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# GENERAL REPORT

ON THE

## OPERATIONS

OF THE

# Survey of India

ADMINISTERED UNDER

THE GOVERNMENT OF INDIA

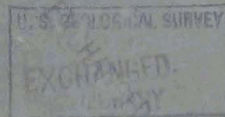
DURING

## 1901-1902.

PREPARED UNDER THE DIRECTION OF

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

SURVEYOR-GENERAL OF INDIA.



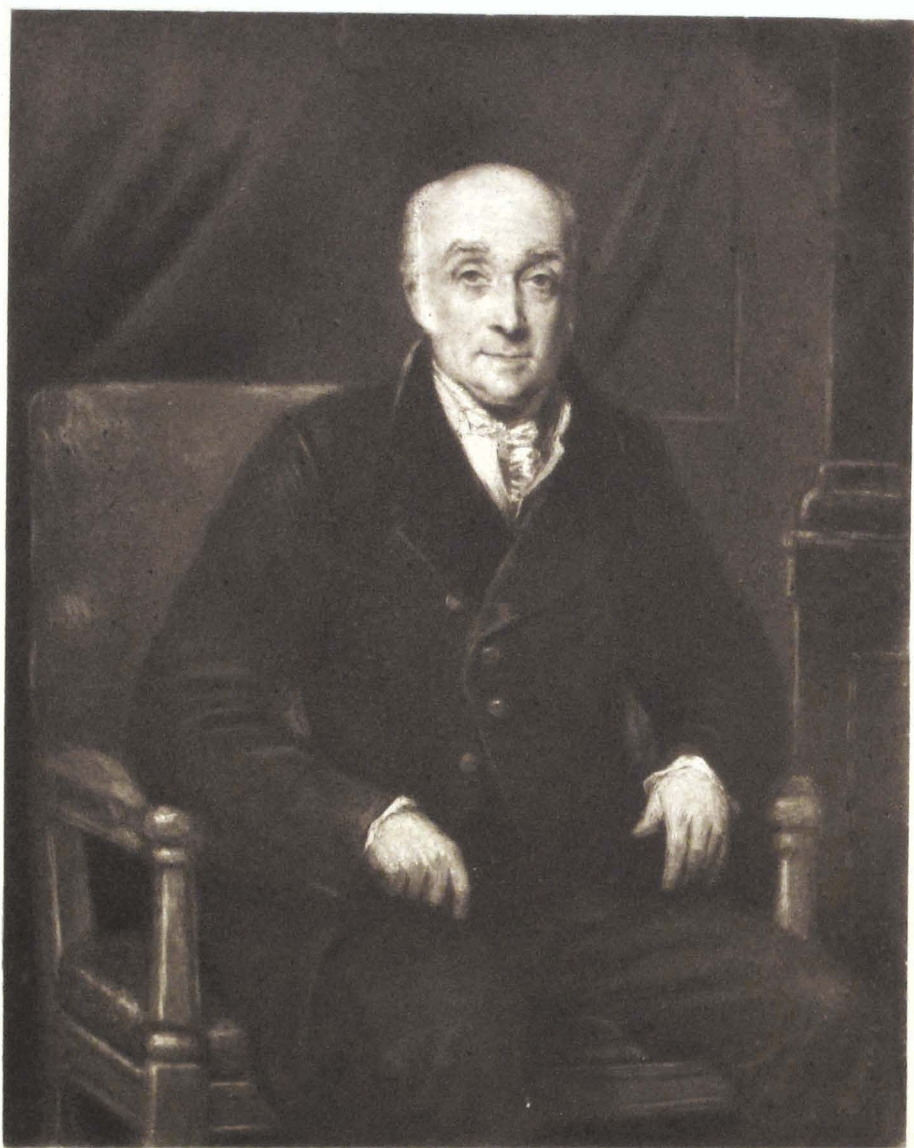
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COLONEL W. LAMBTON, F. R. S.

*Originator and first Superintendent of the Great Trigonometrical Survey*

1800 - 23.

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GENERAL REPORT  
ON THE  
**Operations of the Survey of India**  
DURING THE SURVEY YEAR  
1901-1902.

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PART I.

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SUMMARY.

ADMINISTRATION.

The operations of the department that are now reported on are for the survey year ending 30th September 1902.

2. Colonel St. G. C. Gore, R.E., Surveyor-General, directed the general administration of the department and also superintended the Topographical Branch up to 31st January 1902, when he proceeded on combined leave and Major F. B. Longe, R.E., was appointed to officiate as Surveyor-General. Colonel Gore returned from leave and resumed charge of his office on the 29th September 1902.

On account of Colonel Gore's and Colonel Hobday's absence there were a number of administrative changes.

The office of the Deputy Surveyor-General in charge of the Revenue Branch was held by Major Longe, R.E., up to 31st January, and on his appointment as Officiating Surveyor-General, Major S. G. Burrard, R.E., held charge of this Branch from 1st February to 30th April; when this officer also proceeded on combined leave and Major W. J. Bythell, R.E., was appointed to officiate as Deputy Surveyor-General from 1st May to 28th September. Major Longe reverted to his post of Officiating Deputy Surveyor-General on the 29th September.

The office of the Superintendent, Trigonometrical Branch, was held by Major S. G. Burrard, R.E., up to 31st January and thereafter by Mr. J. Eccles, M.A., up to the end of the year.

Major R. T. Crichton, I.A., and Captain W. M. Coldstream, R.E., held the offices of the Superintendents, Provincial Surveys, Bengal and United Provinces, respectively.

Major P. J. Gordon, I.A., held charge of Forest Surveys during the year. The Governments of Madras and Bombay have accepted the proposals of the Government of India that the terms of Government Resolution (Department of Revenue and Agriculture) No. 7-F., dated 25th April 1901, shall also be applicable to forest survey parties working in these Presidencies. The details of this arrangement are now under consideration, but as a preliminary measure Major Gordon was placed in administrative charge of Nos. 9 and 19 Parties (Madras Forests), and of No. 17 Party (Bombay Forests) from the 1st August 1902.

*Inspection Tours of the Administrative Officers.*

3. Major Longe, R.E., Officiating Surveyor-General, left Calcutta on the 15th April and proceeded to Dehra and Mussooree, inspecting the Trigonometrical Branch Office, the Forest Survey Office and that of No. 20 Party, at

the former place and the offices of Nos. 14 and 15 Parties, the North-West Frontier Drawing Office and the Kashmir Detachment at Mussooree.

At Dehra he was especially occupied with the question of the transfer of the Forest Survey Branch to the Survey of India, of the transfer of the recess quarters of No. 20 Party to Bangalore and the construction of a new office for the Forest Surveys in the compound of the Trigonometrical Branch Office. He left Mussooree on the 30th and reached Simla on the 1st May. During his stay at Simla he, on several occasions, visited the recess office of No. 18 Party. On the 17th July he left Simla and proceeded to Dehra, when he again inspected the Trigonometrical Branch Office, the Forest Survey Office and that of No. 20 Party and drew up a scheme for the future arrangements involved by the transfer of the Forest Survey to the Survey of India.

Proceeding to Mussooree he inspected the office of No. 15 Party and the Drawing Office afresh, as well as the Persian Detachment and No. 14 Party. He returned to Calcutta on the 11th August and proceeded to Bangalore on the 25th idem. At Bangalore he inspected the offices of Nos. 3, 9 and 19, 10, 11 and 21 Parties and the Bangalore Drawing Office. On the 6th September he proceeded to Poona when he, in company with the Superintendent, Forest Surveys, inspected the office of No. 17 Party (Bombay Forests). He returned to Calcutta on the 12th idem. Almost every party was visited during the year by either the Surveyor-General or the Deputy Surveyor-General, many of them by both.

A visit to Assam had been planned for the Deputy Surveyor-General, but unfortunately at the only time it was possible it was found that the Superintendent, Provincial Surveys, had been granted three months' privilege leave, and consequently the question to be gone into in connection with the work in that Province could not have been discussed and the visit had to be abandoned.

4. Major Longe, R.E., Officiating Deputy Surveyor-General, in charge Revenue Branch, left Mussooree on October 27th and proceeded to Allahabad, and on 10th November inspected the camp office of No. 14 Party, which was just starting work in this district on its transfer from Lushai, at that place. The traverse work was already started and, beyond temporary difficulties connected with the transport of the mark stones across the Ganges, was progressing favourably. Thence he proceeded to Jubbulpore and inspected the office of the Central Provinces Detachment and the Drawing Office. He arrived in Calcutta on the 13th idem. On the 24th January 1902 he proceeded to Sihora road and inspected in the field the work of the Central Provinces Detachment, revising the standard maps compiled from reduction of the *patwaris'* cadastral maps. He returned to Calcutta on the 31st January and took over charge of the office of Surveyor-General, on 1st February.

Major Burrard, R.E., Officiating Deputy Surveyor-General, proceeded on a tour of inspection to Burma on the 11th February and after having inspected the field work of Nos. 3 and 7 Parties he returned to Calcutta on the 27th March 1902. The main object of this tour was to go thoroughly into the question of the continuance of the survey on the 1-inch scale in certain districts, to settle with the local authorities what areas were of greater and what of less importance and generally to get an idea of the future employment of the parties working there. A separate report is being submitted to Government on the subject, but generally it was agreed that no area should be excluded from survey on this scale, the proper expansion of the country as regards trade, etc., depending largely on the possession of maps on which roads, telegraphic lines, etc., can be roughly laid out.

Major Bythell, R.E., took over charge of the office of Deputy Surveyor-General from Major Burrard, R.E., on the 1st May. As there were several questions regarding the work of No. 18 Party to be discussed with the Surveyor-General, Major Bythell, with the sanction of the Government of India took over charge by telegram in Simla and remained there till the middle of May. He left Calcutta on the 9th June for Mussooree and inspected the offices of No. 14 Party and the Bengal Traverse Detachment, and also visited the office of No. 15 Party, returning to Calcutta on the 21st. He proceeded to Jubbulpore on the 1st August, and inspected the office of the Central Provinces Detachment, and returned to Calcutta on the 7th. On the 25th August he again left Calcutta for Bangalore, where he inspected the office of No. 3 Party and

visited those of Nos. 9 and 19, the Bangalore Drawing Office and Nos. 11 and 21 and returned to Calcutta on the 7th September. Whilst in Calcutta he twice inspected the work of the Bengal Drawing Office.

5. Major Burrard, R.E., Superintendent, Trigonometrical Surveys, inspected No. 25 Party (Tidal and Levelling) at Dehra Dún in October 1901. Mr. Eccles, Officiating Superintendent, Trigonometrical Surveys, visited Mussooree in June 1902, and inspected Nos. 22 and 23 Parties (Astronomical) and No. 26 Party (Magnetic). He also visited Nos. 14 and 15 Parties and the North-West Frontier Drawing Office. In September he inspected No. 24 Party (Triangulation) at Mussooree and No. 12 Party (Sind) at Kurrachee. During the year he visited the Training School at least once a month and No. 25 Party (Tidal and Levelling) from time to time.

6. Major Gordon inspected in the field the detachments of the Forest Surveys working in the Central Provinces, Bengal and Burma, and No. 20 Party in the field in Burma and also during recess at Dehra Dún. He accompanied the Officiating Surveyor-General to Bangalore and Poona, where he inspected the Forest Survey Parties recessing there. In June he visited Simla to confer with the Officiating Surveyor-General and the Inspector General of Forests regarding the reorganization of the Forest Survey Branch.

### 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 on topographical surveys, one double and two ordinary parties on forest surveys, one double and two ordinary parties on cadastral surveys, two detachments on traverse surveys and four parties on scientific operations.

8. The operations of the Forest Survey Branch, which are under the administration of the Superintendent of 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.
				Inch. Mile.	
24	<i>Trigonometrical.</i> India Triangulation	21	Lieutenant H. Wood, R.E. " H. M. Cowie, R.E.	...	} Supdt., Trig.
3	<i>Topographical.</i> Lower Burma	21	Mr. E. Litchfield	{ 2 = 1 1 = 1 }	D. S. G., Rev.
10	Upper Burma	24	Captain F. W. Pirrie, I.A. Lieutenant A. A. McHarg, R.E.	1 = 1	D. S. G., Topo.
11 & 21	Ditto	25	Mr. F. J. W. Doran	1 = 1	Ditto.
12	Sind	26	" C. F. Erskine	{ 2 = 1 1 = 1 }	Supdt., Trig.
14	United Provinces	27	" R. B. Smart Captain C. W. H. Symonds, I.A.	2 = 1	D. S. G., Rev.
15	North-West Frontier	29	Mr. E. A. Wainright	Various	D. S. G., Topo.
18	Punjab	30	Lieutenant A. A. McHarg, R. E. Major W. J. Bythell, R.E. Captain G. A. Beazeley, R.E.	{ 2 = 1 1 = 1 }	D. S. G., Rev.

## Statement of Survey Operations and Parties—concl'd.

No. of Party.	Nature and locale of operations.	Page in this report.	Executive Officers.	Scale of Survey.		Administrative Superintendent.
				Inch.	Mile.	
	<i>Forest.</i>					
9 & 19	Madras Presidency . . .	32	Mr. H. Todd . . . .	4	= 1	D. S. G., Rev.
17	Bombay Presidency . . .	34	Mr. B. G. Gilbert-Cooper . . . ,, S. F. Norman . . . .	{ 8 = 1 4 = 1 }		D. S. G., Topo.
20	Burma . . . . .	35	Captain A. H. B. Hume, R.E.	4	= 1	Supdt., Forest Surveys.
	Bengal . . . . .	} 37	Major P. J. Gordon, I.A.	4	= 1	Ditto.
	Central Provinces . . . .					
	Burma . . . . .					
	Punjab . . . . .					
	<i>Cadastral.</i>					
2 & 8	United Provinces . . .	40	Captain W. M. Coldstream, R.E.	16	= 1	D. S. G., Rev.
4	Bengal . . . . .	42	Major R. T. Crichton, I.A.	16	= 1	Ditto.
7	Burma . . . . .	45	Mr. J. Connor . . . . Major G. B. Hodgson, I.A. Lieutenant C. P. Gunter, R.E.	16	= 1	Ditto.
	<i>Traverse.</i>					
	Central Provinces . . .	48	Mr. R. C. D. Ewing . . .			Ditto.
	Assam . . . . .	50	,, T. Shaw . . . . .			Ditto.
	<i>Geodetic.</i>					
22 } 23 }	India . . . . .	52	Lieutenant H. M. Cowie, R.E.			Supdt., Trig.
	<i>Tidal &amp; Levelling.</i>					
25	India . . . . .	53	Captain H. L. Crosthwait, R.E. Mr. E. J. Connor			Ditto.
	<i>Magnetic.</i>					
26	India . . . . .	54	Captain H. A. D. Fraser, R.E.			Ditto.

## OUTTURN.

10. The total outturn of detail survey during the year amounts to 104,794 square miles which includes 68,162 square miles of reconnaissance surveys on the  $\frac{1}{4}$ -inch and smaller scales. The area surveyed during the previous year amounted to 48,106 square miles, and the increase is due to large areas of reconnaissance surveys on the North-West and North-East frontiers. The total area of rigorous surveys on all scales is 36,632 square miles, which is 5,526 square miles in excess of that done last year. The total area triangulated is 99,496 square miles, which includes 83,790 square miles triangulated in connection with reconnaissance surveys. The total area traversed for cadastral purpose is 5,424 square miles, *viz.*, 181 square miles in the United Provinces of Agra and Oudh, 4,171 square miles in Bengal and 1,072 square miles in Burma.

## TRIGONOMETRICAL SURVEYS.

11. The Triangulation party (No. 24) was employed in completing the Manipur Minor Meridional Series, extending it southwards over the Kyaukpyu Yomas, in the neighbourhood of Mount Victoria. The work was completed and a very satisfactory junction effected with two stations of the Burma Coast series.

This series of triangulation will be a very valuable one in aiding the extension of topographical and other surveys, and already it has proved of the utmost use to the Forest Surveys in the Chindwin valley.

## TOPOGRAPHICAL SURVEYS.

12. Some changes have been made during the year under report in the composition and the *locale* of operations of the Topographical Survey parties. In Burma the two parties, Nos. 11 and 21, which were working independently in the Shan States have been amalgamated into one party charged with the completion of the work in these States. No. 14 Party has been transferred from Lushai to the United Provinces of Agra and Oudh, and No. 18 Party from the Himalayas to the plains of the Punjab.

13. The work of No. 3 Party, which as before is employed in Lower Burma, consists mainly of surveying the blanks omitted from the cadastral surveys and so filling up and completing the maps, which otherwise would be fragmentary and useless. In addition the party undertook the revision and completion of the topographical detail obtained from the reductions of the cadastral sheets. Work was carried on in the Pegu, Hanthawaddy, Toungoo, Thayetmyo and Prome districts. The outturn for the season is a much more satisfactory one than that of the previous year, 1,905 square miles of detail survey having been completed on the 1-inch scale and 350 square miles on the 2-inch scale, while the revision of the sheets prepared from cadastral reductions has been carried on over an area of 1,048 square miles. In addition the usual triangulation in advance has been carried out.

14. The work of No. 10 Party is confined to the west of Longitude  $96^{\circ} 30'$  and consisted entirely of revising and adding to the maps produced by reducing the cadastral sheets. Such maps without revision are in many parts of Burma quite meaningless and useless owing to the omission of hills and other topographical detail. The large area of 4,100 square miles was thus completed and revised at a cost per square mile considerably less than that of last year.

The large scale maps of the town of Maymyo, which is rapidly extending, were revised and brought up to date.

15. The two parties, Nos. 11 and 21, which worked independently last year, were this year amalgamated and considerably reduced. The combined party continued operations in the Southern Shan States, the ground surveyed on the 1-inch scale lying along the west of the Salween river. The area thus completed amounted to 2,663 square miles. In addition to this some surveyors worked across the Salween to the eastwards, filling up and amending the older reconnaissance survey sheets which had been surveyed on the  $\frac{1}{4}$ -inch scale.

16. The whole question as to how far topographical surveys should be carried in Burma has been under discussion during the year and final orders have not yet been issued on the subject. The  $\frac{1}{4}$ -inch reconnaissance survey which was commenced as soon as Upper Burma was occupied is, except in those cultivated districts in which cadastral operations have been carried on and those areas which have been already mapped on the 1-inch scale, the only guide to the topography of the country. Like all such reconnaissance surveys, it varies both in accuracy and fulness of detail according to the facilities which the surveyors obtained at the moment for traversing the country and the time available for the work. In its present state it certainly is not good or complete enough to suffice for military purposes even if the scale were sufficiently large, which is doubtful, while the scale is unquestionably too small to render the maps of full value in assisting the Public Works and the Civil Administration in opening out the country. It is very essential if new roads, canals and such aids to the development of a country are to be laid out with economy and to the best advantage that the authorities concerned should be in possession of a sufficiently good map of the country so as to prevent costly mistakes being made. It is generally conceded that this want can only be met by a good topographical map on a scale of not less than 1 inch = 1 mile. Burma is being rapidly opened up and the demand for such maps is very great. There are, however, undoubtedly certain areas which from their present remoteness or inaccessibility are unlikely to be exploited for some considerable time, and the mapping of such parts may well be postponed for future consideration.

17. The survey of Sind was continued by No. 12 Party. British territory was as before surveyed on the 2-inch scale, an area of 1,597 square miles being completed, while the more desert portions of the Khairpur State were mapped on the reduced scale of  $\frac{1}{2}$  inch = 1 mile; of this latter the large area of 4,556

square miles was surveyed. The usual triangulation and traverse in advance was also carried out.

18. The work in the Lushai hills having been closed, No. 14 Party, considerably strengthened, was transferred to the United Provinces in order to take up the topographical survey of Allahabad and other districts of which no maps existed. This being the first season in the new ground, the work consisted mainly of traversing in preparation for future detail survey. One thousand nine hundred and eighty-eight square miles were thus prepared and a commencement of the detail survey was made, a small area of 203 square miles having been mapped.

19. No. 15 Party has been employed as in previous years on work required by the Military Authorities. In addition to the continuation of the work in Sind and Kashmir the party commenced the survey of the cantonments in the Bengal Command, eight cantonments and bazars having been surveyed during the season. The outturn of work in Kashmir amounted to 2,787 square miles while 1,696 square miles were completed in Sind. A large area of frontier reconnaissance was also completed.

20. No. 18 Party having completed its programme in the Kángra district commenced work in the plains of the Punjab, its main work being to utilize the large scale *patwari* maps of the Punjab, and from them compile and complete, by work in the field, a topographical map. The village trijunctions of the districts concerned have all been fixed by a professional traverse, so the means are to hand of combining the reduced *patwari* maps which then only require checking and completing in the field, the main points requiring supplement being the river banks and village sites. Three thousand square miles of the Montgomery and Lahore districts were thus mapped. A few hundred square miles of country in the Simla Hill States which remained for completion was also surveyed. In addition to this topographical work a portion of the party was employed in carrying on riverain traverses for the Local Government, in order to give the means of fixing once for all the riverain boundaries of the Punjab districts. The Simla Estate boundary survey was continued during the open season, and if no further extensions of it are asked for should be shortly complete.

21. The total outturn for the year under the head of topographical survey on various scales, from 1-inch upwards, amounted to 8,801 square miles of new survey and 10,084 square miles of topographical revision survey.

The total is made up as follows:—

11,667	square miles surveyed and revised on the 1-inch scale,
7,141	" " " " " " " 2 " "
23	" " " on " " 4 " "
54	" " " " " " 6 " "

### FOREST SURVEYS.

22. The special surveys of Government forests were, as in previous years, carried out by the detachments of the Forest Surveys, Bengal Presidency, and by No. 20 Party under the administration of the Superintendent, Forest Surveys, and the control of the Inspector General of Forests, and by Nos. 9 and 19 Parties in Madras and No. 17 Party in Bombay working under the administrative charge of the Deputy Surveyor-General (Revenue) and the Deputy Surveyor-General (Topo.) respectively and under the control of the Surveyor-General. The scheme for bringing all Forest Surveys in India under similar rules under the administrative charge of the Superintendent of Forest Surveys, and under the control of the Surveyor-General, is well advanced.

23. In Bombay surveys were carried on in the Northern, Central and Southern Circles. The outturn was, in addition to triangulation and traversing, 607 square miles of detail survey on the 4-inch scale and 161 on the 8-inch. It having been decided to confine 16-inch surveys to the more valuable *babul* reserves situated below flood level it was not found necessary to survey any forest areas on this scale during the year. The cost-rates were R63 per square mile for 4-inch detail survey and R136 for 8-inch. The cost-rate of the 4-inch survey is practically the same as for the previous year while that of the 8-inch survey is greater. In this party the charges for supervision of late years have varied greatly and differences in cost-rates are generally attributable more to this circumstance than to any other cause.



24. In Madras Nos. 9 and 19 Parties continued the survey of forests in Kurnool, Cuddapah and South Canara on the 4-inch scale. In addition to the Survey of Government forests a detachment of the parties carried out the preliminary triangulation and traversing of the Godávári delta in preparation for a 16-inch cadastral survey which will be commenced in 1902-03.

An area of 1,306 square miles of forests was surveyed at a cost-rate of **Rs 59** per square mile.

25. In Burma an area of 724 square miles of forest reserves was surveyed on the 4-inch scale by No. 20 Party in the Upper Chindwin, Minbu, Pyinmana and Ataran. A large area was also triangulated and traversed for the current season's detail survey and in advance for that of 1902-03 principally in the Upper Chindwin, Minbu and Thayetmyo.

The cost-rates of triangulation and traversing both show an improvement. The cost-rates of detail work however show an increase being **Rs 122** per square mile, as compared with **Rs 98** in 1900-01. The increase is chiefly due to loss of time owing to the party being detained in quarantine at Rangoon, to the operations being much further from the base than formerly, and to the necessary transfer of a camp from Magwe to the Upper Chindwin during the field season.

26. In addition to the work done by No. 20 Party a small detachment of Forest Surveys surveyed 274 square miles in the Ruby Mines district at a cost of **Rs 85** per square mile. The cost-rate of this detachment cannot be compared with that of No. 20 Party, as the conditions were altogether different.

27. In the Central Provinces four detachments of the Forest Survey Branch were employed and, in addition to other operations, surveyed 699 square miles on the 4-inch scale in Mandla and 725 in Chánda. The survey of the forest reserves in the Central Provinces is now complete with the exception of an area of some 200 square miles in Chánda. The cost-rates of detail survey are even more favourable than for last year, being **Rs 29** per square mile, as compared with **Rs 36**. The reduction is mainly due to the easier nature of the country in Mandla.

28. In Bengal one detachment was employed in Singhbhum and surveyed 369 square miles of reserved and protected forests on the 4-inch scale. A small detachment completed the survey of the Koderma forests (58 square miles) on the 4-inch scale chiefly for the purpose of locating the Mica mines. The cost-rate of 4-inch detail survey was **Rs 48** per square mile, as compared with **Rs 61** in 1900-01 and **Rs 80** in 1899-1900.

The steady reduction of rates in Chota Nagpur is very satisfactory.

29. In the Punjab the survey of the Jubbál and Tarhoch State forests was continued, an area of 100 square miles having been surveyed on the 4-inch scale at a cost-rate of **Rs 23** per square mile. A small area of 12 square miles was also surveyed in Hazára.

30. The total outturn of Forest Surveys executed on various scales during the year amounts to 5,035 square miles, of which 2,961 square miles were surveyed by the Forest Survey Branch (including 20 Party). The total is made up as follows:—

	Square miles.
4-inch scale . . . . .	4,874
8-inch scale . . . . .	161

### CADASTRAL AND TRAVERSE SURVEYS.

31. 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.

32. In Upper Burma 545 square miles were surveyed in detail in the Lower Chindwin district, thus completing the cadastral survey of that district, whilst 911 square miles were traversed in the Pakókkú district preparatory to detail survey. In Lower Burma, 120 square miles were cadastrally surveyed to complete the Sandoway district, and 16 square miles, and 145 square miles traversed in districts Sandoway and Kyaukpyu respectively.

33. In Bengal, 4,171 square miles were traversed, 2,132 square miles cadastrally surveyed and 2,078 square miles of record-writing completed in districts Darjeeling, Monghyr, Purnea, Bhágalpur, Gaya, Backergunge, Sonthal Parganas, Singhbhum, and Ranchi, and small Government estates in Patna

district have been traversed, whilst surveys connected with the relaying of boundaries of other estates have been carried out in districts Malda, Champáran, Shahabad, Monghyr and Darbhanga, and a boundary in Jalpáiguri permanently marked.

34. In the United Provinces 181 square miles were traversed in Etah district, and 2,507 square miles cadastrally surveyed with record-of-rights by *patwari* agency under professional control in districts Azamgarh, Mainpuri, Etah and Jaláun.

35. In the Central Provinces, a number of small scattered areas consisting of excised portions of forest reserves in districts Damoh, Hoshangabad, Chhindwára, Nimár, Chánda, Raipur, Sambalpur, Mandla and Seoni were traversed, amounting in the aggregate to 715 square miles, whilst a disputed boundary between the *jaçirs* of Pagára and Batkágárh, district Chhindwára, was also traversed. There remain some 671 square miles of these excisions to be traversed during 1902-03, and the detachment will in future be employed on the revision of the topographical maps of the Province.

36. In Assam 133 square miles of extensions of cultivated areas, and 94 square miles of tea grants were traversed, the former to serve as a basis for cadastral survey by local agency. There remain some 250 square miles of these tea grants for traverse during 1902-03, which it is estimated will complete them, and as the extensions of cultivated areas do not aggregate more than 50 square miles per annum, the retention of a professional detachment for the traversing of this small area annually, scattered as it is in small patches over the entire Province, seems hardly justifiable, considering the high cost-rate it necessarily incurs, unless some further extension of survey programme to suit local requirements is anticipated.

37. The total areas traversed, and cadastrally surveyed during the season in the several Provinces, are as follows:—

	Traversing square miles.	Cadastral survey square miles.	Record-writing.
Burma . . . . .	1,072	665	...
Bengal . . . . .	4,171	2,132	2,078
United Provinces . . . . .	181	2,507	2,507
Central Provinces . . . . .	715	...	...
Assam . . . . .	227	...	...
TOTAL . . . . .	6,366	5,304	4,585

### SPECIAL OPERATIONS.

38. As there was only one Imperial Officer available for Astronomical work, Nos. 22 and 23 Parties were combined and Astronomical Latitudes were observed at stations on the Calcutta Meridional series and Darjeeling triangulation.

The results are very interesting and remarkable: the zone of positive deflection extends very much closer to the foot of the hills than was expected, and the transition from a positive deflection to a large negative one takes place with startling rapidity.

The whole question of local attraction in India, especially with reference to the effect of the mass of the Himalayas, is one of great interest, and has been partially dealt with by Major Burrard in an able paper published among the Professional Papers during the year. Many more observations and full discussion will be required before we can hope to solve this perplexing problem, a question which at present excites great interest in Europe.

39. Tidal operations were continued by No. 25 Party, observations being recorded at 13 stations. The observatory at Bassein, in Burma, was opened during the year.

The Levelling operations were carried on for a portion of the season on the Eastern Bengal State Railway, and a connection was made with the Sonákhoda Base Line. A commencement of Levelling was also made in Assam, a line of levels being run from Fakírganj to Gauháti.

An urgent call for accurate levels having been made by the Burma Government, the Levelling detachment will be employed in that Province during the coming season.

40. The Magnetic party commenced field work during the year. As the Bombay and Dehra Dún observatories were the only base stations in actual work, the field operations were confined to the country west of the line joining those two stations. As this was the first season of work only three observers were employed, and magnetic determinations made at 163 stations.

The Kodaikánal Base station is now installed, and that at Barrackpore, which is to take the place of the Calcutta one rendered useless by the electric tramways, is under construction. It will, therefore, be possible to push forward operations more quickly in the future.

## GEOGRAPHICAL SURVEYS AND RECONNAISSANCES.

41. Under this head are included surveys and reconnaissances which are executed on the  $\frac{1}{2}$ -inch or smaller scales. In Sind and in Kashmir areas of 4,556 and 7,938 square miles, respectively, were surveyed on the  $\frac{1}{2}$ -inch and  $\frac{1}{4}$ -inch scale, while country to the extent of 63,000 square miles was surveyed and reconnoitred in the Shan States and on the N.-W. Frontier.

A survey party under Lieutenant M. Tandy, R.E., has remained attached to the Aden Boundary Commission throughout the year.

## HEAD-QUARTERS OFFICES, CALCUTTA.

42. The general direction of these offices remained in the hands of Colonel St. G. C. Gore, R.E., Surveyor-General of India, up to 31st January, and during his absence on combined leave Major F. B. Longe, R.E., officiated for him. The Revenue Branch Section was under the superintendence of Major Longe, Major S. G. Burrard, R.E., and Major W. J. Bythell, R.E.

The other offices in Calcutta were supervised by the Assistant Surveyor-Generals, aided by an officer, Captain E. A. Tandy, R.E., who was specially posted to the head-quarters in order to reorganise the working arrangements of the Mathematical Instrument Office.

43. The General and Topographical Branch Sections were under the supervision of Major G. B. Hodgson, I.A., up to 30th October, under Captain E. A. Tandy, R.E., up to 14th November, under Mr. A. E. Spring up to 2nd July, under Captain Tandy up to 13th July, and under Mr. B. G. Gilbert-Cooper up to the close of the year. The Drawing, Engraving and Map, Record and Issue Offices were under the supervision of Major J. M. Fleming, I.A., up to 9th July and during his absence on privilege leave Captain Tandy held charge of the Drawing and Engraving Offices and Mr. Gilbert-Cooper held charge of the Map, Record and Issue Office up to the close of the year. The Photo-Litho. Office was under the supervision of Mr. T. A. Pope throughout the year. The Mathematical Instrument Office was under Major Hodgson up to 30th October, under Captain Tandy up to 17th August, and under Mr. Gilbert-Cooper up to the close of the year.

44. A very interesting relic has come into possession of the Survey of India during the year. This is an original portrait in oils of Colonel Lambton, the originator of the Great Trigonometrical Survey of India, and its first Superintendent. The portrait, which is a very fine painting on copper, was sold to us by a descendant of Mr. dePenning, one of Colonel Lambton's Assistants, and, as far as the hands and face were concerned, was in perfect preservation. It has now been completely restored.

Major Lambton, an officer of the 33rd Regiment, after distinguishing himself at the storming of Seringapatam, placed before Sir Arthur Wellesley in 1800 proposals for a mathematical and geographical survey of the peninsula and the measurement of an arc of the meridian in connection therewith. The proposal was accepted and Major Lambton was himself appointed to conduct the measurement. In 1802, one hundred years ago, the work was commenced. The difficulties were many, but owing to his genius, ability and energy he conquered them all. It is characteristic of the difficulties to be overcome in those

times that the three-foot theodolite which was being sent out from England and captured on the passage to India by the French frigate "Piemontaise" was landed at Mauritius; but it was eventually forwarded to its destination by the chivalrous French Governor, with a complimentary letter to the Governor of Madras. The chain for his base line measurements was one that had been sent as a present to the Emperor of China with Lord Macartney's mission, and refused.

Lambton carried on his work steadily, covering Southern India with a network of triangles until 1823, in which year, on the 20th January, he died at Hinganghát in the Central Provinces. A reproduction of the portrait is published as a frontispiece to this volume.

45. *Correspondence Office.*—There has been no change in procedure throughout the year.

46. *Drawing Office.*—The General Section has, as usual, been engaged in the compilation and revision of the various general maps, as well as on additions to Standard sheets, when fresh material is available. In addition the sheets received from the parties are prepared for press and published. Thirty-five sheets of the North-Eastern Frontier Series on the scale  $\frac{1}{4}$ -inch = 1 mile have been dealt with during the year, the majority being the result of recent work in China. Of these 25 have been published, the remaining ten being at press. Of the South-Eastern Frontier Series, 16 sheets have been in hand of which half has been published. Two sheets of the North-Western Frontier Series on the scale  $\frac{1}{2}$ -inch = 1 mile, formerly issued in part with an adjoining sheet, as double number sheets, are now being prepared separately for publication in standard form completed to margin. Twenty-one sheets on the  $\frac{1}{2}$ -inch scale, giving the results of the recent surveys done by the Survey Detachment with the China Expeditionary Force, were prepared for press and published. The sheets of the Andaman survey on the  $\frac{1}{4}$ -inch scale have been under revision, a large number of additional names of localities having been entered upon them from information supplied by the Commissioner. They will shortly be ready for press.

One hundred and four Standard Sheets on the 1-inch scale have been dealt with during the year under report. Of these 36 belong to Burma, most of them being new publications, and of these six have been drawn in this office. Thirty-three sheets of Madras and seventeen of Rájputána and Central India are comprised in the number, the remaining sheets belonging to Assam, Bengal, Bombay and the Punjab. Press order has been given for 85 sheets, and of these 69 have been published.

47. Of sheets on the scale of 4 inches = 1 mile, 57 have been dealt with, 42 being Madras Forest sheets, and the remainder of the Burma Forest Survey, which have been brought up to date and republished.

48. Eighteen Provincial maps of sorts have been in hand either for revision or completion. One of these is the new North West Frontier Province, which has taken up much time and entailed constant references necessitating corrections and alterations, but it is hoped it will shortly be ready for publication, when the 16-mile Punjab from which it has been largely extracted, will be speedily completed.

49. The revision of the 16-mile Burma has been a most troublesome job, and the greater part of the map has had to be recompiled, as the old material being so faulty it was found impossible to put the new material on to it. To satisfy the urgent demands for the sheet which has been long out of print, a skeleton edition has been published, which it is hoped soon to supersede by a more correct one approaching completion.

50. Thirty-four District maps have been in hand, but kept up to date as they are, not from actual surveys but from information locally obtained, they are most unsatisfactory publications, and shortly it will be impossible to say what on many of them is good and what is bad material. Indeed the state into which all our sheets, standard as well as others, are drifting by the insertion of unreliable material, in the attempt to keep them up to date is a question that demands immediate attention. The material supplied us may serve to give a general idea of changes in a tract of country, but its insertion must lower the value of accurately surveyed sheets to that of mere reconnaissance work, to give it rank higher than it deserves. The system of handing over professional maps to be brought up to date by non-professional agency, which in many cases it is evident is represented by native clerks, is deplorable in its effect on our maps.

51. Fifty-two Administration Report maps have been in hand either for completion or revision. Of these 19 have been published while 16 more are at press. The hills for three of these have been brush shaded for the engravers.

52. One hundred and eleven sheets of the Atlas of India have been in hand for additions to outline or names or for corrections to roads, railways, canals and boundaries. These last taken from the same source as the alterations on our Standard sheets must much detract from their value, though the scale being so much smaller the information given may not be so misleading. But the constant alterations, as each new interpretation of a change comes from the local authorities, must do much to ruin the surface of the plates. Brush shading for the engravers has been executed on eight sheets, while a large amount has also been done on general maps such as the 32 and 64-mile India, etc. A commencement has been made of the compilation of an Index to show the material utilized on our Atlas sheets. Fair progress has been made, and when completed it should be a most useful addition to our records.

53. The new edition of the 48-mile Railway map has been completed, and it is hoped may be published early in the coming year. The 32-mile Railway and Canal Map of India has at last been published, but chiefly owing to the faulty hills is a somewhat unsatisfactory publication which it is hoped may soon be taken in hand again for rectification in several respects. The new 32-mile litho. map of India has been in hand throughout the year, as new material on both frontiers kept continually coming in. Sheets 1 and 4 have been much altered and added to, to incorporate the latest surveys. Sheet 1 is now practically ready for press, and it is hoped a skeleton edition at all events of the whole map, may issue during the coming year. The hill drawing of five of the sheets is ready for the stone draftsmen, and that of sheet 1 is also well in hand. The other general maps of India on the 64, 80, 96, 128 (2), 256 (2) mile scale have all been in hand, and editions of the first and fourth have been published. Work on the duplicate sheets of the 64-mile India has progressed steadily, but owing to new surveys having come in, much of the work already cut in Burma has had to be re-engraved. What has now been received must be final, and it is hoped to push it on without further delays during the ensuing year. Two sheets of the new  $\frac{1}{1,000,000}$  map of India Nos. 78 and 83 are practically completed, and only await the settlement of certain small details before being sent for publication. Work on two other sheets, one of which is for the engravers, is well advanced. Work on the new engraved 32 and 64-mile maps of India has been at a standstill owing to press of other work. A new edition of the 32-mile Burma has been published, but this is a most unsatisfactory map and must soon be superseded by a better. To meet a long felt want, *viz.*, a map of India on a scale suitable for a foolscap report, a new skeleton map on the scale of 1 inch = 192 miles has been prepared and is now in the hand of the engravers.

54. Of city plans, that of Ajjal has been published, while a map of Hsi-paw town has been sent to press. Forty-six of the sheets of the Calcutta survey have had revision work entered, and been published as second editions.

55. Extra departmental work has as usual taken up much of the office time and caused considerable interruption in our ordinary work. Many of the Census maps alluded to in last year's report were on receipt by the district officers pronounced either to have too much or too little detail, or to require alterations of some kind, and quite half have been largely modified. On the Assam, Bengal and Central Provinces maps a large amount of work was done in preparing the material for the colour stones for the various maps required to illustrate the reports of these Provinces. A set of maps was also prepared for the Census Officer in Balúchistán which were not included in the original programme, and also a general map of India on the scale of 1 inch = 192 miles was prepared for the Census Commissioner. The Route map of the Punjab and Bengal Command has at last been got out of hand. The Postal Atlas of India has been carried on as material or corrections became available, and what is hoped are final instructions regarding the Bengal and Bihár sheets have been received, and they should shortly be ready for press. The sheets for other two Provinces have been sent to the local officers for the insertion of information required, and these will be set in hand as soon as received. Other maps have been prepared in considerable numbers for the Foreign, Military, Forest and Medical Departments, as well as for the Botanical and Linguistic Surveys.

There is still a large amount of arrears in the way of bringing sheets out of stock up to date for republication, but the staff cannot anything like keep pace with demands.

The much needed revision of the Catalogues has once again had to be set aside for much of the year owing to various causes. But a considerable amount of work has been done upon them. That of Burma is practically ready for press, and those for Bengal and the Punjab will, it is hoped, shortly be ready, but owing to lack of staff they can only be taken up as opportunity offers.

56. The work in the Examining Section again shows a large increase, 2,977 sheets of sorts having come in for examination. Besides this there has been much work in the collection of geographical data for various officials, etc.

In the Revenue Section most of the outline for the new engraved map of Calcutta on the 6-inch scale has been supplied to the engravers, advantage having been taken of the presence of a surveyor to revise a part of the south district, which was much out of date. Maps of Bareilly, Allahabad, Cawnpore and of Calcutta for the Census report, and of Garden Reach for the Municipality, have been in hand, and all but the first two, which are delayed pending reply to references made about them, have been disposed of.

One hundred and eighty-one standard sheets of Assam, Bengal, Bombay, Burma, United Provinces and Punjab, of which 112 are new receipts from the field parties, have been dealt with during the year. Of these 78 have been published and 103 are passing through press. The new sheets received are mostly compilations of Cadastral Surveys in Burma, Bengal and the United Provinces, and many of the Burma ones are in such fragmentary condition they cannot be published until the work has been added to by new surveys. Four Burma sheets have been completed to margin from work supplied by the local surveys, and in two others area surveyed by the Forest Survey has been added to the material reduced from Cadastral Surveys. Fourteen old litho. prints of Bengal and the United Provinces, of which there are no originals, have been touched up to serve as such. Three Punjab sheets have been completed to margin by adding to them the hill area surveyed by No. 18 Party, which has been drawn for reduction on trace prints for publication in two colours. Two of these have been published. Four sheets have had work of other districts added to them to fill up blanks existing on the sheet as formerly published, and it is proposed in future to publish sheets as complete as possible. A recommencement has also been made of work which is sorely needed, and which has been unaccountably in abeyance for many years, *viz.*, the preparation of the scattered material in Bengal, such as *pargana* or main circuit maps, for publication in standard form. Three sheets have been in hand, and it is proposed to keep any available men on this task until all are completed. There is of course nothing but the ancient surveys to recompile, but the possibility of obtaining in readable form in one sheet, what at present is to be found only in several, should be a convenience to the public, and will be an untold boon to the Map, Record and Issue Office. The sheets before publication will be sent to the local authorities for the insertion of any new public works.

The usual work of revision has been carried out on the Index maps, while several new ones have been prepared. Two thousand one hundred and twenty-six pages of extracts from traverse data have been copied, checked and supplied as required by Departmental or other Government officials. The traverse records of district Toungoo have been finally examined and lodged again in the Map, Record and Issue Office. Those of district Saran are now in hand.

Seven hundred and forty-five traces and copies of 361 original village plans have been supplied to District Officials, while 1,210 applications from private parties for copies of original records have been received and disposed of during the year. On those applications 1,934 copies of maps or traverse records were supplied. The Government fees realised amounted to ₹1,294.2.

Coloured maps for issue to a number of 17,742 have been examined and passed, and in addition 1,409 pairs of office copies have been either newly prepared or brought up to date and compared. A total of 4,191 pairs have now been dealt with.

The renumbering of the published Burma sheets has also been in hand and 1,749 copies have had new numbers pasted upon them. All the 1-inch sheets

have been finished, but a number of large scale maps still remain to be dealt with and these will be taken up as opportunity offers.

In the Cadastral Section the returns for last year showed 5,937 sheets of Burma as remaining to be published, and during the year under report 2,770 original Cadastral sheets of districts Shwebo, Yamèthin, Lower Chindwin and Kyauksè Town of Upper Burma, and 302 sheets of Pegu and Toungoo City in Lower Burma were received from the field party. Six thousand five hundred and fifty-one sheets have been published, a large increase on former years' totals, leaving a balance of 2,548 to be completed, and these it is hoped to finish off by the end of January.

The total number of sheets passed for publication was 6,599, of which 4,596 were photozincographed, 1,035 zincographed, and 920 reproduced by the Vandyke process.

In addition to this much miscellaneous work has been done for Settlement Officers, Collectors and others. A large order for traces of 1,402 sheets of Myingyan district has been complied with.

*Badar* corrections have been made in the field area statements of districts Cachar, Sagaing and Shwebo. The making out of invoice lists to accompany the original Cadastral sheets and area statements of districts Sagaing, Magwe, Meiktila, Pegu and Toungoo of Burma and Raipur of the Central Provinces with area statements of Promé and Biláspur has thrown a considerable amount of extra work on the section, as before the despatch of consignments under recent orders to the local authorities for storage, each sheet has to be examined and checked, this work will be carried on as fast as possible, but without extra staff can only be done as opportunity offers.

57. *Engraving Office*.—The work performed by this office is in amount much the same as last year. Owing to the absence on leave of three European hill etchers and several of the native establishment, the outturn of hill etching and outline is somewhat less than usual, but the letters cut show an increase of 24,546. Only one new quarter Atlas Sheet has been published during the year.

Seven Administration Report Maps and editions of the general maps of India with hills on the 64 and 128 miles = 1 inch scale have also been issued, and a new index to the Atlas Sheets which was much needed has also been completed. Thirty-three new quarter Atlas Sheets have been projected, 107 sheets in various stages have had additional work done upon them, while 145 published quarter sheets, and 17 full Atlas Sheets, have been in hand for additions and corrections.

Seven of the Provincial maps on the scale of 1 inch = 16 miles have been in hand. Sheets 2, 3 and 4 of the Punjab map are almost ready for publication, but sheet 1 has been much delayed pending settlement of certain points in connection with the map of the new North-West Frontier Province which has been prepared from it. It is hoped that these are finally settled now, and that work on this long delayed sheet may soon be resumed.

The other maps dealt with have been those of Bengal, Assam, Central India Agency, Central Provinces, Madras and Rájputána. Considerable progress has been made with the map of the Punjab on the 32-mile scale.

But little work has been done on the new map of India on the 32-mile scale. The projections of sheets 8, 11 and 12 have been completed, and the degree figures cut, while corrections on a matrix of sheets 7 have been completed. On sheets 1 and 3 of the old plate a considerable amount of additions to railways and names has been cut.

Sheets 1 and 2 of the duplicate 64-mile India have been in hand. Unfortunately a considerable amount of revision from new surveys was required on them and this has delayed them, but as much final material is now ready for them work upon them should now progress steadily. Other maps of India on the 80-mile (Railway map) 96-mile, 128 (Outline) and 256-mile scales have all been in hand for large additions and corrections. The last should be ready very soon.

The new 192-mile skeleton Map of India has had the title and graticule cut, and work on the outline will begin at once.

The new engraved map of Calcutta on the scale 6 inches = 1 mile has made satisfactory progress, most of the outline having been cut. Sheets 3 and 4 are still in hand.

Eight of the Provincial Index Map plates have been corrected and brought up to date.

Five of the plates of the new  $\frac{1}{1,000,000}$  map have been projected and had the degree figures cut, and work will be commenced upon them on receipt of material from the Drawing Office.

As usual a considerable amount of work for outside departments and miscellaneous jobs have been done such as Commission Forms, Weather Report plates, scales, etc. Forty-eight plates have had corrections filled in by electro deposition with most satisfactory results. The copper-plate printing section pulled 26,054 impressions, again an increase on last year's outturn, but this is largely due to the smaller size of many of the sheets dealt with. Fifteen transfers from the copper-plates have been sent to the Photo-Litho. Office so that Atlas Sheets which the Engraving Office could not issue might be printed from stone. No less than 134 Atlas Sheets are still out of print, and until the new presses are received from home there seems to be no chance of the office being able to keep pace with orders.

58. *Photographic and Lithographic Office.*—This office remained in the charge of Mr. T. A. Pope, Assistant Surveyor-General, throughout the year. The very large outturn recorded last year has been exceeded during the year under report, the number of copies of maps, plans and other subjects reproduced by lithography and photozincography being again greater than in any previous year. There was a very considerable increase in the amount of work done for the Survey of India, and a corresponding decrease in the amount done for other departments. As the latter class of work has of late years increased to such an extent as to seriously interfere with the reproduction of departmental mapping which should be the first and most important duty of the office, this reduction in the quantity of work received from outside, enabling the office staff to be employed to a larger extent on departmental work, is an important and satisfactory feature in the year's operations. Excluding cadastral maps, the number of copies of departmental maps printed during the year was 251,025, or 58,559 more than last year. Of cadastral maps, 270,871 copies were printed, or 17,876 more than last year. This large cadastral outturn is due to the fact that the reproduction of the Bengal maps, which it was expected would cease in April 1902, was continued till September, as the Bengal Drawing Office was not in a position to take it over till then. Urgent demands were also made by the Burma Government for an increase in the rate of supply of their cadastral maps, and a small addition to the printing establishment was sanctioned by the Government of India up to the close of the current financial year, in order to effect this. The number of subjects sent in for reproduction by other departments was 1,060, or only about half the number received last year; while the number of copies printed was 632,233, or 76,122 less. The aggregate outturn of the lithographic machines and presses reached the large figure of 1,154,129 printed copies, which is practically the same as last year, when it amounted to 1,153,816.

Less work was done in the Type-printing Section, the total number of pages set up being 12,443, as against 14,002 last year and of copies printed, 976,968, as against 984,189. In the Silver-printing Section also the outturn was less, there having been smaller demands for the class of work carried on in the Section than usual. In the Heliogravure Section a large increase is recorded, the number of plates photo-etched amounting to 157, or 42 more than last year, while the number of copies printed from photogravure plates reached the large total of 88,070, or 29,288 more than last year. This is considerably the largest outturn yet recorded for the Section, and it was attained without any increase to the staff or printing power employed.

The following are the principal items of work on which the office was engaged during the year:—

In the Lithographic Branch, considerable progress was made with the new 32-mile map of India, with hills, in six sheets, referred to in paragraph 58 of last year's Report. Five of the six sheets are now completed in outline, and of these, sheets Nos. 3, 4, 5 and 6 were done during the past year. The hills, which are being drawn in chalk on stone, were completed for two sheets, and a third hill stone is now in progress. The Railway and Canal map of India, on the 32-mile scale, referred to in last year's report as being almost ready for publica-



tion, was completed and printed off in March 1902. A Telegraph map of India, on the 32-mile scale, has been in progress throughout the year; proofs of two of the six sheets were submitted to the Director General of Telegraphs for approval, and two others were in hand at its close. A map of India showing the Railway Mail Service system, on the 32-mile scale, was drawn on stone during the year in black and eleven colours; proofs were submitted and these have since been returned with correction and press order. Work on the new Military map of India, on the 32-mile scale, which has been in hand since February 1899, was stopped at the request of the Quarter Master General in India, and an entirely new map has been put in hand to take its place. In this, the outline stones prepared for the railway and canal map are being utilised instead of old and worn-out stones of the old 32-mile map, and the military information is being shown in red. Six small maps of India were prepared for the Report of the Census Commissioner in India. A map of the Punjab and Kashmir, on the 16-mile scale, was put in hand and proof of one of the four sheets was submitted. An Irrigation map of the United Provinces of Agra and Oudh, on the 8-mile scale, was put in hand for lithography; two sheets are in progress and one remains to be taken up. About 40 district maps have been dealt with during the year; proofs of 14 of these were submitted, and several have been returned with corrections which are now in hand.

59. In the Photographic Branch, a map of Afghánistán, on the 16-mile scale, in four sections, with hills in brown, was photozincographed and 1,000 copies were printed off for the Quarter Master General. A Postal map of Rangoon, on the scale of 1 inch to 1,000 feet, was photozincographed for the Rangoon postal authorities and printed off. A Route map of the Bengal and Punjab Commands was photozincographed for the military authorities and 1600 copies supplied. For the Marwar State, a map of Marwar in *Deb Nagri*, in eight sections, was photozincographed in five colours and 1,000 copies supplied. Manceuvre maps on various scales of the country round Meerut, Bareilly, Fyzabad, Nágpur, Maymyo, Mandalay, Jhánsi, Secunderabad, Neemuch, Mhow, Nasirabad, Umballa, Calcutta, Shwebo and Benares were prepared for the military authorities. Of City and Cantonment maps, a map of Aijal station, on the 24-inch scale, and of the city, civil station and environs of Cawnpore, on the 12-inch scale, in 15 sheets, were also photozincographed and printed off. Five Census maps, in colours, of Assam, and three each of Balúchistán, Bengal and the Central Provinces were photozincographed and 1,000 copies of each printed for the Census Commissioners of those Provinces. A considerable number of sheets of the Madras forest surveys were reproduced and printed off. Four hundred and twenty five standard sheets of the Topographical and Revenue Surveys on various scales were either reproduced as new publications or reprinted during the year.

60. The arrival in February 1902 of the new camera, intended for the reproduction of standard sheets and other large maps in one reversed negative, as described in paragraph 59 of last year's Report, enabled the Office to introduce a very important change in the methods in use of dealing with such maps. The old process by which standard sheets were photographed in two or more sections, the negatives being afterwards printed separately on carbon transfers to be joined together before being transferred to zinc, has now been practically abandoned. This method, which has been in use for many years, had serious disadvantages: it was not only troublesome and slow, but it gave inferior results and rendered the registration of colour work practically difficult. By taking the whole map in one reversed negative and printing it direct upon the zinc all these disadvantages have been removed; work is turned out more quickly and the results are sharper and free from distortion. The method, now known as Heliozincography, by which the reversed negative is printed direct upon the zinc was worked out in the Office, is entirely novel, and is a decided improvement on any of the older methods. A full description of it is given in the separately printed Extracts from the Annual Reports of the Survey of India.

61. During the year another important change was brought gradually into effect by the substitution of the new Vandyke process for photozincography for the reproduction of the regular cadastral work of the department. The success which has attended the employment of this method for the reproduction of the Bengal cadastral maps led to its being utilised for the Burma sheets also, and

these are now being traced in the field party office for the purpose. The results have given entire satisfaction. The rates are much lower than the old cadastral rates, and the copies are despatched with less delay than formerly. At the close of the year a large number of sheets which had previously been prepared for photozincography, and were therefore unsuited for the Vandyke process, remained to be dealt with, but these will be cleared off by the middle of February 1903. After that time no more cadastral maps will be reproduced by photozincography and consequently a reduction in the strength of the Negative Section, on the cadastral side, will take place. In this connection Mr. Pope points out that it will not be advisable to effect any large reduction of the Office establishment generally, as it is becoming urgently necessary to increase the staff of Lithographic draftsmen, work being seriously delayed by the insufficiency of drawing power. The want of a small number of additional posts in the lowest grade of the fourth division is also seriously felt, as at present no means exists of providing for the proper training of printers and machinemen. Proposals will therefore be made early next year for a rearrangement of the posts in this Office with the view of rectifying these defects.

62. In September 1902 Mr. Pope submitted a proposal for the substitution of electric motors for steam power for driving the printing and other machines. As the engine which is now in use is showing signs of wearing out, and has already caused much inconvenience by breaking down on more than one occasion, a new engine would in any case be required ere long. There is much to recommend the suggested change. Electricity, when used under the conditions which obtain in this Office, is slightly more economical than steam power, though its installation would cost somewhat more than the erection of a new engine. The great advantage would lie in the fact that each machine, having its own motor, would be independent of the rest and could be switched on and off whenever required, and consequently there would be no waste of power when it was not running or liability to a general breakdown and consequent stoppage of work. Further advantage would be gained by doing away with the shafting and belting, and with the nuisance caused by the smoke from the Office chimney. The sanction of the Government for the new installation will shortly be applied for.

63. *Map Record and Issue Office.*—Work in the Map Record and Issue Office has, as usual, been unceasing and with difficulty coped with. The staff sadly requires augmenting, and until this is done delays in the supply of maps, records, etc., must be anticipated. The staff must now habitually work overtime to comply with demands.

64. Two hundred and seventy thousand, two hundred and four maps of an aggregate cost of Rs. 3,07,905 were issued during the year. Of this sum Rs. 1,4,438 were realized from private sales. The number of new maps received for publication was 3,267, of which 3,072 were cadastral sheets. Besides these 4,089 original volumes of records, maps, etc., were issued from the office to other branches of the department and 1,118 were returned back into store.

65. Apart from the question of space available for them, the accumulation of maps of all kinds is becoming a serious matter. If all our sheets could only be published in standard form a great clearance would at once be effected. The old system of surveying country by *parganas* or main circuits or even by districts was a most fatal one for storage purposes. It often happens that to furnish the area comprised in one standard sheet, three or four sheets and often more of these fragmentary surveys have to be hunted out and supplied, and the searching for and joining up these complementary sheets, means an immense amount of labour for our already insufficient staff, which the public, irritated over delay in supply, cannot understand.

66. The work of clearing out the accumulated bundles of maps from the roof spaces has been carried on throughout the year. Five new racks containing 180 double shelves were constructed by the Public Works Department in a vacant space, and in these five copies of each of 1,789 non-departmental maps or old editions have been put away after being flattened out, numbered and checked with the register. The sheets so dealt with are those of the Punjab, Rájputána and the United Provinces; and constitute about a third of the total stock. Thirty-nine shelves were built departmentally and in these the five stock copies of each of such of the Forest Survey large scale maps which have been

sorted out, have been stored by provinces, and they will be kept thus separately in future.

67. The most satisfactory task accomplished has been the reconstruction of the almirahs for the storage of our original sheets. Built originally of dimensions suitable for the old main circuit maps, sheets of the modern standard size or larger could only be inserted after folding; a practice which has been found to have irretrievably damaged a good many. Entire reconstruction was found necessary, the old material being used as far as possible. Could the whole room have been dismantled at once and rebuilt afresh the business would have been more satisfactory, but as only two racks could be dealt with at a time, defects exist which might under better conditions have been avoided. Though the racks are larger, there has been no loss of storage room. The racks, formerly open at the back, have been closed in, as is evident had formerly been the case, and apparently been found unsatisfactory; whether this will again have a detrimental effect on the paper remains to be seen, but it is a choice of evils, as open—in spite of poisons and disinfectants—rats, cockroaches, etc., were found to have ruined many sheets. The doors are continually opened during office hours to allow of ventilation, and no evil results are apparent so far. The only effective preventive of the inroads of vermin among such perishable materials seems to be constant inspection.

68. The Government of India having decided that cadastral originals after publication are to be in future stored at the head-quarters of Provinces, the sheets of five districts of Burma (Sagaing, Toungoo, Magwe, Pegu, Meiktila) and one of the Central Provinces (Raipur) with their connected area statements have been despatched from this office. In addition, the area statements have been sent of Prome and Biláspur; the cadastral sheets of the last district being already with the local authorities. Further consignments will be sent as soon as sheets can be checked and invoiced, but as no extra staff is sanctioned for this extra work, some time must elapse before all can be despatched from the office.

69. In the *Mathematical Instrument Office* this year was especially noticeable for the introduction of the piecework system in the workshops, and for greater freedom in the management of the budget allotments. Sanction for these reforms was granted in Government of India letter No. 1621—34-2, dated 17th July 1901, from Revenue and Agricultural Department. Captain E. A. Tandy, R.E., was placed on special duty and posted to the charge of the Mathematical Instrument Office in order to carry out the changes and reforms incidental to the introduction of the new system.

70. Piecework was only commenced at the close of 1901, and had to be very gradually introduced, so that it was far from being thoroughly established by the close of the financial year in March 1902. Notwithstanding this it resulted in an immediate increase of outturn in the workshops; while the freedom to engage the requisite additional staff enabled the whole of the serviceable stores to be rearranged and put into proper order; it is hoped that they may never again be allowed to relapse into their previous state of confusion, which was due to the staff having been for a long time very much undermanned.

71. Arrangements were also made for indenting piecemeal on the India Office for European stores; that is to say, small indents can now be sent in from time to time, instead of the whole allotment being expended in a single indent at the beginning of the year. By this means the indents can be more easily adjusted to meet the varying requirements of the year, and a great deal of hurried local purchase of European stores at the last moment can be avoided.

72. By observing careful economy in this respect and by relying on the increased efficiency of the workshops under the new system, the amount spent on the local purchase of European stores was reduced to R17,793 as compared with R36,024 in the year before, the latter sum being itself rather less than what was spent under this head in previous years.

73. It is most desirable that the whole of such savings should be expended, in accordance with Government sanction, in renovating the large store of repairable instruments, so as to enable them to be reissued in place of buying new ones; but the piecework system was commenced very late in the year, and the full capacity of the workshops could not be economically developed in a moment. However, although the workshop outturn was in every respect much

increased, and in spite of the extraordinary expenditure involved in reorganizing the stores, a nett saving of ₹11,319 was effected on the year's budget.

74. Towards the close of the year the arrangements for sorting and registering the office correspondence were remodelled to meet the necessities of the great increase of work in all directions which has occurred in recent years, and definite arrangements were made for carrying on the work of receiving, packing, despatching, etc., on a more orderly and expeditious system from the 1st April 1902. The results of these alterations have so far proved most satisfactory.

75. The book value of the serviceable stores in hand at the end of the year was ₹5,13,547 as compared with ₹5,36,053 at the end of the previous year. That of repairable stores was ₹2,30,155, or 11,056 less than in the previous year. A reduction in both these items is most satisfactory, as the former store is in many respects overstocked, while the latter has attained almost unmanageable dimensions in the past, owing to the inability of the workshops to cope with it. The decrease in the latter store is especially creditable as there was a very large increase in the value of instruments deposited by public officers; the value for the year under report being ₹73,146 as compared with ₹49,718. If it had not been for the introduction of the piecework system it would not have been possible to cope with this large inflow of discarded instruments, and the repairable store would have been still further increased, instead of reduced, as a result of the year's working.

76. There was an increased expenditure in the workshops of about ₹5,000 in labour and ₹5,500 in material; but as a set-off against this increase of expenditure there was an increase in the workshop turn-out of nearly six thousand rupees in manufactures and ten thousand in repairs for store; and the large saving on local purchases noted above was made possible. The outside repair work done for public officers was valued at ₹29,333, which is slightly less than last year.

Since the close of the financial year on the 31st March this development has much increased, and a still more satisfactory statement of the results of the piecework system may be confidently expected at the close of the current year.

77. There was an increase of about ten thousand in the number of instruments issued during the year; the total value being ₹2,84,719 as compared with ₹2,77,715 in the previous year.

78. Considering the all-round increase of work, there was a satisfactory decrease in the number of instruments indented for from the India Office, the total value being ₹4,262. Charges of this kind do not altogether lie in the hands of the management as they depend largely on the demands of outside departments which have to be met; but it is satisfactory to find that every effort is being made to reduce them to a minimum.

79. This piecemeal method of examining results can give no more than a vague idea of the year's progress, but it is the only one available under the present system. It is hoped that arrangements may be made for exhibiting the results of the management more clearly by bringing all figures together into a brief profit and loss statement. At present the profit and loss account is made out for the workshops alone. This is necessarily a somewhat artificial arrangement and has been found to have grave defects as a means of indicating the real state of affairs. The workshop outturn for the year has already been shown to have developed very considerably, and the profit and loss account shows gross credits of ₹1,09,875 and a loss of ₹1,303, compared with a profit of ₹552 and gross credits of ₹97,205 in the previous year.

80. The Surveyor-General wishes to acknowledge his great indebtedness to Captain Tandy for the energy and ability he has displayed in reorganising this office and its work, and also to the Mathematical Instrument-maker and Assistant Mathematical Instrument-maker Messrs. Theakston and Ferrier for their whole-hearted zeal in introducing the new system. The change of method has entailed very hard work on them, but they have cheerfully taken it in hand and devoted their whole energies to make it a success.

#### BRANCH OFFICES.

81. The Trigonometrical Branch was under Major S. G. Burrard, R.E., Superintendent, Trigonometrical Surveys, up to 1st February, when he was

appointed to officiate as Deputy Surveyor-General, Revenue Branch. He made over charge of his duties to Mr. J. Eccles, M.A., who continued in office to the end of the year. Mr. McA'Fee held charge of the technical offices up to the 1st December, when Mr. Eccles, on return from furlough, took over charge and continued in office up to 1st February, when he was relieved by Lieutenant F. B. Tillard, R.E. Mr. McA'Fee on return from leave on the 3rd April relieved Lieutenant Tillard, R.E., and continued in charge to the close of the year. Two Professional Papers, No. 5, "The Attraction of the Himalaya mountains on the plumb line in India," and No. 2 of 1902, "Account of a determination of the co-efficients of expansion of the wires of the Jäderin Base-line Apparatus," were printed and issued. Professional Volume XVI, "Details of tidal observations taken during the period from 1873 to 1892 and a description of the method of reduction," Synoptical Volume XXIX, "Great Arc Meridional series section 8° to 18°," and Addendum to Synoptical Volume XXXIII, "Cutch Coast series," were published and issued. Professional Volume XVII, "Electro-Telegraphic Longitude Operations, executed during the years 1894 to 1896," is now in the hands of the binder and will shortly be issued. The usual routine of map publication was carried on in the Photozincographic section, the greater part of the work consisting of reproduction of maps for the Forest Department and standard maps. The usual meteorological observations were continued and photographs of the sun taken on every day that the sun was visible. In the drawing section a special set of maps of the country surveyed under Dr. Stein in Central Asia was prepared. At the urgent request of the Punjab Government, district maps of Kángra and Kullu have been put in hand, but owing to the small staff of draftsmen, this has necessitated the putting aside of other important work, such as the level charts and the sheets of the map of India on the 1—1,000,000 scale. As these exceptional demands are nearing completion, it is hoped that the regular work of the section will soon be resumed. Three officers of the Imperial Service, Lieutenants F. B. Tillard, R.E., R. H. Thomas, R.E., and L. C. Thuillier, I.A., went through a practical course of trigonometrical, topographical, and astronomical work, and seven sub-assistant superintendents of the Provincial Service were put through a course of topographical surveying, levelling and mapping.

82. 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 working plans and other special maps, and the up-keep of the map records of the Forest Department. During the year 284 maps have been sent to press and 208 have been published, including 10 working plans and other special maps. On the 30th September over 400 maps were in different stages of progress and 178 were in press. Four thousand seven hundred and four printed maps have been distributed, of which 3,219 were coloured and 2,053 were mounted in book form.

The inconvenience and unsuitability of the present Forest Survey office having been brought to notice, Government has sanctioned the erection of a suitable fire-proof building in the compound of the Great Trigonometrical Survey office at Dehra Dún as a permanent office for the Forest Survey Branch and for storing the rapidly increasing maps and records. When the building is ready, it is proposed that the custody and issue of all forest survey maps should be in charge of the Superintendent, Forest Surveys: this should form a considerable relief to the already congested condition of the Map Record and Issue Office at Calcutta.

83. The *North-West Frontier Drawing Office*.—Under the superintendence of the officer in charge No. 15 Party this office was employed as usual at Mussooree on trans-frontier compilation and a certain amount of miscellaneous work for the Intelligence Department. A commencement has also been made with the compilation of the frontier sheets of the new map of "India and Adjacent countries" on the scale of  $\frac{1}{1,000,000}$ . Six sheets of this are in hand, some of them being nearly completed. A good deal of trouble is experienced in making an intelligible reduction of the intricate hills which are surveyed in full detail on the larger scale maps.

## LOCAL DRAWING OFFICES.

84. These have been established for the purpose of compiling one-inch topographical maps from the cadastral surveys that have recently been carried out in various Provinces.

In the United Provinces one is located at Naini Tal, one in Bengal at Calcutta, and one in Assam at Shillong, all in charge of the Superintendents of Provincial surveys in those Provinces.

The maps so obtained are published as preliminary editions and require revision in the field and completion of topography when establishments for the purpose are forthcoming.

Similar drawing establishments exist in the Punjab, and Central Provinces where revision surveys are in progress, these establishments being integral portions of the parties carrying out the revision surveys. The cadastral surveys by local agency are reduced by pantagraph to the 2-inch scale on to plane-table sections, which are then tested in the field, and all topographical details omitted by the local surveys are filled in and completed for the standard maps. The outturns of these drawing offices are detailed in the reports in Part II.

The drawing offices for the compilation of geographical maps on the North-Western and North-Eastern Frontiers of India and Burma were employed as usual at Mussooree and Bangalore.

## ESTABLISHMENT.

85. During the year under report the Department has lost the services of one officer of the Imperial Service.

Mr. A. E. Spring, Deputy Superintendent, 1st grade, died at St. Kilda, Australia, on the 2nd September. Prior to his appointment in the Survey of India Mr. Spring was attached to the Bombay Revenue Survey from August 1881 to February 1891. On joining this Department he was posted to Burma, where he was attached to and held charge of Revenue Survey operations there. His health having broken down he was attached to the Head-Quarters Offices from 1896.

86. In the Provincial Service the Department has lost the services of seven officers during the year, *viz.*, by the retirement of Messrs. W. Stotesbury, R. B. Smart, J. Connor, A. J. James, G. W. Jarbo and Munshi Yusuf Sharif, Khan Bahadur, and by the death of Mr. J. Murphy.

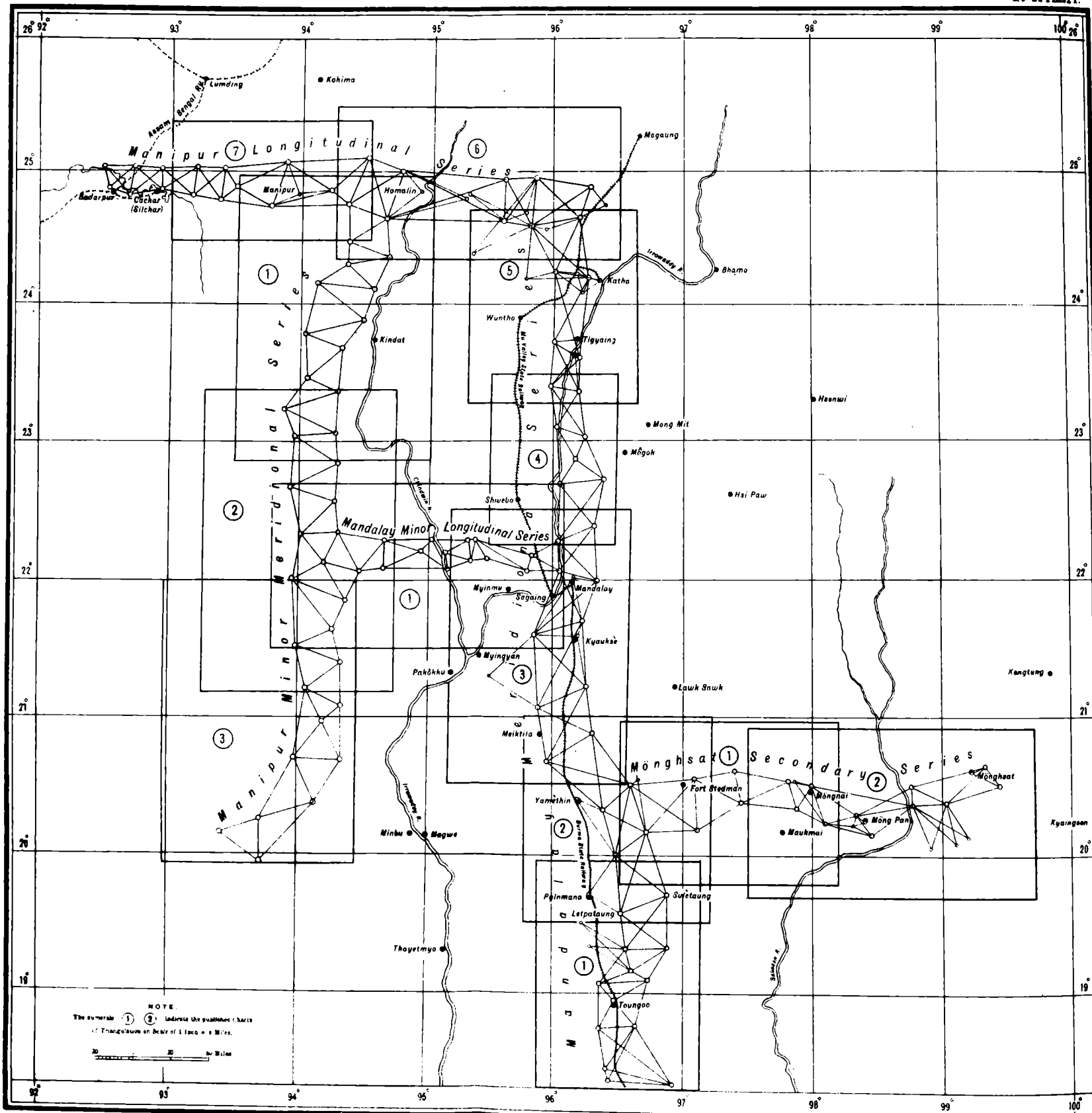


INDEX TO THE CHARTS OF THE PRINCIPAL TRIANGULATION

OF THE

MANDALAY MERIDIONAL AND LONGITUDINAL AND MANIPUR MERIDIONAL AND LONGITUDINAL SERIES.

No. 24 PART.







## PART II.

### THE OPERATIONS OF THE SEVERAL FIELD PARTIES.

#### TRIGONOMETRICAL SURVEYS.

##### INDIA TRIANGULATION.

###### NO. 24 PARTY.

87. The party remained under the charge of Lieutenant H. Wood, R.E., except from 19th May to 19th July, when he was on examination leave, during which period Lieutenant H. McC. Cowie, R.E., held charge.

88. The party left recess quarters at Mussooree on October 14th and reached Pakòkku, Upper Burma, on November 10th. The programme for the season was to complete the Manipur Minor Meridional series and to close it on to two stations of the Burma Coast series.

89. Observations did not begin till December 2nd owing to the distance of some of the stations from Pakòkku, but the work was, after several delays, satisfactorily completed on March 8th. The mean difference between the 2 values of the closing stations are  $0''\cdot186$  in latitude  $0''\cdot200$  in longitude and  $6''\cdot137$  in azimuth. Considerable difficulty was experienced in crossing the Kyaukpyu Yomas owing to the absence of inhabitants and paths. About 1,000 square miles of hitherto unsurveyed country was sketched on the  $\frac{1}{4}$ -inch scale by Lieutenant Wood.

90. The party reassembled at Akyab and, proceeding *via* Calcutta, reached recess quarters in Mussooree, where the office reopened on 14th April 1902.

91. Messrs. Troughton and Simms' 12-inch Theodolite No. III was employed and measures were taken, as in previous seasons, on 4 zeros.

The season's outturn of work was as follows:—

###### *Minor Triangulation.*

Number of stations newly fixed . . . . .	10
Number of figures completed . . . . .	10
Length of series completed in miles . . . . .	148
Area of triangulation in square miles . . . . .	2,800

The mean triangular error, was  $1''\cdot62$ .

92. The Superintendent, Trigonometrical Surveys, inspected the party in recess quarters on 12th September 1902.

#### TOPOGRAPHICAL SURVEYS.

##### LOWER BURMA.

###### NO. 3 PARTY.

93. Mr. Litchfield remained throughout the year in charge of this party, which left recess quarters at Bangalore on the 1st November, and commenced work in Burma between the 15th and 20th idem. The field season was closed on the 20th May and the office opened at Bangalore on the 6th of June 1902. The party was divided into four camps: the head-quarters camp at Prome, camp No. I in the Pegu and Hanthawaddy districts, camp No. II in the Thayetmyo district, and camp No. III in the Toungoo district, each under a Provincial officer.

94. The programme of work for the season comprised—

- (a) The triangulation of parts of standard sheets Nos. 75, 76, 113, 204 and the whole of 157.
- (b) The detail survey on the 1-inch scale of the unsurveyed areas of sheets 115, 159, 206, 207 and, if possible, 164.
- (c) The detail survey on the 2-inch scale of the unsurveyed areas in sheets 253, 254, 255, 261 and 262.
- (d) The revision of the cadastrally surveyed areas in sheets 253, 254, 255 and 262.

With the exception of the triangulation under (a) and the topography of a part of sheet 206 under (b) this programme was adhered to and successfully accomplished. As it was possible and more convenient to survey the areas in sheets 253, 254 and 255 on the 1-inch scale, this scale was adopted instead of the 2-inch as originally proposed. The triangulation under (a), not being urgent, was abandoned in favour of that required for the revision of the cadastrally surveyed areas of sheets 253, 254, 255 and 262.

A certain amount of traversing not included in the programme was also undertaken in these sheets.

95. The outturn for the field season is as follows:—

	Sq. miles.
Detail survey on the 1-inch scale . . . . .	1,905
Revision " " " . . . . .	1,048
Detail " 2-inch " . . . . .	350
Triangulation for revision survey . . . . .	1,530
Traversing { square miles . . . . .	141
{ linear miles . . . . .	65

This outturn compares favourably with that of previous seasons and excluding the revision survey of 1,048 square miles is over 1,000 square miles in excess of that of last year.

In the area topographically revised a few traverse stations (village trijunctions) *pagodas*, etc., in each sheet were trigonometrically fixed to check their positions geographically and to provide heights; some new roads, forest boundaries and hills were added, and the revision or supplementary surveys of the Land Records Department in progress at the time, were utilised.

The spelling of the names in both the field sheets and published sheets was corrected by the Translator to Government in the Burma Secretariat, an arrangement made by the Director of Land Records,

The completion of standard sheets 259, 260, 261 and 262 brings the 2-inch surveys to a close and, in future, the remainder of the country will be surveyed on the 1-inch scale.

96. The total expenditure of the party is ₹90,184 and the cost-rates per square mile are as follows:—

	₹
Detail survey on the 1-inch scale . . . . .	26.8
" " 2-inch " . . . . .	72.5
Triangulation for revision survey . . . . .	5.5
Traversing for 2-inch and 1-inch survey . . . . .	37.3

It is not possible, if the triangulation be excepted, to work out a rate for the revision survey as this work was undertaken by various men at odd times during the progress of their other work, and much assistance was given by the Land Records Department in localities in which their revision survey was in progress. The triangulation, with the exception of about 170 square miles, was undertaken only for the revision survey. Its cost, ₹5.5 per square mile, may therefore be debited to this survey.

The cost-rates are comparatively low, and are nearly half of those of last year, while the total expenditure exceeds that of last year by only ₹300. But in considering cost-rates in Burma, particularly in Lower Burma, it should always be remembered that the conditions under which work is carried on are very unfavourable, and that interpolation and sketching with the plane-table, generally possible elsewhere, are here nearly always impossible.

97. The season on the whole was a healthy one, and most of the country worked over, as expected, was comparatively dry and healthy. The establish-

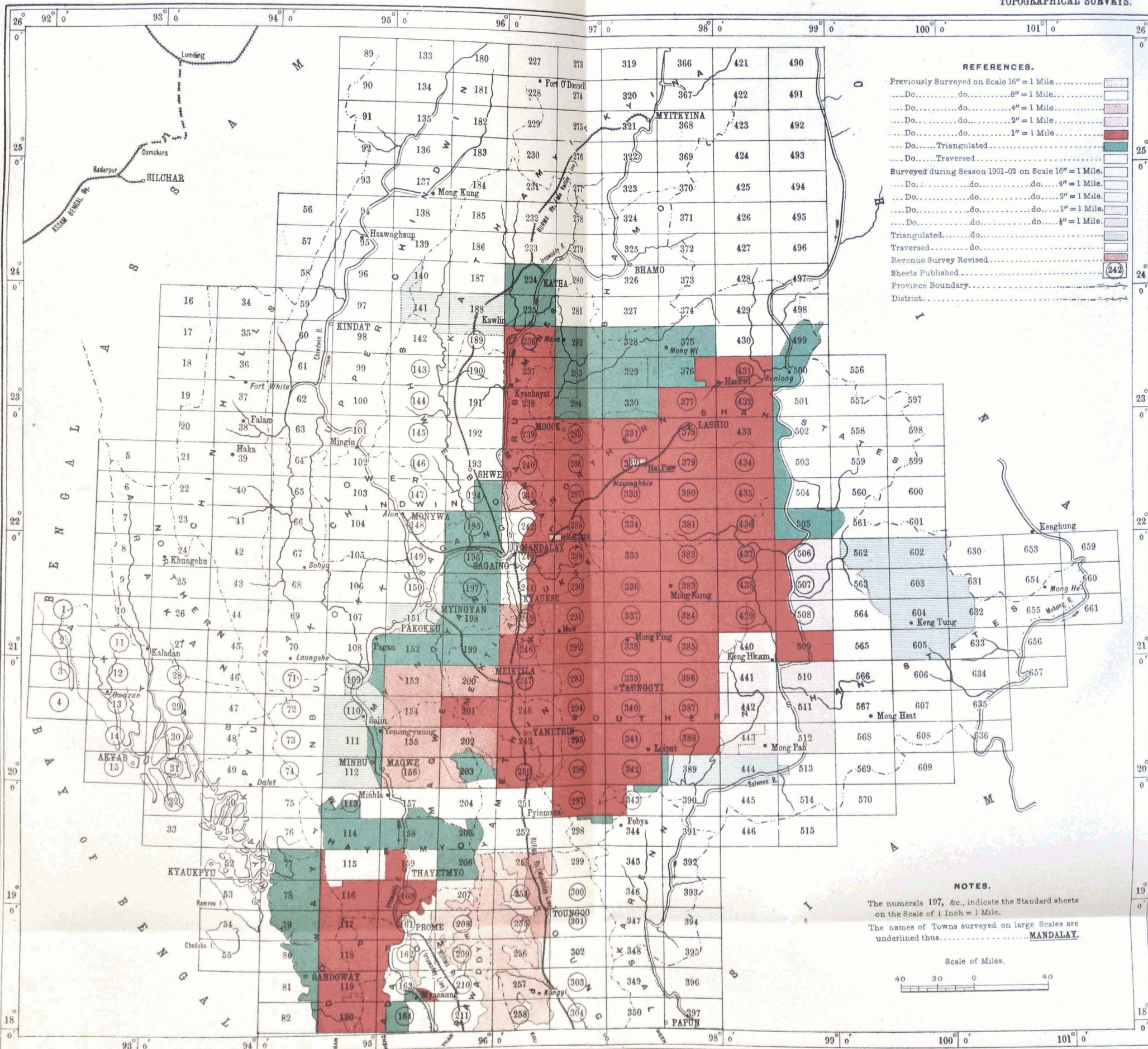


# BURMA SURVEY.

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

1901 02.

TOPOGRAPHICAL SURVEYS.



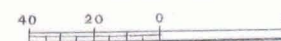
### REFERENCES.

- Previously Surveyed on Scale 16" = 1 Mile
- Do. do. do. 8" = 1 Mile
- Do. do. do. 4" = 1 Mile
- Do. do. do. 2" = 1 Mile
- Do. do. do. 1" = 1 Mile
- Do. do. do. 1/2" = 1 Mile
- Do. do. do. 1/4" = 1 Mile
- Triangulated
- Traversed
- Surveyed during Season 1901-02 on Scale 16" = 1 Mile
- Do. do. do. 8" = 1 Mile
- Do. do. do. 4" = 1 Mile
- Do. do. do. 2" = 1 Mile
- Do. do. do. 1" = 1 Mile
- Do. do. do. 1/2" = 1 Mile
- Do. do. do. 1/4" = 1 Mile
- Triangulated
- Traversed
- Revenue Survey Revised
- Sheets Published
- Province Boundary
- District

### NOTES.

The numerals 107, &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.

Scale of Miles.

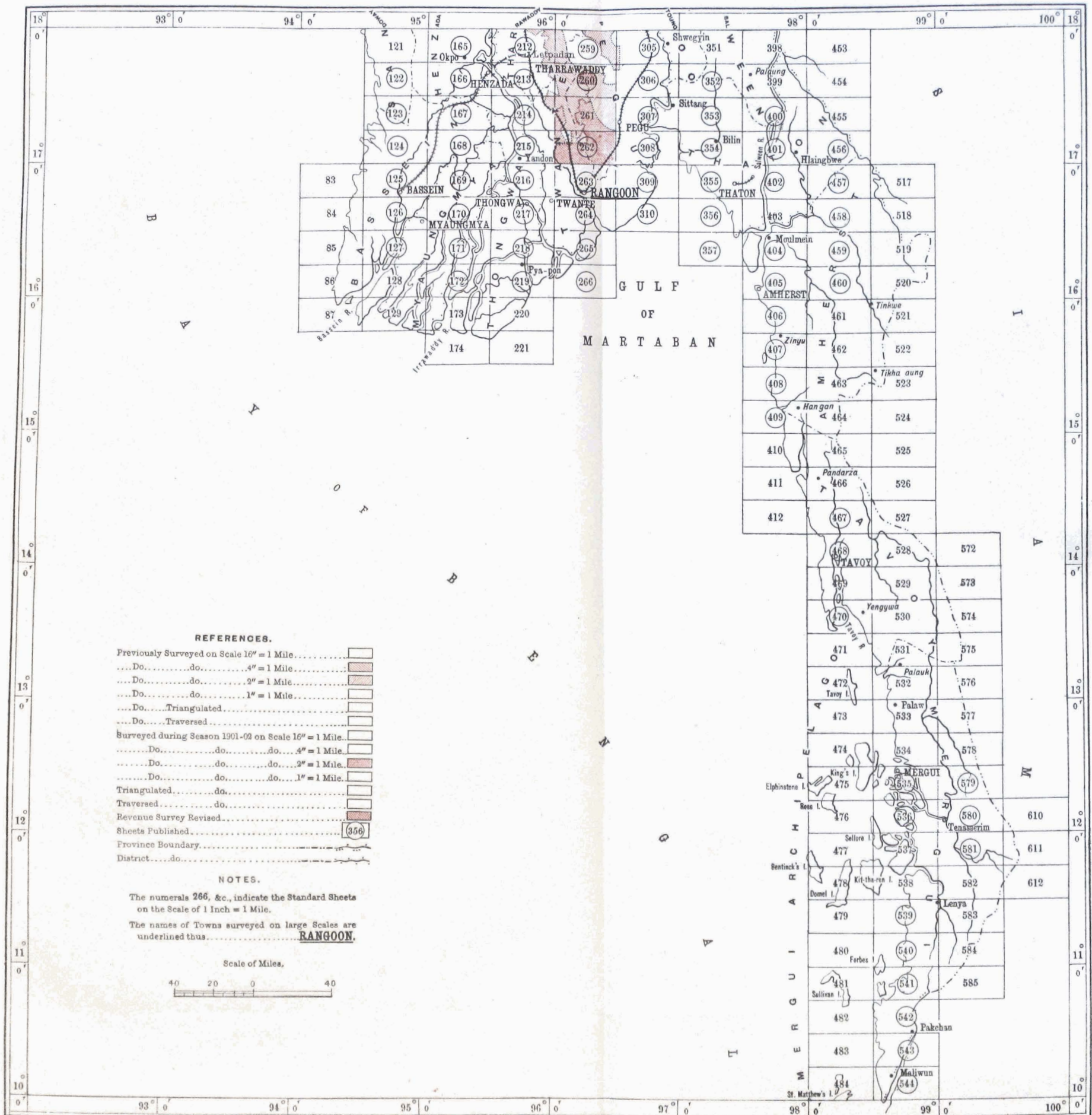


# BURMA SURVEY.

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

1901-02.

TOPOGRAPHICAL SURVEYS.



### REFERENCES.

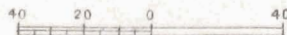
Previously Surveyed on Scale 16" = 1 Mile.....	
.....Do.....do.....do.....4" = 1 Mile.....	
.....Do.....do.....do.....2" = 1 Mile.....	
.....Do.....do.....do.....1" = 1 Mile.....	
.....Do.....Triangulated.....	
.....Do.....Traversed.....	
Surveyed during Season 1901-02 on Scale 16" = 1 Mile.....	
.....Do.....do.....do.....4" = 1 Mile.....	
.....Do.....do.....do.....2" = 1 Mile.....	
.....Do.....do.....do.....1" = 1 Mile.....	
Triangulated.....do.....	
Traversed.....do.....	
Revenue Survey Revised.....	
Sheets Published.....	
Province Boundary.....	
District.....do.....	

### NOTES.

The numerals 266, &c., indicate the Standard Sheets on the Scale of 1 Inch = 1 Mile.

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

Scale of Miles.





ment suffered somewhat in the early part of the season particularly in Wanetchoung in the Hanthawaddy district, in the Mindôn Valley of Thayetmyo district and in the Toungoo district. From Wanetchoung one of the sub-surveyors was sent back to India early in January and the party lost his services for the remainder of the season. The Toungoo detachment suffered most; one sub-surveyor was ill throughout the season and all the men were in hospital at one time or another. As proposed in paragraph 89 of last year's report the medical authorities in Lower Burma were consulted with a view to ascertaining the earliest date on which it may be considered safe to take the field. From the replies received it appears that the date both of taking and of closing the field will vary with the locality in which it is proposed to work. Several precautions are recommended such as extra clothing, the use of mosquito nets, boiled drinking water and daily doses of quinine, nearly all of which, in the case of a large establishment widely scattered without close and continuous personal supervision, it is impossible to adopt. Every precaution, however, will be taken to protect the establishment from unnecessary risks. Experience seems to confirm the view that, except perhaps in the dry zone, the health of the party will be good or bad according as the time is late or early at which it takes the field. As a part of the area to be surveyed in 1902-03 is low and swampy it is proposed to take the field this year a month later than usual.

98. In Toungoo district the ground surveyed lies between Latitude  $18^{\circ}47'$ / $19^{\circ}30'$  and Longitude  $96^{\circ}5'$ / $96^{\circ}30'$  and is composed of low hills of an average height of about 700 feet, and the streams, which all contain water, have generally a very gradual fall. It is occupied by a few *Karens* whose chief occupation is that of *taung-ya* (hill cultivation). Their camps consist of a few bamboo huts which are removed every year to the new area to be cleared and cultivated. The deserted areas are immediately overgrown with a dense crop of bamboos. Most of the big trees have been removed or destroyed and are replaced by bamboos on the hills and tall grass on the flat river banks. But there are still fairly large areas of evergreen forest with a close undergrowth of shrubs, cane and creepers. Owing to this and to the quantity of water the climate is moist and unhealthy. Many of the sandstone boulders contain minute fossil shells.

In the Pegu and Hanthawaddy districts the country surveyed lies between latitude  $17^{\circ}21'$ / $17^{\circ}30'$  and longitude  $96^{\circ}0'$ / $96^{\circ}30'$ , and is all hilly except in the valley of the *Nagamoyeik* creek, the banks of which are occupied by several large villages with extensive paddy fields. This creek lower down is known as the *Pazundaung* creek. The average height of hills is about 350 feet above sea level. They are not so thickly wooded as those in last year's work. In the whole area surveyed this year there are only two trigonometrical points owing to the uniform level of the hills. Consequently, as in previous seasons, the contours do not represent any fixed vertical interval. The work is based entirely on the traversing executed by the Revenue Survey and by No. 20 Party supplemented by a little done by this party. As the traversing of the first two parties was done several years ago, most of the stations had disappeared; but a sufficient number were found, by chaining along the old lines (a slow process), to enable the work to be done.

In the Thayetmyo district the area surveyed completed standard sheets 115, 159 and 207 and a little of 206. A description of the country has been given before and need not be repeated. The survey was based partly on traversing done by No. 20 Party, but chiefly on the triangulation executed by this party in 1899-1900.

99. The drawing of the standard sheets has made satisfactory progress this year, but is still in arrears. Sheets 259, 260 and 261, are nearly ready for the press. These have been drawn in one colour for reduction to the 1-inch scale; sheet 262, of which the survey was completed this year, will be compiled and drawn in the Calcutta Drawing Office. Of the Toungoo 1-inch survey, sheet 253 will be drawn and compiled in Calcutta, and sheet 254 is in hand, but it is improbable that it will be completed this year and 255 is not taken in hand. Of the other 1-inch standard sheets 160, 161 and 162 are in the press; 117, 118, 119 and 120 are complete and under examination; 115 and 163 are in hand and will be finished by the end of the recess, 159 too is in hand but will probably not be finished.



100. The programme for 1902-03 is as follows:—

- (a) The triangulation and traversing of the unsurveyed areas in sheets 211 to 215, 164, 165 and 166.
- (b) The detail survey on the 1-inch scale of the unsurveyed areas in sheets 205, 206, 164, 165, 166, 211, 212, 213, 214, 215.
- (c) The topographical revision of the cadastral and provincially surveyed areas in sheets 204, 205, 206, 211 to 215 and 164, 165, 166. This involves a certain amount of triangulation to be undertaken expressly for the revision.

101. The party was inspected in the field by Major Burrard, officiating Deputy Surveyor-General in the Thayetmyo, Prome and Hanthawaddy districts between the 17th and 26th February, and at Bangalore by Major Longe, Officiating Surveyor-General, and Major Bythell, officiating Deputy Surveyor-General, between the 30th August and 4th September. Major Gordon, Superintendent, Forest Surveys, visited the office at the same time.

## UPPER BURMA.

### NO. 10 PARTY.

102. Captain F. W. Pirrie, I.A., was in charge up to the 6th June 1902, when he proceeded on leave and Lieutenant A. A. Mc.Harg, R.E., held charge of the party for the remainder of the year.

103. The party left recess quarters at Bangalore for the field on the 13th November and had all left Mandalay (the field base) for their ground by 24th November 1901.

The survey operations were of the same nature as those carried out in the previous year and consisted in revising the topographical detail on the 1-inch reductions which have been made from cadastral surveys in the Meiktila, Magwe, Myingyan, Yamèthin and Minbu districts and completing the sheets as topographical maps.

The officer in charge and his senior assistants thoroughly tested on the ground the work of the surveyors employed on revision survey.

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

	Square miles.
Triangulation . . . . .	3,842
Revision survey . . . . .	4,100
Maymyo revision survey . . . . .	19.18

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

	R	a.	p.
Triangulation . . . . .	10	12	0
Revision survey . . . . .	14	5	9

105. Triangulation was carried out in the Minbu, Myingyan, Pakòkku, Magwe, Katha and Upper Chindwin districts. The revision survey comprised an area of 4,100 square miles and includes standard sheets 153, 154, 155, 156, 200, and parts of sheets 202, 203, 241, and 245.

Owing to the very intersected and cut-up nature of the country as well as to the very large amount of scrub-jungle, a great deal of care and supervision was necessary in carrying out the work.

106. The area surveyed this year is slightly larger than that of last year, but this is accounted for by the fact that no new detail survey was taken up this year and the whole of the survey was revision work, whereas last year the work was partly new survey and partly revision.

107. On the completion of the work in the field two detachments of four sub-surveyors, each under two Provincial officers, were formed for the purpose of revising and bringing up to date the Maymyo City survey. This was completed in about a month. The party left Maymyo on the 6th June for recess quarters at Bangalore.

108. The health of the party in the field was fair. One soldier-surveyor suffered from fever throughout the field season and had to be sent on 6 months'

sick leave before the party left the field. Two other sub-surveyors were obliged to proceed on 3 and 6 months' sick leave from recess. There were some cases of fever and dysentery among the menials. Three deaths occurred and one man was drowned.

109. During recess the computations of those portions of the triangulation required for next season's work were completed. Standard sheets 153, 154, 155, 156, 200, 201, 248, 296, were completed and sent to Calcutta for publication, while the data for fair drawing standard sheet 241 were sent to the Calcutta Drawing office.

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

The triangulation of standard sheets 145, 146, 149, 150, 192, 193, and 194 and the completion of the secondary series connecting the Great Trigonometrical Mandalay meridional series near Katha with the secondary Great Trigonometrical Manipur meridional series near Kindat for the future extension of topographical triangulation and to provide stations and points for the Forest survey traverses between those Great Trigonometrical series.

As a matter of secondary importance a connection will be made with No. 14 Party's triangulation west of Fort White and other existing triangulation near Kindat.

The detail survey on the 1-inch scale, partly revision and partly new, of sheets 110, 111 and 112, 151, 198 and 199.

111. The party was inspected by the Officiating Surveyor-General during recess.

## UPPER BURMA.

### NOS. 11 AND 21 PARTIES.

112. As was mentioned in last year's report, Nos. 11 and 21 Parties were amalgamated by order of Government, and Mr. P. J. Doran was in charge of the combined parties throughout the year.

113. The party left Bangalore at the end of October, and after some delay reached the scene of operations about the 15th of December, the last man taking up work about the end of that month. They returned by the end of May.

114. The country surveyed in detail on the one-inch scale was that portion of the Southern Shan States situated on the western side of the Salween river lying between latitude 20° 15' and 21° 15'. It was for the most part very hilly and covered with jungle and was fairly populated averaging a village to every 4 miles. The cultivation, mostly *taung-ya* (hill cultivation) producing sufficient for local consumption both in cereals and vegetables. Oranges and limes are plentiful and trade in them is brisk for two or three months of the year.

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

	Sq. miles.
Triangulation for 1-inch scale survey . . . . .	1,489
Detail " survey on the 1-inch scale " . . . . .	3,740
" " " " ½ " " " . . . . .	2,663
" " " " ¼ " " " . . . . .	2,561

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

	R a. p.
Triangulation for 1-inch scale survey . . . . .	10 6 9
" " " ¼ " " " " . . . . .	2 2 8
Detail survey on the 1-inch scale survey . . . . .	23 4 2
" " " ¼ " " " " . . . . .	3 1 4

The area surveyed on the one-inch scale comprises sheets 440 to 443 and the ground to the west of the Salween river in sheets 510 to 512, and on the quarter-inch scale, the ground to the east of the Salween in sheets 506 to 508 and 510 to 512.

The country triangulated for the one-inch scale lying in sheets 389, 443, 444 and 513, in its natural features resembled much the ground surveyed in detail. 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 work, both topography and triangulation, is very satisfactory considering the obstacles and difficulties which had to be overcome.

116. The loss of time owing to the detention for 12 days on account of a suspected case of plague has contributed somewhat to raising the cost which is slightly higher for the one-inch detail survey this year than that of last year.

117. The work was rigidly tested and the men were constantly visited during the season. Difficulties were solved with the surveyors present and their errors shown them on the spot. The work has proved very good.

118. During the recess the party has completed the fair drawing for publication in two colours of all the one-inch work surveyed during the season. 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.

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

119. The following programme has been sanctioned for the coming season:—

Detail one-inch survey of sheets Nos. 389, 444 and the country falling to the east of the Salween river in sheets Nos. 510 to 512.

Triangulation in sheets 513, 567 and 568 and in portions of 569 and 609 up to the Shan-Siam boundary.

120. The party was inspected by the officiating Surveyor-General on 28th and 29th August 1902, who expressed his satisfaction at the state of the work.

## SIND.

### No. 12 PARTY.

121. The operations during the year under report were in continuation of those of the previous season, Mr. C. F. Erskine remaining in charge of the party.

122. The following programme was completed:—

- (a) Net work of secondary triangulation in two blocks, one covering the whole of the desert of the Khairpur State lying west of the Nára river, and the other covering the desert in the Shikárpur district.
- (b) Village boundary traverse survey in portions of sheets Nos. 41, 42, 43, 44, 45 and 46, together with area of about 300 square miles in the Khairpur State, where the village boundaries are not demarcated.
- (c) The detail survey on the 2-inch scale of portions of sheets Nos. 41, 42, 43, 44, 61, 62, 63, 64, 65, 80, 81, 82 and 83.
- (d) The detail survey on  $\frac{1}{2}$ -inch scale of the whole of the desert of the Khairpur State was also completed.

123. The recess office at Kurrachee was closed on the 30th October 1901, and the party assembled at Ránipur on the 5th November.

124. The traversing in British territory consists, as in former years, of a village boundary survey with offsets, and in the Khairpur State, where the village boundaries are undemarcated, of a series of main and sub-circuits divided into blocks by connecting lines. There were  $7\frac{1}{2}$  main circuits measured, 9 sub-circuits and 334 village circuits.

The angular work was checked by observations for azimuth at 60 stations on main and sub-circuits, the average angular error per station being '34". The linear measurements amounted to 2,125 miles, and were checked by 17 connections with the stations of the minor triangulation executed by this party and with some stations of the Sehwan secondary series.

The average correction per 1,000 links was 0.4 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 village boundaries have been fixed by offsets. In addition to the foregoing traverse operations 34 bench marks laid down by the Railway Department were

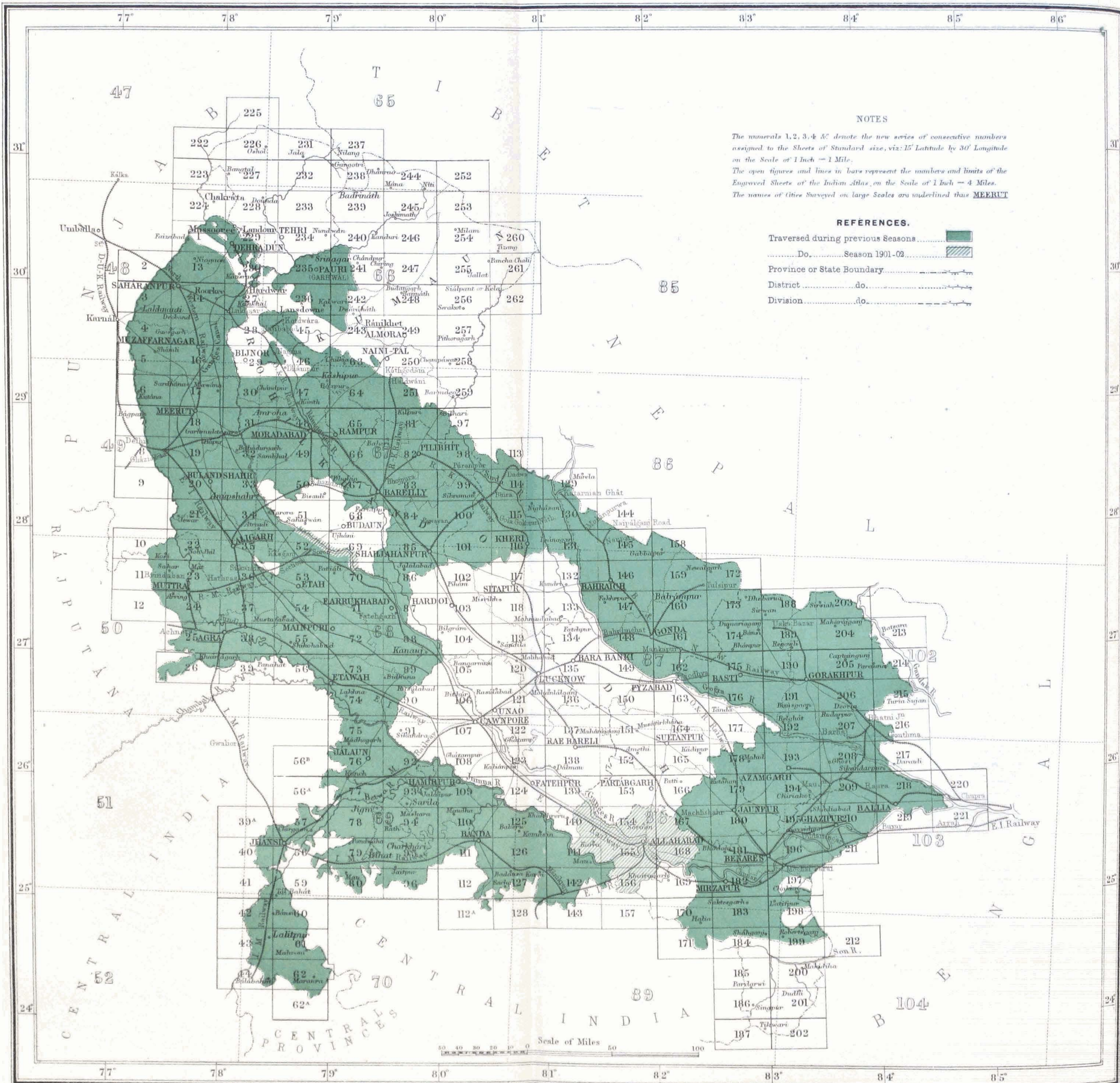


# UNITED PROVINCES OF AGRA & OUDH.

1901-02.

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

Nos. 2 & 8 & 14 PARTIES.



### NOTES

The numerals 1, 2, 3, 4 & K 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 1901-02.....
- Province or State Boundary.....
- District..... do.....
- Division..... do.....



connected with the traversing ; this involved observations at 36 stations and 20½ miles of chain measurement. The cost of the traverse survey amounts to ₹14'9 per square mile.

125. The area surveyed in detail on the 2-inch scale amounts to 1,597 square miles, giving 56 plane-table sections. The survey was carried out entirely by interpolation with the exception of a strip on either bank of the Nára river where owing to the density of *bahul* jungle the chain had to be freely used ; it was tested from 1,150 *in situ* fixings, and was carried out under the direct supervision of the officer in charge. The cost of detail survey is ₹17 per square mile.

126. The survey of the desert of the Khairpur State on ½-inch scale was completed during the field season. The area surveyed amounts to 4,556 square miles, giving 14 plane-table sections.

The survey was carried out entirely by interpolation, it was tested from 329 *in situ* fixings. The cost of the survey is ₹3-1-0 per square mile.

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 32 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. The fair maps of ¾-inch work are all in hand and will be sent to Dehra Dún on the completion of drawing for reproduction and publication.

The triangulation and traverse charts of sheets 41, 42, 43, 61, 62, 63, 64, 80, 81, 82, 97, 98, 99, 100, 101, 102, 112 and 113 have been drawn. All the charts with the lists of co-ordinates have been despatched to Dehra Dún.

128. Next season's triangulation and traversing in advance will be taken up in sheets 34, 35, 36, 45, 52, 53, 54, 55, 56, 65, 72, 73, 74, 75, 76, 92, 93 and 94.

Detail survey will be carried on in sheets Nos. 24, 25, 26, 42, 43, 44, 45, 46, 78, 79, 80, 81, 82, 95, 96, 97, 98, 99, 100, 112 and 113.

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

## UNITED PROVINCES OF AGRA AND OUDH.

### No. 14 PARTY.

130. In October 1901 this party was transferred from the Lushai hills to commence the topographical survey of districts Allahabad, Fatehpur and Cawnpore on the scale of 2 inches = 1 mile, and was placed under the charge of Mr. R. B. Smart, who handed over to Captain C. W. H. Symonds on his return from furlough on the 20th March 1902. The former retired on superannuation pension on 28th June 1902.

131. The party assembled at Allahabad on the 25th October. Owing to the hostile attitude of the people (arising from their superstitions regarding plague) it was found advisable, in consultation with the Collector of Allahabad, to close the field work on the 1st April and return to recess quarters at Mussooree, where the office was opened on the 17th April.

It was decided that the traverse survey should be of such a permanent nature that it might be utilized not only as a basis for the topographical survey, but also for any cadastral survey which, at some future date, may be initiated by the Government of the United Provinces of Agra and Oudh.

132. The following statement gives a summary of the work done and the cost-rates :—

#### DISTRICT ALLAHABAD.

DEMARICATION.		TRAVERSING.		TOPOGRAPHICAL SURVEY 2-INCH = 1 MILE SCALE.	
Square miles.	Cost per square mile.	Square miles.	Cost per square mile.	Square miles.	Cost per square mile.
2,066	₹ a. p. 3 2 2	1,988	₹ a. p. 30 2 10	203	₹ a. p. 16 6 10

133. The area traversed consisted of the whole of the Allahabad district with the exception of a portion of *tahsil* Karchana and the whole of *tahsil* Meja. The traverse of these latter areas and of Allahabad city was abandoned owing to the prevalence of plague.

The origin of survey adopted was  $\frac{\text{Latitude } 25^{\circ} 15' 0''}{\text{Longitude } 81^{\circ} 45' 0''}$  and observations for azimuth were made at 308 stations. The average correction applied to the angular work was + 1 minute in 12 angles and — 1 minute in 17 angles. Connections were made to 9 stations of the Gurwání and the Karára meridional series, the resulting error per linear mile being 2'3 feet. On comparing the direct distance according to the Great Trigonometrical Survey and that arrived at by traverse between Ganeshpur, a trigonometrical station of the Gurwání meridional series, and Singraur of the Karára meridional series it was found that the error per mile in a distance of 33'1 miles was as small as +0'21 of a foot.

134. The area traversed, namely, 1,988 square miles, was divided up into 8 main circuits and 7 river blocks; this was again subdivided into 87 sub-circuits. The above area contained 3,030 villages.

In order to facilitate a cadastral survey on the 16-inch scale, should one be taken up at some future date, 1,488 sub-traverses were run. The stations were marked as follows:—

Stones . . . . .	14,799
Cylinders . . . . .	12,878
Pakka trijunction points . . . . .	4,511
Pegs . . . . .	332
Pakka pillars . . . . .	1,731
	<hr/>
	34,251
	<hr/>

In order to ensure the permanency of the demarcation, stones were embedded at each trijunction and also at the end of each *jawab* station. Further, when trijunction points were more than a mile apart, two stones, at a convenient distance apart, were embedded on the boundary of the village. During the coming field season it is in contemplation to embed stones at the starting and closing points of all sub-traverses, and when these are a mile or more apart, 2 stones on every mile of sub-traverse. This will undoubtedly ensure the permanency of the traverse survey, but will considerably raise the cost-rates. In Government of India letter, No. 730 of 9th May 1902, it was decided that the actual cost of demarcation will be chargeable to Provincial Revenues.

All the traverse computations have been completed together with the computations of secondary triangulation and intersected points which remained in arrears when this party was transferred from the Lushai hills. There are now no arrears.

135. The area topographically surveyed on the 2-inch scale was carried out by a small establishment of 4 men. The area completed amounted to 203 square miles. The outturn is small, but this is accounted for by the fact that no traverse data were available until the end of December 1901. The above area of 203 square miles is mapped on 7 plane-tables, which contained 101 plane-table fixings per square mile. The work was tested by 56'96 linear miles of test lines.

136. The country traversed is for the most part flat and highly cultivated. In the southern portion of the district, where it touches the Rewah State, the ground is broken, and for this reason the chaining was considerably impeded.

137. The health of the establishment throughout the field season was excellent in spite of plague. One menial died of dysentery.

138. The programme for the ensuing field season is as follows:—

- (1) Traverse of about 2,000 square miles in districts Allahabad and Fatehpur.
- (2) Topographical Survey on the 2-inch scale of about 2,000 square miles in Allahabad district.
- (3) Survey of Allahabad cantonment on the scale of 12 inches = 1 mile, and the bazars on the scale of 100 feet = 1 inch.

139. The party was inspected by the officiating Deputy Surveyor-General at Allahabad on 9th November 1901 and by the officiating Surveyor-General at Mussoree on the 5th August 1902.



NORTH-WEST FRONTIER.

NO. 15 PARTY.

140. Mr. E. A. Wainright held charge of the party during the year under report. Captain G. A. Beazeley, who had been attached to the party, was transferred to the charge of No. 18 Party and Lieutenant A. A. Crookshank proceeded on six months' sick leave.

141. The party was divided into the following detachments:—

1. Kashmir and Gilgit Agency under Mr. H. C. H. Cooper.
2. Frontier work under Lieutenant A. A. Crookshank, R.E.
3. Cantonment surveys under Mr. McHatton.
4. Sind and other surveys under Mr. G. A. Knight.
5. Settlement traversing in Balúchistán under Ahmed Ali Khan, K.B.

Besides these detachments, several members of the party were from time to time employed on special work.

142. The programme submitted in last year's report has been fully carried out. In Kashmir a further total of 2,786 square miles of  $\frac{1}{2}$ -inch topography was added in sheets 41 and 46 of the Trans-Frontier standard sheets, including a revision survey undertaken in sheet 43. The Khágan sheets are also being revised to admit of including this work with that of the present Kashmir survey in sheet 39 now being drawn for publication, and some triangulation was carried out by Mr. Cooper in the Khágan valley. The cantonment and bazars of Cawnpore, Jhánsi, Nowgong, Bareilly, Lucknow, Agra, Meerut and Fatehgarh have been completed. In Sind the 1-inch topography of sheets 6, 7, 23-W., 24 and 25 was completed, as also the triangulation of sheets 3, 4, 5, 21-W., 22-W. The traversing for settlement surveys in Balúchistán was carried on as before.

143. In the summer of 1901, Captain Beazeley, who was triangulating in Kashmir, was instructed to make a survey of the Satshe Glacier near Astor, using a Bridges-Lee photo-theodolite instead of a plane-table. He first triangulated the ground and then took the necessary photographs, subsequently plotting the map at Mussooree.

The result, as illustrating the value of the method, is by no means a success; the operation of plotting from the photographs was a most lengthy and laborious work, and when finished, in many ways fell far short of a plane-table survey which would have been completed in one-tenth of the time. Many features, such as huts and paths among the hills, did not show at all in the photographs, and so are entirely omitted from the resulting map. This is not the fault of the surveyor but of the system.

144. During the year a large amount of fair drawing has been got through. The fair drawing of the cantonment and bazar plans of Nowgong, Bareilly and Jhánsi are ready, and during the winter months the drawing of these surveys will be brought up to date. The fair mapping of Sind sheets is well in hand and by the end of the year it is hoped there will be no arrears of drawing with the exception of the Kashmir sheets. The computations of cantonment traverses have been checked and bound in volumes and the Sind triangulation computed and ready for this season's plane-plotting.

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

	Sq. miles.
Triangulation in Kashmir . . . . .	183
"    "    Sind . . . . .	1,215
"    "    Balúchistán . . . . .	54
Detail survey $\frac{1}{2}$ -inch . . . . .	60,450
" $\frac{1}{4}$ " . . . . .	5,151
" $\frac{1}{8}$ " . . . . .	2,787
"    1 " . . . . .	1,696
	Acres.
Cantonment surveys 12-inch . . . . .	26,095
"    "    48 " . . . . .	846
"    "    60 " . . . . .	119

146. The party lost several *khalasis* from dysentery and fever, and the health of the Sind detachment was bad throughout the winter.

147. The programme for the ensuing year includes the continuation and completion of the 1-inch topography in Sind contained in sheets 3, 4, 5, 20-W., 21 W., 22 and 23-W., and the large scale plans of Chakráta, Umballa, Meean-Meer, Pesháwar, Ferozepore and Mooltan are to be undertaken. As the demand for the cantonment surveys under the new Cantonment Act is a much larger one than had been expected, it has been determined to temporarily postpone further work in Kashmir and concentrate the strength of the party as much as possible on the cantonment surveys.

148. The recess office of the party was inspected by the officiating Surveyor-General.

## PUNJAB.

### No. 18 PARTY.

149. Lieutenant A. A. McHarg, R.E., was in charge of the party at the commencement of the year under report, until the 28th October, when Major W. J. Bythell, R.E., rejoined from a month's privilege leave. Major Bythell retained charge until the 13th May 1902, when on appointment as Officiating Deputy Surveyor-General he handed over charge to Captain G. A. Beazeley, R.E., who retained it until the close of the year. Lieutenants R. H. Thomas, R.E., and L. C. Thuillier, I.A., were attached to the party from the 9th April until the 6th August 1902, and during this period they underwent a course of instruction in 2-inch plane-tableing in the Simla Hill States.

150. The work of the party was considerably changed from the purely topographical operations which had hitherto formed its programme. In general terms, the new work of the party may be briefly described as follows:—

- (1) The utilization of the existing large scale *patwaris'* maps to form one inch topographical maps by a process of compilation and revision in the field.
- (2) The execution of riverain surveys in order to allow of the determination of riverain boundaries at any future time.

In carrying out the first of these, the system formerly carried out by No. 1 Party between the years 1884-89 in the Punjab plains was reverted to. In this system, traverses are run over the district connecting the trijunctions of villages and the marked ends of village base lines. These trijunctions and base lines are then plotted on to plane-table sheets on the 2-inch scale. The *patwaris'* maps on the 24-inch are then reduced by pantograph to the 2-inch scale and the reduced maps fitted village by village on to the plotted plane-table sheets, being adjusted in proper position by means of the trijunctions and base lines already plotted.

These plane-table sections are then examined in the field, if necessary corrected and any topographical detail added which may have been omitted from the *patwaris'* maps.

From these plane-table sheets standard sheets are drawn on the 2-inch scale for reduction and publication on the 1-inch scale.

151. On the abolition of No. 1 Party in 1890, the following seven districts had been already traversed and were ready for map revision:—

Lahore.		Siálkot.
Amritsar.		Gujrát.
Gurdáspur.		Gujránwála.

Shahpur (plains portion).

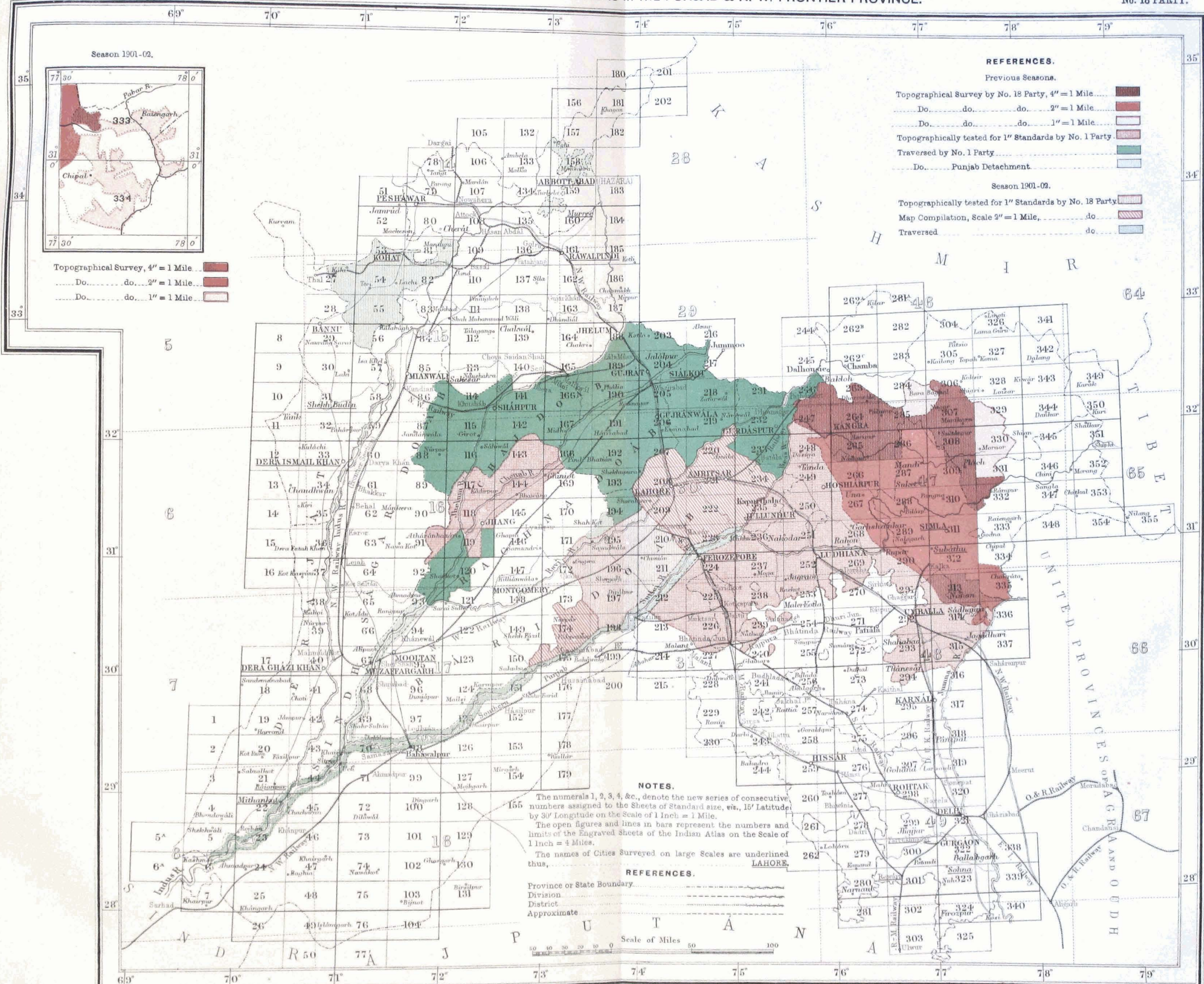
As mentioned in paragraphs 292-294 of last year's General Report, traversing was completed by the Punjab traverse detachment in the Gugera and Dipálpur and a portion of the Pákpattan *tahsils* of the Montgomery district and field sections had been prepared from the traverses. It was therefore determined to commence the revision survey in the Montgomery district.

This portion of the field work, *vis.*, the testing in the field, and insertion, of all topographical details on the reduced and congregated *patwaris'* maps was successfully carried out, in the Gugera and Dipálpur *tahsils* of



# PUNJAB & N. W. FRONTIER PROVINCE SURVEY.

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



- REFERENCES.**
- Previous Seasons.
- Topographical Survey by No. 18 Party, 4" = 1 Mile
  - Do. do. do. 2" = 1 Mile
  - Do. do. do. 1" = 1 Mile
  - Topographically tested for 1" Standards by No. 1 Party
  - Traversed by No. 1 Party
  - Do. Punjab Detachment
- Season 1901-02.
- Topographically tested for 1" Standards by No. 18 Party
  - Map Compilation, Scale 2" = 1 Mile
  - Traversed

- Season 1901-02.
- Topographical Survey, 4" = 1 Mile
  - Do. do. do. 2" = 1 Mile
  - Do. do. do. 1" = 1 Mile

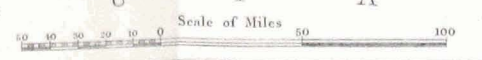
**NOTES.**

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, LAHORE.

- REFERENCES.**
- Province or State Boundary
  - Division
  - District
  - Approximate





Montgomery and the Chunián *tahsil* of Lahore over an area of 3,000 square miles by a detachment of 11 plane-tablers under the charge of a Provincial officer. This detachment was at work in the field from the 15th November 1901 until the 20th April 1902.

152. The traverse work of the party, in preparation for future revision work, consisted of the completion of the traversing in the Pákpattan *tahsil* of the Montgomery district, which had been commenced the year before by the Punjab traverse detachment. This work was completed by nine traversers under the charge of a Provincial officer by the end of December 1901, and comprised an area of 188 square miles.

153. *Riverain Surveys.*—For the execution of these, traverses are to be run along the high banks of certain selected rivers with a view to the preparation of riverain maps showing the district boundaries which lie in the river beds, and from which maps, the correct position of any district boundary mark or trijunction which might be washed away, could at any subsequent time be redetermined.

On this work 11 traversers were employed under a Provincial officer. The portion completed with a main traverse on either high bank, well removed from any river action, extended from the Lahore-Amritsar boundary on the Sutlej, down that river, and the rivers Chenab and Indus to the Sind boundary on the last, a distance of  $815\frac{1}{2}$  linear miles in which 852 dressed stones were embedded, and connections were made with ten principal and two secondary stations of the Sutlej series, two principal stations of both the Gurrhággarh and Jogí Tíla series and with five principal stations of the Great Indus series. The traverse on the left bank of the Sutlej in the Baháwalpur State, opposite the Montgomery district, was not completed as the settlement was still proceeding in the State and no maps were available.

The Drawing section of 14 draftsmen under a Provincial officer remained in Simla during the field season.

Thirty-four sheets, of which 10 were on the 4-inch scale, 21 on the 2-inch and 3 on the 1-inch, were sent for publication during the year. It is satisfactory to be able to report that all the arrears of mapping have been cleared off with the exception of one sheet, whilst all the mapping of the area topographically tested in the Montgomery and Lahore districts has been completed during recess by the field hands. This area of 3,000 square miles has been mapped in thirty-four 2-inch sheets, of which 16 comprising five 1-inch standard sheets will be sent for publication. The remaining sheets must be held over for completion to margin during the coming field season.

154. The topographical work carried out during the year consisted of 4-inch, 2-inch and 1-inch surveys in the Kot Khái *ilaka*, Kumhársain and Jubbal, Balsan, Tarhoch, and other Native Hill States, and small portions in Tehri-Garhwál, comprised in sheets 333 and 334. This was completed by a small detachment consisting of Lieutenants Thomas, R.E., and Thuillier, I.A., and 4 plane-tablers.

155. The total outturn of the field season's work amounts to the following:—

		Square miles.
1. Topography	{ 4-inch scale . . . . .	23
	{ 2 " " . . . . .	43
	{ 1 " " . . . . .	255
2. Traversing . . . . .		Linear miles. 2,406
3. Map revision . . . . .		Square miles. 3,000
4. Preparation of field sheets for revision survey . . . . .		5,210

156. The cost-rate of each description of work per square mile is as follows:—

	₹
Detail survey on 4-inch scale . . . . .	74.3
" " " 2 " " . . . . .	53.7
" " " 1 " " . . . . .	10.1
Traversing . . . . .	28.3
Map revision . . . . .	6.9
Preparation of field sheets for revision survey . . . . .	2.0

157. *Simla Survey*.—The actual traversing in connection with this work has been completed during the year. A small amount of supplementary triangulation was found necessary to facilitate the traversing of the exterior boundary, 15 stations and 21 intersected and bar subtense points having been fixed. The survey of the exterior boundary of 250 estates, 4 sub-traverses and 30 village or "settled-area" blocks was completed by the end of August. All that now remains is the actual testing of the work in the field by means of the plane-table. This work is now in progress and provided the winter is not exceptionally severe should be completed by March next. As each sheet is checked, a trace thereof is made on bank-post paper which will be ready for reproduction by the Vandyke process after the estate names and numbers have been typed on it.

158. The programme for next field season comprises the following:—

- (1) The preparation of Mooltan district for map revision. This implies that either the district will have to be freshly traversed, or the old traverse data of 1854-58 will be utilized as a basis on which to plot the reductions of the *patwaris'* maps. Every effort will be made to utilize these old traverses, but without trial in the field it is impossible to decide definitely, as the matter rests on whether the old trijunction marks of the traverse survey can be identified on the ground or not.
- (2) The examination and correction in the field of the reduced *patwaris'* maps on 2-inch sections to complete the Montgomery, Lahore and Amritsar districts.
- (3) Riverain survey or preliminary traverse along both banks of the river Indus, working northwards from its junction with the Chenab and completing as large an area as possible during the field season.

159. The office of the party was inspected by the Officiating Surveyor-General and Officiating Deputy Surveyor-General on 5th, 15th and by the Officiating Surveyor-General on the 29th May 1902, and visited on occasions by the Officiating Surveyor-General during his stay in Simla.

## FOREST SURVEYS.

### MADRAS PRESIDENCY.

#### NOS. 9 AND 19 PARTIES.

160. Mr. Hugh Todd held charge of the combined parties throughout the year under report.

The parties were divided into three camps for 4-inch forest surveys as follows:—

- (1) Mr. C. C. Byrne with 20 surveyors, Kurnool district (Northern Circle).
- (2) Mr. G. T. Hall with 19 surveyors, Cuddapah district (Central Circle).
- (3) Mr. W. F. E. Adams with 19 surveyors, South Canara district (Southern Circle).

Mr. H. A. Gibson was under training.

In addition to the above, Mr. M. J. Sheehan with 2 traversers carried out the triangulation and traversing in advance for a 16-inch survey of the Godávári delta, which it is proposed to carry out for the Irrigation Department in 1902-03. A surveyor was also lent to the Court of Wards to survey the Sivagiri zemindari forests on the 4-inch scale.

The camps left Bangalore for the field early in November and returned to their recess quarters in May.

161. The advance triangulation in the Kurnool, Cuddapah and South Canara districts was in continuation of the previous season's work and a total area of 1,680 square miles was completed. The results of the triangulation show an improvement on those of previous seasons both as regards quality and quantity and serve to prove that with due precautions, native agency can be usefully and economically utilised for this class of work. With the season under report the triangulation required for the Kurnool and Cuddapah districts

has been completed. In addition to the above area, 300 square miles were triangulated along the Godávári river in advance for the riverain survey. Most of the stations were marked by stone slabs embedded in concrete for the purpose of serving as permanent marks for future surveys which may be required to map changes in the course of the river; as these marks had to be built under the supervision of the triangulator before his observations were taken the work was tedious and costly.

162. Four hundred and fourteen linear miles of forest reserve boundaries were traversed by theodolite in the different districts under survey. The length of traverse falls considerably short of that of the previous season; this was chiefly due to the backward state of cleared lines in the South Canara districts, where in some instances clearing and traversing had to be carried on *pari passu*: the traversing of boundaries in the Kurnool and Cuddapah districts has now been completed. In addition to the above a total length of 411 linear miles in connection with the cadastral survey of the Godávári river was completed.

163. An area of 1,306 square miles of 4-inch detail survey was completed in the Kurnool, Cuddapah, Coimbatore and South Canara districts; this includes an area of 68 miles of resurvey in three districts. The area surveyed is less than for the previous season, and is partly due to the more difficult character of the Cuddapah forests, where the chain had to be more extensively used, and progress was necessarily slower, and partly to a surveyor having been lent to the Court of Wards for the survey of the Sivagiri zemindari forests which comprise an area of 37 square miles. Strict supervision and careful examination of the work while in progress ensured the detail survey being accurate and of good quality.

164. The health of the parties in the field, although better than in the previous season, was not so satisfactory as could have been wished. Malarial fever was prevalent but in many cases did not incapacitate the men until they got to Bangalore. Mr. Wilson suffered from repeated attacks of fever in North Coimbatore and had to close work before completing his work, and several members of the establishment were sent on sick leave during and after the field season. Two menials died of cholera in South Canara, one of fever in Cuddapah, and another from the result of an accident.

165. The mapping, consisting of 54 sheets, will be completed before the party again takes the field and the computations are well advanced. This, considering the many cases of fever during recess, may be considered very satisfactory. Several sheets of Cuddapah and Kurnool will have to be withheld on account of wrongly demarcated rights and boundaries. Owing to certain rights not having been pointed out to the surveyors at the time of survey and to much of the Mysore-South Canara boundary being undemarcated it will not be possible to send any of the South Canara maps to press. The maps of the North Coimbatore forests have also been withheld pending a further examination and revision of field surveys in that district.

166. The actual expenditure for the survey year ending 31st August 1902, inclusive of cost of instruments and exclusive of cost of Godávári river survey, is R91,625 as compared with R93,335 in 1900-01. The difference is accounted for by a percentage of pay and allowances of the officer in charge having been debited to the Godávári river survey, and to the pay and allowances of a surveyor on deputation having been charged to the Court of Wards, Madras. The cost of the Godávári river survey inclusive of the cost of instruments, was R7,483. The following table shows the comparative cost-rates and area surveyed for the last three years:—

DESCRIPTION OF WORK.	AREA SURVEYED.			COST-RATES PER SQUARE MILE.		
	1899-1900.	1900-1901.	1901-1902.	1899-1900.	1900-1901.	1901-1902.
Triangulation (forest) . . .	1,429	1,335	1,680	8	6	5
Ditto (river) . . .	...	...	300	...	..	16
Traversing (forest) . . .	312(a)	771(a)	414(a)	27(b)	8(b)	14(b)
Ditto (river) . . .	...	...	411(a)	...	...	7 b)
Topography (forest) . . .	1,524	1,378	1,306	58	58	59

(a) Linear miles. (b) Per linear mile.



The party worked under similar conditions as during last season and except in the case of traversing, the cost-rates are nearly the same. The increase in the cost of traversing was owing to extra expense in line clearing and to a smaller outturn.

167. The programme for the ensuing field season comprises the further extension of triangulation in South Canara, and a commencement in Ganjám and Godávári and for a small area in Trichinopoly; continuation of traversing of boundaries in South Canara district and commencement of the same in the districts of Ganjám and Godávári; 4-inch detail survey in Kurnool, Cuddapah and South Canara and, if practicable, in Trichinopoly; further examination and revision of work in Coimbatore (north); subsidiary traversing and cadastral survey on the 16-inch scale of a portion of the Godávári river.

168. The parties were inspected in recess by Major Longe, Officiating Surveyor-General, and by Major P. J. Gordon, Superintendent, Forest Surveys.

169. The season's field work was verified with the aid of the Government notifications by the District Forest Officers of Kurnool, Cuddapah and South Canara, who visited the office at Bangalore for the purpose.

## BOMBAY PRESIDENCY.

### NO. 17 PARTY.

170. Mr. S. F. Norman held charge of the party from 1st October to 14th November 1901, when he was relieved by Mr. B. G. Gilbert-Cooper, who held charge throughout the field season and up to 30th June 1902, when, on his transfer to Calcutta to officiate as Assistant Surveyor-General, Mr. S. F. Norman was again appointed to the officiating charge of the party, and held it for the remainder of the year. During the year one draftsman died from plague, and two sub-surveyors from fever; one computer was also invalided.

171. The various detachments left Poona for the field during the fourth week in November, and returned to recess quarters during the first week in June, giving a full working season of six months.

172. The party was divided into three camps, under Messrs. C. A. Norman, S. F. Norman and C. J. Veale respectively, and continued the survey on the 4-inch and 8-inch scales of the forest areas in the Northern, Central and Southern Circles of the Bombay Presidency, these operations comprising—

- (1) *Northern Circle*.—Supplementary triangulation and 8-inch detail survey of teak reserves in the Thána district.
- (2) *Central Circle*.—Supplementary triangulation and detail survey on the 8-inch and 4-inch scales in Násik district.
- (3) *Southern Circle*.—Supplementary triangulation and traversing and 4-inch detail survey in Belgaum, North Kánara and Dhárwár districts.

A small area was also surveyed on the 8-inch scale in Kolába district.

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

DESCRIPTION OF SURVEY.	OUTTURN.			COST-RATES.		
	1899-1900.	1900-1901.	1901-1902.	1899-1900.	1900-1901.	1901-1902.
Triangulation (stations) . . .	256	365	320	23'2	12'5	20'0
Traversing (linear miles) . . .	191	315	504	8'2	7'1	8'7
Topography, 4-inch (square miles)	379	409'7	607	64'1	65'4	63'8
Ditto 8 " ( ditto )	236	254'8	161'5	139'5	106'7	136'1
Ditto 16 " ( ditto )	55	10'8	Nil.	134'1	113'0	Nil.

Owing to one of the triangulators having had to be sent on sick leave, the area triangulated was not so large as was hoped for. Owing to the dense undergrowth in the forests surveyed in the Southern Circle, it was found necessary to do more traversing than has been done for some years.

The outturn of 4-inch detail survey is much in excess of that of the two previous years, while that of 8-inch detail survey shows a decrease. Taking into consideration the relative values of the different scales the total outturn of the party is nearly the same as for last year. The slight decrease in outturn as compared with the average of the last three years is due to the very heavy losses the party has sustained recently from plague and fever. The young apprentices who have been trained to take the places of the experienced surveyors who have died, have not yet had time to attain the proficiency necessary to give a full outturn of first-class work.

The cost-rates for the year under report, except in the case of 8-inch detail survey, are very much the same as those of the two preceding years. The cost-rate of 8-inch detail survey has increased from R106 to R136 per square mile. The favourable rate for 1900-01 was due to Mr. Norman having held charge of the party in addition to his other duties for the whole year. In 1901-02 there was a large increase in the charge for supervision, while, owing to the causes mentioned above, the outturn was somewhat less. The cost-rates considered apart from the charge for supervision, which varies from year to year, may be considered satisfactory. The total cost for the year was R71,364, as compared with R62,350 in 1900-01, the increase is principally due to increased charges for supervision.

174. The work was examined and tested while in progress by the officer in charge and the camp officers.

175. During the recess most of the mapping of the past season's work has been completed.

176. The programme for 1902-03 is in continuation of that for the past season.

177. The party was inspected on 8th and 9th September by Major F. B. Longe, R.E., Officiating Surveyor-General, and by Major P. J. Gordon, I.A., Superintendent, Forest Surveys, who has been placed in administrative charge of the party from 1st August 1902.

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## BURMA.

### NO. 20 PARTY.

178. Captain A. H. B. Hume, R.E., held charge of the party throughout the year under report.

The party left recess quarters at Dehra Dún in the middle of November, but, owing to many of the men being delayed in quarantine at Rangoon on account of an outbreak of cholera on the voyage from Calcutta, field work was not commenced until the middle of December. Field work was closed in Upper Burma on the commencement of the rains in the end of May and in Lower Burma in the beginning of June.

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

- (1) Mr. P. F. Prunty with 14 traversers and five computers, Upper Chindwin and Myittha divisions.
- (2) One Surveyor, with 12 traversers and five computers, Minbu division, and later in Thayetmyo.
- (3) Mr. G. P. Tate with 15 detail surveyors, Minbu division.
- (4) Mr. M. C. Petters with 14 detail surveyors, Minbu division, and later in the Upper Chindwin.
- (5) Mr. S. M. Fielding with five detail surveyors, Upper Chindwin division.

Three sub-surveyors were also detached for work in Ataran, and one for work in the Pyinmana division. Owing to advance traverses in the Upper Chindwin being insufficient it was necessary to delay sending a full detail camp there until February when more data were available. In order also to allow of the detail survey in the Minbu division being completed during the season it was necessary to send the traverse camp which afterwards worked in Thayetmyo, there for the first three months of the season. These changes during the field season resulted in loss of time and outturn but were inevitable.

180. The officer in charge of the Upper Chindwin traverse camp, in addition to its supervision, triangulated an area of 250 square miles based on the Manipur Minor Meridional series. This series, which was completed this year, has proved of the greatest service to forest survey operations in the Upper Chindwin, and had its data not been available a long and expensive triangulation would have had to be carried out by No. 20 Party before forest surveys could have been commenced in that part of the country.

181. Owing to the denseness of the forest growth the topography in this party has to be entirely based on theodolite traverses, the area topographically surveyed being divided into blocks of six to ten square miles. One thousand two hundred and seventy-one linear miles were traversed in the various divisions and 23,098 traverse stations fixed and marked with posts. Vertical as well as horizontal angles were observed, giving a large number of heights for the plane-tables. The computation of most of the traverse work was done in the field and traverse plots were supplied to the detail camps as required.

182. An area of 724 square miles of reserved forests was surveyed on the 4-inch scale in the Upper Chindwin, Minbu, Pyinmana and Ataran Forest divisions. The country was difficult to survey, being hilly and densely wooded. Supplies were scarce and arrangements had to be made for keeping food depôts supplied in order to avoid any chance of the work being delayed.

183. The work of the season was carefully and thoroughly examined while in progress by the officer in charge and his assistants. The testing was in the proportion of one linear mile to every 2'3 square miles of detail survey. In addition to the area surveyed, a further examination and revision of work done during the previous year was carried out. A record of forest growth and soil was made of the area surveyed, and the limits of the teak-growing areas were shown on the maps.

184. Although the general health of the party was fair there were numerous casualties. One sub-surveyor and ten *khalasis* died of cholera, six *khalasis* of fever and dysentery and one sub-surveyor of heart disease. One sub-surveyor also was invalided on account of leprosy.

185. During the recess the computations of triangulation and traversing have been brought up to date. The mapping of the current season's work has been completed and 28 sheets submitted for publication. Forty-one sheets of previous season's work have also been completed, examined and submitted, as well as 12 sheets on the 2-inch scale for reduction to one-inch standard sheets.

186. The total cost for the survey year ending 30th September is ₹1,74,283 or ₹1,000 in excess of last year's total.

The increase was due to a larger number of men being employed in Upper Burma, where local and travelling allowances are higher than in Lower Burma, to increased charges for supervision and to a sum of some ₹14,000 having been expended on the mapping and publication of previous season's work. These extra expenses were, however, partly counterbalanced by a saving in the charges for conveying the party from the field to Rangoon, due to the courtesy of the Marine Transport Officer, who placed Government steamers at the disposal of the officer in charge for the purpose of conveying his men from the field. It is hoped that it will be possible to continue this excellent arrangement in future.

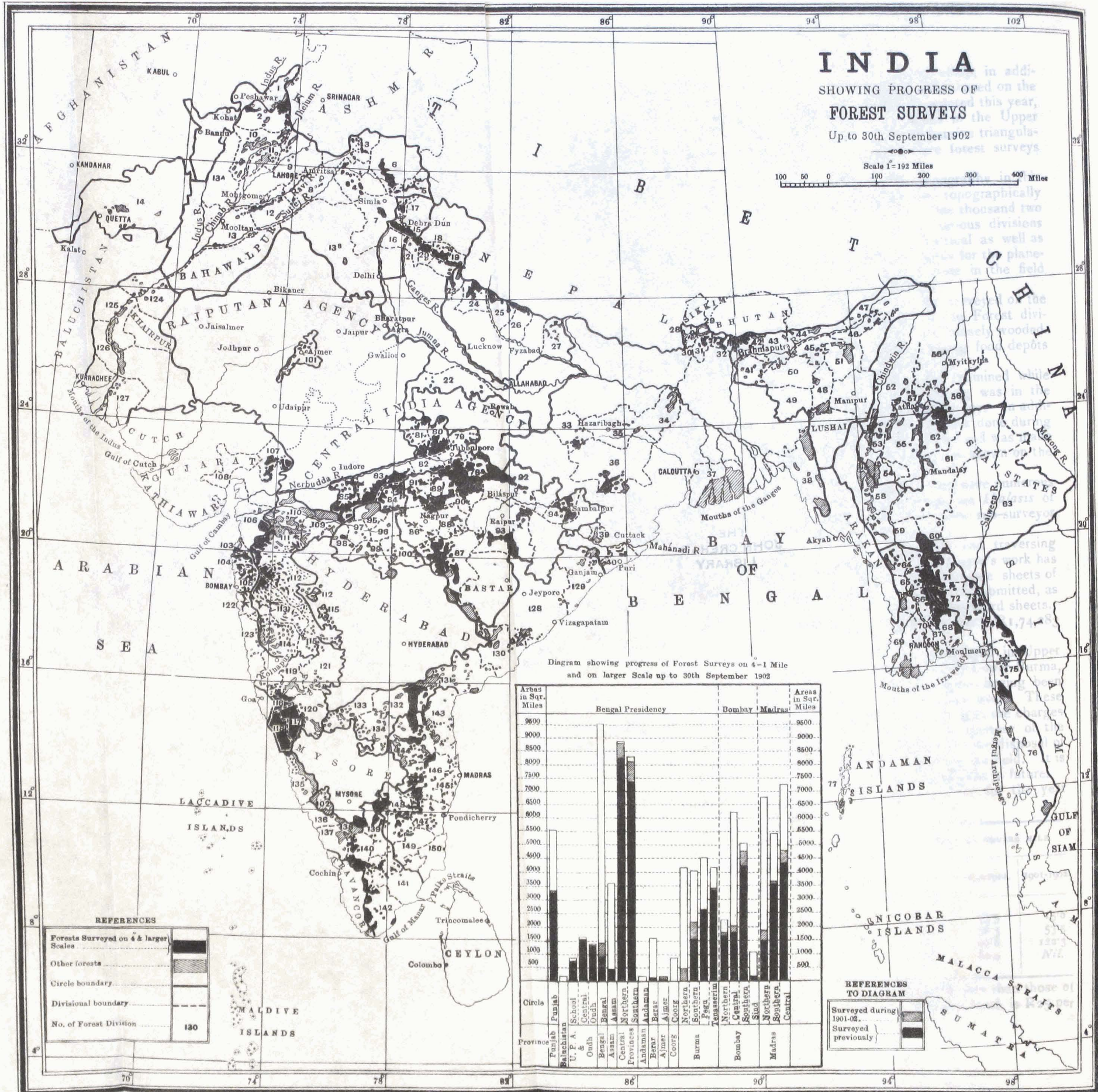
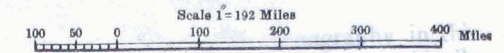
187. The following table shows the cost-rates and outturn for the year under report and for the two previous years:—

DESCRIPTION OF WORK.	AREA SURVEYED.			COST-RATE PER SQUARE MILE.		
	1899-1900.	1900-1901.	1901-1902.	1899-1900.	1900-1901.	1901-1902.
Triangulation . . . . .	1,170	534	250	23'4	33'5	15'0
Traversing . . . . .	1,029	1,237	1,646	65'2	56'5	53'5
Topography, 4-inch . . . . .	708	873	724	97'5	97'8	122'3
Ditto 2-inch . . . . .	<i>Nil.</i>	5	<i>Nil.</i>	<i>Nil.</i>	80'0	<i>Nil.</i>

The cost-rates of both triangulation and traversing are less than those of former years. The cost-rate of detail survey, on the other hand, is ₹25 per

# INDIA

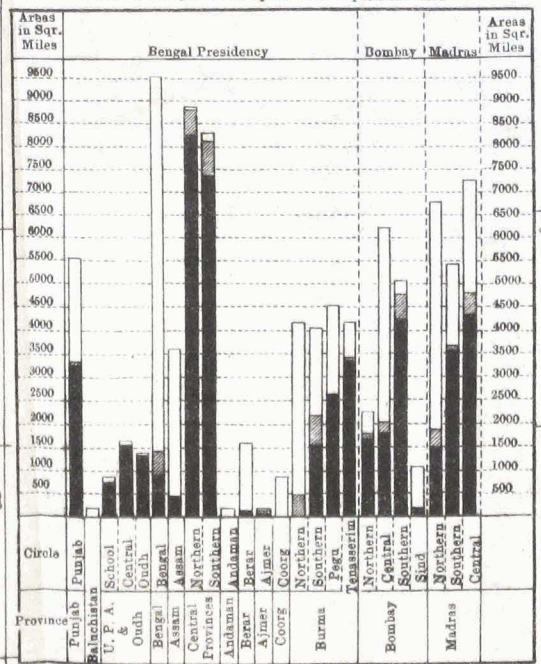
SHOWING PROGRESS OF FOREST SURVEYS  
Up to 30th September 1902



LIST OF FOREST DIVISIONS

Province or Circle	Reference No. on Map	Division	Province or Circle	Reference No. on Map	Division
Punjab	1	Hazara	Central Provinces	75	Hazar
	2	Rawalpindi		76	South Tanasserim
	3	Chamba		77	Indanara
	4	Kangra		78	Mulla
	5	Kashmir		79	Jalapaore
	6	Siala		80	Damah
	7	Lahore		81	Saggar
	8	Chenab		82	Narayangpur
	9	Jhelum		83	Hoshangabad
	10	Shikhar		84	Beril
	11	Margonyra		85	Nisar
	12	Mooltan		86	Niggar Wartha
	13	Deva Sansi Khan		87	Chand
14	Hissar	88	Bhandra		
Baluchistan	15	Uchra Bito	89	Soni	
	16	Sakranpur	90	Khatkhat	
	17	Jambhar	91	Chindwara	
	18	Kinn Tal	92	Bilapur	
	19	Kanaua	93	Rajpur	
	20	Garwal	94	Sambalpur	
	21	Shangra	95	Chitpur	
	22	Sambhalkand	96	Mala	
	23	Pilkhari	97	Budina	
	24	Cher	98	Bain	
	25	Bahraich	99	Wia	
	26	Gand	100	Ajmer Marwaja	
	27	DeraKapur	101	Govr	
Bengal	28	Burjaling	102	Govr	
	29	Tista	103	North Thana	
	30	Karnam	104	Central Thana	
	31	Jalpaiguri	105	South Thana	
	32	Bose	106	Sirt	
	33	Palasna	107	Jalpaiguri	
	34	Sambal Puranas	108	Famoh Mahals	
	35	Singbhan	109	Abmedah	
	36	Sonachana	110	East Khondah	
	37	Chillagang	111	West Khondah	
	38	Angul	112	Malk	
	39	Puri	113	Abnadaagar	
	40	Puri	114	Papa	
Assam	41	Garh Hill	115	Sakra	
	42	Goalpara	116	Madhabpur	
	43	Kamrup	117	Hydrabad	
	44	Naranga	118	Jorhat	
	45	Sowang	119	Tingrapam	
	46	Sankar	120	Gagan	
	47	Lakhimpur	121	Saldari	
	48	Cuttack	122	Pellary	
	49	Sylhet	123	Karool	
	50	Khasi and Jaintia Hills	124	Kama	
	51	Assam	125	Assamgar	
	52	Upper Chindwin	126	South Ganara	
	53	Myittha	127	North Malabar	
54	Lower Chindwin	128	South Malabar		
55	Mu	129	Mylora		
56	Shan	130	Northern		
57	Myittha	131	Northern		
58	Katha	132	Southern		
59	Assam	133	Andaman		
60	Assam	134	Assam		
61	Assam	135	Assam		
62	Assam	136	Assam		
63	Assam	137	Assam		
64	Assam	138	Assam		
65	Assam	139	Assam		
66	Assam	140	Assam		
67	Assam	141	Assam		
68	Assam	142	Assam		
69	Assam	143	Assam		
70	Assam	144	Assam		
71	Assam	145	Assam		
72	Assam	146	Assam		
73	Assam	147	Assam		
74	Assam	148	Assam		
75	Assam	149	Assam		
76	Assam	150	Assam		

Diagram showing progress of Forest Surveys on 4-1 Mile and on larger Scale up to 30th September 1902



REFERENCES

Forests Surveyed on 4 & larger Scales	
Other forests	
Circle boundary	
Divisional boundary	
No. of Forest Division	130

REFERENCES TO DIAGRAM

Surveyed during 1901-02	
Surveyed previously	

square mile more than for 1899-1900 and 1900-01. The increase is capable of a satisfactory explanation and is due to a decrease in the outturn owing to the detention of the party in quarantine, to the transfer of a detail camp from Magwe to the Upper Chindwin during the field season, and to the employment of three surveyors on revision survey. But for this the outturn might reasonably have been expected to equal, if not exceed, that of last year—in which case the cost-rate would have been more favourable. It must not be lost sight of that both in 1899-1900 and 1900-01 a considerable portion of the area surveyed was situated on the coast where the work was comparatively easy and the outturn per man double what is possible in the hills.

The delays affected the cost of the traversing equally with that of the detail survey.

188. The programme for 1902-03 includes—

- (1) Traversing and triangulation in the Myittha, Lower Chindwin and Yaw divisions, and 4-inch detail survey in the Upper Chindwin and Myittha.
- (2) Traversing and 4-inch detail survey in Thayetmyo division.
- (3) Traversing and 4-inch detail survey of recent extensions in Thaungyin division, maps of which are urgently required for working plans.

189. The party was inspected in the field by the Superintendent, Forest Surveys, during February and in recess by the Officiating Surveyor-General in July, and again by the Superintendent, Forest Surveys, in August.

#### OPERATIONS OF THE FOREST SURVEY BRANCH.

190. Major P. J. Gordon, I.A., held administrative charge during the year 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 forest reserves in the several provinces of the Bengal Presidency.

191. 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 Forest Surveys, Bengal Presidency.

192. *Central Provinces*.—Four detachments constituted as follows carried on the survey of the forests in the Central Provinces:—

Mr. J. Marten with 15 surveyors in Mandla.

A native surveyor, with 12 surveyors in Mandla.

Mr. J. H. Nichol with 15 surveyors in Chánda.

A native surveyor, with 12 surveyors in Chánda.

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

DESCRIPTION OF WORK.	OUTTURN.			COST-RATES.		
	1899-1900.	1900-1901.	1901-1902.	1899-1900.	1900-1901.	1901-1902.
Triangulation .	497 S. M.	697 S. M.	1,350 S. M.	R 5'1	R 2'3	R 2'0
Traversing .	184 L. M.	181 L. M.	303 L. M.	18'4	8'3	7'0
Levelling .	791 L. M.	829 L. M.	1,057 L. M.	2'9	1'4	1'7
4-inch detail survey .	1,423 S. M.	1,556 S. M.	1,424 S. M.	39'0	36'8	29'4
16-inch boundary survey .	2,597 L. M.	1,691 L. M.	1,893 L. M.	...	2'1	2'2

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

194. With the exception of about 200 square miles in Chánda, which will be surveyed in 1902-03, the survey of the forest in Central Provinces is now complete.

195. The mapping and publication of the Central Province sheets has made considerable progress. One hundred and seventy-four sheets were sent to press during the year, and 178 have been published. There still remain 230 sheets in press and in different states of progress.

196. *Bengal*.—A detachment of 20 surveyors under Mr. A. Ewing continued the survey of the reserved and protected forests in Singhbhum, 6 surveyors surveyed the Kodarma reserve and protected forests in Hazáribágh, chiefly for the purpose of locating the mica mines there.

197. The survey of the remaining protected forests in Singhbhum will be postponed until 1903-04 pending final settlement. The programme in Bengal for 1902-03 consists of a 4-inch detail survey of the forest reserves in Kurseong and Darjeeling.

198. The outturn and cost-rates for the year under report and for the two previous years, are given in the following statement :—

DESCRIPTION OF WORK.	OUTTURN.			COST-RATES.		
	1899-1900.	1900-1901.	1901-1902.	1899-1900.	1900-1901.	1901-1902.
Triangulation . . .	150 S. M.	650 S. M.	382 S. M.	R	R	R
Traversing . . .	...	167 L. M.	78 L. M.	21 per S. M.	2 per S. M.	2 per S. M.
4-inch detail survey . . .	185 S. M.	361 S. M.	427 S. M.	...	24 " L. M.	17 " L. M.
				81 per S. M.	61 " S. M.	48 " S. M.*

\* Including Kodarma survey.

The conditions of the survey for the three seasons are practically the same, and the favourable results for the year under report are greatly due to the zeal and energy of the camp officer who has held charge of the Singhbhum detachment for two years.

199. The mapping of the Singhbhum survey is complete, but most of the sheets have been withheld for the verification of the boundaries of the protected forests. Tracings of the work have, however, been supplied to the Forest Department, so as to avoid delay in the preparation of the working plans.

200. *Burma*.—Past experience having shown the impossibility of the officer in charge of No. 20 Party exercising effective control over detachments working in all parts of Burma, it was decided as far as possible to limit the operations of that party to the Chindwin Valley and the lower Irrawaddy, leaving the remainder of the Burma forests to be surveyed by detachments of the Forest Surveys working directly under the supervision of the Superintendent in the same manner as the detachments in the Central Provinces and Bengal. Advantage was taken of an area in the Ruby Mines district which had been traversed in advance by No. 20 Party in the previous year, and a detachment consisting of 16 surveyors under Mr. C. Litchfield was detailed for the work.

201. The outturn and cost-rates were as follows :—

DESCRIPTION OF SURVEY.	1900-1901. 20 PARTY.		1901-1902. FOREST SURVEY DETACHMENT.	
	Outturn.	Cost-rates.	Outturn.	Cost-rates.
Traversing . . . . .	427 L. M.	R	190 L. M.	R
4-inch detail survey . . . . .	318 S. M.	34	274 S. M.	29 per L. M.
		79		86 " S. M.

For the sake of comparison the results of a detachment of No. 20 Party working in the same district under somewhat similar conditions are also given.

The fact of No. 20 Party having had to place a considerable area traversed by it during the previous year at the disposal of this detachment indirectly affected disadvantageously the results of No. 20 Party for the year. This detachment, like No. 20 Party, suffered a considerable delay through some of its members having been detained in quarantine in Rangoon.

202. The mapping of the Ruby Mines survey is well advanced and a sufficient number of maps have been supplied to enable a Working Plans party to commence operations next year.

203. During the coming season, in addition to the detachment which will continue the 4-inch detail survey in the Ruby Mines and Bhamo, a traverse detachment will be also sent to do advance traversing in the Ruby Mines, Bhamo and Mandalay.

204. *Punjab*.—In the Punjab Mr. Ewing with 10 surveyors surveyed 100 square miles of the Jubbal and Tarhoch State Forests in October and November at a cost of ₹23 per square mile for the field survey. A triangulator was also sent to Hazára to complete the triangulation of the forests in the Siran range.

205. The mapping of the Jubbal and Tarhoch surveys is well advanced, but so far none of the sheets have been sent to press. The publication of the Chamba maps is still in a backward state owing to the sheets having been withheld for verification of boundaries. As, however, it has been found possible to accept most of the boundaries as surveyed without further verification by the Forest Department, it is hoped that the entire series will be sent to press during next year.

Owing to the greater urgency of other work very little has been done during the year on the remaining 1-inch sheets of Chamba and Bashahr.

206. The programme for 1902-03 in the Punjab and North-West Frontier Provinces consists of the completion of the Jubbal and Tarhoch survey, and of the 4-inch detail survey of the forest reserves in the Khagan and Siran ranges in Hazára, and of some selected reserves in Ráwalpindi and Gujráat.

207. *United Provinces of Agra and Oudh*.—A small detachment, under a surveyor, surveyed 324 linear miles of forest boundaries in Oudh on the 4-inch scale during the year.

208. The programme in these Provinces for 1902-03 consists of the 4-inch detail survey of some recently demarcated reserves in Bijnor, Kumaun, Garhwál and Naini Tal and Almora.

209. The first edition of the Kumaun and Garhwál forest maps having been exhausted the series will be brought up to date and a second edition published.

210. The total cost for the year was ₹1,58,767 (including ₹33,781 for head-quarters), as compared with ₹1,50,352 in 1900-01. The increase is principally due to the extra expenditure in connection with the Burma detachment.

211. The general results of the work done by the Forest Survey detachments both as regards cost and outturn are satisfactory.

With the approaching completion of surveys in the Central Provinces, a field favourable to large outturn and cheap cost-rates, and useful for training young apprentices, will be lost to the Department. The work before the Forest Branch in the future will consist for the most part of surveys in Bengal, Assam and Burma where the character of the country and the cost of labour and transport will render operations tedious, difficult and costly. Hitherto the Forest Survey Branch has been able to utilize to a great extent traverse and triangulation already done by Survey of India parties. In the future, especially in Assam and Burma, much of the triangulation and all the traversing will have to be done by the Forest Survey Branch itself.

212. The publication of maps has made good progress during the year, 298 maps having been published as compared with 151 in 1900-01.

## CADASTRAL AND TRAVERSE SURVEYS.

### UNITED PROVINCES OF AGRA AND OUDH.

#### NOS. 2 AND 8 PARTIES.

213. The Provincial Surveys in the United Provinces of Agra and Oudh remained during the year under the charge of Captain W. M. Coldstream, R.E., as Superintendent. The work has been carried out by three sections, namely, the traverse, drawing and cadastral sections, the last consisting of four district cadastral detachments. There has also been a small detachment working on town and cantonment surveys in Fyzabad and Ajodhya, under the direct supervision of the Superintendent.

214. *Traverse Section.*—As the programme of traverse work for cadastral purposes had been practically exhausted in the previous season, the greater part of the traverse section attached to the Provincial Surveys reverted to Imperial employment in October 1901. A small detachment under Mr. F. S. Bell was retained to complete the traverse of alluvial tracts in Etah, and on the completion of this work, has been retained for a future period to undertake the surveys of roads and towns, and such traverse work as may still be required for cadastral purposes.

As it was necessary to complete both traverse and cadastral operations in Etah within the year, the sheets were plotted and all computations worked out in the field, and the skeleton plots and areas of villages made over to the district survey officer during the months of January, February and March.

The area traversed in Etah was 181 square miles, and being in great part subject to inundation, comparatively few of the traverse stations were marked permanently, except on the main circuits, which were run along the adjoining high ground, on which every alternate pair of stations were marked by stones.

The Great Trigonometrical stations of Sarsotha and Jamalpur were connected with the work, and the error thus found was 1'12 feet per linear mile. The mean corrections obtained by observations for azimuth proved to be 4" per angle on main circuits, 3" on sub-circuits and 12" on village circuits. The chaining was good throughout, the corrections made on the meridian being 3 links and on the perpendicular 0'3 links.

The cost-rate obtained by division of the total area traversed by the total expenditure on the work is Rs 21-6-7 per square mile. If, however, the pay of the whole traverse section for September 1901 before the commencement of the work, which was paid in October and not included in the cost-rates of the previous season is included, the cost-rate works out to Rs 30-8-4.

215. *Drawing Section.*—The drawing office was located at Naini Tal under the charge of Mr. Kennedy. Eleven standard sheets, comprising areas in Meerut and Sháhjahánpur, were submitted for publication, but have been returned for certain alterations, and for the entry of available material in surrounding districts. Work has also been in progress in 26 standard sheets in districts Bareilly, Pilibhít, Kheri and Bahraich.

Under the instructions of the Deputy Surveyor-General the efforts of the drawing office will in future be more concentrated on a limited number of standard sheets, to ensure their completion and early publication, and the staff of draftsmen reduced, in order to keep the work well within control.

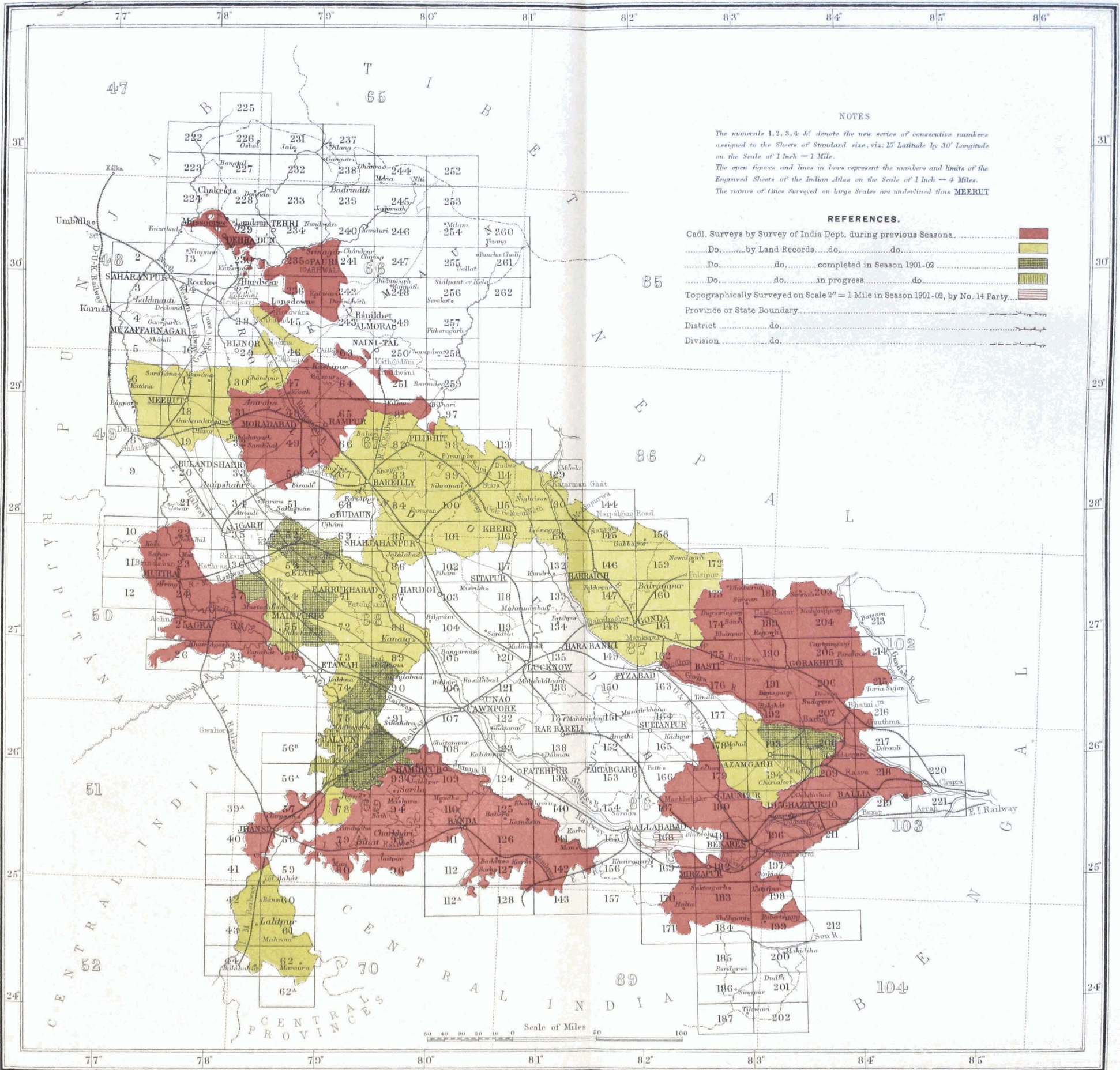
216. *Cadastral Section.*—One cadastral detachment has been employed in each of the following districts: Azamgarh, Mainpuri and Etah, under Messrs. Freeman, Berkeley and Powell, respectively. In Jálaun, in order to shorten the programme of operations by a year, two detachments were employed under Messrs. O. D. and P. C. H. Smart up to the 1st of July 1902, when one of them was disbanded, and the officer in charge, Mr. O. D. Smart, reverted from Provincial employment. The Etah detachment, which will complete the survey and record-writing of the district early in November 1902, will be disbanded. In the Jalesar *tahsil* of Etah, which was professionally surveyed in 1874, new traverse work was not required, and in place of a resurvey, the correction of the existing maps, amounting practically to a resurvey, was carried out.



# UNITED PROVINCES OF AGRA & OUDH.

1901-02.









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



### 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 lines 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.

- |   |   |
|---|---|
| Cadl. Surveys by Survey of India Dept. during previous Seasons.....                   |  |
| .....Do.....by Land Records.....do.....do.....  |  |
| .....Do.....do.....completed in Season 1901-02.....do.....                            |  |
| .....Do.....do.....in progress.....do.....do.....                                     |  |
| Topographically Surveyed on Scale 2" = 1 Mile in Season 1901-02, by No. 14 Party..... |  |
| Province or State Boundary.....   |  |
| District.....do.....do.....   |  |
| Division.....do.....do.....do.....  |  |



The results of the correction were satisfactory, and experience has been gained, which will, it is believed, prove valuable in the event of map correction being required in other districts where the original maps were based on professional theodolite traverse.

All maps before being passed by the officers in charge were checked by European officers, or by partallers working directly under the survey officers. The average linear amount of check lines per square mile of area surveyed was 4.6. Twenty-eight per cent. of the  *khasra*  or field book entries were also checked in the field. Each party was inspected during the cold weather and again in the rainy season by the Superintendent, who also checked a considerable number of maps and records in the field in districts Mainpuri and Etah.

The total area cadastrally surveyed during the year including map correction in Jalesar was 2,507 square miles, and the total expenditure in the several districts amounts to ₹1,78,562 the cost-rate being ₹71.2 per square mile. If, in addition to this expenditure in the districts, the whole cost of the Superintendent's pay and office and the cost of completion of records in Farrukhabad and Gonda is included in the cost-rates of the cadastral section, the mean cost-rate works out to ₹88.5. As the areas left for survey in Azamgarh, Mainpuri, and Jálaun are comparatively small, a higher cost-rate must be expected next year.

The number of  *patwaris*  in the tracts under survey was 1,187, of whom 1,019 qualified as surveyors, 94 were allowed to depute their heirs to do the work, and substitutes were provided for 69, who failed to qualify or were incapacitated through age or other causes. In addition, it was found necessary to employ 44  *amins*  in the alluvial tracts of Etah and in the broken ground in the other districts, but in all cases the record-writing was done by the  *patwaris*  or their heirs. The average outturn in survey per man per diem was 11 acres and in record-writing in the field, 27 numbers, and on map correction, 27 acres.

217.  *Town Surveys.* —The following town surveys have also been completed :—

(1) A survey on the 64-inch scale of Cawnpore Municipality comprised in 193 sheets at the cost of ₹4,635, the cost-rate being ₹553 per square mile.

(2) A survey on the 64-inch scale (with open ground on the 16-inch scale) accompanied by the preparation of a record-of-rights of Ajodhya and Fyzabad for the Local Government comprised in 57 sheets.

The cost-rate of the work up to date, which does not include the completion of the records still remaining to be done, is ₹1,013 per square mile.

(3) A survey on the 12-inch scale, with bazars on the 64-inch scale, of Fyzabad Cantonment for the Military Department, comprised in 7 field sheets, the cost-rate being ₹68.6 per square mile.

(4) The survey of an extension of the civil station of Allahabad, on the scale of 200 feet to the inch comprised in 9 field sheets. The cost-rate of this survey cannot be given till the close of the financial year, when the share of the cost of the traverse section, by which it was executed, will be known.

Each sheet of the above town surveys has been passed after check on the ground either by the Superintendent or by partallers. The execution of such surveys in future will be much simplified as they will form part of the regular programme of the traverse section, a share of the cost of which will be debited to each survey undertaken.

218. During the field season, in addition to the inspection of the traverse and cadastral sections and each town survey, the Superintendent personally conducted a survey training class of 9 Assistant Collectors at Kásganj in the Etah district, and also, under instructions from the Board of Revenue, inspected and reported on the village maps of the Bándá district.

219.  *Road Surveys.* —These were continued in Farrukhabad, Mainpuri, and Jálaun under the system of previous seasons, and 599.51 linear miles of roads were traversed, and the boundaries and other detail recorded in field books for the Public Works Department. The cost-rate worked out to ₹6.10.3 per linear mile. A new method by which plane-table charts will be prepared without field books has been approved by the Public Works Department.

In the rainy season the Superintendent inspected each cadastral party, and checked the work in the town and cantonment surveys of Allahabad, Fyzabad and Ajodhya.

220. The programme of surveys for 1902-03 is as follows :—

(1) *Traverse*.—Three hundred square miles in district Moradabad.

(2) *Cadastral*.—The completion of the cadastral survey, and record-of-rights under the two years' system in the following districts :—

Azamgarh	<i>tahsil</i>	Muhammadabad.
Mainpuri	„	Mustafabad and Shikohabad.
Jálaun	„	Jálaun and Kúnch.

(3) *The training of patwaris*, to enable them to maintain their maps in those parts of Allahabad where the cultivation is fluctuating.

(4) *Municipalities*.—The survey on the 64-inch scale (with open ground on the 16-inch scale) of Koil (Aligarh), Háthras, Sikandra Ráo, Atrauli, entirely at the cost of the Municipalities concerned.

(5) *Roads*.—The survey of Public Works Department roads in Etah, Agra, Muttra, Aligarh, Bulandsháhr, Moradabad, Meerut, Muzaffarnagar and Saháranpur, at the cost of the Public Works Department.

221. The offices of the traverse and drawing sections at Naini Tal were inspected by the Surveyor-General and Deputy Surveyor-General in October 1901, and the Deputy Surveyor-General inspected the drawing office again in October 1902.

## BENGAL.

### NO. 4 PARTY.

222. The traverse and cadastral survey operations in Bengal employed 5 traverse and 4 cadastral camps and detachments. The outturn of work accomplished, *viz.*, 4,171 square miles traverse, 2,132 square miles cadastral, 2,078 square miles record-writing and 23 square miles of topographical survey, is fully up to the programme, and is comprised in major operations in 10 districts and 9 minor surveys. The outturn was considerably larger than that of the foregoing year, and great difficulty was experienced in obtaining the necessary extra establishments. A training school was formed at Dumka for theodolite traverse surveyors, and tindals and local *amins* were trained at Kálimpong and Barisál for the Darjeeling and Backergunge surveys respectively.

### DARJEELING.

223. The survey of the Kálimpong Government estate, area 182 square miles, proved a very difficult task, especially with the indifferent local establishments available. The work commenced in October 1901 and was completed by July 1902. The expenditure on traversing was ₹11,146, with a resultant cost-rate of ₹61·2 per square mile. This high cost-rate is due to the very hilly and difficult nature of the country, which made chaining impossible and compelled the utilization of the subtense bar method of arriving at distances throughout the area under survey. The cadastral survey and record-writing, cost ₹29,811 which gives a cost-rate of ₹163·8 per square mile. This includes the cost of providing chainmen and coolies at very high local rates and, considering the very difficult nature of the work, is not an excessive cost-rate.

### MONGHYR.

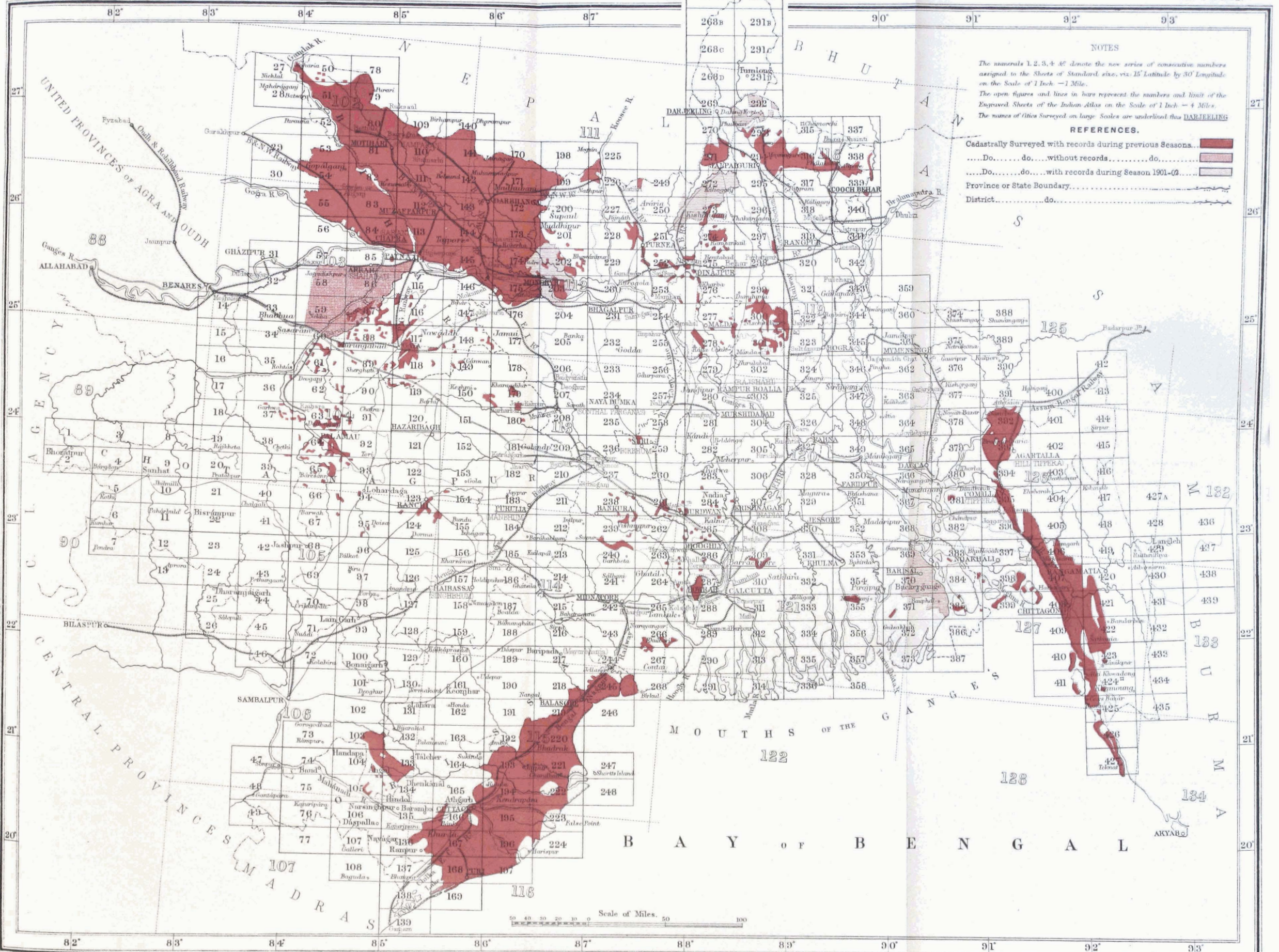
224. The area traversed, *viz.*, 196 square miles, to complete the district as far south as the southern high bank of the Ganges was all low lying and practically all *diára*. Within this tract a considerable number of villages of the Srinagar-Baneli Raj which had been surveyed in 1887-88 were excluded from the current operations. A great deal of trouble was experienced in attempting to connect the new traverses with the old, as although in many cases marks of the former survey were found on the ground it was evident these marks were not in their original positions, and it appears that the marks had been shifted from the traverse points on to the true boundaries of the villages. The result was that no

# BENGAL SURVEY.

## INDEX TO THE CADASTRAL SURVEYS IN BENGAL.

1901-02.

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 = 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 1901-02.....

Province or State Boundary.....

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

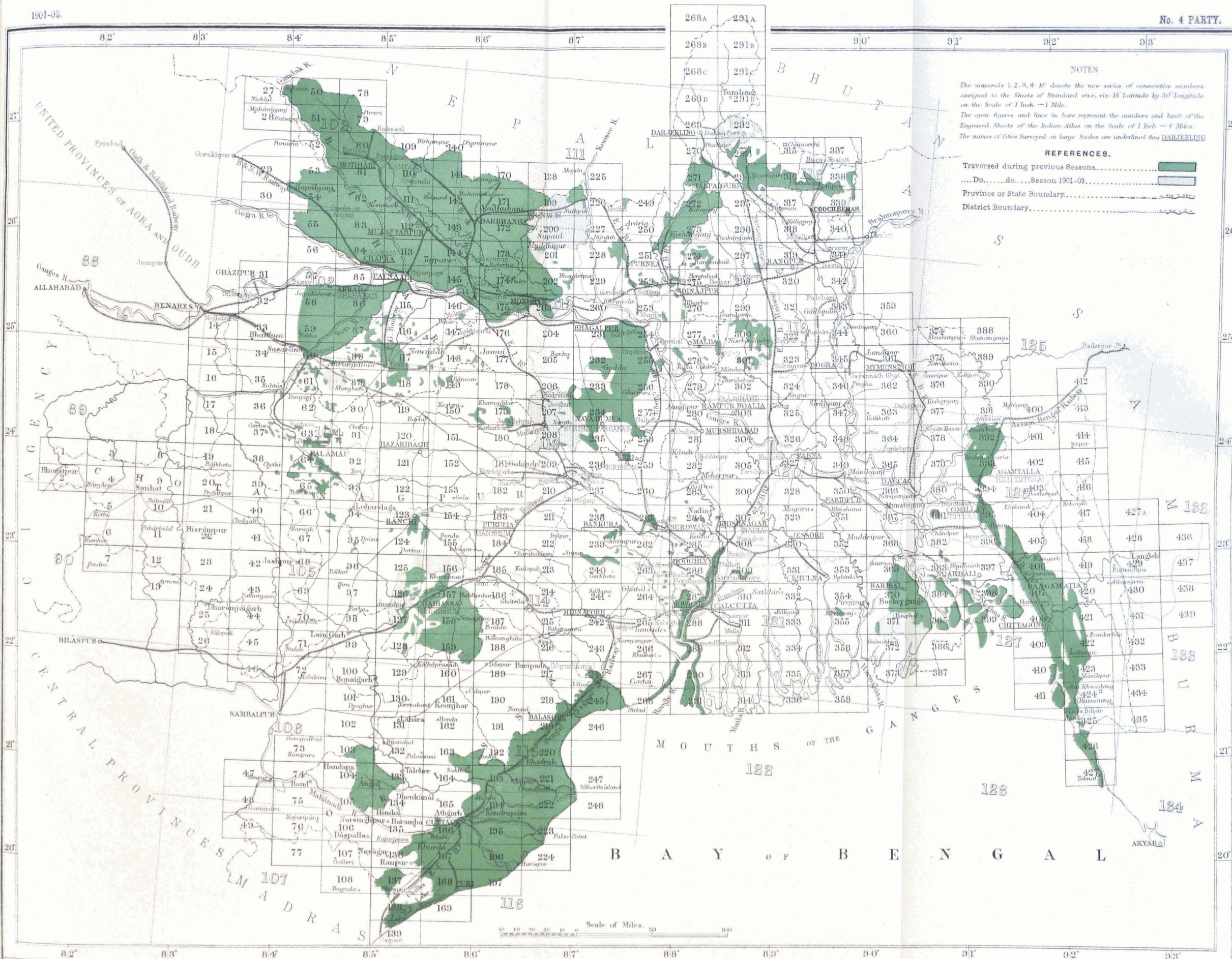
Scale of Miles. 50 100

# BENGAL SURVEY.

## INDEX TO THE TRAVERSE SURVEY IN BENGAL.

1901-02.

No. 4 PARTY.



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268C	291C
268D	291D
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### NOTES

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### REFERENCES.

- Traversed during previous Seasons.....
- Do.....do.....Season 1901-02.....
- Province or State Boundary.....
- District Boundary.....

Scale of Miles. 50 100



connections could be made and new traverses had to be run along the Srinagar-Baneli village boundaries and the two surveys fitted together by means of an overlap survey during the cadastral stage. The expenditure on traversing, including cost of putting down a line of permanent marks along the southern high bank of the Ganges for purposes of future connection, was ₹7,283, which gives a cost-rate of ₹37'1 per square mile.

The cadastral survey of 640 square miles and the record-writing of 652 was accomplished during the season under report. This area comprised the 196 square miles traversed during the same season and the balance consisted of high lands traversed during previous seasons. The expenditure, including the detail overlap survey referred to above which covered an area of 20 square miles, was ₹78,235 and the resultant cost-rate is ₹121'4 per square mile, which is a low rate for Bengal surveys when it is remembered that the services of the Land Records staff are not available free of charge as in other Provinces, and that all labour has to be paid for in full and at high rates. In addition to the cadastral survey an area of 20 square miles consisting of permanently settled estates lying in the Ganges *dáira* has been surveyed topographically on the 16 inch = 1 mile scale at a cost-rate of ₹17'3 per square mile.

#### PURNEA.

225. The cadastral survey with records of the *Súrjapur pargana*, which had been traversed during the previous season, was carried out during the year under report. The area accomplished of both cadastral survey and records was 728 square miles at a cost of ₹1,37,364 which represents a cost-rate of ₹188'7 per square mile. The reasons for this rate being higher than that of Monghyr are several, *viz.*, (a) unhealthiness of the tract under survey, (b) higher rates of payment for labour and (c) smaller average size of the field. The Kishanganj sub-division of the Purnea district is notoriously one of the most unhealthy tracts in Bengal and the establishments suffered very severely. Never more than half the establishment was fit for field work and even such men as could work were debilitated by malarial fever and gave very low outturns of work. A large number of men absconded, and out of the many men who had to be sent to their homes a considerable number have died. The European supervising establishment have suffered equally severely.

#### BHÁGALPUR.

226. The traverse survey of the Bhágálpur district was commenced during the year under report, and an area of 1,095 square miles has been accomplished at a cost of ₹28,654, which gives a cost-rate of ₹26'2 per square mile.

#### GAYA.

227. An area of 121 square miles, representing the Deo Wards estate, has been traversed for subsequent cadastral survey by the Settlement Department. The estate is comprised in two main and several small scattered blocks. The expenditure has been ₹4,701, which gives a cost-rate of ₹39 per square mile.

#### BACKERGUNGE.

228. The traverse operations in this district, which were in continuation of those of the previous year, covered an area of 690 square miles, but out of this area 40 square miles, having already been surveyed in detail by the Settlement Department, have now been traversed only with a view to obtaining the true geographical values of the trijunction points. The whole tract under survey is intersected by tidal rivers and narrow winding creeks, and is therefore difficult to work in. The work was much delayed at the commencement of the field season by the unusually late and heavy rains, and afterwards by stormy weather in the Bay which made work among the islands dangerous. The entire tentage of the detachment was destroyed in a cyclonic storm on the 13th of March, but fortunately the records were carefully secured, and suffered no damage. The expenditure was ₹42,726, which gives a cost-rate of ₹61'9 per square mile. The reasons for this high rate are to some extent apparent from the foregoing remarks, but it must also be remembered that all labour has to be imported, and



paid at very high rates. The cadastral survey and record-writing was confined to the area traversed during the previous season. The area accomplished was 569 square miles of cadastral survey, and 503 of record-writing. The cost-rates are R170·8 for cadastral survey and 102·5 for record-writing. These abnormally high cost-rates are due mainly to the very inferior material the establishment was composed of, and also to the heavy expenditure on coolie labour. The majority of the Bengali inspectors and *amins* have proved to be very corrupt and lazy. The average outturn per *amin* amounted to only 250 acres a month. For this outturn, the expenditure on his chainman and coolies was R32 a month, which represents, with additions for proportionate shares of supervision, an approximate cost-rate of R101 per square mile. The utilization of a purely Bengali agency had been insisted upon, but the introduction of a proportion of foreign inspectors and *amins* has now been agreed to, and this, with several other changes, affords every reason for anticipating a very large reduction in the cadastral rates. Bengalis must, however, be employed on the record-writing, which is very intricate, and on the completion of records and statistics, so no very great reduction under the head of record-writing can be anticipated. During the recess season 400 *amins* and *moharrirs* were trained for the completion of records and statistical work, but in August about half absconded owing to an outbreak of cholera and had to be replaced by untrained establishments.

#### SONTHAL PARGANAS.

229. During the year under report 788 square miles of private estates have been traversed for subsequent detail survey by the Settlement Department, also 243 square miles have been traversed with a view to obtaining the true geographical values of the trijunction points in a tract of country surveyed some years ago in detail by Mr. Craven. This trijunction traversing will allow of the utilization of Mr. Craven's maps, after reduction and topographical revision, for standard mapping purposes. The cost-rates are R43·8 per square mile and R6·6 per square mile for the ordinary *mouzarwar* traversing and trijunction traversing respectively.

#### SINGHBHUM.

230. The traverse survey of the Anandapur estate and of the remaining portions of Poráhát and Kera estates has been accomplished during the year under report. The whole area traversed was 298 square miles, which completes the programme in this district. The cost-rate of the work was R31·9 per square mile.

#### RANCHI.

231. The traverse survey of the Munda country in this district has been commenced, and 430 square miles in the south-eastern portion of the district has been traversed during the year. The tract of country under survey was very hilly and jungly, and the subtense bar had to be used generally instead of the chain. This portion of the district is very unhealthy and the establishment suffered severely from malarial fever and several men have died. The cost-rate of the work was R60·5 per square mile. The reasons for this high rate are as indicated above.

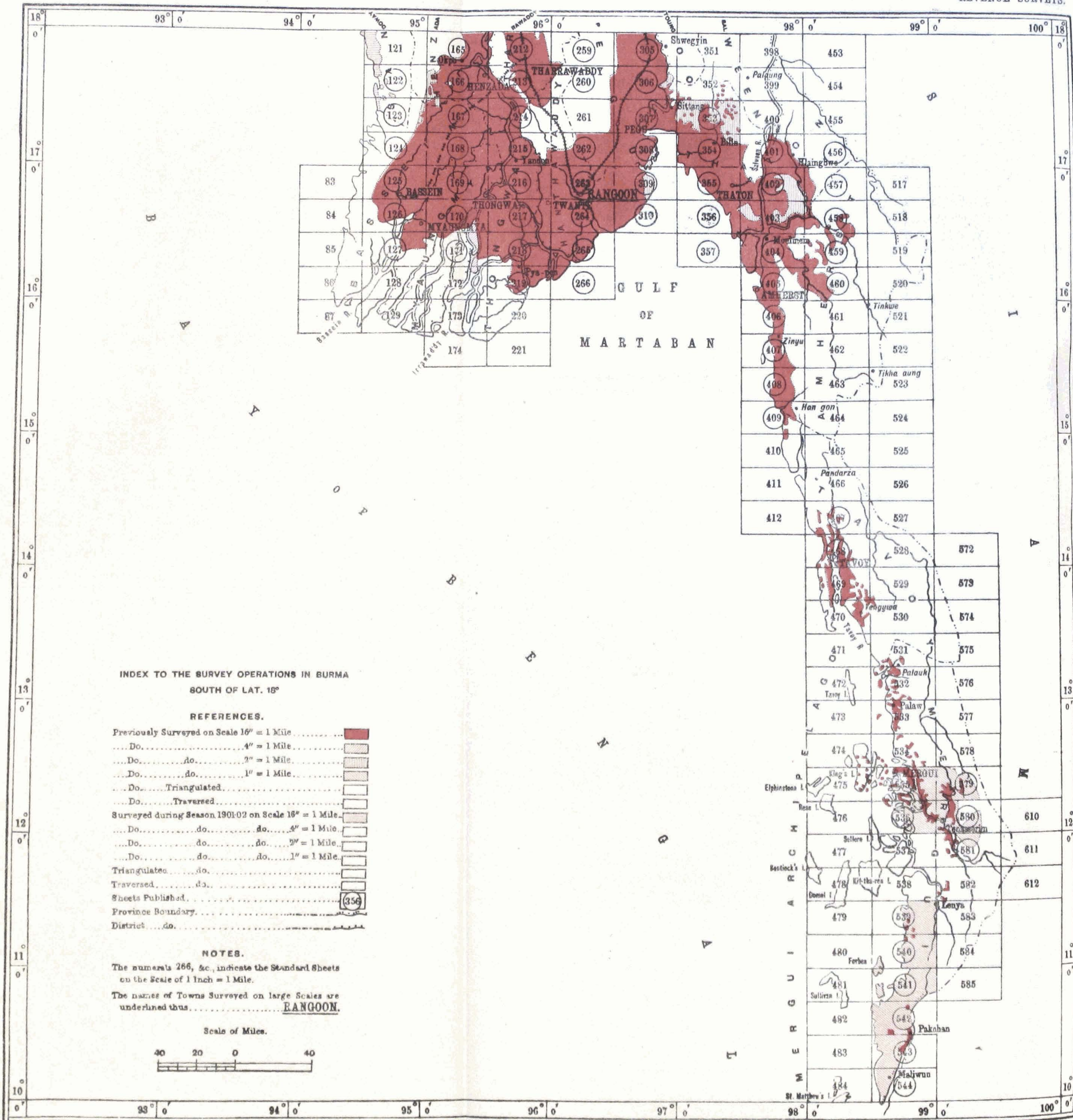
#### MISCELLANEOUS SURVEYS.

232. In the Patna district 47 square miles of scattered Government estates have been traversed. In Bhágalpur 3 square miles in the Ganges *diára* have been surveyed topographically. In Malda the boundaries of some Government estates have been relaid. Surveys in connection with the relaying of boundaries for the settlement of boundary disputes have been carried out in the Champáran, Shahabad, Monghyr and Darbhanga districts. A large scale survey of the Monghyr fort and surrounding area has been accomplished, and in Southern Monghyr 36 Government estates, with an area of 11 square miles, have been traversed and cadastrally surveyed. The boundary of the Baikuntpur estate in the Jalpaiguri district, which had been relaid during the previous season, has now been permanently marked.

#### BENGAL DRAWING OFFICE.
















233. During the year under report the general extension of work on Bengal surveys and the taking over of the work of reproduction of village maps by the





INDEX TO THE SURVEY OPERATIONS IN BURMA  
SOUTH OF LAT. 15°

REFERENCES.

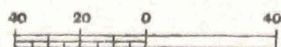
Previously Surveyed on Scale 16" = 1 Mile	
Do. do. do. 4" = 1 Mile	
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Do. Triangulated	
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Traversed do.	
Sheets Published	
Province Boundary	
District do.	

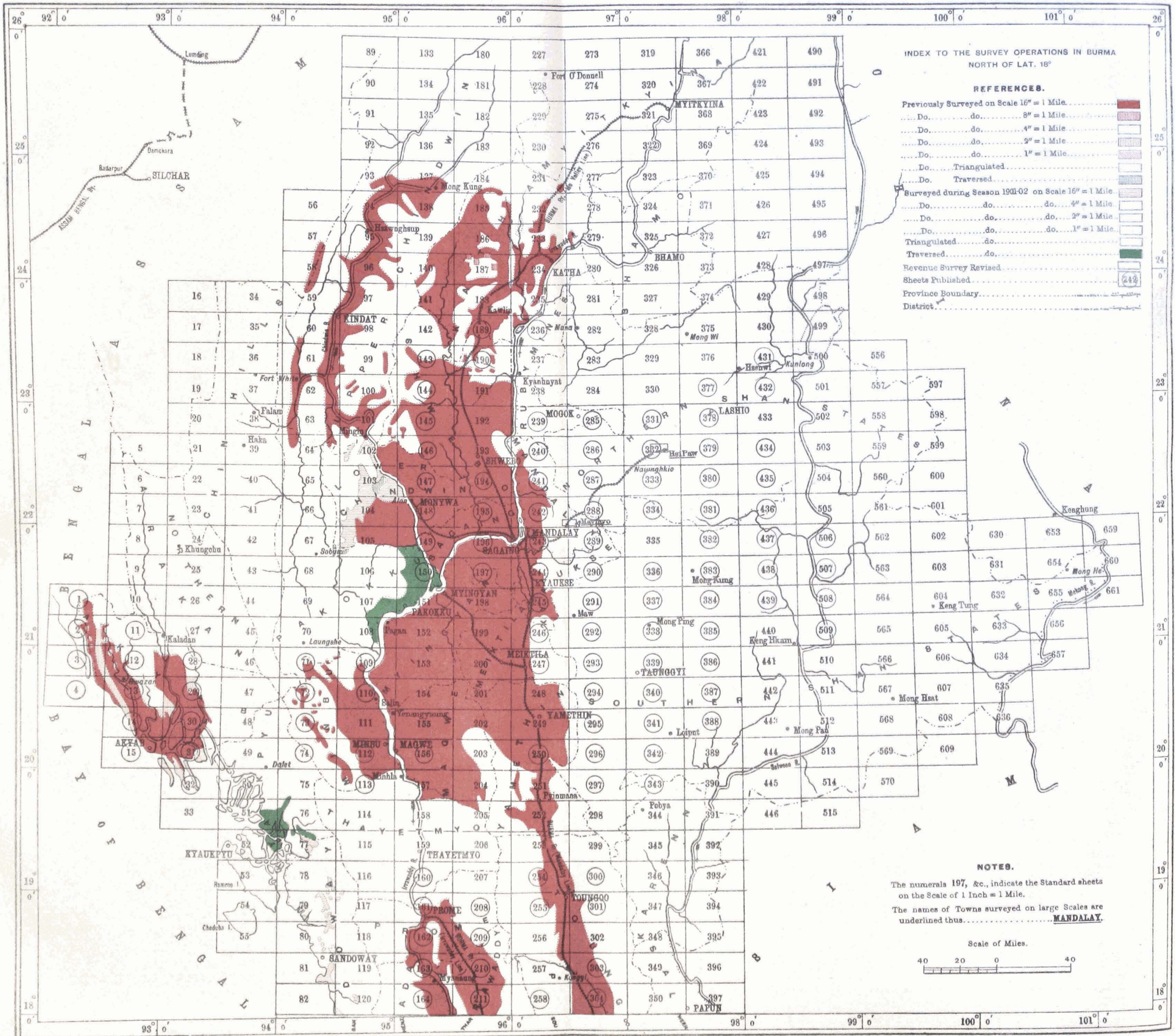
NOTES.

The numerals 266, &c., indicate the Standard Sheets on the Scale of 1 Inch = 1 Mile.

The names of Towns Surveyed on large Scales are underlined thus. RANGOON.

Scale of Miles.





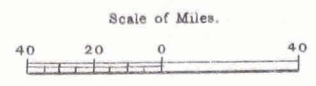
INDEX TO THE SURVEY OPERATIONS IN BURMA  
NORTH OF LAT. 18°

- REFERENCES.**
- Previously Surveyed on Scale 16" = 1 Mile
  - Do. do. do. 8" = 1 Mile
  - Do. do. do. 4" = 1 Mile
  - Do. do. do. 2" = 1 Mile
  - Do. do. do. 1" = 1 Mile
  - Do. Triangulated
  - Do. Traversed
  - Surveyed during Season 1901-02 on Scale 16" = 1 Mile
  - Do. do. do. 4" = 1 Mile
  - Do. do. do. 2" = 1 Mile
  - Do. do. do. 1" = 1 Mile
  - Triangulated
  - 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.





Vandyke process has necessitated the provision of more commodious quarters for the drawing office. A new office in Calcutta has been occupied since April 1902 which affords ample accommodation. The standard mapping of Orissa, Bihár and Chittagong is in hand, that of Orissa and Chittagong being practically completed. In Bihár a preliminary edition of the Muzaffarpur district has been published, and the standard maps of Sâran and Champâran are well advanced, whilst a start has been made with Darbhanga. The *thâna* maps of the foregoing districts have made fair progress, but the publication of most has been delayed owing to discrepancies in the spelling of village names. This has now been rectified, and a large number will be available shortly. The reproduction of village maps by the Vandyke process has been taken over by the Bengal drawing office after purchase of the necessary plant from England, and has made rapid progress. The existing programme, which provides for the supply of 10 copies of 19,000 sheets of Orissa, and of 2,950 sheets of Chittagong, will at the present rate of progress be completed by August 1903. There has also been a considerable amount of miscellaneous work in the Bengal drawing office in connection with the correction of maps of current surveys in accordance with changes notified by the Settlement Department, and also in connection with the correction of spelling of village names in the maps and traverse records of several seasons' work.

234. Major R. T. Crichton, Superintendent of Provincial Surveys, inspected each camp and detachment on an average three times during the field season, and once again during his monsoon tour of inspection.

UPPER AND LOWER BURMA.

NO. 7 PARTY.

235. The operations in Upper Burma were in continuation of those of the previous season. Mr. J. Connor continued in charge until the 6th November, when he was relieved by Major G. B. Hodgson. On the 1st September Major Hodgson proceeded on short leave and the charge devolved on Lieutenant C. P. Gunter, R.E., who joined the party on the 7th November 1901.

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

<i>Locals.</i>	Traversing.	Detail Survey.
<b>UPPER BURMA.</b>	Square miles.	Square miles.
Lower Chindwin (completing the district) . . . . .	...	545
Pakòkku . . . . .	911	...
<b>LOWER BURMA.</b>		
Sandoway (completing the district) . . . . .	16	120
Kyaukpyu . . . . .	145	...
<b>TOTAL</b> . . . . .	<b>1,072</b>	<b>665</b>

The area in Kyaukpyu proved to be nearly double the estimate, and only about half of it was traversed. This under-estimation appears to be due to the fact that the local authorities, in stating their requirements, only gave the estimated area of the land under cultivation, whereas the *kwin* boundaries had to be traversed and they enclose a much larger area than the cleared lands.

237. The following alterations in procedure, etc., were made this season:—

- (a) Topographical details in jungle were omitted, and the rigorous survey of village sites discontinued.
- (b) New arrangements were introduced for supplying printed copies of the 16-inch cadastral sheets to the local authorities.

The traces which they have hitherto always received at the end of each season are now sent to Calcutta in batches of 100 or so at a time, and 30 printed copies of each trace struck off at once by the Vandyke process and

despatched to Deputy Commissioners, so that about three months or so after the close of each season, the full number of copies of each map required by the Settlement Department should be in their hands.

(c) When no longer required by the survey party, the original field sheets will in future be sent to the Deputy Commissioners of districts for record, instead of to the Surveyor-General's Office at Calcutta.

(d) The preparation of duplicate area statements was discontinued.

238. During the field season the sections employed in Upper Burma enjoyed excellent health, but during recess at Mandalay there was a good deal of sickness and two computers died. In Lower Burma, as might be expected, the establishment suffered a good deal from fever and sores on the legs caused by continual wading in the brackish mud of mangrove swamps. Three men died and ten were invalided to their homes.

239. The cost-rates for the season are—

#### UPPER BURMA.

	₹
Traverse survey, per square mile . . . . .	57
Cadastral survey, per square mile . . . . .	115

#### LOWER BURMA.

	₹
Traverse survey, per square mile . . . . .	172
Cadastral survey, per square mile . . . . .	209

Taking Upper Burma first, the cost of the traverse survey is a little less than it was last season. This is due to the easier nature of the work and to the larger outturn and in a small measure to the introduction during the latter part of the field season of line-clearing squads. The cost of the cadastral survey is slightly above last year's, due entirely to the higher cost of superintendence, but for which the rate would have been much less, owing to the omission of topographical details in jungle. In Lower Burma the cost of the traverse survey is less than half what it was last season owing to the larger scope of the operations.

#### UPPER BURMA.

240. The traverse survey was in charge of Mr. G. W. Jarbo. Lieutenant C. P. Gunter, R.E., was attached to this camp for a short time for training in practical traverse work, whilst Babu Abinash Chander Bose was employed in inspecting the traverse surveyors and line-clearers in the field. The subordinate establishment consisted of 12 traverse surveyors and 8 computers. Two probationary Superintendents of the Land Records Department, Messrs. Nolan and Adamson, were attached to this camp for one month only to learn the rudiments of traverse work. The traverse survey of the Pakökku district was commenced this season. The area traversed comprises the Pakökku and Yezagyo townships lying on the right bank of the Chindwin and Irrawaddy rivers. About one-third of the area consists of flat alluvial land and the rest of low hills or broken ground covered with scanty scrub jungle and deeply indented with ravines, with patches of cultivation scattered about in the valleys. Water was very scarce after the middle of February, and the surveyors sometimes had to send long distances for it. The traverse survey was not intelligently supervised. Main circuits were carried over hills and no use was made of subtense bars as should have been done. Very short lines are the rule rather than the exception, and the traverse surveyors were permitted to do their own line-clearing. This will be rectified next season. The demarcation was very defective. Wooden posts had merely been erected here and there at intervals to mark out the general run of the boundaries, but the actual boundaries were not indicated at all. This has been brought to the notice of the local authorities, and it is hoped that next season there will be an improvement. The demarcation maps were excellent and of much assistance.

The traverse section took the field on the 6th November and returned to recess quarters at Mandalay on the 24th April. The theodolite

stations were marked with galvanized iron cylinders. The angular work was checked by observations for azimuth at 90 stations and the angular error is one minute in 17 angles on main circuits, and 1 minute in 13 angles on village circuits. Double chaining was employed on main and sub circuits only and the chain measurements were checked by connection with one intersected point of the Great Trigonometrical Survey-Shinmataung h.m.—and five triangulation stations of the Topographical Survey. Unfortunately these points were all fixed during the season under review and final values were not available in time to enable the results of the connections to be computed. Without them the average error in the chaining is 0.43 links per *mille* and the circuits all closed satisfactorily. All the computations have been completed as far as possible, under the circumstances explained above.

241. Mr. J. Connor was in charge of the cadastral section until he retired, when Mr. J. S. Swiney took his place. He had only one assistant for testing the work, Babu Abinash Chander Bose, for the first half of the field season and Lieutenant C. P. Gunter, R.E., for the latter half. The survey was tested by 670 linear miles of check lines excluding those of the inspectors, an average of 6.3 linear miles to each square mile actually surveyed; but this includes boundary *partals*. Field work continued till the end of April. The average number of *amins* was 48, employed for an average of five months.

242. During recess the 16-inch field sheets were all completed and traces forwarded to Calcutta for reproduction by the Vandyke process with the exception of 99 which contain only jungle blocks and will be completed during the ensuing field season. The maps were entirely outlined in ink by the field surveyors, the boundaries only being left in pencil for comparison in office. Standard sheets 146, 149, 194 and 195 were sent to Calcutta for publication on the 1-inch scale, and sheets 102, 103, 104, 105, 147 and 148 will be sent very shortly. After publication, blue prints of these on the reduced scale will be supplied to No. 10 Party for revision of the topographical details and filling up of gaps. As there is not sufficient detail in sheets 101 and 67 to justify their publication they will be handed over to No. 10 Party, and traces, which are in hand, prepared for the local authorities. In addition to the work of the current season, traces were prepared of 599 16-inch field sheets containing 257 *kwins* of the previous season's work and forwarded to Calcutta for reproduction. There are 625 sheets of the previous season still remaining to be traced, and these will be done during next field season. Much miscellaneous work was also done for the Settlement Department and all arrears have now been completed.

The alterations in *kwin* boundaries give an immense amount of work. Fresh traces and area statements have to be prepared and the original 16-inch maps and 2-inch standard maps altered to correspond. This would be avoided if the work of the demarcation officer were examined before the survey is done. In future it will entail the printing of fresh copies of the 16-inch maps as well. Up to date the number of *kwins* so dealt with in the Yamèthin district, which was surveyed in 1896 and where settlement operations have been in progress for some time, is 642.

243. The programme for next season consists of the traverse survey of 425 square miles and the cadastral survey of 600 square miles in Pakòkku and the traverse survey of 200 square miles in Shwebo.

#### LOWER BURMA,

244. The work in Lower Burma, both traverse and cadastral, was continued under the supervision of Mr. J. S. Swiney, under whom the previous season's work was carried out. He was assisted during the field season by Babu Jagdamba Prasad. The subordinate establishment consisted of 8 theodolite surveyors and 3 computers for the traverse survey, and 1 inspector, 13 *amins*, 2 estimators, and 5 draftsmen for the detail survey. The traverse survey of the Sandoway district was completed this season and that of Kyaukpyu taken up. The origin of survey for the two districts is the same, *viz.*, the intersection of  $\begin{matrix} \text{Lat. } 16^{\circ} 00' \text{ N.} \\ \text{Long. } 94^{\circ} 30' \text{ E.} \end{matrix}$  and is the same as that of the survey by local agency. Only the stations on the *kwin* boundaries were permanently marked with galvanized iron cylinders. The 99 *kwins* surveyed in detail were scattered in small isolated



patches dotted about throughout the district, of which the greater part has been surveyed by local agency.

The detail survey was checked by 122 linear miles of test lines excluding those of the inspector, which is an average of a little over 1 mile for every square mile of survey. The traversing was connected with two stations of the Great Trigonometrical Survey, but there is a chain error in one of the village circuits affecting the connection, which will be revised next season. The average error in the chaining on the village circuits is 0·73 links per *mille*. Double chaining was employed throughout. The angular work was checked by observations for azimuth at 49 stations, and the average angular correction is one minute in 30 angles. The demarcation was very defective and the village headmen were only able to point out the boundaries of circles (*taiks*), and as their circles were sometimes very large, the *thugyis* could not readily be got hold of. Consequently the traverse surveyors, when in difficulty, generally accepted the demarcation maps as their guide. The boundaries generally ran along a footpath, stream or other natural feature, so the maps proved of considerable use, as the nature of each boundary was carefully recorded on them. In the detail survey the same difficulty was met with respect to the boundaries, and in jungle where no marks were found and the boundaries could not be pointed out, the traverse lines have been taken as the boundary.

245. The field establishment assembled at Sandoway on the 25th October, but field work was not in full swing till over a fortnight later. The traverse establishment had to make a journey of 130 miles by steam launch to the nearest point of the Kyaukpyu district and the *amins* proceeded by land, some of them having 120 miles to go and all having to carry their belongings themselves as carts are almost unknown in Arakan, and coolies not procurable. Field work closed on the 23rd May. The entire area that came under survey was densely wooded except where cleared for cultivation. It was intersected by numerous creeks, forming in the Kyaukpyu district a net-work of islands which are fringed with mangrove swamps extending in places to a width of nearly a quarter of a mile from the open water. Unfortunately these creeks represent the larger part of the *kwin* boundaries, and the traverse lines had to be run through the mangrove rendering the work extremely difficult and costly. The traverse computations have all been completed with the exception of the work dependent on the connection with the Great Trigonometrical Survey, of which some of the measurements require revision.

246. The 16-inch cadastral sheets were all completed and traces of all prepared and forwarded to Calcutta for reproduction. No standard fair mapping has been drawn for publication as the amount of detail falling into each sheet is so small, but as, the Land Records Department have published maps on that scale of the surveys done by local agency, 2-inch reductions have been furnished to the local office for incorporation in their maps.

247. The programme for next season is the completion of the traverse and cadastral survey of the Kyaukpyu district. The area remaining for traverse survey is supposed to be about 120 square miles and 265 for cadastral survey but these figures will probably be found above the mark, as the work will be very much simplified next season when confined to the cleared lands. With the concurrence of the Local Government the traverse lines will be run round the clearings only, and the *kwin* boundaries and topographical details in jungle will not be surveyed.

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## CENTRAL PROVINCES.

### CENTRAL PROVINCES DETACHMENT.

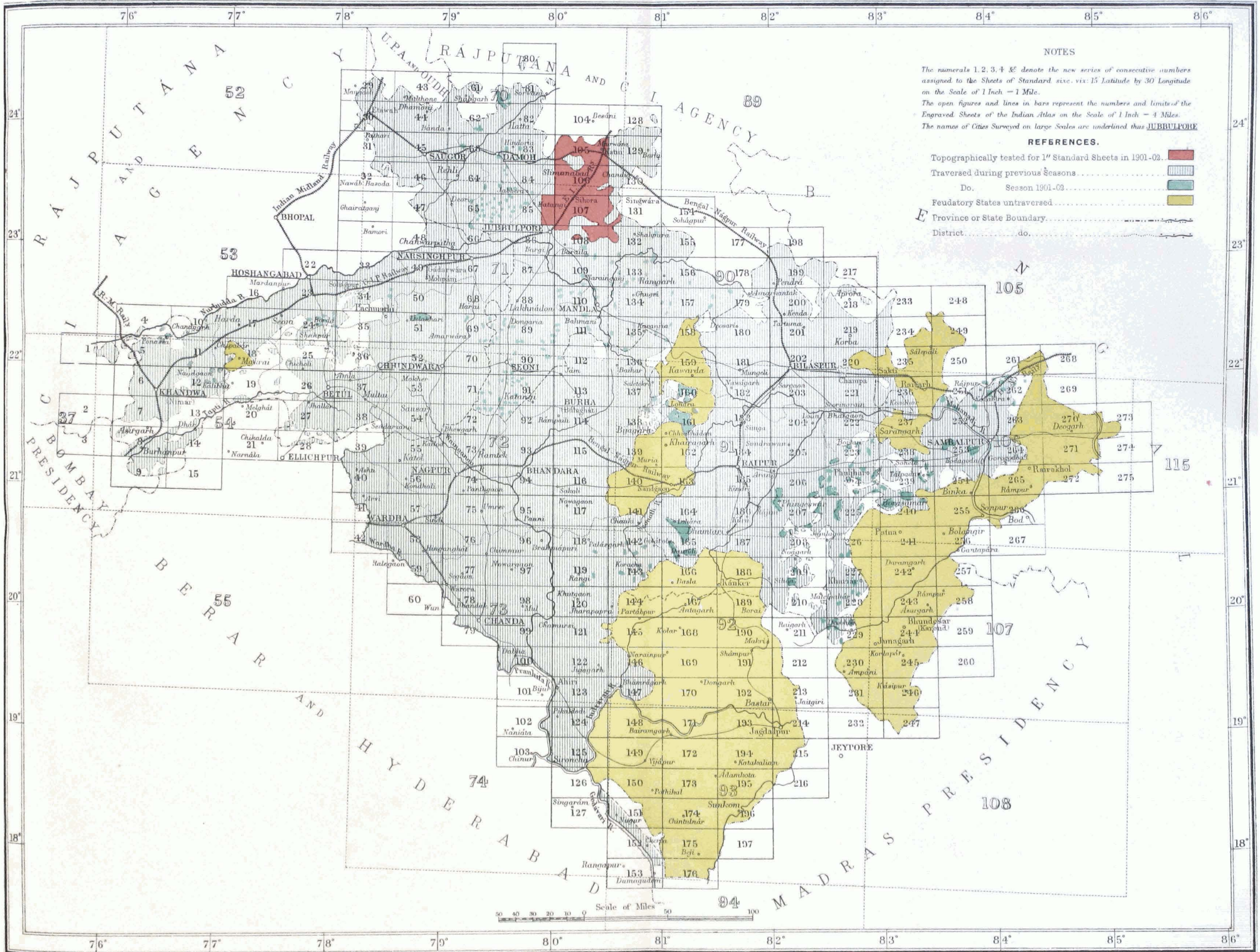
248. Mr. R. C. Ewing held charge of the detachment and was assisted in the topographical revision by Mr. M. Gastaud and Khan Sahib Ikbaluddin. Khan Bahadur Imam Sharif continued in the detachment till 31st December 1901, when he proceeded on combined leave; Khan Bahadur Yusuf Sharif was in the drawing section till 18th December, when he retired on superannuation pension.

# CENTRAL PROVINCES SURVEY.

## INDEX TO SURVEYS IN THE CENTRAL PROVINCES.

1901-02.

C. P. DETACHMENT.

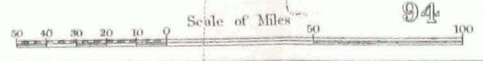


### NOTES

The numerals 1, 2, 3, 4 & E denote the new series of consecutive numbers assigned to the Sheets of Standard six, 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 JABALPUR

### REFERENCES.

- Topographically tested for 1" Standard Sheets in 1901-02.
- Traversed during previous Seasons
- Do. Season 1901-02
- Feudatory States untraversed
- Province or State Boundary
- District  do.



Engraved under the superintendence of J. Fulford.



249. The field operations of the season commenced on 1st November 1901 and comprised—

- (a) Traversing of detached villages (excised from Government forest reserves) in 9 districts of the Province in compliance with the requirements of the Commissioner of Settlement and Agriculture.
- (b) Preparation of field sections for the topographical surveyors.
- (c) Revision in the field of the details reduced from the 16-inch scale cadastral maps surveyed by local agency, and surveying the topographical features omitted.

250. The traversing consisted of enclosing polygons in skeleton (*i.e.* without measuring offsets to boundaries) of excised portions of forest reserves, or of jungle villages whose rent being below ₹15 were omitted at the previous survey, but had now exceeded that sum. There was no demarcation done, nor any needed as the abandoned forest boundary formed in itself three sides of the new village, while the present boundary showed the fourth side.

The theodolite was set up on as many prismatic compass stations of the *patwari's* survey as could be found or identified, and in this connection great inconvenience was felt at the commencement by the non-attendance of the *patwaris*, who were engaged in their fiscal work.

The area traversed was as follows:—

District	Square miles.
Damoh . . . . .	37.5
„ Hoshangábád . . . . .	23.6
„ Chhindwára . . . . .	10.9
„ Nimár . . . . .	21.1
„ Chánda . . . . .	35.6
„ Raipur . . . . .	358.8
„ Sambalpur . . . . .	119.7
„ Mandla . . . . .	54.7
„ Seoni . . . . .	53.5
	715.4

There were traversed 1 sub-circuit checked by 5 azimuths, 570 village circuits, and 630 sub-traverses; the polygons were too scattered to permit of main or other sub-circuits. The average angular error was 4," and the linear error per 100 chains, was 8 links. Connections were made to six G. T. stations, only one of which was used in the sub-circuit, the others being connected with detached villages, could not be used, but will be of service when computing the co-ordinates of villages from origin of survey for plotting of village trijunctions on the 2-inch field sections. The disputed boundary between *jagirs* Pagára and Batkagarh, district Chhindwára, was also traversed at the request of the Deputy Commissioner, to whom the maps and records have been sent for adjudication.

The theodolite stations of the previous surveys on village trijunctions and marked by stones, were generally found except a few riparian ones, also some of the other stations, whilst new stones were embedded where necessary in place of missing ones. The new traverse stations have been marked by embedding undressed stones, about 2 feet underground and 1½ feet 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. The 16-inch skeleton plots with their numerical data have been supplied to Deputy Commissioners for completion of the detail survey by the *patwaris*, aggregating 570 villages in 983 sheets.

The area traversed is 715.4 square miles costing ₹17,503 or ₹24-7-8 per square mile.

251. For the topographical work of revising and completing the field sections, 9 sub-surveyors were transferred to this detachment and 9 men were taken off from the drawing and traverse sections and put through a course of training. The area revised was 1,936 square miles on the 2-inch scale falling in 5 standard sheets in district Jubbulpore, the mapping of which will be completed by close of recess. The accuracy of the work was tested by 923 interpolations, and 24 miles of chaining. The hills were delineated by contours

at vertical intervals of 50 feet apart, determined by numerous clinometric deductions. The hills being low and forest clad, necessitated chaining which under such circumstances is always slow and tedious.

The details reduced from the 16-inch cadastral sheets, and transferred in blue on the field sections were found to be sometimes misleading. Limits of cultivation, which is always a fluctuating quantity, could not always be identified on the ground; again the village sites in the cadastral maps only showed the outer limits of area allotted for building on, whereas the survey had to show only the area actually occupied as such. The hills were not surveyed by the cadastral party, but were merely shown as conventional signs, and therefore of no service; streams flowing through jungle, and ravines were mere eye sketches, or omitted altogether; on the other hand the streams through cultivation, tanks, high roads and railway lines were found in correct position, though in the case of high roads and railway lines all bridges, culverts and mile-stones had to be inserted. This was the surveyors' first attempt at this kind of revision, and as many were inexperienced some attempted to be too minute, while others were disposed to generalize too freely. Much assistance was expected from village trijunctions as initial points of departure for the surveyors, but the *patwaris* and *malguzars* could not be got to attend to point out their positions, and the platforms of a very large number were found not to have been constructed. The Deputy Commissioner has notified his intention of having them constructed shortly.

The cost of this section is ₹18,351, which gives the result of ₹9-7-8 per square mile.

252. The drawing section was engaged in the preparation of field sheets preparatory to their verification, correction and completion of topographical details by surveyors in the field. The village trijunctions are first plotted, and then the original 16-inch cadastral surveys are reduced by pantograph to the 2-inch scale and transferred to the field sheets and inked in blue. The details of the 4-inch forest surveys are also reduced and transferred in burnt sienna to the field sections, by using the village trijunctions common to both. The cost of the drawing section was ₹7,378.

253. The party returned to recess quarters during the first week of May, when the hot winds became very oppressive and the haze obscured the hills; the topographers had uniform good health, while the traversers suffered for a short while only from malarial fever at the commencement of the field season, more particularly in the *semindari*s of Raipur.

254. The programme of the coming season comprises—

- (a) the traversing of 671 square miles, which will complete the traverse work of this Province, so far as is at present known;
- (b) the topographical revision of the remainder of district Jubbulpore and eastern half of district Damoh, approximately about 3,000 square miles;
- (c) the preparation of field sections.

255. In November 1901 the drawing office was inspected, and in January 1902 the topographical revision section by Major Longe, R.E., Officiating Deputy Surveyor-General, and during the recess in August by Major Bythell, R.E., Officiating Deputy Surveyor-General.

## ASSAM.

### ASSAM DETACHMENT.

256. The detachment was under the superintendence of Mr. T. Shaw, Superintendent of Provincial Surveys, up to 28th July, when he proceeded on privilege leave. Mr. C. O'Donel, Sub-Assistant Superintendent, carried on the current duties of the office for the remaining two months of the year under report.

257. The season's programme consisted of the traversing of—

	Square miles.
Villages previously surveyed by local agency . . . . .	135'4
Villages for extension survey by local agency . . . . .	55'9
Tea grants . . . . .	163'4





A small area estimated at 15 square miles was also to be surveyed topographically on the scale of two inches to the mile, to complete standard sheet No. 41 for publication.

Besides the above there were—

	Linear miles.
Resurvey of boundary between Cherra Siemship and British villages	4½
Location of Langái Thána	8½

This programme was not completed. The actual outturn is given below:—

*Traversing.*

DISTRICT.	Area in square miles, Tea grants.	Area in square miles, villages.	No. of azimuths observed.	Permanent marks connected.
Kámrúp . . . . .	23'17	113'99	92	411
Nowgong . . . . .	25'16	...	13	43
Darrang . . . . .	26'69	15'40	26	167
Sibságar . . . . .	18'71	...	21	65
Sylhet . . . . .	...	3'15	1	92
TOTAL	93'73	132'54	153	778

Topographical survey	12'2	Square miles.
Boundary between British villages and Cherra Siemship	4'5	Linear "
Location of Langái Thána	8'6	" "

258. The work was again scattered all over the Province in small blocks. At the commencement of the field season Mr. O'Donel's services were placed at the disposal of the district judge of Sylhet to carry out a survey and local enquiry in a civil suit between the Secretary of State and the Maharaja of Hill Tippera. Mr. O'Donel was absent on this inquiry the whole field season. In consequence of the importance attached to inspection of the land records Mr. Shaw could visit only four out of the eight surveyors at work. The small outturn must, therefore, be partially attributed to insufficient supervision of the sub-surveyors in the field.

259. The cost-rates of traversing per square mile in the different districts are as shown below:—

	R
Kámrúp { Tea grants . . . . .	48
{ Villages . . . . .	48
Darrang { Tea grants . . . . .	86
{ Villages . . . . .	96
Nowgong. Tea grants . . . . .	72
Sibságar. Do. . . . .	77
Sylhet. Disforested area . . . . .	188

The very high rate for Sylhet is due to the small area completed, *viz.*, only 3'15 square miles and to the failure of the local authorities to have the boundaries cleared before the sub-surveyors' arrival on the spot. The surveyor had to be detached from the Brahmaputra valley for this work and the cost of moving him and his squad had to be debited to this small area. The area surveyed topographically on the scale of 2-inch to the mile was 12'2 square miles and it cost R440 or at the rate R36 a square mile. This survey has not yet been tested. At the end of the season a sub-surveyor was sent to district Sylhet to connect, by traverse with previous surveys, a *thána* which had been fixed by the Hill Tippera authorities on the Langái river. The Assam officials were of opinion that the *thána* had been fixed well within the district of Sylhet, but it proved to be over half a mile within Tippera territory. Much delay was caused by the nature of the country through which the traverse survey had to be carried, and by the inclemency of the weather. The total length traversed in connecting the *thána* was 8'6 linear miles and the cost R685.



260. The preparation of the standard sheets was continued in the drawing office. The drawing office is located at Shillong, and for seven months of the year there was no direct supervision of the draftsmen, Mr. Shaw being unable to leave his other duties in the field to even inspect the office. The progress has consequently been very slow. No sheets have yet been submitted for publication.

261. Mr. Shaw examined the maps and records of the Land Records Department in districts Lakhimpur, Sibságar, Darrang, Kámrúp, Sylhet and Cachar. A class for training local officers in practical field surveying was held at Jorhát for one month, during which time Mr. Shaw instructed one Assistant Commissioner, two Extra Assistant Commissioners and three Sub-Deputy Collectors. He also conducted examinations for first class certificates at the Survey Schools at Gauháti and Jorhát.

262. The programme for next field season consists of the following traversing:—

	Square miles.
(1) Areas which have been or are about to be surveyed by local agency . . . . .	91
(2) Tea grants . . . . .	221
(3) Disforested area . . . . .	3

## GEODETIC.

### ASTRONOMICAL LATITUDES.

#### NOS. 22 AND 23 PARTIES.

263. There being only one Imperial officer available for Astronomical work, Nos. 22 and 23 Parties were combined during season 1901-1902 and employed on Latitude work on the Calcutta Meridional series and the Darjeeling triangulation.

264. The stations visited and the results obtained at each are tabulated below:—

Series.	Station.	Height above mean sea level.	Longitude.		Geodetic Latitude = C.			Astronomical Latitude = O.			P. E.	O—C.
			Feet.		°	'	°	'	"	°		
Calcutta Meridional Series.	Madhupur .	92	88	32	23	56	38'97	23	56	42'82	±0'040	+ 385
	Charaldánga .	149	88	26	24	52	43'95	24	52	45'36	±0'051	+ 1'41
	Chanduria .	160	88	25	25	44	27'47	25	44	31'93	±0'058	+ 4'46
	Lohágara .	205	88	24	26	2	12'04	26	2	13'06	±0'055	+ 1'92
	Jalpáiguri .	...	88	47	26	31	15'13	26	31	9'16	±0'056	— 5'97
Darjeeling Triangula- tion.	Silpuri .	401	88	27	26	41	41'11	26	41	18'10	±0'080	—23'01
	Kurseong .	4428	88	18	26	52	6'16	26	51	15'05	±0'060	—51'11
	Senchal .	8600	88	20	26	59	8'78	26	58	32'08	±0'091	—35'80
	Tonglu .	10,073	88	8	27	1	53'54	27	1	11'30	±0'096	—42'24
	Phallut .	11,815	88	3	27	12	42'51	27	12	5'28	±0'073	—37'23

265. The results show that the quantity O—C maintains its positive value till quite close under the outer Himalayas, the sign changing somewhere about north latitude  $26^{\circ} 10'$ , indicating that the zone of positive deflection has, at this longitude  $88^{\circ}$ , a much greater width from North to South than had been expected. Another feature of the results is the very rapid change in the amount of O—C between Lohágara, latitude  $26^{\circ} 2'$ , where  $O—C = +1'92''$  and Kurseong, latitude  $26^{\circ} 51'$  where  $O—C = -51''.11$  giving a change of  $53''$  in  $0^{\circ}-49'$  of latitude. The occurrence of the maximum deflection at Kurseong, half way up the outer ranges is remarkable. In every case, except perhaps Phallut, the Latitude station is well situated as regards local masses and at Phallut the local disturbance cannot be more than  $1''.5$  to the southward.

266. The result obtained at Jalpáiguri is also noteworthy. O—C here is equal to  $-5''.97$  where close on  $30''$  was to be expected. At this station Longitude observations have shown the presence of an apparently abnormal deflection

in the prime vertical of 18" East where only a small deflection was to be expected. It seems then desirable that azimuth observations should be undertaken at this station to supply evidence, corroborative or otherwise.

267. The parties were inspected by the Superintendent, Trigonometrical Surveys in June 1902.

TIDAL AND LEVELLING OPERATIONS.

NO. 25 PARTY.

268. Captain H. L. Crosthwait, R.E., held charge of the party until the 27th January 1902, when he proceeded to attend the Chatham course, and Mr. E. J. Connor took over charge.

TIDAL OPERATIONS.

269. The following stations were under observation at the commencement of the year:—

STATIONS. (Those shown in italics are <i>permanent</i> ).	Automatic or personal observations.	Date of commencement of observations.	Date of closing of observations.	No. of years of observations.	REMARKS.
1. Suez . . . . .	Automatic.	1897	Still working.	5	To be closed.
2. Perim . . . . .	"	1898	"	4	Ditto.
3. <i>Aden</i> . . . . .	"	1879	"	22	
4. <i>Kurrachee</i> . . . . .	"	1881	"	21	
5. Porbandar . . . . .	"	1898	"	4	With certain interruptions.
6. Port Albert Victor (Káthiá-wádar).	"	1900	"	2	
7. <i>Bombay</i> (Apollo Bandar) . . . . .	"	1878	"	24	
8. <i>Bombay</i> (Prince's Dock) . . . . .	"	1888	"	14	Property of Port Trust.
9. <i>Madras</i> . . . . .	"	{ 1880 re-started 1895 }	1890 Still working.	{ 10 } 7 } 17	
10. <i>Kidderpore</i> . . . . .	"	1881	"	21	
11. Bassein (Burma) . . . . .	"	1902	Newly started.	...	Started this year.
12. <i>Rangoon</i> . . . . .	"	1880	Still working.	22	
13. <i>Port Blair</i> . . . . .	"	1880	"	22	

270. The newly built tidal observatory at Bassein, in Burma, was started working by Captain Crosthwait on the 1st January 1902.

271. The 13 tidal observatories at work have been inspected during the year; and all the tidal registrations, except those at Porbandar, where the communication pipe again got choked with sand, have been very satisfactory.

272. The two following tables show the annual and decadal percentages of the predicted time and height errors of high and low water.

PERCENTAGES OF ERRORS IN PREDICTED TIMES AND HEIGHTS AT OPEN COAST STATIONS FROM AUTOMATIC OBSERVATIONS.

YEAR.	No. of stations.	IN TIME.		IN HEIGHT.			
		Within 15 minutes of Actuals.		Within 3 inches of Actuals.		Within 1/16 of mean range at Springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1892 . . . . .	8	75	74	91	85	98	98
1893 . . . . .	9	73	68	93	98	96	95
1894 . . . . .	10	65	62	95	92	97	95
1895 . . . . .	9	68	65	98	97	94	94
1896 . . . . .	9	71	70	97	97	97	93
1897 . . . . .	8	71	75	96	97	97	97
1898 . . . . .	9	74	70	96	96	95	95
1899 . . . . .	9	74	66	95	95	93	92
1900 . . . . .	11	66	60	93	88	93	89
1901 . . . . .	11	71	60	93	91	93	91
Average of 10 years . . . . .	9	71	67	95	94	95	94

PERCENTAGES OF ERRORS IN PREDICTED TIMES AND HEIGHTS AT RIVERAIN STATIONS FROM AUTOMATIC OBSERVATIONS.

YEAR.	No. of stations.	IN TIME.		IN HEIGHT.			
		Within 15 minutes of Actuals.		Within 8 inches of Actuals.		Within $\frac{1}{16}$ of mean range at Springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1892 . . . . .	2	61	60	72	65	94	95
1893 . . . . .	2	57	57	68	50	89	84
1894 . . . . .	2	56	55	66	42	88	80
1895 . . . . .	2	59	55	74	47	94	84
1896 . . . . .	2	56	55	63	42	87	74
1897 . . . . .	2	59	61	75	57	96	91
1898 . . . . .	2	53	59	71	61	90	91
1899 . . . . .	2	55	59	76	65	95	94
1900 . . . . .	2	59	62	70	57	89	87
1901 . . . . .	2	63	65	70	59	90	92
Average of 10 years . . . . .	2	58	59	71	55	91	87

SPIRIT LEVELLING OPERATIONS.

273. The levelling detachment was again employed for a time on the Eastern Bengal State Railway, from Párbatipur to Dhubri; and for the remaining portion of the field season in Bengal, from Siliguri to Sonákhoda Base-Line; and in Assam from Fakirganj to Gauháti. It completed 259 miles of double levelling.

274. During next field season, the levelling operations will be carried on in Burma from Thazi Junction Railway Station to Magwe; and from Mandalay to Tantabin.

The detachment left Dehra Dún on the 20th October 1901, and returned to recent quarters on the 13th May 1902.

MAGNETIC.

NO. 26 PARTY.

275. Captain H. A. D. Fraser, R.E., was in charge of this party throughout the year.

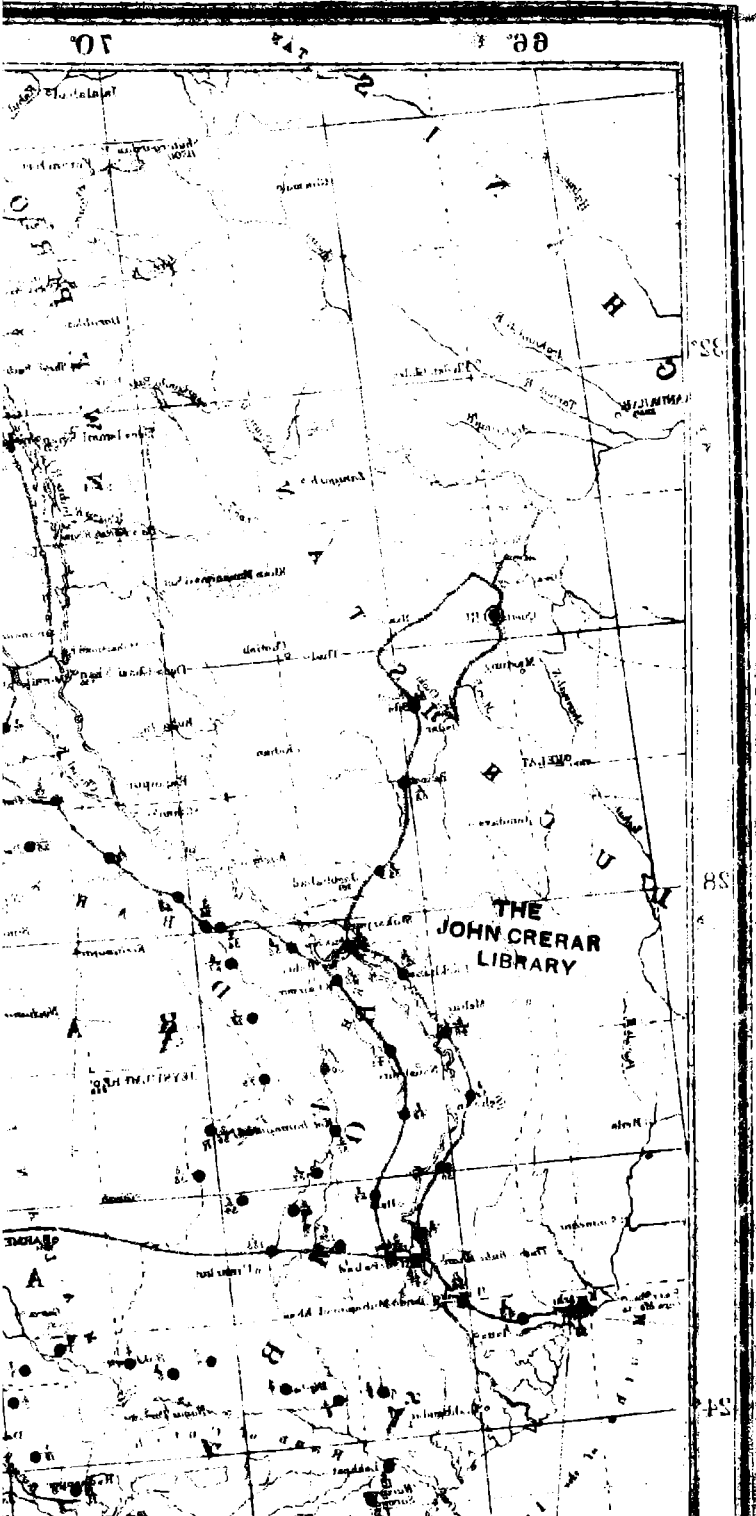
During the season under report field observations were commenced. Three detachments were employed in the area to the west of a line joining Bombay and Dehra Dún observatories and complete sets of observations were taken at each of the stations of observation the total number of which was 163.

276. Two detachments worked along lines of railways: the first along the broad gauge and the second along the narrow gauge systems lying within the area under survey. They completed 65 and 62 stations respectively. The third worked in the desert, using camel transport. This detachment observed at 36 stations averaging about 30 miles apart.

The stations of observation are clearly marked on the accompanying map of India.

277. A table is printed, in the appendix showing the values obtained, but as these are uncorrected for daily variation, secular change and instrumental differences, they are to be considered as preliminary approximate values and not as final results.

Early in March 1902, the officer in charge proceeded on tour and in addition to inspecting the work of the three field detachments, he took very complete sets of observations at five repeat stations (*vide* chart). At each of these stations three sites were occupied from one to two miles apart and the approximate results shown in the table are the means of the three groups of observations thus obtained. Each site was permanently marked and it is intended to repeat the observations at each place as often as possible in the course of the survey.



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278. After the return of the field detachments early in May, a long series of observations was undertaken in Dehra Dún to determine the values of the moments of inertia of the magnets of each of the instruments used in the survey. These were computed out at once and proved quite satisfactory. Subsequently the computation of the field work was taken up and completed.

279. Early in July the officer in charge proceeded to Kodaikánal and installed the self-recording instruments at that base station, returning to Mussooree about the 20th August. The whole of the necessary equipment was handed over to the Director of the Kodaikánal observatory, who is now in sole charge of the magnetic work at this station. This installation enables the area of operations for the ensuing field season to be extended to the south of India.

280. At present three out of the five base stations are in working order, *viz.*, those at Colába, Dehra Dún and Kodaikánal. Of the two remaining the buildings at Rangoon were handed over by the Public Works Department early in 1902, but the instruments originally intended for this station have not been installed as it was decided to reserve them for the Calcutta observatory as soon as it was definitely known that the existing set of instruments at Alipore would not be available for survey purposes.

Another set of Watson's magnetographs is now being made in England for Rangoon and is expected to arrive by the middle of 1903.

The site for the Calcutta observatory has been finally selected at Barrackpore (some 12 miles out of Calcutta itself) and work was to be begun about the 1st November 1902. It is hoped that the buildings will be sufficiently advanced by the end of February 1903 to permit of the installation of the instruments being then undertaken.

281. As the Vertical Force magnetograph at Alipore could not be utilized for survey purposes, sanction was obtained for the purchase of a new instrument of this class. When received it will be installed at Dehra Dún, as this latter is a more suitable place than Calcutta for recording the variations in the vertical force as far as the requirements of the survey are concerned.





Summary of the outturn of work of the

SCALE OF SURVEY.	Number of Party.	LOCALE OF FIELD OPERATIONS.	TRIANGULATION.										SPIRIT-LEVELLING OPERATIONS							
			Instrument used Diameter in inches.	Area in square miles.	Square miles to each point trigonometrically fixed.	Square miles to each height.	1ST CLASS.			SECONDARY.			TERTIARY.		Miles levelled over.	Permanent Stones embedded Trigonometric station connected with.				
							Stations fixed.	Triangular error in seconds.	Error per mile in feet.	Stations fixed.	Triangular error in seconds.	Error per mile in feet.	Intersected points.	Error per mile in feet.						
Inches to a mile. 4	18 Riverain Survey.	Brought forward	56	...	2,300	...	...	...	...	...	...	...	...	...	...	...	...	...		
		18 Forest Branch.	Simla Hill States	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			Ferozepore and Lahore	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			Mooltan and Bahawalpur	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			Muzaffargarh, D. G. Khan and Bahawalpur.	60	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			Burma Forests, Upper Chindwin and Myittha.	...	6	250	31'3"	31'3"	...	...	7	10	0'5"	1	...	...	...	...	...	...
			Burma Forests, Pynmana Division.	...	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		20 Forest Branch.	Burma Forests, Magwe	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			" " Mindon	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			" " Magwe and Mindon.	65	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			" " Aratou	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			Central Provinces, Mandla.	...	5	534	...	...	...	...	166	...	...	180	...	...	...	...	...	...
			" " Chanda.	...	6	810	17'0"	17'7"	...	...	24	14	0'6"	24	1'5"	1,057	...	12	...	...
			" " Sambal- pur.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			Bengal, Singhbhum	70	6	325	7'4"	7'4"	...	...	29	13	0'7"	15	1'3"	...	...	...	...	...
			" Hazaribagh	...	7	57	2'6"	2'6"	...	...	5	6	0'9"	17	1'5"	...	...	...	...	...
			Punjab Hazara	...	7	200	2'2"	2'2"	...	...	19	29	0'9"	73	3'1"	...	...	...	...	...
			" Jubbala and Tarhoch	...	6	30	6'0"	6'0"	...	...	1	4'5"	0'0"	4	2'0"	...	...	...	...	...
U.-P. Agra and Oudh- Kheri-Nepal.	...		5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Upper Burma Ruby Mines	75	5 & 7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		
		TOTAL	...	...	4,512	...	...	...	...	...	...	...	...	...	...	...	...	...		
2	3 12 14 18 Det. Provinci- al Sur- veys.	Pegu and Hanthawaddy	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		
		Sind	...	6,7 & 8	2,027	31	31	...	35	8	0'2"	97	0'2"	...	...	...	...	...		
		Allahabad	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		Montgomery (Tah. Pakpāt- tan).	80	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		Montgomery and Lahore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		Simla Hill States	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		Central Provinces, Jubbul- pore.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		Assam, Kámrúp	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		TOTAL	85	...	2,027	...	...	...	...	...	...	...	...	...	...	...	...	...		
1	3 10 11 & 21 14 15 18	Pegu, Hanthawaddy and Toungoo.	...	6	1,530	20'6"	20'6"	...	...	38	8	0'7"	27	0'8"	...	...	...	...		
		Toungoo	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		Thayetmyo and Prome	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		Upper Burma	...	6	3,842	6'1"	6'7"	...	...	53	5'4"	0'2"	372	0'4"	...	...	...	...		
		Lushai	...	6	1,489	3'9"	4'1"	...	...	26	15'8"	0'2"	354	0'6"	...	...	...	...		
		Sind	...	6	851	6'2"	6'2"	...	...	40	20	0'4"	521	...	...	...	...	...		
		Simla Hill States	...	6	1,215	81	110	...	...	15	4	1'2"	68	4'5"	...	...	...	...		
		TOTAL	...	...	8,927	...	...	...	...	...	...	...	...	...	...	...	...			
1/2	12 15 15	Sind	...	95	...	...	...	...	...	...	...	...	...	...	...	...	...	...		
		Kashmir	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		
		N.-W. Frontier	...	8	183	...	...	...	...	8	...	...	...	...	...	...	...	...		
		TOTAL	...	...	183	...	...	...	...	...	...	...	...	...	...	...	...			
1/2	11 & 21 15	Upper Burma	...	6	3,740	...	...	...	...	23	11'2"	0'3"	168	0'7"	...	...	...	...		
		N.-W. Frontier	100	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		
		TOTAL	...	...	3,740	...	...	...	...	...	...	...	...	...	...	...	...			
1/2	15 25	N.-W. Frontier	...	...	80,050	...	...	...	...	...	...	...	...	...	...	...	...	...		
		India	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		
		GRAND TOTAL	104	...	99,496	...	...	...	...	...	...	...	...	...	...	...	...			

259 (g)  
16 (h) } 40 4



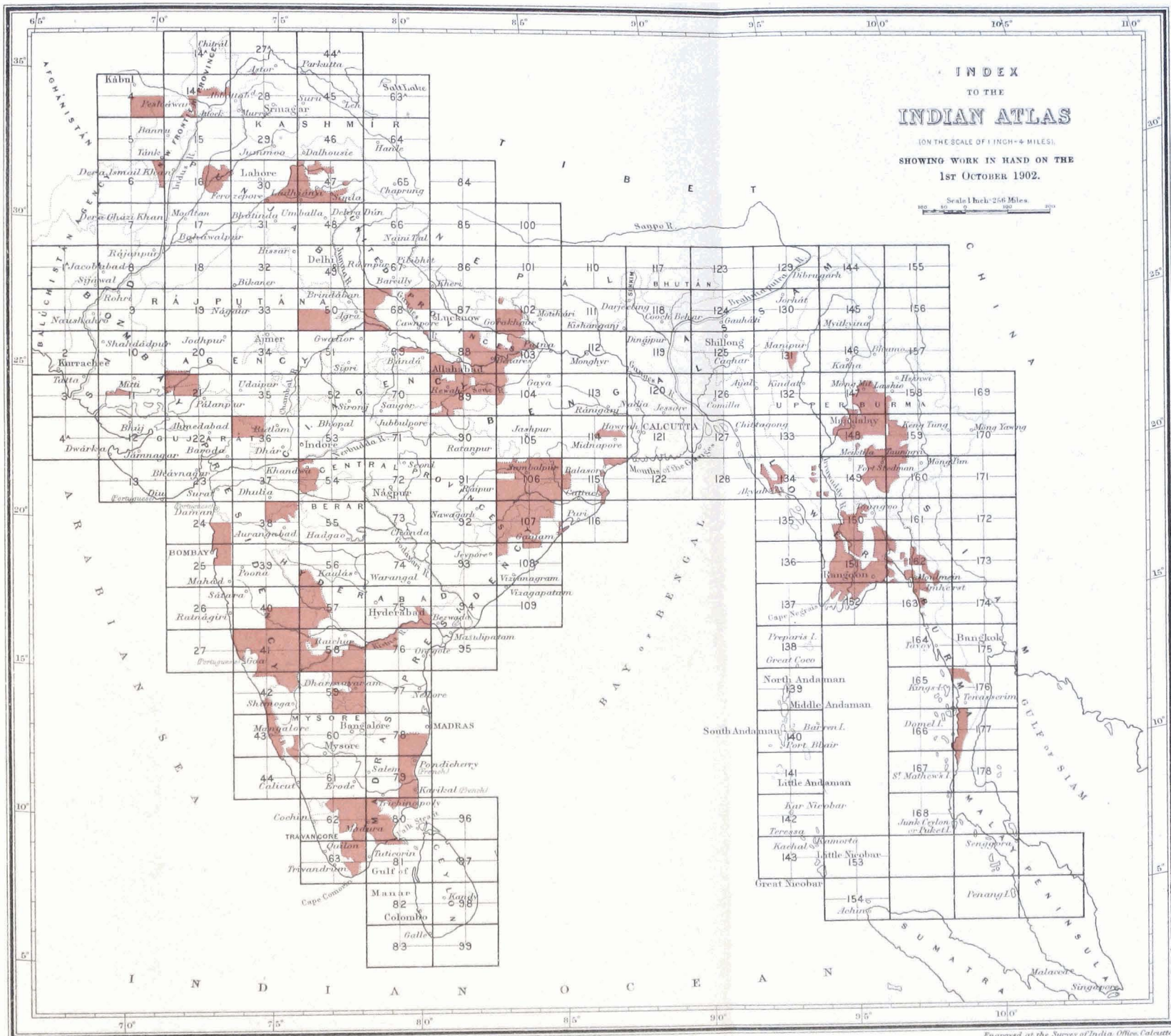
Field Parties during the year 1901-02—contd.

	TRAVERSING.				DETAIL SURVEY.				RECORD-WRITING.			REMARKS.	
	Area in square miles.	Number of stations at which the theodolite was set up.	Angular error per station in seconds.	Linear error per mile.	Area in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Villages.	Average size of fields.	Area in square miles.	Villages.		Fields.
56	...	...	...	...	1,913	...	...	...	...	...	...	...	
...	...	...	...	...	23	30	...	...	...	...	...	...	
...	...	1,548	7	0'3	...	...	...	...	...	...	...	...	
...	1,888	2,176	5	0'3	...	...	...	...	...	...	...	...	
60	...	1,012	6	0'3	...	...	...	...	...	...	...	...	
...	884	15,581	8'4	3'7	266	129	110	...	...	...	...	...	
...	12	111	...	...	10	156	3	...	...	...	...	...	
...	280	5,208	8'4	7'8	410	112	197	...	...	...	...	...	
...	95	2,198	3'4	5'0	...	...	...	...	...	...	...	...	
65	375	7,406	7'0	5'9	...	...	...	...	...	...	...	...	
...	...	...	...	...	38	69	41	...	...	...	...	...	
...	132	799	5	2'3	699	155	194	...	...	...	...	...	
...	231	1,823	...	2'4	725	118	352	...	...	...	...	...	
...	10	76	2	0'2	...	...	...	...	...	...	...	...	
70	20	105	0'04	0'3	369	200	110	...	...	...	...	...	
...	58	679	4	3'1	58	270	28	...	...	...	...	...	
...	...	...	...	...	12	...	...	...	...	...	...	...	
...	...	...	...	...	100	102	42	...	...	...	...	...	
...	5	42	0'1	1'2	...	...	...	...	...	...	...	...	
75	190	3,365	8	4'3	274	170	78	...	...	...	...	...	
...	...	...	...	...	4,897	...	...	...	...	...	...	...	
...	...	...	...	...	350	51'6	77	...	...	...	...	...	
...	1,763	7,402	0'3	0'4	1,597	25'1	931	...	...	...	...	...	
...	1,988	34,251	11	...	203	101	57	...	...	...	...	...	
80	...	2,550	6	0'2	...	...	...	...	...	...	...	...	
...	...	...	...	...	3,000(f)	6'7	...	...	...	...	...	...	
...	...	...	...	...	43	18	...	...	...	...	...	...	
...	...	...	...	...	1,936(f)	11	...	...	...	...	...	...	
...	...	...	...	...	12 (e)	...	...	...	...	...	...	...	(e) Tea grants.
85	...	...	...	...	7,141	...	...	...	...	...	...	...	
...	...	...	...	...	1,048(f)	...	...	...	...	...	...	...	
...	141	1,385	2'9	5'5	350	15	20	...	...	...	...	...	
...	...	...	...	...	1,555	13'6	...	...	...	...	...	...	
...	...	...	...	...	4,100(f)	6'9	768	...	...	...	...	...	
90	...	...	...	...	2,603	7	500	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	1,696	...	in situ	...	...	...	...	...	
...	...	...	...	...	255	4	in situ	...	...	...	...	...	
...	...	...	...	...	11,667	...	...	...	...	...	...	...	
95	...	...	...	...	4,556	1'5	510	...	...	...	...	...	
...	...	...	...	...	2,787	174	in situ	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	7,343	...	...	...	...	...	...	...	
...	...	...	...	...	2,561	...	...	...	...	...	...	...	
100	...	...	...	...	5,151	...	...	...	...	...	...	...	
...	...	...	...	...	7,712	...	...	...	...	...	...	...	
...	...	...	...	...	60,450	...	...	...	...	...	...	...	(g) Double levelling.
...	...	...	...	...	...	...	...	...	...	...	...	...	(h) Branch lines.
104	...	...	...	...	104,794	...	...	...	...	4,585	...	...	



Field Parties during the year 1901-02.

COST-RATE PER ACRE.	COST-RATE PER SQUARE MILE.			Total cost, inclusive of charges for instruments to Provincial Governments.	REMARKS.
	Stone embedding.	Records (Khanapuri).	Completion of Vernacular records assessment, statistics, etc.		
Annas.	R	R	R	R	
...	...	...	...	90,184	(a) Includes Rs91 cost of the portion of the Party working in the Bangalore Drawing Office, and Rs. 143 expended on revision of Maymyo City, 19'18 square miles on 16-inch scale.
...	...	...	...	1,05,927 (a)	(b) Includes Rs3,855 on miscellaneous and compilation works.
...	...	...	...	1,26,075 (b)	(c) Includes Rs1,278 cost of arrears of Lushai triangulation.
...	...	...	...	92,353	(d) Includes Rs24,807 expended on 42 square miles of cantonment surveys on 12", 48" and 66"; Rs9,275 on Baluchistan settlement, Rs2,380 on Frontier surveys.
...	3'1	...	...	70,983 (c)	(e) Includes Rs30,113 for Riverain surveys; Rs7,731 on Simla City survey.
...	...	...	...	1,25,120 (d)	(f) Linear miles.
...	...	...	...	1,00,914 (e)	(g) Inclusive of publication charges.
...	...	...	...	91,625	(h) Includes Rs4,232, cost of 1,893 miles of boundary survey and Rs1,536, cost of 1,037 miles of levelling.
...	...	...	...	71,483	(i) Includes Rs4,635 cost of Cawnpore Municipality Survey; Rs4,266 cost of Fyzabad and Ajodhya Town Survey; Rs50 cost of Fyzabad Cantonment survey, and Rs3,794 cost of Road surveys.
...	...	...	...	71,364	(j) Includes Rs24,669 on miscellaneous surveys; Rs15,911 on standard mapping; Rs58,905 on reproduction of village maps Rs1,420 on Thana maps and Rs7,684 on Orissa and Bihar Badari.
...	...	...	...	1,74,283 (g)	(k) Includes Rs13,030 on completion of arrears of other parties, revision of maps and preparation of fresh traces and area statements and other Miscellaneous work for Settlement Department.
...	...	...	...	29,009 (g)	(l) Includes Rs312 cost of marks for Pakokku City survey.
...	...	...	...	53,328 (h)	(m) Includes Rs7,378 charge of Drawing Office.
...	...	...	...	19,568	(n) For Tea grants.
...	...	...	...	3,090	(o) Includes Rs1,642 on standard mapping; Rs13,965 on maintenance of Records and Rs2,783 on Boundary Commission.
...	...	...	...	1,740	
...	...	...	...	2,538	
...	7	...	...	197,304 (i)	
...	...	...	...		
...	...	53'3	...		
...	...	68'3	...		
...	...	...	...	10,59,900 (j)	
...	...	102'5	...		
...	...	...	...		
...	...	...	...		
3'0	...	...	5'7	82,716 (k)	
...	4	...	...	44,896 (l)	
6'34	2'8	...	20'0	34,604	
...	2'8	...	...	25,425	
...	...	...	...	43,232 (m)	
...	...	...	...	33,497 (o)	
...	...	...	...		
...	...	...	...		
...	...	...	...		
...	...	...	...		

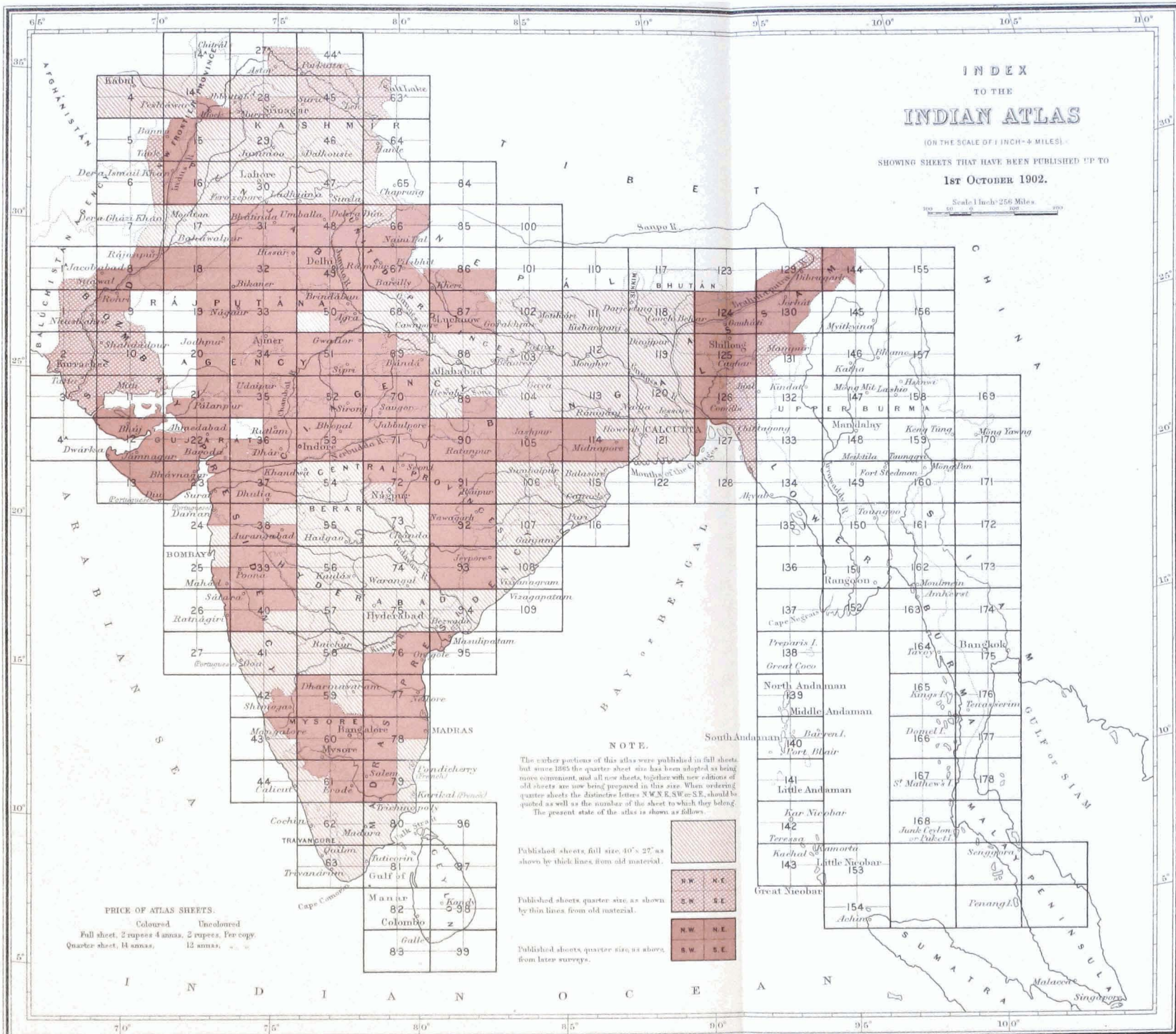


Published under the direction of MAJOR F. B. LONGE, R.E. (Retiring) Surveyor-General of India.

July, 1902

N<sup>o</sup> 639-S. 1902.

Litho. & I. C. Calcutta.



INDEX  
TO THE  
**INDIAN ATLAS**

(ON THE SCALE OF 1 INCH = 4 MILES.)  
SHOWING SHEETS THAT HAVE BEEN PUBLISHED UP TO  
**1st OCTOBER 1902.**

Scale 1 Inch = 256 Miles.  
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Published sheets, quarter size, as shown by thin lines from old material.	
Published sheets, quarter size, as shown from later surveys.	

I N D I A N O C E A N



# APPENDIX.

*Note on Surveys in the United Provinces of Agra and Oudh*, BY CAPTAIN W. M. COLDSTREAM, R.E.

Revenue Surveys in these Provinces were originally carried out by two distinct branches, large scale village maps being prepared by the Settlement Department and small scale maps of large areas by the professional Revenue Survey Department.

During the settlement of a district the Settlement Officer, after demarcation of village boundaries and determination of disputes connected with them, prepared a map for each village on the scale of 16 inches to the mile, or some nearly equivalent scale of local units. The standard of measurement was in all cases the local *bigha*, which varied in nearly every district, and often in different parts of the same district, and rarely bore a simple proportion to the acre, which was in use by the professional survey and in which all English statements were compiled. At first the village maps were mere eye sketches made on the spot by eye, as the dimensions of each field were measured and recorded, but in 1852 the use of the plane-table was introduced, and the resulting improvement in the map was very marked. The agency employed was generally that of *amins*, but in some districts the *patwaris* did the whole or a part of the plane-table survey with considerable success.

The work of the professional Survey Department which dates back to 1833, was the preparation of maps on the scale of 4 inches to the mile based on theodolite traverse data. Reductions, on the 1-inch scale, were afterwards prepared in the form of standard sheets, representing areas included between parallels of latitudes 15 minutes apart, and meridians 30 minutes apart. With the 4-inch maps, the Revenue Survey also provided statements giving statistical information, such as the total areas of villages, the number of houses, ploughs, wells, etc. Practically the whole of the Province except Jhānsi and Kumaun was surveyed in this manner by 1870, and between 1877 and 1884 the districts of Sahāranpur, Muzaffarnagar, Meerut, Bulandshahr, Aligarh and the southern *parganas* of Mirzapur were surveyed topographically on the 2-inch scale. Unfortunately "the records of some 13 districts were lost or practically destroyed during the mutiny and consequently no proper maps of these districts have been since available, the only ones existing, being skeleton district maps on the scale of half an inch to the mile."\*

In 1871 the work of the two branches was amalgamated, and the modern methods of cadastral survey introduced.

The procedure was as follows:—

After demarcation of village boundaries by the district authorities, a party of the Survey of India ran theodolite traverses along the boundaries of each village, and on the skeleton plots thus obtained, carried out the detail survey on the scale of 16 inches to the mile of each village by the methods of chain survey, the use of the plane-table as a survey instrument being restricted to the delineation of topographical features, village sites, etc.

The survey party also prepared the field book or *khasra* of each village, the officer in charge of the survey being responsible for the correct numbering of the map and field book and for the entries in the area, crop and irrigation columns. The columns for the particulars of uncropped land were also filled in by the survey party, but the entries were afterwards checked by the Settlement Officer. The work of the party, both survey and record-writing, was carried out by sub-surveyors and *amins*, the cost of the strictly professional establishment being borne by the Imperial Government. The districts of Agra, Muttra, Bānda, Hamīrpur and Moradabad were surveyed in this manner, and their village maps were reproduced by lithography, standard sheets on the 1-inch scale being afterwards compiled from the village maps.

Between 1877 and 1886 much the same system was applied to the survey of the permanently settled areas, in districts Benares, Mirzapur, Ghazipur, Jaunpur and Ballia. For this a code of instructions was drawn up by Sir Charles (then Mr.) Crosthwaite, and under it the survey party prepared cadastral village maps on the 16-inch scale and area books showing in acres, the area of each field. These were handed over to the settlement party which then made out and subjected to careful and repeated attestation the papers which constitute the record-of-rights for each village. Towards the end of the operations, this system was slightly modified by associating the settlement and survey parties in the preparation of the village papers. Operations were carried on in two or more districts at the same time, and the average duration for each district was about 4½ years. One *tahsil* of Benares district which forms a part of the family domains of the Maharaja of Benares, and for which separate arrangements were made, those portions of Ballia for which a new record had recently been prepared in the Azamgarh Settlement, and all the upland parts of Mirzapur were excluded from the survey. The area remaining was 5,448

\* Note on the state of Topographical Surveys by the Surveyor-General in the annual report of the Survey of India for 1899-1900.

square miles and the total cost of survey was ₹10,16,532 or about ₹186 per square mile. The expense was high owing to the minute sub-divisions of the cultivation and the complexity and number of proprietary holdings and shares.

The cost of these surveys was at first divided equally between the Imperial and Local Governments, but after 1884 the Local Government bore a percentage of the expenditure corresponding to the percentage of land revenue assigned to it. Both maps and records-of-rights were put to the test of constant production before the Courts in dispute cases, and were proved to have attained a very high degree of accuracy.

From 1836 to 1894 this system of survey combined with the writing of certain of the records was used in the settlement of Dehra Dún, Gorakhpur, Basti, Jhānsi (excluding Lalitpur), and Garhwāl. In the last named district only the cultivated parts were surveyed, and the small size of the fields necessitated the adoption of the 64-inch scale, and in Jhānsi the system was modified by the employment of *patwaris* on the survey of the fields.

In 1893 Mr. Darrah, who had inspected the maps and records of several districts in which settlement was about to fall due, submitted, in consultation with Colonel Sandeman, the Deputy Surveyor-General, and Mr. Freeman, the officer in charge of the survey party, working in Garhwāl, a scheme for the preparation of maps and records by *patwari* agency. After a conference of officers at Naini Tal in 1894 the greater part of this scheme, slightly modified by the experience gained by Mr. Fuller in the *patwari* surveys of the Central Provinces, was accepted, and in 1894 the system of local surveys by *patwari* agency was introduced, which with some modifications is still in force.

Under the new system, after demarcation of village boundaries, the preliminary traverse was executed by a professional party of the Survey of India and at the close of each year's work, skeleton plots of each village were made over to the Land Records Survey, which was instituted as a branch of the Department of Land Records under the Board of Revenue, to carry out the cadastral survey and the preparation of records in the following manner:—

In each district coming under survey, the operations were placed in charge of the Collector of the district, or of the Settlement Officer (when the latter was appointed), and an officer of the Provincial Service of the Survey of India, whose services were lent to the Local Government, was appointed as Survey Officer to carry out the work. The Survey Officer, who was assisted by a staff of professional inspectors, estimators and draftsmen, began operations in October by training the *patwaris* in survey, after which each *patwari* surveyed the villages in his circle on the skeleton plots supplied by the traverse party, the methods of survey, check survey and supervision being those of the Survey of India. After the survey of a village the *patwari* prepared in the field, a *khewat* or list of proprietors and a *khaksa* or field book for each village, leaving the area columns to be filled in in office. At the beginning of the rainy season the *patwari* came in to the survey office and after being trained in tracing and estimating, assisted in the preparation of three traces of his village maps, and of village area statements, giving the area of each field or plot of land. He then, under the supervision of the Survey Officer and his staff, completed his field books and prepared a complete preliminary record-of-rights for each village. The Survey Officer also made a preliminary soil classification, but in 1899 this was discontinued, and the soil column of the field book was filled in by the Settlement Department.

One of the three traces was used by the Settlement Officer during his inspection, and at the close of the settlement operations, the second trace was filed in the *tahsil*, and the third made over to the *patwari* and kept by him unaltered as a record of the settlement map. From this copy the *patwari* himself prepared a fourth trace, on which to enter the alterations required from time to time. The original village maps were made over to the Survey of India and standard one-inch maps were compiled from them in a drawing office located at Mussooree.

In professional matters, and in matters of professional establishment, all cadastral surveys were placed in charge of an officer of the Imperial Service of the Survey of India whose services were lent to the Local Government, as Superintendent, Land Records Surveys, and who was also employed in arranging for and carrying out such special surveys of towns or important boundaries as were required by the Provincial Government. The Deputy Surveyor-General was also empowered to inspect the different district survey parties from time to time, to ensure the work being maintained at a professional standard.

In 1899 the system was modified by the transfer of traverse and mapping operations to the control of the Superintendent under the Provincial Government, the head-quarters of the traverse party and the drawing office being moved from Mussooree to Naini Tal, and the combined traverse, cadastral and mapping operations together with such special surveys as were carried out by the Superintendent being termed the Provincial Surveys. As regards professional matters in connection with traverse and mapping sections, the Superintendent was made directly responsible to the Deputy Surveyor-General, and in consideration of their value for cartographical purposes, the cost of the traverse operations, at the rate of ₹30 per square mile of area traversed each year, was refunded to the Provincial Government by the Survey of India, which also continued to pay for the cost of the drawing office.

At the same time an important change in the conduct of cadastral operations was introduced.

Up to 1899 each *patwari* in a tract under survey was given one year in which to complete the survey and record of his circle, but as this arrangement threw heavy work on



the *patwaris* and allowed barely sufficient time, the survey programmes were liable to be upset by any cause which took the *patwaris* off survey duty for even a short interval. On these grounds the two years system was introduced by which each *patwari* was allowed two years in which to complete his maps and records. On this plan the survey operations in a district extended during the first year over an area of about 800 to 1,000 square miles, rather more than half the work in this area being completed the first year and the remainder during the second year, when an additional area of some 400 to 500 square miles was entered. The two years' system, though giving better results and securing a more thorough training for the *patwaris*, has increased the cost of operations by a year's cost of establishment in each district, and by the emoluments of an Assistant Survey Officer, whose appointment was rendered necessary by the increased area over which operations extended. At first, the survey and record-writing of each village was completed within the two years irrespective of the date, but in 1900 the two years' system was modified by making the year of record in most districts under survey, the same for all the villages in a *tahsil*, thus necessitating the revision of all the work done the first year to bring it up to date during the second year.

In 1901 the traverse party having completed its work in districts in which survey was contemplated reverted from Provincial control and was amalgamated with a topographical party of the Survey of India, which has taken up the survey on the scale of two inches to the mile of districts of which there are no proper maps, a beginning being made with Allahabad. A small detachment of the traverse party was retained in Provincial employment to take up such additional traverse and other survey work as might be required in connection with cadastral surveys and surveys of Government roads and of towns or municipalities.

Since 1894 when the *patwari* system was introduced the following districts have been cadastrally surveyed in whole or in part, by the Land Records or Provincial Surveys :—

(1) Jhānsi (Lalitpur sub-division), (2) Bijnor, (3) Bahraich, (4) Kheri, (5) Shāhjahānpur, (6) Bareilly, (7) Sitapur (portions only), (8) Naini Tal (cultivated tracts only), (9) Meerut, (10) Pilibhīt, (11) Gonda, (12) Farrukhabad, (13) Etāwah (portions of two *tahsils* only) and (14) Aligarh (scattered villages only).

A statement giving the years of survey, the cost-rates and other details for the above districts is attached.

The survey of Etah is also completed, but the records have not been made over to the Settlement Department.

The districts of Azamgarh, Mainpuri and Jālaun are now under survey.

The following special surveys, accompanied in some cases by records of holdings, have also been made by the Land Records and Provincial Surveys :—

Municipal surveys of Bareilly, Naini Tal, Shāhjahānpur, Tilhar, Mainpuri, Fatehgarh and Cawnpore, and the survey for Government of Fyzabad and Ajodhya, boundary surveys in connection with the Nepāl frontier and the survey of roads in Farrukhabad, Etāwah and Mainpuri.

The surveys of portion of Allahabad civil station, of Kosi in Muttra and of Koil Atrauli, Hāthras and Sikandra Rao, and of roads in Agra, Etah and Jālaun are now in progress.

In addition to surveys already mentioned the following hilly tracts have been surveyed topographically by parties of the Survey of India :—

1. The hill Native State of Tehri in Garhwāl on the scale of  $\frac{1}{4}$ -inch to the mile in 1851-1853.
2. Dehra Dún and the Siwālik hills on the 2-inch and 4-inch scales in 1873-76.
3. Kumaun and Garhwāl on the 1-inch scale in 1886-1888.

*District Surveys, including preparation of Settlement Records, executed by Land Records and Provincial Surveys between 1894 and 1902.*

DISTRICT.	Traversed by	Years of Survey.	System of Cadastral Survey.	Area surveyed, in square miles.	Total cost of Cadastral Survey.	Cost-rates in each district—Rupees per square mile.	Approximate cost-rates, including share of head-quarter charges.	Approximate cost-rate of Traverse.	Approximate cost-rate, including head-quarter charges and Traverse.	REMARKS.
Meerut . . . . .	Nos. 2 and 8 Parties.	1894-97	One year .	2,367	₹ 65,253	₹ 28 (1)	₹ 31 (1)	₹ a. 27 8(2)	₹ a. 58 8(1)	(1) Survey Officer's pay and allowances not included.
Jhānsi (Lalitpur only)..	"	1894-97	" .	1,059	66,307	63	70		97 8	
Bahraich . . . . .	"	1894-98	" .	2,042	} 1,29,555	58	63		90 8	
Sitapur . . . . .	"	1895-96	" .	196						
Kheri . . . . .	"	1895-99	One year and two years.	2,108	1,43,885	68	75		102 8	
Shāhjahānpur . . . . .	"	1895-98	One year .	1,752	96,508	55	59		86 8	
Bareilly . . . . .	"	1896-99	" .	1,580	1,20,555 (3)	76 (3)	84 (3)		111 8(3)	
Bijnor (four parganas only).	"	1898	" .	405	23,033	57	70		97 8	
Naini Tal . . . . .	No Traverse .	1897-99	" .	101 (4)	45,000	445	523		523 0	
Pilibhit . . . . .	Nos. 2 and 8 Parties.	1898-1900	Two years .	1,072	81,571	76	86		113 8	
Gonda . . . . .	Nos. 2 and 8 Parties and Provincial Surveys.	1897-1901	One year and two years.	2,578	1,80,038	70	78	105 8		
Farrukhabad . . . . .	Provincial Surveys.	1897-1901	Two years .	1,720	1,17,534	68	80	107		
Etāwah . . . . .	"	1900-1901	" .	...	...	...	...	...		
Aligarh (portions of two taluqas).	No new Traverse	1900-1901	One year .	...	...	...	...	...		
Etah . . . . .	Nos. 2 and 8 Parties and Provincial Surveys.	1899-1902	Two years .	...	...	...	...	...		

(2) The figures for each district cannot be separated; ₹27-8 is the average cost-rate.  
 (3) Includes cost of preliminary operations in Aligarh.  
 (4) Scattered cultivation on 64-inch and 32-inch scale.

*District Surveys, including partial preparation of field books, executed by professional Survey parties, 1871-77.*

DISTRICT.	Years of survey.	Cost-rates per square mile.	REMARKS.
		<i>R</i>	
Agra . . . . .	1872-76 . . . . .	160	
Muttra . . . . .	1871-76 . . . . .	183	
Bánda . . . . .	1874-80 . . . . .	192	
Hamírpur . . . . .	1874-76 . . . . .	126	
Moradabad . . . . .	1871-77 . . . . .	198	

*District Surveys, including partial preparation of Settlement Records, executed by professional Survey Parties, 1877-94.*

DISTRICT.	Years of survey.	Cost-rates.	REMARKS.
		<i>R</i>	
Jaunpur . . . . .	1877-81 . . . . .	209	
Ghazipur . . . . .	1878-82 . . . . .	169	
Mirzapur . . . . .	1879-83 . . . . .	151	
Ballia . . . . .	1874-76 . . . . .	} 202	
	1880-84 . . . . .		
Benares . . . . .	1882-84 . . . . .	152	
Gorakhpur . . . . .	1883-88 . . . . .	167	
Basti . . . . .	1883-88 . . . . .	225	
Jhánsi (excluding Lalitpur) . . . . .	1888-90 . . . . .	54	
Dehra Dún . . . . .	1890-92 . . . . .	...	
Garhwál . . . . .	1889-94 . . . . .	...	

By *patwari* agency; cost exclusive of traverse and record operation.

Abstract showing the approximate Magnetic values at Stations observed at  
by No. 26 Party during season 1901-02.

Serial No.	Name of Station.	Survey No.	Latitude.	Longitude.	Dip.	Declination.	Horizontal Force.	REMARKS.
			° ' "	° ' "	° ' "	° ' "	C.G.S.	
1	Pávdásan . . .	3	24 29 20	71 53 50	33 35	E 1 10	0°3535	
2	Sáchor . . .	2	24 45 20	71 45 50	33 45	" 1 40	0°3535	
3	Dúthva . . .	1	24 52 50	71 28 50	33 50	" 2 0	0°3510	
4	Sheria Bhoel . . .	1	24 43 40	70 53 0	33 15	" 1 40	0°3510	
5	Tar Lunian . . .	2	24 39 0	70 31 40	33 55	" 2 15	0°3520	
6	Islamkot . . .	3	24 42 0	70 10 0	33 25	" 1 5	0°3555	
7	Dipla . . .	4	24 28 10	69 34 40	33 15	" 2 0	0°3500	
8	Rahim-ki-bázár . . .	5	24 19 0	69 9 0	32 40	" 1 50	0°3510	
9	Kiria . . .	3	24 20 0	68 46 40	32 35	" 1 35	0°3505	
10	Lakhsat . . .	4	23 49 20	68 46 40	31 45	" 1 40	0°3525	
11	Mhur . . .	5	23 33 20	68 56 50	31 25	" 2 0	0°3535	
12	Nakhtrana . . .	6	23 21 0	69 15 30	31 15	" 1 35	0°3535	
13	Kalyánpur . . .	8	23 13 40	69 35 40	30 40	" 1 15	0°3570	
14	Bhimásar . . .	9	23 11 20	70 9 50	30 20	" 1 5	0°3545	
15	Lákadiya . . .	7	23 20 30	70 34 40	31 10	" 1 5	0°3530	
16	Adesar . . .	10	23 33 20	70 59 10	31 25	" 1 20	0°3560	
17	Váráhi . . .	10	23 47 50	71 26 20	31 45	" 1 25	0°3555	
18	Diodar . . .	7	24 6 30	71 46 10	32 15	" 1 25	0°3560	
19	Sai . . .	2	26 17 0	72 16 20	35 25	" 2 5	0°3520	
20	Asolai . . .	1	26 42 10	72 15 50	37 5	" 0 15	0°3420	
21	Phalodi . . .	5	27 7 40	72 21 30	37 35	" 2 5	0°3440	
22	Nukh . . .	4	27 33 30	72 15 20	38 25	" 2 15	0°3455	
23	Ranjitpura . . .	3	28 1 0	72 7 20	39 10	" 2 15	0°3410	
24	Khangarh . . .	2	28 22 10	71 42 50	40 5	" 2 5	0°3395	
25	Derawar Fort . . .	1	28 46 20	71 20 10	40 50	" 2 45	0°3350	
26	Reti . . .	3	28 5 10	69 51 20	39 15	" 2 45	0°3380	
27	Lunwára Tar . . .	6	27 44 30	69 38 40	38 35	" 2 30	0°3390	
28	Piareh-ka-Toar . . .	7	27 18 20	69 32 20	37 50	" 2 20	0°3405	
29	Jussio . . .	1	26 48 40	69 29 20	37 0	" 2 10	0°3425	
30	Tajal . . .	2	26 52 50	68 59 20	37 5	" 2 0	0°3420	
31	Mubárik Sháh Syed . . .	5	26 23 40	68 56 20	36 15	" 1 55	0°3445	
32	Bakár . . .	4	26 5 10	69 9 0	35 45	" 1 55	0°3450	
33	Khípra . . .	6	25 49 20	69 22 20	35 20	" 2 0	0°3460	
34	Ránáhu . . .	5	25 56 10	69 47 20	35 30	" 2 5	0°3460	
35	Nusseer Areesur . . .	3	26 9 20	70 7 30	36 0	" 1 55	0°3455	
36	Sumrahu . . .	2	26 29 0	69 59 40	36 35	" 2 5	0°3445	
37	Samásata . . .	7	29 21 10	71 32 30	41 20	" 3 0	...	
38	Káráchi . . .	1	24 51 20	67 1 30	33 30	" 1 35	...	
39	Dabeji . . .	2	24 48 50	67 29 50	33 30	" 1 40	...	
40	Jhimpir . . .	11	25 1 50	68 0 50	33 55	" 1 40	...	
41	Hyderabad . . .	10	25 22 30	68 22 30	34 30	" 1 45	...	
42	Shahdádpur . . .	7	25 55 40	68 37 50	35 25	" 1 45	...	
43	Daur . . .	4	26 27 40	68 23 20	36 20	" 1 50	...	
44	Kandiáro Road . . .	1	26 59 20	68 20 50	37 25	" 1 45	...	
45	Khairpur . . .	5	27 31 10	68 44 20	38 10	" 2 0	...	
46	Ruk Junction . . .	3	27 48 20	68 38 20	38 40	" 2 0	...	
47	Lárkhána . . .	4	27 32 40	68 12 10	38 30	" 1 55	...	
48	Sita Road . . .	6	27 2 30	67 51 10	37 30	" 2 10	...	
49	Búbak Road . . .	3	26 29 0	67 46 10	36 30	" 1 50	...	
50	Sann . . .	6	26 1 40	68 6 50	35 40	" 1 50	...	
51	Petáro . . .	8	25 32 0	68 19 10	34 45	" 1 45	...	
52	Jhatpat . . .	2	28 22 20	68 19 20	39 45	" 2 10	...	
53	Bellpat . . .	1	28 59 40	68 0 20	40 45	" 2 25	...	
54	Sibi . . .	1	29 32 50	67 51 30	41 40	" 2 35	...	
55	Pano Ákil . . .	5	27 50 50	69 6 50	38 45	" 2 15	...	
56	Khárpur Daharki . . .	4	28 2 40	69 41 30	39 5	" 2 35	...	
57	Ádikabad . . .	2	28 18 10	70 7 40	39 45	" 2 30	...	
58	Khanpur . . .	1	28 38 20	70 39 10	40 0	" 2 15	...	
59	Chanigot . . .	8	29 5 10	71 1 30	40 55	" 2 30	...	
60	Asrani . . .	6	29 31 30	72 8 10	41 55	" 2 40	...	
61	Bakhshankhan . . .	4	29 44 30	72 42 50	42 0	" 2 35	...	
62	Rojhanwali . . .	4	30 0 50	73 15 40	42 25	" 2 35	...	
63	Orki (Sujáwal-pur.) . . .	2	30 8 50	73 54 30	42 40	" 3 0	...	
64	Malaut . . .	3	30 11 0	74 29 40	42 40	" 2 45	...	
65	Bhuchchu . . .	3	30 12 50	75 5 30	42 50	" 2 40	...	
66	Alál . . .	6	30 21 50	75 43 50	43 10	" 2 45	...	
67	Patiála . . .	4	30 20 40	76 24 0	43 5	" 2 50	...	
68	Sirhind . . .	2	30 7 40	76 22 40	43 30	" 3 0	...	
69	Ladhowál . . .	1	30 59 0	75 47 20	44 10	" 2 55	...	
70	Kartárpur . . .	3	31 26 10	75 29 30	44 45	" 3 0	...	
71	Lahore . . .	8	31 35 50	74 18 50	45 20	" 3 0	0°3240	
72	Chánga Mánga . . .	9	31 5 30	73 56 30	44 5	" 2 55	0°3280	
73	Gámbar . . .	1	30 45 20	73 19 50	43 40	" 2 55	0°3285	
74	Chíchawatni . . .	1	30 32 10	72 41 50	43 20	" 2 50	0°3305	

Abstract showing the approximate Magnetic values at Stations observed at  
by No. 26 Party during season 1901-02—contd.

Serial No.	Name of Station.	Survey No.	Latitude.	Longitude.	Dip.	Declination.	Horizontal Force.	REMARKS.
			° ' "	° ' "	° ' "	° ' "	C.G.S.	
75	Kacha Khúh	३३	2 30 22 40	72 9 10	43 5	E 2 35	0'3285	
76	Mooltan	३	30 10 40	71 27 50	42 45	" 2 50	0'3290	
77	Giláwála	५	29 43 10	71 28 20	41 50	" 2 45	0'3325	
78	Gujránwála	६	32 9 40	74 12 0	45 55	" 3 5	0'3220	
79	Sambriál	५	32 28 10	74 21 20	46 15	" 3 15	0'3210	
80	Jummoo	१	32 43 0	74 51 20	46 25	" 3 25	0'3200	
81	Lála Músa	२	32 42 40	73 57 0	46 40	" 3 20	0'3190	
82	Domeli	२	33 2 10	73 28 0	47 0	" 3 30	0'3170	
83	Mankiala	१	33 29 0	73 14 40	47 30	" 3 40	0'3155	
84	Sarai Kála	५	33 44 40	72 49 10	48 0	" 3 40	0'3140	
85	Khairabad	४	33 54 10	72 13 10	48 5	" 3 45	0'3130	
86	Rashkai	२	34 7 0	72 1 20	48 35	" 3 40	0'3100	
87	Dargai	१	34 30 10	71 53 50	48 55	" 3 55	0'3095	
88	Pesháwar	३	34 0 40	71 33 40	48 15	" 3 45	0'3115	
89	Jand	७	33 26 20	72 0 50	47 35	" 3 35	0'3145	
90	Fatahjang	३	33 34 20	72 38 30	47 40	" 3 35	0'3145	
91	Massan	३	32 53 30	71 43 20	46 50	" 3 20	0'3155	
92	Kundián	४	32 27 30	71 28 20	46 55	" 3 25	0'3130	
93	Hadáli	५	32 18 20	72 10 20	46 5	" 3 25	0'3200	
94	Lilla	२	32 33 0	72 44 40	46 50	" 3 30	0'3180	
95	Khewra	३	32 38 0	73 0 10	46 55	" 3 10	0'3165	
96	Bherah	३	32 29 20	72 55 20	46 20	" 3 5	0'3205	
97	Hariah	४	32 34 30	73 19 30	46 35	" 3 10	0'3180	
98	Amritsar	७	31 38 10	74 51 30	45 0	" 3 0	0'3255	
99	Dháriwal	२	31 57 10	75 18 50	45 45	" 2 45	0'3220	
100	Pathánkot	३	32 16 30	75 38 40	46 0	" 3 30	0'3245	
101	Kesri	५	30 15 50	76 55 30	43 5	" 2 50	0'3340	
102	Virár	३	19 27 10	72 48 30	23 35	" 0 20	0'3640	
103	Dáhnú Road	२	19 58 40	72 44 40	24 5	" 1 20	0'3680	
104	Párdi	१	20 31 0	72 55 40	25 40	" 1 50	0'3645	
105	Sachín	९	21 4 40	72 52 40	26 35	" 0 35	0'3660	
106	Fort Songad	८	21 8 50	73 33 30	26 45	" 0 40	0'3695	
107	Ankleshvar	७	21 37 20	73 0 20	27 50	" 0 50	0'3650	
108	Nándod	६	21 53 20	73 28 30	28 10	" 1 10	0'3630	
109	Bodeli	५	22 10 20	73 42 50	29 25	" 1 15	0'3645	
110	Itola	४	22 9 10	73 9 40	28 40	" 1 10	0'3625	
111	Cambay	५	22 19 20	72 38 0	28 60	" 1 10	0'3615	
112	Bárejádi	२	22 53 40	72 40 20	30 10	" 1 5	0'3580	
113	Parántíj	१२	23 25 40	72 51 50	31 5	" 1 35	0'3585	
114	Jagudan	११	23 30 50	72 24 0	31 20	" 1 20	0'3565	
115	Pátan	९	23 51 0	72 8 10	31 50	" 0 50	0'3565	
116	Kherálu	८	23 52 40	72 37 10	31 40	" 1 20	0'3565	
117	Deesa	६	24 14 30	72 10 40	32 30	" 1 20	0'3555	
118	Roho	५	24 24 20	72 38 20	32 35	" 1 30	0'3555	
119	Pindwára	१	24 47 40	73 2 20	33 55	" 1 50	0'3525	
120	Ráni	७	25 21 10	73 18 20	34 30	" 1 30	0'3520	
121	Khángta	२	26 33 30	73 37 20	36 45	" 2 0	0'3470	
122	Múndwa	५	27 3 50	73 48 30	37 40	" 2 0	0'3450	
123	Bikasar	४	27 34 20	73 28 0	38 25	" 2 0	0'3430	
124	Bikaner	३	28 0 40	73 18 50	39 15	" 2 10	0'3410	
125	Dulmera	२	28 24 20	73 39 50	40 5	" 2 15	0'3390	
126	Mahájan	१	28 47 40	73 50 40	40 30	" 2 25	0'3375	
127	Súratgarh	५	29 19 30	73 54 30	41 25	" 2 35	0'3365	
128	Gachhipura	१	26 57 20	74 24 50	37 25	" 2 5	0'3465	
129	Sámbar	१	26 54 20	75 11 10	37 50	" 2 20	0'3470	
130	Ajmer	३	26 27 30	74 38 30	36 35	" 2 5	0'3480	
131	Beáwár	४	26 6 40	74 18 40	35 55	" 1 50	0'3490	
132	Sojat Rd.	५	25 52 0	73 45 10	35 25	" 1 45	0'3495	
133	Rahoki Junction	९	25 24 30	68 28 0	34 30	" 1 45	0'3465	
134	Mirpur Khás	८	25 31 40	69 0 40	34 45	" 1 50	0'3465	
135	Dhoro Naro	७	25 29 50	69 34 20	34 45	" .. ..	" .. ..	
136	Bhávnagar	८	21 46 40	72 7 40	27 15	" 0 25	0'3670	
137	Ningala	६	22 1 30	71 42 20	28 20	" 1 10	0'3635	
138	Limbdí	४	22 36 30	71 47 30	29 5	" 1 15	0'3570	
139	Viramgám	१३	23 8 10	72 3 30	30 30	" 1 15	0'3580	
140	Dhrángadra	१	22 59 50	71 28 30	29 50	" 1 10	0'3625	
141	Dolia	३	22 31 20	71 21 50	" .. ..	" 1 15	0'3605	
142	Morvi	१	22 49 30	70 51 10	30 0	" 0 45	0'3555	
143	Rájkot	३	22 18 20	70 48 40	28 45	" 1 10	0'3600	
144	Virpur	५	21 51 0	70 42 20	28 15	" 1 10	0'3595	
145	Jámnagar	२	22 28 30	70 4 20	28 55	" 1 20	0'3590	
146	Junágad	७	21 31 50	70 27 0	27 15	" 1 20	0'3590	
147	Veraval	१	20 54 20	70 22 30	25 45	" 1 10	0'3615	
148	Abu Road	४	24 29 0	72 46 40	32 55	" 1 35	0'3550	
149	Chital	७	21 44 40	71 12 40	27 45	" 0 40	0'3610	
150	Jám Jodhpur	४	21 54 10	70 1 50	27 45	" 2 5	0'3600	
151	Porbandar	६	21 38 10	69 36 20	28 10	" 1 20	0'3595	

*Abstract showing the approximate Magnetic values at Stations observed at  
by No. 26 Party during season 1901-02—concl'd.*

Serial No.	Name of Station.	Survey No.	Latitude.			Longitude.			Dip.	Declination.	Horizontal Force.	REMARKS.
			°	'	"	°	'	"	°	'	C. G. S.	
152	Dákor . . .	1/2 1	22	45	10	73	9	10	29 40	E 1 40	0'3600	
153	Chancheláo . . .	" 2	22	47	50	73	42	40	30 5	" 1 10	0'3590	
154	Dohad . . .	" 3	22	50	20	74	14	50	30 0	" 1 10	0'3600	
155	Bhairongarh . . .	1/2 4	23	9	0	74	46	40	30 25	" 1 15	0'3715	
156	Jaora . . .	1/2 2	23	38	0	75	7	0	31 40	" 1 30	0'3590	
157	(Panth) Piplia . . .	" 1	24	12	20	75	0	40	32 5	" 0 50	0'3560	
158	Nim bahera . . .	1/2 3	24	37	20	74	41	40	33 45	" 1 45	0'3535	
159	Kapasin . . .	" 2	24	51	30	74	18	40	33 50	" 1 55	0'3530	
160	Mándal . . .	1/2 6	25	26	50	74	35	10	34 20	" 2 35	0'3485	
161	Naraina . . .	1/2 4	26	47	30	75	11	50	37 45	" 1 55	0'3470	
162	Jaipur . . .	" 2	26	55	0	75	47	0	37 40	" 2 5	0'3465	
163	Arnu . . .	" 3	27	0	0	76	28	50	37 40	" 2 0	0'3480	

*Repeat Stations.*

I	Udaipur . . .	... ..	24	35	33	73	41	57	33 10	E 1 30	0'3545	
II	Karachi . . .	... ..	24	49	50	67	2	2	33 30	" 1 40	0'3475	
III	Quetta . . .	... ..	30	11	52	67	0	20	42 30	" 2 50	0'3255	
IV	Baháwalpur . . .	... ..	29	23	27	71	40	37	41 30	" 2 55	0'3340	
V	Ráwalpindi . . .	... ..	33	35	16	73	3	6	47 45	" 3 40	0'3140	

NOTES.—The above values 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 the observations have been rejected and will be repeated.

The Survey numbers refer to the published chart; thus No. 1/2 3 denotes No. 3 Station in the dotted square, the spherical co-ordinates of whose centre are 26° North Latitude and 76° East Longitude.

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

*Mean monthly readings of earth thermometers taken at the Trigonometrical Branch Office, Dehra Dûn.*

Depth in feet of thermometer bulbs below surface of ground.	Year.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.
25.6	1901-02 . . .	78.16	77.68	77.32	76.90	76.26	75.70	75.10	74.90	75.02	75.45	76.28	76.01
	Mean, 1887-1901 .	77.12	77.10	76.91	76.53	75.87	75.13	74.46	74.13	74.16	74.59	75.96	77.04
12.8	1901-02 . . .	79.83	78.89	77.13	74.93	73.21	72.64	73.43	74.87	77.00	78.50	79.70	79.94
	Mean, 1887-1901 .	79.55	78.54	76.82	74.59	72.45	71.15	71.45	73.26	75.46	77.68	79.53	79.94
6.4	1901-02 . . .	80.01	77.53	73.27	69.17	68.58	70.67	74.35	78.10	81.95	82.24	83.03	81.46
	Mean, 1887-1901 .	81.91	76.33	71.99	67.89	65.86	67.08	71.72	77.20	80.84	81.84	81.69	81.25
3.2	1901-02 . . .	78.97	73.93	67.53	63.95	66.03	72.36	78.77	84.30	86.81	84.31	82.74	82.17
	Mean, 1887-1901 .	78.30	72.36	66.23	62.29	61.54	67.02	76.10	83.15	85.49	83.73	82.19	81.66
1.6	1901-02 . . .	77.20	70.46	61.35	59.60	64.38	73.87	80.32	88.94	90.53	84.91	83.15	81.76
	Mean, 1887-1901 .	76.33	68.37	60.13	57.29	59.08	67.38	78.72	86.93	88.59	84.41	82.32	81.15
Thermometer in shade.	1901-02 . . .	80.98	74.08	66.87	68.64	74.30	82.13	88.19	92.64	90.97	81.52	81.68	81.14
	Mean, 1887-1901 .	80.33	73.35	66.85	63.69	66.61	79.03	89.48	94.32	90.68	82.55	80.53	82.17





1903.

File No. 76 of  
1903.

GOVERNMENT OF INDIA,  
DEPARTMENT OF REVENUE AND AGRICULTURE.

Serial No. 3.

LAND-SURVEYS.

RESOLUTION.

*No. 2—76-3.*

*Simla, the 26th August 1903.*

SUBJECT.

Reviews the General Report on the operations of the Survey of India during the year 1901-1902.



No. 2—76·3.

GOVERNMENT OF INDIA.

DEPARTMENT OF REVENUE AND AGRICULTURE.

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LAND-SURVEYS.

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*Simla, the 26th August 1903.*

READ—

The General Report on the operations of the Survey of India Department during the year 1901-02.

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RESOLUTION.

Field operations were carried on by three double and fifteen ordinary parties and two detachments ; one party was employed on trigonometrical surveys ; one double and six ordinary parties on topographical surveys ; one double and two ordinary parties on forest surveys ; one double and two ordinary parties on cadastral surveys ; two detachments on traverse surveys ; and four parties on scientific operations. In addition to the above, traverse and cadastral surveys were continued in the United Provinces by Local Agency under the general supervision of the Deputy Surveyor General. The total outturn of detail survey during the year amounted to 104,794 square miles, including 68,162 square miles of reconnaissance surveys on the  $\frac{1}{4}$  inch and smaller scales. The total area of rigorous surveys on all scales was 36,632 square miles. The total area triangulated was 99,496 square miles, which includes 83,790 square miles triangulated in connection with reconnaissance surveys, while the total area traversed for cadastral purposes was 5,424 square miles.

2. Of the parties engaged on topographical operations, Nos. 11 and 21 Parties were amalgamated and were engaged in a topographical survey of the Shan States. No. 3 Party was employed in Lower Burma and No. 10 in Upper Burma, mainly in the work of compiling topographical maps from the cadastral sheets. No. 18 Party was employed on similar work in the Punjab. No. 14 Party was engaged on original topographical work in the United Provinces. The subject of topographical surveys in Burma has been under consideration during the year. The completion of the topographical revision of the cadastral maps, and the survey of tracts which have not been cadastrally surveyed, but which are likely to be developed and brought under cultivation in the near future, or of which maps are required for administrative, engineering or railway purposes, will, for some years to come, provide ample work for the two Parties which are at present at work in the Province ; while it is desirable that the 1-inch survey, which is at present being carried on in the Shan States, should be continued along the whole of the tracts bordering on the Siamese and Yunnan frontiers. The three Parties which are now employed in Burma and the Shan States will therefore continue to carry on work there for the present, and the Surveyor General has been requested to prepare and submit in consultation with the Local Government a programme for their employment during the next five years. It is satisfactory that arrangements have been made for the topographical survey of certain districts in the United Provinces, of which topographical maps do not exist and cannot be provided by reductions of cadastral maps.

3. The question of the condition of the existing topographical maps of the country and of the measures to be taken for bringing them up to date is at present engaging the serious attention of the Government of India. In Burma and the Punjab a satisfactory commencement has been made in the work of compiling correct topographical maps from the cadastral sheets; but the facts stated in paragraph 50 of the present report indicate that elsewhere the district maps are in a most unsatisfactory condition. The attempt to keep up the maps in the manner there described has evidently led to unsatisfactory results, and it is obvious that more systematic arrangements will have to be made for the revision of topographical maps generally. The question is now being fully considered in consultation with the Surveyor General.

4. Paragraphs 46-68 of the Report deal with the state of work in the Drawing and Issue Offices at Head Quarters. The details of maps issued are somewhat difficult to follow, but it is stated that there are still a large amount of arrears to be worked off in the way of bringing sheets out of stock up to date for publication, and that the publication of the results of the surveys completed by the Department is being greatly delayed owing to the congestion of work. This congestion is in great measure due to the large and increasing amount of extra departmental work which the Survey Department is called on to undertake, and which interferes considerably with the ordinary work of the Department. It will be necessary to consider the desirability of either strengthening the Head Quarters Offices or of relieving them of the extraneous work by which they are at present overburdened. In any case, the necessity is apparent of introducing stricter rules as to the conditions under which such extra departmental work is to be attempted.

5. The Government of India are glad to observe that the recent changes in the organization of the Mathematical Instrument Office, besides resulting in considerable saving, have enabled the whole of the accumulated stores to be put into proper order.

6. The Government of India fully concur in the opinion expressed by the Surveyor General in paragraph 79 of the Report as to the desirability of exhibiting clearly the financial results of the working of the Head Quarters Offices in a regular profit and loss account, and it is hoped that the arrangements which are reported to be now under consideration will enable this to be done in the Report for next year.

7. In conclusion, the Governor General in Council again desires to acknowledge the manner in which the Department generally under the direction of Colonel Gore has endeavoured to cope with the large and increasing amount of work devolving on it.

**ORDERED** that the above Resolution be forwarded to the Surveyor General

Madras.  
Bombay.  
Bengal.  
United Provinces of Agra  
and Oudh.  
Punjab.

Burma.  
Central Provinces.  
Assam.  
Coorg.  
Berar.  
North-West Frontier Pro-  
vince.

of India, the Inspector General of Forests, the Local Governments and Administrations noted in the margin and to the Foreign, Military and Public Works Departments, and that

it be published in the Supplement to the *Gazette of India*.

J. O. MILLER,

*Secretary to the Government of India.*