

GENERAL REPORT

ON THE

OPERATIONS

OF THE

Survey of India Department

ADMINISTERED UNDER

THE GOVERNMENT OF INDIA

DURING

1897-98.

PREPARED UNDER THE DIRECTION OF

MAJOR-GENERAL C. STRAHAN, R.E.,

SURVEYOR GENERAL OF INDIA.



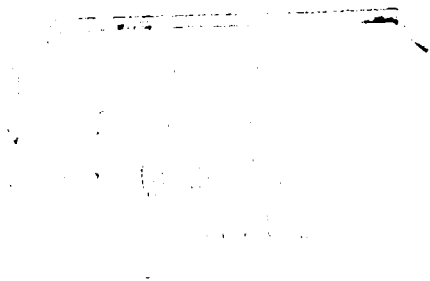
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INDEX CHART
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GREAT TRIGONOMETRICAL SURVEY
OF
INDIA

SHOWING COLONEL LAMBTON'S NET WORK OF TRIANGULATION IN SOUTHERN INDIA,
THE MERIDIONAL AND LONGITUDINAL CHAINS OF PRINCIPAL TRIANGLES,
THE BASE LINES MEASURED WITH THE COLBY APPARATUS,
THE LINES OF THE SPIRIT LEVELLING OPERATIONS,
THE ASTRONOMICAL PENDULUM & TIDAL STATIONS,
THE LONGITUDINAL ARCS,
AND THE SECONDARY TRIANGULATION TO FIX THE PEAKS OF
THE HIMALAYAN & THE SULIMAN RANGES,
AND THE POSITIONS OF BANGKOK, KANDAHAR &c.
Completed to 1st October 1838.

Scale 1 Inch = 96 Miles or 1:115200

REFERENCE

The Principal triangulation shown subsequent to the year 1830 is shown in this line.
The Principal triangulation shown previous to that date and all Secondary triangulation is shown in this line.
The stations where an azimuth has been observed astronomically thus + in this line.
The stations where the longitude has been observed astronomically thus * in this line.
The course of the levelling operations is shown by a dotted line.
The base lines measured with the Colby apparatus thus ————
The lines of the spirit levelling operations thus ————
The astronomical pendulum & tidal stations thus ————
The longitudinal arcs thus ————

Compiled under the orders of Colonel J. T. Walker, R.E.F.R.S. &c.
Superintendent of the Survey of India at Delhi in August 1853.

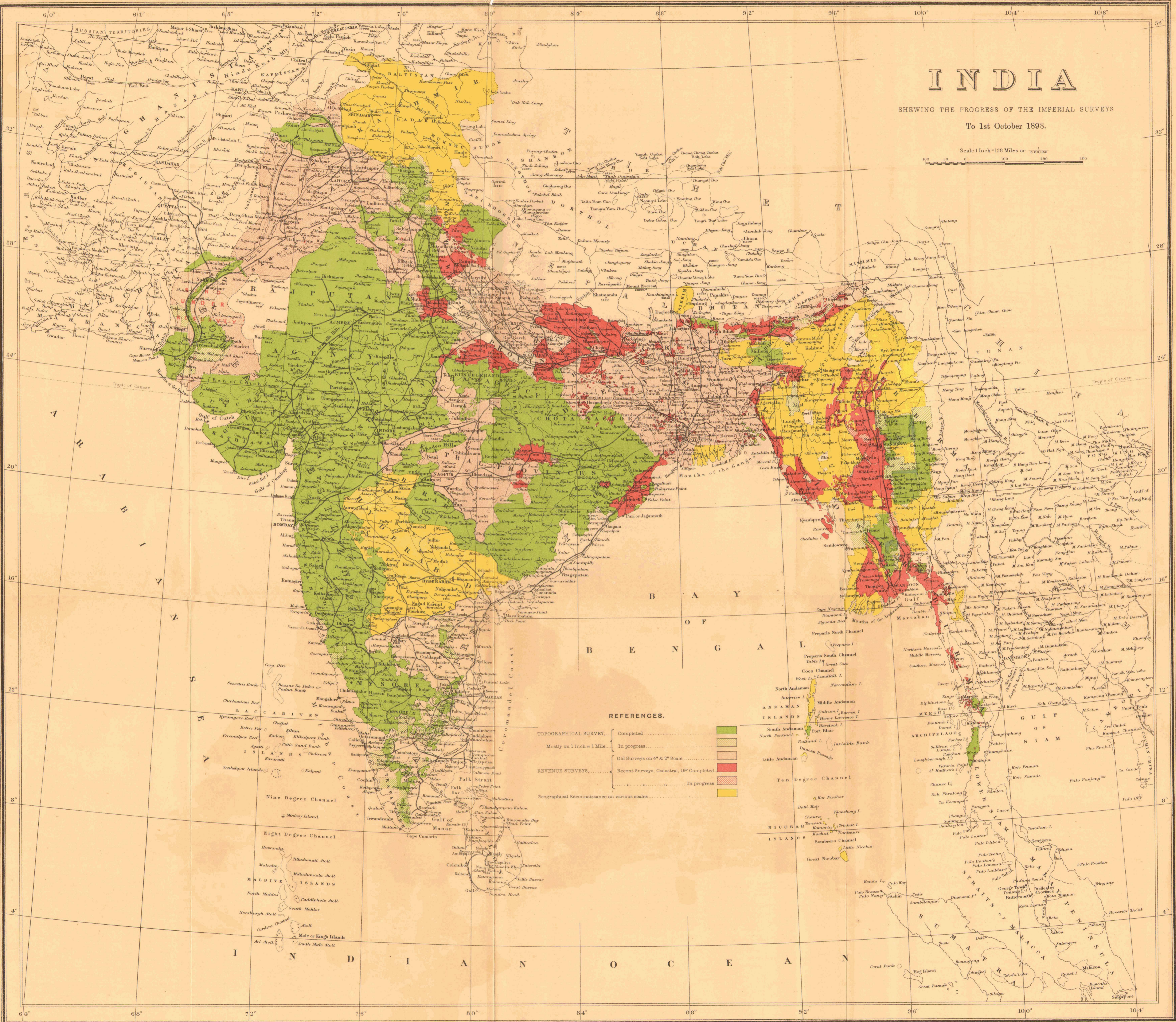
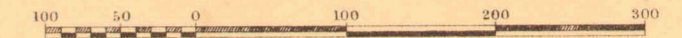
Engraved at the Survey of India Office, Calcutta.
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INDIA

SHOWING THE PROGRESS OF THE IMPERIAL SURVEYS

To 1st October 1898.

Scale 1 Inch = 128 Miles or 1:162560



REFERENCES.

TOPOGRAPHICAL SURVEY.	Completed	
	Mostly on 1 inch = 1 Mile.	
REVENUE SURVEYS.	Recent Surveys, Cadastral, 16" Completed	
	In progress	
Geographical Reconnaissance on various scales		

GENERAL REPORT
ON THE
Operations of the Survey of India
DURING THE SURVEY YEAR

1897-98.

PART I.

SUMMARY.

ADMINISTRATION.

1. The operations of the department that are now reported on are for the survey year ending 30th September 1898.

2. The general administration of the department and the superintendence of the Topographical Branch remained throughout the year in the hands of Major-General C. Strahan, R.E., Surveyor-General of India. Colonel J. E. Sandeman, I.S.C., Deputy Surveyor-General, having been forced through ill health to take furlough during the preceding year, Major-General R. G. Woodthorpe, C.B., R.E., was appointed to officiate for him, but as he was himself out of health and on leave at the time, Lieutenant-Colonel J. R. Hobday, I.S.C., acted as Deputy Surveyor-General, and held charge of the Revenue Branch from the beginning of the year till 9th November 1897, when Major-General Woodthorpe returned and received charge. Notwithstanding his having remained in England for upwards of two years, he had not been able to shake off the malaria from which he had been suffering, and on the 26th May 1898 he died, and Lieutenant-Colonel Hobday again took up the duties of the Deputy Surveyor-General, in which appointment he was confirmed on the 3rd September 1898, when Colonel Sandeman's services were replaced at the disposal of the Military Department. Lieutenant-Colonel St. G. C. Gore, R.E., Superintendent, Trigonometrical Surveys, returned from privilege leave and resumed charge of his office from Captain G. P. Lenox-Conyngham, R.E., on the 20th October 1897. Colonel Gore, however, proceeded on special leave for six months on the 26th April 1898, when Major S. G. Burrard, R.E., was appointed to officiate for him. Captain R. T. Crichton, I.S.C., continued to be Superintendent, Settlement Surveys, Bengal, throughout the year.

Mr. G. B. Scott superintended all the cadastral operations in the North-Western Provinces under the title of Superintendent of Land Records Surveys.

Inspection Tours of the Administrative Officers.

3. The Surveyor-General left Calcutta on the 10th April and proceeded to Dehra, where he visited the Great Trigonometrical Office and training school. On the 17th April he arrived at Simla, where he remained till the 19th July, when he returned to Calcutta, again visiting the Trigonometrical Office at Dehra and the field parties recessing at Mussooree on his way back. During his stay at Simla he inspected the Drawing Office and the Office of No. 18 (Himálaya) Party. On the 18th September Major-General C. Strahan again left Calcutta and proceeded to Bangalore, where he inspected the recess offices of Nos. 9 and 19 Parties (Madras), and of Nos. 10, 11, 20 and 21 Parties (Burma). From Bangalore he went to Poona, where Nos. 17 and 25 Parties were inspected. Having been summoned to Simla to discuss the future of the Forest Survey Branch with the Secretary to Government in the Revenue and Agricultural Department and the Inspector-General of Forests, he proceeded there, arriving on the 10th October. He returned to Calcutta on the 1st November.

4. Major-General R. G. Woodthorpe, R.E., Officiating Deputy Surveyor-General, Revenue Branch, left Calcutta on the 19th November 1897 for Sylhet to assist the officer in charge in making field arrangements for No. 14 Party, which was about to enter the Lushai Hills for the first time, and he returned to Calcutta on the 29th idem. On the 10th December he started for Assam to inspect No. 6 Party in the field at Tezpur, and returned to Head-Quarters on 21st idem. On the 3rd of January 1898 he proceeded to inspect the Bengal survey parties in the field at Samastipur and Darbhanga till the 17th idem, when he left for Allahabad to confer with Mr. G. B. Scott, the Superintendent, Land Records Surveys, and the Board of Revenue in the North-Western Provinces and Oudh. After seeing some of the detachments at work in the field at Fatehgarh and Cawnpore, he returned to Calcutta on the 2nd February. On the 7th March he sailed for Rangoon to inspect Nos. 3, 7 and 20 Parties in the field in Burma and returned to Calcutta on the 28th April.

5. On the death of Major-General Woodthorpe, Lieutenant-Colonel J. R. Hobday was appointed Officiating Deputy Surveyor-General, Revenue Branch. He left Calcutta on the 24th of June to inspect Nos. 6 and 14 Parties at recess quarters in Shillong, returning to Head-Quarters on the 14th July. On the 11th August he sailed from Calcutta for Madras, and inspected Nos. 9 and 19 and 20 Parties at Bangalore, returning to Madras on the 25th idem, when he sailed for Rangoon to confer with the officers in charge of Nos. 3 and 7 (cadastral) Parties, regarding the conversion of the former into a topographical party for the next field season; he returned to Calcutta on the 9th September. On the 20th September he proceeded to Naini Tal to confer with the Superintendent, Land Records Surveys, in the North-Western Provinces and Oudh, and then to Mussooree to inspect Nos. 2 and 8 Parties and the Bengal Surveys at recess quarters, returning to Head-Quarters, Calcutta, on the 11th October. He again started for Darjeeling on the 13th October to confer with the Local Government about matters connected with the Bengal Surveys and returned to Calcutta on the 25th idem.

6. Major S. G. Burrard, R.E., Officiating Superintendent, Trigonometrical Surveys, visited Simla in August to inspect No. 18 Party, and shortly after his return to Dehra in September proceeded to Mussooree, where he inspected the offices of Nos. 22, 23 and 24, the Astronomical and Triangulation Parties.

In October, Major Burrard paid a visit of inspection to Karachi to examine into the work of the Sind Survey Party (No. 12).

FIELD PARTIES.

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

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

Statement of Survey Operations and Parties.

No. of Party.	Nature and locale of operations.	Page in this Report.	Executive Officers.	Scale of Survey.	Administrative Superintendent.
24	Trigonometrical Survey.	17	Captain J. M. Burn, R.E. } Lieutenant H. H. Turner, R.E. } Mr. J. Hickie }	---	Supdt., Trig.
	Assam			64	Mr. J. Bond . . . . .	.....	Ditto.
Det. of 25					

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.
	<i>Topographical Surveys.</i>				
6	Assam	56	Captain C. W. H. Symonds, I.S.C. Mr. W. H. Penrose	$2''=1$ mile for reduction.	D. S. G., Rev.
10	Upper Burma	18	Captain A. J. Pilcher, R.E. Lieutenant W. M. Coldstream, R.E. Lieutenant H. J. Hare, R.E.	$1''=1$ mile for reproduction.	Ditto, Topo.
11	Ditto	19	Captain T. F. B. Renny-Tailyour, R.E. Mr. P. J. W. Doran	Ditto	Ditto.
12	Sind	21	Mr. C. F. Erskine	$2''=1$ mile for reduction	Supdt., Trig.
14	Lushai	23	Major G. B. Hodgson, I.S.C. Mr. J. Keating	$1''=1$ mile for reproduction.	D. S. G., Topo.
15	Baluchistan	26	Colonel Sir T. H. Holdich, K.C.I.E., C.B., R.E. Lieutenant-Colonel R. A. Wahab, C.I.E., R.E. Lieutenant K. W. Pirrie, I.S.C. Mr. T. E. M. Claudius	$6''=1$ mile and $1''=1$ mile for reproduction.	Ditto.
18	Himalayas	27	Lieutenant-Colonel R. A. Wahab, C.I.E., R.E. Mr. L. J. Pocock	$4''=1$ mile for reproduction and reduction to half scale, and $2''=1$ mile for reproduction.	Supdt., Trig.
21	Upper Burma	20	Lieutenant H. J. Hare, R.E.	$1''=1$ mile for reproduction.	D. S. G., Topo.
	<i>Forest Surveys.</i>				
9 & 19	Madras	30	Captain H. A. Denholm Fraser, R.E. Mr. C. F. Hamer	$4''=1$ mile for reproduction.	D. S. G., Rev.
17	Bombay	32	Captain P. J. Gordon, I.S.C. Mr. C. E. Tapsell	$16''=1$ mile, $8''=1$ mile and $4''=1$ mile for reproduction.	Ditto, Topo.
20	Burma	34	Lieutenant A. H. B. Hume, R.E.	$4''=1$ mile and $2''=1$ mile for reproduction.	Ditto, Rev.
	<i>Forest Survey Branch.</i>				
	Central Provinces	37	Mr. W. H. Reynolds	$4''=1$ mile for reproduction.	I. G., Forests.
	Punjab	38	Ditto		
	Burma	38	Ditto		
	North-Western Provinces	39	Ditto		
	<i>Cadastral Surveys.</i>				
3	Upper Burma	40	Mr. E. J. Jackson „ E. G. Little	$16''=1$ mile and $8''=1$ mile.	D. S. G., Rev.
4	Bihar	44	Captain R. T. Crichton, I.S.C.	$16''=1$ mile	S. S. S., Bengal.
7	Lower Burma	49	Mr. B. G. Gilbert-Cooper „ T. E. M. Claudius „ W. C. Price	$16''=1$ mile	D. S. G., Rev.
Land Records Survey.	North-Western Provinces and Oudh.	52	Mr. G. B. Scott	$16''=1$ mile	Ditto.
	<i>Traverse Surveys.</i>				
2 & 8	North-Western Provinces and Oudh.	53	Mr. J. S. Pemberton	$16''=1$ mile (skeleton plots).	D. S. G., Rev.
6	Assam	56	Captain C. W. H. Symonds, I.S.C. Mr. W. H. Penrose . . . . .	.....	Ditto.
	<i>Geodetic.</i>				
22 } 23 }	India	59	Captain G. P. Lenoxy-Conyngnam, R.E.	.....	Supdt., Trig.
	<i>Tidal and Levelling Operations.</i>				
25	India	60	Major S. G. Burrard, R.E. Lieutenant H. L. Crosthwait, R.E. Mr. E. J. Connor . . . . .	.....	Supdt., Trig.

OUTTURN.

9. During the year under report the aggregate area surveyed on all scales amounts to 36,199 square miles, of which 9,976 square miles were reconnaissance only. The report of last year shows an area of 104,987 square miles; the decrease this year is due to the small amount of reconnaissance completed. The aggregate area of rigorous survey on all scales amounted to 26,223 square miles against 26,269 square miles of last year. These areas are exclusive of those embraced by the traverse operations in the North-Western Provinces and Oudh and Assam carried on for the purpose of furnishing a correct skeleton on which to base the field surveys under the Settlement Department; the area thus traversed during this year amounts to 5,128 square miles, whilst that of last year was 6,135 square miles.

10. The operations of the various Field Parties will be found summarized in the following paragraphs. A more detailed report on the operations of each Party for the year is given in Part II.

TRIGONOMETRICAL SURVEYS.

11. The triangulation party, to which had been allotted the work of continuing the Makrán Longitudinal Series westwards, took the field as usual. Shortly after arrival on the ground, when but little of the work had been completed, the serious disturbance in Makrán, which has formed the subject of special reports, took place, and the head-quarters of the survey party was attacked and completely looted, thirteen natives being killed. Captain Burn, who had been suffering from fever, was fortunately encamped on the top of a hill at a little distance from the main camp, and thus he and the men with him escaped with their lives, but with some difficulty and considerable hardships, as they were about 130 miles from the nearest European station. Four *khalásis* who were on detached duty were also killed, but the other officers and men, with the assistance of Mir Dura Khan and of Bibi Ganji Foh, escaped with the loss of part of their property. This brought the work to an abrupt conclusion, and the party was withdrawn to India as soon as feasible.

TOPOGRAPHICAL SURVEYS.

12. Seven parties have been employed during the year in this branch of the department, and triangulation in advance has been carried on by a detachment of No. 3 Party which has been engaged up till now in cadastral operations in Upper Burma, but which is to be turned into a topographical party from the coming field season. Three of these parties, *viz.*, Nos. 10, 11 and 21, have been employed in Burma, and the others, *viz.*, Nos. 12, 14, 15 and 18, in Sind, Lushai Hills, Balúchistán and the Himálayas, respectively.

13. The portions of country surveyed in Upper Burma by the three parties above named are all in the Shan States, and the aggregate area completed amounted to 7,282 square miles on the 1-inch scale and 1,752 square miles on the $\frac{1}{2}$ -inch scale; 8,871 square miles were triangulated. The country surveyed in detail was mostly hilly and intricate and covered with tree or scrub jungle, which adds considerably to the difficulty of surveying and makes progress somewhat slow, so that the average outturn of 2,427 square miles per party is very satisfactory; the average cost rate of Rs 18.4 is low considering the difficulties met with, such as the cost of carriage, the nature of the country and the high rates of pay necessarily given to surveyors working in Burma. Every effort is being made to train more sub-surveyors for these and for other topographical parties, so as to increase the area at a small increase to the cost, but it is a slow business, for sub-surveyors are not fit to work in such country under two or three years and the training school at Dehra cannot turn out many men each year; moreover, these men during the first year at actual work cannot be expected to turn out much area. Both officers and men are very liable to fever, which often shows itself in the early part of the recess season after the party has returned to Bangalore; there is no doubt that the complete change afforded by their recessing at such a place enables them in most cases to shake off the malaria contracted

during the cold weather and allows of their making a fresh start each season. Notwithstanding this, however, one officer, Lieutenant Coldstream, and one European assistant had to be invalided to England, and Major Longe, who originally took only six months' special leave, has had to apply for extension of one year, as he is unable to get out of his system the malaria which he has contracted in eight years of survey work in Burma.

No. 12 Party continued the survey of Sind on the 2-inch scale. The area completed amounted to 2,709 square miles at a cost of ₹14.6 per square mile. The area traversed amounted to 2,971 square miles at a cost rate of ₹10.1 per square mile. The traversing includes a survey of the village boundaries which are fixed by offsets. To meet the requirements of the Irrigation Department, a survey of certain lands in Kalát was carried on *pari passu* with the work in Sind. The area topographically surveyed amounted to 1,477 square miles on the 2-inch scale at a cost rate of ₹10.4 per square mile. The lines of traverse on which the detail work was based were so arranged as to include rectangular blocks of 5 miles by 2 miles, the corners of which were subsequently marked by embedding pieces of rail 5 feet in length; these will be used by the Irrigation Department as bench-marks. These traverse lines covered an area of 1,554 square miles and cost ₹8.9 per square mile.

The topographical survey of the Lushai Hills was commenced this season by No. 14 Party, and an area of 1,300 square miles was triangulated; in addition to this, a secondary series of triangles was started from one of the sides of the Eastern Frontier series near Silchar and carried southwards for a distance of about 100 miles; this will, during the coming field season, be connected with another base of the same series, and will thus give reliable bases on which to base the network of triangulation required by the detail surveyors. No detail survey was done, the party being little more than a detachment of a suitable strength to carry out the necessary triangulation in advance. This country presents numerous and serious difficulties to a surveyor; it is a mass of hills, all covered with dense forest or with long grass and bamboos, except where patches have been cleared for cultivation; thus every hill top selected for a trigonometrical station took several days hard work to clear. In addition to this, the inhabitants are but few and of those few every available man was being employed on road making. No baggage animals are of much use in such a country, so it was necessary to import 350 coolies for the carriage of the baggage; of these, 200, chiefly Nepálese, were from Darjeeling and the remainder from Cachar; the former turned out well, but the Cacharis gave a great deal of trouble and eventually they had to be discharged, and 60 Nágás and Kúkis were engaged in their place. In future all the coolies will be imported from Darjeeling. Another difficulty consisted in rationing the men; rice is the only grain obtainable locally and that only in limited quantities; the bulk of the food supplies was obtained from the Government contractor and then only at high prices. The climate is also unhealthy, as is evidenced by the amount of malarial fever, dysentery and rheumatism amongst the *khalásis* and coolies; there were also a good many cases of mild scurvy, due to the want of fresh meat and vegetables. It is evident that it will be impossible ever to employ a large survey party in these hills; progress will therefore be slow, and the cost rate high, but this is unavoidable.

No. 15 Party was employed on various surveys required by the Military Department and a detachment continued the topographical survey of the hilly country in the western portion of Sind, where an area of 1,857 square miles was completed on the 1-inch scale.

No. 18, the Himálaya Party, completed a total area of 576 square miles, of which 317 square miles were surveyed on the 4-inch scale and 259 square miles on the 2-inch scale. The 2-inch work consists of topography in Mandi, Suket and Simla Hill States, and in Sirmúr; and the 4-inch in Kángra, Kullu and Sirmúr. The large scale (48 inches=1 mile) survey of the town of Náhan was continued. Classification of forest growth and soils was carried out over all the tracts in British territory that came under survey, as also in all the special forest surveys.

14. The areas topographically surveyed on various scales during the year amount to 15,109 square miles against 14,460 square miles executed last year.

The total is made up as follows :—

9,339	square miles surveyed on the	1-inch	scale.	
5,451	"	"	"	2-inch "
171	"	"	"	4-inch "
114	"	"	"	6-inch "
34	"	"	"	16-inch "

FOREST SURVEYS.

15. The special surveys of reserved forests on various scales are made partly by parties of the Survey Department and partly by detachments under Mr. Reynolds, the Superintendent of Forest Surveys. It is contemplated on Mr. Reynolds' retirement, which will take place in September 1899, to appoint an Imperial officer of this department as Superintendent of all Forest Surveys, and thus bring them all more under the professional control of the Surveyor-General. Survey operations were conducted this year in Madras, Bombay and Burma by the Imperial Survey parties, and in the Central Provinces, the Punjab and Burma by the detachments of the Forest Survey Branch. Small areas were also surveyed by the Imperial party working in the Himálayas.

16. In Madras two full parties were employed under the superintendence of one Imperial officer with an Assistant Superintendent. The expected increase in area of detail survey completed has unfortunately not been realised owing to the exceedingly intricate nature of the country, the unusually wet weather experienced at the beginning of the season, the amount of sickness, especially in the native establishments and also to the new hands, who joined the year before, being still unable to make much progress in such an excessively difficult country. An area of 1,050 square miles was surveyed on the 4-inch scale in the Salem, South Arcot, North Coimbatore and Kurnool districts and 1,620 square miles of triangulation in advance were completed in Kurnool and in Cuddapah.

17. In Bombay work is carried on on three different scales, the 4-inch for ordinary forest reserves, the 8-inch for special teak reserves and the 16-inch for small areas of *bábul* reserves. The areas completed on the various scales were as follows : in the districts of North Kánara 444 square miles on the 4-inch ; in Thána, Násik and Kolába 204 square miles on the 8-inch ; and 29 square miles on the 16-inch scale in Ahmednagar and Násik. The cost rate of the 4-inch work is less than that of last year, whilst the 16-inch is almost exactly the same ; the cost of the 8-inch work, however, is more, owing partly to the difficult nature of the country in Násik and Kolába, but mainly to the death of several trained men and experienced surveyors from plague since last field season.

18. The outturn in Lower Burma consisted of 406 square miles on the 4-inch scale in the Pegu and Shwegyin divisions and 118 square miles on the 2-inch scale on the Yenwe river adjoining the latter. The areas on both scales are slightly in excess of those of last year, but the cost rate is higher owing to the increase of the number of native surveyors from 36 last year to 55 this year ; until the new hands are properly trained, they add to the cost of the party without adding to the area surveyed, or at all events to only a very limited extent. In Pegu the men suffered much from fever ; one assistant was ill nearly all the season, whilst two sub-surveyors were discharged as physically unfit and four others were invalided, one of whom subsequently died. No less than twenty of the menial establishment died, two of whom were carried off by tigers ; the presence of these man-eaters caused a scare amongst the surveyors and quite disorganised the postal runners. It is intended to place this party under the Superintendent of the Forest Survey Branch, so that all surveys in the Bengal Presidency, including Burma, shall be under one superintending officer ; it will be a preliminary step to the proposed absorption of the Forest Survey Branch into the Survey Department.

19. An area of 146 square miles in Sirmúr, Kullu and Kángra were completed by the party working in the Himálayas.

20. The Forest Survey Branch continued its operations of last year. In the Central Provinces an area of 1,138 square miles was surveyed on the 4-inch and 16-inch scales, in the Punjab 200 square miles on the 1-inch and 52 square miles on the 4-inch scale, and in Burma 470 square miles on the 4-inch scale were completed. In the Salween Ataran forests the work was much disturbed

by the presence of Siamese dacoits in the near neighbourhood; one elephant was actually stolen and has not yet been recovered, whilst several unsuccessful attempts were made to carry off a second.

21. The total outturn of forest surveys executed on various scales during the year amounts to 4,132 square miles, of which 1,735 were surveyed by the Forest Survey Branch. The area surveyed by the Imperial Survey parties amounts to 2,397 square miles against 3,260 square miles executed last year. The decrease is due to No. 14 Party, which was hitherto employed on forest surveys having been converted into a topographical party.

The areas on the different scales are as follows:—

	118	square miles surveyed on the 2-inch scale.	
	3,545	"	4-inch "
	204	"	8-inch "
	265	"	16-inch "

CADASTRAL SURVEYS.

22. There were two parties in Burma administered directly by the Deputy Surveyor-General, one in Bengal composed of several detachments by the Superintendent of Settlement Surveys and one in the North-Western Provinces working by detachments in seven districts under the Superintendent of Land Records Surveys; the two latter are under the general professional superintendence of the Deputy Surveyor-General, whilst the programme and cost of operations are entirely under the control of the Local Governments.

23. The two parties in Burma were working, the one in Upper and the other in Lower Burma; the former continued the survey of the district Myingyan and completed the survey of Minbu; the detail survey of the Lower Chindwin district was commenced and a small area in scattered portions was surveyed in Katha. Traverse operations in advance were carried on in Lower Chindwin. The total area of each operation amounted to 1,466 square miles of cadastral on the 16-inch scale and 816 square miles of traverse survey. No writing of records is done by the Survey Department in Burma. Orders having been issued that this party should be converted into a topographical party and commence operations in Lower Burma next field season, an area of 2,345 square miles of advance triangulation was completed in the neighbourhood of Prome. The survey of the remaining areas in Upper Burma will be made by the party at present working in Lower Burma.

This latter party completed the traversing of the Toungoo district covering an area of 893 square miles and also surveyed 770 square miles of detailed survey on the 16-inch scale. In addition to this, the fair mapping and records of the Rangoon Town Survey were completed and a special survey of the Rangoon Sadar Bazar was made on the scale of 50 feet to the inch at the request of the Cantonment authorities.

24. The programme of surveys in Bengal was a varied one; it consisted of traverse, cadastral and topographical operations in Sárán, of traverse and cadastral surveys in Darbhanga and the cadastral survey of a small area in Noákháli; in addition to this, small areas were completed in various districts. The redemarcation of the greater part of the boundary between Nepál and districts Purnea and Bhágalpur was also made by this party. The following is a summary of the larger portions of the work completed together with the cost rates:—

In Sárán 555 square miles of cadastral and 27 square miles of topographical survey, both on the 16-inch scale, were completed, the former at a cost of ₹85.89 and the latter of ₹26.36 per square mile; the writing of records cost ₹104.29 per square mile; these rates are very much less than those of last year, as was anticipated. The area topographically surveyed represents the *diára* lands or lands subject to inundation by rivers where field boundaries are liable to be obliterated every year and where an expensive cadastral survey would be useless.

In Darbhanga no topographical survey was required, but an area of 733 square miles was cadastrally surveyed, 598 square miles were traversed; the cost rate of the cadastral operations was ₹74.86 and of writing the records ₹78.33 per square mile. A great deal of extra labour is thrown on this party from the excessive detail in the village sites which necessitates these

portions being surveyed on the scale of 64 inches to the mile; the average size of the field is also very small, less than half an acre in Darbhanga and not even one-third of an acre in Sâran. In these districts the attitude of the inhabitants is indifferent whilst the survey is going on, but great keenness is shown in watching the operation of writing the records.

In Noákháli two *chars* (recently-formed islands in the delta) to the east of the island of Sandip were surveyed, the area amounted to about 10 square miles; this small area had been left incomplete from last survey operations owing to exceptional difficulties.

The total amount of cadastral survey completed in Bengal consisted of 1,300 square miles.

25. The cadastral survey and writing of records were continued in the North-Western Provinces.

In Meerut and Lalitpur the records were completed, whilst in Sháhjahánpur and Bahraich the survey and writing of records were both finished; in Bijnor, Bareilly, Kheri and Gonda part of the field survey and records were accounted for. The total area surveyed during the past year is 3,440 square miles, whilst the total area of which survey and record writing has been completed since 1894 covers 7,165 square miles at an average cost, including superintendence and cost of instruments, but excluding traverse which is undertaken by Nos. 2 and 8 parties, of ₹58-13-7 per square mile.

26. A survey on the 64-inch scale of the cultivated lands in the Naini Tal district, which was just commenced last year, was continued and an area of 64 square miles were completed, leaving a little over 30 square miles for next season; according to the previous records, only a little over 50 square miles were said to exist. The actual cost rate for survey and record writing is ₹360-11-0 per square mile.

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

	Square miles.
Bengal	1,300
Burma	2,236
North-Western Provinces and Oudh	3,440
	<hr style="width: 100%; border: 0.5px solid black;"/>
	6,976
	<hr style="width: 100%; border: 0.5px solid black;"/>

TRAVERSE SURVEYS.

28. The two parties which were occupied in making the traverse surveys in advance of the cadastral operations in the North-Western Provinces and Oudh during last season were this year amalgamated into one double party, partly to reduce the cost of superintendence and partly because the two complete parties turned out more work than was required by the Land Records Department. It is probable that eventually they will be entirely under the control of the Superintendent of the Land Records Surveys, as has always been the case in Bengal, and will not form a separate establishment as at present. Another party was employed in Assam in traversing and surveying on the 2-inch scale the gaps existing between previous cadastral surveys and the banks and channels of the Brahmaputra river; this party also located and traversed the boundaries of tea grants and of villages which had been cadastrally surveyed by local agency as well as those which remain for survey in the Assam Valley and certain villages and waste land grants in Sylhet and Cachar; thus its work was much scattered.

29. In the North-Western Provinces and Oudh an area of 3,851 square miles was completed in the districts of Farrukhabad, Pilibhít, Gonda, Kheri and Azamgarh. In connection with this traverse party is a detachment whose duty it is to survey topographically on the 2-inch scale the gaps left between the areas which have been surveyed cadastrally; its work was confined to the Lalitpur sub-division of the Jhánsi district and comprised an area of 104 square miles.

30. In Assam the following areas were completed :—

In the Assam Valley 902 square miles of 2-inch topographical survey and 195 square miles of traverse;

In Sylhet and Cachar 177 square miles of traverse and a survey of the Cherra Poonjee coal mines on the 32-inch scale was also completed; this did not complete the programme of the party as had been anticipated, and it has been decided to retain it for yet another year.

31. The areas traversed during the year, not including the traversing done by the cadastral parties for their own surveys, are as follows :—

	Square miles.
North-Western Provinces and Oudh	3,851
Assam	1,277
TOTAL	<u>5,128</u>

SPECIAL OPERATIONS.

32. The system of determining latitudes by observing at groups of stations close together instead of at a single station, was again given a trial; it had been originated by Lieutenant J. Herschel, R.E., some years ago, but had been allowed to drop, because that officer was removed from the work before he had fully elaborated the system. The Agra longitudinal station was selected as the central point, but for reasons which had not been foreseen it was found impossible to connect the outlying stations by a sufficiently rigorous triangulation for a proper comparison of the observed and computed azimuths; the latitude observations, however, led to interesting results, and there is good reason to believe that in more favourable country the system will prove highly valuable.

33. The tidal observations have been continued as usual. Observations with the self-registering tide-gauges have been made at 13 stations in India, Burma, the Persian Gulf, the Andaman Islands and the Red Sea. During the year the observatory at Muscat was closed. It is not intended to close any observatories during the ensuing year, but, if possible, the observatory at Port Albert Victor will be opened.

In addition to the automatic registering made during the year, personal tidal observations to graduated staves were taken at six stations to compare the actual times and heights of high and low water with those predicted in the tide tables.

34. In addition to the above which form part of the annual programme of the department, a revision of the principal triangulation in the Khási and Gáro Hills was undertaken, with a view to ascertaining what displacement vertically or horizontally had taken place during the earthquake of June 1897. No instrument of equal calibre to that employed in the original work was available, moreover it did not seem advisable to organise a fully equipped triangulation detachment in the first instance, as there was no certainty that any appreciable changes had actually occurred; the object was mainly to see whether such changes had taken place, so as to judge of the desirability of taking really accurate observations hereafter to determine the amount and area of the displacement. The detachment employed was the levelling section of the tidal and levelling party, and the instrument used was a 7-inch micrometer theodolite. Horizontal and vertical observations were taken at 13 stations, fixing the positions of 22 and the heights of 25 old stations, embracing an area of 1,020 square miles. The results show that the whole lay within the area affected by the earthquake, so it is impossible to say how much any one station has been displaced in comparison with the unaffected area outside, but apparently all have suffered more or less. The average horizontal displacement appears to be about 7 feet, whilst the changes in height vary from a subsidence of 4·3 feet to an upheaval of 24 feet; these, however, for the reasons given above cannot be considered as absolute but only relative changes. The general apparent effect is that the area has been both widened and raised. It is a question for consideration as to whether this revision work should be continued with a small instrument or whether it should be rigorously executed with the best possible theodolite, or indeed whether it should be proceeded with at all. As a matter of scientific interest it should be rigorously executed, as it is believed to be almost, if not quite, the only opportunity that has ever occurred of the possibility of actually measuring the movement of the earth's crust due to a large earthquake.

35. This department assisted to a considerable extent in the observation of the total eclipse of the sun which occurred on January 22nd, 1898. A detachment under Mr. Pope, the Assistant Surveyor-General in charge of the Photographic and Lithographic Offices was equipped with an equatorial camera which was erected at Dumráón. An excellent picture of the corona was obtained, as will be seen from the heliogravured copy of it which forms the frontispiece of last year's report. Mr. Pope deserves much credit for the excellent results he obtained. The camp at Sahdol where the Astronomer Royal and Professor Turner erected their instruments was managed by Major Burrard, R.E., assisted by Lieutenant Crosthwait, R.E., whilst that at Pulgáon where Mr. and Mrs. H. F. Newall and Captain and Mrs. E. H. Hills, R.E., made their observations was under the charge of Captain Lenox-Conyningham, R.E. In both cases all the arrangements were most satisfactory. In addition to the above, the services of Mr. Turner of the Photographic Office were lent to Sir Norman Lockyer, who expressed himself as well satisfied with the help he rendered him.

36. A magnetic survey of India is under consideration, and it is believed that a detachment under a Royal Engineer Officer will be formed some time next year to undertake the same.

GEOGRAPHICAL SURVEYS AND RECONNAISSANCES.

37. In Upper Burma an area of 1,752 square miles of new country was geographically surveyed on the $\frac{1}{4}$ inch scale by No. 21 Party.

38. The aggregate area geographically surveyed during the year on the eastern and western frontiers amounts to 9,976 square miles.

HEAD-QUARTERS OFFICES.

39. The details of the work done at the various offices at the head-quarters will be found in Part III of this Report.

40. The offices located in Calcutta were, as usual, in charge of three Assistant Surveyor-Generals. The Drawing, Engraving and Map Record and Issue Offices, as well as the Bengal Provincial Drawing Office, remained in the hands of Mr. A. E. Spring. The Photographic and Lithographic Offices remained under the supervision of Mr. T. A. Pope. The Correspondence and Mathematical Instrument Offices were in the hands of Major F. B. Longe, R.E., up to 9th November 1897, under Lieutenant-Colonel J. R. Hobday, I. S. C., up to 12th June, under Major W. J. Bythell, R.E., up to 6th August, and under Captain H. A. D. Fraser, R.E., up to the close of the year.

41. The Geographical Section of the Drawing Office has, as usual, been employed on the work of completing and keeping up to date the maps of the North-Eastern and South-Eastern Frontiers. Sheets Nos. 15 N. E. (3rd edition), 23 N. W. (8th edition), and 23 S. E. (2nd edition), on the 4-mile scale were brought up to date and published, and sheets Nos. 23 S. W. (8th edition) and parts of sheet 23 (N. E. and N. W.) on the same scale were corrected and brought up to date. Sheet No. 15 (4th edition) on the 8-mile scale was brought up to date and published. Sheets Nos. 1, 2, 3, 4, 5, 6 and 8 of the South-Eastern Frontier series were added to, corrected, and brought up to date, and the following on the 4-mile scale published, *viz.*, Nos. 1 N. E., 1 N. W., 2 S. E., 2 N. W., 2 S. W., and 5 N. W., and sheet No. 1 on the 8-mile scale was republished. Sheet No. 306 of Upper Burma on the 1-mile scale was brought up to date and published, and sheets Nos. 314 and 359 of the same series were published. Sheet No. 260 (2nd edition) is now under publication. The general maps of India on various scales have been added to, corrected, and brought up to date; the 3rd edition of the map of India on the 32-mile scale was completed and sent to the Lithographic office; a new canal map and railway map on the same scale were also published. A new railway map of India on the 32-mile scale showing railway and steamer stations was also put in hand, and is nearing completion; another map on the same scale was prepared for the Military Department showing railways on different gauges, canals and hills in grey; this map is now at press, being lithographed, and will probably be published during the ensuing year. The provincial map of Bengal, Bihar and Orissa on the 16-mile scale had the hills brush-shaded and sent for engraving. The

map of the Madras Presidency was compiled from materials furnished by the Local Government. The divisional map of Tenasserim was brought up to date and published, and seventeen district maps were revised and brought up to date. A large number of sheets of the atlas have, as in previous years, been dealt with; seventy-seven have been corrected and brought up to date, and eight have had the hills brush-shaded and sent for engraving. A large number of maps were prepared in connection with the Famine reports of Bengal and Central Provinces, and also for the Military and other Departments.

42. The work of the Revenue Section has been mainly of the usual routine nature. A third edition of the map of Calcutta and surrounding country on the scale of 1 inch=1 mile has been prepared in three sections: one section embracing the northern portion has been compiled, the two southern sections have been passed through press with additions. The map of "City of Calcutta" (in two sections) on the scale of 6 inches=1 mile is being recompiled. Four standard sheets of district Pesháwar, a map of Naiháti municipality on the scale of 4 inches=1 mile, and a map of Narhan Estates (district Monghyr) on the scale of 1 inch=1 mile have been compiled, and one standard sheet of district Montgomery has been recompiled. The drawing of 14 standard sheets on the 2-inch scale of district Tavoy has been completed. In the North-Western Provinces and Oudh series, ten (old) sheets in 40 sections on the scale of 2 inches=1 mile, previously published without village boundaries, were completed with village boundaries, corrected, and brought up to date for republication. Of the large scale maps, press order was given on 50 sheets on the scale of 50 feet=1 inch, and 8 sheets on the scale of 400 feet=1 inch of the Moulmein town maps; 51 sheets of the Rangoon Town Survey were also sent to press for reproduction. Of the office copies, 5 standard sheets of Bengal, 5 of Bombay, 22 of the North-Western Provinces and Oudh, and 19 of Punjab were revised and corrected as to their boundaries and brought up to date; also 15 *pargana* maps of Bengal and 7 of the Central Provinces. Seven (old) standard sheets of the Punjab, 1 of the North-Western Provinces and Oudh, 39 *pargana* or main circuit maps of Bengal on the scale of 1 inch=1 mile were touched up, corrected and brought up to date for republication. Of the district maps on the $\frac{1}{2}$ -inch and $\frac{1}{4}$ -inch scales, 2 districts of the Punjab, one North-Western Provinces and Oudh, 3 in Bengal, and 2 in the Central Provinces were corrected and brought up to date from information supplied by the local authorities.

43. In the Cadastral Section 4,731 cadastral sheets were published of which 3,306 belonged to the North-Western Provinces, 1,114 to Burma, and 311 to Assam.

44. The Bengal Provincial Drawing Office continued to be employed on the compilation of standard sheets on the scale of 2 inches=1 mile for reduction to half from the 16 inches=1 mile cadastral maps of Bihar, Orissa and Chittagong. The number of cadastral maps dealt with during the year was as follows: Bihar, 1,672; Orissa 4,864; Chittagong 1,847. The outlining of 11 standard sheets in 44 sections of Bihar was completed, of which 16 sections were sent to the Photographic office for reduction to the 1-inch scale. The greater portion of the Chittagong cadastral maps have been reduced by pentagraph to the scale of 2 inches=1 mile; the drawing of the standard sheets will shortly be taken up.

45. In the Engraving Office the quarter sheets of the Atlas of India have been steadily worked upon, six new plates having been completed; 65 new quarters have been added to with the latest material, while 63 published quarters and 26 published full sheets have been brought up to date for printing, and 25 new ones have been projected and the borders cut on them. The hills have been put in hand on the new 128-mile map of India, and the 256-mile map brought up to date. Of the provincial maps on the 16-mile scale, Gujarát has been published with hills; Bengal in two sheets, Bombay and Madras in six sheets, Rájputána in two sheets, and Punjab and Kashmir in four sheets, have all had new material added to them. Two provincial maps for administration reports have been added to, 14 district maps for the same purpose completed and published, and 21 others were in hand in various stages of progress. Four sheets of the plan of Calcutta, a plan of Simla and Jutogh, the Index Chart to the Great Trigonometrical Survey, two India Weather Charts, and 51

miscellaneous plates have been in hand during the year. The Copper-plate Printing Section of this office pulled more impressions, and the Steel-facing Section dealt with more plates than last year.

46. In the Photographic and Lithographic Offices, the amount of work received for reproduction was somewhat less than usual, owing to a large reduction in the number of cadastral sheets sent in (about 1,100 less than last year), and to a slight decrease in the number both of departmental subjects and in those received from other departments. The aggregate outturn of the office is nevertheless well up to the average of former years. The number of original subjects dealt with was 6,364, or 1,516 less than last year, and they comprised 785 departmental maps, 4,477 cadastral maps, and 1,102 maps, plans, etc., received from other departments. The total value of the work done was ₹1,92,927, as against ₹2,13,518 last year.

The outturn of the zincographic and lithographic machines and presses was 695,812 copies, or 157,260 less than last year. The number of pulls, however, was nearly the same, *viz.* 845,562, as against 853,945. There was a large increase in the number of copies of departmental maps printed, the defect being in copies of cadastral maps and of subjects reproduced for other departments. The type-printing work has increased largely during the year, the number of copies printed amounting to 700,756 from 13,819 pages or items set up, as against 529,664 from 10,054 pages last year. The Heliogravure Section, as usual, shows an increase of printing work done, with an outturn of 73,801 prints from 101 photo-etched plates, or an increase of 1,555 prints over last year. In this section 82 half-tone blocks were prepared by the newly introduced enamelline process, from which 8,100 prints were struck off in one of the type-machine presses—a very substantial increase to the ordinary work of the Section. Somewhat less silver and cyanotype printing than usual was done during the year, the demand for this class of work varying considerably from year to year. Full details of the work done in each section will be found, as usual, in the Appendix.

It is satisfactory to record that orders were received during the year to publish the third edition of the map of India on the 32-mile scale, which has been for some years in abeyance pending the final settlement of frontier boundaries. Much work had to be done to the map before it could be issued, but there is every prospect of its final publication shortly. A skeleton map of the Punjab and surrounding country, on the 32-mile scale, and two maps of Bengal, Bihar, Orissa and Chota Nágpur, one on the 32-mile scale, and the other on the 16-mile scale, were published during the year. A large number of district maps were either published or reprinted, and also 221 standard sheets of the Topographical and Revenue Surveys on various scales. City and Cantonment maps of Simla and Jutogh, Jubbulpore, Sipri, Allahabad and Bareilly were also printed, and a large variety of other miscellaneous departmental work was done as usual.

The principal item of extra departmental work done was the illustration, with 29 maps and diagrams, of the plague report issued during the year by the Home Department. These were all either lithographed or photozincographed in colours, and 29,000 copies in all were supplied. A map of Siam and various district maps of that country were photozincographed, and copies supplied to the Director of the Royal Survey Department, Siam; and for the Colonial Secretary, Singapore, a map of Penang Island and the province of Wellesley was photozincographed. A number of maps were reproduced for the military authorities, including maps of the country round Ajmere, Deoli, Nusseerabad, Neemuch, Sirdarpore, Mhow, Kohát, Abbottabad, Umballa and Meerut. The reproduction of the map of Rangoon town in 358 sheets on the scale of 50 feet to an inch was commenced during the year, and blue prints of 77 sheets were supplied to the Rangoon Municipality. Eight sheets of the Moulmein Town Survey, on the scale of 400 feet to 1 inch were photozincographed for the Director of Land Records and Agriculture, Burma, and also a cantonment map of Moulmein. Work of the usual miscellaneous character was executed for the Public works, Telegraph and Meteorological Departments, for the Archaeological Survey and the Asiatic Society of Bengal, further particulars of which are given in Part III of this Report.

In the Heliogravure Section 13 plates were photo-etched for the Technical Art Series of the year, 12 plates each for the Indian Museum notes and the

report on the Zoology of R.I.M.S. *Investigator*, 14 for a catalogue of *Echinoderma* for the Indian Museum, 17 for the report on the earthquake of 1897 by Mr. R. D. Oldham, and 6 for the eclipse report issued by this department. The enamelline half-tone blocks prepared included 37 enlarged copies of thumb impressions for a report on the subject prepared by Mr. E. R. Henry, C.S., and 18 views from negatives illustrating Mr. Oldham's earthquake report. In addition to the regular work of the Section, some useful experimental work was done in trichromatic photography and in electro-deposition for the correction of hand-engraved copper plates.

Considerable assistance was afforded by the Photographic Branch of the Office to the Astronomer Royal, Sir Norman Lockyer and other scientists, who came out from England for the purpose of observing the total solar eclipse of the 22nd January 1898. A small party under Mr. Pope also proceeded to Dumraon to obtain photographs of the corona with the old photo-heliograph belonging to the office, and the results obtained were completely successful. A report on this expedition has already been submitted to the Government.

47. In the Map Record and Issue Office the number of new maps and editions of departmental subjects received during the year amounted to 2,787, of which 2,489 were cadastral maps. The total number of maps issued was 156,523, and their value ₹117,942, which shows a decrease of 50,807 in number and ₹39,985 in value on those of the preceding year. The cash sale of maps amounted to ₹19,314, which also shows a decrease of ₹5,345 below the cash receipts of the past year.

48. In the Mathematical Instrument Office the total number of instruments issued was 59,100, and their value ₹2,83,857, against 50,727 and ₹2,68,704, issued during the preceding year. The number of instruments received into store was 54,246, and their value ₹2,61,816, against 61,558, and ₹2,59,405, last year. There has been an increase in the number and value of instruments issued during the year; there has also been an increase in the value of instruments received though their number is less. The number of instruments taken from the repairable stock and rendered serviceable was 7,644, and their value ₹92,059, against 20,857 and ₹82,453 last year. This shows an increase in value though a decrease in number.

The conversion of old pattern levels and theodolites has been steadily continued and 80 levels of obsolete pattern have been converted into serviceable instruments and issued. Since the increased establishment for the repair of instruments was sanctioned 416 levels and 107 theodolites have been converted and issued and all indents for such instruments have been discontinued. The value of instruments indented for during 1898-99, from England amounted to £4,823. This shows a small increase over last year's figure, but is considerably less than the figures of former years.

49. The Trigonometrical Branch Office, Dehra Dún, was engaged mainly on the routine work appertaining to that office. Very considerable assistance was rendered to the two official British Solar Eclipse Expeditions, by sending a provincial officer and a number of computers to aid in recording and helping generally in the work of the Eclipse parties.

The usual meteorological and solar photographic observations were continued and the large photo-heliograph giving pictures of the sun 12 inches in diameter was again brought into use. The monthly magnetic observations which were commenced last year have been continued. The Computing Office and Drawing Section have also been kept fully occupied.

The training school has more than justified its institution. Seventeen pupils were entertained and put through a complete course of plane-tableing and traversing, and a certain number of them were instructed in levelling. All passed the examination at the end of the course and the greater number of them promise to become valuable surveyors.

For the first time, the newly-appointed Provincial officers were sent to Dehra to go through a course of training. The results have been excellent and the advantage to the department can hardly be over-estimated of having the newly-joined assistants thoroughly grounded in the theory and practice of both field surveying and the use of instruments.

Six of the Provincial officers went through the course extending over 10 months, and were all pronounced thoroughly fit for field work at its completion.

50. The Forest Survey Branch Office at Dehra Dún was engaged as usual upon the final computations of the several field detachments; on the up-keep of the Forest Department map records; on the compilation and drawing of special maps; and on the training of surveyors for field work. Eighty-four special maps on various scales were prepared of which 29 have been published, 31 were in press, and 24 were in different stages of progress; of 4-inch standard sheets 92 were published, 131 were in press, and 168 sheets were in hand. One standard sheet on the 1-inch scale was also published. In addition to the above a considerable amount of colouring, tracing, mounting, and other miscellaneous work for forest and district officers was performed.

ESTABLISHMENT.

51. During the year under report the Department has lost the services of six officers of the Imperial Service.

Colonel J. E. Sandeman, I.S.C., Deputy Surveyor-General in charge Revenue Branch, attained the age of 55 years on the 3rd September 1898, and his services were replaced at the disposal of the Military Department from that date. He joined the Revenue Branch of the Department on the 6th October 1864. He was principally employed on revenue operations in the Punjab, North-Western Provinces, Assam, Bengal and Burma. He was in charge of the North-Western Provinces Cadastral Survey from November 1883 to the end of 1891, where he carried out for the first time cadastral operations combined with the writing of records by the aid of *patwáris* and local labour, which resulted in the completion of the cheapest accurate cadastral maps ever produced in any province. He was placed in charge of the Cuttack Cadastral Survey operations in the end of 1891, and was appointed Director, Bengal Surveys, in April 1892. He was appointed Deputy Surveyor-General, Revenue Branch, and also Director of Bengal Surveys on 26th March 1895; but the latter appointment was abolished in October 1895. It may safely be said that no officer in India had a greater practical knowledge of cadastral work combined with the writing of records than Colonel Sandeman, and his loss to the Department in that Branch is very great. A scheme devised by him for the future employment of the revenue surveyors of the Department to the greatest possible advantage to the Imperial as well as to the Provincial Governments is now under discussion, and it is believed will be introduced. Colonel Sandeman was an enthusiast in his work, and his constant application to it resulted in his having to take furlough before his time was completed, which was much to be regretted.

Colonel Sir T. H. Holdich, K.C. I.E., C.B., R.E., Superintendent, 1st grade, retired from the Survey Department from the 17th February 1898. He commenced his survey career as an assistant with the Bhután Field Force during the cold season of 1865-66, but was not appointed permanently to the Department until 23rd July 1866. After serving a little more than a year in Rájputána he was selected as one of the officers to accompany the Abyssinian Expedition in December 1867 returning to India in May 1869, when he joined the Topographical Survey Party in Central India. In 1877 he was given charge of the Vizagapatam Survey, after which he took furlough to England, before the expiration of which, however, he was recalled to join the Southern Afghánistán Field Force in December 1878; he was afterwards attached to the Northern Afghánistán Field Force; for his services during these two campaigns he received a Brevet Majority. After the Afghán war he was placed in charge of the Kohát Topographical Survey, and thenceforth he was always employed on surveys either on or near the North-Western Frontier. In 1881 he accompanied the Wazír Expedition, and in 1889-90 the Zhob Gomal Expedition. From August 1884 to November 1886 he was Chief Survey Officer with the Afghán Boundary Commission, and he then received a Brevet Lieutenant-Colonelcy. He accompanied Mr. Udny in November 1894 with the Kunar Valley Delimitation Expedition, in 1895 he accompanied the Pamir Commission, and in 1896 was appointed British Commissioner for the delimitation of the Perso-Balúch Boundary. He was made Chief Survey Officer in charge of all the detachments accompanying the different expeditionary columns on the North-Western Frontier in 1897-98, which appointment he held till his retirement from the Survey Department. It is greatly due to Sir Thomas Holdich's untiring zeal that the Survey Department

now possesses reliable maps of the whole of Balúchistán and of the countries bordering in the North-Western Frontier and elsewhere. In May 1894 he was made a C.B. and a C.I.E., and in June 1897 he was appointed K.C.I.E. He also received the gold medal of the Royal Geographical Society for 1887 for his Afghán Boundary Surveys.

Mr. E. C. Barrett, Superintendent, 1st grade, retired from the service on superannuation on the 15th April 1898. He joined the Provincial Service (Junior Division) on the 18th November 1862 and was promoted to the Imperial Service (Senior Division) on 30th December 1868. During his whole period of service of nearly 36 years he was employed on Revenue Surveys in Sind, Central Provinces, North-Western Provinces and Oudh, Cuttack, Burma and Assam. He served with the Lushai Expeditionary force in 1871-72, for which he received a medal and a clasp and the thanks of the Government of India.

Major-General R. G. Woodthorpe, C.B., R.E., Officiating Deputy Surveyor-General, died on the 26th May 1898. He joined the Topographical Branch of the Department in July 1871. He accompanied the Lushai Expeditionary force in 1871-72, the Gáro Hills Expedition in 1872-73, and the Nága Hills Punitive Expedition in 1875, when he was mentioned in despatches. In October 1878 he joined the Kurram Column of the Afghán War and was present at the action in the Peiwar Kotal, where he was slightly wounded; he was again mentioned in despatches. He accompanied the forces during the second Afghán War, and was present at the actions at Alikhel, Killa Kariz Mir, and Charda, the attack of Takhti-Shah Asmai and subsequent operations till 23rd December 1879, he was also present at the skirmish at Saidabad, when he was again slightly wounded; for his gallant services he received the thanks of the Governor General in Council and the Secretary of State for India; he was mentioned in the despatches of Generals Roberts and Ross, and was promoted first to Brevet Major in November 1879, and then to Brevet Lieutenant-Colonel in March 1881. On the conclusion of the Afghán War he returned to Assam, and in 1883-84 he accompanied the Aka Expedition. In the following year he, with Major C. R. Macgregor, visited the Bor Hkamti country on the western branch of the Irrawaddy. Immediately after his return to Shillong, after this trying experience from which he suffered much in health, he was ordered to the North-West Frontier on special duty at Gilghit. After a year at that place with General Lockhart's mission, he was sent in charge of a survey party which accompanied a military column from Assam, *via* Manipur, into the Chindwin Valley in Upper Burma, when a large area of previously unknown country was reconnoitred. The excellent service rendered by him in various parts of the frontiers, under such hazardous conditions, were recognized by Government by conferring on him the title of Companion of the Bath.

In February 1889 he was appointed Deputy Quarter Master General for Intelligence, but in June 1892 he returned to the Survey Department and was placed in charge of a topographical party in Upper Burma. In 1892-93 he conducted the survey operations in connection with the eastern portion of the Anglo-Siamese Boundary, and in the cold weather of 1894-95 he accompanied the Mekong Commission. After this his health having given way he took furlough for two years, which he was obliged to extend on medical certificate for three months. In November 1897 he returned to India and was appointed to officiate as Deputy Surveyor-General, which appointment he was holding when he died. By his death the Department has lost the services of a most valuable officer, and all those who knew him have to deplore the loss of one of the most genial and sincere friends that man could wish for.

Mr. J. S. Pemberton, Officiating Deputy Superintendent, 1st grade, retired from the service on 1st October 1898. He joined the Revenue Branch of the Provincial Service (Junior Division) on the 6th October 1860, and during his entire service of 38 years he was employed on revenue survey operations in the Central Provinces, Assam, Punjab, Bihar and North-Western Provinces, except for two short periods when he was attached to the Head-Quarters Office, Calcutta. He was promoted to the Imperial Service on the 1st April 1892, and held charge of traverse survey parties in the North-Western Provinces from October 1895.

Captain A. J. Pilcher, R. E., Officiating Deputy Superintendent, 2nd grade, reverted to the Imperial establishment on the 10th December 1898. He joined

the Survey Department on the 16th July 1892. During his short service in the Department he was attached to the Bihar Cadastral Survey, for a season, and to the Burma Trigonometrical Party for two seasons. In September 1895 he was placed in charge of the Bombay Topographical Survey and he was transferred with that party the following season to Burma, remaining with it till 15th April 1897, when he was again placed in charge of Nos. 10 and 21 parties.

52. In the Provincial Service there were three vacancies, *viz.*, two by the retirement of Messrs. W. A. Wilson and H. W. Peychers, and one by the resignation of Babu Sarat Chunder Sen. Four officers, *viz.*, Messrs. J. Smith, C. G. Lee, F. P. Walsh, and H. W. Biggie have been lent to the Government of Siam. On the 1st October, owing to Mr. Pemberton's retirement, an appointment in the 2nd grade of Deputy Superintendent was transferred to the Provincial list, thus creating the first appointment of 2nd grade Extra Deputy Superintendent.

PART II.

THE OPERATIONS OF THE SEVERAL FIELD PARTIES.

TRIGONOMETRICAL SURVEYS.

PRINCIPAL AND SECONDARY TRIANGULATION.

BALÚCHISTÁN.

No. 24 PARTY.

53. This party, under Captain Burn, R.E., started from Karáchi for Makrán on the 9th September 1897.

Personnel.

Captain J. M. Burn, R.E., Officiating Deputy Superintendent, 1st grade, in charge till 12th April 1898.

Lieutenant H. H. Turner, R.E., Assistant Superintendent, 1st grade, in charge from 8th August to 30th September 1898.

Mr. J. Hickie, Extra Assistant Superintendent, 4th grade, in charge from 13th April to 7th August 1898.

Mr. P. F. Prunty, Extra Assistant Superintendent, 6th grade.

A special British India steamer had to be hired to take the party to Ormára, as there is no regular service between Karáchi and Ormára. A halt of some three weeks was made in Ormára, during which time instruments and lamps were tested. There was some difficulty in collecting sufficient transport, and sufficient camels were only obtained by indenting on the Las Bela State.

54. The work of this party was commenced at the end of October 1897, the idea being to continue the triangulation of the Makrán Longitudinal series westwards. Unfortunately the season started badly as when Captain Burn had observed the angles and an azimuth at Kargazi H. S. he had a bad attack of fever which laid him up for nearly three weeks. After observing at Hazárbuzi H. S. he was again taken ill. Lieutenant Turner observed the angles at Kapar H. S. in the same quadrilateral as Hazárbuzi and Kargazi, and then went to Girdank H. S., the south-western station of the second quadrilateral. These were the only four stations at which final observations were taken, no single figure being completed. The approximate work laid out in advance this year comprised three figures, a quadrilateral, a tetragon and a double quadrilateral included by ten stations, covering an area of 1,400 square miles, and extending over a direct distance of 70 miles. Of the ten stations, two were old ones and seven were newly selected and built, and one point was not built on.

55. One secondary station, Chambor, in the Kolwa valley, was also selected and built, but final observations were not taken at it. The season came to an abrupt conclusion owing to the rising in Makrán. Captain Burn's main camp itself being attacked and several men killed. All the property, both Government and private, being looted, besides ₹15,000. Captain Burn himself, who was not in the camp at the time, fortunately escaped and managed to reach Ormára; the other members of the party, who were scattered over the country, also managed to reach the coast in safety. One lamp squad, consisting of four men, who took refuge in Nag fort, were afterwards killed by the insurgents. The other lamp squads all escaped, some to Karáchi, some to the coast.

56. The principal observations were taken with Troughton and Simm's 12-inch micrometer theodolites Nos. 1 and 2. The method of observing was to measure angles on nine zeros, two faces on each zero and two swings on each face. Unfortunately both instruments were seriously damaged, No. 1 beyond repair, No. 2, however, has been sent back to the makers and is being repaired.

57. The health of the party was not very satisfactory, the *khalásis* were continually suffering from sores. Recorder Dhondu Balwant Joshi died at the commencement of the season and besides him, irrespective of the men killed, four others died from natural causes. The cause of all this sickness probably is not so much due to hardships undergone as to the bad state of health in which the men started owing to the famine of 1897.

58. The party was inspected by the Superintendent, Trigonometrical Surveys, on 21st September 1898.*

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

TOPOGRAPHICAL SURVEYS.

UPPER BURMA.

NO. 10 PARTY.

59. Captain A. J. Pilcher, R.E., continued to hold charge of this party up to 9th November 1897, when he proceeded on privilege leave, previous to reverting to military duty on the Home establishment; the direction then devolved on Lieutenant W. M. Coldstream, R. E., who held

Personnel.
 Captain A. J. Pilcher, R.E., Officiating Deputy Superintendent, 2nd grade, in charge up to 9th November 1897.
 Lieutenant W. M. Coldstream, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 10th November to 31st May, and again from 28th July 1898.
 Lieutenant H. J. Hare, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 1st June to 27th July 1898.
 Mr. G. D. Cusson, Extra Assistant Superintendent, 4th grade
 " G. T. Hall, " 5th "
 " P. J. Serrao, Sub-Assistant " 1st "
 " J. A. Freeman, " 2nd "
 10 Sub-Surveyors, 5 Probationary Sub-Surveyors, 1 Writer and 1 Hospital Assistant.

charge of the party for the rest of the year, except for the period from 1st June to 27th July 1898, when he was on privilege leave, and Lieutenant H. J. Hare, R.E., held charge.

60. During the previous season No. 10 Party had worked in conjunction with No. 21 Party in the Northern Shan States, but during the recess season 1897 a special sphere of operations had been laid down for the party in Upper Burma, and the triangulators were accordingly employed in the newly allotted area, while the majority of the surveyors completed the detail survey of sheets Nos. 401 and 402 and half of sheet No. 458 in the Shan States, which had been triangulated in season 1896-97.

61. The party left recess quarters at Bangalore on the 9th November, arriving in Mandalay on the 18th, and leaving again for its ground on the 22nd idem.

62. Mr. G. D. Cusson with 11 sub-surveyors took up the work in the Shan States in the vicinity of Kehsi Mānsām (sheets Nos. 401, 402, 458). Two assistants and one sub-surveyor triangulated in sheets Nos. 261, 262, 263, 264, 265, 266, Upper Burma, and one assistant was employed in executing a series of triangulation from the Mandalay meridional G. T. series in the neighbourhood of Katha to the Chinese Frontier, in order to provide the survey detachments with the Chinese Boundary commission with initial data.

On Mr. Serrao's return from the completion of this series he was directed to take up triangulation in sheet No. 256, and the two sub-surveyors with him were employed on the detail survey of sheet No. 259.

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

Triangulation Frontier Extension Series	{ From Katha to Chinese Frontier. Square miles.
Triangulation for detail survey	2,742
Topography on 1-inch scale (including 205 miles overlap)	2,116

This shows a considerable improvement in quantity as compared with the previous season, and a similar improvement was shown in the quality of the work.

64. The country surveyed in the Shan States occupied a comparatively open, healthy table-land lying at an average elevation of 3,000 feet above sea-level. The triangulators were, however, working in very jungly, unhealthy country, forming the scarp between the Shan plateau and the plains of Burma.

65. The health of the party was on the whole good, that of the detachment in the Shan States being excellent. The triangulators and their *khalāsis* suffered to some extent from fever. At the close of the field season the officer in charge of the party was laid up with dysentery, and he and one assistant have eventually been invalided to England.

66. The party reassembled at Mandalay by the 19th May and reached Bangalore on the 26th, the recess office being opened on June 1st.

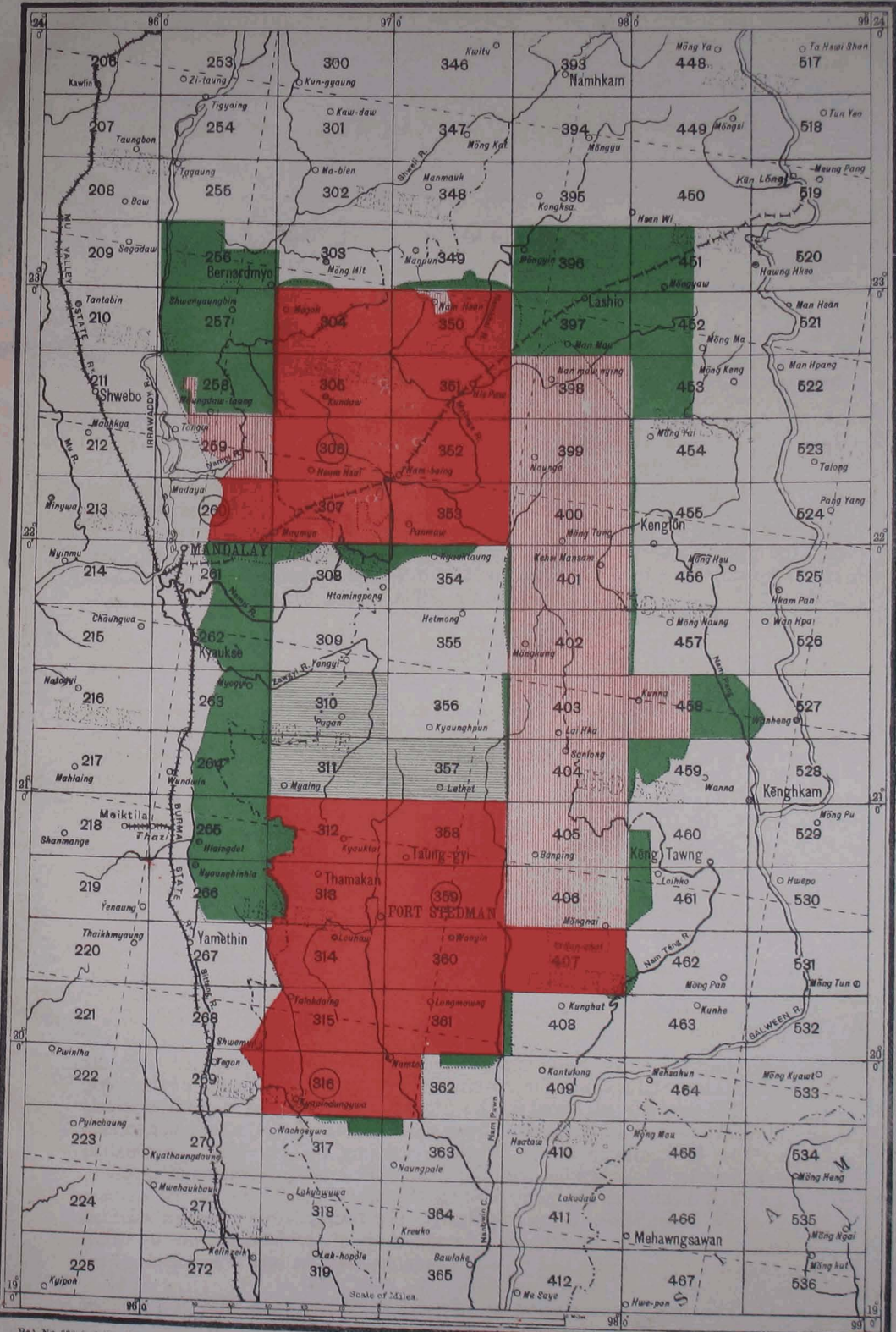
67. During the recess the computations have been brought up to date, and sheets Nos. 401 and 402, and the western half of sheet No. 458, have been

UPPER BURMA SURVEY.

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

1897-98.

Nos 10, 11 & 21 PARTIES.



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REFERENCES.

- Sheets published are shown thus. 316
- Area previously surveyed. 317
- Surveyed in Season 1897-98. 318
- Triangulated in advance. 319
- during the Season 1897-98. 320

NOTES.

The numerals 312, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

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

Photo S. I. O., Calcutta.

prepared for publication in two colours. Sheet No. 259 has also been partially drawn.

68. The total cost of the party for the year was R85,179, and the cost rates per square mile are—

	R	a.	p.
For triangulation	13	3	7
For topography	21	13	10

69. The programme for next season is—

The triangulation of sheet No. 255 and the completion of sheet No. 256.

The triangulation of the unsurveyed gaps in sheets Nos. 210, 211, 212, 267, 268, and a network to connect the gaps in the neighbourhood of sheets Nos. 170, 171, 219 and 220. In detail survey, the completion of the large scale survey begun by No. 3 Party of the country round Maymyo, and the 1-inch survey of the eastern halves of sheets Nos. 261, 262, 263, 264, 265, 266, 267 and 268.*

UPPER BURMA.

NO. 11 PARTY.

70. Captain Renny-Tailyour's services being required for the China-Burma Boundary Commission, Mr. P. J. W. Doran was put in charge of the party from the 4th November.

Personnel.

Captain T. F. B. Renny-Tailyour, R.E., Officiating Superintendent, 2nd grade, in charge till the 3rd November.

Lieutenant W. M. Coldstream, R.E., Officiating Deputy Superintendent, 2nd grade, transferred to No. 10 Party from the 1st November.

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

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

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

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

" H. H. B. Hanby, Sub-Assistant Superintendent, 2nd grade, up to 19th February.

Surveyors and Sub-Surveyors.

Mahmud Husain, J Sebastian, Ramsabad
Abdul Rahim, 14 Sub-Surveyors and Probationary Sub-Surveyors.

71. The party lost the services of two of its best native surveyors Mahmud Husain and Abdul Rahim, owing to their accompanying Captain Renny-Tailyour. Mr. Shaw was temporarily detached to carry on a secondary series from a base of the Mönghsat G. T. series to the China Boundary on the Mekong river, accompanied by Surveyor Ramsabad. Mr. Hanby's services were lost owing to his unfortunately contracting dysentery on his way to Fort Stedman. Acting under medical advice he left for the hills and was later on appointed to the headquarters office, Calcutta. Two probationary sub-surveyors were appointed from Dehra Dún Training School. They joined the party at Rangoon on the 5th and 9th November, respectively.

72. The party left recess quarters on the 3rd November, with the exception of Mr. H. G. Shaw and Mr. H. H. B. Hanby, who had started a week in advance, sailed from Madras on the 4th, and arrived at Rangoon on the 8th. Here the party was joined by men returning from departmental leave and left Rangoon for Thazi by rail, and thence by daily marches for Fort Stedman, which was reached on the 23rd November and which was to be the head-quarters of the party during the field season. Arrangements were made for taking the field and a start made on the 4th December.

73. The programme of the season was:—

(a) Detail survey of sheets, Nos. 403 to 406, and the resurvey of a portion of sheet No. 407, on the 1-inch scale.

(b) The triangulation "in advance" of sheets, Nos. 310, 311, 356 and 357.

The former was completed, but the latter could not be finished off owing to the loss of Mr. Hanby's services. Sheets Nos. 310, 311 and 357 have been triangulated and sheet No. 356 has been partly reconnoitred.

Triangulation was carried on in the districts of Möngh Nai, Möngh Ping, Lai Hka, Lawk Sawk, Ye Ngan, and Baw-ye-u. Secondary triangulation was carried on from the Mönghsat G. T. series to the China Boundary.

* The officer in charge reports that Mr. G. T. Hall deserves special mention for the excellence of his work, and among the sub-surveyors, Shaikh Mahomed and Shaikh Abdullah did specially good work.

74. Topographical work was carried on in the Sawbwa portions of Mông Nai, Lai Hka, Mawkmai, Mông Pawn and Myoza portions of Môngsit and Mông Küng. The ground was hilly and intricate, mostly covered with tree and scrub jungle, and numerous "devil's cauldrons" were met with. The flat and undulating portions were mostly overgrown with *kain* grass and dotted over with hillocks, the latter, as a rule, being covered with sharp pointed rocks and inaccessible.

75. The Officer in charge personally undertook the secondary triangulation of sheet No. 357 in the absence of Mr. Hanby, and instructed the new hands in their duties, as well as exercising a general superintendence of the whole work in hand.

76. The outturn of work is as follows:—

	Square miles.
Triangulation	1,833
Do. secondary series to China boundary	1,040
Topography, 1-inch scale (including 241 square miles of overlap)	2,571.

77. The health of the party was not as good as in previous years. One European assistant fell sick at the commencement of the field season and had to leave for the hills. Several of the surveyors suffered during the season; some have only just recovered from the fever contracted there. Many of the menial establishment contracted fever and dysentery on their way up. Six men, *i.e.*, four natives of India and two Burmese interpreters died during the season.

78. The programme for the ensuing season will be the detail survey of sheets Nos. 310, 311 and 357 and endeavours will be made to complete sheet No. 356, whilst sheets Nos. 308, 309, 354, 355, 356, 456 and 457 will be triangulated in advance for the detail survey of season 1899-1900.

79. The Surveyor-General visited the party at the end of September and after a minute examination expressed his satisfaction with all he saw.*

UPPER BURMA.

NO. 21 PARTY.

80. Lieutenant Hare took over charge of this party on the 1st October 1897 from Captain Pilcher, R.E., who was under orders to revert to home service in the following month.

Personnel.

Lieutenant H. J. Hare R.E., Assistant Superintendent, 1st grade, in charge.
 Mr. A. J. James, Extra Assistant Superintendent, 3rd grade.
 „ W. F. E. Adams, Sub-Assistant Superintendent, 1st grade.
 „ P. Williams, Sub-Assistant Superintendent, 3rd grade.
 „ P. R. Anderson, Sub-Assistant Superintendent, 3rd grade.

Surveyors and Sub-Surveyors.

Ganu Mal, Natha Singh, Mohamed Latif, Jamna Pershad, Keshao Jadoo and 7 probationary and apprentice Sub-Surveyors, 1 Writer, 1 Hospital Assistant and 1 Shan Interpreter.

81. One Sub-Surveyor was sent to accompany the Civil Officers delimitating the boundary between the Chin Hills district and Upper Burma.

82. The party left recess quarters at Bangalore during the first week of November and proceeded to Lashio in the Northern Shan States, where the head-quarters of the party were established. Field work ceased about May 1st and the party left Rangoon by the steamer of the 21st May, the recess office at Bangalore being opened on June 1st.

83. The operations of the season included the survey on the 1-inch scale of sheets Nos. 398, 399 and 400, the last two being required to assist the railway engineer in selecting a line into the Southern Shan States.

Triangulation in advance was carried on in sheets Nos. 396, 397 and parts of 451, 452 and 453.

84. The outturn of work is as follows:—

	Square miles.
Triangulation for the 1-inch scale	3,256
Topography 1-inch scale	2,595
Do. ½-inch „	1,752

* The officer in charge reports favourably of the services of Messrs. W. M. Kelly and H. G. Shaw. Mr. Kelly had charge of plane tablers during the field season and of the drawing during recess.

He also reports favourably of surveyors and sub-surveyors Ramsabad, Kudratulla, Mowni Ram, Hayat Mahomed, and probationary sub-surveyor Hafizuddin and writer Chandoo Meean. Special mention is made of surveyor J. Sebastian's work.

The area surveyed is very creditable considering that two of the best surveyors and one assistant were employed on the boundary work, and that two of the assistants were triangulating for the first time.

85. The country surveyed, which included parts of the Hsi Paw and South Hsinwi states is hilly, and, as a rule, covered with tree and scrub jungle. Hollows into which the surrounding drainage disappears or devil's cauldrons, a feature of the Shan States, were very numerous in parts.

Several herds of wild elephants were to be found near Lashio, and in one case were a source of some danger to the party working in that district.

Loi Ling, 8,771 feet, the highest hill in this part is noticeable for the dense growth of wild tea with which a large part of it is covered, and also for the remarkable size of some of the tea trees.

86. The total cost of the party is ₹81,761, and the cost rates per square mile are as follows:—

Triangulation for 1-inch survey,	₹11-5-1	per square mile.
Detail survey on 1-inch scale,	₹18-4-11	„ „
Do. do. $\frac{1}{4}$ do.	₹ 4-4-9	„ „

These figures compare favourably with those of former years.

87. The surveyors were systematically visited and their work carefully tested with excellent results.

88. During the recess the whole of the computations were brought up to date and the mapping of sheets Nos. 304, 307, 398, 399 and 400 and most of 350 was completed.

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

Lieutenant Hare with a detachment will accompany the Burma-China Boundary Commission.

Two surveyors will accompany Captain Pottinger on his reconnaissance to Yunnan from the Shanghai side and a similar detachment will probably be sent with Captain Ryder from the Kunlôn side.

Triangulation will be pushed on up to Kunlôn where a useful connection will be given to both the Boundary Commission and to Captain Ryder's party.

Sheet No. 397 and possibly No. 395 will be surveyed on the 1-inch scale and the triangulation of sheets Nos. 451, 452 and 453 will be proceeded with.

90. The recess office was inspected by the Surveyor-General at Bangalore in September, who expressed his appreciation of the efficient state in which he found the party.*

SIND.

NO. 12 PARTY.

91. The operations during the year under report were in continuation	of those of the previous
	season. Mr. C. F. Erskine
	held charge of the party
	throughout the season.
	92. The programme, which
	was as follows, was completed:—
	(a) The completion of the
	village boundary tra-
	verse survey in sheets
	Nos. 50, 51, 70, 71, 90,
	91, 108 and 109 from
	the Indus river on the
	west to the desert on the east.
(b) The detail survey on the 2-inch scale of an area between the same	limits in sheets Nos. 48, 49, 68, 69, 88, 89, 106 and 107.

* The officer in charge reports that Mr. James has again proved himself an able assistant, and that Mr. Adams and Mr. Anderson both did very satisfactory work. Among the native staff Sub-Surveyor Natha Singh and Jamna Pershad are deserving of special mention.

93. The recess office at Mussooree closed on the 9th October 1897 and the party reassembled at Tando Adam on the 18th idem, and each man was on his ground by the end of the month.

94. The traversing consists of a village boundary survey with offsets and the area traversed is 2,971 square miles. There were $7\frac{1}{4}$ main circuits measured, 12 sub-circuits and 603 villages. The angular work was checked by observations for azimuth at 107 stations on main and sub-circuits, and the average angular error is 4 seconds. The linear measurements amounted to 3,115 miles, and were checked by 18 connections, with stations of the secondary triangulation executed during the previous season. The average correction per 1,000 links is 0.4 links. No permanent marks were laid down at traverse stations, but the position of all marks used to demarcate the village boundaries have been fixed by offsets, wherever possible.

95. The cost of the traverse survey amounts to ₹10.1 per square mile.

96. In addition to the village boundary survey, 123 bench marks of the Irrigation Department chiefly on embankments and canal banks, and 69 of the North-Western Railway were connected with the traversing involving additional observations at 742 stations, and 209.8 linear miles of chain measurements.

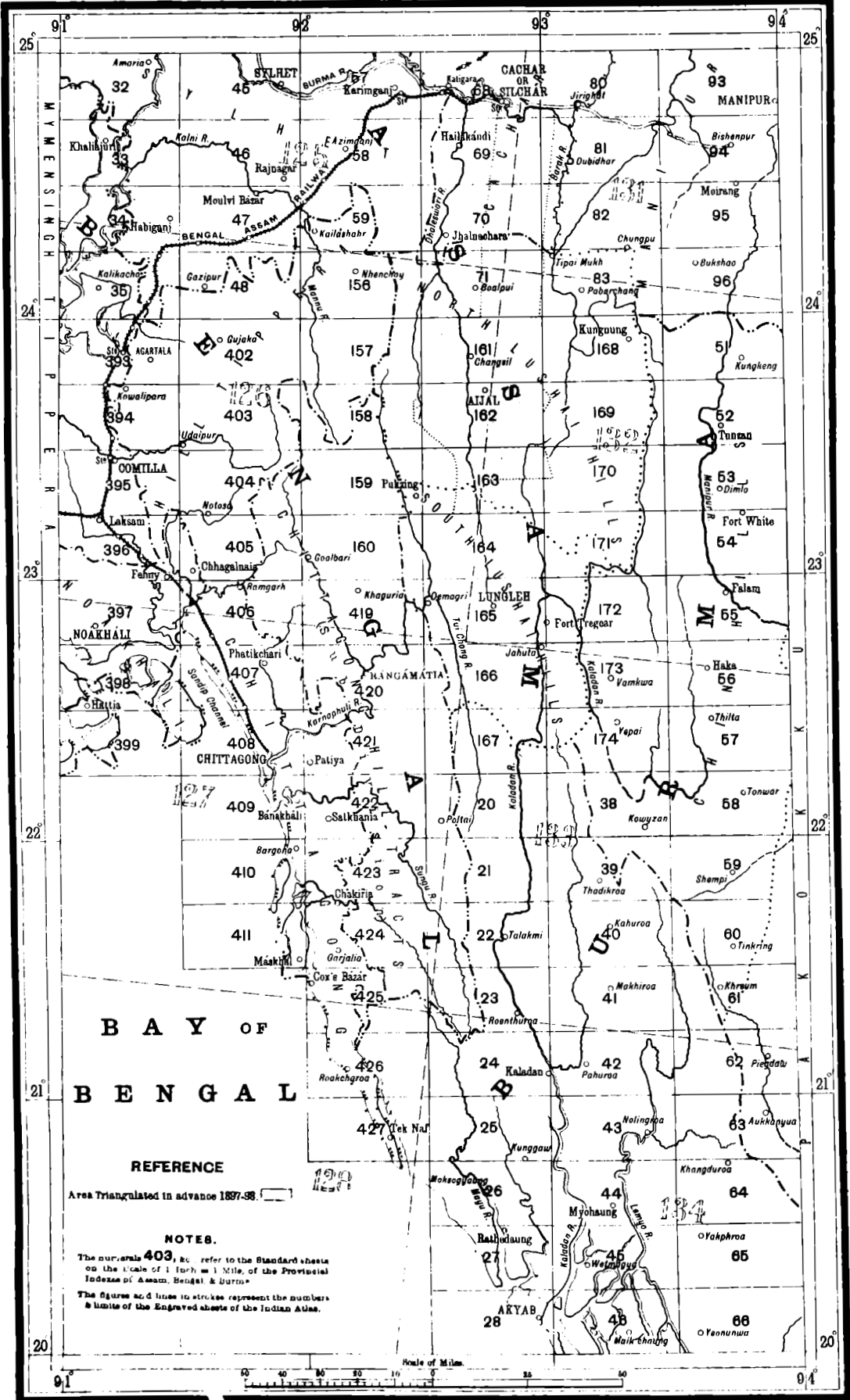
97. The area surveyed in detail on the 2-inch scale amounts to 2,709 square miles and was mapped on 52 plane-table sections. It comprises portions of sheets Nos. 48, 49, 106 and 107 and the whole of Nos. 68, 69, 88 and 89. An area of 84 square miles was also surveyed in standard sheet No. 70. In sheets Nos. 106 and 107 the survey has been carried to the edge of the desert. Sheets Nos. 48 and 49 have been surveyed up to the work of the Indus Riverain Survey. The remainder of these sheets will be surveyed on the 1-inch scale by No. 15 Party. The detail survey was carried out almost entirely by interpolation, and was based mainly on the traversing, it was tested from 1,588 *in situ* fixings, and a small amount of chain measurements, and was done under the direct supervision of the officer in charge and three assistants. The cost of detail survey is ₹14.6 per square mile, a rate almost identical with that incurred last year.

98. The character of the country surveyed varied considerably, in sheets Nos. 48 and 49 it was thickly populated and well watered, in sheets Nos. 68, 69, 88 and 89, the country to the west was generally, fairly well populated, and contained some large and flourishing villages, but journeying eastwards large tracts of waste land and sand are met with and the country is more sparsely populated; in sheets Nos. 89 and 107 a very large area was under water and a portion of the last mentioned sheet had to be left unsurveyed on this account. Near the Nára river there is a considerable amount of jungle, and further east the country is still thinly populated, although a few fairly flourishing villages were met with. The banks of nearly all the canals falling in the seasons work are lined with *bábul* trees.

99. There was little or no sickness.

100. In accordance with a request preferred by the Irrigation Department, a camp under the supervision of Mr. R. C. D. Ewing was detailed to undertake the survey of certain lands situated in Kalát, in connection with the proposed Desert Canal Scheme.

101. As there was a sufficient number of Great Trigonometrical Survey and triangulated stations of the Balúchistán Survey in the vicinity, and no defined village boundaries, traversing was carried on by means of lines running from one Great Trigonometrical station to another, these formed the sides of the main circuits, of which there were five and a subsidiary one; the main circuits were sub-divided into blocks by meridional lines of traverse five miles apart, the main circuit stations were primarily marked by embedding two bricks, on end, the stations on the block lines being similarly marked. The meridional lines were run so that the entire area might be divided into rectangular blocks of 5 miles \times 2 miles, the corners being subsequently permanently marked by embedding pieces of rail, five feet in length, on the exact spots occupied by the bricks, these permanent marks will hereafter be utilized by the Irrigation Department as bench marks. The entire area surveyed was 1,554 square miles, consisting of five main circuits and one subsidiary; the angular work was checked by observations for azimuth at 40 stations, the average angular error being 5



BAY OF
BENGAL

REFERENCE

Area Triangulated in advance 1897-98.

NOTES.

The numbers 403, &c. refer to the Standard sheets on the scale of 1 inch = 1 Mile, of the Provincial Indexes of Assam, Bengal & Burma.

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

seconds per station. The linear measurements amounted to 884 miles, and were checked by 17 connections with triangulated stations. The average correction per 1,000 links is 0.6 links.

102. The cost of traverse survey is ₹13,874, giving a cost rate of ₹8.9 per square mile.

103. The area surveyed in detail on the 2-inch scale, in Kalát, amounts to 1,477 square miles, and was mapped on 44 plane-table sections, and extends from Kashmir on the east to Shadihar on the west; it is a tract of country about 125 miles in length, with an average width of 12 miles, and is situated immediately north of the Upper Sind districts.

104. The cost of the 2-inch detail survey is ₹10.4 per square mile.

105. The character of the country topographically surveyed by the Desert Canal Camp may be divided into (a) well cultivated portion in the centre of the work, (b) waste *pat* land on the north and west, and (c) sandy wastes on the east. The portion under cultivation is well populated and very fertile; the *pat* land is peculiar, it is perfectly flat, bare of all vegetation and destitute of water; the soil is apparently good, and yields fair crops when cultivated by the help of canal water.

106. Field work closed very early in April and the party moved down to Karáchi for the recess. During recess the fair mapping of the entire area surveyed in detail was completed with the exception of a small portion of sheet No. 70, this sheet will be drawn next year when the survey is completed. The mapping was comprised in 75 quarter sheets, of which 22 were blank. They were drawn on the 2-inch for reduction by photography to one half, and have all been despatched to the Trigonometrical Survey office at Dehra Dún for publication. Sheets Nos. 48 and 49 have been drawn as far as surveyed. The remainder of these sheets will be mapped by No. 15 Party. Sheets Nos. 106 and 107 have been mapped as far as they are to be surveyed at present and will be published. The area surveyed in standard sheet No. 70 has not been mapped, the detail survey of the remainder of the sheet will be completed during the coming field season, and will be fair drawn in due course.

107. The triangulation and traverse charts of sheets Nos. 49, 50, 69, 70, 89, 90, 108 and 109 have been drawn. All the charts with list of co-ordinates have been despatched to Dehra. In addition to this 11 traverse charts prepared for the work of the Desert Canal Camp have been prepared.

108. Reconnaissance triangulation and traversing in advance will be taken up in sheets Nos. 19, 20, 21, 37, 38, 39, 40, 57, 58 and 59. Detail survey will be carried on sheets Nos. 50, 51, 70, 71, 90, 91, 108 and 109. The survey of about 30 square miles in the vicinity of Sukkur is to be undertaken, at the request of the Military Works Department.

109. Major L. Erard, R.E., Officiating Superintendent, Trigonometrical Surveys, says, "I inspected the party and considered its work satisfactory. This is all the more creditable as Mr. Erskine has had considerable unforeseen difficulties to contend with."*

LUSHAI HILLS, ASSAM.

NO. 14 PARTY.

110. Major Hodgson proceeded on furlough on the 19th June 1898, and

Personnel.

Major G. B. Hodgson, I.S.C., Superintendent, 2nd grade, in charge up to 18th June 1898.
Mr. J. Keating, Extra Assistant Superintendent, 6th grade, in charge from 19th June 1898.
Mr. R. Waller-Senior, Extra Assistant Superintendent, 6th grade.

Sub-Surveyors, etc.

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

closed at the end of April, and the party returned *via* Silchar, Fenchuganj and

Mr. Keating was placed in temporary charge of the party.

111. The party left recess quarters on the 15th October 1897 and proceeded to the Lushai Hills. Field work was

* Mr. Erskine reports that all his assistants worked well this season, while as regards the native establishment the sub-surveyors, with one or two exceptions, worked well throughout the field season.

Cherra Poonjee to recess quarters at Shillong, where the office was opened on the 25th May 1898.

112. The programme proposed in last year's annual report was carried out with modifications as suggested by the late General Woodthorpe when he proceeded to Silchar to inspect the arrangements made by the officer in charge for the commencement of the survey of the Lushai Hills, resulting in a larger outturn than would probably have been the case.

113. As there were no Great Trigonometrical Survey stations in the Lushai Hills, a series of first-class secondary triangles was commenced, starting from the Salama Tila-Ramphan Great Trigonometrical Survey stations of the Eastern Frontier Series, near Silchar, eventually closing on a base of the same series near Rángámáti in the Chittagong Hill tracts. The total length of this secondary series will be about 170 miles, of which nearly 100 were covered by this season's triangulation. The sides of some of the triangles are of considerable length, between 30 and 40 miles. This work was carried out by Mr. Keating, and the results are very satisfactory.

All the stations of this series were selected beforehand with the aid of the maps and charts of the previous surveys of 1871 and 1889. The series closed for the season on two stations of the triangulation which was carried out during the military expedition of 1871-72, but the old marks were not found, having most probably been removed by the Lusháis. Major Hodgson, Mr. Waller-Senior, and two sub-surveyors were employed on net work triangulation in the immediate vicinity of Aijál, the head-quarters of the Lushai Hills, and completed 1,300 square miles. This work gave very satisfactory results when computed. This triangulation comprised the whole of sheets Nos. 161 and 162, and half of 163.

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

	Square miles.
Network triangulation	1,300
1st class secondary series, including an area of 700 square miles of country covered by the net- work triangulation	1,800

115. By the middle of March three sub-surveyors had completed the work they were told off to do, and the opportunity was taken to practise them in topographical work on the 1-inch scale, in which they had had no previous instruction. The work turned out, though carefully executed, cannot be relied on to form part of the season's outturn as it is based on two points only.

116. The field season was closed in April to avoid the great heat and heavy rainfall that prevails in the district during May, rendering the climate unhealthy to work in.

117. The country in which work was carried on this season was throughout densely wooded or covered with long hemp grass and bamboos, except where patches had been prepared for cultivation, and every hill-top selected as a station had to be cleared at a cost of several days' labour. The Lusháis cultivate on the *jhum* system. In the neighbourhood of Aijál, villages were numerous, but elsewhere the country was very sparsely populated, except in the direction of Lungleh to the south. Lungleh was formerly the head-quarters of the Political Officer of the South Lushai Hills which were included within the Lower Provinces of Bengal; a small detachment of military police was located there. This part of Lushai has lately been transferred to the administration of Assam; the North and South Lushai Hills have been amalgamated under one Superintendent. The hills, as may be seen from the old maps, consist of high parallel ranges running generally north and south, and divided by very deep valleys. The ranges rise to a height of about 5,000 feet, the valleys only 400 to 500 feet, above sea-level. The Lushai villages are generally perched on the tops of hills or on projecting spurs, and in the dry season the water supply is often a great distance away. They are abandoned every 4 or 5 years when a whole village community will move to a fresh site, build a new village, and clear new *jhums*, as the inhabitants do not consider that they get enough return from their labour by remaining longer in one place. Every village is known by the name of its chief for the time-being, though each site has a distinguishing name of its own. Where, however, villages are fairly numerous, almost every separate range and conspicuous hill has its name, so that the appearance on the map of

a name, which is really the name of the hill, does not necessarily indicate the presence of a village. It is therefore considered useless to show the village sites on the maps or enter the names of the chiefs, as the information would soon be obsolete.

118. Only one metalled road exists at present in the Lushai Hills; it commences at Silchar, proceeds *via* Kolosib outpost to Aijál, and thence on to Lungleh. This latter portion has just been completed.

119. Three hundred and fifty coolies for the carriage of the party's baggage had to be imported, as every available able bodied Lushai was employed on road making. Of the former, 200, chiefly Nepálese, were imported from Darjeeling, and the remainder were recruited from the Cachar district. The Nepálese turned out well, but the coolies from Cachar gave a lot of trouble, so that it was necessary to get rid of all of them except 60 Nágás and Kúkis who, though made to serve against their will, worked well, especially the latter. Arrangements have now been made to recruit all coolies required for the next field season from Darjeeling as the Cachar district is not to be relied on.

120. Transport difficulties added greatly to the cost of the season's work; rations were also expensive. Rice is the only grain obtainable in the Lushai Hills, and in limited quantities; the bulk of the food supplies was obtained from the Government contractor for the Police, Public Works Department, etc., and then only at high prices; all measures in connection with the rationing of the party were framed in accordance with the advice of the Superintendent, Lushai Hills, and the Deputy Commissioner of Cachar, both these officers being frequently consulted on all points relating to transport, rations, and other matters affecting expenditure.

121. As far as the health of the party was concerned several of the *khalásis* and coolies suffered from malarial fever owing to the nature of the country they were working in; dysentery and rheumatism of a mild nature were prevalent; thirty-three cases of mild scurvy occurred owing to want of fresh meat and vegetables.

122. The programme of work for the ensuing field season is as follows:—

- (a) The completion of the first-class secondary series of triangulation commenced last field season. This work, starting from the base Sítapahár-Gilasari G. T. S. stations of the Eastern Frontier Series in the Chittagong Hill tracts, and extending northwards, will connect in the interior of the Lushai Hills with Sailam and Darlung hill stations on which the series was closed last season.
- (b) Network triangulation will be carried on in sheets Nos. 163, 164 and 165.
- (c) Detail survey on 1-inch scale of the area triangulated last season.

123. Lieutenant-Colonel J. R. Hobday, Officiating Deputy Surveyor-General, Revenue Branch, inspected the office of this party early in July 1898, and expressed his satisfaction of the work done, taking into consideration the new nature of work undertaken by the party for the first time, and the difficulties met with in the Lushai Hills. It will be noticed that no detail survey at all was completed this year; this was unavoidable, as from the nature of the country it was impossible to push triangulation on ahead sufficiently in this the first year of the survey to allow of the points being computed out, and the results plotted for the detail surveyors. This having been foreseen, almost all the sub-surveyors were temporarily transferred to other parties, where their services could be usefully employed.*

* The officer in charge reports very highly of Mr. Keating's work, and his satisfaction of the cheerful manner in which all the members of the party performed their duties under trying conditions. Mr. Waller Senior is especially mentioned for the zeal which he displayed; of the native establishment, Ram Singh, Abdul Haq and Syed Razi Hasan are specially mentioned.

BALÚCHISTÁN.

NO. 15 PARTY.

124. Colonel Sir T. Holdich, K.C.I.E., C.B., R.E., was in charge from the

Personnel.
 Colonel Sir. T. H. Holdich, K.C.I.E., C.B., R.E., Superintendent, 1st grade, in charge up to 17th February 1898.
 Lieutenant-Colonel R. A. Wahab, C.I.E., R.E., Superintendent, 2nd grade, in charge from 7th May 1898.
 Lieutenant F. W. Pirrie, I.S.C., Officiating Deputy Superintendent, 2nd grade, in charge from 20th April to 6th May 1898.
 Mr. T. E. M. Claudius, Extra Assistant Superintendent, 1st grade, in charge from 18th February to 19th April 1898.
 „ E. A. Wainright, Extra Assistant Superintendent, 4th grade.
 „ G. A. Knight, „ „ 5th „
 „ G. P. Tate, „ „ 6th „
 Yusuf Sharif, Khan Bahadur, Sub-Assistant Superintendent, 1st grade.
 Hira Singh, Rai Bahadur, „ „ 1st grade.
 Mr. M. C. Petters, „ „ 2nd „
 „ H. C. H. Cooper, „ „ 3rd „
 Ahmed Ali Khan, Khan Bahadur, „ „ 3rd „
 5 Surveyors, 23 Sub-Surveyors, etc.

1st October 1897 till the 17th February 1898, when he retired from the department on attaining the age of 55, after which the charge of the party devolved on the several officers as marginally noted.

Lieutenant Pirrie was transferred to take over charge of No. 10 Party on the 20th September 1898, and Mr. Claudius of No. 7

Party on the 1st September 1898.

125. The party was divided into two detachments, one of which under Mr. Claudius was employed round Ráwalpindi, and took the field on the 22nd December 1897, closing work on the 14th April 1898, when it returned to recess quarters at Quetta. The other detachment under Mr. Tate was employed on a 1-inch survey of the hilly portion of Sind along the Balúchistán border. This detachment left Quetta on the 1st November 1897 and remained in the field until the 20th April 1898.

Triangulation was extended from the sides of the Indus series which runs through Sind. The instrument used was an 8-inch theodolite by Cooke and Sons. The country surveyed extends from the Indus near Sehwan westwards to the Sind border, and is for the most part open and cultivated. During the recess the computations of the season's triangulation were completed. The computations of the Kuram triangulation of 1894-95 were revised, and considerable progress has been made in the preparation of standard charts of triangulation and general reports, of which two have been completed and submitted for publication. The drawing of the fair maps has fallen somewhat into arrears, chiefly owing to the number of draftsmen taken during the recess season of 1897 for trans-frontier service.

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

	Square miles.
Triangulation for 1-inch detail	1,430
Detail survey on 1-inch scale	1,857
„ „ 6 „ „	114
Reconnaissance	8,224

127. The 16-inch survey of the Quetta cantonment was revised during the recess and brought up to date; the fair drawing is still in hand.

128. Next season the different surveys now in progress will be continued and a special survey on the 6-inch scale of the coal bearing area near Quetta, which has been commenced, will employ a small detachment for about 4 months.*

* The officer in charge reports very favourably of the whole party. Mr. Claudius deserves special mention for his able superintendence of the party during the absence of the Superintendent on field service; Messrs. Petters and Cooper both promise to become thoroughly useful assistants. Of the native establishment, Asghar Ali Beg, Khan Bahadur, Ahmed Hasan, and Tulsi Ram deserve special mention.

PUNJAB SURVEY

INDEX TO THE SURVEY OPERATIONS IN THE HIMALAYAS

1897-98

NO. 18 PARTY

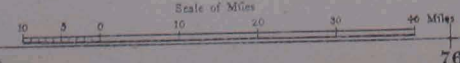


REFERENCES.

2" = 1 Mile	4" = 1 Mile	1" = 1 Mile
Surveyed during previous Seasons		
Do. 1897-98		
Area Triangulated in advance		
Do. 1897-98		
Simla-Kalka Road Survey, published on } Scale 6 Inches = 1 Mile		
Approximate limits of Hill tracts.		

NOTES.

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



HIMALAYAS, PUNJAB.

No. 18 PARTY.

129. Mr. L. J. Pocock remained in charge of the party throughout the year, except for sixteen days, during which time Lieutenant-Colonel R. A. Wahab, R. E.; held charge.

Personnel.

Lieutenant-Colonel R. A. Wahab, R. E., Superintendent, 2nd grade, in charge from 1st to the 16th November 1897.	
Mr. L. J. Pocock, Extra Assistant Superintendent, 1st grade, in charge from 1st to 31st October and from 17th November 1897 to 30th September 1898.	m
Mr. C. D. Potter, Extra Assistant Superintendent, 4th grade.	
" W. Robert, " " " 5th " from 17th January 1898.	
" G. E. Parker, " " " 5th " to the 2nd November 1897.	
" W. A. Fielding, " " " 6th " from 19th October 1897.	
" J. O. Greiff, Sub-Assistant Superintendent, 2nd grade, from 19th October 1897.	
" W. M. Gorman, " " " 2nd "	
" E. J. Biggie, " " " 2nd "	
" C. E. C. French " " " 3rd "	

130. The work of the party, as in former years, comprised the topography of British tracts on the 4-inch scale; of the Native States on the 2-inch scale,

Shah Nasiruddin, Ram Saran, Garjman Rai, Amir Sing and 32 others. and of all demarcated forests, wherever situated, on the 4-inch and 2-inch scales.

131. The localities that were under survey were—

- (i) The Kángra district and Kullu sub-division of that district, on the 4-inch scale.
- (ii) The Native States of Mandi, Suket, and Simla Hill States, on the 2-inch scale.
- (iii) Special surveys of the forests in the Sirmúr State, and in the Simla Hill States, on the 4-inch and 2-inch scales.
- (iv) Triangulation in advance of topography in the Simla Hill States, in the districts of Hoshiárpur and Kángra and in the snowy regions of the Kullu sub-division of Kángra.
- (v) The classification of forest growth and soils *pari passu* with the topography in British tracts, and special forest surveys.
- (vi) The large scale survey, 48 inches=1 mile, of the town of Náhan in Sirmúr, carried out at the special request and cost of the Sirmúr State.
- (vii) Some revisionary work along the left bank of the Jumna river where it runs through Sirmúr, required on account of change of course of river.

132. All of the above operations, except the last, were in continuation of the previous season's work. The system of classification of forest growth and soils was continued in Kullu, Sirmúr and Kángra, and local officers as before, were supplied with ferrotyped reproductions of the field work, in advance of the publication of the 4-inch sheets. In keeping with the arrangements made last year by Captain Robertson, the preparation of these traces of classification was done once for all in the field, for reproduction, and so the necessity for redrawing them in recess was avoided.

133. The party was divided into five sections, the head-quarters being in charge of the Executive Officer, and the other four in charge of Messrs. C. D. Potter, W. Robert, J. O. Greiff and W. M. Gorman, the first three supervising squads of sub-surveyors, and the last named carrying on the triangulation in advance. These detachments left recess quarters on various dates between the beginning of October and the end of November, returning to recess quarters during the period between the middle of April and beginning of July.

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

(a) Triangulation in the Simla Hill States and in Kullu	Square miles. . 663
(b) Detailed survey on the 4-inch scale—	
Kángra	112
Kullu	89
Sirmúr	116
	317

(c) Detailed survey on the 2-inch scale —

	Square miles.
Mandi, Suket, and Simla Hill States	235
Sirmúr State	24
	259

The surveys of the following forest blocks are included in the areas shown above :—

	Number of blocks.	Area in square miles.
In Sirmúr	48	135'5
„ Kullu	4	3'2
„ Kángra	15	7'4
TOTAL	67	146'1

135. The usual tests were applied by the Executive Officer and assistants, who constantly visited some one or other of the squads. During the year 41 plane-table sections were thus examined, the work proved of good quality in all cases.

136. The triangulation was carried on in the districts of Kángra and Hoshiárpur, the Native State of Biláspur, the Simla Hill States, and in the snowy regions of Kullu, where stations over 17,000 feet were visited.

The results prove that the observations are good and Mr. Gorman deserves credit for his good work in the high altitudes above mentioned.

137. The cost rates per square mile of the various operations are as follows :—

	R
Triangulation	11'5
Average of all detail survey, 4-inch	107'5
Ditto 2-inch	53'4

The cost of the triangulation is much below last year's, which was nearly R30 per square mile.

The cost rates for the detail survey are in excess of those quoted last year, for which there are the following reasons: (1) The Kullu detachment lost the services of three of its best and most experienced surveyors, who were selected for frontier and exploration work with the Malakand and Mohmand expeditions and elsewhere; (2) the very unexpected and continuously unfavourable weather for nearly a month during the spring months in the snowy regions; (3) the area surveyed in Kángra was of a very difficult nature and forest clad; (4) there was a paucity of old hands in this detachment. All these causes tended to decrease the area and therefore to raise the cost rates.

138. The country surveyed in Sirmúr on 4-inch and 2-inch scales being mostly open, admitted of survey by interpolation, and progress was easy, and all testing was done by *in situ* fixings. The 48-inch survey of the city of Náhan was tested by actual measurements of the various buildings shown on the plane-tables, a large percentage of each being tested. It should be stated that during the season under report a change of scale from 4-inch to 2-inch in Sirmúr was decided on. The State was addressed on the subject on the 28th June 1897, when it was proposed that a final decision should be arrived at whether the high and generally bare ground should be surveyed on the 4-inch, as are the other portions of Sirmúr that are covered with forest. The contribution of the cost of a 4-inch survey by the State was R40 per square mile, and it was suggested that if the scale were reduced to 2 inches the contribution towards unsurveyed ground would be R20 and over ground already surveyed and published on the 2-inch scale R30 per square mile. The State decided on accepting the proposals, and accordingly all future surveys in Sirmúr will

be executed on the smaller scale. This will very considerably quicken the work and lessen the cost.

139. The large scale survey of Náhan town was continued, but on account of the intricate nature of the work could not be completed. It is intended to have a series of spirit levels carried over the ground so as to leave suitable bench marks, which will be of much use in case of any engineering projects being undertaken hereafter by the State Engineer.

140. In the snowy regions of Kullu proper the country plane-tabled is, in general character and in physical aspect, in every respect the same as described in last season's Report, being, if possible, more wild in its solemn grandeur and bleak beyond description. The great peaks of the main ridge dividing Kullu proper from Spiti attain an average altitude of nearly 19,000 feet above sea level, at the base of which lie several glaciers, some being many miles in length but narrow in width, the two largest dropping down to an elevation of 11,500 feet. The forests surveyed are second class and these extend far up the main streams to an elevation of 12,500 feet above sea level, and consist chiefly of stunted trees of *bhúj*, *tós* and rhododendron, and higher up, in isolated patches, juniper bushes are found.

141. The 2-inch work in the Native States of Mandi, Suket, and the Simla Hill States has its limits, on the north, marked by the Naina Devi range, to the south by the low Siwálik range, broken by the Sutlej river, and the high Jorjorn range immediately above the low ground of the *Dún* of Nálagarh on the east. The whole of this, which is on an average only 1,000 feet above sea level, is of an extremely intricate nature, being cut up by numerous small streams and ravines, with sheer precipitous banks of a conglomerate formation and about 100 feet in height.

142. In Kángra the country surveyed embraced chiefly the watershed between the Chakki and Chhamach *khads* together with a small area of the low hills to the south of the latter. This country, as a whole, presented a confused undulating mass of hills and water courses, rising in succession as they approach the bold clearly defined range that bounds Kángra on the north and north-west. The low hills south of the Chhamach spread out from their flat topped summits in spurs of even slopes and are assiduously cultivated. Owing to the remarkable flatness of this mass of hills and their uniform elevation they were difficult to survey, necessitating innumerable plane-table fixings in order to see all the topographical detail. In places also they are thickly wooded, especially on the flanks of the spurs, and all these disadvantages combined, rendered the progress of the work slow. In some parts of the work, however, the ground presented a marked difference to that just described. As you approach the mountain range that lies to the north, and which rises up to 17,000 feet, the country is of greater elevation and the hills begin to assume larger and bolder features. The general aspect is more rugged and rocky and the shrubbery that clothes the lower hills gives place to tall pines and trees of kindred growth. From its structure and formation the country is naturally less cultivated and has a smaller number of inhabitants.

143. The further instruction in surveying during a two years' course of Native Soldier students from the Thomason Civil Engineering College forms one of the duties of this party. One man, Havildar Ude Ram of the 6th Bengal Light Infantry, completed his course in July and returned to his regiment. The Naik of the 44th Gurkhas who joined the party last October will remain a year longer. In lieu of Ude Ram another man, it is expected, will join the party very soon. Ude Ram and Madho Ram have both shown aptitude for the work and the Havildar gave much satisfaction.

144. Steady progress has been made with the drawing of the fair maps and forwarding of them for publication. During the year 34 sheets on the 4-inch and 7 on the 2-inch scale and one triangulation chart have been sent for publication, as also the 6-inch sheets (2) of the revised survey of the Mahásu extension survey. Also 16 forest traces showing the classification of soils and forest growth have been prepared and sent for ferrotype copies, for supply to Forest Officers. It will thus be seen that the mapping has been well advanced, a total of 44 sheets of different scales having been submitted for publication, besides the examination and passing of 20 proofs, and the same number of specimens for colorists.

145. In order to deal more rapidly with the arrears of mapping, the officer in charge arranged, with the consent of the Superintendent Trigonometrical Surveys, to make each field detachment responsible for the fair drawing, during the recess, of the sheets surveyed during the field season, the arrears, if any, being handed over to the permanent drawing establishment attached to the party. It is thus hoped to clear off the arrears during the next 18 months. The party has however always been much hampered in its efforts to keep abreast of the mapping, by the constant requisitions for special surveys for various purposes, all of which are urgently required, and the drawing of which greatly impedes the completion of the sheets of the regular survey.

146. Considering the disadvantages under which the party worked in having so many of its best men temporarily withdrawn, the season's work shows a good outturn and does not compare unfavorably with that of previous years.

147. His Highness of Sirmúr, as well as all District and Forest Officers were most helpful in ensuring the progress of the work, and the Executive Officer acknowledges the same with much pleasure.

148. The proposed programme for this party for season 1898-99 consists of the continuation of 4-inch topography in Kullu and Káugra; topography on the 2-inch scale will also be carried on in the Native States of Mandi, Suket and Sirmúr and the Simla Hill States. As noted above, all future surveys in Sirmúr will be executed on the 2-inch scale, including the State forests.

149. The party was inspected by the Surveyor-General in July, and by the Superintendent Trigonometrical Surveys, in August, and both these officers expressed their unqualified approval of the state in which they found the party.*

FOREST SURVEYS.

MADRAS PRESIDENCY.

NOS. 9 AND 19 PARTIES.

150. Under orders from the Surveyor-General the amalgamation of Nos. 9

Personnel.
 Captain H. A. Denholm Fraser, R. E., Deputy Superintendent, 2nd grade, in charge up to 7th April 1898.
 Lieutenant A. Mears, I. S. C., Assistant Superintendent, 2nd grade.
 Mr. A. G. Wyatt, Extra Assistant Superintendent, 2nd grade, up to 26th April 1898.
 " C. F. Hamer, " 3rd grade, in charge from 8th April 1898.
 " H. Todd, Extra Assistant Superintendent, 3rd grade.
 " R. Todd, " 4th "
 " C. George, " 6th "
 " W. C. G. Barkley, Sub-Assistant Superintendent, 1st grade.
 " J. H. S. Wilson, " 2nd grade.
 " M. J. Sheehan, " 2nd "
 " J. O'B. Donaghey " 2nd "
 67 Surveyors, Sub-Surveyors, etc.

and 19 Parties took place on the 1st September 1897, and the programme for 1897-98 has been carried out.

151. The double party was employed during the season on the 4-inch survey of forest reserves in Salem, South Arcot, North Coimbatore and Kurnool districts; triangulation and traversing was also carried out in these districts, and triangulation in Cuddapah was commenced this season.

152. The triangulation carried out in North Coimbatore district amounted to 1,711 square miles, which was executed by Lieutenant Mears, Mr. J. H. S. Wilson and Surveyor Govind Raju Mudaliar. As reported before, the previous year's triangulation carried out by Mr. Barkley being defective in many ways, it was found necessary to triangulate the whole of it again and Mr. Wilson was deputed to take up the work.

153. In Kurnool district the triangulation was extended northwards by Mr. R. Todd from the previous season's work; the area triangulated was 720 square miles, which may be looked upon as satisfactory considering the difficult and inaccessible nature of the ground.

154. The triangulation in Cuddapah district was commenced this season in the extreme north but could not be completed on account of Mr. Barkley being incapacitated by illness in March. The outturn of 900 square miles is

* Mr. Pocock reports very highly of the services of Messrs. Potter and Robert, and adds that Messrs. Parker, Greiff, Gorman, Biggie and French rendered excellent service.

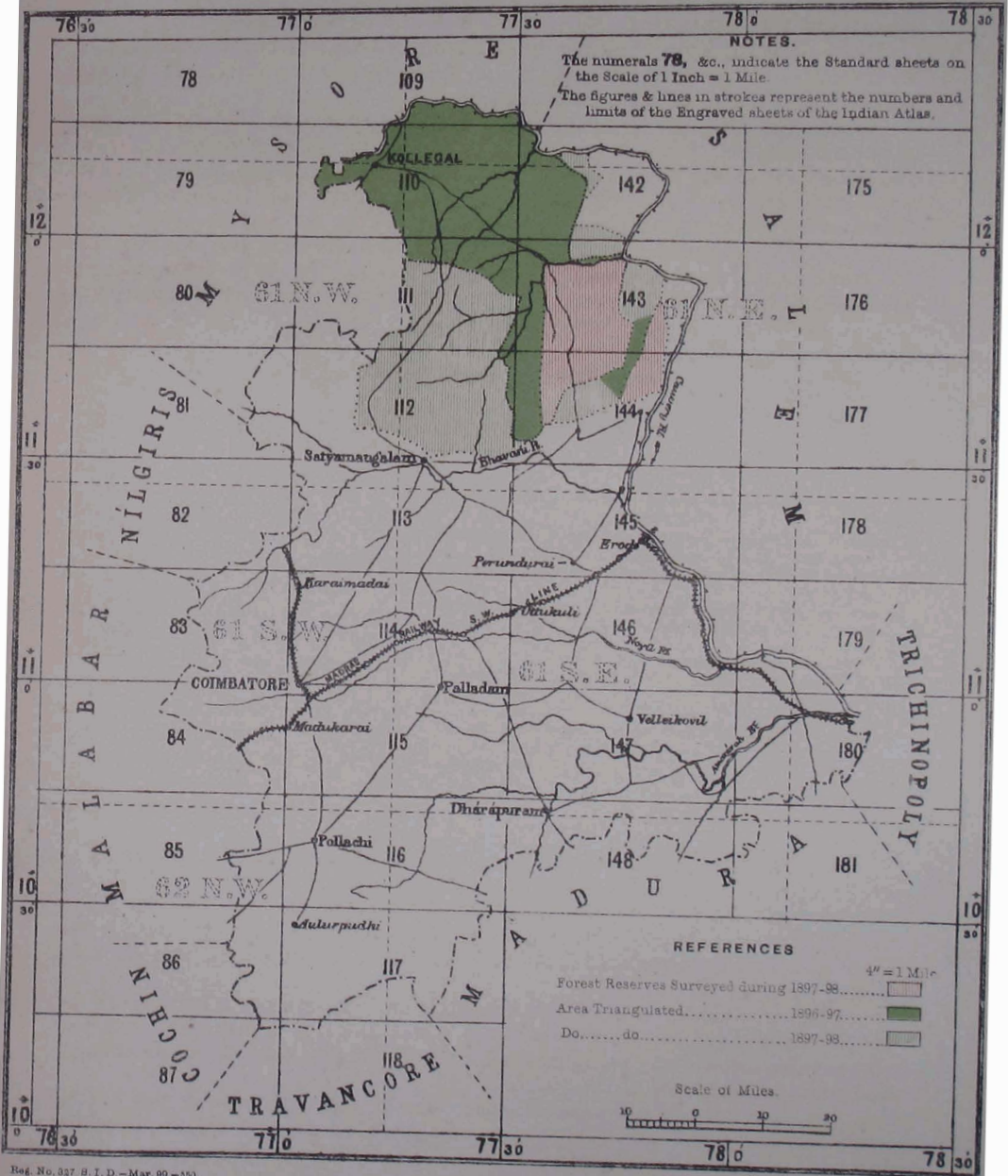
Of the subordinate establishment the following are specially brought to notice:—Amir Singh, Garjiman Rai, Narain Dutt, Fateh Mahomed, Sheopal Misser, Sanker Singh, Ramaaran, Abdul Kibria and Khushi Nand.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE COIMBATORE DISTRICT.

Nos. 9 & 19 PARTIES

1897-98.



Reg. No. 327 B. I. D. - Mar. 99 - 550.

Photo, S. I. O., Calcutta.

No. 450-S. 99.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE NORTH ARCOT DISTRICT.

Nos. 9 & 19 PARTIES.

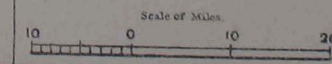
1897-98.



REFERENCES.

- Forest Reserves published [Red Box] [Scale 1 Mile]
- Do. surveyed during previous Seasons [Red Box]
- Do. do. do. 1897-98 [Red Box]
- Area Triangulated in advance [White Box]
- Do. do. 1897-98 [White Box]

The numerals 170, &c. indicate Standard sheets on the Scale of 1 Inch = 1 Mile.



NOTE

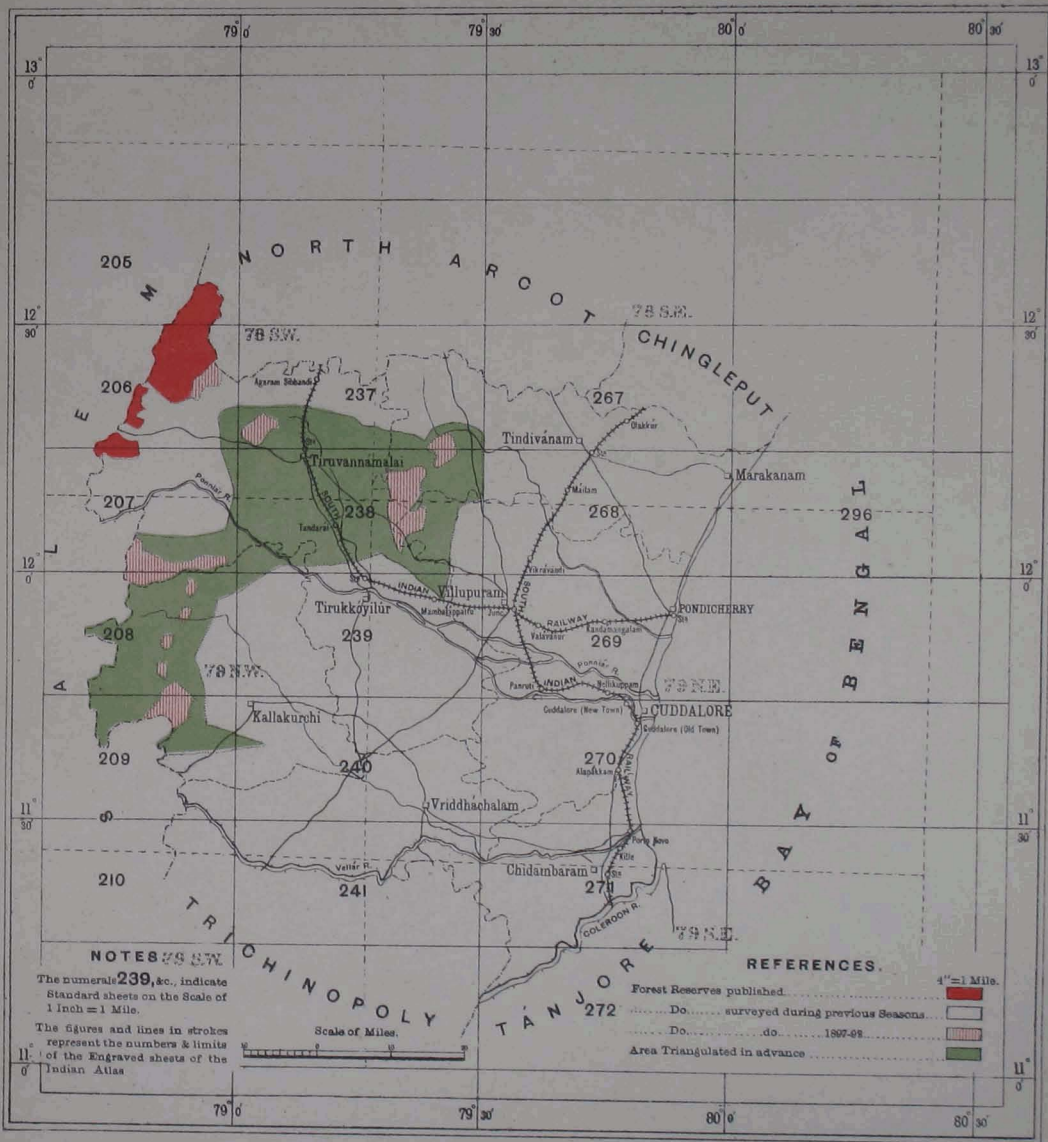
The figures and lines in strokes represent the numbers and limits of the Engraved sheets of the Indian Atlas.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE SOUTH ARCOT DISTRICT.

1897-98.

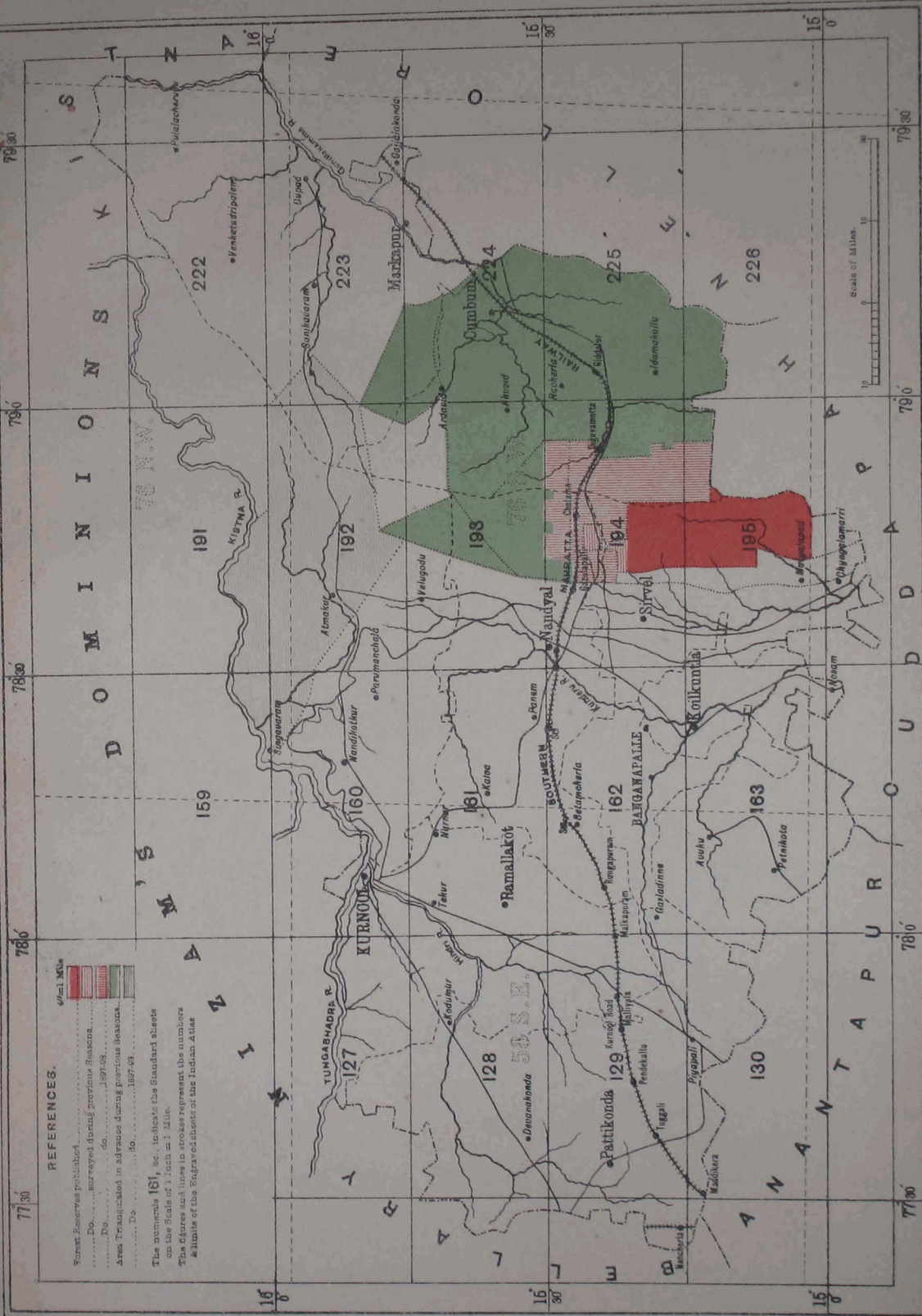
Nos. 9 & 19 PARTIES



Reg. No. 527, S. I. D. - Mar. 99 - 550.

Photo. S. I. O., Calcutta.

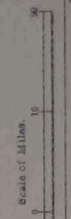
No. 451-S. 39.



REFERENCES.

- Forest Reserves published.....
- Do. surveyed during previous seasons.....
- Do. do. do. 1897-98.....
- Areas Transcribed in surveys during previous seasons.....
- Do. do. do. 1897-98.....

The numerals 161, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.
 The figures and lines in brackets represent the numbers & names of the Standard sheets of the Indian Atlas

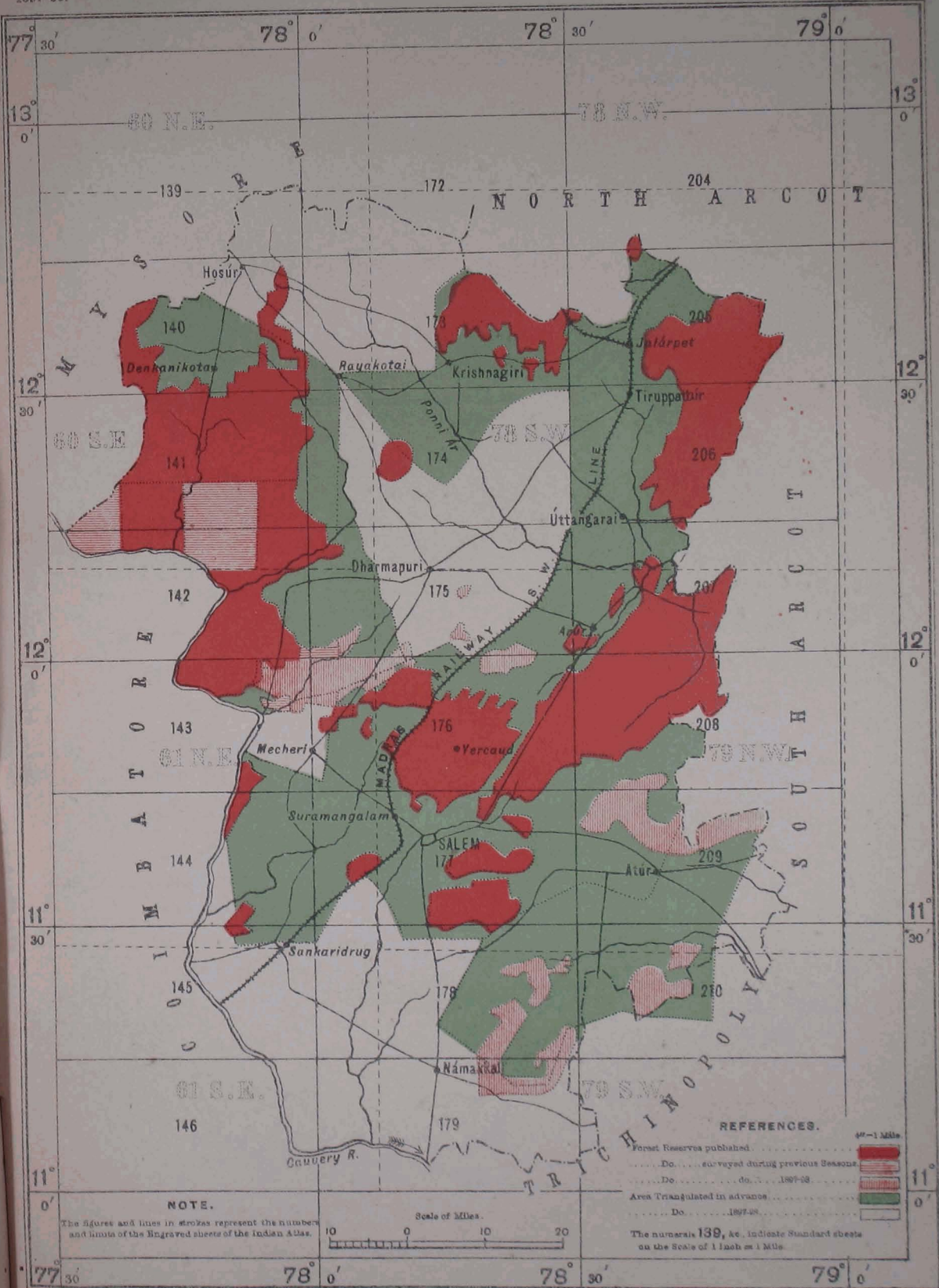


MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE SALEM DISTRICT.

1897-98.

Nos. 9 & 19 PARTIES.



MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE CUDDAPAH DISTRICT.

Nos. 9 & 19 PARTIES.

1897-98.



REFERENCES.

Area Triangulated in advance during 1897-98.

NOTES.

The numerals 163, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.
The figures and lines in strokes represent the numbers and limits of the Engraved sheets of the Indian Atlas.

good and is an improvement on the previous season's work done by this officer in Coimbatore district.

155. The traversing carried out during the season amounts to 712 linear miles in Salem, South Arcot, North Coimbatore, Kurnool and Cuddapah districts. Traverse plots of district and *taluk* boundaries have been obtained from the Madras Revenue Survey and utilized.

156. The area of topography for the year amounts to 1,050 square miles; it would no doubt have been still greater had it not been for the exceedingly intricate and difficult nature of the ground, the unusually wet weather experienced at the beginning of the season, the amount of sickness which prevailed, especially amongst the native establishment, and, lastly, owing to the large number of young hands new to the work.

157. The country surveyed (except in South Arcot) is everywhere mountainous and in most parts covered with dense jungle. The average elevation of hill tops exceeds 3,000 feet above sea-level, the highest point, 4,250 feet, being on the Kalráyan Hills of Salem district. On most of these hills (except in Kurnool) there are numerous villages with a considerable, though scattered, area of cultivation. As the demarcation of these villages has not yet been carried out, the whole area has been surveyed, and the limits of cultivation existing at the time of survey have been shewn: this procedure was adopted for the Shevaroy, Jávidi and Kalráyan Hills in previous seasons. The whole of the work was examined by the section officers concerned by *in situ* fixings or chain measurement as was found most suitable. The accuracy of the work was very satisfactory.

158. There were two deaths from cholera; a sub-surveyor died in Kurnool and a *khalási* in South Arcot. Several men of the native establishment had to be invalidated.

159. During the recess the various computations have been brought up to date, the large amount of triangulation entailing heavy work on the computers. The fair mapping of 53 sheets has also been completed, 17 sheets are to be held back from publication for resurvey of boundaries wrongly demarcated by the forest officials, and 6 sheets, the survey of which has not been completed, will be held over till next year.

160. The actual expense, including cost of instruments for the survey year ending 31st August 1898, is ₹1,29,293, or an average of ₹119 per square mile.

161. This high rate is chiefly due to the following causes:—

- (a) The extra expense in Kurnool district where the menial establishment had to be increased by 30 per cent.
- (b) Extra travelling allowance by 50 per cent in Kurnool and Coimbatore to European assistants and native staff.
- (c) The expense incurred in carriage of provisions for most of the squads in the districts of Kurnool and Coimbatore.
- (d) And the expense incurred in keeping up a computing section in Coimbatore district.

162. The programme for the ensuing field season comprises the completion of the triangulation in North Coimbatore, the Nallamalai Hills of Kurnool, and a portion of the incompleting work of last field season in Cuddapah; this, it is hoped will be carried out by Mr. R. Todd and native surveyors. The topography will be extended in Kurnool and North Coimbatore and commenced in Cuddapah. Traversing will also be continued in these three districts.

163. The party was inspected by the Deputy Surveyor-General in August.

164. The District Forest Officers of Salem, South Arcot, Kurnool, and Coimbatore visited the office at Bangalore between April and July for the purpose of verifying the maps. All omissions and corrections as far as possible have been made. Fifteen sheets of Salem district have been held over from publication till next year on account of faulty demarcation and clearing of forest boundaries.*

* The officer in charge reports that Messrs. C. F. Hamer, H. Todd, and C. George have worked with energy and good will, and that Messrs. J. H. S. Wilson, M. J. Sheehan, and J. O'B. Donaghey have rendered good service.

The surveyors and sub-surveyors as well as the soldier surveyors, with a few exceptions, are well spoken of. Writers Tara Prasanna Roy and Pulin Bihari Roy have also given satisfaction.

BOMBAY PRESIDENCY.

No. 17 PARTY.

165. Mr. C. E. Tapsell held temporary charge of this party throughout the

Personnel.
 Captain P. J. Gordon, I. S. C., Deputy Superintendent, 1st grade, in charge from 7th June 1898.
 Mr. C. E. Tapsell, Extra Assistant Superintendent, 3rd grade, in charge up to 6th June 1898.
 Mr. S. F. Norman, Extra Assistant Superintendent, 6th grade.
 Mr. C. A. Norman, " " " 6th "

Surveyors and Sub-Surveyors.
 G. R. Bhopatkar, R. V. Joshi, Govind Gopál and 43 others.

field season and until the 7th June when Captain Gordon, I.S.C., on return from furlough, was appointed to the charge of the party; the actual field work was therefore executed under Mr. Tapsell's supervision.

166. The party continued the survey of the forest reserves in the northern, central and southern circles of the Bombay Presidency on various scales, these operations comprising:—

- (1) *In the Northern Circle.*—Preliminary triangulation in Thána. Detail survey on the 8-inch scale of the teak reserves in Thána (Máhim *táluka*).
- (2) *In the Central Circle.*—Advance triangulation in Násik. Detail survey on the 8-inch scale of forest reserves in Násik (Igatpuri *táluka*). Detail survey on the 16-inch scale of *bábul* reserves in Ahmednagar (Ráhuri and Kopargaon *tálukas*) and Násik (Niphád and Yeola *tálukas*).
- (3) *In the Southern Circle.*—Advance triangulation in Kolába. Advance traversing in north Kánara (Sirsi and Siddápur *tálukas*). Detail survey on the 8-inch scale of forest reserves in Kolába (Roha *táluka*) and on the 4-inch scale in North Kánara (Sirsi *táluka*).

167. The field season lasted from the beginning of December to the end of May.

168. The following table shows the total cost rates and area surveyed for the last three years:—

DESCRIPTION OF WORK.	COST-RATES PER SQUARE MILE.			AREA SURVEYED IN SQUARE MILES.		
	1895-96.	1896-97.	1897-98.	1895-96.	1896-97.	1897-98.
	<i>R</i>	<i>R</i>	<i>R</i>			
Triangulation .	5'4	7'4	7'9	505	1,376	718
Traversing .	25'5(a)	14'3(a)	16'7(a)	165(a)	188(a)	164(a)
Topography, 4-inch	66'8	77'6	60'2	829	522	444
8 "	122'4	135'7	173'9	108	168	204
16 "	130'0	156'1	154'5	15	33	29

(a) Linear miles.

169. The outturn of triangulation and traversing need not be compared as no attempt has been made to triangulate or traverse a larger area than is actually required as a basis for the topography of the ensuing season. As regards the outturn of topography, in order to obtain a just comparison in a party where surveys on several scales are being done at the same time, it is necessary to form a scale of relative values for the different descriptions of survey. This cannot be done with any great degree of accuracy but it may be assumed in the districts where the party is working at present that a square mile of 8-inch or 16-inch survey is equal to three of 4-inch.

Applying this scale to the areas of topography for the last three years the following results are obtained:—

	Square miles.
1895-96	1,198
1896-97	1,125
1897-98	1,143

BOMBAY SURVEY.

1897-98.

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

No 17 PARTY.



REFERENCES.

- 125 Sheets Published on 1" Scale are shown thus
- Surveys during previous Seasons
- Do. 1897-98 on 1" Scale
- Do. 1897-98 on 1/4" Scale
- Areas Triangulated in advance
- Native States
- Forest Circle Boundaries
- State do
- District do
- Taluka do

NOTE.

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

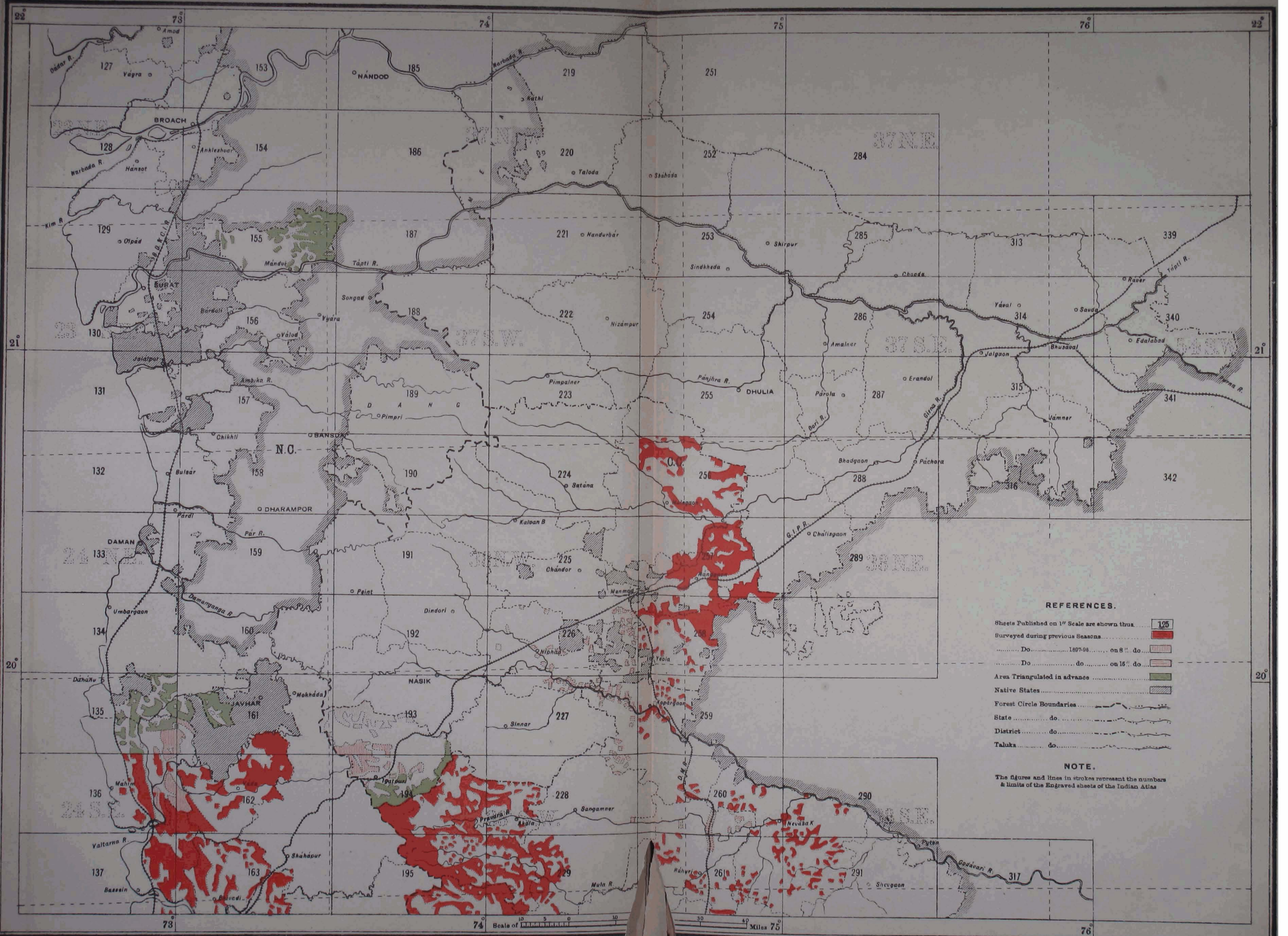
Scale of 1" = 1 Mile

BOMBAY SURVEY.

1897-98.

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

No. 17 PARTY.



REFERENCES.

- Sheets Published on 1" Scale are shown thus 126
- Surveyed during previous Seasons
- Do 1897-98. on 8" do
- Do do on 16" do
- Area Triangulated in advance
- Native States
- Forest Circle Boundaries
- State do
- District do
- Taluka do

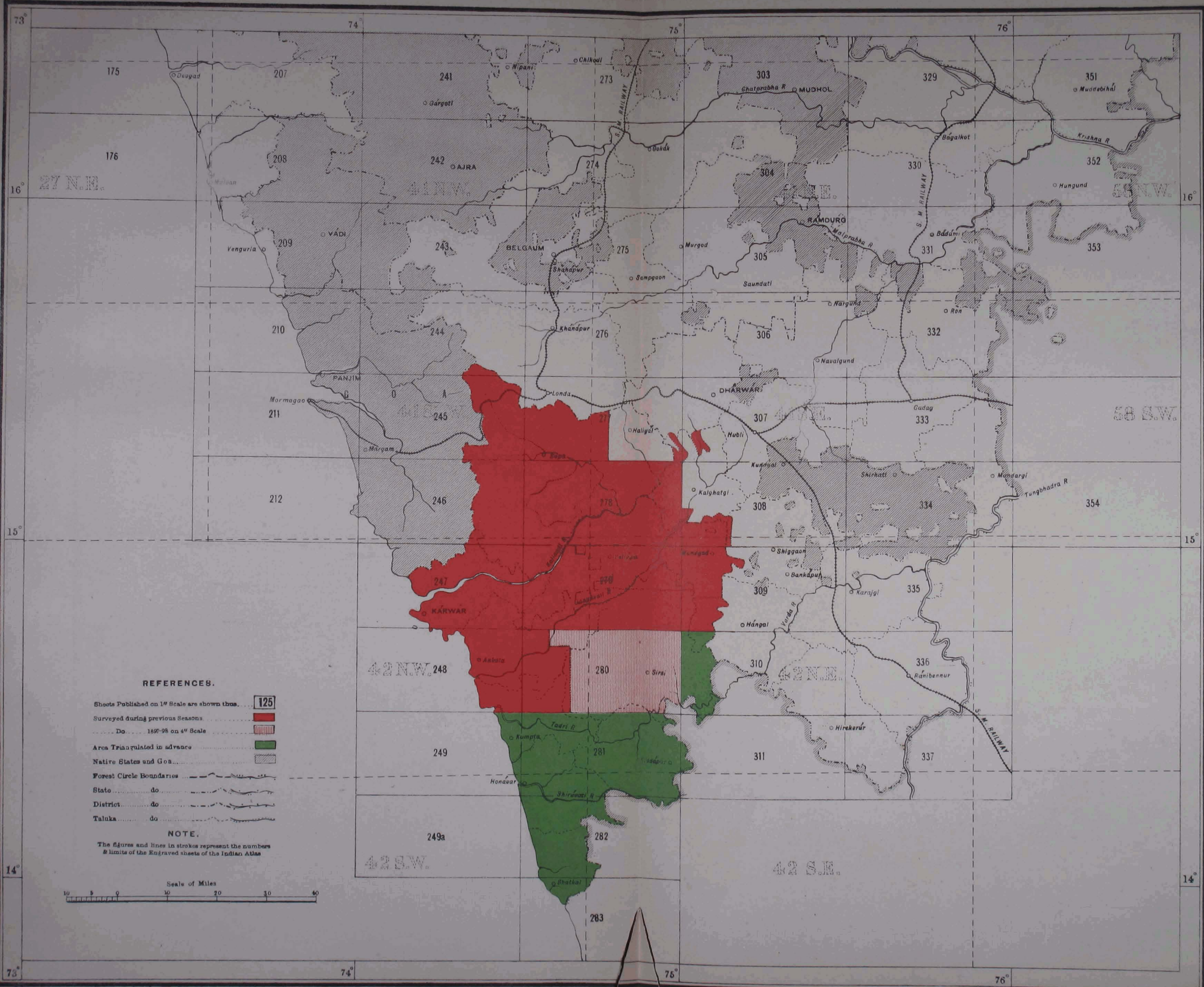
NOTE.

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

Scale of Miles 0 10 20 30 40 50 60 70 75

BOMBAY SURVEY.

INDEX TO THE FOREST SURVEYS IN PORTION OF THE SOUTHERN CIRCLE

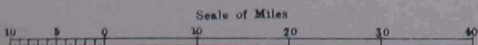


REFERENCES.

- Sheets Published on 1st Scale are shown thus. 125
- Surveyed during previous Seasons
- Do. 1897-98 on 4th Scale
- Area Triangulated in advance
- Native States and Goa
- Forest Circle Boundaries
- State
- District
- Taluka

NOTE.

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



170. Although the cost rates of triangulation appear much the same as for last season they are in reality considerably less. Area as a test of triangulation is misleading, especially where the areas triangulated are scattered, as is the case in this party. The number of stations of observation forms a much better standard for comparing cost rates. The cost for each station of observation for the last three years is:—

	<i>R</i>
For 1895-96	27.6
„ 1895-97 : : : : :	50.8
„ 1897-98	22.4

The decrease in the cost is chiefly due to the triangulation having been entirely executed by native agency.

171. The cost rates of 4-inch surveys also show a decrease, while those of 16-inch surveys are practically the same as for last year.

The cost rates of 8-inch surveys unfortunately show a considerable increase. This is attributable partly to the more difficult nature of the country under survey in Násik and Kolába, but principally to the death of several trained and experienced surveyors from plague since last field season. The places of these men had to be filled by apprentices, who were unable to produce nearly such a large area of topography, and it must be borne in mind that it is on area principally that cost rates depend.

172. The total cost of the party is R6,230 less than for 1896-97, as will be seen in the table below —

DESCRIPTION OF WORK.	TOTAL COST.		
	1895-96.	1896-97.	1897-98.
	<i>R</i>	<i>R</i>	<i>R</i>
Triangulation	77,368	82,337	76,107
Traversing			
Topography, 4-inch			
„ 8 „			
„ 16 „			

This decrease is chiefly due to a saving in the cost of supervision, Mr. Tapsell having officiated in charge of the party for eight months, in addition to his other duties.

173. The work was thoroughly examined and tested while in progress.

174. During the recess the fair mapping and computations of the season's work have been completed, 125 sheets on the various scales having been prepared for the press. All arrears of mapping have been taken up and it is hoped that by the end of next field season they will be out of hand. All maps submitted to the Bombay Government Photozincographic Office have been published.

175. The health of the party on the whole was good with the exception of the usual cases of fever in the Kánara detachment. Three surveyors have died of plague since the submission of last report, but these casualties all occurred before the party took the field.

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

- Triangulation in Násik and Thána.
- Traversing in North Kánara.
- 4-inch surveys in North Kánara.
- 8-inch „ in Kolába, Násik and Thána.
- 16-inch „ in Ahmednagar and Sholápur.

177. The recess office was inspected towards the end of the recess by the Surveyor-General.*

LOWER BURMA.

NO. 20 PARTY.

178. This party was under the charge of Lieutenant A. H. B. Hume, R.E., throughout the year. Its programme for the season comprised :—

<i>Personnel.</i>		
Lieutenant A. H. B. Hume, R. E.,	Officiating Deputy Superintendent, 2nd grade in charge.	
Mr. W. A. Wilson,	Extra Assistant Superintendent, 1st grade, retired 4th June 1898.	
" C. W. Wilson	" " " 5th "	
" A. George	" " " 6th "	
" A. Ewing	" " " 6th "	
" H. A. Charrier, Sub.	" " 2nd "	
55	Surveyors, Sub-Surveyors, etc.	

- (1) Traverse survey in advance of the East Yoma forest reserve, Thayetmyo division, and of the Shwelaung, Kodugwe and Salu reserves and unreserved forest lands neighbouring on the Pegu division.
- (2) Detail survey on the 4-inch scale of forest reserves of the Pegu division and of the Shwegyin division and on the 2-inch scale of unreserved forests on the Yenwe river adjoining the latter.

179. The party left recess quarters at Bangalore about the middle of November and commenced field work in the first week of December.

The return to recess quarters was made in the first week in June 1898. Owing to the unhealthiness of the forests in the early part of the season, and the early breaking of the monsoon in May or April it is hard to get much more than five months' work in the field which greatly tends to increase the cost rate.

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

	Square miles.
Traversing	773
Topography, 4-inch	406
Ditto, 2-inch	118

181. No triangulation in advance was carried on as it was already completed for this district and was sufficient for 2 or 3 seasons' topography.

182. The traverse work was conducted by Mr. W. A. Wilson in the field, and on his retirement by Mr. C. W. Wilson; a good outturn was completed showing a total number of linear miles equal to last year's with the same number of men employed and covering a considerably larger area. The work was checked by 124 sun azimuths, giving good results.

183. The detail work was divided into two sections, one under Mr. George in the Shwegyin division, and the second under Mr. Ewing in the Pegu division. On account of the large increase to the party in transfers from other parties and apprentices much training work was required. Mr. George being new to the work of the party was given men of some experience and only two of the apprentices. Mr. Ewing had among his section 8 sub-surveyors from other parties, Mr. Davies and 6 apprentices all requiring training. This training of sub-surveyors will now cease as the Dehra Training School gets into full swing. Mr. Charrier was employed on 4-inch work, and on Mr. George leaving on account of illness he took charge of that detail section. The assistants tested the plane-tables by *partial* lines, and the Officer in charge visited the camps and men at their work and tested some of the boards.

The classification of forests and soils was continued.

184. The outturn of both 4-inch and 2-inch work is a little larger than last year.

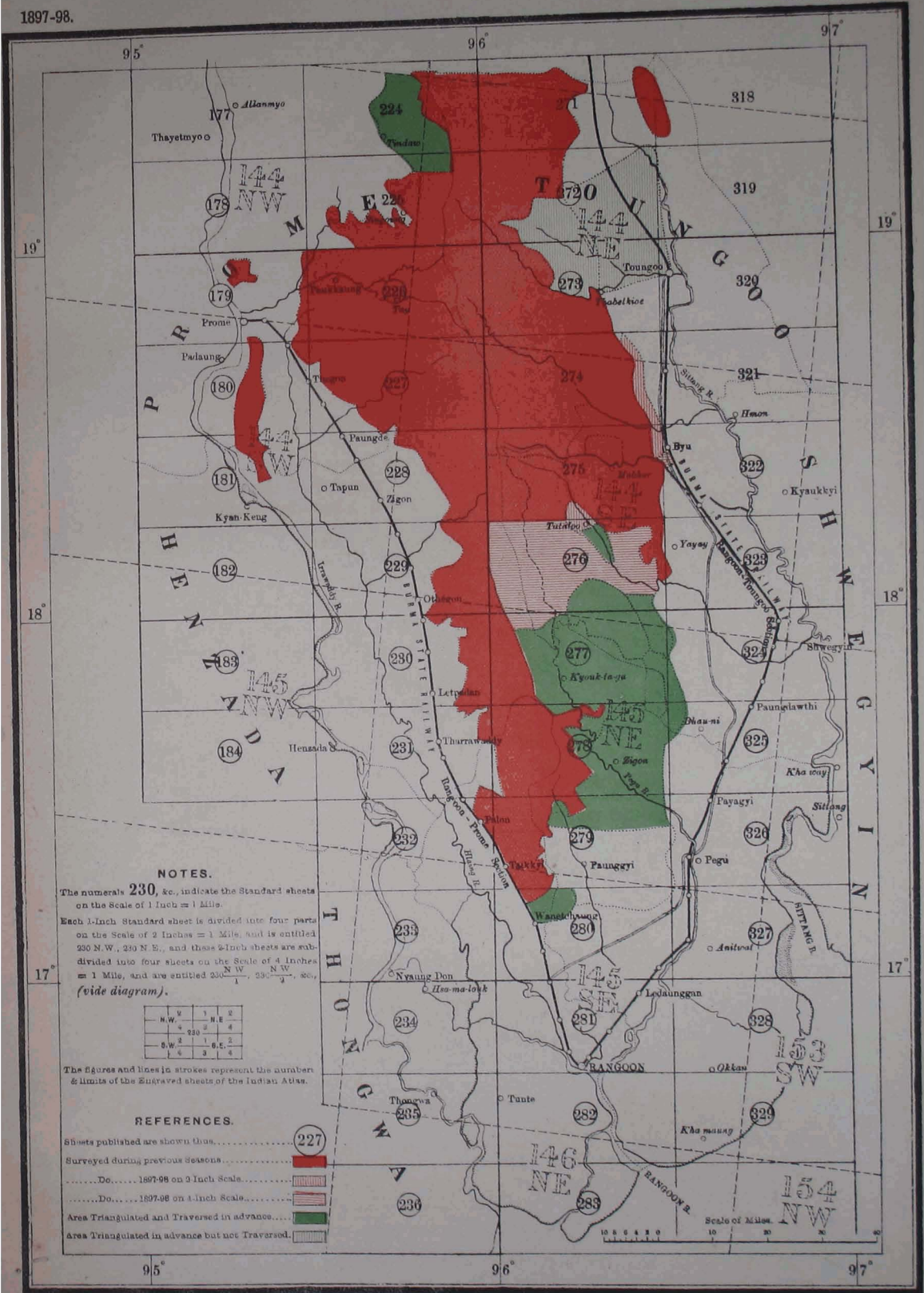
* The Assistants in charge of camps performed their duties satisfactorily, and Surveyors G. R. Bhopatkar, Govind Gopál, Hari Ramchandra, Mashud Khan, and L. B. Lele may be mentioned as having done good work.

BURMA SURVEY.

INDEX TO THE FOREST SURVEY IN LOWER BURMA.

No. 20 PARTY.

1897-98.



NOTES.

The numbers 230, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

Each 1-inch Standard sheet is divided into four parts on the Scale of 2 Inches = 1 Mile, and is entitled 230 N.W., 230 N.E., and these 2-inch sheets are subdivided into four sheets on the Scale of 4 Inches = 1 Mile, and are entitled 230 N.W., 230 N.E., &c., (vide diagram).

N.W.	N.E.
230	230
S.W.	S.E.
230	230

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

REFERENCES.

- Sheets published are shown thus..... 227
- Surveyed during previous seasons.....
- Do..... 1897-98 on 2 Inch Scale.....
- Do..... 1897-98 on 1 Inch Scale.....
- Area Triangulated and Traversed in advance.....
- Area Triangulated in advance but not Traversed.....

The cost rate of combined survey, as seen from the following table, shows a small reduction from last year, notwithstanding the amount of training of inexperienced hands :—

YEAR.	COST RATE PER SQUARE MILE.			
	Triangulation.	Traversing.	Detail survey 4-inch scale.	Combined survey.
1891-92	35·2	150·6	175·3	361·1
1892-93	33·2	138·1	160·1	331·4
1893-94	36·9	133·9	159·3	330·1
1894-95	30·1	94·0	153·5	277·6
1895-96	21·2	58·5	158·1	237·8
1896-97	...	81·8	169·8	251·6
1897-98	...	56·3	192·7	249·0

185. The cost rate for traverse work shows a very large reduction, but the cost of a square mile is not a fair comparison. The linear miles traversed are the same as last year, but the blocks being for 2-inch survey a much larger area is covered. Certain economies in the supervision which, it is thought, can be made, should keep down and reduce this item in the future.

The cost rate for detail survey shows a higher figure; this was unavoidable this year, partly on account of the sudden increase and changes in the party; the good effects of the increase should be partly felt next season and quite the season after, when the new men will produce a full outturn. The early commencement of the rains reduced the last month's outturn by an anticipated area of about 30 square miles, but for this and the excessive amount of sickness this cost rate would have been the same as last year, notwithstanding the loss due to training the new hands.

186. The country was as difficult and as thickly covered with dense jungle, as described in previous reports. The rainfall for April and May was more than double the normal amount and commenced as early as the 12th April.

187. The health of the party was worse than usual, allowing for the large increase in numbers, probably due partly to the Pegu forests which have a bad name for fevers, and partly to the early rains; also a large number being new to the country might account for some increase in sickness. One assistant was sick most of the field season and then left on special leave. Two sub-surveyors were discharged as physically unfit and four others were invalided, one of whom died at Rangoon; the head *tindal* and 12 *khalásis* and one interpreter died of diseases, 3 were killed by the fall of a tree in a storm, 2 were carried off by tigers, and one died of snake-bite. The tiger scare caused some delay in the work and disorganization among the post runners. Most of the surveyors were provided with guns and ammunition, which gave them some confidence.

188. No supplies, except small quantities of rice, being obtainable near the main part of the work, food depôts were established and the supply and distribution of provisions successfully done by the party.

189. During the recess all the computations and 4-inch mapping were brought up to date. Twelve 4-inch sheets were submitted for publication, and 4 more, there being a small gap in the survey, will be submitted during next field season. Eight 2-inch sheets for reduction to 1-inch have been drawn, excepting some work which will be obtained from No. 7 Party; also 18 charts were submitted for publication and 12 General Report Volumes—

190. The programme for next season comprises :—

- (1) The triangulation and traversing of reserved forests, as may be pointed out by the Conservator, Tenasserim Circle.
- (2) The detail survey on the 4-inch scale of the remainder of the South Zamayi, Kadat, Zahakawliya and Mayan reserves and small

detached reserves in Pegu and Shwegyin divisions and the East Yoma reserve in Thayetmyo. On the 2-inch scale all remaining areas unsurveyed on 4-inch scale in sheets 276 and 277. This will complete the survey of all the forest reserves of this district.

191. The party was inspected in the field by the late General Woodthorpe, R.E., Officiating Deputy Surveyor-General, in March 1898, and in recess quarters by Lieutenant-Colonel Hobday, I.S.C., Officiating Deputy Surveyor-General, in August 1898, and by General Strahan, R. E., Surveyor-General, on 30th September 1898.*

OPERATIONS OF THE FOREST SURVEY BRANCH.

192. The administrative control of this Branch was under the Inspector-General of Forests and the direct supervision of the survey operations remained, throughout the year, in the hands of Mr. W. H. Reynolds, Superintendent of Forest Surveys.

193. Survey operations were carried on in seven districts of the Central Provinces; in the Chamba State, Punjab; in two districts in Upper Burma and in the Tenasserim Circle of Lower Burma. In addition to the above the realignment and survey of the Nepal-Kheri boundary was taken in hand, and the survey of the realigned forest boundaries in the districts of Gonda, Bahraich and Kheri in Oudh was also taken up.

194. The field establishment comprised ten separate detachments, each of which worked under European or qualified native supervision. The total outturn of field work for the year is as follows:—

Triangulation	.	.	.	.	.	.	.	.	.	2,617 square miles.
Traversing	.	.	.	.	.	.	.	.	.	399 linear miles.
Detail Survey	{	Topographical	1-inch scale,	200	}	.	.	.	.	1,935 square miles.
		Forests	{	4						
				16						236
Spirit levelling	.	.	.	.	.	.	.	.	.	672 linear miles.

195. The detail survey on the 1-inch scale was done for topographical purposes only.

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

PROVINCE.	DETAIL SURVEY.	
	4-inch scale.	1-inch scale.
	₹	₹
Central Provinces	41'3	...
Punjab	50'5	19'9
Burma	90'7	...

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

198. The topographical work was tested by running 517 miles of *partdi* or check surveys through it, and the instrumental contours, which were run at fixed vertical intervals in the Central Provinces and Chamba surveys, also afforded a further check on the detail survey.

* The Officer in charge reports that Mr. W. A. Wilson conducted the traverse work in the field very satisfactorily. Mr. Ewing, always hard-working, carried out all field and recess duties with energy and ability. Messrs. Charrier and Davies returned useful work both in the field and recess.

Of the native establishment, Amjad Ali, Sharifuddin, Kyaw Nyem, Surjan Singh, Alla Ditta, Zahur Hasan, Ishaq Husain, Upendra Nath Mukerji and Mahomed Abdul Karim are deserving of special mention.

CENTRAL PROVINCES.

199. In the Central Provinces five separate detachments of the Forest Survey Branch were employed on field operations in the districts of (i) Biláspur and Ráipur, (ii) Chhindwára, (iii) Nágpur and Wardha, (iv) Seoni, and (v) Saugor. The operations were in continuation of the previous year. With the exception of the Biláspur party, the several survey detachments took the field about the middle of November and returned to recess quarters at various dates between the 4th and 25th June. The Biláspur detachment, owing to the unhealthiness of the district, was unable to commence field work before the middle of January, and was obliged to close field operations on the 12th May.

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

FOREST DIVISION.	TRIANGULATION.		LEVELLING.		TOPOGRAPHY, CHIEFLY ON 4-INCH SCALE, INCLUDING FOREST GROWTH AND SOIL RECORD.	
	Area in square miles.	Cost rate per square mile.	Linear miles.	Cost rate.	Area in square miles.	Cost rate per square mile.
Saugor . .	730	} 7'1 {	...	...	215	54'7
Chhindwára . .	503		...	...	268	31'4
Biláspur . .	...	...	...	...	94	76'7
Nágpur, Wardha . .	...	...	} 672 {	6'7 {	306	25'6
Ráipur . .	...	...			...	...
Seoni . .	...	...			255	46'1
TOTAL .	1,233	...	672	...	1,138	...

201. Of the total area topographically surveyed in detail, 902 square miles were executed on the 4-inch scale and 236 square miles on the 16-inch scale. The larger scale survey was done, as explained in last year's report, for the purpose of securing a large scale and indisputable boundary record of the Government forest reserves. The outturn of the previous season was 1,002 square miles on the 4-inch scale and 206 square miles on the 16-inch scale. The outturn of 4-inch work is somewhat less than the outturn of the previous year, which is due chiefly to the abnormally short field season of the Biláspur detachment.

202. Triangulation was extended in the Saugor and Chhindwára districts. In the former district the triangulation was done by Mr. T. S. Marten, and Mr. J. H. Nichol carried on similar work in the Chhindwára district. The only traversing that it was found necessary to run were short lengths for the purpose of connecting the existing traverse stations with trigonometrical points, and this was only done where the existing traversing passed within easy distance of the trigonometrical stations. Twenty-seven trigonometrical points were connected with the traversing. For the purpose of affording a sufficient and ample basis for adding instrumental contours to the topographical work, it was found necessary to run spirit levels through the forest blocks in the districts of Seoni, Nágpur and Wardha. A total length of 672 miles of levels was run in the reserved forests of these districts.

203. The topographical work was tested by running 343 miles of *partál* or check surveys through it and no serious errors were discovered, and the

instrumental contours, which were run at 250 feet vertical intervals, afforded a further check on the detail survey.

204. A large amount of work has been completed in the way of mapping; out of a total of 254 sheets 76 on the 4-inch scale have been published, 95 are in the press, and 83 are well advanced towards completion.

205. The average cost rate of the detail topographical surveys was R41'3 against R43'3 in the previous year.

206. Mr. W. H. Reynolds, Superintendent of Forest Surveys, visited the survey detachments in turn and inspected the field work that was in progress; he was in the Central Provinces from the 5th to the 21st March.

PUNJAB.

207. The survey in the Chamba State of the Government leased forests on the 4-inch scale and the remainder on the

Personnel.
Mr. J. Marten, Extra Assistant Superintendent, 6th grade.
" B. R. Hughes, Offg. " " 6th grade.
8 Native Surveyors.

1-inch scale for topographical purposes was in continuation of the previous year's operations. Field work was carried on during the summer months, from May to September, and owing to the tracts under survey during the year being for the most part situated at high elevations and sparsely populated, it was only possible to arrange for the provisioning of a limited number of men and hence fewer surveyors than usual were employed on the 1-inch work.

208. Triangulation was extended over the greater part of the Pangî range which is an exceedingly elevated tract of country averaging from about 7,000 to 20,000 feet above sea level and drained by the Chandra Bhága river. The season's triangulation was done by Mr. Hughes assisted by a native surveyor.

209. Topographical operations on the 1-inch scale were carried on at the head waters of the main tributaries of the Ravi in the Barmaur, Chamba and Tisa ranges, and at higher elevations than usual; the 4-inch surveys were also confined to the forests in those ranges.

210. The following statement gives the areas completed during the year as well as the cost rates per square mile for each branch of the work:—

STATE.	TRIANGULATION.		DETAIL SURVEY.			
	Area in square miles.	Cost rate.	1-inch.		4-inch.	
			Area in square miles.	Cost rate.	Area in square miles.	Cost rate.
Chamba	580	8'5	200	19'9	52	50'5

The total expenditure incurred in the Punjab was R12,258, of which R11,550 were on account of the survey operations in the Chamba State, whilst R708 were expended on map drawing and the publication of maps of the Bashahr State.

211. Mr. W. H. Reynolds, Superintendent of Forest Surveys, personally directed and supervised the Chamba survey, and Mr. J. Marten was with the Chamba party from June to September examining and testing the details of the topographical survey.

BURMA.

212. The surveys in Burma were in continuation of the previous year's operations. The field establishment was divided into three detachments and the forests surveyed were those in the divisions

Personnel.
Mr. B. R. Hughes, Offg. Extra Assistant Superintendent, 6th grade.
Babu Bhup Sing,
" Udey Ram,
" Dalip Sing,
and 46 other Native Surveyors.

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

The survey establishment left Dehra on the 13th November and field work was commenced on various dates between the 6th and 17th December; the surveyors returned to recess quarters in June.

213. All three detachments were employed on traversing as well as detail survey on the 4-inch scale, and in the Ruby Mines division triangulation was extended as a basis for the following season's topographical work. In addition to the triangulation for the following year's work, a second connection with the Mandalay Meridional Series was effected as a check on the triangulation of the previous season. The triangulation was done by Mr. Hughes assisted by a native surveyor.

214. The following statement exhibits the areas completed, the cost of each branch of the work, as well as the average cost-rates of each class of survey:—

FOREST DIVISION.	COST OF			Total expenditure.
	Triangulation.	Traversing.	4" detail survey including mapping.	
	R	R	R	R
Salween-Ataran . . . . .	...	3,587	12,376	15,963
Pyinmana . . . . .	...	1,729	22,176	23,905
Ruby Mines	13,932	2,276	8,076	24,284
Total expenditure	13,932	7,592	42,628	64,152
Total areas sq. mile	804	* 211	470	...
Average cost per sq. mile	17'3	36'0	90'7	...

* Linear miles.

215. The average cost of the 4-inch work last year was R103'1, whilst in 1895-96 it was R92 per square mile.

216. For the purpose of testing the accuracy of the 4-inch detail survey 174 miles of *partial* or check surveys were run through the topographical work.

217. The field work of the Salween-Ataran detachment was considerably disturbed throughout the season owing to the presence of Siamese dacoits in the neighbourhood of the tracts under survey; one elephant was stolen, and several unsuccessful attempts were made to carry off a second. Although the Civil authorities have used their best endeavours, the stolen elephant (which was traced into Siamese territory) has not yet been recovered.

218. The fair mapping is progressing; out of a total of 79 sheets, 49 have been published, 8 are in press, and the remaining 22 are in progress.

219. Mr. W. H. Reynolds, Superintendent of Forest Surveys, was in Burma from the 8th February to the 1st March inspecting and directing the Forest Survey Operations in that province.

NORTH-WESTERN PROVINCES AND OUDH.

220. The Government of India in letter No ^{367-F}/₁₄₀₋₂ (Revenue and Agricultural Department), dated the 26th April 1897, having ordered the realignment and survey of the Nepal-Kheri boundary, this work was taken in hand in January and completed by the 7th of May. The realignment comprised the substitution of a line of pillars mutually visible one from the other in place of the Mohán river boundary which was constantly changing and was the source of numerous frontier boundary disputes. The demarcation which comprised a length of 64 miles of boundary defined by 81 boundary marks, was done by Mr. W. H. Reynolds, Superintendent of Forest Surveys, who was accompanied

along the whole length of the boundary by a Nepálese representative. The re-aligned Nepál-Kheri boundary will not be shown on any of the forest maps until the new boundary has been finally approved of by Government.

221. In connection with this demarcation of the Nepál boundary, 184 miles of traversing was run at a cost-rate of R6'7 per mile, and 75 square miles of detail survey was done on the 4-inch scale at a cost-rate of R39'3 per square mile.

222. In the Districts of Gonda, Bahraich and Kheri a few surveyors were employed in surveying the monoliths or new boundary marks that have recently been erected along forest boundaries; a total length of 263 miles was surveyed and the details added to the existing 4-inch maps at an average cost of R5'3 per mile.

223. Further details regarding the work carried on by the Forest Survey Branch and index maps illustrating the same, will be found in the report on the operations of the branch published under the direction of the Superintendent of Forest Surveys.*

CADASTRAL SURVEYS.

MYINGYAN, MINBU, KATHA AND LOWER CHINDWIN DISTRICTS, UPPER BURMA.

NO. 3 PARTY.

224. Mr. E. J. Jackson took charge of this party from Mr. E. G. Little on the 3rd November.

Personnel.

Mr. E. J. Jackson, Superintendent, 1st grade, in charge from the 3rd November 1897.	
Mr. E. G. Little, Extra Assistant Superintendent, 1st grade.	
" J. Connor, " " 3rd "	
" G. C. Swiney, " " 5th "	
" M. Gastaud, " " 6th "	
" W. J. Baker, Sub-Assistant Superintendent, 1st "	
" W. Newland, " " 2nd "	
Babu H. K. Roy, " " 3rd "	
Mr. E. G. Hardinge, " " 3rd "	
78 Sub-Surveyors and others.	
8 Inspectors.	
55 Field Surveyors (Indians).	
25 " " (Burmans).	

225. The programme for the season was carried out in continuation of the previous season's operations. It comprised the following:—

(a) The cadastral survey of 927 square miles

in the Myingyan district.

- (b) The cadastral survey of 94 square miles of scattered work in the Minbu district.
- (c) The cadastral survey of 20 square miles of scattered work in the Katha district.
- (d) The cadastral survey of 425 square miles in the Lower Chindwin district.
- (e) The traverse survey of 23 square miles in the Minbu district to admit of the cadastral survey of scattered patches of cultivation being completed this season.
- (f) The traverse survey of 764 square miles in the Lower Chindwin district, as advance work for cadastral survey.
- (g) The traverse survey of 4 square miles in the Myingyan district.
- (h) The traverse survey of 25 square miles of the Maymyo station.
- (i) The triangulation of 2,345 square miles in the vicinity of Prome in Lower Burma.
- (j) The extension of the triangulation from the Myingyan to the Lower Chindwin district.
- (k) The resetting up of 400 square miles of traverse work in the Yamèthin and Meiktila districts surveyed by local agency in season 1892-93.

* Mr. Reynolds reports that Mr. Nichol has worked most efficiently both in the field and recess, and is a promising assistant; Messrs. T. and J. Marten, B. R. Hughes, and C. Litchfield are also mentioned as having worked well and given satisfaction.

The following members of the subordinate establishment are worthy of special mention: Babus Bhoop Singh, Odey Singh, Dalip Singh and Udey Ram, as good surveyors; and Babus Badri Dutt and Bimala Charan Shome, as having done good work in the computing office.

INDEX TO THE TOPOGRAPHICAL SURVEY IN UPPER AND LOWER BURMA.

1897-98.

No. 3 PARTY.



NOTE.

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

The names of Cities Surveyed on large Scale are underlined thus BANGALORE

REFERENCES.

Area previously Surveyed █
 .. Triangulated in advance, 1897-98 █

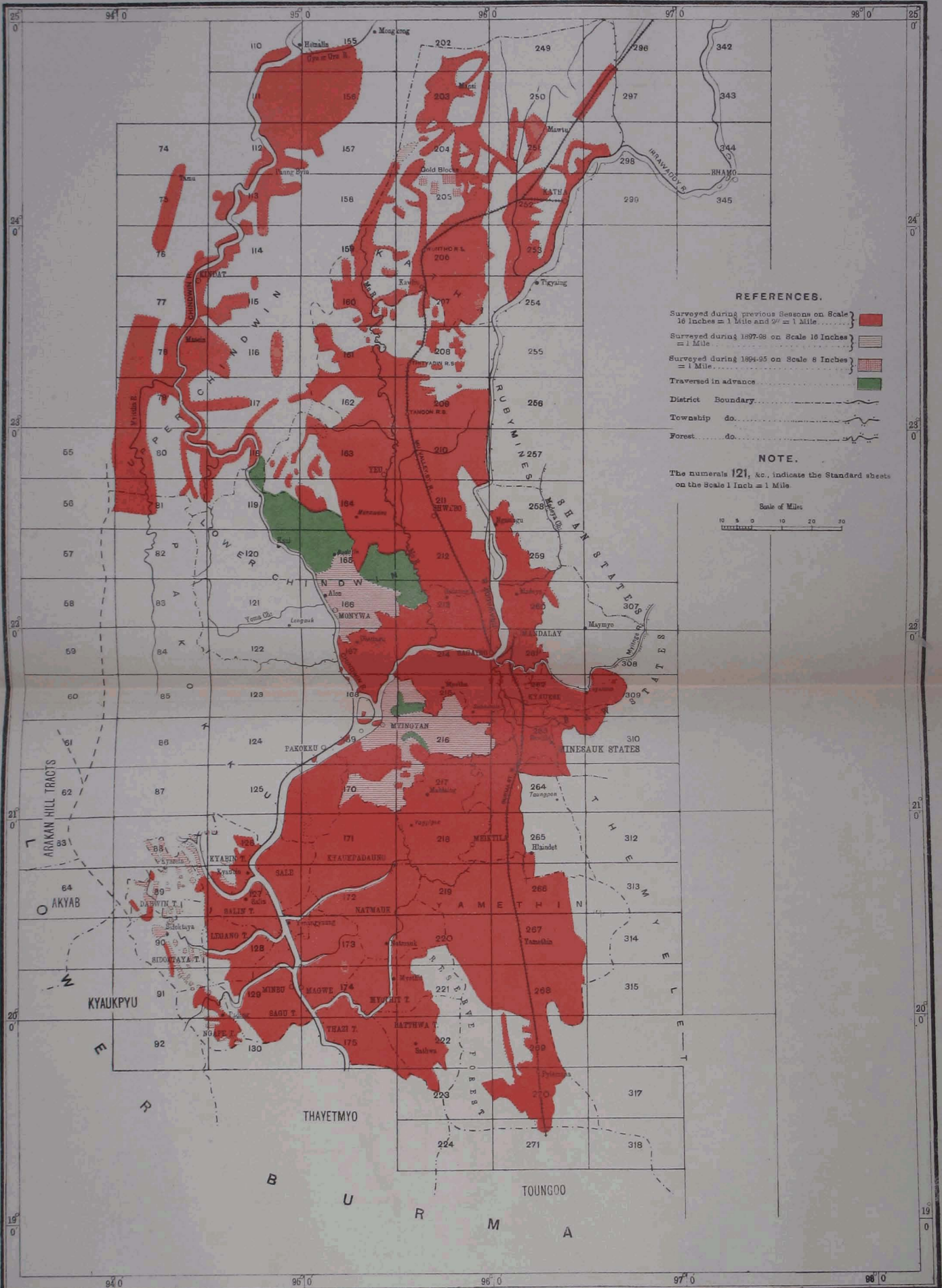
Photo. S. I. D., Calcutta.

BURMA SURVEY.

INDEX TO THE CADASTRAL SURVEY IN UPPER BURMA.

1897-98.

No. 3 PARTY.

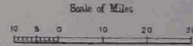


REFERENCES.

- Surveyed during previous seasons on Scale 16 inches = 1 Mile and 27" = 1 Mile. ■
- Surveyed during 1897-98 on Scale 16 inches = 1 Mile.
- Surveyed during 1894-95 on Scale 8 inches = 1 Mile.
- Traversed in advance. ■
- District Boundary.
- Township do.
- Forest.

NOTE.

The numerals 121, &c., indicate the Standard sheets on the Scale 1 inch = 1 Mile.



226. The detachments left Mandalay on the 9th November and assembled at Myingyan and Mõnywa on the 10th and 11th dem, respectively. The *amins* and their squads had all arrived from India by the 1st December, and work was commenced soon afterwards. The establishment returned to Mandalay on the 7th and 15th July.

227. The origin of the Myingyan and Minbu districts is in Latitude 21° N., and Longitude 95° E. and the Lower Chindwin district Latitude 22° N., and Longitude 95° E. The angular work was checked by 77 observed azimuths. Two chains were used throughout, one of 100 feet in length and the other 66 feet. The traverse work was all that could be desired.

DISTRICT MYINGYAN.

228. The cadastral survey of the district was carried on in continuation of the previous season's work in 142 circles, containing 888 *kwins* situated in the townships of Natogyi, Taungtha and Myingyan. The area surveyed was 927 square miles, and the 1,241 sheets mapped on the 15-inch scale were checked by 2,805 linear miles of chain measurements of which 219 were done by European assistants, 1421 by Inspectors and 1165 by independent *partállers* after the sheets had been received in office. The average size of the field is 1.09 acres. In this district there remains 119 square miles for cadastral survey, also the scattered hills, which will be undertaken by No. 10 Party.

DISTRICT MINBU.

229. The scattered work in this district at the foot of the Arakan Yomas was carried on in continuation of the previous work and consisted of the traverse survey of 41 villages, also the cadastral survey of 163 villages along the valleys of Ngapè, Kyabin, Salin, and Sidòktaya townships. The detail survey was mapped on 208 sheets on the 16-inch scale, and comprised an area of 94 square miles. The sheets were checked by 225 linear miles of chain measurements, of which 30 miles were measured by an assistant, 96 by inspectors and 99 by independent *partállers*. Owing to the unhealthiness of the country the men suffered much from fever, two died, and at one time it was feared that a portion of the work would have to stand over for the ensuing season, as many of the men absconded; however, the district has been completed in accordance with the wishes of the local authorities.

DISTRICT KATHA.

230. This season 20 square miles of cadastral work was completed in the Ganan circle; it contained 35 villages, which were mapped on 35 sheets on the 16-inch scale. The average size of the field was 0.77 acre. An assistant *partállé* 22 miles, inspectors 19 miles, and the independent *partállér* 87 miles.

DISTRICT LOWER CHINDWIN.

231. The traverse operations in this district were carried on in continuation of the previous season's work, and comprised an area of 764 square miles. This area contained 65 circles, 393 *kwins* with 22 *pardahs*, 814 sub-traverse lines, which were checked by 42 azimuthal observations.

232. The area cadastrally surveyed in the Lower Chindwin district comprised 425 square miles, containing 49 circles and 337 *kwins* within the townships of Budalin, Mõnywa and Kani. The detail survey was checked by 517 linear miles of independent *partál*, 446 miles inspectors' *partál*, and 51 linear miles by European assistants; in all 1,014 linear miles were *partállé* on 545 sheets. The average size of the fields is 1.50 acres.

233. There remain 390 villages embracing an area of 764 square miles traversed during the current season as advance work for cadastral survey; in addition to this area there remain 375 square miles for traverse and detail survey to complete the Lower Chindwin district; in all 1,139 square miles.

The outturn of cadastral work for the season is shown in the following table:—

DISTRICTS.	CADASTRAL SURVEY. 16 INCHES = 1 MILE.		
	Number of villages.	Number of fields.	Area in square miles.
Myingyan	888	539,257	926.5
Minbu	163	64,906	94.0
Katha (Ganan)	35	16,556	20.0
Lower Chindwin	337	161,811	425.0
TOTALS .	1,423	782,530	1,465.5

234. The following traces were supplied to Calcutta and the Settlement Department:—

DISTRICTS.	TRACINGS FOR CALCUTTA.			TRACINGS FOR SETTLEMENT.		
	<i>Kwins.</i>	Fields.	Traces.	<i>Kwins.</i>	Fields.	Traces.
Myingyan . . . . .	...	...	...	888	539,257	908
Katha	198	2,22,947	319	183	58,112	175
Upper Chindwin . . . . .	...	...	...	508	383,863	489
Minbu . . . . .	...	...	...	163	64,405	163
Shwebo	749	270,003	784	349	260,348	429
Sagaing	70	45,556	70	70	45,556	70
Yamèthin . . . . .	...	...	...	58	13,099	84
Lower Chindwin . . . . .	...	...	...	337	161,811	337
Magwe	4	8,472	7	...	...	...
TOTAL .	1,021	546,978	1,180	2,556	1,526,451	2,656

235. Besides the current work 27 azimuths were observed at selected trijunctions extending over an area of 400 square miles in the Yamèthin and Meiktila districts which had been surveyed by Local Agency in season 1892-93; these observations were made to admit of the revision of the traverse computations which had been based on the magnetic needle, and were consequently unfit for incorporation with our 16-inch maps, as was necessary for the completion of the 2-inch standard maps.

236. The Settlement Department divided one *kwin* as surveyed in previous season into 4 in the Magwe district, also 7 *kwins* into 14 *kwins* in the Katha district, and cut up 34 circles in the Shwebo district into 240 *kwins*, so that fresh traces and area statements, with altered field numbers had to be prepared in duplicate, one for the Settlement Officer and the other for publication.

In the Sagaing district the Settlement Department revised 70 *kwin* boundaries surveyed during season 1891-92 and 1893; here again therefore the 16-inch scale sheets had to be corrected and fresh traces prepared for publication. The area statements also had to be revised.

237. The Burma Government having asked for a survey of the station of Maymyo on a scale of 16 inches = 1 mile extending to a distance of 2½ miles all round from the Sub-divisional Officer's court, the work was started on the 28th April and by the end of August 25 square miles of traverse work with 36 sub-traverse lines were surveyed and connected with Phanlan and Taungbyo trigonometrical stations. During the recess months an *amin* started the detail survey, but owing to the rains and sickness amongst the men the work was stopped for a time. The detail survey, however, will be taken up by No. 7 Party, and the contouring by No. 10 Party during the ensuing season.

238. According to the orders of Government conveyed in No. 2663—122-2, dated 12th November 1897, to the Revenue Secretary to the Government of Burma, this party was to be converted in 1898 into a topographical party to complete the details in Lower Burma, and the area remaining for cadastral survey in Upper Burma was to be handed over to No. 7 Party. In preparation therefore for this change an area of 2,345 square miles was triangulated in the vicinity of Prome. The area was confined between Latitudes 18° 15' and 19° 15', and Longitudes 94° 30' and 95° 30', within which 55 stations were observed at, and 43 secondary stations and 127 tertiary points fixed.

239. The triangulation was continued from the work done during season 1896-97 in the Myingyan district, based on the Great Trigonometrical bases Mozataung-Taungnyo and Taungnyo-Taungpila, and carried along the Chindwin river to test the co-ordinates brought down from Shwebo district, so that all the calculations have now been based on the same data.

240. The outturn of traverse work for the season is shown in the following table:—

DISTRICTS.	Number of villages.	Number of sub-traverses.	Number of traverse stations.	Area in square miles.
Myingyan	6	115	819	4
Minbu	41	10	763	23
Lower Chindwin	393	814	15,186	764
Maymyo station . . . . .	...	36	579	25
TOTAL .	440	975	17,347	816

241. In the above districts 10,400 zinc cylinders in addition to 6,947 purchased in season 1896-97, making a total of 17,347 zinc cylinders were embedded on theodolite stations as permanent traverse marks over a scattered area of 816 square miles. The cost of the cylinders purchased this season was R1,560, their carriage R1,623, and embedding them R986, in all R4,169.

242. To facilitate the preservation of the professional survey marks, 2-inch scale plots of the *kwins* surveyed were prepared in duplicate, one copy being retained by the *thugyi* and one by the Deputy Commissioner.

243. As a rule, the demarcation of the circle boundaries was good. The village or *kwin* boundaries were also demarcated in most places; where a natural feature, such as a stream or a road, did not form the boundary, or where the boundary posts had been destroyed or omitted, the boundary as indicated by the *thugyi* was surveyed.

244. No previous surveys of the districts had been made, so rough demarcation maps were furnished by the Settlement Department, but these were but little more than guides to the names and number of *kwins*.

245. The country traversed was similar to that of the previous season in the Lower Chindwin, Myingyan and Minbu districts.

246. On the whole the health of the establishment was fairly good, but two *khalasis* died in the Minbu district.

247. The Deputy Surveyor-General inspected the cadastral and traverse camps in the field in the Lower Chindwin district on the 28th and 29th March,

He also inspected the head-quarters office camp and a cadastral camp at Myingyan on the 1st and 2nd April.

The assistants were constantly inspecting the field squads and *partalling* the 16-inch scale sheets. The Executive Officer inspected the camps, inspectors and *amins*, compared *partalls* with the 16-inch scale sheets, and satisfied himself that the work was being properly looked after.*

BENGAL.

No. 4 PARTY.

248. The programme of surveys in the Province of Bengal for 1897-98 consisted of—

Personnel.

Captain R. T. Crichton, I. S. C., Deputy Superintendent, 1st grade, in charge.
Mr. H. Dowman, Extra Assistant Superintendent, 1st grade.
„ H. T. Hanby, Extra Assistant Superintendent, 2nd grade, attached from 1st May 1898.
„ A. W. Smart, Extra Assistant Superintendent, 5th grade.
„ C. S. Kraal, „ „ 6th grade.
„ E. F. Berkeley, „ „ 6th grade.
„ C. G. Lee, Sub-Assistant Superintendent, 1st grade, to 1st July 1898.
„ T. W. Babonau (Junior), Sub-Assistant Superintendent, 1st grade, from 9th December 1897.
„ C. S. Gasper, Sub-Assistant Superintendent, 1st grade.
„ P. L. Causley, „ „ 2nd grade, from 23rd November 1897.
Babu Nilmoni Chatterjee, Sub-Assistant Superintendent, 2nd grade.
75 Supervisors and Inspectors.
12 Surveyors and Sub-Surveyors.
10 Computers.
20 Estimators, Draftsmen, Writers, etc.
322 <i>Amins</i> (local).
322 „ (imported).

(a) In Sárán—	Square miles.
Traverse survey	• 34
Cadastral survey	• 536
Topographical survey	26
(b) In Darbhanga—	
Traverse survey	• 613
Cadastral survey	• 710
(c) In Noákháli—	
Cadastral survey	• 9'45

In addition to the above orders were received to relay the Nepal boundary touching on districts Bhágalpur and Purnea, and also the boundary of the Kachnar *mahal* in district Sháhabad.

249. The general principle of employing one native establishment for all processes of survey and record writing until the attestation stage is arrived at has been fully maintained again this year. The survey officer, besides being responsible for the accuracy of the survey, aids in the checking of the record-writing in the field, under instructions from the Settlement Department, and during recess supervises the completion of records and compilation of statistics, also under instructions from the Settlement Department.

250. The orders regarding the topographical survey of certain *diára* villages have been adhered to. The *diára* line, or line demarcating permanent from temporary cultivation in alluvial tracts, was duly laid down after the *diára* tracts had been traversed, and then the orders of the Settlement Department were taken as to which villages should be cadastrally surveyed, the remainder being taken up topographically on the 16-inch scale.

251. A difficulty arose with regard to the district boundary between Sárán and Ballia which, by Government Notification, is declared to be the deep stream of the river Gogra. In consequence of the constant changes in this river, villages which are borne on the collectorate roll of one district are now on the other side of the river, and therefore within the boundary of the adjoining district. The difficulty was eventually solved by the Settlement Officer deciding that the district boundary need not be the village boundary; the survey was therefore invariably extended to the farther bank of the river, and all villages which indisputably belonged to Sárán, but lying on the Ballia side of the river, were also surveyed. On the Gandak river the difficulties were further complicated by the fact that the river which forms the district boundary had completely altered its course since the survey of Muzaffarpur in 1893-94, consequently there

* Mr. Jackson reports highly of Messrs. Little and Connor as having managed their camps with great credit. Messrs. Gastaud, Baker, Newland and Hardinge are also mentioned as having performed their duties satisfactorily.

Of the native establishment the names of Bhagobutty Charan Chuckerbutty, Kedar Nath, Abdul Shakoor, Bhola Nath Packrasy, Mohamed Nisaraly, Bechái Khan, Tajammulaly, Pardrajoo, Rafatulla, Shafiqat Rasool, Shadilall, Gaya Perahad, and Tha Aung have been brought to special notice.

was one boundary for the district as surveyed in 1893-94, and another in accordance with the present position of the river. This difficulty has been overcome by deciding that the district boundary is to be shown on our present maps as surveyed now, and that the boundary of 1893-94 is to be shown in red, with a note on the maps that the old boundary does not affect areas. This procedure, it is believed, is the best that could be adopted under the circumstances; but Captain Crichton, the Superintendent of Settlement Surveys, considers that the proper way to deal with inter-district *diára* tracts is to notify a line of villages of the adjoining district, well beyond the likely limits of river action, and to survey these in connection with the *diára* villages of the district actually under survey.

252. As a rule, the demarcation of village boundaries was very fairly done and generally followed the revenue survey *mauza* boundaries, except in the *diára* tracts, where in waste lands the inhabitants often do not know their own boundaries. All village trijunction points are marked by stones; all the intermediate traverse stations, whether actually on the boundary or at a slight distance therefrom, are marked by clay cylinders. In *diára* tracts and on disputed lands, only bamboo or wooden pegs are used to mark theodolite stations.

253. The very intricate and difficult nature of the village sites in Bihar necessitated their survey on the large scale of 64 inches=1 mile. In many instances there is no room on the margin of the 16-inch sheets for these large scale plans, and hence they have to be plotted on extra sheets: no less than 1,254 extra sheets were required for these plans of village sites. Special precautions were taken to ensure the correctness of these surveys, as an error of only two or three links is visible on such a large scale.

254. No free labour has been supplied in any of the districts in Bengal in which survey operations were in progress. Each *amin* is allowed one chainman on fixed pay, but he is provided with three coolies in addition when actually employed on surveying; these coolies received $1\frac{1}{2}$ annas each per diem in Bihar.

255. The greatest difficulty was experienced both in Sárán and Darbhanga, in inducing the people to attend on the *amins* during survey, but they were eager enough to come when the record of rights was being written. This is a great improvement in the attitude of the people during the first two years of the Bihar Survey, when they were most apathetic at all stages.

256. The following civilians went through a course of survey and settlement work, *viz.*, Messrs. Marr, Emslie, Coutts, Maxwell, Kilby, in the Sárán district, and Messrs. Adie, Ramsay, Vernede, and Heycock in Darbhanga. Mr. Jeffries attended the traverse class only for a few days, when he was recalled by order of the Commissioner.

SURVEY OF THE SARAN DISTRICT.

257. *Traverse Survey.*—The detachment employed on traversing in North Bihar was under the charge of Mr. H. Dowman, and consisted of 12 surveyors and 10 computers. Field work commenced in Sárán on the 25th October and was practically completed by the end of November, a few small details only remaining to be completed. The whole area traversed is contained in seven river circuits, each of which was sub-divided into sub-circuits containing from seven to eight villages each; within the sub-circuits were run, when necessary, sub-traverses at an average distance of 30 chains apart. The total number of linear miles of new chaining amounts to 295 miles. Two chains of unequal lengths were as usual made use of on the river and sub-circuits; orders were issued to the surveyors to test these chains daily against two standard chains which were supplied to each man, these standards again being sent in alternately, once a week, to the head-quarters camp to be tested against the steel standard bars. One chain only was used on the village circuits. The angular work was checked by astronomical azimuths.

258. The area traversed, although supposed to be entirely *diára*, was found to comprise a considerable amount of high land. In these high portions the usual stones and cylinders were used for marking theodolite stations, but in the *aiára* portions only pegs were utilised. The preliminary demarcation carried out by the inhabitants was found to be satisfactory. No opposition was experienced

by the traverse surveyors and willing assistance was as a rule afforded. The health of the establishment was excellent.

259. *Cadastral Survey and writing of Records.*—This section was under the superintendence of Mr. A. W. Smart assisted by Messrs. E. F. Berkeley, P. L. Causley, H. H. Taylor and C. S. Gasper (up to the end of November only). The native establishment consisted of 294 *amins*, 294 *moharrirs* with 33 inspectors, and the usual staff of draftsmen, estimators, etc. The section left its recess quarters at Dígha on the 28th October and commenced field work on the 2nd November. Field work was completed on the 14th April with the exception of portions of 40 villages which were under water, to finish which a small establishment kept the field until the beginning of June.

260. The programme in this district, which was drawn up by *thánas*, consisted of the completion of *thánas* Gopálganj, Mashrak, Mánjhi, Darauli and Basantpur and of an area of about 80 square miles in Chapra. The whole was completed, notwithstanding the unexpectedly large number of fields and intricate tenures.

261. The area surveyed is mapped on 996 sheets on the usual scale of 16 inches=1 mile, whilst in addition there were no less than 614 sheets on the 64-inch scale of village sites. The average size of the field is only 0.30 of an acre, the smallest yet reached in Bihar, though there is every reason to suppose that next year's work will show a still smaller size. The detail survey was checked by 1,484 linear miles run by European officers and independently, and 1,564 linear miles by inspectors, which gives an incidence of 5.49 miles of test survey to each square mile of detail. The total number of entries in the records which were checked by Europeans amounted to 6,866 and by inspectors 317,834, which give an average of 27.5 per cent on the total number of plots. These figures are exclusive of the checking done by the Assistant Settlement Officers and *kánungos*. The cost rate for detail survey was ₹85.89 and for the writing of records ₹104.29 per square mile.

262. The health of the establishment during the field season was excellent, but immediately after returning to recess quarters, there were nine cases of cholera, of which two proved fatal.

263. *Topographical Survey.*—The areas forming the *diára* tracts along the banks of the Gandak and Gogra rivers were surveyed topographically on the 16-inch scale. The survey is mapped on 46 sheets. The village sites were surveyed in blocks in their true positions on the plans. All topographical items of importance and suitable for reduction for the standard maps were accurately surveyed. The work has been checked by 44 linear miles of chaining run by Europeans independently and by 31 linear miles by inspectors. The cost rate is ₹26.36 per square mile.

264. The areas of work completed are given in the following table:—

District.	TRAVERSE SURVEY.		CADASTRAL SURVEY, 16 INCHES= 1 MILE AND RECORD WRITING.			TOPOGRAPHICAL SURVEY 16 INCHES=1 MILE.
	Number of stations.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.	Area in square miles.
Sáran	1,173	36.7	877	1,180,871	555.3	27.4 includes 14.2 square miles in Ballia.

SURVEY OF THE DARBHANGA DISTRICT.

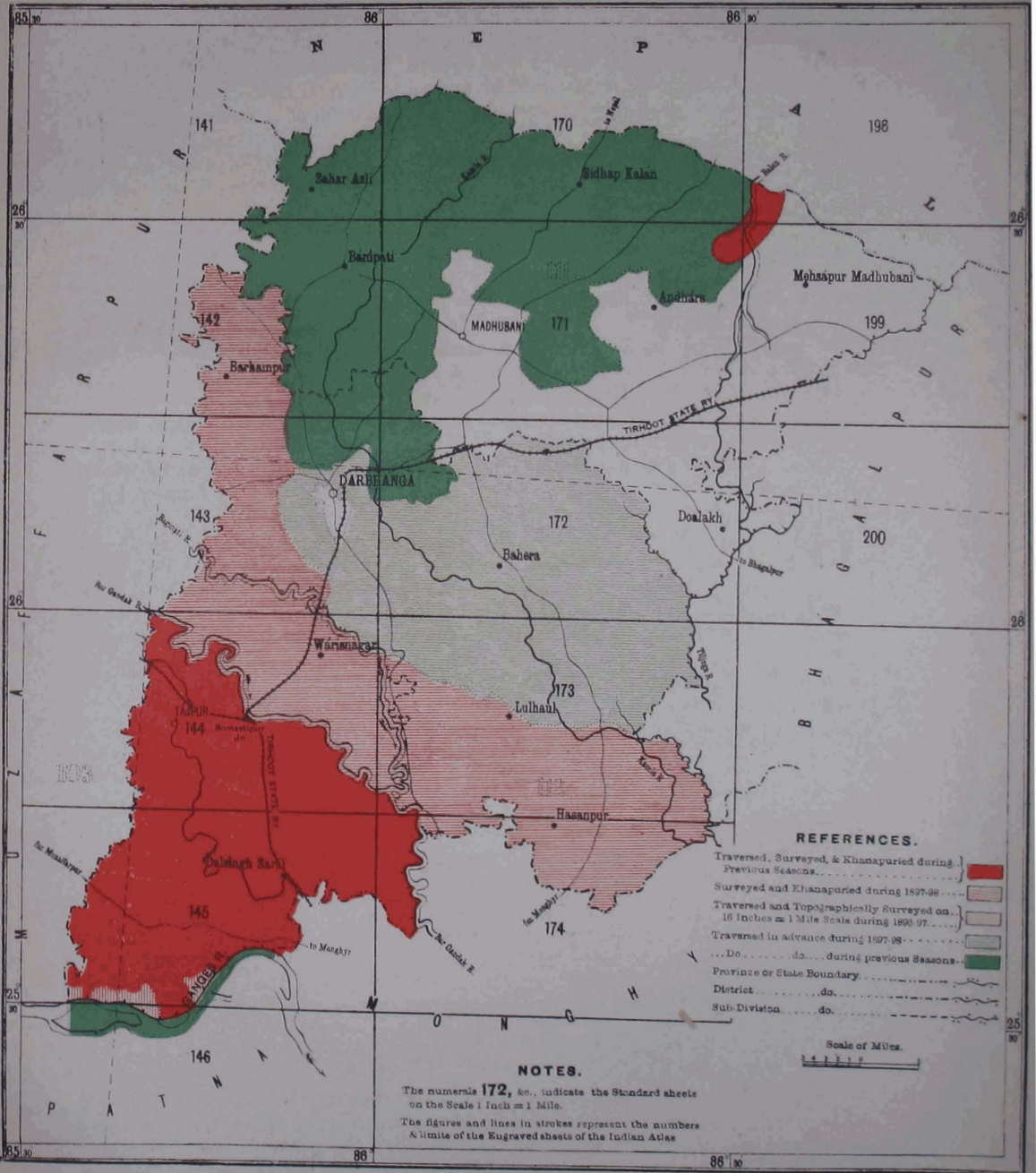
265. *Traverse Survey.*—The field work in this district commenced about the beginning of December when the traverse operations in Sáran had been completed, and was completed by the 20th April, when the traverse section retired to its recess quarters at Mussooree; office was opened on the 3rd May. The area completed is comprised in three main circuits, containing 40 sub-circuits; each sub-circuit contained on an average 22 villages and covered an area of 15 square miles. Within the village circuits there were 1,056 sub-traverses, at an average

BENGAL SURVEY.

1897-98.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT DARBHANGA.

No. 4 PARTY.



Rea. No. 317, S. I. D. - (Ac. 98 - 1,050).

Photo. S. I. O., Calcutta.

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT MUZAFFARPUR.

1897-98.

No. 4 PARTY.



distance apart of 30 chains. The aggregate number of linear miles of new chaining amounts to 2,617. The same arrangements for ensuring accurate chaining were made here as in Sâran. Of the 14,855 new theodolite stations, 1,538 trijunctions have been marked by stones, 12,612 stations on the village and sub-traverse circuits by clay cylinders, and the remaining 705 stations, which were on disputed lines, by pegs. Astronomical azimuths were taken at 127 stations on the main and sub-circuits. Four stations of the North Pârasnâth Meridional series have been connected with. The demarcation was found to be satisfactory, and there was no difficulty in dealing with the inhabitants, who as a rule, freely accorded all necessary assistance. The health of the establishment was excellent.

266. *Cadastral Survey and writing of Records.*—The cadastral section was under Mr. C. S. Kraal assisted by Messrs. C. G. Lee, T. W. Babonau and Babu Nilmoni Chatterji. The native establishment consisted of 39 inspectors, 350 *amins*, 350 *moharrirs* with the usual staff of draftsmen and estimators. The section left for the field on the 28th October, and returned on the completion of its programme on the 26th April. The programme, which was by *thânas*, comprised the *thânas* of Roserha and Warisnagar, and an area of about 187 square miles in *thâna* Darbhanga.

267. The area surveyed is mapped on 1,298 sheets on the 16-inch scale, and on 640 additional sheets of village sites on the 64-inch scale. The average size of the field is 0.42 of an acre. The detail survey was checked by 1,259 linear miles of chaining run by survey officers and independently, and by 1,918 miles by inspectors, giving an incidence of 4.34 linear miles of test survey to each square mile of detail. The total number of entries in the records checked by survey officers was 10,105, and by inspectors 276,103, giving an average of 26 per cent on the total number of plots. The demarcation by the inhabitants was fairly good and the boundaries agree well with the old revenue survey *mauzas*. The general health of the establishment during both the field and recess seasons was fairly good. The attitude of the villagers towards the survey operations was exactly the same as in Sâran, *i.e.*, indifference during the survey stage, and great keenness when the records were being written. The cost rate of detail survey is R74.86, and for writing records R78.32 per square mile.

The areas completed are given in the following table:—

DISTRICT.	TRAVERSE SURVEY.		CADASTRAL SURVEY, 16 INCHES = 1 MILE, AND RECORD-WRITING.		
	Number of stations.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.
Darbhanga.	14,855	597.7	965	1,100,868	732.54

SURVEY OF THE MUZAFFARPUR DISTRICT.

268. *Traverse Survey.*—During the survey of *thâna* Mashrak, in Sâran, it was ascertained that an adjoining tract of about 5 square miles had been omitted from the district of Muzaffarpur in 1893-94. This omission was due to a change in the course of the river Gandak, which had cut into the Muzaffarpur district, thus temporarily placing this area in the Sâran district. The amount of traversing executed, including the necessary overlap to form a proper connection with the old work, has been included in the statement of areas completed in the Sâran district.

269. *Cadastral Survey and writing of Records.*—Of the above area it was decided to cadastrally survey only about $1\frac{1}{2}$ square miles; the survey is contained in 5 sheets on the 16-inch scale. The average size of the fields is 3.72 acres. It was subjected to the usual amount of testing.

270. *Topographical Survey.*—The balance of nearly 4 square miles was surveyed topographically; it was completed and tested on exactly the same lines as the topographical work in the Sâran district.

SURVEY OF THE NOÁKHÁLI DISTRICT.

271. *Cadastral Survey and writing of Records.*—The survey in this district comprised the *chars* Magdhora and Magdhora Mudafat Amanat Ali, both on the east of Sandip Island; the area amounted to approximately only 10 square miles. The traversing and the topographical survey of the neighbouring portions had been completed in 1896-97, but this small area had to be omitted owing to the exceptional difficulties alluded to in last year's report. The area to be surveyed being small, and there being no detachment working in Eastern Bengal, it was decided that no assistant should be deputed, but that Captain Crichton should himself control the establishment directly through the Settlement Officer. The area surveyed was 10.28 square miles, comprised on 9 sheets on the 16-inch scale. The accuracy of the survey was checked by 53 linear miles of test survey, whilst 22 per cent of the entries in the field records were checked. Difficulties in obtaining provisions and good drinking water were experienced, but these are unavoidable in such situations.

272. In addition to the above more important works several smaller ones were completed, such as the completion of the traverse computations and of the records and statistics of eight villages of the Majnamutha estate in Midnapore district; the finishing up of the traverse records of the Tikári Wards Estate, in Gaya, the survey of which was completed by No. 2 Party in 1894-95; the final examination of the traverse records of the Narhan Ward's Estates in district Monghyr; and the survey on the 64-inch scale of the town of Samastipur in Darbhanga, the *raiyati* lands of which had been surveyed in 1895-97; the relaying of the boundary marks of the Kachnar *mahal* lying within the Government estate of Banskáti in district Sháhábad, which, however was not successful owing to the surveyor having misunderstood his instructions; and the survey of 3.3 square miles of *mauza* Gobindpur Tera Rasia in the Hájipur *diára* tracts in district Muzaffarpur.

THE RELAYING OF MARKS ON THE NEPÁL FRONTIER TOUCHING ON DISTRICTS BHÁGALPUR AND PURNEA.

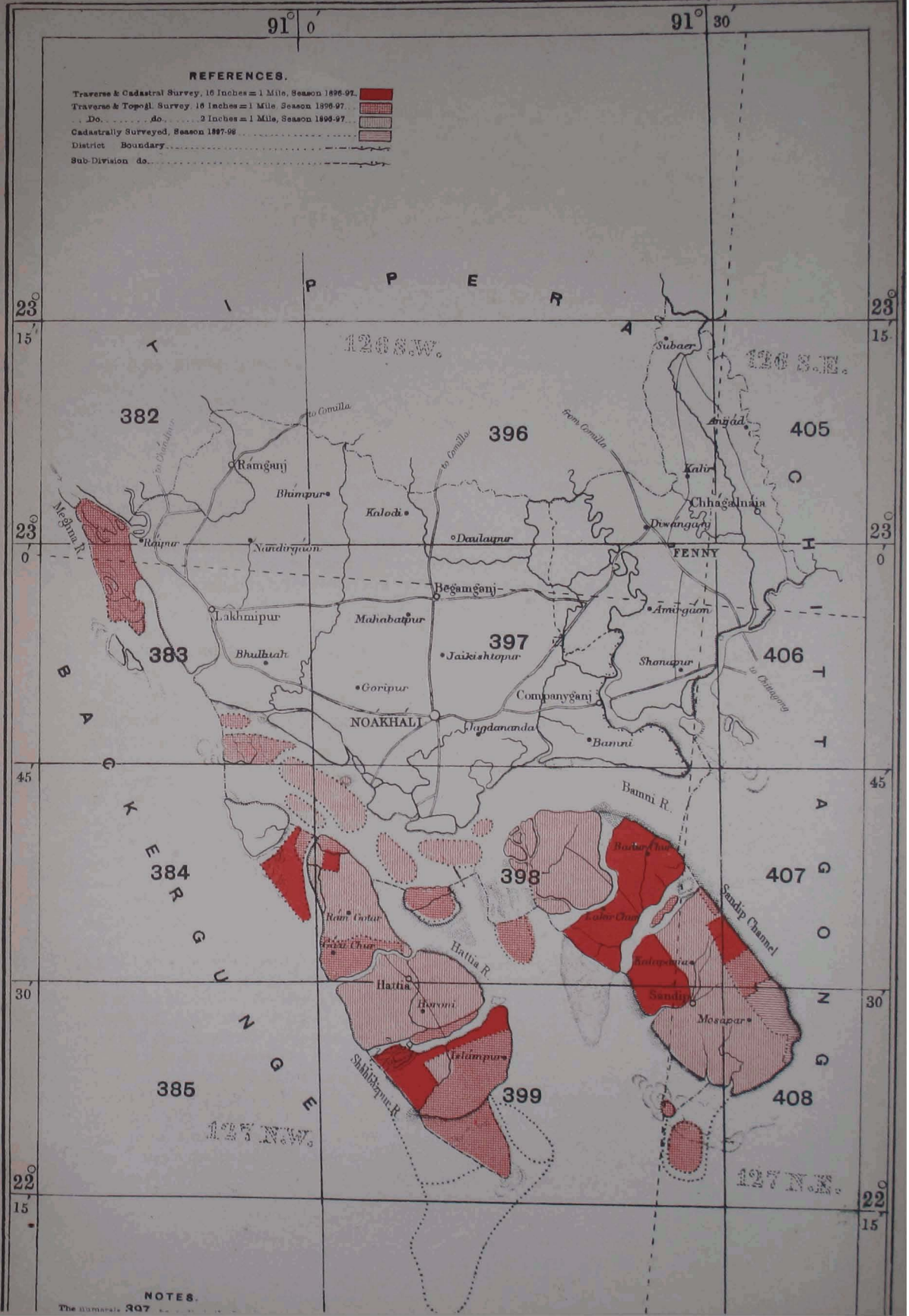
273. Acting under instructions from the Government of Bengal, the Superintendent of Settlement Surveys deputed Mr. E. F. Berkeley to relay the boundary marks in the places where they had been swept away during the inundation. By the middle of November the river Kosi had fallen sufficiently to allow the work to be commenced, but it was not until the 3rd December that a Nepálese official, the Lieutenant of Rangli, arrived; then Mr. Berkeley, accompanied by the Deputy Magistrate of Araria and the Lieutenant of Rangli, marched along the boundary erecting new posts where required. The ditch which had originally been dug along the boundary was so much out of repair as to be in parts not traceable; Captain Crichton accordingly suggested to the Commissioner that, as the boundary is marked out by pillars, except where it follows natural features such as streams, also as no reference is made to it on the old map, the ditch should be ignored; this was agreed to. On the 14th December the work along the Bhágalpur and Nepál boundary was completed and the Lieutenant of Rangli took his departure. Again considerable delay was caused by the non-attendance of an official from the Nepál side, and as Mr. Berkeley was urgently wanted for his proper work in Bihar, he was recalled and Mr. C. S. Gasper took his place. After much delay the same procedure was carried out along the boundary bordering on the Purnea district. Owing to dilatoriness on the part of the Nepál Darbár in replying to suggestions made to them with reference to the position of certain pillars it was impossible to complete the whole line before the commencement of the rains. In order to save the expense of sending a survey officer almost every season to relay this line of boundary whenever it, or portions of it, are washed away by the Kosi river, the Superintendent, Settlement Surveys, suggested to the Commissioner that points be permanently fixed by erecting reference pillars on the high banks on each side, so that the intersection of lines drawn between these reference pillars should indicate the site of the three points at which the boundary takes a new direction. The Commissioner approved of this, but the Nepálese official objected to the erection of any pillar on the Nepálese territory without reference to the Darbár.

BENGAL SURVEY.

INDEX TO THE CADASTRAL & TOPOGRAPHICAL SURVEYS IN DIST. NOAKHÁLI.

1897-98.

DETACHMENT.



REFERENCES.

- Traverse & Cadastral Survey, 16 Inches = 1 Mile, Season 1896-97.
- Traverse & Topog. Survey, 16 Inches = 1 Mile, Season 1896-97.
- Do. do. do. 2 Inches = 1 Mile, Season 1899-97.
- Cadastrally Surveyed, Season 1897-98.
- District Boundary.
- Sub-Division do.

NOTES.

The numerical 307

Programme for season 1898-99.

274. The following statement shows the areas remaining to complete the survey of North Bihar :—

DISTRICT.	Traverse survey.	Cadastral survey and records.	Diara Topographical survey.
	Sq. m.	Sq. m.	Sq. m.
Sáran	143	535	87
Darbhangá	521	1,900	...
TOTAL	664	2,435	87

The existing orders of Government of India, *vide* No. ¹⁸⁶⁸₄₀₋₅₁ dated 3rd June 1896, are that this survey is to be completed by the 30th September 1900; it has therefore been arranged to complete the whole of the traverse and *diara* survey and 1,215 square miles of cadastral survey this next season, leaving the balance of 1,220 square miles for season 1899-1900. The Bengal Government has also issued orders for several other survey operations to be undertaken; the whole programme is exhibited in the following table :—*

DISTRICT.	Traverse survey.	Cadastral survey and records.	TOPOGRAPHICAL SURVEY.		
			16" scale.	4" scale.	2" scale.
	Sq. m.	Sq. m.	Sq. m.	Sq. m.	Sq. m.
Sáran	143	535	87	...	...
Darbhangá	521	680	...	...	...
Backergunge	150	...	...	...	...
Champáran	90	...	...	...	90
Bardwan	88	...	...	88	...
Bhágalpur	33	33	...	...	...
Darbhangá City	7	7	...	...	...
Roserha	2	2	...	...	...
Nepál Boundary . . . . .	...	...	...	...	...
Sháhabad (Kachnar Mahal) . . . . .	...	...	...	...	...
TOTAL	1,034	1,357	87	88	90

TOUNGGOO DISTRICT, LOWER BURMA.

No. 7 PARTY.

275. Up till 15th December 1897 Mr. W. C. Price held temporary charge

Personnel.

- Mr. B. G. Gilbert-Cooper, Deputy Superintendent, 1st grade, in charge from 16th December 1897 up to 11th September 1898.
- " T. E. M. Claudius, Extra Assistant Superintendent, 1st grade, in charge from 22nd September 1898.
- " W. C. Price, Extra Assistant Superintendent, 2nd grade, in charge up to 15th December 1897, and again from 12th to 21st September 1898.
- " G. W. Jarbo, Extra Assistant Superintendent, 4th grade.
- " J. S. Swiney, " " 5th "
- " M. Gastaud, " " 6th " up to 14th November 1897.
- " T. W. Babonau, Sub-Assistant Superintendent 1st grade, up to 8th December 1897.
- Babu Amar Singh, " " 2nd grade, up to 31st May 1898.
- " Abinash Chunder Bose, " " 2nd grade.
- 22 Sub-Surveyors, etc., and 165 temporary Field Surveyors, Inspectors, etc.

of this party, when Mr. B. G. Gilbert-Cooper returned from privilege leave and resumed charge. On the 12th September 1893 Mr. Gilbert-Cooper was transferred to the charge of Nos. 2 and 8 Parties and Mr. Price was again placed in temporary charge until relieved by Mr. T. E. M. Claudius on the 22nd September 1898.

* Captain Crichton reports that Messrs. H. Dowman, A. W. Smart and C. S. Kraal in charge of traverse and cadastral sections have managed their camps very well; Mr. H. T. Hanby, who was lent from Nos. 2 and 8 Parties for the recess season, has rendered valuable service and that the Assistants, Messrs. E. F. Berkeley, T. W. Babonau (Jr.), C. G. Lee, C. S. Gasper, Nilmoni Chatterji and P. L. Causley, have given satisfaction. In the temporary establishment Messrs. H. H. Taylor, A. E. LeFranc, and W. Babonau are well spoken of.

276. The party was divided into three sections as follows : section No. 1 (cadastral) under Mr. J. S. Swiney, operated in the Shwegyin and Kyaukkyi townships of the Toungoo district, commencing field work on 16th December 1897 and closing on 31st May 1898. Section No. 2 (cadastral) under Mr. Price, commenced field work on 16th December 1897, in the Zeyawadi township of district Toungoo, and closed on 31st May 1898. Section No. 3 (traverse) under Mr. Jarbo, began work on 2nd November 1897, and closed on 28th May 1898, operating in the Shwegyin, Bônmedi, Zeyawadi, Tantabin, Myoma, and Thagaya townships of the Toungoo district.

277. The programme of the field season consisted of:—

- (a) The completion of the traversing in the Toungoo district.
- (b) Detail Survey, Toungoo district, 800 square miles on 16-inch scale in circles Kyaungbya, Sethlèdaung, Kyaukkyi, Kyaukhmaw, Môn, Bônmedi, Tantabin, Minbôn, Zeyawadi, Tetpyauk and Kaungyan.

278. The demarcation was well done this year and there were no complaints of delay to the work in consequence of the demarcation not being ready. The Settlement Officer complained of the large size of some of the *kwins* in the Yegyi and Tantabin circles, which had to be sub-divided, and the Demarcation Officer received instructions to be careful to make them smaller in future.

279. The following statement shows the season's outturn, exclusive of the survey of the Sadar Bázár, Rangoon:—

LOCALITIES.	TRAVERSE SURVEY.		CADASTRAL SURVEY 16 INCHES=1 MILB.		
	Number of <i>kwins</i> .	Area in square miles.	Number of <i>kwins</i> .	Number of fields.	Area in square miles.
Toungoo	424	893	376	423,365	770

280. Of the total area traversed embracing 424 *kwins*, 67½ square miles consist of forest and fuel reserves falling within the area to be cadastrally surveyed, the traverse data of which will be made over to No. 20 Party, which will take up the details topographically in due course; thus leaving 825½ square miles of advance traverse ready for cadastral detail survey. The theodolite was set up at 19,574 stations, and 2,734 linear miles of double chaining was done. This work was checked by 135 astronomical observations for azimuth. Owing to their great portability clay cylinders were used throughout for marking the stations.

281. The detail operations on the 16-inch scale in the Toungoo district were checked by 2,005 linear miles of chain measurements, of which 822 were done, partly independently after the sheets had been received in office and partly by European assistants. The proportion of cultivation to jungle is as 1 to 2, and the average size of the field is 0.44 of an acre, calculated on the cultivated area only.

282. In addition to the above new survey 60 villages of district Pegu were revised owing to representations of the Settlement Officer that large extensions of cultivation and alterations in field limits had taken place, particularly in the areas more recently brought under cultivation, in some instances necessitating an entire resurvey of a village.

283. The total expenditure for the year, inclusive of Rangoon Town Survey charges, was R1,83,352, including a charge of 4 per cent for instruments. The cost rate of the traverse operations in district Toungoo was R57.10.1 per square mile, and the cost rate of detail 16-inch survey in the same district, was R142.15.0 per square mile. The cost rate of revision, or rather extension survey in district Pegu, was R249.5.11 per square mile, being nearly double that of original detail survey, on account of the very scattered nature of the work.

284. The country under traverse and cadastral survey was very unhealthy and retarded the work considerably.

285. The season's detail 16-inch work in district Toungoo is mapped on 1,006 sheets. The whole of the sheets will be completed and ready for publication by the end of the recess season. The tracings and area statements of the 376 villages cadastrally surveyed in district Toungoo are nearing completion, and will be ready for despatch to the Settlement Officer by the commencement of the field season.

286. The 2-inch mapping of standard sheets Nos. 372 S.W., N.E., S.E., 373 S.W., N.E., S.E., 326 S.E., 325 N.W., N.E., 324 N.W., S.W., N.E., S.E., 323 N.W., S.W., and 374 N.E., S.E., has been completed. The hill drawing remaining over from last year was completed this season by Mr. M. Gastaud, who was attached to the party for the work. The following are remaining to complete, *viz.*, 323 N.E., S.E., 322 N.W., S.W., N.E., S.E., 321 N.W., S.W., S.E.

287. Dysentery and fever were very prevalent amongst the *khalásis* working in the Toungoo district, nearly one-fifth of the menial establishment being incapacitated for work during the field season from these causes, 16 men died from fever and dysentery, 4 from cholera and 1 from small-pox; 14 men absconded, and 20 men had to be sent home, being too ill to continue at work. The health of the assistants was good throughout.

288. The number of Burmans and Karens employed this season in the detail survey was 26. They all worked well and gave satisfaction. The two Burman inspectors know their work thoroughly and gave complete satisfaction. The average monthly earnings of the Burmans and Karens employed is ₹37-13-9, and those of the Hindustáni surveyors for the same period ₹41-4-3.

289. The programme of the party for the coming field season consists of:—

	Square miles.
Cadastral survey, Toungoo	700
Revision survey, Toungoo	55
Cadastral survey, Myingyan	119
TOTAL	874

The above figures represent the areas remaining for survey to complete districts Toungoo and Myingyan. This latter district formed part of the programme to be completed by No. 3; this party is however to be made into a topographical party and its programme in Upper Burma will be handed over to No. 7.

290. Thanks are due to the Deputy Commissioner of Toungoo, Mr. D. Wilson, I.C.S., and to his successor, Captain Pritchard, I.S.C., for the cordial assistance rendered by them to the Survey Department during the past year.

Rangoon Town Survey.

291. The remaining maps and records of the Rangoon town survey were completed by the end of November 1897 within the time allotted, and the maps were shortly after sent to Calcutta for publication. The cost of completing these sheets, etc., was ₹5,007. The total cost of the Rangoon town survey from start to finish amounted to ₹1,08,104, exclusive of the printing and publication of the maps, for which a separate estimate was made. There was, therefore, a saving of ₹5,926 on the sanctioned estimate.

Survey of Rangoon, Sadar Bázár.

292. The Rangoon Sadar Bázár was surveyed at the request of the cantonment authorities on the scale of 50 feet to the inch, its cost amounted to ₹1,428 and ₹28 for demarcation.

293. The party was inspected in the field in February 1898 by the late Major-General Woodthorpe, who was then officiating as Deputy Surveyor-General; he expressed his satisfaction with all he saw. The party was again inspected in recess on 30th and 31st August, and on 1st September 1898 by Lieutenant-Colonel Hobday, who had succeeded Major-General Woodthorpe, when the arrangements for the approaching transfer of the party to Upper Burma, to take the place of No. 3 Party, were discussed.*

* The officer in charge reports that Messrs. W. C. Price, G. W. Jarbo, and J. S. Swiney have managed their sections in a very satisfactory and able manner; and that the other assistants have also given every satisfaction. Of the Native establishment, the following are deserving of special mention:— Mr. C. Abrew, Moug Hpo Kah, Shashi Bhusan Ghosal, Durga Prosona Shore, and Mahbub Ali

NORTH-WESTERN PROVINCES AND OUDH.

294. The records of district Meerut and the Lalitpur sub-division of Jhānsi, which had not been finished in October 1897, were completed by December, and made over to the Settlement Officers. The original field maps were despatched to the drawing section of Nos. 2 and 8 Parties, Mussooree.

The survey and records of Sháhjahánpur were completed, the maps sent to drawing office, and the records made over to the Settlement Officer.

The field survey and record writing of four *parganas*, Chándpur, Bāshta, Burhpur and Nagína in district Bijnor were completed; the records prepared in office, are nearing completion, and will be made over to the Settlement Officer in December.

The field survey and record writing of the Bahraich district have been completed; the office records will probably be ready by December.

A small portion of the Nepál and Bahraich boundary re-demarcated by officials deputed for this duty was surveyed under the Survey Officer's orders and a map made over to the Deputy Commissioner. Certain points were still pending approval.

Survey and record writing were continued in Bareilly and Kheri and commenced in Gonda. In the last two districts on the two years' system.

295. The total area of the districts and tracts of which survey and record writing has been completed since 1894 (including the small tracts of Kakarbái and Gursarái in Jhānsi and the alluvial *mahals* in Sítápur) covers 7,165 square miles, and the average cost per square mile, taken all round, ₹49-5-7, or, with superintendence and all other charges, including cost of instruments, ₹58-13-7 per square mile. Of the above area 1,085 square miles were surveyed during the past season (1897-98).

In the districts not yet completed an area of 2,355 square miles was surveyed, and *khasras* written of 2,080 square miles at an average cost of ₹49-12-0 per square mile, or, with superintendence and all other contingencies, ₹59-4-0 per square mile. A portion of the enhanced cost is due to the completion of records of previous years where this had fallen into arrears, and partly that on the two years' system where the operations are extended over a much larger area, assistant surveyors, and a greater number of inspectors and *mirdahas* (or chainmen) are required.

296. In the several districts under survey 1,533 *patwáris* were attached to survey training classes; of these, 1,295 qualified, and surveyed villages, 164 sent heirs as substitutes, who were provided chiefly from the *umedwár kanungos* sent from other districts for training, of whom there were 222 in all, most of whom qualified.

Twenty-five *kanungos* and 7 *naib* registrar *kanungos* joined the surveys; 4 of the former were transferred before passing.

Thirteen students of the Agricultural School, Cawnpore, were trained in Bareilly; only one failed.

Twenty junior civilians were instructed in the methods of surveying villages cadastrally, and were attached subsequently to the several survey parties for two months.

297. The survey of cultivated lands in the Naini Tal district on the scale of 64 inches to the mile and the preparation of 4-inch index maps was extended, and 64 square miles were completed.

It is believed there are still 20 square miles of cultivation to survey, the total cultivation according to the previous district records, being a little over 50 square miles. The cost for survey and *khasra* writing has been ₹360-11-0 per square mile, or, if cost of preliminary test surveys and of instruments is added, the total is ₹416-11-0 per square mile. That of the Garhwál survey on the 32-inch scale and based on the traverse survey was about ₹800 per square mile.

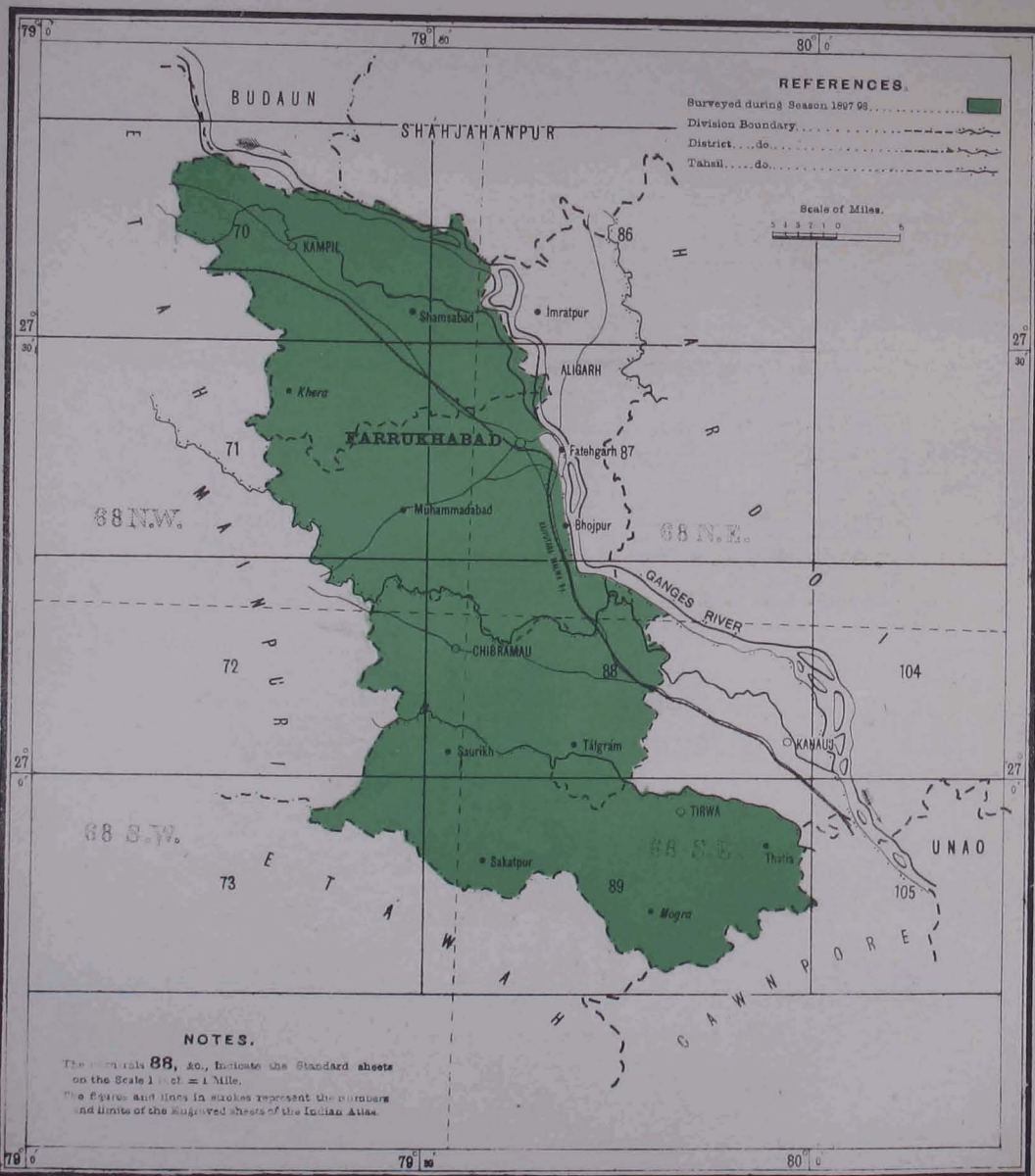
The survey is being made entirely by Garhwáli *amins* trained on the Garhwál survey as there are no *patwáris* in the ordinary sense of the term.

298. The accuracy of the old Settlement village maps of Cawnpore, Fatehpur and Allahabad districts were checked by numerous lines run across them by the Superintendent and Mr. Johnson. Those of the first two were fairly accurate, those of Allahabad less so, especially on the outskirts of large villages.

N. W. PROVINCES SURVEY.

1897-98.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT FARRUKHABAD. Nos. 2 & 8 PARTIES.



Reg. No. 261, S. I. D., - Dec. 98 - 500.

Photo. S. I. O., Calcutta

No. 533-S. 98.

N. W. PROVINCES.

1897-98.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT AZAMGARH.

Nos. 2 & 8 PARTIES.



NOTES.

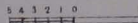
The numerals 193, &c., indicate the Standard sheets on the Scale 1 Inch = 1 Mile.

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

REFERENCES.

- Surveyed during Season 1897-98.
- Division Boundary.
- District do.
- Tahsil do.

Scale of Miles



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

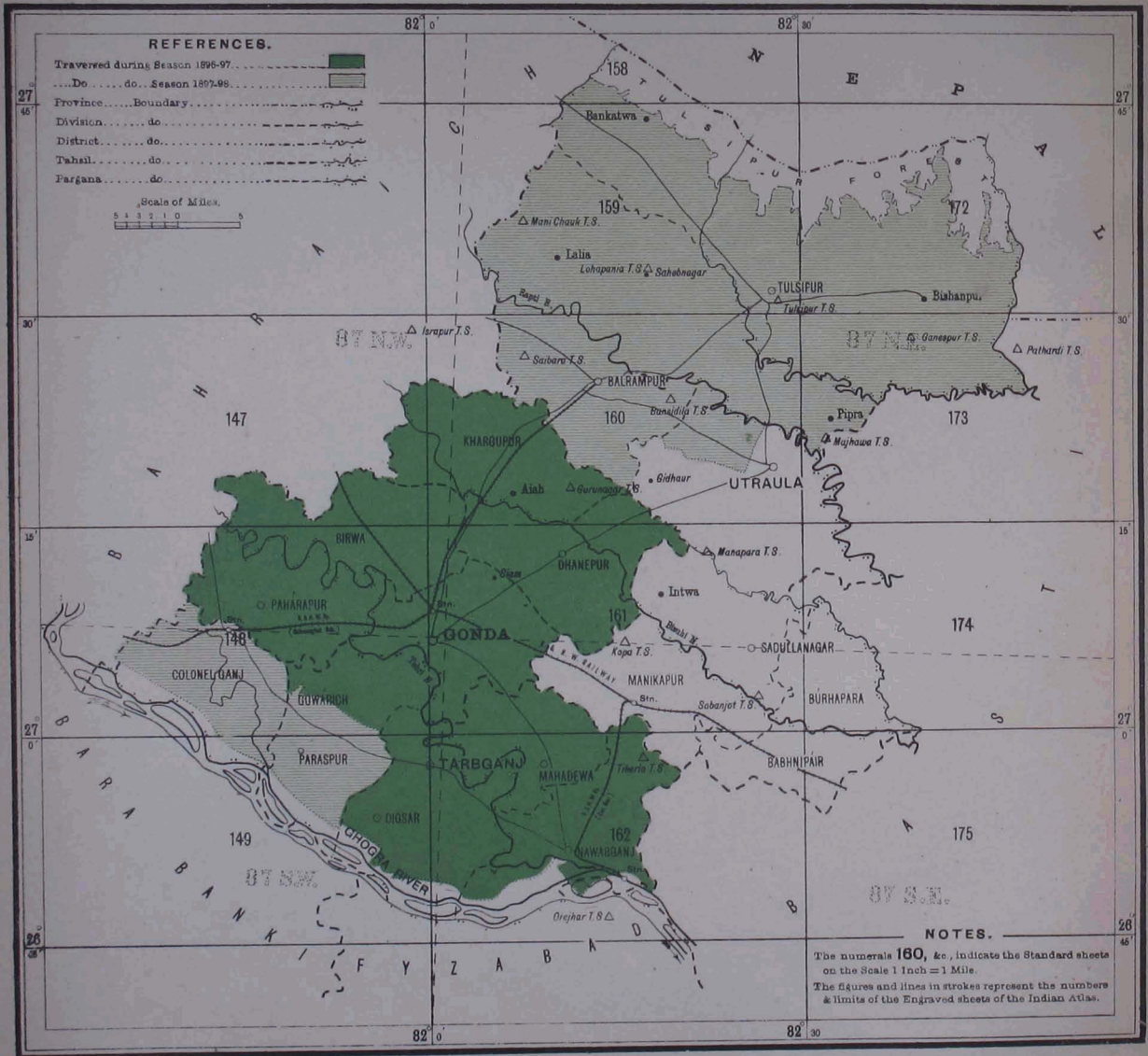


N. W. P. & OUDH SURVEY.

1897-98.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT GONDA.

Nos. 2 & 8 PARTIES.



N. W. P. & OUDH SURVEY.

1897-98.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT KHERI.

Nos. 2 & 8 PARTIES.



9. The programme for the coming season is as follows:—

The completion of the Bareilly and Kheri districts and of the Naini Tal irrigated tracts, continuation of survey in Gonda, commencement of survey in Farrukhabad, Azamgarh and Pilibhit; all on the 2 years' system, except one *nsil* of Farrukhabad. The testing of the old village maps of districts Agra and Muttra, the re-demarcation of some pillars on the Nepal-Almora boundary, and the extension of the contour survey of Naini Tal Municipality for the Public Works Department as far as the shaken hill slopes round the brewery.

300. During the season three of the senior survey officers were compelled to go on leave from ill health, and in consequence the paucity of survey officers employed was severely felt. The scheme of placing traverse surveys under local Governments lately proposed, if carried out, with the proviso that all the assistants are to be interchangeable between traverse and cadastral sections, to a great extent, remedy this defect.

In conclusion, the Superintendent would again call attention to the hard good work done by the several survey officers.

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TRAVERSE SURVEYS.

NORTH-WESTERN PROVINCES AND OUDH.

Nos. 2 AND 8 PARTIES.

301. At the close of season 1896-97, Nos. 2 and 8 Parties were amalgamated into one under Government Order No. ²⁰⁰⁸₁₋₄₀₄B, dated 5th August 1897, and has been under the charge of Mr. J. S. Pemberton throughout the year. The amalgamation of the two parties was called for by the fact of the annual area, hitherto turned out by the two parties working separately at full strength, being in excess of the requirements of the Land Records Department, and also with a view to reducing the cost of superintendence.

<i>Personnel.</i>			
Mr. J. S. Pemberton, Officiating Deputy Superintendent, 1st grade, in charge.			
Mr. W. S. Buttress, Extra Assistant Superintendent, 1st grade.			
„ R. B. Smart, „ „ „ 3rd „			
„ J. McHatton, „ „ „ 4th „			
„ T. Shaw, „ „ „ 5th „			
„ J. Murphy, „ „ „ 5th „			
Munshi Aulad Hussein, Sub-Assistant Superintendent, 2nd grade.			
Mr. O. C. Ollenbach, „ „ „ 2nd „ from 10th November 1897.			
Babu Amar Singh, „ „ „ 2nd „ from 1st June 1898.			
Mr. A. H. Peychers, „ „ „ 2nd „ up to 9th May 1898.			
Babu Jagdamba Prasad, „ „ „ 3rd „			
Mr. C. O'Donel, „ „ „ 3rd „			
„ C. S. Littlewood, „ „ „ 3rd „ from 7th January 1898.			
109 Sub-Surveyors, Computers, etc., etc.			
1 Hospital Assistant.			

Mr. J. S. Pemberton throughout the year. The amalgamation of the two parties was called for by the fact of the annual area, hitherto turned out by the two parties working separately at full strength, being in excess of the requirements of the Land Records Department, and also with a view to

reducing the cost of superintendence.

302. The changes in the establishment were as follows:—Mr. J. McHatton from head-quarters office and Mr. C. O'Donel from No. 20 Party were transferred to fill the vacancies caused by the absence on leave of Mr. H. T. Hanby, and the transfer of Mr. P. Williams to No. 21 Party. Mr. A. H. Peychers was transferred to the head-quarters office, his place being taken by Babu Amar Singh from No. 7 Party. The newly organised Drawing Office consisted of Messrs. T. Shaw, O. C. Ollenbach, and C. S. Littlewood.

303. The recess offices of the party were closed at Mussooree and Naini Tal between the 15th and 25th October 1897, and field work was started in districts Gonda, Kheri, Azamgarh and Farrukhabad between 10th and 25th November 1897, and in district Pilibhit on the 15th January 1898. The recess offices were re-opened at Mussooree on the 15th April.

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

- (a) Completion of remaining areas in district Pilibhit comprising 189 square miles included in the *pargana* of Jahánabad, and in district Kheri comprising 129 square miles included in detached alluvial lands along the Chauka or Sarda and Gogra rivers.

District Pilibhit was commenced on the 15th January and completed on the 24th March 1898. The attendance of *patwáris* to show the boundaries was unsatisfactory. As in Farrukhabad so in this district, the plan of additional azimuths other than those observed on main and sub-circuits was carried out with equally good, if not better, results.

District Kheri was completed with considerable difficulty, owing to the absence of demarcation, the non-attendance of *patwáris* and the difficult nature of the country for surveying. It took two surveyors the entire season to finish it.

(b) District Gonda, 900 square miles, comprised in *parganas* Balrámpur and portions of Tulsipur, Guwárich and Utraula.

This district was commenced on about the 15th November 1897, and completed on the 21st March 1898. A total area of 1,630 square miles remained to be traversed in this district; of this by the terms of the programme, only 900 square miles were required to be done. Owing, however, to a demand by the Land Records Department that the survey of districts Mainpuri and Etah should be started next season, it was found necessary to exceed the programme by 308 square miles, in order not to leave more area than could be completed by the section at work in Azamgarh, in addition to any left unfinished in that district. This would set the Gonda section free to take up the new work.

In *pargana* Guwárich no demarcation had been carried out, and the non-attendance of the *patwáris* to point out the boundaries caused considerable delay and trouble. In other parts of the area traversed the demarcation was better, but still far from good.

The Tulsipur forest reserve to the north of the district, abutting on to the Nepal-Tarái is well demarcated by stone pillars, most of which have been incorporated with the traverse survey, but the values obtained by the forest survey have not been utilized; the Superintendent of Forest Surveys having intimated that they were not reliable, the area remaining for survey, exclusive of forest reserves, is 550 square miles.

(c) District Farrukhabad, 956 square miles, in *parganas* Kampil, Shám-sabad West and East, Mahammadabad, Pahára, Bhojpur, Chhíbrámau and Tálgrám commenced on 10th November 1897 and completed on the 21st April 1898.

A special feature of the work in this district was the excellent state of the demarcation, and the interest taken by the Collector, Mr. E. Galbraith, who saw to the measures adopted for securing the permanency of the traverse stations and the attendance of *patwáris* at time of survey, and that they were given due effect to by the *tahsildárs* and other officials concerned. As an additional check on the angular work beyond the usual azimuth observations on main and sub-circuits, the camp officer, Mr. McHatton, introduced the plan of observing azimuths in the centre of blocks of villages, the bearings of which had already been closed, with very satisfactory results. An excess of 379 square miles, beyond what was required by the programme, was traversed in order to keep down the cost rates which otherwise would have been abnormally high. The area remaining for survey amounts to 398 square miles which will be completed next season.

(d) District Azamgarh, 1,138 square miles, in *parganas* Deogaon, Bela Daulatabad, Belhabáns, Nizámabad, Atraulia, Kauria, and Máhul.

Work was commenced on the 25th November 1897 and completed on the 10th April 1898; progress was at first slow owing to the nature of the country, which is under water till the end of December and to the want of demarcation in the submerged tracts. The Collector took active measures to remove this last difficulty, and after the 1st of January 1898 the demarcation was kept well in advance, and no further inconvenience was experienced, 1,005 square miles remain to be traversed in the district which it is expected will be completed next field season.

305. The average size in square miles of village circuits in the several districts traversed is as follows:—district Farrukhabad 0.99; district Pilibhit 0.93; district Gonda 1.23; district Kheri 1.73; district Azamgarh 0.40.

306. Azimuth observations were taken at 424 points on main and sub-circuits in the season's work. With very few exceptions, as in the case of

alluvial lands, main and sub-circuit traverses have been run along *pargana* and *tappa* boundaries. In alluvial lands the main circuits have followed the first line of village boundaries above the high bank of river.

307. The marks used have been the usual prism-headed stones obtained from Chunar and baked clay cylinders locally manufactured. The former have been used as before in marking (a) village trijunction points where settlement marks were non-existent, (b) one satellite station at every trijunction and (c) two consecutive stations between trijunctions a mile or more apart. Cylinders have been used for all other stations. The total number of stones used have been 11,061, and cylinders 43,857. The number left unused and which will be utilized next season, are, stones 1,151, cylinders 9,042. The cost of 5,085 stones purchased during the present season amounts to ₹1,747 including railway freight, and 44,059 cylinders to ₹1,171. The local carriage for both descriptions of marks cost ₹2,605.

308. Traverse charts of every district under survey have been prepared, showing the run of main and sub-circuits with their trijunction points. Azimuth and G. T. S. stations plotted and a table showing their co-ordinate values from origin was also prepared.

309. The plotting done on various scales by the traverse sections during the season is as follows:—

1,517 villages on	28 sheets on the scale of 2 inches=1 mile ;
949 " on	26 sheets " 4 inches=1 mile ;
591 " on	6,971 sheets " 16-inches=1 mile ;
39 " on	96 sheets " 32-inches=1 mile ;

310. The party was divided into one Drawing Office and three traverse sections, the latter being in charge of Messrs. Buttress, Smart and McHatton, and the former of Mr. Shaw; combined with the Drawing Office was a small topographical section.

311. The field work of this topographical section was confined to the Lalitpur sub-division of the Jhānsi district, in which the detail survey has been made of 104 square miles, consisting of gaps left between the areas cadastrally surveyed, and which were scattered over an area of 1,189 square miles. Mr. Ollenbach accompanied by two sub-surveyors left Shāhjahānpur on the 31st December 1897, and started field work in the third week of January. The surveys have been made on the scale of 2 inches to the mile, and based on the traverse stations fixed for the cadastral survey. The country surveyed consisted entirely of hills. The vertical interval adopted between the contours was 50 feet and relative heights were all determined by the clinometer. No absolute heights were observed, but this omission will be made good during the ensuing field season, when the remaining area in *parganas* Bānpur and Lalitpur are surveyed. Field work was closed on the 22nd May. The mapping of Lalitpur has been taken in hand first and is now in progress.

The work of the Drawing Office comprised compiling and mapping 2-inch topographical standard sheets, for reduction to half scale from original village plans supplied by the Land Records Department, for which no provision had hitherto been made.

312. The following shows the particulars of the outturn of traverse survey for the season:—

DISTRICTS.	Number of villages and river blocks.	Number of sub-traverses.	Number of traverse stations,	Linear miles of traverse.	Area in square miles.
Farrukhabad	1,316	} 1,800	21,259	4,808	1,310
Ditto river blocks	19				
Pilibhit	201	} 269	2,982	743	189
Do. river blocks	10				
Gonda	875	1,076	16,586	3,755	1,081
Kheri	74	41	764	228	128
Azamgarh	2,866	1,158	25,389	5,146	1,143
Oudh blocks	7	...	...	...	...
Villages Blocks	5,332 36	} 4,344	66,980	14,680	3,851

313. The total expenditure for the year ending 30th September 1898 is ₹1,23,888, *i.e.*, ₹95,598 for traversing, or ₹24-13-2 per square mile, ₹6,539 for stone embedding, or ₹26-8-4 per square mile for both the above operations. Drawing section expenditure amounts to ₹17,555, distributed as follows:— detail survey ₹4,205-8-5, or ₹40-7-0 per square mile mapping ₹13,349, of which the rate cannot be calculated.

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

315. During the recess season the Government of the North-Western Provinces and Oudh asked for the preparation of a half inch map of district Sháhjahánpur for local requirements. Proposals for its preparation *pari passu* with that of the standard sheets of that district, and an estimate for the work have been submitted.

The projection of the standard sheets of Sháhjahánpur has been completed, but owing to the village cadastral maps having been received very late from the Land Records Department, very little of the mapping can be done before the close of the present season.

316. The party was inspected in the field by the late Major-General R. G. Woodthorpe, Officiating Deputy Surveyor-General, and the recess office by Major-General C. Strahan, Surveyor-General, and Colonel J. R. Hobday, Officiating Deputy Surveyor-General.*

ASSAM.

NO. 6 PARTY.

317. Captain C. W. H. Symonds, I.S.C., held charge of this party until the 12th September 1898,

Personnel.

Captain C. W. H. Symonds, I.S.C., Officiating Deputy Superintendent, 1st grade, in charge up to 12th September 1898.
Mr. W. H. Penrose, Extra Assistant Superintendent, 5th grade, in charge from 13th September 1898.
Mr. F. S. Bell, Sub-Assistant Superintendent, 1st grade.
31 Permanent and 23 temporary Sub-Surveyors, Computers, etc.

when he proceeded on one month's privilege leave and Mr. W. H. Penrose assumed temporary charge of the party.

318. The recess office was closed at Shillong on the 6th November 1897 and field operations commenced at Tezpur on the 15th idem. A detachment under Mr. Penrose, detailed for traversing the boundaries of *ilam* lands and waste land grants in Sylhet and Cachar districts, left Shillong on the 7th October, and commenced field work at Sylhet on the 16th November 1897.

319. The programme was the completion, as far as possible, of the different operations detailed in Revenue and Agricultural Department No. 3906, dated 16th October 1896, and which had been commenced in the field season of 1896-97. It consisted of:—

- (1) Traverse and detail survey on 2-inch scale of all gaps existing between previous cadastral surveys and the riverain of the Brahmaputra river.
- (2) Traverse of tea grants.
- (3) Traverse of all villages, both those which had been already cadastrally surveyed by local agency, and also those which remain for survey by the same agency.
- (4) The survey in the Sylhet and Cachar districts of about 200 square miles.
- (5) Detail survey on a scale of 32 inches to the mile of the Cherra Poonjee coal mines.

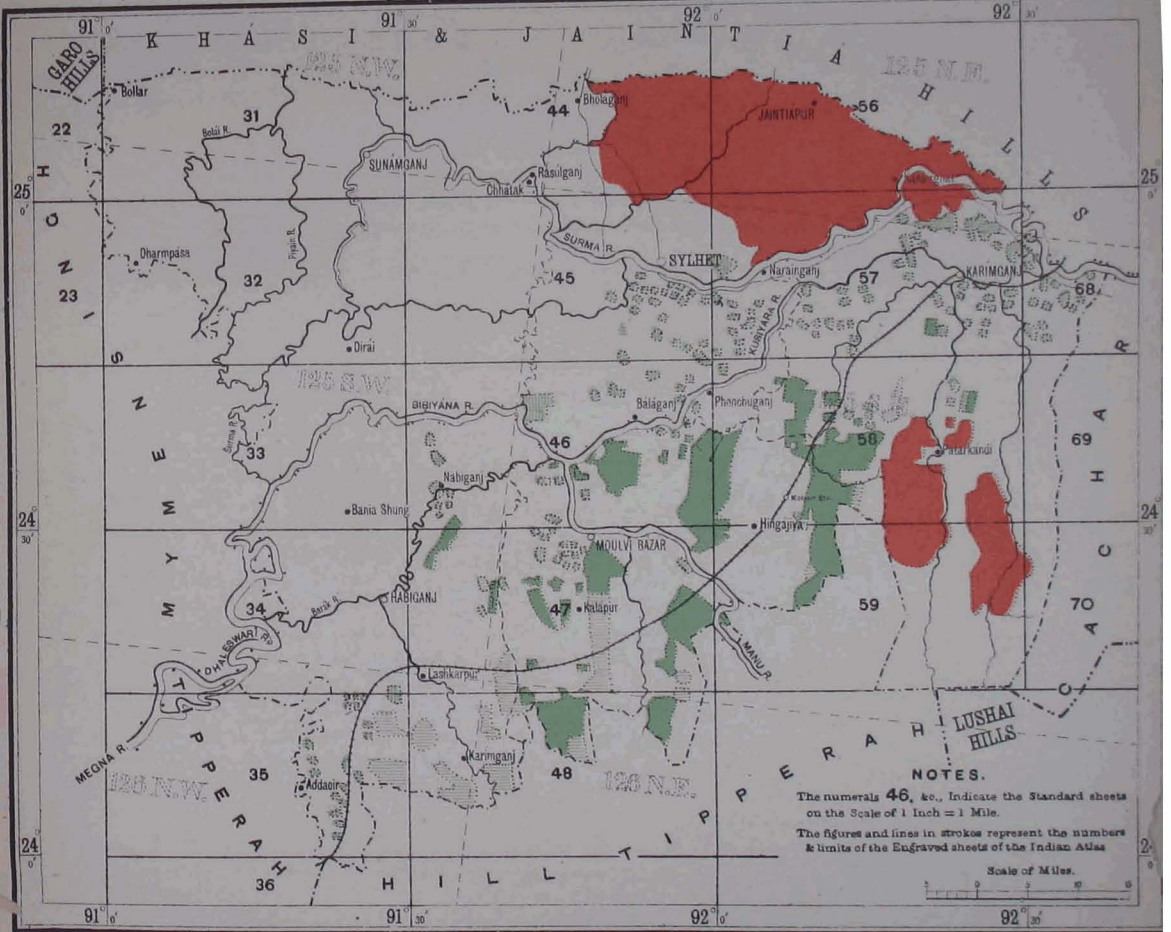
* The officer in charge reports that Messrs. W. S. Buttress, R. B. Smart, J. McHatton and T. Shaw have conducted their duties in a most satisfactory and able manner, specially mentioning Mr. R. B. Smart, and that Messrs. J. Murphy, O. C. Ollenbach, Munshi Aulad Hussein, Babu Amar Singh, Babu Jagdamba Prasad, Messrs. C. O'Donel and C. S. Littlewood have rendered efficient service. Of the native establishment, Sanat Kumar Chatterjee, Monohar Lall, Latifulla Khan, Kanhia Lal, Dharani Dhur Mukerjee, Jowla Pershad I, Annada Pershad, Mohadeo Ram, Mumtaz Ali, Mohamed Ali, Basant Rai, Gokul Chand, Ramphal, Abdulla Khan, Krishna Prosad Chatterjee, Fani Bhusan Rai and Enayetulla are commended.

ASSAM SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DIST. SYLHET.

No. 6 PART

1897-98.



NOTES.
 The numerals 46, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.
 The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas.
 Scale of Miles.

REFERENCES.

Previously Surveyed.....	
Traversed in Season..... 1898-97	
Traverse of Boundary of Ilam Lands, Season 1897-98	
Traverse of Grants, Season..... 1897-96	
State..... Boundary.....	
District..... do.....	
Sub-Division do.....	

Photo. S. I. D. Calcutta.

320. The statement below will show the area contained in the programme and the area actually completed :—

	Area to be completed.	Area actually completed.
<i>Assam Valley.</i>		
	Square miles.	Square miles.
(1) 2-inch topographical survey	1,045·1	901·8
(2) Traverse of tea grants	118·2	127·1
(3) Traverse of villages surveyed by local agency in extension of the cadastral survey	237·4	68·2
<i>Sylhet and Cachar.</i>		
(4) Traverse of <i>ilam</i> and waste-land grants	200·0	176·6
(5) 32-inch survey of the Cherra Poonjee coal mines	3·0	3·0
TOTAL	1,603·7	1,276·7

From the above it will be seen that the area surveyed under head 2 is in excess of the original programme by 8·9 square miles, but that the area surveyed under heads 1, 3 and 4 falls short of the original programme by 25·9 square miles. The following remarks will explain the reason of the shortfalls :—

No. 1.—Refers partly to small areas omitted from the original cadastral surveys which lie to the south-east, south, and south-west of Gauhati. At the commencement of the season an attempt was made to traverse these portions, but it was found that the country was inundated and unhealthy, so that the line cutters had to be withdrawn and employed on the north bank of the Brahmaputra river. At the close of the field season, as soon as the riverain of the Brahmaputra had been surveyed on the 2-inch scale, another attempt was made to complete these small portions, but failed owing to the prevalence of cholera, small pox and fever. These areas will be completed during the coming field season.

No. 3.—Originally it was thought that, after running sub-traverses through these groups of villages and picking up as many trijunction points as possible, sufficient points would have been available to enable the boundaries and topographical details to be reduced by pentagraph on to the 2-inch standard sheets. But it was found impossible to run these sub-traverses owing to the ignorance of the *mandals* and their inability to point out the trijunction marks or even the boundaries of their villages. Another attempt was made late in the season to survey them topographically, using the stations of the old 16-inch cadastral survey, but that again was found to be impracticable owing to the fact that (1) a great many of the stations could not be found, (2) that several of those found were not in their true position, the result of their not having been embedded at the time of the survey.

No. 4.—In the Sylhet district the outturn is slightly less than that anticipated. This must be attributed to the scattered nature of the work. In several instances the area of pieces of *ilam* lands does not exceed $1\frac{1}{2}$ to 3 acres, for the survey of which sub-surveyors had to march 20 to 40 miles. The scattered nature of the work may be judged from the fact that the area under survey extended over a tract of country of not less than 6,000 square miles.

321. In the Assam valley the area was divided up into one main circuit, one river circuit and six sub-circuits. In the Sylhet district the area being

scattered no main or sub-circuits were run. In both the Assam valley and district Sylhet two chains were used, and the resulting measurements found to be very satisfactory, with the exception of a small area in south Sylhet which will have to be revised next season.

322. In the Darrang district in the Assam valley all co-ordinates were referred to the origin, consisting of the intersection of longitude $91^{\circ}30'$ and latitude $26^{\circ}30'$, and in the Nowgong district the intersection of longitude $92^{\circ}30'$ and latitude $20^{\circ}30'$. In the Sylhet district the origin of the Jaintia survey was preserved, namely, the intersection of longitude $92^{\circ}00'$ and latitude $24^{\circ}30'$.

323. Each subsurveyor was supplied with a spare chain for the purpose of testing his working chain. These testing chains were submitted weekly and checked against the standard steel bars kept in the head camp.

324. From the sub-joined statement will be seen the number of times the theodolite was set up and the number of linear miles of chaining which was run in the Assam valley and the Cachar and Sylhet districts :—

NAMES OF DISTRICTS.	Number of Stations.	Linear miles of chaining.
Assam Valley	6,867	1,237.8
Cachar and Sylhet	10,051	889.7
TOTAL .	16,918	2,127.5

The angular work was checked by astronomical observations, and the detail survey by 194 linear miles of chaining.

325. In the Assam valley, when traversing those villages which had been already surveyed by local agency, only a certain number of the old trijunction marks were taken up to render it possible to pentagraph the topographical detail on to the 2-inch standard sheets. In the few villages lying in the Assam valley which were traversed with a view to their being subsequently surveyed cadastrally by local agency, all stations were temporarily marked by means of a peg, and at the same time in order to afford a means of readily identifying the stations a small bough of the *semal* tree was planted 5 feet magnetic north of the station. These stations will be permanently marked by the Settlement Department hereafter.

326. In the Assam valley, in all the tea grants and villages traversed for future cadastral survey by local agency, the boundaries were traversed, in the former as shown by the proprietors and managers of gardens, and in the latter as pointed out by the *mandals*. In the Sylhet district all the boundaries of grants and *ilam* lands were previously demarcated by a staff of demarcation *amins* under the direct control of the Settlement Officer. The boundaries were traversed in accordance with the above demarcation. In the traverse of the area topographically surveyed on the 2-inch scale pegs only were used. In the Sylhet and Cachar districts the total number of old and new permanent marks (embedded by the Settlement Department) utilized as theodolite stations was 1,549. The balance, namely, 8,502, were marked by wooden pegs with the usual mound and tree planted 5 feet magnetic north.

327. At the request of the Deputy Commissioner of the Khási and Jaintia hills a topographical survey of the coal mines at Cherra Poonjee was made. Two traces on the scale of 32 inches = 1 mile were supplied to the Administration.

328. The revision survey of 540.5 square miles in Cachar was continued during the past season by an establishment of two *amins* under the direct control of the Settlement Officer of Cachar.

329. A survey training class was opened at Sylhet on the 2nd January 1898 under the supervision of Mr. W. H. Penrose for the purpose of instructing the following officers :—

Mr. S. G. Hart, Assistant Commissioner.
 Babu Nagendra Chandra Datta, Probationary Sub-Deputy Collector.
 „ Mohendra Chandra De, do. do. do.

The above officers all passed after completing the work allotted to them, Messrs. Skinner and Graham also rejoined for the purpose of completing the course of training which was commenced last year. They passed on the 17th February and 5th March 1898, respectively.

330. In the Assam valley considerable difficulty was experienced in getting the *mandals* of villages to point out the boundaries of those villages which had been surveyed by local agency. In most instances they professed themselves absolutely ignorant of the position of the boundaries of villages under their charge. It was owing to the apathy shown by them that it was found necessary to abandon the idea of traversing those villages surveyed by local agency in the Nowgong district. In the traverse of tea grants every possible assistance was received from managers and assistants. In the Sylhet and Cachar districts no obstruction of a serious nature was experienced. A few of the native permanent settlement-holders proved obstructive and delayed the traverse survey to a certain extent.

331. Throughout the whole season the health of the establishment was exceptionally good. In the Assam valley four *khalásis* died from fever and debility, one sub-surveyor Rahimuddin was killed by a wild buffalo while surveying on the Nowgong side of the river. In the Sylhet district four *khalásis* died from fever and one *tindal* from cholera.

332. In consequence of the failure to complete the two years' programme which had been laid down in October 1896, it was suggested that this party should be retained for yet another year. This was sanctioned, *vide* Revenue and Agricultural Department No. 978, dated 21st May 1898. Acting on the instructions conveyed in the above letter, the officer in charge reports that the programme will consist approximately of the following:—

Assam Valley.

- No. 1.—Traverse and survey on the 2-inch scale of the riverain of the Brahmaputra and the gaps lying between the meridians of 93° and 95° ; also gaps left over on the southern bank from last season's programme. This represents an area of about 1,045 square miles.
- No. 2.—Traverse of certain villages which will be surveyed cadastrally by local agency and will cover an area of about 30 square miles.

Sylhet.

- No. 3.—Completion of last year's programme in district Sylhet; area remaining is 23'4 square miles.
- No. 4.—Demarcation of the boundary between Sylhet and Hill Tippera in the Sátgaon on Balisum hills.*

GEODETIC.

NOS. 22 AND 23 PARTIES, ASTRONOMICAL.

333. During the season 1897-98 the Astronomical Parties were in Captain Lenox-Conyngham's charge, and Lieutenant Beazeley, R.E., was attached to No. 22 Party.

<i>Personnel.</i>		
Captain G. P. Lenox-Conyngham, R.E., Deputy Superintendent, 1st grade, in charge.		
Lieutenant G. A. Beazeley, R.E., Assistant Superintendent, 1st grade.		The programme of work consisted of a resumption of determination of latitude on the group system which had been originated by Lieutenant J. Herschel, R.E., but had been allowed to drop, because Lieutenant Herschel was removed from the work before he had fully elaborated the system.
" E. A. Tandy, R.E., Assistant Superintendent, 1st grade, from 15th September 1898.		
Babu Hanuman Prasad, Sub-Assistant Superintendent, 3rd grade.		
" Govind Balwant Joshi, Computer. " Lal Singh, "		

* The officer in charge reports that both Messrs. W. H. Penrose and F. S. Bell have given entire satisfaction, the latter specially was of great assistance in supervising the 2-inch detail survey and traverse of tea grants, etc., in the Assam valley.
The following members of the native establishment have done good work:—
Fatch Mahomed, Gholam Hyder Khan, Mohamed Tabrez Khan, Sakhawat Hosain, S'inder Singh, Khurshed Hosain and Rajab Alli.

334. Two improvements are intended to be introduced into the system, namely, a symmetrical arrangement of the stations round the central one, and the addition of the measurement of astronomical azimuths at each.

The Agra longitude station was selected as the central point, and it was surrounded by a quadrilateral figure, the corner stations being respectively north, south, east and west of the centre and 5 miles distant from it.

335. Owing to the difficult nature of the country round Agra, it was not possible to connect the points by a sufficiently rigorous triangulation for the comparison of the observed and computed azimuths to be of value, but the latitude observations led to interesting results, and there seems every prospect that the system when carried out in the light of the experience gained, and in more favourable country will prove highly valuable. The object in view is the determination of the direction and magnitude of the deviation of the plumb line in the area examined.

336. In addition to the regular work of the parties, they were entrusted with the formation of two camps for the parties of scientists who came from England to observe the total eclipse of the sun in January 1898. The native establishment of No. 22 Party was lent to Major Burrard for the camp at Sahdol at which the Astronomer Royal and Professor Turner were the observers, and No. 23 Party with Captain Lenox-Conyngham, and Lieutenant Beazeley undertook that at Pulgáon for Mr. Newall, and Captain Hills, R.E. This caused an interruption from the middle of December till the first week of February, but the time was well spent.

337. During the recess the greater part of Captain Lenox-Conyngham's time was taken up in preparing for the press the records and computations of the Electro-Telegraphic Longitude observations for the connection of Karáchi with Greenwich and in writing the explanatory chapters for inclusion in the volume in which they will be published. The computation of the field season's work was therefore entrusted for the most part to Lieutenant Beazeley and Sub-Assistant Superintendent Hanuman Prasad.

338. Lieutenant Beazeley was transferred in September from No. 22 Party to the Head Quarters' Office, Calcutta, and Lieutenant Tandy was appointed to take his place.

339. The parties were inspected in September by Major Burrard, R.E., Officiating Superintendent, Trigonometrical Surveys.*

TIDAL AND LEVELLING OPERATIONS.

NO. 25 PARTY.

340. Major S. G. Burrard, R.E., remained in charge of the tidal and levelling operations up to the 21st April 1898. When he

Personnel.

Major S. G. Burrard, R.E., Superintendent, 2nd grade, in charge until 21st April 1898.
 Lieutenant H. L. Crosthwait, R.E., Assistant Superintendent, 1st grade, in charge from 6th May 1898.
 Mr. G. Belcham, Extra Assistant Superintendent, 1st grade.
 " E. J. Connor, " " 3rd grade, in charge from 21st April to 5th May 1898.
 " J. Bond, Extra Assistant Superintendent, 3rd grade.
 " J. P. Barker, Officiating Extra Assistant Superintendent, 6th grade.

Surveyors, etc.

Syed Zille Hasnain, Dhondu Venayek, Venayek Narayen, N. V. Apte, 3 native Mechanics, 14 Recorders and Computers.

of arrival of Lieutenant H. L. Crosthwait, R.E., who had been on temporary duty at Dehra Dún.

TIDAL OPERATIONS.

341. The automatic recording of the tidal curves by means of self-registering gauges, their reduction, and the publication of the tide-tables containing the predicted times and heights of high and low water, have been continued during

* Captain Lenox-Conyngham was satisfied with the work done by the members of the two parties.

the year. The following is a list of stations at which tidal observations have been, and are still being taken. Permanent stations are shown in italics :—

STATIONS.		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 .	1	
2	Perim	Ditto	1898	Ditto	...	
3	Aden	Ditto	1879	Ditto	18	
4	Muscat	Ditto	1893	1898	5	
5	Bushire	Ditto	1892	Still working .	5	
6	Karachi	Ditto	1881	Ditto	17	
7	Hanstal	Ditto	1874	1875	1	
8	Navánár	Ditto	1874	1875	1	
9	Okha Point	Ditto	1874	1875	1	
10	Porbandar	Personal .	1893	1894	2	
10 A	"	Automatic .	1898	Still working .	...
11	Port Albert Victor (Káthiáwádar)	Personal .	1881	1882	1	
11 A	" " (") .	Automatic .	.....	.....	...
12	Bhávnapar	Ditto	1889	1894	5	
13	Bombay (Apollo Bandar)	Ditto	1878	Still working .	20	The tide-gauge is the property of Bombay Port Trust.
14	Bombay (Prince's Dock)	Ditto	1888	Ditto	10	
15	Mormugáo (Goa)	Ditto	1884	1889	5	
16	Kárwár	Ditto	1878	1883	5	
17	Beypore	Ditto	1876	1884	6	
18	Cochin	Ditto	1886	1892	6	
19	Tuticorin	Ditto	1888	1893	5	
20	Minicoy	Ditto	1891	1896	5	
21	Galle	Ditto	1884	1890	6	
22	Colombo	Ditto	1884	1890	6	
23	Trincomalee	Ditto	1890	1896	6	
24	Pámban Pass	Ditto	1878	1882	4	
25	Negapatam	Ditto	1881	1888	6	The year 1884-85 is excluded.
26	Madras	Ditto	1880	1890	10	
			Restarted 1895.	Still working .	3	13
27	Cocanada	Ditto	1886	1891	5	
28	Vizagapatam	Ditto	1879	1885	6	
29	False Point	Ditto	1881	1885	4	
30	Dublat (Saugor Island)	Ditto	1881	1886	5	
31	Diamond Harbour	Ditto	1881	1886	5	
32	Kiddeepore	Ditto	1881	Still working .	17	
33	Chittagong	Ditto	1886	1891	5	
34	Akyab	Ditto	1887	1892	5	
35	Diamond Island	Ditto	1895	Still working .	3	
36	Elephant Point	Ditto	1880	1881	1	6
			Restarted 1884	1888	5	
37	Rangoon	Ditto	1880	Still working .	18	
38	Amherst	Ditto	1880	1886	6	
39	Moulmein	Ditto	1880	1886	6	
40	Mergui	Ditto	1889	1894	5	
41	Port Blair	Ditto	1880	Still working .	18	

342. During the year 1897-98 the observatory at Muscat was closed and the observatories at Perim and Porbandar were finally completed by the kind co-operation of Major A. Speed, R.E., Executive Engineer, Aden Military Works, and Mr. J. B. Benson, State Engineer, Porbandar, and their registrations were started. In 1898-99 no observatories are to be closed. The observatory at Port Albert Victor, where the building work has been unavoidably postponed, will, if possible, be opened.

343. In addition to the automatic registrations made during the year at the 13 stations enumerated above, personal tidal observations to graduated staves were taken at Bhávnagar, Colombo, Tuticorin, Chittagong, Akyab, and Moulmein, with the object of comparing the actual times and heights of high and low water with those predicted in the tide-tables. No such observations have been made at any of the other closed stations since the automatic registrations ceased, and it is not known if the predictions continue accurate. The method at present in use for making comparisons by means of tide-pole observations has not proved satisfactory, but a scheme is under consideration for its improvement.

344. All the tidal observatories in operation during the year were inspected either by Major Burrard, Lieutenant Crosthwait or Mr. Belcham, portable meteorological instruments being taken by them for testing those working, locally.

345. The tidal observatories on the whole have all worked very satisfactorily at Diamond Island a fortnight's curves were not recorded owing to the annual cleaning of the pipe and cylinders, but otherwise the registrations are perfect and it is hoped that communication between the sea and the float cylinder will remain free until the completion of the term of observations.

346. The reduction of the tidal observations has been carried on steadily during the year: observations for the year 1897 at 12 stations have been reduced, and there are no arrears. The usual work in connection with the preparation of the tide-tables for 1899, which will contain the predictions of high and low water at 38 ports, has been satisfactorily got through.

347. In the following statements are summarised the percentage of error in the predicted times and heights of high and low water for the last 8 years:—

PERCENTAGE OF ERROR 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 8 inches of Actuals.		Within $\frac{1}{2}$ of mean range at Springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1890 . . .	13	69	70	95	93	91	91
1891 . . .	10	74	73	94	87	98	97
1892 . . .	8	75	74	91	85	98	98
1893 . . .	9	73	68	93	98	96	95
1894 . . .	10	65	62	95	92	97	95
1895 . . .	9	68	65	98	97	94	94
1896 . . .	9	71	70	97	97	97	93
1897 . . .	8	71	75	96	97	97	97
Average of 8 years.	10	71	70	95	93	96	95

PERCENTAGE OF ERROR 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 $\frac{1}{10}$ of mean range at Springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1890 . . .	3	53	55	64	63	90	86
1891 . . .	3	64	58	66	66	92	92
1892 . . .	2	61	60	72	65	94	95
1893 . . .	2	57	57	68	50	89	84
1894 . . .	2	56	55	66	42	88	80
1895 . . .	2	59	55	74	47	94	84
1896 . . .	2	56	55	63	42	87	74
1897 . . .	2	59	61	75	57	96	91
Average of 8 years.	2	58	57	69	54	91	86

348. Bushire, treated as an open coast station, is the only port where the predictions are not good, as will be seen from the table given below. It was thought that the meteorological conditions prevailing in the Persian Gulf had caused the peculiarities exhibited by the tidal curves, but though several tests were applied no connection could be found between them. Mr. E. Roberts, of the Nautical Almanac Office, has been furnished with tracings of the tidal curves, and he proposes to treat the predictions in a similar manner to that adopted for riverain ports; it is, therefore, proposed to keep the Bushire Observatory open until the accuracy of his method can be tested.

PERCENTAGE OF ERROR IN PREDICTED TIMES AND HEIGHTS AT BUSHIRE, OPEN COAST STATIONS.

YEAR.	No. of Stations.	IN TIME.		IN HEIGHT.			
		Within 15 minutes of Actuals.		Within 8 inches of Actuals.		Within $\frac{1}{10}$ of mean range at Springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1895 . . .	...	45	41	86	54	69	45
1896 . . .	...	58	44	77	70	73	62
1897 . . .	...	57	37	85	88	78	81
Average of Open Coast Stations.	10	71	70	95	93	96	95

SPIRIT-LEVELLING OPERATIONS.

349. No levelling operations were carried on by this party during the past field season, the levelling detachment being employed on revisionary triangulation in Assam.

350. During the approaching field season the levelling operations will be resumed and the detachment under Mr. Bond will be employed in completing the main lines of levels between Katni and Allahabad and Katni and Sironj; and, if possible, the line connecting Bidar and Bhopál will be started.

ASSAM REVISIONARY TRIANGULATION.

351. The regular levelling operations of this party, under Mr. Bond, were postponed to admit of the detachment being employed on the revision of the triangulation in the Khási and Gáro hills, owing to alleged changes in their position, due to the earthquake of 12th June 1897.

352. Mr. Bond's instructions were to re-observe the horizontal angles of the Eastern Frontier Series, and to re-determine heights of stations, with a view to ascertaining what effect the earthquake had produced on the triangulation, and also, if possible, to ascertain the seat of seismic disturbance. It was found, however, that the disturbed area was very much more extensive than at first anticipated, and that the work was never outside the affected locality. Mr. Bond's results are therefore only relative. A lateral displacement seems to have taken place towards the north-west, varying from 2 to 12 feet, apparently indicating that the centre of the core of the earthquake lies about midway between the Eastern Frontier and Brahmaputra Series. The heights of stations exhibit changes, showing in some cases a subsidence of 4 feet or an upheaval of 24 feet.

353. Mr. Bond's Narrative Report is given in the Appendix, and with it a chart illustrating his operations.

The detachment commenced observations at Cherra Poonjee and carried the work northwards along the Eastern Frontier Series. The observations were taken with Troughton and Simm's new 8-inch micrometer theodolite. The mean triangular error, which ranged between 1".57 and 5".82, was 3".41. In connection with the work, observations were taken at three topographical survey stations with an Everest's pattern 8-inch vernier theodolite.

354. The season's outturn was as follows:—

Horizontal and vertical angles were taken at 13 stations, fixing the positions of 22 and the heights of 25 old stations. The series extended over a direct distance of 50 miles and embraced an area of 1,020 square miles.

The triangulation was carried across the Khási hills, where the earthquake was most felt, and where numerous landslips and extensive fissures were met with everywhere, particularly along the courses of rivers and streams. The roads and bridle-paths were greatly damaged and in many cases destroyed. In the course of the operations the party had to ascend and descend bare landslip slopes from 1,500 to 2,000 feet in height, and to cross over steep narrow wedge-shaped ridges with landslips on either side, extending to depths ranging from 600 to 1,000 feet, which were in many places dangerous. Mr. Bond reports that throughout his whole sojourn in Assam earthquakes were of continuous occurrence and he is of opinion that the hills may still be undergoing slight changes.

355. In addition to the regular departmental work of the tidal and levelling party, a considerable amount of extra work had to be undertaken to furnish other departments and Local Governments with information applied for by them.

356. The recess office of this party was inspected by the Superintendent, Trigonometrical Surveys, in January 1898.*

* Lieutenant Crosthwait reports favourably of Messrs. Belcham, Connor, and Barker and Surveyor Dhondu Venayek in the tidal section, and of Mr. Bond and Surveyor Syed Zille Hasnain employed on the revisionary triangulation. The staff of mechanics, sub-surveyors, and computers are reported to have worked well.

TABULAR STATEMENTS.

Summary of the outturn of work of the

SCALE OF SURVEY.	No. of Party.	LOCALE OF FIELD OPERATIONS	TRIANGULATION.										SPIRIT-LEVELLING OPERATIONS.						
			Instruments used. Diameter in inches.	Area in square miles.	Square miles to each point trigonometrically fixed.	Square miles to each height.	SECONDARY.			TERTIARY.		Miles levelled over.	Permanent bench-mark stones embedded.	Trigonometrical stations connected with.					
							Stations fixed.	Triangular error in seconds.	Error per mile in feet.	Intersected points.	Error per mile in feet.								
Inches to a mile. 64	4	Samastipur Municipality (Darbhanga).	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32	6	Cherra Poonjee Coal Mines	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16	2 & 8	Farrukhabad . . . . .	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...
		Pilibhit . . . . .	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Gonda . . . . .	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Kheri . . . . .	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	3	Azamgarh . . . . .	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Myingyan . . . . .	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Minbu . . . . .	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	4	Maymyo (Mandalay) . . . . .	...	10	6	...	...	...	...	...	...	...	...	...	...	...	...	...
		Katha . . . . .	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	4	Lower Chindwin . . . . .	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Noakháli . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Sáran . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Darbhanga . . . . .	...	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Forest Branch.	4	Muzaffarpur . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
			Patna (Railway Ghát Survey).
		6	Sylhet and Cachar
			Toungoo
		Land Records Survey.	17	Ahmednagar and Násik (Bombay).	20
				Saugor
			6	Biláspur
Nágpur and Wardha
6			Seoni
			Chhindwára	25
6			Bahraich
			Sháhjahánpur
6			Bijnor
			Kheri
6			Bareilly	30
			Gonda
6			Basti
	TOTAL . . . . .		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8	17		Násik, Thána and Kolába	...	7	718	2.7	2.7	226	11.1	0.27	1,101	0.28	...	...	...	...	...
6	15		Ráwalpindi . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	9 & 19		Kurnool	35	6, 7 & 8	720	3.3	3.2	61	15	0.5	153	0.8	...	...	...	...	...
		Cuddapah . . . . .	...	6, 7 & 8	900	3.3	3.4	50	18	0.4	221	1.3	...	...	...	...	...
		North Coimbatore . . . . .	...	6, 7 & 8	1,711	2.8	3.1	107	10	0.5	530	0.9	...	...	...	...	...
		Salem . . . . .	...	6, 7 & 8	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	17	South Arcot . . . . .	...	6, 7 & 8	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		North Kánara . . . . .	...	40	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Himálaya . . . . .	...	7	527	1.16	1.16	60	9	0.37	402	0.57	...	...	...	...	...
		Lower Burma (Forests) . . . . .	...	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Saugor . . . . .	...	7	730	19.7	13.8	17	...	...	20	1.7	...	...	...	...	...
		Biláspur . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Nágpur-Wardha . . . . .	...	45	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Forest Branch	Seoni . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Chhindwára . . . . .	...	7	503	5.5	5.1	27	8	0.67	65	0.9	...	...	...	...	...
	Chamba (Punjab) . . . . .	...	7	580	...	...	25	...	...	181	...	...	...	...	...	...
Carried over	...	...	...	5,671	...	...	347	...	...	1,572	...	...	...	...	...	...

Field Parties during the year 1897-98.

	TRAVERSING.				DETAIL SURVEY.					RECORD WRITING.			REMARKS.
	Area in square miles.	Stations at which the theodolite was set up.	Angular error per station in seconds.	Linear error per mille.	Area in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Villages.	Average size of fields.	Area in square miles.	Villages.	Fields.	
...	1	154	...	...	2	...	...	7	0'20	2	7	5,074	
...	3	...	...	...	3	...	...	...	...	...	...	...
...	1,310	21,259	3	0'15	...	...	...	...	...	...	...	...
...	189	2,982	4	0'15	...	...	...	...	...	...	...	...
...	5	1,081	4	0'10	...	...	...	...	...	...	...	...
...	128	764	...	...	...	...	...	...	...	...	...	...
...	1,143	25,389	1	1'76	...	...	...	...	...	...	...	...
...	4	219	15	1'30	927	...	2,805	888	1'09	...	...	539,257	
...	23	763	8	0'51	94	...	225	163	0'93	...	...	64,906	
...	10	25	6	1'04	...	...	...	...	...	...	...	...
...	...	...	...	...	20	...	128	35	0'77	...	...	16,556	
...	764	15,186	3	4'7	425	...	1,014	337	1'50	...	...	161,811	
...	...	...	...	...	10	...	53	6	1'54	10	6	4,254	
...	51	1,613	...	...	582(a)	...	3,123	918(a)	0'30	555	877	1,180,871	(a) Includes 27 square miles = 41 villages surveyed topographically on 16" = 1 mile.
...	15	598	...	...	733	...	3,177	965	0'42	733	965	1,100,808	(b) Includes 7 square mile = 11 villages surveyed topographically on 16" = 1 mile.
...	10	...	...	...	9 (b)	...	33	16(b)	3'72	2	5	250	
...	1	94	...	...	1	...	...	3	...	...	...	...
...	177	10,051	6'2	0'16	...	...	...	...	...	...	...	...
...	893	19,574	4	0'36	770	...	2,005	376	0'44	...	...	423,365	
...	20	...	...	...	29	...	321	115	...	...	...	...
...	...	...	...	...	60	112	...	...	...	...	...	...
...	...	...	...	...	17	59	<i>in situ</i>	...	...	...	...	...
...	...	...	...	...	78	160	127	...	...	...	...	...
...	...	...	...	...	25	184	60	...	...	...	...	...
...	25	...	...	...	56	234	78	...	...	...	...	...
...	...	...	...	...	451	...	...	330	0'4	451	330	693,754	
...	...	...	...	...	228	...	...	275	1'1	228	275	123,904	
...	...	...	...	...	406	...	...	732	0'6	406	732	475,064	
...	...	...	...	...	1,035	...	...	470	0'8	1,035	470	560,237	
...	30	...	...	...	558	...	...	722	0'7	735	958	719,830	
...	...	...	...	...	677	...	...	771	0'4	310	521	528,597	
...	...	...	...	...	85	...	...	118	0'2	1	...	...
...	6,397	133,814	...	...	7,276	...	12,943	7,125	...	4,466	5,139	6,593,464	
...	...	...	...	...	204	216	131	...	...	...	...	...
...	...	...	...	...	114	73'2	52	...	...	...	...	...
...	35	...	...	...	214	...	...	...	...	...	...	...
...	
...	...	...	...	...	300	...	...	...	...	...	...	...
...	...	...	...	...	366	...	...	...	...	...	...	...
...	...	...	...	...	170	...	...	...	...	...	...	...
...	40	1,188	0'01	1'1	444	81'3	<i>in situ</i>	...	...	...	...	...
...	...	...	...	...	317	71	<i>in situ</i>	...	...	...	...	...
...	224	...	2'4	4'1	406	...	153	...	...	...	...	...
...	...	...	...	...	155	112	78	...	...	...	...	...
...	...	...	...	...	77	59	<i>in situ</i>	...	...	...	...	...
...	45	...	...	...	228	...	included in 16" work	...	...	...	...	...
...	...	...	...	...	230	ditto	ditto	...	...	...	...	...
...	...	...	...	...	212	ditto	ditto	...	...	...	...	...
...	...	...	...	...	52	61	<i>in situ</i>	...	...	...	...	...
...	224	6,244	...	...	3,171	...	231	...	...	...	...	...

Summary of the outturn of work of the

SCALE OF SURVEY.	No. of Party.	LOCALE OF FIELD OPERATIONS.	TRIANGULATION.								SPIRIT-LEVELLING OPERATIONS.			
			Instrument used, Diameter in inches.	Area in square miles. 1	Square miles to each point trigonometrically fixed.	Square miles to each height.	SECONDARY.			TERTIARY.		Miles levelled over.	Permanent bench-mark stones embedded.	Trigonometrical stations connected with.
							Stations fixed.	Triangular error in seconds.	Error per mile in feet.	Intersected points.	Error per mile in feet.			
Inches to a mile.	Forest Branch	Brought forward	5,671	347	1,572
		Dudwa Kheri (Oudh)
		Pyinmana	50	5.7 & 4 1/2
		Tenasserim	4 & 7
		Ruby Mines	7, 8 & 10	804	53.6	53.6	9	8.1	0.34	6
		TOTAL . . . . .	...	...	6,475	...	...	356	...	...	1,578	...	...
2	2 & 8 6 12 18 20	Jhansi (Lalitpur Sub-Division). . . . .	...	...	...	...	...	...	...	...	...	...	...
		Kamrup, Darrang and Nowgong. . . . .	...	...	...	...	...	...	...	...	...	...	...
		Kalát and Dera Ghazi Khan (Desert Canal Survey).	55	5 & 6	...	...	...	...	...	...	...	...	...
		Sind . . . . .	...	5 & 6	...	...	...	...	...	...	...	...	...
		Himálaya . . . . .	...	7	136	1.0	1.0	30	10	...	105	...	...
		Lower Burma (Forests) . . . . .	...	5	...	...	...	...	...	...	...	...
		TOTAL . . . . .	...	...	136	...	...	30	...	...	105	...	...
1	10 11 14 15 21 Forest Branch.	Upper Burma . . . . .	...	6	2,742	4.7	6.4	66	11.7	0.22	492	0.77	...
		Ditto (Katha and Bhamo).	60	6	2,447	4.6	5.2	9	5.8	0.69	42	0.5	...	
		Upper Burma . . . . .	...	6	2,873	6.6	6.6	58	14.0	0.23	219	0.82	...
		Lushai Hills . . . . .	...	6 & 7	2,400	6	9	50	6.9	0.17	204	1.4	...
		Sind (Karachi and Sehwan) . . . . .	...	8	1,430	11.4	18.9	16	5.2	0.15	107	0.43	...
		Upper Burma . . . . .	...	6 & 8	3,256	12.8	20.2	37	11.1	0.22	259	1.6	...
		Chamba	65	...	...	...	...	...	...	...	...	...	...
		TOTAL . . . . .	...	...	15,148	...	...	236	...	...	1,323	...	
1/4	3 21	Prome, Thayetmyo and Henzada. . . . .	...	6	2,345	...	...	43	6.1	0.14	127	0.9	...
		Upper Burma . . . . .	...	...	...	...	...	...	...	...	...	...	...
		TOTAL . . . . .	...	...	2,345	...	...	43	...	...	127	...	
1/4	15	Persia (sistán)	68	...	...	...	...	...	...	...	...	...
		GRAND TOTAL . . . . .	...	...	24,822	...	...	891	...	...	4,234	...	

Field Parties during the year 1896-97—(contd).

	TRAVERSING.				DETAIL SURVEY.					RECORD-WRITING.			REMARKS.
	Area in square miles.	Stations at which the theodolite was set up.	Angular error per station in seconds.	Linear error per mille.	Area in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Villages.	Average size of fields.	Area in square miles.	Villages.	Fields.	
...	224	6,244	...	...	3,171	...	231	...	...	...	...	...
...	...	773	8'3	2'0	75	77	...	...	...	...	...	...
50	...	1,340	1'1	5'3	277	274	83	...	...	...	...	...
...	...	1,663	6'5	3'2	104	242	65	...	...	...	...	...
...	...	1,262	4'7	3'9	89	400	26	...	...	...	...	...
...	224	11,282	...	...	3,716	...	405	...	...	...	...	...
...	...	...	...	...	104	...	...	197	...	...	...	...
...	1,097	6,867	3'7	0'33	902	...	194	85	...	...	...	...
55	1,554	1,350	5	0'56	1,477	10	641	...	...	...	...	...
...	2,971	14,498	4	0'42	2,709	17	1,588	...	...	...	...	...
...	...	...	...	...	259	22	<i>in situ</i>	...	...	...	...	...
...	549	...	2'4	4'1	118	...	13	...	...	...	...	...
...	6,171	22,715	...	...	5,569	...	2,436	282	...	...	...	...
...	...	...	...	...	2,116(c)	7	94	...	...	...	...	...	(c) Includes 205 square miles of overlap survey.
60	...	...	...	...	...	...	...	...	...	...	...	...	(d) Includes 241 square miles of overlap survey.
...	...	...	...	...	2,571(d)	7'6	64	...	...	...	...	...	(e) Also 80 miles of boundary demarcation in Kohistan.
...	
...	...	...	...	...	1,857(e)	...	...	...	...	...	...	...
...	...	...	...	...	2,595	...	<i>in situ</i>	...	...	...	...	...
65	...	...	...	...	200	9	...	...	...	...	...	...
...	...	...	...	...	9,339	...	158	...	...	...	...	...
...	
68	...	...	...	...	1,752	...	...	...	...	...	...	...
...	...	...	...	...	1,752	...	...	...	...	...	...	...
68	...	...	...	...	8,224	...	...	...	...	...	...	...
...	12,796	167,065	...	...	36,199	...	16,125	7,414	...	4,468	5,146	6,593,538	

several Field Parties during the year 1897-98.

	Cost-rate per acre.	COST-RATE PER SQUARE MILE.			Total cost, inclusive of charges for instruments to Provincial Governments.	REMARKS.
	Cadastral survey, including traversing, detail survey and mapping.	Stone embedding.	Records (Khanapuri).	Completion of vernacular records, assessment statistics, etc.		
	Annas.	₹	₹	₹	₹	
...	...	...	—	...	70,281(a)	(a) Includes ₹1,415 expended on demarcation; ₹7,470 expended on completion of cadastral maps; ₹2,120 expended on 2" mapping; ₹4,415 expended on field statistics; ₹1,015 expended on training of officers; ₹150 expended on miscellaneous works for Settlement Officer and Director, Land Records.
...	...	...	...	...	14,304(b)	(b) Includes ₹5,075 cost of revision survey in District Cachar; ₹3,613 expended on 2" mapping.
...	...	...	...	...	85,179(c)	(c) Includes ₹7,128 cost of triangulation of the Frontier extension series.
...	...	...	...	...	88,608	(d) Includes ₹2,000 expended on instruction of surveyors, etc.
...	...	...	...	...	1,10,276	(e) Includes ₹1,267 expended on Quetta Revision Survey; ₹28,902 on mapping and ₹4,600 on Kach Settlement.
...	...	...	...	...	91,687(d)	(f) Includes ₹13,263 expended on arrears of mapping; ₹2,522 on Nahan Town Survey; ₹355 on revision of Jumna bank survey; and ₹3,245 on instruction of Soldier Surveyors, etc.
...	...	...	...	...	95,769(e)	(g) Includes ₹2,740 expended on traversing.
...	...	...	...	...	67,698(f)	(h) Includes ₹4,531 expended on levelling.
...	...	...	...	...	81,761	(i) Includes ₹708 expended on Mashahr mapping.
...	...	...	...	...		(j) Includes ₹7,592 expended on traversing 211 linear miles.
10	—	...	...	...	45,307	(k) Includes ₹3,422 expended on revision of Shwebo maps and ₹2,283 in Azimuth observations of Meiktila and Yamethin local survey.
...	...	...	...	...	37,719	(l) Includes ₹509 expended on Resnabad badars; and ₹462 expended on arrears of work in District Midnapore.
...	...	...	...	...	10,696	(m) Includes ₹3,646 expended on 16" Diara Topographical Survey; ₹446 expended on demarcation in Kachnar Mahal; and ₹103 expended on Champaran Traversing.
...	...	...	...	...	25,065	(n) Includes ₹2,606 expended on revision work; ₹18 expended on 16" Diara Topographical Survey; ₹684 expended on 64" survey of Samastipur Municipality; ₹1,826 expended on demarcation of Bhagalpur-Purnea Nepal Boundary and ₹3,791 on Bihar badars.
...	...	...	...	...	10,506	(o) Includes ₹981 expended on 16" Diara Topographical Survey; ₹334 expended on arrears of traversing; ₹95 expended on survey of Govindpur Terasia; ₹1,763 on Orissa badars and revision work; and ₹152 on Patna Railway Ghat Survey.
...	...	...	...	...	76,107(g)	(p) Includes ₹2,317 expended on demarcation; ₹6,463 expended on Rangoon Town; ₹3,688 expended on 2" mapping of District Amherst and ₹8,858 expended on revision survey and 2" traces of District Pegu.
...	...	...	...	...	1,31,267	(q) Includes ₹4,197 debitible to late No. 2 Party; ₹4,205 expended on 2" detail survey of 104 square miles in District Jhansi, giving a rate of ₹40.4 per square mile; and ₹13,349 charge of North-Western Provinces Drawing Office.
...	...	...	...	...	60,209(h)	
...	...	...	...	...	12,258(i)	
...	...	...	...	...	64,152(j)	
20	3'55	1'8	...	7'7	98,634	
...	4'46	7'4	...	7'7	10,465	
...	5'07	5'2	...	7'7	1,21,034	
...	2'94	...	...	7'7	2,505	
...	—	1'7	...	—	1,128	
25	...	...	...	...	19,974(k)	
...	...	...	55'5	4'9	2,441(l)	
...	4'85	—	57'9	46'4	1,14,014(m)	
...	2'80	—	51'0	27'3	1,53,739(n)	
...	4'56	...	89'3	1'3	3,800(o)	
30	5'01	—	...	—	1,83,352(p)	
...	
...	
...	...	1'7	...	...	1,23,888(q)	
...	
35	...	...	...	...	...

Particulars of Cadastral Surveys completed since 1896-97.

DISTRICT.	Scale of survey.	Number of villages.	Number of fields.	Area surveyed. Sq. miles.	Average size of fields. Acre.	Cost, exclusive of demarcation and charge for instruments. ₹	RATE PER SQUARE MILE.			By whom and when surveyed.
							Traverse survey. ₹ a. p.	Cadastral survey. ₹ a. p.	Cadastral survey with Record of Rights. ₹ a. p.	
Minbu	16" = 1 mile	815	753,045	1,400	1.2	280,506	57 14 5	138 5 2	...	Messrs. W. H. Patterson, G. H. Cooke, E. G. Little and E. J. Jackson during 1892-94 and 1896-98.
Bijnor	16" = 1 mile	732	475,064	406	0.6	33,337	25 9 1	...	56 10 4	Traverse survey done by Mr. J. S. Pemberton during 1896-97. Cadastral survey done by Land Records Surveys.
Sháhjahánpur	16" = 1 mile	2,365	1,332,737	1,738	1.1	149,996	29 11 10	...	56 9 9	Traverse survey done by Mr. J. S. Pemberton during 1895-97. Cadastral survey done by Land Records Surveys.
Bahraich	16" = 1 mile	1,996	2,908,299	2,265	0.5	207,965	22 10 8	...	59 5 3	Traverse survey done by Mr. J. S. Pemberton during 1894-96. Cadastral survey done by Land Records Surveys.

PART III.

THE OPERATIONS AT THE HEAD-QUARTERS OFFICES.

357. These offices comprise—

- (1) The Head-Quarters Offices at Calcutta.
- (2) The Trigonometrical Branch Office at Dehra Dún.
- (3) The Drawing Office at Simla.
- (4) The Forest Survey Branch Office at Dehra Dún.

A description of the work carried on in each office is given below :—

I.—HEAD-QUARTERS OFFICES, CALCUTTA.

SUPERINTENDENCE, CORRESPONDENCE AND ACCOUNTS.

Superintendence.

Major-General C. Strahan, R.E., Surveyor-General of India.
 Colonel J. E. Sandeman, I.S.C., Deputy Surveyor-General in charge Revenue Branch (on furlough up to 2nd September 1898).
 Major-General R. G. Woodthorpe, C.B., R.E., Officiating Deputy Surveyor-General, in charge Revenue Branch, from 10th November 1897 to 26th May 1898.
 Lieutenant-Colonel J. R. Hobday, I.S.C., Assistant Surveyor-General from 10th November 1897 to 12th June 1898. Officiating Deputy Surveyor-General in charge Revenue Branch, up to 9th November 1897 and again from 27th May 1898; confirmed 3rd September 1898.
 Major F. B. Lorge, R.E., Officiating Assistant Surveyor-General up to 9th November and on special duty up to 18th November 1897.
 Major W. J. Bythell, R.E., Officiating Assistant Surveyor-General, from 13th June to 6th August 1898.
 Captain H. A. D. Fraser, R.E., Officiating Assistant Surveyor-General, from 8th August 1898.
 Mr. T. W. Babonau, Registrar.

Correspondence.

Mr. T. A. Milne, Head Assistant.
 „ G. C. Walker, Head Clerk.
 Babu Kalipodo Banerji, Clerk.
 „ Beni Madhab Banerji, Clerk.
 „ Chuni Lal Dey, „
 „ Durga Narayan Ghosh, „
 „ Ramkristo Chunder, „
 Mr. H. E. D'Cruz, Clerk, on leave from 15th November 1897.
 Babu Gopal Chunder Dass, Clerk.
 „ Kali Kristo Chunder, „
 and seven others.

Accounts.

Mr. C. O. Gray, Head Clerk.
 Babu Raj Krishna Mukerji, Clerk.
 „ Hem Nath Dutt, „
 and nine others.

358. The general direction of these offices remained in the hands of Major-General C. Strahan, R.E., throughout the year. The Revenue Branch Section was under Lieutenant-Colonel J. R. Hobday, I.S.C., up to 9th November 1897, under Major-General R. G. Woodthorpe, C.B., R.E., up to 26th May 1898, when he died, and again under Lieutenant-Colonel Hobday, from 27th May up to the close of the year. The services of Colonel J. E. Sandeman, I.S.C., having been replaced at the disposal of the Military Department, Lieutenant-Colonel Hobday was confirmed as Deputy Surveyor-General from 3rd September 1898. The General and Topographical Branch Sections were under Major F. B. Lorge, R.E., up to 9th November 1897, under Lieutenant-Colonel Hobday up to 12th June 1898, under Major W. J. Bythell, R.E., up to 6th August and under Captain H. A. D. Fraser, R.E., up to the close of the year.*

* The Assistant Surveyor-General reports as follows :—

Mr. T. W. Babonau has continued to perform with credit the duties connected with the general superintendence of the office.

Messrs. Milne and Gray have superintended their respective sections very satisfactorily, and Mr. J. A. Vallis has carried out the arrangements for the despatch of survey *thalesis* to Burma in a satisfactory manner. The native clerks have done well, more especially Babus Beni Madhab Banerji, Chuni Lal Dey, Doorga Narayan Ghose, Ram Kristo Chunder, Raj Krishna Mukerji, Gopal Chunder Dass and Norendro Nath Mukerji.

The Deputy Surveyor-General, Revenue Branch, reports that his Head Clerk, Mr. G. C. Walker, conducted his work in a very efficient manner, and that the native clerks, Babus Kalipodo Banerji and Kanti Chunder Sen are deserving of special mention.

DRAWING OFFICE.

359. The Drawing Office continued under the superintendence of Mr. A. E. Spring throughout the year.

SECTION I.—GEOGRAPHICAL, DRAWING, AND COMPILATION.

360. During the year under review a few changes have taken place

		<i>Personnel.</i>	
Mr. W. Stotesbury, Chief Draftsman.		Mr. W. Green, Draftsman.	in the <i>personnel</i>
<i>Extra Assistant Superintendents and Sub-Assistant Superintendents on duty.</i>		" A. J. Musgrove "	and organization of
		" J. R. Adels " up to	this section. Mr. J.
		6th April 1898.	R. Adels retired on
Mr. A. G. Wyatt, Extra Assistant Superintendent, 2nd Grade, from 27th April 1898.		" R. C. Sinclair up to 12th May 1898.	pension on the
		" A. S. Bateman "	6th April ; Mr. R.
" T. H. Rendell, Extra Assistant Superintendent, 3rd grade, up to 27th March 1898.		" A. J. Wilson "	C. Sinclair left on
		" C. L. Green "	12th May on deputa-
" J. A. Barker, Extra Assistant Superintendent, 4th grade.		" E. W. Stark "	tion to Siam,
		" A. S. Nelson "	where he died on
" G. E. Parker, Extra Assistant Superintendent, 5th grade, up to 4th January 1898.		<i>Native Draftsmen.</i>	16th July. The
		Babu Purna Chandra Sen.	vacancies thus
" J. Campbell, Extra Assistant Superintendent, 5th grade.		Munshi Muttyullah up to 17th August 1898.	caused were filled
" S. O. Madras, Sub-Assistant Superintendent, 1st grade.		" Rahim Baksh up to 20th September 1898.	up by the appoint-
" A. H. Peychers, Sub-Assistant Superintendent, 2nd grade.		Babu Sarat Chandra Chatterjee.	ment of Mr. E. W.
" C. C. Byrne, Sub-Assistant Superintendent, 3rd grade.		" Narendra Nath Mukherjee.	Stark and Mr. A.
		" Subodh Chandra Sarkar.	S. Nelson.
		" Sarat Chandra Coomar and 28 others.	

361. During the year the amalgamation of the three drawing offices, *viz.*, Calcutta, Simla and Dehra, was effected and all the draftsmen, both European and Native, have been put on to one list.

362. This Section has as usual been employed to a very large extent in dealing with the compilation of the maps of the several frontier series ; of those of the North-Eastern Frontier series, sheets Nos. 15 N. E. (3rd edition), 23 N. W. (8th edition), and 23 S. E. (2nd edition) on the 4-mile scale were brought up to date and published ; sheet No. 23 S. W. (8th edition), parts of sheets Nos. 23 N. W. and N. E. on the 4-mile scale, as well as sheet No. 23 (2nd edition) on the 8-mile scale, were corrected and brought up to date. Of the South-Eastern Frontier series, sheets Nos. 1, 2, 3, 4, 5, 6 and 8, on the 8-mile scale were also added to, corrected, and brought up to date ; and the following published : sheet No. 1 N. E. (6th edition), No. 1 N. W. (5th edition), No. 2 S. E. (5th edition), sheet No. 2 N. W. (2nd edition), No. 2 S. W. (2nd edition), No. 5 N. W. (5th edition), all on the 4-mile scale ; also sheet No. I. (5th edition) on the 8-mile scale.

363. The standard sheets of Upper Burma on the 1-inch scale have been added to, by the publication of sheet No. 306 with additions and corrections to date ; sheets Nos. 314 and 359 were completed and published ; and sheet No. 268 (2nd edition) is at present under publication.

364. The standard sheets of the other provinces on the 1-inch scale which were added to, changes made in boundaries and otherwise brought up to date, were as follows : of Bengal, 3 sheets ; Central India and Rájputána, 7 sheets ; Central Provinces, 4 sheets ; Hyderabad, 1 sheet ; Punjab, 1 sheet ; and 2 sheets of the Bombay series on the 2-inch scale were also completed and published, *viz.*, Nos. 199 N. E., and 199 S. E. ; and 3 sheets of Central India and Rájputána, and 4 sheets of Central Provinces are still in hand.

365. Among the General maps, those which might be specially mentioned here are.—The 3rd edition of the 32-mile map of India which was brought up to date and sent to press for publication ; Burma and adjacent countries on the 32-mile scale ; India, 32-mile scale, showing railways ; India, 32-mile scale, showing canals ; India, 32-mile (skeleton) ; also India, 128-mile scale, and India, 256-mile scale, were all brought up to date and completed. A new Railway Map of India on the 32-mile scale, showing railways and steamer stations, was put in hand and is nearing completion for press ; this map is to take the place of the old 64-mile map hitherto used, as the scale has been found too small and the map is now too crowded with names of stations, so much so, that it is difficult

to make any more additions to it. Another map of India on the same scale (32-mile), showing railways on the different gauges, canals in blue, and hills in grey, was also newly prepared for the Military Department and sent to press; this map will be published during the coming year.

366. The provincial maps of India on the 16-mile scale were all more or less added to and brought up to date, that of Bengal, Bihar and Orissa had the hills brush-shaded and sent for engraving. The map of the Madras Presidency is still under compilation from material supplied by the Madras Revenue Survey and will be ready for publication early next year. The divisional map of Tenasserim was brought up to date and published, and 17 district maps were also revised and brought up to date.

367. Of the sheets of the Atlas of India, 77 passed through various stages, such as additions made to railways, roads, canals, boundaries, and names, etc., 8 of which had the hills brush-shaded and sent for engraving.

368. The maps for the Administration Reports of the several Provincial Governments, which were attended to, were those of the Punjab and Upper Burma, that of Assam had the hills brush-shaded and sent for engraving; also 25 district maps on the 8-mile and 16-mile scales were corrected and added to, those of Chhindwára, Mirzápur, and Hoshiárpur had the hills added in brush-shading for engraving.

369. Of the cantonment and city plans, 91 were corrected and brought up to date, from recent data supplied by the Military Works Department or Local Governments.

370. In addition to the preparation of the 32 Index maps required for this report, a large number of special maps were prepared and printed for the Military Department; being mostly maps of cantonments including the country within a radius of 12 miles, also maps to illustrate the Famine Report of Bengal, the Famine Report of the Central Provinces, the Sanitary Commissioner's Report on cholera and mortality in Central Provinces; 4 sets of the map of India on 192-mile scale, showing the quinquennial progress of education 1892-97, for Home Department; also 14 maps in connection with the work of the Burma-China Boundary Commission.

371. The colouring of 1946 maps as office copies and for other Departments was also accomplished. A large amount of professional data was supplied to various officers and to the Portuguese Government of Goa. The correspondence in connection with the work of this section still keeps increasing, no fewer than 2,500 letters having been received and answered during the year under report.

SECTION II.—REVENUE.

372. The work of this section consists in examining and preparing for

Personnel.

Mr. T. Shaw, Head Draftsman, up to 11th December 1897.
 " G. Campbell, do. do. (*sub. pro tem.*), from 12th December 1897 to 12th April 1898.
 " E. P. S. Hill, Head Draftsman, from 13th April 1898.

Sub-Assistant Superintendents on duty.

Mr. H. W. Biggie, Sub-Assistant Superintendent, 2nd grade, up to 1st April 1898.
 " H. H. B. Hanby, Sub-Assistant Superintendent, 2nd grade, from 20th February 1898.
 " P. K. Vaughan, Sub-Assistant Superintendent, 2nd grade, from 10th October 1897.

Native Draftsman.

Munshi Abdúl Azíz.
 " Abdúl Ruzzaq.
 Babu Tincory Sen.
 " Bacharam Banerjea.
 " Ram Chunder Sen and 20 others.

Sub-Surveyor, etc., on duty.

Babu Rhedoy Chunder Das.

from the field parties of the Revenue Branch; in bringing up to date, and republishing the old maps; in the preparation of the index maps for field parties and for the General Report; in colouring maps on various scales; in tracing maps, furnishing plans, and supplying data to Government Officials and others. The examination of the field books, and azimuth computations, etc., on which the several Revenue Surveys are based, is also done in this section.

373. Of the maps of district Pesháwar (Punjab) reported on last year in paragraph 409, the drawing of four sheets on scale 1 inch = 1 mile for reproduction to full scale was finished, and two of them are passing through press; the compilation of the remaining sheets is in progress.

374. One sheet of district Montgomery (Punjab) has been recompiled from the old

pargana maps on scale of 1 inch=1 mile for republication on full scale, and passed with final press order, and one printed sheet of this district has also been corrected to true standard form and sent to press for reprint.

375. Three sheets of district Hissar and five sheets of district Umballa and Karnál were corrected up to date, and additions to boundaries, roads, etc., made thereto; and eleven sheets of district Dera Gházi Khán were revised as to their boundaries from materials furnished by the Settlement Officer.

376. The old sheets of the North-Western Provinces, previously printed without village boundaries, were completed from five sets on scale 2 inches=1 mile, and corrected up to date from information supplied by local authorities, and were sent to press for reduction to scale 1 inch=1 mile; besides this a large number of sheets of this Province, Bengal, Bombay and Lower Burma on scale 1 inch=1 mile were also corrected and brought up to date, for republication from materials supplied either by the district officials or from data obtained from latest surveys.

377. Corrections have been made in spelling of names and details of nine sheets of districts Hooghly and Howrah, on scale 2 inches=1 mile for a new issue on scale 1 inch=1 mile; the typing of the sheets is well advanced.

378. Of the sheets of district Tavoy (Lower Burma) reported on last year in para. 410, the drawing and typing of two sheets (in 8 sections) were finished and other two sheets are nearing completion.

379. Three large scale plans of the cities of Cawnpore on the 12-inch scale, Allahabad and Lucknow on the 6-inch scale were corrected, and additions made thereto from information supplied by the Executive Engineer and Military authorities, and a map of Calcutta city with suburbs (in two sections) on scale 6 inches=1 mile is being recompiled from the materials of the last Calcutta and Dihí-Panchánnagrám surveys. A map of Moulmein Town (complete in 8 sheets) on scale 400 feet=1 inch has been corrected and published; the same map (complete in 69 sheets) on scale 50 feet=1 inch has also undergone corrections, of which 50 sheets were published last year and the remaining 19 are in press.

380. One sheet embracing the northern section of the map of Calcutta and surrounding country has been compiled from the sheets of districts Hooghly, 24-Parganas and Nadia on scale of 1 inch=1 mile, and the two southern sections of the same were corrected up to date from the materials furnished by the local authorities. The whole was published as a third edition.

381. In addition to the above, a large amount of mapping has, as usual, been done for other departments. A special map of Narhan estate has been compiled from the sheets of district Monghyr on scale of 1 inch=1 mile for reduction to $\frac{1}{4}$ inch scale, for the Director of Land Records and Agriculture, Bengal, and a plan in two sections on scale of 4 inches=1 mile of Naiháti Municipality was prepared for the Chairman of that Municipality.

382. The traverse computations of districts Amherst and Palámau extending over eight seasons were thoroughly examined during the year. Traverse data, calculation of areas and such like information has, as usual, been prepared in this office, and supplied to field parties and district officials. Of traverse data, 589 pages were copied and supplied. A traverse of Captain Anderson's survey of the Nepál boundary along the Province of Oudh was prepared from his field-book of 1859-60 for record and use of this office. Latitudes, Longitudes and direct distances of revenue survey points in districts Nimár, Hoshangabad, Prome, Tharrawaddy and Henzada were calculated, also bearings and distances of *pucki* pillars on the Bhután and Assam boundary and of points of the Hooghly river survey. An area statement showing the areas of all the districts in the North-Western Provinces and Oudh was prepared for North-Western Provinces Government. The areas of districts Dera Gházi Khán, Dera Ismáil Khán, Bannu and Hazára of the Punjab according to *parganas* and *tahsils* were calculated, and the area of district Puri according to *parganas* by summation of villages was prepared and supplied. The co-ordinates of all triple junctions of villages of districts Prome, Tharrawaddy and Henzada falling in Burma standard sheets Nos. 179 and 181 were calculated and plotted from one common origin. Traverse circuits and *pardahs* of two groups of villages were calculated and plotted, and congregated village maps prepared and supplied to the Collector of Nadia. Eighty-six tracings of sheets and forty-nine tracings of village

plans were also made and supplied to district and other officers. Fifty maps on various scales were coloured. Eleven thousand four hundred twenty-seven maps coloured in Map Record and Issue Office for stock were examined in this section.

During the year under report a large amount of correspondence was dealt with by this office, the total number of letters being 1,265.

SECTION III.—CADASTRAL.

383. This section is employed in preparing the original maps of all cadastral surveys for photozincography and zincography. The maps to be examined are, on receipt of the originals, submitted to a cursory examination in order to see that the sheets are in every respect fit for reproduction.

Personnel.

Mr. J. H. D. Ewing, Sub-Assistant Superintendent, 1st grade.

Permanent Establishment.

6 Draftsmen.
1 Writer.

Temporary Establishment.

6 Tracers.
3 Moharrirs.

384. In the North-Western Provinces the returns for the previous year showed 3,939 sheets of district Garhwál remaining to be published, and during the year 3,306 sheets of the same have been published, so the balance of 633 sheets remain to be printed during next season; of these 430 sheets have been prepared for publication.

385. In Burma the returns for the previous year showed 1,214 sheets remaining to be published, and during the past 12 months 1,808 sheets of districts Katha, Kyauksè, Meiktila, Magwe and Mandalay of Upper Burma and Pegu of Lower Burma were received from Parties; out of these 1,114 sheets of the same have been published, leaving a balance of 1,908 sheets remaining to be printed; of these 500 sheets have been prepared for publication.

386. In Assam the returns for the previous year showed 71 sheets remaining to be published and during the past twelve months 304 original sheets of district Cachar were received; out of these 311 sheets have been published during the year, leaving a balance of 64 sheets remaining to be printed; of these 50 sheets have been prepared for publication; 5 sheets of district Kámrúp were published. Those remaining incomplete are districts Kámrúp (8 sheets), Sibságar (8 sheets), and Sylhet (45 sheets). These are mostly blocks and waste lands, and, under existing orders, are not to be printed.

The total number of maps passed for publication during the year was 4,800: of which 4,731 were actually printed, 3,526 having been photozincographed and 1,205 zincographed. At the close of the year there were remaining to be published 2,666 sheets against 5,285 sheets in last year, showing a decrease of 2,619 sheets.

387. The services of 3 *moharrirs* were sanctioned by the Board of Revenue to do all the *badar* corrections of district Tippera which was supplied to this office by the Settlement Officer; of this 900 original sheets have been corrected of the northern and central divisions of the district.

388. In addition to this a good deal of miscellaneous work for Collectors, Settlement Officers and others has been done.

SECTION IV.—BENGAL PROVINCIAL.

389. The Cadastral maps dealt with during the year under report were those of Bihar, Orissa, and Chittagong.

Personnel.

Mr. E. P. S. Hill, in charge from 1st October 1897 to 13th April 1898.
Mr. A. B. Smart, in charge from 14th April to 30th September 1898.
Mr. P. K. Vaughan, from 1st October to 5th November 1897.
Mr. C. C. Byrne, from 13th April to 30th September 1898.

Permanent Establishment.

6 Draftsmen.

Temporary Establishment.

6 Computers, Writer, etc.
5 Draftsmen.

For Bihar, 1,672 Cadastral maps were received during previous years and were reduced by pentagraph to the scale of 2 inches = 1 mile for the completion of the standard sheets; there were received during the year 1,062 maps.

390. The reduction of 4,864 cadastral maps of Orissa

received during previous years, to the scale of 2 inches=1 mile was completed during the year under report, this completed the reduction of the Orissa maps.

391. From Chittagong 3,264 cadastral maps were received, of which 1,120 were reduced to the scale of 2 inches=1 mile, the total number of sheets dealt with of Chittagong reached 1,844, of which 727 were received during previous years.

392. For Bihar 44 sheets have been outlined and completed. The interior details of 56 were examined and 16 were finally examined and forwarded to the Photographic Office for reduction to the scale of 1 inch=1 mile. The outlining of 56 sheets has yet to be dealt with though several have been plotted, and the details of a number reduced by pentagraph.

The publication of the Orissa standard maps has for some time been brought to a standstill owing to numerous unsettled boundary disputes and the non-return of the proof sheets from the Settlement authorities. The outlining of four sheets was completed during the year under report. The publication of the Chittagong standard maps will be taken in hand during the current year. The 26 sections on the scale of 2 inches=1 mile of the Orissa standard sheets containing irrigated areas, specially called for by the Government of Bengal, have not yet been published owing to the numerous additions that are being made to them at the request of the Canal Department.*

ENGRAVING OFFICE.

393. Mr. A. E. Spring held charge of this office throughout the year.

Personnel.

Mr. A. E. Spring, Assistant Surveyor-General in charge.	
" J. Fulford, Head Engraver.	
" S. M. Coard, Engraver.	
" T. B. Rodger, " retired November 1897.	
" A. W. N. James, "	
" A. R. Coard, " on furlough.	
" E. Earle, "	
" F. R. C. Scallan, "	
" E. C. V. Ollenbach, "	
" L. H. Musgrove, "	
" A. T. Vieux, "	
" A. E. W. Cann, "	
" H. H. Green, "	
30 Native engravers.	
1 Apprentice "	

Copper-plate Printing Section.

Mr. W. T. Collins, Copper-plate Printer.	
" A. E. Pilley, Assistant Copper-plate Printer and Store-keeper.	

Mr. T. B. Rodger, who had been on furlough on medical certificate, was invalided in November 1897. Mr. A. R. Coard was on furlough to Europe till 25th September 1898.

394. The outturn of work for the year has been very satisfactory, it being in excess of last year in all items except outline; but many sheets were under correction for accentuating the village names, and this work accounts for the slightly less outturn in that branch.

395. The sheets published during the year are six quarter atlas sheets, fourteen district maps for administration reports, the 16-mile map of Gujarát (with hills), four plates of a daily weather report for the Photo-Litho. Office, a scale plate containing 5 scales, and 2 tint plates.

396. Sixty-five unpublished quarter atlas sheets in various stages of progress have been added to and corrected, 63 published quarter sheets and 26 full plates have been brought up to date for printing, and 25 quarter sheets have been projected and borders cut. In all 310 plates have been in hand.

397. The map of India, 128 miles, has been brought up to date, a matrix and duplicate taken and the hills put in hand on the original plate. The 256-mile map has also been brought up to date. Of the 16-mile provincial maps, Bengal, in 2 sheets, has been nearly completed in outline and writing as far as material supplied, but there are still blank portions in each sheet waiting to be filled in with the latest available material, Bombay has been completed as far as material supplied, Madras has been completed in outline and writing as far as material supplied in all sheets but No. 5, which is waiting the return of the duplicate plate to complete the Travancore State, the four sheets of Punjab and Kashmir without hills have been in hand to bring them up to date for publication, and good progress has been made with them, sheet No. 2 of the hill edition is well advanced, the two sheets of Rájputána have had additions made to them.

* Mr. Stotesbury and Mr. Hill in their posts as Chief and Head Draftsmen, respectively, supervised their establishments very efficiently. Messrs. Wyatt, Smart and Ewing have also done well as heads of the Examining, Bengal Drawing, and Cadastral Sections. Mr. Madras has also done very good work. The European draftsmen have been well reported on, especially Messrs. Green and Musgrove, and of the Native Establishment, Baboo Purna Chandra Sen, Sarat Chandra Chatterji, Narendra Nath Mukerji, Subodh Chandra Sarkar, Bepin Behari Ghose, Tincory Sen, Bacharam Banerji, Abdul Azzis, Abdur Razzaq, R. C. Sen, and Habibnurr Rahman, amongst others, have rendered good service.

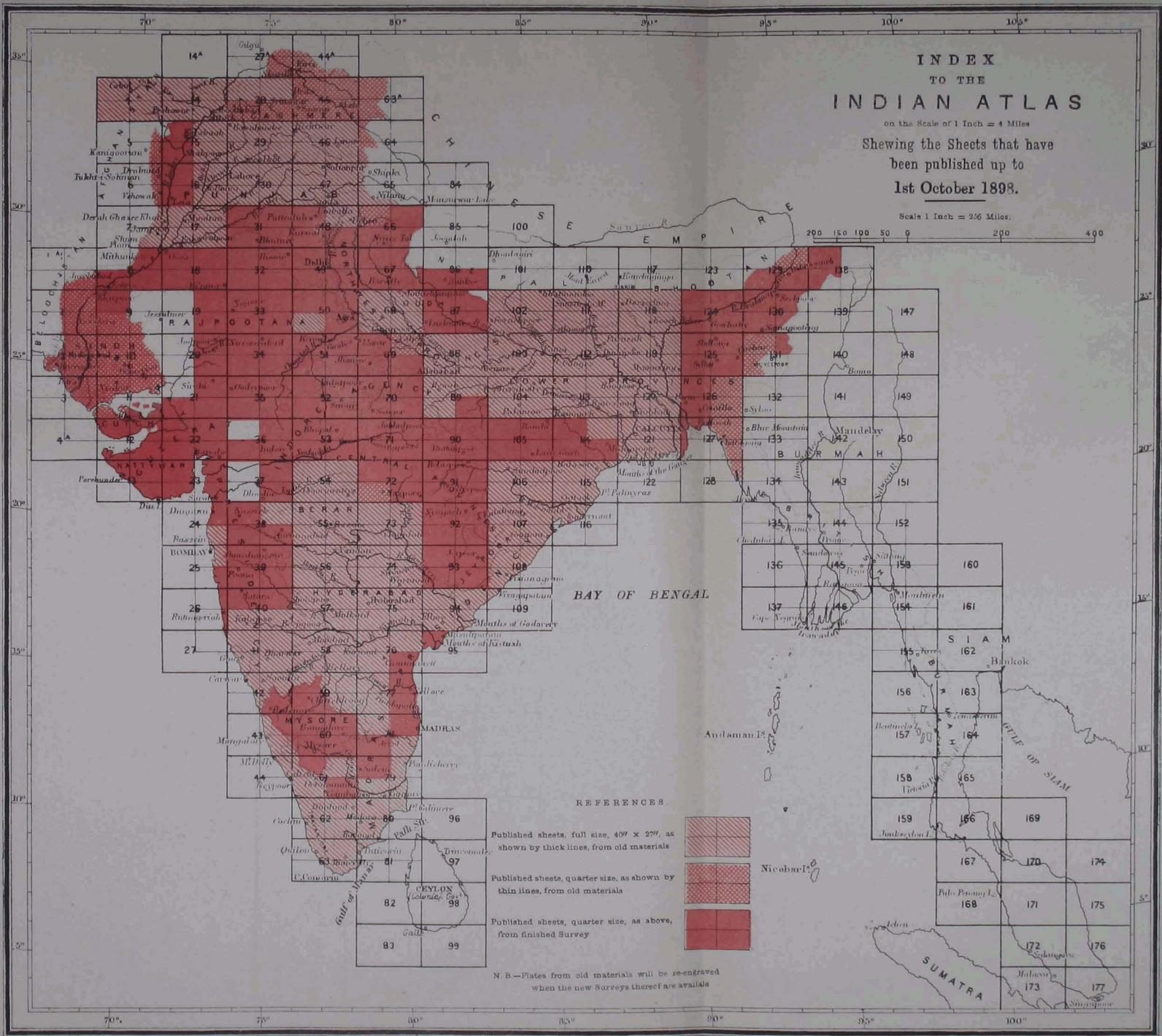
INDEX TO THE INDIAN ATLAS

on the Scale of 1 Inch = 4 Miles

Shewing the Sheets that have
been published up to
1st October 1893.

Scale 1 Inch = 256 Miles.

200 150 100 50 0 200 400



REFERENCES.

- Published sheets, full size, 409 x 270, as shown by thick lines, from old materials
- Published sheets, quarter size, as shown by thin lines, from old materials
- Published sheets, quarter size, as above, from finished Survey

N. B.—Plates from old materials will be re-engraved when the new Surveys thereof are available



Photo-Block

Survey of India Office, Calcutta, March 1899.

STATUE IN CALCUTTA
of
Field Marshal Lord Roberts of Kandahar,
V.C., G.C.B., G.C.S.I., G.C.I.E.,
COMMANDER-IN-CHIEF OF HER MAJESTY'S FORCES IN INDIA
From November 1885 to April 1893.

398. Two provincial maps for administration reports have been added to and 21 district maps for the same, besides the 14 mentioned as published, have been in hand; four sheets of the plan of Calcutta, 16 inches = 1 mile, and a plan of Simla and Jutogh have had corrections carried out on them. The Index chart to the Great Trigonometrical Survey and two Indian weather charts have been added to. Forty-eight plates have had the titles and footnotes engraved for the Photo-Litho. Office.

399. The Copper-plate Printing Section has printed 25,971 impressions, which is in excess of the last four years and about as much as this Section can turn out with its present staff. The Steel-facing Section has dealt with 245 plates, which is more than treated last year.*

THE PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE.

400. Mr. T. A. Pope remained in charge of this Office throughout the year.

Personnel.

Mr. T. A. Pope, Assistant Surveyor-General in charge.

NORMAL ESTABLISHMENT.

LITHOGRAPHIC AND PRINTING DIVISION.

Mr. R. Fogarty, Head Assistant.
 " A. J. J. Rodrigues, Head Draftsman.
 Babu Ambica Charan Mookerjee, Draftsman.
 Munshi Abdool Mujeed, Examiner.
 1 Apprentice, 28 draftsmen, and 6 colourists.

Lithographic and Zinc Printing Section.

Mr. E. A. LeFranc, Head Printer.
 " D. Deas, Chromo-Litho-Printer.
 " S. U. Ravenscroft, Assistant Printer.
 1 Apprentice, 2 machine printers, 15 litho and zinc printers, 9 machine men, 17 spongemen, 40 pressmen, 1 paper wetter, 2 stone grainers, 2 stone polishers, 4 zinc grainers, 1 ink grinder, 1 engine-driver, and fireman.

Type Printing Section.

Mr. E. De Pyvah, Head Printer, 12 compositors, 3 type printers, 3 inkmen, 3 mates, 2 machine type printers, 2 machine inkmen, 1 impositor, 1 roller-moulder and 1 boy.

PHOTOGRAPHIC AND GENERAL DIVISION.

Mr. J. Harrold, Photographer, up to 24th June 1898.
 " C. J. Meade, Assistant Photographer.
 " F. N. Murphy, ditto.
 " N. J. Gonsalves, ditto.
 Munshi Habibul Hossain ditto, up to 23rd June 1898.
 Munshi Abdul Rahman, Assistant Photographer, from 1st July 1898.
 6 Assistant Photographers and 8 labourers.

Heliogravure Section.

Mr. A. W. Turner, Photo-engraver.
 1 Apprentice, 1 Assistant Photo-engraver, 1 engraver, 1 Assistant engraver, 4 copper-plate printers, 6 pressmen, and 11 plate polishers.

Correspondence, Stores and Account Section.

Babu Kanny Lall Sen, Store-keeper.
 Mr. A. B. Carville, Head Clerk.
 Babu Kedar Nath Ghose, clerk, up to 31st January 1898.
 " Khetter Mohan Dass, clerk, from 1st February 1898.
 " Gopal Chunder Mookerjee, clerk.
 " Surja Kumar Banerjee, clerk.
 " Rajani Kanta Chatterjee, clerk.
 4 Clerks and 1 paper-keeper.

CADASTRAL ESTABLISHMENT.

Photographic Section.

Mr. H. Howard, Head Assistant.
 " R. George, Photographer.
 " L. Lagnier, ditto.
 " J. Lloyd, ditto.
 " J. Vieux, Assistant ditto.
 7 Assistant Photographers and 10 labourers.

Zinc Printing Section.

Mr. F. R. Vandyke, Zinc Printer.
 " J. B. Mackenzie, ditto.
 " P. Michael, Assistant Zinc Printer.
 Babu Khetter Mohan Dass, clerk, up to 31st January 1898.
 " Ganoda Persad Pal from 1st February 1898.
 1 Clerk, 9 zinc correctors, 9 zinc printers, 10 spongemen, 17 pressmen, and 11 zinc grainers.

On the 24th May 1898 the Office lost the services of Mr. J. Harrold, Photographer, who retired on pension after an efficient service of 22 years. Four old members of the native staff also retired on pension during the year, viz., Munshis Abdul Futtah and Elahi Bux, draftsmen, and Tamizuddin, zinc corrector, and Babu Kedarnath Ghose, clerk. The first three had all rendered excellent service for periods of over thirty years, and the last had completed 38 years and was a most useful clerk.

Owing to Mr. Harrold's retirement, Mr. R. George, Photographer, who had been acting as Storekeeper, was placed in charge of the Transfer-printing Section, and Mr. A. B. Carville, head clerk, took charge of the Stores Section.

401. The following is an abstract of the year's outturn of work in each section of the Office :—

* Mr. Spring reports that the Head Engraver, Mr. Fulford, has as usual given great satisfaction in the discharge of his duties. Both the European and Native engravers and the Copper-plate Printer have given entire satisfaction.

General Abstract of work done during the year 1897-98.

CLASSIFICATION.	Sheets of subjects.		PHOTO-ZINCOGRAPHIC AND LITHOGRAPHIC PRINTING.							TYPE PRINTING.			SILVER AND OTHER PRINTING.		HELIOGRAVURE AND ELECTROTYPING.		VALUE.			
	Subjects.	Negatives and transparencies.	Photo-transfer prints.	Zinc Plates transferred.	Zinc Plates printed.	Stones.	Pulls.	Number of copies.			Pages or items.	Pulls.	Copies.	Silver Prints.	Blue Prints.	Heliogravure Plates.		Heliogravure Prints.	Photo-Blocks.	Electro types.
								Coloured.	Uncoloured.	Total.										
Departmental maps . . .	785	1,081	1,152	422	339	50	161,253	23,385	132,769	156,155	13,819	1,176,837	700,756	230	1,306	8	2,521	7	13	58,654 0 3
Cadastral maps . . .	4,477	3,288	3,443	4,649	4,619	...	103,530	...	94,328	94,328	...	...	...	...	...	...	...	...	...	56,325 14 3
Extra-Departmental maps, etc.	1,102	873	566	316	578	471	580,779	101,455	343,873	445,329	...	...	...	53	868	93	71,286	75	...	77,937 9 6
Totals . . .	6,364	5,242	5,161	5,387	5,566	523	845,562	124,831	570,971	695,812	13,819	1,176,837	700,756	283	2,174	101	73,801	82	13	1,92,927 8 0
TOTALS OF 1896-97 . . .	7,880	6,272	5,794	6,438	6,749	544	853,945	144,074	709,990	853,072	10,054	991,543	529,664	354	3,207	131	72,246	...	13	2,13,517 14 8
Differences . . .	1,516	1,030	633	1,051	1,183	20	8,383	19,243	138,027	157,260	3,765	245,294	171,092	71	1,093	30	1,555	82	...	20,590 6 8

There was a falling off in the number of original subjects received for reproduction, which is chiefly due to the large reduction in the number of cadastral sheets sent in by the field parties; though the number of maps and other subjects, both departmental and received from other departments, is also somewhat smaller than last year. The total number of copies printed from zinc and stone amounted to 695,812, against 853,072 last year, though the number of pulls is nearly the same, *viz.*, 845,562, against 853,945 last year. The decrease in the number of copies printed is in cadastral maps and extra-departmental subjects, there being a large increase in the number of departmental maps printed. The proportion of subjects of which only a small number of copies are required seems to be yearly on the increase, and it is therefore impossible to estimate the total amount of work done by the number either of pulls from the machines and presses or of finished copies printed, as the amount of time and labour involved in getting a stone or plate ready for printing is the same whether the number of copies printed be 100 or 10,000. The Type-printing Section shows a large increase over last year, the number of pages or items set up being 13,819, against 10,054, and of copies 700,756, against 529,664. The Heliogravure Section also shows an increase in the number of photogravure prints, though a smaller number of plates was etched, *viz.*, 73,801 prints from 101 plates, as against 72,246 prints from 131 plates last year. A large quantity of work which would formerly have been turned out by the photogravure process was this year printed from half-tone blocks made by the enamelline process. Eighty-two half-tone blocks were prepared by this process, and 8,100 prints made from them in the Type printing Section, thus relieving to some extent the strain on the copper-plate printing staff. The number of hand-engraved plates electrotyped was thirteen—the same as last year. Less work was done in the Silver-printing Section, the outturn both of blue prints and silver prints being smaller than last year.

402. Among the more important departmental publications dealt with during the year, the following may be specially mentioned:—

Additions and corrections continued to be made to the six sheets of the third edition of the map of India, with hills, on the 32-mile scale. In February 1898 the Government of India sanctioned the publication of this map. There were at that time considerable additions to be made to each of the sheets, and when these were completed it was necessary to pull retransfers from all the stones and put them down on zinc. This was due to the fact that the stones, having been several years under correction, had become quite unprintable. The new plates of sheets Nos. 1 and 4 will require a good deal of touching up after retransferring, but it is practically certain that the map will be finally published during December 1898.

Of provincial maps, the skeleton map of the Punjab and surrounding country, on the 32-mile scale, has been published and 650 copies were supplied. Two maps of Bengal, Bihar, Orissa, and Chota Nájpur were published during

the year, one on the 16-mile scale, and the other on the 32-mile scale, the former being photozincographed, and the latter lithographed. Two hundred copies were printed off of each.

The following district maps were printed off:—Sháhábád, 4 sheets; Pesháwar, 6 sheets; Sylhet, 11 sheets, and Ráwalpíndi, 4 sheets, all on the 1-inch scale. Also district maps of Bogra, Darbhanga, Nadiá, Pabna, Champáran, Darjeeling, Gaya, Howrah and Palámau on the $\frac{1}{4}$ -inch scale, and sheet No. 6 of the map of the 24-Parganá's on the 1-inch scale, all of which were reprinted from stone or zinc.

Two hundred and twenty-one standard sheets of the Topographical and Revenue Surveys, on the 4-inch, 2-inch, 1-inch, $\frac{1}{2}$ -inch and $\frac{1}{4}$ -inch scales, were taken in hand during the year either for reprinting or as new publications. Eighty-two plates were printed off, comprising 48 sheets on the 1-inch scale, and including 1 of Balúchistán, 2 of Bengal, 3 of Bombay, 10 of Upper Burma, 3 of Lower Burma, 13 of Central India and Rájputána, 3 of the Central Provinces, 8 of the Indus River survey, 1 of Hyderabad, 1 of the North-Western Frontier, 1 of the North-Western Provinces and Oudh and 2 of the Punjab. Of the Trans-frontier surveys, 6 sheets on the $\frac{1}{4}$ -inch scale and 2 sheets on the $\frac{1}{2}$ -inch scale of the S.E. Frontier, and 1 sheet on the $\frac{1}{2}$ -inch scale of the N. E. Frontier were printed off. Twenty-one sheets of the Lower Burma Survey on the 4-inch scale, and 4 sheets of the Balúchistán survey on the $\frac{1}{2}$ -inch scale, were also printed off.

The following city and cantonment plans were printed off:—Map of Simla and Jutogh, on the 6-inch scale; city and cantonment of Jubbulpore, on the 8-inch scale, and Sipri, on the scale of 500 feet to the inch. Maps of the cantonment of Allahabad (in 9 sheets, on the 12-inch scale), and Bareilly (in 21 sheets, on the 16-inch scale) were photozincographed.

The following miscellaneous departmental publications may be mentioned:—A map of Hswe Htame (Wa country), on the $\frac{1}{2}$ -inch scale; various maps and sketches illustrating the operations of the Tirah Field Force; a map of the Yunnan frontier, Upper Burma, on the $\frac{1}{4}$ -inch scale, with hills in brown; a map pertaining to the Northern Party, Burma-China Boundary Commission, in 3 sheets, on the 1-inch scale, with hills in brown, and a reconnaissance map on the $\frac{1}{4}$ -inch scale of the same country. As usual, a considerable number of sheets of the forest surveys in Madras were photozincographed and printed off. A number of maps, diagrams and eye-sketches were also reproduced for the report on the total eclipse of the sun issued by this Department.

403. The number of subjects received from other departments and dealt with during the year was 1,102, as against 1,197 last year, and the number of copies printed 445,329, against 600,702.

Perhaps the most important extra-departmental undertaking of the year was the volume of maps and charts prepared to illustrate the report on the Plague in India issued by the Home Department. These were 29 in number, and were nearly all either lithographed or photozincographed in colours, 28,000 copies being supplied. For the Revenue and Agricultural Department three maps of India to illustrate Dr. Voelcker's report on the Improvement of Indian Agriculture were lithographed in six colours, and 1,050 copies of each were printed. For the Finance and Commerce Department a diagram showing the course of Exchange and price of Silver in London from January 1892 to December 1897 was lithographed and 450 copies were printed.

For the Director of the Royal Survey Dept., Siam, a map of the Kingdom of Siam and 11 district maps of that country were photozincographed and 230 copies of each supplied. For the Colonial Secretary, Singapore, a map of Penang island and the province of Wellesley, in two sheets, was photozincographed and 500 copies printed off.

A map of India and the Punjab, to illustrate the rail and river-borne trade was lithographed in colours for the Financial Commissioner, Punjab, and 460 copies were supplied; and for the Chief Engineer, Public Works Department, Punjab, a map of the Simla Extension in three sheets, was photozincographed and 300 copies were printed. Thirteen thousand copies of various section papers were reprinted from stone for the Chief Engineer, Irrigation Works, Punjab.

For the Director General of Military Works, maps of the country 12 miles round Ajmere, Deoli, Nusseerabad, Neemuch, Sirdarpore and Mhow were photo-

zincographed, but only that of Mhow was printed off during the year. For the same officer a plan of the Bareilly water-supply scheme was lithographed in seven colours and 150 copies were supplied. Five-mile radius maps of Kohát and Abbottabad, and ten-mile radius maps of Umballa and Meerut were re-printed and copies supplied to the military authorities.

For the Director General of Telegraphs six diagrams pertaining to the telegraphic operations during the Tirah expedition were lithographed and 400 copies of each printed off.

Nine diagrams to illustrate a monograph on cotton fabrics were lithographed for the Director of Land Records and Agriculture, Bengal, and 500 copies of each were printed; and a map of Chitagon was chromo-lithographed for the same officer, but not printed during the year. For the Director of Land Records and Agriculture, Burma, eight sheets of the Moulmein town survey, on the scale of 400 feet to the inch, were photozincographed, and also a cantonment map of Moulmein.

For the Meteorological Department as usual a very large amount of work was done. Thirty maps and weather charts were reprinted, and 114,146 copies printed off during the year.

For the Archæological Survey of Madras the 62 inscriptions pertaining to the monumental remains of the Dutch East India Company, mentioned in last year's report, were printed off and 30 copies of each supplied. The plates of Part 4 of Mr. E. W. Smith's report on Fatehpur-Sikri were completed during the year; 59 plates were photozincographed and 650 copies of each printed. The remaining plates were photo-etched.

For the Asiatic Society of Bengal two plates showing the conspectus of text to accompany a report on the Ratnapála Grant were lithographed and 612 copies printed. Plates 1 and 3 of block-type figures from Khotan in Central Asia were photozincographed and 630 copies of each supplied. An old Persian damascened shield was lithographed in bronze and 1,000 copies printed for the Technical Art Series.

Seventy-seven sheets, out of a total of 358 sheets, of the Rangoon town survey, including one index and one reference sheet, were received during the year from the Rangoon Municipality. The index sheet was printed off and blue prints of the others were supplied.

404. The Heliogravure Section was fully occupied during the year on work of the usual kind, chiefly for other departments. Thirteen plates were photo-etched for the Technical Art Series of the year and 1,000 copies printed from each. For the Indian Museum Notes twelve plates were made and 1,025 copies of each printed. As usual, twelve plates illustrating the zoology of the R.I.M.S. *Investigator* were prepared, of which 250 copies were printed of each. Fourteen plates were etched for a catalogue of Echinoderma for the Indian Museum and 500 copies of each printed. For the earthquake report under preparation by Mr. R. D. Oldham, of the Geological Survey, seventeen plates were etched and 1,000 copies of each printed. For the Survey of India report on the total solar eclipse of January 1898 six plates were etched and 200 copies of each printed. The Enameline half-tone blocks prepared included 37 enlarged impressions of thumb marks, to illustrate a report on the subject of thumb impressions by Mr. E. R. Henry, C. S., Inspector General of Police, Bengal, and 18 views prepared from negatives submitted by the Geological Survey to illustrate the earthquake report.

405. In addition to the regular work of the Heliogravure Section, instruction was imparted to the late Captain E. D. Bullen, R. E., and Mr. J. O'Neill, from the Thomason College, Roorkee, in the processes employed in the section. A considerable amount of useful experimental work was carried on in the section during the year in electro-deposition for correcting hand-engraved plates, and in trichromatic photography, the details of which are given in the Appendix.

406. Mr. Pope, with a small party of assistants, proceeded to Dumráon in Bihar, in January 1898, to obtain photographs of the corona of the total eclipse, with results which were entirely successful. A separate report on this expedition has already been submitted to Government. The three English parties, under the Astronomer Royal, Mr. Stone and Sir Norman Lockyer, respectively, which came to India to make observations of the eclipse, were each

supplied with a photographer from this Office, and with photographic stores and apparatus of various kinds according to their requirements.

407. The scheme for the reorganisation of the Office, referred to in para. 439 of last year's report, which was submitted to Government early in the year, had not, at its close, received the sanction of the Secretary of State for India.*

MAP RECORD AND ISSUE OFFICE.

Personnel.
Mr. A. E. Spring, Officiating Deputy Superintendent, 1st grade, in charge.
" F. A. D'Rosario, Head Clerk.
,, H R. Vallis, Map-Curator; and 17 other clerks.

408. Mr. A. E. Spring was in charge of this office throughout the year.

409. The number and value of maps issued during the year are as follows:—

Maps issued.	Number.	Value.
		R.
General maps to Government officials	60,768	43,132
Ditto to India Office, London	3,572	4,667
Ditto to private individuals	8,842	11,133
Ditto to agents	1,447	2,244
TOTAL	74,629	61,176
Cadastral maps to Government officials	81,894	56,766
GRAND TOTAL	1,56,523	1,17,942

There has been a considerable reduction in the number and value of maps issued during the year when compared with those of the year preceding: during 1896-97 they were 2,07,330 and R1,57,927, whereas during the year under review they were 1,56,523 and R1,17,942; showing a decrease of 50,807 in number, and R39,985 in value.

The amount realized from cash sales was R19,314, *vis*, R11,133 from private individuals, R477 from agents, and R7,704 from Government officials; showing a decrease of R5,345 below the cash receipts of the past year.

In the Revenue Section 733 applications were received from private individuals for extracts from original records of the Revenue Surveys, and 2,249 for certified copies of village plans, tracings and traverses, which realized a sum of R7,687.

* Mr. Pope reports that Messrs. Fogarty and Haward, Head Assistants in charge of the Lithographic and Photographic Branches, respectively, have rendered most useful assistance in the management of the Office; that Mr. Turner, Photo-engraver, has as usual worked with zeal and skill, and that Messrs. LeFranc and Vandyke, in charge of the zinc and litho. printing sections, have continued to perform their duties efficiently. Messrs. Deas, McKenzie, Ravenscroft, Michael and DePyvah, in the litho. zinc and type-printing sections, and Messrs. George, Lagnier, Meade, Andrews and Murphy, in the Photographic sections, have all worked satisfactorily. Of the junior assistants, Messrs. Rodrigues, Carville, Vicux, Gonsalves, D'Silva and Francis are also well reported on.

Of the Native staff the following are specially mentioned:—Babus A. C. Mukerjee, Dino Nath Dass, Ashutosh Dass, and Munshis Abdul Mujid, Mohamed Yasin, and Enavetullah, draftsmen; Abdul Rahman, A. C. Bhattacharjee, Preonath, Abdul Ali, Abdul Wadood and Monmotho Nath Sett, assistant photographers. Of the clerical staff, Babu K. L. Sen, head clerk and accountant, has again given entire satisfaction, and Babus K. M. Dass, G. C. Mukerjee, S. K. Bauerjee, R. K. Chatterjee, G. P. Pal and N. N. Mookerjee, clerks, have all worked well.

The details of work are specified in the following statement and show a small decrease below last year's figures:—

Details.	Number.
Applications received for maps	3,969
Letters issued in reply	3,190
Cash and credit map sale bills	1,630
Invoices and receipts issued for published maps	2,336
Ditto ditto cadastral maps	169
Ditto ditto extracts from original records	332
Packets, parcels and local despatches	3,687
Ditto received in office	681
Packages despatched by rail and steamer	328
Ditto received ditto	41
Maps coloured for sale and issue	35,141
Ditto for other departments	550

A list of the maps and charts published during the year, copies of which have been stored in this Office, will be found at page 91.*

[MATHEMATICAL INSTRUMENT OFFICE.

410. The charge of the office was held by Lieutenant-Colonel J. R. Hobday, I.S.C., from 1st to 29th April and from 10th November 1897 to 31st March 1898, and by Major F. B. Longe, R.E., from 30th April to 9th November 1897.

Personnel.

Lieutenant-Colonel J. R. Hobday, I.S.C., Assistant Surveyor-General in charge, from 1st to 29th April and again from 10th November 1897 to 31st March 1898.
Major F. B. Longe, R.E., Officiating Assistant Surveyor-General, in charge from 30th April to 9th November 1897.

Workshop Branch.

Mr. T. Bolton, Mathematical Instrument Maker.
Mr. T. R. Theakston, Assistant ditto.

Store Branch.

Mr. M. C. Belletty, Instrument Store-keeper.
Babu Woomesh Chunder Chowdhry, Material Store-keeper.

Office Establishment.

Mr. W. Campagnac, Head Clerk.
" W. R. Tulloch, 2nd Clerk.
Six clerks and three temporary clerks.

411. This report refers to the financial year, *i.e.*, from 1st April 1897 to 31st March 1898, and not to the survey year from 1st October to 30th September. During this period the number of serviceable instruments received into store was 54,256 and their value was ₹2,61,816, whilst the number of those issued from store was 59,100 valued at ₹2,83,857. In the subjoined statement these figures are compared with those of the preceding year. Owing to the demand for instruments from Railways and other large works there has been an increase both in number and value of instruments issued. There also has been an increase in the value of instruments received, though their number is less.

	1896-97.	1897-98.	Increase.	Decrease.
Number of instruments received	61,558	54,256	...	7,302
Value of ditto in rupees	2,59,405	2,61,816	2,411	...
Number of instruments issued	50,727	59,100	8,373	...
Value of ditto in rupees	2,68,704	2,83,857	15,153	...

* Mr. Spring reports that Mr. D'Rozario has continued to perform his duties to his entire satisfaction. Mr. H. R. Vallis, Map Curator, has as usual rendered excellent service. Messrs. J. A. Vallis, S. A. Hazra and the other assistants have also worked satisfactorily. Mr. Bonnaud, who was transferred as assistant to the Map Curator, has worked well and performed the Map-Curator's duties satisfactorily during Mr. Vallis' absence on privilege leave.

From this table it will be seen that the number of serviceable instruments in store has decreased by 4,844 and their value by ₹22,041.

412. In the following statement are shown the principal sources from which the serviceable instruments were received :—

SOURCES OF RECEIPT.	Number.		Value.
	1896-97.	1897-98.	
From England on indent	16,046	17,039	81,090
By purchase in the local market	12,117	5,757	36,773
Manufactured in the workshop	7,045	14,374	28,766
Returned to store by public officers	8,865	11,836	9,132
From repairable stock after repair	17,474	5,250	1,06,055
From other sources	11	...	.....
TOTAL	61,558	54,256	2,61,816

The number of the instruments received from England on indent has increased by about 993, while their value has decreased by about ₹11,278. This is mainly due to the fact that no indents for the large expensive instruments such as levels and theodolites have been made for three years, all such instruments having been supplied from the repairable stock, which is being put into serviceable order by the establishments sanctioned for their repair. The value of instruments purchased in India has increased by about ₹5,099. The number and value of instruments issued has increased by 8,373 in number, and ₹15,153 in value. The number of instruments manufactured in the workshop has also increased this year owing to the demands on this office from various departments being more this year than the previous one. Their class and value will be found in Table C in the Appendix.

413. The number of instruments taken from the repairable stock and rendered serviceable by the workshop is smaller in number than last year, but their value when repaired is in excess of that of last year. During the year under report, the office has received into store 7,644 repairable instruments valued at ₹92,059, compared with 20,857 valued at ₹82,453 in the previous year. The total number of instruments from the repairable stock which were rendered serviceable was 5,250 and their original value was ₹66,382. These were repaired in the workshop at a cost of ₹39,673 and transferred at the enhanced value to the serviceable stock. The repairable stock has thus been increased by 2,394 instruments, valued at ₹25,677. This result is due to large returns of instruments into store by public officers, the number being so large as to defy the best efforts of the workshop to reduce the stock of repairable instruments, although, as shown above, the number and value of the instruments rendered serviceable has considerably increased this year.

414. The conversion of old pattern levels and theodolites, alluded to in para. 446 of last year's report, has been steadily continued, and during the year under report 80 levels of obsolete patterns have been converted into serviceable instruments and issued.

Since the increased establishments for the repair of instruments have been sanctioned as already alluded to in previous reports, 416 levels and 107 theodolites have been converted and issued and all indents for such instruments on England have been discontinued.

415. During the year the number of indents complied with was 1,598, being about 300 more than last year. They were of the usual description and were submitted from all parts of India.

416. The cash payments for charges under ₹50 amounted to ₹38,776, being more than the previous year by ₹7,648.

417. The value of the English indents for the last five years is shown in the following table, which gives some indication of the saving which is being effected by the utilisation of the extra grant for repairing instruments :—

Year.	Value of English Indent.
	£
1894-95	12,981
1895-96	5,208
1896-97	5,079
1897-98	3,995
1898-99	4,823

418. Table A (in the Appendix) shows the amount of debits against various officers and departments for instruments supplied and for work done. It also exhibits the credits for all instruments and materials returned to store. The value of the issues and repairs executed on book debit was ₹2,57,239, being ₹9,259 more than last year. This amount includes the value of instruments purchased with the extra departmental grant of ₹30,000, out of which ₹29,151 was expended. The credits for instruments returned into store amounted to ₹1,00,786, which is an increase on the previous year. The grand total of the value of supplies, including the cash sales, is ₹2,96,015, or about ₹17,000 more than last year.

419. The total number of instruments of all kinds repaired amounts to 5,106 or about 178 less than last year.

420. The profit and loss account of the workshop will be found in the Appendix, the result of the operations showing a nominal profit of ₹2,625 from which it appears that the rates for work are fairly correct. A large number of indents were received during the year for instruments such as signalling equipment, range-finders, Scott's sights, clinometers, etc., used by various regiments in the Tirah Expedition. All these demands were efficiently and promptly supplied.*

* The Assistant Surveyor-General reports that Mr. Bolton has conducted the management of the Mathematical Instrument Office with ability, and that he has worked with zeal and energy. Mr. Theakston, his Assistant, has performed his duties efficiently and with thoroughness, and has been well reported on.

In the Correspondence and Store branches, Messrs. Campagnac, Belletty, and Tulloch have given entire satisfaction, and among the native assistants the following are deserving of special mention :—Durga Churn Ghose, Gossain Das Roy, Shib Chunder Ghose, and Narain Chunder Banerji, Clerks; and Woomesh Chunder Chowdhry, Material Store-keeper.

TRIGONOMETRICAL BRANCH OFFICE, DEHRA DÚN.

421. Lieutenant-Colonel St. G. C. Gore, R.E., Superintendent Trigonometrical Surveys,

Personnel.

Superintendence.

Lieutenant-Colonel St. G. C. Gore, R. E., Superintendent, Trigonometrical Surveys, from 20th October 1897 to 25th April 1898.
 Major S. G. Burrard, R.E., Officiating Superintendent, Trigonometrical Surveys, from 26th April 1898.
 Mr. J. Eccles, M.A., Superintendent, 2nd grade, in charge Computing Party, from 22nd November 1897.
 Captain G. P. Lenox-Conyngham, R.E., Officiating Superintendent, Trigonometrical Surveys, up to 19th October 1897.
 Mr. H. W. Peychers, Extra Assistant Superintendent, 1st grade, in charge Computing Party, up to 21st November 1897.

Attached Officers.

Lieutenant E. A. Tandy, R.E., Assistant Superintendent, 2nd grade, from 31st January to 25th August 1898.
 Lieutenant A. Mears, S.C., " " 2nd grade, from 13th April 1898.

(1) Computing Section.

Mr. H. W. Peychers, Extra Assistant Superintendent, 1st grade, up to 13th December 1897.
 Mr. A. D. L. Christie, " " 2nd grade.
 Babu Amba Prasad and 8 other Computers, 2 Copyists and 2 Writers.

(2) Printing Section.

9 Compositors and 2 Distributors.

(3) Photo-Zincographic Section.

Mr. J. S. Manuel, Zincographer, up to 19th February 1898.
 Mr. G. A. LeFranc, Officiating Zincographer.
 1 Photographer, 6 Plate correctors, 5 Retouchers, 4 Zinc printers, 12 Assistant Zinc printers, 1 Accountant, 1 Storekeeper, and 1 Despatcher.

(4) Correspondence Section.

Mr. J. Burbridge, Head Clerk, and 3 other clerks.

(5) Stores, Workshops and Observatories Section.

1 Writer, 1 Head Artificer, and 3 Artificers.

(6) Drawing Section.

Mr. C. H. McA'Fee, Extra Assistant Superintendent, 2nd grade.
 Mr. J. A. Higgs, " " 6th "
 15 Draftsmen and 1 Surveyor.

(7) Solar Photographic Section.

Mr. R. W. Foster, Assistant Solar Photographer, [*Sub. pro tem.*]

(8) Training School.

Mr. W. A. Fielding, Extra Assistant Superintendent, 6th grade, from 4th November 1897.
 Messrs. D. J. Hunter, E. H. Corridon, Babu Dhani Ram, Messrs. W. G. Jarbo, H. R. Hunter and B. M. Berrill, Probationary Sub-Assistant Superintendents.
 One Surveyor, 1 Sub-Surveyor and 17 Probationary Sub-Surveyors.

astronomical observations, levelling, and the computations of the Trigonometrical Branch. He passed the departmental examination and was confirmed on the 4th August.

Mr. A. E. Wackrill, A.M.I.C.E., Superintendent of Trigonometrical Surveys, Ceylon, who had joined the office in order to learn the methods of observing and computing, left the office about the middle of November. Mr. H. W. Peychers retired on superannuation pension on the 14th December. Mr. W. A. Fielding, was transferred from No. 18 Party on the 4th November to take charge of the Training school. Mr. J. S. Manuel, Zincographer, retired on invalid gratuity from 19th February, and Babu Umbica Churn Shome retired on superannuation pension on the 2nd July.

on return from privilege leave, took over charge of the office on the 20th October 1897 from Captain G. P. Lenox-Conyngham, R.E. On 25th April 1898, he proceeded on special leave for six months. During his absence Major S. G. Burrard, R.E., officiated as Superintendent, Trigonometrical Surveys. Mr. J. Eccles, M.A., returned from furlough on the 22nd November 1897, and took over charge of the technical offices of the Trigonometrical Branch from Mr. H. W. Peychers. Lieutenant E. A. Tandy, R.E., on appointment to the department was posted to this office on the 31st January for a course of technical training, and left on the 25th August to join No. 22 Party (Astronomical). Lieutenant A. Mears, I. S. C., was transferred from Nos. 9 and 19 Parties on the 13th April to be put through a course of instruction in

The office is divided into the following sections :—

- (1) Computing.
- (2) Printing.
- (3) Photozincographic.
- (4) Correspondence.
- (5) Stores, Workshops and Observatories.
- (6) Drawing.
- (7) Solar Photographic.
- (8) Training School.

(1) *Computing Section.*

422. Seven instalments of field records were received during the year and stored as usual. In all 19 requisitions for data and 49 indents for forms were complied with. A revision of the heights of the principal and secondary stations of the Biláspur Meridional Series, necessitated owing to sensible discrepancies being disclosed by the extension of the lines of spirit-levelling, was begun. A reduction of the observations of a new net work triangulation of the country round Dehra for the training school was completed. A table for determining heights in traversing was prepared. A considerable amount of work, still progressing, is involved in the reduction of the observations by Captain Deasy in his explorations in Tibet. Two triangulation charts of Burma and Assam were compared and examined, and four of the Great Arc Meridional Series, Section 8° to 18° , and two of the Indus Delta Triangulation are in hand. The meteorological and magnetic observations were continued as usual.

(2) *Printing Section.*

423. The following is the progress made :—

- (a) Tidal Volume, 16 pages printed.
- (b) Synoptical Volumes of the Great Arc Meridional Series, Section 8° to 18° , and Indus Delta Triangulation, 80 pages printed.
- (c) The Solar Eclipse Report, 16 pages printed.

In addition to the above, a large amount of work was done in printing the letter-press for charts, headings and foot-notes for maps, and 64,000 copies of professional and other forms were printed.

(3) *Photo-zincographic Section.*

424. The entire work of the section devolved on the Assistant Zincographer since the retirement of Mr. Manuel. The usual routine of map publication was carried on, and no arrears remain.

(4) *Correspondence Section.*

425. This has been conducted as usual.

(5) *Stores, Workshops and Observatories Section.*

426. An astronomical equipment for the Solar Eclipse Camp at Sahdol was prepared and despatched. The work in the observatories was done as usual.

(6) *Drawing Section.*

427. As the mapping of No. 18 Party was very much in arrears, assistance was rendered by this section in preparing the 4-inch sheets for reduction to half scale, and in extracting the *muza* areas from four of the 4-inch sheets. The outturn will be found fully detailed in the appendix.

(7) *Solar Photographic Section.*

428. The work of this section was conducted as usual; experiments with dry plates were continued and fairly successful results were obtained. The 12-inch instrument was also put in working order.

(8) Training School.

429. The Training School, under Mr. W. A. Fielding, imparted instruction in theodolite traversing, triangulation, levelling and plane-tableing, also fair mapping, projection, plotting, and the computations of the topographical branch. The six new Probationary Sub-Assistant Superintendents and 17 Apprentice Sub-Surveyors were passed through the School. Besides these, instruction in practical plane-tableing was given to Lieutenants Tandy and Mears and to four recorders of No. 24 Party, and in levelling to one Sub-Surveyor of No. 18 Party.

The offices were inspected by the Surveyor-General in April and July, and he was quite satisfied with the working of the several sections.*

III.—DRAWING OFFICE, SIMLA.

430. Mr. Atkinson held charge of the Simla Drawing Office till the return

Personnel.
Lieutenant-Colonel R. A. Wahab, C.I.E., R.E., Officiating Superintendent, 1st grade.
Mr. G. W. E. Atkinson, Officiating Deputy Superintendent, 1st grade.
Mr. W. J. Cornelius, Extra Assistant Superintendent, 4th grade.
Mr. R. R. Dickinson, " " 5th grade.
Mr. F. E. Warde, Sub-Assistant Superintendent, 2nd grade.
Mr. F. Rozario, Surveyor.
Mr. H. Sindon, Draftsman.
Munshi Noor Baksh, " and four other draftsmen and one writer.

of Lieutenant-Colonel Wahab from field service on the 13th April 1898, and again held charge during that officer's absence at Quetta from the 5th to the 30th May 1898. Mr. Atkinson, besides holding charge of the office for about seven months of the year, has taken a large share in the actual mapping. He retires within the next few days after a service of over 39 years, during a great part of which he has been

employed on the compilation of the maps of the Indian frontier and surrounding countries. His long experience and intimate knowledge of the geography of Central Asia have been of great value to the office, the superintendence of which has devolved on him for long periods during the absence of the Superintendent in the field.

431. The office was inspected by the Surveyor-General in July.†

IV.—FOREST SURVEY BRANCH OFFICE, DEHRA DÚN.

432. Mr. W. H. Reynolds, Superintendent, Forest Surveys, was in charge of the head-quarters offices of the Forest Survey Branch throughout the year. The following branches of work were dealt with:—

- (i) Correspondence and accounts of the several provincial forest survey detachments.
- (ii) Computations and areas of the several field detachments.
- (iii) Up-keep of the Forest Department map records of the several provinces under the Government of India.
- (iv) Compilation and drawing of special maps for the Forest Department.
- (v) Training of surveyors.
- (vi) Other miscellaneous work for the Forest Department.

433. The up-keep of the map records of the forests in the several provinces under the Government of India, as well as Madras, have been posted up

* Mr. Eccles reports very highly of the work done by his assistants, Messrs. Christie, McA'Fee Higgs, Le Franc and Foster, and speaks well of the computers, draftsmen, accountant, and the head writer of the Computing Section.

† The Superintendent reports very favourably of the assistance rendered him by Messrs. Christie and McA'Fee; also of the services rendered by Mr. J. Burbridge, the Head Clerk, and Babu Hira Singh, the Second Clerk of his office.

The Superintendent expresses his satisfaction with the work done by Mr. Fielding and Munshis Muhammad Zakaria and Zakiruddin, instructors of the training school.

‡ The officer in charge reports favourably on the continued zeal and good character of work of Mr. Cornelius, and on Messrs. Dickinson and Warde as painstaking and diligent assistants. Of the draftsmen it is said that they have all worked well, Messrs. H. Sindon, Rozario, and Noor Baksh being specially mentioned. Writer Ganga Ram is also specially mentioned.

from time, to time, and all new tracts gazetted as State forests have been located on existing maps. This branch of the work was unusually heavy during the year under report, more particularly for Madras and the Central Provinces.

434. During the year, 29 maps on various scales for special purposes have been published, 31 are in the press, and 24 are in different stages of progress. Of the 4-inch standard sheets of the reserved forest areas surveyed by the Forest Survey Branch, 92 sheets were published, 131 are in the press, and 168 sheets are in progress and well advanced towards completion. Of the 1-inch standard sheets of the Punjab, one sheet has been published, one is in the press, and nine are in progress.

435. In the way of miscellaneous work, 2,156 printed maps of various sorts were coloured, and 350 tracings were prepared for various Forest and District officers; information regarding the distribution of forests was added to 20 printed maps and 1,512 printed sheets were cut up and mounted in book form for the use of Forest and other officials.

436. During the year 29 new men were instructed in the use of the plane-table, 3 were taught theodolite traversing, and two men learnt the use of the spirit level.

Mr. Reynolds reports that Mr. Descubes has, as usual, conducted his duties in a highly satisfactory manner and spared no personal trouble to push on his work; he is a most valuable assistant. Mr. Watson is also mentioned as having performed his duties with zeal and ability.

Of the native establishment, the following are specially brought to notice:—Babus Kali Kanth Kar, Lalit Mohan Basak, Tulsi Ram, and Mohamed Hossain.

LIST OF MAPS AND CHARTS PUBLISHED AT CALCUTTA DURING THE 91
YEAR 1897-98.

LIST OF MAPS AND CHARTS PUBLISHED AT CALCUTTA DURING
THE YEAR 1897-98.

Titls.	Scale.	Number of sheets.	REMARKS.
ATLAS OF INDIA.			
	In. M.		
Sheet No. 88	1=4	1	With additions to 1896.
Sheet No. 89	1=4	1	With additions to 1898.
Sheets Nos. 94 and 118	1=4	2	With additions to 1897.
Sheet No. 106	1=4	1	With additions and corrections to December 1893.
Sheets Nos. 1 N. E., 3 N. E., 11 N. E., 11 N. W., 35 N. E., 36 N. E., 67 S. E., and 67 S. W.	1=4	8	With additions to 1895.
Sheet No. 52 N. W.	1=4	1	With additions to 1891.
Sheets Nos. 31 N. W., 31 S. E., 39 S. E., 49 N. E., 52 N. E., 52 S. E., 66 S. E., and 129 N. E.	1=4	8	With additions to 1896.
Sheet No. 69 N. W.	1=4	1	With additions to 1894.
Sheet No. 71 N. E.	1=4	1	With additions to 1888.
Sheet No. 71 S. E.	1=4	1	With additions to May 1897.
Sheet No. 127 N. W.	1=4	1	With additions to January 1897.
Sheets Nos. 37 N. E., 87 N. W., and 91 S. E.	1=4	3	With additions to 1892.
Sheet No. 127 S. E.	1=4	1	With additions to 1887.
Sheets Nos. 24 N. E., 26 S. E., 48 S. W., 61 S. E., 77 S. E., and 89 S. E.	1=4	6	
Sheet No. 90 N. W.	1=4	1	With additions to 1898.
Sheet No. 95 N. W. 1.	1=4	1	With additions to 1889.
Sheets Nos. 124 N. E. and 124 S. E.	1=4	2	With additions to 1893.
GENERAL MAPS.			
India (with hills)	1=128	1	With additions to railways to 1897.
Persia (1897)	1=16	6	
PROVINCIAL MAPS.			
Bengal, Bihar, Orissa and Chota Nágpur (skeleton)	1=16	2	
Bengal, Bihar, Orissa and Chota Nágpur (with hills)	1=32	1	
Gujarát (with hills)	1=16	1	
Mysore and Coorg	1=16	1	
Punjab and surrounding countries (skeleton)	1=32	1	

TITLE.	Scale.	Number of sheets.	REMARKS.	
DISTRICT MAPS.				
	In. M.			
Backergunge	1=4	1	With additions and corrections to March 1896.	
Darjeeling (with hills)	1=4	1		
Nadia	1=4	1		With additions and corrections to May 1898.
Pabna (skeleton)	1=4	1		
Rájsháhi	1=4	1		With additions and corrections to 1897.
Simla with adjoining Native States	1=4	1		
STANDARD MAPS.				
<i>Bengal.</i>				
Sheet No. 125	1=1	1	With additions to 1892.	
Sheet No. 126	1=1	1	With additions to railways to 1896.	
<i>Bombay.</i>				
Sheets Nos. 199 N.E. and 199 S.E.	2=1	2	With corrections to names to October 1897.	
Sheet No. 192	1=1	1	With additions to forest boundaries and canals to May 1897.	
<i>Burma (Lower).</i>				
Hanthawaddy District—Sheets Nos. 232 $\frac{N.E.}{2}$; 232 $\frac{N.E.}{4}$ and 280 $\frac{N.W.}{1}$	4=1	3		
Pegu District—Sheet No. 279 $\frac{N.W.}{3}$	4=1	1		
Hanthawaddy and Pegu Districts—Sheet No. 278 $\frac{N.W.}{4}$	4=1	1		
Sheets Nos. 281 and 282	1=1	2	With corrections to September 1897. Preliminary edition. and edition.	
Sheet No. 371	1=1	1		
Sheet No. 374	1=1	1		
Sheets Nos. 476 and 477	1=1	2		
<i>Burma (Upper).</i>				
Sheets Nos. 89, 90, 130 and 314	1=1	4		
Sheets Nos. 260 and 359	1=1	2	Preliminary edition.	
Sheet No. 306	1=1	1	and edition.	
<i>Central India and Rájputána.</i>				
Sheets Nos. 213, 441 and 459	1=1	3		
Sheet No. 252	1=1	1	With corrections to 1895.	
Sheet No. 304	1=1	1	With additions to railways to 1896.	
Sheet No. 312	1=1	1	With additions to June 1897.	
Sheet No. 381	1=1	1	With additions to 1894.	
Sheets Nos. 159, 160, 192 and 193 (in one)	1=2	1	With corrections to boundaries to November 1896.	
Sheets Nos. 161, 162, 194 and 195 (in one)	1=2	1	With additions to railways to 1896.	

**LIST OF MAPS AND CHARTS PUBLISHED AT CALCUTTA DURING THE 93
YEAR 1897-98.**

TITLE.	SCALE.	Number of sheets.	REMARKS.
<i>STANDARD MAPS—continued.</i>			
<i>Central Provinces.</i>			
	In. M.		
Betúl District—Sheets Nos. 27 $\frac{N.W.}{1}$; 27 $\frac{S.W.}{1}$ and 27 $\frac{S.W.}{2}$ (in one); 28 $\frac{N.W.}{3}$; 36 $\frac{N.W.}{1}$ and 25 $\frac{N.E.}{2}$ (in one); 36 $\frac{N.W.}{2}$; 36 $\frac{N.W.}{3}$; 36 $\frac{N.W.}{4}$; 36 $\frac{S.E.}{2}$ and 36 $\frac{S.E.}{4}$ (in one); 36 $\frac{N.E.}{3}$; and 37 $\frac{N.W.}{1}$	4=1	10	
Biláspur District—Sheet No. 180 $\frac{N.W.}{4}$	4=1	1	
Damoh District—Sheets Nos. 61 $\frac{S.E.}{2}$; 61 $\frac{S.E.}{4}$; 62 $\frac{N.E.}{2}$; 62 $\frac{N.E.}{3}$; 62 $\frac{N.E.}{4}$; 62 $\frac{S.E.}{1}$; 62 $\frac{S.E.}{2}$ and 62 $\frac{S.E.}{3}$ (in one) 63 $\frac{N.W.}{4}$; 63 $\frac{S.E.}{4}$; 64 $\frac{S.E.}{1}$; 64 $\frac{S.E.}{2}$; 64 $\frac{S.E.}{3}$; 64 $\frac{S.E.}{4}$; 64 $\frac{N.E.}{1}$; 64 $\frac{N.E.}{2}$; 64 $\frac{N.E.}{3}$; 64 $\frac{N.E.}{4}$; 65 $\frac{N.E.}{1}$; 65 $\frac{N.E.}{2}$; 65 $\frac{N.E.}{3}$; 65 $\frac{N.E.}{4}$; 65 $\frac{N.W.}{2}$ and 65 $\frac{N.W.}{4}$ (in one); 65 $\frac{S.E.}{2}$; 65 $\frac{S.E.}{3}$; 65 $\frac{S.E.}{4}$; 65 $\frac{S.W.}{2}$ and 65 $\frac{S.E.}{1}$ (in one); 65 $\frac{S.W.}{4}$ and 66 $\frac{N.W.}{2}$ (in one); 66 $\frac{N.E.}{1}$ 66 $\frac{N.E.}{2}$; 66 $\frac{N.E.}{3}$; 66 $\frac{N.E.}{4}$; 81 $\frac{N.W.}{1}$ and 81 $\frac{N.W.}{2}$ (in one); 81 $\frac{N.W.}{4}$; 81 $\frac{S.W.}{1}$; 81 $\frac{S.W.}{2}$; 81 $\frac{S.W.}{3}$; 81 $\frac{S.W.}{4}$; 82 $\frac{S.E.}{2}$ and 83 $\frac{S.E.}{4}$ (in one); 83 $\frac{N.E.}{1}$; 83 $\frac{N.E.}{2}$; 83 $\frac{N.E.}{3}$; 83 $\frac{N.E.}{4}$; 83 $\frac{N.W.}{2}$; 83 $\frac{N.W.}{4}$; 83 $\frac{S.E.}{1}$; 83 $\frac{S.E.}{2}$; 83 $\frac{S.E.}{3}$ and 83 $\frac{S.E.}{4}$ (in one); 83 $\frac{S.W.}{2}$; 83 $\frac{S.W.}{3}$ and 83 $\frac{S.W.}{4}$ (in one); 84 $\frac{N.E.}{1}$; 84 $\frac{N.E.}{2}$; 84 $\frac{N.E.}{3}$; 84 $\frac{N.E.}{4}$; 84 $\frac{N.W.}{3}$; 84 $\frac{S.E.}{1}$; 84 $\frac{S.E.}{2}$; 84 $\frac{S.E.}{3}$; 84 $\frac{S.W.}{1}$; 84 $\frac{S.W.}{2}$; 84 $\frac{S.W.}{3}$; 84 $\frac{S.W.}{4}$ and 84 $\frac{N.W.}{4}$ (in one); 85 $\frac{N.E.}{1}$; 85 $\frac{N.E.}{2}$; 85 $\frac{N.W.}{1}$; 85 $\frac{N.W.}{2}$; 85 $\frac{N.W.}{3}$; 85 $\frac{N.W.}{4}$; 85 $\frac{S.W.}{1}$; 85 $\frac{S.W.}{2}$ and 85 $\frac{S.E.}{1}$ (in one); 85 $\frac{S.W.}{3}$; 85 $\frac{S.W.}{4}$; and 86 $\frac{N.W.}{1}$.	4=1	71	
Hoshangabad and Betúl Districts—Sheet No. 35 $\frac{S.W.}{1}$.	4=1	1	
Nimár District—Sheet No. 8 $\frac{N.E.}{4}$	4=1	1	With corrections to boundaries to 1897.
Sheets Nos. 35 and 50	1=1	2	
<i>Hyderabad.</i>			
Sheet No. 168	1=4	1	
<i>North-Western Provinces and Oudh.</i>			
Sheet No. 13	1=1	1	With additions to roads and canals to July 1897.
<i>Punjab.</i>			
Kángra District—Sheets Nos. 264 $\frac{N.E.}{2}$ and 264 $\frac{S.W.}{2}$.	4=1	2	
Patiála State Forests—Sheets Nos. 312 $\frac{N.W.}{1}$; 312 $\frac{N.W.}{2}$; 312 $\frac{N.W.}{3}$ and 312 $\frac{N.E.}{1}$	4=1	4	
Sirmúr State Forests—Sheets Nos. 314 $\frac{N.E.}{2}$ and 336 $\frac{N.W.}{2}$ (in one); 336 $\frac{N.W.}{1}$; 336 $\frac{N.W.}{3}$ and 336 $\frac{N.W.}{4}$.	4=1	4	
Umballa District and Simla Hill States—Sheet No. 313 $\frac{N.W.}{1}$	4=1	1	

TITLE.	Scale.	Number of sheets.	REMARKS.
<i>STANDARD MAPS—concluded.</i>			
<i>Punjab—concluded.</i>			
	In. M.		
Kángra District—Sheet No. 265 N.W.	2=1	1	
Kángra and Hoshiárpur Districts—Sheets Nos. 265 S.E. and 265 S.W.	2=1	2	
Kángra District and Mandi State—Sheet No. 285 S.W.	2=1	1	
Simla Hill and Suket States—Sheet No. 311 N.E.	2=1	1	
Sheet No. 260	1=1	1	With corrections to 1895.
<i>Sind.</i>			
Sheets Nos. 1 and 2 (in one) 15, 16, 17, 66, 67, 87, and 88	1=1	8	
<i>North-Eastern Frontier Series.</i>			
Sheet No. $\frac{5-12}{6-13}$	1=16	1	
<i>South-Eastern Frontier Series.</i>			
Sheet No. 1 N.E.	1=4	1	6th edition. With additions and corrections to 1896. 4th edition. With additions to May 1898. 5th edition. With additions to 1898.
Sheet No. 1 N.W.	1=4	1	
Sheet No. 5 N.W.	1=4	1	
<i>PLANS OF CITIES AND CANTONMENTS.</i>			
Calcutta, Sheets Nos. P24 and N17	1=50 ft.	2	2nd edition.
Karáchi City (Layári Quarter) with Index Sheets, 1 to 18	1=80	18	
Sipri	1=500 ft.	1	With additions to 1898.
Mussooree and Landour Guide Map	8=1 M.	1	Corrected to 1896.
Mooltan and environs (1894-95)	6=1	8	
Simla and Jutogh	6=1	1	3rd edition. Revised and corrected to 1897.
<i>ADMINISTRATION REPORT MAPS.</i>			
Bhandára, Bogra, Burdwan, Cuttack, Dacca, Darbhanga, Delhi, Hazáribágh, Hissar, Karnál, Lahore, Ludhiána, Monghyr, Montgomery, Nágpur, Pesháwar, Rájsháhi, Saugor, Sonthál Parganá, and Wardha	1=8	20	
Bálághát	1=12	1	
Biláspur, Chánda, Dehra Ismáil Khán, and Ferozepore	1=16	4	
<i>INDEX MAPS.</i>			
To the standard sheets of the Punjab . . . . .	...	1	Corrected to 1898.
To Sheet No. 1 of the standard sheets of Sind (Bombay Presidency) . . . . .	...	1	With additions and corrections to 1897.
<i>STATISTICAL MAPS.</i>			
India, shewing Railways	1=80	1	Corrected to 31st March 1898.
<i>MISCELLANEOUS.</i>			
Pyinma Forest Reserve, part of sheet Nos. 278 $\frac{S.W.}{3}$ and 278 $\frac{S.E.}{1}$ (Pegu District, Lower Burma)	4=1	2	

**LIST OF MAPS AND CHARTS PUBLISHED AT CALCUTTA DURING THE 95
YEAR 1897-98.**

TITLE.	Scale.	Number of sheets.	REMARKS.
<i>MISCELLANEOUS—concluded.</i>			
	In. M.		
Nos. 43B. and 128, Airala and Putramaddi reserved forests, Chittoor Táluk, North Arcot District, Madras	4=1	1	
No. 45, Matarakadapa reserved forest, Tiruppattúr Táluk, Salem District, Madras	4=1	1	
No. 49, Ammur reserved forest; Wálájápet Táluk; North Arcot District, Madras	4=1	1	
No. 68, Kelur reserved forest, Polur Táluk; North Arcot District, Madras	4=1	1	
Nos. 76 & 84, Naikaneri Extension and Charagallu reserved forests, Gudiyáttam and Palmanér Táluks, North Arcot District, Madras	4=1	2	
No. 77, Morthana Extension reserved forest, Gudiyáttam Táluk, North Arcot District, Madras	4=1	1	
No. 85, Pednaigdrug reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	2	
No. 92, Gundalapalle reserved forest; Gudiyáttam Táluk; North Arcot District, Madras	4=1	1	
No. 93, Pallelakuppam reserved forest, Gudiyáttam Táluk; North Arcot District, Madras	4=1	1	
No. 96A, Tavanampalle reserved forest, Chittoor Táluk; North Arcot District, Madras	4=1	1	
No. 102, Mel Mayi reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	1	
No. 107, Palmanér reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	1	
Nos. 115 & 135, Zangalapalle and Gundalapalle extension reserved forests, Palmanér and Gudiyáttam Táluks; North Arcot District, Madras	4=1	1	
No. 116, Pattikonda reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	1	
No. 125B, Parappu Malai reserved forest, Chittoor Táluk; North Arcot District, Madras	4=1	1	
No. 132, Pallelakuppam extension reserved forest, Gudiyáttam Táluk; North Arcot District, Madras	4=1	1	
Nos. 133A and 133B Kempasamudram reserved forests Gudiyáttam Táluk; North Arcot District, Madras	4=1	1	
No. 162, Pápanayakanhalli reserved forest, Dharmapuri and Krishnagiri Táluks; Salem District, Madras	4=1	1	
Hosúr and Dharmapuri Táluks, reserved forests, sheets Nos. 13, 15, 17, 19, 20, 21, 22, 23, 24 and 26, Madras	4=1	10	
Totakanáma reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	1	
Virlabanda and Nellipatta reserved forests, Palmanér Táluk; North Arcot District, Madras	4=1	2	
Plan of the camp at Saldol (Central India) for the total eclipse of the sun, on 22nd January 1898	24=1	1	
The Kháibar Pass (1898)	2=1	1	
The Karenni boundaries	1=4	1	
Tenasserim and adjacent provinces of the Kingdom of Siam	1=4	6	
Part of the North-West Frontier	1=16	1	With additions to boundaries to October 1897.
CHARTS.			
Central Provinces. Sheets Nos. 61 and 85, seasons 1894-96.	1=2	2	
Gujarát Survey. Degree Sheet No. X, seasons 1874-75, 1879-81 and 1891-92	1=4	1	
Madras Forest, Sheets Nos. 1, 2 and 3, District Madura (1866-93)	1=2	3	
Sind Survey, Sheet No. 17	1=2	1	

LIST OF MAPS PUBLISHED AT DEHRA FOR THE FOREST SURVEY
BRANCH DURING 1897-98.

Title of Map.	Scale.	Number of sheets.
STANDARD MAPS.		
BURMA.		
<i>Pyinmana Forest Survey.</i>		
Sheets Nos. 222 $\frac{N. E.}{3}$, $\frac{S. E.}{1}$, $\frac{S. E.}{3}$; 270 $\frac{N. W.}{1}$, $\frac{N. W.}{2}$, $\frac{N. W.}{3}$ and $\frac{N. W.}{4}$.	4=1	7
<i>Salween-Ataran Forest Survey.</i>		
Sheet No. 551 $\frac{N. E.}{1}$.	4=1	1
CENTRAL PROVINCES.		
<i>Bálóghát Forest Survey.</i>		
Sheets Nos. 90 $\frac{S. E.}{2 \& 4}$; 91 $\frac{N. E.}{4}$; 111 $\frac{S. W.}{2}$, $\frac{S. W.}{4}$, $\frac{S. E.}{1 \& 2}$, $\frac{S. E.}{3}$, $\frac{S. E.}{4}$; 112 $\frac{N. W.}{1}$, $\frac{N. W.}{4}$; 112 $\frac{N. E.}{1}$; 112 $\frac{S. W.}{1}$, $\frac{S. W.}{2}$, $\frac{S. W.}{3}$, $\frac{S. W.}{4}$; 113 $\frac{N. W.}{2}$; 136 $\frac{N. W.}{1}$ and part of 135 $\frac{S. W.}{3}$; 136 $\frac{N. W.}{2}$; $\frac{S. W.}{2}$; 137 $\frac{N. W.}{1}$ and $\frac{N. W.}{2}$.	4=1	20
<i>Bhandára Forest Survey.</i>		
Sheets Nos. 95 $\frac{S. E.}{1}$, $\frac{S. E.}{4}$; 117 $\frac{N. W.}{1}$, $\frac{S. W.}{1}$, $\frac{S. W.}{3}$ and 118 $\frac{N. W.}{1 \& 3}$.	4=1	6
<i>Chhindwára Forest Survey.</i>		
Sheets Nos. 70 $\frac{S. E.}{1}$ and $\frac{S. W.}{2}$, $\frac{S. E.}{3}$ and part of $\frac{S. W.}{4}$, $\frac{S. E.}{4}$, $\frac{S. W.}{3 \& 4}$; 71 $\frac{N. W.}{3 \& 4}$, $\frac{N. E.}{1}$, $\frac{N. E.}{3}$, $\frac{S. E.}{1}$, $\frac{S. E.}{3}$; 72 $\frac{N. W.}{2}$, $\frac{N. W.}{4}$ and $\frac{N. E.}{1 \& 3}$.	4=1	18
<i>Narsinghpur Forest Survey.</i>		
Sheets Nos. 47 $\frac{S. E.}{4}$; 48 $\frac{N. E.}{2}$; 66 $\frac{N. W.}{1}$, $\frac{N. W.}{4}$, $\frac{N. W.}{3}$ and $\frac{S. E.}{1}$.	4=1	6
<i>Nágpur-Wardha Forest Survey.</i>		
Sheets Nos. 72 $\frac{N. W.}{4}$, $\frac{N. E.}{1}$, $\frac{N. E.}{3}$, $\frac{N. E.}{4}$, $\frac{S. W.}{2}$, $\frac{S. W.}{3}$, $\frac{S. W.}{4}$, $\frac{S. E.}{1}$, $\frac{S. E.}{2}$, $\frac{S. E.}{3}$, $\frac{S. E.}{4}$; 73 $\frac{N. E.}{1}$; 92 $\frac{N. W.}{3}$, $\frac{N. W.}{4}$ and $\frac{S. W.}{3}$.	4=1	15
<i>Ráipur Forest Survey.</i>		
Sheets Nos. 205 $\frac{S. W.}{4}$; 206 $\frac{N. W.}{2}$, $\frac{N. W.}{4}$ and $\frac{S. W.}{2}$.	4=1	4
<i>Saugor Forest Survey.</i>		
Sheets Nos. 47 $\frac{S. W.}{2}$; 65 $\frac{N. W.}{4}$, $\frac{S. W.}{2}$, $\frac{S. W.}{4}$, $\frac{S. E.}{1}$, $\frac{S. E.}{3}$; 66 $\frac{N. W.}{1}$, $\frac{N. W.}{2}$ and $\frac{N. W.}{4}$.	4=1	9
<i>Seoni Forest Survey.</i>		
Sheet No. 92 $\frac{S. W.}{1}$.	4=1	1

LIST OF MAPS PUBLISHED AT DEHRA FOR THE FOREST SURVEY 97
BRANCH DURING 1897-98.

Title of Map.	Scale.	Number of sheets.
STANDARD MAPS—(contd.)		
NORTH-WESTERN PROVINCES AND OUDH.		
<i>Gonda Forest Survey.</i>		
Sheets Nos. 158 $\frac{S.W.}{2 \& 4}$, $\frac{S.E.}{3}$, 159 $\frac{N.E.}{1}$, $\frac{N.E.}{2}$ and part of 171 $\frac{S.W.}{3}$; 172 $\frac{N.W.}{1}$ and $\frac{N.W.}{4}$	4=1	6
<i>Lalitpur Forest Survey.</i>		
Sheet No. 60 $\frac{N.W.}{3}$ and part of 60 $\frac{N.W.}{1}$	4=1	1
PUNJAB.		
<i>Bashahr Forest Survey.</i>		
Sheet No. 346	1=1	1
<i>Index Maps.</i>		
Index showing progress of Forest Surveys in the Central Provinces	1=32	1
" to the Forest Surveys in the Pynmana District	1=8	1
" " " " " Ruby Mines Division, Burma	1=8	1
" " " " " Salween-Ataran Division, Burma	1=32	1
" " " " " Chamba State	1=8	1
" " " " " Biláspur District	1=12	1
" " " " " Goálpára District Assam Working Plan	1=2	1
<i>Miscellaneous.</i>		
Kullu District, Inner Seoráj Range	1=2	1
" " Wazíri Rupi Range	1=2	1
" " Outer Seoráj Range	1=2	1
" " Kullu Proper Range	1=2	1
Pynmana Division, Lewé Range, Yeni Reserve, Yeni Working Circle	1=1	1
Hyderabad Assigned Districts or Berar, Akola District, Khámgaon Táluk	1=1	1
" " " " " Jalgaon Táluk	1=1	1
" " " " " Bálapur Táluk	1=1	2
Coorg Forests, Devammachi-Mawukal Forest Reserve	2=1	1
Sketch of the leased Chir Forests Tehri Garhwál	2=1	1
Nepál-Kheri Boundary (on the Mohan River)	1=1	1
" " " " " showing the give and take areas	1=1	1
Sketch Map of the Melghát Táluk, Ellichpur, Berar	1=4	1
Esemble d'un appareil distillatoire No. 1 . . . . .	...	1
Esemble d'un distillerie d'essence de terrebenhine No. 2 . . . . .	...	1
Municipal Forests, Simla, 1897	8=1	1

APPENDIX.

EXTRACTS

FROM

REPORTS BY EXECUTIVE OFFICERS.

Narrative report by MAJOR F. B. LONGE, R.E., Superintendent, 2nd grade, on the Survey operations with the Burma-China Boundary Commission, Southern Section, season 1897-98.

Introductory.—In 1894 a "Convention" between Great Britain and China was signed on the 1st March, defining amongst other things the boundary between Burma and Yunnan; owing, however, to the failure of the Chinese Government to abide by its stipulations, certain modifications became necessary, and, in consequence, further negotiations were commenced towards the end of 1895, which resulted in what is termed the "Agreement," a document signed in Peking on the 4th February 1897, which, while modifying the boundary between the two countries, did not otherwise differ very materially from the previous convention. The original "Convention" was never annulled, but is constantly referred to in the "Agreement," consequently the two documents have to be read together, a fact which led to a vast amount of trouble and argument in the field, and in a great measure contributed to the failure of the Southern party to carry out the work entrusted to it.

There were also, as will be seen later on, mistranslations of the English text in the version supplied to the Chinese Commissioners and no proper orders had apparently been issued to the Commission by the Tsung-li Yamen. Thus while the British sections had definite orders and fairly accurate maps of the country, maps which at any rate clearly showed the intention of the wording of the articles of the "Agreement," the Chinese Commission appeared to be endeavouring not to lay down the boundary as defined by the two Governments, but to discover on the spot some imaginary boundary formerly existent between the two countries. Differences of opinion thus arose at the outset.

Constitution of the Commission.—The composition of the Commission (British Section) was as follows:—

Mr. H. Thirkell White, C.I.E.,	Commissioner.
„ E. C. S. George, C.I.E.,	Sub-Commissioner.
„ W. Warry,	Chinese Adviser.
„ P. F. Hausser,	Consul at Momein.
Major F. B. Longe, R.E.,	} Survey Officers.
Captain T. F. B. Renny-Tailyour, R.E.,	
Lieutenant W. K. Scharlieb,	} Commanding the Escorts,
Lieutenant J. F. W. French-Mullen, and	
Captain E. W. M. Norie,		Middlesex Regiment, Intelligence Officer.

The Chinese Commission consisted of —

General Liu Wan Sheng	Commissioner.
P'eng Chi Chih, Magistrate of Chan-i	} Sub-Commissioners.
Yang Chun, Sub-Prefect of Long-Ling,	
Ling,	
Chen-li-ta, Magistrate of Milo,	

with a number of other officers, Military and Civil, and some so-called Surveyors.

The Survey portion of the Commission was divided into two sections as follows:—

Northern Section.—Captain Renny-Tailyour, R.E., in charge.
Mahmud Hussain and Abdul Rahim, Surveyors, with 34 *tindals* and *khalásis*.

NOTE.—Only those articles which differ from the similarly numbered articles of the "Convention" are given *in extenso* in the "Agreement," the numbers of the other articles and a reference to the Convention only being given.

Southern Section.—Major F. B. Longe, R.E. in charge.

Ikbaluddin, Sub-Assistant Superintendent.

Lachman Jadu, Surveyor, and a similar number of *khalásis*.

Preliminary work.—An estimate showing the initial, final and monthly recurring cost of two parties of this strength was submitted to and received the sanction of the Government of India, and the assistants and *khalásis* were selected from Nos. 21 and 11 Parties, then recessing at Bangalore. Their instrumental equipment was also mainly taken from the stores of those parties, but tents were purchased from the Elgin Mills.

As the G. T. Triangulation (Irrawaddy series) only extended as far north as Katha and the Shan States secondary series as far as the Salween river, it was considered advisable, in order to render the work as final and accurate as possible, to detail special triangulators to carry these two series, to points on or near the frontier, to allow of the surveys being started from accurate bases, and to carry this out, Mr. P. J. Serrao of No. 10 Party was sent on ahead to continue the Mandalay series northwards and Mr. H. G. Shaw of No. 11 Party to produce the Shan States secondary series eastwards to the frontier.

It was arranged that rations for the *khalásis* and private followers should be supplied by the military police, and mule transport (Panthay mules) was obtained through the Deputy Commissioner of Bhamo at the comparatively cheap rate of Rs 2-3 per mule per mensem.

Concentration of Parties.—I left Calcutta by the British India Steam Navigation Company's ship *Lindula* on the morning of the 19th November 1897, and arrived at Rangoon on the evening of the 22nd. The 23rd and 24th were spent making arrangements with the Burma Secretariat, etc., in conjunction with Captain Renny-Tailyour, and on the 26th Mr. Thirkell White having come to Rangoon from Mandalay, I went with him to the Secretariat for final instructions and left the same night with Captain Renny-Tailyour for Mandalay.

While in Rangoon, I arranged with Lieutenant Hare, at the request of the Lieutenant-Governor, for the despatch of Natha Singh with a Civil Officer, to demarcate the boundary between the Chin Hills and Upper Chindwin district.

Captain Renny-Tailyour and I remained at Mandalay until the morning of the 30th November when we sailed in the Irrawaddy Flotilla Company's boat *Mogaung* for Bhamo, arriving there on December 2nd. On arrival there certain re-arrangements had to be effected; our surveyors were out clearing distant peaks and some had to be recalled, others had to be sent with escorts to clear minor hills, and we were fully employed till 17th and 18th December, when we finally left for the frontier.

Meeting of the Commissions at Bhamo.—On the 6th December the Commissioner, accompanied by Messrs. Warry and Hausser, arrived at Bhamo from Rangoon, Mr. George had already come down from Myitkyina, and everything was ready with the exception of the mule transport which had not arrived.

On the 8th, the Chinese Commissioner arrived and was suitably housed in one of the Missionary bungalows, the owner being away in the district; he was given a salute of 11 guns by the mountain battery stationed in the Fort, and on the 9th at 1 P.M. he made his official call on the British Commissioner at the Deputy Commissioner's bungalow. All the members of the British Commission were present, as well as Colonel Howlett, Commanding the Station, Major Munn, Commanding the Detachment, Royal Irish Fusiliers, Captain Fuller, Commanding the Mountain Battery, and Lieutenant Gould, the Station Staff Officer.

This ceremonial visit lasted nearly two hours, and was very tedious. On the following day General Liu, with a large retinue, visited the Fort and was shown over it by Colonel Howlett, and on the 10th the British Commissioner and the members of the Commission returned their call officially, and were received by a guard of honour of our own troops outside the compound, while inside from the gate to the steps, we walked through a double line of Chinese soldiers, who were armed with various patterns of rifles, Martinis, Colts, Sniders and Winchesters, as well as with *dahs*, and there were also displayed a good many standards. Here we remained for about an hour and a half being regaled with champagne, burgundy, etc., cakes, sweets, fruit and cigarettes, much in the same way as they were treated by us two days previously.

On neither of these visits was any business discussed, and it was not till the 13th December owing to the dilatory nature of the Chinese, that the first meeting to discuss preliminaries could be arranged.

Preliminary discussions with Chinese Commissioner.—This meeting took place at the Deputy Commissioner's house, and the discussion was long and troublesome, a hitch occurring almost immediately.

General Liu wished to take up a central position, with the main body of the Commission, and suggested Momein, from which parties could be sent north and south along the boundary, and to which all questions could be referred to the Commissioners by their subordinates. This after some discussion was abandoned, and it was agreed that the Commission should be divided into two parties, one working northwards from the Taping and the other southwards. It was also arranged after much talking that Mr. George, who knew the northern section well, should go there with Chen, while the

Commissioners themselves worked the southern section. As Captain Renny-Tailyour will have submitted his report on this section I shall practically say nothing more on the subject, beyond stating that we were in constant communication by helio and by telegraph through Bhamo with the Northern party, and all references were made by Messrs. George and Chen to Mr. Thirkell White and General Liu for decision, and in, I believe, every case matters were satisfactorily arranged.

The question of a starting point for the Southern party was then opened, and the British Commissioner, after previous discussion with myself and local officers suggested that we should go to a place called Lwe Leing, which is one of the points mentioned in Article 2 of the Agreement; and this place was pointed out to the Chinese Commissioner on our map and all the circumstances explained, namely, that there was a specially prepared road to this spot, and that from its position, it was a very suitable one to start from; there being no road along the southern bank of the Taping river, to get any other way to the point at which the boundary leaves the river and ascends to the Lwe Leing ridge would be very difficult, especially as there is neither bridge nor ferry between Myothit and near Momein, but they were very determined and for a long time insisted on going to Nampaung and commencing work from there on the grounds that this was the starting point of the Southern section.

It was then pointed out that the Northern party must go there and mark the junction of the Nampaung and the Taping, and that consequently it was unnecessary for the Southern party to do so also, that it was quite unnecessary for the Commission to go actually along the Taping river itself, the course of which in these parts cannot change, and that all we had to do was to find a suitable spot on the southern bank at which the boundary should leave the Taping, and to mark that as our starting point, and that the most convenient camp from which to do this would be at or near Lwe Leing.

The Chinese Commissioners then remarked that they had no such places as Lwe Leing or the Lwe Leing ridge mentioned in their documents, but that in place of Lwe Leing, was a name "Wälän," which they said they believed was somewhere north of the Taping near Alaw Pum. Eventually, however, they agreed to go to Lwe Leing with us starting on the 15th, and the names of and distances to our intermediate camps were written out and given to them.

The question of the style of pillars to be erected along the boundary was also discussed at this and other meetings, the Chinese being anxious to erect *pukka* pillars at once. This would have caused much delay and was not necessary, and it was eventually agreed, that rough stone pillars should be built and a trench cut all round.

Subsequently they wrote to say that many other questions of procedure, etc., had to be settled and they begged that the start might be postponed till Friday, the 17th. The British Commissioner yielded in so far, that the start should be postponed till the 17th, and eventually we actually left Bhamo on the morning of the 18th. They were apparently much pleased at the respite, and I find in my notes that it was my impression that they had evidently now made up their minds to work smoothly after making the usual objections; this, however, was an entirely erroneous idea on my part. The whole Commission was photographed in a group on the morning of the 18th.

Survey work around Bhamo.—I have before mentioned that various parties were out clearing hill tops and flashing signals to Mr. Serrao. A station was selected on Alaw Pum by Ganu Mal and another on Naru Pum, which two hills had to be fixed by Mr. Serrao; a hill above the village of Kanlain, north of Bhamo, was also cleared for him by Mahmud Hussain; while another was cleared above Myothit for Captain Renny-Tailyour. Sheik Mahomed had been sent to Naru Pum with an escort, but did not clear it or apparently attempt to do so, and it was not until Friday, the 18th, that the hill was cleared and a signal was flashed to me at Bhamo by Ikbaluddin, whom I had sent there some days previously, in order that he might observe from it and thus avoid any further delay. Mr. Serrao subsequently reported to me that none of the surveyors showed him signals in a satisfactory way, and that his work was very much delayed in consequence, and he was given much extra trouble at, to us, a critical time. A fairly good base, however, was eventually secured.

While at Bhamo, the Executive Engineer was good enough to build for us a masonry bench-mark in a suitable spot, and this was subsequently connected by triangulation, and its position and height were determined by Mr. Serrao on his return journey.

The march to the frontier at Lwe Leing.—Our escort of 100 Military police had been previously sent on and were encamped at Momauk, 9½ miles from Bhamo, and at 1 P.M. on the 18th December the Chinese Commissioner and we ourselves left Bhamo under a salute; we went into camp and the Chinese who had no tents to speak of were given houses in the village of Momauk. This Camp was pitched in low ground, near the foot of the hills, and was damp and uncomfortable, however there was no choice. Next morning we left at 8 A.M. and marched up the hills to Lawtan camp, distance from Bhamo about 16¾ miles, the camping ground was very confined about ¼ mile short of the village of Lawtan, and about 3,300 feet above our last camp. The Chinese were again accommodated in the village and in grass and bamboo huts specially prepared for them.

On the 20th we reached Sin Lum, and halted the following day. This enabled me to get in my men from Naru Pum and to make a supplementary station on a hill not far from camp, from which, I took observations the same day.

On the 22nd we marched to Mông Loi, a very prettily situated village and camp in and above the paddy fields. On the 23rd we moved to Môngkha-Lwelong and camped on a knoll on the north side of the paddy fields, our escort being below us in the fields themselves, water being abundant in the stream immediately below us, namely, the Kulong-hka, the stream which in this neighbourhood had for some time been recognised as our administrative boundary. The Chinese were camped about $\frac{1}{2}$ mile further back, as some huts had been prepared there for them.

Visit of the Môngwân Sawbwa.—In the afternoon General Liu, Peng (his assistant and adviser) and the young Môngwân Sawbwa paid a visit to the Commissioner and remained some time. The Sawbwa was introduced to us all round, he was in full Chinese official dress, and appeared very uneasy and nervous. Before leaving General Liu spoke to him very seriously, told him that we were his neighbours and that he was to cultivate friendly relations with us, he was to take note of each of us, in order that he might in future recognise and treat us with proper respect, he then re-introduced us individually and he. The Sawbwa was told at this interview how the boundary ran (in the agreement) and seemed much put out, but Liu made no suggestions. Next day, 24th, as we were now in new country we marched in more regular formation.

The march continued.—The few men of the Burma company of Sappers and Miners we had with us were usefully employed in improving some almost impassable places on the track. The top of the ridge is here of considerable width and densely wooded, and we marched down the wooded slope, past the village of We-ong to our camping ground at Lwe Leing. At Lwe Leing the Chinese and ourselves camped together, they being to the south of us and about 50 yards away.

Trip to the Lwe Leing ridge.—On the 25th, X'mas day, accompanied by a surveyor, Mr. Cholmeley (Deputy Commissioner, Bhamo), Lieut. French-Mullen and a small escort, I went up the hills to the north to try and reach the conical peak—on the Lwe Leing ridge, called Janmai Bum, which is a point on the boundary, the path took us through the villages of Manseng and Nong Chêng, at which latter place the people seemed either frightened or hostile. However, after a short time I managed to get a guide and soon they were re-assured and became quite friendly. After some delay here we started afresh, and reached a curious tract of country on the top of the range, consisting of a series of steep grassy knolls, separated by swampy hollows, the track winding about between the knolls. Finding it would be impossible to reach the point we were making for and have any time left for surveying, I decided to stop short on a commanding knoll, from which Lachman Jadu managed to do a lot of work, fixing all the Lwe Leing ridge to which rays had been drawn previously, besides other important points; as soon as this was completed, we retraced our steps reaching camp a little after dark. It was as well that I went out this X'mas day, and also that I decided to halt short of the hill and get as much work done as possible, as, though I had no thought at the time of its being our only chance of surveying this bit of country, it turned out we were destined never to be able to ascend the hills on this side again.

Reference to Governments.—On the 26th and 27th we had long conferences with the Chinese Commissioner. It was decided at the first of these conferences that we should leave standing camps, at Lwe Leing, and go with a small escort to the Taping to find a suitable starting point for the boundary, and that the survey of the country round was to be proceeded with. At the second conference it was arranged that to avoid delay, I should be allowed to go for a trip of 4 or 5 days into the hills to the north and north-east. At first General Liu requested that I should take an escort of 5 men only, but eventually agreed to my taking 15, the least number that it was in any way safe to have. My object was to survey all the ridge and the country between that and the Taping river.

Lwe Leing.—Enquiries on the spot from local head men and others elicited the fact that the site of our camp was almost exactly that of the former village of Lwe Leing, which was situated on the banks of the Nam-pa-hka; that the little stream to the north-east of our camp used to be called the Lwe Leing hka, and flowed past the Sawbwa's house; that the spot on which our camp was pitched was still known to the Burmans as Kungon Taban and to the Kachins as Lwe Leing Taban, and that it was the spot at which, when following this route, the embassies from Burma to China were met by the Chinese authorities and where the escorts were changed, and that the meaning of the name is "the place where presents are given." Nothing more conclusive than that this was recognised as the boundary between the states under Burmese and Chinese rule could possibly be found, but as we were not searching for but merely demarcating a boundary, it was merely an interesting piece of information.

Our position at Lwe Leing and cause of withdrawal to (Môngkha) Lwe Long.—For the last few days Mr. Rae had been collecting information from friendly natives and by spies, and his enquiries showed that the Kachins of Hohsa-Lahsa-Môngmow and Môngwân were assembling to attack us or at any rate to oppose any attempt of ours to move forward from our camp. We were thus in a very unpleasant position, our camp was incapable of defence as it stood. It was difficult to get supplies and consequently when the General came over that evening, he was informed that it was thought best, as there was no wish to have any fighting over the matter and we did not wish to have trouble on the frontier, that we should all march to the Kulong-hka at Lwe Long the next day and there await the orders of Government. The Kulong-hka being the stream

which had been for some time past recognised as the boundary between the two countries. To this General Liu readily agreed and it was eventually settled that we should march the next day and that he should follow the day after, as he wished not to move, till his reinforcements and the Mōngna Sawbwa whom he had sent for had joined him. The fact of Liu sending for reinforcements shows that he expected trouble. Accordingly next day we returned to Lwe Long and were joined on the 31st by the Chinese, General Liu and Peng coming over at once to see the Commissioner.

General Liu's Birthday.—On 1st January General Liu, Peng and the Mōng-na (Kan-gai) Sawbwa called on the Commissioner. They would do no business, but agreed to a conference on the morrow; this happened, however, to be General Liu's 59th birthday, and an unusually heavy breakfast so incapacitated him that it did not come off.

Lwe Long.—At Lwe Long where we had now settled ourselves, we were in heliographic communication with Bhamo, through two intermediate stations at Mongloi and Sinlum and here we remained until the Commission was broken up in April. Our only move being from the paddy fields which were getting rather insanitary to a spur above them, from which we had a very pretty view of the valley. The Chinese also moved their camp back about $\frac{1}{4}$ of a mile to a pretty wooded spur on the other side of the Kulong-hka.

I have previously mentioned that this stream, the Kulong-hka, had for some years been recognised as the boundary between the two countries and it seemed the most suitable place for a camp pending decisions on our disputes. The term applied to this boundary in Burma, was the "Provisional line" and up to it we had administered.

Chinese Search for Wālān.—For some time they were very busy in making enquiries regarding this imaginary place "Wālān," and they mentioned that they had located it several times, the sites varying considerably being always however west of our present camp and never north of the Kulong-hka. As however they had refused to sanction our surveying the country on their side, and we found that they were interfering with, giving orders to and misleading, our Kachins, the Commissioner very properly informed Liu that while he would give them every opportunity of making enquiries, provided they gave him warning and were accompanied by some of our people as escort, he would on no account allow any Chinese Officials or armed parties to cross the "provisional" frontier unattended. This was a most necessary and important action and was thoroughly understood by the Chinese.

Our visit to Matin and the Sawbwa's evidence.—On the 3rd January the Commissioner rode over to Matin, Mr. Rae, Captain Norie and I accompanied him. The Matin Sawbwa, who is one of the most influential chiefs in the neighbourhood, is blind, but pleasant old man, very superior to the mass of the "duwas," he seemed very pleased to see us, and we had an hour's talk with him. He volunteered that there was no such place as "Wālān" which showed that the Chinese had been there making enquiries; he also told us that the "Tai-pi-kwan" one of the "gates" given back to China by the "Convention" was in the neighbourhood of Pakwān, and this I subsequently verified as on the 20th when I was at Kadaw Kongra, I went to see it at Mungdung village. Also that he knew Lwe Leing and the streams around and that the Lwe Leing and Kangma streams were practically identical; that the stream formed by the combined Pautai Nampa and Kangma hkas was called alternatively the "Lwe Leing" or "Namwa" hka, a further confirmation of our previous information, and this was satisfactory as previous to our visit to that spot, no Europeans or surveyors had visited Lwe Leing at any rate since the annexation of Upper Burma, and its position was merely inserted on the survey of India maps from native information.

Mr. White proposes commencing work on Shweli section.—Immediately on our return we received a call from the Chinese Commissioner, and during the visit Mr. Thirkell White endeavoured to persuade General Liu that the whole party should proceed to Namhkam and commence work on the Shweli section.

This they would not agree to, going over all the old ground about Wālān and the "Taping nor" and insisting that the junction of the Nampaung and the Taping was the place we should go to.

Further attempts to commence work.—During the next few days further attempts were made to get the Chinese to start work on one section or the other, but with no results.

Survey work (Shweli Valley).—Meanwhile I had been employing Lachman Jadu in surveying all the country on our side of the Kulong-hka, while I and Ikbaluddin were working out computations, and on the 11th all the work in the neighbourhood having been finished, I arranged with the Chinese that Lachman Jadu should go to Namhkam with a Chinese Officer and survey all the country adjacent to the Shweli river on both sides, in order that there should be nothing to delay us, when we commenced work on that section; he left on the 13th and completed the work told off to him, as far as he was enabled to do, and returned to camp *via* Bhamo on February 18th. He reported that he practically received no assistance from the Chinese official, who was sent to accompany him—beyond being supplied daily with a guide—and that he was not allowed to survey freely on the Chinese side of the river, consequently he had no more than what was undisputed British territory on his plan.

Further discussions with the Chinese.—So things dragged on until the 25th when the Chinese came over and said that that they had received orders to go by the

reply to our "reference," which reply was that if it was found that we could not arrange matters on this section, we should leave it and proceed to work on the Shweli section. Next day Liu informed Mr. White that he had telegraphed for permission to commence on the Shweli section.

Kan-gai and Mōngwān Sawbwās begin to be actively hostile.—All this delay, which was unavoidable, however, encouraged the local Sawbwās to show more or less open hostility to us, and early in February the Kan-gai Sawbwa, one of the most powerful, took upon himself to assert rights over the territory immediately north and east of the Kulong-hka, he refused to allow the Kachins on our side of the stream to cultivate land on the far side, as they had been in the habit of doing, and proceeded during the course of the next few weeks to erect stockades all along the line. The first that came to our notice was one on the road from our camp to Lwe Leing, and this was garrisoned by some Chinese Shan Levies and Kachins. Liu said that this was erected to protect his (Liu's) convoys of provisions, etc.; and for no other purpose, but when others came under our notice, this excuse was of no avail. The village of Khukha only a few hundred yards from our camp was stockaded and the trees round it cut down; and a big stockade was erected with much display of bunting at Yinfan. In fact on our front and right flank no less than 20 stockades were built; they were placed as follows:—

- 2 at Hpa-lum.
- 2 „ Khukha.
- 1 on road to Lwe Leing.
- 1 at Yinfan.
- 1 „ Lakhum.
- 1 „ Krimudan.
- 1 near Kam-gau.
- 2 „ Kan-hsa.
- 3 „ junction of the Taping and the Kulong-hka, and
- 3 „ Lwe Leing.

None of these were probably at all formidable, but to force a way past them would mean the loss of some lives at any rate, and showed the spirit of the Sawbwās, and can only be regarded as an act of hostility. General Liu was remonstrated with, but said that it was only within the rights of Chiefs and villagers to take any means they pleased to protect their villages; and as they were outside our provisional line though all of them inside the "Agreement" line, pending some proper decision on the points referred to the Government at Pekin or the despatch of reinforcements to us, it was unwise to insist on their being dismantled. It was later admitted by the son of the Kan-gai Sawbwa and the Regent of Mōngwān that the stockades were erected to bar our advance. They were warned that any encroachment into territory administered by us at any time would be severely dealt with, and notwithstanding this they later proceeded to erect stockades at Sadōn and other places on our side of the Mantein hka, and these, though adjoining Mōngwān, were partly garrisoned by Kan-gai's troops, who actually left the Chinese camp in full view of us, with many standards and marched across the hills.

Langtry carries and destroys the stockade at Sadōn Sengmye, etc.—The Government of Burma had however been informed and retribution was speedily to follow, for a detachment of Military Police under Lieutenant Langtry, with Mr. Hertz as Civil Officer, was despatched from Bhamo and on arrival found them occupied, and were fired on. The police charged and carried the stockades, Lieutenant Langtry and two or three sepoy's being wounded. The Chinese fled, leaving 7 dead, 25 prisoners and 9 standards in the hands of our men. In this action, the first in which the sepoy's of the newly raised Kachin Company of the Bhamo battalion were engaged, they behaved splendidly, hacking down under fire the stockade with their *dāhs*, and one of them was severely wounded in a hand to hand encounter with several Chinese, during the pursuit. This and the other stockades in that neighbourhood which were found to have been evacuated were levelled by Lieutenant Langtry's party.

The Commission breaks up.—We parted quite friendly as in fact we had always remained, notwithstanding the official troubles and disputes, and on the 2nd April the British portion of the Commission, having established a post of 200 Military police, who had been sent up from Bhamo as reinforcements early in March, on a hill commanding the whole of the paddy fields of Lwe Long, within rifle range of the village of Khukha and commanding the trade route between Bhamo and Mōngwān.

Some little time before we left, the regent of Mōngwān, a fine determined-looking woman, step-mother of the Sawbwās, came in to see the Commissioner and plead his (Mōngwān's) cause. She remained some time in a camp adjoining the Chinese and Mōngna's (Kan-gai's).

I had met her before in Namhkam in 1894, at about which time I had made the acquaintance of Kan-gai, who then appeared very friendly, and who supplied me with some special cigars of his, which, he said, were unusually good.

General Liu found it inconvenient to leave Lwe Long quite so soon as we did. We reached Bhamo on the 5th April and I remained there, completing as far as possible my maps and settling matters for the northern party, till the 10th, when I left for Mandalay, where I stored the camp equipment and instruments, and on the 14th I rejoined the Commissioner at Maymyo, reporting my arrival to the Lieutenant-Governor, who was there at

the time, and I stayed there mapping and writing a report, which the Commissioner required of me, till the 20th, when I left with the late General Woodthorpe for Mandalay and India.

General deductions.—Thus it will be seen that we were no nearer any settlement of our disputes, at the end of the four months the Commissions were together, than we were the day we first met.

There is no doubt that the frontier Sawbwas had not been advised of the fact that the Commission was to start work, nor were the terms of the agreement imparted to them and our arrival to carry out the work came unexpectedly and as a disagreeable surprise to them.

The time, however, was not all thrown away; I was enabled to get done a considerable amount of survey work with my surveyors, and a good deal of triangulation was carried out and computed, so that there are ample points fixed for work next season, and the country is known.

Behaviour of escorts, etc.—The behaviour of both escorts throughout the season was excellent, and, except on one occasion, there was nothing but the utmost cordiality between both camps, and this was on the occasion of the flogging of some muleteers for theft, bludgeons and arms were seized by an excited crowd of men, and there was a great deal of noise, however no blow was struck, and after some trouble the camp was cleared and quiet was restored. Next day, under a strong guard, the men were properly flogged, as well as one of the ringleaders of the riot, and from that day there was no trouble whatever. Though General Liu had a flogging parade some time later, owing to his finding that his men spent a good deal too much time in gambling, and with money probably stolen from himself and other Chinese officers, as they had several thefts in their camp.

Chinese copy our customs.—None of the Chinese had any knowledge of surveying or of the use of surveying instruments, so those supplied to them on payment from Calcutta at their request, were never brought into use.

It was amusing to note the way they copied us in everything. At first they did not fly a flag, but seeing we always did a very enormous one with Liu's name on it was soon to be seen floating over the entrance to his tent. If we went out for a ride, some of them would start for one on their side of the stream.

We used to send our ponies for exercise on a track made for tent-pegging in the paddy fields, they almost immediately commenced doing likewise. If we had a little revolver practice, within a few minutes you heard shots in their camp. The Chinese soldiers began to salute, as in English fashion, and stand to attention, at times when we passed. And they took the keenest interest in our parades and drills crowding round to see exactly what was done.

When in Bhamo, they of course heard the morning and evening guns fired by the Mountain Battery there. Consequently, we were destined, while in camp, to have an explosion of powder, every morning at about sun rise and at sun set, as soon as the last note of their horns was blown, they sunk some powder in a tube into the ground as they had no gun and fired this by means of a train of gunpowder. They took down their flag with ours at sunset.

On the 22nd January I returned from Kadaw Kongra just in time to reach the Head-Quarter Camp in time to see the eclipse of the sun. There was great excitement in the Chinese camp. They were all on the alert, firing guns, blowing horns and beating drums. This noise and excitement were kept up until the sun was once more free. They explained that they did it to frighten away the dog, which was attacking the sun.

Kachins on our side of the border.—Throughout the season I was much struck wherever I went by the great cordiality and friendliness of the Kachins in our territory, who seemed as happy and contented as men could be. It was rather a surprise to me, as my experiences on the other side of Namhkam, 4 years before, were not by any means the same, and the fact reflects great credit on Mr. Rae, the Civil Officer, and other officers of the Bhamo district. The Kachin sepoy also, many of whom come from these parts, were most happy, cheerful little chaps, and we had some most useful men in the Kachin dooly bearers, who kept us supplied with firewood, carried our *dák* and made themselves generally useful. They had, however, a sincere friend in their commanding officer Lieutenant French-Mullen, and they thoroughly appreciated and reciprocated his feelings.

Behaviour of Survey detachment.—As regards the Survey party, I can give nothing but praise on the subject of their behaviour. They gave no trouble to any one and the *khalásis* were always ready to do anything. Ikbaluddin and Lachman Jadu did all that was possible in the way of surveying, and it was due to the fact that our movements were so restricted that we did not secure a large outturn.

Health.—The health of the whole party was, throughout the year, wonderfully good and the men were well looked after by a very intelligent hardworking hospital assistant attached to the military police.

Note on the topography, etc., of the country traversed by the Southern Section of the Burma-China Boundary Commission, Season 1897-98.

1. *General description.*—The country to which the operations of the Southern Section of the Boundary Commission during 1897-98 was confined lies between the river

Taping on the north and the Namwan on the south. These streams in the area under review flow parallel to one another in a south-westerly direction, and at an average distance apart of about 30 miles as the crow flies, approaching nearest to each other at a boundary line between the two countries (Burma and China) where the distance apart is only 24 miles, the boundary itself as laid down in the Agreement following almost exactly the shortest line.

The streams are by no means identical in character. The Taping, which is by far the biggest, rising in far distant hills, is a deep, rapid stream flowing between steep, forest-clad hills, is a serious obstacle, and cannot be crossed between Manwaing and Myothit, at both of which places there are ferries, except in one or two places by foot passengers over bamboo suspension bridges; while the Namwan, rising in the more immediate neighbourhood, flows gently for some considerable distance through the fertile valley of Mōngwān, and is crossed by several bridges, eventually passing into the hills at the south-west end of the plain, where it is joined from the north by the Mantain *hka*, our present provisional boundary in that region, and continuing to flow south-east for some 30 miles as far as Namkhai, at which point it turns abruptly to the south-east, and eventually discharges itself near Namhkam into the Shweli.

This latter river has also a south-westerly course, and from its junction with the Namwan forms the boundary to the north-east for a distance of some 25 miles till joined by the Namyang, a small affluent from the east.

2. These three rivers are separated from one another by two high ranges of hills, that between the Taping and Namwan being by far the grandest, the highest and most broken, more wooded and offering extensive and magnificent views. The hills gradually diminish in height from the highest, Namkhai Pum (8,687 feet), immediately over the Taping on the north-east, to the peaks on the spurs overlooking the Irrawaddy valley, which run to about 4,000 feet; but almost in the middle of the area, and slightly detached from the main range, rises the fine peak Naru Pum (7,867 feet) above the sea, visible from Bhamo, from near Namhkam and other important places, and from which a most extensive view is obtained in all directions.

The principal peaks on the range starting from the north are Namkhai Pum (8,687 feet), Khokhai Pum (7,720 feet), Janmai Bum (6,835 feet) (the boundary peak above Lwe Leing), Inrakawng (6,384 feet), and close to it Lwelong or Pantein Shan (6,290 feet), on which is the grave of a former Kachin *duwas* (Chief) of Lwelong, and over which the trade route between Bhamo and Mōngwān passes, the hill above Krimudan village (7,350 feet) and Naru Pum already mentioned. Near Janmai Bum the range is joined by another, of which Loi Pangkham (6,864 feet) was the highest peak seen. This range forms the southern and eastern boundaries of Hosa and Lasa, and in reality is the main range, that previously mentioned being cut through between Khokhai and Janmai Bums by the Namsa, which, draining the Hosa-Lasa basin, forces its way through the hills to the Taping.

The hills are very steep and rugged, the valleys deep, and, except in the case of the Kulong *hka*, little cultivated. Having from time immemorial been subjected to the devastating system of *taungya* cultivation, the hills are much more bare of real forest than one would expect or even judge them to be when looking at them from a distance.

The clearing is absolute, not a tree being left where cultivation is intended, and an enormous area is consequently denuded and covered with dense impenetrable *kaing* grass and small jungle. This grass, from even a short distance, gives the impression that the hill is bare, but growing to a height of 10 or 12 feet it is most difficult to contend with until the jungle fires, which occur from April until the rains have swept it away, when no doubt the hills become practicable, though till then one cannot leave the beaten track.

Water is abundant, though not in large quantities in any particular spot, except, of course, the main water-courses, and in many places there is a considerable amount of terraced rice cultivation, notably about north Hoton, Matin, etc.

3. *Streams, etc.*—The main streams in this tract, starting from the north-east, are—

- (a) The Namsa, which drains Hosa and Lasa and falls into the Taping. (The actual course of this stream has not been surveyed, but is approximately known).
- (b) The Kulong *hka*, of which the whole course has been surveyed this year on the scale 1 inch = 1 mile; and
- (c) The Nantabet *chaung*, both flowing into the Taping.
- (d) The Namsiri, which, with the Nantabet, rises in Naru Pum and which flows into the Irrawaddy south of Bhamo.
- (e) The Nampapwe *chaung* with a fairly large catchment area, rising at Pumsen Pum, draining the country between that hill and Karwan, and eventually flowing into the Irrawaddy, four miles south of Bhamo; and
- (f) The Nammu, which flows into the Sinkan *chaung* and thence to the Irrawaddy.

While flowing into the Namwan and Shweli are the Namwa or Lweleing stream, the Mantain *hka* and the Nammak. There is nothing remarkable about any of these streams except, perhaps, the Kulong *hka*, the bed of which is very level for some miles at an altitude of about 4,400 feet, admitting of rice cultivation on either bank, when it suddenly assumes its proper rôle of a mountain stream and falls rapidly and in torrents to the Taping. There are some fairly big falls in several streams, the beds of which are all

picturesque, one below Sinlum being several hundred feet in height by report, though not one clear fall.

One curious feature about several of these streams was observed, namely, that though there was abundance of water and many fine pools, not a fish of greater length than, say, 1 inch appeared to exist.

4. *Villages*.—The principal villages met with are *Matin* (Chinese Matang), on the southern slopes of the Taping, with its blind but very intelligent Chief, who was visited by the Commissioner and myself in January, and who owns the most imposing house in these hills, it being surrounded by a mud and brick or stone wall and approached by a flight of stone steps leading through a Chinese style of gateway into the outer courtyard, which in this case surrounds an ordinary Kachin house, though one of much better construction than is usually the case.

Heton.—A large village near Matin and situated on the ridge forming the north-eastern edge of curious depression in the hills overlooking the Taping and south of the Kulong *hka*.

Chikai.—Another large village close by, with considerable rice-lands.

Möngloi.—On the trade routes between Bhamo and Möngwän, a very prettily placed village with fine trees and much cultivation.

Hpalum.—North of the Kulong *hka*.

Pomshi.—On the slopes of the Taping between the Mankong and Kuli *hkas*.

Lakhum.—A large village or cluster of villages on the spur south of the upper waters of the Namwa and near Lweleing and Ngaseing in the Möngwän valley.

5. *People of note*.—The Matin and Hoton *Duwas* appear to be the most influential of our Kachins in this neighbourhood, while a most useful guide is to be found in the *Pawmaing* of Möngloi, an old but energetic man, with great knowledge of the country.

6. *Roads*.—The country is traversed by many paths following generally the watersheds, after the usual Kachin fashion, but these, owing to the exertions and influence of Mr. Rae, the Political Officer, have of late been much improved and some very creditable traces have been worked, as between Lwelôn and Chikai, Möngloi and Kadaw Kongra, and Möngloi and Matin, but much remains to be done, and the trials of the transport between Sinlum (up to which place a well-laid-out path has been made from the foot of the hills on the Bhamo side by Mr. Cholmeley, Deputy Commissioner, Bhamo, and which may stand the rains) and Lwelôn post during the rains are appalling to contemplate, the line selected by the Kachins between these places apparently following the steepest instead of the easiest gradients.

7. *Tai-pi-kwan*.—One curious discovery was made during this season, and that was the finding of the Tai-pi-kwan in a most unexpected place in Mundung village near Pakwan. I supplied Mr. Warry with a drawing of this stone, which was unearthed by some Chinese explorers. It was in two pieces and half-buried, having been treated with some want of consideration by the Kachins, who had periodically thrown it down the *khud*. The Hoton *Duwas* suggested that the proper place for it was the bottom of the Taping river.

8. Game was not abundant, but by dint of great perseverance Mr. Warry secured a few silver-pheasants, bamboo-partridges and francolin, a woodcock, snipe, and a few quail. Sambhur and barking deer as well as *serao* are to be had, but are rare, and one hare is known to exist. A fine bear was killed close to camp at Lwelôn after an exciting fight and vast expenditure of ammunition by the Kachin sepoy, assisted by some Dogras, an orderly with a fixed bayonet, and a large audience of officers, Kachins, sepoy, followers and Chinamen. It was an exciting time, but no one was shot. The doctor was in attendance with a case of surgical implements and a dresser.

Some rare and one or two new butterflies were secured.

Lweleing.—Lweleing camp, at which place in former days the Burmese escort with tribute to China was usually exchanged for one of Chinese soldiers, is situated in a hollow, at an elevation above the sea of about 3,600 feet, and is almost entirely surrounded by hills, which are highest on the north and west, and the direct road to it from Bhamo, which passes over Pantein Shan, is steep and difficult. The hills round are densely wooded and rather thickly populated, though there is little cultivation about. There are four streams meeting practically at this spot, namely, the Namwa, the Pautai *hka*, the Nampa *hka*, and the Kangma *hka*, and the combined stream under the name Namwa flows at a distance of a mile to 1½ miles through a narrow pass into the low undulating country bordering the Möngwän paddy plain. Close to Lweleing camp we found, what appeared to be the remains of an old fort or gate still visible, a stone causeway separating two swamps, being in a fair state of preservation.

Narrative report by CAPTAIN T. F. B. RENNY-TAILYOUR, R.E., Officiating Superintendent, 2nd grade, on the Survey Operations with the Burma-China Boundary Commission, Northern Section, season 1897-98.

The survey detachment detailed to accompany the northern party is given in the margin. Mr. E. C. S. George, C.I.E., I.C.S., was the Sub-Commissioner with the northern party, Mr. Hausser, of the China Consular Service, was the Chinese adviser, and Lieutenant W. R. Scharlieb, I.S.C., was in command of the escort consisting of 100 Military Police from the Bhamo Battalion; there were also 10 men of the Burma Sappers and Miners to erect the cairns. The transport consisted of Chinese mules.

Our programme was to demarcate the boundary from where the Nampaung river joined the Taping river northward to a high peak the approximate position of which was supposed to be latitude $25^{\circ} 35'$ and longitude $98^{\circ} 14'$. The country through which the boundary passed was not well known and the existing maps turned out very unreliable.

I arranged to do the triangulation myself, Mahmud Husain was to survey as much as possible on the $\frac{1}{4}$ -inch scale assisting with the 1-inch when required, and Abdul Rahim was to survey along the boundary on the 1-inch scale, also surveying on the $\frac{1}{4}$ -inch when possible.

The Chinese had very little idea of the country where we were going to, and Mr. Chen, the Sub-Commissioner, said it was impossible for him to go the whole way as he could ride "no better than a turtle." It was eventually decided that he should go as far as Warawng Pum hill, and that another Sub-Commissioner should meet us there.

It was arranged that we should meet and discuss details with Mr. Chen at Nampaung, a small Military Police post about 30 miles from Bhamo on the main road to Momiën, and within a mile of where we commenced demarcating the boundary.

I left Bhamo on the 17th December, a day before Mr. George, as I wished to visit and observe from a hill near Myothit. Mr. George with the main party caught me up at Myothit and we arrived together at Nampaung on the 20th, Mr. Chen arriving the next day.

At the first interview with the Chinese we got a very fair idea of the difficulties we would have in working with them. It was, however, decided at a subsequent interview that Abdul Rahim and the Chinese surveyor should proceed along the boundary and choose the site for the cairns, but in the event of their being unable to agree the matter was to be referred to the Sub-Commissioners.

While at Nampaung I made a station on a hill to the west and connected up with the station near Myothit; owing, however, to the confined nature of the country, these stations were useless for my main extension.

We left Nampaung on the 28th and arrived at a camp near Alaw Pum hill on the 29th December. The highest part of this hill had been cleared and observed to by Mr. Serrao who was extending from the G. T. series. I observed to Mr. Serrao's stations from Alaw Pum and the connection gave very good results on which to base my main triangulation.

The Chinese objected to the boundary line near Alaw Pum and after several interviews the matter was referred to the Commissioners. In the meantime I formed a second station near Alaw Pum and another near Nawku about four miles further on, to which village we moved camp on the 8th January.

None of the country we were going through had been triangulated before and I was very anxious to get as much work as possible done before the haze set in, and, if possible, to keep the plane-tablers always supplied with points; consequently, as it was uncertain when the disputed questions would be settled, I arranged with Mr. George to go on ahead with Mahmud Husain and an escort of 25 men.

I was delayed a few days waiting for rations and did not leave Nawku until the 14th January. During the time I was separated from the main party I observed from five stations, and the weather being good, I managed to fix a large number of points, some of them well in advance of the work; Mahmud Husain was also enabled to do a considerable amount of plane-tabling on the $\frac{1}{4}$ -inch scale.

The difficulties with the Chinese near Alaw Pum were settled towards the end of January and the main party moved on slowly. I joined them on the 8th February at Pajau, a large Yawyin village about 13 miles from Sä-ma and on the main road between Sä-ma and Si-ma-pa.

At Pajau we again came to a standstill with the Chinese and were delayed there as well as at Paknoi Prang, to which place the main party moved on the 25th February. During the delay I went for a small tour by myself and formed some new stations. We found it very cold at Pajau and Paknoi Prang which were both at an elevation of nearly 7,000 feet, and frequently there was thick ice in the mornings on the basins inside our tents.

We left Paknoi Prang on the 4th March and moved on slowly so as to give time for the 1-inch survey and for the cairns to be erected. In order to expedite the work Mahmud Husain was here told off to survey a portion of the boundary.

We were delayed again at Lung-pien village owing to Mr. Chen refusing to allow us to march through China, but as the road on our side of the boundary was a very long way round we insisted and eventually gained our point.

On the 7th April we arrived at Sansi gorge, a very cold and windy camp, over 9,000 feet elevation and close to where the boundary crosses the main road from Myitkyina to Momien. A few miles beyond Sansi gorge there is a high peak called Tabu Pum about 11,200 feet elevation. I was most anxious to visit and observe from this hill, and moved on to a camp near it. Luckily we had heavy rain about this time which cleared away a good deal of the haze, but owing to clouds I had to spend three days on the hill before I got satisfactory observations.

From the camp near Tabu Pum we marched by a very rough road to Waw-hkyun (a temporary Military Police post), and here I made a station. We then moved on to Kambaiti camp which is at an elevation of nearly 7,000 feet. This camp lies to the south of Warawng Pum hill previously mentioned, and is on one of the trade routes into China. From Waw-hkyun I had sent Mahmud Husain with Mr. Duff, the local Civil Officer, to survey on our side of the boundary up to the position of the high peak where we were to finish work, nothing being known of that part of the country.

As the Chinese Sub-Commissioners changed at Kambaiti, a map in duplicate of the boundary on the 1-inch scale up to this point had to be prepared, these were both signed and sealed by Messrs. George and Chen, and one kept by each.

After the final interview with Mr. Chen we had a meeting with Colonel Yang, the new Sub-Commissioner, and at once found that the change would cause us considerable delay. Colonel Yang refused to allow us to go through China, among other reasons stating that there was a rising on his side. From Kambaiti to the end of our work was only 3 marches through China, but on our side it was 5 or 6 marches round, so naturally we insisted on the former road. The matter was referred to the Commissioners and General Liu, the Chinese Commissioner, twice telegraphed to Colonel Yang from Momien to allow us to proceed. These telegrams came in English and were translated by Mr. Hausser to Colonel Yang, who evidently did not consider them genuine and must have written to this effect to General Liu, for a few days later, we were much amused by another telegram arriving from General Liu. The next day he withdrew his objections to our going on through China.

Since the 26th April it had been raining more or less continuously, and the streams being in flood it was considered impossible to send on more than a small party, consequently Abdul Rahim and the new Chinese surveyor started off on the 6th May leaving the main party at Kambaiti. The surveyors reached a high hill near the position given as the high peak in the convention, put up cairns there and returned to Kambaiti on the 13th May, after an extremely wet and difficult journey. Mahmud Husain returned with Abdul Rahim.

Another map in duplicate was drawn and the final interview was held on the 14th May.

While at Kambaiti the weather was most unsuited for surveying and we were seldom without heavy clouds or mist. I made two stations, one of them on Warawng Pum (which was at an elevation of over 11,000 feet). I visited them on the three finest days we had, but even then experienced great difficulty in getting the observations I required.

In this part of the country the regular rains had evidently set in, and as we were anxious to get away before the roads became impassable we left Kambaiti on the 15th and marching hard reached Myitkyina on the 19th May. On the march down I observed again at Waw-hkyun and formed stations at Sadon and at Warraw Pum, a hill between Waw-hkyun and Sadon which had been cleared in advance.

The defile on the Irrawaddy river above Bhamo had been closed for steamers at the beginning of May, but was luckily now open enabling us to get down to Bhamo by river instead of having to go round by Mogaung and Katha. Four small steamers were put at the disposal of our party, and leaving Myitkyina at about 4 A.M. on the 20th, we arrived at Bhamo in the evening of the same day.

I got the survey party on to a Government steamer from Bhamo to Mandalay and catching the next Madras steamer from Rangoon, reached Bangalore on the 2nd June.

Owing to the ways of the Chinese and the inaccuracy of the existing maps it was generally necessary to have the country near the boundary surveyed on the $\frac{1}{2}$ -inch scale in advance, and on several occasions I could have employed a third surveyor with advantage. The Chinese hampered us a good deal, and our escort was also hardly large enough to supply separate detachments for myself and the two surveyors, let alone the question of keeping them supplied with rations. Taking, however, everything into consideration I think the outturn of survey work was very satisfactory: 4,750 square miles were triangulated, 690 square miles were surveyed on the 1-inch scale along the boundary as well as 1,960 square miles on the $\frac{1}{2}$ -inch scale. I was able to carry on the triangulation throughout and observed from 20 stations and fixed 132 intersected points; by working out the triangulation roughly in the field, I was almost always enabled to keep the surveyors supplied with fixed points. Among the intersected points I fixed as many distant hills in China as possible.

In recess my triangulation has been carefully computed and has worked out well. The 1-inch work has been fair mapped in 6 sheets, and the $\frac{1}{2}$ -inch work has been drawn out in a special map, all for reproduction in two colours.

The general health of the survey detachment was very good in spite of a good deal of wet and cold weather; the *khalásis* were all given rations, and consequently fed a good deal better than usual.

I am very much indebted to Mr. George for all the help I received from him; from start to finish he did everything he possibly could to assist our work.

Surveyor Mahmud Husain is very energetic and hard working and surveyed most of the $\frac{1}{4}$ -inch work. At one part of the season he had a bad foot, and I had to send him for a short time to the hospital at Sā-ma until it was healed but he himself was most unwilling to stop work.

Sub-Surveyor Abdul Rahim showed much zeal and energy and worked very well. He was principally employed on the 1-inch work along the boundary, and by his tact and the friendly terms on which he kept with the Chinese considerably facilitated the work of the Commission.

Extract from the Narrative Report by MR. J. BOND, Extra Assistant Superintendent, 3rd grade, on the Assam Revisionary Triangulation, Season 1897-98.

The triangulation was carried out with one of the modern 8-inch micrometer theodolites, the vertical and horizontal limbs being graduated to 10 minutes, and the micrometer heads of the microscopes to 10 seconds, and by estimation, reading to single seconds. The work was executed after the method of the best class of topographical triangulation, but a greater number of zeros were used, namely, L. 0°, R. 180°, L. 45°, R. 225°, L. 90°, R. 270°, L. 135°, and R. 315°. All the observations were taken to heliotropes except in the cases of two intersected points. It was also intended to use lamps for night work, but they were not ready when the party took the field, and they would have been of little use during the cold weather, owing to clouds settling on the hills at night.

I proceeded by rail from Poona on the 12th November 1897, and arrived at Allahabad the following day, where I was joined by the members of the party who were on recess leave and by Surveyor Syed Zille Hasnain, transferred from No. 14 Party, who brought with him from Katni the camp kit of the party which had been stored there at the close of the previous season's levelling operations.

On the completion of arrangements for the field at Allahabad, I despatched the establishment, as under, to Gauhāti on the 20th November: Surveyor Syed Zille Hasnain, Sub-Surveyor Balwant Atmaram, 30 *khalásis* and 1 *peon*.

The camp kit was forwarded by goods train and the men had to see it safely transhipped at each junction station and ferry between Allahabad and Gauhāti, which caused a delay of three days before reaching Jatrápúr railway terminus, where a further delay of two days occurred for want of room in the steamers: thus the men and kit did not reach Gauhāti until the 29th November.

I myself went to Calcutta to collect the instruments, maps, etc., required for the triangulation, and after receiving instructions from Major Burrard in the use of the micrometer theodolite, not having had the opportunity of using one before, I proceeded to Gauhāti, arriving there on the 1st December, a couple of days after my detachment.

It was considered advisable to proceed to Shillong in order to obtain information and assistance from the civil authorities before beginning the observations along the Eastern Frontier Series. The whole party accordingly marched to Shillong, where it arrived on the 8th December, and after unpacking and adjusting the instruments and training the signallers, the several squads were sent to their respective stations, while I went with the main or observing camp to Rangsañobo H. S. near Cherra Poonjee, and commenced observations on the 21st December.

The stations visited are shown in the accompanying chart; the dates of closing observations are as follows:—

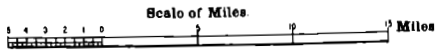
Rangsanobo H. S.	. . . . .	24th December.
Mopen H. S.	. . . . .	6th January
Mosingi H. S.	. . . . .	13th "
Laidera H. S.	. . . . .	28th "
Mautherichan H. S.	. . . . .	9th February.
Maonai H. S.	. . . . .	16th "
Maophanu H. S.	. . . . .	25th "

No approximate work had been done beyond the new station of Maophanu H.S., which had to be introduced on account of Maopáni H. S. of the old work having been so completely destroyed, that it was found impracticable to rebuild it without great loss of time and very heavy expenditure.

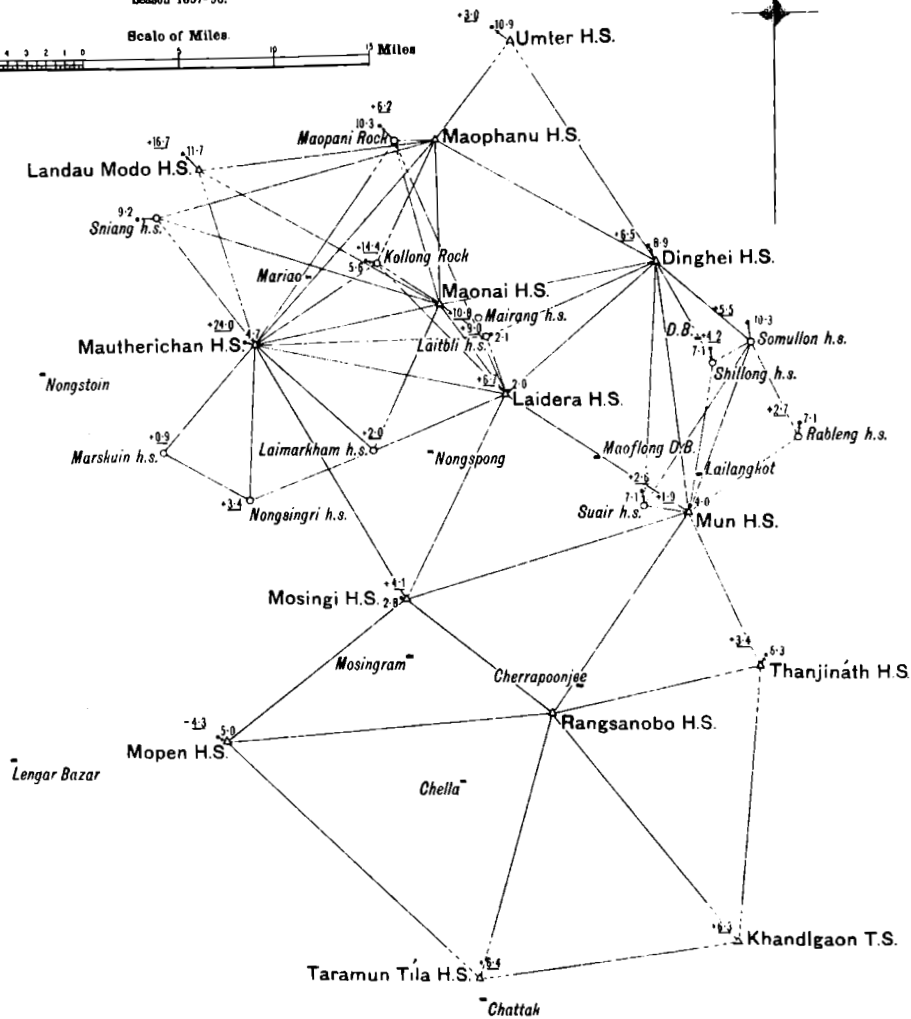
It was now rather late in the season and the atmosphere had become so hazy that neither the signals nor hills were visible. As the observations already taken had supplied sufficient data to show that the stations of the Eastern Frontier Series had been affected by the earthquake, it was deemed expedient to suspend further observations along it, and to try what could be done on the Brahmaputra series, as it would be interesting to know if the stations in the Gáro hills had also been affected. I accordingly closed my observations at Maophanu H. S., and was obliged to send messengers to recall the signalling squads; this necessitated great delay, and the signallers did not join me at Shillong until the 8th March.

TRIANGULATION CHART
OF THE
KHASHI HILLS.

Season 1897-98.



- Nongpoh



Scale 1 O., Calcutta

REFERENCES.

Figures underlined are the alterations in height in feet, + denoting an upheaval and - a subsidence, on the assumption that the height of Rangsanobo H. S. remained unaltered. Other figures denote the lateral displacements in feet, and the dots show the relative displacements exaggerated, and the arrows their directions.

NOTE.—The triangulation emanates from the side Taramun Tila H. S. — Rangsanobo H. S. assumed to be unchanged.

The party left Shillong on the 11th March, arrived at Gauháti on the 13th, and thence took steamer, reaching Dhubri on the 15th. The signalling squads were at once despatched to the surrounding stations of the Dhubri polygon. I prepared for observations by having the Dhubri station platform rebuilt, as it had been destroyed by the earthquake. To my great disappointment, the atmosphere was so thick with clouds of dust and sand from the Brahmaputra, that the opposite bank of the river was not visible and no observations could possibly be obtained on this series. Messengers were sent out on the 24th March to recall the signalling squads, and the detachment once more assembled at Shillong to connect the trigonometrical points in its vicinity.

Observations were completed as follows :—

Mun H. S.	. . . . .	15th April.
Dinghei H. S.	. . . . .	22nd "
Somullon H. S.	. . . . .	29th "

The party returned to Shillong on the 30th April, and proceeded on the 4th May, *viá* Gauháti to Dhubri, to pick up the sick members of the party and the spare kit that had been left behind on the return of the party to Shillong.

I sent the *khalásis* away to their homes on the 10th May and proceeded, in accordance with instructions, to Calcutta with the instruments and camp equipment. The instruments were made over to the Mathematical Instrument Office for deposit, and the camp equipment was stored in the Surveyor General's Office, after which I left Calcutta on the 14th and arrived at Poona on the 16th May.

The health of the party was good until about the end of the season, when, in the attempt to start the observations on the Brahmaputra Series in the middle of March, influenza and malarial fever began to attack the establishment. When we were leaving Dhubri to return to Shillong to strengthen the triangulation by observing at Mun H.S., I was obliged to leave the surveyor and 4 men behind for medical treatment; subsequently 5 others fell ill, and I was thus deprived of the services of a large percentage of my small party.

There was one death during the season, that of a signaller who succumbed after two days' acute illness brought on from the excessive cold and bad weather experienced on the highest of the hill stations.

The season's outturn is as follows :—

Horizontal and vertical angles were taken at 13 stations, of which 2 were newly selected ones, fixing the positions of 22 and the heights of 25 stations.

The following table shows the outturn of work :—

Assam Revisionary Triangulation Season, 1897-98.

Description of Work.	Number or Amount.
Principal stations observed at	7
Auxiliary principal stations selected and observed at	2
Principal stations connected but not observed at	4
Secondary stations observed at	4
Secondary stations and intersected points connected but not observed at	7
Principal triangles in which all three angles were observed	9
" " " two angles were observed	6
Secondary triangles in which all three angles were observed	4
" " " two angles were observed	23
Average triangular error in seconds	3.41
Stations and points the heights of which have been determined	25
Mean coefficient of refraction	0.055
Area of triangulation in square miles	1020
Length of series in miles	50
Station pillars built	2
Station platforms constructed	9
Hill tops cleared of jungle	7

DRAWING OFFICE, CALCUTTA.

SECTION I.—GEOGRAPHICAL, DRAWING, AND COMPILATION.

Statement showing the work performed during the year 1897-98.

TITLE.	Scale.	Number of Sheets.	REMARKS.
ATLAS OF INDIA.			
Sheets Nos. 10 N.E., 14, 29, 30, 31 N.E., 31 N.W., 40, 48, N.W., 48 S.W., 53 S.E., 62, 66 S.E., 66 S.W., 67 N.E., 67 S.W., 71 S.W., 80, 90 N.W., 91 N.W., 95 N.W., 104, 106 113, 126 S.W. and 130 S.W.	1=4	25	Additions made to railways, roads, canals, and changes to boundaries.
Sheets Nos. 31 N.W., 40 S.E., 41 N.E., 41 N.W., 41 S.W., 4 N.E., 42 N.W., 47 N.E., 4 S.E., 47 N.W., 48 N.E., 57 S.W., 58 S.E., 58 S.W., 59 N.E., 59 S.E., 59 N.W., 62 N.E., 78 N.E., 78 S.E., 79 N.E., 79 S.E., 80 N.E., 80 N.W., 80 S.W., 127 N.W., 142 N.E., 142 N.W., 142 S.W., 143 N.W., 144 N.E., 144 S.E., 144 N.W., 144 S.W., 145 N.E., 145 S.E., 157 N.E., 157 S.E., 163 S.W., 164 N.E., 164 N.W., 164 S.W., 165 N.W. and 165 S.E.	1=4	44	Additions made to names and details for engraving.
Sheets Nos. 14 N.E., 14 S.E., 24 S.E., 25 N.E., 48 N.E., 59 N.W., 77 S.W., and 78 N.W.	1=4	8	Hills brush shaded for engraving.
GENERAL MAPS.			
Afghanistan (Photo.)	1=24	2	Additions to date.
India (showing canals) (Photo.)	1=32	6	Ditto ditto.
Do.	1=32	6	Compilation in progress for engraving.
Do. (Skeleton) (Litho.)	1=32	6	Railways to date.
Do. (2nd edition) (do.)	1=32	6	Additions to date and published.
Do. (showing railways) (do.)	1=48	6	Ditto ditto.
Do. (3rd edition) (Litho.)	1=32	6	Under publication.
Do. (engraved)	1=128	1	Additions to date.
Do. (do.)	1=256	1	Railways and boundaries to date.
PROVINCIAL MAPS.			
Assam (Skeleton) (Litho.)	1=16	1	Additions to date.
Do. (do.)	1=16	1	Ditto to railways to date.
Do. (engraved)	1=16	1	Ditto ditto.
Bengal, Bihar, Orissa and Chota Nágpur (Litho.)	1=16	2	Additions to date and published.
Do. do.	1=16	2	Hills brush-shaded for engraving.
Do. do. (Skeleton) (Photo.)	1=16	2	Additions to date and published.
Burma and Adjacent Countries (Photo.)	1=32	2	Ditto ditto.
Do. do. (do.)	1=48	1	Ditto ditto.
Central Provinces (Litho.)	1=16	2	Additions to date.
Gujarát (engraved)	1=16	1	Completed and published.
Madras	1=16	4	Additions to date for engraving.
Nizám's Dominions and Assigned Districts of Berar (Litho.)	1=16	2	Ditto to date.
Punjab	1=16	4	Ditto ditto for engraving.
Punjab (Skeleton) (Litho.)	1=16	4	Ditto to railways to date.
Rájputána Agency (do.)	1=16	2	Ditto to date.
Upper Burma (2nd edition) (Photo.)	1=16	2	Do. to railways, boundaries and names to date.
Upper Burma (3rd edition)	1=16	2	Compilation in progress.
DIVISIONAL MAP.			
Tenasserim (Photo.)	1=4	6	Additions to date and published.

DRAWING OFFICE, CALCUTTA.

SECTION I—continued.

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
DISTRICT MAPS.			
ASSAM—			
Darrang	1=4	1	Additions to date.
BENGAL—			
Backergunge, Bogra, Champáran, Darbhanga, Dinájpur, Monghyr, Nadia, and Palámau	1=4	8	Completed and published.
Chittagong, Jalpáiguri, and Midnapore	1=4	3	Additions and corrections to date.
Puri	1=4	1	Railways to date.
PUNJAB—			
Hissar	1=4	1	Railways to date.
Jhelum (in 4 sections)	1=1	4	Ditto.
Ráwalpindi in 4 sections)	1=1	4	Completed and published.
Jhelum and Ráwalpindi	1=4	2	Additions and corrections to date.
STANDARD MAPS.			
BENGAL—			
Sheets Nos. 74, 125 and 126	1=1	3	Completed and published.
BOMBAY—			
Sheets Nos. 199 N.E., 199 S.E.	2=1	2	Completed and published.
CENTRAL INDIA AND RAJPUTANA—			
Sheets Nos. 213, 304, 312, 381, 441, 459 and 472	1=1	7	Completed and published.
Sheets Nos. 307, 408 and 474	1=1	3	In progress.
CENTRAL PROVINCES—			
Sheets Nos. 35, 39, 50 and 154	1=1	4	Completed and published.
Sheets Nos. 18, 20, 28 and 67	1=1	4	In progress.
HYDERABAD—			
Sheet No. 168	1=1	1	Completed and published.
NORTH-WEST TRANS-FRONTIER—			
Sheet No. 28 S.E.	1=4	1	Additions to date and published.
PUNJAB—			
Sheet No. 54	1=1	1	Completed and published.
Parts of sheets Nos. 28 and 53 and 55 and 83	1=1	2	Additions and corrections to date.
UPPER BURMA—			
Sheet No. 306	1=1	1	Additions and corrections to date and published.
Sheet No. 200 (2nd edition)	1=1	1	Completed and under publication.
Sheets Nos. 314 and 359	1=1	2	Ditto and published.

DRAWING OFFICE, CALCUTTA.

SECTION I—continued.

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS—conold.			
UPPER BURMA—			
Sheet No. 316	1=1	1	In progress.
NORTH-EASTERN FRONTIER SERIES—			
Sheet No. 15 N.E. (3rd edition)	1=4	1	Corrections to date and published.
Sheet No. 15 (4th edition)	1=8	1	Boundaries brought up to date.
Sheet No. 23 N. W. (8th edition)	1=4	1	Brought up to date and published.
Sheet No. 23 S. W. (8th edition)	1=4	1	Boundaries brought up to date.
Sheet No. 23 S. E. (2nd edition)	1=4	1	Brought up to date and published.
Parts of Sheets Nos. 23 N. E. and N. W.	1=4	1	Additions to date.
Sheet No. 23 (2nd edition)	1=8	1	In progress.
SOUTH-EASTERN FRONTIER SERIES—			
Sheet No. 1 N. E. (6th edition)	1=4	1	Additions to date and published.
Sheet No. 1 N. W. (5th edition)	1=4	1	Ditto ditto.
Sheet No. 1 S. W. (4th edition)	1=4	1	Boundaries to date.
Sheet No. 1 (5th edition)	1=8	1	Completed and published.
Sheet No. 2 S. E. (5th edition)	1=4	1	Published.
Sheets Nos. 2 N. W. (2nd edition) and 2 S. W. (2nd edition)	1=4	2	Ditto.
Sheet No. 2 N. E. (7th edition)	1=4	1	In progress.
Sheets Nos. 3 S. E. and 3 A. N. E.	1=4	2	Ditto.
Sheet No. 4 (2nd edition)	1=8	1	Ditto.
Sheet No. 5 S. W. (6th edition)	1=4	1	Boundaries to date.
Sheet No. 5 N. W. (5th edition)	1=4	1	Completed and published.
Sheet No. 5	1=8	1	In progress.
Sheet No. 6 N. W. (7th edition)	1=4	1	Boundaries to date.
Sheet No. 6 (2nd edition)	1=8	1	In progress.
Sheet No. 8 (2nd edition)	1=8	1	Ditto.
ADMINISTRATION REPORT MAPS.			
Assam	1=48	1	Hills brush shaded for engraving.
Punjab	1=32	1	Corrections to date.
Upper Burma	1=64	1	Completed and published.
BENGAL—			
Burdwan	1=8	4	Additions and corrections to date.
Dacca			
Jalpaiguri			
Noakhali			
Bogra	1=8	1	Published.
Cuttack	1=8	1	Completed and published.
Hazaribagh	1=8	1	Published.
Monghyr	1=8	1	Completed and published.
Mymensingh	1=8	1	Ditto ditto.
Rajshahi	1=8	1	Ditto ditto.
CENTRAL PROVINCES—			
Balaghát	1=8	1	Brought up to date and published.
Bastar	1=16	1	Completed and published.
Bhandára	1=8	1	Ditto ditto.
Biláspur	1=16	1	Ditto ditto.
Chindwára	1=8	1	Hills brush shaded for engraving.
Hoshangabad	1=12	1	} Additions to date.
Nimár	1=8	1	

DRAWING OFFICE, CALCUTTA.

SECTION I—continued.

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
ADMINISTRATION REPORT MAPS—concl'd.	In. M.		
CENTRAL PROVINCES—concl'd.			
Saugor	1=8	1	Completed and published.
Wardha	1=8	1	Brought up to date and published.
NORTH-WESTERN PROVINCES—			
Mirzápur	1=12	1	Hills brush shaded for engraving.
PUNJAB—			
Dehra Ismáil Khán	1=16	1	Completed and published.
Delhi	1=8	1	Ditto ditto.
Gurgáon	1=8	1	Additions and corrections to date.
Hissár	1=8	1	Completed and published.
Hoshiárpur	1=8	1	Hills brush shaded for engraving.
Karnál	1=8	1	Brought up to date and published.
Ludhiána	1=16	1	Completed and published.
Montgomery	1=8	1	Ditto ditto.
INDEX MAPS.			
For Administration Report	Various.	24	Brought up to date.
Index to the standard sheets of Assam	1=24	1	Additions to railways and boundaries.
Index to the sheets of Assam, Bengal and Burma	1=16	1	Tracing made on vellum cloth.
Index to the sheets of Topo- graphical Survey in North and South Lushai Hills	1=16	2	{(a) Showing different surveys. {(b) Additions to details.
Index to the standard sheets of Upper and Lower Burma	1=32	1	Additions to date.
Index to the Standard Sheets of the Punjab	1=50	1	Brought up to date.
Index to the Standard Sheets of Bengal	1=52	1	Additions and corrections to date.
Index to the Standard Sheets of Upper and Lower Burma	1=64	1	Corrections to railways and boundaries.
PLANS OF CITIES AND CANTONMENTS.			
Sketch plan, part of Nusseer- abad	In. Ft. 1=100	1	A trace made on vellum cloth.
Plan of Solon	1=110	1	Ditto ditto .
Plan of Karáchi Cantonment	1=300	1	Ditto ditto .
Plan of Sipri Cantonment	1=500	1	Additions to date and published.
Plan of East Coast Railway (Cuttack and Puri Branch)	In. M. 1=1	1	A trace made on vellum cloth.
Plan of Simla and Jutogh	6=1	1	Published.
Plan of permanent Barrack at Mhow	6=1	1	Additions and corrections to date.
Plan of King's Bank Battery, Rangoon Cantonment	12=1	1	A trace made on vellum cloth.
Plan of Wellington Cantonment	12=1	1	Ditto ditto.
Plan of Secunderabad Canton- ment	12=1	1	Ditto ditto.
Plan of Bangalore Cantonment	12=1	1	Ditto ditto.
Plan of Isthmus Cantonment, Aden	24=1	1	Ditto ditto.
Plan of Crater, Aden	24=1	1	Ditto ditto.
Plan of Steamer Point Canton- ment, Aden	24=1	1	Ditto ditto.
Plans of Dagshái, Jutogh, and Subáthu Cantonments	24=1	3	Additions and corrections to date.
Plans of Forts Sandeman and Kasauli	24=1	2	Ditto ditto.
SPECIAL MAPS.			
Route from Pathámkot to Simla	1=4	2	Completed.
Map of Central Provinces	1=32	1	Corrections to date.
Map of India	1=192	1	Showing Educational progress for Quinquennial Report, 1892—97.

DRAWING OFFICE, CALCUTTA.

SECTION I—continued.

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
WORK DONE FOR OTHER DEPARTMENTS.	In. M.		
MISCELLANEOUS.			
Country 12 miles round Quetta Cantonment	2=1	1	Prepared for the Military Department.
Countries 12 miles round Ajmere, Deoli, Mhow, Neemuch, Nusserabad, and Sirdarpore Cantonnments	1=1	6	Prepared for the Adjutant General Commanding the North Western Divisions.
Country 12 miles round Nimár	1=1	1	Additions to date.
Map of Largha Shirani Country	1=1	1	A trace made on vellum cloth for Foreign Department.
Map of Simla	1=4	1	Completed and published for Sir H. Collett.
Maps of Assam, Bhágalpur, Burdwan, Chittagong, Chota-Nágpur, Dacca, Orissa, Patna Presidency, and Rájsháhi Divisions	1=8	10	Prepared for the Inspector General of Registration.
Province of Assam	1=16	1	Additions to names for the High Court of Judicature.
Bengal, Bihar, Orissa and Chota Nágpur	1=32	1	Prepared for the Inspector General of Registration.
Central Provinces (illustrating Famine report)	1=32	1	Prepared for the Administrative Medical Officer, Central Provinces.
Famine Map of the Central Provinces, showing (1) Aborigines, (2) Crop outturn, (3) Death rates, (4) Forms of relief, (5) Rise of prices, (6) Village Relief	1=48	6	Ditto ditto ditto.
India (showing railways)	1=32	6	Under preparation for the Public Works Department.
MAPS, COLOURED, ETC.			
Maps on various scales . . . . .	...	1,364	For Surveyor General's Office.
Ditto ditto . . . . .	...	582	For other Departments.
TOTAL . . . . .	...	1,946	

DRAWING OFFICE, CALCUTTA.

SECTION I.—concluded.

Statement of work.—concluded.

Description of work.	Number of sheets.
MAPS EXAMINED.	
Atlas Sheets	84
General Maps	13
Provincial Maps	9
District Maps	2
Standard Maps	52
Plans of cities and cantonments	3
Administration Report Maps	15
Index Maps	15
Statistical and Extra Departmental Maps	55
Miscellaneous Maps	48
Triangulation Charts	1
Originals and Office copies of various maps with additions and corrections in territorial boundaries, public works, etc	670
Tracing prints prepared for Atlas Reductions	69
Tracings of roads, canals and railways from originals supplied by Public Works Department	16
Engraved proofs of Atlas Sheets in various stages	189
Ditto of General and Provincial Maps, including Index Charts	33
Ditto of large scale plans	4
Ditto of Administration Report Maps	43
Ditto of Statistical Maps	1
Litho. proofs of General and Provincial Maps including Index Charts	30
Ditto of Atlas Sheets and District Maps transferred from copper plates	23
Ditto of Statistical and Extra-Departmental Maps	7
Photo. proofs of Standard and various other maps	381
Colouring of maps for various purposes	513
Projection and examination of graticules and plotting of points	46
TOTAL	2,327

Note.—In addition to the above, many miscellaneous jobs, such as supply of geographical data to various officials, calculation of areas, computation of graticules for the projection of the sheets of the Indian Atlas, examination of the printed catalogues of maps as to additions and corrections up to date, examination of the proof sheets of the Survey of India Department Notes, and of the "General Report on the Operations of the Survey of India Department" as to the correct orthography of geographical names, and various other minor works have been performed by the Examining Section.

DRAWING OFFICE, CALCUTTA.

SECTION II.—REVENUE, DRAWING, AND COMPILATION.

Statement showing the work performed during the year 1897-98.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS.			
PUNJAB.			
<i>Indus Riverain Survey.</i>			
Sheets Nos. 23, 46, 47, 48, 59, 68 and 99	1=1	7	Proofs passed, press order given.
<i>District Pesháwar.</i>			
Sheets Nos. 1, 2, 3, 5, 8 and 9 (old Sheets)	1=1	6	Ditto ditto.
Sheets Nos. 79 and 80	1=1	2	Compiled from the old sheets with additions from tracings received from the district officials; proofs passing through press.
Sheets Nos. 78 and 106	1=1	2	Drawing and typing almost finished.
Sheets Nos. 51, 52, 105, 107, 108 and 134	1=1	6	Drawing and typing in progress.
<i>District Habára.</i>			
Sheet No. 12	1=1	1	Proof examined with district officer's proof and sent to press for corrections.
<i>District Hissár.</i>			
Sheets Nos. 257, 258 and 275	1=1	3	Additions and corrections made to boundaries and roads.
<i>Districts Umballa and Karnál.</i>			
Sheets Nos. 292, 293, 294, 315 and 316	1=1	5	Ditto ditto.
<i>District Dera Gházi Khán.</i>			
Sheets Nos. 17, 18, 19, 20, 36, 37, 38, 39, 40, 41, and 42	1=1	11	Corrected up to date from the 16-inch tracings received from the district officials.
<i>District Montgomery.</i>			
Sheet No. 198	1=1	1	Redrawn, proofs passed, and press order given.
Sheet No. 174	1=1	1	Printed map touched up, corrected and sent to press for reproduction. Proofs sent out to district officers for corrections.
NORTH-WESTERN PROVINCES AND OUDH.			
<i>Districts Meerut and Moradabad.</i>			
Sheet No. 31	1=1	1	Examined with district officer's proofs and returned to press for corrections.
<i>District Saháranpur, Muzaffarnagar and Meerut.</i>			
Sheets Nos. 2 and 4	1=1	2	Additions and corrections made to roads and boundaries.
Sheet No. 13	1=1	1	Completed with village boundaries; proof passed; press order given.
Sheets Nos. 6, 13 and 16	2=1	3	Completed with village boundaries; proofs returned to press for corrections.
Sheets Nos. 10, 14 and 18	1=1	3	Completed with village boundaries; proofs sent out to local officers for corrections up to date.
Sheet No. 19	1=1	4	Fair maps corrected and sent to press for reduction to 1-inch scale.

DRAWING OFFICE, CALCUTTA.

SECTION II—continued.

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS—contd.	In. M.		
NORTH-WESTERN PROVINCES AND OUDH—contd.			
<i>District Aligarh.</i>			
Sheets Nos. 23 and 35	2=1	8	Fair maps corrected and sent to press for reduction to 1-inch scale.
Sheet No. 36	1=1	1	Additions and corrections made to boundaries and roads.
<i>Districts Aligarh, Muttra and Agra.</i>			
Sheets Nos. 24, 25, 37 and 38	1=1	4	Proofs sent to district officers for corrections up to date.
<i>Districts Jaunpur, Benares and Mirzāpur.</i>			
Sheets Nos. 168 and 169	1=1	2	Proofs returned to press for corrections.
Sheet No. 171	1=1	1	Blue and black proofs transferred to Geographical Section, Drawing Office.
<i>Districts Ghāziipur, Benares and Mirzāpur.</i>			
Sheet No. 195	1=1	1	Proofs sent out to district officers for completion up to date.
Sheets Nos. 196 and 197	1=1	2	Second proof returned to press for further corrections.
<i>Districts Basti, Gorakhpur and Ghāziipur.</i>			
Sheets Nos. 175, 188, 190, 203, 205, 208, 220 and 221	1=1	8	Proofs returned to press for further corrections.
Sheet No. 189	1=1	1	Proofs sent to local officers for corrections up to date.
<i>District Banda.</i>			
Sheet No. 112A	1=1	1	Proof transferred to Geographical Section, Drawing Office.
<i>Districts Gorakhpur, Ghāziipur, Ballia and Benares.</i>			
Sheets Nos. 209, 210, 211, 217, 218 and 219	1=1	6	Additions and corrections made to boundaries and roads.
<i>Districts Bareilly and Pilibhit.</i>			
Sheet No. 82	1=1	1	Ditto ditto.
<i>Portion of Naini Tal (Kumāun Bhābar) District.</i>			
Sheets Nos. 63 $\frac{N.W.}{1 \text{ and } 3, 4}$, $\frac{S.W.}{1, 2, 3, 4}$ and 251 $\frac{S.E.}{1, 3}$ and $\frac{S.W.}{1, 2, 3, 4}$	4=1	9	Proofs passed, press order given.
Sheets Nos. 46 $\frac{N.E.}{2, 4}$, $\frac{S.E.}{2}$, 63 $\frac{N.E.}{3}$, $\frac{S.E.}{1}$, 64 $\frac{N.E.}{1, 3, 4}$, $\frac{S.E.}{1, 2, 4}$, 250 $\frac{S.W.}{3}$ and 251 $\frac{N.W.}{1, 2, 3, 4}$	4=1	19	Proofs returned to press for further corrections.
Sheets Nos. 63 $\frac{S.E.}{3}$ and 64 $\frac{N.E.}{2}$	4=1	2	Proofs sent to district officers.

DRAWING OFFICE, CALCUTTA.

SECTION II—continued.

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS—contd.			
	In. M.		
ODDH.			
Sheet No. 136	1=1	1	Proofs sent to district officers for completion up to date.
Sheets Nos. 88, 99, 129, 130, 131, 145, 148, 158, 160, 161, 173, 174 and 175	1=1	13	Additions and corrections made to boundaries, roads, etc.
BENGAL.			
<i>District Darjeeling (including British portion of Sikkim).</i>			
Sheet No. 269	1=1	1	Second proof returned to press for corrections.
Sheet No. 270	1=1	1	Proof corrected from district officer's copies, and returned to press for corrections.
<i>Districts Hooghly and Howrah.</i>			
Sheets Nos. 263, 264, 265, (285 and portion of 308), 285, 286, 287 and (288 and portion of 239)	2=1	21	Spelling of names of fair sheets being corrected to Hunterian system and sites altered into blocks for republication.
<i>District Midnapore.</i>			
Sheets Nos 3, 6 and 9	1=1	3	Additions and corrections made to boundaries and roads.
<i>District Mymensingh.</i>			
Sheet No. 389	1=1	1	Proof examined and corrected up to date.
Sheets Nos. 347 and 343	1=1	2	Proofs sent to press for corrections.
<i>Districts Puri and Balasore.</i>			
Sheets Nos. 138 and 248	1=1	2	Additions and corrections made to boundaries and roads.
ASSAM.			
<i>District Cachar.</i>			
Sheets Nos. 68 and 69	1=1	2	Second proofs returned to press for corrections.
BOMBAY.			
Sheets Nos. 192, 206 and 301	1=1	3	Second proofs returned to press for further corrections.
Sheets Nos. 164, 183, 201, 231 and 232	1=1	5	Proofs returned to press for corrections.
Sheet No. 349	1=1	1	Proof passed, press order given.
Sheets Nos. 195, 328, 350, and 351	1=1	4	Proofs sent to district officers for correction up to date.
Sheets Nos. 233, 239, 240, 272 and 273	1=1	5	Additions and corrections made to boundaries and roads.
<i>District Thana.</i>			
Sheets Nos. 133 $\frac{\text{S.E.}}{1, 2, 3, 4}$, 134 $\frac{\text{N.E.}}{1, 2, 3, 4}$ and $\frac{\text{S.E.}}{1, 2, 3, 4}$	4=1	12	Proofs corrected from district officer's copies.

DRAWING OFFICE, CALCUTTA.

SECTION II—continued.

Statement of work—continued.

TITLE.	Scale.	Number of sheets.	REMARKS.
STANDARD MAPS—concl'd.	In. M.		
LOWER BURMA.			
Sheets Nos. 282, 371, 374, 476 and 477	1=1	5	Proofs passed ; press order given. Second proofs returned to press for corrections. Proof sent to district officer for further reference.
Sheets Nos. 421 and 422	1=1	2	
Sheet No. 179	1=1	1	
<i>District Tavoy.</i>			
Sheet No. 487	2=1	4	Completed and being examined. Drawing and typing completed. Fair maps examined with 16-inch plans corrected and sent to press for reduction to 1-inch scale.
Sheets Nos. 488 and 489	2=1	8	
Sheet No. 486	2=1	4	
UPPER BURMA.			
<i>District Minbu.</i>			
Sheets Nos. 89, 90 and 130	1=1	3	Proofs passed ; press order given. Second proofs being examined. Proofs sent to district officers.
Sheets Nos. 127, 128 and 129	1=1	3	
Sheets Nos. 174 and 175	1=1	2	
<i>District Kyaukse.</i>			
Sheets Nos. 263 and 264	2=1	6	Fair maps being corrected from informations supplied by local officers.
PARGANA MAPS.			
<i>District Bānkura.</i>			
Main Circuit Nos. 17 and 18	1=1	2	Printed maps touched up, corrected and sent to press for reproduction ; proofs passed ; press order given.
GANGES DIARA SURVEY.			
Main Circuit Nos. 1, 2, 3 and 4	1=1	2	Ditto ditto.
<i>District Mānbhūm.</i>			
Main Circuit No. 2	1=1	1	Ditto ditto.
<i>District Mymensingh.</i>			
Main Circuit Nos. 2, 6, 23, (34, 35, 36) and (43 and 44)	1=1	6	Ditto ditto.
<i>District Nadia.</i>			
Sheets Nos. 1, 2, 4, 6 and 7	1=1	5	Additions and corrections made to boundaries and roads.
<i>District Pabna.</i>			
Main Circuit No. 4	1=1	1	Printed maps touched up, corrected and sent to press for reproduction, proof passed, press order given.
<i>District Shāhabad.</i>			
Sheets Nos. 6, 9 and 10	1=1	3	Ditto ditto.
<i>District Sylhet.</i>			
Sheets Nos. 1 to 11	1=1	11	Ditto ditto.
<i>District Tippera.</i>			
Main Circuit Nos. 1 to 10	1=1	10	Additions and corrections made to boundaries and roads.

DRAWING OFFICE, CALCUTTA.

SECTION II—continued.

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.		
PARGANA MAPS—concl'd.					
<i>District 24-Parganas.</i>					
Sheets Nos. 3, 4, 5 and 6	1=1	4	Printed maps touched up, corrected and sent to press for reproduction; proofs passed, press order given.		
Sheets Nos. 1 and 2	1=1	2	Ditto, proofs corrected and sent to press.		
DIHI PANCHANNAGRÁM.					
Grand Division 1, Sub-Division 3	99-ft. = 1 inch	1	Printed maps touched up, corrected and sent to press for reproduction; proofs passed, press order given.		
Grand Division 2, Sub-Division 9, Sections 1 and 2		2			
Grand Division 3, Sub-Division 23, Section 2		1			
Grand Division 5, Sub-Division 5, Section 2		1			
Grand Division 6, Sub-Division A Ditto ditto 7, Section 1		1			
Grand Division 6, Sub-Division Q 2nd		1			
CENTRAL PROVINCES.					
<i>District Bhandára.</i>					
Main Circuits Nos. 3, 5, 6, 8 and 12	1=1	5	Additions and corrections made to boundaries and roads.		
<i>District Jubbulpore.</i>					
Main Circuit No. 16, portion of 17 (19, 20 and 21)	1=1	2	Printed maps touched up, corrected and sent to press for reproduction; proofs passed, press order given.		
DISTRICT MAPS.					
PUNJAB.					
Gujránwála	1=2	2	Additions and corrections made to roads, boundaries, etc.		
Mooltan	1=2	2	Ditto ditto.		
Siáلكot (skeleton)	1=4	1	Proofs passed, press order given.		
NORTH-WESTERN PROVINCES AND OUDH.					
Jhánsi	1=2	2	Printed maps touched up, corrected and sent to press for corrections; proofs passed, press order given.		
BENGAL.					
Noákháli	1=4	1	} Additions and corrections made to roads, boundaries,		
Chittagong	1=4	1			
ASSAM.					
Sylhet	1=4	1	Ditto ditto.		
CENTRAL PROVINCES.					
Nágpur and Wardha	1=2	4	Ditto ditto.		
Saugor	1=2	6	Further corrections and additions made to boundaries, etc., from the tracings received from Settlement Officers.		

DRAWING OFFICE, CALCUTTA.

SECTION II—continued.

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
PLANS OF CITIES AND CANTONMENTS.			
	In. M.		
Hubli	8=1	2	Proofs passed, press order given.
Devlali	12=1	1	} Additions and corrections made to roads, etc.
Rawalpindi	6=1	2	
Ferozepore	6=1	4	
Jullundur	6=1	6	
Mooltan	6=1	2	
Bareilly	16=1	21		Originals sent to press for reduction to 6-inch scale.
Cawnpore	12=1	9	Proofs corrected up to date from local officer's proofs.
Lucknow	6=1	4	Ditto ditto.
Allahabad	6=1	6	Proofs returned to local officers for further reference.
Meerut	12=1	16	Additions and corrections made to roads, etc.
Sialkot	8=1	16	Ditto ditto.
Meean Meer	6=1	6	Ditto ditto.
Jubbulpore	8=1	2	Proofs passed, press order given.
Ditto, Topo-portion	8=1	1	Printed maps corrected and sent to press for reproduction; proofs passed, press order given.
Kamptee	8=1	4	Additions and corrections made to roads, etc.
Calcutta and Suburbs	6=1	2	Completed from the materials of the last survey and drawn to scale, typing in progress.
Dacca	8=1	2	Printed maps corrected and sent to press for reproduction; proofs passed, press order given.
Moulmein Town	50 feet = 1	41 to 50	Proofs passed, press order given.
Ditto	50 feet = 1	51 to 69	Proofs sent to press for correction.
Ditto	400 feet = 1	8	Proofs passed, press order given.
Rangoon Town	50 feet = 1	51	Original sent to press for reproduction.
MISCELLANEOUS MAPS.			
Naihati Municipality	4=1	2	Drawn and sent to local officer for further correction.
Narhan Estate . . . . .	...	...	Compiled for reduction to $\frac{1}{4}$ -inch scale.
Calcutta and surrounding country	1=1	3	One sheet on the north compiled from 1-inch sheets, and the two old sheets corrected up to date. Proofs passed, press order given.
Reference of Rangoon sheets . . . . .	...	1	Redrawn for reduction and sent to press, proofs passed.
Alphabetical list of villages of District Hoshiarpur, in English and Urdu . . . . .	...	2	Proofs passed, press order given.
TRIANGULATION CHART.			
GUJARAT SURVEY.			
Degree Sheets Nos. 10 and 14	1=4	2	Proofs sent to press for corrections.
INDEX MAPS.			
Moulmein Town . . . . .	...	1	Proofs passed, press order given.
Rangoon Town	1,250 ft. = 1	2	Ditto ditto.
Ditto	2,500 ft. = 1	1	Ditto ditto.
For Administration Report	Various	2	Drawn and sent to press.
Ditto ditto	"	12	Corrected to 1898 and sent to press.
TRACINGS ON CLOTH.			
Tracings of sheets	"	86	} These tracings and plans have been prepared for Government officials and other departments. For Office use.
Village plans	"	49	
Maps coloured	"	50	
Ditto	"	11,427		Colouring examined for stock in M. R. I. O.

DRAWING OFFICE, CALCUTTA.

SECTION II—continued.

Statement of work—continued.

DESCRIPTION OF WORK.	REMARKS.
<i>Computations examined.</i>	
District Amherst 1889—95 (6 seasons).	
" Palámau 1892—95 (3 seasons).	
<i>Traverse data, etc., supplied.</i>	
Traverse of Districts Purnea and Bhágalpur along Nepál (4 pages).	To Superintendent, Settlement Surveys, Bengal.
Traverse of District Kheri along Nepál (4 pages)	To Superintendent, Forest Surveys.
" of Captain Anderson's Survey of Oudh and Nepál Boundary (11 pages).	To O. C. Nos. 2 and 8 Parties.
Traverse of Lieutenant-Colonel Macdonald's Survey of Bhután Boundary along Districts Kámrap and Darrang of Assam (10 pages).	To O. C. No. 6 Party.
Traverse of Nepál and Purnea and Bhágalpur Boundary.	To Resident, Nepál.
Traverse of District Budaun along District Farukhabad (6 pages).	To O. C. Nos. 2 and 8 Parties.
Traverse of District Ballia, Gházipur, Jaunpur and Gorakhpur along District Azamgarh (45 pages).	Ditto ditto.
Traverse of District Tarái along District Pilibhít (2 pages).	Ditto ditto.
Traverse of District Agra along District Etáwah	Ditto ditto.
" of District Agra along District Etah with connections to G. T. Stations and co-ordinates calculated from the origin of survey (8 pages).	Ditto ditto.
Traverse of District Agra along Districts Mainpuri and Etáwah and the Gwalior State (15 pages).	Ditto ditto.
Traverse of District Etah along District Mainpuri with co-ordinates calculated from the origin of survey (5 pages).	Ditto ditto.
Traverse of District Darjeeling along Cart Road (15 pages).	To Under Secretary, Government of India, P. W. D.
Traverse of District Sylhet along Hill Tippera (55 pages).	To Deputy Commissioner, Sylhet.
Traverse of Sylhet Frontier Circuit (3 pages)	Ditto ditto.
" of District Seoni with co-ordinates calculated from the origin of survey (33 pages).	To Superintendent, Forest Surveys.
Traverse of Districts Sagaing and Kyaukse along District Myingyan (23 pages).	To O. C. No. 3 Party.
Traverse of District Gurdáspur along District Kángra Supplied Village Traverses (237 pages).	" O. C. No. 18 Party.
Field Book of Lieutenant-Colonel Macdonald's survey of Bhután and Assam Boundary with co-ordinates of <i>pucka</i> pillars and their description (49 pages).	" Public Officers.
Tables of co-ordinates of Prome Villages (48 pages).	" O. C. No. 6 Party.
Latitudes and longitudes of stations of Balúchistán Series.	" Commissioner, Pegu Division.
Lists of Villages of <i>Pargana</i> Shergarh, District Burdwan (21 pages).	" Superintendent, Settlement Surveys, Bengal.
<i>Miscellaneous.</i>	
Calculated latitudes and longitudes and direct distances of certain triangulated stations in District Nimár, also latitudes and longitudes of triangulated stations in District Hoshangabad, and plotted the same for incorporation of Revenue Survey portion into Topographical Survey degree sheet.	

DRAWING OFFICE, CALCUTTA.

SECTION II—concluded.

Statement of work—concluded.

DESCRIPTION OF WORK.	REMARKS.
<p style="text-align: center;"><i>Miscellaneous—concluded.</i></p> <p>Calculated bearings and distances of certain Hooghly River Survey points for the Superintendent, Marine Surveys. Calculated bearings and distances of <i>pucka</i> pillars on the Nepal and Sarda River boundary, also of <i>pucka</i> pillars on the Nepal and Rohilkhand boundary with latitudes and longitudes of stations from the origin, Bhugora Tal. Set up and proved a Traverse of Nepal and Oudh boundary from the Field Book of Captain Anderson's Survey of 1859-60 for Office record. Prepared a statement of Village areas of Pataspur Estate, District Midnapore. Prepared and supplied area statements of districts Dera Ghazi Khan, Dera Ismail Khan and Bannu. Calculated areas by <i>parganas</i> and <i>tahsils</i> of District Hazara; also of sheets Nos. 165 and 232 Bombay. Prepared another statement showing the areas of all the districts in the North-Western Provinces and Oudh. Computation and plotting of two groups of villages of District Nadia for preparation of congregated village maps. Calculated co-ordinates from one common origin of all trijunctions of villages in sheets Nos. 179 and 181, districts Prome, Tharrawaddy and Henzada, and plotted the same for filling in Topographical operations of the hilly and forest portions in those sheets. Prepared Summary of Outturn Statement, also statement of cost-rates for General Report. Checked annual statements received from Executive officers.</p>	

DRAWING OFFICE, CALCUTTA.

SECTION III.—CADASTRAL.

State of publication of Cadastral Maps on the 30th September 1898.

DISTRICTS.	NUMBER OF SHEETS.						REMARKS.
	MAPS RECEIVED.			MAPS PUBLISHED.			
	Up to 30th September 1897.	Added during past 12 months.	Total up to 30th September 1898.	Up to 30th September 1897.	By Surveyor General's Office during past 12 months.	Total to 30th September 1898.		Remaining to be published.
<i>North-West Provinces.</i>							
Agra	2,942	...	2,942	2,942	...	2,942	...
Azamgarh	930	...	930	930	...	930	...
Ballia	1,601	...	1,601	1,601	...	1,601	...
Banda	3,317	...	3,317	3,317	...	3,317	...
Basti	5,571	...	5,571	5,571	...	5,571	...
Benares	2,052	...	2,052	2,052	...	2,052	...
Bijnor	31	...	31	31	...	31	...
Dehra Dún	701	...	701	701	...	701	...
Fyzabad	14	...	14	14	...	14	...
Gorhwal	9,100	...	9,100	5,161	3,306	8,467	633
Ghazipur	4,021	...	4,021	4,021	...	4,021	...
Gorakhpur	8,615	...	8,615	8,615	...	8,615	...
Hamirpur	2,926	...	2,926	2,926	...	2,926	...
Jaunpur	3,583	...	3,583	3,583	...	3,583	...
Jhansi	1,661	...	1,661	1,661	...	1,661	...
Kumáun (Bhábar)	332	...	332	332	...	332	...
Morádábád and Taráí	4,023	...	4,023	4,023	...	4,023	...
Muttra	1,658	...	1,658	1,658	...	1,658	...
Mirzápúr	3,794	...	3,794	3,794	...	3,794	...
Rámpur State	1,356	...	1,356	1,356	...	1,356	...
Taráí	862	...	862	862	...	862	...
TOTALS	59,090	...	59,090	59,090	3,306	58,457	633
<i>Burma.</i>							
Akyab	2,785	...	2,785	2,785	...	2,785	...
Amherst	3,664	...	3,664	3,664	...	3,664	...
Bassein	3,437	...	3,437	3,437	...	3,437	...
Hanthawaddy and Pegu	4,601	...	4,601	4,601	...	4,601	...
Henzada	1,391	...	1,391	1,391	...	1,391	...
Katha	56	228	284(a)	...	235	235	49
Kyaüksè	801	13	814(a)	801	13	814	...
Magwe . . . . .	...	1,024	1,024(a)	...	38	38	986
Mandalay	781	11	792(a)	781	11	792	...
Meiktila	1,861	13	1,874(a)	1,369	505	1,874	...
Mergui	1,071	...	1,071	1,071	...	1,071	...
Minbu	1,447	...	1,447	1,447	...	1,447	...
Pegu . . . . .	...	519	519(a)	...	135	135	384
Prome	847	...	847	847	...	847	...
Rangoon Town and Index	20	...	20	20	...	20	...
Sagaing	2,286	...	2,286	1,714	83	1,797	489
Tavoy	763	...	763	763	...	763	...
Tharrawaddy	1,363	...	1,363	1,363	...	1,363	...
Thatón	1,200	...	1,200	1,106	94	1,200	...
Thóngwa	3,749	...	3,749	3,749	...	3,749	...
TOTALS	32,123	1,808	33,931	30,909	1,114	32,023	1,908
<i>Bengal and Orissa.</i>							
Backergunge	261	...	261	261	...	261	...
Cuttack Town	86	...	86	86	...	86	...
Muzaffarpur	1	...	1	1	...	1	...
Patna and Gaya	3,054	...	3,054	3,054	...	3,054	...
Puri (Khurda Estate)	4,565	...	4,565	4,565	...	4,565	...
Sháhábád	4,924	...	4,924	4,924	...	4,924	...
TOTALS	12,891	...	12,891	12,891	...	12,891	...
<i>Assam.</i>							
Cachar	191	304	495(a)	120	311	431	64
Darrang	1,074	...	1,074	1,074	...	1,074	...
Kámrúp	2,218	...	2,218	2,210	...	2,210(b)	8(c)
Lakhimpur	346	...	346	346	...	346	...
Nowgong	1,277	...	1,277	1,277	...	1,277	...
Sibságar	2,050	...	2,050	2,042	...	2,042	8(c)
Sylhet	213	...	213	168	...	168	45(c)
Sylhet (Jaintia)	651	...	651	651	...	651	...
TOTALS	8,020	304	8,324	7,888	311	8,199	125
<i>Central Provinces.</i>							
Ráipur	43	...	43	43	...	43	...
TOTALS	43	...	43	43	...	43	...
GRAND TOTALS	112,167	2,112	114,279	106,832	4,731	111,613	2,666

(a) These figures are liable to alteration until publication has been completed.

(b) Exclusive of 9 sheets reprinted.

(c) These are not to be printed.

Abstract of work performed during 1897-98.

PROVINCES.	NUMBER OF SHEETS.				REMARKS.
	Examined and rendered suitable for Photo-Zincography.	Traced and examined for Zincography.	Proof sheets examined previous to press order.	Coloured and subsequently examined.	
North-West Provinces	2,796	668	3,357	.....	32 inches = 1 mile. 16 " = 1 " 16 " = 1 "
Burma	1,103	364	1,132	.....
Assam	223	122	311	.....
TOTALS	4,122	1,154	4,800	.....

DRAWING OFFICE, CALCUTTA.

SECTION IV.—BENGAL PROVINCIAL.

Statement showing progress of 2-inch mapping during 1897-98.

PROVINCES.	Total number of sheets.	Graticules projected.	Stations plotted.	Details reduced by Pentagraph and transferred to 2-inch sheets.	Number of villages, streams etc., typed.	Outlining completed.	Footnotes, margin, etc. completed.	Examined.	Finally examined.	Sent to Photographic office for reduction to 1-inch scale.	Proofs examined.	Final press order given.	REMARKS.
<i>Orissa.</i>													
Previously reported	124	124	121	114	114	114	114	114	114	88	88	12	
Completed during the year, including Khurda.	...	...	3	10	10	4	...	...	...	...	...	...
Total to 30th September 1898	124	124	124	124	124	118	114	114	114	88	88	12	
<i>Bihar.</i>													
Previously reported	116	67	59	33	28	24	...	...	...	...	...	...
Completed during the year	8	51	59	71	64	44	40	56	16	16	...	...

ENGRAVING OFFICE, CALCUTTA.

Statement showing the work performed during the year 1897-98.

TITLE OF MAP.	Number of plates.	Outline, square inches.	Number of letters cut.	Hills, sand, lakes, square inches.	REMARKS.
<i>Atlas of India.</i>					
Scale 1 inch=4 miles.					
Quarter sheets, new, completed	6	59	4,983	53	
Ditto " in progress	65	1,540	81,106	540	
Additions and corrections to published quarter sheets	63	336	19,414	38	
Ditto ditto full sheets	26	381	48,672	249	
New plates projected, etc., (Atlas sheets)	25	33	4,665	...	
<i>General Maps.</i>					
On various scales	6	32	8,818	3	
<i>Provincial Maps.</i>					
On scales 1 inch=16 and 32 miles	19	248	72,210	156	
On various scales for Administration Reports	2	4	160	...	
<i>District Maps.</i>					
On various scales for Administration Reports	35	407	25,125	173	
Plans	5	42	8,691	16	
Charts	7	22	14,232	64	
Miscellaneous plates	51	...	30,074	580	
TOTAL	310	3,104	318,150	1,872	

COPPER-PLATE PRINTING.

Impressions taken	24,972
Proofs pulled	483
Transfers pulled	516
TOTAL	25,971

STEEL FACING.

Double elephant plates, steel faced	39
Ditto " removed	15
Atlas sheets " faced	113
Ditto " removed	43
Miscellaneous plates " faced	26
Ditto " removed	19
TOTAL	245

PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, CALCUTTA.

Extract from the Narrative Report of Mr. T. A. POPE, Assistant Surveyor-General, Season 1897-98.

OUTTURN.—The outturn of work performed in the Photographic and Lithographic Office during the past year is satisfactory, each section having been kept fully employed throughout the year. Estimated by the number of pulls from stone and zinc the outturn is about the same as last year. The total number of printed copies is, however, again less, which seems to be due to the fact that the number of copies of maps and plans indentured for by Government officials is gradually becoming smaller, and there is probably less unnecessary printing and consequent waste of labour and material than was formerly the case. The outturn of work in each section is given in full detail in the annexed statements.

ORIGINAL SUBJECTS.—The total number of original subjects received and taken in hand for reproduction during the year was 6,364, as against 7,880 last year. The falling off is principally due to the comparatively small number of cadastral maps sent in for reproduction, about 1,100 less than last year. There is a slight decrease also in the number of departmental maps received, while the number of extra-departmental subjects remains about the same as last year.

The number of subjects lithographed was 524 (58 departmental and 466 extra-departmental), or 88 less than last year. The remaining 5,840 subjects were reproduced by various photographic processes or zincographed, and include 727 departmental maps, etc., 4,477 cadastral maps, and 636 extra-departmental subjects. The actual number of maps, etc., received during the year was 6,391 (802 departmental, 4,294 cadastral, and 1,235 extra-departmental). The number completed and despatched was 6,187 (519 departmental, 4,766 cadastral, and 902 extra-departmental).

LITHOGRAPHIC DRAWING SECTION.—The total number of new subjects drawn on transfer paper or stone, or of additions and corrections made to work already on stone, during the year was 650, of which 54 were departmental and 596 extra-departmental. Last year, the number was 515 (26 departmental and 489 extra-departmental). The section was somewhat handicapped by the retirement on pension of two of the senior native draftsmen and the death of a promising junior hand. One or two young hands were taken on as apprentice draftsmen and are making good progress under Mr. Fogarty's training. Mr. Fogarty was in charge of the section throughout the year, and has again shown much ability in arranging for the speedy and methodical completion of the large mass of work passing through his hands, and in supervising and training the staff of draftsmen under him.

LITHOGRAPHIC PRINTING SECTION.—The number of subjects printed from stone was 524, or 88 less than last year. Of these, 58 were departmental and 466 extra-departmental, as against 56 departmental and 556 extra-departmental last year. The number of pulls from stone was 547,497, of which 95,716 were departmental and 451,781 extra-departmental. The total number of copies printed from stone was 402,906 (87,728, departmental and 315,178 extra-departmental). The work of the section was carried on as usual by Sergeant Vandyke, R.E., under Mr. Fogarty's supervision, to my entire satisfaction. Sergeant Vandyke's practical knowledge of steam-printing machinery was turned to good account on the arrival of the new double-demy litho. and zinc printing machine received from England in June last, as he undertook to set it up himself and did so successfully in much less time and at considerably less cost than such work has been done for us on previous occasions by the Public Works Department.

ZINC-PRINTING SECTION (NORMAL).—The number of zinc plates printed during the year was 917, of which 339 were departmental and 578 extra-departmental. The number of pulls was 194,535, of which 95,537 were departmental and 128,998 extra-departmental, and of complete copies 198,578 (68,427 departmental and 130,151 extra-departmental). Last year, the corresponding figures were as follows:—Number of zinc plates printed, 1,104 (509 departmental and 595 extra-departmental); number of pulls 148,003 (87,818 departmental and 60,185 extra-departmental); number of copies 175,254 (84,957 departmental and 90,297 extra-departmental). The amount of printing done during the year under report thus shows a large increase over last year, though the number of plates printed from is less. Mr. E. A. Lefranc continued in charge of the section throughout the year, except for a period of two months and a half while he was absent on privilege leave owing to ill health. Mr. Lefranc's duties are arduous, and he is much to be commended for remaining at his post during the hot weather, though he was really ill at the time, and for the efficient manner in which he has managed the work of the section generally.

ZINC-PRINTING SECTION (CADASTRAL).—There has been a considerable reduction in the number of cadastral sheets received during the year, due in part to the injury done to the office of No. 6 Parly at Shillong by the earthquake in June 1897, when a considerable number of Assam cadastral sheets which should have been reproduced this year were seriously damaged and could not be sent in. The number of plates of cadastral maps of Burma, Assam and the North-Western Provinces printed off was 4,649, the number of pulls being 103,530, and of copies of complete villages 94,328. Last year, 5,645 plates were printed, the pulls being 133,223, and copies 122,293. Mr. J. B. McKenzie continued in charge of the section and managed the work very efficiently. He held

SPECIMEN OF TRICHROMATIC PHOTOGRAPHY.



PRINTED FROM THREE PHOTOGRAVURE PLATES.

Survey of India Offices, Calcutta, March 1893.

part and exposing a clean surface of copper. Close up to the portions of the surface thus removed a line about a sixteenth of an inch wide is made with black varnish, and when this is dry the plate is ready to be placed in the depositing battery, which gives an even deposit of copper all over the plate except in the parts where it is black varnished. In about three days sufficient copper is deposited to fill up the parts cut away, and the plate is then removed from the battery, washed and dried. The edges of the plate are then filed, and the layer of deposited copper is stripped off, separating easily from all parts of the plate in which the coating of silver remains, and adhering only to those parts in which the copper is exposed by cutting away to make the necessary alterations, and which have been separated from the remainder of the plate by the line of black varnish. The parts requiring correction have then to be scraped down to the level of the original plate when they are ready for the engraver to work upon. The advantage of this method is that it obviates the necessity of beating up the parts to be corrected from the back of the plate, which, if frequently repeated, causes buckling and eventually renders the plate unprintable.

Trichromatic Photography.—Mr. Turner has given some attention to this subject during the year, and has made a number of experiments in printing in natural colours by photo-mechanical means, the details of which may be given here.

The first stage in the process is to obtain three negatives, the varying gradations of which will represent the different shades of blue, red and yellow in the subject to be reproduced, which when combined will give an image more or less true to the original according to the coloured screens used in making the negatives and the inks used in printing the combined impressions. For this purpose Carbutt's orthochromatic colour screens were used, modified by fine films of gelatine or collodion, stained with such dyes as were found necessary to give the screens the correct tint. The only means of illumination available was sunlight reflected on to the subject by a large mirror. By this means a fully exposed negative was obtained for printing in blue, taken through a deep orange-coloured screen, in seven minutes. The negative for printing in red was taken through a green screen, and for the same subject required an exposure of three minutes. For the negative to be reproduced in yellow a violet screen was used, with an exposure of one second. It will thus be seen that the exposure through the orange screen was 420 times longer than through the violet screen, and 180 times longer than through the green one. The subject photographed was a set of brightly coloured butterflies, pinned to a white sheet of paper, and taken in the office studio with a 14-inch Ross-Goerz anastigmatic lens, with the full aperture.

Having obtained satisfactory negatives, the three images can be transferred to copper or zinc by any of the known photo-mechanical processes, and can then be printed, one colour superimposed upon the other, in blue, red and yellow inks, the correct colour values being dependent upon the colour of the inks employed. The annexed illustration is the result of these experiments with the sheet of butterflies referred to above. With the improvements constantly being made in the manufacture of sensitive plates, and increasing facilities for photo-mechanical reproduction, the process of photographic work in colour has a great future before it, and must eventually supersede chromo-lithography and monochrome reproduction for illustrating subjects in which the correct representation of colour is an important factor.

The above experiments have for the most part been carried on during the Pujahs and other holidays, as Mr. Turner's time is fully occupied during office hours with the current work of his section, and he has but little leisure for experimental work. He has as usual conducted the duties of his section with much skill and shown a keen interest in its improvement and development.

MACHINERY.—The new double-demy Express litho. and zinc-printing machine, made for the office by Messrs. Furnival & Co., of Reddich, was received in June 1898, and has proved to be a most useful addition to the resources of the office. As it registers with more accuracy than any of the older machines it will be especially useful for colour work. Sergeant Vandyke undertook to set it up, doing the work out of office hours and supplying his own labour, at a cost of £300. The last machine of a similar kind, received in the Office in 1893, was erected by the Public Works Department at a cost of £1,270 and after very considerable delay; and credit is due to Sergeant Vandyke for the speedy and thoroughly satisfactory manner in which he set up the new machine and got it in good running order unassisted. The machine first began to work on the 4th August, and up to the end of the year under report (a period of less than two months) had turned out 23,096 pulls and 30,780 copies.

The new beds, the necessity for which was explained on page XXXI of the Appendix to last year's Report, were also received, but have not as yet been used, as they were found to require certain alterations to make them fit our machines. These are being executed at the Cossipore Foundry.

The new spare pistons for the Willans' engine have also been received, and will be available in case of accident to the old ones, which would cause serious delay if they could not be at once replaced.

One of the type-printing machines and several of the old litho. and type presses, some of which have been running for over thirty years, are completely worn out and require replacing by new plant of modern construction. I have, therefore, included in the

annual store indent of this office for 1899-1900 the following new machines and presses, to be supplied by Messrs. R. Hoe & Co., all of which are urgently required :—

- (1) An improved stop-cylinder type machine.
- (2) A Washington hand type press.
- (3) A litho. press to take a stone 60" × 40", arranged for either steam or hand power.
- (4) A litho. press to take a stone 32" × 24", to be driven by hand power.

Some delay was caused in the early part of the year by the boiler having to be laid off for a few days for repairs, owing to one of the tubes suddenly beginning to leak and having to be taken out and replaced by a new one. The advisability of our having a second boiler to fall back upon in case of accident has been referred to in previous annual reports, and though the boiler inspector, who was specially asked to report upon the condition of the boiler at his last inspection, states that it is in fair working order and should last several years with care, it is felt that the risk of delay to the work, owing to such accidents as occurred during the year under report, is so serious that no more time should be lost in obtaining a second boiler. I have, therefore, indented for another 12-horse power multitubular boiler, by Messrs. Marshall, Sons & Co., makers of the old one, to be sent out complete, with injector and all the usual fittings. When received, it is intended to work both boilers alternately for a week at a time, which will enable us to keep both clean and in good working order, and should prolong the life of the present boiler by many years.

THE TOTAL SOLAR ECLIPSE.—The small party formed in this office to take photographs of the corona of January 22nd, 1898, consisting of myself, with Mr. H. Haward, Head Assistant, Mr. T. R. Theakston, Assistant Mathematical Instrument maker, and two native workmen, proceeded to Dumraon, in Bihar, on the 12th January and returned to Calcutta immediately after the eclipse. The photographs obtained were entirely successful. A report on the operations has already been submitted to the Government, and there is no need to give any further account of them here. A copy of the report was also sent to Captain E. H. Hills, R.E., Secretary to the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society, at whose instance the observations were made, and in acknowledging it Captain Hills wrote as follows, dated 12th May 1898 :— "You seem to have got excellent results, and luckily yours was not a unique experience. We should much like to have a set of glass positives of your negatives, copied by contact. Could you manage to get these done and send them to the Royal Astronomical Society? A glass positive shows up the delicate details so much better than any sort of print; in fact a corona photograph should really never be looked at in any other way. I hope you will send your instrument to Sumatra in 1901." A set of glass positives made from the seven corona negatives taken by the party was accordingly prepared and sent.

INSTRUCTION TO OFFICERS FROM ROORKEE COLLEGE.—In the month of November 1897, the late Captain E. D. Bullen, R.E., Officiating Principal of the Roorkee Civil Engineering College, accompanied by Mr. J. O'Neill, Instructor in Drawing, visited Calcutta for the purpose of receiving instruction in photo-mechanical work and steam printing. Captain Bullen visited the office daily for about ten days and took notes of the various processes in which he was interested, with the view of introducing them into the regular curriculum at Roorkee. Mr. O'Neill remained here for a month, working principally at heliogravure and half-tone processes and lithographic printing. Two native printers also accompanied the party and remained in the office for three months, one being attached to one of the large litho. printing machines and the other to the Bremner type-printing machine. Both these men had had a certain amount of previous experience and profited fully by the instruction imparted to them here.

REORGANISATION OF THE OFFICE.—No orders were received during the year on the scheme for the re-grading of the office establishment and the amalgamation of it with the photo-zinco. and type-printing staff of the Trigonometrical Branch Office at Dehra Dún, which has been submitted to the Government for approval. As promotion among the European and Eurasian assistants is practically in abeyance, and there are several vacancies among them which it is undesirable to fill up until the scheme is sanctioned, it is greatly to be hoped that orders on the subject will not be delayed much longer.

PHOTOGRAPHIC AND
Abstract of Departmental Works

SPECIFICATION.	Sheets or subjects.	Negatives and transparencies.	PHOTO-ZINCGRAPHIC AND LITHOGRAPHIC PRINTING.							
			Photo-transfer prints.	Zinc-plates transferred.	Zinc plates printed.	Stones.	Pulls.	Number of copies.		
								Coloured.	Uncoloured.	Total.
DEPARTMENTAL MAPS, PLANS, ETC.										
General Maps	1	1	1	1	...	...	...	...	...	...
Provincial Maps	4	6	6	3	8	2	1,853	...	1,854	1,854
District Maps	44	108	110	34	27	10	3,344	...	3,346	3,346
Plans of Cities and cantonments	44	58	50	17	17	...	2,630	...	2,630	2,630
Standard Maps	221	322	380	134	82	...	12,435	...	12,235	12,235
Index Maps	32	23	27	49	94	11	37,600	20,536	4,648	25,184
Atlas Sheets	3	...	...	...	...	3	277	...	277	277
Technical Charts	20	21	18	6	5	...	125	...	150	150
Miscellaneous Maps, etc.	411	542	560	178	106	19	76,664	2,850	91,582	94,432
Transfers and Proofs . . . . .	...	...	...	...	...	...	1,303	...	1,526	1,526
Departmental Forms	5	...	...	...	...	5	25,022	...	14,521	14,521
Type Printings . . . . .	...	...	...	...	...	...	...	...	...	...
TOTALS (NORMAL)	785	1,081	1,152	422	339	50	161,253	23,386	132,769	156,155
CADASTRAL MAPS.										
<i>Assam—</i>										
Photo-zincographs	144	144	176	155	155	...	9,085	...	9,085	9,085
Zincographs	99	...	...	99	99	...	5,577	...	5,577	5,577
TOTALS	243	144	176	254	254	...	14,662	...	14,662	14,662
<i>Burma—</i>										
Photo-zincographs	694	694	735	894	894	...	26,960	...	26,960	26,960
Zincographs	411	...	...	411	411	...	12,536	...	12,536	12,536
TOTALS	1,105	694	735	1,305	1,305	...	39,496	...	39,496	39,496
<i>North-Western Provinces—</i>										
Photo-zincographs	2,450	2,450	2,532	2,411	2,411	...	31,343	...	31,343	31,343
Zincographs	679	...	...	679	679	...	8,827	...	8,827	8,827
TOTALS	3,129	2,450	2,532	3,090	3,090	...	40,170	...	40,170	40,170
Transfers and Proofs . . . . .	...	...	...	...	...	...	9,202	...	...	...
TOTALS (CADASTRAL)	4,477	3,288	3,443	4,640	4,640	...	103,530	...	94,328	94,328

PHOTOGRAPHIC AND

Statement of Work done for other

DEPARTMENTS, ETC.	Sheets or subjects.	Negatives and transparencies.	PHOTO-ZINCOGRAPHIC AND*				
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Stones.	Pulls.
Adjutant General in India	1	...	...	...	...	1	94
Administrative Medical Officer, Central Provinces	1	1	1	1	1	...	255
Agent and Chief Engineer, Bengal and North-Western Railway	3	4	4	3	3	...	350
Agent and Chief Engineer, Assam-Bengal Railway Company, Limited	9	9	9	3	...	...	...
Agent to the Governor-General, Central India and Rájputána	1	...	...	...	...	3	195
Architectural Surveyor, North-Western Provinces and Oudh	23	23	59	17	17	...	11,050
Asiatic Society of Bengal	19	21	2	2	2	1	1,972
Board of Revenue, Bengal	5	...	...	...	3	4	1,020
Calcutta Municipality	1	...	...	2	...	1	150
Chamber of Commerce, Calcutta . . . . .	...	...	...	...	...	...	...
Chief Commissioner, Assam	1	...	...	...	3	2	7,500
" " Central Provinces	3	...	...	4	10	11	9,580
" " Engineer, Bengal Public Works Department	6	15	15	8	8	4	3,700
" " Public Works Department, Punjab	6	13	13	4	4	...	1,100
" " Irrigation Works, Punjab	25	19	19	20	19	3	12,260
" " East Indian Railway	41	43	43	13	15	1	1,707
Collector of Customs, Calcutta	7	...	...	...	...	10	5,500
Colonial Secretary, Singapur	1	4	4	2	2	...	1,000
Commissioner of Excise, Bengal	6	...	...	2	2	6	3,480
" of " Punjab	7	...	...	...	...	8	1,720
" of Police, Calcutta	1	...	...	...	...	2	2,168
" of Gurgaon	1	...	...	...	...	1	105
" of Patna Division	10	...	...	2	2	20	12,150
Commissary General-in-Chief	1	...	...	...	...	1	12
Conservator of Forests, Bengal	2	...	...	...	...	3	70
" Tenasserim Circle	20	9	6	2	1	2	110
Dacca Municipality	1	...	...	...	...	1	100
Deputy Adjutant General, Bengal	5	11	11	5	7	...	750
" Assistant Adjutant General, Oudh District	5	6	...	...	...	...	...
" Commissioner, Lahore	1	...	...	...	...	1	105
" Conservator of Forests (through Printing, India)	1	1	1	1	1	...	1,008
" " Coorg	1	1	1	1	1	...	40
" " of Port, Rangoon	1	...	...	...	...	1	100
" Consulting Engineer to the Government of India for State Railways . . . . .	...	...	...	...	4	...	212
Deputy Post Master General, Burma	1	...	...	...	...	4	600
Divisional Engineer, Gwalior Light Railways	3	...	...	...	4	5	1,200
Director, Botanical Survey of India	4	1	...	2	2	2	1,560
" Geological Survey of India	55	23	...	...	...	4	1,560
" Royal Indian Marine	12	24	...	...	...	...	...
" " Survey, Bangkok	23	95	95	41	45	...	2,890
" General of Military Works	19	43	43	15	15	21	6,577
" " of Post Office, India	7	8	...	...	...	8	1,760
" " of Telegraphs	14	1	1	1	1	12	5,640
" " of Land Records and Agriculture, Assam	5	5	...	...	...	...	...
" " " " Bengal	30	3	3	1	23	21	19,820
" " " " Burma	9	20	20	9	20	...	722
" " " " Punjab	7	25	25	7	8	...	1,560
" " " Gwalior State	3	...	...	...	1	1	5,000
" " of Military Education in India	1	...	...	...	...	3	900
" " of Public Instruction, Bengal	7	...	...	...	...	7	3,927
" " of Railway Construction	10	7	7	4	8	...	1,800
Engineer-in-Chief, Bombay, Sind Connection Railway	1	...	...	...	...	3	225
" " Eastern Bengal State Railway	24	27	27	8	8	2	525
" " N. W. Railway	1	1	1	...	...	...	...
" " Goona Bara Railway	1	...	...	...	1	1	240
" " Vizianagram	1	2	2	1	...	...	...
Famine Administration, Central Provinces . . . . .	...	...	...	2	2	...	1,200
Financial Commissioner, Punjab	2	...	...	...	2	5	1,610
General Officer Commanding Meerut District . . . . .	...	...	...	...	1	...	50
" " " Presidency District	1	4	4	1	1	...	120
" " " Punjab Frontier Force	2	6	6	2	3	...	470
" " " Sirhind District . . . . .	...	...	...	...	1	...	75
" " " Tirah Expeditionary Force	13	4	4	2	2	9	2,100
Government of India, Revenue and Agricultural Department	20	31	3	...	10	8	18,150
Carried over	492	510	429	186	263	203	159,844

LITHOGRAPHIC OFFICE.

Departments during the year 1897-98.

LITHOGRAPHIC PRINTING.			SILVER AND OTHER PRINTING.		HELIOGRAVURE AND ELECTROTYPING.				Value.
Number of copies.			Silver prints.	Blue prints.	Helio gravure plates.	Helio gravure prints.	Photo-blocks.	Electrotypes.	
Coloured.	Uncoloured.	Total.							
27	20	47	...	...	...	...	...	...	R a. p.
...	255	255	...	...	...	...	...	...	35 7 0
...	350	350	...	...	...	...	...	...	32 0 0
...	...	...	...	...	...	...	...	...	105 3 6
65	...	65	...	...	...	...	...	...	122 4 0
...	38,350	38,350	10	90	...	13,650	...	...	58 13 0
...	1,972	1,972	...	11	10	9,080	...	...	4,413 8 0
620	...	620	...	...	...	...	...	...	2,220 4 0
...	150	150	...	...	...	...	...	...	187 13 0
...	...	...	...	...	...	300	...	...	57 12 0
375	6,000	6,375	...	...	...	...	...	...	30 0 0
1,325	3,800	5,125	...	...	...	...	...	...	476 3 0
1,500	700	2,200	...	...	...	...	...	...	882 13 6
...	1,200	1,200	...	...	...	...	...	...	598 13 3
...	16,910	16,910	...	...	...	...	...	...	413 6 3
...	4,031	4,031	...	...	...	...	...	...	1,459 6 9
3,850	...	3,850	...	...	...	...	...	...	1,205 6 3
...	1,000	1,000	...	...	...	...	...	...	593 4 0
2,450	50	2,500	...	...	...	...	...	...	327 3 3
1,505	...	1,505	...	...	...	...	...	...	297 12 0
1,084	...	1,084	...	...	...	...	...	...	340 8 0
...	105	105	...	...	...	...	...	...	170 8 0
2,200	3,875	6,075	...	...	...	...	...	...	44 15 0
...	12	12	...	...	...	...	...	...	1,459 13 6
20	30	50	...	...	...	...	...	...	30 0 0
40	30	70	...	...	...	...	...	...	147 12 0
...	100	100	...	...	...	...	...	...	274 3 0
...	550	550	...	...	...	...	...	...	21 7 0
...	...	...	...	...	...	...	...	...	247 0 3
...	105	105	...	12	...	...	...	...	56 0 0
...	1,008	1,008	...	...	...	...	...	...	14 14 0
...	40	40	...	...	...	...	...	...	80 1 0
...	100	100	...	...	...	...	...	...	16 9 0
...	...	...	...	...	...	...	...	...	250 0 0
...	156	156	...	...	...	...	...	...	76 15 0
...	150	150	...	...	...	...	...	...	609 1 0
400	...	400	...	...	...	...	...	...	202 7 0
880	340	1,220	...	2	...	...	...	...	149 10 9
...	1,560	1,560	4	7	23	17,023	28	...	3,702 12 0
...	2,890	2,890	...	...	12	2,762	...	...	1,126 0 0
950	1,377	2,327	...	...	...	...	...	...	2,497 9 9
90	1,230	1,320	...	...	4	2,204	...	...	1,670 12 0
...	6,090	6,090	...	...	...	...	...	...	317 2 0
...	...	...	...	...	...	...	...	...	698 10 9
8,645	4,805	13,450	...	...	...	...	5	...	126 0 0
...	722	722	...	...	...	...	...	...	1,089 7 0
...	1,560	1,560	...	...	...	...	...	...	826 2 6
...	5,000	5,000	...	...	...	...	...	...	745 1 9
300	...	300	...	...	...	...	...	...	523 11 0
3,235	60	3,295	...	...	...	...	...	...	182 3 0
...	4,500	4,500	...	...	...	...	...	...	314 4 0
75	...	75	...	...	...	...	...	...	221 7 9
100	712	812	...	...	...	...	...	...	41 5 0
...	...	...	...	...	...	...	...	...	472 14 6
120	...	120	...	...	...	...	...	...	9 12 0
...	1,200	1,200	...	...	...	...	...	...	41 15 0
460	...	460	...	...	...	...	...	...	31 8 0
...	50	50	...	...	...	...	...	...	84 5 3
...	120	120	...	...	...	...	...	...	289 8 0
...	470	470	...	...	...	...	...	...	12 5 3
...	75	75	...	...	...	...	...	...	89 13 0
...	2,950	2,950	...	...	...	...	...	...	209 4 0
...	...	...	...	...	...	...	...	...	20 11 0
4,150	1,200	5,350	...	28	13	9,013	...	...	498 1 6
34,466	117,960	152,426	14	150	62	54,638	33	...	37,765 3 6

PHOTOGRAPHIC AND

Statement of Work done for other

DEPARTMENTS, ETC.	Sheets or subjects.	Negatives and transparencies.	PHOTO-ZINCOGRAPHIC AND				
			Photo-transfer prints.	Zinc plates transferred	Zinc plates printed.	Stones.	Pulls.
Brought forward	492	510	429	186	263	203	159,814
Government of India, Finance and Commerce Department	1	...	...	...	...	1	450
Government of India Foreign Department	15	3	3	...	...	19	1,272
" " Home Department	30	16	16	61	66	20	84,080
" " Military Department	9	4	4	2	4	8	1,620
" " Public Works Department	34	10	12	6	34	17	34,851
" Bengal, Revenue and General Department	7	"	...	...	2	11	31,786
Government of Bengal, Judicial and Political Department	1	...	...	...	...	1	50
Government of Bengal, Financial Department	...	...	...	...	...	...	683
" " Marine Department	45	...	...	...	45	24	15,450
" " Public Works Department, Irrigation Branch	16	8	12	7	12	7	6,320
Government of Bengal, Municipal Department	2	...	...	...	...	2	200
" Bombay, Public Works Department, Railway Branch	...	...	...	...	2	...	40
Government of North-Western Provinces and Oudh, Public Works Department	3	...	...	...	16	3	8,100
Government of Punjab, Public Works Department	2	1	1	1	1	1	106
Government Epigraphist, Madras	5	4	...	...	...	...	...
Indian Museum	20	40	...	...	...	...	...
Inspecting Officer, Rájputána Imperial Service Infantry	4	12	12	4	4	...	150
Inspector General of Artillery in India	8	...	...	...	3	6	5,834
" " Civil Veterinary Department	6	...	...	...	...	7	1,040
" " Jails, Bengal	1	...	...	...	...	1	50
" " Police, Bengal	80	17	...	...	...	11	6,050
" " Civil Hospitals, Bengal	...	...	...	...	2	...	1,500
Magistrate of the 24-Parganas	3	3	...	...	...	...	...
Manager, North-Western Railway	1	...	...	...	...	1	7,000
Master of the Mint, Calcutta	3	3	...	...	...	1	100
Meteorological Reporter to the Government of Bengal	9	...	...	...	9	2	66,209
" " to the Government of India	21	...	...	...	9	12	65,765
Military Authorities, Quetta	1	4	4	...	...	...	...
Officer Commanding the Hyderabad Contingent	...	...	...	...	1	...	100
" " Oudh District	2	8	8	2	2	...	140
" " in charge, Andamanese	1	4	4	...	...	1	1,150
Photographic Society, India	5	6	...	...	...	...	...
Port Commissioners, Calcutta	3	14	8	3	4	...	480
Port Officer and Registrar of Wrecks, Calcutta	2	...	...	...	...	4	528
Principal, Civil Engineering College, Sibpur	...	...	...	...	...	...	...
Quarter Master General in India	4	1	1	1	11	5	12,251
Rangoon Municipality	77	151	11	5	3	...	500
Reporter of Economic Products to the Government of India	4	...	...	...	7	1	3,750
Resident Engineer, Bonares Water Works, Sewerage	1	1	1	2	1	...	100
Resident, Western Rájputána States	...	...	...	22	30	...	7,800
Sanitary Commissioner, Assam	1	...	...	...	...	1	300
" " Bengal	13	6	6	2	2	12	6,680
" " Central Provinces	...	...	...	1	2	...	460
" " Hyderabad Assigned Districts	1	...	...	...	...	2	400
" " with the Government of India	1	...	...	...	1	4	3,812
Secretary for Berar to the Resident at Hyderabad	...	...	...	...	1	...	325
Secretary, Lady Dufferin's Fund	1	...	...	...	...	2	3,000
Station Staff Officer, Siáلكot	...	...	...	...	1	...	100
Superintending Engineer, Hyderabad, Public Works Department	1	...	...	...	...	1	20
Superintending Engineer, Irrigation Circle, Upper Burma	3	...	...	...	1	1	750
Superintendent, Archaeological Survey, Madras	...	...	...	...	16	...	4,800
" " Civil Veterinary Department, Bengal	2	...	...	...	...	3	2,700
" " Forest Surveys, Dehra Dún	6	5	...	...	...	1	36
" " Government School of Arts	...	...	...	...	...	...	...
" " Printing, India	102	23	20	4	14	55	17,380
" " Press, North-Western Provinces and Oudh	33	5	1	...	...	10	3,675
Superintendent of Stationery, Calcutta	2	...	...	...	3	2	6,177
" " of Survey and Settlement, Darbhanga	1	...	...	...	...	1	500
Special work done for trade and Private Individuals	17	14	13	7	7	10	2,667
Pulls and Proofs	...	...	...	...	...	...	1,545
TOTAL	1,102	873	566	316	578	474	5,80,779

LITHOGRAPHIC OFFICE.

Departments during the year 1897-98—contd.

LITHOGRAPHIC PRINTING.			SILVER AND OTHER PRINTING.		HELIOGRAVURE AND ELECTROTYPING.				Value.		
Number of copies.			Silver prints.	Blue prints.	Helio gravure plates.	Helio gravure prints.	Photo.-blocks.	Electrotypes.	Rs.	a.	p.
Coloured.	Uncoloured.	Total.									
34,466	117,960	152,426	14	150	62	54,638	33	...	37,765	3	6
...	450	450	...	...	...	...	...	...	69	12	0
216	430	646	...	...	...	600	...	...	971	15	0
5,010	23,070	28,080	...	...	...	...	...	...	6,542	3	3
380	800	1,180	...	...	...	...	...	...	370	11	0
4,502	11,061	15,563	...	...	...	...	...	...	3,579	1	0
19,577	1,350	20,927	...	...	...	...	...	...	1,629	12	6
...	50	50	...	...	...	...	...	...	34	12	0
686	...	686	...	...	...	...	...	...	27	5	0
10,440	...	10,440	...	...	...	...	...	...	1,759	12	0
1,080	1,520	2,600	...	3	...	...	...	...	1,029	7	3
...	200	200	...	...	...	...	...	...	86	3	0
...	40	40	...	...	...	...	...	...	18	4	0
2,100	...	2,100	...	...	...	...	...	...	569	8	0
...	106	106	...	...	...	...	...	...	32	8	3
...	...	...	...	...	...	...	...	...	585	0	0
...	...	...	...	28	20	2,804	...	...	1,888	8	0
...	150	150	...	...	...	...	...	...	201	6	6
120	6,754	6,874	...	...	...	...	...	...	700	11	0
300	640	940	...	...	...	...	...	...	485	1	0
...	50	50	...	...	...	...	...	...	79	7	0
3,300	...	3,300	...	...	...	...	37	...	746	1	0
...	1,500	1,500	...	...	...	...	...	...	90	13	0
...	...	...	...	6	...	...	...	...	30	0	0
...	7,000	7,000	...	...	...	...	...	...	419	5	0
...	100	100	...	...	...	...	...	...	34	4	0
146	44,830	44,976	...	...	...	...	...	...	763	15	0
8,040	61,130	69,170	...	...	...	...	...	...	1,637	3	6
...	...	...	...	8	...	...	...	...	52	8	0
...	100	100	...	...	...	...	...	...	21	9	0
...	140	140	...	...	...	...	...	...	138	7	6
...	230	230	...	...	...	...	...	...	500	8	0
...	...	...	...	...	6	6,607	...	...	350	0	0
...	480	480	...	...	...	...	...	...	320	11	0
132	132	264	...	...	...	...	...	...	111	6	0
...	...	...	...	...	...	75	...	...	12	0	0
1,470	641	2,111	...	...	...	...	...	...	1,078	6	3
...	500	500	...	662	...	...	...	...	2,630	13	0
200	2,350	2,550	...	...	...	...	...	...	200	0	0
...	200	200	...	...	...	...	...	...	48	7	3
...	2,080	2,080	...	...	...	...	...	...	1,405	0	0
...	300	300	...	...	...	...	...	...	16	8	0
3,550	1,810	5,360	...	...	...	...	...	...	959	13	6
...	230	230	...	...	...	...	...	...	25	3	0
200	...	200	...	...	...	...	...	...	29	3	0
950	12	962	...	...	...	...	...	...	498	0	0
...	325	325	...	...	...	...	...	...	10	2	6
1,500	...	1,500	...	...	...	...	...	...	160	9	0
...	100	100	...	...	...	...	...	...	24	10	6
...	20	20	...	...	...	...	...	...	373	1	0
...	1,000	1,000	...	...	...	...	...	...	64	0	0
...	18,600	18,600	...	...	...	...	...	...	928	12	0
800	800	1,600	...	...	...	300	...	...	150	5	0
...	30	30	...	...	...	...	...	...	86	3	0
...	...	...	12	...	...	...	...	...	21	0	0
1,510	15,951	17,461	...	11	...	235	...	...	3,418	11	3
780	7,735	8,515	...	...	...	...	...	...	1,010	12	0
...	6,177	6,177	...	...	...	...	...	...	339	8	0
...	500	500	...	...	...	...	...	...	131	3	0
...	2,667	2,667	27	...	1	1	...	...	678	4	0
...	1,567	1,567	...	...	...	...	...	...	...	...	...
101,455	343,874	445,329	53	868	93	71,280	75	...	77,937	9	6

MATHEMATICAL INSTRUMENT OFFICE.

TABLE A.

Details of Issues and Receipts from Provinces and Departments during the Financial year 1897-98.

PROVINCES AND DEPARTMENTS.	VALUE OF			
	Receipts.	Issues.	Debits.	Credits.
	R	R	R	R
Assam . . . . .	...	8,780	8,780	...
Bengal, Civil	24,652	35,658	11,006	...
" Military, Bengal Command	305	9,792	9,487	...
" " Punjab "	4,927	31,128	26,201	...
Bombay, Civil	278	4,208	3,930	...
" Military . . . . .	...	10,128	10,128	...
Burma	2,934	15,489	12,555	...
Central India . . . . .	...	62	62	...
" Provinces	180	7,220	7,040	...
Foreign States, Berar	92	381	289	...
Forests . . . . .	...	7,782	7,782	...
Geological Survey and Museums . . . . .	...	256	256	...
Guaranteed Railways, East Indian Rail- way . . . . .	...	3,564	3,564	...
Madras, Civil	6,142	11,450	5,308	...
" Military	562	2,335	1,773	...
Marine	65	846	781	...
Meteorological Department . . . . .	...	1,930	1,930	...
Mint	157	...	...	157
North-Western Provinces and Oudh " State Railway, Public Works Department	5,071	6,146	1,075	...
Public Works Department, Military Works	15,890	2,183	...	13,707
Public Works Department, Balúchistán, Railway Branch	525	2,259	1,734	...
Public Works Department, Balúchistán, Ordinary Branch	1,985	...	...	1,985
Punjab . . . . .	...	66	66	...
Rájputána, Public Works Department, and Central India	2,465	11,030	8,505	...
Survey Department, Field Parties	86	1,144	1,058	...
" " Head Quarter's Offi- ces, Calcutta and Dehra Dún	30,168	71,764	41,596	...
" " Head Quarter's Offi- ces, Calcutta and Dehra Dún	4,302	11,638	7,336	...
TOTAL	1,00,786	2,57,239	1,72,302	15,849
NET DEBIT . . . . .	...	...	1,56,453	...
CASH SALES . . . . .	...	...	38,776	...
GRAND TOTAL . . . . .	...	...	1,95,229	...

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the local market during 1897-98.

SPECIFICATION.	Number.	Value.
<i>Instruments.</i>		
		<i>R a.</i>
Barometers, aneroid, ordinary	3	240 0
Boards, drawing or sketching, cavalry pattern	24	804 0
Callipers, micrometer, small	2	55 0
Cameras, lucida, for sketching	1	634 0
Cards for prismatic compasses	125	275 0
Cases, leather and morocco, spare	152	399 8
Chronographs, watch pattern	14	350 0
Clinometers, Watkins' pattern	16	512 8
" survey pattern	24	348 0
Clocks	14	345 0
Compasses, bow, ink, brass, double jointed	12	90 0
" " " electrum " "	12	102 0
" " " spring " "	24	156 0
" magnetic, pocket, in electrum cases	12	144 0
" " rectangular, 2" x 2½"	73	511 0
" " " 3" x 3½"	12	96 0
" " " 5"	199	2,587 0
" " " 6"	118	1,770 0
" proportional, electrum, 6"	12	228 0
Canvas covers, for planetables	86	476 12
Ghat tracers	2	100 10
Glasses, binocular, large	15	570 0
Havresacks	62	93 12
Instruments, drawing, electrum, 2nd sort	12	600 0
Lamps, argand	6	19 8
Levels, spirit, in wooden case, 6"	4	8 0
" " " " 8"	4	9 2
Map printing machines, Ordnance	18	855 0
Mekometers	1	245 0
Pedometers	15	444 0
Pens, double, or road	24	144 0
Protractors, cardboard, circular, 9"	6	30 0
" rectangular, ivory, 6"	36	210 0
" " " wooden, 6"	60	117 0
Rules, parallel, bar, wooden, 6"	204	153 0
" " on rollers, brass, 12"	3	90 0
" " " " 18"	3	144 0
" " " wooden	34	491 0
" sight, wooden	400	1,200 0
Scales, diagonal, wooden	773	478 5
" marquis, wooden, sets	1	5 0
" offsets, single, wooden	30	11 4
" plotting, sets, wooden	12	276 0
" " single " "	300	656 4
Squares, set, ebonite	20	174 0
" " " single	154	303 0
" optical	572	3,718 0
Stands for planetables, survey pattern	220	1,540 0
Staves, levelling, telescopic, Sopwith's	175	2,625 0
Stencil plates	13	20 0
Sundials	3	300 0
Tapes, measuring, metallic, 50'	29	126 14
" " " 66'	52	322 0
" metallic, of sizes	6	16 8
" steel, 100'	11	314 8
Carried over	4,214	26,534 7

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the local market during 1897-98—concluded.

SPECIFICATION.	Number.	Value.
<i>Instruments—concluded.</i>		
Brought forward		<i>R a.</i>
Telescopes of sorts	4,214	26,534 7
Thermometers, common, in tin case	12	144 0
" maximum, self-registering	19	32 12
Trunks, mule	6	156 0
Umbrellas, surveying	42	651 12
Watches, common	42	631 0
" stop	88	2,304 0
	6	1,050 0
TOTAL	4,429	31,503 15
<i>Books.</i>		
Hints to travellers	6	38 9
Chamber's hand book of astronomy	2	32 0
Manual of surveying (Thuillier's)	1	12 0
Nautical almanacs	68	172 9
Tables, log, Hutton's	3	20 10
" " Shortrede's, sines, etc.	4	93 12
" " traverse, Boileau's	4	36 8
TOTAL	88	406 0
<i>Sundries.</i>		
Brushes, stencil	84	41 4
Glasses, ink, bottles	96	36 0
Apparatus, camera	1	175 0
Boxes, brass, for rectangular compasses, 5"	50	575 0
" " " " 6"	50	625 0
Carbon paper, black	Doz. 2	6 12
Chimneys, for lamps	48	12 8
Cold chisels	12	18 0
Cords for mekometers	500	100 0
Dogs, Yost Type-writer	1	10 8
Eyelets, brass	60	22 8
Frames and fittings, brass, for clinometers, survey pattern	112	2,011 0
Frena cameras	1	65 0
Hammers	4	5 12
Impression strips	3	0 12
Jewel lamps	2	7 8
Lactometers	34	84 14
Leather stamps, etc.	21	4 0
Papers, Legal, No. 1	Doz. 1	4 12
Pump spring bow ink	28	30 0
Springs, punch, plier	2	7 0
Stencil inks, black	18	9 0
" " red	4	3 0
" " blue	6	4 8
Steel yards	3	108 0
Wicks for lamps	96	9 13
Types	sets 2	614 11
TOTAL	1,240 1/2	4,863 2
TOTAL OF BOOKS	88	406 0
" " INSTRUMENTS	4,429	31,503 15
SUM TOTAL	5,757 1/2	36,773 1

MATHEMATICAL INSTRUMENT OFFICE.

TABLE C.

Instruments, etc., manufactured in the Mathematical Instrument Office during 1897-98.

SPECIFICATION.	Number.	Value.	
<i>Instruments.</i>		<i>R</i>	<i>a.</i>
Boards, drawing, deal	86	1,080	0
Chains, measuring, iron, 66'	310	1,085	0
" steel, " 100'	160	1,120	0
" of sorts and sizes	140	1,270	0
Clinometers, survey pattern	44	201	0
" wooden, with shade scale	104	3,228	0
"	12	18	0
Combs, acre, card-board	4,000	1,500	0
Compasses, magnetic, rectangular, 5"	19	247	0
"	24	360	0
Canvas covers, for plane-tables	2	10	12
Curves, French, wooden, sets	1	1	8
Gauges, writing	60	132	0
Glasses, copying or tracing	3	115	0
Hold-alls, leather	172	3,044	0
Lamps, argand	7	880	0
Pins, for chains, ordinary	1,012	92	12
Plane-tables, survey pattern	100	643	0
" deal, military pattern	18	240	0
Plates, graticule	2	130	0
Pluviometers, Symon's	125	775	0
Protractors, horn	6	72	0
Rods, measuring	25	31	4
Rules, flat, ebonite, plain, 18"	4	12	0
" " wooden, " 12"	105	19	11
" " " " 2'	82	20	8
" sight, brass	18	288	0
" " wooden	50	300	0
Scales, card-board, miscellaneous	1,150	187	8
" diagonal, card-board	4,500	1,125	0
" engineering, metal	18	180	0
Sheets, celluloid	993	682	2
Stamps, for conventional signs	80	164	0
Stands, for heliotropes	22	348	0
" " levels, dumpy	6	21	0
" " telescopes, metal	1	40	0
" " theodolites, transit, 5"	8	355	0
" " " " 6"	6	260	0
" " " " railway, 5" and 6"	25	1,060	0
Staves, cross or offsets	12	60	0
" levelling, Roorkee, double	12	291	0
" " sopwith's, telescopic	218	5,405	0
Stencil plates	365	784	0
Tapes, metallic, 66'	2	9	8
Thermometers, maximum and minimum, 9" sets	5	100	0
Yards, standard	3	180	0
TOTAL	14,117	28,168	9
<i>Sundries.</i>			
Boxes, of sorts	21	79	7
Alum-contact breakers	3	90	0
Back board, for pluviometer	4	60	0
Brass moulds	1	8	0
Bubble testers	1	16	0
Carried over	30	253	7

MATHEMATICAL INSTRUMENT OFFICE.

TABLE C.

Instruments, etc., manufactured in the Mathematical Instrument Office during 1897-98—concluded.

SPECIFICATION.	Number.	Value.
<i>Sundries—concluded.</i>		<i>R a.</i>
Brought forward	30	253 7
Corner-pieces, brass	2	9 0
Cords and Reels, for Mekometers	1	22 8
Doolies	1	1 12
Ferrotypes printing frames	2	110 0
Glass plates, square	2	12 0
Gauges, steel	18	36 0
Handles, brass, for chains	4	2 0
Screws, brass	19	17 12
Silvered glasses	1	2 0
Seismometers	1	60 0
Tops, brass, rain-gauge	12	54 0
Zinc tickets	152	4 12
bottles, for pluviometers	12	12 0
TOTAL	257	597 3
SUM TOTAL	14,374	28,765 12

MATHEMATICAL INSTRUMENT OFFICE.

TABLE D.

List of principal instruments repaired in Workshop during the financial year 1897-98.

SPECIFICATION.	Number.
Anemographs, of sorts	4
Anemometers, "	30
Arithmometers	1
Balances, chemical	1
Barographs	1
Barometers, of sorts	110
Bars, lengthening	1
Boards, drawing, of sorts	3
Cameras	3
Chains, of sorts	116
Chronographs, of sorts	18
Chronometers, "	6
Chrono-micrometers, of sorts	2
Clinometers, of sorts	157
Clocks	14
Compasses, beam, of sorts	4
" bow, ink and pencil, of sorts	115
" " dividers	27
" drawing, of sorts	184
" magnetic, "	90
" prismatic, "	151
" proportional "	13
" surveying, "	3
Cords and Reels	47
Curves	1
Ghat tracers	1
Glasses, binocular, of sorts	32
" magnifying	1
" measure	3
Heliographs	24
Heliotropes	25
Horizons, mercurial, ordinary	1
Hydro-clinometers	1
Hydrometers	28
Hygrometers	7
Hypsometers	1
Indicators	2
Instruments, drawing, mathematical, of sorts	127
Lamps, of sorts	2
Lens, reading	1
Levels, of sorts	178
" spirit	10
Magnets	2
Map printing machines	2
Mekometers	106
Micrometers	2
Microscopes	5
Mining dials	2
Pens, drawing, of sorts	239
" dotting	1
Pentagraphs	7
Perambulators	1
Pins, of sorts	97
Plane tables, of sorts	69
Planimeters	6
Pluviometers or rain-gauges	4
Pointers, station	5
Protractors, of sorts	24
Range-finders	10
Carried over	2,128

MATHEMATICAL INSTRUMENT OFFICE.

TABLE D.

List of principal instruments repaired in Workshop during the financial year 1897-98—concluded.

SPECIFICATION.	Number.
Brought forward	2,128
Rules, of sorts	201
Scales, " "	45
Scott's sights, B. L., telescopic	98
Sectors	3
Set squares	1
Sextants, of sorts	26
Squares, optical	164
Stands, for camera	1
" " compasses	62
" " heliographs	7
" " levels	89
" " mining dial	1
" " plane-tables	50
" " sextants	1
" " theodolites	57
Staves, levelling, of sorts	122
Sundials	1
T squares	3
Tapes, of sorts	545
Telemeters, of sorts	21
Telescopes, " "	172
Theodolites, " "	123
Thermographs	1
Thermometers, of sorts	51
Time-pieces	1
Type writers, of sorts	17
Vanes, wind	2
Walker's harpoon log	1
Yards, steel	1
Watches, common	6
TOTAL OF PRINCIPAL INSTRUMENTS REPAIRED	4,001
" " MINOR INSTRUMENTS REPAIRED	1,105
TOTAL OF ALL INSTRUMENTS REPAIRED	5,106

MATHEMATICAL INSTRUMENT OFFICE.

Profit and Loss account of the Workshop for the financial year 1897-98.

DEBITS.		CREDITS.					
	R	a.	R	a.	R	a.	
To Workshop establishment (less proportion debitable to the Store Branch for clean- ing and adjusting serviceable instruments)	43,528	1	By repairs for public officers on book debit	14,651	0		
„ One-third of office establish- ment	2,710	3	„ repairs for public officers on payment	9,833	6	24,484	6
„ Pay of Material Store- keeper for the whole year	780	0	„ repairs for stock			39,672	15
„ Workshop contingencies as distinguished from materials purchased	3,104	8	„ manufacture for stock— instruments			27,556	12
„ Value of materials :— For ordinary work	29,047	11	packing cases			1,574	2
„ general workshop use			„ manufacture of material	3,959	0		
„ manufacture of packing cases							
„ Paid for repairs	135	8					
„ Wear and tear of plant	811	1					
„ Half of rent at R600 per mensem	3,600	0					
„ Printing and stationery	379	5					
„ Four per cent. on value of tools and plant amounting to R1,42,522-11	5,700	15					
„ Half of rates, taxes, etc.	877	0					
„ Liability for pensions	3,948	0					
„ Profit	2,624	15					
TOTAL	97,247	3	TOTAL	97,247	3		

TRIGONOMETRICAL BRANCH OFFICE, DEHRA DÚN.

Narrative Report of Mr. J. ECCLES, M. A., Superintendent, 2nd grade, in charge Computing Party, Season 1897-98.

The occurrence of the total solar eclipse necessitated the absence of some officers for a short time. Mr. Eccles visited Dumraon to take part in the observations at that place. Mr. McA' Fee left Dehra on the 28th December and proceeded to Sahdol to help in the arrangements for the camp and to assist Major Burrard in the observations: he also made a plane-table survey of the camp, on the scale of 48 inches to the mile. He returned to Dehra on the 14th February 1898. Four Computers, Babus Shoshi Bhoosan Shome, Shiv Nath Saha, Isan Chandra Dev and Sarat Chandra Guha, were sent to Pulgáon in the Central Provinces to help the party there. They were absent for 17 days.

Before proceeding to the field, Lieutenant H. H. Turner, R.E., Assistant Superintendent, 1st grade, of No. 24 Party, was instructed in the use of the 24-inch theodolite with which he took a set of azimuth observations.

Lieutenant E. A. Tandy, R.E., Assistant Superintendent, 2nd grade, on appointment to the Department, was posted to this Office on the 31st January, and was put through a course of astronomical observations, and triangulation, and taught the methods of computations used in the Department: he was also shown the working of the various sections of the Trigonometrical Branch office. He was transferred to No. 22 Party on the 25th August. Lieutenant A. Mears, I.S.C., Assistant Superintendent, 2nd grade, was transferred to this office from Nos. 9 and 19 Parties on the 13th April. He was put through a course of instruction in the methods of astronomical observations and the computations of the Trigonometrical Branch and in levelling. He passed the departmental examination and was confirmed on the 4th August. Both these officers were attached for a short time to the training school to learn plane-tableing. Mr. A. E. Wackrill, Superintendent of Trigonometrical Surveys, Ceylon, who came here to acquaint himself with the methods of observing and computing, as well as with all details in connection with field and office work obtaining in the Survey of India Department, left the Office about the middle of November.

For the first time in the history of this Office a training class for the newly appointed officers of the Provincial Service was started, and the six Probationary Sub-Assistant Superintendents on appointment to the Department were posted to the office for training, instead of directly to a field party. They were attached to the training school and received a regular course of professional instruction in the plane-table, theodolite and level, and were shown the processes in the various sections of the Trigonometrical Branch Office. They were also instructed in topographical drawing and in the computations of the Topographical Branch.

In the training school, in addition to the above, a class of 17 apprentice sub-surveyors was instructed in the use of the plane-table and theodolite, and 7 of them were taught levelling. Four of them obtained over 75 per cent. of marks in the examination prior to their final posting to field parties.

The instruction given in the training school consisted of plane-tableing on the 1-inch, 4-inch, 36-inch, and 100 feet to the inch scales, theodolite traversing both by chain and bar subtense, prismatic compass surveying, levelling with the dumpy level, model surveying, star observations for time and azimuth, drawing of scales, graphical projections and hand-printing.

The four recorders of No. 24 Party were sent down in September and received instructions in drawing scales, printing, drawing and graticule projecting, also in prismatic reconnaissance with pacing, and interpolation and intersecting with the plane-table. One sub-surveyor of No. 18 Party was instructed in levelling.

The following changes took place in the *personnel* of the Office during the year: Mr. J. Eccles, M.A., Superintendent, 2nd grade, returned from furlough and took over charge of the Computing Party on the 22nd November from Mr. H. W. Peychers, Extra Assistant Superintendent, 1st grade. Mr. Peychers retired on superannuation pension from 14th December. Mr. W. A. Fielding, Extra Assistant Superintendent, 6th grade, was transferred from No. 18 Party from 4th November to take charge of the training school. Mr. J. S. Manuel, Zincographer, who was absent on sick leave, retired on invalid gratuity from 10th February, and Mr. G. A. LeFranc officiated as Zincographer. Munshi Zakir-uddin, Sub-surveyor, was transferred from No. 15 Party to the training school on the 1st November. Babu Umbica Churn Shome, Computer, retired on pension from 2nd July, and Babu Karuna Kumar Das was appointed as Copyist in the Computing Section.

The cost of the Computing Section under its various class heads and the percentage thereof, together with those of the three preceding years, are given in the following statement:—

CLASS.	COST IN RUPEES		PERCENTAGE OF COST.		
	1897-98	1898-99	1899-00	1900-01	1901-02.
1. Records, Library	994	36	3.0	2.9	3.4
2. Accounts, Returns, Correspondence	1,964	7.4	6.4	5.2	8.1
Carried over	2,958	10.8	9.4	8.1	11.5

CLASS.	COST IN RUPES.	PERCENTAGE OF COST.			
	1897-98.	1897-98.	1896-97.	1895-96.	1894-95.
Brought forward	2 958	10.8	9.4	8.1	11.5
3. Supply of data, etc.	1,796	6.6	0.8	1.7	2.7
4. Computations	3,018	67.9	79.9	78.5	5.3
5. Preparation of Press copy	5,254				
6. Examination of Press proofs	10,194				
7. Ditto of charts	403	1.5	1.9	2.9	1.4
8. Protection of stations	1,096	4.0	3.4	3.3	2.2
9. Miscellaneous	1,359	5.0	3.2	4.4	4.3
10. Meteorology, etc.	1,158	4.2	1.4	1.1	1.9
11. Extra-Departmental work . . . . .	...	...	...	...	0.2
TOTAL	27,236	100	100	100	100

From the above table it will be seen that the working power of this section has been distributed much in the same way as in the preceding years, except that an unusually large percentage appears against the 3rd class owing to the great demand made on the section by a requisition from Professor Helmert of the International Geodetic Association ; and class 10 shows an enhanced percentage owing to the deputation of four computers to assist in the eclipse observations at Pulgáon.

The following is an account of the work done under the several classes shown in the foregoing table :—

CLASS 1.—RECORDS, LIBRARY, ETC.—Seven fresh instalments of field records were received during the year ; these together with those already in the office have received the usual care and attention. The three standard copies of the library catalogue have been kept up to date.

CLASS 2.—ACCOUNTS, RETURNS AND CORRESPONDENCE.—In this is included the preparation of indents, estimates, monthly detailed and abstract progress reports, annual reports, stock returns of office stores, and various other items.

CLASS 3.—SUPPLY OF DATA.—Nineteen requisitions for data and 49 indents for forms were received and complied with, in all about 36,000 copies of professional and other forms were issued during the year.

CLASS 4.—COMPUTATIONS.—The following are the details :—

Revision of heights of principal triangulation of the Biláspur Meridional Series.—This revision was necessitated by the extension of lines of spirit levels across this series which shewed sensible discrepancies in the published values.

Burma Coast Series, Section 11° to 23°.—Examination of certain angle books in regard to the observations for azimuth, and computations of azimuths observed at three stations completed ; and errors in log sides of certain triangles ascertained.

Mandalay Meridional Series.—Reduction of azimuth observations partly examined.

New net work Triangulation of Country round Dehra for the Training School.—Reduction completed.

Revisionary observations in Assam—This revision was necessitated to ascertain what changes might have been caused by the earthquake of June 1897. A preliminary reduction of the observations was made in the Computing office, as soon as they were sent in from the field, so as to ascertain, as early as possible, the results obtained.

Hand-Book of Professional Instructions for the Trigonometrical Branch.—Revision of certain tables completed.

Tables for Determining Heights in Traversing.—Computations completed and tables prepared.

Captain Burton's Explorations in Persia, 1897.—Barometric heights computed.

Captain Deasy's Explorations in Tibet, 1897-98.—Computations being proceeded with and about two-thirds of the work done. The work includes the computations of astronomical azimuths, latitudes and time, geodetic latitudes, longitudes and azimuths, and triangles.

In addition to the above the computers were employed on the following :—

- (a) Determining the probable error between the old and new values of Captain Lenox-Conyngham's determination of the longitude of Teheran.
- (b) Preparing a table to show errors obtainable by working with rectangular co-ordinates.
- (c) Reducing experimental observations by an explorer.
- (d) Examining star chart for the Total Solar Eclipse of 22nd January 1898.

CLASS 5.—PREPARATION OF PRESS COPY.—This requires the abstracting and entering in suitable tables of the final results of several calculations for publication, all these compilations are twice compared, once against the original field records and once against the final computations, prior to being sent to the press. The details of the work done are as follows:—

- (a) *Indus Delta Secondary Triangulation.*—Final revision of the co-ordinate list as regards orthography and description of stations completed.
- (b) *Jubbulpore Meridional and Bilaspur Meridional Series.*—Revised heights abstracted.
- (c) *Net work Triangulation of Country round Dehra-Dun for the Training School.*—An abstract of rectangular co-ordinates and heights of points prepared.

CLASS 6.—EXAMINATION OF PRESS PROOFS.—This requires the utmost care and attention in comparison and examination in the several stages of first, second and form proofs. Most of the matter printed is numerical, or depending on numerical data, hence it necessarily involves a strictly critical examination which can only be given by men specially trained to this style of work. The printing of the following has been proceeded with:—

Sixteen pages of the Tidal Volume were examined and printed off; 80 pages of the Synoptical Volumes of the Indus Delta Triangulation and the Great Arc Meridional Series, Section 8° to 18° were also printed off. The printing of these volumes, both professional and synoptical, is nearing completion. About 64,000 copies of professional and other forms were printed. The total amount of work executed will be seen by reference to the tabular statement of the Printing Section.

CLASS 7.—EXAMINATION OF CHARTS.—Comparison and examination of the following completed:—

- Preliminary Chart of Secondary Triangulation, Thayetmyo *viâ* Prome, etc. Seasons 1875-76 and 1879-81.
- Preliminary Chart of Assam Longitudinal Series, Seasons 1853-55.
- Four final charts of the Great Arc Meridional Series, section 8° to 18°, and two of the Indus Delta Triangulation are in hand.

CLASS 8.—PROTECTION OF STATIONS.—The usual professional work in connection with the protection of survey stations and certain of the bench marks in the North-Western Provinces and Bengal was performed. During the year 547 stations have been repaired by the District Officers at a cost of Rs. 1,863-4-4, six districts out of 347, from which reports are generally received, failed to submit them.

CLASS 9.—MISCELLANEOUS.—In this are included various duties which cannot be fairly assigned to any of the other classes such as the following:—

- (a) The examination and despatch of the printed papers to the Survey of India Office, Calcutta, for safe custody.
- (b) The examination of all bound volumes and pamphlets prior to issue, and the preparation of the distribution lists and presentation labels for the same.
- (c) The preparation of examination papers for the Provincial Service of the Survey of India Department of which 39 sets were prepared, despatched and examined the results being tabulated and submitted to the Surveyor-General.

CLASS 10.—METEOROLOGY AND GENERAL SCIENCE.—As hitherto a complete set of meteorological observations was taken daily throughout the year, and monthly and annual abstracts prepared. Monthly magnetic observations were also taken regularly throughout the year, and the results are tabulated with those taken here previously. The meteorological and magnetic results are given in the following tabular statements:—

Mean monthly Readings of Earth Thermometers.

Depth in feet of thermometer bulbs below surface of ground.	Year.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.
		1897-98	77.13	77.34	77.25	76.97	76.57	75.95	75.39	74.91	74.91	75.22	76.70	78.48
Mean, 1881-97	76.81	76.85	76.60	76.09	75.55	74.94	74.37	74.08	74.03	74.36	75.60	76.57	
12.8	1897-98	79.61	78.84	77.38	75.20	73.51	71.99	72.21	74.30	76.28	78.36	79.91	80.03
Mean, 1881-97	79.43	78.08	75.88	73.31	71.60	70.74	71.33	73.11	75.22	77.21	79.14	79.70	
6.4	1897-98	80.44	77.38	72.97	69.12	67.59	67.05	73.04	78.66	81.62	82.07	81.63	80.36
Mean, 1881-97	79.71	75.82	71.21	67.25	65.54	67.13	71.50	76.79	80.25	81.34	81.45	81.23	
3.2	1897-98	79.58	73.06	67.07	64.20	62.82	66.78	79.18	84.21	85.93	83.23	81.74	80.79
Mean, 1881-97	78.19	71.75	65.59	61.91	61.28	66.71	75.43	82.12	84.72	83.41	82.08	81.73	
1.1	1897-98	78.56	70.64	60.95	59.99	59.68	67.77	82.30	87.65	89.04	81.61	81.43	80.11
Mean, 1881-97	76.17	67.64	60.16	57.36	58.66	67.69	78.67	86.08	87.81	84.22	82.34	81.65	
Thermometer in shade	1897-98	81.37	73.83	66.85	68.53	64.73	70.68	93.20	92.11	89.44	81.91	79.68	81.10
Mean, 1881-97	80.54	73.36	67.68	64.13	66.99	78.50	89.75	93.93	90.10	82.54	80.66	82.53	

Mean velocity in miles of the Winds which blew at Dehra Dún during the twelve months of 1897-98 for each hour of the day.

CIVIL HOURS.		October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Mean.
0 to 1	.	0'81	1'10	0'87	1'30	1'04	1'57	1'90	1'97	0'50	0'58	0'42	0'62	1'05
1 " 2	.	0'71	0'93	0'65	1'50	1'04	1'33	2'03	1'58	0'67	0'61	0'39	0'76	1'01
2 " 3	.	0'26	0'73	0'39	1'13	0'96	1'03	1'34	1'61	0'83	0'55	0'19	0'69	1'81
3 " 4	.	0'23	0'50	0'45	0'63	1'04	0'93	1'38	1'00	0'87	0'65	0'23	0'52	0'70
4 " 5	.	0'13	0'37	0'42	0'70	1'00	0'97	1'17	0'90	0'87	0'39	0'26	0'59	0'65
5 " 6	.	0'29	0'27	0'29	0'53	0'86	0'70	0'83	0'97	0'87	0'42	0'19	0'59	0'57
6 " 7	.	0'19	0'47	0'19	0'50	0'95	0'70	0'72	1'00	0'63	0'53	0'35	0'55	0'57
7 " 8	.	0'06	0'10	0'19	0'50	0'71	0'67	0'52	0'64	1'10	0'63	0'55	0'69	0'55
8 " 9	.	0'16	0'07	0'23	0'43	0'89	0'87	0'67	1'58	1'60	0'97	0'97	0'76	0'77
9 " 10	.	0'26	0'33	0'39	0'73	1'18	1'53	1'40	2'23	2'47	1'35	1'10	1'03	1'17
10 " 11	.	0'71	0'93	0'87	1'52	1'54	2'19	2'00	2'52	2'53	1'61	1'84	1'43	1'64
11 " 12	.	1'13	1'23	1'71	2'29	2'25	2'77	3'53	2'65	2'53	1'71	1'87	1'83	2'12
12 " 13	.	1'23	1'27	1'77	2'13	2'53	3'55	3'93	3'55	2'50	2'13	2'13	1'31	2'17
13 " 14	.	1'42	1'53	1'87	2'70	3'07	3'84	4'00	4'48	3'07	2'10	2'06	1'62	2'64
14 " 15	.	1'68	1'30	1'65	3'23	3'29	4'55	4'24	4'77	2'90	2'35	1'94	1'76	2'80
15 " 16	.	1'35	0'83	1'74	2'83	3'57	4'42	4'10	4'55	2'30	1'90	1'68	1'69	2'58
16 " 17	.	0'87	0'47	1'10	1'91	3'29	4'10	5'38	4'45	1'93	1'26	1'00	1'14	2'24
17 " 18	.	0'29	0'10	0'19	0'90	2'07	2'35	3'48	4'26	1'63	0'90	0'77	0'62	1'46
18 " 19	.	0'29	0'27	0'29	0'50	1'00	0'71	1'03	2'48	1'47	0'74	0'45	0'66	1'82
19 " 20	.	0'68	0'73	0'68	0'60	1'11	0'87	0'55	1'68	0'87	0'42	0'32	0'76	0'77
20 " 21	.	0'87	1'13	1'03	1'26	1'18	1'19	1'10	1'29	1'17	0'32	0'32	0'76	0'97
21 " 22	.	1'06	1'17	0'90	1'50	1'21	1'84	2'03	1'42	1'10	0'19	0'45	0'90	1'15
22 " 23	.	0'94	1'20	0'97	1'43	1'36	1'97	2'41	2'10	1'23	0'35	0'29	0'93	1'26
23 " 24	.	0'77	1'23	1'00	1'30	0'96	1'67	2'38	2'35	0'83	0'58	0'45	0'93	1'19
Suma	.	16'39	18'26	19'84	31'97	38'51	46'32	52'12	56'23	36'47	23'24	20'22	23'14	...
Average	.	0'68	0'76	0'83	1'33	1'60	1'93	2'17	2'34	1'52	0'97	0'84	0'96	...

Monthly Meteorological Results of observations taken at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún.

YEAR AND MONTH.	BAROMETER REDUCED TO 32° FAH.						HYGROMETER.			THERMOMETER.			RAIN.		WIND.		CLOUD.	
	AT 10 A.M.		AT 4 P.M.		Monthly mean.		to A.M.	4 P.M.	Highest in air.	Lowest in air.	Monthly mean in air.	Wet Bulb.	Number of days it fell.	Fall in inches.	Most frequent direction.	At 10 A.M.	At 4 P.M.	
	Highest.	Lowest.	Highest.	Lowest.	Inches.	Inches.	Monthly mean hu-	Monthly mean hu-	Inches.	Inches.	°	°						
1897.																		
October	'816	'476	'732	'415	'597	'718	52	49	86.8	0	0	49.8	...	...	Calm.	0.7	0.7	At 4 P.M.
November	'900	'628	'784	'589	'592	'686	53	48	82.3	47.8	63.5	45.2	...	...	Calm & S.	0.5	1.3	At 10 A.M.
December	'966	'675	'863	'591	'739	'739	54	47	72.8	40.4	55.0	37.0	1	0.07	Calm.	2.8	1.8	
1898.																		
January	'969	'693	'904	'597	'718	'718	49	39	78.2	40.7	56.6	37.8	3	0.35	W. & Calm.	2.1	3.2	
February	'829	'426	'742	'370	'592	'592	60	50	79.0	39.1	55.3	38.0	9	5.18	W.	3.6	5.3	
March	'790	'517	'688	'412	'586	'586	37	23	93.7	38.5	67.3	35.8	...	...	W. & S.W.	2.2	3.4	
April	'783	'450	'654	'361	'479	'479	26	20	102.6	58.5	80.4	49.6	1	1.53	W.	0.8	1.8	
May	'658	'365	'576	'263	'400	'400	29	21	102.2	60.8	81.4	51.9	5	0.63	S. W. & W.	3.9	4.2	
June	'542	'212	'443	'114	'272	'272	64	55	100.1	68.7	83.0	63.8	13	8.31	S & S.E.	4.6	5.3	
July	'506	'246	'451	'167	'306	'306	82	79	91.1	67.9	77.8	66.3	21	30.18	S. E.	7.2	7.8	
August	'539	'248	'463	'185	'333	'333	86	84	88.3	69.5	76.6	65.2	28	47.87	S. E. & Calm.	8.2	8.7	
September	'718	'420	'628	'309	'460	'460	76	72	87.8	61.1	74.7	58.4	13	23.17	S. E. & Calm.	5.3	5.0	

Synopsis of the results of the Monthly Magnetic observations taken at the Trigonometrical Branch Office, Dehra Dun. The measures of Intensity are all expressed in C. G. S. units.

YEAR AND MONTH.	MAGNETIC ELEMENTS				REMARKS.
	Declination East.	Horizontal Intensity.	Dip North.	Total Intensity.	
1868.	° ' "		° ' "		
January	3 2 14	0'33,634	41 27'4	0'44,878	} With unifilar magnetometer No. 16 and Dip circle No. 43.
February	—	'33,635	27'1	'44,875	
March	—	'33,656	25'2	'44,882	
April	—	'33,573	30'0	'44,826	
May	—	'33,569	33'0	'44,856	
June	—	'33,614	29'3	'44,873	
July	—	'33,685	34'0	'45,023	
August	—	'33,625	28'7	'44,880	
September	3 3 4	'33,608	32'5	'44,901	
October	3 2 13	'33,551	30'0	44,796	
November	—	'33,632	30'9	'44,915	
December	—	'33,616	35'0	'44,942	
1869					
January	—	0'33,643	41 32'2	0'44,946	} With unifilar magnetometer No. 19 and Dip circle No. 43.
February	—	'33,636	31'3	'44,925	
March	--	'33,621	28 1	'44,868	
September	3 5 10	'33,466	35'4	'44,746	
November	3 6 44	'33,644	32'1	'44,946	
1897.					
January	2 49 39	0.33,659	42 40'2	0'45,778	} With unifilar magnetometer No. 19 and Dip circle No. 43.
February	48 42	'33,730	42'1	'45,898	
April	48 17	'31,901*	41'0	'43,396*	
May	50 4	'33,667	46'5	'45,866	
June	48 15	'34,032	50 5	'46,413	
July	48 42	'33,646	38'8	'45,743	
August	45 22*	'33,056	45'6	'45,840	
September	48 10	'33,695	45'2	'45,888	
October	49 27	'33,639	46'2	'45,824	
November	50 33	'33,627	44'4	'45,786	
December	48 24	'33,667	48 0	'45,884	
1898.					
January	2 50 45	0'33,757	42 48'0	0'46,007	} With unifilar magnetometer No. 19 and Dip circle No. 43.
February	50 1	'33,605	48'2	'45,802	
March	51 12	'33,665	46'8	'45,867	
April	50 32	'33,660	52'9	'45,936	
May	51 11	'33,842	51'9	'46,173	
June	51 14	'33,544	48'3	'45,721	
July	54 24	'33,271	52'1	'45,396	
August	48 24	'33,714	48'5	'45,955	
September	51 32	'33,569	52'8	'45,811	

* Observations unsatisfactory.

TYPE-PRINTING SECTION.—As will be seen from the annexed statement the greater part of the work done consisted in setting up the large number of headings, foot-notes, etc., required in the Drawing Section in connection with the publication of maps and miscellaneous work :—

Statement of work done during 1897-98.

SPECIFICATION OF PRINT.	No. of pages.	Total No. of pulls.	No. of copies of each page.	VALUE.
				R
Professional volume	44	5,490	500	1,647
Synoptical volume	80	8,670	350	1,992
Letter-press for charts, map headings, foot-notes	396	9,190	...	3,851
Forms	188	104,810	...	5,480
Eclipse Report	16	1,080	200	265
Miscellaneous	221	19,880	...	2,474
Extra-departmental work	191	8,300	...	150
	1,136*	157,420	...	15,859

*Equal to 1,597 pages of standard (foolscap) size.

The usual table showing the work annually performed by this section during the past five years is given below, the unit (a page of foolscap) being the same throughout :—

	1893-94	1894-95	1895-96	1896-9	1897-98
Pages composed	1,638	1,219	1,135	1,110	1,597

An analysis of the pages composed in 1897-98 is as follows :—

PROFESSIONAL VOLUME	{ Bidar Longitudinal Series (Revision of heights) Great Arc Meridional Series, Section 18° to 24° (ditto) Tidal volume }	76
SYNOPTICAL VOLUME	{ Great Arc Meridional Series, Section 8° to 18° and Indus Delta Triangulation }	120
MISCELLANEOUS	{ Letter-press for charts, map headings, foot-notes 536 Forms, orders, memoranda, etc. 415 Miscellaneous 254 Extra-departmental work 172 Eclipse Report 24 }	
	TOTAL	1,597

PHOTO-ZINCOGRAPHIC SECTION.—The only change which has occurred in the working of this section is in the process employed for cleaning the glasses for negatives. The laborious method of polishing with tripoli powder has been discarded, and instead the glass is placed film and all in a solution of—

Bichromate of potash	5 oz.
Sulphuric acid	5 oz.
Water	100 oz.

and allowed to remain for 24 hours. On removal the film has generally completely peeled off. The glass is scrubbed on both sides with a hard brush and well washed in clean running water. It is then placed in a trough of clean water till such time as the photographer may be ready to apply the substratum which consists of—

Gelatine	22 grains.
Liquor ammonia	40 minims.
Water	20 oz.

This is applied to the wet plate, the first coating being run off and second applied. The plate is allowed to dry and put away for use next day. Negatives which have been varnished with a hard benzole or spirit varnish require to be soaked longer in the solution.

The following tables exhibit the value and outturn of the work done by this section :—

Abstract of departmental work done during the year 1897-98.

SPECIFICATION.	Sheets or subjects.	Negatives and transparencies.	PHOTO-ZINCOGRAPHIC PRINTING.						SILVER AND OTHER PRINTING.		VALUE. R a.		
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Pulls.	Number of copies.			Silver prints.		Blue and other prints.	
							Coloured.	Uncoloured.	Total.				
Standard maps . . .	209	389	461	210	256	31,547	4,085	23,405	27,490	...	...	14,133	15
Index maps . . .	6	2	8	6	14	2,434	1,145	127	1,272	...	...	189	13
Technical charts . . .	8	19	19	8	8	500	...	500	500	...	...	416	10
Miscellaneous maps, plans, etc. . . .	214	99	109	66	130	10,682	686	9,824	10,510	32	115	3,151	9
Departmental forms . . .	1	1	1	1	1	200	...	100	100	...	...	37	10
Transfers and proofs . . .	...	...	...	...	...	1,164	...	...	...	...	...	...	...
TOTALS . . .	438	510	598	291	409	46,527	5,916	33,956	39,872	32	115	17,929	9

Statement of work done for other departments, etc., during the year 1897-98.

DEPARTMENTS, ETC.	Sheets or subjects.	Negatives and transparencies.	PHOTO-ZINCOGRAPHIC PRINTING.						SILVER AND OTHER PRINTING.		VALUE. R a.		
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Pulls.	Number of copies.			Silver prints.		Blue and other prints.	
							Coloured.	Uncoloured.	Total.				
Forest Survey . . .	125	194	209	132	133	17,861	1,400	12,696	14,096	...	...	6,091	3
Engineer-in-Chief, Hardwar-Dehra Railway . . .	7	4	4	2	2	200	...	700	700	...	...	71	0
TOTALS . . .	132	198	213	134	135	18,061	1,400	13,396	14,796	...	...	6,162	3

Table showing the amount realised from other departments, etc., by book debit and cash sales during 1897-98.

DEPARTMENTS, ETC.	By book debit.		By cash sales.		TOTAL.	
	R	a.	R	a.	R	a.
Forest Department	63	4	240	14	304	2
Forest Survey	6,253	0	386	2	6,639	2
Quarter Master General	12,297	13	88	5	* 12,386	3
Military Department . . . . .	.....		176	14	176	14
Other Departments	114	9	566	3	680	12
Private individuals . . . . .	.....		133	7	133	7
TOTALS	18,728	10	1,591	13	20,320	7

* The greater portion of this sum was for work completed in 1896-97, but the adjustment was not made in time to permit of its being shown in last year's report.

CORRESPONDENCE SECTION—The work in this section has been carried on as usual
STORES, WORKSHOPS AND OBSERVATORIES SECTION.—An astronomical equipment was cleaned and taken to the solar eclipse camp at Sahdol. The instruments returned by the survey officers with the Tirah Expeditionary Field Force were cleaned and stored, while some alterations in the instruments of the astronomical parties were successfully carried out. In the observatories, the usual time observations were taken, the chronometers rated and kept in order and other miscellaneous work done.

SOLAR PHOTOGRAPHIC SECTION.—The work of this section was conducted as usual; experiments with dry plates were continued and fairly successful results were obtained. The 12-inch instrument was also put in working order.

he details of the work of this section are given below :—

Table showing the number and character of negatives.

1897-98.	NUMBER OF DAYS.				NUMBER OF NEGATIVES.								TOTAL.		NUMBER OF WORKING DAYS WHEN PHENOMENA WERE	
	Failures.			TOTAL.	Solar Phenomena.											
	When negatives were taken.	From bad weather.	From various causes.		Spots and faculæ.		Spots only.		Faculæ only.		None.					
					8"	12"	8"	12"	8"	12"	8"	12"	8"	12"		
October . . .	31	...	...	31	37	...	...	...	20	...	...	...	57	...	31	...
November . . .	30	...	...	30	44	...	...	...	11	...	...	...	55	...	30	...
December . . .	30	1	...	31	50	...	...	...	4	...	...	...	54	...	30	...
January . . .	28	3	...	31	52	...	...	...	...	...	...	...	52	...	28	...
February . . .	21	7	...	28	34	...	...	...	6	...	...	...	40	...	21	...
March . . .	29	2	...	31	38	...	...	...	12	...	...	...	50	...	29	...
April . . .	29	1	...	30	39	...	...	...	15	...	...	...	54	...	29	...
May . . .	31	...	...	31	54	...	...	...	2	...	...	...	56	...	31	...
June . . .	26	4	...	30	34	...	...	...	12	...	...	...	46	...	26	...
July . . .	23	8	...	31	20	...	...	...	19	...	...	...	39	...	23	...
August . . .	21	10	...	31	31	1	...	...	1	...	...	...	32	1	21	...
September . . .	26	4	...	30	43	3	...	...	...	...	...	...	43	3	26	...
TOTAL	325	40	...	365	476	4	...	...	102	...	...	...	578	4	325	...

Five hundred and thirteen silver prints of the 8-inch pictures, and four of 12-inch pictures were prepared, and weekly despatches of both silver prints and negatives made as usual to the India Office.

Table showing the visibility of Sun at Dehra Dún and Greenwich.

YEAR.	AT DEHRA DÚN.			AT GREENWICH.		REMARKS.
	Number of days on which negatives were taken.	Percentage of days on which negatives showed features.	Number of days on which sun was invisible.	YEAR.	Number of days on which negatives were taken.	
1880-81*	307	96	55	1880	156	* From 1st October to 30th September following. † Year ending 10th May 1896 obtained from the report to the Board of Visitors.
1881-82	328	100	37	1881	181	
1882-83	318	100	47	1882	221	
1883-84	285	100	78	1883	215	
1884-85	284	100	81	1884	154	
1885-86	290	100	75	1885	206	
1886-87	302	91	61	1886	199	
1887-88	328	71	38	1887	188	
1888-89	315	78	50	1887-88	205	
1889-90	320	99	45	1888-89	182	
1890-91	303	100	62	1889-90	212	
1891-92	304	100	62	1890-91	224	
1892-93	292	100	73	1891-92	219	
1893-94	304	100	61	1892-93	220	
1894-95	313	100	52	1893-94	230	
1895-96	324	100	41	1894-95	199	
1896-97	316	100	49	1895-96†	229	
1897-98	325	100	40	1896-97	Not obtainable.	
Mean	309	...	56	...	203	

DRAWING SECTION.—The details of the work of this section are given below :—

Statement showing the work performed during 1897-98.

Title of Map.	Number of sheets.	Scale.	REMARKS.
<i>General Maps.</i>			In. M.
North-Eastern Frontier sheet No. $\frac{5-12}{6-13}$	1	1=16	Completed. Final press order given.
Map of Persia, 1897	6	1=16	Ditto ditto.
<i>Standard Maps.</i>			
North-Western Provinces, Dehra Dún and Siwálíks (2nd edition)	4	1=1	Corrections completed. Final press order given.
Central Provinces Survey sheet No. 8 $\frac{N. E.}{4}$	1	1=1	Boundaries corrected. Final press order given.
Punjab Survey Sheets Nos. 265 N.W., 265 S.W., 285 S.E., 286 S.W., 289 N.E., 289 S.E., 311 S.W., 312 S.E. and 313 N.E.	36	1=1	Corrections completed for reduction to half scale. Final press order given.
Punjab Survey Sheets Nos. 264 N.E., 264 S.W., 307 S.W., 308 N.W., 313 N.W., 313 S.W. and 336 N.W.	28	1=1	Corrections for reduction to half scale. In hand.
<i>Plans of Cities and Cantonments.</i>			In. Ft.
Karáchi City, Layári Quarter, Sheets Nos. 1 to 18	18	1=80	Touched up for Photography. Final press order given.
<i>Index Maps.</i>			In. M.
Triangulation Chart of India	1	1=96	Corrected and brought up to date for Annual Report.
Index to illustrate survey operations by No. 18 Party in the Himálayas	1	1=20	Ditto ditto.
Index to illustrate survey operations by Nos. 12 and 15 Parties in Sind	1	1=50	Ditto ditto.
<i>Charts.</i>			
Triangulation Chart of Great Arc Series, Sections 8° to 18°	4	1=4	In hand.
Nos. 43 and 44, Preliminary Charts of Indus Delta Coast Triangulation	2	1=4	In hand.
Chart of Triangulation Sheets Nos. 1, 5, 6 and 7 (Central Provinces)	4	1=1	For reduction to half scale. Completed headings and footnotes. Final press order given.
Chart of Triangulation Sheets Nos. 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 23, 24, 25, 26, 27, 28, 34, 35, 36, 37, 38, 39, 63, 64, 82, 83 and 84 (Central Provinces)	29	1=1	For reduction to half scale. In hand.
Chart of Triangulation Sheet No. 17 (Sind Survey)	1	1=1	For reduction to half scale. Corrected. Headings and footnotes completed. Final press order given.
Chart of Triangulation Sheets Nos. 15, 16, 32, 33, 34, 47, 48, 66, 67, 68, 87, 88, 89, 108 and 109 (Sind Survey)	15	1=1	For reduction to half scale. Corrections in hand.
Triangulation Chart of Dehra Dún Survey	1	1=1	In hand.
Chart of Triangulation Sheet No. 332 (Punjab Survey)	1	1=1	For reduction to half scale. In hand.
Level Charts Nos. 67 and 74	2	1=2	Compilation in hand.
Level Chart No. 88	1	1=2	Completed. Final press order given.

Statement showing the work performed during 1897-98—concl'd.

Title of Map.	Number of sheets.	Scale.	REMARKS.
<i>Miscellaneous.</i>			
	In. M.		
Tidal Maps of Tuticorin, Galle, Amherst, Minicoy, Rangoon, Pámban Pass, Dublat, Hansthal Point and Diamond Harbour	9	Various	Completed, Final press order given.
Tidal Maps of Bhávnagar, Bombay and Moulmein	3	Various	In hand.
Other maps	14	Various	Touched up for photography and completed as regards headings and footnotes. Final press order given.
Maps coloured	3,383	Various	

MAPS EXAMINED.

Standard original maps	130
Charts	16
Miscellaneous maps	21
Photographic proofs of Standard sheets and other maps	290
TOTAL	457

N.B.—In addition to the above other miscellaneous duties have been performed, such as correcting and completing the Standard sheets and Triangulation Charts of the Central Provinces, Punjab, and Sind Surveys in respect of headings, foot-notes, symbols, etc., for press; taking out and checking areas of villages with their cultivation in the Punjab Survey sheets and incorporating the Indus Riverain Survey on the Sind Survey sheets. Preparing descriptive diagrams of the Pentagraph and Planimeter with specimens of hill shading and printing for the Survey Training School and diagrams, sketches and charts for the Solar Eclipse Report; examination of and custody of records, making all the despatches of maps, etc., etc., etc.

Statement of work done for other departments during 1897-98.

TITLE OF MAP.	Number of sheets.	Scale.	REMARKS.
<i>Standard Maps.</i>			
		In. M.	
Forest Surveys	88	4 = 1	Completed headings, foot-notes and references. Final press order given for Forest Department.
Ditto	1	1 = 1	Ditto ditto.
<i>Index Maps.</i>			
Forest Surveys	7	Various.	Ditto ditto.
<i>Miscellaneous.</i>			
Forest Surveys	17	Various.	Ditto ditto.

1899.

File No. 89 of
1899.

GOVERNMENT OF INDIA.

Serial No. 2.

DEPARTMENT OF REVENUE AND AGRICULTURE.

LAND SURVEYS.

RESOLUTION.

No. 3—89-2.

Dated Simla, the 8th July 1899.

SUBJECT.

General Report on the Operations of the Survey of India Department during 1897-98.

READ—

The General Report on the Operations of the Survey of India Department during the year 1897-98.

RESOLUTION.

The field operations of the Survey of India Department during the year ending 30th September 1898 were carried on by two double and seventeen ordinary parties.

The various classes of work on which these parties were engaged were as follows :—

	Number of parties employed.	Number of detachments employed.
1. Trigonometrical	1	1
2. Topographical	7	...
3. Forest (excluding the Forest Survey Branch) ...	3 (1 double)	...
4. Cadastral	3	...
5. Traverse	2 (1 double)	...
6. Scientific	3	...
TOTAL ...	19 (2 double)	1

Thus 6 single and 2 double parties were employed on traverse, cadastral and forest surveys, as compared with ten whole parties and two detachments so employed in 1896-97.

2. The total area surveyed on all scales during the year, excluding reconnaissance surveys, was 26,223 miles against 26,269 in the previous year.

3. The party employed on trigonometrical operations undertook the work of continuing the Makran Longitudinal series westwards. It was however attacked, 17 lives were lost, much personal and public property was plundered, and work was brought to an abrupt conclusion.

4. Topographical operations were carried on in the Shan States of Upper Burma, Sindh, Lushai Hills and the Himalayas. To meet the requirements of the Irrigation Department a survey of certain lands in Kalat was undertaken *pari passu* with the work in Sindh, the area topographically surveyed amounting to 1,477 square miles. The topographical survey of the Lushai Hills was

begun during the season and in addition to the triangulation of 1,300 square miles, a secondary series of triangles was started from one of the sides of the eastern frontier series. The topography of Mandi, Suket and the Simla Hill States was also continued. The total area topographically surveyed during the year amounted to 15,109 square miles against 14,460 square miles in the year 1896-97.

5. Forest surveys were conducted by the Imperial parties in Madras, Bombay, Burma and the Himalayas. In the Madras Presidency two full parties were employed, but, owing to unforeseen difficulties, the expected increase in the area of detail survey completed was not realised. In the Bombay Presidency an area of 677 square miles was surveyed on three different scales; while the outturn in Lower Burma consisted of 406 square miles on the 4-inch scale in the Pegu and Shwegyin Divisions and 118 square miles on the 2-inch scale on the Yenwe river. The Himalaya party completed 146 square miles in Sirmur, Kulu and Kangra.

The Forest Survey Branch continued its operations in Oudh, Punjab, Burma and the Central Provinces. The outturn of work of the Imperial parties and the Forest Survey Branch for the past two years is given below:—

			1896-97.	1897-98.
			Sqr. miles.	Sqr. miles.
(1) Imperial parties	...	...	3,260	2,397
(2) Forest Survey Branch	...	...	1,563	1,737
			<hr/>	<hr/>
			4,823	4,134
			<hr/>	<hr/>

The decrease in area surveyed by the Imperial parties was due to the conversion of No. 14 party, hitherto employed on forest surveys, into a topographical party.

The cost rate of the 4-inch work in Bombay has been reduced, but that of the 8-inch survey was higher than in the previous year, owing to the difficult nature of the country in Nasik and Kolaba and to casualties amongst the trained men and experienced surveyors from plague. The cost rate of the detailed survey as far as executed by the Survey of India Department in Burma continued to be high owing to the entertainment of a large number of new men, inexperienced in forest surveys. The early commencement of the monsoon and excessive sickness also affected the cost rate.

6. Cadastral operations (Imperial) were carried on by one party in Bengal, two parties in Burma and by local agency in the North-Western Provinces and Oudh under the Superintendent of Land Records Survey. The programme of surveys in Bengal consisted of operations in the Saran, Darbhanga and Noakhali districts and the re-demarcation of the boundary between Nepal and the districts of Purnea and Bhagalpur. In the North-Western Provinces and Oudh record writing in Meerut and Lalitpur was completed, whilst in Shahjehanpur and Bahraich the surveys and writing of records were both finished. Survey and record operations were begun in Bijnor, Barcilly, Kheri and Gonda. In Burma the survey of the Minbu District and the traversing of the Toungoo District were completed, whilst the survey of the Lower Chindwin was begun. A special survey of the Rangoon Sadar Bazar was also undertaken at the request of the

Cantonment authorities. The total area cadastrally surveyed in the three provinces was 6,976 square miles against 7,190 square miles in the previous year.

7. One double party was engaged on traverse operations in the North-Western Provinces and Oudh and one single party in Assam. The total area traversed was 5,128 square miles compared with 6,135 square miles in the preceding year.

8. The system of determining latitudes by observing at groups of stations close together instead of at a single station was given a trial during the year, and although the experiment was not entirely successful, interesting results were obtained.

9. Tidal observations with the self-registering tide-gauges were made at 13 stations in India, Burma, the Persian Gulf, the Andaman Islands and the Red Sea. Personal tidal observations to graduated staves were also taken at six stations to compare the actual times and heights of high and low water with those predicted in the Tide Tables.

A detachment of the Tidal and Levelling party undertook the revision of the principal triangulations in the Khasi and Garo Hills with a view to ascertain what displacement vertically or horizontally had taken place during the earthquake of June 1897. The result shows that the stations observed lay within the area affected by the earthquake, and that all of them have suffered more or less within a range of a few feet, the general apparent effect being that the area has been both widened and raised.

Considerable assistance was also afforded to the English Astronomers in the observation of the total eclipse of the sun which occurred on January 22nd, 1898.

10. In Upper Burma an area of 1,752 square miles of new country was geographically surveyed. The aggregate area geographically surveyed on the Eastern and Western Frontiers amounted to 9,976 square miles.

11. The work done in the various head-quarters offices was satisfactory. The Drawing Section continued to make progress in the completion of the maps of the North-Eastern and South-Eastern Frontiers. The third edition of the map of India on the 32-mile scale was completed, whilst a new canal map and a railway map on the same scale was published and a railway map showing railway and steamer stations was put in hand. The revision of district maps was continued, seventy-seven of the Atlas sheets were completed and brought up to date, and a large number of maps were executed in connection with the famine in Bengal and the Central Provinces as well as for the Military and other Departments. The total number of cadastral sheets published was 4,731.

12. In the Engraving Office considerable progress was made in the preparation of the quarter sheets of the Atlas of India, 16 maps for administration reports were published, and 21 District maps and various other maps, charts and plans were in hand in different stages of progress. The provincial map on the 16-mile scale of Gujarat was issued, whilst those of Bengal, Bombay, Madras, Rajputana, Punjab, and Kashmir had new material added to them. The outturn of work in the Printing Section of this office was more than in the preceding year.

13. The total value of the work done by the Photographic and Lithographic offices was Rs. 1,92,927 against Rs. 2,13,518 in the previous year, the

amount of work received for reproduction being somewhat less than usual. The principal item of extra-departmental work done was the illustration with 29 maps and diagrams of the plague reports issued by the Home Department. In the Heliogravure Section, in addition to regular work, some useful experiments were made in trichromatic photography and in electro-deposition for the correction of hand-engraved copper plates.

14. The total number of maps issued from the Map, Record and Issue Office was 156,523 and their value Rs. 1,17,942, a decrease of 50,807 in number and Rs. 39,985 in value on the figures of the previous year.

15. There was an increase of 8,373 in the number and Rs. 2,411 in the value of the instruments issued by the Mathematical Instrument Office. There was also an increase in the value, though a decrease in the number, of the instruments received and made serviceable by that office. Since the increased establishment for the repair of instruments was sanctioned, 416 levels and 107 theodolites have been converted and issued, and all indents for such instruments have been discontinued. The value of instruments indented for during 1898-99 was £4,823, a slight increase over the figure of the year immediately preceding, but considerably less than the figures of former years.

16. The Government of India have noticed with satisfaction that the Training School at Dehra has justified its institution. Seventeen pupils were under instruction, during the year, all of whom passed the examination at the end of the course. Six newly appointed Provincial Officers also went through a course of training and were all pronounced thoroughly fit for field work at its completion.

17. The Survey of India Department lost during the year the services of two distinguished officers by the retirement of Colonel J. E. Sandeman, I.S.C., Deputy Surveyor General in charge Revenue Branch, and Colonel Sir T. H. Holdich, K.C.I.E., C.B., R.E., and by the death of Major-General R. G. Woodthorpe, C.B., R.E., the Government of India were deprived of another most valuable and distinguished officer. The Department remained throughout the year under the administration of Major-General C. Strahan, R.E., and the Government of India desire to acknowledge the energy and success with which he has maintained the efficiency of the Department, and the value of the work carried out in the various branches.

Madras.
Bombay.
Bengal.
North-Western Provinces and Oudh.
Punjab.
Burma.
Central Provinces.
Assam.
Coorg.
Berar.

ORDER.—Ordered that the above Resolution be forwarded to the Surveyor General of India, the Inspector General of Forests, the Local Governments and Administrations noted on the margin, and to the Foreign, Military and Public Works Departments.

Ordered also that the Resolution be published in the Supplement to the *Gazette of India*.

[True Extract.]

M. FINUCANE,

Offg. Secretary to the Government of India.

GENERAL REPORT
ON THE
OPERATIONS
OF THE
Survey of India Department
ADMINISTERED UNDER
THE GOVERNMENT OF INDIA
DURING
1897-98

PREPARED UNDER THE DIRECTION OF
MAJOR-GENERAL C. STRAHAN, R.E.,
SURVEYOR GENERAL OF INDIA.



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