also various maps and diagrams for the same purpose, either lithographed or photo-zincographed, of which copies were printed to the number of 30,150.

The sheets of the Rangoon town survey were proceeded with during the year, and 173 sheets were transferred to zinc and proofs supplied.

For the Meteorological Department a very large amount of work was done as usual; 115 maps and charts were either re-produced or re-printed, and 205,371 copies supplied.

373. In the Heliogravure Section the principal items of work comprised 19 plates of ancient manuscripts, coins, etc., to illustrate Dr. Hærnle's work on Central Asian Antiquities, and 850 copies of each were printed. Many of the originals were much discoloured by age, and were particularly difficult subjects for photographic re-production. Twenty-seven plates were photo-etched, to illustrate Mr. E. W. Smith's archæological report on the Moghul colour decoration of Agra, from which 650 copies of each were printed. For the Technical Art Series 12 plates were photo-etched, and 1,000 copies of each printed. In consultation with the Superintendent of the Calcutta School of Art, it was decided that specimens of metal work should form the principal subjects in this year's series, instead of confining it to architectural subjects, as in the past, and it is proposed that next year's series shall be wholly devoted to metal work designs. Seventy-eight Enameline half-tone blocks were prepared, from which 12,100 copies were printed in the Type Section. These include 29 blocks to illustrate the Gazetteer of Upper Burma, by Mr. J. G. Scott, C.I.E., and 17 to illustrate a report on the Peryar project. The process of electro-deposition for correcting hand-engraved copper-plates, described in last year's report, was used with success throughout the year, and ten plates were dealt with in this way. The total outturn of the section is much larger than in any previous year.

374. The scheme for the reorganization of the office, which provides for the amalgamation of the establishment with that of the technical sections of the Trigonometrical Branch Office at Dehra Dún, and for the abolition of most of the posts on progressive salaries, was sanctioned by the Secretary of State during the year, and came in force on the 1st December 1898. So far the experience of its working shows it to be completely successful.*

MAP RECORD AND ISSUE OFFICE.

375. The charge of this office was held at various times during the year, as

Personnel.
Mr. A. E. Spring, Deputy Superintendent, 1st grade, in charge from 1st October 1898 to 6th July 1899, from 30th August 1899 to 12th September 1899, and from 28th September 1899 to 30th September 1899.

Mr. E. Litchfield, Deputy Superintendent, 2nd grade, from 7th July 1899 to 29th August 1899.

Major J. M. Fleming, Superintendent, 2nd grade, from 13th September 1899 to 27th September 1899.

Mr. F. A. D'Rozario, Head Clerk.

„ H. R. Vallis, Map-Curator, and 16 other clerks.

shown in the *personnel*, by Mr. A. E. Spring, Deputy Superintendent, 1st grade, Major J. M. Fleming, Superintendent, 2nd grade, and Mr. E. Litchfield, Deputy Superintendent, 2nd grade.

* Mr. Pope reports that Mr. R. Fogarty, Head Assistant, Litho. Branch, has continued to perform his duties with zeal and intelligence, and that Mr. H. Haward, Head Assistant, Photo. Branch, has worked satisfactorily. Mr. A. W. Turner, Photo-engraver, has carried on the work of the Heliogravure Section with his usual ability. Sergeant F. R. Vandyke, R.E., Foreman Litho. Printer, was on leave during the greater part of the year, but while present continued to perform his duties efficiently.

In the Second Division, Mr. E. A. LeFranc, Head Zinc Printer, has worked most assiduously; and Messrs. George, Lagnier, MacKenzie, Meade, Michael, Andrews, Murphy, Gonsalves, and Vieux, in the Photographic Sections, and Messrs. DePyvah, Ravenscroft, Rodrigues, Babu A. C. Mookerjee, and Munshi A. Mujid, in the Lithographic Branch, all deserve commendation for good work. The apprentices, Messrs. DeSilva, Francis, Wilson, and Aratoon, have made good progress.

The following members of the Third Division may be specially mentioned: Mohamad Yasin, Abdul Hakim, Hyder Ali, Dino Nath Dass, Enayatullah, Gossain Dass Nath, Golam Jelaney, Abdul Wadood, Abdul Ali, Abdul Aziz, Akhoy Kumar Nath, and Ashutosh Dass.

Of the clerical staff, Babu K. L. Sen, Head Clerk and Accountant, has performed his duties efficiently, and Babus K. M. Dass, G. C. Mookerjee, S. K. Banerjee, R. K. Chatterjee, N. N. Mukerjee, and M. N. Biswas have all worked well.

376 The number and value of maps issued during the year are as follows:—

| MAPS ISSUED. | Number. | Value. |
|--|---------|----------|
| | | ₹ |
| General maps to Government officials | 62,494 | 46,226 |
| Ditto to India Office, London | 11,460 | 12,495 |
| Ditto to Private individuals | 6,399 | 5,338 |
| Ditto to Agents | 2,286 | 3,018 |
| TOTAL | 82,639 | 67,077 |
| Cadastral maps to Government Officials | 112,209 | 1,48,118 |
| GRAND TOTAL | 194,848 | 2,15,195 |

During the year under review, there has been an increase in the number and value of maps issued when compared with those of the preceding year, which numbered 156,523, valued at ₹1,17,942, whereas during 1898-99 they were 194,848 in number and ₹2,15,195 in value, showing an increase of 38,325 in number and ₹97,253 in value.

The amount realized from cash sales also exceeded that of the year preceding by ₹1,602. The sales in 1897-98 being ₹19,314, whereas those of the past year were ₹20,916. Of this amount ₹9,266 were for maps sold to private individuals, ₹10,554 to Government officials, and ₹1,096 recovered from the several Agents.

The work of supplying tracings to private individuals was transferred to the Revenue Section of the Drawing Office, but this section supplied upwards of 2,000 original plans to that office for the purpose; and in addition upwards of 600 volumes of records for reference, etc., moreover 455 original volumes were received from Field Parties, of which 253 being new, were registered and sent to the Drawing Office for examination, the others being merely stored away in their respective shelves; 276 volumes and 1,100 maps were also despatched to Field Parties.

The details of work are specified in the following statement and shew a slight decrease below last year's figures, which is due to a smaller number of maps having been coloured for sale than during the preceding year:—

| DETAILS. | Number. |
|---|---------|
| Applications received for maps | 5,130 |
| Letters issued in reply | 4,250 |
| Cash and credit map sale bills | 1,626 |
| Invoices and receipts issued for published maps | 3,831 |
| Ditto ditto cadastral do. | 152 |
| Packets, parcels, and local despatches | 3,523 |
| Ditto received | 711 |
| Packages despatched by rail and steamer | 619 |
| Ditto received ditto | 86 |
| Maps coloured for sale and issue | 19,911 |
| Ditto for other departments | 1,832 |

A list of the maps and charts published during the year, copies of which have been regularly issued to the India Office and the several departments of the Government of India, and District Officers, in keeping with standing orders, will be found at page 93.*

* Mr. Spring reports that Mr. D'Rozario has continued to perform his duties to his entire satisfaction. Mr. H. R. Vallis has rendered excellent service. Messrs. J. A. Vallis, E. A. Bonnaud, S. A. Hazra, and the other clerks have also worked satisfactorily.

MATHEMATICAL INSTRUMENT OFFICE.

Personnel.

Lieut.-Colonel J. R. Hobday, S.C., Assistant Surveyor-General, in charge, from 1st April to 12th June.

Major W. J. Bythell, R.E., from 13th June to 9th August.

Captain H. A. D. Fraser, R.E., from 10th August to 12th October.

Lieut. G. A. Beazeley, R.E., from 13th to 30th October, and again from 4th February to 31st March 1899.

Major S. J. Burrard, R.E., from 31st October 1898 to 3rd February 1899.

Workshop Branch.

Mr. T. Bolton, Mathematical Instrument Maker, up to 24th February 1899.

Mr. T. R. Theakston, Assistant Mathematical Instrument Maker, up to 28th February 1899, and Mathematical Instrument Maker, from 1st to 31st March 1899.

Mr. T. A. Ferrier, Assistant Mathematical Instrument Maker, from 1st to 31st March 1899. Two hundred and thirty Artificers.

Store Branch.

Mr. M. C. Belletty, Instrument Storekeeper.
Babu W. C. Chowdhry, Material Storekeeper.

Office Establishment.

Mr. W. Campagnac, Head Clerk.
Mr. W. R. Tullock, 2nd Clerk.
Six Clerks and three temporary clerks.

377. The charge of the office was held as follows:—Lieut.-Colonel J. R. Hobday, S.C., from 1st April 1898 to 12th June 1898; Major W. J. Bythell, R.E., from 13th June to 9th August; Captain H. A. D. Fraser, R.E., from 10th August to 12th October; Lieut. G. A. Beazeley, R.E., from 13th to 30th October, and again from 4th February to 31st March 1899; Major S. J. Burrard, R.E., from 31st October 1898 to 3rd February 1899.

378. The figures in this report refer to the financial year, *i.e.*, from 1st April 1898 to 31st March 1899. During this year 61,407 serviceable instruments, valued at ₹2,84,208, were received into store, and 72,514 instruments, valued at ₹2,59,435, were issued. Compared with the preceding year this shows an increase in both number and value in the receipts; whilst the issues were considerably greater in number, but somewhat less in value as shown below:—

| | 1897-98. | 1898-99. | Increase. | Decrease. |
|--------------------------------|----------|----------|-----------|-----------|
| Number of instruments received | 54,256 | 61,407 | 7,151 | ... |
| Value of ditto in rupees | 2,61,816 | 2,84,208 | 22,392 | ... |
| Number of instruments issued | 59,100 | 72,514 | 13,414 | ... |
| Value of ditto in rupees | 2,83,857 | 2,59,435 | ... | 24,422 |

From the above table it will be seen that the number of serviceable instruments in store has decreased by 11,107 and their value increased by ₹24,773.

379. The following statement shows the principal sources from which the serviceable instruments were received.—

| SOURCES OF RECEIPTS. | Number. | Value. |
|--|---------------|-----------------|
| From England on indent | 14,624 | 98,368 |
| By purchase in the local market | 11,865 | 36,414 |
| Manufactured in the workshop | 18,574 | 26,902 |
| Returned to store by public officers | 12,207 | 14,394 |
| From repairable stock after repair | 4,118 | 1,07,967 |
| From other sources | 19 | 163 |
| TOTAL | 61,407 | 2,84,208 |

The number of instruments received on indent from England has decreased by 2,415, whilst their value has increased by ₹17,278, this is due to the fact

that our stock of more expensive instruments had become low and had to be brought up to the required strength. The purchases in the local market were practically the same as last year. The instruments manufactured in the workshop have increased, though their value has decreased. The manufactures depend entirely on the number of men who can be spared from the execution of repairs. The class and value of instruments will be found in Table C. in the appendix.

380. The number of instruments taken from the repairable stock and rendered serviceable for issue is less, but their value when repaired is greater than in the preceding year. This decrease in number is due to the fact that larger and more expensive instruments have been repaired.

During the year the office received 3,311 repairable instruments, valued at ₹55,760, compared with 7,644, valued at ₹92,059, in the preceding year. The total issues from the repairable stock were 4,118, valued at ₹64,132, these were repaired in the workshop at a cost of ₹43,835, and transferred at an enhanced value to the serviceable stock. The repairable stock has thus been decreased by 807 instruments, valued at ₹8,372. The decrease shows that the workshop has been able to cope successfully with the amount of repairable instruments returned to store, and at the same time to meet all current demands thereon.

381. The conversion of old pattern levels and theodolites, alluded to in para. 414 of last year's report, has been steadily continued, and during the year 71 levels of obsolete patterns have been converted into serviceable instruments. Since the increased establishment for the repair of instruments have been sanctioned, as already alluded to in previous reports, 487 levels and 192 theodolites have been rendered serviceable, and all indents for levels and theodolites, except those for railway pattern theodolites, have been complied with from this source, and indents on England for such instruments have been discontinued.

382. During the year the number of indents complied with was 1,396, being 202 less than last year. They were of the usual description and were submitted from all parts of India, from Siam, and China.

383. The cash payments for charges under ₹50, amounted to ₹50,664, being more than the previous year by ₹11,888.

384. The value of English indents for 1898-99 is £5,090, and for the previous eight years is shown in the following table, which gives some indication of the saving which is being effected by the utilisation of the extra grant for repairing instruments:—

| Years. | Value of English Indent. |
|-------------------|--------------------------|
| | £ |
| 1890-91 | 6,194 |
| 1891-92 | 8,464 |
| 1892-93 | 8,128 |
| 1893-94 | 13,875 |
| 1894-95 | 12,981 |
| 1895-96 | 5,208 |
| 1896-97 | 5,079 |
| 1897-98 | 3,995 |

385. Table A (in the appendix) shows the amount of debits against various officers and departments for instruments supplied and for the work done. It also exhibits the credits for all instruments and materials returned to store. The value of the issues and repairs executed on book-debit was ₹2,27,539, being ₹29,700 less than last year, this amount includes the value of instruments purchased with the extra departmental grant of ₹30,000, of which ₹28,513

rs expended. The credit for instruments returned into store amounted to ₹68,899, which is a decrease on the previous year. The grand total of the value of supplies including the cash sales is ₹2,78,203, or about ₹17,800 less than last year.

386. The total number of instruments of all kinds repaired for public officers amounts to ₹5,868 or 762 in excess of last year.

387. The profit and loss account of the workshop will be found in the appendix, the result of the operations showing a nominal profit of ₹2,241, from which it appears that the rates for work are fairly correct.

II.—TRIGONOMETRICAL BRANCH OFFICE, DEHRA DÚN.

388. Colonel St. G. C. Gore, R.E., Superintendent, Trigonometrical Surveys, on return from special leave, took over charge of the office on the 25th October 1898, from Major S. G. Burrard, R.E. During the absence, on privilege leave, of Mr. J. Eccles, M.A., from 5th June to 2nd July 1899, Mr. C. H. McA'Fee held charge of the Computing Party. Lieutenant A. Mears, I.S.C., having gone through his course of instruction in the Trigonometrical Branch, was transferred to No. 4 party on the 29th October 1898. Lieutenants H. Wood, R.E., H. McC. Cowie, R.E., B. R. Daunt, I.S.C., C. P. Gunter, R.E., E. T. Rich, R.E., and A. A. Crookshank, R.E., on their appointment to the department were attached to this office for a course of technical training. Lieutenant Daunt was attached to the

Personnel.

Superintendents.

Colonel St. G. C. Gore, R.E., Superintendent, Trigonometrical Surveys, from 25th October 1898.

Major S. G. Burrard, R. E., Officiating Superintendent, Trigonometrical Surveys, up to 24th October 1898.

Mr. J. Eccles, M.A., Superintendent, 2nd grade, in charge Computing Party, up to 4th June 1899, and from 3rd July to 30th September 1899.

Mr. C. H. McA'Fee, Extra Assistant Superintendent, 1st grade (Supernumerary), in charge Computing Party, from 5th June to 2nd July 1899.

Attached Officers.

Lieut. A. Mears, I.S.C., Offg. Assistant Superintendent, 1st grade, up to 28th October 1898.

Lieut. H. Wood, R.E., Assistant Superintendent, 2nd grade, from 16th November 1898.

Lieut. H. McC. Cowie, R.E., " " " from 12th November 1898.

" B. R. Daunt, I.S.C., " " " from 31st October 1898 to 14th May 1899.

Lieut. C. P. Gunter, R.E., " " " from 10th July 1899.

" E. T. Rich, R.E., " " " from 3rd July 1899.

" A. A. Crookshank, R.E., " " " from 15th July 1899.

(1) Computing Section.

Mr. A. D. L. Christie, Extra Assistant Superintendent, 2nd grade.

" J. M. Kennedy, " " " 6th grade, from 24th Nov. 1898 to 14th September 1899.

Babu Amba Prasad and 8 other Computers, 2 Copyists and 2 Writers.

(2) Printing Section.

11 Press Assistants and 2 Distributors.

(3) Photo-Zincographic Section.

Mr. G. A. LeFranc, Assistant

13 Sub-Assistants, 16 Press Assistants, 1 Accountant, 1 Storekeeper, and 1 Despatcher.

(4) Correspondence Section.

Mr. J. Burbridge, Head Clerk, and 3 other Clerks.

(5) Stores, Workshops, and Observatories Section.

1 Writer, 1 Head Artificer, and 3 Artificers.

(6) Drawing Section.

Mr. C. H. McA'Fee, Extra Assistant Superintendent, 1st grade (Supernumerary).

" J. A. Higgs, " " " 6th grade.

15 Draftsmen and 1 Surveyor.

(7) Solar Photographic Section.

Mr. R. W. Foster, Assistant Solar Photographer (Sub. pro tem.).

(8) Training School.

Mr. W. A. Fielding, Extra Assistant Superintendent, 5th grade.

Babus Aulad Hussein, Nilmoni Chatterjee, Amar Singh, Abinash Chandra Bose, Jagdamba Prasad, and Himansu Kumar Roy, Sub-Assistant Superintendents.

Babus Pramada Ranjan Roy, Messrs. H. P. D. Morton, S. S. Fielding, P. A. T. Kenny, H. C. Stotsbury, S. F. Norman, and J. R. Newland, Probationary Sub-Assistant Superintendents.

2 Surveyors, 1 Sub-Surveyor, and 15 probationary Sub-Surveyors.

office of the Superintendent, Land Records Surveys, N.-W. P. and Oudh, from

18th November 1898 to 22nd February 1899, for instruction in the work of the Revenue Branch. He rejoined this office on the 23rd February, but owing to failing health, he proceeded on leave on medical certificate on the 15th May. Lieutenants Wood and Cowie completed their course and were posted to field parties at the end of the year.

Captain H. A. D. Fraser, R.E., before proceeding to England to consult Professor Rücker regarding the Magnetic Survey of India, was posted to this office to receive instruction in the subject. Four officers from the department of the Quarter-Master General were temporarily attached to this office for instruction in exploration work, of whom two are still under instruction. Mr. J. M. Kennedy was posted to the computing section of this office on the 24th November 1898 and on the 15th September 1899 he was transferred to the N.-W. P. Drawing Office.

389. The experimental base line in the Survey Office compound was re-measured for the instruction of the newly appointed officers of the Imperial and Provincial Services, and a short base of 100 feet was laid down by two measurements for comparison of chains and wires.

The office is divided into the following sections:—

| | | |
|-------------------------|---|---|
| (1) Computing. | } | (5) Stores, Workshops, and Observatories. |
| (2) Printing. | | (6) Drawing. |
| (3) Photo-zincographic. | | (7) Solar Photographic. |
| (4) Correspondence. | | (8) Training School. |

(1) *Computing Section.*

390. Four instalments of field records were received during the year and stored as usual. In all 13 requisitions for data and 68 indents for forms were complied with. The reduction of the observations by Captain Deasy in his explorations in Thibet is still in progress. The examination of the four charts of the Great Arc Meridional Series, section 8° to 18°, is still in hand. A table for ascertaining horizontal distances for use with a subtense instrument was completed, also a table of places of circumpolar stars from William's college catalogue and Greenwich 10-year and 9-year catalogues. The preparation of name lists for the North-East Longitudinal Series Synoptical Volume was begun. The meteorological and magnetic observations were continued as usual.

(2) *Printing Section.*

391. The following is the progress made:—

- (a) Tidal Volume, 76 pages printed.
- (b) Synoptical Volumes, of the Great Arc Meridional Series, Section 8° to 18°, and Indus Delta Triangulation, 47 pages printed.
- (c) The Solar Eclipse Report, 25 pages printed.
- (d) A beginning was made at printing a series of professional papers to be numbered in serial order. Five pages were printed of Professional Paper No. 1 "On the projection for a map of India and adjacent Countries on the scale of 1:1,000,000", and 32 pages of No. 2 which is a translation of M. Jäderin's "Method of measuring Geodetic Bases by means of metallic wires".

In addition to the above, a large amount of work was done in printing the letter-press for charts, headings, and foot-notes for maps, and about 45,000 copies of professional and other forms were printed.

(3) *Photo-Zincographic Section.*

392. The usual routine of map publication was carried on. The work is well up to date.

(4) *Correspondence Section.*

393. This has been conducted as usual.

(5) *Stores, Workshops, and Observatories Section.*

394. A series of observations were taken with Zenith Sector No. 2 to determine the value of the Screw of Bubble tester No. 2; and the instruments of the

Base Line apparatus were examined and cleaned. The work in the observatories was carried on as usual.

(6) *Drawing Section.*

395. An index to the map of India and adjacent Countries on the scale of 1 : 1,000,000 was begun. As mentioned in last year's report, owing to the mapping of No. 18 Party being very much in arrears, assistance was again rendered by this section in preparing the 4-inch sheets for reduction to half scale, and in extracting the *mausa* areas from 18 of the 4-inch sheets. The outturn will be found fully detailed in the appendix.

(7) *Solar Photographic Section.*

396. The work of this section was conducted as usual. The results obtained with dry plates have been so successful as to lead to a large substitution of them for the old wet process, and in time it is expected that they will entirely supersede the wet plates.

(8) *Training School.*

397. The training school, under Mr. W. A. Fielding, imparted instruction in theodolite traversing, triangulation, levelling, and plane-tableing, also fair mapping, projection, plotting, and the computations of the Topographical Branch. Six Sub-Assistant Superintendents, who had been employed only in the Revenue Branch, as well as the seven probationary Sub-Assistant Superintendents, and 15 probationary Sub-Surveyors were put through the school course. Of the Sub-Assistant Superintendents, two proceeded on medical leave during the course of the year owing to ill health.

Besides the above, instruction in practical plane-tableing was given to seven officers of the Imperial Service; and two Sub-Surveyors of No. 15 Party received special instruction in theodolite traversing, triangulation, and plane-tableing.

The offices were inspected by the Surveyor-General in October 1898, April and July 1899, and he was quite satisfied with the working of the several sections.*

III.—NORTH-WESTERN FRONTIER DRAWING OFFICE.

398. This office was moved to Mussooree in March last, with the object of bringing it into closer connection with the office of No. 15 (N.-W. F.) Party. Colonel R. A. Wahab, R. E., held charge until the 12th July 1899, when he went on privilege leave, and Lieutenant G. A. Beazeley, R. E., held charge till the end of the survey year.

Personnel.

Colonel R. A. Wahab, C. I. E., R. E., Superintendent, 1st grade.

Lieutenant G. A. Beazeley, R. E., Officiating Deputy Superintendent, from 12th July 1899.

Mr. G. W. E. Atkinson, Officiating Deputy Superintendent, 2nd grade, up to 10th October 1898.

Mr. W. J. Cornelius, Extra Assistant Superintendent, 4th grade.

Mr. R. R. Dickinson, Extra Assistant Superintendent, 5th grade.

Mr. P. F. Prunty, Extra Assistant Superintendent, 5th grade, from 21st June to 30th September 1899.

Mr. F. E. Warde, Sub-Assistant Superintendent, 1st grade.

Mr. F. Rozario, Surveyor.

H. Sindon, Draftsman.

Munshi Nur Baksh, Draftsman, and four other draftsman, and one writer.

The outturn of work includes the preparation of 8 sheets on the $\frac{1}{2}$ -inch scale, containing the results of the surveys executed during the North-Western Frontier Expeditions up to April 1897. These sheets are drawn as standard sheets of the Northern and North-Western Trans-Frontier Series, and they include besides new work, a large amount of old material not previously put together in standard sheets. It is intended to continue the series of sheets as material becomes available so as to complete all the frontier mapping on this scale ($\frac{1}{2}$ -inch = 1 mile) as has already been done in the case of Balúchistán

* Mr. Eccles reports very highly of the work done by his assistants, Messrs. McA'Fee, Christie, Kennedy, Higgs, LeFranc, and Foster, and speaks well of the computers, draftsman, accountant, and the head writer of the Computing Section.

The Superintendent reports very favourably of the assistance rendered him by Messrs. McA'Fee and Christie; also of the services rendered by Mr. J. Burbridge, the Head Clerk, and Babu Hira Singh, the second clerk of his office.

The Superintendent expresses his satisfaction with the work done by Mr. Fielding and Munshi Muhammad Zakaria, instructor of the training school.

East of 65th meridian. New editions of sheets 3 N. W. and S. W. of the Northern Trans-Frontier have been submitted for publication and several more on the $\frac{1}{2}$ -inch scale are in hand. Of the 8-mile sheets two have been sent in and a large amount of material has been compiled for the corrections of the sheets of S. W. Asia on the same scale, which will be taken up now that the $\frac{1}{2}$ -inch sheets are out of hand.

Three Sections of the 16-mile map of Afghánistán have been completed and the fourth which includes the whole of the recent work on the North-Western Frontier will very shortly be ready. The same corrections have still to be carried out on the 32-mile map of Turkestan. Eight charts of triangulations have been completed embodying all the results of trans-frontier triangulation in regular standard sheets uniform with those prepared by No. 15 Party for the country south of 32°.*

IV.—FOREST SURVEY BRANCH OFFICE, DEHRA DÚN.

399. Throughout the year the charge of the head-quarters offices at Dehra Dún was in the hands of Mr. W. H. Reynolds, Superintendent of Forest Surveys, and the following branches of work were dealt with:—

- (i) Correspondence and accounts of the several provincial survey detachments.
- (ii) Computations and areas.
- (iii) Up-keep of the Forest Department map records of the several provinces under the Government of India.
- (iv) Compilation and drawing of special maps for the Forest Department.
- (v) Training of surveyors.
- (vi) Other miscellaneous work for the Forest Department.

400. The up-keep of the map records of the forests in the several provinces under the Government of India, as well as Madras, has received due attention. The alterations of forest boundaries and the afforested and disforested areas notified from time to time in the several Provincial Gazettes, have been recorded on the best available maps. The forest map records for Bombay have also been taken in hand and good progress has been made in this particular branch of the work. The details of the up-keep of the provincial map records have been fully described in previous reports, hence it is not necessary to record them again; nevertheless the work continues to grow heavier year by year, as new tracts, specially in Burma and Madras, continue to be brought under Forest management, and existing forest boundaries continue to undergo constant changes owing to new or revised settlements.

401. A large amount of work of a miscellaneous nature was also turned out during the year. Under this head might be noted the colouring of 3,274 printed maps of various sorts and scales and the preparation of 440 tracings for various Forest and District officers; also 2,230 printed maps, on various scales, were cut up and mounted in book form for the use of the Forest Department and other branches of the Provincial Administration.

402. During the year 12 men were instructed in surveying, *viz.*, one in the use of the theodolite for traverse purposes and 11 in plane-tableing.†

* Messrs. Cornelius and Dickinson have worked most zealously throughout the year, and among the draftsmen, Messrs. Sindon and Rozario, and Ishar Dass deserve special mention.

† Mr. Reynolds records his high appreciation of Mr. Descube's services; he works with energy and good will and in a most systematic manner, and always succeeds in turning out a vast amount of work of an excellent quality.

Mr. Watson has also done good work in the drawing office; he is a neat draftsman and is steady at his work and reliable.

Of the Subordinate Establishment the following are specially brought to notice:—

Babu Kali Kanth Kar, as an excellent head clerk; Badri Dutt and Bamala Charan Shome have done good work in the computing office, and Tulsi Ram, Mahomed Hussain, Jadu Nath, and Munzur Ahmed are commended for their excellence in map drawing. Oodey Singh, Bhup Singh, Dalip Singh, and Oodey Ram are good Surveyors and have turned out a creditable amount of field work.

LIST OF MAPS AND CHARTS PUBLISHED AT CALCUTTA DURING THE YEAR 1898-99.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|--------|-------------------|--|
| ATLAS OF INDIA. | | | |
| | In. M. | | |
| Sheets Nos. 1 S.E., 2 S.E., 9 N.W., 10 N.E., 10 N.W., and 39 N.E. | 1=4 | 6 | With additions to 1895. |
| Sheets Nos. 11 S.W., 14 S.E., 37 S.W., 48 N.E., 61 N.E., 76 N.E., 77 N.W., and 79 S.W. | 1=4 | 8 | |
| Sheets Nos. 31 N.W., 49 N.E., 49 N.W., 70 S.W., 126 N.W., 126 N.E., 126 S.W., and 126 S.E. | 1=4 | 8 | With additions to 1898. |
| Sheets Nos. 48 N.W., 48 S.E., 53 S.E., and 87 S.W. | 1=4 | 4 | With additions to 1897. |
| Sheets Nos. 52 S. E., 53 N. E., 66 N. E., 66 N. W., and 69 S. W. | 1=4 | 5 | With additions to 1896. |
| Sheet No. 69 S. E. | 1=4 | 1 | With additions to 1893. |
| Sheet No. 129 S. E. | 1=4 | 1 | With additions to 1891. |
| Sheets Nos. 48 S. W. and 66 S. W. | 1=4 | 2 | With additions to 1899. |
| Sheets Nos. 15, 29, 102, 119, and 120 | 1=4 | 5 | With additions to 1897. |
| Sheet No. 30 | 1=4 | 1 | With additions to 1896. |
| Sheets Nos. 88 and 104 | 1=4 | 2 | With additions to 1898. |
| Sheet No. 58 | 1=4 | 1 | With additions to 1893. |
| Sheets Nos. 111 and 115 | 1=4 | 2 | With additions to 1895. |
| Sheets Nos. 94 and 116 | 1=4 | 2 | With additions to 1899. |
| GENERAL MAPS. | | | |
| Burma and adjacent countries | 1=32 | 2 | 2nd edition. With additions and corrections to boundaries and Railways to December 1898. |
| India | 1=32 | 6 | 3rd edition. |
| India (skeleton) | 1=32 | 6 | October 1898. |
| PROVINCIAL MAPS. | | | |
| Upper Burma | 1=64 | 1 | 2nd edition. |
| Bengal, Bihar, Orissa, and Chota Nágpur (skeleton) | 1=32 | 1 | |
| Bombay Presidency | 1=32 | 1 | With additions to Railways to February 1899. |
| Madras Presidency | 1=32 | 1 | With additions to Railways, etc., to September 1897. |
| Punjab and surrounding countries (skeleton) | 1=32 | 1 | With additions to Railways, etc., to September 1898. |
| Bengal, Bihar, Orissa, and Chota Nágpur (with hills) | 1=16 | 2 | With additions and corrections to Railways and boundaries to December 1898. |
| Upper Burma | 1=16 | 2 | 2nd edition. With additions to Railways, etc., to February 1899. |
| His Highness the Nizam's Dominions, including the Assigned Districts of Berar. | 1=16 | 2 | With additions to May 1898. |

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|--------|-------------------|---|
| DISTRICT MAPS. | | | |
| | In. M. | | |
| Bogra | 1=4 | 1 | With additions to roads, etc., to December 1897. |
| Chittagong | 1=4 | 2 | With additions to August 1898. |
| Darbhanga | 1=4 | 1 | With additions to roads, etc., to April 1899. |
| Dinájpur | 1=4 | 1 | With additions to roads, etc., to 1897. |
| Hissar | 1=4 | 1 | |
| Jalpáiguri and the Native State of Cooch Behar | 1=4 | 1 | With additions to Railways, etc., to October 1898. |
| Jhelum | 1=4 | 1 | |
| Malda | 1=4 | 1 | 2nd edition. |
| Monghyr | 1=4 | 1 | With additions to Railways, etc., to January 1898. |
| Ráwalpindi | 1=4 | 1 | |
| Singhbhum | 1=4 | 1 | With additions to Railways, etc., to November 1898. |
| Ráwalpindi—sheet No. 4 of the Kohistán of the Sindh Ságar Doáb | 1=1 | 4 | With additions to Railways to September 1897. |
| Dehra Dún and Siwálíks | 1=1 | 4 | 2nd edition. |
| STANDARD MAPS. | | | |
| <i>Bombay.</i> | | | |
| Sheet No. 165 | 1=1 | 1 | With additions to Forests, etc., to February 1898. |
| Sheets Nos. 350 and 351 | 1=1 | 2 | |
| <i>Burma (Lower).</i> | | | |
| Toungoo District—Sheets Nos. 272 $\frac{S. W.}{3}$; 274 $\frac{N. W.}{1}$, 274 $\frac{N. W.}{2}$ (2nd edition), 274 $\frac{N. W.}{4}$ (2nd edition), 274 $\frac{S. W.}{2}$ (2nd edition), 274 $\frac{S. W.}{4}$; 275 $\frac{N. W.}{2}$ and 275 $\frac{N. W.}{4}$ | 4=1 | 8 | |
| Toungoo and Tharrawaddy Districts—Sheets Nos. 274 $\frac{N. W.}{3}$, 274 $\frac{S. W.}{1}$, and 274 $\frac{S. W.}{3}$ | 4=1 | 3 | |
| Toungoo and Pegu Districts—Sheet No. 275 $\frac{N. W.}{1}$ | 4=1 | 1 | |
| Hanthawaddy District—Sheets Nos. 279 $\frac{S. W.}{4}$ and 280 $\frac{N. W.}{2}$ | 4=1 | 2 | |
| Pegu District—Sheets Nos. 275 $\frac{N.E.}{3}$; 275 $\frac{N.E.}{4}$; 275 $\frac{S.E.}{1}$; 275 $\frac{S.E.}{2}$; 275 $\frac{S.E.}{3}$; 275 $\frac{S.E.}{4}$; 275 $\frac{S.W.}{2}$; 275 $\frac{S.W.}{4}$; 276 $\frac{N.E.}{1}$ | 4=1 | 9 | |
| Pegu and Tharrawaddy Districts—Sheets Nos. 275 $\frac{N.W.}{3}$; 275 $\frac{S.W.}{1}$ and 275 $\frac{S.W.}{3}$ | 4=1 | 3 | |

LIST OF MAPS AND CHARTS PUBLISHED AT CALCUTTA DURING 95
THE YEAR 1898-99.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|---|--------|----------------------|--|
| <i>STANDARD MAPS—continued.</i> | | | |
| <i>Burma (Upper).</i> | | | |
| Sheets Nos. 315, 352, 353, 360, 361, and 362 | 1=1 | 6 | Preliminary edition. Preliminary edition. With additions to roads, etc., to June 1898. |
| Sheet No. 358 | 1=1 | 1 | |
| <i>Central India and Rájputána.</i> | | | |
| Sheets Nos. 307, 379, and 474 | 1=1 | 3 | |
| <i>North-Western Provinces and Oudh.</i> | | | |
| Naini Tal District—Sheets Nos. 63 $\frac{N.W.}{1 \& 3}$ (in one); 63 $\frac{N.W.}{4}$; 63 $\frac{S.W.}{1}$; 63 $\frac{S.W.}{2}$; 63 $\frac{S.W.}{3}$, and 63 $\frac{S.W.}{4}$ | 4=1 | 6 | With additions to June 1897. With additions to August 1897. |
| Naini Tal District—Sheets Nos. 251 $\frac{S.E.}{1}$ and 251 $\frac{S.E.}{3}$ | 4=1 | 2 | |
| Naini Tal District—Sheets Nos. 251 $\frac{S.W.}{1}$; 251 $\frac{S.W.}{2}$; 251 $\frac{S.W.}{3}$, and 251 $\frac{S.W.}{4}$ | 4=1 | 4 | With additions to September 1897. |
| <i>Punjab.</i> | | | |
| Kángra District—Sheets Nos. 246 $\frac{S.W.}{4}$; 247 $\frac{S.W.}{4}$; 264 $\frac{N.W.}{1}$; 264 $\frac{N.W.}{3}$; 264 $\frac{N.W.}{4}$; 264 $\frac{S.W.}{2}$; and 264 $\frac{S.W.}{4}$ | 4=1 | 7 | |
| Kullu Sub-division of Kángra District—Sheets Nos. 307 $\frac{S.W.}{1}$; 307 $\frac{S.W.}{3}$; 308 $\frac{N.W.}{1}$; 308 $\frac{N.W.}{3}$; 308 $\frac{S.W.}{4}$; 308 $\frac{S.E.}{3}$; 309 $\frac{S.E.}{1}$; 309 $\frac{S.E.}{2}$, and 309 $\frac{S.E.}{3}$ | 4=1 | 9 | |
| Patialá State Forests—Sheets Nos. 311 $\frac{N.W.}{3}$ and 311 $\frac{S.W.}{1}$ (in one); 311 $\frac{N.W.}{4}$; 311 $\frac{S.W.}{1 \& 3}$; 311 $\frac{S.W.}{2}$; 311 $\frac{S.W.}{4}$; 312 $\frac{N.W.}{3}$; 312 $\frac{S.W.}{3}$, and 312 $\frac{S.W.}{3 \& 1}$ | 4=1 | 8 | |
| Sirmür State Forests—Sheets Nos. 314 $\frac{N.E.}{1}$; 335 $\frac{S.W.}{3}$; and 335 $\frac{S.W.}{4}$ | 4=1 | 3 | |
| Kalsia State Forest, Umballa District—Sheet No. 336 $\frac{S.W.}{1}$ | 4=1 | 1 | |
| Simla Hill States—Sheets Nos. 289 N. E., 312 S. E., and 313 N. E. | 2=1 | 3 | |
| Gurdáspur and Kángra Districts—Sheet No. 246 N. E. | 2=1 | 1 | |
| Simla and Patialá States—Sheet No. 289 S. E. | 2=1 | 1 | |
| <i>Sind.</i> | | | |
| Sheets Nos. 18; 19; 20; 33; 34; 35(a); 19A., and 37 (in one); 37A.; 38; 57; 57A.; 77; 77A.; 87; 89; 95; 95A.; 106, and 107 | 1=1 | 20 | (a) Preliminary edi- tion. |
| <i>North-Eastern Frontier Series.</i> | | | |
| Sheet No. 15 N. E. | 1=4 | 1 | 3rd edition. With additions to bound- aries to February 1896. |
| Sheet No. 23 N. W. | 1=4 | 1 | 8th edition. |
| <i>South-Eastern Frontier Series</i> | | | |
| Sheets Nos. 2 N. W. and 2 S. W. | 1=4 | 2 | 2nd edition. |
| Sheet No. 2 S. E. | 1=4 | 1 | 5th edition. |
| Sheet No. 5 S. W. | 1=4 | 1 | 6th edition. With additions and correc- tions to June 1898. |
| Sheet No. 1 | 1=8 | 1 | 5th edition. |

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|---|-----------|-------------------|---|
| PLANS OF CITIES AND CANTONMENTS. | | | |
| | In. M. | | |
| Calcutta and surrounding country | 1=1 | 3 | 3rd edition. |
| Hubli City and Environs, District Dhárwár | 8=1 | 2 | 1895-96. |
| Jullundur | 6=1 | 6 | With additions and corrections to 1897. |
| ADMINISTRATION REPORT MAPS. | | | |
| Amráoti, Betúl, Ellichpur, Gurgáon, Hoshiárpur, Jubbulpore, Mandla Mymensingh, Nágpur, Nágpur (with hills), Narsinghpur, Nimár, Noákháli, Ráwalpindi, Seoni, Sháh-pur, and Wún | 1=8 | 17 | |
| Bálághát, Hoshangabad, and Kángra | 1=12 | 3 | |
| Dera Gházi Khan | 1=16 | 1 | |
| Ráipur | 1=20 | 1 | Engraved. |
| Ráipur | 1=20 | 1 | Photo-zincographed. |
| INDEX MAPS. | | | |
| To the Indian Atlas Sheets showing the sheets that have been published up to 1st October 1898 | 1=256 | 1 | |
| Chart to the Great Trigonometrical Survey of India, showing Colonel Lambton's net work of Triangulation in Southern India, the meridional and longitudinal chains of principal triangles; the base lines measured with the Colby apparatus; the lines of the spirit levelling operations; the astronomical, pendulum, and tidal stations; the longitudinal arcs and the secondary triangulation to fix the peaks of the Himálayan and the Sulémán ranges; and the positions of Bangkok, Kandahár, etc., completed to 1st October 1898 | 1=96 | 1 | |
| To the Standard Sheets of Assam | ... | 1 | |
| To the Standard Sheets of Bengal | ... | 1 | With additions to 1898. |
| STATISTICAL MAPS. | | | |
| Railway map of India | 1=48 | 4 | Railways brought up to 31st March 1899. |
| MISCELLANEOUS. | | | |
| Special survey of the Mahásu Range, Simla Extension | 6=1 | 2 | With additions and corrections to 1897. |
| Reserved Forests, Vellore and Arcot Taluks, North Arcot District, Madras | 4=1 | 4 | |
| Reserved Forests, Gudiyáitam and Chittoor Taluks, North Arcot District, Madras | 4=1 | 4 | |
| Reserved Forests, Krishnagiri Taluk, Salem District, Madras | 4=1 | 4 | |
| Sheets Nos. 1 to 12, 14, 16, and 18, Hosúr and Dharmapuri Taluks, Reserved Forests, Salem District, Madras | 4=1 | 15 | |
| Nos. 1 to 6 Pachaimalai Hills Reserved Forests, Purambalur and Musiri Taluks, Trichinopoly District, Madras | 4=1 | 6 | |
| Nos. 12 to 17, Jávidi Hills, Vellore and Palúr Taluks, North Arcot District, Madras | 4=1 | 6 | |
| Plan of the Zoological Gardens, Alipur, 1899 | 1=150 ft. | 1 | 2nd edition. |

LIST OF MAPS AND CHARTS PUBLISHED AT CALCUTTA DURING 97
THE YEAR 1898-99

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|---|--------|----------------------|--------------|
| CHARTS. | | | |
| | In. M. | | |
| Bombay Topographical Survey—Sheets Nos. 209 and 210 (in one) | 1=4 | 1 | 1892-93. |
| Bombay Topographical Survey—Sheets Nos. 243, 244, 275, and 276 (in one) | 1=4 | 1 | 1884-90. |
| Central Provinces—Sheets Nos. 1, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 23, 24, 25, 26, 27, 28, 34, 35, 36, 37, 38, 39, 63, 64, 82, 83, and 84 | 1=2 | 33 | |
| Punjab—Sheet No. 311 | 1=2 | 1 | 2nd edition. |
| Punjab—Sheet No. 332 | 1=2 | 1 | |
| Sind—Traverse of Sheets Nos. 19, 20, 38, 47, 48, 57, 68, 88, and 89 | 1=2 | 9 | |
| Sind—Triangulation and Traverse of Sheets Nos. 15, 16, 32, 33, 34, 37, 37A, 49, 50, 57A, 66, 67, 69, 70, 77, 80, 87, 90, 91, 95, 95A, 105, 106, 107, 108, and 109 | 1=2 | 26 | |
| Levels in the Punjab, parts of Districts Montgomery, Sirsa, Baháwalpur, and Bikaner states, with pamphlet—sheet No. 88 | 1=2 | 1 | |

98 LIST OF MAPS PUBLISHED AT DEHRA FOR THE FOREST SURVEY BRANCH DURING 1898-99.

| TITLE OF MAP. | Scale. | Number of sheets. |
|---|--------|-------------------|
| | In. M. | |
| STANDARD MAPS. | | |
| BURMA. | | |
| <i>Ataran Forest Survey.</i> | | |
| Sheets Nos. 480 $\frac{N. W.}{1}$ and $\frac{N. W.}{3}$ | 4=1 | 2 |
| <i>Pyinmana Forest Survey.</i> | | |
| Sheets Nos. 268 $\frac{S. W.}{1}$; $\frac{S. W.}{3}$; $\frac{S. W.}{4}$; 269 $\frac{N. W.}{1}$; $\frac{N. W.}{2}$; $\frac{N. W.}{4}$; $\frac{S. W.}{1}$; $\frac{S. W.}{3}$; 221 $\frac{S. E.}{1}$; $\frac{S. E.}{3}$; 222 $\frac{N. E.}{1}$; $\frac{N. E.}{2}$; $\frac{N. E.}{4}$; $\frac{S. E.}{2}$ and $\frac{S. E.}{4}$ | 4=1 | 15 |
| CENTRAL PROVINCES SURVEY. | | |
| <i>Bálághát Forest Survey.</i> | | |
| Sheets Nos. 112 $\frac{N. E.}{2}$; $\frac{N. E.}{3}$; $\frac{N. E.}{4}$; $\frac{S. E.}{1}$; $\frac{S. E.}{2}$; $\frac{S. E.}{3}$; $\frac{S. E.}{4}$; 113 $\frac{N. W.}{4}$; $\frac{N. E.}{2}$; $\frac{N. E.}{4}$; $\frac{S. W.}{4}$; and 114 $\frac{N. W.}{2}$ (in one); $\frac{S. E.}{1}$; $\frac{S. E.}{2}$; $\frac{S. E.}{3}$; and $\frac{S. E.}{4}$ (in one); $\frac{S. E.}{4}$; 114 $\frac{N. E.}{2 \& 4}$; 137 $\frac{S. W.}{3}$ and 138 $\frac{N. W.}{1 \& 3}$ (in one); 135 $\frac{S. E.}{2}$; $\frac{S. E.}{3}$; and $\frac{S. W.}{4}$ (in one); $\frac{S. E.}{4}$; 136 $\frac{N. W.}{3}$; $\frac{N. E.}{1}$; $\frac{N. E.}{2}$; $\frac{N. E.}{3}$; $\frac{N. E.}{4}$; $\frac{S. W.}{1}$; $\frac{S. W.}{3}$; $\frac{S. W.}{4}$; $\frac{S. E.}{1}$; $\frac{S. E.}{2}$; $\frac{S. E.}{3}$; $\frac{S. E.}{4}$; 138 $\frac{S. W.}{1}$; $\frac{S. W.}{2}$; $\frac{S. W.}{3}$; $\frac{S. W.}{4}$; $\frac{S. E.}{1}$; 139 $\frac{N. W.}{1}$; $\frac{N. W.}{2}$ and part of $\frac{N. W.}{4}$ (in one); $\frac{N. E.}{1}$ and $\frac{N. E.}{3}$ (in one); 158 $\frac{S. W.}{3}$; 159 $\frac{N. W.}{1}$; $\frac{N. W.}{3}$; and $\frac{S. W.}{1}$ | 4=1 | 42 |
| <i>Biláspur Forest Survey.</i> | | |
| Sheet No. 223 $\frac{N. W.}{3}$ and $\frac{S. W.}{1}$ (in one) | 4=1 | 1 |
| <i>Chhindwára Forest Survey.</i> | | |
| Sheets Nos. 54 $\frac{N. E.}{2}$; $\frac{N. E.}{4}$; $\frac{S. W.}{4}$ and 55 $\frac{N. W.}{2}$ (in one); $\frac{S. E.}{2}$; $\frac{S. E.}{4}$; $\frac{S. E.}{4}$; and 55 $\frac{N. E.}{2}$ (in one); 71 $\frac{N. E.}{2}$; $\frac{S. W.}{1}$; $\frac{S. W.}{2}$; $\frac{S. W.}{4}$; 72 $\frac{N. W.}{1}$; $\frac{N. W.}{3}$; and $\frac{S. W.}{1}$ | 4=1 | 13 |
| <i>Nágpur-Wardha Forest Survey.</i> | | |
| Sheets Nos. 41 $\frac{N. E.}{1}$; $\frac{N. E.}{3}$; $\frac{S. E.}{2}$; 56 $\frac{S. W.}{2}$; $\frac{S. W.}{4}$; $\frac{S. E.}{1}$; $\frac{S. E.}{2 \& 4}$; $\frac{S. E.}{3}$; 57 $\frac{N. W.}{2}$; $\frac{N. W.}{3}$; $\frac{N. W.}{4}$; $\frac{N. E.}{1}$; $\frac{N. E.}{2}$; $\frac{N. E.}{3}$; $\frac{N. E.}{4}$; 72 $\frac{S. W.}{1}$ and part of 54 $\frac{S. E.}{2}$ (in one); 75 $\frac{N. W.}{3}$ and $\frac{N. W.}{4}$ | 4=1 | 19 |
| <i>Káipur Forest Survey.</i> | | |
| Sheets Nos. 205 $\frac{S. E.}{3}$; $\frac{S. E.}{4}$; 206 $\frac{N. E.}{1}$; $\frac{N. E.}{2}$ and 223 $\frac{S. W.}{1}$ | 4=1 | 5 |

LIST OF MAPS PUBLISHED AT DEHRA FOR THE FOREST SURVEY 99
BRANCH DURING 1898-99.

| TITLE OF MAP. | Scale. | Number of sheets. |
|--|--------|-------------------|
| STANDARD MAPS—contd. | | |
| CENTRAL PROVINCES SURVEY—contd. | | |
| <i>Saugor Forest Survey.</i> | | |
| Sheets Nos. 45 $\frac{S. E.}{1}$; $\frac{S. E.}{2}$; $\frac{S. E.}{3}$; $\frac{S. E.}{4}$; 46 $\frac{N. E.}{1}$; $\frac{N. E.}{2}$; $\frac{N. E.}{3}$; $\frac{N. E.}{4}$; $\frac{N. E.}{1}$; $\frac{S. W.}{3}$; $\frac{S. W.}{4}$; and 47 $\frac{N. W.}{2}$ (in one); $\frac{S. E.}{4}$ and $\frac{S. E.}{2}$ (in one); 47 $\frac{N. E.}{1}$; $\frac{N. E.}{2}$; $\frac{N. E.}{3}$; and part of $\frac{N. W.}{4}$ (in one); $\frac{N. E.}{4}$; $\frac{S. E.}{1}$; $\frac{S. E.}{2}$; 63 $\frac{N. W.}{3}$; $\frac{S. W.}{1}$; $\frac{S. W.}{2}$; $\frac{S. W.}{3}$; 64 $\frac{N. W.}{1}$; $\frac{N. W.}{2, 3 \& 4}$; $\frac{N. W.}{3}$; $\frac{N. E.}{1}$; $\frac{N. E.}{3}$; $\frac{N. E.}{4}$; $\frac{S. W.}{1}$; $\frac{S. W.}{2}$; $\frac{S. W.}{3}$; $\frac{S. E.}{4}$; $\frac{S. E.}{1}$; $\frac{S. E.}{3}$; 65 $\frac{N. W.}{1}$; $\frac{N. W.}{2}$ and $\frac{N. E.}{1}$ | 4=1 | 35 |
| <i>Seoni Forest Survey.</i> | | |
| Sheets Nos. 71 $\frac{N. E.}{3}$; $\frac{S. E.}{2}$; $\frac{S. E.}{3}$; $\frac{S. E.}{4}$; 72 $\frac{N. E.}{1}$ and part of $\frac{N. E.}{3}$ (in one); 91 $\frac{N. W.}{3}$; $\frac{S. W.}{3}$; 92 $\frac{N. W.}{1}$ and $\frac{N. W.}{3}$ | 4=1 | 9 |
| NORTH-WESTERN PROVINCES AND OUDH. | | |
| <i>Bahraich Forest Survey.</i> | | |
| Sheets Nos. 129 $\frac{N. W.}{4}$ and 145 $\frac{N. W.}{2 \& 4}$ | 4=1 | 1 |
| <i>Gonda Forest Survey.</i> | | |
| Sheets Nos. 161 $\frac{S. W.}{4}$ and 162 $\frac{N. W.}{2}$ (in one); $\frac{S. E.}{3}$ and 162 $\frac{N. E.}{1}$ | 4=1 | 3 |
| <i>Gerakhpur Forest Survey.</i> | | |
| Sheets Nos. 188 $\frac{S. E.}{4}$; 189 $\frac{N. E.}{1}$; $\frac{N. E.}{2}$; $\frac{N. E.}{3}$; $\frac{N. E.}{4}$ and $\frac{S. E.}{2}$ (in one); $\frac{S. E.}{1}$; $\frac{S. E.}{3 \& 4}$; 190 $\frac{N. E.}{2}$ and $\frac{N. E.}{4}$ (in one); $\frac{S. E.}{4}$ and 205 $\frac{S. W.}{3}$ (in one); 191 $\frac{N. E.}{2}$ and 206 $\frac{N. W.}{1}$ (in one); 203 $\frac{N. W.}{4}$; $\frac{N. W.}{1}$; $\frac{S. W.}{1}$; $\frac{S. W.}{2}$; $\frac{S. W.}{3}$; $\frac{S. W.}{4}$; $\frac{S. E.}{1}$ and part of $\frac{S. E.}{2}$ (in one); $\frac{S. E.}{3}$ and part of $\frac{S. E.}{4}$ (in one); 204 $\frac{N. W.}{1}$; $\frac{N. W.}{3}$; $\frac{N. E.}{1}$ and $\frac{N. E.}{2}$ (in one); and $\frac{S. W.}{3}$ and 205 $\frac{N. W.}{1}$ (in one). | 4=1 | 22 |
| PUNJAB. | | |
| <i>Chamba Forest Survey.</i> | | |
| Sheet No. 246 $\frac{N. E.}{2}$ | 4=1 | 1 |
| <i>Index Maps.</i> | | |
| Index showing progress of Forest Surveys in the Central Provinces | 1=32 | 1 |
| „ to the Forest Surveys in the Chamba State, 1897-98 | 1=8 | 1 |
| „ „ Government Forests in the Ruby Mines | 1=8 | 1 |
| „ „ Forest Surveys in the Pynmana District | 1=8 | 1 |
| „ „ Forest Surveys in Tenasserim Circle | 1=32 | 1 |

| TITLE OF MAP. | Scale. | | Number of sheets. |
|---|--------|----|-------------------|
| | In. | M. | |
| STANDARD MAPS—concl'd. | | | |
| <i>Miscellaneous.</i> | | | |
| Airadeo Range, Naini Tal Division | 2=1 | | 1 |
| Ajmer-Merwára, showing the distribution of Forest areas, 1898-99 | 1=4 | | 1 |
| Andamans, showing the distribution of reserved Forests gazetted up to 1898-99 | 1=8 | | 1 |
| Balúchistán, showing the distribution of Forest areas, 1898-99 | 1=8 | | 1 |
| Burma, showing distribution of reserved Forests gazetted up to 30th June 1898 | 1=32 | | 1 |
| Coorg Forests, Devammachi-Mawukal Forest Reserve | 2=1 | | 1 |
| Coorg-Dubari Forest Reserve | 1=4 | | 1 |
| Hyderabad Assigned Districts or Berar, Akola Taluk, Akola District | 1=1 | | 2 |
| " " " " Chikhli " Buldána District | 1=1 | | 3 |
| " " " " Mehkar " Buldána " | 1=1 | | 3 |
| " " " " Amráoti District, Murtazapur Taluk | 1=1 | | 2 |
| " " " " Wún " Wún Taluk | 1=1 | | 2 |
| " " " " Buldána Division, Amdari Range | 2=1 | | 1 |
| North-Western Frontier, Punjab Revenue Survey, sheets Nos. 1, 3, 4, 6, and 7, District Hazára (Forests) | 1=1 | | 5 |
| Ránikhet Forest Sub-division Working Circles | 1=1 | | 1 |
| " Range, Ránikhet, Naini Tal Division | 2=1 | | 1 |
| Sauni Range, Ránikhet, Naini Tal Division | 2=1 | | 1 |
| School Circle, North-Western Provinces and Oudh Forest Map | 1=4 | | 1 |

APPENDIX.

EXTRACTS

FROM

REPORTS BY EXECUTIVE OFFICERS.

Narrative Report by Captain C. H. D. RYDER, R.E., Officiating Deputy Superintendent, 1st Grade, on the Survey Operations in Yünnan, Season 1898-99.

Having received orders to accompany Captain Davies, Oxfordshire Light Infantry, into Yünnan, I left Bangalore on the 26th October, reaching Rangoon on the 31st. Captain Davies arrived on the 4th, and on the 8th after handing over charge of No. 21 Party, I left by mail train, reaching Katha on the 10th and Bhamo on the 11th November. At Bhamo I was kept busy arranging for transport, but we finally got away on the 16th and marching *viâ* Myothit and Nampaung, crossed the frontier on the morning of the 19th. Our party was composed as follows:—

Captain H. R. Davies, Oxfordshire Light Infantry.
Captain C. H. D. Ryder, R. E., Survey Officer.
Lieutenant Watts-Jones, R.E., Railway Survey Officer.
Two Survey of India Surveyors, Lachman Jadu and Ram Sabad.

An Intelligence Surveyor was to have accompanied us, but fell sick, and had to be left behind at Nampaung.

We each had two servants, my own two Madrassis; Captain Davies had a North-Western Provinces Mahomedan and a Chinaman, and Watts-Jones a Goanese and a Chinaman; four Indian *khalásis* and some Chinese coolies and interpreters completed the party. Our transport, which was on the whole satisfactory, consisted of mules with Chinese drivers. After crossing the frontier we passed a number of small Chinese stockades, with a few so-called soldiers loafing about; however, they did not interfere with us, after seeing our passports and although at first we felt rather shy of surveying openly, neither then, nor at any other time was any obstacle placed in the way of our surveying as much as we liked.

On the 18th we reached Man-yuen, a small town with a stockade, and had our first sight of the Chinese and a first experience of a Chinese crowd and their untiring curiosity. The women here had their feet bound up, a curious sight at first, but one to which a traveller in China soon gets accustomed to. From Man-yuen, Captain Davies left us for a couple of days in order to visit Santa and the path on the right bank of the Taping, and Watts-Jones and I marched straight up the valley, crossing the river about 200 yards wide by ferry. After two days' march we halted to allow Captain Davies to catch us up and then continuing up the Taping valley, or rather one branch of it, we reached Momen on the 26th.

The following day we paid a long visit to the Ting Kuan (magistrate) and were regaled with Peek and Frean's biscuits and green chartreuse. Here I first noticed the long finger nails on which a literary Chinaman prides himself, as a sign that he has never had to do any manual labour. The Ting-Kuan, however, showed us that his long nail had its advantages, as with its help and with great deftness he picked a fly out of Watts-Jones' chartreuse much to the latter's disgust.

That night I was able to take longitude observations with Captain Pirrie at Bhamo, but with some difficulty, as my star observations were executed before a noisy spitting

crowd of Chinese, and the telegraph operations were not improved by being carried out at my end in a room in which the Telegraph clerk had invited several friends and his family to watch the performance. One of the sights of Momiën is a waterfall about 60 feet high, about a mile outside the town, down which it is said the Chinese threw 500 Mahomedan prisoners at the close of the rebellion.

At Momiën we again separated, Captain Davies leaving on the 29th to explore to the north, he visited Si-lien and Pa-lien, and reached Yungchang-fu by a path north of the main road; from Yungchang-fu he proceeded southwards to Tawnio, our frontier post, where he was delayed a month waiting for Mr. Turner and Mr. Ker, who had been sent out by the Yünnan company to report on the province, the former from a commercial, the latter from a mining point of view.

Lieutenant Watts-Jones and I left Momiën on the same day the 29th, and reached Yungchang-fu, following the main trade route in 5 marches continuously up or down hill, and crossing the Shweli and Salween rivers by iron chain suspension bridges, distinctly creditable to the Chinese in their design and construction. Watts-Jones only stopped here a couple of days, but I was delayed a week owing to cloudy weather.

Six marches through jungly country took us to Shunning-fu and two more to Yünchon, a small town, but one that will be of importance, as it is the first town in Chinese territory on the line of the proposed railway. My interpreter, Haroon, was a native of this place and he had many marvellous stories to relate of the fighting between Mahomedans and Chinese during the rebellion. From here turning towards our frontier, the country becomes more Shan-like in appearance and after a few marches Shan villages are met with. The path does not follow the Nam Ting valley, as the railway will, but keeps on the hills to the south. On the 26th I caught up Watts-Jones at Man-hkü, a small Shan village; he had been exploring the Nam Ting valley and found it possible for a railway but not good.

After a day's halt at Mong-hsa and an excursion for a couple of days on the road towards Kunlong, I struck over the hills by a little used path for Mienling, which I reached on the 6th, crossing one range at 9,500 feet. From Mienling I made for Ching-tong-ting, by a very rough path, crossing the Mekong by ferry at Kali-kai.

The headman of this and the surrounding villages had an unenviable notoriety, one of his proudest feats having been the drowning of 13 Panthays in the river, as they were escaping from the Chinese. On January 16th I got into the valley, narrow but well cultivated, of the Black river and following it up, in two days reached Ching-tong-ting. Here I found two missionaries, Messrs. Nichols and Sanders, and was glad to meet a European again. I then followed up the valley to its source for several days, crossed over a watershed to Nantien on the 26th; here I heard that Watts-Jones, who had returned from Mong-hsa *via* Yünchon had passed through some days before: two days more brought me to Meng-hua, a fairly large town in a good plain, and two more to Hsia-kuan at the foot of the Tali plain. I had a very fine view of the Tali lake, crossing a watershed at 8,700 feet and looking straight down on to the lake; it was bitterly cold as snow was falling, but the view was magnificent. The lake some 30 miles long by 4 to 7 wide is encircled by hills, those to the west being covered with snow and rising to 14,000 feet.

A short march, snow hills to the left and lake to the right, brought us to Tali-fu. Meeting Watts-Jones on the road, I persuaded him to return and come northwards with me as he had been several days in Tali-fu, I only allowed myself a day's halt which was well filled up by calls on the officials, seeing the missionaries and longitude observations.

Leaving Tali-fu on the 3rd February, we reached the Yangtze on the 11th having to halt two days *en route* for the Chinese New Year. The country we passed through was a succession of well cultivated plains over 7,000 feet in elevation. We had good shooting as the plains were full of duck and the hill sides crowded with pheasant. The cold was very great, my thermometer marking 19° of frost one night. A short march down the right bank of the river here, 6,000 feet above sea-level, and a long up hill march the following day, brought us to another fine plain, Li-Chiang-fu 8,000 feet in height, with a splendid snow-clad mass of mountains to the north, over 18,000 feet in height. Our reception in Li-Chiang-fu was not cordial, but we halted a day there. On the 15th we left, Watts-Jones marching southwards to Hsüching and the main trade route from Tali-fu to Yünnan-fu. I proceeded eastward, crossing a range at 10,500 feet and then descending very abruptly to the Yangtze, which was crossed by a chain suspension bridge in a very bad state of repair. On the 17th, while on the march, my mule men got into a row with another set of mule drivers connected with some copper mines in the neighbourhood, one of the men, not mine, was nearly killed and his comrades went off vowing to bring the rest of the miners to attack us that night; however, the night passed over without incident and a forced march took us to Yungpe-ting the following day, where I settled the matter satisfactorily with the Chinese officials.

The next six marches were very much up and down, crossing affluents of the Yangtze several times. I had fine views northwards, the country apparently one mass of hills, many of them under snow. At Chin-ya-pin I came upon some very good coal, which was being used in all the houses for fuel; and the next day, the 26th, after a short march reached the Yangtze again at Machang, where I found two French priests who very hospitably insisted on my stopping the night with them. They informed me that a great deal of coal existed in the neighbourhood. I then followed the left bank of the river until I crossed it on the 28th at a height of 3,500 feet. The river here is fast running, about 150 yards wide, and a small quantity of gold is found in the sand. After crossing the

river I turned south and reached Tsu-hsiung on March 11th, meeting Captain Davies, Lieutenant Watts-Jones, and Mr. Ker two days previously. Here we halted six days while I got my longitude observations; the main party then went into Yünnan-fu by the main road, I marching by a route more to the south. Mr. Ker, with whom I sent Surveyor Ram Sabad, left Tsu-hsiung for the north going up to Hui-li-chon and returning to Yünnan-fu, early in May. Yünnan-fu, the capital of the province, where we arrived on the 24th, is a fine large town, walled as all the Chinese towns are, and contains some 50,000 inhabitants. The trade in foreign goods is nearly all carried on with Tong King, but a great many goods of English manufacture come that way. Here I was obliged to stay 28 days, trying in vain to get direct telegraphic communication with Bhamo for longitude, but it ended in a failure owing to the incapacity and laziness of the clerks at intermediate stations. In the mean time Captain Davies and Lieutenant Watts-Jones left by different roads for Weining and Pichich-hsien, near where they finally met Captain Pottinger's party who had been much delayed by the weather and by the hostility of the Chinese. Captain Davies then returned to Yünnan and marching on the direct road to Mongtzu-hsien came out down the Red river. I finally left Yünnan on the 23rd April and marching south-east visited several fair sized towns, but their trade is small and the country generally poor. On the 4th April I reached Mongtzu-hsien, a place comparatively civilized, there being a French Consulate as well as a Chinese customs station. Mr. Spinney, the head of the customs, kindly put me up and I halted 3 days there expecting letters. However, none came, so I left on the 7th, 4 days taking me to Kai-hua-fu and five more down to Lad-kai on the Red river, and the French frontier station. Here I got a boat and two days down stream brought us to Yen-bai, where I had to wait a couple of days for the steamer, then three more days took us to Hai-phong, the port of Tong King, from where I found a steamer going to Hong Kong and so to India by P. and O.

The results of our trip were as follows:—

Some 44,000 square miles of country were surveyed on the $\frac{1}{4}$ -inch scale, of which the Survey of India may take credit for 29,000 square miles. A possible route for a railway has been found in continuation of the Kunlong line, and a great deal of miscellaneous information has been collected about the country. I have the pleasure of recommending very highly the two surveyors who accompanied us—Lachman Jadu and Ram Sabad. They both worked untiringly and with great energy in a country, where the people were foreign to them and very often unfriendly, and their traverses checked by the longitude and latitude observations were generally found very good. I also wish to mention the very excellent work done by my interpreter Haroon. In addition the longitudes of Momiën, Yungchang-fu, Tali-fu, and Tsu-hsiung-fu were fixed by telegraph and over a hundred latitudes were observed.

During the field season 1899-1900, another expedition, will be sent into Yünnan, consisting of Captain Davies, Oxfordshire Light Infantry, Captain Ryder, R. E., Survey of India, and Major Manifold, I. M.S., each accompanied by a surveyor; Captain Rigby of the Wiltshire Regiment and Lieutenant Fraser, R.A., each also accompanied by a surveyor, will also be exploring in Yünnan, so that by the end of the season a fairly complete map and Gazetteer of Yünnan will be available.

Narrative report by CAPTAIN T. F. B. RENVY-TAYLOR, R.E., Offg. Superintendent, 2nd grade, on the Survey operations with the Burma-China Boundary Commission, Northern Section, season 1898-99.

It was again decided to send two parties to demarcate the Burma-China Boundary, one working at the northern end and the other at the southern end, leaving in the centre the frontier between the Wa country and China for next season.

The distance between the parties was so great that, as far as actual survey operations were concerned, they were practically independent of each other, and Captain H. J. Hare, R.E., who was in charge of the Survey Detachment with the Southern Party, is submitting a separate report.

Captain T. F. B. Renny-Taylor, R.E.
Surveyor Mahmud Husain.
Abdul Rahim.
Sub-Surveyor Mowmi Ram,
39 *Khaldis*, Interpreters, etc.

} The Survey detachment detailed to accompany the Northern Party is given in the margin.

Mr. J. C. Scott, C.I.E., was the British Commissioner and accompanied the Northern Party. Mr. J. W. Jamieson, of the China Consular Service, was the Chinese Adviser and the following officers were posted to the party:—Lieutenant-Colonel Lloyd, V.C., R.A.M.C., as Medical Officer, Captain H. B. Walker, D.C.L.I., as Intelligence Officer, Captain R. C. Dundas, the Royal Scots, as Signalling Officer after Namhkam, and Captain J. L. W. French-Mullen, 13th B.L., as Signalling Officer up to Namhkam, 25 Sappers and Miners of the Burma Company were also sent.

General Liu was again the Chinese Commissioner, he was accompanied by Mr. P'eng, several other civil officers and a fairly large escort. Our programme was to demarcate the boundary from the Taping river in a south-easterly direction as far as the Nam Ting (river).

We left Bhamo on the 28th November, arriving at Nampaung on the 30th, ready to meet the Chinese Commission on the 1st December, as had been previously settled. Mr. Rae, the Civil Officer in charge of this part of the Bhamo district, joined us here.

My arrangements for the survey operations were:—To do the triangulation myself, Mahmud Husain to survey as much as possible along the frontier and in China on the $\frac{1}{4}$ -inch scale, Abdul Rahim to survey the boundary on the 1-inch scale, and to fix the position of each of the boundary marks, and Mowni Ram to assist with the survey on the 1-inch scale, when necessary, and at other times to survey on the $\frac{1}{4}$ -inch scale. There was already a certain amount of triangulation as far as Namhkam, but practically none at all beyond; I intended to push on as fast as possible, strengthening the work up to Namhkam and completing the triangulation to the end of our portion of the boundary before the haze set in, and expected to be away from the party for at least two months.

On the 1st December we exchanged calls with the Chinese and held our first official meeting on the 2nd. Questions referring to maps were constantly cropping up, and after consulting with Mr. Scott I found it was impossible for me to go on ahead with the triangulation as I had intended. This was rather a serious matter, as with the haze in the latter part of the season, it was most improbable that I should now be able to carry my triangulation right through, and it would be extremely unsatisfactory to survey the boundary on the 1-inch scale without fixed points. I accordingly applied to the Surveyor-General and asked him to arrange for triangulation being carried from the Nam Ting northwards, along the Kokang boundary, by Mr. Adams of No. 21 Party.

Nampaung is a low and feverish place, and I was very glad when we left it on the 7th December. After halting several days *en route*, we arrived on the 16th at a very confined camp, more or less in the centre of the disputed country.

We left this camp on the 24th December, and arrived at Loileng on Xmas day. There was first rate camping ground at Loileng, and the main body of the escort marched in on the 26th December, having come from Bhamo by another and more direct road.

Just beyond Loileng the boundary became rather complicated, running across fields near the edge of the Mêng Wan plain, and in order to decide on the best line we moved to Homun on the 5th January. At Homun we settled the boundary down to the Nam Wan, which river it then follows to the Shweli river near Namhkam.

Up to date I had made and observed from 4 stations, but to obtain a satisfactory connection, it was necessary for me to visit and observe from 2 hills, to the west of the road from Homun to Namhkam; Naru Pum, one of these hills, was nearly 8,000 feet elevation and the highest in this part of the country.

The line being now settled so far in advance, gave me an excellent opportunity of doing this work. I accordingly left Homun on the 7th January and rejoined the Commission, a march before Namhkam, which place we arrived at on the 15th.

In the Mêng Wan plain we had made considerable concessions to the Chinese, on the understanding that they would give us corresponding concessions in the Shweli Valley, near Namhkam, and further on in the neighbourhood of Mông Ko. In order to decide what these concessions were, I sent Abdul Rahim to survey the Shweli Valley, and Mahmud Husain with a strong escort was sent to survey at Mông Ko and beyond.

On Abdul Rahim's return we settled the boundary line for the Shweli Valley, and decided to move on slowly, demarcating it leaving the Mông Ko question until our arrival there.

At Namhkam, which is in the Northern Shan States, Mr. Rae left us and Mr. Breithaupt took his place. The main body of the escort followed us to Namhkam, but never advanced beyond and returned to Bhamo soon after we moved on.

The Commission left Namhkam on the 26th January and arrived at Mông Ko on the 8th February.

The 10th February was the Chinese New Year; we sent them presents and returned calls in honour of the occasion. Several conferences were held at Mông Ko and after considerable discussion, the boundary line was settled down to the Salween river.

Since our arrival at Namhkam, I had been able to get away from the Commission on several occasions for short periods, and being lucky in the matter of weather, had managed to observe from a good number of stations, and had carried on the triangulation as far as Mông Ko, besides fixing a certain number of points in advance.

From Mông Ko it was decided that the Commission should proceed to Mêng P'êng, an important Chinese village, with good camping ground, and not far from where the frontier line along the boundary of the sub-state of Kokang leaves the Salween river. The direct road through our territory is extremely hilly and the Chinese being anxious to entertain the Commission at Mêng Ka, Mr. Scott decided to go round with General Liu through China, taking about a fortnight *en route*. At the same time Mr. Jamieson persuaded the Chinese to allow Captain Walker with a surveyor to take a month's trip through China, travelling by a different road to the Commission. I took advantage of these opportunities to send Abdul Rahim with Mr. Scott, Mahmud Husain with Captain Walker, and Mowni Ram by the direct road to Mêng P'êng near the frontier.

In the mean time I had heard that it was impossible for Mr. Adams to carry on his triangulation more than a few miles north of the Nam Ting, and that practically I should get no help from him; under the circumstances my only chance was to make a dash into Kokang while the Commission was going round through China and try and run my triangulation as far to the east and south as possible; this I did and having the good fortune to get some rain, the haze partially cleared off and I was able to do a lot of work.

I obtained observations from 9 stations, and fixed a number of points in China, and along the boundary to within 10 or 12 miles of the Nam Ting. I had certainly extremely good luck, as the day after observing from my last station, the haze became like peasoup.

I arrived at Mêng P'êng on the 17th March within an hour or two of the Commission, who had had a very good time in China; the Chinese had been most hospitable and entertained them in great style; at Mêng Ka' the programme included a variety show which was made particularly amusing by each of the members of the Commission taking a turn!

After staying a few days at Mêng P'êng to settle details about the boundary, the Commission moved on slowly, eventually arriving at Tashuit'ang on the 6th April. Tashuit'ang was within about 6 miles of the Capital of Kokang and delightfully cool. Owing to the early commencement of the rains in this part of the country, the haze cleared away considerably during April, and enabled me to form 3 more stations in connection with my others in Kokang, and to fix sufficient points to carry the survey accurately down to the end of the boundary on the Nam Ting.

The demarcation of the Kokang boundary progressed rapidly, and the last boundary mark was put up on the 18th April.

The duplicate 1-inch maps for signature by the Commissioners had been taken in hand soon after our arrival at Tashuit'ang, they were completed by the 22nd April, and the final meeting for attaching seals and signatures took place the following day.

Our social relations with the Chinese were very cordial, and before parting we did our best to return the hospitality they had shown our party when in China. Among other entertainments we gave them a dinner and a musical evening. On the completion of the work, Mr. Scott started off to interview the Viceroy of Yunnan, with reference to next season's delimitation. Mr. Jamieson went off to Ssümao, joining Mr. Scott at Yunnan.

Captain Walker obtained leave from General Liu to return to Burma *via* T'êngyüeh (Momiën) and the Kambaiti pass, and Mahmud Husain accompanied him.

The remainder of the Commission left Tashuit'ang on the 26th April and marched back to Bhamo, arriving there on the 16th May. The march back was rendered somewhat unpleasant, owing to the fact that the rains had now more or less set in, and we got soaked through on several occasions.

Our transport during the season was composed of Chinese and Government mules, but it is to be hoped that only Chinese mules will be employed next season, as with a Commission like ours Government mules are decidedly objectionable. Mr. Scott takes a great interest in survey work and did his utmost to assist us. I am also greatly indebted to Mr. Jamieson, whose influence with General Liu was invaluable, and to Captain Walker who took every advantage that was offered to make reconnaissances into China, always taking one of my surveyors with him and doing everything he could to facilitate the mapping. After the first few days the surveyors were continuously employed and I consider we had a very successful season. Triangulation was carried on throughout, and besides plenty of points along the frontier, a number of distant hills were fixed in China; altogether 33 stations were observed from, and in addition, 170 intersected points were fixed.

The boundary line, which was nearly 300 miles in length, was accurately surveyed on the 1-inch scale; by working out my triangulation roughly in the field I was always able to supply the surveyors with fixed points.

Every opportunity was taken advantage of to survey in China, and nearly all the country surveyed on the $\frac{1}{4}$ -inch scale was across the frontier.

The following are the areas completed after deducting overlaps:—

- Triangulation, 4,000 square miles.
- Plane-tabling on 1-inch scale, 1,300 square miles.
- Plane-tabling on $\frac{1}{4}$ -inch scale, 7,500 square miles.

In recess at Bangalore the triangulation has been carefully computed, and as my last two stations were also observed from by Mr. Adams (whose work is based on the triangulation brought up by No. 21 party from Mandalay), a very good check was obtained, and I am glad to say the connection is very satisfactory, the differences being only about 2 seconds in latitude, 1 second in longitude, and 30 feet in height.

The 1-inch work has been fair mapped in 8 sheets and the $\frac{1}{4}$ -inch work has been fair mapped on the ordinary $\frac{1}{4}$ -inch sheets.

The country passed through was hilly, moderately open, and appeared to be very healthy in the cold weather; the climate, on the whole, was cool and pleasant, and consequently the general health of the Survey Detachment was very good.

Surveyor Mahmud Husain surveyed an area of 7,300 square miles on the $\frac{1}{4}$ -inch scale. He is an accurate and experienced surveyor, and considering that he is 55 years of age, marvellously active and hard working.

Surveyor Abdul Rahim surveyed an area of 835 square miles on the 1-inch scale and an area of 1,400 square miles on the $\frac{1}{4}$ -inch scale. He is a particularly quick surveyor and worked very well. He was always on the best of terms with the Chinese, thereby considerably facilitating the work.

Sub-Surveyor Mowni Ram surveyed an area of 480 square miles on the 1-inch scale and an area of 1,000 square miles on the $\frac{1}{4}$ -inch scale. He is a good surveyor and worked well.

Narrative report by CAPTAIN H. J. HARE, R. E., Officiating Deputy Superintendent, 2nd grade, on the Survey Operations with the Burma-China Boundary Commission, Southern Section, Season 1898-99.

The boundary line to be demarcated by the Southern party of the Burma-China Boundary Commission extended from the south of the Wa country to the Mekong river.

Captain H. J. Hare, R.E., Officiating Deputy Superintendent- The *personnel* of the survey detachment with the party is given in the margin.

Sub-Assistant Superintendent Ikkaluddin.

Sub-Surveyor Kudratulla.

Sub-Surveyor Jamna Pershad.

Mr. E. C. George, C.I.E., was the British Sub-Commissioner, with Mr. P. F. Hausser of the China Consular service as Chinese adviser.

The following Officers also accompanied the Commission :—

Major S. N. Caulfield, D.S.O., 1st Burma Gurkha Rifles, as Signalling Officer.

Capt. J. K. Tod, 7th Bengal Cavalry, as Intelligence Officer.

Mr. C. B. Sterling, as Civil Officer.

Lieutenant J. Whitehead and later Lieutenant H. G. Corbett, 3rd Burma Regiment, Commanding the escort, and Lieutenant H. Sant Fournier, of the Essex Regiment, as Transport Officer.

The escort consisted of 130 men of the 3rd Burma Regiment from Kengtung, and a detachment of 25 men from the Burma Company of the "Q. O." Sappers and Miners.

The Chinese Sub-Commissioner was Chen Tsan from Pu-erh, and he was accompanied by several Military and Civil officials from his district. He also was accompanied by an escort of 150 men or more when we first met him, but this was considerably reduced towards the close of the work.

The party started from Mandalay on November 20th, but halted at Maymyo owing to Mr. George being unexpectedly delayed. This was a very late start and meant that the Commission could not get to work before the end of December.

As I had to start triangulation from the Salween and carry it up some 50 miles to where the boundary work would start, I decided to push ahead of the Commission and eventually reached Na-Lawt on 21st December, 3 days in advance of the rest of the party.

We found that the Chinese had arrived and were encamped two miles off at Mong Nga across the Nam Hka, and on the 26th December we moved across to their camp and paid the usual official calls.

The total length of boundary to be laid down was 225 miles. No triangulation existed along it until near the end, where I hoped to connect with a series brought up from Kengtung by Mr. Shaw for the purpose.

The haze would set in about March 1st, after which date, I could not count on being able to take any observations, consequently I was anxious to push on ahead of the Commission, and this Mr. George very kindly arranged for me to do.

The Commission did not leave Mong Nga until the 25th January, having spent a month endeavouring to come to an understanding with the Chinese over the first few miles of the boundary. The country in dispute lay on the steep slopes of Loi Ang Lawng, scarcely inhabited and most difficult ground for a surveyor.

The second camp at Lah Hpok was reached on February 2nd, and 18 days more were spent before the Chinese Commissioner could be persuaded to consent to our proposals.

In all, the first two months' work resulted in only 20 of the 225 miles being agreed to. After this fewer difficulties were raised by the Chinese, and Kenglaw the half-way point of the work was reached early in March.

The remainder of the boundary up to the Mekong was agreed to on the last day in April, the survey work being completed on the 20th of that month.

Owing to the difficulties raised by the Chinese from the beginning, the Sub-Commissioner required the large scale 1-inch survey, from which to discuss the boundary line, instead of being able to settle its run from a $\frac{1}{4}$ -inch reconnaissance, and confining the work on the 1-inch scale to a survey of the boundary when laid down. The strength of the detachment was not of course calculated for this, and it entailed a large amount of extra work on the surveyors.

I am greatly indebted to Mr. George for the assistance he rendered to the survey work, and also to Mr. Sterling and Captain Tod whose ready help was most valuable.

The survey of the boundary was made on the scale of 1 inch to 1 mile, with the exception of where the line followed the river Nam Lam. This was mapped on the 4 miles to the inch scale, the saving of time being of great consequence and a large scale record unnecessary.

I was able to give the plane-tablers points throughout the work by computing the triangulation in the field.

In all, 30 stations were observed from, 7 of these being by Munshi Ikkaluddin. The areas triangulated being 3,578 square miles by myself and 1,146 by Munshi Ikkaluddin; total 4,724 square miles. The areas plane-tabled were 915 square miles on the 1-inch scale and 4,216 square miles on the $\frac{1}{4}$ inch.

The triangulation was carefully computed in recess at Bangalore.

Mr. C. Williams had connected on the stations from which I started near the Salween with the triangulation of No. 21 Party, and I had also a connection with Mr. Shaw's

series from Kengtung. The results were extremely good, the difference being less than one second both in latitude and longitude, and within 17 feet in height.

The country throughout was extremely difficult for survey work, being very broken and hilly and covered with jungle. Until close to the Mekong I did not meet with a single clear hill, and many required a hundred coolies for two or three days to make any sort of clearing. This added greatly to the difficulties of the work and made it impossible, where local assistance was not to be obtained.

Villages were small and not very numerous, but the natives were expert in the use of the axe when they could be induced to work.

The haze set in about the 3rd March and continued till the rains broke. It was astonishingly thick and like a London fog, hiding the sun for days and making it often impossible to see more than half a mile.

The rains broke early in April and continued with scarcely three fine days until we finished our long march back at the end of June. With such a large party as ours the results to both men and animals were very bad, and the experience was not one that any of us would care to repeat.

Sub-Assistant Superintendent Ikbaluddin did excellent work for me during the time I was triangulating, in choosing and clearing stations in advance, and I consider it was largely due to his energy that the work was as good as it proved to be. He also did a considerable area of triangulation and survey on both the 1-inch and $\frac{1}{2}$ -inch scale. I formed a very high opinion of him and consider he is well fitted for the position he has gained in the Department. Sub-Surveyor Kudratulla was mostly employed on $\frac{1}{2}$ -inch work with some 1-inch survey towards the close of the season. He worked most cheerfully and willingly, and his marching powers, considering his age, are surprising.

Sub-Surveyor Jamna Pershad had a difficult position, as the principal surveyor between the Chinese and our Sub-Commissioner, and acquitted himself very well. He is a very quick worker on the 1-inch scale, and I think with more experience should make a valuable surveyor.

DRAWING OFFICE, CALCUTTA.

SECTION NO. I.—GEOGRAPHICAL, DRAWING, AND COMPILATION.

Statement showing the work performed during the year 1898-99.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|--------|-------------------|---|
| ATLAS OF INDIA. | | | |
| Sheets Nos. 1 S. E., 2 S. E., 8 S. E., 9 N. W., 10 N. E., 11 S. W., 29, 30, 37 N. W., 37 S. W., 39 N. W., 44, 47 S. E., 48 N. E., 51 S. W., 61, 61 N. E., 64 S. W., 66 N. W., 67 S. E., 63 S. E., 69 S. W., 70 S. E., 70 S. W., 71 S. W., 76, 76 N. E., 76 S. E., 77 N. E., 78, 78 N. E., 80 S. E., 86 S. W., 87 N. W., 87 S. W., 88, 94, 111, 116, 119, 125 S. E., 120 N. E., 126 N. W., 128 N. E., and 131 N. W. | 1=4 | 45 | Additions made to railways, roads, canals, and changes to boundaries. |
| Sheets Nos. 21 N. W., 27 N. E., 40 S. E., 41 S. E., 41 N. W., 41 S. W., 42 N. E., 42 N. W., 57 S. W., 58 N. W., 58 S. W., 59 S. E., 59 N. W., 61 S. W., 62 N. E., 62 S. E., 62 N. W., 78 S. E., 79 N. E., 79 S. E., 80 S. E., 80 N. W., 80 S. W., 81 N. W., 106 S. E., 107 N. E., 107 S. E., 107 N. W., 107 S. W., 134 N. E., 134 S. E., 134 N. W., 134 S. W., 141 S. W., 142 N. E., 142 S. E., 142 N. W., 142 S. W., 143 N. E., 143 S. W., 144 N. E., 144 S. E., 144 S. W., 145 N. E., 145 S. E., 145 N. W., 145 S. W., 146 N. E., 146 N. W., 150 S. W., 151 N. W., 152 S. W., 151 N. E., 153 S. E., 153 N. W., 153 S. W., 154 N. E., 154 S. E., 154 N. W., 154 S. W., 163 S. W., 164 N. W., 164 S. W., and 165 N. W. | 1=4 | 64 | Additions made to names and details for engraving. |
| Sheets Nos. 14 N. E., 25 N. E., 40 S. W., 41 N. E., 41 S. E., 41 N. W., 48 N. E., 58 S. E., 59 N. W., 66 S. W., 77 S. W., 78 S. E., 79 S. W., and 159 N. W. | 1=4 | 14 | Hills brush-shaded for engraving. |
| GENERAL MAPS. | | | |
| Afghanistan (Photo.) | 1=24 | 2 | Boundaries to date. |
| Route map of Western Himá- layas, Kashmir, Punjab, and Northern India (Engraved) | 1=32 | 1 | Additions to date. |
| India (skeleton) (showing rail- ways) (Photo.) | 1=32 | 6 | In progress. |
| India (Blue print) (Litho.) | 1=32 | 6 | Additions to date. |
| Do. (2nd Edition) (do.) | 1=32 | 6 | Ditto ditto. |
| Do. (skeleton) (do.) | 1=32 | 6 | Railways to date and published. |
| Do. (showing railway stations) (Photo.) | 1=32 | 6 | Additions to date. |
| India (showing canals) (Litho.) | 1=32 | 6 | Ditto ditto. |
| Do. (3rd Edition) (Litho.) | 1=32 | 6 | Ditto ditto. |
| Do. (showing railways) (Photo.) | 1=48 | 4 | Railways to date and published. |
| Do. (Engraved) | 1=64 | 4 | Additions to date. |
| Do. (Litho.) | 1=64 | 2 | Boundaries to date. |
| Do. (Engraved) | 1=80 | 1 | Additions to date. |
| Do. (ditto) | 1=96 | 1 | Ditto ditto. |
| Do. (ditto) (with hills) | 1=128 | 1 | Railways to date. |
| PROVINCIAL MAPS. | | | |
| Bengal, Bihar, Orissa, and Chota Nágpur (2nd Edition) (Engraved) | 1=16 | 2 | Additions to date. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. I—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|--------|-------------------|--|
| PROVINCIAL MAPS—contd. | | | |
| Bengal, Bihar, Orissa, and Chota Nágpur (Litho.) | 1=16 | 2 | Additions to date and published. |
| Ditto Ditto (skeleton) | 1=32 | 1 | Ditto ditto ditto. |
| Bombay Presidency (Engraved) | 1=16 | 1 | Hills brush-shaded for engraving. |
| Ditto ditto (ditto) | 1=16 | 1 | Additions to railways to date. |
| Ditto ditto (Litho.) | 1=32 | 1 | Ditto to date and published. |
| Central India Agency (Engraved) | 1=16 | 2 | Ditto ditto ditto. |
| Central Provinces (ditto) | 1=16 | 2 | Ditto ditto ditto. |
| Madras Presidency (ditto) | 1=16 | 4 | Hills brush-shaded for engraving. |
| Ditto ditto (ditto) | 1=16 | 4 | Boundaries to date. |
| Ditto ditto (Litho.) | 1=32 | 1 | Additions to date and published. |
| Nepál | 1=32 | 1 | Ditto ditto. |
| Nizam's Dominions (Litho.) | 1=16 | 2 | Ditto to railways, roads, etc., to date and published. |
| North-Western Provinces and Oudh (Litho.) | 1=32 | 1 | Ditto ditto to date. |
| Punjab (Engraved) | 1=16 | 4 | Hills brush-shaded for engraving. |
| Ditto (ditto) | 1=16 | 4 | Additions to railways and boundaries. |
| Ditto (ditto) (skeleton) | 1=32 | 1 | Ditto to date. |
| Ditto (ditto) | 1=80 | 1 | Ditto to boundaries. |
| Rájputána Agency (Engraved) | 1=16 | 1 | Ditto to date. |
| Ditto ditto (Litho.) | 1=16 | 1 | Ditto ditto. |
| Sind (Litho.) | 1=16 | 1 | Ditto ditto. |
| Upper Burma (2nd Edition) | 1=16 | 2 | Ditto ditto and published. |
| Do. ditto (3rd Edition) | 1=16 | 2 | Compilation in progress. |
| DIVISIONAL MAPS. | | | |
| Chittagong | 1=8 | 1 | Additions to railways to date. |
| Dacca | 1=8 | 1 | Ditto ditto ditto. |
| Pegu | 1=4 | 4 | Brought up to date. |
| Presidency | 1=8 | 1 | Additions to railways to date. |
| DISTRICT MAPS. | | | |
| ASSAM— | | | |
| Darrang | 1=4 | 1 | Railways to date and published. |
| Gáro Hills | 1=4 | 1 | Brought up to date and published. |
| Goálpára | 1=4 | 1 | Additions to date. |
| Kámrúp | 1=4 | 1 | Ditto ditto. |
| Khási and Jaintia Hills | 1=4 | 1 | Ditto ditto. |
| Lakhimpur | 1=4 | 1 | Ditto ditto. |
| Nága Hills | 1=4 | 1 | Ditto ditto. |
| Nowgong | 1=4 | 1 | Ditto ditto. |
| Sibságar | 1=4 | 1 | Ditto ditto. |
| BENGAL— | | | |
| Bogra | 1=4 | 1 | Additions to date. |
| Chittagong | 1=4 | 1 | Completed and published. |
| Darbhanga | 1=4 | 1 | Additions to date and published. |
| Dinájpur | 1=4 | 1 | Completed and published. |
| Jalpáiguri | 1=4 | 1 | Ditto ditto. |
| Malda (2nd Edition) | 1=4 | 1 | Ditto ditto. |
| Midnapore | 1=4 | 1 | Additions to date. |
| Monghyr | 1=4 | 1 | Ditto do. and published. |
| Patna | 1=4 | 1 | Ditto do. |
| Sháhábád | 1=4 | 1 | Ditto do. |
| Singhbhum | 1=4 | 1 | Ditto do. and published. |
| BOMBAY— | | | |
| Ahmedabad | 1=4 | 1 | Prepared and sent for Lithography. |
| Ahmednagar | 1=4 | 1 | Ditto di to. |
| Kolába | 1=4 | 1 | Ditto ditto. |
| Násik | 1=4 | 1 | Ditto ditto. |
| Poona | 1=4 | 1 | Ditto ditto. |
| Ratnágiri | 1=4 | 1 | Ditto ditto. |
| Sátára | 1=4 | 1 | Ditto ditto. |
| Surat | 1=4 | 1 | Ditto ditto. |
| Káthiáwár Agency | 1=16 | 1 | Additions to date and published. |
| CENTRAL PROVINCES— | | | |
| Hoshangabad | 1=4 | 1 | Additions to date. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. I—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|---|--------|-------------------|------------------------------------|
| DISTRICT MAPS—concluded. | | | |
| BURMA— | | | |
| Bhamo and Myitkyina | 1=8 | 1 | Railways brought up to date. |
| PUNJAB— | | | |
| Hissar | 1=4 | 1 | Completed and published. |
| Jhelum | 1=4 | 1 | Ditto ditto. |
| Peshāwar | 1=4 | 1 | Additions to boundaries. |
| Rāwalpindi | 1=4 | 1 | Completed and published. |
| STANDARD MAPS. | | | |
| ASSAM— | | | |
| Sheets Nos. 28, 40, 50, and 52. | 1=2 | 4 | Completed. |
| BENGAL— | | | |
| Sheet No 74 | 1=1 | 1 | Additions to date and published. |
| Sheets Nos. 2, 4, 6, 11, and 15. | 1=1 | 5 | Ditto ditto. |
| BOMBAY— | | | |
| Sheet No. 279 $\frac{S. W.}{3}$ | 4=1 | 1 | Boundaries to date. |
| CENTRAL INDIA AND RAJPUT- ANA— | | | |
| Sheets Nos. 118, 147, 206, 241, 258, 303, 306, 318, 332, 345, 379, and 471 | 1=1 | 12 | Brought up to date and published. |
| Sheets Nos. 307, 378, 410, and 474 | 1=1 | 4 | Completed and published. |
| Sheets Nos. 71, 347, and 408 | 1=1 | 3 | Additions and corrections to date. |
| Sheets Nos. 108, 109, 134, and 135 | 1=2 | 1 | Ditto to date and published. |
| CENTRAL PROVINCES— | | | |
| Sheet No. 109 $\frac{N. W.}{2}$ | 4=1 | 1 | Additions to details. |
| Sheets Nos. 4, 8, 18, 20, and 68 | 1=1 | 5 | Completed and published. |
| Sheets Nos. 19, 34, and 266 | 1=1 | 3 | Additions to date and published. |
| Sheet No. 28 | 1=1 | 1 | Ditto to boundaries. |
| Sheet No. 67 | 1=1 | 1 | In progress. |
| HYDRABAD— | | | |
| Sheet No. 173 | 1=1 | 1 | Additions to date. |
| MADRAS— | | | |
| Chendragiri Taluk | 4=1 | 10 | Completed and under publication. |
| Chittoor and Gudiyāttam Taluk | 4=1 | 4 | Published. |
| Hosūr and Dharmapuri Taluks | 4=1 | 15 | Ditto. |
| Jāvidi Hills | 4=1 | 6 | Ditto. |
| Krishnagiri Taluk | 4=1 | 4 | Ditto. |
| Pachaimalai Hills | 4=1 | 6 | Ditto. |
| Sheets Nos. 23, 24, 50, 51, 78, 102, 104, 105, and 172 | 1=1 | 9 | Additions and corrections to date. |
| NORTH-WESTERN PROVINCES AND OUDH— | | | |
| Sheets Nos. 63 $\frac{S. W.}{1}$, $\frac{S. W.}{2}$, $\frac{S. W.}{3}$, and $\frac{S. W.}{4}$ | 4=1 | 4 | Additions and corrections to date. |
| Sheet No. 171 | 1=1 | 1 | Completed and published. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. I—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|---|--------|-------------------|-----------------------------------|
| STANDARD MAPS—contd. | In. M. | | |
| PUNJAB— | | | |
| Sheets Nos. 66 S. E., 67 S. E., 68 N. E., 68 S. E., 69 N. E., 69 N.W., 69 S.W., 70 N.W., 93 S. E., 93 S.W., 94 S. E., 94 N.W., 95 N.W., 121 S. E., 121 S.W., and 122 S.W. | 2=1 | 16 | Completed and published. |
| Sheets Nos. 69 S. E., 70 N. E., 94 N. E., 94 S.W., 122 N. E., and 122 N.W. | 2=1 | 6 | In progress. |
| UPPER BURMA— | | | |
| Sheets Nos. 305, 307, 315, 351, 352, 353, 358, 360, 361, and 362 | 1=1 | 10 | Completed and published. |
| Sheet No. 306 (2nd Edition) | 1=1 | 1 | Ditto ditto. |
| Sheets Nos. 304, 350, 398, 399, 402, and 458 | 1=1 | 6 | Ditto and under publication. |
| Sheets Nos. 260 (2nd Edition), 316, 400, 401, 403, 404, 405, 406, and 407 | 1=1 | 9 | In progress. |
| Sheets Nos. 313 and 314 | 1=1 | 2 | Boundaries brought up to date. |
| LOWER BURMA— | | | |
| Sheets Nos. 272 $\frac{S. W.}{3}$, 274 $\frac{N. W.}{1}$, $\frac{N. W.}{2}$ (2nd Edition), $\frac{N. W.}{3}$, 274 $\frac{N. W.}{4}$ (2nd Edi- tion), 274 $\frac{S. W.}{1}$, $\frac{S. W.}{2}$ (2nd Edition), $\frac{S. W.}{4}$, 275 $\frac{N. E.}{3}$, 275 $\frac{N. E.}{4}$, 275 $\frac{S. E.}{1}$, $\frac{S. E.}{2}$, $\frac{S. E.}{4}$, $\frac{S. E.}{275}$, $\frac{N. W.}{1}$, $\frac{N. W.}{2}$, $\frac{N. W.}{3}$, $\frac{N. W.}{4}$, 275 $\frac{S. W.}{1}$, $\frac{S. W.}{3}$, $\frac{S. W.}{4}$, $\frac{S. W.}{1}$, 276- $\frac{N. E.}{1}$, (276 $\frac{N. E.}{4}$ and 323 $\frac{N. W.}{3}$) 279 $\frac{S. W.}{4}$, and 280 $\frac{N. W.}{2}$ | 4=1 | 26 | Completed and published. |
| NORTH-EASTERN FRONTIER SERIES. | | | |
| Sheet No. 15 N. E. (3rd Edition) | 1=4 | 1 | Boundaries to date and published. |
| Sheet No. 15 S. E. (6th Edition) | 1=4 | 1 | Brought up to date and published. |
| Sheet No. 22 S. W. (2nd Edi- tion) | 1=4 | 1 | Railways brought up to date. |
| Sheet No. 22 (6th Edition) | 1=8 | 1 | Completed and published. |
| Sheet No. 23 N. W. (8th Edition) | 1=4 | 1 | Brought up to date and published. |
| Sheet No. 23 S. W. (8th Edition) | 1=4 | 1 | Ditto ditto ditto. |
| Sheet No. 23 (2nd Edition) | 1=8 | 1 | Hill shading in progress. |
| SOUTH-EASTERN FRONTIER SERIES. | | | |
| Sheet No. 1 N. E. (7th Edition) | 1=4 | 1 | In progress. |
| Sheet No. 1 S. E. (5th Edition) | 1=4 | 1 | Ditto. |
| Sheet No. 1 N. W. (5th Edition) | 1=4 | 1 | Ditto. |
| Sheet No. 1 S. W. (4th Edition) | 1=4 | 1 | Additions to date. |
| Sheet No. 2 N. E. (7th Edition) | 1=4 | 1 | In progress. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. I—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|-------------------------------------|--------|-------------------|----------------------------------|
| STANDARD MAPS—concl'd. | | | |
| | In. M. | | |
| Sheet No. 2 S.E. (5th Edition) | 1=4 | 1 | Additions to date and published. |
| Sheet No. 2 S.W. (2nd Edition) | 1=4 | 1 | Ditto ditto ditto. |
| Sheet No. 4 N.W. (6th Edition) | 1=4 | 1 | Ditto ditto ditto. |
| Sheet No. 4 (2nd Edition) | 1=8 | 1 | In progress. |
| Sheet No. 5 S.W. (6th Edition) | 1=4 | 1 | Additions to date and published. |
| Sheet No. 5 | 1=8 | 1 | Completed and under publication. |
| Sheet No. 6 N.W. (7th Edition) | 1=4 | 1 | Additions to date and published. |
| Sheet No. 6 (2nd Edition) | 1=8 | 1 | In progress. |
| Sheet No. 7 (2nd Edition) | 1=8 | 1 | Completed and under publication. |
| Sheet No. 8 (2nd Edition) | 1=8 | 1 | In progress. |
| ADMINISTRATION REPORT MAPS. | | | |
| Upper Burma (2nd Edition) | 1=64 | 1 | Additions to date and published. |
| N.-W. P. and Oudh | 1=32 | 1 | Ditto ditto ditto. |
| Punjab | 1=32 | 1 | Ditto ditto ditto. |
| ASSAM— | | | |
| Cachar | 1=8 | 1 | Additions to railways. |
| BENGAL— | | | |
| Hill Tippera | 1=8 | 1 | Completed and published. |
| Mymensingh | 1=8 | 1 | Ditto ditto. |
| Noákháli | 1=8 | 1 | Ditto ditto. |
| Purnea | 1=8 | 1 | Additions to date. |
| Ránci | 1=16 | 1 | Completed and published. |
| Tippera | 1=8 | 1 | Additions to date. |
| CENTRAL PROVINCES— | | | |
| Bálághát | 1=12 | 1 | Completed and published. |
| Betúl | 1=8 | 1 | Ditto ditto. |
| Bhandára | 1=8 | 1 | Additions to date and ditto. |
| Hoshangabad | 1=12 | 1 | Completed and published. |
| Jubbulpore | 1=8 | 1 | Ditto ditto. |
| Mandla | 1=8 | 1 | Ditto ditto. |
| Nággpur | 1=8 | 1 | Ditto ditto. |
| Narsinghpur | 1=8 | 1 | Ditto ditto. |
| Nimár (skeleton) | 1=8 | 1 | Ditto ditto. |
| Nimár (with hills) | 1=8 | 1 | Ditto ditto. |
| Raipur | 1=20 | 1 | Ditto ditto. |
| Seoni | 1=8 | 1 | Ditto ditto. |
| HYDRABAD ASSIGNED DISTRICTS— | | | |
| Amráoti | 1=8 | 1 | Completed and published. |
| Buldána | 1=8 | 1 | Corrections to date. |
| Ellichpur | 1=8 | 1 | Completed and published. |
| Wún | 1=8 | 1 | Ditto ditto. |
| PUNJAB— | | | |
| Dera Gházi Khan | 1=8 | 1 | Corrections to date. |
| Dera Gházi Khan | 1=16 | 1 | Completed and published. |
| Gurgáon | 1=8 | 1 | Ditto ditto. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. I—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|------------------------|-------------------|---|
| ADMINISTRATION REPORT MAPS—concl'd. | | | |
| PUNJAB— | | | |
| Hoshiárpur | 1=8 | 1 | Completed and published. |
| Kángra | 1=12 | 1 | Ditto ditto. |
| Kohát | 1=8 | 1 | Hills brush-shaded for engraving. |
| Pesháwar | 1=8 | 1 | Additions to date. |
| Ráwalpindi | 1=8 | 1 | Completed and published. |
| Rohtak | 1=8 | 1 | Compilation completed. |
| Sháhpur (skeleton) | 1=8 | 1 | Completed and published. |
| INDEX MAPS. | | | |
| For Administration Report | Various. | 12 | Brought up to date. |
| Provincial Index File | Various. | 24 | Ditto. |
| Index to the traverse operations in Dera Ismáil Khan | 1=8 | 2 | Traces made on vellum cloth. |
| Index to the standard sheets of Lushai Hills | 1=16 | 1 | A trace made on vellum cloth. |
| Index showing survey opera- tions in the Himálayas | 1=20 | 2 | Showing 2-inch and 4-inch publications. |
| Index to the standard sheets of Assam | 1=24 | 1 | Brought up to date and published. |
| Index to the standard sheets of Upper and Lower Burma | 1=32 | 1 | In progress. |
| Index to the standard sheets of Bengal | 1=48 | 1 | Showing different surveys. |
| Index to the standard sheets of Central Provinces | 1=48 | 1 | Additions to date. |
| Index to the standard sheets of Madras | 1=48 | 2 | Showing publications. |
| Index to the standard sheets of North-Western Provinces and Oudh | 1=48 | 1 | Additions to date. |
| Index to the standard sheets of the Punjab | 1=48 | 1 | Ditto. |
| Index to the geographical surveys in Upper Burma | 1=128 | 1 | Showing different publications. |
| Index to the Indian Atlas Sheets | 1=256 | 1 | In progress. |
| TRIANGULATION CHARTS. | | | |
| Triangulation Chart of Khási Hills | 1=8 | 1 | Completed and published. |
| Triangulation of Sheet 272 of Lower Burma Survey | 1=4 | 1 | Ditto ditto. |
| Triangulation Chart of Bombay Survey | 1=4 | 2 | Published. |
| Triangulation Chart of No. 20 Party | 1=4 | 9 | In progress. |
| Triangulation Chart of No. 21 Party | 1=4 | 1 | Completed and published. |
| PLANS OF CITES AND CANTONMENTS. | | | |
| Plan of Intrenched position of the British Garrison at Luck- now | 1=400ft. and 800ft. | 2 | Completed. |
| Lucknow, General Plan | 1=800ft. | 2 | Ditto. |
| Plan of Alipur Zoological Gardens | 1=150ft. | 1 | Completed and published. |
| Plan of Umballa Cantonment | 1=110ft. | 1 | A trace made on vellum cloth. |
| Plan of Calcutta Town | 16=1 | 18 | Additions to date. |
| Plan of Belgaum City and Environs | 8=1 | 1 | Ditto ditto. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. I—*continued.**Statement of work—continued.*

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|----------|-------------------|---|
| PLANS OF CITIES AND CANTONMENTS—<i>contd.</i> | | | |
| Plan of Jullundur Cantonment | 6=1 | 1 | A trace made on vellum cloth. |
| Plan of Secunderabad Cantonment and Environs | 2=1 | 1 | Ditto ditto. |
| Map of Simla and Jutogh | 6=1 | 1 | Corrections to date. |
| MISCELLANEOUS MAPS. | | | |
| Plan of South Indian Railway | 1=1 | 1 | A trace made on vellum cloth. |
| Plan of Bezwada-Madras Railway | 1=1 | 1 | Ditto ditto. |
| Plan of proposed Santal Railway | 1=8 | 1 | Completed. |
| SPECIAL MAPS. | | | |
| Map to illustrate History of Mutiny, 1857 | 1=6qoft. | 1 | Prepared. |
| District Malda—Sheets Nos. 2, 4, 6, and 7 | 1=1 | 4 | Additions to date. |
| District Purnea—Sheets Nos. 1, 3, 4, 5, 7, 8, 9, 11, 12, 14, and 15 | 1=1 | 11 | Ditto ditto. |
| Postal Atlas of India—Sheets Nos. 103, 112, 113, 114, 120, and 121 | 1=4 | 6 | In progress. |
| Map of Rájputána Agency | 1=4 | 1 | Completed. |
| Sketch map of Borakka Range | 1=4 | 1 | A trace made on vellum cloth. |
| Map of Orissa and Burdwan Divisions | 1=8 | 2 | Additions to Railways. |
| Sketch map of countries 10 miles round Saugor, Meerut, Muttra, Nowgong, Allahabad, and Bareilly | 1=1 | 6 | Completed. |
| Route map of Assam | 1=16 | 1 | In progress. |
| Route map of Bengal, Bihar, Orissa, and Chota Nágpur | 1=16 | 2 | Ditto. |
| Route map of Central Provinces | 1=16 | 2 | Ditto. |
| Route map of North-Western Provinces and Oudh | 1=16 | 2 | Ditto. |
| Route map of Punjab | 1=16 | 4 | Ditto. |
| Map of Nepal | 1=32 | 1 | Additions and corrections to date. |
| Map of Assam to illustrate Police Report | 1=32 | 1 | Ditto ditto. |
| WORK DONE FOR OTHER DEPARTMENTS. | | | |
| MISCELLANEOUS. | | | |
| Map of Gwethe Working Circle | 1=1 | 65 | Completed for the Conservator of Forests, Tenasserim Circle. |
| Map of Saing Yane Working Circle | 1=1 | 65 | In progress, for the Conservator of Forests, Tenasserim Circle. |
| Sonthál Pargana showing the distribution of the Aryan Languages of the District | 1=8 | 1 | Completed and under publication in connection with Linguistic Survey. |
| Aryan Languages and dialects spoken in East Chota Nágpur. Illustrating the meeting ground of Bengali, Oriyá, and Bihári. | 1=16 | 1 | Ditto ditto ditto. |
| Illustrating the meeting ground of Bengali, Oriyá, and Bihári. | 1=16 | 1 | Ditto ditto ditto. |
| Illustrating the meeting ground of Bengali, Oriyá, and Bihári. | 1=32 | 1 | Ditto ditto ditto. |
| Languages spoken near the North-West Frontier of India. Illustrating the area in British India in which Pusto Language is spoken | 1=32 | 1 | Ditto ditto ditto. |
| Illustrating the dialects and sub-dialects of the Bihári Language | 1=32 | 1 | Ditto ditto ditto. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. I—*continued.*

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|--------|-------------------|---|
| WORK DONE FOR OTHER DEPARTMENTS—<i>contd.</i> | | | |
| <i>MISCELLANEOUS—contd.</i> | | | |
| Illustrating the dialects and sub-dialects of the Bengali Language | 1=64 | 1 | Completed and under publication in connection with Linguistic Survey. |
| Illustrating the area in British India in which Oriyá Language is spoken | 1=64 | 1 | Ditto ditto. |
| India, showing Plague Inspection stations | 1=80 | 1 | Prepared. |
| MAPS, COLOURED, <i>etc.</i> | | | |
| Maps on various scales | | 1,501 | For Surveyor General's Office. |
| Ditto ditto | | 485 | " Other departments. |
| TOTAL | | 1,986 | |

DRAWING OFFICE, CALCUTTA.

SECTION NO. I—concluded.

Statement of work—concluded.

| Description of work. | Number of sheets. |
|---|-------------------|
| MAPS EXAMINED. | |
| Atlas Sheets | 82 |
| General Maps | 5 |
| Provincial Maps | 24 |
| District Maps | 1 |
| Standard Maps | 76 |
| Plans of Cities and Cantonments | 15 |
| Triangulation Charts | 20 |
| Administration Report Maps | 13 |
| Index Maps | 10 |
| Statistical and Extra Departmental Maps | 30 |
| Miscellaneous maps | 42 |
| Originals and office copies of various maps with additions and corrections in territorial boundaries and public works | 576 |
| Tracing prints prepared for Atlas Reductions | 76 |
| Tracings of various maps and of roads, canals, and railways from originals, supplied by Public Works Department | 30 |
| Engraved proofs of Atlas Sheets in various stages | 164 |
| Engraved proofs of General and Provincial maps including Index charts | 53 |
| Engraved proofs of Administration Report maps | 40 |
| Litho. proofs of General and Provincial maps including Index charts | 28 |
| Litho. proofs of District maps transferred from copper plates | 25 |
| Litho. proofs of statistical and extra-departmental maps | 6 |
| Photo. proofs of standard sheets and various other maps | 304 |
| Colouring of maps for various purposes | 638 |
| Projection and examination of graticules and plotting of points | 51 |
| TOTAL | 2,318 |

N. B.—In addition to the above, many miscellaneous jobs, such as supply of geographical data to various officials, calculation of areas, computation of graticules for the projection of the sheets of the Indian Atlas, examination of the proof sheets of the 'Survey of India Department Notes,' and the 'General Report on the operations of the Survey of India Department' during 1897-98, as to the correct orthography of geographical names, and various other minor works have been performed by the Examining section.

DRAWING OFFICE, CALCUTTA.

SECTION NO. II.—REVENUE, DRAWING, AND COMPILATION.

Statement showing the work performed during the year 1898-99.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|--------|-------------------|--|
| ATLAS OF INDIA. | In. M. | | |
| Sheet No. 121 | 1=4 | 1 | Corrections made to Railway lines. |
| STANDARD MAPS. | | | |
| PUNJAB. | | | |
| <i>District Pesháwar.</i> | | | |
| Sheets Nos. 78 and 79 | 1=1 | 2 | Proofs sent to press for correction. |
| Sheet No. 80 | 1=1 | 1 | Completed up to margin from data of the surrounding countries. Surveyed topographically. Proof sent to local officers for examination. |
| Sheets Nos. 51 and 52 | 1=1 | 2 | Completed and sent to press for reproduction to full scale. |
| Sheets Nos. 105, 106, and 107 | 1=1 | 3 | Completed. |
| Sheets Nos. 108 and 134 | 1=1 | 2 | Compilation in progress. |
| <i>District Hasáwa.</i> | | | |
| Sheet No. 12 | 1=1 | 1 | Proof passed, press order given. |
| <i>District Dera Gházi Khan.</i> | | | |
| Sheets Nos. 1 to 20 | 1=1 | 20 | Additions and corrections made from 4-inch tracings of Settlement officer. |
| NORTH-WESTERN PROVINCES AND OUDH. | | | |
| <i>Districts Meerut and Moradabad.</i> | | | |
| Sheet No. 31 | 1=1 | 1 | Second proof sent to press for correction. |
| <i>Districts Saháranpur, Musaffarnagar, and Meerut.</i> | | | |
| Sheet No. 15 | 1=1 | 1 | Completed and published. |
| Sheets Nos. 6 and 16 | 1=1 | 2 | Proofs returned to press for correction. |
| Sheets Nos. 10, 14, 18, and 19 | ... | 4 | Ditto ditto. |
| <i>Districts Aligarh, Agra, and Muttra.</i> | | | |
| Sheets Nos. 23, 24, 25, 35, 37, and 38 | 1=1 | 6 | Ditto ditto. |
| <i>Districts Jaunpur, Benares, and Mirzápur.</i> | | | |
| Sheets Nos. 163, 169, and 171 | 1=1 | 3 | Ditto ditto. |
| <i>Districts Gháziipur, Benares, and Mirzápur.</i> | | | |
| Sheets Nos. 195, 196, and 197 | 1=1 | 3 | Ditto ditto. |
| <i>Districts Basti, Gorakhpur, and Gháziipur.</i> | | | |
| Sheets Nos. 175, 188, 189, 190, 203, 205, 208, and 220 | 1=1 | 8 | Ditto ditto. |
| Sheet No. 221 | 1=1 | 1 | Completed and published. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. II—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|--------|-------------------|---|
| STANDARD MAPS—contd. | In. M. | | |
| NORTH-WESTERN PROVINCES AND OUDH—contd. | | | |
| <i>Districts Sahāranpur, Garhwāl, Dehra Dūn, and Bijnōr.</i> | | | |
| Sheet No. 27 | 1=1 | 1 | New compilation in progress for republication. |
| <i>Districts Meerūt and Muzaffar- nagar.</i> | | | |
| Sheet No. 31 | 1=1 | 1 | Proof sheet sent to press for correction. |
| <i>Portion of Naini Tal (Kumhūn Bhābar) District.</i> | | | |
| Sheets Nos. 63 $\frac{S.E.}{3}$, 64 $\frac{N.E.}{1, 2, 3}$ | 1=4 | 4 | Proofs passed and press order given. |
| Sheets Nos. 46 $\frac{N.E.}{2, 4}$, $\frac{S.E.}{2}$, 64 $\frac{S.E.}{1, 2, 4}$, and 251 $\frac{N.W.}{1, 2, 3, 4}$ | 1=4 | 11 | Proofs sent to press for correction. |
| OUDH. | | | |
| Sheets Nos. 134 and 148 | 1=1 | 2 | Additions and corrections made to boundaries, roads, etc. |
| BENGAL. | | | |
| <i>District Darjeeling.</i> | | | |
| Sheets Nos. 269 and 270 | 1=1 | 2 | Proofs sent to press for correction. |
| <i>District Muzaffarpur.</i> | | | |
| Sheets Nos. 114 and 115 | 1=1 | 2 | Additions and corrections made to boundaries, roads, etc. |
| <i>Districts Hooghly and Howrah.</i> | | | |
| Sheets Nos 285 and portions of 208, 263, and portions of 262, 264, and 265 | 1=1 | 4 | Proofs sent out to district officers for corrections up to date. |
| Sheets Nos. 286, 287, and 288 and portion of 289 | 2=1 | 7 | Corrected for republication. |
| <i>District Mymensingh.</i> | | | |
| Sheets Nos 347 and 348 | 1=1 | 2 | Proofs examined and sent to press for correction. |
| Sheets Nos. 345 and 361 | 1=1 | 2 | Additions and corrections made to boundaries, roads, etc. |
| Sheet No. 389 | 1=1 | 1 | Compiled from old Main Circuit Maps. |
| <i>District Faridpur.</i> | | | |
| Sheets Nos 2 and 4 (old) | 1=1 | 2 | Additions and corrections made to boundaries, roads, etc. |
| <i>District Rājshahi.</i> | | | |
| Sheets Nos. 2, 3, 5, 12, and 13 | 1=1 | 5 | Additions and corrections made to boundaries, roads, etc. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. II—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|--|--------|-------------------|--|
| STANDARD MAPS—contd. | | | |
| ASSAM. | | | |
| <i>District Cachar.</i> | | | |
| Sheets Nos 68 and 69 | 1=1 | 2 | Proofs returned to press for final press order. Additions and corrections made to boundaries, roads, etc. |
| Sheets Nos. 1 and 3 (old) | 1=1 | 2 | |
| CENTRAL PROVINCES. | | | |
| <i>District Betúl.</i> | | | |
| Sheets Nos. 2, 4, 5, 7, 13, and 36 | 1=1 | 6 | Additions and corrections made to boundaries, roads, etc., from 16-inch tracings supplied by the local officers. |
| <i>District Nimár.</i> | | | |
| Sheets Nos. 1 to 9 | 1=1 | 9 | Additions and corrections made to boundaries, roads, etc., from 16-inch tracings supplied by the local officers. |
| BOMBAY. | | | |
| Sheets Nos. 164, 192, 350, and 351 | 1=1 | 4 | Proofs passed and press order given. |
| Sheets Nos. 183, 195, 201, 203, 204, 206, 231, 232, and 328 | 1=1 | 9 | Proofs sent to press for correction. Additions and corrections to boundaries, etc. |
| Sheets Nos. 206 and 240 | 1=1 | 2 | |
| <i>District Thána.</i> | | | |
| Sheets Nos. 133 $\frac{\text{S.E.}}{1, 2, 3, 4}$ | 4=1 | 12 | Proofs sent to press for correction. |
| 134 $\frac{\text{N.E.}}{1, 2, 3, 4}$ and $\frac{\text{S.E.}}{1, 2, 3, 4}$ | | | |
| LOWER BURMA. | | | |
| <i>Districts Pegu, Tharrawaddy, and Toungoo.</i> | | | |
| Sheets Nos. 274, 275, 276, 322, 323, 324, and 325 (in 4 sections each) | 2=1 | 28 | Fair maps received from the executive officers, examined cursorily and reported. |
| <i>Districts Pegu and Thatón.</i> | | | |
| Sheets Nos. 326, 327, 372, and 373 (in 4 sections each) | 2=1 | 16 | Ditto ditto. |
| Sheets Nos. 179, 277, 280, 232, 421, and 422 | 1=1 | 6 | Second proof returned to press for correction. |
| Sheets Nos. 140 and 278 | 2=1 | 2 | Fair maps corrected and sent to press for further proofs. |
| <i>District Tavoy.</i> | | | |
| Sheets Nos. 486, 487, and 488 | 1=1 | 3 | Proofs sent out to district officers for approval and reference. |
| Sheet No. 489 | 2=1 | 4 | Fair maps examined. |
| Sheets Nos. 557 S.W. and 558 N.W. | 2=1 | 2 | Compiled from Cadastral maps and examined. |
| UPPER BURMA. | | | |
| <i>Southern Shan States.</i> | | | |
| Sheet No. 404 | 1=1 | 1 | Finished hill shading for No. 11 Party. |
| <i>District Minbu.</i> | | | |
| Sheets Nos. 127 and 174 | 1=1 | 2 | First proof returned to press for corrections. |
| Sheets Nos. 128, 129, and 175 | 1=1 | 3 | Second proof sent to press for correction. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. II—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|---|--------|-------------------|--|
| STANDARD SHEETS -contd. | In. M. | | |
| UPPER BURMA—contd. | | | |
| <i>District Kyaukse.</i> | | | |
| Sheets Nos. 263 and 264 . . . | 2=1 | 6 | Fair maps corrected from district officer's maps and sent to press for republication. |
| <i>District Maiktila.</i> | | | |
| Sheets Nos. 263 ^{N.W.} / _{S.W.} , 264 ^{N.W.} / _{S.W.} , 265 ^{N.W.} / _{S.W.} , 216 S.W., S.E., 217 ^{N.W.N.E.} / _{S.W.S.E.} , 218 ^{N.W.N.E.} / _{S.W.S.E.} , and 219 N.W., N.E. . . . | 2=1 | 18 | Fair maps received from the Executive Officer, examined and blue print reductions sent to o/c No. 10 or 11 Party. |
| <i>District Yamethin.</i> | | | |
| Sheets Nos. 269, 270, and 271 . . . | 2=1 | 12 | Ditto ditto. and proofs sent to district officer for reference. |
| Sheets Nos. 218 S.E., 219 ^{N.W.N.E.} / _{S.W.S.E.} , 220 ^{N.E.} / _{S.E.} , 221 N.E., 266 ^{N.W.} / _{S.W.S.E.} , and 267 ^{N.W.} / _{S.W.} | 2=1 | 13 | Fair maps received from the Executive Officer, examined and 1 inch blue prints supplied to the o/c No. 10 or 11 Party. |
| Sheets Nos. 267 ^{N.W.} / _{S.F.} , ^{N.E.} / ₁₋₃₋₄ , and 261 ^{N.E.} / ₁₋₂₋₃₋₄ | 4=1 | 11 | Ditto. ditto. |
| PARGANA MAPS. | | | |
| <i>District Bírbbúm.</i> | | | |
| Sheets Nos. 1, 9, and 10 | 1=1 | 3 | Additions and corrections made to boundaries, roads, &c. |
| <i>District Champáran.</i> | | | |
| Sheets Nos. 7 and 11 | 1=1 | 2 | Ditto ditto. |
| <i>District Cuttack.</i> | | | |
| Sheets Nos. 7 and 8 | 1=1 | 2 | Ditto ditto. |
| <i>District Dacca.</i> | | | |
| Main Circuit No. 12 | 1=1 | 1 | Printed map touched up, corrected, and sent to press. Proof examined and returned to press for corrections. |
| Main Nos. 1, 2, 3, 4, 5, 6, 7, and 8 | 1=1 | 8 | Additions and corrections made to boundaries, roads, etc. |
| <i>District Monghyr.</i> | | | |
| Sheet No. 8 | 1=1 | 1 | Printed map touched up. Corrected and sent to press for reproduction. Proofs passed and press order given. |
| <i>District Mymensingh.</i> | | | |
| Main Circuits Nos. 3, 8, 9, 15, and 16 | 1=1 | 5 | Additions and corrections made to boundaries, roads, etc. |
| Main Circuit No. 20 | 1=1 | 1 | Printed copy corrected and touched up for press. |
| <i>District Cooch Behar.</i> | | | |
| Sheets Nos. 2 and 8 | 1=1 | 2 | Additions and corrections made to boundaries, roads, etc. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. II—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|---|----------------|-------------------|--|
| PARGANA MAPS—contd. | In. M. | | |
| <i>District Nadia.</i> | | | |
| Sheet No. 5 | 1=1 | 1 | Additions and corrections made to boundaries, roads, etc. |
| <i>District Rájsháhi.</i> | | | |
| Main Circuits Nos. 1, 6, and 8 . | 1=1 | 3 | Additions and corrections made to boundaries, roads, etc. |
| <i>District Sylhet.</i> | | | |
| Main Circuits Nos. 6, 8, 9, and 10 | 1=1 | 4 | Additions and corrections made to boundaries, roads, etc. |
| <i>District Tippera.</i> | | | |
| Main Circuits Nos. 1, 2, 5, 6, 8, 9, and 12 | 1=1 | 7 | Additions and corrections made to boundaries, roads, etc. |
| <i>District 24-Parganas.</i> | | | |
| Sheets Nos. 1 and 2 | 1=1 | 2 | Proofs examined and returned to press for corrections. |
| <i>Panchánagrám Survey.</i> | | | |
| Grand division 2, Sub-division 3 } Ditto ditto O } Ditto ditto N. Secn. 2 } | 1 in. = 99 ft. | 1 1 1 | } Printed maps touched up, corrected, and sent to press for reproduction. Proofs passed, press order given. |
| CENTRAL PROVINCES. | | | |
| <i>District Bhandára.</i> | | | |
| Sheets Nos. 2, 3, 4, 5, 7, 8, and 20 | 1=1 | 7 | Additions and corrections made to boundaries, roads, etc., from 16-inch tracings supplied by local officers. |
| <i>District Maps.</i> | | | |
| PUNJAB. | | | |
| Gujránwála | 1=2 | 2 | Additions and corrections made to boundaries, roads, etc. |
| Hasára.—(Skeleton map without numbers, with village boundaries) | 1=4 | 1 | Proofs passed, press order given. |
| Umballa.—(Skeleton with Nos.) | 1=2 | 2 | Compiled from 1-inch sheets and drawn for reduction to scale 1-inch=4 miles. Proofs sent to district officer for examination and approval. |
| CENTRAL PROVINCES. | | | |
| Nágpur and Wardha | 1=2 | 2 | Additions and corrections made to boundaries, roads, etc. |
| Ditto | 1=4 | 1 | Additions and corrections made to boundaries, roads, etc. |
| BENGAL. | | | |
| Palámau | 1=4 | 1 | Proofs passed, press order given. |
| PLANS OF CITIES AND CANTONMENTS. | | | |
| Bareilly | 12=1 | 21 | Typed and drawing in progress for reduction to half scale. |
| Cawnpore | 12=1 | 9 | Proofs corrected and sent to press for further proof. |
| Allahabad | 6=1 | 6 | Proofs corrected and sent to press for further proof. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. II—continued.

Statement of work—continued.

| TITLE. | Scale. | Number of Sheets. | REMARKS. |
|---|--------------|-------------------|---|
| PLANS OF CITIES AND CANTONMENTS— <i>contd.</i> | In. M. | | |
| Calcutta | 3=1 | 1 | Press order given. |
| Calcutta and Suburbs with added area | 6=1 | 2 | Re-compiled from old data brought up to date with reference Nos. to roads, streets, and lanes, etc., explained in columns of alphabetical lists. Additions and corrections made to boundaries, etc. |
| Murree (Sanitarium) | 10=1 | 6 | |
| Campbellpur | 6=1 | 1 | Ditto ditto. |
| Ránikhet | 6=1 | 1 | Ditto ditto. |
| Lansdowne | 12=1 | 1 | Ditto ditto. |
| Ghoradhaka (Hutted Camp) | 12=1 | 1 | Ditto ditto. |
| Barágali . (Ditto) | 12=1 | 1 | Ditto ditto. |
| Kálabágh . (Ditto) | 12=1 | 1 | Ditto ditto. |
| Thoba . . (Ditto) | 12=1 | 1 | Ditto ditto. |
| Khyragali (Ditto) | 12=1 | 1 | Ditto ditto. |
| Changlagali (Ditto) | 12=1 | 1 | Ditto ditto. |
| Nasirabad (District Ajmer) | 6=1 | 1 | Ditto ditto. |
| Bareilly | 16=1 | 21 | Ditto ditto. |
| Sítabáldi Fort | 10=1 | 1 | Ditto ditto. |
| Hazára | 10=1 | 1 | Ditto ditto. |
| Gharail Cantonment | 10=1 | 1 | Ditto ditto. |
| Dharamsála „ | 10=1 | 1 | Ditto ditto. |
| Moulmein Town | 1 in.=50 ft. | 51 to 69 | Proofs passed and press order given. |
| Rangoon „ | 1 in.=50 ft. | 51 | Ditto ditto. |
| Ditto „ | 1 in.=50 ft. | 140 | Originals sent to press for reproduction and proofs passed, press order given. |
| Ditto „ | 1 in.=100ft. | 154 | Originals sent to press for reproduction. |
| Basti Civil Station | 8=1 | 1 | Compiled from Cadastral plans, proofs passed, press order given. |
| MISCELLANEOUS. | | | |
| Naiháti Municipality | 4=1 | 2 | Compiled from data supplied by the Municipal authorities. Proofs sent to local officers. |
| Narhan Estate | 1=4 | 2 | Proofs passed and press order given. |
| Handkerchief Map of 10 miles round Calcutta for Officer Commanding Fort William | 1=1 | 1 | Compiled, proofs passed, and press order given. |
| Ditto ditto | 2=1 | 2 | Compiled, proofs returned to press for corrections. |
| Pargana Talla Des (District Naini Tal—Bhábar) | 1=2 | 1 | Proofs passed, press order given. |
| <i>Index Maps.</i> | | | |
| For Administration Report | various . | 2 | Drawn and sent to press. |
| Ditto ditto | „ | 14 | Corrected up to 1899 and sent to press. |
| <i>Tracing on cloth.</i> | | | |
| Tracings of sheets | „ | 79 | } These tracings, sheets, and plans have been prepared for Government officials and other departments. |
| Sheets congregated | 4=1 | 3 | |
| Plans | various. | 21 | |
| <i>Maps coloured.</i> | | 46 | For office use. |
| Ditto. | | 22,465 | Colouring examined for stock in Map Record and Issue Office. |

DRAWING OFFICE, CALCUTTA.

SECTION NO. II—concluded.

Statement of work—concluded,

| DESCRIPTION OF WORK. | REMARKS. |
|---|--|
| <i>Computations Examined.</i> | |
| District Magwe, Seasons 1891-94, (3 seasons) . . . | |
| " Sylhet " 1890-93, (3 seasons) . . . | |
| <i>Traverse data, etc., supplied.</i> | |
| Of Nepál boundary along Sárda River with Synopsis of boundary and Bearing Pillars of the Survey of 1893 (25 pages). | To Superintendent, Land Records Surveys, North-Western Provinces and Oudh. |
| Of Pargana Jalesar along District Etah . . . | To O. C., Nos. 2 and 8 Parties. |
| " Sylhet along Hill Tippera with Co-ordinates from Origin of Survey. | To O. C., No. 6 Party. |
| " Forest blocks, district Hoshangabad (201 pages) . | To Forest Divisional Officer, Hoshangabad. |
| " district Naini Tal along district Pilibhít . . . | To Superintendent, Land Records Surveys, North-Western Provinces and Oudh. |
| " " Chhindwára along Jagirs (6 pages) . . . | To Superintendent, Forest Surveys. |
| " Seoni Forests (8 pages) . . . | Ditto ditto. |
| " villages along Ye river, district Amherst (9 pages). | To O. C., No. 20 Party. |
| " Pegu villages (20 pages) . . . | Ditto ditto. |
| " Thatón villages and Forests (50 pages) . . . | Ditto ditto. |
| " Backergunge villages (24 pages) . . . | To Collector. |
| " districts Amherst and Thatón (349 pages) . . . | To Deputy Commissioner. |
| " district Pegu (69 pages) . . . | To Settlement Officer. |
| " " Mandalay (45 pages) . . . | To Deputy Commissioner. |
| " " Henzada (28 pages) . . . | Ditto ditto. |
| " " Amherst, along Forest boundary (12 pages) | Ditto ditto. |
| Village Traverses (49 pages) . . . | To public officers. |
| Field Area statements of district Puri (23 pages) . . . | To Settlement Officer. |
| " " " " Minbu (225 pages) . . . | To Deputy Commissioner. |
| " " " " Akyab (219 pages) . . . | Ditto ditto. |
| " " " " Mergui (4 pages) . . . | To Director, Land Records. |
| " " " " Magwe (6 pages) . . . | To Settlement Officer. |
| " " " " Prome (5 pages) . . . | To Deputy Commissioner. |
| Tables of Co-ordinates of district Hanthawaddy (297 pages). | To Settlement Officer. |
| Tables of Co-ordinates of district Henzada (650 pages) | To Deputy Commissioner. |
| <i>Miscellaneous.</i> | |
| Calculated latitudes and longitudes of certain Nepál Boundary pillars along Oudh; also Origin and certain stations of district Azamgarh. Calculated areas by talukas of the Nizam's dominions and of Sheet 201 Bombay; also by <i>parganas</i> of sheets 307 and 347 of Central India Agency; of districts 24-Parganas and Ránci in Bengal; of districts Gurdáspur, Jhelum, and Ráwalpindi in the Punjab; of the Sámbar Lake in Rájputána, and of Banaili Raj estates in sheets 1, 3, 4, 8, 9, 10, 11, and 17, Bhágalpur. Revised the areas of districts Cuttack, Balasore, and Puri. Calculated and prepared two tables for converting acres and decimals into <i>bighas</i> , <i>cottahs</i> , and <i>chittacks</i> and <i>vice versa</i> , for the Collector of Dacca. Computed 4 traverse circuits and 11 sub-circuits, and plotted the same for preparation of a congregated map on a radius of 10 miles round Calcutta City for Government, Bengal; also of a group of 13 villages for the Collector of Pabna. Plotted traverse stations of one line of bordering villages of district Midnapore transferred to district Hooghly. Prepared a statement showing areas by Imperial Traverse Surveys, by Patwári Cadastral Surveys and by Forest Surveys of the districts in Central Provinces, from commencement of operations, for Deputy Surveyor-General. Prepared Summary of Outturn and Cost-rate statements, etc., for General Report. Examined Annual Statements received from executives. | |

DRAWING OFFICE, CALCUTTA.

SECTION NO. III.—CADASTRAL.

State of publication of Cadastral Maps on the 30th September 1899.

| DISTRICTS. | NUMBER OF SHEETS. | | | | | | | REMARKS. |
|---------------------------------------|----------------------------|------------------------------|----------------------------------|----------------------------|--|-------------------------------|----------------------------|--|
| | MAPS RECEIVED. | | | MAPS PUBLISHED. | | | | |
| | Up to 30th September 1898. | Added during past 12 months. | Total up to 30th September 1899. | Up to 30th September 1898. | By Surveyor or General's Office during past 12 months. | Total to 30th September 1899. | Remaining to be published. | |
| <i>North-West Provinces.</i> | | | | | | | | |
| Agra | 2,942 | ... | 2,942 | 2,942 | ... | 2,942 | ... | |
| Azamgarh | 930 | ... | 930 | 930 | ... | 930 | ... | |
| Ballia | 1,601 | ... | 1,601 | 1,601 | ... | 1,601 | ... | |
| Banda | 3,317 | ... | 3,317 | 3,317 | ... | 3,317 | ... | |
| Basti | 5,571 | ... | 5,571 | 5,571 | ... | 5,571 | ... | |
| Benares | 2,052 | ... | 2,052 | 2,052 | ... | 2,052 | ... | |
| Bijnor | 31 | ... | 31 | 31 | ... | 31 | ... | |
| Dehra Dún | 701 | ... | 701 | 701 | ... | 701 | ... | |
| Fyzabad | 14 | ... | 14 | 14 | ... | 14 | ... | |
| Garhwal | 9,100 | ... | 9,100 | 8,467 | 633 | 9,100 | ... | |
| Ghazipur | 4,021 | ... | 4,021 | 4,021 | ... | 4,021 | ... | |
| Gorakhpur | 8,615 | ... | 8,615 | 8,615 | ... | 8,615 | ... | |
| Hamirpur | 2,926 | ... | 2,926 | 2,926 | ... | 2,926 | ... | |
| Jaunpur | 3,583 | ... | 3,583 | 3,583 | ... | 3,583 | ... | |
| Jhansi | 1,661 | ... | 1,661 | 1,661 | ... | 1,661 | ... | |
| Kumáun (Bhábar) | 332 | ... | 332 | 332 | ... | 332 | ... | |
| Moradabad and Taráí | 4,023 | ... | 4,023 | 4,023 | ... | 4,023 | ... | |
| Muttra | 1,658 | ... | 1,658 | 1,658 | ... | 1,658 | ... | |
| Mirzapur | 3,794 | ... | 3,794 | 3,794 | ... | 3,794 | ... | |
| Rampur State | 1,356 | ... | 1,356 | 1,356 | ... | 1,356 | ... | |
| Taráí | 862 | ... | 862 | 862 | ... | 862 | ... | |
| TOTAL | 59,090 | ... | 59,090 | 58,457 | 633 | 59,090 | ... | |
| <i>Burma.</i> | | | | | | | | |
| Akyab | 2,785 | ... | 2,785 | 2,785 | ... | 2,785 | ... | |
| Amherst | 3,664 | ... | 3,664 | 3,664 | ... | 3,664 | ... | |
| Bassein | 3,437 | ... | 3,437 | 3,437 | ... | 3,437 | ... | |
| Hanthawaddy and Pegu | 4,601 | ... | 4,601 | 4,601 | ... | 4,601 | ... | |
| Henzada | 1,391 | ... | 1,391 | 1,391 | ... | 1,391 | ... | |
| Katha | 284 | 1,322 | 1,606(a) | 235 | 922 | 1,157 | 449 | (a) These figures are liable to alteration until publication has been completed. |
| Kyaukse | 814 | ... | 814 | 814 | ... | 814 | ... | |
| Magwe | 1,024 | 6 | 1,030 | 38 | 992 | 1,030 | ... | |
| Mandalay | 792 | ... | 792 | 792 | ... | 792 | ... | |
| Meiktila | 1,874 | 2 | 1,876 | 1,874 | 2 | 1,876 | ... | |
| Meiktila Town | ... | 19 | 19 | ... | 19 | 19 | ... | |
| Mergui | 1,071 | ... | 1,071 | 1,071 | ... | 1,071 | ... | |
| Minbu | 1,447 | ... | 1,447 | 1,447 | ... | 1,447 | ... | |
| Pegu | 519 | 71 | 590 | 135 | 455 | 590 | ... | |
| Prone | 847 | ... | 847 | 847 | ... | 847 | ... | |
| Hangoon Town and Index | 2,286 | 1 | 2,287(a) | 1,797 | 3 | 1,800 | 487 | |
| Shwebo | ... | 2,796 | 2,796(a) | ... | 1,038 | 1,038 | 1,758 | (b) Exclusive of 5 sheets reprinted. |
| Tavoy | 763 | ... | 763 | 763 | ... | 763 | ... | |
| Tharrawaddy | 1,363 | ... | 1,363 | 1,363 | ... | 1,363 | ... | |
| Thatou | 1,200 | ... | 1,200 | 1,200 | ... | 1,200(b) | ... | |
| Tbongwa | 3,749 | ... | 3,749 | 3,749 | ... | 3,749 | ... | |
| TOTAL | 33,931 | 4,217 | 38,148 | 32,023 | 3,431 | 35,454 | 2,694 | |
| <i>Bengal and Orissa.</i> | | | | | | | | |
| Packerunge | 86 | ... | 86 | 86 | ... | 86 | ... | |
| Cuttack Town | 86 | ... | 86 | 86 | ... | 86 | ... | |
| Gaya (Tikári Ward's Estate) | ... | 700 | 700(a) | ... | 289 | 289(c) | 411 | (c) Published by order of the Board of Revenue, Lower Provinces. |
| Muzaffarpur | 1 | ... | 1 | 1 | ... | 1 | ... | |
| Patna and Gaya | 3,054 | ... | 3,054 | 3,054 | ... | 3,054 | ... | |
| Puri (Khurda Estate) | 4,924 | ... | 4,924 | 4,924 | ... | 4,924 | ... | |
| Shahabad | 4,924 | ... | 4,924 | 4,924 | ... | 4,924 | ... | |
| TOTAL | 12,891 | 700 | 13,591 | 12,891 | 289 | 13,180 | 411 | |
| <i>Assam.</i> | | | | | | | | |
| Cacher | 495 | 685 | 1,180(a) | 431 | 256 | 687 | 493 | (d) Exclusive of 99 sheets reprinted. |
| Diarrang | 1,074 | ... | 1,074 | 1,074 | ... | 1,074(d) | ... | (e) Exclusive of 1 sheet reprinted. |
| Kamrup | 2,218 | ... | 2,218 | 2,210 | ... | 2,210 | 8(g) | (f) Index to villages of them has been printed. |
| Lakhimpur | 346 | ... | 346 | 346 | ... | 346(e) | ... | (g) These are not to be printed. |
| Mowong | 1,277 | ... | 1,277 | 1,277 | ... | 1,277 | ... | |
| Sibságar | 2,050 | ... | 2,050 | 2,042 | ... | 2,042 | 8(g) | |
| Sylhet | 213 | ... | 213 | 168 | ... | 168 | 45(g) | |
| Sylhet (Jaintia) | 651 | ... | 651 | 651 | ... | 651(f) | ... | |
| TOTAL | 8,324 | 685 | 9,009 | 8,199 | 256 | 8,455 | 554 | |
| <i>Central Provinces.</i> | | | | | | | | |
| Raipur | 43 | ... | 43 | 43 | ... | 43 | ... | |
| TOTAL | 43 | ... | 43 | 43 | ... | 43 | ... | |
| GRAND TOTAL | 114,270 | 5,602 | 119,881 | 111,613 | 4,609 | 116,222 | 3,659 | |

DRAWING OFFICE, CALCUTTA—*continued.*SECTION No. III.—CADASTRAL—*continued.**Abstract of work performed during 1898-99.*

| PROVINCES. | NUMBER OF SHEETS. | | | | REMARKS. |
|--------------------------------|---|--------------------------------------|--|-------------------------------------|--|
| | Examined and rendered suitable for Photo-zincography. | Traced and examined for zincography. | Proof sheets examined previous to press order. | Coloured and subsequently examined. | |
| North-West Provinces | 476 | ... | 633 | ... | 32 inches & 16 inches=1 mile. 16"=1 mile. 16"=1 mile. 16"=1 mile. |
| Burma | 3,703 | 982 | 3,435 | ... | |
| Bengal | 241 | 72 | 300 | ... | |
| Assam | 399 | 69 | 258 | ... | |
| TOTAL . | 4,819 | 1,123 | 4,626 | ... | |

ENGRAVING OFFICE, CALCUTTA.

Statement showing the work performed during the year 1898-99.

| TITLE OF MAP. | Number of plates. | Outline, square inches. | Number of letters cut. | Hills, square inches. | REMARKS. |
|---|-------------------|-------------------------|------------------------|-----------------------|----------|
| <i>Atlas of India.</i> | | | | | |
| Scale, 1 inch=4 miles. | | | | | |
| Quarter sheets, new, completed | 8 | 88 | 7,250 | 127 | |
| Ditto do. in progress | 64 | 1,555 | 104,511 | 253 | |
| Additions and corrections to published quarter sheets | 50 | 287 | 55,290 | 64 | |
| Ditto ditto full sheets | 15 | 322 | 35,321 | 212 | |
| New plates projected, etc. (Atlas sheets) | 29 | 197 | 4,467 | ... | |
| <i>General Maps.</i> | | | | | |
| On various scales | 15 | 414 | 8,698 | 109 | |
| <i>Provincial Maps.</i> | | | | | |
| On scales, 1 inch=16 and 32 miles | 22 | 179 | 60,534 | 244 | |
| <i>District Maps.</i> | | | | | |
| On various scales for Administration Reports | 28 | 545 | 25,649 | 185 | |
| Index Maps | 6 | 81 | 1,904 | ... | |
| Charts | 5 | 91 | 3,971 | ... | |
| Miscellaneous subjects | 64 | ... | 40,953 | ... | |
| TOTAL | 306 | 3,759 | 348,548 | 1,194 | |

COPPER-PLATE PRINTING.

| | |
|-----------------------------|---------------|
| Impressions taken | 17,514 |
| Proofs pulled | 581 |
| Transfers pulled | 529 |
| TOTAL | 18,624 |

STEEL FACING.

| | |
|---|------------|
| Double elephant plates, steel faced | 25 |
| Ditto " " removed | 32 |
| Quarter sheet " " faced | 77 |
| Ditto " " removed | 70 |
| Miscellaneous " " faced | 19 |
| Ditto " " removed | 13 |
| TOTAL | 236 |

PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, CALCUTTA.

Extract from the Narrative Report of MR. T. A. POPE, Assistant Surveyor General, season 1898-99.

Outturn.—The past year has been one of much activity in the Photographic and Lithographic Office, and the outturn of printed maps and plans has increased very considerably. The increase is principally owing to a much heavier demand than usual made upon the Office by other departments and Government officials, while the amount of work done for the Survey Department has also been larger during the year, owing to an increase in the number of cadastral maps printed. The details of the work performed in each Section are given in full in the statements which appear in the Appendix.

Original Subjects.—During the year, the number of original subjects of all kinds received for reproduction and put in hand was 6,873, or 509 more than in the previous year. The increase is in the number of extra-departmental subjects undertaken, which amounted to 1,524, or 422 in excess of last year. The number of departmental maps other than cadastral sheets shows a falling off during the year, but the number of cadastral sheets is somewhat larger.

Of the 6,873 subjects dealt with during the year, 540 were lithographed, of which 53 were departmental maps and 487 were extra-departmental subjects. The remaining 6,333 subjects were either reproduced by the various photographic processes or zincographed, and include 601 departmental maps, 4,695 cadastral maps, and 1,037 extra-departmental subjects. The actual number of subjects received during the year, including those not as yet taken up for reproduction, was 6,932 (598 departmental, 4,821 cadastral, and 1,513 extra-departmental). The number completed, and of which the required number of copies was supplied during the year, was 6,470 (438 departmental, 4,699 cadastral, and 1,333 extra-departmental).

Lithographic Drawing Section.—During the year, the time of several of the senior draftsmen was largely occupied with long and important pieces of work, such as the preparation of the six sheets of the new railway and canal map of India, the new edition of the military map of India, and other large maps, and consequently the number of new subjects drawn on stone or transfer paper is somewhat less than usual, *viz.*, 483, of which 68 were departmental and 415 extra-departmental, as against 650 (54 departmental and 596 extra-departmental) last year. The draftsmen were kept fully employed throughout the year and the younger hands have made very satisfactory progress. The younger draftsmen are now all being trained to work on stone, zinc and transfer paper, instead of, as formerly, having one set of men trained for each class of work. This will be advantageous at times when there is no work to be done on transfer paper, as the men can then be employed on either stone or zinc. The Section is directly supervised by Mr. Fogarty, Head Assistant, Litho. Branch, but in the course of time I hope to be able to relieve him of the duty of constantly supervising the draftsmen while at work by placing a young Assistant, who is now in course of training, in subordinate charge. The management of a staff of 36 draftsmen is in itself sufficiently heavy to occupy all the time of one man; and with this relief the Head Assistant will be able to give more close supervision to the lithographic transferring, proving, and printing, for all of which he is responsible.

Lithographic Printing Section.—Sergeant Vandyke, R.E., who is in charge of this Section, proceeded to England on a year's furlough in February 1899, and the duties have since been carried on by Mr. Deas. The number of subjects printed from stone was 540, or 16 more than last year. Of these 53 were departmental and 487 extra-departmental, as against 58 departmental and 466 extra-departmental last year. The number of pulls from stone was 607,450, as against 547,497, and the total number of copies printed was 529,360, as against 402,906—a very substantial increase.

The new double demy litho. and zinc-printing machine, the arrival of which was reported last year, has worked very satisfactorily. Without it it would have been quite impossible to have turned out the very large amount of printing work that has passed through the Office this year. On Mr. Deas giving up the charge of No. 1 machine to relieve Sergeant Vandyke, Mr. Ravenscroft was placed in charge of it, and Mr. Aratoon, a young apprentice who has been in training for this work for some months, was given the new machine, No. 3, and considering his youth and inexperience he has managed it extremely well. No. 2 machine has been run throughout the year by one of the native printers who has had several years training; and the small litho. machine, No. 4, was made over to another native printer who had previously assisted Mr. Deas in running No. 1. That three of the lithographic machines should have been managed for the past seven months by a young apprentice of less than a year's standing and two native printers trained in the Office, without any hitch, and with only occasional assistance from the Foreman Litho. Printer, is very creditable to the men concerned. The small litho. machine, No. 4, was under repair for about a month owing to the accidental fracture of the spring in the cylinder. It is not probable that this machine, which has been many years in use, will last much longer.

Zinc plates are now used instead of paper for pulling all impressions for making off-sets, thus doing away with any chance of shrinking or stretching, with the result that much less difficulty is experienced in registering colour stones and plates. Another slight in-

provement, recently introduced, consists in the use of pumice stone powder to remove all traces of offset before transferring copper-plate rulings in making up administration report and other similar maps. This saves much time, as the tints now roll up clean and no trace of offset appears.

Zinc-Printing Section (Normal).—This Section remained under the charge of Mr. E. A. LeFranc throughout the year. The number of zinc plates printed was 927, or 10 more than last year, and of these 301 were departmental subjects and 626 extra-departmental, as against 339 departmental and 578 extra-departmental last year. The number of pulls was 229,458 (departmental 93,239, extra-departmental 136,219), and of complete copies 299,463 (departmental 68,104, extra-departmental 231,359). Last year the number of pulls was 194,539 (departmental 65,537, extra-departmental 128,998) and of complete copies 198,578 (departmental 68,427, extra-departmental 130,151). From these figures it will be seen that the work of the Section shows a very large increase for the year under report, which is entirely in work done for other departments. The transferring and proving of the sheets of the Rangoon town map occupied considerable time, and during the latter part of the year one hand press and the services of an Assistant Zincographer had to be utilized for this work alone. The standard sheets of frontier surveys, with hills in brown, which have latterly been reproduced in considerable numbers and require great care in transferring and printing, also occupied a large share of Mr. LeFranc's time and attention during the year.

Zinc-Printing Section (Cadastral).—Mr. J. B. MacKenzie continued in charge of this Section during the year. The number of cadastral sheets received for reproduction shows a slight increase, amounting to 4,695, as against 4,477 last year. These were nearly all sheets of the Burma and Assam surveys, of which a much larger number of copies is required than of the North-West Provinces sheets, and consequently the number of copies printed during the year is very considerably larger than that of last year, when the sheets of the North-West Provinces were principally dealt with. The number of plates printed off was 4,621, the number of pulls being 145,312 and of copies of complete villages 136,630, as against 103,530 pulls and 94,328 copies of complete villages, printed from 4,649 plates, last year.

Type-Printing Section.—As measured by the number of copies printed, the work of this Section shows a slight falling off from the large outturn recorded last year, owing to the requirements of the department for professional forms having been well supplied in advance in the previous year. The number of pages or items set up is, however, somewhat larger, *viz.*, 13,932, as against 13,819 last year, as is also the number of pulls, which was 1,277,949, as against 1,176,837. The total number of copies printed was 684,039, as against 700,756 last year.

The type-printing machine mentioned in last year's Report, as having been indented for, was duly received and was in course of erection at the close of the year. After some correspondence with the Store Department of the India Office, it was decided not to obtain a stop-cylinder machine by Messrs. Hoe and Sons, as this proved to be a much more expensive type of machine than we required, and a "Royal Wharfedale" machine, by Messrs. Payne and Sons, was substituted for it. So far as can be judged at present it seems likely to answer, but a further report will be made on this point next year. The "Washington" hand type press was also received and fitted up, and has been of great assistance in proving half-tone blocks, for which purpose we had no suitable press before.

The working of this Section is much handicapped for want of proper accommodation for the compositors, and storage for type materials and for the large and constantly increasing number of professional forms which have to be kept in type. As explained below, it will also be necessary to find other space for the duties and despatching clerks, and the best arrangement seems to be to locate these in the two small rooms now occupied by the compositors, and to build a new room for the Head Type Printer and his staff over the stone godown at the rear of the office, and I trust that this may receive sanction and be put in hand next year.

Negative Section.—The number of negatives taken during the year was 5,567, or 325 more than last year. These include 110 transparencies taken in the Heliogravure Section. The number of negatives of departmental subjects was 846, of cadastral maps 3,621, and of extra-departmental subjects 1,100.

As it was found that by obtaining our stock of photographic glass from England in one large consignment once every year, portions of it which were not brought into use until after the rainy season were liable to become so corroded by damp as to be useless for negative work, arrangements were made with the Director General of Stores, India Office, to receive it in four quarterly instalments, so that the whole of the newly arrived glass could be unpacked and given out for use during the quarter. This system has been in force during the past year and has worked well. The Section remained under the charge of Mr. H. Haward, Head Assistant, Photo. Branch. No changes of any importance were found necessary in the processes employed.

Photo-Transfer Printing Section.—There were 5,711 photo-transfer prints made during the year, or 550 more than in the year previous. Of these 913 were departmental subjects, 3,645 cadastral maps, and 1,153 extra-departmental subjects. The Section was in charge of Mr. R. George throughout the year, and there is nothing special to record in connection with its working.

Silver-printing Section.—Somewhat less work was done in this Section. The number of blue or cyanotype prints made, fell from 2,174 in the previous year to 1,631 in the year under report, and of silver-prints from 283 to 120. The demand for these latter depends upon outside requirements and varies considerably. Prints from negatives can now be obtained so quickly and cheaply by the half-tone block process that silver-prints are rarely made except when the number required is very small. When, as sometimes happens, there is no work for the men employed in this Section (which only consists of one European Assistant, a native photographer, and one cooly) they are employed in the Negative Section where work can always be found for them. Mr. C. J. Meade continued in charge throughout the year.

Heliogravure Section.—I have again to report a large increase of work in this Section. The number of photogravure plates etched was 128, or 27 more than last year, and the number of prints made amounted to 86,514, as against 73,801 last year. This output was yielded by the same number of presses (one copperplate printing machine and three hand presses) as has been in use for some years past, the new "D" copperplate printing machine not having been received in time to be worked during the year. This has now been set up and it will enable the Section to deal more expeditiously with the constantly increasing amount of printing work required. It has not been found necessary to introduce any changes in the method of working the photogravure process. The frontispiece to this Report, a portrait of Major-General C. Strahan, R.E., late Surveyor General of India, is a specimen of the work turned out by it during the year. Another specimen, representing one of the trigonometrical stations of the Manipur Longitudinal Series, will be found at p. 82.

Seventy-eight half-tone blocks were made by the "Enameline" process, and the number of prints made from them was 12,100, as against 8,100 prints from 82 blocks last year.

Only eight hand-engraved plates were electrotyped during the year, or five less than last year, but in addition to this, ten hand-engraved plates were prepared for correction by the process of electro-deposition described in last year's Report. This process is proving itself very useful, as in cases in which very heavy corrections are required to be made, the necessity for preparing electrotyped duplicates is obviated. It has been worked with fair success throughout the year, but is found to require the utmost care and the most absolute chemical cleanliness at every stage. Consequently failures have occasionally resulted, but in such cases the original plate is in no way injured, the work having only to be done again. Mr. Turner has been in charge of the Section throughout the year. The constantly increasing quantity of routine work that passes through his hands has prevented him from giving as much time as he would wish to experimental work in new directions.

Machinery.—With the exception of the accident to the spring of the small litho. machine mentioned above, all the printing machinery worked well throughout the year. The new type machine, the "Washington" hand type press, the copperplate printing machine, and the two litho. presses ordered last year to replace old and worn out plant, were all received, but only the hand type press, the copperplate machine, and one of the litho. presses could be set up and put in running order before the close of the year. These have proved valuable additions to our printing power, and the type machine and litho. press (which latter can be adapted to either steam or hand power) seem also to be likely to suit us. It is hoped that they will be set to work very shortly, but it has been found necessary to lengthen the shafting somewhat in order to find room for them, and this has taken longer than I expected.

The space at present available for the printing and other machinery is, owing to the recent additions that have been made, somewhat too restricted either for safety or convenience. I propose therefore to remove the duftries from the space they now occupy at one end of the Press Room, and to extend the main shafting to the end of the room, which will enable the machines to be placed in positions slightly further apart, and give sufficient space for the workmen to pass between them, and for inking tables, roller stands, etc. Before this can be done it will be necessary to provide other accommodation for the duftries and despatchers, and the best plan will be to give them the two rooms now occupied by the Type-printing Section, which, as I have already mentioned, is very much cramped for want of space. This Section should have entirely new accommodation provided for it by the erection of an upper storey to the stone godown. The Executive Engineer, Second Calcutta Division, has at my request examined the stone godown and informs me that this can easily be done, at no very great expense. I have, therefore, applied in the usual manner for the inclusion of this very necessary building, and of the extension of the shafting, among the items of new work to be carried out by the Public Works Department during the next financial year.

The new boiler by Messrs. Marshall, Sons & Co. was duly received and erected, and was in working order at the close of the year, but had not then been passed by the Boiler Inspector.

Reorganisation of the office.—The scheme for the reorganisation of the Office establishment received the sanction of the Secretary of State and came in force on the 1st December 1898. It provides for the amalgamation of the establishment of this Office with the small photo-zinco staff of the Trigonometrical Branch Office at Dehra Dûn; for the grading of the entire establishment in one list for the purpose of promotion, and

for the abolition of nearly all the old posts on progressive salaries. The only posts remaining on progressive pay are the four posts which comprise the First Division, which will, as a rule, be recruited from England, and four apprentice posts in the Second Division. The Second Division comprises all the other European and Eurasian assistants and one or two selected natives; the Third Division contains all the draftsmen and assistant photographers, and the Fourth Division all the compositors, printers, and pressmen. Promotion will not be made from one division to another, except in cases of specially deserving men; but the scale of pay in each division has been so regulated that every man may look forward to receiving in due course an amount of promotion commensurate with his standing in the Office, and with the duties he is called upon to perform. It is satisfactory to record that after ten months' experience of its working, the new scheme has proved to entirely fulfil the objects for which it was introduced.

PHOTOGRAPHIC AND
Abstract of Departmental Work

| SPECIFICATION. | Sheets or subjects. | Negatives and transparencies. | PHOTO.-ZINCOGRAPHIC AND LITHOGRAPHIC PRINTING. | | | | | | | |
|--|---------------------|-------------------------------|--|--------------------------|----------------------|------------|----------------|-------------------|----------------|----------------|
| | | | Photo-transfer prints. | Zinc plates transferred. | Zinc plates printed. | Stones. | Pulls. | Number of copies. | | |
| | | | | | | | | Coloured. | Uncoloured. | Total. |
| DEPARTMENTAL MAPS, PLANS, ETC. | | | | | | | | | | |
| General Maps | 18 | 30 | 30 | 8 | 27 | 6 | 8,550 | 350 | 3,400 | 3,750 |
| Provincial Maps | 3 | ... | ... | 2 | 4 | 4 | 2,153 | ... | 1,353 | 1,353 |
| District Maps | 19 | 9 | 9 | 5 | 7 | 12 | 2,891 | ... | 2,741 | 2,741 |
| Plans of Cities and Cantonments | 33 | 84 | 19 | 8 | 18 | ... | 1,470 | ... | 1,470 | 1,470 |
| Standard Maps | 290 | 374 | 399 | 144 | 80 | ... | 13,900 | ... | 12,500 | 12,500 |
| Index Maps | 25 | 17 | 17 | 62 | 63 | 14 | 40,750 | 13,615 | 9,865 | 23,480 |
| Technical Charts | 13 | 13 | 18 | 13 | 4 | ... | 590 | ... | 590 | 590 |
| Miscellaneous Maps and Plans, etc. | 241 | 319 | 421 | 74 | 96 | 13 | 74,265 | 600 | 62,345 | 62,945 |
| Transfers and Proofs | ... | ... | ... | ... | ... | ... | 1,766 | ... | 2,115 | 2,115 |
| Departmental Forms | 12 | ... | ... | ... | 2 | 9 | 19,150 | ... | 24,150 | 24,150 |
| Type Printing | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TOTAL (NORMAL) | 654 | 846 | 913 | 316 | 301 | 58 | 165,485 | 14,565 | 120,529 | 135,094 |
| CADASTRAL MAPS. | | | | | | | | | | |
| <i>Assam—</i> | | | | | | | | | | |
| Photo.-zincographs | 287 | 287 | 258 | 219 | 219 | ... | 15,803 | ... | 15,803 | 15,803 |
| Zincographs | 69 | ... | ... | 69 | 69 | ... | 5,809 | ... | 4,689 | 4,689 |
| TOTAL | 356 | 287 | 258 | 288 | 288 | ... | 21,612 | ... | 20,492 | 20,492 |
| <i>Bengal—</i> | | | | | | | | | | |
| Photo.-zincographs | 222 | 222 | 230 | 228 | 228 | ... | 2,508 | ... | 2,508 | 2,508 |
| Zincographs | 65 | ... | ... | 65 | 65 | ... | 715 | ... | 715 | 715 |
| TOTAL | 287 | 222 | 230 | 293 | 293 | ... | 3,223 | ... | 3,223 | 3,223 |
| <i>Burma—</i> | | | | | | | | | | |
| Photo.-zincographs | 2,615 | 2,615 | 2,618 | 2,494 | 2,494 | ... | 75,027 | ... | 76,837 | 76,837 |
| Zincographs | 940 | ... | ... | 940 | 940 | ... | 28,200 | ... | 28,200 | 28,200 |
| TOTAL | 3,555 | 2,615 | 2,618 | 3,434 | 3,434 | ... | 103,227 | ... | 105,037 | 105,037 |
| <i>North-Western Provinces—</i> | | | | | | | | | | |
| Photo.-zincographs | 497 | 497 | 539 | 606 | 606 | ... | 7,878 | ... | 7,878 | 7,878 |
| Zincographs | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TOTAL | 497 | 497 | 539 | 606 | 606 | ... | 7,878 | ... | 7,878 | 7,878 |
| Transfers and Proofs | ... | ... | ... | ... | ... | ... | 9,372 | ... | ... | ... |
| TOTAL (CADASTRAL) | 4,695 | 3,621 | 3,545 | 4,621 | 4,621 | ... | 145,312 | ... | 136,630 | 136,630 |

Statement of work done for other

| DEPARTMENTS, ETC. | Sheets or subjects. | Negatives and transparencies. | PHOTO-ZINCOGRAPHIC AND | | | | |
|--|---------------------|-------------------------------|------------------------|--------------------------|----------------------|---------|---------|
| | | | Photo-transfer prints. | Zinc plates transferred. | Zinc plates printed. | Stones. | Pulls. |
| Adjutant General in India | 20 | 11 | 10 | ... | 8 | 12 | 17,500 |
| " " in Mhow District | ... | ... | ... | ... | 2 | ... | ... |
| Administrative Medical Officer, Central Provinces | ... | ... | 1 | 2 | 2 | ... | 500 |
| Agent and Chief Engineer, Assam-Bengal Railway | 21 | 22 | 22 | 13 | 11 | ... | 950 |
| " " " Bengal and North-Western Railway | 26 | 50 | 50 | 16 | 16 | ... | 1,600 |
| Agent to the Governor General in Baluchistan | 1 | 1 | 1 | 1 | 1 | ... | 55 |
| " " " and Chief Commissioner, Rajputana and Central India | 1 | ... | ... | ... | ... | 3 | 195 |
| Architectural Surveyor, North-Western Provinces and Oudh | 46 | 16 | 23 | 4 | 4 | 3 | 3,850 |
| Asiatic Society, Bengal | ... | ... | ... | ... | ... | ... | 1,440 |
| Board of Revenue, Bengal | 5 | ... | ... | ... | 3 | 4 | 1,020 |
| " " North-Western Provinces and Oudh | 3 | 10 | 5 | 2 | 1 | .. | 200 |
| Boundary Settlement Officer, Kashmir | 28 | 39 | 39 | 2 | 2 | ... | 24 |
| Brigadier-General Commanding Mandalay District | ... | ... | ... | ... | 2 | ... | 70 |
| Brigadier-General Commanding Peshawar District | ... | ... | ... | 1 | 2 | ... | 350 |
| Calcutta Municipality | 3 | ... | ... | ... | 2 | 1 | 450 |
| Chief Commissioner, Assam | 1 | ... | ... | ... | ... | ... | 9,000 |
| " " Central Provinces | 1 | ... | ... | ... | ... | 3 | 1,325 |
| " " Engineer, Bengal, Public Works Department | 12 | 13 | 13 | 7 | 8 | 5 | 3,760 |
| Chief Engineer, Bengal Dooars Railway extension | 19 | 18 | 18 | 9 | 9 | 2 | 1,100 |
| " " East Indian Railway | 54 | 99 | 100 | 35 | 18 | ... | 3,730 |
| " " for Irrigation, Madras | ... | ... | ... | ... | ... | ... | ... |
| " " Irrigation Works, Punjab | 16 | 10 | 10 | 12 | 11 | 3 | 13,720 |
| " " Public Works Department, Punjab | 20 | 13 | 13 | 10 | 13 | 1 | 4,145 |
| Collector of Customs, Calcutta | 7 | ... | ... | ... | ... | 11 | 5,775 |
| Commissioner of Excise, Bengal | 7 | ... | ... | ... | ... | 7 | 3,430 |
| " " Punjab | 2 | ... | ... | ... | ... | 4 | 800 |
| " " Police, Calcutta | 1 | ... | ... | ... | ... | 2 | 2,168 |
| Conservator of Forests, Bengal | 1 | ... | ... | ... | ... | 2 | 60 |
| Conservator of Forests, Tenasserim Circle | ... | ... | 3 | 1 | 2 | ... | 130 |
| Deputy Adjutant General, Bengal Command | 45 | 8 | 8 | 7 | 16 | 21 | 4,500 |
| " " Murree District | ... | ... | ... | ... | 2 | ... | 200 |
| " " Assistant Adjutant General, Oudh District | 3 | 11 | 6 | 4 | ... | ... | ... |
| " " Adjutant General, Punjab Command | 3 | 7 | 7 | 4 | 8 | ... | 690 |
| " " Assistant Adjutant General, Rangoon District | ... | ... | ... | ... | 2 | ... | 100 |
| " " " Secunderabad | 3 | 4 | 4 | 3 | 3 | ... | 1,500 |
| " " Commissioner, Ludhiana | 1 | ... | ... | ... | ... | 1 | 100 |
| Director General of Military Works | 8 | 19 | 19 | 6 | 12 | ... | 3,035 |
| " " Post Office, India | 4 | ... | ... | ... | ... | 7 | 3,080 |
| " " Telegraphs | 42 | 5 | 3 | 4 | 4 | 16 | 8,460 |
| " " Statistics | 2 | ... | ... | ... | ... | 2 | 1,050 |
| " " Geological Survey of India | 14 | 8 | 1 | 1 | 1 | 10 | 8,540 |
| " " Royal Indian Marine | 12 | 26 | ... | ... | ... | ... | ... |
| " " of Land Records and Agriculture, Assam | ... | ... | ... | ... | ... | 1 | 140 |
| " " " " Bengal | 25 | 2 | 2 | 4 | 20 | 14 | 16,240 |
| " " " " Burma | ... | ... | ... | ... | 19 | ... | 1,298 |
| " " " " Gwalior State | 3 | ... | ... | ... | ... | 3 | 6,000 |
| " " Public Instruction, Bengal | 4 | ... | ... | ... | ... | 4 | 2,800 |
| " " Land Records, Punjab | 1 | ... | ... | ... | ... | ... | ... |
| Engineer-in-Chief, Dhubri-Gauhati Railway Survey | 1 | 4 | ... | ... | ... | 1 | 200 |
| " " E. B. State Railway | 9 | 8 | 8 | 4 | 5 | 1 | 280 |
| " " Vizianagram | ... | ... | ... | 2 | 3 | ... | 300 |
| Executive Engineer, Eastern Berar Division | ... | ... | ... | ... | ... | 1 | 80 |
| " " Kashmir Railway Survey | 1 | ... | ... | ... | ... | 1 | 250 |
| " " Simla Provincial Survey | 6 | 14 | 14 | 6 | 12 | ... | 600 |
| Examiner of Telegraph Accounts | 2 | ... | ... | ... | ... | 2 | 400 |
| General Officer Commanding Allahabad District | 2 | 8 | 8 | 2 | ... | ... | ... |
| " " The Forces, Bengal | 2 | 6 | 6 | 1 | ... | ... | ... |
| " " Bundelkhand District | 1 | 4 | 4 | 2 | 2 | ... | 100 |
| " " Meerut District | 3 | 12 | 12 | 4 | 2 | ... | 400 |
| " " Punjab Frontier Force | 1 | 2 | 2 | 1 | 1 | ... | 70 |
| " " Rawalpindi District | ... | ... | ... | ... | 2 | ... | 240 |
| " " Sind District | 2 | 6 | 6 | 2 | 2 | ... | 300 |
| Government of India, Revenue and Agriculture Department | 29 | 54 | 2 | 2 | 3 | 6 | 18,780 |
| " " Foreign Department | 19 | 9 | 9 | 5 | 7 | 12 | 815 |
| " " Home Department | 2 | ... | ... | 4 | 16 | 2 | 11,880 |
| " " Linguistic Survey | 9 | 6 | 6 | 7 | 6 | 8 | 598 |
| " " Military Department | 6 | 7 | 7 | 9 | 11 | 1 | 3,420 |
| Carried over | 560 | 532 | 442 | 199 | 286 | 178 | 174,433 |

LITHOGRAPHIC OFFICE.

Departments during the year 1898-99.

| LITHOGRAPHIC PRINTING. | | | SILVER AND OTHER PRINTING. | | | HELIOGRAVURE AND ELECTROTYPING. | | | | Value. |
|------------------------|-------------|---------|----------------------------|--------------|-----------------------|---------------------------------|-----------------------|---------------|---------------|-------------|
| Number of copies. | | | Silver prints. | Blue prints. | Miscellaneous prints. | Helio gravure plates. | Helio gravure prints. | Photo-Blocks. | Electrotypes. | |
| Coloured. | Uncoloured. | Total. | | | | | | | | |
| 6,400 | 6,200 | 12,600 | ... | 4 | ... | ... | ... | ... | ... | R 1,833 3 0 |
| ... | 165 | 165 | ... | ... | ... | ... | ... | ... | ... | 43 4 3 |
| ... | 250 | 250 | ... | ... | ... | ... | ... | ... | ... | 26 14 6 |
| ... | 2,050 | 2,050 | ... | ... | ... | ... | ... | ... | ... | 482 12 3 |
| ... | 2,400 | 2,400 | ... | ... | ... | ... | ... | ... | ... | 1,028 10 9 |
| ... | 55 | 55 | ... | ... | ... | ... | ... | ... | ... | 21 13 3 |
| 65 | ... | 65 | ... | ... | ... | ... | ... | ... | ... | 74 10 0 |
| ... | 12,650 | 12,650 | ... | ... | ... | 30 | 15,430 | ... | ... | 4,997 5 0 |
| 720 | 720 | 720 | ... | ... | ... | ... | ... | ... | ... | 88 4 0 |
| 020 | ... | 620 | ... | ... | ... | ... | ... | ... | ... | 229 13 0 |
| ... | 200 | 200 | ... | 26 | ... | ... | ... | ... | ... | 144 13 0 |
| ... | 24 | 24 | ... | ... | ... | ... | ... | ... | ... | 565 3 9 |
| ... | 70 | 70 | ... | ... | ... | ... | ... | ... | ... | 19 7 0 |
| ... | 175 | 175 | ... | ... | ... | ... | ... | ... | ... | 74 14 6 |
| 450 | ... | 450 | ... | ... | ... | ... | ... | ... | ... | 186 4 0 |
| ... | 9,000 | 9,000 | ... | ... | ... | ... | ... | ... | ... | 538 5 0 |
| 375 | 150 | 525 | ... | ... | ... | ... | ... | ... | ... | 101 1 0 |
| 1,310 | 410 | 1,720 | ... | ... | ... | ... | ... | ... | ... | 773 12 0 |
| 100 | 1,800 | 1,900 | ... | ... | ... | ... | ... | ... | ... | 483 6 0 |
| ... | 3,130 | 3,130 | ... | ... | ... | I | I | ... | ... | 2,113 13 0 |
| ... | ... | ... | ... | 17 | ... | ... | ... | ... | ... | 17 6 0 |
| ... | 17,560 | 17,560 | ... | ... | ... | ... | ... | ... | ... | 1,395 2 6 |
| ... | 6,320 | 6,320 | ... | ... | ... | ... | ... | ... | ... | 900 8 3 |
| 3,675 | ... | 3,675 | ... | ... | ... | ... | ... | ... | ... | 666 14 0 |
| 3,430 | ... | 3,430 | ... | ... | ... | ... | ... | ... | ... | 348 3 0 |
| 430 | ... | 430 | ... | ... | ... | ... | ... | ... | ... | 76 15 0 |
| 1,084 | ... | 1,084 | ... | ... | ... | ... | ... | ... | ... | 147 13 0 |
| ... | 60 | 60 | ... | ... | ... | ... | ... | ... | ... | 16 10 0 |
| ... | 130 | 130 | ... | ... | ... | ... | ... | ... | ... | 49 12 0 |
| 3,920 | 400 | 4,320 | ... | ... | ... | ... | ... | ... | ... | 1,591 3 6 |
| ... | 100 | 100 | ... | ... | ... | ... | ... | ... | ... | 35 6 6 |
| ... | ... | ... | ... | 10 | ... | ... | ... | ... | ... | 149 8 0 |
| ... | 385 | 385 | ... | ... | ... | ... | ... | ... | ... | 271 6 9 |
| ... | 100 | 100 | ... | ... | ... | ... | ... | ... | ... | 29 0 6 |
| ... | 500 | 500 | ... | ... | ... | ... | ... | ... | ... | 269 1 6 |
| ... | 100 | 100 | ... | ... | ... | ... | ... | ... | ... | 210 0 0 |
| ... | 3,235 | 3,235 | ... | ... | ... | ... | ... | ... | ... | 857 13 9 |
| 1,760 | ... | 1,760 | ... | ... | ... | ... | ... | ... | ... | 274 0 0 |
| 50 | 21,910 | 21,960 | ... | 2 | ... | ... | ... | ... | ... | 1,486 8 0 |
| ... | 1,650 | 1,650 | ... | ... | ... | ... | ... | ... | ... | 150 13 0 |
| 2,180 | 3,000 | 5,180 | 23 | ... | ... | 8 | 2,659 | 7 | ... | 1,427 5 6 |
| ... | ... | ... | ... | ... | ... | 12 | 3,012 | ... | ... | 1,321 8 0 |
| ... | 140 | 140 | ... | ... | ... | ... | ... | ... | ... | 26 15 0 |
| 8,340 | 860 | 9,200 | ... | 3 | ... | ... | ... | ... | ... | 2,015 4 6 |
| ... | 1,298 | 1,298 | ... | ... | ... | ... | ... | ... | ... | 606 12 0 |
| ... | 9,000 | 9,000 | ... | ... | ... | ... | ... | ... | ... | 737 12 0 |
| 2,800 | ... | 2,800 | ... | ... | ... | ... | ... | ... | ... | 175 8 0 |
| ... | ... | ... | ... | 12 | ... | ... | ... | ... | ... | 31 0 0 |
| 100 | ... | 100 | ... | ... | ... | ... | ... | ... | ... | 47 8 0 |
| 100 | 160 | 260 | ... | ... | ... | ... | ... | ... | ... | 148 13 0 |
| ... | 100 | 100 | ... | ... | ... | ... | ... | ... | ... | 56 11 3 |
| ... | 80 | 80 | ... | ... | ... | ... | ... | ... | ... | 13 10 0 |
| ... | 250 | 250 | ... | ... | ... | ... | ... | ... | ... | 210 8 0 |
| ... | 000 | 000 | ... | ... | ... | ... | ... | ... | ... | 408 12 3 |
| ... | 400 | 400 | ... | ... | ... | ... | ... | ... | ... | 22 9 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 102 0 0 |
| ... | 50 | 50 | ... | ... | ... | ... | ... | ... | ... | 78 12 0 |
| ... | 200 | 200 | ... | ... | ... | ... | ... | ... | ... | 78 12 0 |
| ... | 70 | 70 | ... | ... | ... | ... | ... | ... | ... | 259 3 6 |
| ... | 120 | 120 | ... | ... | ... | ... | ... | ... | ... | 53 13 3 |
| ... | 300 | 300 | ... | ... | ... | ... | ... | ... | ... | 93 4 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 190 5 3 |
| 850 | 57,120 | 57,970 | ... | 80 | ... | 30 | 35,280 | ... | ... | 8,663 15 6 |
| 247 | 349 | 596 | ... | ... | ... | ... | ... | ... | ... | 1,134 7 9 |
| 600 | 5,610 | 6,240 | ... | ... | ... | ... | ... | ... | ... | 1,311 8 9 |
| 106 | 166 | 272 | ... | ... | ... | ... | ... | ... | ... | 420 3 9 |
| 40 | 1,640 | 1,680 | ... | ... | ... | ... | ... | ... | ... | 680 4 3 |
| 39,752 | 172,722 | 212,474 | 40 | 137 | ... | 81 | 56,382 | 7 | ... | 43,088 15 0 |

Statement of work done for other

| DEPARTMENTS, ETC. | Sheets or subjects. | Negatives and transparencies. | PHOTO-ZINCOGRAPHIC AND | | | | |
|---|---------------------|-------------------------------|------------------------|--------------------------|----------------------|---------|---------|
| | | | Photo-transfer prints. | Zinc plates transferred. | Zinc plates printed. | Stones. | Pulls. |
| Brought forward | 560 | 532 | 442 | 199 | 286 | 178 | 174,453 |
| Government of India, Public Works Department, Rail- way Construction | 139 | 82 | 82 | 64 | 106 | 16 | 83,015 |
| Government of Bengal, Financial Department | 1 | ... | ... | ... | ... | ... | 686 |
| " " Municipal Department | 1 | ... | ... | ... | 7 | 1 | 982 |
| " " Public Works Department, Irriga- tion Branch | 54 | 70 | 70 | 29 | 54 | 42 | 21,560 |
| " " Railway Department | 1 | ... | ... | ... | ... | 3 | 750 |
| " " Revenue and General Depart- ment | 2 | ... | ... | ... | 5 | 2 | 25,902 |
| Government of Bombay | 1 | 2 | ... | ... | ... | ... | ... |
| Government of Madras, Public Works Department | 17 | ... | ... | ... | ... | ... | ... |
| Government of Punjab, " " " | 1 | ... | ... | 1 | 1 | 1 | 700 |
| Indian Famine Commission | 1 | ... | ... | ... | 3 | 1 | 13,240 |
| Indian Museum, Calcutta | 9 | 12 | ... | ... | ... | 1 | 500 |
| Inspector General of Artillery in India | 1 | 1 | 1 | 2 | 1 | ... | 600 |
| " " Civil Veterinary Department | 1 | ... | ... | ... | 5 | 1 | 1,800 |
| " " Jails, Bengal | 6 | 3 | ... | ... | ... | 3 | 125 |
| " " Forests, Government of India | 7 | 7 | 7 | ... | ... | 1 | 1,000 |
| " " Police, Bengal | 36 | 11 | 6 | 4 | 8 | 16 | 10,223 |
| " " Registration, Bengal | 1 | ... | ... | ... | ... | 2 | 2,400 |
| Master of the Mint, Calcutta | ... | ... | ... | ... | ... | ... | ... |
| Meteorological Reporter to the Government of India Bengal | 110 | 30 | 32 | 23 | 37 | 15 | 84,910 |
| Military Secretary to the Viceroy | 5 | ... | ... | ... | 5 | 6 | 70,559 |
| Officer Commanding Fort William, Calcutta | 3 | 2 | 2 | 2 | ... | 5 | 412 |
| " " Oudh District | 2 | 2 | 2 | 2 | 2 | ... | 100 |
| " " in charge, Bengal Secretariat Book Depôt of Records, Government of India | 3 | 12 | 12 | ... | ... | ... | ... |
| Photographic Society of India | 7 | 8 | 5 | 4 | ... | ... | ... |
| Port Commissioners, Calcutta | 4 | 4 | ... | ... | ... | ... | ... |
| " " Officer and Registrar of Wrecks, Calcutta | 2 | 4 | 10 | 4 | 4 | ... | 500 |
| Principal, Civil Engineering College, Sibpur Dacca College | 4 | 6 | 6 | 2 | 2 | 4 | 820 |
| Quarter Master General in India | ... | ... | ... | ... | ... | ... | ... |
| Rangoon Municipality | 4 | 1 | 1 | 3 | 6 | 7 | 4,034 |
| Resident in Nepal | 116 | 155 | 310 | 173 | ... | ... | ... |
| Sanitary Commissioner, Bengal | ... | ... | ... | 1 | ... | ... | ... |
| " " with the Government of India | 6 | ... | ... | ... | ... | 8 | 5,680 |
| Sanitary Engineer, Bengal | 2 | 1 | 1 | 2 | 2 | 4 | 5,700 |
| Secretary, Government of Burma | 12 | 18 | 18 | 6 | 6 | ... | 1,800 |
| " " for Berar to the Resident at Hyderabad | 43 | 4 | ... | ... | ... | 1 | 600 |
| " " Lady Dufferin's Fund | ... | ... | ... | ... | 1 | ... | 170 |
| " " to the Plague Commission, Bengal | 1 | ... | ... | ... | ... | 2 | 3,000 |
| " " Indian Plague Commission, Bombay | 3 | ... | ... | ... | ... | 1 | 2,610 |
| Settlement Officer, Bassein, Burma | 14 | ... | 2 | 3 | 18 | 14 | 77,840 |
| " " Hanthawaddy | ... | ... | ... | ... | ... | ... | 400 |
| State Engineer, Kashmir Darbar | ... | ... | ... | ... | ... | 1 | 120 |
| Superintendent, Civil Veterinary Department | 2 | 1 | 1 | 1 | 1 | 2 | 451 |
| " " Forest Surveys, Bengal | 4 | 1 | 1 | ... | ... | 5 | 2,000 |
| " " Dehra Dún | ... | ... | ... | ... | ... | 1 | 1,000 |
| Superintending Engineer, Irrigation Circle, Upper Burma | 5 | 7 | ... | ... | ... | 3 | 1,320 |
| Superintendent, Government Central Branch Press, Simla | 9 | 7 | 7 | 17 | 17 | ... | 1,275 |
| Superintending Engineer, 3rd Circle, Irrigation Works, North-Western Provinces and Oudh | 1 | 2 | 2 | ... | ... | ... | ... |
| Superintending Engineer, Orissa Circle | 9 | ... | ... | ... | ... | 4 | 122 |
| Superintendent of Harness and Saddlery Factory, Cawn- pore | ... | ... | ... | ... | ... | ... | ... |
| Superintendent, Government Printing, India | 2 | ... | ... | ... | ... | 2 | 512 |
| " " Press, North-Western Pro- vinces and Oudh | 209 | 73 | 102 | 7 | 11 | 50 | 29,572 |
| Superintendent of Land Records, North-Western Provin- ces and Oudh | 2 | ... | ... | ... | ... | 4 | 1,878 |
| Superintendent of Stationery of Land Records Survey, North-Western Provinces and Oudh | 4 | ... | ... | ... | ... | 2 | 6,000 |
| Superintendent of Telegraphs, Stores | 5 | ... | ... | ... | 4 | 7 | 10,900 |
| Traffic Manager, East Indian Railway | ... | ... | ... | ... | ... | 1 | 200 |
| " " Superintendent, Eastern Bengal State Railway | 1 | ... | ... | ... | ... | 1 | 1,920 |
| Vice-President to the Commissioners for Inspection of Steam Boilers | ... | ... | ... | ... | 2 | ... | 475 |
| Special work done for trade and private individuals | ... | ... | ... | ... | ... | 2 | 400 |
| Pulls and proofs | 92 | 42 | 31 | 21 | 30 | 2 | 7,527 |
| TOTAL | 1,524 | 1,100 | 1,153 | 508 | 620 | 420 | 671,423 |

LITHOGRAPHIC OFFICE.

Departments during the year 1898-99—(continued).

| LITHOGRAPHIC PRINTING. | | | SILVER AND OTHER PRINTING. | | | HELIOGRAVURE AND ELECTROTYPING. | | | | Value. | | |
|------------------------|-------------|---------|----------------------------|--------------|-----------------------|---------------------------------|---------------------------|---------------|--------------------|--------|-----|-----|
| Number of copies. | | | Silver prints. | Blue prints. | Miscellaneous prints. | Helio- gravure plates. | Helio- gravure prints. | Photo-Blocks. | Electro- types. | R | s. | p. |
| Coloured. | Uncoloured. | Total. | | | | | | | | | | |
| 39,752 | 172,722 | 212,474 | 40 | 137 | | 81 | 56,382 | 7 | | 43,088 | 15 | 0 |
| 8,365 | 61,866 | 70,231 | ... | ... | ... | ... | ... | ... | ... | 7,824 | 14 | 9 |
| 686 | ... | 686 | ... | ... | ... | ... | ... | ... | ... | 27 | 13 | 0 |
| 140 | 702 | 842 | ... | ... | ... | ... | ... | ... | ... | 189 | 4 | 0 |
| 5,714 | 5,050 | 10,764 | ... | 2 | ... | ... | ... | ... | ... | 4,139 | 9 | 9 |
| 250 | ... | 250 | ... | ... | ... | ... | ... | ... | ... | 295 | 0 | 0 |
| 19,143 | ... | 19,143 | ... | ... | ... | ... | ... | ... | ... | 1,382 | 1 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 36 | 0 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 612 | 0 | 0 |
| ... | 700 | 700 | ... | ... | ... | ... | ... | 17 | ... | 149 | 12 | 0 |
| 3,310 | ... | 3,310 | ... | ... | ... | ... | ... | ... | ... | 806 | 12 | 0 |
| ... | 1,500 | 1,500 | ... | ... | ... | ... | ... | ... | ... | 2,121 | 2 | 0 |
| ... | 600 | 600 | ... | ... | ... | 6 | 13,206 | ... | ... | 52 | 13 | 3 |
| 300 | ... | 300 | ... | ... | ... | ... | ... | ... | ... | 313 | 8 | 0 |
| ... | 175 | 175 | ... | ... | ... | ... | ... | ... | ... | 368 | 7 | 0 |
| ... | 7,000 | 7,000 | ... | 3 | ... | ... | ... | ... | ... | 226 | 5 | 0 |
| 4,245 | 1,700 | 5,945 | ... | ... | ... | ... | ... | ... | ... | 753 | 0 | 3 |
| 1,200 | ... | 1,200 | ... | ... | ... | ... | ... | 8 | ... | 162 | 15 | 0 |
| ... | ... | ... | 2 | ... | ... | ... | ... | ... | ... | 2 | 8 | 0 |
| 9,600 | 139,445 | 149,045 | ... | ... | ... | ... | ... | ... | ... | 4,397 | 12 | 6 |
| 146 | 56,180 | 56,326 | ... | ... | ... | ... | ... | ... | ... | 1,066 | 7 | 0 |
| 200 | 12 | 212 | ... | ... | ... | ... | ... | ... | ... | 384 | 14 | 0 |
| ... | 50 | 50 | ... | ... | ... | ... | ... | ... | ... | 74 | 15 | 3 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 134 | 0 | 0 |
| ... | 27 | 27 | ... | ... | ... | ... | ... | ... | ... | 7 | 8 | 0 |
| ... | ... | ... | ... | 2 | ... | ... | ... | ... | ... | 180 | 12 | 0 |
| ... | ... | ... | ... | ... | ... | 1 | ... | ... | ... | 195 | 0 | 0 |
| ... | 500 | 500 | ... | ... | ... | 4 | 3,204 | ... | ... | 262 | 4 | 0 |
| 260 | 300 | 560 | ... | ... | ... | ... | ... | ... | ... | 267 | 10 | 6 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 12 | 0 | 0 |
| ... | 200 | 200 | ... | ... | ... | ... | 100 | ... | ... | 38 | 0 | 0 |
| 1,280 | 434 | 1,714 | ... | ... | ... | ... | ... | ... | ... | 976 | 4 | 9 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4,410 | 12 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4 | 12 | 0 |
| 3,550 | 710 | 4,260 | ... | ... | ... | ... | ... | ... | ... | 552 | 11 | 0 |
| 930 | 950 | 1,900 | ... | ... | ... | ... | ... | ... | ... | 549 | 13 | 0 |
| ... | 3,600 | 3,600 | ... | ... | ... | ... | ... | ... | ... | 367 | 15 | 0 |
| ... | 600 | 600 | ... | ... | ... | ... | ... | ... | ... | 2,268 | 2 | 0 |
| ... | 340 | 340 | ... | ... | ... | 7 | 5,004 | 45 | ... | 9 | 8 | 9 |
| 1,500 | ... | 1,500 | ... | ... | ... | ... | ... | ... | ... | 128 | 12 | 0 |
| ... | 7,830 | 7,830 | ... | ... | ... | ... | ... | ... | ... | 308 | 13 | 0 |
| 17,570 | 12,580 | 30,150 | ... | ... | ... | ... | ... | ... | ... | 5,676 | 4 | 6 |
| ... | 400 | 400 | ... | ... | ... | ... | ... | ... | ... | 80 | 0 | 0 |
| ... | 120 | 120 | ... | ... | ... | ... | ... | ... | ... | 31 | 4 | 0 |
| 150 | 151 | 301 | ... | ... | ... | ... | ... | ... | ... | 119 | 12 | 6 |
| 250 | 1,500 | 1,750 | ... | ... | ... | ... | ... | ... | ... | 100 | 12 | 0 |
| ... | 1,000 | 1,000 | ... | ... | ... | ... | ... | ... | ... | 193 | 8 | 0 |
| ... | 1,320 | 1,320 | ... | ... | ... | 5 | 2,405 | ... | ... | 687 | 0 | 0 |
| ... | 600 | 600 | ... | ... | ... | ... | ... | ... | ... | 291 | 4 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 23 | 8 | 0 |
| ... | 142 | 142 | ... | ... | ... | ... | ... | ... | ... | 329 | 9 | 0 |
| ... | ... | ... | ... | 52 | ... | ... | ... | ... | ... | 68 | 0 | 0 |
| ... | 524 | 524 | ... | ... | ... | ... | ... | ... | ... | 34 | 8 | 0 |
| 4,074 | 37,261 | 41,335 | ... | 1 | ... | 1 | ... | 11 | ... | 3,912 | 10 | 9 |
| 381 | 735 | 1,116 | 7 | ... | ... | ... | ... | ... | ... | 410 | 8 | 0 |
| ... | 24,000 | 24,000 | ... | ... | ... | ... | ... | ... | ... | 384 | 11 | 0 |
| ... | 10,960 | 10,960 | ... | ... | ... | ... | ... | ... | ... | 668 | 12 | 0 |
| ... | 200 | 200 | ... | ... | ... | ... | ... | ... | ... | 43 | 3 | 0 |
| ... | 960 | 960 | ... | ... | ... | ... | ... | ... | ... | 50 | 0 | 0 |
| ... | 475 | 475 | ... | ... | ... | ... | ... | ... | ... | 116 | 9 | 6 |
| ... | 400 | 400 | ... | ... | ... | ... | ... | ... | ... | 128 | 12 | 9 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 41 | 9 | 0 |
| 600 | 11,380 | 11,980 | 24 | 18 | ... | 5 | 1,908 | ... | ... | 2,270 | 6 | 0 |
| ... | 2,212 | 2,212 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 123,616 | 570,113 | 693,729 | 73 | 215 | ... | 111 | 82,222 | 77 | ... | 94,813 | 14 | 9 |

*For colouring.

MATHEMATICAL INSTRUMENT OFFICE.

TABLE A.

Details of Issues to and Receipts from Provinces and Departments during the Financial year 1898-99.

| PROVINCES AND DEPARTMENTS. | VALUE OF | | | |
|--|-----------|----------|----------|----------|
| | Receipts. | Issues. | Debits. | Credits. |
| | R | R | R | R |
| Assam | 441 | 5,891 | 5,450 | ... |
| Bengal Civil | 10,180 | 21,299 | 11,119 | ... |
| " Military Bengal Command | 1,146 | 6,538 | 5,392 | ... |
| " Punjab " | 12,959 | 17,271 | 4,312 | ... |
| Bombay Civil | 1,707 | 4,681 | 2,974 | ... |
| " Military | 111 | 2,850 | 2,739 | ... |
| Burma | 865 | 17,547 | 16,682 | ... |
| Central Provinces | 440 | 4,795 | 4,355 | ... |
| Foreign States, Berar | ... | 246 | 246 | ... |
| Forests | ... | 1,056 | 1,056 | ... |
| Geological Survey and Museums | ... | 225 | 225 | ... |
| Guaranteed Railways, East Indian Rail- way | 150 | 4,565 | 4,415 | ... |
| Madras Civil | ... | 706 | 706 | ... |
| " Military | 836 | 2,573 | 1,737 | ... |
| Marine | ... | 1,334 | 1,334 | ... |
| Meteorological Department | ... | 1,771 | 1,771 | ... |
| Mint | ... | 345 | 345 | ... |
| North-Western Provinces and Oudh | 4,408 | 15,217 | 10,809 | ... |
| " State Railway, Public Works Department | 2,220 | 12,046 | 9,826 | ... |
| Public Works Department, Military Works | 323 | 1,563 | 1,240 | ... |
| Public Works Department, Coorg | 213 | 77 | ... | 141 |
| " Railway " Baluchistan, " Railway Branch " | ... | 826 | 826 | ... |
| Punjab | 4,945 | 9,914 | 4,969 | ... |
| Rajputana, Public Works Department, and Central India | 325 | 670 | 345 | ... |
| Survey Department (Field Parties) | 21,387 | 83,366 | 61,979 | ... |
| " Head-Quarters Offi- ces Calcutta and Dehra Dún | 6,238 | 8,905 | 2,667 | ... |
| Burma-China Boundary Commission | ... | 1,032 | 1,032 | ... |
| Telegraph | ... | 230 | 230 | ... |
| TOTAL | 68,899 | 2,27,539 | 1,58,781 | 141 |
| NET DEBIT | ... | ... | 1,58,640 | ... |
| CASH SALES | ... | ... | 50,664 | ... |
| GRAND TOTAL | ... | ... | 2,09,304 | ... |

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the local market during 1898-99.

| SPECIFICATION. | Number. | Value. |
|---|---------|-------------|
| <i>Instruments.</i> | | |
| | | <i>R a.</i> |
| Barometers, aneroid, ordinary, pocket | 4 | 250 0 |
| Cases, leather, and Morocco, spare | 103 | 302 12 |
| Chronographs, watch pattern | 9 | 225 0 |
| Clinometers, road reflecting, Cook's pattern | 24 | 1,344 0 |
| Clocks | 7 | 172 0 |
| Cords for range finders | 1,000 | 210 0 |
| Compasses, drawing, ordinary, 5" | 252 | 252 0 |
| " magnetic, rectangular, 2" and 2½" | 20 | 140 0 |
| " " " 5" | 237 | 3,081 0 |
| " " " 6" | 124 | 1,860 0 |
| " prismatic, card dial, 2" and 2½" | 2 | 50 0 |
| " " Hutchinson's pattern | 3 | 96 0 |
| " proportional, brass, 6" | 24 | 480 0 |
| Covers for plane tables | 66 | 348 4 |
| Curves, French, wooden, sets | 2 | 12 0 |
| " Railway, card board, large, sets | 2 | 75 0 |
| Glasses, binocular, large | 9 | 360 0 |
| " " small | 8 | 270 0 |
| " magnifying or reading, folding, 1" to 2" | 6 | 7 8 |
| " measuring for rain-gauges, 5" | 2 | 13 0 |
| Haversacks | 24 | 36 8 |
| Lamps, Argand | 15 | 45 0 |
| " bull's eye | 12 | 58 10 |
| Levels, spirit, in wooden case, 4" to 7" | 24 | 22 8 |
| " " " 8" to 10" | 10 | 11 4 |
| " " " 11" to 15" | 2 | 2 4 |
| Map printing machines, Gastrell's | 6 | 375 0 |
| " " Ordnance | 12 | 570 0 |
| Opisometers | 1 | 10 8 |
| Cords for mekometer | 6 | 396 0 |
| Pins for chains, ordinary | 4,000 | 250 0 |
| Plane tables, deal, survey pattern | 300 | 2,100 0 |
| Protactors, rectangular, wooden | 32 | 76 0 |
| " brass, semicircular, plain | 18 | 234 0 |
| Presslers borers for hard wood | 36 | 576 0 |
| Rules, parallel on rollers, brass, 12" | 1 | 30 0 |
| " " " 15" and 18" | 9 | 432 0 |
| " sight, wooden | 514 | 1,542 0 |
| Scales, architects, boxwood, sets | 8 | 200 0 |
| " " " single | 18 | 87 12 |
| " diagonal, wooden | 1,400 | 787 8 |
| " offsets, single, wooden | 18 | 6 12 |
| " plotting, sets, ebonite | 12 | 312 0 |
| " " single, wooden | 18 | 40 8 |
| Squares, set single, ebonite | 108 | 126 0 |
| " optical | 687 | 4,465 8 |
| Stands for plane tables, survey pattern | 705 | 4,935 0 |
| " " " military pattern | 25 | 450 0 |
| Staves, levelling, Sopwith's, telescopic | 120 | 2,050 0 |
| Stencil plates, various | 5 | 18 4 |
| Tapes, metallic, 50' | 50 | 275 0 |
| " " other sizes | 9 | 15 12 |
| Thermometers, chemical, or Traveller's, from 0° to 400° | 12 | 84 0 |
| " clinical | 6 | 37 0 |
| Carried over | 10,127 | 30,297 2 |

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the local market during 1898-99—concluded.

| SPECIFICATION. | Number. | Value. |
|--|---------|-----------|
| <i>Instruments—concluded.</i> | | |
| <i>R a.</i> | | |
| Brought forward | 10,127 | 30,297 2 |
| Thermometers, common, in tin cases | 30 | 69 0 |
| " grass | 2 | 40 0 |
| " maximum, self-registering | 12 | 240 0 |
| " oven | 6 | 270 0 |
| Trunks, mule | 12 | 186 0 |
| Umbrellas, surveying | 72 | 1,081 8 |
| TOTAL | 10,261 | 32,183 10 |
| <i>Books.</i> | | |
| Hints to travellers | 2 | 14 0 |
| Manual of Surveying, Thuillier's | 2 | 24 0 |
| Nautical almanacs | 62 | 155 0 |
| Tables, log, Chamber's | 13 | 43 14 |
| " " Hutton's | 5 | 45 9 |
| " " Shortrede's, sines, etc. | 12 | 270 10 |
| Tables, " Traverse, Boileau's | 6 | 54 12 |
| Merces, Income table | 1 | 1 8 |
| Addition exchange tables | 1 | 1 8 |
| TOTAL | 104 | 610 13 |
| <i>Sundries.</i> | | |
| Brushes, stencil | 72 | 36 0 |
| Glass, ink, bottles | 36 | 13 8 |
| Acetylene, lamp fitting | 5 | 241 10 |
| Cards for Richard barographs | 100 | 18 12 |
| Charts for sun-shine recorder | 365 | 40 0 |
| Charts for anemographs | 500 | 93 12 |
| Chimneys | 99 | 30 9 |
| Elastic rubber bands | 12 | 0 12 |
| Eye pieces, for levels | 2 | 30 0 |
| Frames and fittings, for clinometer | 80 | 1,352 0 |
| " " with folding sights | 18 | 405 0 |
| Frames, for levelling staves | 30 | 450 0 |
| Indelible pad, for Yost Type Writer | 1 | 12 0 |
| Lactometers | 26 | 71 8 |
| Lamps, Hink's, duplex, with wicks | 5 | 20 0 |
| Lamps, silvered, with 18 wicks | 2 | 36 4 |
| Observatory tents with round sheet of canvas | 2 | 208 8 |
| Printing ink, black | 5 | 7 8 |
| " " red | 5 | 12 8 |
| Search light lanterns | 9 | 51 12 |
| Seismoscopes | 6 | 390 0 |
| Shades for lanterns | 6 | 3 12 |
| Stencil ink, black | 53 | 26 8 |
| " ink | 3 | 2 4 |
| " ink, red | 9 | 6 12 |
| Tin boxes, small | 12 | 6 0 |
| Tool chest | 1 | 50 0 |
| Wicks, for lamps | 36 | 2 7 |
| TOTAL | 1,500 | 3,619 10 |
| TOTAL OF BOOKS | 104 | 610 13 |
| TOTAL OF INSTRUMENTS | 10,261 | 32,183 10 |
| SUM TOTAL | 11,865 | 36,414 1 |

MATHEMATICAL INSTRUMENT OFFICE.

TABLE C.

Instruments, etc., manufactured in the Mathematical Instrument Office during 1898-99
—concluded.

| SPECIFICATION. | Number. | Value. |
|---|---------|-------------|
| <i>Sundries.</i> | | <i>£ a.</i> |
| Boxes of sorts | 25 | 37 4 |
| Plummets, brass | 20 | 20 0 |
| Back-boards for barometers | 16 | 240 0 |
| Board for thermometer, maximum and minimum | 1 | 1 0 |
| Bolts and nuts for plane-tables | 20 | 5 0 |
| Brass, plate | 2 | 3 0 |
| Brass, roller, 12" long, 3" diameter | 1 | 12 0 |
| Brushes for theodolite | 5 | 5 8 |
| Bubble-tubes for theodolite | 1 | 18 0 |
| Cases, deal-wood, with hasps and padlocks | 2 | 10 0 |
| Cash box | 1 | 20 0 |
| Clamping screws for plane-table | 6 | 5 10 |
| Cylindrical piece of pluviometer | 1 | 3 0 |
| Cylinder vessel | 1 | 2 8 |
| Frames for tents | 2 | 150 0 |
| Handles for chains | 2 | 1 0 |
| Hinges, brass | 12 | 12 0 |
| Medicine box | 1 | 3 8 |
| Mercury bottles with 4 lb mercury | 2 | 18 0 |
| Numbers for chains | 61 | 5 2 |
| Nuts for plane-table stands | 5 | 1 4 |
| „ for theodolite stands | 2 | 1 4 |
| Pins for theodolite | 15 | 3 12 |
| Plumb, level | 1 | 1 0 |
| Reservoirs of rain-gauge with bottles, complete | 2 | 5 0 |
| Rope, chain, 66', with handle | 18 | 90 0 |
| Screws for plane-tables | 5 | 7 8 |
| Slate and pencil for typograph | 1 | 4 8 |
| Spiders, web | 4 | 20 0 |
| Tops, brass, for rain-gauge | 6 | 17 0 |
| Turnscrews, for theodolite | 3 | 2 4 |
| Type-frames, for printing machine | 15 | 79 8 |
| Washers, brass | 40 | 16 14 |
| Water-levels | 6 | 45 0 |
| Wrenches for theodolite | 1 | 1 4 |
| TOTAL | 306 | 878 10 |
| TOTAL OF INSTRUMENTS | 18,268 | 26,023 5 |
| SUM TOTAL | 18,574 | 26,901 15 |

MATHEMATICAL INSTRUMENT OFFICE.

TABLE D.

List of principal instruments repaired in Workshop during the financial year, 1898-99.

| SPECIFICATION. | Number. |
|--|---------|
| Anemograph | 1 |
| Anemometers | 29 |
| Arithmometer | 1 |
| Balances, chemical | 3 |
| Bars, lengthening | 3 |
| Barographs | 2 |
| Barometers of sorts | 97 |
| Boards, drawing | 2 |
| Chains of sorts | 67 |
| Chronographs | 2 |
| Chronometers of sorts | 6 |
| Chrono-micrometers of sorts | 2 |
| Clinometers | 135 |
| Clocks | 17 |
| Compasses, azimuth | 1 |
| " beam | 3 |
| " bow, pen | 116 |
| " " pencil | 14 |
| " " dividers | 8 |
| " drawing | 430 |
| " magnetic rectangular | 118 |
| " marine | 8 |
| " mining | 1 |
| " prismatic | 126 |
| " proportional | 9 |
| " subtense | 1 |
| " surveying | 9 |
| Cards for compasses | 7 |
| Cords and reels | 34 |
| Deodrometer | 1 |
| Eyelet machine | 2 |
| Glasses, binocular | 47 |
| " magnifying | 1 |
| Heliographs | 13 |
| Heliotropes | 43 |
| Hold-alls, leather | 22 |
| Hydrometers | 43 |
| Hygrometers | 8 |
| Indicators | 2 |
| Instruments, drawing, of sorts | 45 |
| Lamps of sorts | 10 |
| Lens | 1 |
| Levels of sorts | 169 |
| " spirit | 13 |
| Map printing machines | 5 |
| Mekometers | 172 |
| Meter current | 1 |
| Microscopes | 1 |
| Mining dial | 1 |
| Pens double or road | 1 |
| " drawing | 199 |
| Pantagraphs | 8 |
| Perambulator | 1 |
| Pins of sorts | 122 |
| Plane-tables | 47 |
| Planimeters | 14 |
| Pointers, station | 7 |
| Protractors | 2 |
| Carried forward | 2,253 |

MATHEMATICAL INSTRUMENT OFFICE.

TABLE D.

List of principal instruments repaired in Workshop during the financial year, 1898-99—concluded.

| SPECIFICATION. | Number. |
|---|---------|
| Brought forward . | 2,253 |
| Quintants | 11 |
| Range-finders | 11 |
| Rain-gauges | 6 |
| Rules of sorts | 126 |
| Scales of sorts | 92 |
| Scott's sights B. L. telescopic | 142 |
| Set squares | 2 |
| Sextants | 21 |
| Squares, optical | 236 |
| Stands, for compasses | 63 |
| " " heliographs | 3 |
| " " heliotropes | 9 |
| " " levels | 91 |
| " " plane-tables | 50 |
| " " theodolites | 53 |
| Staves, levelling | 118 |
| Sundials | 2 |
| Sunshine Recorder | 1 |
| Tapes | 782 |
| Telemeters | 37 |
| Telescopes | 264 |
| Theodolites | 122 |
| Thermographs | 2 |
| Thermometers | 71 |
| Time-pieces | 2 |
| Type writers | 17 |
| Watches | 44 |
| TOTAL OF PRINCIPAL INSTRUMENTS REPAIRED . | 4,631 |
| " " MINOR INSTRUMENTS REPAIRED . | 1,237½ |
| TOTAL OF ALL INSTRUMENTS REPAIRED . | 5,868½ |

MATHEMATICAL INSTRUMENT OFFICE,

Profit and Loss account of the Workshop for the financial year, 1898-99.

| DEBITS. | | CREDITS. | | | | |
|---|---------------|-----------|--|-----------|---------------|-----------|
| | R | a. | R | a. | R | a. |
| Workshop establishment (less proportion debitable to the Store Branch for cleaning and adjusting serviceable instruments) | 43,061 | 10 | By repairs for public officers on book debit | 14,703-5 | ... | |
| One-third of office establishment | 2,758 | 5 | " repairs for public officers on payment | 10,004-15 | 24,708 | 4 |
| Pay of Material Storekeeper for the whole year | 780 | 0 | " repairs for stock | | 43,834 | 15 |
| Workshop contingencies as distinguished from materials purchased | 3,167 | 14 | " manufacture for stock :— | | | |
| Value of materials :— | | | instruments | | 25,358 | 7 |
| For ordinary work | 29,679 | 8 | packing cases | | 1,693 | 4 |
| " general workshop use | | | " manufacture of material | | 2,591 | 0 |
| " manufacture of packing cases | | | | | | |
| Paid for repairs | ... | | | | | |
| Wear and tear of plant | 867 | 7 | | | | |
| Half of rent at R600 per mensem | 3,600 | 0 | | | | |
| Printing and stationery | 472 | 15 | | | | |
| Four per cent. on value of tools and plant amounting to R1,41,997-2-0 | 5,679 | 14 | | | | |
| Half of rates and taxes, etc. | 702 | 0 | | | | |
| Liability for pensions | 5,175 | 6 | | | | |
| Profit | 2,240 | 15 | | | | |
| TOTAL | 98,185 | 14 | TOTAL | | 98,185 | 14 |

TRIGONOMETRICAL BRANCH OFFICE, DEHRA DÚN.

*Narrative Report of MR. J. ECCLES, M.A., Superintendent, 2nd grade, in charge.
Computing Party, Season 1898-99.*

The experimental base line in the Survey Office compound was re-measured for the instruction of the newly appointed officers of the Imperial and Provincial Services, and a short base of 100 feet was laid down by two measurements for comparison of chains and wires.

The Solar Eclipse Report containing the results of observations at Sahdol, Pulgáon, and Dumráon was completed and issued.

Lieutenant A. Mears, I.S.C., having gone through his course of instruction in the methods of astronomical observations and computations of the Trigonometrical Branch and in levelling and plane-tabling, was transferred to No. 4 Party on the 29th October 1898. Lieutenants H. Wood, R.E., H. McC. Cowie, R.E., B. R. Daunt, I.S.C., C. P. Gunter, R.E., E. I. Rich, R.E., and A. A. Crookshank, R.E., on their appointment to the department, were posted to this office, and were put through a course of astronomical observations and triangulation, and taught the methods of computations used in the department. For a short time they were attached to the Training School to learn plane-tabling. Lieutenant Daunt was attached to the office of the Superintendent of Land Records Surveys, North-Western Provinces and Oudh, from 18th November 1898 to 22nd February 1899 for instruction in the work of the Revenue Branch. He rejoined this office on the 23rd February, but owing to failing health he proceeded on leave on medical certificate on the 15th May 1899. Lieutenants Wood and Cowie completed their course and were posted to field parties at the end of the year.

Captain H. A. D. Fraser, R.E., before proceeding to England to consult Professor Rücker regarding the Magnetic Survey of India, was posted to this office to receive instruction in the subject. Four officers from the department of the Quarter-Master General in India were temporarily attached to this office for instruction in exploration work, of whom two are still under instruction.

Six Sub-Assistant Superintendents were transferred from the Revenue Branch for instruction in topographical work and were attached to the Training School. Two of them had to proceed on medical leave owing to ill-health before they could complete their course; but the others with the seven newly appointed Probationary Sub-Assistant Superintendents received a regular course of professional instruction in the use of the plane-table, theodolite, and level, and were shown the processes in the various sections of the Trigonometrical Branch Office. They were also instructed in topographical drawing and in the computations of the Topographical Branch. All of these completed their course and were transferred to field parties at the end of the year.

In the training school, in addition to the above, a class of fifteen Probationary Sub-Surveyors were instructed in the use of the plane-table and theodolite, and all of them passed the final examination and were posted to field parties. Two Sub-Surveyors of No. 15 Party received special training in theodolite traversing, triangulation, and plane-tabling; they were also taught how to finish up their work.

The instruction given in the Training School consisted of plane-tabling on the 1-inch, 4-inch, and 36-inch scales, theodolite traversing both by chain and bar-subtense, levelling with the dumpy level, model surveying, star observations for time, latitude and azimuth, drawing of scales, graphical projection and hand-printing.

At the special request of the Military Secretary, His Excellency the Viceroy's stables were surveyed on the 36-inch scale.

The following changes took place in the *personnel* of the office during the year:— Mr. J. M. Kennedy, Extra Assistant Superintendent, who was posted to this office on the 24th November 1898, was transferred to the North-Western Provinces Drawing Office on the 15th September 1899. Munshi Golam Muhammad, draftsman, died. Babu Navin Chandra Gupta, copyist, resigned, and Babu Mukundananda Acherya was appointed as copyist in the computing section.

The cost of the computing section under its various class heads and the percentage thereof, together with those of the three preceding years, are given in the following statement:—

| CLASS. | COST IN RUPEES. | PERCENTAGE OF COST. | | | |
|--|--------------------|---------------------|----------|----------|----------|
| | | 1898-99. | 1898-99. | 1897-98. | 1896-97. |
| 1. Records, Library | 938 | 33 | 36 | 30 | 29 |
| 2. Accounts, Returns, Correspondence | 2,370 | 83 | 72 | 64 | 52 |
| 3. Supply of Data, etc. | 425 | 15 | 66 | 08 | 17 |
| Carried over | 3,733 | 131 | 174 | 102 | 98 |

| CLASS. | COST IN RUPEES. | PERCENTAGE OF COST. | | | |
|--------------------------------|-----------------|---------------------|---------|----------|----------|
| | 1898-99. | 1898-99. | 1897-8. | 1896-97. | 1895-96. |
| Brought forward | 3,733 | 13.1 | 17.4 | 10.2 | 9.8 |
| 4. Computations | 6,122 | 74.3 | 67.9 | 79.9 | 78.5 |
| 5. Preparation of Press copy | 5,653 | | | | |
| 6. Examination of Press proofs | 9,410 | | | | |
| 7. Ditto charts | 385 | | | | |
| 8. Protection of stations | 1,457 | | | | |
| 9. Miscellaneous | 1,192 | 1.4 | 1.5 | 1.9 | 2.0 |
| 10. Meteorology, etc. | 548 | 5.1 | 4.0 | 3.4 | 3.3 |
| 11. Extra-departmental work | ... | 4.2 | 5.0 | 3.2 | 4.4 |
| | ... | 1.9 | 4.2 | 1.4 | 1.1 |
| | ... | ... | ... | ... | ... |
| TOTAL | 28,500 | 100 | 100 | 100 | 100 |

From the above table, it will be seen, that the working power of this section has been distributed much in the same way as in the preceding years.

The following is an account of the work done under the several classes shown in the foregoing table:—

CLASS 1.—RECORDS, LIBRARY, ETC.—Four fresh instalments of field records were received during the year; these together with those already in the office have received the usual care and attention. The three standard copies of the library catalogue have been kept up to date.

CLASS 2.—ACCOUNTS, RETURNS, AND CORRESPONDENCE.—In this is included the preparation of indents, estimates, monthly detailed and abstract progress reports, annual reports, stock returns of office stores, and various other items.

CLASS 3.—SUPPLY OF DATA.—Thirteen requisitions for data and 68 indents for forms were received and complied with; in all about 42,000 copies of professional and other forms were issued during the year.

CLASS 4.—COMPUTATIONS.—The following are the details:—

Great Arc Meridional Series, Section 18° to 24°.—Certain secondary triangles were re-computed; this was necessitated by Narsula and Chittial stations being found to be identical.

North-east Longitudinal Series.—Preparation of name list and selection of points for computation being proceeded with.

Table of horizontal distances when the slope of the hill and the angle subtended by the bar are known.—Computed and prepared.

Spirit-levelled heights, section Vizagapatam to Raipur.—A portion was adjusted.

Heights in China obtained by Captain Wingate.—Barometric heights were computed.

Captain Deasy's explorations in Tibet, 1897-98 and 1898-99.—Reduction being proceeded with. The work includes the computations of astronomical azimuths, latitudes and time, geodetic latitudes, longitudes and azimuths, and triangles.

In addition to the above the computers were employed on the following:—

- (a) Computation of rectangular co-ordinates on the Secant, Conical, and Bonne's projections.
- (b) Deduction of telegraphic longitude of four stations in China.
- (c) Reduction of Lushai Triangulation for No. 14 Party.
- (d) Computation of places of circumpolar stars from William's College catalogue and Greenwich 10-year and 9-year catalogues.
- (e) Computation of azimuths at three stations observed by No. 23 Party.
- (f) Computation of stars' places for latitude observations of 1898-99 for No. 22 Party.
- (g) Reduction of observations to determine the value of the Bubble tester.
- (h) Re-computation of observations of the Dehra Dún Experimental Base Line.

CLASS 5.—PREPARATION OF PRESS COPY.—This requires the abstracting and entering in suitable tables of the final results of several calculations for publication, all these compilations are twice compared, once against the original field records and once against the final computations, prior to being sent to the press. The details of the work done are as follows:—

(a) *Great Arc Meridional Series, Section 8° to 16°.*—Revision of orthography and compilation of descriptions of stations of the appendix finished, and the preface written out.

(b) *Great Arc Meridional Series, Section 18° to 24°.*—Correction of certain secondary triangles and azimuth table on account of Narsula and Chittial stations being found to be identical, and revision of descriptions of principal stations being proceeded with.

(c) *Net-work Triangulation of Country round Dehra Dún for the Training School.*—Orthography of names of stations corrected for letter-press.

CLASS 6.—EXAMINATION OF PRESS PROOFS.—This requires the utmost care and attention in comparison and examination in several stages of first, second, and form proofs. Most of the matter printed is numerical, or depending on numerical data; hence it necessarily involves a strictly critical examination which can only be given by men specially trained to this style of work. The printing of the following has been proceeded with:—

- (a) The Solar Eclipse Report has been completed and issued.
- (b) Seventy-six pages of the Tidal volume have been printed, and the volume is almost completed.
- (c) Synoptical volumes of Great Arc Meridional Series, Section 8° to 18°, and Indus Delta Triangulation have been completed. These only want the charts, on the completion of which they will be put in the hands of the binder.
- (d) Five pages of Professional Papers No. 1, "On the projection for a Map of India and adjacent countries on the scale of 1 : 1,000,000," and 32 pages of No. 2, which is a translation of M. Jäderin's "Method of measuring Geodetic Bases by means of Metallic Wires," were printed.

In addition to the above, a large amount of work was done in printing the letter-press for charts, headings and foot-notes for maps, and about 45,000 copies of professional and other forms were printed. The total amount of work executed will be seen by reference to the tabular statement of the Printing Section.

CLASS 7.—EXAMINATION OF CHARTS.—The examination of the corrections of the four final charts of the Great Arc Meridional Series, Section 8° to 18°, has been finished, and that of the rays against the azimuth list is being proceeded with.

CLASS 8.—PROTECTION OF STATIONS.—The usual professional work in connection with the protection of survey stations in India and Burma, and certain of the benchmarks in the North-Western Provinces and Bengal was performed. During the year 535 stations have been repaired by the District Officers at a cost of ₹2,234-4-10. Two districts out of 347, from which reports are generally received, failed to submit them.

CLASS 9.—MISCELLANEOUS.—In this are included various duties which cannot be fairly assigned to any of the other classes such as the following:—

- (a) The examination and despatch of the printed papers to the Survey of India Office, Calcutta, for safe custody.
- (b) The examination of all bound volumes and pamphlets prior to issue, and the preparation of the distribution lists and presentation labels for the same.
- (c) The preparation of examination papers for the Provincial Service of the Survey of India Department, of which 32 sets were prepared, despatched, and examined, the results being tabulated and submitted to the Surveyor General.

CLASS 10.—METEOROLOGY AND GENERAL SCIENCE.—As hitherto, a complete set of meteorological observations were taken daily throughout the year, and monthly and annual abstracts prepared. Monthly magnetic observations were also taken regularly throughout the year, and the results are tabulated with those taken here previously. The meteorological and magnetic results are given in the following tabular statements:—

Mean monthly Readings of Earth Thermometers.

| Depth in feet of thermometer bulb below surface of ground. | Year. | October. | November. | December. | January. | February. | March. | April. | May. | June. | July. | August. | September. |
|--|-------------------------------|----------|-------------------------|-----------|----------|-----------|--------|--------|-------|-------|-------|---------|------------|
| | | 25'6 | 1898-99 78°30 | 77°86 | 77°58 | 77°00 | 76°28 | 75°36 | 74°62 | 74°31 | 74°33 | 75°21 | 76°12 |
| | Mean, 1881-98 76°83 | 76°88 | 76°70 | 76°14 | 75°61 | 75°00 | 74°43 | 74°13 | 74°08 | 74°41 | 75°67 | 76°69 | 76°69 |
| 12'8 | 1898-99 79°53 | 78°73 | 76°98 | 74°67 | 72°52 | 71°29 | 71°88 | 73°52 | 75°56 | 78°21 | 79°18 | 79°42 | 79°42 |
| | Mean, 1881-98 79°44 | 78°12 | 75°96 | 73°41 | 71°70 | 70°81 | 71°37 | 73°18 | 75°28 | 77°27 | 79°18 | 79°71 | 79°71 |
| 6'4 | 1898-99 79°35 | 78°85 | 71°34 | 66°62 | 65°26 | 67°44 | 72°67 | 78°19 | 82°06 | 81°69 | 82°37 | 82°34 | 82°34 |
| | Mean, 1881-98 79°75 | 75°91 | 71°31 | 67°36 | 65°66 | 67°12 | 71°59 | 76°89 | 80°32 | 81°38 | 81°46 | 81°18 | 81°18 |
| 3'2 | 1898-99 78°58 | 71°33 | 65°73 | 60°48 | 62°09 | 68°50 | 76°77 | 84°05 | 86°17 | 82°47 | 84°17 | 83°78 | 83°78 |
| | Mean, 1881-98 78°27 | 71°88 | 65°68 | 62°04 | 61°37 | 66°73 | 75°65 | 82°24 | 84°79 | 83°40 | 82°06 | 81°68 | 81°68 |
| 1'1 | 1898-99 77°22 | 66°50 | 59°80 | 54°92 | 60°54 | 70°11 | 78°90 | 88°34 | 88°56 | 82°87 | 85°13 | 83°14 | 83°14 |
| | Mean, 1881-98 76°31 | 67°81 | 60°21 | 57°51 | 58°72 | 67°63 | 78°88 | 86°17 | 87°88 | 84°18 | 82°29 | 81°57 | 81°57 |
| Thermometer in shade | 1898-99 80°59 | 72°52 | 64°64 | 62°09 | 68°69 | 82°39 | 86°21 | 93°69 | 88°96 | 81°11 | 84°31 | 86°14 | 86°14 |
| | Mean, 1881-98 80°59 | 73°38 | 67°63 | 64°39 | 66°86 | 78°59 | 89°95 | 93°82 | 90°46 | 82°51 | 80°61 | 82°45 | 82°45 |

Mean velocity in miles of the winds which blew at Dehra Dún, during the twelve months of 1898-99, for each hour of the day.

| Civil Hours. | October. | November. | December. | January. | February. | March. | April. | May. | June. | July. | August. | September. | Mean. |
|--------------|----------|-----------|-----------|----------|-----------|--------|--------|-------|-------|-------|---------|------------|-------|
| 0 to 1 | 1'10 | 2'08 | 1'39 | 1'11 | 1'36 | 1'90 | 1'97 | 1'41 | 1'25 | 0'72 | 1'07 | 2'37 | 1'48 |
| 1 " 2 | 1'00 | 1'62 | 1'07 | 1'26 | 1'61 | 1'83 | 1'17 | 1'24 | 1'71 | 0'62 | 0'97 | 1 83 | 1'33 |
| 2 " 3 | 0'90 | 1'31 | 1'00 | 0'74 | 1'04 | 1'20 | 1'03 | 0'79 | 1'57 | 0'86 | 0'77 | 1'37 | 1'05 |
| 3 " 4 | 0'80 | 1'08 | 0'68 | 0'48 | 1'61 | 1'43 | 1'34 | 1'00 | 1'25 | 1'00 | 0'70 | 1'27 | 1'05 |
| 4 " 5 | 0'80 | 0'73 | 0'93 | 0'63 | 1'46 | 1'20 | 1'31 | 0'83 | 0'96 | 0'90 | 0'60 | 1'23 | 0'96 |
| 5 " 6 | 0'53 | 0'62 | 0'79 | 0'67 | 1'00 | 1'20 | 0'83 | 0'93 | 0'61 | 0'72 | 0'60 | 1'00 | 0'79 |
| 6 " 7 | 0'37 | 0'54 | 0'93 | 0'48 | 0'89 | 1'10 | 1'31 | 0'52 | 0'89 | 0'79 | 0'57 | 0'90 | 0'77 |
| 7 " 8 | 0'27 | 0'54 | 0'61 | 0'78 | 0'79 | 0'90 | 0'97 | 0'79 | 1'00 | 0'93 | 0'60 | 0'47 | 0'78 |
| 8 " 9 | 0'23 | 0'38 | 0'96 | 0'56 | 1'04 | 0'97 | 2'10 | 1'33 | 1'21 | 1'21 | 1'37 | 0'57 | 0'99 |
| 9 " 10 | 0'47 | 0'73 | 1'00 | 0'89 | 1'68 | 1'40 | 1'80 | 2'04 | 1'67 | 1'62 | 1'73 | 0'90 | 1'33 |
| 10 " 11 | 1'13 | 1'27 | 1'34 | 1'56 | 2'00 | 1'87 | 2'47 | 2'39 | 2'37 | 2'47 | 1'97 | 1'40 | 1'85 |
| 11 " 12 | 1'65 | 1'92 | 1'97 | 1'78 | 2'36 | 2'33 | 3'27 | 2'57 | 2'48 | 2'40 | 2'10 | 1'87 | 2'22 |
| 12 " 13 | 1'50 | 1'77 | 1'83 | 2'39 | 2'61 | 3'17 | 4'33 | 2'78 | 2'59 | 1'94 | 2'29 | 1'77 | 2'41 |
| 13 " 14 | 1'67 | 2'15 | 2'00 | 2'21 | 3'11 | 3'52 | 4'27 | 3'25 | 3'00 | 2'48 | 2'61 | 2'27 | 2'71 |
| 14 " 15 | 1'87 | 2'42 | 1'79 | 1'93 | 3'25 | 3'35 | 4'37 | 3'43 | 3'00 | 2'74 | 2'48 | 2'33 | 2'74 |
| 15 " 16 | 1'60 | 1'62 | 1'28 | 2'11 | 4'04 | 3'27 | 4'21 | 3'86 | 3'50 | 2'42 | 2'03 | 1'23 | 2'59 |
| 16 " 17 | 0'67 | 0'92 | 0'69 | 2'04 | 3'29 | 2'90 | 3'90 | 3'90 | 3'36 | 2'07 | 2'10 | 0'47 | 2'19 |
| 17 " 18 | 0'20 | 0'38 | 0'55 | 0'80 | 1'68 | 1'77 | 2'59 | 2'83 | 2'64 | 1'76 | 1'53 | 0'07 | 1'41 |
| 18 " 19 | 0'60 | 1'00 | 0'50 | 0'39 | 0'71 | 0'83 | 2'24 | 1'34 | 1'25 | 1'48 | 1'00 | 0'50 | 0'99 |
| 19 " 20 | 1'03 | 1'85 | 0'50 | 0'46 | 1'39 | 0'97 | 1'48 | 1'34 | 0'96 | 0'79 | 0'93 | 1'37 | 1'09 |
| 20 " 21 | 1'17 | 2'35 | 0'96 | 0'93 | 1'43 | 1'57 | 2'24 | 1'17 | 1'50 | 0'62 | 0'57 | 1'90 | 1'37 |
| 21 " 22 | 1'37 | 2'54 | 1'18 | 1'29 | 1'68 | 1'97 | 2'34 | 1'79 | 1'25 | 0'69 | 0'93 | 2'17 | 1'60 |
| 22 " 23 | 1'40 | 2'46 | 0'93 | 1'39 | 1'43 | 1'73 | 2'97 | 1'76 | 1'00 | 0'52 | 0'77 | 2'23 | 1'55 |
| 23 " 24 | 1'47 | 2'08 | 0'81 | 1'18 | 1'57 | 1'63 | 2'14 | 1'31 | 1'07 | 0'69 | 1'30 | 2'10 | 1'45 |
| Sums | 23'80 | 34'36 | 25'69 | 28'15 | 43'03 | 44'01 | 56'65 | 44'60 | 42'09 | 32'44 | 31'59 | 33'59 | |
| Average | 0'99 | 1'43 | 1'07 | 1'17 | 1'79 | 1'83 | 2'36 | 1'86 | 1'35 | 1'35 | 1'32 | 1'40 | |

Monthly Meteorological Results of observations taken at the office of the Trigonometrical Branch, Survey of India, Dehra Dún.

| YEAR AND MONTH. | BAROMETER REDUCED TO 32° FAH. | | | | | | HYGROMETER. | | THERMOMETER. | | | | RAIN. | | WIND. | CLOUD. | |
|---------------------|-------------------------------|---------|---------------|-----------|---------|---------------|------------------------|------------------------|-------------------------|------------------------|----------------------|-----------------|----------------------|-----------------|--------------------------|------------|-----------|
| | AT 10 A.M. | | | AT 4 P.M. | | | 10 A.M. | 4 P.M. | DRY BULB. | | | WET BULB. | No. of days it fell. | Fall in inches. | Most frequent direction. | At 10 A.M. | At 4 P.M. |
| | Highest. | Lowest. | Monthly mean. | Highest. | Lowest. | Monthly mean. | Monthly mean humidity. | Monthly mean humidity. | Highest maximum in air. | Lowest minimum in air. | Monthly mean in air. | Lowest minimum. | | | | | |
| 1898. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | ° | ° | ° | ° | ° | ° | ... | ... | | | |
| October | 27'771 | 27'558 | 27'692 | 27'713 | 27'490 | 27'601 | 50 | 47 | 86'5 | 52'7 | 70'3 | 49'0 | ... | ... | Calm & S.E. | 0'2 | 1'7 |
| November | '875 | '587 | '770 | '776 | '509 | '676 | 48 | 43 | 79'8 | 46'8 | 60'9 | 43'0 | 3 | 1'01 | S.W. & Calm. | 0'5 | 0'6 |
| December | '872 | '669 | '785 | '793 | '589 | '696 | 62 | 58 | 77'5 | 42'1 | 54'7 | 39'2 | 7 | 3'26 | W. & Calm. | 4'9 | 6'0 |
| 1899. | | | | | | | | | | | | | | | | | |
| January | '857 | '658 | '783 | '821 | '588 | '700 | 59 | 43 | 71'6 | 35'1 | 51'1 | 33'3 | 4 | 0'50 | S. & W. | 3'3 | 4'9 |
| February | '870 | '546 | '701 | '808 | '490 | '618 | 55 | 41 | 75'6 | 38'9 | 58'1 | 35'8 | 3 | 2'52 | S. W. & W. | 3'2 | 3'8 |
| March | '849 | '516 | '677 | '748 | '392 | '579 | 37 | 26 | 93'6 | 47'2 | 69'4 | 41'3 | 3 | 0'09 | W. & S.W. | 2'2 | 2'7 |
| April | '681 | '498 | '597 | '559 | '398 | '490 | 29 | 21 | 97'0 | 54'7 | 75'3 | 49'1 | 6 | 0'70 | W.&S.W. | 2'5 | 3'6 |
| May | '688 | '299 | '485 | '517 | '206 | '382 | 43 | 34 | 103'8 | 66'3 | 83'5 | 55'7 | 8 | 2'25 | W. & E. | 1'8 | 2'7 |
| June | '471 | '289 | '394 | '362 | '219 | '303 | 58 | 52 | 104'6 | 64'6 | 81'7 | 56'1 | 15 | 14'20 | W. & N. | 5'4 | 4'6 |
| July | '587 | '237 | '373 | '492 | '191 | '308 | 85 | 83 | 88'0 | 68'4 | 77'4 | 66'4 | 30 | 31'88 | S. S. E. & W. | 7'2 | 8'0 |
| August | '549 | '335 | '437 | '441 | '278 | '363 | 76 | 72 | 91'5 | 69'1 | 78'6 | 63'7 | 14 | 7'19 | N.&N.W. | 4'4 | 5'1 |
| September | '674 | '448 | '571 | '612 | '354 | '483 | 59 | 53 | 90'9 | 62'5 | 77'2 | 56'6 | 3 | 1'10 | N. W. & Calm. | 1'0 | 1'3 |

Synopsis of the results of the monthly magnetic observations taken at the Trigonometrical Branch Office, Dehra Dún. The measures of Intensity are all expressed in C. G. S. units.

| YEAR AND MONTH. | MAGNETIC ELEMENTS. | | | | REMARKS. |
|---------------------|--------------------|-----------------------|------------|------------------|--|
| | Declination East. | Horizontal Intensity. | Dip North. | Total Intensity. | |
| 1869. | ° ' " | | ° ' " | | |
| January | ... | 0'33,643 | 41 32'2 | 0'44,946 | With unifilar magnetometer No. 16 and Dip Circle No. 43. |
| February | ... | '33,636 | 31'3 | '44,925 | |
| March | ... | '33,621 | 28'1 | '44,868 | |
| September | 3 5 10 | '33,466 | 35'4 | '44,746 | |
| November | 6 44 | '33,644 | 32'1 | '44,946 | |
| 1867. | | | | | |
| January | 2 49 39 | 0'33,659 | 42 40'2 | 0'45,778 | With unifilar magnetometer No. 19 and Dip Circle No. 43. |
| February | 48 42 | '33,730 | 42'1 | '45,898 | |
| April | 48 17 | '31,901* | 41'0 | '43,396* | |
| May | 50 4 | '33,667 | 46'5 | '45,866 | |
| June | 48 15 | '34,032 | 50'5 | '46,413 | |
| July | 48 42 | '33,646 | 38'8 | '45,743 | |
| August | 45 22* | '33,656 | 45'6 | '45,840 | |
| September | 48 10 | '33,695 | 45'2 | '45,888 | |
| October | 49 27 | '33,639 | 46'2 | '45,824 | |
| November | 50 33 | '33,627 | 44'4 | '45,786 | |
| December | 48 24 | '33,667 | 48'0 | '45,884 | |
| 1868. | | | | | |
| January | 2 50 45 | 0'33,757 | 42 48'0 | 0'46,007 | With unifilar magnetometer No. 19 and Dip Circle No. 43. |
| February | 50 1 | '33,605 | 48'2 | '45,802 | |
| March | 51 12 | '33,665 | 46'8 | '45,867 | |
| April | 50 32 | '33,660 | 52'9 | '45,936 | |
| May | 51 11 | '33,842 | 51'9 | '46,173 | |
| June | 51 14 | '33,544 | 48'3 | '45,721 | |
| July | 54 24 | '33,271 | 52'1 | '45,396 | |
| August | 48 24 | '33,714 | 48'5 | '45,955 | |
| September | 51 32 | '33,569 | 52'8 | '45,811 | |
| October | 49 30 | '33,589 | 52'9 | '45,839 | |
| November | 48 37 | '33,389 | 47'9 | '45,505 | |
| December | 51 14 | '33,673 | 51'6 | '45,938 | |
| 1869. | | | | | |
| January | 2 50 24 | 0'33,64* | 42 51'0 | 0'45,884 | With unifilar magnetometer No. 19 and Dip Circle No. 43. |
| February | 50 23 | '33,617 | 51'9 | '45,864 | |
| March | 50 28 | '33,700 | 52'1 | '45,981 | |
| April | 51 10 | '33,616 | 52'1 | '45,865 | |
| May | 48 41 | '33,801 | 54'7 | '46,150 | |
| June | 48 55 | '32,821 | 49'4 | '44,748 | |
| July | 50 14 | '33,742 | 52'6 | '46,044 | |
| August | 48 46 | '33,786 | 53'0 | '46,109 | |
| September | 47 51 | '33,566 | 53'5 | '45,815 | |

* Observations unsatisfactory.

TYPE-PRINTING SECTION.—As will be seen from the annexed statement the greater part of the work done consisted in setting up the large amount of headings, foot-notes, &c., required in the Drawing Section in connection with the publication of maps, and miscellaneous work :—

Statement of work done during 1898-99.

| SPECIFICATION OF PRINT. | No. of pages. | Total No. of pulls. | No. of copies of each page. | Value. |
|---|---------------|---------------------|-----------------------------|----------|
| | | | | <i>R</i> |
| Professional volume | 76 | 10,750 | 500 | 2,447 |
| Synoptical volumes | 47 | 6,390 | 350 | 1,230 |
| Letter-press for charts, map headings, foot-notes | 352 | 8,600 | ... | 4,017 |
| Pamphlet of Spirit-levelled heights | 24 | 1,390 | 350 | 622 |
| Forms | 194 | 96,710 | ... | 5,217 |
| Miscellaneous | 95 | 12,630 | ... | 1,039 |
| Eclipse Report | 25 | 2,330 | 200 | 265 |
| Professional Papers | 37 | 840 | 60 | 240 |
| Extra-departmental | 274 | 7,280 | ... | 114 |
| | 1,124* | 146,920 | | 15,191 |

* Equal to 1,332 pages of Standard (foolscap) size.

The usual table showing the work annually performed by this section during the past five years is given below, the unit (a page of foolscap) being the same throughout:—

| | 1894-95. | 1895-96. | 1896-97. | 1897-98. | 1898-99. |
|--------------------------|----------|----------|----------|----------|----------|
| Pages composed | 1,219 | 1,135 | 1,110 | 1,597 | 1,332 |

An analysis of the pages composed in 1898-99 is as follows:—

| | | |
|-------------------------------|--|-------|
| PROFESSIONAL VOLUME | Tidal volume | 152 |
| SYNOPTICAL VOLUMES | Great Arc Meridional Series, Section 8° to 18° | 94 |
| | and Indus Delta Triangulation | |
| | Letter-press for charts, map headings, foot-notes, | 295 |
| | Forms, Order's memoranda, &c | 378 |
| MISCELLANEOUS | Miscellaneous | 94 |
| | Extra-departmental | 208 |
| | Eclipse Report | 35 |
| | Professional Papers | 52 |
| | Pamphlet of Spirit-levelled heights | 24 |
| | TOTAL | 1,332 |

PHOTO. ZINCOGRAPHIC SECTION:—The usual routine of map publication was carried on. The work is well up to date.

The following tables exhibit the value and outturn of the work of this section:—

Abstract of departmental work done during the year 1898-99.

| SPECIFICATION. | Sheets or subjects. | Negatives and transparencies. | PHOTO.-ZINCOGRAPHIC PRINTING. | | | | | | SILVER AND OTHER PRINTING. | | Value. | |
|---|---------------------|-------------------------------|-------------------------------|--------------------------|----------------------|--------|-------------------|-------------|----------------------------|----------------|--------|------------------------|
| | | | Photo-transfer prints. | Zinc plates transferred. | Zinc plates printed. | Pulls. | Number of copies. | | | Silver prints. | | Blue and other prints. |
| | | | | | | | Coloured. | Uncoloured. | Total. | | | |
| Standard maps | 160 | 306 | 278 | 106 | 126 | 10,322 | 616 | 9,094 | 9,710 | 17 | 108 | 6,981 11 |
| Index maps | 11 | 5 | 12 | 8 | 29 | 3,690 | 1,185 | 105 | 1,290 | ... | ... | 269 5 |
| Technical charts | 79 | 137 | 138 | 74 | 74 | 3,324 | ... | 3,324 | 3,324 | ... | 2 | 2,531 11 |
| Miscellaneous maps, plans, etc. | 266 | 51 | 116 | 47 | 297 | 7,788 | 106 | 15,814 | 15,920 | 6 | 2 | 2,472 6 |
| Departmental forms | 7 | 7 | 19 | 6 | 7 | 1,896 | ... | 1,773 | 1,773 | ... | ... | 350 14 |
| Transfers and proofs | ... | ... | ... | ... | ... | 964 | ... | ... | ... | ... | ... | ... |
| TOTALS | 523 | 506 | 563 | 241 | 533 | 27,984 | 1,907 | 36,110 | 32,017 | 23 | 112 | 12,605 13 |

Statement of work done for other departments, &c., during the year 1898-99.

| DEPARTMENTS, ETC. | Sheets or subjects. | Negatives and transparencies. | PHOTO-ZINCOGRAPHIC PRINTING. | | | | | | SILVER AND OTHER PRINTING. | | Value. | |
|---------------------------------|---------------------|-------------------------------|------------------------------|--------------------------|----------------------|---------------|-------------------|---------------|----------------------------|----------------|------------|------------------------|
| | | | Photo-transfer prints. | Zinc plates transferred. | Zinc plates printed. | Pulls. | Number of copies. | | | Silver prints. | | Blue and other prints. |
| | | | | | | | Coloured. | Uncoloured. | Total. | | | |
| Forest Survey | 228 | 357 | 372 | 245 | 248 | 30,028 | 3,365 | 20,439 | 23,803 | ... | 104 | R s. 10,878 11 |
| Military Department | 6 | 6 | 2 | 2 | 3 | 107 | ... | 57 | 57 | ... | 50 | 19 2 |
| Other Departments, etc. | 7 | 9 | 9 | 7 | 7 | 274 | ... | 274 | 274 | ... | ... | 146 0 |
| TOTAL | 241 | 372 | 383 | 254 | 258 | 30,409 | 3,365 | 20,769 | 24,134 | ... | 154 | 11,043 13 |

Table showing the amount realized from other departments, &c., by book debit and cash sales during 1898-99.

| DEPARTMENTS, ETC. | By book debit. | | By cash sales. | | TOTAL. | |
|----------------------------------|----------------|----------|----------------|-----------|---------------|----------|
| | R. | a. | R. | a. | R. | a. |
| Forest Department | 536 | 11 | 240 | 12 | 777 | 7 |
| Forest Survey | 10,757 | 5 | 305 | 8 | 11,062 | 13 |
| Quarter Master General | 64 | 12 | 151 | 1 | 215 | 13 |
| Military Department | ... | ... | 99 | 2 | 99 | 2 |
| Other Departments | 858 | 13 | 585 | 15 | 1,444 | 12 |
| Private Individuals | ... | ... | 309 | 4 | 309 | 4 |
| TOTAL | 12,217 | 9 | 1,691 | 10 | 13,909 | 3 |

CORRESPONDENCE SECTION.—The work in this section has been carried on as usual.

STORES, WORKSHOPS, AND OBSERVATORIES SECTION.—A series of observations were taken with Zenith Sector No. 2 to determine the value of the screw of Bubble tester No. 2; and the instruments of the Base Line apparatus were examined and cleaned. In the Observatories, the usual time observations were taken, the chronometers rated and kept in order and other miscellaneous work done.

SOLAR PHOTOGRAPHIC SECTION.—The work of this section was conducted as usual. The results obtained with dry plates have been so successful as to lead to a large substitution of them for the old wet process, and in time it is expected that they will entirely supersede the wet plates.

The details of the work of this section are given below :—

Table showing the number and character of negatives.

| 1898-99. | NUMBER OF DAYS. | | | | NUMBER OF NEGATIVES. | | | | | | | | | | NUMBER OF WORKING DAYS WHEN PHENOMENA WERE | |
|-----------|----------------------------|-------------------|----------------------|--------|----------------------|-----|-------------|-----|-------------|-----|-------|-----|--------|-----|--|---------|
| | When negatives were taken. | Failures | | | Solar Phenomena. | | | | | | | | TOTAL. | | Visible. | Absent. |
| | | From bad weather. | From various causes. | Total. | Spots and lacuæ. | | Spots only. | | Facuæ only. | | None. | | 8" | 12" | | |
| | | | | | 8" | 12" | 8" | 12" | 8" | 12" | 8" | 12" | | | | |
| October | 31 | ... | ... | 31 | 52 | 4 | ... | ... | 4 | ... | ... | ... | 56 | 4 | 31 | ... |
| November | 29 | 1 | ... | 30 | 53 | 1 | ... | ... | ... | ... | ... | ... | 53 | 1 | 29 | ... |
| December | 24 | 7 | ... | 31 | 32 | 1 | ... | ... | 11 | ... | ... | ... | 43 | 1 | 24 | ... |
| January | 28 | 3 | ... | 31 | 47 | ... | ... | ... | 4 | ... | ... | ... | 51 | ... | 28 | ... |
| February | 26 | 2 | ... | 28 | 28 | ... | ... | ... | 19 | ... | ... | ... | 47 | ... | 26 | ... |
| March | 29 | 2 | ... | 31 | 43 | ... | ... | ... | 9 | ... | ... | ... | 59 | ... | 29 | ... |
| April | 29 | 1 | ... | 30 | 52 | 6 | ... | ... | ... | ... | ... | ... | 52 | 6 | 29 | ... |
| May | 29 | 2 | ... | 31 | 36 | ... | ... | ... | 16 | ... | ... | ... | 52 | ... | 29 | ... |
| June | 21 | 9 | ... | 30 | 32 | ... | ... | ... | 5 | ... | ... | ... | 37 | ... | 21 | ... |
| July | 19 | 12 | ... | 31 | 27 | ... | ... | ... | 5 | ... | ... | ... | 32 | ... | 19 | ... |
| August | 26 | 5 | ... | 31 | 3 | ... | ... | ... | 45 | ... | ... | ... | 48 | ... | 26 | ... |
| September | 30 | ... | ... | 30 | 23 | ... | ... | ... | 33 | ... | ... | ... | 56 | ... | 30 | ... |
| TOTAL | 321 | 44 | ... | 365 | 428 | 12 | ... | ... | 151 | ... | ... | ... | 579 | 12 | 321 | ... |

Five hundred and sixteen silver prints of the 8 inch pictures, and eleven of the 12-inch pictures were prepared, and weekly despatches of both silver prints and negatives made as usual to the India Office.

Table showing the visibility of Sun at Dehra Dún and Greenwich.

| YEAR. | AT DEHRA DÚN. | | | AT GREENWICH. | | REMARKS. | |
|----------|---|--|--|---------------|---|---|---|
| | Number of days on which negatives were taken. | Percentage of days on which negatives showed features. | Number of days on which sun was invisible. | Year. | Number of days on which negatives were taken. | | |
| 1880-81* | 307 | 96 | 55 | 1880 | 156 | * From 1st October to 30th September following. | |
| 1881-82 | 328 | 100 | 37 | 1881 | 181 | | |
| 1882-83 | 318 | 100 | 47 | 1882 | 221 | | |
| 1883-84 | 285 | 100 | 78 | 1883 | 215 | | |
| 1884-85 | 284 | 100 | 81 | 1884 | 154 | | |
| 1885-86 | 290 | 100 | 75 | 1885 | 206 | | |
| 1886-87 | 302 | 91 | 61 | 1886 | 199 | | |
| 1887-88 | 328 | 71 | 38 | 1887 | 168 | | |
| 1888-89 | 315 | 78 | 50 | 1887-88 | 205 | | |
| 1889-90 | 320 | 99 | 45 | 1888-89 | 182 | | |
| 1890-91 | 313 | 100 | 62 | 1889-90 | 212 | | |
| 1891-92 | 304 | 100 | 62 | 1890-91 | 224 | | |
| 1892-93 | 292 | 100 | 73 | 1891-92 | 219 | | |
| 1893-94 | 304 | 100 | 61 | 1892-93 | 220 | | |
| 1894-95 | 313 | 100 | 52 | 1893-94 | 230 | | |
| 1895-96 | 324 | 100 | 41 | 1894-95 | 199 | | |
| 1896-97 | 316 | 100 | 49 | 1895-96 | 229 | | |
| 1897-98 | 325 | 100 | 40 | 1896-97† | 222 | | |
| 1898-99 | 321 | 100 | 44 | 1897-98 | Not obtainable. | | |
| Mean | 309 | ... | 55 | ... | 203 | | † Year ending 10th May 1897, obtained from the report to the Board of Visitors. |

DRAWING SECTION.—The details of the work of this section are given below:—

Statement showing the work performed during 1898-99.

| TITLE OF MAP. | Number of Sheets. | Scale. | REMARKS. |
|--|-------------------|---------------|--|
| <i>Standard Maps.</i> | | | |
| Punjab Survey sheets Nos. 264 N. E., 264 S. E., 264 S. W., 308 N. W., and 336 N. W. | 20 | In. M. 1=½ | Corrections completed for reduction to half scale. Final press order given. |
| Punjab Survey sheets Nos. 247 N. E., 247 S. E., 306 N. W., 307 S. W., 313 N. W., and 313 S. W. | 24 | 1=½ | Corrections for reduction to half scale. In hand. |
| Sind Survey sheets Nos. 18, 19, 19A, and 37 (in one); 20, 33, 34, 35, 37A, 38, 48, 49, 57, 57A, 69, 77, 77A, 95, 95A, 88, 89, 106, and 107 | 88 | 1=1 | For re-duction to half scale. Completed headings and footnotes. Final press order given. |
| Sind Survey sheets Nos. 47 and 68 | 8 | 1=1 | For reduction to half scale. In hand. |
| Sind Survey sheets Nos. 19, 19 A, and 37 (in one); 20, 20A, 37A, 38, 57, 57A, 77, 77A, 95, and 95A. | 48 | 2=1 | For re-production. Completed headings and footnotes, for other Department. |
| Gujarát Survey sheet No. 17. | 4 | 1=1 | Touched up for photography. |
| <i>Plans of Cities and Cantonments.</i> | | | |
| Cantonment of His Excellency The Viceroy's Body Guard, Dehra Dún, 1898 | 1 | 30=1 | Completed. Final press order given. |
| <i>Index Maps.</i> | | | |
| Triangulation Chart of India | 1 | 1=96 | Corrected and brought up to date for Annual Report. |
| Index to the Map of India and adjacent countries | 1 | 1=128 | Compilation in hand. For reduction to half scale. |
| Index to illustrate survey operations by No. 18 Party in the Himálayas. | 1 | 1=20 | Corrected and brought up to date for Annual Report. |
| Index to illustrate survey operations by Nos. 12 and 15 Parties in Sind. | 1 | 1=50 | Ditto ditto. |
| Diagram of Group of Astronomical Latitudes and Azimuths round Kaliánpur H. S. | 1 | 1=16 | Prepared for Annual Report. |
| <i>Charts.</i> | | | |
| Triangulation Chart of Great Arc Series, Section 8° to 18° | 4 | 1=4 | In hand. |
| Nos. 43 and 44, Preliminary Charts of Indus Delta Coast Triangulation | 2 | 1=4 | Do. |
| Preliminary Chart of Assam Longitudinal Series, 1853-55 | 1 | 1=4 | Corrections completed. Final press order given. |
| Charts of Triangulation sheets Nos. 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 23, 24, 25, 26, 27, 28, 34, 35, 36, 37, 38, 39, 63, 64, 82, 83, and 84 (Central Provinces) | 29 | 1=2 | For reduction to half scale. Completed headings and footnotes. Final press order given. |
| Charts of Triangulation sheets Nos. 311 (2nd edition) and 332 (Punjab) | 2 | 1=2 | Ditto ditto. |
| Charts of Triangulation and Traverse sheets Nos. 15, 32, 33, 34, 37, 37A., 38, 49, 50, 57A., 66, 67, 68, 69, 70, 77, 77A., 86, 87, 90, 91, 95, 95A., 105, 106, 107, 108, and 109. (Sind) | 28 | 1=2 | Ditto ditto. |
| Chart of Triangulation sheet No. 16 (Sind) | 1 | 1=2 | Ditto ditto. |
| Chart of Traverse sheets Nos. 19, 20, 47, 48, 57, 88, and 89 (Sind) | 7 | 1=2 | Ditto ditto. |
| Level Charts Nos. 67 and 74 | 2 | 1=2 | Compilation in hand. |
| Triangulation Chart of Dehra Dún Survey | 1 | 1=½ | In hand. |

Statement showing the work performed during 1898-99—concl'd.

| TITLE OF MAP. | Number of Sheets. | Scale. | REMARKS. |
|---|-------------------|---------------|--|
| <i>Miscellaneous.</i> | | | |
| Tidal Maps of Coconada, Chittagong, Akyab, Elephant Point, Moulmein and Mergui. | 6 | Various | Completed. Final press order given. |
| Tidal Maps of Bhávnagar, Bombay, Mormugáo, Vizagapatam, and Kidderpore. | 5 | Various | In hand. |
| Tidal Curves of Aden, Karáchi, Okha Point, Port Albert Victor, Bhávnagar, Bombay (Apollo Bandar), Bombay (Prince's Dock), Kárwár, False Point, Dublat, Diamond Harbour, Chittagong, Akyab, Rangoon, Amherst, Moulmein, Mergui, and Port Blair | 18 | Various | Completed. Final press order given. |
| Tidal Curves of Mormugáo, Beypore, Cochin, Tuticorin, Minicoy, Galle, Colombo, Trincomalee, Pámbau Pass, Negapatam, Madras, Coconada, Vizagapatam, Kidderpore, Elephant Point, and Hanstal Point | 16 | Various | In hand. |
| Special Survey of the Mahásu Range, Simla Extension | 2 | In. M. 6=1 | Touched up for photography. Final press order given. |
| Other Maps | 9 | Various | Touched up for photography and completed as regards headings and footnotes. Final press order given. |
| Maps coloured | 1,812 | Various | |

MAPS EXAMINED.

| | |
|---|------------|
| Standard original maps | 165 |
| Charts | 68 |
| Miscellaneous maps | 35 |
| Photographic proofs of Standard sheets and other maps | 280 |
| TOTAL | 548 |

N.B.—In addition to the above other miscellaneous duties have been performed, such as correcting and completing the Standard sheets and Triangulation Charts of the Central Provinces, Punjab, and Sind Surveys in respect of headings, footnotes, symbols, etc., for press; taking out and checking areas of villages with their cultivation in the Punjab Survey sheets and incorporating the Indus Riverain Survey on the Sind Survey sheets; examination of and custody of records, making all the despatches of maps, etc., etc., etc.

Statement of work done for other departments during 1898-99.

| TITLE OF MAP. | Number of Sheets. | Scale. | REMARKS. |
|--------------------------|-------------------|---------------|---|
| <i>Standard Maps.</i> | | | |
| Forest Surveys | 169 | In. M. 4=1 | Completed headings, footnotes, and references. Final press order given for Forest Department. |
| <i>Index Maps.</i> | | | |
| Forest Surveys | 5 | Various | Ditto ditto. |
| <i>Miscellaneous.</i> | | | |
| Forest Surveys | 29 | Various | Ditto ditto. |

FOREST SURVEY BRANCH OFFICE, DEHRA DÚN.

Statement showing the progress made in map drawing during the year.

| NAME. | Province. | NO. OF SHEETS | | | REMARKS. |
|---|--|----------------------------|---------------|----------------------------------|---|
| | | Published during the year. | In the Press. | In different stages of progress. | |
| Special maps on various scales, chiefly for Forest Working-plans purposes . . . | North-Western Provinces and Oudh . . . | 3 | ... | ... | |
| | Central Provinces . . . | ... | ... | I | |
| | Berar | I | ... | I | |
| | Coorg | I | ... | ... | |
| Other special maps on various scales for use of Forest Department . . . | North-Western Provinces and Oudh . . . | ... | I | ... | |
| | Bengal | ... | I | ... | |
| | Assam | ... | I | ... | |
| | Punjab | 7 | ... | 4 | |
| | Central Provinces . . . | ... | I | I | |
| | Berar | 6 | 17 | ... | |
| | Ajmer-Merwára . . . | I | ... | ... | |
| | Coorg | ... | I | ... | |
| | Balúchistán | I | ... | ... | |
| | Andamans | I | ... | ... | |
| | Burma | I | ... | ... | |
| | Madras | ... | I | ... | |
| | India | I | 9 | ... | |
| | Miscellaneous | 11 | ... | ... | |
| 4-inch standard sheets of Forest tracts surveyed by the Forest Surveys, Bengal Presidency . . . | North-Western Provinces and Oudh . . . | 27 | ... | 46 | |
| | Punjab | 9 | 2 | 29 | |
| | Central Provinces . . . | 129 | 45 | 163 | |
| | Burma | 17 | 36(a) | 34(b) | (a) Includes 35 sheets of No. 20 Party. (b) 3 on 2-inch. |
| 1-inch standard sheets of Forest tracts surveyed by the Forest Surveys, Bengal Presidency . . . | Punjab | ... | ... | 7 | |
| TOTAL . . . | | 216 | 115 | 286 | |

1900.

GOVERNMENT OF INDIA.
DEPARTMENT OF REVENUE AND AGRICULTURE.

File No. 96 of
1900.

Serial No. 2.

LAND-SURVEYS.

RESOLUTION.

No 1—96-2.

Dated Simla, the 10th July 1900.

SUBJECT.

Reviews the General Report on the operations of the Survey of India Department for the year 1898-1899.

Extracts from the Proceedings of the Government of India, Department of Revenue and Agriculture, No. 1—96-2, dated Simla, the 10th July 1900.

READ—

The General Report on the operations of the Survey of India Department during the year 1898-99.

RESOLUTION.

During the year ending the 30th September 1899, the field operations of the Survey of India Department were carried on by two double and seventeen ordinary parties.

The various classes of work on which these parties were engaged are shown below :—

| | | | | No. of parties employ- ed. | No. of detachments employed. |
|-----------------|-----|-----|-----|-------------------------------|---------------------------------|
| Trigonometrical | ... | ... | ... | 1 | |
| Topographical | ... | ... | ... | 8 | |
| Forests | ... | ... | ... | 3 (1 double). | |
| Cadastral | ... | ... | ... | 2 | |
| Traverse | ... | ... | ... | 2 (1 double). | 1 |
| Scientific | ... | ... | ... | 3 | |
| TOTAL | | | ... | 19 | 1 |

2. The total area surveyed on all scales during the year was 95,934 square miles against 36,199 square miles in 1897-98. The increase is due to the large amount of reconnaissance executed in Yunnan and along the Burma-China boundary.

3. Trigonometrical operations were, as in the previous year, carried on by one party only. As conditions in Makrán were still unfavourable, the opportunity was taken to complete the Manipur Longitudinal Series and to link up the Burma Triangulation with the other Principal Triangulation in India. The angles at some of the stations of season 1894-95 were reobserved, and the results proved that no displacement in that part of Assam had been caused by the great earthquake of 1897.

4. Eight parties as against seven in the previous year were employed on topographical surveys in the Shan States, Upper and Lower Burma, Sindh, the Lushai Hills and the Himalayas. The following are the most noticeable items of work—the beginning of a large scale survey of the station of Maymyo, the complete survey of the town and cantonment of Nahan at the expense of the State,

surveys connected with military requirements in the Rawalpindi District and in Kashmir, and a special survey of the coal bearing area on the Sor Range near Quetta. The area topographically surveyed amounted to 18,280 square miles against 15,109 square miles in the previous year.

5. Forest surveys were continued by Imperial Survey parties in Madras, Bombay, Burma and part of the Himalayas and by the Forest Survey Branch in the Central Provinces, Punjab and Burma. In Madras the amalgamation and reorganization of two parties under a single Imperial Officer resulted in a large increase of outturn, 1,350 square miles being surveyed on the 4-inch scale. A total area of 738 square miles was surveyed in Bombay on three different scales. In Lower Burma No. 20 Party carried on operations in the Pegu, Shwegyin, Thayetmyo and Rangoon Forest divisions in the face of considerable difficulties, due to the wild and inhospitable nature of the country. An area of 559 square miles was surveyed, while 1,200 square miles of triangulation and 186 square miles of traversing were completed. The outturn of work for the past two years executed by the Imperial Parties and the Forest Survey Branch is given below:—

| | | | | |
|----------------------|-----|-----|----------|----------|
| | | | 1897-98. | 1898-99. |
| Imperial Parties | ... | ... | 2,397 | 2,960 |
| Forest Survey Branch | ... | ... | 1,737 | 2,257 |
| | | | <hr/> | <hr/> |
| Total | ... | ... | 4,134 | 5,217 |
| | | | <hr/> | <hr/> |

The cost rate in Madras was greatly reduced, being Rs. 74 per square mile, and was the lowest since work was begun in that Presidency. In Bombay also the cost rates were satisfactory, and the same may be said of rates in Burma, those for detail survey and triangulation being the lowest hitherto recorded by No. 20 Party.

6. Cadastral operations were carried on by one party in Burma, one in Bengal and one in the North-Western Provinces, the two latter being under the control of Local Governments. The Burma party completed an area of 711 square miles in the Toungoo District and 109 square miles in the Myingyan District. In Bengal 607 square miles were completed in Saran and 684 square miles in Darbhanga, while large areas were traversed in Saran, Darbhanga, Champaran and the Sonthal Parganas. In addition the towns of Darbhanga and Chapra were traversed and surveyed, and some minor miscellaneous work, topographical and traverse, was carried out in the Districts of Champaran and Shahabad, and in the Kachnar and Banskati *mahals* and on the Nepal Frontier in connection with the rectification of boundaries. In the North-Western Provinces the cadastral survey of the Districts of Bareilly and Kheri and of the hill parganas of Naini Tal was completed. The total area surveyed in the different provinces amounted to 5,554 square miles against 6,976 in the preceding year, the figures for the three provinces being as follows:—

| | | | | |
|----------------------------------|-----|-----|----------|----------|
| | | | 1897-98. | 1898-99. |
| Bengal | ... | ... | 1,300 | 1,420 |
| Burma | ... | ... | 2,236 | 820 |
| North-Western Provinces and Oudh | ... | ... | 3,440 | 3,314 |
| | | | <hr/> | <hr/> |
| | | | 6,976 | 5,554 |
| | | | <hr/> | <hr/> |

The decrease in the total as compared with the previous year is due to a reduction of the annual outturn in Burma to about 800 square miles with a view to preventing the survey getting too far ahead of the revenue settlement operations.

7. Traverse operations were executed by one double party in the North-Western Provinces and Oudh, one single party in Assam and a detachment in the Central Provinces. The total area traversed in the three Provinces during the year was 5,354 square miles, an increase of 226 square miles on the outturn of 1897-98.

8. Latitude observations were continued by the two astronomical parties with results that promise in the case of No. 22 Party, which worked on the East Coast, to be of considerable interest in connection with oceanic attraction and the deviation of the plumb line.

9. Tidal observations with self-registering tide-gauges were continued at 13 stations in India, Burma, the Andaman Islands, the Persian Gulf and the Red Sea, while a series of personal tidal observations to graduated staves was continued at 6 stations with the object of comparing the actual times and heights of high and low water with those predicted in the tide tables. The observations at Diamond Island were completed. The further investigation of meteorological conditions prevailing in the Persian Gulf conclusively proved that wind produces a considerable effect on tides in the Gulf. Spirit levelling operations were continued from Katni to Allahabad and from Katni to Kethora and from thence to the two ends of the Sironj Base line, giving a total outturn of 378½ miles of double levelling.

10. In Kashmir and Gilgit 2,043 square miles were geographically surveyed, while geographical reconnaissance on the ¼ inch scale was carried out over no less than 65,000 square miles on the frontiers.

11. In the various head-quarters offices the progress of work has been satisfactory. The Drawing Office was occupied with completing and keeping up to date the maps of the North-Eastern and South-Eastern Frontiers. The 3rd edition of the 32-mile map of India has been published, and a new Railway map of India on the same scale is in course of publication. Eighteen sheets of the Town of Calcutta on the scale of 1"=50 feet were revised and tested by a Provincial Officer during the year under a scheme sanctioned by the Government of Bengal. A series of maps was also prepared to illustrate Mr. Grierson's work in connection with the Linguistic Survey of India, and 4,609 cadastral sheets were published during the year.

12. The Engraving Office made steady progress in the publication of the quarter sheets of the Atlas of India. Additions and corrections were made to the 16-mile provincial maps of Madras, Bombay, Bengal, Central Provinces, Central India, Rajputana and Gujrat. Thirteen district maps for administration reports have been completed and published, while others together with Index maps, charts, imprint and note plates were in hand for correction. The process of correction of copper plates by cutting out the face and refilling by electro-deposited copper, which was first devised in the Engraving Office, has apparently given excellent results.

13. A large increase in the amount of work sent in by other Departments and Government officials was successfully dealt with in the Photographic and Lithographic Office. The number of original subjects disposed of during the year was 6,873 as against 6,364 in 1897-98. The printed outturn, excluding type work, amounted to 965,453 against 695,812 in the previous year. This increase was due to the fact that the outturn consisted of Burma and Assam sheets, of which more copies were required than of the North-Western Provinces sheets which formed the bulk of last year's outturn. The total value of the work done was Rs. 2,17,622, an increase of Rs. 24,696 over the value of the outturn of 1897-98.

14. The total number of maps issued from the Map Record and Issue Office amounted to Rs. 1,94,848 and their value Rs. 2,15,195, an increase on the figures of the previous year of 38,325 and Rs. 97,253 respectively.

15. In the Mathematical Instrument Office, the total number of instruments issued was 72,514 and their value Rs. 2,59,435 against 59,100 and Rs. 2,83,857 for 1897-98. There was a slight increase in the value, though a decrease in the number, of instruments taken from the repairable stock and rendered serviceable. The conversion of old pattern levels and theodolites was steadily continued. There was, however, a slight increase in the value of instruments indented for from England, owing to the necessity for replenishing the stock of more expensive instruments, the figures for 1898-99 being £5,174 and for 1897-98 £4,823.

16. In the Trigonometrical Branch Office at Dehra, a good deal of heavy computation work was carried out, and the usual meteorological and solar photographic observations were continued. In the latter work the substitution of dry for wet plates promises success. The Training School continued to do

good work. Seven officers of the Imperial Service, 13 of the Provincial Service, and 15 sub-surveyors passed through appropriate courses.

17. The administration of the Department continued during the year under Major-General C. Strahan, R.E. He retired at the close of the survey year on the 30th of September 1899, the value of his services being acknowledged at the time by the Government of India. An interesting retrospect of the progress of the Department during his tenure of the office of Surveyor-General was drawn up by him and is printed on pages 13—16 of the report. The administration of the Department during the closing year of his service and the work of the officers under him was maintained at the same high standard of efficiency which it has been the pleasure of the Government of India to acknowledge in previous years.

ORDER.—Ordered that the above Resolution be forwarded to the Surveyor-

Madras
Bombay.
Bengal.
North-Western Provinces and
Oudh.
Panjab.

Burma.
Central Provinces.
Assam.
Coorg.
Bear.

General of India, the Inspector-General of Forests, the Local Governments and Administrations noted on the margin, and to the Foreign, Military and

Public Works Departments.

Ordered, also, that the Resolution be published in the Supplement to the *Gazette of India*.

[True Extract.]

T. W. HOLDERNESS,

Secretary to the Government of India.