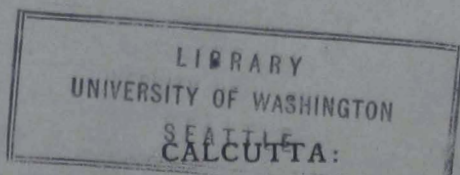


GENERAL REPORT
ON THE
OPERATIONS
OF THE
Survey of India

ADMINISTERED UNDER
THE GOVERNMENT OF INDIA
DURING
1902-1903.

PREPARED UNDER THE DIRECTION OF
COLONEL ST. G. C. GORE, C.S.I., R.E.
SURVEYOR-GENERAL OF INDIA.



OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.

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THE MIL-I-KĀSAMĀBĀD, SEISTAN.

From a negative by M^r G. P. Tate.

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SURVEY OF INDIA
1902-1903.

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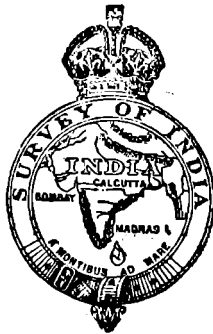
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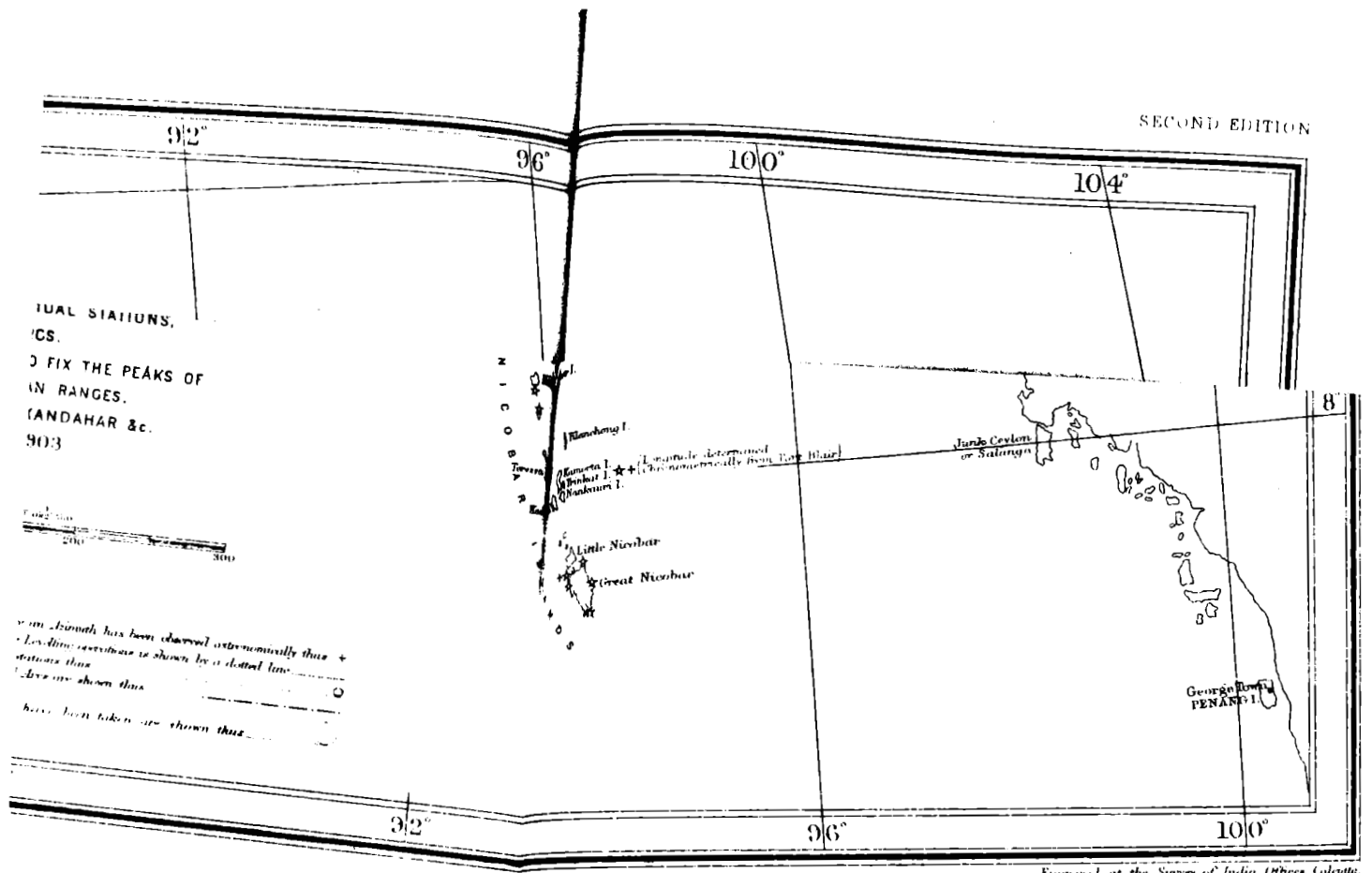
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Engraved at the Survey of India (Where Calcutta) Under the superintendence of J. Edmond, Captain & Major in the Army

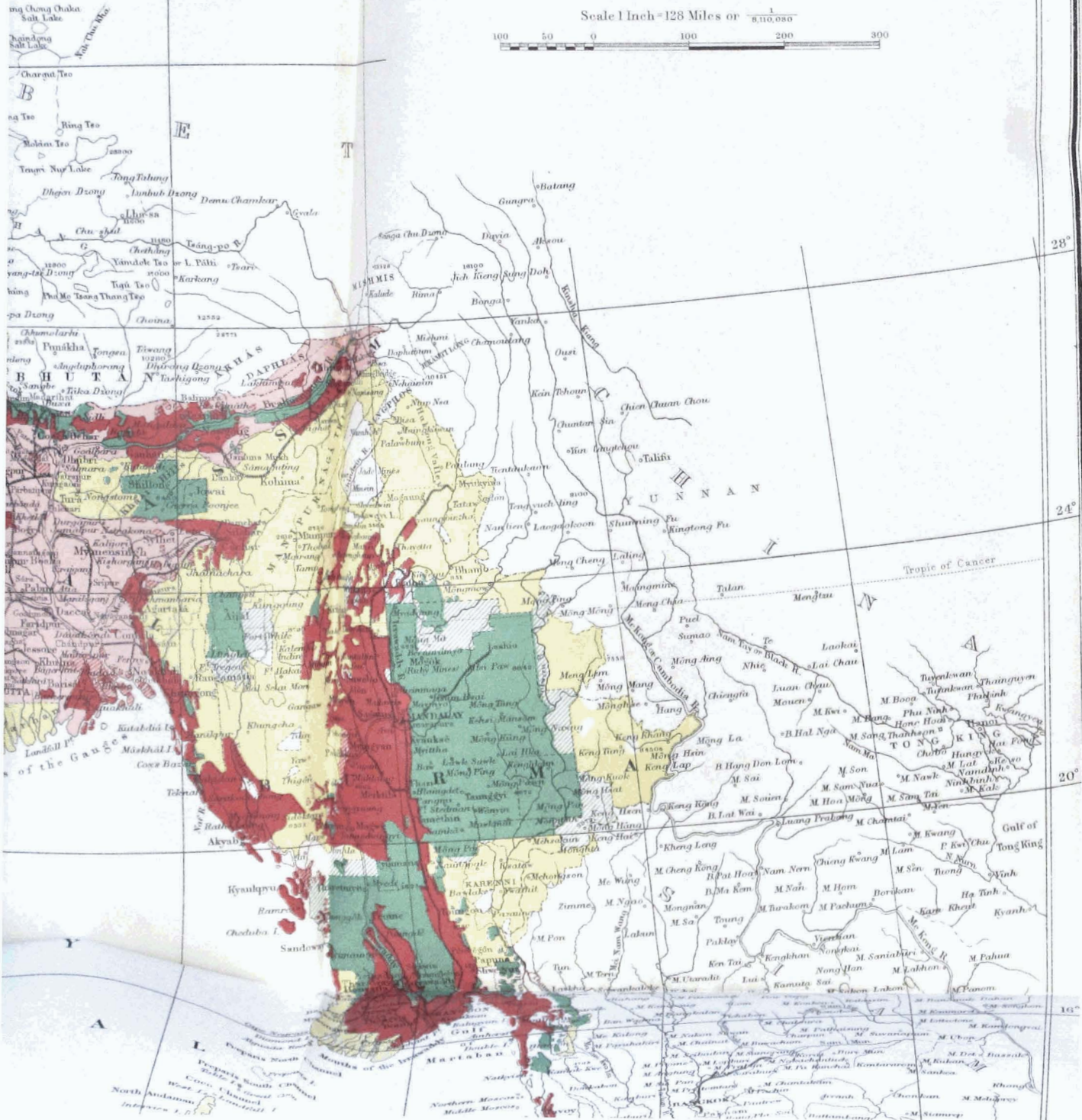
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INDIA

SHEWING THE PROGRESS OF THE IMPERIAL SURVEYS

To 1st October 1903.

Scale 1 Inch = 128 Miles or $\frac{1}{8,110,080}$



GENERAL REPORT
ON THE
Operations of the Survey of India
DURING THE SURVEY YEAR
1902-1903.

PART I.
SUMMARY.

ADMINISTRATION.

The operations of the department that are now reported on are for the survey year ending 30th September 1903.

2. Colonel St. G. C. Gore, C.S.I., R.E., Surveyor-General, directed the administration of the department and also superintended the Topographical Branch throughout the year.

The office of the Deputy Surveyor-General in charge of the Revenue Branch was held by Lieutenant-Colonel F. B. Longe, R.E., up to 6th October, when Colonel J. R. Hobday, I.A., returned from furlough and resumed charge of the office.

Mr. J. Eccles, M.A., officiated as Superintendent, Trigonometrical Surveys, throughout the year.

The office of the Superintendent, Provincial Surveys, Bengal, was held by Major R. T. Crichton, I.A., up to 6th August when he proceeded on three months' privilege leave and Lieutenant F. C. Hirst, I.A., held charge of the office up to the close of the year. Captain W. M. Coldstream, R.E., continued as Superintendent, Provincial Surveys, United Provinces, throughout the year.

Major P. J. Gordon, I.A., was in charge of Forest Surveys during the year. A draft resolution on the extension to Madras and Bombay of the rules for adjustment of expenditure on Forest Surveys applicable to the Bengal Presidency, and the amalgamation of the Forest Survey Branch with the Survey of India, has been issued by the Government of India and the revised rules contained therein will apply to the Forest Survey Head-Quarters and to all Forest Surveys in Provinces under the Inspector General of Forests from the 1st of April 1904 by which time it is hoped that the Governments of Madras and Bombay will agree to their being also applied to Forest Surveys in these Presidencies, thereby completing the scheme for the formation of a Forest Survey Branch under the Surveyor-General which has been under consideration for some time.

Inspection tours of Administrative Officers.

3. The Surveyor-General left Calcutta on the 7th April for Simla, but on his way he inspected No. 14 Party at Allahabad and the offices of the Superintendent, Trigonometrical Surveys, and Superintendent, Forest Surveys, at Dehra Dún, and that of No. 15 Party and the North-West Frontier drawing office at Mussooree, arriving at Simla on the 1st May. During his stay at Simla he inspected

the recess office of No. 18 Party on several occasions. He left Simla on the 24th July, and arrived at Roorkee the following day where he visited the Engineering College with a view to examine the capabilities of its map-reproducing establishment. He arrived at Dehra Dún on the 26th and again inspected the offices of the Superintendent, Trigonometrical Surveys, and Superintendent, Forest Surveys. On the 1st August he proceeded to Mussooree, and again inspecting the office of No. 15 Party and the North-West Frontier drawing office and other offices, returned to Calcutta on the 11th August. On the 1st September he again left Calcutta and proceeded to Bangalore where he inspected the recess offices of Nos. 3, 9 and 19, 10, 11 and 21 Parties, Godávari detachment, and the Bangalore drawing office; on the 16th he proceeded to Poona where he inspected No. 17 Party. He left Poona on the 20th for Simla to attend the committee appointed to report on the reorganization of the Survey of India with a view to arrange for bringing the topographical maps of India up to date, and form establishments for their periodic revision. On the 10th October he left Simla, and again visiting the Dehra Dún offices, arrived at Calcutta on the 17th October.

All the parties were inspected either by the Surveyor-General, or other administrative officers, during the year.

4. Colonel Hobday, I.A., Deputy Surveyor-General, inspected No. 2 and 8 Parties at Naini Tal in October 1902, and again in July 1903, when he was present at a meeting of the Board of Revenue to discuss future survey requirements. In November and December 1902, he inspected the following survey parties in the field; No. 14 Party at Allahabad, No. 18 Party at Mooltan, and the Central Provinces detachment at Garha near Jubbulpore. At the same time he visited Sámbar to confer with Mr. Dane, the Salt Commissioner, and Dr. Noetling of the Geological Survey, and advise as to the conduct of a special survey required of the Sámbar lake. He inspected No. 14 Party again in February and April; also the Central Provinces detachment at Jubbulpore. In May he proceeded to Rajahmundry to inspect the work of the Godávari survey detachment in the field, and in June he visited Simla to inspect No. 18 Party (Punjab). In July he inspected the Bengal survey camps at Dinapore and Dígha, and the Bengal drawing office at Calcutta on several occasions throughout the year. In September he accompanied the Surveyor-General to Bangalore where he inspected No. 3 Party (Burma) and the Godávari detachment. In September he proceeded to Shillong to inspect the Assam detachment and confer with the Local Government as to the future survey needs of the Province.

5. Mr. Eccles, Officiating Superintendent, Trigonometrical Surveys, visited Mussooree in June 1903 and inspected Nos. 22, 23, 24 and 26 Parties and the detachment of No. 25 Party. He also inspected No. 25 Party (Tidal and Levelling) and the Survey Training School, during the year from time to time.

6. Major Gordon inspected the detachments of Forest Surveys working in the Punjab, Bengal, Burma, and Assam, and No. 20 Party in the field in Burma, and again during recess at Dehra Dún. He also inspected Nos. 9 and 19 Parties at Bangalore and No. 17 Party at Poona.

FIELD PARTIES.

7. Field operations were carried on by three double and fifteen ordinary parties and two detachments; of these one was employed on trigonometrical, one double and six ordinary parties, and one detachment on topographical surveys, one double and two ordinary parties, and detachments on forest surveys, one double and two ordinary parties and one detachment on cadastral and traverse surveys and four parties on scientific operations.

8. The operations of the Forest Survey Branch, which are under the administration of the Superintendent Forest Surveys, are fully reported on in the Forest Survey Report and are therefore only briefly mentioned here.

The surveys carried on by local agency in the United Provinces of Agra and Oudh, which are under the general supervision of the Deputy Surveyor-General, have also been included in this report under the head of Cadastral Surveys.

9. In the following statement the whole of the operations are grouped according to the nature of the work on which the parties are 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. |
|---------------|--|----------------------|--|--------------------------|--------------------------------|
| | <i>Trigonometrical.</i> | | | Inch. Mile. | |
| 24 | Indian Triangulation . . . | 25 | Captain H. Wood, R.E. . . . | | Supdt., Trig. |
| | <i>Topographical.</i> | | | | |
| 3 | Lower Burma | 26 | Mr. E. F. Litchfield " P. J. Doran | 1 = 1 | D. S. G., Rev. |
| 10 | Upper Burma | 27 | Captain F. W. Pirrie, I.A. Lieutenant A. A. McHarg, R.E. | 1 = 1 | D. S. G., Topo. |
| 11 & 21 | Ditto | 29 | Captain C. H. D. Ryder, R.E. Mr. P. J. Doran | 1 = 1 | Ditto. |
| 12 | Sind | 30 | Mr. C. F. Erskine Lieutenant E. T. Rich, R.E. | 2 = 1 | Supdt., Trig. |
| 14 | United Provinces | 31 | Captain C. W. H. Symonds, I.A. | 2 = 1 | D. S. G., Rev. |
| 15 | North-West Frontier | 33 | Captain G. A. Beazeley, R.E. Mr. E. A. Wainright | Various | D. S. G., Topo. |
| 18 | Punjab | 34 | Major W. J. Bythell, R.E. Captain E. A. Tandy, R.E. Mr. W. Robert | Do. | D. S. G., Rev. |
| | Central Provinces | 37 | Mr. R. C. D. Ewing | 2 = 1 | Ditto. |
| | <i>Forest.</i> | | | | |
| 9 & 10 | Madras Presidency | 39 | Captain C. L. Robertson, R.E. Mr. H. Todd " G. T. Hall | 4 = 1 | } Supdt., Forest Surveys. |
| 17 | Bombay ditto | 41 | Mr. B. G. Gilbert-Cooper " S. F. Norman | 4 = 1 8 = 1 16 = 1 | |
| 20 | Burma | 42 | Captain A. H. B. Hume, R.E. " A. Mears, I.A. | 4 = 1 | |
| | Bengal | 44 | Major P. J. Gordon, I.A. | 4 = 1 | |
| | Assam | | | | |
| | Punjab | | | | |
| | North-West Frontier Jubbal and Tarchoch United Provinces Central Provinces Burma | | | | |
| | <i>Cadastral and Traverse.</i> | | | | |
| 2 & 8 | United Provinces | 47 | Captain W. M. Coldstream, R.E. | 16 = 1 | D. S. G., Rev. |
| 4 | Bengal | 50 | Major R. T. Crichton, I.A. Lieutenant F. C. Hirst, I.A. | 16 = 1 | Ditto. |
| 7 | Burma | 53 | Major G. B. Hodgson, I.A. Lieutenant C. P. Gunter, R.E. Mr. J. S. Swiney | 16 = 1 | Ditto. |
| | Godávari | 56 | Babu Nilmoni Chatterjee Mr. S. F. Norman (Jr.) | 16 = 1 | Ditto. |
| | Assam | 58 | Mr. T. Shaw | | Ditto. |
| | <i>Geodetic.</i> | | | | |
| 22 23 | } India | 60 | Lieutenant H. M. Cowie, R.E. | | Supdt., Trig. |
| | <i>Tidal and Levelling.</i> | | | | |
| 25 | India | 61 | Captain H. H. Turner, R.E. Lieutenant F. B. Tillard, R.E. Mr. E. J. Connor | | Ditto. |
| | <i>Magnetic.</i> | | | | |
| 26 | India | 62 | Captain H. A. D. Fraser, R.E. | | Ditto. |

OUTTURN.

10. The total outturn of detail survey during the year amounts to 70,797 square miles, which includes 38,000 square miles of reconnaissance surveys on $\frac{1}{8}$ -inch scale. The area surveyed during the previous year amounted to 104,794 square miles which included a reconnaissance surveys of 68,162 square miles. In the returns for the present year, however, the reconnaissance surveys done by the surveyors attached to the different expeditions and missions have not been taken credit for. The total area triangulated is 15,223 square miles, which is about the same as last year excluding the area done in connection with the reconnaissance surveys. The total area traversed for cadastral purpose is 10,067 square miles, *viz.*, 2,253 square miles in the United Provinces of Agra and Oudh, 6,884 square miles in Bengal, 799 square miles in Burma and 131 square miles in Madras,

TRIGONOMETRICAL SURVEYS.

11. The triangulation party (No. 24) having last year completed the Manipur Minor Meridional series, was employed during the year under review in extending the Great Salween principal series eastwards. This series of triangles emanates from the Mandalay Meridional series about the parallel of 24° Latitude. It will be carried eastwards up to the Salween river and then turning southwards will follow the course of that river, eventually joining on to the previously executed principal triangulation to the south. It will thus form a strong frontier series to support any extension of triangulation which may hereafter be required further eastward.

TOPOGRAPHICAL SURVEYS.

12. During the year under report no changes of the *locale* of operations of the Topographical Survey parties have taken place, the work being carried on in continuation of that of previous seasons.

13. In Lower Burma topographical work was carried on as in the previous year by No. 5 Party. Surveys were carried on in the Thayetmyo, Magwe, Henzada and Tharrawaddy districts and consisted of the supplementary survey of topographical detail omitted from the cadastral maps and the complete detail survey of those parts of the sheets in question which had not been touched by the cadastral operations. A good season's work was accomplished, 1,786 square miles of new detail survey and 2,934 square miles of supplementary topographical survey being completed.

14. In Upper Burma, No. 10 Party, as before, was engaged partly in new topographical survey and partly in supplementary survey to fill up the topographical deficiencies in the maps compiled from reductions of the cadastral sheets. In Burma, where hilly and broken ground is often much intermingled with cultivated areas, it is sometimes difficult to say whether work should be classified as new or as supplementary survey.

Work was carried on in the districts of Meiktila, Myingyan, Kyauksè, Sagaing, Pakòkku, Magwe and Minbu. A total area of 3,336 square miles of detail survey on the 1-inch scale was completed.

The station of Maymyo is increasing so rapidly that it has been found necessary to revise the large scale map of it which was prepared two or three years ago. The new roads, buildings and forest and other boundaries have been now surveyed and a second edition of the map is being brought out.

15. The Shan States survey which is being carried on by the amalgamated party, Nos. 11 and 21, progressed steadily during the year, the portion of the country under survey being that part of the Southern Shan States on either side of the Salween river between Latitude 20° and 21°. Taking into consideration the difficulties of the country the progress has been very satisfactory; an area of 2,432 square miles having been surveyed in detail on the 1-inch scale and a proportionate area of triangulation executed in advance.

16. The question as to the extent to which topographical surveys in Burma should be carried, which was alluded to in last year's report as under discussion, has now been decided by the Government of India. For Burma proper a 5 year programme for Nos. 3 and 10 Parties has been sanctioned. This embraces

a large area of the more important tracts of country, and it has been drawn up to meet as far as possible the wishes of the Local Government. On the completion of this the matter will be reconsidered as to what further area should be taken in hand. As regards the survey of the Shan States and the country contiguous to the Eastern Frontier, it has been decided to carry on the 1-inch topographical survey right up to the frontier.

17. The survey of Sind was continued by No. 12 Party, detail survey being carried on in the north-eastern portion of the division. The cultivated country was surveyed on the scale of 2 inches = 1 mile, an area of 1,946 square miles being so mapped while the desert area lying to the east was mapped on the $\frac{1}{2}$ -inch scale, the area thus completed amounting to 2,164 square miles, making a total of 4,110 square miles of completed survey. The usual triangulation and traversing in advance was also carried on.

The Geological Survey Department being anxious to make certain investigations into the problem of the supply of salt in the Sámbar Salt lake, the Survey Department was asked to make a detail survey of the lake. This was undertaken by a detachment from No. 12 Party, and a complete survey of the lake and its surroundings on the scale of 2 inches = 1 mile, comprising an area of 178 square miles, was completed. Lines of spirit levelling were run round and across the lake, so that a closely contoured map of the lake area has been made, thus giving the Geological Department the means of estimating the amount of water in the lake at any moment.

18. The survey of the districts of the Allahabad division of the United Provinces which was commenced in the previous year by No. 14 Party, has been continued. The work consists of a full topographical survey of the country in question on the scale of 2 inches = 1 mile, the stations of the traverses on which the topography is based being carefully marked and preserved in order to be available should a cadastral survey be determined on at any future time. On account of the minute area of many of the villages, it has been found necessary to publish two editions of the maps, one on the 2-inch scale, showing village boundaries and a second a general topographical map on the 1-inch scale omitting these boundaries. The area completed during the year was 1,885 square miles.

19. No. 15 Party has been employed as in previous years on work required by the Military authorities. In addition to work on the frontier this party has now completed the survey of the hilly portion of Sind which was allotted to it, an area of 1,499 square miles having been mapped. The cantonments of Chakráta, Meean Meer, Umballa, Mooltan and Pesháwar with their bazars and also the bazars of Ferozepore were mapped, and the maps of the Khágan valley revised over an area of 1,033 square miles.

20. In the Punjab No. 18 Party continued the work on which it had been employed during the previous year. Supplementary topographical surveys were carried over an area of 3,653 square miles in parts of Montgomery, Lahore and Amritsar districts in order to render the maps compiled from the *patwáris* surveys available for general topographical purposes. Riverain surveys are at the request of the Punjab Government being carried on wherever the new policy of demarcating riverain boundaries permanently once for all has been carried out. These surveys are to enable such boundaries to be accurately relaid at any time however much the present course of the river may have shifted. The great difficulty in carrying them out satisfactorily is that these boundaries are, as a rule, not settled and demarcated until late in the working season and the marks are liable to be entirely obliterated by the first floods of the rainy seasons. Of these riverain traverses, 1,158 square miles were traversed during the season. The Simla Estate boundary survey is completed with the exception of a few sheets held over to enable the railway to be inserted and the greater part of the sheets have been fair drawn. This party is much hampered by a quantity of arrears of map drawing. It has been employed on several large scale operations such as the Simla and the riverain surveys, which entail the drawing of a very large number of sheets. All map draftsmen have to be specially enlisted and trained and with the present pay offered it is difficult to find and keep suitable men.

The Punjab Government is anxious that the work of preparing and issuing new topographical maps of the Province should be pushed forward with much greater rapidity than at present. This is of course very desirable, but unfortunately the Survey Department has no staff available for the purpose.

21. In the Central Provinces the detachment which has hitherto been employed on traversing forest excisions and *samindári* villages for the local authorities, having completed the greater part of the traverse work required, has been to a great extent employed in bringing out new topographical maps of the Jubbulpore and surrounding districts. These maps are being compiled from various sources, the forest surveys, the old revenue surveys and the local agency cadastral surveys, being all utilized as far as possible. These are filled up and worked together by supplementary topographical survey carried on in the field, thus furnishing good modern topographical maps. During the season 2,834 square miles were thus mapped and surveyed. It is hoped that this detachment may be increased in strength and raised to the status of a party as there is a very large area of country in the Central Provinces of which modern maps are badly wanted.

22. In the Appendix to the General Report of the Survey of India for 1899-1900 a note was given detailing the present state of the topographical maps throughout India, which pointed out to what a very great extent they were either obsolete or in need of revision. Excluding the greater part of the Province of Bengal, for which it is hoped that topographical maps may be obtained from the cadastral surveys which are likely to be undertaken, it may be said that there are over 200,000 square miles of country, of which entirely new topographical maps are required, while a further area of over 250,000 square miles requires either supplementary survey or revision to bring the maps up to date. The matter is at present engaging the attention of the Government of India, and it is hoped that arrangements may be made, which in the course of time will put the up-keep of the topographical maps of India on a permanent footing.

23. The total outturn for the year under the head of topographical survey on various scales from 1 inch upwards including both full and supplementary surveys, amounted to 22,646 square miles.

This is made up as follows :—

| | | | | | |
|------------------------------|---|---|---|---|----------------------|
| Surveyed on the 1-inch scale | . | . | . | . | 12,052 square miles. |
| " " 2-inch " | " | " | " | " | 9,895 " " |
| " " 4-inch " | " | " | " | " | 699 " " |

FOREST SURVEYS.

24. The special surveys of Government forests were, as in previous years, carried out by detachments of the Forest Surveys, Bengal Presidency, and by No. 20 Party under the administration of the Superintendent, Forest Surveys, and the general control of the Inspector General of Forests, and by Nos. 9 and 19 Parties in Madras and No. 17 Party in Bombay. The Superintendent, Forest Surveys, held administrative charge of the latter parties under the control of the Surveyor-General as a preliminary measure to the formation of a special Forest Branch of the Survey of India which will, it is hoped, be completed early in 1904.

25. In Madras, Nos. 9 and 19 Parties continued the survey of forests in Kurnool, Cuddapah and South Canara on the 4-inch scale. Preliminary triangulation was also carried out in the Ganjam and Godávári districts. Further examination and revision was continued in North Coimbatore. The detachment employed on the survey of the Godávári delta was placed under the orders of the Deputy Surveyor-General, Revenue Branch.

An area of 1411 square miles was surveyed at a cost of ₹58 per square mile which is the average rate for three years.

26. In Bombay surveys were carried out in the Northern, Central and Southern circles, the survey of the forests in the last named being now complete. The triangulation of the Khándesh forests, where most of the work of the party will lie in the future, was commenced.

The outturn of the party for the year was, in addition to 1373 square miles of triangulation, 487 square miles of detail survey on the 4-inch, 240 on the 8-inch and 6 on the 16-inch scale, the cost-rates being ₹61, ₹130, and ₹137, respectively.

The rates, in spite of an increase in the cost of supervision, are less than those of last year and may be considered satisfactory.

Excluding Sind, proposals for the survey of whose forests have not yet been made, an area of over 4,000 square miles remains for survey and under favourable conditions should be completed in 1907 or 1908.

27. In Burma an area of 623 square miles of forests was surveyed on the 4-inch scale by No. 20 Party in the Upper Chindwin, Thayetmyo and Ataran

districts. A large area was also triangulated and traversed in advance for next season's detail survey. The cost-rates of triangulation and traverse survey were ₹3.2 and ₹4.7, respectively and continue to show a marked improvement but those of detail survey again show an increase, being ₹136 per square mile as compared with ₹122 in 1901-1902. The high cost-rates are fully explained by a decrease in the outturn which was due principally to the curtailment of the working season by the time occupied in the long river journey from and to the base, by the extremely difficult nature of the country and to sickness among the members of the party: unusually large non-effective charges also helped to augment the cost. It is confidently hoped that next year there will be a substantial improvement in the cost-rates, although it must be remembered that with a short field season of 5 months, which is all that the climate will admit of, and an average outturn of $3\frac{1}{2}$ square miles a man a month which experience shows cannot be exceeded in the difficult country of the Upper Chindwin valley if good work is to be done, it is impossible to work at the low rates which prevail in easier country and under most favourable conditions.

28. In addition to No. 20 Party two detachments of Forest Surveys were employed on survey work in the Irrawaddy valley, and in addition to some triangulation brought in an outturn of 303 square miles of 4-inch detail survey and 810 linear miles of traverse in the Bhamo, Ruby Mines, and Mandalay districts. The country was comparatively easy, and there was little sickness among the men. The cost-rates were ₹64 per square mile of detail survey and ₹37 per linear mile of traversing.

As explained in last year's report the cost-rates of these detachments cannot be well compared with those of No. 20 Party, the conditions being altogether different.

29. In the Central Provinces one small detachment completed the survey of Chánda, with the exception of the Cherla range the survey of which has not yet been sanctioned. The survey of the forests in the Central Provinces is now complete: it has for many years afforded a favourable field of operations, owing to the easy nature of the country, and to the facility for obtaining supplies and cheap labour. In all over 19,000 square miles of forest have been surveyed in these Provinces, and in addition to the special value of the surveys to the Forest Department they are now beginning to supply useful material for the revised 1-inch standard maps which are being compiled.

The outturn for the year in Chánda was 226 square miles at a cost of ₹26 per square mile of detail survey.

30. In Bengal a detachment commenced the 4-inch detail survey of the forests in the Kurseong, Darjeeling, and Kálimpong divisions of the Darjeeling district. In addition to triangulation and traversing 232 square miles were topographically surveyed on the 4-inch scale at a cost of ₹64 per square mile. The survey of these forests will be completed in 1903-04.

31. The survey of the forests in the Gáro Hills and Kámrúp districts were commenced by a detachment of Forest Surveys and in addition to traversing and triangulation an area of 134 square miles was topographically surveyed on the 4-inch scale at a cost of ₹98 per square mile. The difficulties attending the operations cannot well be exaggerated. Most of the surveyors as well as the *khalásis* imported from Chota Nagpur suffered severely from fever and dysentery and many were incapacitated often for weeks together. It was almost impossible to obtain local labour and the clearing of the traverse lines and of trigonometrical stations was a tedious and costly process. Existing triangulation and traverse stations were few in number and the forest blocks were much scattered.

32. In the Punjab the survey of the Jubbal and Tarhoch State forests was completed. A detachment was also employed on 4-inch detail survey in Gujrát and Ráwalpindi districts, where 100 square miles were surveyed at a cost of ₹34 per square mile. The detachment then proceeded to Hazára where 173 square miles were surveyed at a cost of ₹24 per square mile. A surveyor was also sent to Chamba to fix the positions of new boundary pillars.

33. In the United Provinces a small detachment surveyed 100 square miles in Kumaun, Garhwál and Naini Tal, at a cost of ₹30 per square mile.

34. The total outturn of Forest Surveys on various scales during the year amounts to 4,062 square miles of which 1,918 square miles were surveyed by the Forest Branch including No. 20 Party.

The total is made up as follows :—

| | |
|-------------------------|---------------|
| | Square miles. |
| 4-inch scale | 3,816 |
| 8-inch scale | 240 |
| 16-inch scale | 6 |
| | <hr/> |
| TOTAL | 4,062 |
| | <hr/> <hr/> |

The cost-rates were generally moderate except in the case of No. 20 Party in Burma and of the Forest detachment in Assam, where high rates were inevitable, owing to the natural difficulties of the area under survey, its unhealthiness and the cost of importing labour.

CADASTRAL AND TRAVERSE SURVEYS.

35. During the year under report there was one cadastral party in Burma, one in Bengal, and one in the United Provinces of Agra and Oudh.

36. In Upper Burma 606 square miles of Pakòkku district were cadastrally surveyed, and 455 square miles traversed, also 302 square miles were traversed in district Shwebo. In Lower Burma 74 square miles were cadastrally surveyed in district Kyaukpyu and 42 square miles traversed, thus completing the cadastral survey of the district.

37. In Bengal 6,884 square miles were traversed, 2,838 square miles cadastrally surveyed, and 2,620 square miles of record-writing completed, in districts Bhágalpur, Backergunge, Sonthal Parganas, Ránchi, Hazáribágh, Monghyr, Purnea, Rangpur, Midnapore, and Shahabad. An area of 12 square miles has also been traversed for the Calcutta suburbs survey, and 3 square miles surveyed in detail on the scale of 50 feet to the inch.

38. In the United Provinces Nos. 2 and 8 double party cadastrally surveyed 195 square miles in districts Mainpuri and Jálaun, and traversed 140 square miles in district Moradabad, and 155 linear miles along the high banks of the Rámghanga and Dhela rivers for future cadastral survey; also the survey of the civil station of Allahabad on the scale of 200 feet to the inch, and the following towns for municipalities on the scale of 64 inches = 1 mile, *viz.*, Háthras, Koil, Sikandra Rao, Atrauli and Kosi, the whole covering an area of about 12 square miles. This party also surveyed for the Public Works Department 1,113 linear miles of first class roads in districts Etah, Agra, Muttra, Aligarh, Bulandshahr, and Meerut on the scale of 64 inches = 1 mile. No. 14 Party also traversed 2,113 square miles in districts Allahabad and Fatehpur.

39. In the Central Provinces a number of small scattered areas consisting of excised portions of forest reserves were traversed in districts Saugor, Seoni, Nimár, Chánda, Raipur, Betúl, Bhandára, and Sambalpur, amounting in the aggregate to 619 square miles, also 10 square miles in the town and cantonment of Jubbulpore.

40. In Assam 129 square miles of extensions of cultivated areas, and 145 square miles of tea grants were traversed in districts Kámrup, Darrang, Nowgong, Sibságar and Lakhimpur, the former to provide data for cadastral survey by local agency.

41. In Madras an area of 131 square miles was traversed and cadastrally surveyed for the Irrigation Department in the vicinity of the Godávári delta.

42. The total areas traversed and cadastrally surveyed during the season are as follows :—

| Province. | Traversing square miles. | Cadastral survey, square miles. |
|-----------------------------|--------------------------|---------------------------------|
| Burma | 799 | 680 |
| Bengal | 6,884 | 2,838 |
| United Provinces | 2,253 | 195 |
| Central Provinces | 619 | ... |
| Assam | 274 | ... |
| Madras | 131 | 131 |
| TOTAL | <hr/> 10,960 | <hr/> 3,844 |

SPECIAL OPERATIONS.

43. Astronomical observations for latitude have been carried on for many years in India, and have now been completed at 176 stations. In 1901 a theory was advanced by Major Burrard, that the deflections of gravity in India, which had hitherto been attributed to accidental and local attractions, could in reality be classified by regions. This new theory had, as a working hypothesis, the great advantage over the old, that it could be tested by further investigation in the field. From the classification of results made in 1901, it was predicted that a southerly deflection of gravity would be found to exist throughout a great strip of country of unknown breadth, running parallel to the Himalayas from Calcutta to Jodhpur; but that both north and south of this strip gravity would, as a general rule, be discovered to possess a northerly inclination.

With the object of testing the correctness of these predictions, Lieutenant Cowie, R.E., was directed in 1901 to observe several latitudes between Calcutta and Darjeeling, working across the strip of southerly deflection and up to the Himalayas. The results which he obtained were as follows: in the zone immediately south of the strip Lieutenant Fandy had previously found northerly deflections of 3" and 4" south of Calcutta: at Calcutta the inclination of gravity was slightly southerly. In the two hundred miles immediately north of Calcutta, Lieutenant Cowie found southerly deflections at four successive stations: the inclination of gravity then changed to northerly, at Jalpaiguri it was 6" northerly, at Siliguri 23", at Kurseong 51".

In 1902-03, Lieutenant Cowie was directed to work again northwards across the strip and to follow the meridian of $78^{\circ} 30'$: the results which he obtained were as follows: in latitude $23^{\circ} 30'$ the direction of gravity was inclined 5" towards the north: in the next 200 miles Lieutenant Cowie found a southerly deflection at seven successive stations: in latitude $27^{\circ} 47'$ the inclination of gravity began to be slightly northerly; in $29^{\circ} 16'$ its inclination was 12" northwards. At Birond in the hills, Lieutenant Cowie found a deflection of 44".

It can therefore now be prophesied with tolerable certainty that on all Himalayan meridians the direction of gravity will be found to follow one general law: in the neighbourhood of the tropic as we move northwards its direction will change from northerly to southerly: it will then remain deflected towards the south for some hundreds of miles, and it will again become northerly, as the Himalayas come into view. The substitution of this regional law for the old theory of local attraction will probably exercise a profound influence on future investigations and programmes.

44. A plate is attached to the report of the Astronomical party on which two sections of the Earth's crust in Upper India have been drawn. The first section shows the actual height of the surface of the ground above sea level, as determined by levelling. The second section shows the actual distribution of matter in the crust, and it indicates what the height of the ground would be if the underlying crust could be brought everywhere to an uniform density.

The profile of the imaginary surface in the second section is practically independent of the density adopted; but when a line, indicating the sea-level, comes to be added to this section, the relative height of this line is governed by the density. If the mean density of the Earth's crust in India had been adopted, the line of sea-level would have been drawn very much lower. But the mean surface density of the whole earth has been utilised, and this being sensibly larger than the density of India, it has raised the sea-level-line.

The second section has been constructed from Captain Basevi's pendulum results in accordance with the formulæ and methods of Professor Helmert, the celebrated geodesist. The weak point in the section is the insufficiency of the number of pendulum stations: it is extremely unlikely that Dehra Dún is the minimum point of the true curve, or that Mussooree is the maximum: Dehra Dún happens to be the minimum discovered by Basevi, and Mussooree happens to be his maximum. Basevi's value for Moré—his only high Himalayan station—cannot be accepted with confidence, as he employed here a light and portable stand, of a class, that has been found by recent experience in Europe to sway with the pendulum itself through an abnormally large arc. A comparison of the two sections illustrates the extent, to which the Himalaya mountains are compensated by their underlying deficiencies of matter; it also shows the relative

excess of matter that lies hidden in the crust to the south of the Ganges valley, and which is doubtless the cause of the southerly deflections that prevail throughout the Calcutta-Jodhpur zone. From this section it is calculated, that a southerly deflection of gravity of 8" or 10" must exist at Kaliánpur, the origin of the principal triangulation, and it would follow that the mapping of India has been given always a value of latitude too high by that amount.

GEOGRAPHICAL SURVEYS AND RECONNAISSANCES.

45. Under this head are included surveys and reconnaissances which are executed on the $\frac{1}{2}$ -inch and smaller scales. In Sind an area of 2,164 square miles of desert country was surveyed on the $\frac{1}{2}$ -inch scale, while a surveyor attached to a shooting party has brought in a reconnaissance survey of 38,000 square miles of Western Tibet. Much work has also been done across the frontier, but the details of the surveys are not available.

46. The question of meeting the constant demands on the Survey Department for survey officers and subordinates for employment on commissions and Military and Political expeditions is a most serious one. The strength of the department, both in officers and native surveyors, is kept at the minimum which will suffice for carrying on the current work in India, no reserve whatever being provided, consequently whenever a call is made to supply surveyors for work outside India, men have to be withdrawn from current work to the great detriment of both efficiency and economy; the point indeed is quickly reached when men cannot possibly be spared. Moreover there are comparatively few native surveyors who are fitted for semi-independent work of this class. A long training in surveying in rough and hilly ground is requisite, and unfortunately there is very little of this class of work now going on in India, the training obtained in a party which is employed in surveying in open cultivated ground being of no use whatever in fitting a man for frontier surveying. The demands for trans-frontier surveys are far more likely to increase than diminish in future, and it seems imperative that a sufficient number of trained officers and men should be kept ready to meet such demands.

HEAD-QUARTERS OFFICES, CALCUTTA.

47. The general direction of these offices remained in the hands of Colonel St. G. C. Gore, C.S.I., R.E., Surveyor-General of India, throughout the year. The Revenue Branch Section was under the superintendence of Lieutenant-Colonel F. B. Longe, R.E., up to 6th October, and thereafter under Colonel J. R. Hobday, I.A.

48. The other offices in Calcutta were, as usual, supervised by three Assistant Surveyor-Generals. Captain E. A. Tandy, R.E., who was specially posted to head-quarters to reorganise the working arrangements of the Mathematical Instrument Office, was transferred to No. 18 Party on the 16th April. Lieutenant C. M. Browne, R.E., has been posted to the head-quarters from 2nd July to assist the Assistant Surveyor-General in charge of the Mathematical Instrument Office. The General and Topographical Branch Sections were under Lieutenant-Colonel F. B. Longe, R.E., up to 11th November; under Captain E. A. Tandy, R.E., up to 23rd November; and under Captain J. M. Burn, R.E., up to the close of the year. The Drawing, Engraving and Map Record and Issue Offices were under Captain Tandy, R.E., up to 17th October, and thereafter Major J. M. Fleming, I.A., returned from leave and resumed charge of these offices. Mr. T. A. Pope supervised the Photo-Litho Office throughout the year. The Mathematical Instrument Office was under Captain E. A. Tandy, R.E., up to 16th March and under Captain J. M. Burn, R.E., up to the close of the year.

49. *Correspondence Office.*—There has been no change in procedure in this office.

50. *Drawing Office.*—The work of the General Section of the Drawing Office has been, as usual, the compilation and revision of the general maps, as well as the addition of any new material to the various standard sheets of which reprints or new editions are required. Besides this a large amount of time is spent in completing for press sheets sent in from the various parties for

publication, and the preparation of any special maps which may be required by Government. Eleven sheets of the North-Eastern Frontier series on the scale $\frac{1}{4}$ inch=1 mile have been completed for press and published, 8 of these being new publications, and the remainder new editions; one other has been brought up to date. Sheet No. 23 of that series on the scale of 1 inch=8 miles has had a large amount of revision work entered upon it, and should soon be published. This sheet has been in hand for years, but having so often had to be laid aside for other urgent cases, work done upon it has been over and over again found superseded before it could be finished off, and portions of it have been done two or three times over. But this is unavoidable as long as it is impossible to keep draftsmen continuously on departmental work. Under the present system draftsmen are liable to be called off their survey maps at any moment in order to take in hand work for other departments, a system which leads to the maximum possibility of mistakes, and the minimum of outturn. Twelve sheets of the South-Eastern Frontier series have been dealt with and of these 7, one being a new publication, have been published.

Of the North-Western Trans-Frontier series 15 sheets on the $\frac{1}{2}$ -inch scale have been in hand, and 9 of these have been published. There being no originals extant, it has been decided to redraw and republish the old $\frac{1}{2}$ -inch map of Kashmir in standard form, no better material being available of a country, of which maps are so much in demand, and the outline of sheet 44 is almost ready.

Eight sheets of the Andaman Survey on the scale of $\frac{1}{2}$ inch=1 mile have been republished. A large number of names of various localities, tribes, etc., supplied by the Commissioner has been added to these.

The general map of Aden on the scale $\frac{1}{4}$ inch=1 mile has been prepared as a reprint, and published to meet immediate demands. Some additional material from recent surveys having come to hand, this is being added to the existing standard sheet No. 66 N.-W. of the South-West Asia series, from which and the adjoining sheet the above map was prepared. The sheet being in a bad condition must all be redrawn, and fair progress in spite of continual interruptions has been made on this. The map of the Chih-li Province on the scale of 1 inch=8 miles, a compilation from surveys lately done by the China Field Force has also been published.

One hundred and seventy standard sheets on the scale of 1 inch=1 mile have been in hand. Of these 59 have been published, 22 being new publications and 11 new editions. Twenty more are under publication. The above comprise 39 Burma sheets, of which several have been drawn in the office, 88 Central India and Rájputána sheets, 24 Madras, 11 of Bengal, 4 of which are from obsolete surveys being drawn afresh in standard form, 2 Assam, 4 Bombay and 2 Central Provinces sheets. All these maps are being sent to press in modern form under provincial numbers with areas extracted, and completed to margin, where blanks exist, as far as possible from other surveys formerly published separately. The reconciling of these separate surveys, often executed after the lapse of many years, has presented many difficulties, and a certain amount of forcing has been necessary with some, but the advantages to be gained from having all material in a manageable and intelligible form more than compensates for any more or less slight displacements of detail.

The material, obtained from outside sources, added to sheets in the attempt to bring them up to date leaves everything to be desired and is, taken as a whole, utterly undeserving of being included in any professional maps. It may in this connection be interesting to note that from local and Public Works Department sources we have received no less than four different alignments of the railways around Gwalior, and are apparently likely to obtain a fresh one, every additional time we ask for it. From all over India reports come to hand of glaring inaccuracies on our maps, entirely due to the insertion of unreliable material, and this carried on during all the years this system has been in force, must have made many of our sheets quite untrustworthy.

Four sheets of the Madras Forest Survey and 3 Burma Forest sheets on a scale of 4 inches=1 mile have been published. Three more Burma sheets are in hand for reprints.

The Provincial maps of Assam, Bengal, Bombay, Central India Agency, Central Provinces, North-West Frontier Province, Punjab, Rájputána Agency, and Upper Burma have all been in hand during the year. Skeleton and shaded

editions of the Burma map, the maps of the Central Provinces and of the North-West Frontier Province have been published. The Skeleton map of the Punjab is ready, but awaits a final settlement of boundaries, information regarding which is shortly expected from the Foreign Office. Eight of the sheets of the map of Bengal on the scale of 1 inch=8 miles have been brought up to date, but nothing much can be done with such antiquated maps.

The progress on the new 1 inch=32 mile map of India, has not been as satisfactory as was hoped, and some time must yet elapse before even a skeleton edition can be available. Sheet 1 was early in the year made over to the Litho Office, and a proof in outline should be ready before long. The hills are drawn as far as information here is available, but a small amount has yet to be completed, material for which is daily expected from the Frontier drawing office. The remaining sheets are all complete on the stone in outline, but a large amount of correction is necessary on sheet 4, principally due to the receipt of further information from surveys in Yün-nan etc., as well as to the faultiness of names on the old plates from which the transfers were originally taken. The sheet has been thoroughly revised and will go to press soon. The hills are ready for the litho draftsman. A large amount of fresh work has been added to sheet 2, which is now with the Litho Office. Sheets 3, 5, 6 are all far advanced both in hills and outline on the stones and but little correction is required upon them.

The 1 inch=48 mile Railway map, after several unavoidable delays, was published, brought up to 1st June, and is an improvement on the previous edition. The 1 inch=64 mile India has progressed steadily. A large amount of addition and alteration was necessary on sheet 2 to incorporate recent survey material, but the outlines of sheets 1 and 3 should shortly be ready, and the brush-shading for the hills of both sheets is ready for the engravers when they can take it. It has been found necessary to entirely reject sheet 4 of the old map which it was hoped would serve for the duplicate map. A new outline is ready for the engravers, and arrangements will be made to have it finished as soon as the other plates. A new edition of the 1 inch=64 mile district map of India has been prepared and published. Additional information to bring the 1 inch=80 mile and 1 inch=96 mile engraved skeleton maps up to date has been supplied to the engravers. All the general maps are thus now in a fair way to having the latest information upon them, and the coming year should see most of them issued. The skeleton 1 inch=192 mile, prepared for use with foolscap reports, has been completed and the outline for a similar map on the 1 inch=128 mile scale is approaching completion.

Three maps of the $\frac{1}{1,500,000}$ series have been completed, as a provisional edition, during the year, Nos. 78, 83 and 93. Press order has been given for the first two, and the third along with sheets 91, 92, 100, 101 and 102, received from Bangalore, are in proof. Two more sheets, Nos. 85 and 94, are in hand in this office. It is proposed to complete the sheets of this provisional edition which comprise Burma and Yün-nan, before commencing sheets on a revised projection.

Forty-one District maps on the scale of 1 inch=4 miles have been in hand. Of these fourteen have been published, while 19 more are under publication, and proofs are awaited after corrections, etc.

Thirty-nine Administration Report maps on the scale of 1 inch = 8 miles have been dealt with and 12 of these reissued.

The maps of Aden on the scale of 8 inches = 1 mile, the map of Aden Cantonment and the map of Steamer Point Cantonment, both on a scale of 24 inches = 1 mile have been brought up to date from information supplied by the Military Works. Plans of Lebong, and Mysore and environs, have been brought up to date and published, as also a map of Hsi Paw town in six sheets. Sheet No. 6 of the 16 inch = 1 mile map of Calcutta has been revised and sent to the engravers, and sheets 2 and 5 are in hand. Of the sheets of the Calcutta Survey on the scale of 50 feet equal one inch, 5 sheets have been sent to press for second editions, and 26 more are in hand for additions.

Besides the above a large amount of miscellaneous work has been done in the matter of index maps, type and map specimens, etc.

On 115 sheets of the Atlas of India corrections or additions have been made, and as these are mostly from extra departmental sources their accuracy

is doubtful. On 45 other plates additional work has been prepared for the engravers from survey sheets. On 13 sheets brush-shading has been carried out for the engraving of the hills.

Two of the new Degree sheets of Burma on the scale of 1 inch = 4 mile which are intended to take the place of Atlas sheets until these can be engraved (Nos. 52 and 53) have been sent in for publication and are passing through the press. They should form very useful and satisfactory maps.

The staff available has been quite unable to keep pace with the demand for reprints of sheets out of stock, and arrears are great and increasing. Sheets would be sent as they are, uncorrected, if the press could take them in hand.

As usual the demands for extra departmental work have been continuous, and until a separate staff can be arranged for this work, it can only result in delay and unsatisfactory work all round, when men have to be continually shifted from job to job. Early in the year the office had to undertake the preparation of a general map of India to illustrate the report of the Irrigation Commission. As no existing map would meet requirements, a new edition of the 64-mile District map had to be set in hand, and pushed forward with all speed, necessitating the removal of draftsmen from their tasks in hand, until the outline, hills and copies for colour plates had been completed. Twenty-one maps for Dr. Grierson's Linguistic Survey have been dealt with, either for preparation or examination in the proof stage, and as these are all intended for publication in several colours they involved much work. There has been the usual work in bringing up the various Provincial Administration Report maps, almost invariably asked for at the last moment, and expected at once. A series of four maps intended for the India Office Decennial Report on the Moral and Material Progress of India, to illustrate the progress of Railways and Canals, as well as the areas affected by famine was also pushed through at high pressure. Besides the above many other minor maps for the Civil, Foreign, Public Works Department, and Military Department, besides a series of manœuvre maps, etc., for the Military authorities have all been prepared for press. The Postal map of Bihâr drawn on the scale of 1 inch = 4 miles has been completed and published on half that scale. A similar Postal map of Bengal has been drawn on the same scale, and is now at press for reduction while the drawing of the Postal map of the Central Provinces is practically completed. All the above are being drawn on trace prints of Atlas sheets, the Postal information being supplied by the Postal authorities, and are component parts of a general Postal Atlas of India.

The preparation of the New Gazetteer of India has thrown a large amount of work on this office for which we are most inadequately provided with staff. From every part of India have come incessant and urgent demands to be supplied with information as to the geographical positions of long lists of names of places, lengths of rivers, etc., etc., and as many of these involved much searching, it has all hindered the work of the Examining section enormously, and the sheets passed number 2,504.

All through the year there has been much sickness among the staff, and the inevitable lack of supervision has caused many mistakes and delays which with better fortune might have been avoided. In a climate such as this the strength sanctioned should allow a margin for sickness and leave.

51. In the Revenue Section 204 standard sheets have been dealt with. Of these 79 are new publications, 50 of which in 103 sections are new receipts from the parties, 49 are new editions, or old sheets again published in modern form, and 75 are reprints. On these last, however, there has been much work in the shape of extraction of areas, not formerly given, rearrangement of notes, etc. Of the above, 106 have been published, and 32 are passing through the press. The new sheets received in the office are from recent surveys in Bengal, Burma (7 of which are mere fragments), Central Provinces, United Provinces and the Punjab. An effort has been made when possible to complete all sheets to margin, and 40 have been thus prepared. The work of attempting to join up into standard form the fragmentary sheets of Bengal has been steadily prosecuted, and 31 have been in hand, 7 of which are now passing through the press. The compilation of these has presented many difficulties, some being based on spherical values, while others are entirely on rectangular ones, even Great Trigonometrical stations within the circuits being plotted from traverse values. Wherever possible the initial point of circuits has been converted to a spherical

value, all Great Trigonometrical stations have been plotted from spherical co-ordinates and the intervening detail gradually forced in when necessary between these points, a note to this effect being placed on all sheets thus treated. They can at best be but makeshift maps, though infinitely better than what they supersede, and will afford much relief in the Issue Office. Any sheets or portions thereof (chiefly district maps) which could be reproduced, after touching up, by photography have been so treated, the remainder being either entirely or in part redrawn.

A new edition of the 6 inches = 1 mile map of Calcutta has been published, and the 3-inch one is being similarly revised, and should shortly go to press.

The three special maps illustrating the Nepal boundary along the Sárda river, having been declared faulty, the old traverses have been recomputed, convergence corrections applied and connections made with Great Trigonometrical stations lying near, while they have been linked on to more recent traverse work along the boundary. The values for the pillars thus obtained should admit of their being easily placed on any map. The three sheets have all been redrawn for publication in two colours, and proofs are now with the Foreign Office for final orders.

The usual revision work has been carried out on Index maps and two new ones prepared. Eight hundred and fifteen pages of traverse records have been copied and examined in response to applications, while much miscellaneous computation work, calculation of areas, etc., has been completed. The final examination of the traverse records of Chhindwára district has been in hand and has been almost completed.

Eighty traces and copies of village plans have been prepared for district officials, while 1,203 applications from private parties for copies of original records have been received. In response to these appeals 2,154 authenticated copies have been supplied, the Government fees thereon amounting to ₹1,206.

Coloured copies of maps for issue to a number of 21,786 have been examined and passed and in addition 771 pairs of office copies have been prepared and passed, while 718 more have been corrected or added to. These are now getting into somewhat better order, and the register of them now kept up should prevent their being lost or mislaid amid the various sections of the office.

The publication of the few remaining cadastral sheets, 2,548 in number, was completed by the end of March, 858 of these having been reproduced by the Vandyke process.

52. Engraving Office.—The amount of engraving work turned out by this office is much the same as last year. Three new quarter sheets of the Atlas of India Nos. 24 S. E., 79 N. E. and 178 N. W. have been published, as also a map of the Central India Agency with hills on the scale of 1 inch = 80 miles, and the new outline map of India for reports on a scale of 1 inch = 192 miles has been completed. A large number of sheets of the edition of the 1 inch = 64 mile India issued in 1902 has had to be reprinted, the paper having been found to be damp spoiled when coloured. A new edition of the skeleton 1 inch = 128 mile India has been issued, and prints from the Central Province map and from 54 other sheets corrected to date have been supplied to the Map Record and Issue Office in full compliance with indents, while numerous pressing demands have been met by small supplies of 122 sheets.

Work on the proposed 1 inch = 32 mile map of India has been carried on as opportunity offered. Matrices have been obtained of four of the plates, and a considerable amount of correction done upon these, while one of them has been sent for a duplicate. Sheet 12 has been reengraved in outline. Most of the other general maps of India have been in hand. Much work has been cut on plates one and two of the duplicate 1 inch = 64 mile India, and the former plate is nearly ready to commence the hill engraving upon: the old map has also been in hand for correction. Much work has been done on the plates of the 1 inch = 80 and 1 inch = 96 mile maps. Besides internal corrections a large amount of revised survey is being cut on both frontiers. Both the hill and outline plates of the 1 inch = 128 mile map have been corrected, and the projection for a new skeleton map on this scale has been cut upon a plate, and a print sent for compilation. Corrections have also been made on the two plates of the 256-mile India.

The 1 inch = 16 mile map of Assam has had much additional work cut upon it, necessitated by the expansion of the Province. The Central Province

map has been again corrected and added to, while the outline and writing of the Mysore portion of the 1 inch=16 mile Madras has been almost completed, and this outline map in six sheets should shortly be available for issue. The 1 inch=16 mile map of the Punjab has been off and on in hand for corrections, and is awaiting what it is hoped will be final information regarding frontier boundaries, which is daily expected from the Foreign Office. Should this not entail large alterations, the map is practically ready for publication.

The outline of the 1 inch=32 mile map of the Punjab has also been revised and completed, but the writing still remains to be finished.

Five provincial and 31 district maps, for administration reports have had work done upon them. The plates of the map of Calcutta on the scale of 16 inches=1 mile have been taken in hand for revision, and a considerable amount of work has been done on plates 3 and 6.

Good progress has been made with the plates of the new map of Calcutta on the scale of 6 inches=1 mile, and the cutting of the street names is now in hand. Two charts, two index maps, eighty quarter Atlas sheets in various stages of progress have been added to, ninety-two published quarter sheets have been corrected in order to keep them up to date from information furnished by the Drawing Office, which must often be far from reliable. Thirty-three new quarter sheets have been projected, and new borders and graticule figures cut. Twenty-four of the old pattern full plates have also been corrected, while 103 miscellaneous plates of scales, tints, map headings, heliogravure plates, including the certificate for exhibitors at the Delhi Art Exhibition, etc., have been worked upon during the year.

It has been decided to restrict the issue of the full Atlas sheets as much as possible, and in cases when two or more of the quarters of any sheet have been published, the remaining quarters will be in future published from stones prepared from transfers from the old full plates, until such time as engraved plates are available. Sixteen of these quarter sheets will be thus prepared, and transfers for seven of these have been supplied to the Litho Office where the borders, footnotes, etc., will be added. Besides the above, transfers from ten quarter plates, which for lack of printing power could not be taken up, have been supplied to the Litho Office, and prints from the stone of all of these have been obtained. Though small supplies of sheets urgently wanted have from time to time been made to tide over pressing demands arrears are great, and 109 sheets are still entirely out of stock, while 121 more are practically so.

The new room for the copper plate printing section has been completed, and the additional space gained by alterations has allowed of a rearrangement of the presses in the old room. An additional press, which formerly could be little used, has of late been in constant work, and the outturn of the section has been 31,472 prints, an increase of 5,418 pulls on last year's returns. The cases containing the three new presses, one of which will be worked by an electric motor, have arrived, and these will be got into working order as soon as possible.

Two hundred and seventy-one plates were steel faced, and 52 plates have had surface corrections filled in by electro deposition. As far as this method of obtaining a new surface to work upon is concerned, the process continues to give satisfaction, but it has been found latterly on several occasions, that prints obtained from plates which have been frequently subjected to the process are not as clean as they should be. The silver deposit made on the plate prior to immersion in the bath appears in time to affect the surface of the plate, making it take up ink, and the necessary burnishing to remove these slight inequalities is far from good for the engraved detail. But it is hoped that this difficulty may be surmounted shortly.

53. *Photographic and Lithographic Office.*—The outturn of this office, as measured by the number of copies of maps, plans and other subjects printed in the lithographic machines and presses, is again very large. For the third year in succession the number of copies printed, coloured and uncoloured exceeded one million, the actual figures being 1,032,495, or 131,634 less than the record outturn of last year. Of these, 312,812 were copies of maps printed for the Survey of India, the balance of 719,638 copies being printed for other departments and officials. In no previous year has the proportion of departmental work done been so small. The large excess of work done for other departments

is chiefly due to the demands made on the office during the first three months of the year for work in connection with the Delhi Durbar and the manœuvres at Delhi and in other parts of India carried out last cold season. This work occupied the whole printing power of the office during October and November 1902, to the exclusion of all departmental work. The defect in the amount of the latter class of work is also in part attributable to the small amount of cadastral work received for reproduction. The heavy arrears of Burma cadastral mapping had all been worked off in the preceding year, when an extra establishment was sanctioned for the purpose, and the cadastral work of the year under review was confined to the current outturn of No. 7 Party in Burma, amounting to 3,870 sheets received, as compared with 13,115 received last year.

In the other sections the amount of work executed is also highly satisfactory. The type-printing section, owing to heavy demands for departmental forms, established a record with over two million pulls and one million copies—a result obtained without any increase of establishment, and only by working at high pressure throughout the year. The silver-printing section yielded a considerably larger outturn both of silver-prints and cyanotype prints. In the heliogravure section the outturn of copies printed from photogravure plates was less than last year, though the number of plates prepared was considerably larger.

54. The disproportionate amount of work executed in this office for other departments, as shewn by the above figures, is a matter which requires serious attention. And not only is it the case that the *quantity* of work done for the Survey Department suffers from the heavy demands made from outside, but, what is even more important, the *quality* suffers also, owing to the fact that so large a proportion of the outside work has to be done by litho draftsmen, such work not being usually of a kind that can be executed by photozincography. The result is that, of the total strength of the drawing section, two thirds are constantly engaged on extraneous work, thus rendering it impossible to employ the section to anything like the proper extent in reproducing the maps of the department by lithography. It is unfortunately also the case that the quality of much of the work executed by photography is not as good as it should be. This is due in part to circumstances over which the reproducing office has no control, but in a larger measure to the fact that the skilled European element in the office has been allowed to fall much below its due strength. There are now only four posts reserved for assistants trained in England, and only one of these exercises supervision over the photozincographic work; whereas when this branch of the work was first started no less than five European assistants were brought out to supervise it. These men have all retired, and their places, with one exception, have been taken by Eurasians trained in the office. The ever-increasing quantity of work which the office is called upon to undertake has of course rendered increases to the native subordinate staff necessary from time to time, and these have been made from savings effected by the retirement of the senior European assistants. The result is that, while much more work is now done at a considerably reduced cost in labour, this has been effected at the expense of quality. The manner in which these defects can best be remedied is now occupying the attention of the Government of India, and it is to be hoped that no expense will be spared to place this office on a footing which will enable it to carry out in an efficient manner the important work it has to perform.

55. The following are the principal items of work executed in the Lithographic Branch of the office during the year:—The drawing of the new 32-mile map of India was continued throughout the year, new material being added to the stones as fast as it was received from the Drawing Office. The sheets in hand were Nos. 1 and 4 for outline and Nos. 3 and 6 for hills. No. 1 contains much heavy work and will take about four months longer to complete. The hill stone of No. 6 was completed and a proof in outline and hills sent to the Drawing Office in March 1903. The hill stone of No. 3 will be finished by the end of December 1903. The remaining departmental work done in this branch includes (1) a map of the Punjab and Kashmir, on the 16-mile scale, with hills in brown, lithographed from a copper-plate transfer. A proof of one of the sheets has been submitted and the other should be ready in November 1903. (2) A map of the North-West Frontier Province, on the 16-mile scale, in one sheet, lithographed from a copper-plate transfer. (3) Fifty-four district maps,

also from copper-plate transfers, of which 10 were printed off, proofs of 18 more were submitted, and the remaining 26 were still in hand at the close of the year.

56. The work done by lithography for other departments included (1) the completion of the drawing of one more sheet of the Telegraph map of India, on the 32-mile scale, and much work done to the remaining three sheets, which ought to be completed in about two months' time. (2) The Railway Mail Service map of India, on the 32-mile scale, was printed from stone in black and eleven colours and despatched in February 1903. (3) The six sheets of the new Military map of India, on the 32-mile scale, with the military information shewn in red, were put in hand and completed during the year, and proofs submitted. (4) A 16-mile map of the Punjab and Kashmir, in two sheets, was lithographed from a copper-plate transfer for the Punjab Government, of which one sheet was completed and the other should be ready by December 1903. (5) Five maps were lithographed and printed in colours for the Census Commissioner's report. The six census maps mentioned in last year's report were printed off, as well as two maps prepared for the Linguistic Survey but also published in the Census Commissioner's report. (6) Thirteen maps, each in numerous colours, were lithographed for Dr. Grierson's Linguistic Survey, and proofs submitted, of which six have been returned with press order and one has been printed off. Besides the above a large variety of miscellaneous work has been lithographed for different extra-departmental purposes, including 31 maps and sketches for the Foreign Department.

57. In the Photographic Branch the most important departmental publications of the year included a new edition of the 48-mile Railway map of India, in four sheets, with hills in brown, photozincographed and 400 copies supplied; and a map of India shewing district boundaries, on the 64-mile scale, in two sheets, photozincographed and 300 copies supplied. Three hundred and eight standard sheets of the Topographical and Revenue Surveys, on various scales, were either photozincographed or reprinted from old plates, of which 48 were in two colours. In addition to the number of standard sheets printed for departmental purposes, 31 sheets of the Central India and Rájputána Survey were printed for the Director of Land Records, Gwalior State, and 5,600 copies supplied on cloth.

58. A very large amount of photozincographic work was executed for other departments, of which the following items are the most important:—(1) An Irrigation map of India, on the 64-mile scale, in two sheets and in six colours, was prepared for the report of the Irrigation Commission, and 3,900 copies were supplied. (2) For the same report a map showing the principal canal systems in Bengal, on the 8-mile scale, was prepared and 4,050 copies were printed. (3) Two skeleton maps of India, on the 128-mile scale, illustrating progress of railways and irrigation respectively, were prepared for the Secretary of State for India, and 900 copies of each were printed, in two colours. (4) Two maps of Chinese Turkestán were prepared for Dr. M. A. Stein and 100 copies of each printed, in eight colours. (5) A Postal map of Bihár, in two sheets, was prepared for the Post Master General, Bihár, and 135 copies printed. (6) For Dr. Grierson's Linguistic Survey seven maps in various colours were prepared, and 9,240 copies supplied. (7) A very large number of manœuvre maps, on various scales, and chiefly in two colours, were photozincographed and supplied to the Military authorities. For the Delhi manœuvres alone three maps were prepared and over 5,000 copies printed. (8) For the Delhi Durbar a number of miscellaneous maps and plans were reproduced (including 29 plates of music for the massed bands) and 30,238 copies were supplied to various officials connected with the Durbar, and for stock in the Map Record and Issue Office.

59. The substitution of the Vandyke process for photozincography, as a cheaper and more expeditious method of reproducing the cadastral work of the department, enabled a reduction of the cadastral staff to be made during the year. A scheme was submitted to Government and received their sanction, which involved the abolition of several cadastral posts, including one on R200 in the second division. Advantage was taken of the saving thus effected to add four new posts to the Litho Drawing section, which, as pointed out in paragraph 61 of last year's Report, was considerably undermanned, and four new posts were also added at the bottom of the fourth division to provide the

means of training a better class of men as machine printers. Provision was also made for the Direct Zinc-printing section, to work the Vandyke process, this section having originally been organised for the reproduction of Bengal cadastral maps, and maintained by a special grant from that Government who are now carrying on the work with an establishment of their own. These changes, which have resulted in a small monthly saving, and added greatly to the efficiency of the office, are due to the inventive skill of Sub-Conductor F. R. Vandyke, R.E., Foreman Litho-Printer, the patentee of the process which bears his name.

60. The proposal referred to in paragraph 62 of last year's report for the substitution of electric power for steam for driving the printing and other machinery was carried into effect at the close of the year, with the sanction of the Government of India. At the end of September 1903 the motors had been installed, and the changes gave promise of being entirely successful. Further report on the subject will be made next year.

61. *Map Record and Issue Office.*—The demands upon the Map Record and Issue Office have as usual been incessant, and with difficulty coped with, and delays in the supply of maps, etc., are still far too frequent.

62. One hundred and seventy-six thousand seven hundred and forty-four sheets of an aggregate value of R1,85,938 were issued during the year. Of this sum R12,487 were realized from private sales. The falling-off in both numbers and value is due to the cessation in the supply of cadastral sheets, 71,385 of these having been despatched this year, as against 166,780 during 1901-02. No further despatches of these maps will be made by this office, but as they were always forwarded in large consignments their absence does not materially lighten the daily work. The number of new maps received for publication was 105. In addition 7,239 original maps, volumes of records, etc., were issued from store to other branches of the department, and 6,303 were received back again.

63. The work of transferring the original cadastral sheets from this office to the head-quarters of the various Local Governments or districts, has been carried on throughout the year, and the sheets of fourteen districts in Burma, and one in Assam, a total of 26,799 sheets, have been despatched from the office during the year. Others are partly invoiced and ready, and will be sent gradually as opportunity offers. The Governments of Burma, Central Provinces, United Provinces, and Assam have intimated that they can now receive the sheets if sent. The sheets of Burma and Assam will be stored at district head-quarters while those of the remaining two will be kept at provincial centres, as will also those of Bengal. A commencement has also been made with the transfer of the stock of large scale forest maps to Dehra, where they will be stored and issued under the orders of the Superintendent, Forest Surveys. Despatches of 896 copies of 20 maps, besides 538 original plane-table sections, have been made, and a further consignment is ready as soon as an intimation comes to hand that they can be housed.

64. Work on the catalogues has been carried on and fair progress has been made. The catalogue of Burma has been issued, while those of the Atlas of India, Bengal, Punjab, United Provinces and of the general maps of India and adjacent countries are all in the proof stage, and the first three should shortly be finally passed for press.

65. The task of rearranging and reconstructing the map storage space has been steadily prosecuted. All the racks in the east wing have now been moved from the walls—a most laborious task—but it is hoped the ravages of white ants, which were continually ruining the stock, may be now easily detected. By slight rearrangement 380 new shelves have been provided among existing racks, which will give ample space for many years to come for the Burma and Sind sheets, which required more room. For the Administration Report maps 33 new shelves have been added. Much work has been done in rearranging the maps and bringing all connected together, as owing to the filling up of allotted space, sheets of Provinces had perforce been placed apart.

66. Though 652 special maps have been opened out and re-stored flat, work on these has been in abeyance during most of this past year. The new racks built for these maps have all been filled up, and as the despatch of the forest sheets will shortly provide ample space, it is not necessary to build more. When our existing sheets have been rearranged and fragmentary main circuit

and district maps replaced by standard sheets, there should be ample space for all maps that can be reasonably expected for many years to come. For efficient working, our sheets must be standardized, and only delay and disappointment even with overtime working, can be expected when the staff has to deal with the meaningless fragments which constitute a large part of our present stock. It will be necessary to examine our stock of both original and printed maps, as much of the latter might be destroyed without loss to any one, and among the former there are many antiquated maps which are utterly useless to us and are decaying away unseen when they may possibly have some antiquarian value. An attempt is being made to have them placed by themselves, but current work prevents much time being spared for this additional labour, and of late it has had to be dropped entirely. It is to be regretted that the staff is still not sufficient for efficient working. There are invariably men absent from sickness, etc., and consequently arrears accumulate. The recent most necessary order regarding the entry on the invoices of all register numbers of maps has much increased the work of the despatching section, and arrangements must be made to augment it from elsewhere.

67. Although a great deal still remains to be done in this office, the improvement in its state which has been brought about during the last few years is enormous. By careful rearrangement a large amount of rack room has been made available, maps previously stowed away in rolls in inaccessible spots have been opened out, listed and racked, valuable original fair maps hitherto put away folded up for want of space have been properly arranged in reconstructed almirahs and the whole storage arrangements greatly improved.

These reforms are entirely due to the Assistant Surveyor-General, Major Fleming who, despite having to work with a staff insufficient even for its ordinary routine duties, has by his untiring energy and zeal succeeded in effecting this transformation. He has been ably assisted by the staff of the office, especially by Mr. Rundlett, the map curator. There is still further room for improvement, but unless speedy relief is given to this office by transferring the issue of provincial maps to local centres it will be necessary to increase its staff.

68. *Mathematical Instrument Office.*—Piecemeal work which was introduced last year has been gradually extended and the number of men employed on it at the end of the year under report was 85, while the number still on daily labour was 170. This system of working has proved most satisfactory and the figures below show that it has led to a large increase in the amount and value of the work done.

69. A net saving of ₹9,500 was effected on the year's budget.

70. The book value of the serviceable stores in hand at the end of each of the last three years ending 31st March 1903 was ₹5,36,053, ₹5,13,547 and ₹4,72,065, respectively. This gradual decrease is due to a considerable extent to the economy which has been effected by submitting our indents for instruments from England piecemeal as the necessity for any particular article arises or is foreseen instead of, as in former years, submitting only one large annual indent which often led to certain classes of instruments accumulating in great numbers owing to a change in the type of article required or a sudden cessation in the demand. There have, however, been heavy demands from the various Government Departments for the more valuable instruments such as theodolites and levels, which take a considerable time to manufacture and the stock of these is getting somewhat dangerously low.

71. The book value of the repairable instruments in store at the end of each of the same three years was ₹2,41,211, ₹2,30,155 and ₹1,81,000 and the value of instruments and stores purchased locally during these years was ₹36,024, ₹17,793 and ₹13,328. Thus we have a steady and satisfactory decrease under both these headings.

72. These reductions have been effected by the increased efficiency of the workshops, the cost of which has increased but not nearly to the same extent.

The workshop expenditure on labour and materials for the three years under comparison was ₹42,823, ₹54,180 and ₹60,700, respectively, while the value of the work done in the corresponding years was ₹98,283, ₹1,11,344 and ₹1,24,125. Therefore taking the first year which was the last under the old system as our starting point, we find that we have spent in the two years during which the new system has been gradually introduced ₹29,234 more than we

should have done perhaps under the old system but have raised the value of our work by ₹38,903, and to this must be added a very large proportion of the amount saved under local purchases which, as will be seen from the last paragraph, amounts in the two years to ₹40,927, the instruments now being made in our shops being mostly those which were formerly purchased locally.

73. The number of instruments issued during the year was 76,334 as against 73,903 in the previous year, their corresponding values being ₹3,22,657 and ₹2,84,719, while the number brought into the issue store from all sources for the same years was 80,116 and 71,831, their values being ₹2,79,587 and ₹2,68,426, of these 29,398 and 29,593, valued at ₹47,729 and ₹33,427, respectively were manufactured in the workshops.

74. The number and value of instruments returned to store finally by public officers has decreased but more have been sent for repairs and reissue.

75. The value of instruments obtained from the Director General of Stores was ₹4,820 and of materials for manufacture ₹1,584. This total is about the same as in the previous year. The average value for the past 11 years is ₹6,753 but nothing definite can be laid down on this account as the demand for theodolites, levels and other expensive instruments obtained from this source varies very much and is more or less dependent on Famine Works, Railway and Irrigation extensions and other similar undertakings.

76. The profit and loss statement for the workshop shows a profit of ₹15,865 while last year there was a loss of ₹1,308. This tends to prove the value of the piecework system and is more than six times as great as the average profit of the last ten years. Considerable improvements have been effected in the arrangements of the shops facilitating the supervision and concentrating the workmen employed on certain classes of instruments, such as theodolites, in certain rooms, etc. Good progress has been made in the erection of the new testing and adjusting building and much attention has been given to the more systematic arrangement of the stores generally. The reorganisation, both in the system of working and in the arrangement of the stores, machines, etc., has had to be carried out with as little dislocation to the regular work of the offices as possible and the results on the whole are very satisfactory.

BRANCH OFFICES.

77. The superintendence of the Trigonometrical Branch was in the hands of Mr. J. Eccles, M.A., throughout the year, and Mr. C. H. McA'Fee held charge of the technical offices.

During the year the following papers were printed and issued :—

1. On the Projection for a Map of India and Adjacent Countries on the scale of 1 : 1,000,000 by Colonel St. G. C. Gore, R.E. (second edition).
2. Spirit Levelled Heights No. 10 Madras Presidency, Central Provinces, Central India Agency and the United Provinces of Agra and Oudh.
3. Spirit Levelled Heights No. 1 Assam.
4. Spirit Levelled Heights—Bengal and Assam ; and the following were printed for the use of the department :—
5. Notes on Triangulation by Colonel St. G. C. Gore, R.E.
6. Notes on the Theory of Error of Observations by Mr. J. Eccles, M.A.
7. On the Projection used for the General Map of India.

As the first issue of 150 copies of Professional Paper No. 5 "The Attraction of the Himalaya Mountains on the plumb line in India" had been exhausted, a reprint was put in hand and will be ready for issue early in 1904.

The Computing section had so many calls for data that very little could be done to the regular work. The greater portion of the computations of the secondary triangulation in Kumaun and Garhwál was however revised for incorporation with the N. E. Longitudinal series, and a beginning was made on the press copy of the second edition of the Great Arc series, section 18° to 24° after the completion of the correction of the computations. Data was supplied to 46 officers, Captain C. G. W. Hunter's Astronomical observations in China were computed for the Quarter Master General and Lieutenant A. A. Crookshank's

triangulation in Southern Persia was computed and adjusted and the data supplied to the North-West Frontier drawing office. The examination and comparison of press proofs is a heavy item in the routine of this section and it often happens that all the computers are employed as proof readers and correctors. Besides the proofs of all the pamphlets published in this office which were examined by this section, the proofs of the Professional Papers published in Calcutta were sent here for comparison and examination.

In the Drawing section the District Map of Kánga was completed and sent to press and a "Map of the Ssü-Ch'uan Province of China, showing the routes of Lieut-Colonel C. C. Manifold, I.M.S., and Captain C. G. W. Hunter, R. E.," is being prepared for the Quarter Master General; sheet No. 7 N. W. of the N. E. Trans-Frontier series was corrected up to date and a second edition issued and 43 plates for Professional Paper No. 7 were drawn and zincographed. As the Settlement Commissioner, Central Provinces, required plots of the Hoshangabad district and forest boundaries, on the scale of 16 inches to a mile, this section had to take up the work. The plotting was done principally by contract but the examination of 254 sheets of plots of traverse line with details, employed three draftsmen for 10 months.

During the year under report 889 maps and diagrams were photozincographed against 618 in 1900-1901 and 1,002 in 1901-1902. Most of the arrears have been worked off and as the Superintendent, Forest Surveys, has reduced the number of copies of the forest sheets required by 40 per cent. it is hoped that the work will continue well up to date.

The compilation of the Professional Volume giving the results of the Spirit Levelling in India, has made fair progress. During the year 37 of the 118 lines of levels have been tabulated. Some of these had to be recomputed owing to connections having been made to tidal stations started subsequent to the levelling.

A topographical survey of the Native State of Tehri-Garhwál, as a training ground in topographical work for young officers of the Imperial and Provincial Branches of the Survey of India, having been sanctioned under Revenue and Agricultural Department letter No. 1067 of the 7th July 1902, Lieutenant R. H. Thomas, R.E., and Lieutenant L. C. Thuillier, I.A., were posted to the detachment and started the triangulation on the 20th November 1902, the former in sheet 228 and the latter in sheet 229 and 230 of the standard sheets of the United Provinces of Agra and Oudh. During the months of May and June the dust haze retarded the work and an outbreak of cholera in Lieutenant Thuillier's camp in April necessitated his closing work for three weeks until the epidemic abated. The field work closed on the 15th June 1903, by which time Lieutenant Thomas had completed the triangulation of 513 square miles and Lieutenant Thuillier had partially completed 361 square miles. As both these officers were posted to field parties early in the recess they were not able to complete the computations of their work, and hence the resulting errors could not be tabulated.

One officer of the Imperial Service, Lieutenant C. M. Browne, R.E., went through a practical course of trigonometrical, topographical and astronomical work, and nine sub-assistant superintendents of the Provincial Service were put through a course of a topographical surveying, levelling and mapping.

A sub-surveyor who accompanied a shooting party, has succeeded in surveying 38,000 square miles, making a valuable addition to the geography of western Tibet.

Six levelling staves, made by the Mathematical Instrument Office after the design of officer in charge No. 25 Party, were compared against the Standard foot with micrometers G and H of the base line equipment. Each staff is graduated on both faces, one the plain face being graduated in centesimal divisions of 12 inches and the other the red face in centesimal divisions of 12.5 inches. The first pair received in December 1902 and now marked 00 and 04 showed that the red faces were extremely well graduated, each division averaging 0.12500088 inches but the divisions on the plain faces were not so satisfactory. The result of the comparisons was reported to the Assistant Surveyor-General, Mathematical Instrument Office, and the defect was remedied in the two pairs received in September 1903, as the comparisons of both faces of Staves 01, 02, 03 and 05 show that the graduation has been

very carefully made. Opportunity was also taken to examine the divisions on Troughton and Simms Steel Bar No. 1 received in September 1900.

78. The new office for the Superintendent, Trigonometrical Surveys, the construction of which was sanctioned by Government, was completed and occupied during the year.

It is a compact two-storied building containing convenient accommodation for the Superintendent and the clerical establishment of his office and for the officer in charge of the Computing Office, as well as two rooms for attached officers. There is also an excellent library room.

79. The offices of the Forest Surveys, Bengal Presidency, were under the superintendence of Major P. J. Gordon throughout the year and were employed as usual on correspondence and accounts, computations, area statements, the mapping of field surveys, the compilation of special working plans and other maps, the distribution of published maps and the up-keep of the map records of the Forest Department. During the year 269 maps have been sent to press and 350 have been published. On the 30th September over 450 maps were in different stages of progress and 83 were in the press. 10,117 printed maps have been distributed, of which 7,205 were coloured and 3,795 were mounted in book form.

80. The new office which was sanctioned by Government as a Head-Quarter office for the Forest Survey Branch was commenced in November 1902 and completed in the following May. The office is a large one-storeyed fire-proof building with out-houses for storing instruments, tents, etc., and is conveniently situated in the compound of the Great Trigonometrical Survey Offices. It has been specially designed as a Drawing and Map Record Office and has proved most convenient and suitable for the purpose.

Considerable numbers of original records and printed maps have already been transferred to it from Calcutta and it is hoped that by the end of the year all forest maps will be stored at Dehra Dún.

81. *North-West Frontier drawing office.*—This office has as usual been employed on the preparation of maps of the Northern and North-Western Trans-Frontier series, together with a map of the Province of Kiangsu in China, prepared under the direction of the Surveyor-General of India for the Intelligence Branch of the Quarter Master General's Department.

The following sheets were sent to press and subject to slight corrections by the Quarter Master General's Department will shortly be published:—

Northern Trans-Frontier series, sheet No. 2 S. W., scale 1 inch=4 miles. *North-Western Trans-Frontier series*, sheet No. 333, scale 1 inch=2 miles; No. 15 N. W. (2nd edition), No. 15 S. W. (2nd edition), No. 15 N. E. (5th edition), No. 15 S. E. (3rd edition), scale 1 inch=4 miles. *China Survey*, map of the Province of Kiangsu, scale $\frac{1}{1,000,000}$. *General Map*, India sheet No. 1, scale 1 inch=32 miles.

A list of maps is in course of preparation showing the number of sheets of the $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ -inch scales of the Northern and North-Western Trans-Frontier series and those of the South West Asia series that require either new editions or corrections to bring them up to date. The present staff of this office is not sufficiently strong to cope with its current work, and if any attempt is to be made to revise and keep up to date the older editions of the maps, a considerable increase to its strength will be necessary.

LOCAL DRAWING OFFICE.

82. These continued the compilation of one inch topographical maps from cadastral surveys. Such maps are published as preliminary editions, and require supplementary survey in the field before they fulfil the requirements of military topographical maps.

83. One such drawing office is located at Naini Tal in the United Provinces, one in Bengal at Calcutta and a third in Assam at Shillong. The progress made in the mapping in these offices is to be found in Part II.

There still remains a large amount of arrears of this mapping, to cope with which the drawing establishments have been increased.

84. The drawing offices for the compilation of geographical maps of the frontiers of India and Burma were employed as usual at Mussooree and Bangalore.

ESTABLISHMENT.

85. The department has lost the services of one officer of the Imperial Service during the year.

Lieutenant F. B. Tillard, R.E., Assistant Superintendent, 2nd grade, died at Mussooree on the 2nd May 1903. He joined the Survey of India on the 11th April 1901 and during the short period he was found to be a most able and promising officer, and his untimely death is a great loss to the department.

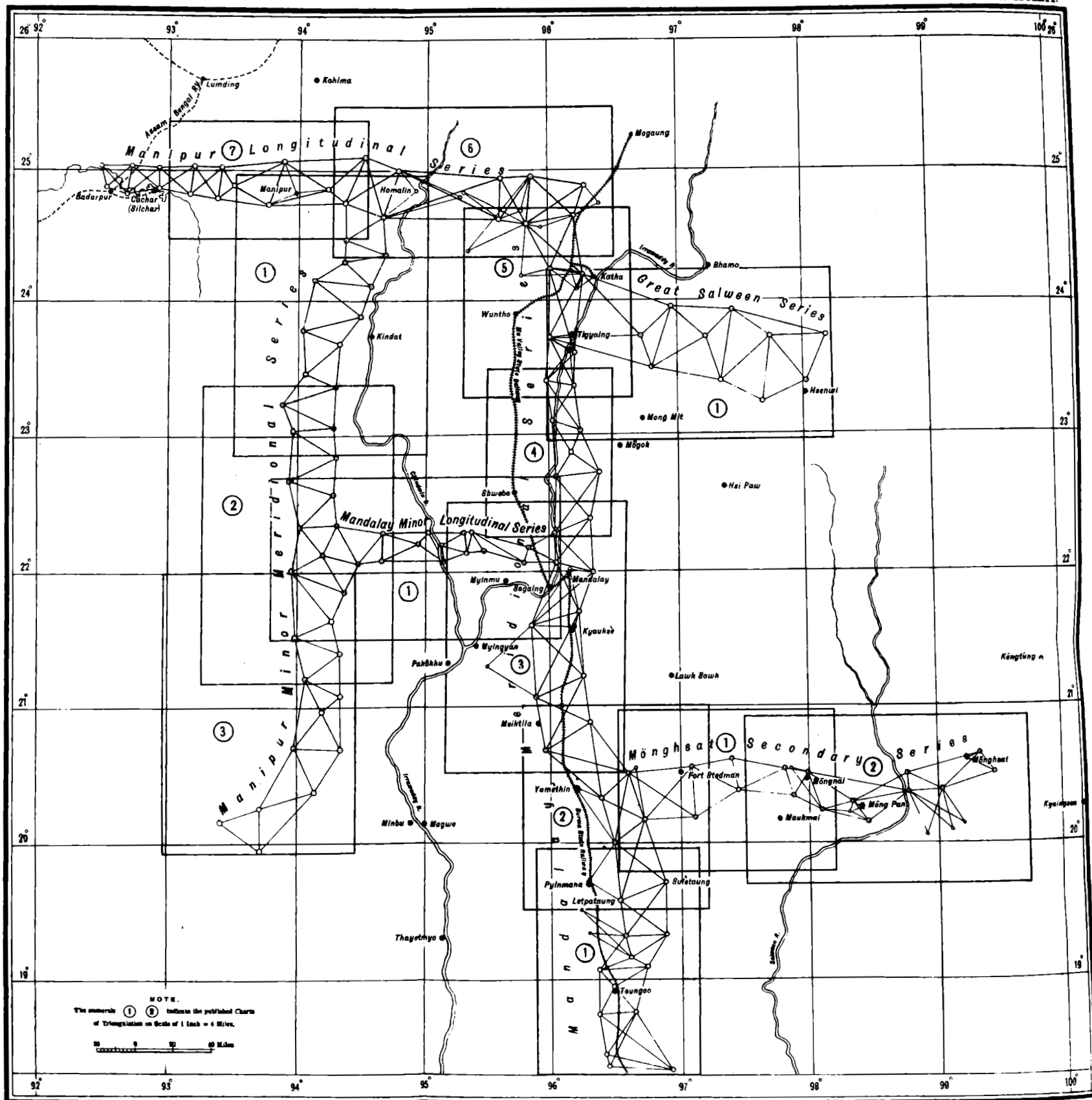
86. In the Provincial Service the department has lost the services of nine officers during the year, *viz.*, by the retirement of Messrs. H. Todd, E. J. Connor, T. H. Rendell, G. Campbell, W. A. Fielding, and Ahmed Ali Khán, Khán Bahádur; and by the death of Mr. J. Keating. Mr. H. R. Hunter resigned his appointment and Probationary Sub-Assistant Superintendent Abdus Sami was discharged.

INDEX TO THE CHARTS OF THE PRINCIPAL TRIANGULATION

OF THE

MANDALAY MERIDIONAL AND LONGITUDINAL, MANIPUR MERIDIONAL AND LONGITUDINAL AND GREAT SALWEEN SERIES.

No. 24 PART.



NOTE.
The numbers ① ② indicate the published Charts
of Triangulation on Scale of 1 Inch = 4 Miles.

0 20 40 60 Miles

PART II.

THE OPERATIONS OF THE SEVERAL FIELD PARTIES.

TRIGONOMETRICAL SURVEYS.

INDIA TRIANGULATION.

NO. 24 PARTY.

Personnel.

Captain H. Wood, R.E., Officiating Deputy Superintendent, 2nd grade, in charge.
 Mr. D. J. Hunter, Sub-Assistant Superintendent, 1st grade.
 Mr. C. D. Simons, Sub-Assistant Superintendent, 3rd grade.
 4 Recorders and 1 Writer.

87. The party remained under charge of Captain Wood (promoted from Lieutenant early in the year) during the season under review.

88. The programme was to continue eastwards the Great Salween series in Upper Burma, but previous to this it was employed in executing a small figure of triangulation on the hills north of Mussooree, and also in obtaining by means of simultaneous reciprocal vertical angles, the difference in height between two bench-marks of the Levelling detachment of No. 25 Party, one on either bank of the river Irrawaddy near Sagaing in Upper Burma.

89. The party took the field for the Mussooree work on September 20th, 1902, and after the completion of it left for Burma. Observations were not begun there for the principal triangulation till December 6th. The weather remained favourable for work until March 12th when haze and smoke prevented further observations being made. Mussooree, the recess quarters, was reached on April 16th.

90. During the recess the computations were completed. The season's outturn of work being—

PRINCIPAL TRIANGULATION.

| | |
|---|-------|
| Number of stations newly fixed | 10 |
| Number of figures completed | 2 |
| Length of series completed, in miles | 80 |
| Area of triangulation, in square miles | 3,310 |
| Number of stations at which astronomical azimuths were observed | 1 |
| Mean triangular error (12 triangles) | 0.408 |

SECONDARY TRIANGULATION.

| | |
|---|-------|
| Number of stations newly fixed | 3 |
| Number of figures completed | 1 |
| Length of series completed, in miles | 10 |
| Area of triangulation, in square miles | 120 |
| Number of stations at which astronomical azimuths were observed | 1 |
| Mean triangular error (7 triangles) | 1.444 |

91. The Superintendent, Trigonometrical Surveys, inspected the party in recess quarters on June 23rd, 1903.

TOPOGRAPHICAL SURVEYS.

LOWER BURMA.

NO. 3 PARTY.

Personnel.

Mr. E. F. Litchfield, Officiating Superintendent, 2nd grade, in charge up to 22nd July 1903.
 Mr. P. J. Doran, Extra Assistant Superintendent, 1st grade, in charge from 23rd July 1903.
 Mr. J. Keating, Extra Assistant Superintendent, 4th grade.
 Mr. C. George, Extra Assistant Superintendent, 4th grade.
 Mr. W. M. Gorman, Extra Assistant Superintendent, 6th grade.
 Mr. J. Donaghey, Sub-Assistant Superintendent, 1st grade.
 Mr. E. Claudius, Sub-Assistant Superintendent, 2nd grade.
 Munshi Asmatulla Khan, Sub-Assistant Superintendent, 3rd grade.
 29 Sub-Surveyors, etc., and 1 Writer.

92. The party suffered a serious loss by the death of the senior assistant Mr. J. Keating, who died suddenly on the 4th December 1902, the morning after his arrival at Prome. He was an efficient, conscientious, and hard working officer.

93. The party left recess quarters at Bangalore between the 27th November and the 9th December, one triangulator being sent in advance on the 30th September. The field season closed at the end of May, and the recess office opened at Bangalore on the 12th of June.

Four camps were formed. The head-quarters camp at Prome, camp I working first in the Thayetmyo and Magwe districts and afterwards in the Hanthawaddy district, and camps II and III in the Henzada and Tharrawaddy districts. These three camps were each under a provincial officer.

94. The season's programme of work was as follows—

- (a) The detail survey of sheets 204, 205, 206, 164, 165, 166, 211, 212, 213, 214, 215. This included the supplementary topographical survey (hitherto called "revision survey") of parts of these sheets which had been previously surveyed by the revenue survey.
- (b) Triangulation and traversing in sheets 211 and 215 and parts of 164, 165, 166, for both detail and supplementary work.

With the exception of the supplementary topographical survey of sheet 215 this programme was successfully accomplished.

The area triangulated in advance which it is usual to provide for the detail survey of subsequent seasons has become dangerously small. This will be rectified by triangulating a large area during the coming field season.

95. The outturn is as follows—

| | Square miles. |
|--|---------------|
| Detail survey on 1-inch scale | 1,786 |
| Supplementary topographical survey | 2,934 |
| Triangulation for detail survey | 569 |
| Triangulation for supplementary topographical survey | 1,319 |
| Traversing for detail survey | 324 |

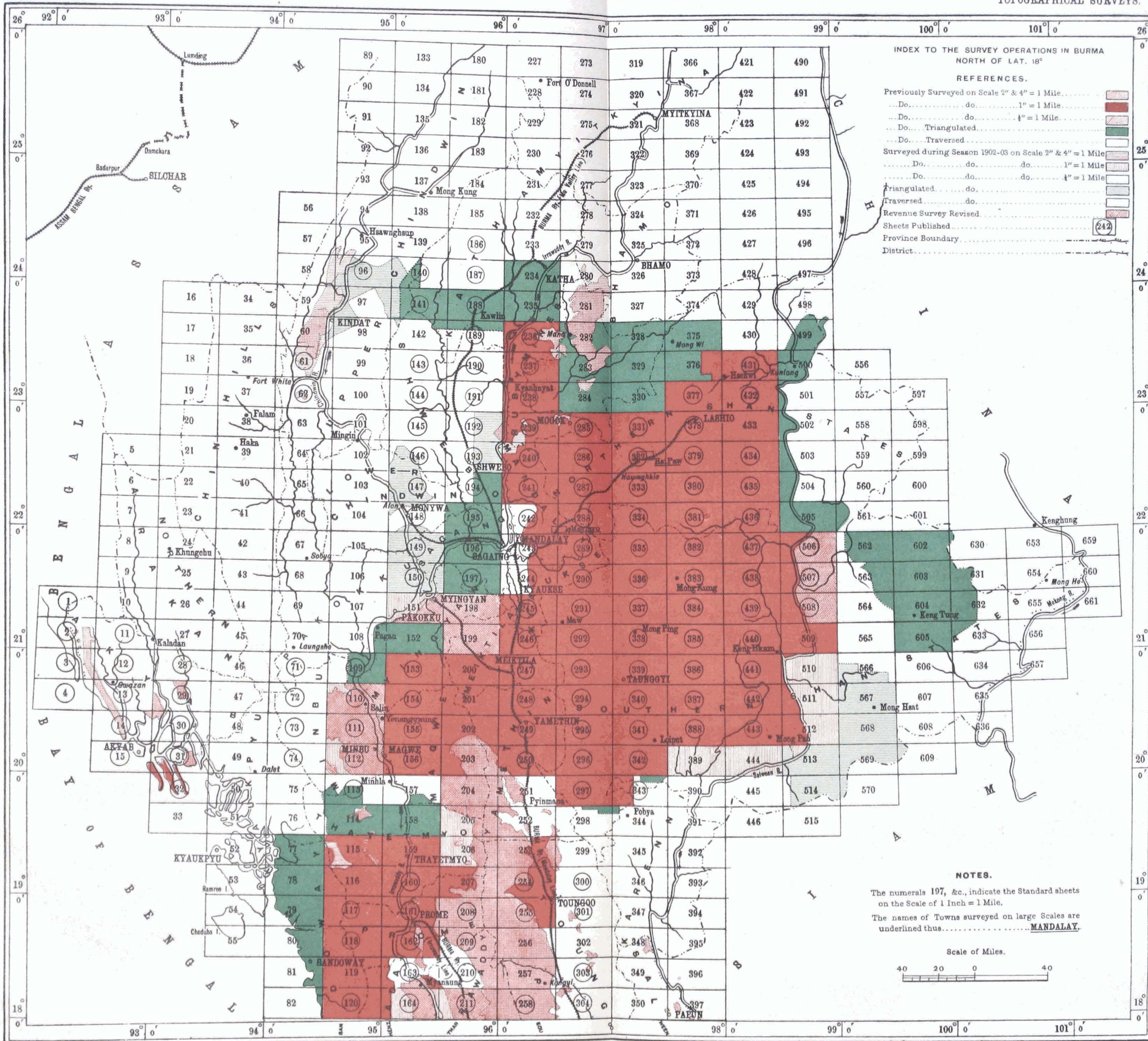
This outturn is considerably in excess of that of last year. The area covered by the supplementary topographical survey was composed almost entirely of the open highly cultivated paddy lands bordering the Irrawaddy and the railway line. The triangulation undertaken for the supplementary survey as stated in last year's report, was confined to the fixing of a few trijunctions, pagodas, etc., and providing heights.

96. The total expenditure of the party is ₹95,000 and the cost-rates per square mile are, as follows—

| | R |
|--|------|
| Detail survey on 1-inch scale | 21.8 |
| Supplementary topographical survey | 11.5 |
| Triangulation for detail survey | 8.1 |
| Triangulation for supplementary survey | 2.9 |
| Traversing | 12.1 |

The traversing consisted of a zig-zag line run down the middle of an un-surveyed area between the Irrawaddy and the Myitmakha stream, the periphery of which had been previously traversed. Hence the low cost-rate.

97. The season on the whole was a healthy one. There were no deaths and the cases of serious illness were few.



INDEX TO THE SURVEY OPERATIONS IN BURMA
NORTH OF LAT. 18°

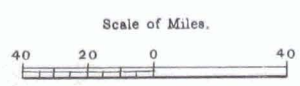
REFERENCES.

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| Previously Surveyed on Scale 2" & 4" = 1 Mile | [Red box] |
| Do. do. do. 1" = 1 Mile | [Green box] |
| Do. do. do. 1/2" = 1 Mile | [Blue box] |
| Do. Triangulated | [White box] |
| Do. Traversed | [Grey box] |
| Surveyed during Season 1902-03 on Scale 2" & 4" = 1 Mile | [Light Green box] |
| Do. do. do. 1" = 1 Mile | [Light Blue box] |
| Do. do. do. 1/2" = 1 Mile | [Light Grey box] |
| Triangulated do. | [Light Green box] |
| Traversed do. | [Light Blue box] |
| Revenue Survey Revised | [Light Green box] |
| Sheets Published | (242) |
| Province Boundary | [Dashed line] |
| District | [Dotted line] |

NOTES.

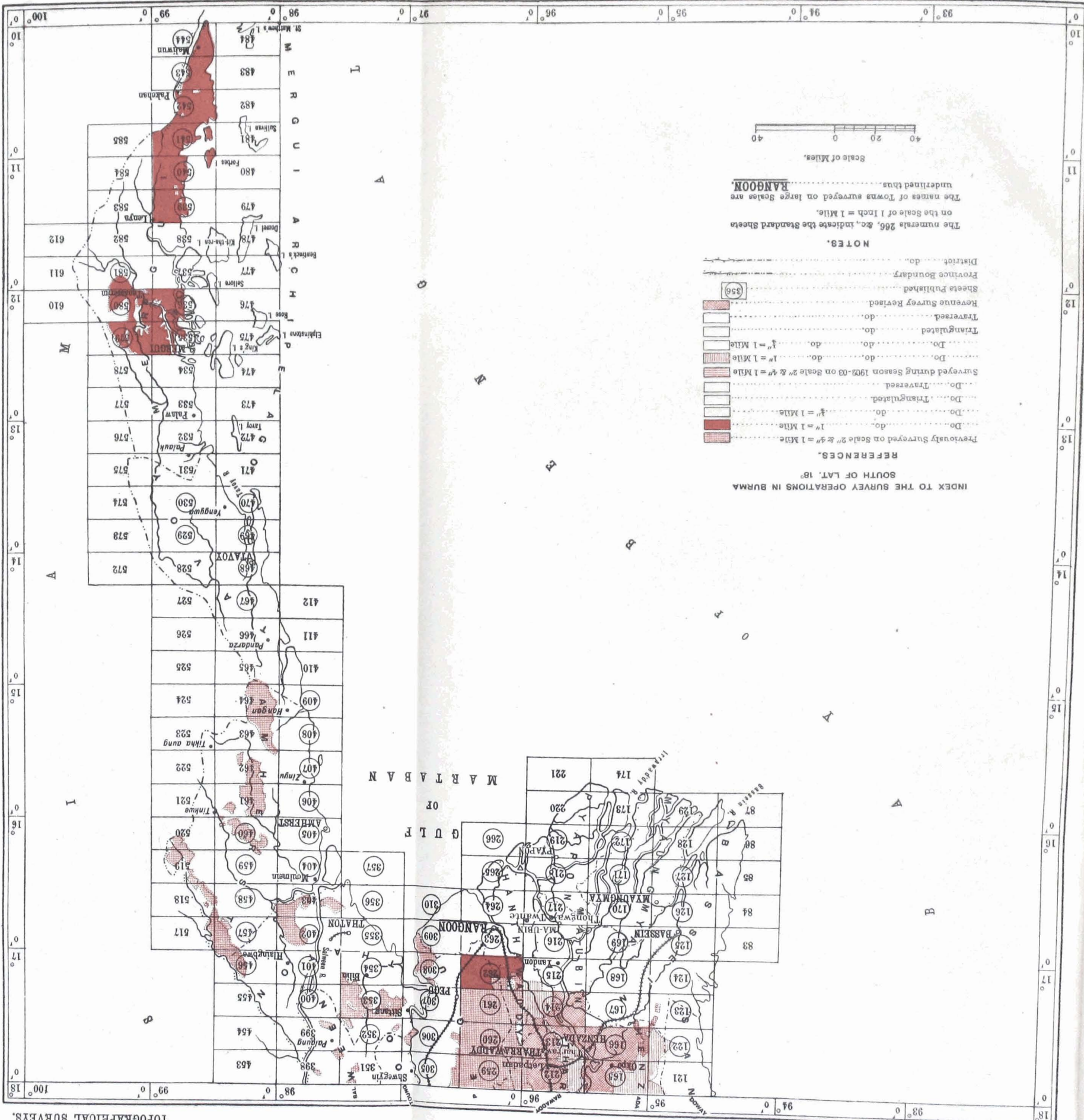
The numerals 197, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

The names of Towns surveyed on large Scales are underlined thus.....MANDALAY.



BURMA SURVEY.

TOPOGRAPHICAL SURVEYS.



INDEX TO THE SURVEY OPERATIONS IN BURMA SOUTH OF LAT. 18°

REFERENCES.

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- Do. do. 1/21062458344184202415197317159278977777888" = 1 Mile
- Do. do. 1/42124916688368404830394634318557955557776" = 1 Mile
- Do. do. 1/842498333767368096607892686371159111115552" = 1 Mile
- Do. do. 1/1684996667334736193215773726742282222336" = 1 Mile
- Do. do. 1/3369993334669472386431547453484564444672" = 1 Mile
- Do. do. 1/67399866693389447728628949069691288889344" = 1 Mile
- Do. do. 1/13479973338677889545725798013938577777888" = 1 Mile
- Do. do. 1/26959946677355779091455960027877155557776" = 1 Mile
- Do. do. 1/53919893354711558182911180055754311111568" = 1 Mile
- Do. do. 1/10783978670942311636582236011150862222336" = 1 Mile
- Do. do. 1/2156795734188462327316462002230174444672" = 1 Mile
- Do. do. 1/4313591468376924654632924004460348889344" = 1 Mile
- Do. do. 1/8627182936753849309265848008920697777888" = 1 Mile
- Do. do. 1/172543658735076986185316960178413955557776" = 1 Mile
- Do. do. 1/345087317470153972370633920356827911111568" = 1 Mile
- Do. do. 1/69017463494030794474126784071365582222336" = 1 Mile
- Do. do. 1/1380349269880615894882535681427117444672" = 1 Mile
- Do. do. 1/27606985397612317897751113628542348889344" = 1 Mile
- Do. do. 1/55213970795224635795502227257084697777888" = 1 Mile
- Do. do. 1/110427941590449271591004445154163955557776" = 1 Mile
- Do. do. 1/220855883180898543182008890308327911111568" = 1 Mile
- Do. do. 1/4417117663617970863640177806166558222336" = 1 Mile
- Do. do. 1/883423532723594172728035561233113444672" = 1 Mile
- Do. do. 1/17668470654471883454560711224662268889344" = 1 Mile
- Do. do. 1/35336941308943767109121424481324537777888" = 1 Mile

98. The country under detail survey in the Thayetmyo district was similar in character to that previously described. In the Henzada district this area was confined to the eastern slopes of the Arakan Yoma. In the Tharrawaddy district the detail was confined to the narrow strip of swampy grass land between the Irrawaddy and the Myitmakha stream. The area under supplementary topographical survey was composed mainly of paddy fields. Some important additions were made, such as the Letpadan Bassein railway line, some new roads, villages, cultivation, etc., but the revenue survey work was found to be extremely accurate.

99. The fair mapping, though still in arrears, has made more rapid progress than it did last year. Sheets 115, 117, 118, 120, 259, 260, 261 have been sent for publication; whilst sheets 116, 119, 159, 163, 204, 211, 212, 213, 214, 254 and 255 are ready for final examination. Sheets 164, 165, 166, and part of 207 will be completed in the Bangalore drawing office during next field season. The outlining of these sheets is finished and the hill drawing of all but one is well advanced. Sheets 119 and 163, though nearly ready last year, were kept back pending the settlement and survey of some boundaries. The spelling of the names was examined and corrected by the Government Translator in the Burma Secretariat.

100. The programme for field season 1903-04 is as follows:—

- (1) Detail and supplementary survey of sheets 113, 114, 157 and 158, and eastern parts of 75 and 76, up to the crest of the Yonins.
- (2) Triangulation and traversing in sheets 251, 252, 298, 299 and 300.

The following five years' programme has, with the approval of the Burma Government, been sanctioned for this party—

| Year. | Programme. |
|---------------|--|
| 1902-03 . . . | Completion of sheets 164, 165, 166, 204, 205, 206, 211, 212, 213, 214 and 215. |
| 1903-04 . . . | 113, 114, 157, 158, and eastern parts of 75, 76. |
| 1904-05 . . . | Completion of 251, 252, 298, 299, 300. |
| 1905-06 . . . | Completion of 301, 302, 303, 304, 305, 306. |
| 1906-07 . . . | 77, 78, 79, 80, 81, 82. (These sheets are already triangulated.) |
| 1907-08 . . . | 32, 33, 50, 51, 52, 53, 54, 55, and western halves of sheets 75 and 76. |

101. The party was inspected by the Surveyor-General and Deputy Surveyor-General during the recess.

UPPER BURMA.

NO. 10 PARTY.

Personnel.

Captain F. W. Pirrie, I.A., Officiating Deputy Superintendent, 1st grade, in charge from 7th December 1902.
 Lieutenant A. A. McHarg, R.E., Officiating Deputy Superintendent, 2nd grade, in charge up to 6th December 1902.
 Mr. R. Waller-Senior, Extra Assistant Superintendent, 4th grade.
 " P. J. Barrington, " " " 5th "
 " F. P. Walsh, " " " 6th "
 " W. G. Jarbo, Sub- " " " 2nd "
 " C. West " " " 3rd "
 20 Sub-Surveyors and 1 Writer.

102. Lieutenant A. A. McHarg, R.E., held charge of this party up to 6th December 1902 when he handed it over to Captain F. W. Pirrie, I.A., who held charge for the remainder of the year.

103. The party left recess quarters for the field in two detachments on 29th October and 5th November 1902 and arrived again at recess quarters in various detachments between 30th April and 25th June 1903.

104. The survey operations were of the same nature as those carried out during the past four years and consisted of topographical survey over new ground on the scale of 1 inch = 1 mile and supplementary topographical survey on the same scale on the ground previously cadastrally surveyed in the districts of Meiktila, Myingyan, Kyaukse, Sagaing, Pakòkku, Magwe and Minbu.

Towards the close of the field season additions to the map of Maymyo on the scale of 16 inches = 1 mile were carried out and the map brought up to date for a second edition.

The work of the party was thoroughly supervised and checked by the officer in charge and his assistants during the field season.

105. The outturn for the field season was as follows :—

| | Square miles. |
|----------------------------------|---------------|
| Triangulation | 3,403 |
| Detail survey | 3,336 |
| Maymyo revision survey | 19 |

The cost-rates per square mile were as follows :—

| | <i>R a. p.</i> |
|-------------------------|----------------|
| Triangulation | 12 1 3 |
| Detail survey | 19 1 11 |

106. Triangulation was carried out in the Pakòkku, Myingyan, Lower Chindwin, Sagaing and Shwebo districts for future detail survey.

The secondary series between the Great Trigonometrical Mandalay meridional series near Katha and the secondary Great Trigonometrical Manipur meridional series near Kindat for future topographical and forest surveys was completed.

The detail survey in the field comprises the following 1-inch standard sheets : 198, 199, 151, 110, 111, 112. The ground topographically surveyed varied much in character. In Myingyan, Meiktila, Sagaing, Kyaukse and Pakòkku districts the country was open and free from forest, while the ground was much cut up by ravines in Magwe and the view obstructed by large trees and forest in Minbu district which added to the difficulty of the detail survey. The area of both triangulation and detail survey was slightly less than that of the previous year owing to the difficulty of the triangulation in the Upper Chindwin and parts of Shwebo districts where eventually careful height traverses had to be substituted for triangulation, and the intricate nature of the ground surveyed in detail in Minbu district.

The additions required to the Maymyo map consisted of new roads, buildings, forest and other boundaries, and the work was carried out by a provincial officer and four sub-surveyors toward the close of the field season.

107. The health of the party was good as only one death from fever in the menial establishment took place during the field season. One sub-surveyor died at his home during recess, and the writer of the party died of plague at Bangalore just before the party left for the field in October 1903.

108. During recess the computations for those portions of the triangulation required for next season's work were completed, standard sheets 110, 111, 112, 202, 203, 198, 199 and 151 were fair drawn, and as many of these as possible will be sent for publication in November 1903. The second edition of the Maymyo map on the scale of 16 inches = 1 mile was completed and sent for publication. Atlas and degree sheet data were despatched to the Calcutta and Bangalore drawing offices, and the preparation of triangulation charts for publication proceeded with during recess.

109. The programme for next field season is as follows :—

The triangulation of the remaining portions of 1-inch sheet 109 and 148 and the whole of sheet 108 and perhaps 107, if time admits.

Theodolite height traverses in the portions of sheets 145, 147, 192, 193, 194, not already triangulated.

The officer in charge of the party will himself connect by triangulation the existing triangulation east of Kalewa and the secondary Great Trigonometrical Manipur meridional series to the west.

The detail survey on the scale of 1 inch = 1 mile, partly new and partly supplementary, of sheets 146, 147, 192, 193, 194, 195.

110. The following five years' programme has been sanctioned for this party and will be kept to as nearly as may be possible :—

| Year. | Programme. |
|-------------------|--|
| 1902-03 | Sheets 110 111, 112, 151, 198 and 199. |
| 1903-04 | " 145, 146, 192, 193, 194 and 195. |
| 1904-05 | " 147, 148, 149, 150, 196 and 197. |
| 1905-06 | " 105, 106, 107, 108, 109 and 152. |
| 1906-07 | " 101, 102, 103, 104, 73 and 74. |
| 1907-08 | " 143, 144, 190, 191, 71, 72 and revision of western portion of sheets 242, 243 and 244. |

111. The party was inspected by the Surveyor-General in September, who expressed himself pleased with the state of the work.

UPPER BURMA.

NOS. 11 AND 21 PARTIES.

112. The party remained in the charge of Mr. P. J. Doran till 5th February 1903, and from 6th February till 26th September, in that of Captain C. H. D. Ryder, R.E., who then received orders to make over charge to Mr. W. M. Kelly and proceed to join the Sikkim Tibet Mission in Sikkim. Mr. Doran was temporarily transferred to the charge of No. 3 Party on 23rd July 1903.

Personnel.

Captain C. H. D. Ryder, R.E., Officiating Superintendent, 2nd grade, in charge from 6th February to 26th September.

Mr. P. J. Doran, Extra Assistant Superintendent, 1st grade, in charge up to 5th February.

Mr. W. M. Kelly, Extra Assistant Superintendent, 3rd grade, in charge from 27th to 30th September.

Mr. J. H. Nichol, Extra Assistant Superintendent, 6th grade.

Babu Pramadarajan Roy, Sub-Assistant Superintendent, 2nd grade.

Mr. P. A. T. Kenny, Sub-Assistant Superintendent, 2nd grade.

Mr. H. C. W. Stotesbury, Sub-Assistant Superintendent, 2nd grade.

Mr. V. W. Morton, Sub-Assistant Superintendent, 3rd grade.

24 Surveyors, Sub-Surveyors, etc. and 1 Writer.

113. The party left Bangalore at the end of October and reached the scene of operations about middle of December, the last man taking up work about the end of that month. They returned early in May.

114. The country surveyed in detail on the one inch scale was that portion of the Southern Shan States situated on the eastern side of the Salween river lying between Latitude 20° 10' and 21° 0' falling in sheets 510, 511 and 512 and that on the west of the Salween between Latitude 20° 0' and 20° 15' and Longitude 97° 30' and 98° 30' comprising sheets 389, 444 and part of 513. It was for the most part very hilly and covered with jungle and was fairly populated, averaging a village to every 10 miles, the cultivation mostly *taung-ya* (hill cultivation) producing sufficient for local consumption both in cereals and vegetables.

115. The work completed during the season under report is:—

| | Square miles. |
|---|---------------|
| Triangulation for one inch survey | 1,797 |
| Detail survey on the one inch scale | 2,432 |

The cost-rates per square mile were as follows:—

| | R | s. | p. |
|---|----|----|----|
| Triangulation for one inch survey | 10 | 7 | 2 |
| Detail survey on the one inch scale | 28 | 3 | 8 |

The country triangulated for the one inch scale lying in sheets 567 to 568 and parts of 569, 609, 513 and 514 in its natural features resembled much the ground surveyed in detail, although the hills are higher and the low ground very broken, all covered with dense jungle, the low ground particularly being overgrown with brushwood and high grass.

The outturn, both of topography and triangulation, is very satisfactory considering the obstacles and difficulties which had to be overcome.

The surveys were rigidly tested and the men were constantly visited during the season; difficulties were overcome with the surveyors present and their errors shown them on the spot. The work has proved very good.

116. During the recess the party has completed the fair drawing for publication in two colours as well as in black only, all the one inch work surveyed during the season with the exception of a portion of that done in 513. In order to enable the hills to be printed either in black or in colour, blank spaces have been left in the hill shading where the names will fall in the completed map.

The computation of the triangulation has also been finished and the results are satisfactory. The only arrears consist of the triangulation charts of the parties and these are being pushed on so as to be out of hand as quickly as possible. Seven of these charts have been completed for publication during this recess.

117. The health of the party was not as good as in previous years, there were several cases of fever and dysentery, some very sudden and severe. There were four deaths among the menials.

118. The Government having ordered that the whole of the Shan States up to the frontier should be surveyed on the one inch scale, the following programme has been sanctioned for the coming season.

Detail one inch survey of sheets 568, 513 and portions of 569, and 609 up to the Shan-Siam boundary and of the portions of sheets 506, 507, 508, east of the Salween river.

Triangulation in sheets 564, 565, 604, 605 and remainder of 566.

119. The party was inspected by the Surveyor-General on 7th September who expressed his satisfaction at the state of the work.

SIND.

NO. 12 PARTY.

Personnel.

Mr. C. F. Erskine, Deputy Superintendent, 1st grade, in charge up to 20th March 1903.

Lieutenant E. T. Rich, R.E., officiating Deputy Superintendent, 2nd grade, in charge from 21st March 1903.

Mr. G. G. Vander-Beek, Extra Assistant Superintendent, 2nd grade.

Mr. R. F. Warwick, Extra Assistant Superintendent, 4th grade.

Munshi Rahmatullah " " " 6th "

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

Mr. E. C. J. Bond " " " 1st "

Babu Dhani Ram " " " 2nd "

Mr. B. M. Berrill " " " 2nd "

45 Surveyors and Sub-Surveyors and 3 Writers.

120. Mr. Erskine was in charge of the party till the 21st March 1903, on which date he made over to Lieutenant E. T. Rich, R.E., who held charge of the party for the remainder of the year.

121. The survey operations were of the same nature as in the year 1901-02, and the following programme was completed:—

- (a) A series of secondary triangulation running through the Kurrachee and Hyderabad districts in portions of sheets 53, 72, 73, and 92 connecting the Cutch coast series with the Kurrachee Longitudinal series of the South-West quadrilateral.
- (b) Village boundary traverse survey in portions of sheets 34, 35, 52, 53, 54, 72, 73, 74, 92, 93, and 94.
- (c) The detail survey on the 2-inch scale of portions of standard sheets 24, 25, 42, 43, 44, 78, 79, 80, 95, 96, 97, and 98.
- (d) The detail survey on $\frac{1}{2}$ -inch scale of the desert in portions of standard sheets 80, 81, 82, 97, 98, 99, 100, 112, and 113.
- (e) The survey of the country round Jungsháhi amounting to 91 square miles on the scale of 4 inches to a mile.
- (f) A survey of the Sámbhar Salt lake in Rájputána amounting to 178 square miles.

122. The recess office at Kurrachee was closed on the 29th October 1902, and the party assembled at Mirpur Mathelo on the 3rd November. The traversing in British territory consists, as in former years, of a village boundary survey with offsets. There were 8 main circuits measured, 13 sub-circuits and 494 village circuits. The angular work was checked by observations for azimuth at 80 stations on main and sub-circuits, the average angular error per station being 45". The linear measurements amounted to 2,727 miles and were checked by 29 connections with the stations of the minor triangulation executed by this party and with some stations of the Cutch coast series. The average correction per 1,000 links was 0.46 link. No permanent marks were laid down at traverse stations, but the marks erected by the revenue authorities to demarcate village boundaries have been utilized and the angles of the village boundaries have been fixed by offsets. The cost of the traverse survey amounts to R13-12-2 per square mile.

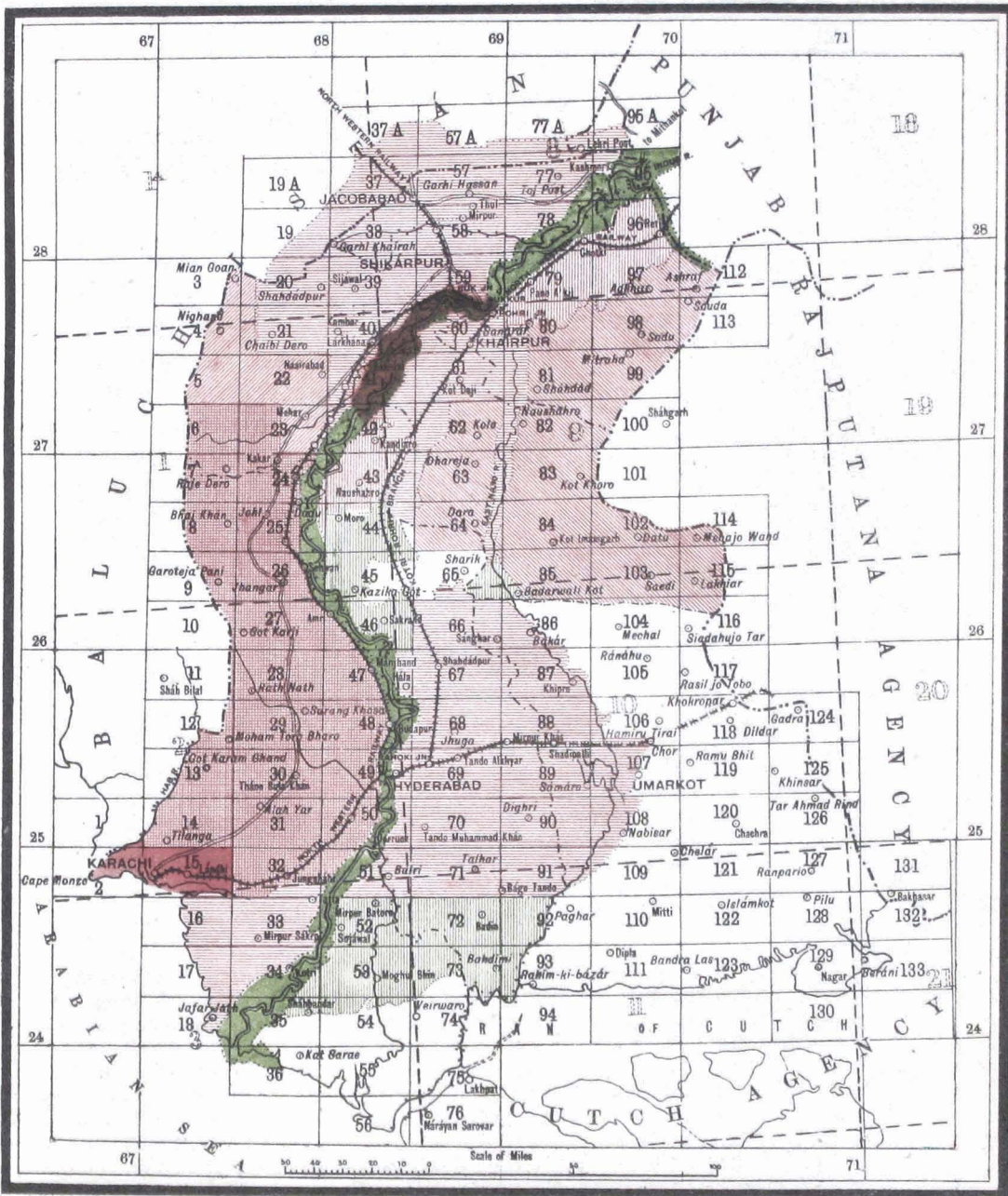
123. The area surveyed in detail on the 2-inch scale amounts to 1,946 square miles, giving 49 plane-table sections. The survey was carried out entirely by interpolation. It was tested from 1,135 *in situ* fixings and was carried out under the direct supervision of the officer in charge. The cost of detail survey is R13-3 per square mile.

124. The survey of the desert in sheets 80, 81, 82, 97, 98, 99, 100, 112, and 113, on the half inch scale, was completed during the field season. The area surveyed amounts to 2,164 square miles, giving 5 plane-table sections. The

SIND SURVEY.

1902-1903

Nos. 12 and 15 PARTIES



No. D. 150, S. I. 5-10-1903-549

Photographed at the Office of the Triangulation Branch, Survey of India, Dabra Din, February 1904.

REFERENCES.

- Surveyed in previous Seasons Scale 1" = 1 Mile by No. 19 Party
- Do. do. do. 8" = 1 Mile do.
- Do. do. do. 4" = 1 Mile do.
- Do. do. do. 1" = 1 Mile do.
- Do. 1902-1903 5" = 1 Mile do.
- Do. do. do. 1" = 1 Mile do.
- Triangulated and Traversed in advance do.
- Surveyed in previous Seasons Scale 1" = 1 Mile by No. 15 Party.
- Do. 1902-1903 1" = 1 Mile do.
- Indus Riverain Survey

Reg. No. 38-S 04.

NOTES.

The numerals 63, etc., indicate the Standard sheets on the Scale 1 Inch = 1 Mile.
The figures and lines in strokes represent the numbers and limits of the Engraved sheets of the Indian Atlas.

survey was carried out entirely by interpolation, and was tested from 161 *in situ* fixings. The cost of the survey is ₹5-8-1 per square mile.

125. The contoured survey of the country round Jungsháhi was undertaken and completed at the request of the Military authorities on the scale of 4 inches = 1 mile. The area surveyed amounts to 91 square miles, giving 9 plane-table sections. The survey was carried out entirely by interpolation and the heights by the clinometer. It was tested by 87½ miles of test line fixings. The cost of the survey is ₹48-8-1 per square mile.

126. The survey of Sámbar Salt lake in Rajputáná on a scale of 2 inches = 1 mile was undertaken and completed at the request of the Geological Survey Department. The area surveyed amounts to 178 square miles. The detail survey was carried out entirely by interpolation and clinometric heights were taken at nearly every fixing; it was tested from 97 *in situ* fixings. The cost of this survey was ₹15-2-8 per square mile, exclusive of preliminary triangulation and levelling.

Before detail survey was commenced a preliminary series of triangulation had to be run to give points in the vicinity of the lake. Spirit levelled lines were also run round and across the dry bed of the lake in order to be able to fix accurate one-foot contours all over it. These lines amounted to 170 miles in length.

127. Field work closed by the end of March and the party returned to Kurrachee for recess.

During recess the fair mapping of the entire area surveyed in detail on the 2-inch scale was completed. The mapping comprised 39 quarter sections. They were drawn on the 2-inch scale for reduction and have all been despatched to the Trigonometrical Office, Dehra Dún, for publication. Several of the fair maps of ½-inch work have been completed and sent to Dehra for reproduction and publication and the remainder will be sent to Dehra Dún on completion of the drawing.

The fair maps of the Sámbar lake survey have all been completed and sent to Dehra for reproduction and publication. The fair maps of the Jungsháhi survey were fair drawn at Dehra Dún and have already been published. The Upper Sind Frontier District map has also been drawn on the ½-inch scale and sent to Dehra for reduction and publication on the ½-inch scale.

The triangulation and traverse charts of sheets 24, 25, 26 and 52 have been drawn and despatched to Dehra with list of co-ordinates. Those of sheets 44, 53, 54, 72, 73, and 92 will be sent when completed.

128. Next season triangulation in advance will be taken up in sheets 86, 87, 104, 105, 106, 116, 117, 118, and 124, also a small net work in sheets 45 and 65 and another net work of triangulation in sheets 35, 36, 54, 55, 56, 74 and 75.

Traversing will be done in the sheets 44, 45, and 65, also traversing in connection with the resurvey of the Jamrao canal lands in standard sheets 66, 67, 68, 69, 88, 89, 90, and 91.

Detail survey on 2-inch scale will be carried on in sheets 26, 44, 45, 46, 65, and 85, also 52 and 72.

129. The health of the party during the field season was far from satisfactory, there being a great many cases of pneumonia. From this complaint one Sindhi writer and five *khalásis* died in the field and one *khalási* soon after he reached his home on leave.

130. The party was inspected by the Superintendent, Trigonometrical Surveys.

UNITED PROVINCES OF AGRA AND OUDH.

NO. 14 PARTY.

Personnel.

Captain C. W. H. Symonds, I.A., Deputy Superintendent,
1st grade, in charge.
Mr. E. J. Biggie, Sub-Assistant Superintendent, 1st grade.
" J. K. Newland, " " 2nd "
" J. H. Williams, " " 2nd "
" H. B. Simons, " " 2nd "
65 Sub-Surveyors, Computers and 2 Writers.

131. The programme was in continuation of that of season 1901-02, namely, the traverse and topographical survey of the Allahabad and Fatehpur districts, and the traverse and detail survey, on

a scale of 12 inches = 1 *mīle*, of Allahabad cantonments. The field office was

opened at Allahabad on the 26th of October. Work was carried on until the 2nd of May 1903 and the recess office opened in Mussooree on the 20th. During the field season Mr. E. J. Biggie supervised the field work. At the commencement of the field season Messrs. Newland, Williams, and Simons were employed on main circuit traversing. On the completion of this work, each of them carried out the detail survey of one plane-table section. They were then employed on testing the work of the plane-tables in the field.

132. From the subjoined tabular statement will be seen a summary of the work completed together with the cost-rates of each different kind of work:—

| DISTRICT. | DEMARCATON. | | TRAVERSING. | | TOPOGRAPHICAL SURVEY 2 INCHES = 1 MILE. | | ALLAHABAD CANTONMENT SURVEY 12 INCHES = 1 MILE. | |
|-------------|---------------|-----------------------|---------------|-----------------------|---|-----------------------|---|---------------------------|
| | Square miles. | Cost per square mile. | Square miles. | Cost per square mile. | Square miles. | Cost per square mile. | Square miles. | Cost per square mile. |
| Allahabad . | 833 | R a. } 3 0 | 833 | R a. } 26 10 | 1,885 | R a. } 6 7 | 6.02 | { Tra. 28 13 Top. 85 0 |
| Fatehpur . | 1,280 | | 1,280 | | ... | ... | .. | |
| TOTALS . | 2,113 | 3 0 | 2,113 | 26 10 | 1,885 | 6 7 | 6.02 | 113 13 |

133. The origin of the survey used was, in the Allahabad district, the intersection of Longitude $81^{\circ} 45' 00''$ and Latitude $25^{\circ} 15' 00''$, and in the Fatehpur district that of Longitude $80^{\circ} 45' 00''$, and Latitude $25^{\circ} 45' 00''$. As a check on the angular work, observations for azimuth were made at 260 stations. Connections were made to 8 principal stations of the Gurwani and Karara Meridional series. The average error was 3.75 feet per mile.

134. The area which came under traverse survey was divided into 8 main circuits and 11 river blocks. These were again divided into 86 sub-circuits, which were found to contain 2,019 villages giving an average area of 1.04 square miles in each village. In the above 2,019 villages, 1,286 sub-traverses were run. The following statement shows the number and description of each mark used:—

| | |
|------------------------------------|---------------|
| Stones | 13,444 |
| Cylinders | 10,929 |
| Pakka trijunction points | 3,453 |
| Pegs | 429 |
| Pakka pillars | 1,985 |
| TOTAL | <u>30,240</u> |

The demarcation was carried out in accordance with the method adopted last season.

135. All the traverse computations have been completed. The arrears of the Lushai triangulation have been completed and the records and triangulation charts despatched to Calcutta. There are no arrears in the traverse section.

136. The area which has been topographically surveyed on a scale of 2 inches = 1 mile, *viz.*, 1,885 square miles, is contained in sheets 140, 141, 154, 155, 156, 157, 167, and 168. Of these all have been completed with the exception of sheets 155 and 156. The former has not been completed owing to one plane-table section having to be rejected on account of bad work. This plane-table will be resurveyed during the coming field season. The number of linear miles of check survey amounted to 246.5 miles. Each square mile of survey contained an average of 26 plane-table fixings.

137. The following fair sheets have been drawn during recess on the scale of 2 inches = 1 mile for reproduction, and will be shortly sent to Calcutta for publication, *viz.*, sheets 141, 154, 155, 167, and 168. It has been decided to draw a separate set of standard maps on the 1 inch = 1 mile scale, in which village boundaries are to be omitted. The drawing of these maps will be taken up

during the ensuing field season. The detail survey on a scale of 12 inches = 1 mile of the Allahabad cantonments has been completed and the maps drawn on 3 sheets.

138. The country traversed and topographically surveyed was similar to that of last season and no special difficulties were met with.

139. The programme for the ensuing field season comprises the following :—

- (a) Completion of the traversing of the Fatehpur and Cawnpore districts consisting of an area of approximately 2,700 square miles.
- (b) The topographical survey on a scale of 2 inches = 1 mile of 2,000 square miles in the Allahabad and Fatehpur districts.
- (c) Traverse and topographical survey of the Rewah-Allahabad boundary. Scale of survey not yet determined by the Local Government.
- (d) The supplementary survey of those portions of districts Rae Bareilly and Partabgarh, which fall within the standard sheets of Allahabad district surveyed during the season under report. This supplementary survey is experimental, in order to ascertain the value of the old maps, and whether the village trijunctions are to be found on the ground in the event of this party taking up the survey of the Oudh districts after completing Allahabad, Cawnpore, and Fatehpur, which seems highly probable.
- (e) Revision survey of those portions of Mirzapur and Jaunpur districts and Rewah which fall in sheets 156, 157, 167, 168, 169, and 170.

140. The office was inspected in the field by the Deputy Surveyor-General in November 1902 and again in March. During the recess season it was inspected in August by the Surveyor-General.

NORTH-WEST FRONTIER.

NO. 15 PARTY.

141. Mr. E. A. Wainright held charge of the party for the year under report with the exception of two months when Captain Beazeley held charge.

Personnel.

Captain G. A. Beazeley, R.E., Officiating Deputy Superintendent, 1st grade, in charge up to 2nd January 1903.

Mr. E. A. Wainright, Extra Deputy Superintendent, 2nd grade, in charge from 3rd January 1903.

Mr. J. McHatton, Extra Assistant Superintendent, 1st grade.

" G. A. Knight, " " 3rd grade.

Munshi Imám Sharíf, K.B., Extra Assistant Superintendent, 6th grade.

Babu Amar Singh, Extra Assistant Superintendent, 6th grade.

Mr. H. C. H. Cooper, Sub-Assistant Superintendent, 1st grade.

Subadar Kanak Singh, " " 2nd "

Mr. E. B. West, " " 3rd "

25 Surveyors, Sub-Surveyors, etc., 2 Writers and 1 Hospital assistant.

Munshi Imám Sharíf, K.B., was transferred to the party and Babu Amar Singh was transferred from the party and the party lost in the death of Muhammad Ali, a sub-surveyor of promise.

143. The party was divided into detachments for the following work :—

1. Sind one inch topography.
2. Triangulation in Balúchistán.
3. Traversing in Balúchistán.
4. Cantonment surveys.
5. Revision of sheets of the Khágan valley.

144. The programme submitted in last year's report has been fully carried out. In Sind the remainder of the topography allotted to the party, an area of 1,499 square miles was completed. In Balúchistán an area of 850 square miles was triangulated. The cantonments of Chakráta, Mian Mir, Umballa, Mooltan and Pesháwar with their bazars and the bazars of Ferozepore were surveyed on the 12 and 48-inch scales, amounting to an area of 45,700 square miles. An area of 1,033 square miles was revised in the Khágan valley.

145. A comparison has been now arrived at between contract labour and the use of trained soldier surveyors, in connection with the cantonment surveys. The balance of advantage seems to be in favour of the employment of soldier surveyors, especially if their services can be retained for a sufficiently long period to enable them to acquire skill in chain surveying. Their work, although slower than that of the contract surveyor is far more reliable and necessitates far less supervision.

146. During the past winter and during recess, the following fair mapping has been got through of the cantonment plans:—Nowgong, Jhānsi, Bareilly, Cawnpore, Agra and Meerut and bazars of Lucknow and Fatehgarh, have been drawn and were sent to press, but have been returned for additions now wanted by the Military authorities; the plans of Chakráta, Mooltan, Umballa and Pesháwar are in hand. Of the Sind survey one inch maps the following have been sent to press, *viz.*, sheets 3, 4, 20, 21, 24 and 25. Besides this fair mapping five sheets on the 6-inch scale have also been completed and are ready for press. The triangulation has been computed in duplicate and the traverse computations and records are up to date.

147. The programme for the ensuing season allows for the continuation of triangulation in Balúchistán and the continuation of the topography connected with it, also the continuation of the survey of cantonment plans and bazars, those of Ferozepore, Amritsar and Jullundur being surveyed this winter.

148. The office of the party was inspected by the Surveyor-General in August.

PUNJAB.

NO. 18 PARTY.

149. The field season extended from the beginning of November to end of April. This was the second year of work in the Punjab plains, previous to which the party was solely occupied with Himalayan surveys.

Personnel.

Major W. J. Bythell, R.E., Superintendent, 2nd grade, in charge up to 7th March 1903.

Captain E. A. Tandy, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 5th May 1903.

Mr. W. Robert, Extra Assistant Superintendent, 1st grade, in charge from 8th March to 4th May 1903.

Mr. G. C. Swiney, Extra Assistant Superintendent, 2nd grade.

Mr. J. O. Greiff, Extra Assistant Superintendent, 6th grade.

Mr. C. E. C. French, Sub-Assistant Superintendent, 1st grade.

Babu Maya Das Puri, Sub-Assistant Superintendent, 2nd grade.

59 Sub-Surveyors, etc., and 1 Writer.

The initial difficulties arising from so complete a change in the style of work have been much enhanced by the distracting nature of the new requirements, which are most varied and far too widely scattered to be satisfactorily dealt with by one field party.

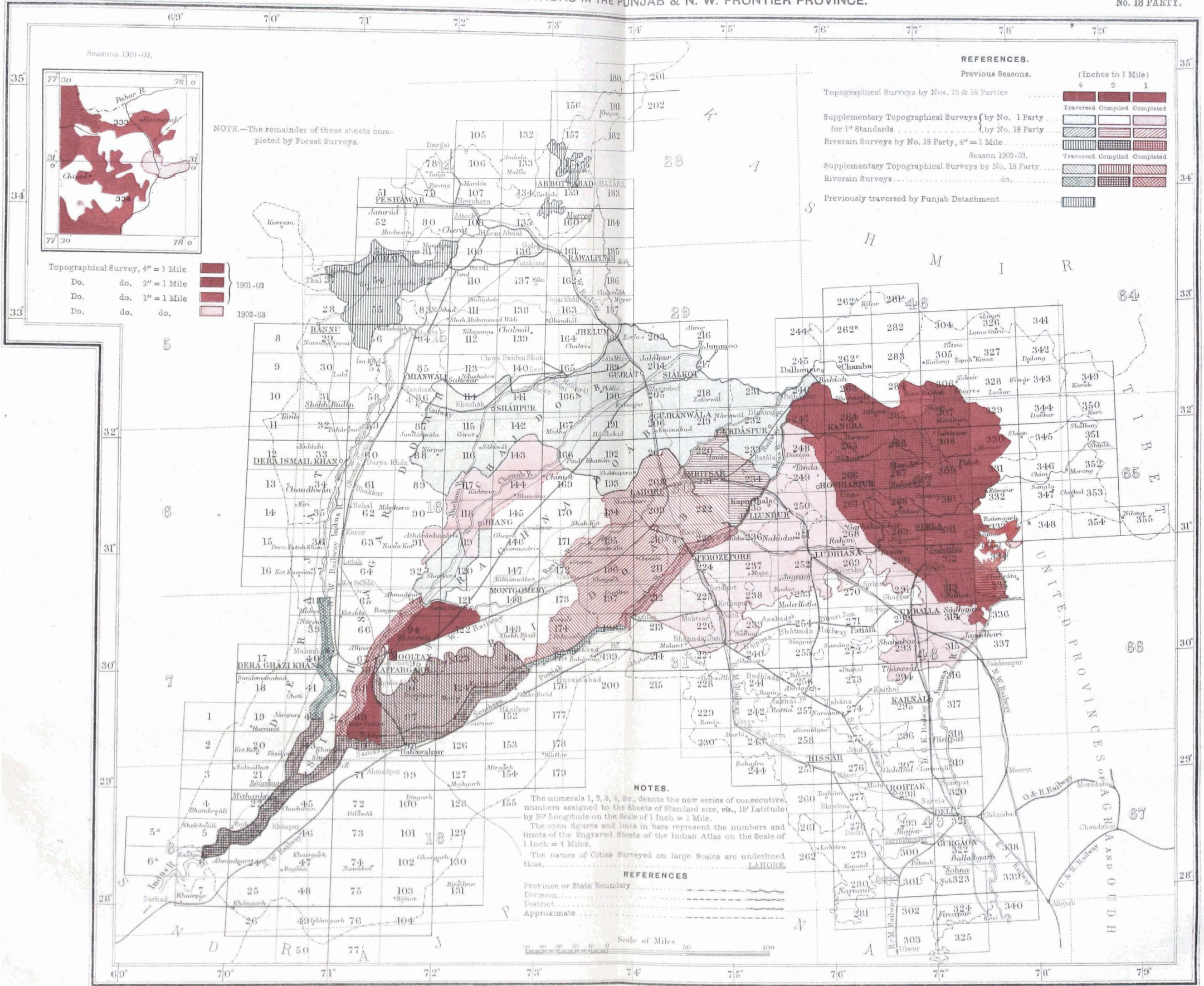
150. The different operations in hand during the year were as follows:—

- (1) Completion of fragmentary remnants of previous Himalayan work in the Simla Hill States, Tehri-Garhwál, and Jaunsár Báwar.
- (2) Supplementary topographical survey, for the preparation of standard sheets on the 1-inch scale, in parts of districts Montgomery, Lahore and Amritsar.
- (3) Preliminary compilation and traverse work with the same object in district Mooltan.
- (4) Riverain surveys on the 4-inch scale and preliminary compilations and traverse for the same, on the Chenab, Sutlej, and Indus rivers.
- (5) The Simla boundaries survey, on the scale of 50 feet = 1 inch together with the demarcation and survey on the 6-inch scale, of the preliminary suggestions for the extension of the Simla Municipal limits.

151. *Himalayan surveys.*—These consisted in the completion of blanks in sheets 333 and 334 on the 4-inch, 2-inch, and 1-inch scales. Three sub-surveyors were employed on this work for two months in the autumn of 1902; and in May 1903 another man was sent to fill up some trifling omissions. The whole area embraced in the Himalayan work of this party has now been filled, and except for

PUNJAB & N. W. FRONTIER PROVINCE SURVEY.

INDEX TO THE SURVEY OPERATIONS IN THE PUNJAB & N. W. FRONTIER PROVINCE.



NOTE.—The remainder of these sheets completed by Forest Surveys.

Topographical Survey, 4" = 1 Mile
 Do. do. 2" = 1 Mile
 Do. do. 1" = 1 Mile
 Do. do. do.

REFERENCES.

Previous Seasons. (Inches to 1 Mile)

| | | | |
|---|-----------|-----------|-----------|
| Topographical Surveys by Nos. 15 & 18 Parties | 4 | 2 | 1 |
| Supplementary Topographical Surveys (by No. 1 Party for 1" Standards) | Traversed | Completed | Completed |
| Riverain Surveys by No. 18 Party, 4" = 1 Mile | Traversed | Completed | Completed |
| Supplementary Topographical Surveys by No. 18 Party | Traversed | Completed | Completed |
| Riverain Surveys | Traversed | Completed | Completed |
| Previously traversed by Punjab Detachment | Traversed | Completed | Completed |

NOTES.

The numerals 1, 2, 3, 4, &c., 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.

REFERENCES

| | |
|----------------------------|-------|
| Province or State Boundary | ----- |
| Division | ----- |
| District | ----- |
| Approximate | ----- |



the possible necessity of strengthening weak portions, no more field work in this direction will be required until it is decided to extend the Himalayan surveys over fresh areas. On the other hand, there is a great deal of indoor work to be done; this will chiefly consist of redrawing, on 1-inch standard sheets, large portions of the work which have been so far only reproduced, as surveyed on 2-inch and 4-inch scales.

152. *Supplementary topographical surveys.*—Twelve plane-tables were employed on this work for an average of 111 working days each. The area surveyed was 3,653 square miles, which works out at $2\frac{3}{4}$ square miles per man per working day; with scattered work, however, it is hardly safe to estimate for more than one plane-table, or 64 square miles per man per month, at the present rate of progress, though it is hoped that as the men become more thoroughly versed in this work, a higher rate may be attained. For the greater portion of the season Mr. Robert and Babu Maya Das Puri were employed in the supervision of the work, which was carried out on the principles described in last year's report. The cost of this portion of the work during the past season is estimated at R6-5 per square mile; this rate allows for the drawing of the fair sheets.

153. *Reduction of masavis and compilation of field sheets.*—Seventy-five 2-inch field sections, comprising an area of 3,700 square miles and 884 villages in the southern half of Mooltan were prepared during the year. Practically the whole work of reducing the original village *masavis* was carried out at Mooltan during the field season. The compilation and completion of the field sections, together with a small amount of miscellaneous Himalayan work, was carried out by Mr. Robert and 7 surveyors during 4 months of the recess season. The total cost works out at R2-9 per square mile.

154. *Traverse work in Mooltan district.*—An area of 3,150 square miles was completed at an estimated cost-rate of R8-8 per square mile. The field work was carried out by an average of nine traversers, working under Mr. Swiney, who also had charge of the various riverain traverses, as well as of the Mooltan office, where an average of 6 computers and 4 or 5 draftsmen and probationers were employed in the pantagraphing of *masavis* and the office work and computation of all the traverses. This district traverse was of especial interest, as it was a first attempt at utilizing the data of traverses nearly 50 years old, in place of carrying out a completely new traverse survey. The traverse operations carried out by the party, to knit together the old detached village traverses, consisted in the first place of seven main circuits connected with several trigonometrical stations on the Sutlej series and two others to the north of the work; these main circuits were sub-divided by further traverses into blocks of about 50 square miles area. The new traverse lines did not follow the village boundaries but ran from trijunction to trijunction, picking up all adjacent village *base lines* on the way. In parts of the district where there is much waste land, with forest reserves and what are called jungle villages, the old work is generally useless or non-existent, and here more or less complete traversing is necessary; especially as the new settlement *masavis* are also liable to be of inferior quality.

155. *Riverain surveys.*—These surveys are carried along the riverain tracts in which state and district boundaries have recently been once for all settled. The Settlement Department have found that their surveys, based on the *square* system, when advanced from two separate districts across wide riverain tracts where all marks are annually washed away, do not join up satisfactorily; so that they cannot get a reliable map of the tract, and have very little to go upon when attempting to relay boundaries or settle disputes. The assistance of this party has therefore been requisitioned with a two-fold object; first, to afford data by which important disputes may be authoritatively disposed of; and secondly, to provide a clear and definite plan of the riverain area. The essential difficulty lies in the evanescent nature of the facts to be recorded; not only do the rivers change annually, but the boundaries have to be hurriedly relaid every autumn by means of the local method of *squares*. The actual positions of the whole of the features of the riverain tract are therefore more or less variable from year to year. A complete and rigorous survey made at the time of settlement would solve these difficulties on paper, but this could hardly be arranged for under present conditions, and also the expense would be great. It was therefore decided to run two traverses, one along each high bank, picking up trijunctions and *base lines*; and to tie both together at intervals by cross

traverses of a similar nature. The idea was that the points so obtained should be plotted geographically on the 8-inch scale, and would be sufficient to enable the village *masavis*, reduced to that scale, to be satisfactorily built together. On trial, however, it was found that the *masavis* were not accurate enough for so large a scale, so that the apparent accuracy of the results would be fictitious. Further, it was found that with wide rivers, where numerous inferior *masavis* had to be built in between traverse points, several miles apart, no definite results of any kind were obtainable; this difficulty was much enhanced by the largeness of the scale, owing to which, in a river six miles broad, compilation had to be carried across many sheets of paper. For these reasons it was decided to reduce the scale to 4-inches, and to strengthen the original traverses by a certain amount of interior traverse work. Thus the previous traverses on the Chenab and Sutlej had to be strengthened last season before compilation could be effected; and even in the coming season a certain amount of supplementary work will be necessary in the traverses just completed. A further modification of the original scheme has been adopted, and consists of sending all work into the field after compilation, in order to obtain a satisfactory map of the country; this greatly improves the resultant maps, facilitates the settlement of vexed questions on the ground, and enables the work to be subsequently incorporated with the ordinary surveys of the party. During the previous year mark-stones were embedded at intervals in the traverse lines run along the high banks; but this practice has been abandoned from motives of economy. During the past season the riverain surveys of the Chenab west of Mooltan, and the portion of the Sutlej on the Ferozepore-boundary, were tested in the field and completed. The portion of the Indus bordering Muzaffargarh was traversed, and as far as possible the compilations for this portion and for the riverain tract extending from the south-west of Montgomery district to the south of Dera Ghazi Khan were completed.

The area traversed was 1,158 square miles; map compilation was carried over 1,611 square miles; 697 square miles were tested in the field, and the fair drawing of nearly half of this was completed. The cost-rates of these operations work out at R8-8, R2 and R1-8 respectively; but owing to the incompleteness of much of the traverse and compilation the ultimate cost will be somewhat more.

156. *Drawing section.*—The section was brought down for the field season and established at Mooltan. It was further hoped that economy, on account of fuel, Simla allowances, etc., and more work, owing to a temperate climate, might ensue from this measure. But practically such a move means a great dislocation of the work twice a year; while it is impossible to bring along the whole impedimenta, or to arrange for satisfactory accommodation, with a due regard for economy; so that the field drawing is carried on amidst innumerable difficulties. It has therefore been decided not to repeat the experiment at present. Mr. Greiff held charge of this section, but had to leave it on account of traverse work soon after arrival at Mooltan, and was away about a month. On return to recess quarters measures were taken to re-strengthen the section by the enlistment of new men, but the value of their services only began to be appreciable towards the close of the year. It was decided during recess to put aside all Himalayan work, and to concentrate the whole power of the section on the new surveys.

157. *Simla boundaries survey.*—The work of testing this survey by plane-table work in the field was completed in June. Twelve sheets have been held over till next year, so as to enable the railway, which is not yet completed, to be shewn; the remaining 97 sheets have been fair drawn and partially typed. The traverse computations have been completed, as also the calculation of the areas of the 420 estates comprised in the survey; the work of taking out areas of Government blocks is still in hand. Progress was somewhat interrupted during the spring by the Deputy Commissioner calling for a 6-inch survey of certain Simla extension proposals, which was accordingly done; it included the preliminary demarcation of about 25 miles of proposed boundary, much of which consisted of laying out contour lines through difficult ground. The whole of this work has continued in charge of Mr. French, whose wide knowledge of Simla boundary disputes and difficulties has been invaluable. The work should be finished next recess, unless further extensions of Simla have to be taken up.

158. *Programme for next field season.*—It has become necessary to somewhat modify the original programme on account of the recent decision to adhere very rigidly to complete standard sheets, and, where new sheets consist partly of modern surveys, to roughly revise the latter so as to bring the whole sheet thoroughly up to date. Under these terms the immediate completion of Amritsar district has to be postponed; and the following programme has been adopted.

Supplementary topographical survey.—Southern half of Mooltan district and completion of sheet 221 in Amritsar. Traverse in Mooltan and the southern portion of Muzaffargarh district.

Compilation and reduction of masavis.—In districts Siálkot, Gurdáspur, Mooltan and Muzaffargarh.

Revision.—Portions of sheets 211, 212 and 223 in Ferozepore district, and of sheet 124 in Baháwalpur State.

Riverain surveys.—Traverses on Indus river, east of Dera Ismail Khan, Beas river, and Gujrát portion of Jhelum river, if time permits. Completion as far as possible of all portions previously traversed.

Simla survey.—Resurvey of sheets containing the new railway line, and completion of the whole work.

159. The party was inspected by the Deputy Surveyor-General in the field at Mooltan in December, and again by the Surveyor-General and Deputy Surveyor-General at Simla in June.

CENTRAL PROVINCES.

CENTRAL PROVINCES DETACHMENT.

Personnel,
Mr. R. C. D. Ewing, Extra Deputy Superintendent, 2nd grade,
in charge.
Mr. G. J. S. Rae, Extra Assistant Superintendent, 6th grade.
Munshi Ikbaluddin, K.S., Sub-Assistant " and "
33 Sub-Surveyors, etc., and 1 Writer.

160. The head-quarters camp was pitched at Garha, about 6 miles west of Jubbulpore, from which visits of inspection

were made by the officer in charge.

161. The field operations of this season commenced on 15th October and comprised—

- (a) the traversing of forest excisions and *samindári* villages which had previously been surveyed with the prismatic compass by local agency.
- (b) the supplementary topographical survey and completion of district Jubbulpore left over from last season.

162. *Traversing* consisted of enclosing polygons in skeleton (*i.e.*, without measuring offsets to boundaries) of excised portions of forest reserves, and of "jungle villages" whose revenue at time of previous survey was less than ₹15, likewise the retraversing of *samindári* villages which had previously been surveyed with the prismatic compass by local agency. The theodolite was set up on as many prismatic compass stations of the *patwári* survey as could be found or identified. There was some difficulty in effecting this, as generally there were numerous stones, similar in appearance, but undistinguishable, whether station stones of the previous survey, or land marks set up by the villagers. The help of the *patwári* in such cases was indispensable. The extent of work done in each district is as follows:—

| | No. of polygons. | Area in square miles. |
|--|---------------------|--------------------------|
| District Saugor | 2 | 1'1 |
| " Seoni | 130 | 126'4 |
| " Nimár | 4 | 9'8 |
| " Chánda | 93 | 274'8 |
| " Raipur | 120 | 162'7 |
| " Betúl | 1 | 0'9 |
| " Bhandára | 8 | 9'4 |
| " Sambalpur | 24 | 33'7 |
| Jubbulpore Town and Cantonment | 2 | 10'0 |
| TOTAL | 384 | 628'8 |

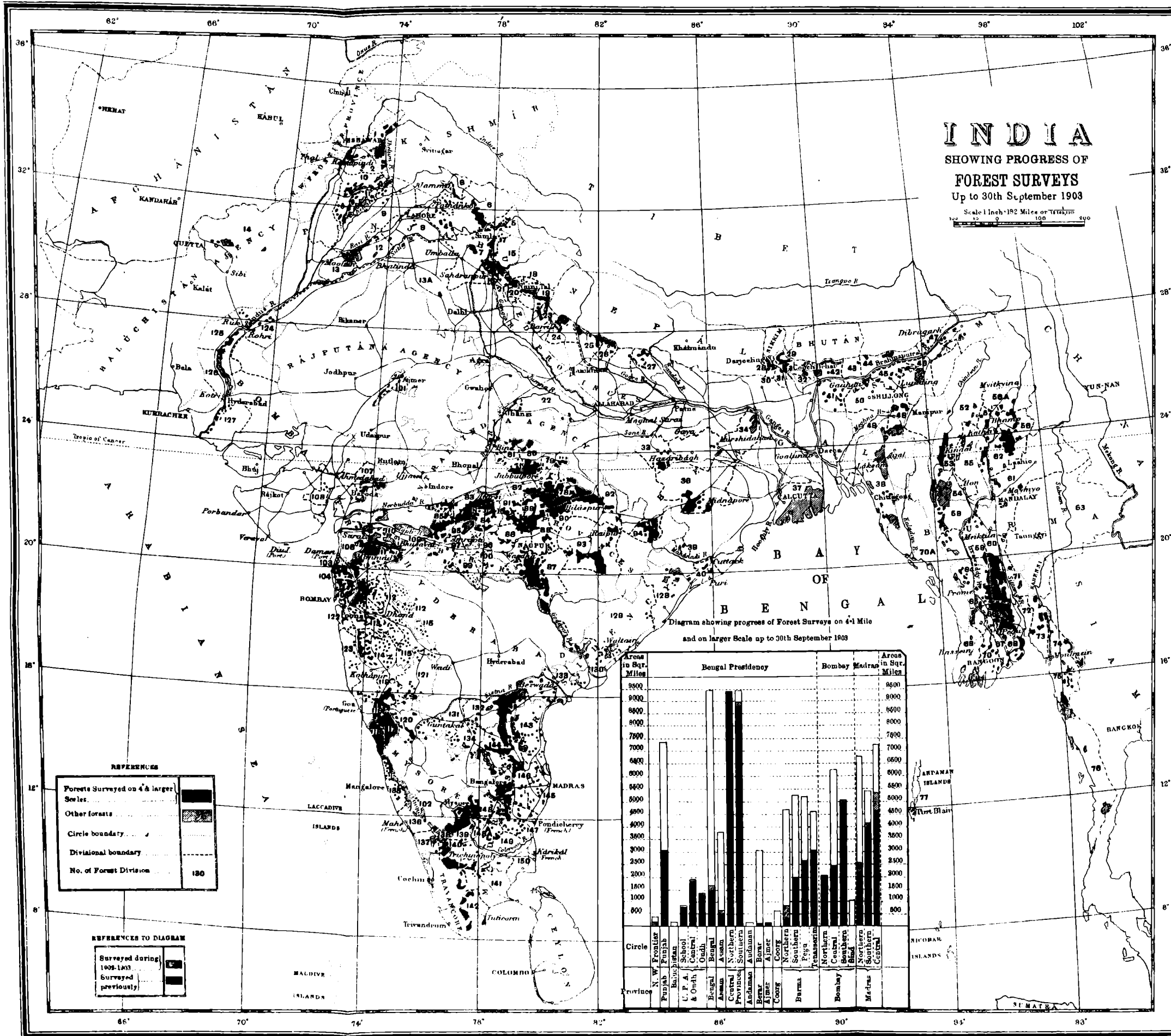
For this small area scattered through 9 districts, 8 traverse sub-surveyors were employed, which gives the average of 11.58 square miles per man per month. Owing to the scattered position of the villages, there was great loss of time in travelling by rail or marching from village to village, whereby the expense (cost-rate) was considerably increased. The polygons were too scattered to permit of main circuits, only one sub-circuit, checked by 3 azimuths, was surveyed in Raipur, *viz.*, *samindári* Khujji. Numerous villages were situated in isolated positions within Government forest reserves in Raipur, and to locate them in their true positions, connecting lines through forest had to be measured, the bearings being checked by 4 azimuths. In all 10,054 angles were observed and 1,682 miles of chaining measured, checked by 9 azimuths. The average angular error is 3.6 seconds and linear error per 100 chains, is 6 links. There was only one G. T. Survey intersected point connected, *viz.*, Kumhár-ki-Toria temple in Jubbulpore cantonment. There were no others in the proximity of the detached villages under survey. The stations of the previous professional survey being marked by stones or platforms were generally found (except a few riparian ones), as also some of the satellite stations. The new stations are rough undressed stones, embedded about 2 feet under ground and $1\frac{1}{4}$ above, marked at top with a circle and dot. The computations of the season's work have been completed and the records prepared for lodgement. 817 sheets of 384 villages have been plotted on the 16-inch scale and sent to the Settlement Department, with abbreviated sets up of traverse and rough index plots on 2-inch scale. The expenditure incurred amounts to ₹9,153.0.4 giving a cost-rate of ₹14.8.10 per square mile.

163. *Supplementary topographical survey.*—For supplementary topographical survey there were employed 18 sub-surveyors and 1 apprentice for half the season, and Mr. Rae from 9th December 1902 to 16th February 1903. The area surveyed on the 2-inch scale is as follows:—

| | Square miles. |
|---|---------------|
| District Jubbulpore | 1,748 |
| „ Damoh | 187 |
| „ Seoni | 157 |
| „ Narsinghpur | 182 |
| Overlap into Native States | 73 |
| | <hr/> 2,347 |
| Transferred to maps from reductions of forest surveys | 487 |
| | <hr/> 2,834 |

Included in the Jubbulpore area, 11 scattered villages of the Nagode State (Bundelkhand) covering an area of 27 square miles, have been surveyed to avoid gaps in the standard sheets. The work was tested by 813 interpolations and 310 miles of chaining. At the north-east corner of the district there was an insufficiency of heights. In this area, 5 stations and 46 intersected points were trigonometrically fixed, and their heights determined to aid the sub-surveyors in their contouring. 1,812 clinometric heights were deduced this season, which works out 0.8 per square mile of survey, the average difference *inter se* being 10.9 feet. The expenditure on supplementary topographical survey (2,347 square miles) amounts to ₹22,812.11.1 which gives a cost-rate of ₹9.11.6 per square mile. The daily average per man was 0.63 square mile and monthly average 19 square miles.

164. *Drawing section.*—This section was engaged as in the previous year, in the preparation of field sheets preparatory to their verification, correction, and completion of topographical details by surveyors in the field. The experience gained this year conclusively proves that the topographical details to be derived from the local agency cadastral maps, are practically *nil*, since the cultivated areas alone were surveyed, and these generally fluctuate from year to year, whilst all jungle and waste land areas had evidently never been entered, and were left blank. During the recess the old revenue surveys conducted by professional survey parties during 1854 to 1869 on the scale of 4 inches to the mile in districts Jubbulpore, Damoh, Seoni, and Narsinghpur were examined, and tested with the current season's surveys, when it was found that the difference



LIST OF FOREST DIVISIONS

| Province or Circle | Division | Area in Sq. Miles | Division | Area in Sq. Miles |
|--------------------|----------------------|-------------------|--------------------|-------------------|
| Punjab | 1. Rawalpindi | 75 | 13. Lahore | 100 |
| | 2. Ferozpur | 75 | 14. Multan | 100 |
| | 3. Lyallpur | 75 | 15. Bahawalpur | 100 |
| | 4. Gurdaspur | 75 | 16. Jhelum | 100 |
| | 5. Amritsar | 75 | 17. Sialkot | 100 |
| | 6. Ludhiana | 75 | 18. Ferozpur | 100 |
| | 7. Patiala | 75 | 19. Jalandhar | 100 |
| | 8. Nabha | 75 | 20. Hoshiarpur | 100 |
| | 9. Kapurthala | 75 | 21. Gurdaspur | 100 |
| | 10. Mohak | 75 | 22. Amritsar | 100 |
| | 11. Gurdaspur | 75 | 23. Ludhiana | 100 |
| | 12. Ferozpur | 75 | 24. Patiala | 100 |
| Baluchistan | 25. Quetta | 100 | 37. Karachi | 100 |
| | 26. Dera Ismail Khan | 100 | 38. Hyderabad | 100 |
| | 27. Dera Ghaat Kot | 100 | 39. Sukkur | 100 |
| | 28. Dera Bugti | 100 | 40. Mirpur Khas | 100 |
| | 29. Dera Ghokri | 100 | 41. Thatta | 100 |
| | 30. Dera Taji | 100 | 42. Dera Gokul | 100 |
| | 31. Dera Ismail Khan | 100 | 43. Dera Ghaat Kot | 100 |
| | 32. Dera Bugti | 100 | 44. Dera Ghokri | 100 |
| | 33. Dera Taji | 100 | 45. Dera Gokul | 100 |
| | 34. Dera Ismail Khan | 100 | 46. Dera Ghaat Kot | 100 |
| | 35. Dera Bugti | 100 | 47. Dera Ghokri | 100 |
| | 36. Dera Taji | 100 | 48. Dera Gokul | 100 |
| Central Provinces | 49. Jabalpur | 100 | 61. Nagpur | 100 |
| | 50. Bilaspur | 100 | 62. Raipur | 100 |
| | 51. Bilaspur | 100 | 63. Bilaspur | 100 |
| | 52. Bilaspur | 100 | 64. Bilaspur | 100 |
| | 53. Bilaspur | 100 | 65. Bilaspur | 100 |
| | 54. Bilaspur | 100 | 66. Bilaspur | 100 |
| | 55. Bilaspur | 100 | 67. Bilaspur | 100 |
| | 56. Bilaspur | 100 | 68. Bilaspur | 100 |
| | 57. Bilaspur | 100 | 69. Bilaspur | 100 |
| | 58. Bilaspur | 100 | 70. Bilaspur | 100 |
| | 59. Bilaspur | 100 | 71. Bilaspur | 100 |
| | 60. Bilaspur | 100 | 72. Bilaspur | 100 |
| Madras | 73. Madras | 100 | 85. Madras | 100 |
| | 74. Madras | 100 | 86. Madras | 100 |
| | 75. Madras | 100 | 87. Madras | 100 |
| | 76. Madras | 100 | 88. Madras | 100 |
| | 77. Madras | 100 | 89. Madras | 100 |
| | 78. Madras | 100 | 90. Madras | 100 |
| | 79. Madras | 100 | 91. Madras | 100 |
| | 80. Madras | 100 | 92. Madras | 100 |
| | 81. Madras | 100 | 93. Madras | 100 |
| | 82. Madras | 100 | 94. Madras | 100 |
| | 83. Madras | 100 | 95. Madras | 100 |
| | 84. Madras | 100 | 96. Madras | 100 |

in the topographical features were hardly perceptible. The hills however were mostly shown by brush shading. It has therefore been decided to utilise, in future, the local agency maps only for plotting the village boundaries, and limits of cultivation, whilst the topographical details will be pantographed from the old professional 4-inch surveys. With this additional material, it is hoped that the rate of progress in the field, and general outturn will be sensibly increased, though it is still a moot question whether the cost of utilising old material by keeping up pantographing establishments, and verifying and supplementing this material in the field, is greater or less than the cost of a new survey.

The cost of the drawing section has been Rs. 967-12-7. The fair mapping has been completed in 11 standard sheets, and only requires final examination before submission for publication.

165. The programme for next field season is as follows—

- (1) *Supplementary topographical survey* of district Saugor, and portions of Damoh, and Narsinghpur.
- (2) *Revision survey* of such portions of Mandla district, Rájputána, and Central India as fall in the standard sheets of Jubbulpore, Damoh, and Saugor, so as to complete them up to margin, as up to date sheets in their entirety. This is effected by sending printed copies of these sheets to local officials, and asking them to roughly indicate thereon all changes, and any new public works, railways, roads, etc., etc., as may have been constructed since the publication of the sheets, and then by sending surveyors in the field to survey and locate this new material. In Mandla district, the village boundaries and forest reserves had been omitted in the old publications. These have now been inserted on the maps from the local agency and forest surveys.
- (3) *Traversing* as in previous seasons, chiefly in Sambalpur district. The area for traversing being small, all the traverse sub-surveyors with the exception of one, have been transferred to other survey parties.

166. The party was inspected by the Deputy Surveyor-General in the field in December 1902 and again at commencement of recess in April 1903.

FOREST SURVEYS.

MADRAS PRESIDENCY.

NOS. 9 AND 19 PARTIES.

Personnel.

Captain C. L. Robertson, R.E., Officiating Deputy Superintendent, 1st grade, in charge from 9th September 1903.

Mr. H. Todd, Extra Deputy Superintendent, 2nd grade, in charge up to 15th June 1903.

Mr. G. T. Hall, Extra Assistant Superintendent, 2nd grade, in charge from 16th June to 8th September 1903.

Mr. W. F. E. Adams, Extra Assistant Superintendent, 6th grade.

Mr. J. H. S. Wilson, " " " " 1st grade.

Mr. M. J. Sheehan, Sub-Assistant Superintendent, 1st grade.

Mr. C. C. Byrne, " " " " 1st grade.

Mr. H. A. Gibson, " " " " 2nd grade.

54 Surveyors, Sub-Surveyors, etc., and 2 Writers.

167. As in previous years the parties were divided into sections as follows:—

- (1) Mr. G. T. Hall, with one assistant and 23 surveyors and apprentices, in Cuddapah district (Central circle).
- (2) Mr. W. F. E. Adams, with 16 surveyors and apprentices in South Canara district (Southern circle).
- (3) Mr. C. C. Byrne, with 16 surveyors and apprentices in Kurnool district (Northern circle).
- (4) Mr. J. H. S. Wilson, with 4 surveyors and apprentices from the Cuddapah section in North Coimbatore district (Southern circle).

In addition to the above Mr. Sheehan and 5 sub-surveyors were employed on triangulation and traversing in Ganjam and Godávári districts.

168. The parties left their recess quarters at Bangalore in the beginning of November and, after a full working season of 6 months, closed field work in May. The Coimbatore detachment which did not take the field till January returned to Bangalore in July.

169. An area of 590 square miles was triangulated in South Canara in continuation of last season's work. In the Ganjam and Godávári districts 1,090 and 350 square miles, respectively, were completed. The difficult nature of the country and the scarcity of labour retarded the work in the latter district. In Ganjam, Mr. Sheehan did the triangulation, but in Godávári and South Canara, native agency was employed, and the results are generally satisfactory.

170. 538 linear miles of forest boundaries were traversed by theodolite in the Ganjam, Godávári, and South Canara districts. The area topographically surveyed on the scale of 4 inches to a mile amounts to 1,411 square miles including 111 square miles of resurvey of former season's work in Coimbatore. Owing to the thickness of the jungle it was found necessary to use the chain more extensively than formerly in the detail survey. An even more rigorous examination than usual was made and the quality of the work done was up to the standard of the department.

171. The country presented much the same difficulties as formerly. In South Canara, with its almost impenetrable undergrowth, work was tedious and slow. In Cuddapah the forest growth is heavy and the water exceptionally bad, and the Nallamalai hills in Kurnool, with their densely covered slopes, scanty population, and bad water, presented many difficulties.

172. The health of the party was bad, in the early portion of the field season being even worse than it was last year. In Cuddapah the unusually heavy rain in November impeded the operations and temporarily incapacitated several of the establishment. Fever and influenza were general for nearly a month at the commencement of the season, and several members of the section were constantly on the sick list throughout the season. South Canara proved as usual an unhealthy district and the section officer and many of his men suffered continually from fever. Two soldier surveyors and two sub-surveyors were sent on medical leave, and three sub-surveyors died during the year. Even during the recess the effects of the malaria contracted in the field were felt by the members of the parties.

173. During the recess the computations of triangulation and traversing, with few exceptions, were completed. 108 sheets, including 45 sheets partially completed last year, have been mapped. Owing to the incomplete verification of the forest boundaries, 10 sheets are withheld from publication in the Cuddapah district, 9 in Kurnool, and 2 in South Canara. The mapping of the revision survey of North Coimbatore is in progress. The Mysore-South Canara boundary is still undemarcated, but proposals have been made for the publication of a provisional issue of the maps in which the boundary occurs.

174. The actual expenditure for the survey year ending 31st August 1903, inclusive of cost of instruments is ₹8,038-8-8 in excess of that of the previous year. The increase is due principally to increased charges for local labour, carriage, and establishment. In spite, however, of the increase, the cost-rates of last season are fully maintained.

175. The following table shows the comparative cost-rates, and area surveyed for the last three years:—

| | AREA SURVEYED. | | | COST-RATES PER SQUARE MILE. | | |
|-------------------------|----------------|------------|------------|-----------------------------|------------|------------|
| | 1900-1901. | 1901-1902. | 1902-1903. | 1900-1901. | 1901-1902. | 1902-1903. |
| Triangulation | 1,335 | 1,680 | 2,030 | 6 | 5 | 5 |
| Traversing | 771 | 414 | 538(a) | 8 | 14 | 13 (b) |
| Topography | 1,378 | 1,306 | 1,411(c) | 58 | 59 | 58 (c) |

(a) Linear miles.

(b) Per linear mile.

(c) Including revision survey.

176. The programme for the ensuing season, comprises the continuation of the triangulation in Ganjam, Godávári and South Canara districts and of small area in Trichinopoly and Chingleput. The continuation of the traversing in South Canara, and the completion of the same in the Ganjam and Godávári reserves. The 4-inch detail survey includes the completion of the forests in Kurnool, continuation of the work in South Canara, and the commencement of the same in Ganjam and Godávári. The revision and examination of work in North Coimbatore will be continued.

177. The parties were inspected during September by Colonel St. G. C. Gore, R. E., Surveyor-General and also by Major P. J. Gordon, I. A., Superintendent, Forest Surveys. The season's work has been verified with the aid of the Government notifications by the District Forest Officers of Kurnool and Cuddapah, South Canara, and Coimbatore, who visited the office for that purpose.

BOMBAY PRESIDENCY.

NO. 17 PARTY.

178. Mr. S. F. Norman held officiating charge of the party from the 1st to the 19th October 1902, when Mr. B. G. Gilbert-Cooper, on his return from Calcutta, where he had been officiating as Assistant Surveyor-General resumed charge and continued to hold it throughout the remainder of the year.

Personnel.

Mr. B. G. Gilbert-Cooper, Officiating Superintendent, 2nd grade, in charge from 20th October 1902.

Mr. S. F. Norman, Extra Assistant Superintendent, 3rd grade, in charge up to 19th October 1902.

Mr. C. A. Norman, Extra Assistant Superintendent, 4th grade.

Mr. C. J. Veale, Sub-Assistant Superintendent, 1st grade.

Mr. P. R. Anderson, " "

2 Surveyors, 37 Sub-Surveyors, etc., and 1 Writer.

179. The various detachments left Poona for the field at the end of November, and returned to recess quarters early in June, giving a full working season of six months.

The party was divided into three camps under Messrs. S. F. Norman, C. A. Norman, and C. J. Veale, respectively, and continued the survey on various scales of forest areas in the Northern, Central, and Southern circles of the Bombay Presidency, these operations comprising:—

- (1) *Northern circle*.—Supplementary triangulation and detail survey on the 8-inch scale of teak reserves in the Thána district.
- (2) *Central circle*.—Supplementary triangulation and detail survey on the 4-inch and 8-inch scales in the Násik district.
Detail surveys on the 8-inch and 16-inch scales in Ahmednagar district.
Supplementary triangulation in Khándesh and Sátára.
The 8-inch surveys were confined to the more valuable "teak" reserves and the 16-inch to the riverain "babul" reserves.
- (3) *Southern circle*.—Detail survey on the 4-inch scale in Belgaum, Dhárwár and North Kánara districts.

The work of the party in the southern circle is now complete, it having been decided that the forests in Bijápur, the only remaining district, are not of sufficient value to justify the expenditure on a large scale survey.

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

| DESCRIPTION OF SURVEY. | OUTTURN. | | | COST-RATES. | | |
|---|------------|------------|------------|-------------|------------|------------|
| | 1900-1901. | 1901-1902. | 1902-1903. | 1900-1901. | 1901-1902. | 1902-1903. |
| Triangulation (No. of stations) . | 365 | 320 | 758 | 12'5 | 20 | 19 |
| Traversing (linear miles) . | 315 | 504 | ... | 7 | 8'7 | ... |
| Topography, 4-inch scale (square miles). | 410 | 607 | 486'73 | 65'4 | 63'8 | 61 |
| Topography, 8-inch scale (square miles). | 255 | 161'5 | 239'97 | 106'7 | 136'1 | 130 |
| Topography, 16-inch scale (square miles). | 11 | ... | 6'11 | 113 | .. | 137 |

The cost-rates are slightly more favourable than those of last year, in spite of an increase in the cost of supervision, and may be considered satisfactory.

181. During the recess, good progress has been made in the mapping both of the current and of arrears of the former season's field work. The large out-turn of 8-inch surveys, which covers four times the number of sheets the same area of 4-inch work would, makes it difficult to avoid having arrears, but every effort is being made to cope with them.

182. The programme for 1903-04 is in continuation of that for the past season. The 8-inch detail surveys in Thána and the 4-inch and 8-inch surveys in Násik will be continued. Triangulation will be continued in Sátára and Khándesh and the 4-inch detail survey will be commenced in Khándesh where the operations of the party will principally lie in the future, and in Sátára. In these districts it is intended to confine all detail surveys to the 4-inch scale instead of as in other districts surveying the teak forests on the 8-inch scale. Under favourable conditions the forest surveys of the Bombay Presidency, not including Sind, should be completed in 1907 or 1908.

183. The party was inspected in September by the Surveyor-General, and by the Superintendent, Forest Surveys.

BURMA.

NO. 20 PARTY.

184. Captain A. H. B. Hume, R.E., held charge of the party from the 1st

Personnel.

Captain A. H. B. Hume, R.E., Deputy Superintendent, 2nd grade, in charge up to 15th November 1902.

Captain A. Mears, I.A., Officiating Deputy Superintendent, 2nd grade, in charge from 16th November 1902.

Mr. W. H. Penrose, Extra Assistant Superintendent, 3rd grade.

Mr. P. F. Prunty, " " " 3rd grade.

Mr. M. C. Petters, Sub-Assistant Superintendent, 1st grade.

Mr. S. S. M. Fielding " " 2nd grade.

Munshi Amjad Ali, " " 3rd grade.

64 Surveyors, Sub-Surveyors, etc., and 1 Writer.

October to the 15th November 1902, when he proceeded on leave, and was succeeded by Captain A. Mears, I.A., who continued to hold charge for the rest of the year.

The party left Dehra Dún on the 15th November, but, owing to delays in the river journey by Government steamer, field work could not be commenced until the end of December. The field

season closed in Upper Burma at the end of May and in Lower Burma, owing to the early rains, it was found necessary to stop work about two weeks earlier.

185. The party was divided into five camps as follows:—

- (1) Mr. P. F. Prunty with 14 traverse surveyors and 5 computers in the Upper and Lower Chindwin, Myittha and Yaw divisions.
- (2) Mr. W. H. Penrose with 15 detail surveyors, afterwards reduced to 10, in the Upper Chindwin division.
- (3) Mr. M. C. Petters with 14 detail surveyors in the Myittha division.
- (4) Mr. S. Fielding with 6 detail surveyors from No. 2 camp in the Upper Chindwin division from March.
- (5) Munshi Amjad Ali with 3 traverse and 6 detail surveyors and 2 computers in the Thayetmyo division.

In addition to the above 6 surveyors and computers were detached for the traverse and detail survey of the Mepalè extension reserve in the Thaugyin division.

186. Subsidiary triangulation based on the Manipur Minor Meridional series was carried out over an area of 1,161 square miles. Mr. Fielding was employed on this work for the first two months of the season after which he was placed in charge of a detail camp in the Upper Chindwin and Mr. Prunty completed the triangulation in addition to supervising his traverse camp.

187. As in the previous season the densely wooded nature of the country necessitated the detail survey being entirely dependent on theodolite traverses. A total of 1,173 linear miles of traverse (inclusive of 139.6 linear miles revision) was run in the various divisions under survey, the theodolite being set up at 17,866 stations which were marked by posts. In addition to the horizontal angles, vertical angles were observed at each theodolite station to provide heights for the detail surveyors. Most of the traverses were computed in the field.

188. The forest area topographically surveyed on the 4-inch scale was (inclusive of 26 square miles of resurvey) 623 square miles, and comprised reserves of the Upper Chindwin, Myittha, Thayetmyo and Thaungyin divisions. The country was nowhere easy, being very hilly and thickly wooded, necessitating the almost exclusive employment of plane-table traverses in order to map the topographical details. Owing to the villages being few and far between and also to a partial failure of the rice crop, supplies were expensive and difficult to obtain. Small food depôts were established at the head-quarters of each camp for the use of their establishments. It is probable that these food depôts will have to be largely increased during next season.

189. The testing and examination of the area topographically surveyed kept pace with the work and, except in the Thaungyin division, all the field sections were *partalled* by one or more lines. The testing was in the proportion of one linear mile to every 2'27 square miles of detail survey.

190. The health of the establishment, more especially that of the detail camps, was indifferent, a large percentage of surveyors being laid up with fever from time to time. Sixteen deaths occurred from an epidemic of cholera which broke out amongst the *khalâsis* on their way down to Rangoon, 3 *khalâsis* died of fever and dysentery, one was drowned, and one was killed by one of the elephants belonging to the party.

191. During the recess months the triangulation and traverse computations were completed. The mapping of the current season's work has been as far as possible finished. Four sheets of which the full area has not been surveyed will be completed during the field season as materials become available. In all 25 sheets have been submitted for publication, including 4 sheets of the previous season's work.

192. The total cost of the survey operations for the year ending 30th September 1903, was R1,48,468 or R25,815 less than the expenditure for 1901-02. This decrease is in part due to the employment of Government steamers for the river journeys both to and from the field, and partly to the absence of heavy arrears of mapping and publication charges of previous season's work, and to a shorter field season.

193. The following statement shows the outturn and cost-rates for the year under report and the two previous seasons—

| DESCRIPTION OF WORK. | AREA SURVEYED. | | | COST-RATE IN RUPEES PER SQUARE MILE. | | |
|--------------------------|----------------|------------|------------|--------------------------------------|------------|------------|
| | 1900-1901. | 1901-1902. | 1902-1903. | 1900-1901. | 1901-1902. | 1902-1903. |
| Triangulation | 534 | 250 | 1,161 | 33'5 | 15'0 | 3'2 |
| Traverse | 1,237(a) | 1,646(a) | 1,173(a) | 56'5(b) | 53'5(b) | 44'7(b) |
| Topography, 4-inch . . . | 873 | 724 | 623(c) | 97'8 | 122'3 | 136'6(c) |

(a) Linear miles and includes 139'6 linear miles of revision for 1902-1903.

(b) Cost-rate per linear mile.

(c) Includes 28'02 square miles of resurvey.

The cost-rates of triangulation and traversing show a satisfactory decrease over those of last year.

The general cost per square mile of 4-inch detail survey is R14 more than for last season. This is principally due to a shorter working season owing to the bulk of the party having been employed in the Upper Chindwin valley the journeys to and from which, attended as they were by unavoidable delays, formed an unproductive period during which there was no outturn for the pay and allowances of the men. The country under survey was uniformly of a most difficult nature from a surveyor's point of view, rugged ridges and deep valleys, both covered with the densest forest growth, made progress necessarily slow. Added to this there was much sickness among the surveyors and their men and supplies were often scarce and difficult to obtain. After mentioning these circumstances which were the cause of a small outturn which more than anything else affects the rates, it is unnecessary to do more than merely refer to such matters as a non-effective charge on account of the pay of Captain Hume while on privilege

leave as well as the pay of his successor having to be taken into account in calculating cost-rates. The fact of the services of one of the assistants of the party having been required for a trans-frontier mission and his successor being a highly paid officer with no recent experience of forest survey work may also be mentioned in this place as it affected both outturn and rates.

Had not the officer in charge and most of the members of the party worked energetically and cheerfully under trying circumstances the cost of the detail survey, high as it is, would have been still higher.

194. In country such as the Upper Chindwin valley a higher rate of progress than $3\frac{1}{2}$ square miles of detail survey a man a month or a field season of more than five working months cannot be looked for when estimating the outturn to be expected during the year.

195. The programme for 1903-04 is as follows:—

1. Triangulation and traversing in the reserves of the Lower Chindwin division and 4-inch detail survey in the Upper and Lower Chindwin and Myittha divisions.
2. Traversing and 4-inch detail survey in the Thayetmyo division.

196. The Superintendent, Forest Surveys, inspected the party in the field during the month of February and in recess in August.

OPERATIONS OF THE FOREST SURVEY BRANCH.

197. Major P. J. Gordon, I.A., during the year held administrative charge of the Forest Surveys, Bengal Presidency, which, under the orders of the Inspector General of Forests and the professional control of the Surveyor-General, continued the survey of forests in the several Provinces of the Bengal Presidency.

198. The operations of the various detachments are briefly reported on in the following paragraphs, and the full details will be published as usual in the Annual Progress Report of the Forest Surveys, Bengal Presidency.

199. *Central Provinces*.—A detachment consisting of seven surveyors under

Personnel.

Surveyor Odey Singh and 7 Sub-Surveyors. Babu Odey Singh completed the survey of the Chánda forests and with it of the forests of the Central Provinces.

The outturn and cost-rates in Chánda for the year under report and the two previous years are given in the following table:—

| Description of work. | OUTTURN. | | | COST-RATE. | | |
|-----------------------------|------------|------------|------------|------------|------------|------------|
| | 1900-1901. | 1901-1902. | 1902-1903. | 1900-1901. | 1901-1902. | 1902-1903. |
| Triangulation (a) | 293 | 816 | ... | R 3'1 | R 1'6 | ... |
| Traversing (b) | 76 | 231 | 58 | 7'6 | 6'0 | 8'4 |
| Levelling (b) | 686 | 1057 | 171 | 1'4 | 1'7 | 5'9 |
| 16-inch boundary survey (b) | 740 | 872 | 211 | 2'0 | 2'1 | 7'7 |
| 4-inch detail survey (a) | 776 | 725 | 226 | 28'1 | 27'5 | 25'7 |

(a) Square miles.

(b) Linear miles.

The results are satisfactory, the cost-rates for detail survey being the lowest yet reported. The higher rates for the other operations are due to the small area dealt with and to the scattered nature of the work.

The total expenditure for the year was R20,637 as compared with R63,943 in the previous year.

The mapping and publication of the Central Provinces sheets has made good progress. Eighty-three sheets were sent to press during the year and 137 have been published.

200. *Bengal*.—A detachment consisting of 12 surveyors under Mr. B. R. Hughes commenced the survey of the forests in the Kurseong, Darjeeling, and Kalimpong divisions of the Darjeeling district.

Personnel.
Mr. B. R. Hughes, Extra Assistant Superintendent, 5th grade.
12 Sub-Surveyors.

The outturn and cost-rates are given below :—

| Forest Division. | 4-INCH DETAIL SURVEY. | | TRIANGULATION. | | TRAVERSING. | | Total expenditure. |
|---|-----------------------|------------|----------------|------------|----------------------|------------|--------------------|
| | Area | Cost-rate. | Area. | Cost-rate. | Outturn. Lin. miles. | Cost-rate. | |
| | | R | | R | | R | R |
| Darjeeling Kalimpong Kurseong . . . | } 232 | 64 | 330 | 5 | 102 | 18 | 18,268 |

The outturn is satisfactory and the rates are reasonable.

The detachment will complete the survey of these divisions during 1903-04.

201. The mapping of the Singhbhum sheets is complete and these only await the verification of the boundaries of protected forests before being sent to press. Seven sheets have been already sent to press and four have been published during the year.

A preliminary outline edition of the map of the Kodarma forests has been published in order to facilitate the granting of new mica mine leases, the demarcation of which will be done in October next by some surveyors lent to the divisional Forest Officer for the purpose.

202. *Burma*.—In addition to No. 20 Party a traverse and a detail detachment of forest surveys consisting of 27 surveyors under Messrs. A. Ewing and C. Litchfield, were employed in Burma in the Mandalay, Ruby Mines, and Bhamo districts.

Personnel.

Mr. A. Ewing, Extra Assistant Superintendent, 5th grade.
Mr. C. Litchfield, Extra Assistant Superintendent, 6th grade.
27 Sub-Surveyors.

The outturn and cost-rates were as follows :—

| Districts. | 4-INCH DETAIL SURVEY. | | TRIANGULATION. | | TRAVERSING. | | Total expenditure. |
|---|-----------------------|------------|----------------|------------|----------------------|------------|--------------------|
| | Area. | Cost-rate. | Area. | Cost-rate. | Outturn. Lin. miles. | Cost-rate. | |
| | | R | | R | | R | R |
| Bhamo . . . Ruby Mines . . . Mandalay . . . | } 303 | 64 | 450 | 10 | 810 | 37 | 55,316 |
| Totals for 1901-1902. | 274 | 86 | ... | ... | 190 | 29 | 30,695 |

The area surveyed was not of a difficult nature and the health of the detachments was uniformly good. Little time was lost in reaching the ground and, in spite of several moves from one district to another during the period, a full working season of six months was obtained. The rates were satisfactory.

A surveyor was also sent to Ataran district to resurvey and test part of the Mepalè reserve, the survey of which had been done some years ago and was reported inaccurate by the Forest Officer in charge working plans.

Fifteen maps were sent to press and fourteen were published during the year including four working plan maps.

During 1903-04 the same detachments will continue their operations in Mandalay, Ruby Mines, and Katha districts.

Personnel.

Surveyor Udey Ram.
" Bhup Singh.
13 Sub-Surveyors.

203. *Punjab and North-West Frontier Provinces.*—The following statement shows the nature and extent of operations in these Provinces :—

| Districts and States. | 4-INCH DETAIL SURVEY. | | TRIANGULATION. | | Total cost. | REMARKS. |
|-----------------------|-----------------------|------------|----------------|------------|-------------|--|
| | Area. | Cost-rate. | Area. | Cost-rate. | | |
| | | <i>R</i> | | <i>R</i> | <i>R</i> | |
| Jubbal and Tarhooh | 27 | 47 | ... | ... | 1,279 | Four surveyors under Babu Udey Ram. } Nine surveyors under Babu Bhup Singh. } Mapping and publishing charges, and 98 linear miles of boundary surveys. |
| Gujrát | 60 | } 34 | 110 | 3'5 | 3,806 | |
| Ráwalpindi | 40 | | | | | |
| Hazára | 173 | 24 | 30 | 9 | 4,453 | |
| Chamba | ... | ... | ... | ... | 1,962 | |
| | 300 | ... | 140 | ... | 11,500 | |

The outturn and rates are both satisfactory.

Next season the outline survey of the Jhelum and Shahpur forests will be taken in hand and the detail survey of the forests in Hazára will be continued.

Twenty-two 4-inch sheets of Chamba were sent to press and the same number published during the year.

204. *United Provinces of Agra and Oudh.*—A small detachment of surveyors under Babu Udey Ram was employed on the survey of newly reserved

areas in the Ganges, Kumaun, Garhwál, and Naini Tal forest divisions.

The outturn and cost-rates were as follows :—

| Forest Division. | 4-INCH DETAIL SURVEY. | | TRAVERSING. | | LEVELLING. | | Total expenditure. |
|------------------------|-----------------------|------------|----------------------|------------|----------------------|------------|--------------------|
| | Area. | Cost-rate. | Outturn. Lin. miles. | Cost-rate. | Outturn. Lin. miles. | Cost-rate. | |
| | | <i>R</i> | | <i>R</i> | | <i>R</i> | <i>R</i> |
| Kumaun | } 100 | 29'7 | 165 | 5'7 | 23 | 2'4 | 3,971 |
| Garhwál | | | | | | | |
| Ganges | | | | | | | |
| Naini Tal | | | | | | | |
| Pilibhit | } ... | ... | ... | ... | ... | ... | 884 |
| Kheri | | | | | | | |
| Gorakhpur | | | | | | | |
| Bahraich | | | | | | | |
| TOTAL | | | | | | | 4,855 |

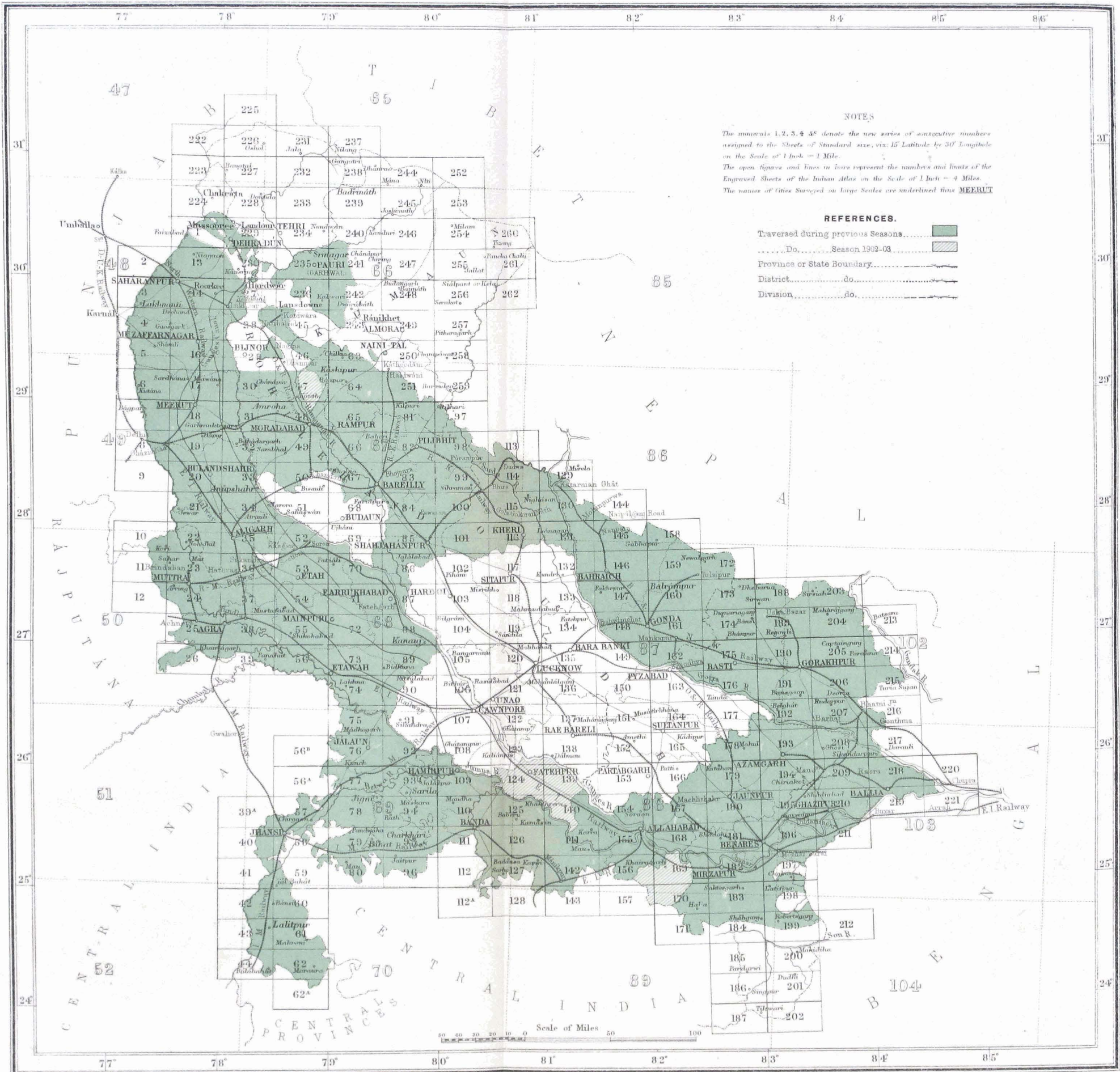
Most of the old revenue survey traverse stations had disappeared and it was found necessary to do a considerable amount of traversing. This somewhat delayed the work and there remains in consequence a small area to be completed next season.

UNITED PROVINCES OF AGRA & OUDH.

1902-03.

INDEX TO THE TRAVERSE SURVEY IN THE U. P. A. & OUDH.

Nos. 2 & 8 & 14 PARTIES.



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

REFERENCES.

- Traversed during previous Seasons.....
-Do..... Season 1902-03.....
- Province or State Boundary.....
- District.....do.....
- Division.....do.....

Three sheets of the United Provinces Survey were sent to press and 13 published during the year. There has also been a good deal of work done in entering newly surveyed boundaries by hand on the printed maps.

When the working plan details have been received from the Forest Department the new edition of the Kumaun-Garhwál series of forest maps will be taken in hand.

Personnel.

Mr. J. Marten, Extra Assistant Superintendent,
4th grade.
15 Sub-Surveyors.

205. *Assam.*—A detachment consisting of 15 surveyors, under Mr. J. Marten, commenced the survey of the reserves in the Gáro Hills and Kámrúp.

The outturn and cost-rates were as follows :—

| Forest Division. | 4-INCH DETAIL SURVEY. | | TRAVERSING. | | TRIANGULATION. | | Total expenditure. |
|----------------------|-----------------------|------------|---------------------|------------|----------------|------------|--------------------|
| | Area. | Cost-rate. | Outturn Lin. miles. | Cost-rate. | Area. | Cost-rate. | |
| Gáro Hills Kámrúp | 134 | R 97·8 | 117 | R 33 | 70 | R 37 | 19,668 |

The cost-rates are high, but this was almost unavoidable owing to the difficult nature of the country and its unhealthiness, which caused much sickness among both surveyors and *khalásis*, much time being lost in consequence. Local labour could not be obtained and the *khalásis* were imported from Chota Nágpur. Every effort will be made to reduce the cost of the work in this Province, but very cheap rates cannot be looked for.

206. The tendency in all surveys is to take up the easier and more healthy districts first and this course is justified as it enables the surveyors to gain, under favourable conditions, the experience and training which are more than ever essential for work in more difficult country. This is the case in the forest surveys of the Bengal Presidency whose remaining programme now lies in Burma, Assam, and Bengal, where the large outturn and cheap rates which were possible in the open forests of the Himalayas, Oudh, and the Central Provinces, can never be maintained. Had the work in the former areas been taken up first progress would have been still more slow and cost-rates much higher than they are at present.

Taking everything into consideration the general results may be considered satisfactory. In easy country cost-rates are lower than they have ever been before and the higher rates in more difficult districts admit of a satisfactory explanation.

CADASTRAL AND TRAVERSE SURVEYS.

UNITED PROVINCES OF AGRA AND OUDH.

NOS. 2 AND 8 PARTIES.

207. The preparation of cadastral maps and preliminary records-of-rights

Personnel.

Captain W. M. Coldstream, R.E., Officiating Deputy Superintendent 1st grade, in charge.
Mr. L. F. Berkeley, Extra Assistant Superintendent, 4th grade.
" J. M. Kennedy " " " "
" P. C. H. Smart " " " "
" F. C. Bell " " 5th "
" F. B. Powell " " " "
" J. H. Murphy " " 6th "
" C. S. Littlewood, Sub-Assistant Superintendent 1st "
21 Sub-Surveyors, Computers, etc., and 2 Writers.

in districts Mainpuri, Azamgarh, and Jálaun has been brought to a close, and the cadastral establishments concerned have now been transferred to Moradabad, Bánda, and Hamírpur, to commence survey and record operations

in these districts. Under the system in force, by which the survey and record writing in each *patwári's* circle extend over a period of two years, it is not possible to give accurate cost-rates of the work during the last year of operations in a district, and the cost-rates given below are those for the complete survey and record writing in each district.

208. *Cadastral surveys—Mainpuri.*—The maps and preliminary records of *tahsils* Shikohabad and Mustafabad, have been completed during the year and made over to the Settlement Officer. Operations commenced in the district in October 1899. The area surveyed is 1664.47 square miles, the total expenditure has been ₹1,52,894-14-2, and the cost-rate for combined survey and record-writing is ₹91-14-9 per square mile, or about ₹47 for survey, and ₹40 for record-writing. Only 20 square miles of survey, and 611 square miles of record-writing in the field remained for completion during the past year. The survey of the ravines intersecting the left bank of the Jumna was beyond the capabilities of the *patwáris*, so when they had finished the survey of the cultivation and village sites, a small establishment of *amins* was employed to undertake the ravines. An area of 34 square miles was topographically surveyed in this manner, at a cost of ₹14-8-0 per square mile. Of the 220 *patwáris* in *tahsils* Shikohabad and Mustafabad, 211 qualified as cadastral surveyors, 18 were allowed to depute their heirs for training and assist in their work, whilst substitutes had to be provided for 2.

209. *Azamgarh.*—All field work in this district was practically finished last year. The maps and records-of-rights of *tahsil* Muhammadabad, were completed during the past year and made over to the Settlement Officer. Survey and record operations were begun in October 1898. The area surveyed is 2156.76 square miles, the total expenditure ₹1,21,132-2-3, and the cost-rate is ₹56-2-5 per square mile. These figures, however, do not include the pay and allowances of Mr. Freeman, the officer in charge, during the first four years of the work. Mr. Freeman having previously been transferred to the Provincial Civil Service, these charges were not borne by the survey budget. If they were included, the cost-rate would be about ₹72.

210. *Jálaun.*—An area of 175 square miles remained for survey, and 218 square miles for record-writing during the past year, and the maps and records of *tahsils* Jálaun and Kúneh, were completed. Operations commenced in the district in October 1900. The area surveyed is 1,469 square miles and the expenditure ₹1,17,617-4-6. The cost-rate is ₹80-1-0. At the request of the Director of Land Records and Agriculture, each *patwári* in the district has been provided with a complete set of survey instruments to enable him to maintain his maps. If the value of these instruments is excluded from the expenditure, the cost-rate is ₹74-3-0 per square mile. As in Mainpuri, some professional assistance had to be given to the *patwáris*, and 11 *amins* were employed for a portion of the field season in surveying ravines. The attendance of the *patwáris* at office during the recess season, has been particularly bad in this district, in spite of the fines inflicted by the Collector and Survey Officer, and at one time it appeared doubtful whether the work could be completed within the period allotted by the programme. This has, however, been accomplished and all maps and records have been made over to the Settlement Officer.

211. *Traverse surveys.*—This section under Mr. F. S. Bell completed the traverse survey of 140 square miles in Moradabad district at a cost-rate of ₹29-7-10 per square mile. One hundred and fifty-five linear miles of main circuit traverses were also run in advance, along the high banks of the Rámghanga and Dhela, in order to allow of both the traverse and cadastral surveys of the alluvial tracts of these rivers being carried out next season. The cost-rate for these additional traverses was ₹11-9-7 per linear mile. The Great Trigonometrical stations of Akbarpur, Nandi, and Bhatauli were connected with the work. The mean errors so disclosed being 1.2, and 3.4 feet per mile.

212. *Town surveys.*—The traverse section has carried out the following town surveys for municipalities during the year:—

(i) The survey on the scale of 200 feet to one inch of the extension of the civil station of Allahabad (2.16 square miles).

(ii) The survey on the scale of 64 inches to one mile of—

| | |
|-----------------------------|--------------------|
| Háthras city | 3.21 square miles. |
| Koili city | 4.27 " " |
| Sikandra Rao city | 0.88 " " |
| Atrauli city | 0.99 " " |
| Kosi city | 0.70 " " |

TOTAL 10.05 square miles.

In Koil, Háthras, Atrauli, and Sikandra Rao, the survey was a very detailed one, the interior limits of each house being shown. In Kosi and Allahabad, only the exterior limits of buildings were surveyed. The cost-rate of the former surveys works out to R1,291-14-5 per square mile, that of Kosi to R910, and that of Allahabad Civil Station to R521-14-5. The work, which was based on a thorough network of theodolite traverses, was checked by an average of 8.9 linear miles and 14.2 acres of check survey per square mile.

213. *Road surveys.*—Boundary charts for the Public Works Department on the scale of 64 inches to the mile, shewing all adjacent detail, were prepared by plane-table traverse of 1113.09 linear miles of first class roads in districts Etah, Agra, Muttra, Aligarh, Bulandshahr, and Meerut. The cost-rate works out to R8-14-5 per linear mile. As a check upon the work 99.80 linear miles were re-surveyed independently. In addition to the above the theodolite traverse survey of 100.48 linear miles of the first class roads in Jálaun, begun last year under the former method of road survey, was completed, at a cost of R6-13-2 per linear mile.

214. *Drawing office.*—This office, located at Naini Tál, has been moved during the year into new quarters, which are more suitable in every way than the small bungalow it previously occupied. Under Mr. J. Kennedy, the officer in charge, eleven standard sheets, including areas in districts Sháhjahánpur, Bareilly, Pilibhít, and Kheri, have been completed and submitted for publication. Twenty-five standard sheets, two district maps, and ten traverse charts are in various stages of progress. One sub-surveyor was employed towards the end of the field season on a topographical survey of the Jumna river bed in Meerut district, as the cadastral material available was found not of sufficient topographical value to allow of its being used in compiling the standard sheets. Thirty-four square miles have been surveyed in this manner, on the scale of two inches to one mile, and the fair mapping of the standard sheet concerned has been completed. The drawing office was instituted in 1898 to compile the material resulting from cadastral surveys, five seasons after the modern cadastral surveys had begun. At that time the annual cadastral outturn was very great, no less than seven districts being under survey at one time. There is, in consequence, a mass of cadastral material available, with which the present strength of the office will take some years to cope.

215. The programme for the next field season is as follows:—

Topographical surveys.—The completion of the survey on the scale of 2 inches to the mile of the Jumna river bed in district Meerut, and the topographical revision of portions of Bulandshahr district falling in standard sheets 8, 19, and 31, for which no modern cadastral material is available.

Traverse surveys.—The traverse of 270 square miles in Moradabad district, and the traverse in advance of about 270 linear miles of main circuits along the high banks of the Ganges in the same district.

Cadastral surveys.—The survey and preparation of preliminary records-of-rights of 390 square miles in the Moradabad, Thákurdwára, and Amroha *tahsils*, and the correction of maps and records in 60 square miles in the sandy tracts of Amroha *tahsil* in the Moradabad district. The correction of maps and partial preparation of records of about 789 square miles in *tahsils* Bánda, and Pailáni of Bánda district. The correction of maps and partial preparation of records of about 607 square miles in *parganas* Hamírpur, Sumerpur, and Maudha of Hamírpur district.

Town surveys.—The survey on the scale of 64 inches to the mile, with open ground on the scale of 16 inches to one mile, of about 4.1 square miles in the municipalities of Muttra, Brindaban, and Tanda-khas.

Road surveys.—The survey of 1,335 linear miles of first class roads in districts, Muzaffarnagar, Saháranpur, Dehra Dún, Bijnor, Bareilly, Moradabad, Budaun, Pilibhít, Sháhjahánpur, Kheri, Sítapur, Hardoi, Lucknow, Unao, and Naini Tál.

216. During the field season the Superintendent, Captain Coldstream, R.E., inspected the survey offices at Mainpuri, Jálaun, Azamgarh, and Fyzabad, and the traverse office at Aligarh; he also checked the survey and record work in the field in Mainpuri and Jálaun, and the town surveys in Koil and Háthras, and inspected and reported on the condition of the village maps of Lalitpur surveyed in 1894-97. On his rains tour he inspected all survey offices, and visited

Bánda, Hamírpur, and Moradabad, to make arrangements for the work of the next season.

217. The Deputy Surveyor-General inspected the drawing office at Naini Tál in October 1902, and again in June 1903, when he was present at a meeting of the Board of Revenue to discuss the future survey programme and other matters.

BENGAL.

NO. 4 PARTY AND 5 DETACHMENTS.

218. The traverse and cadastral survey operations in Bengal remained under the supervision of Major R. T. Crichton, I.A., Superintendent of Provincial Surveys, except for a period of nine weeks (7th August to 30th September), when Lieutenant F. C. Hirst, I.A., officiated during Major Crichton's absence on leave. The outturn of work accomplished, *viz.*, 6,884 square miles of traverse, 2,838 square miles of cadastral and 2,620 square miles of record writing is fully up to the programme, and is considerably greater than the outturn of previous years.

BHÁGALPUR.

219. In this district 572 square miles have been traversed at a cost-rate of **Rs 26'6** per square mile.

Personnel-Traverse.

Lt. F. C. Hirst, *offg.* Assistant Superintendent, 1st grade, in charge. The cadastral survey of 1,622 square miles and the record writing of 1,594 square miles has been completed at a cost-rate of **Rs 132'5** for both cadastral and records. Considering that there are 1,966,842 fields in this area, the cost-rate is satisfactory. The detail survey has been checked by an average of 4'8 linear miles of *partáls* or test surveys to each square mile of detail, and 28'4 per cent of the entries in the records have been checked by the survey staff. The same trouble as reported in last season in

Personnel-Cadastral.

Section I.

Mr. A. W. Smart, Extra Assistant Superintendent, 2nd grade, in charge.
 " O. J. H. Hart, Sub-Assistant Superintendent, 2nd grade.
 " O. E. C. Judd, " " " "
 2 Supervisors. 33 Inspectors. 20 Office establishment. 304 *Amins.*
 295 *Moharrirs*, etc.

Section II.

Mr. C. S. Kraal, Extra Assistant Superintendent, 4th grade, in charge.
 " H. W. Biggie, Extra Assistant Superintendent, 6th grade.
 " S. F. Norman, (Jr.) Sub-Assistant Superintendent, 2nd grade, till 4th April.
 " H. A. Hardless, Sub-Assistant Superintendent, 3rd grade, from 21st July.
 " G. Archer, Sub-Assistant Superintendent, 3rd grade.
 2 Supervisors. 35 Inspectors. 20 Office establishment. 310 *Amins.*
 300 *Moharrirs*, etc.

connected on to the previous Srinagar-Baneli survey was experienced and there is now no doubt that the traverse marks of the old survey had been moved at the settlement stage. Consequently in order to fit in the Srinagar-Baneli survey, an expensive overlap detail survey has had to be undertaken. The Nepal-Bhágálpur boundary, as now surveyed, has been compared with the maps of 1882-83, and the result shows the former survey to be wrong along the Tiljúga and Dumrah rivers.

BACKERGUNGE.

220. During the year under report 1,027 square miles have been traversed

Personnel-Traverse.

Mr. C. H. G. Johnson, Extra Assistant Superintendent, 6th grade, in charge.
 Mr. P. Kennegy, Sub-Assistant Superintendent, 3rd grade.
 28 Sub-Surveyors. 14 Computers, etc.

Personnel-Cadastral.

Mr. N. Bedford, Extra Assistant Superintendent, 5th grade, in charge.
 Mr. E. G. Hardinge, Sub-Assistant Superintendent, 1st grade.
 Mr. F. W. Marten, " " " " 2nd grade.
 2 Supervisors. 20 Office establishment. 46 Inspectors. 420 *Amins.*
 420 *Moharrirs*, etc.

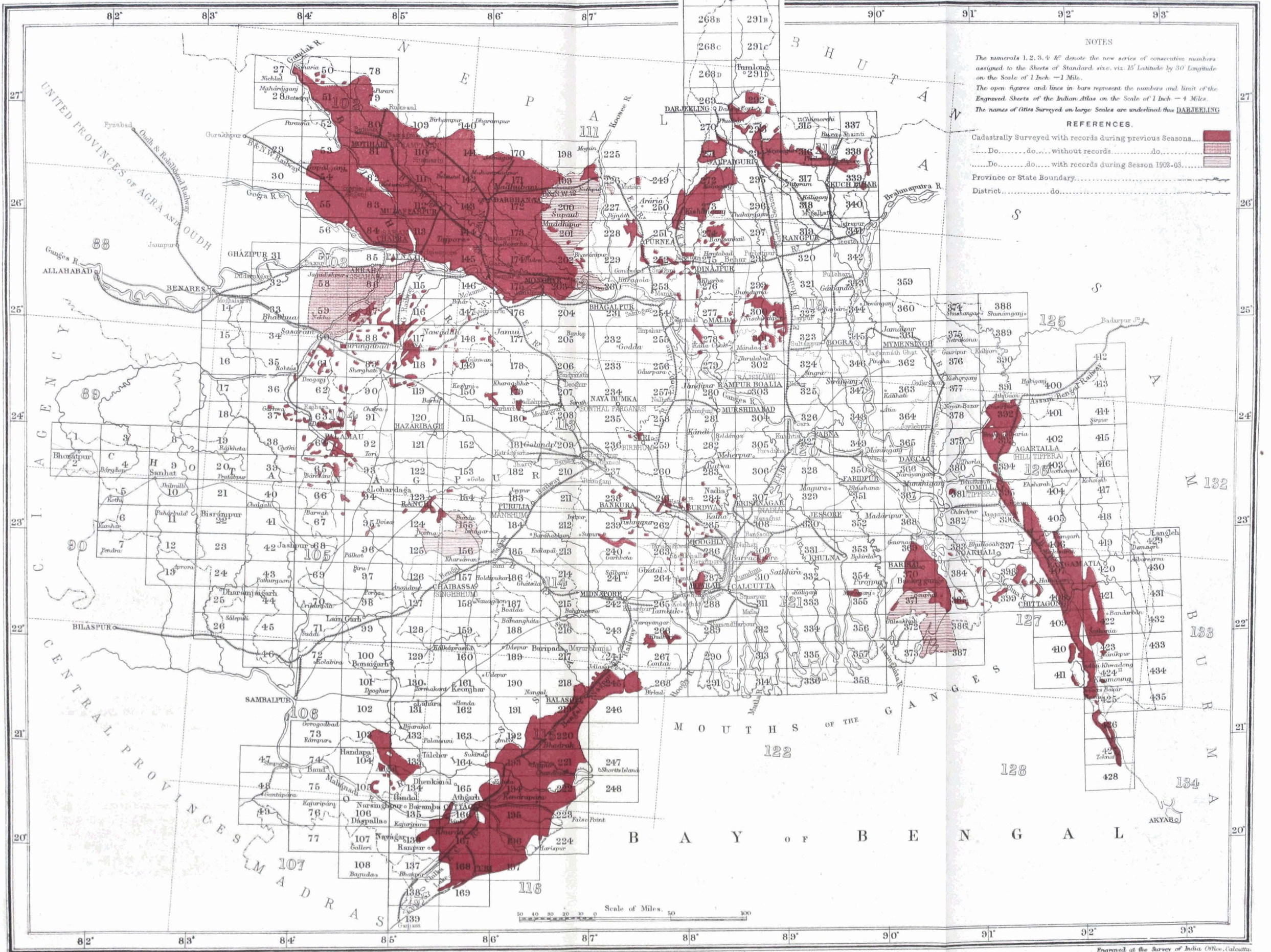
at a cost-rate of **Rs 43'6** per square mile. Considering the unhealthiness and water-logged nature of the country, and the high cost of local labour, this rate is fair and cannot be much reduced until programmes of 1,600 square miles per season in compact blocks are sanctioned. The rate is **Rs 18** per square mile less than last year. This is due to the larger area of the programme. The cadastral survey of 574 square miles and the record writing of 567

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEYS IN BENGAL.

1902-03.

No. 4 PARTY.



NOTES

The numerals 1, 2, 3, 4 &c 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 limit 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 DARJEELING.

REFERENCES.

Cadastrally Surveyed with records during previous Seasons.....

.....Do.....do.....without records.....do.....

.....Do.....do.....with records during Season 1902-03.....

Province or State Boundary.....

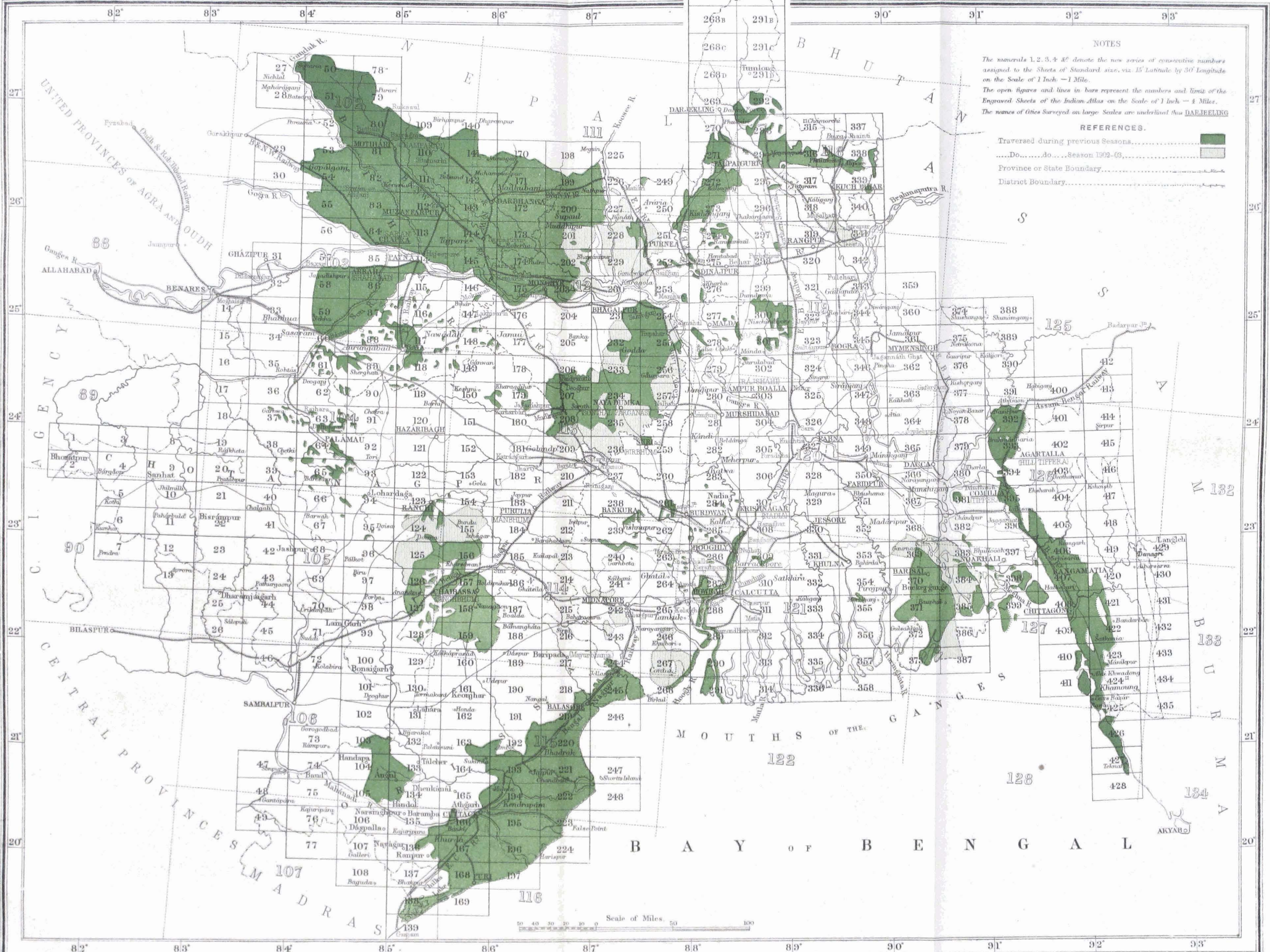
District.....do.....

BENGAL SURVEY.

INDEX TO THE TRAVERSE SURVEY IN BENGAL.

1902-03.

No. 4 PARTY.



NOTES

The numerals 1, 2, 3, 4 &c 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 = 1 Mile.

The names of Cities Surveyed on large Scales are underlined thus DARJEELING.

REFERENCES.

Traversed during previous Seasons.....

.....Do.....do.....Season 1902-03.....

Province or State Boundary.....

District Boundary.....

square miles have been completed at cost-rates of ₹114.7 and ₹53 per square mile, respectively. The reduction in the cadastral rate as compared with that of last season is due to (a) introduction of a certain number of experienced foreign *amins*; (b) introduction of a new system of contract payments whereby the *amin* has to provide his own coolie labour. The reduction in the cost-rate of record writing is due to the average size of the field being twice that of the foregoing season.

SONTHAL PARGANAS.

221. During the year under report 2,159 square miles have been traversed.

Personnel.

- Mr. C. S. Gasper, Extra Assistant Superintendent, 5th grade, in charge.
- Mr. P. F. Delaney, Sub-Assistant Superintendent, 2nd grade.
- 20 Sub-Surveyors, 19 Computers, etc.

Of this, 861 square miles were traversed in detail for subsequent cadastral survey by the settlement authorities, and the balance of 1,298 square miles, is skeleton traversing with a view to fixing the trijunction points in the area surveyed by Mr. Craven. The cost-rates are ₹28.3 per square mile for the detail *mauzawar* traversing and ₹14.1 for the skeleton traversing. The rate for the *mauzawar* traversing is considerably lower than that of last season, but that for trijunction traversing higher, which is accounted for by the fact that the country was jungly and necessitated heavy line clearing work. The traverse survey of the Sonthal Parganas has now been completed except a small area of about 100 square miles in the Ganges *diara* which will be dealt with as the adjoining districts come under survey.

RANCHI.

222. During the season, 1,001 square miles have been traversed at a cost-rate of ₹28.9 per square mile, which is a great reduction on last season's rates.

Personnel-Traverse.

- Mr. T. W. Babonau, Extra Assistant Superintendent, 5th grade, in charge.
- Mr. H. A. Hardless, Sub-Assistant Superintendent, 3rd grade, up to 21st July.
- 29 Sub-Surveyors. 16 Computers, etc.

The major portion of the area traversed is hilly, but not nearly so unhealthy as last season's area, which accounts principally for the reduction in cost-rates. During the season experiments were in progress with a view to finding a simple and expeditious method of checking measurements obtained from the observation to a 10 feet subtense bar. This has been effected by fixing two more discs on the bar 8 feet apart, check observations being taken to the 8 feet base.

Personnel-Cadastral.

- Mr. W. Skilling, Extra Assistant Superintendent, 5th grade, in charge.
- Mr. J. C. C. Lears, Sub-Assistant Superintendent, 2nd grade.
- Mr. A. B. Smart (Junior), Sub-Assistant Superintendent, 3rd grade, to 15th May.
- 1 Supervisor from 4th May. 32 Inspectors. 316 *Amins*, etc.

The cadastral survey covered an area of 616 square miles, of which 437 have also been completed in record writing. Owing to the indifferent quality of the newly trained local establishments, it was found impossible to complete the whole area surveyed in record writing as well, but no scattered arrears of work have been left, and the record writing will be brought up to date with the detail survey next season. The cost-rates are ₹61.7 and 32.3 for detail survey and records, respectively. The low rate for detail survey is due to the provision of free labour; and that of record writing, to the large size of the plot.

HAZARIBÁGH.

223. The traverse survey of the Kodarma Government Estate comprising 120 square miles has been accomplished at a cost-rate of ₹35 per square mile.

Personnel.

Same as Ranchi Traverse.

MONGHYR.

224. Two small Government estates have been cadastrally surveyed, and records written, in continuation of the operations of last season. As these estates only total about 100 acres, and are formed of scattered blocks of land no traverse survey was done.

Personnel.
Same as Bhágalpur Traverse.

PURNEA.

225. The traverse survey of 1,189 square miles has been carried out at a cost-rate of ₹24·3. This is the lowest cost-rate reached as yet in Bengal and is due to unusually favourable conditions, *i.e.*, large and compact programme, large average size of village, healthy tract of country, and also to some extent to a new system of contract payments for field work and for a part of the computing work, which has been tried with considerable success in a part of this area.

Personnel.

Same as Bhágálpur Traverse.

Same as Bhágálpur Traverse.

RANGPUR.

226. The traverse survey of 88 square miles of the Cooch Behar estates has been completed at a cost-rate of ₹57·3 per square mile. The high rate is due to the small and detached area and also to its very scattered nature.

Personnel.

Same as Bhágálpur Traverse.

Same as Bhágálpur Traverse.

MIDNAPORE.

227. The traverse survey of 655 square miles, comprising the Májnamútha, Jalamútha and other estates, has been accomplished at a cost-rate of ₹38·5 per square mile. An area of 35 square miles only remains to complete these estates, and this will be attended to early next season. The cost-rate, considering the very small average size of the village in the area traversed, is not high.

Personnel.

Same as Backergunge Traverse.

Same as Backergunge Traverse.

MISCELLANEOUS SURVEYS.

228. An area of 21 square miles in *pargana* Harwat of the Purnea district has been traversed, cadastrally surveyed, and completed in records by the Bihar traverse and cadastral sections, at cost-rates of ₹29·8, ₹50 and ₹55, respectively. A number of minor surveys in connection with the relaying of old boundaries in the Monghyr and Shahabad districts have been undertaken by the Bihar traverse section. The area of all these minor surveys is 30 square miles, and in each case the expenditure is met by deposits made by the applicants. Large scale surveys of the Bhágálpur and Roserha municipalities are also in progress, the expenditure being met by the municipalities concerned.

CALCUTTA SUBURBS SURVEY.

229. During the year the Bengal Government requested that a large scale survey of the added area of Calcutta might be undertaken. As no survey officer could be spared from the existing staff employed on Bengal Provincial Surveys, and the Surveyor-General could not provide any more, it was agreed that the work be entrusted to Mr. R. B. Smart, a retired officer of the department, under the supervision of the Superintendent of Provincial Surveys, Bengal. The area to be dealt with is 12 square miles. The work started in the middle of February and during the year the 12 square miles have been traversed (further sub-traverses will be necessary as the detail survey proceeds) and 3 square miles have been surveyed in detail on the scale of 50 feet to the inch (the same scale as that of the Calcutta survey). A certain amount of the record writing has also been completed, but considering the present incomplete state of the work, no attempt to calculate the cost-rates has been made.

BENGAL DRAWING OFFICE.

230. There are now, excluding the supervising or general section, 6 different sections in the Bengal drawing office,

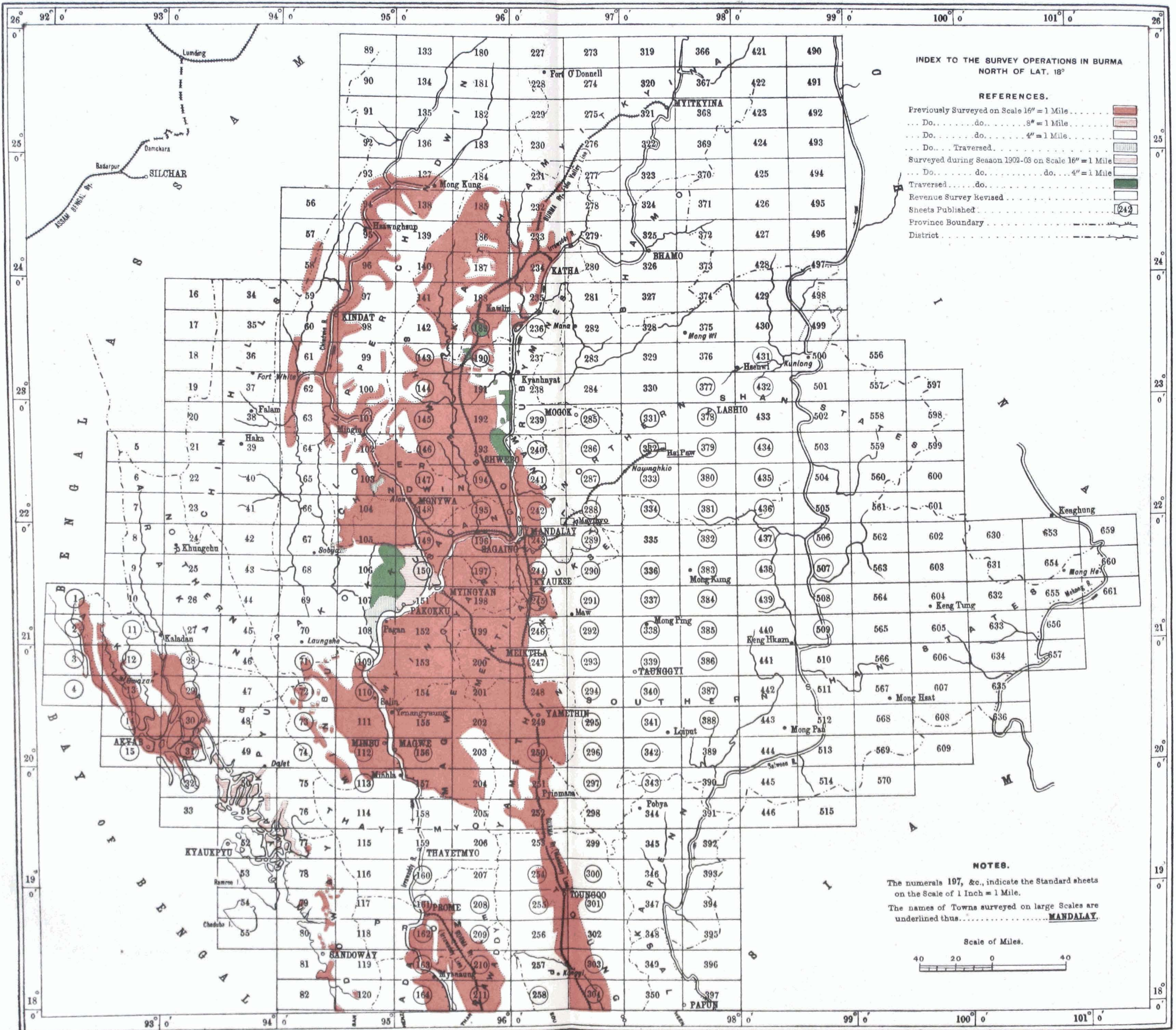
Personnel.

Mr. E. F. Berkeley, Extra Assistant Superintendent, 5th grade, in charge.

Mr. A. B. Smart (Junior), Sub-Assistant Superintendent, 3rd grade, from 21st May.

viz., (a) Standard and district mapping, (b) Bihar *badars*, (c) Orissa *badars*, (d) *Thána* mapping, (e) Reproduction of village maps, and (f)

Map record.



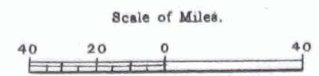
INDEX TO THE SURVEY OPERATIONS IN BURMA
NORTH OF LAT. 18°

- REFERENCES.
- Previously Surveyed on Scale 16" = 1 Mile
 - Do. 8" = 1 Mile
 - Do. 4" = 1 Mile
 - Do. Traversed
 - Surveyed during Season 1902-03 on Scale 16" = 1 Mile
 - Do. 4" = 1 Mile
 - Traversed
 - Revenue Survey Revised
 - Sheets Published
 - Province Boundary
 - District

NOTES.

The numerals 197, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

The names of Towns surveyed on large Scales are underlined thus. MANDALAY.



231. During the year the standard mapping section has been considerably augmented to permit of the bringing up of arrears and of keeping pace with the large increase of outturn of the field parties. The section now comprises 24 draftsmen, computers and typers. Of the 32 standard sheets of Orissa, 27 have been revised during the year under report and 23 sent in for publication. Thus, including previous totals there only remain now 4 sheets of Orissa for publication. Out of the 8 standard sheets of Bihar (excluding Darbhanga), 7 have now been completed and sent in for publication. The standard mapping of the Darbhanga district is proceeding satisfactorily and a start is about to be made in that of Backergunge. The standard maps of Chittagong have been unavoidably delayed owing to the difficulties in incorporating old and indifferent material. The compilation of the four sections of the district map of Muzaffarpur on the $\frac{1}{2}$ -inch scale for reduction to the $\frac{1}{4}$ -inch, has been in hand, and at commencement has been made with that of Balasore, both these should be ready by April 1904.

232. In the *thána* mapping section satisfactory progress has been made. Of the 24 *thánas* of Orissa, 9 now remain for publication, and of the 29 of Bihar only 2 remain for publication. During the year an experiment to reproduce *thána* maps by the Vandyke process has proved successful, and 100 copies of a *thána* map, including cost of compilation of same, are now provided at a cost of under ₹30 as against ₹160 of former years.

233. In the village map reproduction section a very large increase of plant and establishment has been sanctioned. During the year, 5,916 sheets of Orissa have been traced, 5,067 examined and 5,300 reproduced. The Orissa work is practically completed, as is also that of Chittagong, and a start has been made with Sárán. During the year, 60,778 copies of village maps have been issued to the Collectors of different districts. The average cost of a copy of a village map is now about 6 annas, inclusive of all supervision charges, but this rate will shortly be materially lowered as experiments conducted with a view to finding a paper sufficiently tough to stand field work and at the same time transparent enough to allow of direct reproduction, have been completely successful. In future sheets can be reproduced without the expense of preparing and examining the intermediate trace, and as the process will be purely mechanical, the reproduced copies can be stamped as certified copies, which will largely increase the demand. The future cost of reproduction of a village map will be about 3 annas (with an increased demand, even less) and if a small profit is made on each, and credited against the cost of the survey and settlement, the cost-rates will be materially lowered. Owing to the decision that each Local Government should take over the custody of its original cadastral maps, a new map record section has been added to the Bengal drawing office. Racks have been built to provide accommodation for the requirements of the next 10 years, and a small establishment provided.

234. Major R. T. Crichton, Superintendent of Provincial Surveys, inspected each section of the Bengal surveys in the field on an average of 3 times, and several also during recess. Lieutenant F. C. Hirst also inspected the sections during recess while Major Crichton was on leave.

235. The Deputy Surveyor-General inspected the recess office of the two Bihar sections at Dinapore, and visited the Bengal drawing office at frequent intervals throughout the year.

UPPER AND LOWER BURMA.

NO. 7 PARTY.

Personnel.

Major G. B. Hodgson, I. A., Superintendent, 1st grade, in charge from 29th October 1902 to 30th April 1903.

Lieutenant C. P. Gunter, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 1st to 28th October 1902 and from 1st May to 21st June 1903.

Mr. J. S. Swiney, Extra Assistant Superintendent, 2nd grade, in charge from 22nd June 1903.

Mr. O. D. Smart, Extra Assistant Superintendent, 4th grade.

" C. G. Lee " " " 5th "

Babu Abinash Chunder Bose, Sub-Assistant Superintendent, 1st grade.

Babu Jagdamba Prasad " " " 1st grade.

Mr. W. E. S. Swiney " " " 3rd grade.

51 Surveyors, Sub-Surveyors, Computers, etc., and 3 Writers.

236. The outturn of work for the season is as follows :—

| Locale. | SQUARE MILES. | |
|---|---------------|-------------------|
| | Traversing. | Cadastral Survey. |
| UPPER BURMA. | | |
| Pakòkku town (completing the town) | 4 | 3 |
| Pakòkku district | 455 | 603 |
| Shwebo district | 302 | ... |
| LOWER BURMA. | | |
| Kyaukpyu district (completing the district) | 42 | 74 |
| TOTALS | 803 | 680 |

The area traversed in Shwebo is in excess of the proposed programme owing to the desire of completing as much of this district as possible, the local settlement having already commenced. In Kyaukpyu the area surveyed is cultivated land only, and proved to be much less than the estimate which included jungle.

237. During the field season the sections employed in Upper Burma enjoyed good health, except during the month of May in the Shwebo district when five men died from dysentery. In Lower Burma, as was expected, the men suffered a great deal from fever throughout the field season; there were, however, no deaths, but four men were invalided to India.

238. The cost-rates for the season are—

| UPPER BURMA. | | R |
|---|--|-----|
| Traverse survey— | | |
| Pakòkku district, per square mile | | 61 |
| Shwebo district, " " " | | 85 |
| Cadastral survey— | | |
| Pakòkku district, per square mile | | 117 |
| LOWER BURMA. | | R |
| Traverse survey, per square mile | | 438 |
| Cadastral survey, " " " | | 536 |

In Upper Burma the cost of traversing Pakòkku district is R4 more than it was last year, due entirely to the nature of the work being more difficult and the area less. In Shwebo, as was expected, the cost is much greater due to the area surveyed being scattered in small blocks throughout the entire length of the district, and to the loss of time entailed in opening up old traverse stations. The rate of the cadastral survey is much the same as last year; this is satisfactory, as the average area of fields is smaller, and the proportion of jungle to cultivation less. In Lower Burma the cost of both traversing and cadastral survey is very high, due entirely to the very small areas surveyed, the scattered nature of the work, and the enormous difficulties encountered in the district; the expenditure on transport (water carriage being the only means of conveyance of men and baggage) almost alone accounts for the difference between the cost-rates in Kyaukpyu and in Sandoway last year.

UPPER BURMA.

239. The traverse survey was in charge of Lieutenant C. P. Gunter, R.E., assisted by Mr. C. G. Lee, and towards the end of the field season by Babu Jagdamba Prasad. The subordinate establishment consisted of ten traverse surveyors and eight computers. In the Pakòkku district the traverse survey was in continuation of last season's work, and situated in the Myaing township. In the Shwebo district the traverse work consisted of the completion of small blocks of country, scattered throughout the district east of the railway line, which had been omitted by the survey of 1892-94.

240. The country traversed in the Myaing township is hilly and deeply indented with ravines, about two-thirds of it being covered with scrub-jungle, water being scarce everywhere. In the Shwebo district the areas traversed comprised hilly country, cut up by deep ravines and three-fourths of it covered with thick bamboo and scrub-jungle. The results of this season's work show a great improvement on last year's. The demarcation in the Myaing township was good and in Shwebo as good as can be expected in such wild country. The demarcation maps were excellent. The traverse section took the field on the 16th October, and returned to recess quarters at Mandalay on the 1st June. The theodolite stations were marked with galvanized iron cylinders. The angular work was checked by observations for azimuths at 38 stations in Pakòkku and at six stations in Shwebo. Double chaining was employed on main and sub-circuits and in the town work only. Connections were made to two intersected points of the Great Trigonometrical Survey, *Pagodas* 63 and 64, from last season's traverse work. The average error in chaining in the Pakòkku district works out to 0·22 links per mille; the error in the Shwebo district necessarily involves the errors of the former surveys and is of no value here; all the circuits closed satisfactorily. All the computations have been completed as far as is possible.

241. Mr. J. S. Swiney was in charge of the cadastral section. He had two assistants, Babu Abinash Chunder Bose and Mr. W. S. Swiney. The survey was tested by 725 linear miles of check lines, giving an average of 3 linear miles per square mile actually surveyed. The cadastral work in Pakòkku was started on 11th November 1902, and was completed on 11th June 1903. The average number of *amins* was 55 employed for an average of six months. The detail survey was mapped on 680 sheets on the 16-inch scale. Of the field sheets 153 were mapped on bank-post paper by the field surveyors, and these original sheets have been sent to Calcutta for reproduction by the Vandyke process, and it is hoped that they will prove a success, as the cost and trouble of making traces will be saved by this means.

242. During the recess the 16-inch field sheets were all completed, and traces have been sent to Calcutta for reproduction by the Vandyke process. In addition to this, the traces of 703 16-inch field sheets of previous season's work, and work revised by local authorities, have been completed and sent to Calcutta for reproduction. Miscellaneous work has also been done for the Settlement Department. Standard sheet 151 has been completed to date on the 2-inch scale, and will be sent to No. 10 Party for their use. Standard sheets 102, 103, 104, 105, 147 and 148 have been completed and sent to Calcutta.

243. The programme for next season consists of the traverse survey of 220 square miles in the Shwebo district, 450 square miles in the Pakòkku district, the cadastral survey of 520 square miles in the Shwebo district, and 280 square miles of Pakòkku district.

LOWER BURMA.

244. Mr. O. D. Smart was in charge of the survey work in Lower Burma, both traverse and cadastral. He was assisted during the field season by Babu Jagdamba Prasad. The subordinate establishment consisted of six traverse surveyors, 34 field surveyors and 13 office hands. The work commenced in Kyaukpyu on 14th November 1902 and closed on 24th April 1903. This year's work completes the Kyaukpyu district, and also the programme as laid down by the Burma Government for Lower Burma. All the theodolite stations were marked with galvanized iron cylinders. The angular work was checked by observations for azimuth at 64 stations and the angular error is 1 minute in every 15 angles on village circuits. Double chaining was employed throughout, as there were no main circuits owing to the scattered nature of the work. The traversing was connected in three separate blocks to three hill stations of the topographical survey, and the average error in chaining works out to 0·3 links per mille. All the circuits closed satisfactorily. The 148 *kwins* surveyed in detail were scattered along a sea coast line of 100 linear miles. The detail survey was checked by 120 linear miles of check lines, giving an average of 1·6 linear miles per square mile of area actually surveyed, and was mapped on 323 sheets on the 16-inch scale.

245. The country surveyed in Kyaukpyu is densely wooded and covered with mangrove jungle, and cut up every few miles by huge arms of the sea. Only the cultivated areas were surveyed in detail.

246. The 16-inch cadastral sheets were all completed during the recess, and traces of all have been prepared and sent to Calcutta for reproduction by the Vandyke process. The area surveyed in Kyaukpyu being so small and scattered, 2-inch reductions have not been made for the local authorities.

247. The Government of Burma have asked for the survey of the added area of Rangoon town for the municipality on the scale of 100 feet to the inch covering an area of about $15\frac{1}{2}$ square miles, but since this area has not yet been demarcated, it is doubtful if the work can be commenced next field season.

GODÁVARI DETACHMENT.

248. On 13th May 1901, the Government of Madras in their No. 405 I to

Personnel.

Babu Nilmoni Chatterji, Extra Assistant Superintendent, 6th grade, in charge up to 9th April 1903.
Mr. S. F. Norman (Jr.) Sub-Assistant Superintendent, 2nd grade, in charge from 10th April 1903.
7 Sub-Surveyors, etc.

the Government of India, applied for the topographical survey of the Godávári delta embracing an area of about 300 square miles on the same

scale as the village maps in the vicinity, *viz.*: 16 inches = 1 mile, for the purposes of Madras Act VI of 1884. A number of permanent marks along both banks of the river were also required to be fixed, and built. For this latter purpose a detachment from Nos. 9 and 19 Forest parties under Mr. Sheehan was deputed to undertake the triangulation during season 1901-02, when 109 permanent stations were built, and 39 intersected points fixed. In November, 1902, it was ascertained from the Chief Engineer for Irrigation, Madras, and from information derived from the Madras Conservancy Act that of the 300 square miles, about 180 square miles were required to be surveyed cadastrally with a record of rights, and the remaining 120 miles only, consisting of water and sand in the river bed, were for topographical survey. A representation was accordingly made to the Madras Government on 28th November 1902, and early instructions solicited as to whether under the circumstances the work was to proceed. In the meanwhile a small establishment of traversers were sent into the field on 29th November under Babu Nilmoni Chatterjee, Extra Assistant Superintendent, to provide a sufficiency of data for the detail surveyors, and as no *amins* or inspectors were available locally, they were engaged in the United Provinces, and kept on a small retaining fee pending the receipt of final orders from the Madras Government, which, however, notwithstanding repeated references, were not received till the 9th March 1903. Thus $3\frac{1}{2}$ months of the best part of the field season were lost.

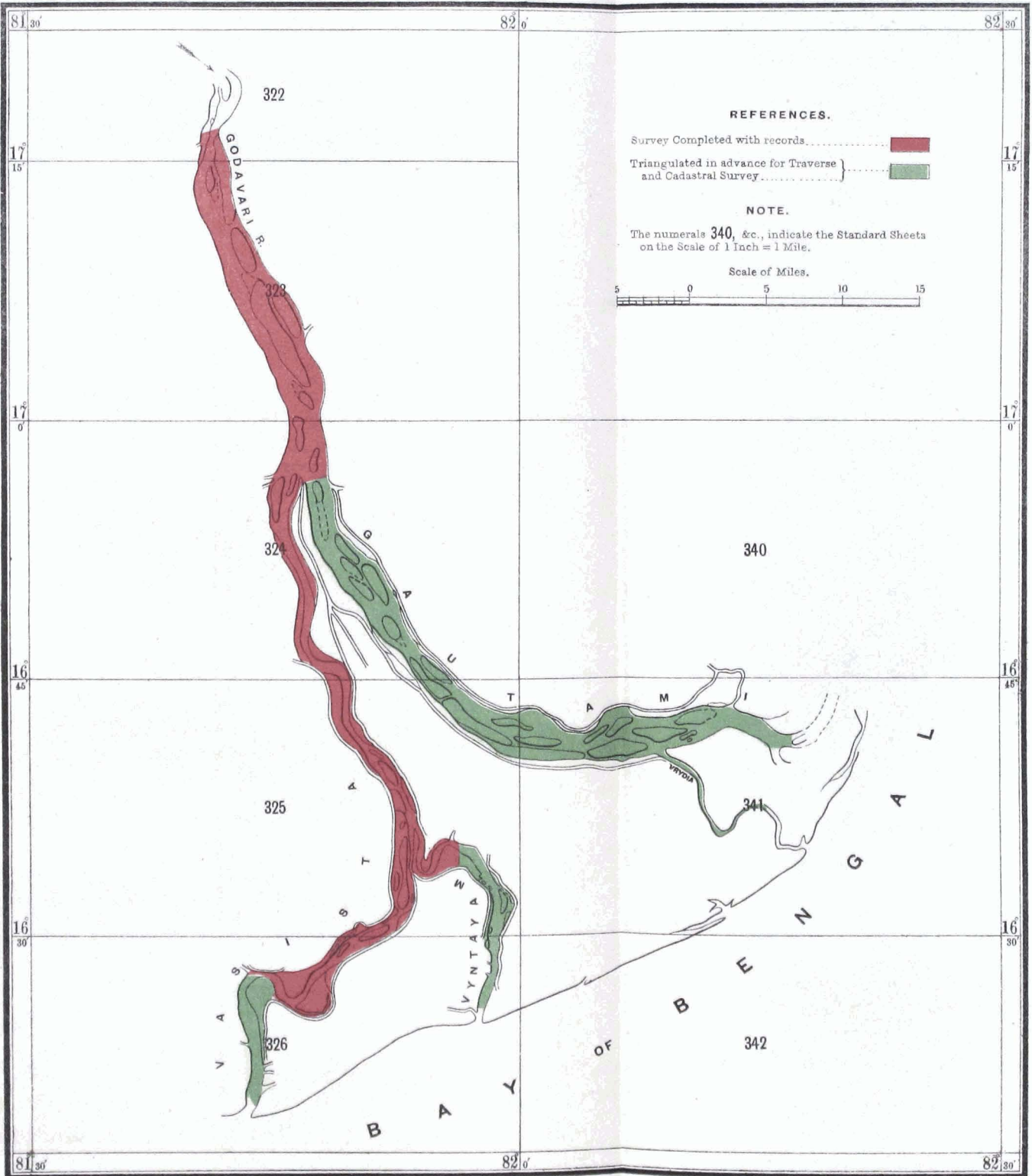
249. The establishment engaged on the work was formed into a separate detachment from 1st December 1902 and placed under the administrative control of the Deputy Surveyor-General from 17th idem. Babu Nilmoni Chatterji held charge of the detachment till the 9th April, when falling ill, was obliged to apply for leave on medical certificate, and was relieved of his duties by Mr. S. F. Norman, Sub-Assistant Superintendent.

250. The area both traversed and cadastrally surveyed was 131 square miles which included the river from Golavaram to the anicut, a distance of 25 miles, and practically the whole of the western delta (distance 30 miles). The *amins* to take up the detail survey did not arrive till March. The origin of survey is latitude $16^{\circ}50'$ and longitude $81^{\circ}55'$, the traverses being based on the triangulation of the river which was completed the previous year. The traverse stations were marked by pegs, the average number of stations laid down during the year being 12 per square mile. The area was subdivided into 3 river circuits comprising 31 blocks. The chaining proved very well, the error being 5 links in 1,000 chains, the angular error working out to 4 seconds per station. 93 sub-traverses were run and 51 permanent mark stones with a circle and dot chiselled on the flat top, have been embedded along both flood banks of the river at intervals of from 2 to 4 miles by triangulation, ensuring the greatest intervisibility, whilst traverses have also been run con-

MADRAS SURVEY.

INDEX TO THE GODAVARI CADASTRAL SURVEY.

1902-03.



necting the river survey to the fixed points of the Madras Revenue Survey. The outturn in traversing per man per mensem was 28 linear miles of chaining and 151 angles; and in cadastral survey 698·66 acres or 224 fields, the average size of the field being 3·11 acres.

251. The cadastral survey was mapped on 165 sheets on the 16-inch scale, and checked by 89 linear miles of *partals* by the officer in charge independently, and 153 linear miles by inspectors, or a total of 242 miles of test lines to each square mile of detail survey. No demarcation was carried out, but *lanka* boundaries have been shown on the charts as pointed out by the *kernams*. Only two disputes arose regarding these, one of which is between Government and *samindari* lands,

252. The record writing was done chiefly under the supervision of the village *kernams*, and written up by local men appointed especially for this work; the *amins*, being unacquainted both with the language and the tenure system, simply reading and numbering the charts; next year, however, the Superintendent, Madras Survey, has promised to lend the services of local *amins* thoroughly versed in *khánápurí*, which will not only ensure more correctness in the work, but will, it is expected, greatly reduce the cost of the same. The average outturn in *khánápurí* per man per day was 60 numbers, 25 per cent. of the whole being checked by inspectors. The following statement gives particulars of the work done and cost-rates.

| DISTRICT. | TRIANGULATION DURING 1901-02. | | | TRAVERSING. 1902-03. | | | CADASTRAL SURVEY AND RECORD- OF-RIGHTS. 1902-03. | | | |
|---|----------------------------------|---------------|-----------------------|-------------------------|---------------|-----------------------|--|---------------|---------|-----------------------|
| | Blocks. | Square miles. | Cost per square mile. | Blocks. | Square miles. | Cost per square mile. | Blocks. | Square miles. | Fields. | Cost per square mile. |
| Godávári (river- area under Con- servancy Act). | ... | 300 | 17 | 31 | 131 | 24 | 31 | 131 | 26,947 | 119·25 |

The rate $\text{R}143$ per square mile for both traverse and cadastral survey combined is not excessive, taking into consideration the fact that the inspectors and *amins* and tindals had to be imported from the United Provinces, entailing an expenditure of $\text{R}3,500$ and the high rate of pay fixed in order to induce them to come. The loss of $3\frac{1}{2}$ months of the field season referred to above, also reduced the outturn, which necessarily affects the cost-rate. The cost of the triangulation cannot rightly be included in the expenditure, as a triangulation was not necessary for the cadastral survey, but for laying down permanent marks as explained above. Again, the nature of the country made the supply of boats to the surveyors necessary, and this is a heavy item of expenditure, as is also the high local rate of pay of interpreters for *amins*.

253. The detachment remained out in the field till 4th August to complete the *khánápurí* of the area cadastrally surveyed, and proceeded to recess quarters at Bangalore.

254. The health of the detachment was satisfactory on the whole, two deaths occurred among the cadastral staff, one died of plague.

255. During recess the computations have been completed, the tracing of the field maps will be completed by the end of the recess, as also the areas. The traces are being done on vellum cloth for reproduction by the Vandyke process; the block numbers and also those of adjoining sheets have been printed on the traces, so that no difficulty may be experienced hereafter in fitting them together.

256. The area surveyed being 131 square miles, leaves approximately 169 square miles to be completed. The triangulation of this has been done, the traverse and detail survey remain to be finished next season. If the orders of the Madras Government had been received earlier, there is no doubt the whole area could have been done in one field season, at a much reduced cost-rate.

257. The detachment was inspected by the Deputy Surveyor-General during the field season in May, and by the Chief Engineer accompanied

by the Superintending and Executive Engineers on the 26th June. The latter examined all maps and records and expressed their satisfaction on the work done, and concluded by inspecting the permanent mark stones laid down by triangulation. The detachment was again inspected at Bangalore in August by the Surveyor-General and Deputy Surveyor-General.

ASSAM.

ASSAM DETACHMENT.

258. The detachment continued traverse work under Mr. T. Shaw who was in charge throughout the year. Mr. C. O'Donel was on deputation under the District Judge of Sylhet from the 28th October 1902 till the 11th July 1903 as a Commissioner in a boundary dispute case between Government and the Hill Tippera State.

Personnel.

Mr. T. Shaw, Extra Assistant Superintendent, 2nd grade, in charge.
 „ C. O'Donel, Sub-Assistant Superintendent, 1st grade.
 8 Sub-Surveyors, 3 Computers, 4 Draftsmen, 1 Writer, 1 Land Records Clerk.

259. The actual areas traversed are shown in the following statement :—

| DISTRICT. | TRAVERSE FOR DETAIL SURVEY ON SCALE 16" = 1 MILE. | | TRAVERSE FOR SKELETON SURVEY OF TEA GRANTS. | | TOTAL. |
|---------------------|---|---------------|---|---------------|---------------|
| | Villages. | Square miles. | Grants. | Square miles. | Square miles. |
| Kámrúp | 79 | 96 | ... | ... | 96 |
| Darrang | 27 | 21 | 42 | 19 | 40 |
| Nowgong | ... | ... | 10 | 25 | 25 |
| Sibságar | 11 | 12 | 9 | 20 | 32 |
| Lakhimpur | ... | ... | 85 | 81 | 81 |
| TOTAL | 117 | 129 | 146 | 145 | 274 |

Out of 6,440 stations at which the sub-surveyors set up their theodolites —

459 were on *pakka* pillars.
 519 „ „ old stone prisms.
 158 „ „ rough stones.
 5,304 „ „ wooden pegs.

Most of the wooden pegs have had mounds erected five feet north of them. The traverse stations have been connected with former traverse surveys and so their geographical positions are ascertained for projection on the standard maps. The season's work involved 860.85 linear miles of new chain measurements and observations for azimuth at 89 stations.

260. The area of 96 square miles in district Kámrúp was traversed in order to supply the Settlement Department with fixed points for the purpose of bringing up to date the cadastral maps of *pargana* Barama surveyed by No. 6 Party in 1883-85. During the cadastral survey of part of district Kámrúp by No. 6 Party only trijunction points were permanently marked, all other theodolite stations being left unmarked. As extensive changes were found to have taken place in the fields originally mapped, the Settlement Department was unable to carry out the alterations properly without the help of fixed points, and it was to supply these and to mark the new points on the printed cadastral maps that the fresh traverse survey of these 96 square miles was undertaken.

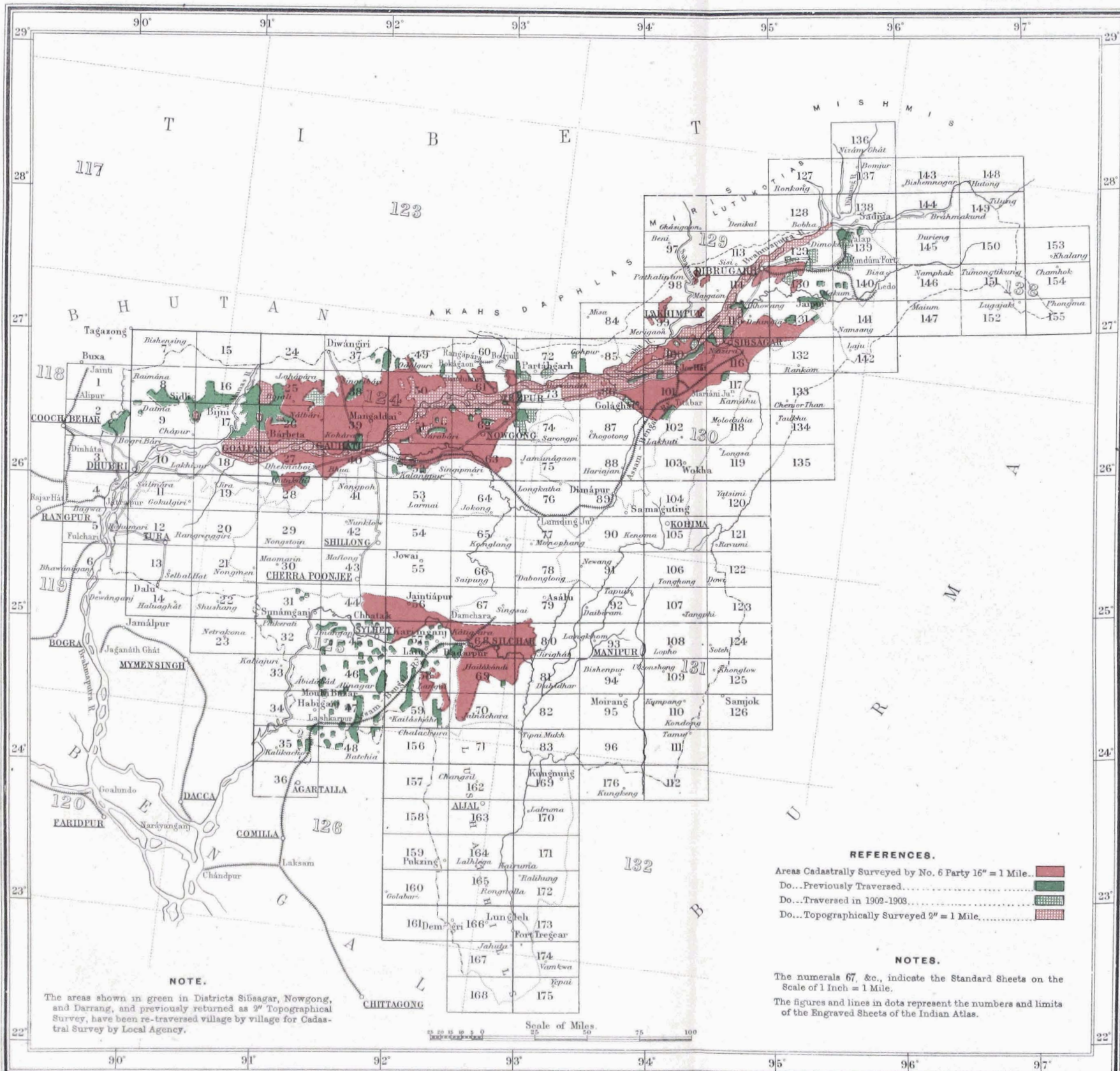
261. The cost-rates for traverse survey vary from Rs. 20 per square mile in district Kámrúp where only villages in one ring fence were traversed, to Rs. 83 in district Lakhimpur where only tea grants were dealt with. The high cost-rate for tea grants is not due solely to the scattered nature of the work nor to the inclusion of cost of connecting traverses, but principally to the want of co-

ASSAM SURVEY.

INDEX TO RECENT CADASTRAL, TRAVERSE, & TOPOGL. SURVEYS IN THE BRAHMAPUTRA & SURMA VALLEYS.

1902-03.

ASSAM DETACHMENT.



NOTE.

The areas shown in green in Districts Sibsagar, Nowzong, and Darrang, and previously returned as 9th Topographical Survey, have been re-traversed village by village for Cadastral Survey by Local Agency.

REFERENCES.

- Areas Cadastrally Surveyed by No. 6 Party 16" = 1 Mile. [Red box]
- Do...Previously Traversed. [Green box]
- Do...Traversed in 1902-1903. [Dotted box]
- Do...Topographically Surveyed 2" = 1 Mile. [Cross-hatched box]

NOTES.

The numerals 67, &c., indicate the Standard Sheets on the Scale of 1 Inch = 1 Mile.
The figures and lines in dots represent the numbers and limits of the Engraved Sheets of the Indian Atlas.

Scale of Miles. 0 25 50 75 100

operation on the part of tea grant managers. The cost-rates per square mile by districts and class of work are, as follows:—

| District. | Villages. | Grants. |
|---------------------|-----------|---------|
| | R | R |
| Kámrúp | 20 | ... |
| Darrang | 55 | 54 |
| Nowgong | ... | 78 |
| Sibságar | 63 | 62 |
| Lakhimpur | ... | 83 |

Taken as a whole, the cost-rate per square mile of traversing was Rs. 55. This includes the cost of measurement of offsets to the boundaries of 145 square miles of tea grants.

262. In district Cachar a sum of R225-13-8 was expended without any traverse survey being done. A sub-surveyor with squad was sent to Cachar to undertake the traverse survey of about 3 square miles of disforested area which the local authorities wish to lease out to cultivators. When the surveyor reached Silchar the country was found to be flooded and the traverse survey had consequently to be abandoned till next field season. Timely information by the local authorities concerned would have prevented this mishap and waste of money. In future the employment of professional surveyors on such very small and detached operations is not to be recommended.

263. No topographical surveys were undertaken in the Province during the year under report.

264. The preparation of standard maps was continued in the drawing office, but, owing to the smallness of the establishment, and the continued lack of supervision due to Mr. Shaw's absence from Shillong for seven months of the year, no maps were submitted for publication. Arrangements have been made to strengthen the drawing establishment considerably as well as for the continuous residence at Shillong of an officer of the provincial service to supervise the drawing office. Greater efficiency will consequently result and the publication of maps may be expected early in the ensuing year.

265. A class for training local officers in practical field surveying was held at Palásbári in district Kámrúp for five weeks in February and March 1903, during which time Mr. Shaw instructed one Extra Assistant Commissioner and one Sub-Deputy Collector. There were to have been eight officers present at the class but six were not able to attend owing to the urgency of revenue collection at the time. Mr. Shaw also conducted an examination for first class certificates at the Gauháti survey school. Mr. Shaw examined the maps and records of the Land Records Department in districts Darrang, Kámrúp, Sibságar and Lakhimpur, and completed a revised demarcation of the coal mines at Cherra Poonjee.

266. The proposed programme for next field season is as follows:—

| District. | Traversing for cadastral survey by local Agency. | Traversing of tea grants. |
|---------------------|--|---------------------------|
| | Square miles. | Square miles. |
| Kámrúp | 15 | 16 |
| Darrang | 19 | 14 |
| Nowgong | ... | 19 |
| Sibságar | ... | 9 |
| Lakhimpur | ... | 165 |
| TOTAL . | 34 | 223 |

Also the demarcation of a boundary between *pargana* Habraghát, and the Kámrúp district and other miscellaneous surveys.

267. The Deputy Surveyor-General inspected the office at the end of September 1903 and looked carefully into the state of each map. He also brought forward certain proposals before the Chief Commissioner for placing the detachment on the same footing as the Central Provinces detachment as regards control and audit of pay.

GEODETIC

ASTRONOMICAL LATITUDES.

NOS. 22 AND 23 PARTIES.

268. During the season 1902-03, these parties were combined and employed under Lieutenant H. McC. Cowie, R.E., on Latitude operations on the southern portion of the Budhon Meridional series, between the parallels of $24^{\circ} 30'$ and $27^{\circ} 0'$ North Latitude; on the Calcutta Longitudinal series at stations about 79° E. Longitude, and at one station, Birond of the N. E. Longitudinal series.

269. The instrument used was Troughton and Simms' Zenith Telescope No. 1, furnished with two levels.

Talcott's method of observation was employed.

270. The following table gives the results of the season's work:—

Table giving the final values for Latitude and the apparent deflection of the plumb-line at each station.

| Series. | Stations. | Height above M.S.L. | East Long. | Astronomical Latitude = O. | P. E. | Geodetic Latitude = C. | Apparent deflection of plumb-line = O—C. |
|-------------------------------|----------------|---------------------|------------|----------------------------|--------|------------------------|--|
| | | | o ' " | o ' " | | o ' " | " |
| Budhon Meridional series. | Gúrmí . . . | 575 | 78 33 | 26 36 5'97 | ±0'049 | 26 36 3'63 | + 2'34 |
| | Majhár . . . | 1028 | 78 31 | 26 6 20'30 | ±0'039 | 26 6 17'00 | + 3'30 |
| | Algi . . . | 1154 | 78 24 | 25 29 48'15 | ±0'038 | 25 29 46'20 | + 1'95 |
| Calcutta Longitudinal series. | Andhiári | 1630 | 78 16 | 24 41 11'29 | ±0'026 | 24 41 6'77 | + 4'52 |
| | Dargawa . . . | 1452 | 79 4 | 24 37 17'31 | ±0'040 | 24 37 13'21 | + 4'10 |
| N. E. Longl. series. | Budhon . . . | 1367 | 78 34 | 24 5 8'99 | ±0'034 | 24 5 8'41 | + 0'53 |
| | Saugor . . . | 2033 | 78 49 | 23 49 48'71 | ±0'043 | 23 49 48'07 | + 0'64 |
| | Náharmau . . . | 2240 | 78 52 | 23 30 13'11 | ±0'049 | 23 30 18'14 | — 5'03 |
| | Birond . . . | 6967 | 79 45 | 29 14 29'71 | ±0'053 | 29 15 14'15 | —44'44 |

The apparent deflections of the plumb-line, deduced from the latitude results, seem to indicate that the northern limit of the area of positive deflections is trending from south-west to north-east between the meridians of 77° and 80° . Between these meridians the line of maximum positive deflection appears also to run to the north-east.

The results also seem to show that Rangir (Lat. $24^{\circ} 0'$ Long. $79^{\circ} 28'$) is similar to Pahargarh (Lat. $24^{\circ} 56'$ Long. $77^{\circ} 44'$) in exhibiting an isolated negative deflection in a locality where the deflections are generally positive.

The result given by the observations at Birond falls into line with those already obtained round Darjeeling and Mussooree and seems to indicate that the large northerly deflections found in these two localities are not abnormal, and that similar northerly deflections will be met with all along the outer ranges of the hills.

The minor investigations carried out during the season were in connection, for the most part, with the micrometer and the systematic and periodic errors of the screw. Corrections for these, however, have not as yet been introduced into the computations.

271. The parties were inspected by the Superintendent, Trigonometrical Surveys, in June 1903.

TIDAL AND LEVELLING OPERATIONS.

NO. 25 PARTY.

Personnel.

Captain H. H. Turner, R.E., Officiating Deputy Superintendent, 1st grade, in charge from 16th April 1903.
 Lieutenant F. B. Tillard, R.E., Officiating Assistant Superintendent, 1st grade, in charge from 23rd October 1902 to 15th April 1903.
 Mr. E. J. Connor, Extra Deputy Superintendent, 2nd grade, in charge up to 22nd October 1902.
 Mr. J. P. Barker, Extra Assistant Superintendent, 5th grade.
 " H. G. Shaw, " " 6th "
 " E. H. Corridon Sub-Assistant " 1st. "
 Munshi Syed Zille Hasnain, Sub-Assistant Superintendent, 2nd grade.
 21 Surveyors, Computers, etc.

272. Mr. E. J. Connor held charge of the party until the 22nd October 1902 when Lieutenant F. B. Tillard, R.E., took over and held charge until 15th April when he was relieved by Captain H. H. Turner, R.E., who continued in charge for the remainder of the year.

TIDAL OPERATIONS.

273. Observations were being taken at the following tidal stations at the commencement of the survey year:—

| STATIONS. (Those shown in italics are permanent.) | | Automatic or Personal observations. | Date of commencement of observations. | Date of closing of observations. | Number of years of observations. | REMARKS. |
|--|-----------------------------------|-------------------------------------|---------------------------------------|----------------------------------|----------------------------------|-------------------------------|
| 1 | Suez | Automatic | 1897 | Still working | 6 | To be closed. |
| 2 | Perim | " | 1898 | 1902 | 5 | Closed on 25th February 1903. |
| 3 | Aden | " | 1879 | Still working | 23 | |
| 4 | Kurrachee | " | 1881 | " | 22 | |
| 5 | Porbandar | " | 1898 | 1902 | 5 | Closed. |
| 6 | Port Albert Victor (Kathia-wader) | " | 1900 | Still working | 3 | To be closed. |
| 7 | Bombay (Apollo Bandar) | " | 1878 | " | 25 | |
| 8 | Bombay (Prince's Dock) | " | 1888 | " | 15 | Property of Port Trust. |
| 9 | Madras | " | 1880 restarted 1895 | 1890 Still working | 10 8 | 18 |
| 10 | Kidderpore | " | 1881 | " | 22 | |
| 11 | Bassein (Burma) | " | 1902 | " | 1 | |
| 12 | Rangoon | " | 1880 | " | 23 | |
| 13 | Port Blair | " | 1880 | " | 23 | |

274. The 11 tidal observatories now working were inspected during the year, and in addition those at Porbandar and Perim were visited and finally closed. The registrations at all the observatories, except those at Porbandar, have been satisfactory. At Porbandar the communication pipe again became choked with sand.

275. The two following tables show the annual and decadal percentages of the predicted time and height errors of high and low water at open coast and riverain stations.

Percentages of Errors in Predicted Times and Heights at open Coast Stations from Automatic Registrations.

| Year. | Number of stations. | IN TIME | | IN HEIGHT | | | |
|-------------------------------|---------------------|-------------------------------|-------|-----------------------------|-------|---------------------------------------|-------|
| | | Within 15 minutes of actuals. | | Within 8 inches of actuals. | | Within 1/16 of mean range at Springs. | |
| | | H. W. | L. W. | H. W. | L. W. | H. W. | L. W. |
| 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 | 95 |
| 1897 | 8 | 71 | 75 | 96 | 97 | 97 | 97 |
| 1898 | 9 | 74 | 70 | 96 | 96 | 95 | 95 |
| 1899 | 9 | 74 | 66 | 95 | 95 | 93 | 92 |
| 1900 | 11 | 66 | 60 | 93 | 88 | 93 | 89 |
| 1901 | 11 | 71 | 60 | 93 | 91 | 93 | 91 |
| 1902 | 9 | 76 | 67 | 94 | 95 | 96 | 96 |
| Average of 10 years | 9 | 71 | 66 | 95 | 95 | 95 | 94 |

Percentages of Errors in Predicted Times and Heights at Riverain Stations from Automatic Registrations.

| Year. | Number of stations. | IN TIME | | IN HEIGHT | | | |
|-------------------------------|---------------------|-------------------------------|-------|-----------------------------|-------|---|-------|
| | | Within 15 minutes of actuals. | | Within 8 inches of actuals. | | Within $\frac{1}{16}$ of mean range at Springs. | |
| | | H. W. | L. W. | H. W. | L. W. | H. W. | L. W. |
| 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 | 51 | 75 | 57 | 96 | 91 |
| 1898 | 2 | 53 | 59 | 71 | 61 | 90 | 91 |
| 1899 | 2 | 55 | 59 | 76 | 65 | 95 | 94 |
| 1900 | 2 | 59 | 62 | 70 | 57 | 89 | 87 |
| 1901 | 2 | 63 | 65 | 70 | 59 | 90 | 92 |
| 1902 | 2 | 63 | 54 | 76 | 53 | 96 | 90 |
| Average of 10 years | 2 | 58 | 58 | 71 | 53 | 91 | 87 |

276. After a lapse of 30 years, tidal observations will in 1904 be again taken at Okha on the Gulf of Cutch, and the question as to whether the land round the Gulf is gradually rising will be finally settled.

277. The tide predicting machine which till now has been in the charge of Mr. Roberts of the Nautical Almanac Office will at the end of this year be moved to the National Physical Laboratory at Teddington and Dr. Glazebrook will supervise the tide predictions.

SPIRIT LEVELLING OPERATIONS.

278. The levelling detachment was employed in Burma on two separate lines of levelling.

1. Thazi to Minbu.
2. Sagaing to Tantabin.

It completed 215 miles of double levelling, which included the crossing of the Irrawaddy river from Magwe to Minbu.

The detachment left Delra Dún on the 14th October 1902 and returned to recess quarters on the 17th May 1903.

During next field season the levelling operations will be continued in Burma, the line Sagaing to Tantabin being continued as far as Myitkina.

MAGNETIC.

NO. 26 PARTY.

279. During the past year satisfactory progress has been made with the

Personnel.

Captain H. A. D. Fraser, R.E., Officiating Superintendent, 2nd grade, in charge.
 Mr. H. P. D. Morton, Sub-Assistant Superintendent, 2nd grade.
 Babu Rama Prasad Ray " " 2nd "
 Mr. A. M. Talati " " 3rd "
 " E. A. Meyer " " 3rd "
 8 Observers, Recorders, etc., and 1 Writer.

work of the magnetic survey, but owing to the non-delivery of certain instruments from England, only four out of the five base stations or fixed observatories are at present in working order.

280. During the field season the officer in charge took observations at four new repeat stations in addition to revisiting the five old ones established last season. He took also comparative observations at the Dehra Dún, Colába and Kodaikánal observatories, and inspected each of the five field detachments.

Of these detachments only two were able to work for a full season, *viz.*, six months, as one of the first three observers trained during the previous year had resigned his appointment. The work done by each detachment was as follows.

281. The first was employed in various parts of the Punjab, partly in revising some of the work of the previous season along the N. W. Railway, and partly in running a line of stations parallel to and west of the Indus, observations being taken at 69 stations. The second detachment worked nearly the whole season in the Rájputána desert, and in many places had considerable difficulties to contend with in obtaining supplies and drinking water. The observer visited 60 new stations and reobserved at five old ones, in every case observing all three elements. The officer in charge of the third detachment, after a preliminary tour in the neighbourhood of Dehra Dún, started for Bombay and traversing the Railway systems in the south of India, observed at 64 stations. The fourth detachment was employed in observing at points on the narrow gauge railway system in the south of India, thirty-two stations being thus completed. Owing to the late appointment of the observer, and the paucity of instruments, the fifth detachment was not able to commence work till late in the season, when observations were taken at 14 stations.

282. Up to the present time observations have been taken at 370 different places in addition to the nine repeat stations, and a considerable proportion of the first year's stations have also been revisited.

283. On returning from the field each observer took a number of comparative observations at Dehra Dún to find the differences between his instruments and the Survey Standards, and then proceeded to recess quarters at Mussooree, where the office opened on the 7th May 1903. The accuracy of the work done during this season leaves little to be desired, and was fully up to the standard laid down. During the recess season all field work was computed and abstracts of the results made, besides which the reduction and tabulation of the Dehra Dún base station records for the year 1902 was completed.

284. The erection of the buildings for the new base station at Barrackpore was not completed till early in July 1903, but by the 10th August the installation of the instruments was satisfactorily completed, and since that date the work has been carried on continuously. The Barrackpore buildings are entirely above ground, and should therefore be free from those troubles inseparable from underground installations, which have caused such serious difficulties both at Dehra Dún and Kodaikánal.

285. There now remains only the Rangoon observatory, the installation at which place will complete the five base stations sanctioned for the survey. The magnetographs were ordered early in 1902, but contrary to expectation they have not yet been received in India, the delay having arisen because the Kew authorities, owing to pressure of other work, have so far been unable to test them.

286. The vertical force instrument for Dehra Dún has also been delayed for the reason above given. Sanction for the purchase of three more of these instruments for use at Barrackpore, Kodaikánal, and Rangoon has been obtained, but they will not be ordered till the set shortly expected for Dehra Dún has been erected and tested. When the four new base stations are supplied with vertical force magnetographs their equipment may be considered complete as far as can be foreseen at present, but until that time the final reduction of the field work now in full progress must be carried out at a considerable disadvantage, as it will rest, as far as the results in vertical force are concerned, solely on the indications of the vertical force magnetograph at Bombay (Colába). This is unfortunate, but under the circumstances was unavoidable.

287. A table showing the approximate preliminary values of the magnetic elements observed during the last field season is printed in the Appendix, together with a reference index map. All stations from 164 onwards are new stations, and the results shown against numbers less than 163 are repetitions of the first season's observations, which were to some extent defective.

288. During the field season 1903-04, there will be five field detachments at work during the whole season. Of these one will be employed in further revision of the first season's work, and in filling up the few gaps remaining in the area west of the line, Bombay to Dehra Dún. Two others will complete the work in the south of India, west and south of the main railway line from Bombay to Madras, and the remaining two will be engaged in traversing the numerous railway lines west of the meridian of Calcutta, which have not hitherto been visited.

The officer in charge will reobserve at the nine existing repeat stations and establish six new ones, thus completing the full number contemplated west of

the meridian of Calcutta. In addition to the above the usual comparative observations will be made at the four existing base stations, and the installation at Rangoon will be effected as soon as the instruments are available.

289. Provision has been made to train another officer in magnetic work, so as to be available during the absence of the present officer in charge of the survey. By the end of the next field season this officer's training will have been completed and the work will no longer be dependent entirely on the continuation in office of one man, as has hitherto been the case.

290. Steps have been taken, in consultation with Sir Arthur Rücker, F.R.S., and other magnetic experts, to settle the main principles on which the final reduction of the field results are to rest, and some progress has already been made in this most important matter.

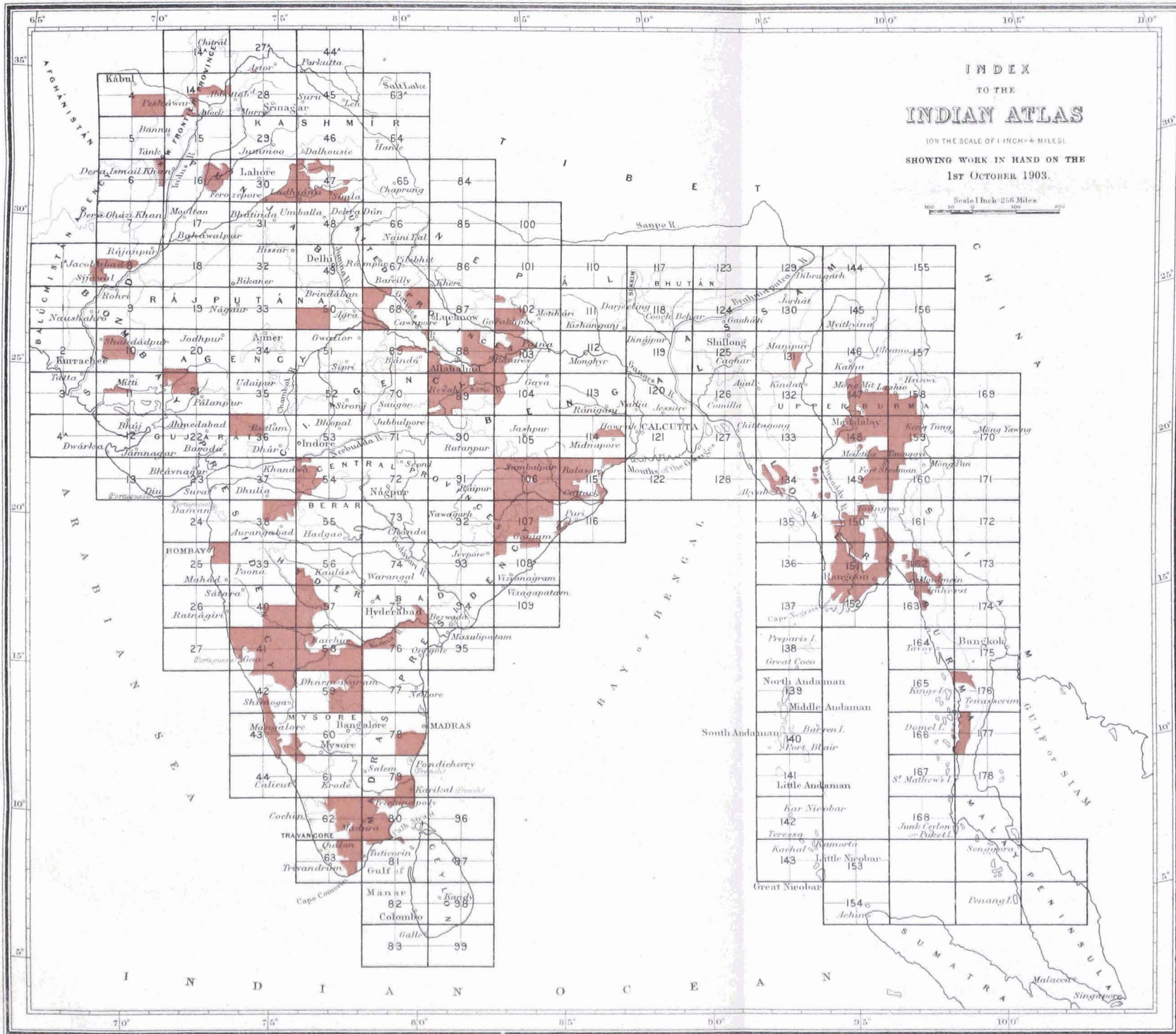
TABULAR STATEMENTS.

Field Parties during the year 1902-03.

| | 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 mille. | 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. |
| ... | ... | 252 | 3 | 0.2 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 12 | 5,818 | ... | ... | 3.4 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 12 | ... | ... | ... | 3.4 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 3.6 | 899 | 2 | ... | 3 | ... | ... | ... | ... | ... | ... | ... | |
| 5 | ... | ... | ... | ... | 4.3 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 3.2 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 0.9 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 1.0 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 0.7 | ... | ... | ... | ... | ... | ... | ... | |
| 10 | 9 | 2,413 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 9 | ... | ... | ... | 10.1 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 41 | 1,664 | 6 | ... | 45.7 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 2.2 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 140 | 4,203 | 5 | 4 | ... | ... | ... | ... | ... | ... | ... | ... | |
| 15 | ... | ... | ... | ... | 20 | ... | ... | ... | ... | ... | ... | ... | |
| ... | ... | ... | ... | ... | 175 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 302 | 8,156 | 2 | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 455 | 7,055 | 4 | 0.2 | 47.2 | ... | 7.25 | 37.1 | 0.83 | ... | ... | 376,957 | |
| ... | ... | ... | ... | ... | 1 | ... | ... | 2 | ... | ... | ... | 221 | |
| 20 | ... | ... | ... | ... | 130 | ... | ... | ... | ... | ... | ... | ... | |
| ... | 42 | 3,929 | 4 | 0.3 | 74 | ... | 120 | 148 | 0.25 | ... | ... | 183,312 | |
| ... | 120 | 2,063 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 572 | 11,912 | ... | ... | 1,622(a) | ... | 7,806 | 937(a) | 0.52 | 1,594 | 962 | 1,952,689 | (a) Excludes two villages area 1 square mile of district Monghyr. |
| ... | 1,189 | 24,324 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| 25 | 88 | 4,855 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 1,027 | 24,927 | ... | ... | 574 | ... | 1,971 | 390 | ... | 567 | 408 | 423,210 | |
| ... | 655 | 21,037 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 861 | 39,534 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 1,208(b) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | (b) Skeleton traversing of village trijunctions. |
| ... | 1,001 | 22,944 | ... | ... | 617 | ... | 1,942 | 422 | ... | 437 | 282 | 224,204 | |
| 30 | 53 | 1,470 | ... | ... | 21 | ... | 69 | 9 | ... | 21 | 9 | 9,317 | |
| ... | 1 | 87 | 2 | 0.2 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 126 | 2,336 | 8 | 0.9 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 10 | 119 | 5 | 0.7 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 275 | 3,513 | 3 | 0.6 | ... | ... | ... | ... | ... | ... | ... | ... | |
| 35 | 163 | 3,220 | 6 | 0.4 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 1 | 41 | ... | 1.1 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 9 | 97 | 1 | 0.3 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 34 | 387 | 5 | 0.5 | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 10 | 254 | 3 | 0.4 | ... | ... | ... | ... | ... | ... | ... | ... | |
| 40 | 131 | 1,583 | 4 | 0.5 | 131 | ... | ... | 31 blocks. | 3.10 | ... | ... | 26,947 | |
| ... | ... | ... | ... | ... | 6 | ... | 193 | 11 | ... | ... | ... | ... | |
| ... | 96 | 1,511 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 40 | 1,134(c) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 25 | 873(d) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | (c) Tea Grants and Villages. |
| 45 | 31 | 860(c) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | (d) Tea Grants. |
| ... | 81 | 2,758(d) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | |
| ... | 8,836 | ... | ... | ... | 3,843 | ... | ... | ... | ... | ... | ... | ... | |
| 48 | 8,901.6 | ... | ... | ... | 3,907.4 | ... | ... | ... | ... | ... | ... | ... | |

Field Parties during the year 1902-03.

| Cost-rate per acre, cadastral survey, including traversing, detail survey and mapping. | COST-RATE PER SQUARE MILE. | | | Total cost inclusive of charges for instruments to Provincial Government. | REMARKS. |
|--|----------------------------|----------------------|--|---|---|
| | Stone embedding. | Records (Khanapuri). | Completion of Vernacular Records, Assessment, Statistics, etc. | | |
| R a. p. | R | R | R | R | |
| ... | ... | ... | ... | 95,000 | (a) Includes Rs.472 expended on revision survey of Maymyo city on 16" scale. |
| ... | ... | ... | ... | 1,05,950(a) | (b) Includes Rs.11,679 expended on miscellaneous compilation work. |
| ... | ... | ... | ... | 1,09,564(b) | (c) Includes Rs.7,397 expended on triangulation, levelling and 2" survey of Sambhar Salt lake; Rs.12,316 on mapping. |
| ... | ... | ... | ... | 1,02,151(c) | (d) Includes Rs.1,138 expended in bringing up arrears of Lushai triangulation. |
| ... | } 3 0 | ... | ... | 76,665(d) | (e) Includes Rs.4,894 expended on detail survey in Kashmir; Rs.4,504 on 6" Khojak survey, Rs.4,268 on 1,033 sq. miles of revision survey in Khojak; Rs.5,015 on arrears of mapping; Rs.983 on leave pay, Drawing Office, etc. |
| ... | | ... | ... | ... | 85,918(e) |
| ... | ... | ... | ... | 85,345(f) | (g) Rate per linear mile. |
| ... | ... | ... | ... | 99,664 | (h) Includes Rs.7,091 expended for mapping and publication. |
| ... | ... | ... | ... | 77,086 | (i) Includes Rs.1,002 expended on levelling, Rs.1,615 on 16" boundary survey. |
| ... | ... | ... | ... | 1,48,468(h) | (j) Includes Rs.281 expended on 4" boundary survey. |
| ... | ... | ... | ... | 55,316 | (k) Includes Rs.56 expended on levelling. |
| ... | ... | ... | ... | 8,924(i) | (l) Rates for Mainpuri and Jalaun. |
| ... | ... | ... | ... | 18,268 | (m) Includes Rs.1,929 expended on miscellaneous surveys; Rs.30,298 on standard mapping; Rs.78,072 on reproduction of village maps; Rs.3,898 on Thana maps and Rs.13,958 on Orissa and Bihar badars. |
| ... | ... | ... | ... | 19,668 | (n) Rate of skeleton traversing of trijunctions. |
| ... | ... | ... | ... | 4,087(j) | (o) Includes Rs.5,371 on Pakoleku city survey on 64" scale and Rs.4,488 on mapping. |
| ... | ... | ... | ... | 4,453 | (p) Includes Rs.1,902 on mapping. |
| ... | ... | ... | ... | 1,279 | (q) Includes Rs.1,724 on triangulation. |
| ... | ... | ... | ... | 3,971(k) | (r) Includes Rs.5,968 on Drawing Section. |
| ... | ... | ... | ... | 1,24,928 | (s) Tea Grants. |
| ... | ... | ... | ... | 18,53,205(m) | (t) Includes Rs.14,343 on maintenance of Records; Rs.3,594 on Sylhet Boundary Commission; Rs.1,764 on mapping standard sheets; Rs.226 on traversing for 16" survey in district of Cachar. |
| ... | ... | 71'2 | ... | } 1,43,703(o) | |
| ... | ... | 53'0 | ... | | |
| ... | ... | 30'3 | ... | | |
| ... | ... | 46'0 | ... | | |
| ... | 12'1 | ... | ... | } 69,225(p) | |
| 0 4 5 | 12'2 | ... | 6'2 | | |
| 1 9 10 | 25'8 | ... | 40'5 | 20,693(q) | |
| ... | ... | 1'5 | ... | 37,934(r) | |
| ... | ... | ... | ... | } 34,669(l) | |
| ... | ... | ... | ... | | |
| ... | ... | ... | ... | | |
| ... | ... | ... | ... | | |



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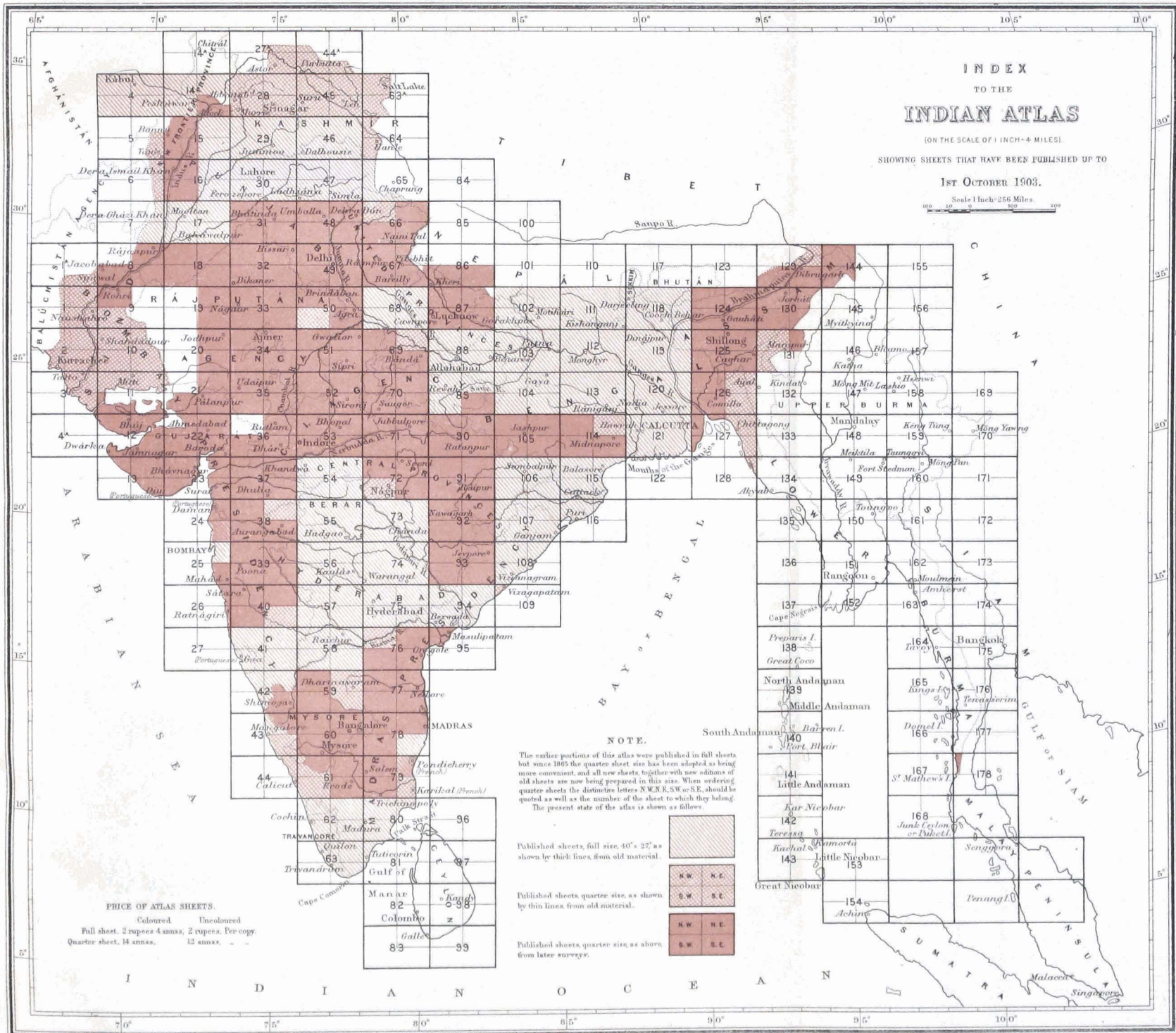
INDEX
TO THE
INDIAN ATLAS

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APPENDIX.

Abstract showing the Approximate Magnetic Values at Stations observed at by No. 26 Party during Season, 1902-03.

| Serial No. | Name of Station. | Survey No. | Latitude. | | Longitude. | | Dip. | Declination. | Horizontal Force. | REMARKS. | | | | |
|------------|---------------------|------------|-----------|----|------------|----|------|--------------|-------------------|----------|---|--------|----|--------|
| | | | ° | ' | ° | ' | ° | ' | ° | | ' | C.G.S. | | |
| 164 | Jhajra . . . | 30 2 | 30 | 20 | 30 | 77 | 54 | 50 | 43 | 15 | E | 2 | 40 | ... |
| 165 | Ambári . . . | " 1 | 20 | 29 | 20 | 77 | 48 | 20 | 43 | 30 | " | 2 | 45 | ... |
| 166 | Mirzapur . . . | " 3 | 30 | 15 | 30 | 77 | 37 | 40 | 43 | 10 | " | 2 | 45 | ... |
| 167 | Ghuna . . . | " 4 | 30 | 3 | 50 | 77 | 34 | 40 | 42 | 50 | " | 2 | 40 | ... |
| 168 | Fatehpur . . . | " 5 | 30 | 2 | 40 | 77 | 45 | 40 | 42 | 45 | " | 2 | 45 | ... |
| 169 | Kalyán . . . | 30 6 | 19 | 15 | 0 | 73 | 8 | 20 | 23 | 35 | " | 0 | 25 | 0°3645 |
| 170 | Lonáva . . . | " 1 | 18 | 45 | 10 | 73 | 24 | 20 | 22 | 10 | " | 0 | 15 | 0°3720 |
| 171 | Kirkee . . . | " 2 | 18 | 33 | 30 | 73 | 50 | 0 | 22 | 5 | " | 0 | 35 | 0°3705 |
| 172 | Dhond . . . | " 3 | 18 | 28 | 0 | 74 | 35 | 10 | 21 | 20 | " | 0 | 25 | 0°3720 |
| 173 | Jeúr . . . | " 1 | 18 | 15 | 50 | 75 | 9 | 40 | 21 | 5 | " | 0 | 15 | 0°3730 |
| 174 | Bársi . . . | " 2 | 18 | 14 | 30 | 75 | 42 | 20 | 21 | 0 | " | 1 | 0 | 0°3745 |
| 175 | Hotgi . . . | " 3 | 17 | 33 | 40 | 76 | 0 | 20 | 19 | 50 | " | 0 | 30 | 0°3735 |
| 176 | Ghangapur . . . | " 4 | 17 | 20 | 20 | 76 | 36 | 0 | 18 | 30 | " | 0 | 40 | 0°3765 |
| 177 | Vadi Junction . . . | " 1 | 17 | 3 | 0 | 77 | 0 | 0 | 18 | 10 | " | 0 | 25 | 0°3765 |
| 178 | Yádgiri . . . | " 1 | 16 | 44 | 40 | 77 | 8 | 10 | 17 | 35 | " | 0 | 20 | 0°3765 |
| 179 | Ráichur . . . | " 2 | 16 | 12 | 0 | 77 | 20 | 30 | 16 | 30 | " | 0 | 15 | 0°3790 |
| 180 | Adóni . . . | " 3 | 15 | 37 | 0 | 77 | 16 | 30 | 15 | 15 | " | 0 | 5 | 0°3790 |
| 181 | Guntakal . . . | " 4 | 15 | 10 | 20 | 77 | 22 | 40 | 14 | 40 | " | 0 | 15 | 0°3805 |
| 182 | Kondápuram . . . | " 4 | 14 | 46 | 20 | 78 | 11 | 40 | 13 | 20 | W | 0 | 10 | 0°3825 |
| 183 | Cuddapah . . . | " 4 | 14 | 27 | 10 | 78 | 49 | 20 | 12 | 35 | E | 0 | 5 | 0°3815 |
| 184 | Reddipalle . . . | " 2 | 14 | 5 | 30 | 79 | 14 | 0 | 11 | 45 | W | 0 | 10 | 0°3820 |
| 185 | Rénigunta . . . | " 3 | 13 | 38 | 20 | 79 | 30 | 50 | 10 | 40 | " | 0 | 5 | 0°3810 |
| 186 | Arkónam . . . | " 5 | 13 | 4 | 30 | 79 | 40 | 20 | 9 | 40 | " | 0 | 10 | 0°3835 |
| 187 | Perambúr . . . | " 6 | 13 | 6 | 40 | 80 | 15 | 0 | 9 | 55 | " | 0 | 10 | 0°3850 |
| 188 | Kátpádi . . . | " 1 | 12 | 58 | 40 | 79 | 7 | 40 | 9 | 20 | " | 0 | 15 | 0°3840 |
| 189 | Jalárpét . . . | " 3 | 12 | 31 | 0 | 78 | 34 | 10 | 8 | 45 | " | 0 | 35 | 0°3800 |
| 190 | Bowringpet . . . | " 1 | 12 | 58 | 50 | 78 | 11 | 0 | 9 | 20 | " | 0 | 20 | 0°3810 |
| 191 | Morappúr . . . | " 4 | 12 | 7 | 30 | 78 | 21 | 40 | 7 | 15 | " | 0 | 30 | 0°3845 |
| 192 | Salem . . . | " 5 | 11 | 40 | 0 | 78 | 6 | 50 | 5 | 25 | " | 0 | 30 | 0°3820 |
| 193 | Erode . . . | " 6 | 11 | 19 | 40 | 77 | 43 | 50 | 5 | 30 | " | 0 | 30 | 0°3840 |
| 194 | Sómanúr . . . | " 7 | 11 | 5 | 10 | 77 | 11 | 0 | 5 | 10 | " | 0 | 30 | 0°3780 |
| 195 | Coonoor . . . | " 6 | 11 | 20 | 40 | 76 | 47 | 50 | 5 | 40 | " | 0 | 25 | 0°3795 |
| 196 | Olavakod . . . | " 2 | 10 | 48 | 10 | 76 | 38 | 20 | 4 | 30 | " | 0 | 40 | 0°3775 |
| 197 | Pattámbi . . . | " 1 | 10 | 48 | 10 | 76 | 10 | 40 | 5 | 5 | " | 0 | 25 | 0°3750 |
| 198 | West hills . . . | " 7 | 11 | 17 | 10 | 75 | 45 | 20 | 7 | 35 | " | 0 | 10 | 0°3865 |
| 199 | Cannanore . . . | " 5 | 11 | 52 | 30 | 75 | 22 | 0 | 7 | 0 | " | 0 | 5 | 0°3825 |
| 200 | Vottekolli . . . | " 3 | 12 | 7 | 20 | 75 | 50 | 20 | 7 | 35 | " | 0 | 35 | 0°3785 |
| 201 | Húnsúr . . . | " 2 | 12 | 18 | 20 | 76 | 16 | 50 | 7 | 40 | " | 0 | 40 | 0°3790 |
| 202 | Nanjangúd . . . | " 4 | 12 | 7 | 40 | 76 | 40 | 40 | 7 | 30 | " | 0 | 30 | 0°3820 |
| 203 | Seringapatam . . . | " 1 | 12 | 25 | 30 | 76 | 40 | 40 | 8 | 5 | " | 0 | 20 | 0°3800 |
| 204 | Channapatna . . . | " 2 | 12 | 39 | 40 | 77 | 12 | 0 | 8 | 50 | " | 0 | 20 | 0°3820 |
| 205 | Túmkúr . . . | " 10 | 13 | 20 | 0 | 77 | 6 | 0 | 10 | 5 | E | 0 | 15 | 0°3785 |
| 206 | Tiptur . . . | " 5 | 13 | 15 | 10 | 76 | 28 | 30 | 10 | 5 | W | 0 | 15 | 0°3795 |
| 207 | Birur . . . | " 4 | 13 | 35 | 50 | 75 | 58 | 10 | 10 | 45 | " | 0 | 10 | 0°3795 |
| 208 | Shimoga . . . | " 3 | 13 | 55 | 30 | 75 | 34 | 0 | 11 | 20 | " | 0 | 5 | 0°3780 |
| 209 | Sásalu . . . | " 2 | 14 | 12 | 40 | 76 | 6 | 40 | 12 | 10 | " | 0 | 10 | 0°3790 |
| 210 | Ránebennur . . . | " 1 | 14 | 37 | 0 | 75 | 38 | 30 | 13 | 0 | " | 0 | 0 | 0°3785 |
| 211 | Valvigi . . . | " 1 | 15 | 1 | 50 | 75 | 25 | 0 | 14 | 5 | E | 0 | 10 | 0°3765 |
| 212 | Mormugao . . . | " 5 | 15 | 24 | 10 | 73 | 47 | 30 | 15 | 10 | " | 0 | 25 | 0°3770 |
| 213 | Castle Rock . . . | " 6 | 15 | 24 | 0 | 74 | 18 | 50 | 13 | 55 | W | 0 | 10 | 0°3820 |
| 214 | Belgaum . . . | " 4 | 15 | 50 | 30 | 74 | 31 | 10 | 15 | 50 | " | 0 | 15 | 0°3735 |
| 215 | Gokák Road . . . | " 3 | 16 | 14 | 0 | 74 | 44 | 40 | 16 | 25 | E | 0 | 15 | 0°3770 |
| 216 | Miraj . . . | " 1 | 16 | 49 | 10 | 74 | 38 | 10 | 18 | 30 | " | 0 | 5 | 0°3795 |
| 217 | Kolhápur . . . | " 2 | 16 | 41 | 50 | 74 | 14 | 10 | 17 | 25 | " | 0 | 25 | 0°3755 |
| 218 | Karad . . . | " 6 | 17 | 18 | 40 | 74 | 13 | 10 | 19 | 5 | " | 0 | 25 | 0°3730 |
| 219 | Wathar . . . | " 5 | 17 | 53 | 20 | 74 | 8 | 10 | 20 | 20 | " | 0 | 25 | 0°3715 |
| 220 | Rajewádi . . . | " 4 | 18 | 23 | 0 | 74 | 8 | 30 | 20 | 55 | " | 0 | 25 | 0°3705 |
| 221 | Ahmednagar . . . | " 7 | 19 | 4 | 20 | 74 | 43 | 10 | 22 | 35 | " | 0 | 30 | 0°3705 |
| 222 | Puntámba . . . | " 4 | 19 | 45 | 40 | 74 | 37 | 20 | 23 | 55 | " | 1 | 10 | 0°3690 |
| 223 | Manmád . . . | " 2 | 20 | 14 | 40 | 74 | 26 | 20 | 24 | 35 | " | 0 | 55 | 0°3665 |
| 224 | Khervádi . . . | " 3 | 20 | 2 | 50 | 73 | 58 | 10 | 25 | 10 | " | 0 | 50 | 0°3670 |
| 225 | Igatpuri . . . | " 5 | 19 | 41 | 20 | 73 | 34 | 40 | 24 | 0 | " | 0 | 35 | 0°3650 |
| 226 | Dhulia . . . | " 1 | 20 | 53 | 10 | 74 | 4 | 20 | 26 | 0 | " | 0 | 50 | 0°3670 |
| 227 | Chálisgaon . . . | " 1 | 20 | 27 | 30 | 75 | 1 | 0 | 25 | 0 | " | 0 | 55 | 0°3665 |
| 228 | Lhaksar . . . | " 7 | 29 | 45 | 20 | 78 | 1 | 20 | 4 | 5 | " | 2 | 35 | 0°3370 |
| 229 | Saháranpur . . . | " 6 | 29 | 57 | 50 | 77 | 32 | 40 | 42 | 35 | " | 2 | 45 | 0°3360 |
| 230 | Muzaffarnagar . . . | " 8 | 29 | 28 | 30 | 77 | 42 | 0 | 41 | 50 | " | 2 | 35 | 0°3385 |

Abstract showing the Approximate Magnetic Values at Stations observed at by No. 26 Party during Season, 1902-03—contd.

| Serial No. | Name of Station. | Survey No. | Latitude. | Longitude. | Dip. | Declination. | Horizontal Force. | REMARKS. |
|------------|-------------------------------|------------|-----------|------------|-------|--------------|-------------------|----------|
| | | | ° / ' " | ° / ' " | ° / ' | ° / ' | C.G.S. | |
| 231 | Meerut City . . . | १ | 28 58 40 | 77 41 0 | 40 55 | E 2 30 | 0'3405 | |
| 232 | Delhi . . . | २ | 28 40 20 | 77 14 20 | 40 30 | " 2 10 | 0'3415 | |
| 233 | Samálkha . . . | १० | 29 14 40 | 77 0 10 | 41 20 | " 2 35 | 0'3385 | |
| 234 | Taráori . . . | १० | 29 48 20 | 76 56 0 | 42 15 | " 2 40 | 0'3365 | |
| 235 | Sangaria . . . | १० | 29 47 50 | 74 27 40 | 42 15 | " 2 25 | 0'3345 | |
| 127 | Súratgarh . . . | ५ | 29 20 0 | 73 54 30 | 41 30 | " 2 35 | 0'3360 | |
| 236 | Balochia . . . | ११ | 29 14 50 | 73 27 20 | 41 20 | " 2 30 | 0'3355 | |
| 237 | Walar or Sardár- garh. . . | १० | 29 15 30 | 73 1 40 | 41 25 | " 2 25 | 0'3340 | |
| 238 | Ranabhana Toba . . . | १३ | 28 54 30 | 72 38 10 | 41 5 | " 2 0 | 0'3350 | |
| 239 | Maujagarh . . . | १३ | 29 0 50 | 72 8 20 | 40 50 | " 2 15 | 0'3365 | |
| 240 | Kumhariwála . . . | १३ | 28 32 0 | 72 14 10 | 41 15 | " 3 5 | 0'3365 | |
| 24 | Khángarh . . . | २ | 28 22 10 | 71 42 50 | 40 10 | " 2 5 | 0'3385 | |
| 241 | Lohita Tibba . . . | ११ | 27 55 10 | 71 32 10 | 39 50 | " 1 50 | 0'3400 | |
| 242 | Sarwar ka Toba . . . | १३ | 28 17 30 | 71 6 40 | 39 45 | " 2 20 | 0'3370 | |
| 243 | Islamgarh . . . | १३ | 27 51 30 | 70 48 40 | 39 15 | " 2 10 | 0'3370 | |
| 244 | Maruwála Toba . . . | ११ | 28 15 30 | 70 38 50 | 39 45 | " 2 10 | 0'3355 | |
| 245 | Bher Tibba . . . | १२ | 28 0 25 | 70 22 10 | 39 30 | " 2 20 | 0'3375 | |
| 57 | Sadikabad . . . | २ | 28 18 10 | 70 7 40 | 40 0 | " 2 35 | 0'3365 | |
| 246 | Ganeshgarh . . . | १० | 29 45 0 | 73 54 0 | 42 10 | " 2 50 | 0'3340 | |
| 247 | Lálgarh . . . | १३ | 20 38 20 | 73 22 50 | 42 0 | " 2 35 | 0'3335 | |
| 248 | Gegra . . . | १३ | 28 49 10 | 73 15 0 | 40 35 | " 2 30 | 0'3365 | |
| 249 | Kelasar . . . | १३ | 28 28 0 | 73 15 20 | 40 15 | " 2 20 | 0'3385 | |
| 250 | Pungal . . . | १३ | 28 30 50 | 72 48 40 | 40 10 | " 2 5 | 0'3385 | |
| 251 | Angnao . . . | १० | 28 6 0 | 72 47 0 | 39 35 | " 2 20 | 0'3400 | |
| 252 | Hadda . . . | १२ | 27 37 50 | 72 52 30 | 38 50 | " 2 5 | 0'3415 | |
| 253 | Ranisar . . . | १३ | 27 12 40 | 72 42 40 | 37 55 | " 2 5 | 0'3425 | |
| 254 | Panchora . . . | १३ | 27 6 40 | 73 13 30 | 38 0 | " 1 25 | 0'3445 | |
| 255 | Khetasar . . . | ३ | 26 41 0 | 72 49 20 | 37 10 | " 1 50 | 0'3465 | |
| 256 | Jodhpur . . . | १३ | 26 16 20 | 73 1 30 | 36 20 | " 1 25 | 0'3480 | |
| 257 | Marwar Páli . . . | १३ | 25 47 50 | 73 19 30 | 35 30 | " 1 40 | 0'3495 | |
| 258 | Dundrá . . . | १३ | 25 53 40 | 72 47 50 | 35 45 | " 1 30 | 0'3475 | |
| 259 | Bálotra . . . | ५ | 25 50 10 | 72 14 40 | 36 40 | " 1 25 | 0'3515 | |
| 260 | Kavas . . . | ६ | 25 52 15 | 71 31 40 | 35 20 | " 2 5 | 0'3470 | |
| 261 | Bhachbhar . . . | ७ | 25 44 0 | 70 59 0 | 36 25 | " 2 25 | 0'3420 | |
| 262 | Jaisingder . . . | १३ | 25 45 40 | 70 24 30 | 35 35 | " 1 50 | 0'3440 | |
| 135(a) | Dhoro Naro . . . | ७ | 25 29 50 | 69 33 50 | 34 55 | " 2 0 | 0'3465 | |
| 263 | Dugoli . . . | १२ | 27 22 0 | 74 10 20 | 38 15 | " 2 10 | 0'3440 | |
| 264 | Bana . . . | १० | 27 58 40 | 74 1 50 | 39 15 | " 2 10 | 0'3415 | |
| 265 | Sardárshahr . . . | १३ | 28 26 10 | 74 28 50 | 40 5 | " 2 30 | 0'3395 | |
| 266 | Saringsar . . . | ६ | 28 54 40 | 74 28 30 | 40 50 | " 2 25 | 0'3380 | |
| 267 | Mirjawali . . . | १३ | 29 20 40 | 74 30 20 | 41 30 | " 2 25 | 0'3360 | |
| 268 | Malsisar . . . | १ | 28 58 20 | 75 1 30 | 40 55 | " 2 30 | 0'3375 | |
| 269 | Sarpura . . . | २ | 28 40 20 | 75 37 0 | 40 30 | " 2 25 | 0'3395 | |
| 270 | Tamkor . . . | ४ | 28 26 20 | 75 15 10 | 40 0 | " 2 20 | 0'3415 | |
| 271 | Fatehpur . . . | ७ | 28 0 30 | 74 57 20 | 39 35 | " 2 0 | 0'3425 | |
| 272 | Singrawat . . . | ११ | 27 26 10 | 74 52 50 | 38 25 | " 1 55 | 0'3450 | |
| 273 | Khátu . . . | १२ | 27 22 10 | 75 24 10 | 38 5 | " 2 10 | 0'3440 | |
| 274 | Gudha . . . | १३ | 27 51 40 | 75 31 40 | 39 0 | " 2 15 | 0'3435 | |
| 275 | Koharwas . . . | ५ | 28 15 40 | 75 57 30 | 39 40 | " 2 25 | 0'3425 | |
| 276 | Nangal Chau- dhri. . . | १३ | 27 53 30 | 76 6 20 | 39 10 | " 1 45 | 0'3440 | |
| 277 | Shahpura . . . | ११ | 27 23 30 | 75 58 0 | 38 15 | " 1 55 | 0'3440 | |
| 162 | Jaipur . . . | २ | 26 55 0 | 75 47 0 | 37 45 | " 2 5 | 0'3465 | |
| 278 | Alwar . . . | १० | 27 33 40 | 76 38 0 | 38 40 | " 2 15 | 0'3450 | |
| 279 | Rewári . . . | ६ | 28 12 20 | 76 36 20 | 39 50 | " 2 15 | 0'3425 | |
| 280 | Dádrí . . . | ३ | 28 36 10 | 76 16 40 | 40 35 | " 2 15 | 0'3390 | |
| 281 | Hánsi . . . | १२ | 29 5 40 | 75 57 0 | 41 10 | " 2 30 | 0'3380 | |
| 282 | Ádampur . . . | ११ | 29 17 20 | 75 27 50 | 41 30 | " 2 20 | 0'3360 | |
| 283 | Sirsa . . . | १० | 29 32 10 | 75 2 40 | 41 50 | " 2 40 | 0'3355 | |
| 284 | Budhláda . . . | ७ | 29 55 30 | 75 33 20 | 42 25 | " 2 35 | 0'3335 | |
| 285 | Kaláyat . . . | १३ | 29 41 10 | 76 13 40 | 42 5 | " 2 25 | 0'3340 | |
| 286 | Karainth . . . | १३ | 29 1 10 | 76 29 0 | 41 15 | " 2 10 | 0'3390 | |
| 287 | Tokara . . . | १४ | 30 50 50 | 76 55 20 | 43 55 | " 2 55 | 0'3310 | |
| 67 | Patáála . . . | ४ | 30 20 40 | 76 24 0 | 43 10 | " 2 50 | 0'3335 | |
| 66 | Alal . . . | ३ | 30 21 50 | 75 43 50 | ... | ... | 0'3325 | |
| 65 | Bhuchhu . . . | ६ | 30 12 50 | 75 5 30 | ... | ... | 0'3330 | |
| 64 | Malaut . . . | ३ | 30 11 0 | 74 29 40 | 42 50 | " 2 45 | 0'3325 | |
| 63(a) | Orki (a) . . . | २ | 30 8 40 | 73 54 30 | ... | ... | 0'3325 | |
| 62 | Rojhánwáli . . . | ४ | 30 0 50 | 73 15 40 | ... | ... | 0'3320 | |
| 61 | Bakhshankhan . . . | ४ | 29 44 30 | 72 42 50 | ... | ... | 0'3330 | |
| 60 | Asrani . . . | ६ | 29 31 30 | 72 8 10 | ... | ... | 0'3335 | |
| 37 | Samsata . . . | ७ | 29 21 10 | 71 32 30 | 41 30 | " 3 0 | 0'3355 | |
| 59 | Chani Got . . . | १ | 29 5 10 | 71 1 30 | ... | ... | 0'3340 | |
| 58(a) | Khánpur (a) . . . | १ | 28 34 50 | 70 39 10 | ... | ... | 0'3355 | |
| 57 | Sadikabad . . . | २ | 28 18 10 | 70 7 40 | ... | ... | 0'3365 | |

Abstract showing the Approximate Magnetic Values at Stations observed at by No. 26 Party during Season, 1902-03—contd.

| Serial No. | Name of Station. | Survey No. | Latitude. | Longitude. | Dip. | Declination. | Horizontal Force. | REMARKS. |
|------------|-------------------|------------|-----------|------------|-------|--------------|-------------------|----------|
| | | | ° ' " | ° ' " | ° ' | ° ' | C.G.S. | |
| 55 | Pano Ákil | 5 | 27 50 50 | 69 6 50 | 38 55 | E 2 15 | 0'3370 | |
| 46 | Ruk | 3 | 27 48 20 | 68 38 20 | ... | ... | 0'3370 | |
| 52 | Jhatpat | 2 | 28 22 20 | 68 19 20 | ... | ... | 0'3340 | |
| 53 | Bellpat | 1 | 28 59 40 | 68 0 20 | ... | ... | 0'3315 | |
| 54(a) | Sibi (a) | 1 | 29 32 40 | 67 51 40 | 41 45 | " 2 40 | 0'3280 | |
| 288 | Chachar | 8 | 28 12 10 | 68 9 20 | 39 45 | " 2 10 | 0'3345 | |
| 289 | Shahdampur | 9 | 27 51 0 | 67 54 40 | 39 10 | " 2 20 | 0'3365 | |
| 290 | Guibe Dera | 10 | 27 36 0 | 67 38 50 | 38 35 | " 2 20 | 0'3375 | |
| 291 | Gote Mado | 11 | 27 11 20 | 67 35 30 | 37 50 | " 2 20 | 0'3390 | |
| 292 | Haira Khan | 12 | 20 49 20 | 67 28 10 | 37 15 | " 2 10 | 0'3400 | |
| 293 | Tando Rahim Khan. | 13 | 26 30 30 | 67 25 40 | 36 45 | " 2 0 | 0'3415 | |
| 294 | Narani | 14 | 26 7 30 | 67 32 50 | 35 55 | " 1 55 | 0'3440 | |
| 295 | Pokrun Lundi | 16 | 25 48 30 | 67 44 30 | 35 25 | " 1 50 | 0'3445 | |
| 296 | Belo | 15 | 25 47 10 | 67 26 50 | 35 15 | " 1 50 | 0'3445 | |
| 297 | Kund | 17 | 25 34 50 | 67 19 0 | 35 0 | " 1 50 | 0'3450 | |
| 298 | Kharr | 18 | 25 17 20 | 67 7 50 | 34 30 | " 1 40 | 0'3455 | |
| 39 | Dabeji | 2 | 24 48 50 | 67 29 50 | ... | ... | 0'3475 | |
| 40 | Jhampir | 11 | 25 1 50 | 68 0 50 | ... | ... | 0'3470 | |
| 41 | Hyderabad | 10 | 25 22 30 | 68 22 30 | 34 35 | " 1 45 | 0'3495 | |
| 42 | Shadadpur | 7 | 25 55 40 | 68 37 50 | ... | ... | 0'3450 | |
| 43 | Daur | 4 | 26 27 40 | 68 18 30 | ... | ... | 0'3425 | |
| 44 | Kandiáro Road | 1 | 26 59 20 | 68 20 50 | ... | ... | 0'3415 | |
| 45 | Khairpur | 5 | 27 31 10 | 68 44 20 | 38 20 | " 2 0 | 0'3380 | |
| 47(a) | Lárhána Nazr | 4 | 27 32 30 | 68 11 50 | ... | ... | 0'3375 | |
| 48 | Sita Road | 6 | 27 2 30 | 67 51 10 | ... | ... | 0'3400 | |
| 49 | Bubak Road | 3 | 26 29 0 | 67 46 10 | ... | ... | 0'3425 | |
| 50 | Sann | 6 | 26 1 40 | 68 6 50 | 35 45 | " 1 50 | 0'3440 | |
| 51 | Petaro | 8 | 25 32 0 | 68 19 10 | ... | ... | 0'3460 | |
| 299 | Hamid Pawhar | 7 | 28 26 0 | 68 46 50 | 39 50 | " 2 15 | 0'3340 | |
| 300 | Bela (Taz) | 9 | 28 23 40 | 69 14 10 | 39 50 | " 2 20 | 0'3350 | |
| 301 | Bara | 10 | 28 33 0 | 69 39 30 | 40 0 | " 2 40 | 0'3345 | |
| 302 | Tuziani | 8 | 28 56 40 | 69 54 40 | 40 50 | " 2 45 | 0'3330 | |
| 303 | Drigri | 7 | 29 24 30 | 70 8 30 | 41 40 | " 2 50 | 0'3320 | |
| 304 | Ganehar | 6 | 29 44 0 | 70 20 20 | 42 15 | " 2 40 | 0'3290 | |
| 305 | Vidor | 4 | 30 5 10 | 70 32 20 | 42 35 | " 2 45 | 0'3300 | |
| 306 | Mandrani | 3 | 30 25 20 | 70 36 50 | 43 20 | " 2 50 | 0'3280 | |
| 307 | Jhok Bodo | 1 | 30 55 0 | 70 32 20 | 43 55 | " 3 10 | 0'3250 | |
| 308 | Gurwáli | 5 | 31 21 50 | 70 29 0 | 44 25 | " 3 10 | 0'3240 | |
| 309 | Darában | 4 | 31 44 0 | 70 19 40 | 45 0 | " 3 15 | 0'3235 | |
| 310 | Tánk | 3 | 32 12 30 | 70 23 20 | 46 15 | " 3 15 | 0'3160 | |
| 311 | Darra Pezu | 2 | 32 19 20 | 70 44 20 | 46 10 | " 3 20 | 0'3180 | |
| 312 | Sarai Naurang. | 1 | 32 49 40 | 70 47 0 | 46 50 | " 3 25 | 0'3150 | |
| 313 | Latammar | 2 | 33 7 0 | 70 51 50 | 47 5 | " 3 35 | 0'3145 | |
| 314 | Bánda Dáúd Shah. | 9 | 33 16 40 | 71 11 10 | 47 25 | " 3 25 | 0'3130 | |
| 315 | Kohát | 8 | 33 34 40 | 71 26 30 | 47 45 | " 3 35 | 0'3125 | |
| 316 | Thal | 1 | 33 21 50 | 70 33 50 | 47 30 | " 3 30 | 0'3130 | |
| 317 | Dhanda | 6 | 32 46 30 | 71 57 40 | 46 50 | " 3 25 | 0'3160 | |
| 318 | Talagang | 7 | 32 55 50 | 72 25 0 | 47 15 | " 3 25 | 0'3155 | |
| 319 | Chakwál | 8 | 32 56 10 | 72 51 10 | 47 5 | " 3 25 | 0'3160 | |
| 320 | Khaie Kutan | 10 | 31 46 50 | 72 11 0 | 45 35 | " 3 0 | 0'3215 | |
| 321 | Atháránhazári | 13 | 31 10 30 | 72 5 40 | 44 25 | " 2 40 | 0'3235 | |
| 322 | Nawankot | 14 | 31 6 30 | 71 31 0 | 44 5 | D 3 0 | 0'3265 | |
| 323 | Rangpur | 10 | 30 31 0 | 71 34 50 | 43 10 | " 3 5 | 0'3285 | |
| 324 | Muzaffargarh | 11 | 30 4 40 | 71 10 50 | 42 25 | " 2 50 | 0'3295 | |
| 70 | Kartárpur | 3 | 31 26 10 | 75 29 30 | ... | ... | 0'3270 | |
| 69 | Ladhowal | 1 | 30 59 0 | 75 47 20 | ... | ... | 0'3295 | |
| 68 | Sirhind | 2 | 30 37 40 | 76 22 40 | ... | ... | 0'3315 | |
| 325 | | ... | ... | ... | ... | ... | ... | |
| 326 | | ... | ... | ... | ... | ... | ... | |
| 327 | Tuticorin | 1 | 8 48 10 | 78 9 0 | 0 25 | W 0 50 | 0'3810 | |
| 328 | Palamcottah | 2 | 8 42 50 | 77 44 30 | 0 10 | " 0 50 | 0'3800 | |
| 329 | Koilpati | 7 | 9 10 30 | 77 51 50 | 0 35 | " 0 55 | 0'3805 | |
| 330 | Ammayanayákanúr. | 4 | 10 10 30 | 77 54 20 | 2 40 | " 0 35 | 0'3820 | |
| 331 | Manappárai | 3 | 10 36 40 | 78 25 30 | 3 55 | " 0 40 | 0'3840 | |
| 332 | Mandapam | 3 | 9 16 50 | 79 8 30 | 1 0 | " 0 45 | 0'3815 | |
| 333 | Sathirakkudi | 6 | 9 24 0 | 78 42 10 | 1 5 | " 0 50 | 0'3805 | |
| 334 | Tiruppuvanam | 5 | 9 49 20 | 78 15 40 | 2 5 | " 0 50 | 0'3795 | |
| 335 | Trichinopoly | 2 | 10 47 30 | 78 40 40 | 4 20 | " 0 35 | 0'3815 | |
| 336 | Paliyur | 1 | 10 56 0 | 78 10 10 | 4 50 | " 0 50 | 0'3780 | |
| 337 | Tanjore | 1 | 10 46 40 | 79 8 20 | 4 0 | " 0 40 | 0'3815 | |
| 338 | Máyavaram | 8 | 11 5 50 | 79 18 30 | 5 0 | " 0 15 | 0'3835 | |
| 339 | Tirutturaipúndi. | 2 | 10 32 20 | 79 38 10 | 3 35 | " 0 30 | 0'3820 | |

Abstract showing the Approximate Magnetic Values at Stations observed at by No. 25 Party during Season, 1902-03—concl'd.

| Serial No. | Name of Stations. | Survey No. | Latitude. | Longitude. | Dip. | Declination. | Horizontal Force. | REMARKS. |
|------------|----------------------|------------|-------------|------------|-------|--------------|-------------------|----------|
| | | | o ' " | o ' " | o ' " | o ' " | C. G. S. | |
| 340 | Állappákkam . . . | १३ | 7 11 37 10 | 79 43 10 | 6 15 | W 0 40 | 0'3845 | |
| 341 | Villupuram . . . | " 5 | 11 56 40 | 79 29 50 | 6 25 | E. 0 0 | 0'3775 | |
| 342 | Pondicherry . . . | " 6 | 11 56 0 | 79 49 50 | 7 15 | W 0 30 | 0'3840 | |
| 343 | Tandara . . . | " 4 | 12 6 40 | 79 9 0 | 7 10 | " 0 25 | 0'3815 | |
| 344 | Polur . . . | " 3 | 12 30 50 | 79 7 50 | 7 25 | E 0 5 | 0'3805 | |
| 188 | Kátpádi . . . | " 1 | 12 58 40 | 79 7 40 | 9 20 | W 0 15 | 0'3840 | |
| 345 | Chingleput . . . | " 2 | 12 41 20 | 79 58 30 | 8 5 | " 0 25 | 0'3825 | |
| 185 | Ranigunta . . . | १३ | 3 13 38 0 | 79 30 50 | 10 40 | " 0 5 | 0'3810 | |
| 346 | Gudur . . . | " 1 | 14 8 40 | 79 51 10 | 11 55 | E 0 0 | 0'3830 | |
| 347 | Pákala . . . | " 4 | 13 27 0 | 79 7 20 | 9 40 | W 0 5 | 0'3820 | |
| 348 | Kalikiri . . . | १३ | 8 13 38 40 | 78 47 40 | 10 40 | " 0 15 | 0'3825 | |
| 349 | Tummanamgutta . . . | " 7 | 13 42 50 | 78 21 30 | 11 15 | " 0 10 | 0'3830 | |
| 350 | Kadiri . . . | " 5 | 14 6 50 | 78 9 0 | 12 0 | " 0 10 | 0'3815 | |
| 351 | Dharmavaram . . . | " 3 | 14 25 20 | 77 42 40 | 12 55 | " 0 10 | 0'3800 | |
| 352 | Malugur . . . | " 6 | 13 54 0 | 77 32 50 | 11 45 | E 0 10 | 0'3775 | |
| 353 | Thondebhari . . . | " 9 | 13 30 10 | 77 31 0 | 10 35 | W 0 15 | 0'3825 | |
| 354 | Garladinne . . . | " 1 | 14 50 0 | 77 35 20 | 12 55 | E 0 10 | 0'3815 | |
| 181 | Guntakal . . . | १३ | 4 15 10 20 | 77 22 40 | 14 40 | " 0 15 | 0'3805 | |
| 355 | Bellary . . . | १३ | 2 15 8 50 | 76 55 30 | 14 5 | W 0 5 | 0'3770 | |
| 350 | | ... | ... | ... | ... | ... | ... | |
| 357 | Mangi . . . | १३ | 2 30 22 0 | 67 28 10 | 42 55 | E 2 50 | 0'3240 | |
| 358 | Saiyad Hamid . . . | " 2 | 30 35 20 | 66 43 20 | 43 10 | " 2 50 | 0'3230 | |
| 359 | Chaman . . . | " 1 | 30 56 10 | 66 25 20 | 43 50 | " 2 40 | 0'3210 | |
| 360 | Abigum . . . | १३ | 4 29 48 10 | 67 23 10 | 42 5 | " 2 40 | 0'3265 | |
| 361 | Spintingi . . . | " 3 | 29 55 50 | 68 4 50 | 42 15 | " 2 40 | 0'3270 | |
| 362 | Gházi Ghat . . . | १३ | 5 30 4 50 | 70 51 50 | 42 30 | " 2 45 | 0'3305 | |
| 363 | Dairadin Panah . . . | " 2 | 30 34 10 | 70 55 30 | 43 30 | " 2 45 | 0'3270 | |
| 364 | Dorala . . . | १३ | 6 31 5 10 | 70 55 30 | 44 15 | " 3 5 | 0'3250 | |
| 365 | Bhakkar . . . | १३ | 11 31 37 10 | 71 3 0 | 45 0 | " 3 5 | 0'3225 | |
| 366 | Shah Alam . . . | " 9 | 31 58 40 | 71 9 0 | 45 25 | " 3 20 | 0'3205 | |
| 367 | Kaleke . . . | १३ | 10 31 58 20 | 73 36 20 | 45 40 | " 3 10 | 0'3235 | |
| 368 | Chiniot Road . . . | " 11 | 31 34 20 | 73 10 40 | 44 55 | " 2 55 | 0'3255 | |
| 369 | Gojra . . . | १३ | 12 31 8 40 | 72 40 30 | 44 15 | " 3 0 | 0'3265 | |
| 370 | Darkhana . . . | १३ | 9 30 39 50 | 72 11 10 | 44 35 | " 2 45 | 0'3285 | |

Repeat Stations.

| | | | | | | |
|------|------------------|----------|----------|-------|--------|-------|
| I | Udaipur . . . | 24 35 33 | 73 41 57 | 33 15 | E 1 30 | '3540 |
| II | Kurrachee . . . | 24 49 50 | 67 2 2 | 33 35 | " 1 40 | '3475 |
| III | Quetta . . . | 30 11 52 | 67 0 20 | 42 35 | " 2 50 | '3250 |
| IV | Baháwalpur . . . | 29 23 27 | 71 40 37 | 41 35 | " 2 50 | '3335 |
| V | Ráwalpindi . . . | 33 35 16 | 73 3 6 | 47 45 | " 3 40 | '3140 |
| VI | Bharatpur . . . | 27 13 31 | 77 29 28 | 38 15 | " 2 5 | '3470 |
| VII | Bangalore . . . | 12 59 35 | 77 35 58 | 9 15 | W 0 15 | '3815 |
| VIII | Dhárwár . . . | 15 27 20 | 74 59 35 | 14 45 | 0 0 | '3765 |
| IX | Porbandar . . . | 21 38 20 | 69 37 6 | 28 10 | E 1 15 | '3610 |

N.B.—Barrackpore Observatory to be plotted.

NOTE—The above value of Dip, Declination and Horizontal Force are uncorrected for secular change, diurnal variation, instrumental differences, etc., and are to be considered as preliminary values only.

Where blanks occur, values have been already found during field season, 1901-02, or the observations have not been completed.

The Survey numbers refer to the published chart: thus No. १३ 3 denotes No. 3 Station in the dotted square, the spherical co-ordinates of whose centre are 26° North Latitude and 70° East Longitude.

All Longitudes are referable to that of Madras Observatory taken at the value, 80° 14' 47" East from Greenwich.

GENERAL REPORT
ON THE
OPERATIONS
OF THE
Survey of India

ADMINISTERED UNDER
THE GOVERNMENT OF INDIA
DURING
1902-1903.

PREPARED UNDER THE DIRECTION OF
COLONEL ST. G. C. GORE, C.S.I., R.E.
SURVEYOR-GENERAL OF INDIA.



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