

GENERAL REPORT  
ON THE  
OPERATIONS ~~RESTRICTED~~  
OF THE  
**Survey of India**

ADMINISTERED UNDER  
THE GOVERNMENT OF INDIA  
DURING

1907-08

PREPARED UNDER THE DIRECTION OF  
COLONEL F. B. LONGE, R.E.,  
SURVEYOR GENERAL OF INDIA



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1907-08

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# GENERAL REPORT

ON THE

## OPERATIONS

OF THE

# Survey of India

ADMINISTERED UNDER

THE GOVERNMENT OF INDIA

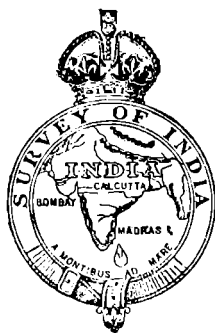
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GENERAL REPORT  
ON THE  
Operations of the Survey of India

DURING THE SURVEY YEAR

1907-1908.

PART I.  
SUMMARY.

ADMINISTRATION.

1. This report deals with the operations of the department for the year ending the 30th September 1908.

Colonel F. B. Longe, R.E., administered the department throughout the year, except from 28th February to 24th September 1908, when he proceeded on combined leave to Europe. During his absence, Colonel S. G. Burrard, R.E., F.R.S., Superintendent, Trigonometrical Surveys, officiated for him, and Mr. J. Eccles, M.A., officiated for Colonel Burrard. Mr. Eccles also officiated for Colonel Burrard as Superintendent, Trigonometrical Surveys, from 1st October 1907 to 10th November 1907. Colonel G. B. Hodgson, I.A., continued to hold his appointment of Deputy Surveyor General. Lieutenant-Colonel P. J. Gordon, I.A., and Major C. H. D. Ryder, D.S.O., R.E., held the appointments of Superintendents, Burma Surveys, and of the Northern Circle, respectively, throughout the year. Captain F. C. Hirst, I.A., officiated as Superintendent, Provincial Surveys, Bengal, for Major Crichton, I.A., who was on furlough.

2. In March 1908, the property known as Castle Hill estate at Mussooree was purchased by Government, for the accommodation of the topographical parties and offices under the Superintendent, Northern Circle, and such of the trigonometrical parties as recess at Mussooree. It covers an area of about 182 acres and there are 8 houses of various sizes on it, besides a very large number of out-offices. It has also suitable sites for building, but the present houses, when necessary alterations are made to adapt them for survey offices, will, it is hoped, meet the immediate requirements of this department. It will, however, be necessary to build later on when money is available, as several of the houses are not really suitable for permanent offices, and it will probably be found more convenient and economical to rent them as dwelling-houses to members of the department.

*Inspection Tours of Administrative Officers.*

3. Colonel F. B. Longe, R.E., Surveyor General, left Simla on the 29th October 1907 and visited Roorkee and Dehra Dún, arriving at Calcutta on the 15th November. At Dehra Dún he inspected the office of the Superintendent, Trigonometrical Surveys and the Forest Map office. On the 28th February he proceeded on combined leave.

On the 25th September 1908 he returned from furlough, and on the following day, he left Bombay for Bangalore.

It had been intended to hold the annual conference of senior officers at Bangalore, this year, but owing to Colonel Burrard's indisposition, this was not possible. All the points, however, that would have come before it, were discussed by the Surveyor General with Colonel Hodgson and Lieutenant-Colonel Gordon

at Bangalore and later on with Colonel Burrard and Majors Ryder and Coldstream, at Mussooree.

The main points considered were as follows :—

- (a) The classification of surveyors throughout the department as a whole, their pay, rules of service, etc.
- (b) Means for insuring uniformity in the method of showing past and proposed surveys on index maps.
- (c) The progress made in the style of mapping and the improvements that should be introduced in the matter of lettering and ornamentation.
- (d) The transfer of all triangulation to the Trigonometrical Branch.

A satisfactory scheme has, it is hoped, been drawn up on the first subject. It may be roughly described as follows :—

There will be three classes of surveyors, who will be recruited and trained as pupils for two years before being classed. They will then be on probation for two more years, after which, they will be appointed surveyors :—

R	
The pay of the 1st class will be	. 30-5-100
" " " 2nd " " "	. 25-3-60
" " " 3rd " " "	. 20-2-45

the increments being biennial.

It is hoped, that gradually the third class will die out, as the class of recruit improves— as no doubt it will—and that no men will be retained in the service who are not worthy of being placed into classes 1 or 2.

During his stay at Bangalore the Surveyor General inspected the offices of Nos. 3, 10, 11, 19 and 20 Parties and the circle drawing office. The whole of the work and arrangements showed great improvement, and indicate that all classes are working most creditably, and with a little more experience, the fair mapping will leave little to be desired.

4. Bt.-Colonel S. G. Burrard, R.E., Officiating Surveyor General of India, left Calcutta for Dehra Dún on 4th and arrived there on 6th April 1908. He inspected the Trigonometrical Survey office and Forest Map office at Dehra Dún, and then proceeded to Mussooree, where he inspected the Castle Hill estate, which had been purchased by the Government, to provide office accommodation for the parties of the Survey of India recessing at Mussooree. From Mussooree, he returned to Dehra Dún and conferred with the Superintendent, Trigonometrical Surveys, and the Castle Hill estate committee, regarding the future management of the estate. He left for Simla on the 29th April, arriving there on the 30th.

He left Simla on 8th September 1908 and arrived at Dehra Dún on the 5th ; after conferring with the Superintendent, Trigonometrical Surveys, he left for Mussooree, where he inspected the Frontier and other Drawing offices and the offices of the several field parties both of the Northern Circle and of the Trigonometrical Branch.

5. Colonel G. B. Hodgson, I.A., Deputy Surveyor General, inspected the United Provinces drawing office at Naini Tál during October 1907. Proceeding from Calcutta in December, he inspected in the field Nos. 1, 2, and 17 Parties and also the two cantonment sections, returning the same month. In January, he inspected at Jubbulpore, the survey of cantonments then in progress. In July, he went from Calcutta to Pachmarhi, and inspected No. 2 cantonment section, and from there proceeded to Pooona, where he inspected in recess, Nos. 1, 2, and 17 Parties, remaining there till the end of August.

6. Mr. J. Eccles, M.A., officiating Superintendent, Trigonometrical Surveys, visited Mussooree in June, July and September 1908, and inspected the recess offices of Nos. 22, 23, 24, and 26 Parties. He also inspected at Dehra Dún, in September 1908, the Forest Map office, No. 25 Party (Tidal and Levelling), and also the Survey Training school during the year from time to time.

7. Lieutenant-Colonel P. J. Gordon, I.A., Superintendent in charge Burma Surveys, was present at a conference held in Shillong, in November 1907, for the purpose of discussing the programme of topographical surveys in Assam, and the question of the offices for the Eastern Circle at Shillong, at which the Lieutenant-Governor of Eastern Bengal and Assam, the Chief Secretary, the



Director of Land Records, and the Superintendent, Provincial Surveys, Bengal, were present. He inspected No. 19 Party in the field in Malabar in December 1907 and again in the Wynaad in April 1908. During January and February he inspected Nos. 3, 7, and 10 Parties in the field in Burma and No. 20 Party in Assam.

8. Major C. H. D. Ryder, D.S.O., R.E., Superintendent, Northern Circle, proceeded to Quetta during September 1907, and returned to his head-quarters at Mussooree, on the 3rd October 1907. In the beginning of November his head-quarters office was moved to Dehra Dún. He left Dehra Dún to inspect his field parties on the 7th December and returned to his head-quarters at Dehra Dún on the 25th idem. He again proceeded to the field on 1st February and returned to Dehra Dún on 7th idem. He proceeded to inspect all his parties on the 11th February, and returned to Dehra Dún on 7th March 1908. He left Dehra Dún for Dera Gházi Khan and Dera Ismaíl Khan to inspect Nos. 9 and 18 Parties on 26th March and returned to Dehra Dún on 5th April. In April his head-quarters office was again moved to Mussooree. He left for Pesháwar to inspect No. 12 Party on the 19th April and returned to his head-quarters at Mussooree on 11th May. He inspected the Training Party at Dehra Dún on the 23rd July and proceeded to Quetta on 31st August and returned to Mussooree on 13th September. He inspected the Simla Drawing office the same month and returned to Mussooree on 13th October 1908.

9. Captain F. C. Hirst, I.A., officiating Superintendent, Provincial Surveys, Bengal, inspected each section working under him at least once in the field season and again during a monsoon tour. He also inspected the mapping of several Settlement offices in Bengal and Eastern Bengal.

#### DISTRIBUTION OF FIELD PARTIES.

10 Field operations were carried out by 22 parties and 3 sections or detachments. Of the parties, 13 were employed on topographical surveys, 1 on principal triangulation, 4 on purely scientific operations, 1 on traverse surveys for cadastral purposes, 1 on traverse and cadastral surveys, and 2 on traverse and topographical surveys. The following table shows the distribution according to the nature of the work on which the parties were employed.

No. of Party.	Nature and <i>locale</i> of operations.	Page in this Report.	Executive Officers.	Scale.	Administrative Superintendent.				
24	TRIGONOMETRICAL.	23	Captain C. M. Browne, D.S.O., R.E.	...	S. T. S.				
	India . . . . .								
22	SCIENTIFIC.	25	Captain H. M. Cowie, R.E.	...	S. T. S.				
	India (Latitudes) . . . . .								
	.. (Pendulums) . . . . .					27	Major G. P. Lenox-Conyngham, R.E.	...	Ditto.
	.. (Tidal and Levelling). . . . .								
	.. (Magnetic) . . . . .					29	Mr. C. F. Erskine . . . . .	...	Ditto.
.. (Magnetic) . . . . .	32	Captain R. H. Thomas, R.E.	...	Ditto.					
.. (Magnetic) . . . . .	Lieutenant H. J. Couchman, R.E.								
1	TOPOGRAPHICAL.	37	Lieutenant M. N. Macleod, R.E.	2" = 1 M. 1" = 1 M.	D. S. G.				
	Central and United Provinces and Central India States.					.. K. W. Pye, R.E.			
2	Benar . . . . .	38	Captain H. Wood, R.E.	2" = 1 M. 1" = 1 M.	Ditto				

No. of Party.	Nature and <i>locale</i> of operations.	Page in this Report.	Executive Officers.	Scale.	Administrative Superintendent.
<b>TOPOGRAPHICAL—contd.</b>					
17	Bombay Presidency	39	Mr. B. G. Gilbert-Cooper. Mr. S. F. Norman (senior)	$2'' = 1 \text{ M.}$	D. S. G.
3	Burma	41	Captain C. P. Gunter, R.E.	$\left. \begin{array}{l} 2'' = 1 \text{ M.} \\ 1'' = 1 \text{ M.} \end{array} \right\}$	Supdt., Burma Surveys.
10	"	42	Captain A. A. McHarg, R.F.	$\left. \begin{array}{l} 4'' = 1 \text{ M.} \\ 2'' = 1 \text{ M.} \\ 1'' = 1 \text{ M.} \end{array} \right\}$	Ditto.
11	Shan States	44	Captain R. H. Phillimore, R.E.	$1\frac{1}{2}'' = 1 \text{ M.}$	Ditto.
19	Madras	45	Captain F. F. Hunter, I.A.	$\left. \begin{array}{l} 4'' = 1 \text{ M.} \\ 2'' = 1 \text{ M.} \\ 1'' = 1 \text{ M.} \end{array} \right\}$	
20	Eastern Bengal and Assam	47	Major A. Mears, I.A.	$\left. \begin{array}{l} 2'' = 1 \text{ M.} \\ 1'' = 1 \text{ M.} \end{array} \right\}$	Ditto.
9	Northern Circle	48	Lieutenant E. C. Baker, R.E. " F. J. M. King, R.E.	$\left. \begin{array}{l} 2'' = 1 \text{ M.} \\ 1'' = 1 \text{ M.} \end{array} \right\}$	Supdt., Northern Circle.
12	"	49	Brevet-Major E. T. Rich, R.E.	$2'' = 1 \text{ M.}$	Ditto.
14	"	50	Captain H. L. Crosthwait, R.E. Lieutenant V. R. Cotter, I.A.	$2'' = 1 \text{ M.}$	Ditto.
18	"	51	Captain E. A. Tandy, R.E.	$\left. \begin{array}{l} 2'' = 1 \text{ M.} \\ 1'' = 1 \text{ M.} \end{array} \right\}$	Ditto.
Training	"	52	Mr. G. P. Tate	$2'' = 1 \text{ M.}$	Ditto.
"	Burma Surveys detachment.	46	Mr. G. T. Hall	$2'' = 1 \text{ M.}$	Supdt., Burma Surveys.
<b>CADASTRAL AND TRAVERSE.</b>					
4	Bengal	52	Mr. N. Bedford	$\left. \begin{array}{l} 16'' = 1 \text{ M.} \\ 2'' = 1 \text{ M.} \end{array} \right\}$	S. P. S., Bengal.
5	"	53	Mr. C. S. Kraal	$16'' = 1 \text{ M.}$	Ditto.
6	Eastern Bengal	54	Mr. A. W. Smart	$\left. \begin{array}{l} 16'' = 1 \text{ M.} \\ 2'' = 1 \text{ M.} \end{array} \right\}$	Ditto.
7	Burma	55	Mr. O. D. Smart	$16'' = 1 \text{ M.}$	Supdt., Burma Surveys.
<b>CANTONMENT SURVEYS.</b>					
Section No. 1	Peshāwar, Meerūt, and Lucknow Divisions.	57	Mr. E. G. Little	$\left. \begin{array}{l} 16'' = 1 \text{ M.} \\ 64'' = 1 \text{ M.} \end{array} \right\}$	D. S. G.
2	Poona and Mhow Divisions.	58	Mr. L. J. Pocock	$\left. \begin{array}{l} 16'' = 1 \text{ M.} \\ 64'' = 1 \text{ M.} \\ 105.6'' = 1 \text{ M.} \end{array} \right\}$	Ditto.

### TRIGONOMETRICAL SURVEYS.

11. The triangulation party (No. 24) was divided into three detachments; of these, one worked in western Baluchistán, one in Burma, and one in northern Baluchistán.

(a) In western Baluchistán, the Kalát longitudinal series was completed up to the point of trijunction of Baluchistán, Persia, and Afghánistán (Koh-i-Malik Siah, longitude  $60^{\circ} 54'$ ); a length of 107 miles. Thirteen triangles were observed covering an area of 2,375 square miles, the average triangular error being  $0.35''$ .

(b) In Burma, the Great Salween series was continued eastwards to longitude  $98^{\circ} 42'$ , a length of 55 miles. Fourteen triangles were observed covering an area of 1,800 square miles, with an average triangular error of  $0.6\frac{1}{2}''$ .

(c) In northern Baluchistán, the selection of the stations was carried from Kalát *via* Quetta and Pishin into Zhōb.

## SCIENTIFIC AND SPECIAL OPERATIONS.

12. Major G. P. Lenox-Conyngham, R.E., and Captain H. M. Cowie, R.E., were employed in the continuation of the gravimetric survey. Captain Cowie took observations for latitude, to determine the deflection of plumb-line, at six stations near Deesa, with the object of investigating the variations in the density of the earth's crust, that have been discovered in this region.

13. Major Lenox-Conyngham took pendulum observations at eight stations in Southern India, with the object of ascertaining whether the structure of mountains in the peninsula resembled the structure of the Himalaya.

14. Major Lenox-Conyngham observed his pendulums both at the top and at the bottom of the Edgar shaft of the Mysore mine. His two pendulum stations were in the same vertical line, and were separated by a vertical distance of 2,617 feet. His results here furnish data from which a new value of the mean density of the earth can be deduced, but it has not as yet been decided how to utilise the data.

In view of the employment in the near future of a new 4-metre invar bar as the survey standard in place of Colonel Everest's old standard 10 feet bar A, it was deemed advisable to send the latter to Europe for comparison with the International Metre at Sèvres. Before the bar left Dehra Dún for France, it was carefully compared against the secondary standard bars I<sub>B</sub> and I<sub>S</sub> by Major Lenox-Conyngham and Captain Cowie.

15. Tidal operations were continued by No. 25 Party, observations being recorded at the eight permanent stations. The new observatory at Moulmein was constructed.

16. Levelling operations were carried out by three separate detachments. The revision of the line of levels from Bombay to Madras was completed, and new lines were taken through the southern Punjab and Rajputana. Six new standard bench-marks were connected.

17. The preliminary magnetic survey was completed with the exception of (a) the coast of Burma, (b) the wild country north of Burma, and (c) the Himalayan-Karakoram regions. This was the first year that the magnetic base-stations have worked throughout with their now complete instrumental equipments. The detailed magnetic survey is about to be commenced.

18. The following statement shows the cost of the more purely scientific work of the department for the survey year under report :—

		Cost.
		₹
Field Parties, No. 22 Party,	Astronomical . . . . .	21,343
" " " 23 "	Pendulums . . . . .	33,691
" " " 24 "	Triangulation . . . . .	1,83,680
" " " 25 "	Tidal and Levelling—	
	₹	
	Tidal observations . . . . .	14,627
	Preparation of Tide	26,669
	Tables.	
	Levelling operations . . . . .	44,891
		86,187
" " " 26 "	Magnetic—	
	Magnetic observa-	13,423
	tories.	
	Magnetic field work	74,959
		88,382
	TOTAL . . . . .	4,13,283
Controlling and Administrative staff	Trigonometrical	63,569
Trigonometrical Branch Office . . . . .		1,59,874
		2,23,443
	GRAND TOTAL . . . . .	6,36,726
	₹	
Last year the cost of the field parties was . . . . .		2,89,999
Controlling and Administrative staff . . . . .		91,281
Trigonometrical Branch Office . . . . .		1,59,529
	GRAND TOTAL . . . . .	5,40,809

There was therefore an increased expenditure of ₹95,917 on scientific work, which was entirely due to the increased cost of No. 24 Party, which had temporarily to be very considerably enlarged, to provide triangulation in advance for the topographical expansion.

19. At the request of the Government of Eastern Bengal and Assam, a surveyor was deputed to accompany an expedition which was sent to define the boundaries of the Lushai Hills, Chin Hills, and Arakan Hill Tracts, and an area of 1,194 square miles was surveyed on the  $\frac{1}{4}$ -inch scale.

### TOPOGRAPHICAL SURVEYS.

20. *Central and United Provinces and Central India States.*—No. 1 Party continued to carry out supplementary survey, mainly on the 2-inch scale, of the area previously surveyed cadastrally in the Central and United Provinces. An area of 2,619 square miles was thus revised and contoured, while in addition, in the adjoining Native States of Central India, an area of 528 square miles was re-surveyed. An area of 2,274 square miles was also triangulated in advance, while 253 miles of traversing for topographical requirements was also completed, in addition to a boundary traverse of 86 villages, aggregating 433 miles, undertaken for the Local Government.

21. *Berar.*—No. 2 Party, which, as in previous years, was an instructional one for the training of young officers of the Provincial service, continued the topographical survey of Berar and an area of 1,316 square miles was mapped on the 1-inch and 2-inch scales, while a tract of 2,180 square miles was triangulated in advance. The boundaries of all A and B class forest reserves falling within the area under survey, aggregating 286 miles, were surveyed on the 4-inch scale for the Forest department.

22. *Bombay Presidency.*—No. 17 Party re-surveyed on the 2-inch scale 1,250 square miles of old survey, and revised and contoured 1,108 square miles of the east and west Khândesh districts and of the adjoining States of the Central India Agency. Besides this, an area of 3,375 square miles was triangulated in advance, while 423 linear miles of forest boundaries, falling within the area mapped, were surveyed for the Forest department on the 4-inch scale.

23. *Eastern Bengal and Assam.*—No. 20 Party commenced the topographical survey of this province and surveyed an area of 3,135 square miles on the 2-inch scale in the Sylhet, Tippera, and Mymensingh districts.

24. *Burma.*—Nos. 3, 10, and 11 Parties continued their surveys on the 1-inch  $\frac{1}{2}$ -inch, and 2-inch scales chiefly in the Pakòkku and Katha districts and in the Shan States. A total area of 7,855 square miles was surveyed, 4,785 being on the 1-inch, 2,303 on the  $\frac{1}{2}$ -inch, and 768 square miles of reserved forests on the 2-inch and 4-inch scales. More than half of the area surveyed on the 1-inch scale was supplementary survey.

25. *Madras Presidency.*—No. 19 Party continued topographical and forest surveys in the Madras Presidency. The forest surveys were on the 4-inch scale in Ganjám and completed the programme of 4-inch forest surveys in the Presidency. In future, forests occurring in the general programme of a party will be surveyed on the 2-inch scale as in other parts of India. The topographical survey consisted of 2-inch and 1-inch surveys in the Malabar and Nilgiri districts and in Coorg and of revision survey in Mysore State; the total outturn of the party was 39 square miles on the 4-inch, 1,512 on the 2-inch, and 605 on the 1-inch scale. An area of 289 square miles on the 2-inch scale was also surveyed by the Training Party in the Salem district.

26. *Northern Circle.*—No. 9 Party triangulated 1,534 square miles and surveyed 1,543 square miles in the Dehra Gházi Khan district on the 1-inch scale, and 770 square miles on the 2-inch scale. No. 12 Party triangulated 1,200 square miles and surveyed 1,582 square miles on the 2-inch scale in the Hazára and Attock districts.

No. 14 Party triangulated 1,365 square miles and surveyed 2,103 square miles on the 2-inch scale in the Kohát and Attock districts.

No. 18 Party triangulated 1,712 square miles and surveyed 1,267 square miles on the 2-inch scale, and 539 on the 1-inch scale, in the Dera Ismail Khan district. They also traversed 1,851 linear miles for the above topography and worked 400 bases in the Bári Doáb.

The Training party in the Jhelum district triangulated 790 square miles and surveyed 487 square miles on the 2-inch scale.

The area triangulated is smaller this year than last year, as a larger area was not required. The cost-rate is reduced from ₹9-10-0 per square mile to ₹8-5-0, mainly due to the triangulation this year being mostly for 1-inch instead of 2-inch survey.

The area surveyed under the Superintendent, Northern Circle, on the 2-inch scale has increased from 7,261 square miles last year to 8,911 square miles this year, in spite of the fact that a large number of surveyors were employed on 1-inch work. The cost-rate is reduced from ₹44-10-0 to ₹33-0-0 per square mile.

The area surveyed on the 1-inch scale was 5,360 square miles as against *nil* last year and the cost-rate was ₹24-5-0 per square mile. This cost-rate will be materially reduced next year. The increased area surveyed renders it difficult to keep the fair mapping up to date, and this difficulty will increase year by year until all the surveyors now under training are also trained to be fair draftsmen.

The Castle Hill estate in Mussooree was purchased during the year, and next recess all the parties will recess in close proximity to each other, a convenience that should result in better drawing and supervision.

27. *Bengal*.—The survey of the block of hills in the south of Monghyr mentioned in paragraph 35 of last year's report was completed. The total area was 183 square miles, on the 2-inch scale. The completion of the survey of the lower Sundarbans on the 2-inch scale was effected, 1,257 being traversed and surveyed in detail.

28. The outturn of the topographical surveys on all scales is as follows :—

	Square miles.
Central and United Provinces and Central India States . . . . .	3,147
Berar . . . . .	1,316
Bombay . . . . .	2,358
Bengal . . . . .	1,440
Assam . . . . .	3,135
Burma . . . . .	7,856
Madras . . . . .	2,445
Northern Circle . . . . .	14,271
TOTAL	<u>35,968</u>

### FOREST SURVEYS.

29. The forest survey operations of the year were conducted principally on the scale of 2 inches = 1 mile, instead of, as heretofore, on the 4-inch scale. The work was carried out by the various topographical parties in whose sphere of operations the forests lay.

30. *Central Provinces*.—No. 2 Party surveyed an area of about 57 square miles of forests on 2-inch scale, and the boundaries of this area, approximating to 286 miles were traversed. This area includes certain reserves of A and B class forests of the Baisim and Mangrúl taluks of the Akola division, and certain others of the Pusad and Dárwha taluks of the Yeotmal division.

31. *Northern Circle*.—No. 14 Party surveyed on the 2-inch scale the Khwarra protected forests in the Pesháwar district, and the Zira reserve in the Kohát district. It also surveyed on the same scale the Kalu Chitta reserve forests in Punjab, and the following unclassed forests under the Forest department, *viz.*, Makhad, Jabi, Tawin, Nakka Kalan, Goki, Tora Bhera, Sautian, Chitti, Trap, Gulal, Kot Chajji, Jalwal A and B, and Niari, as well as, those under the Deputy Commissioner of Attock, *viz.*, Maira, Nalhan, Amanpur, Bani Raman Shah, Narian, Sukhwan, Bhajur, Uchhri and Kalri.

The Gadbar reserve and part of the Girgi reserve in Baluchistán amounting to about 34 and 9 square miles respectively were also surveyed.

32. *Burma*.—No. 10 Party continued the survey of the reserves situated on the western border of the Mu division, and an area of 232 square miles was completed on the 2-inch scale. These reserves comprise the Wabo, Nabe, Tinwa, Nanbyan, Nangyitha, Myaingwun, and Kalawpa reserves. This party proposes to complete next, the survey of the Yabin, Pyaungwè, Myaingwun, Sareikta, Nangyitha, Nanbyan, Tinwa, and Nabe reserves, and will also survey 60 square miles of the Panlaung, Mainghein, Simaw, Nanhan, Munsin, and the

Mohlaing reserves of the Bhamo division ; it will also take up the Mosit reserve, of which the Government of India has sanctioned the survey, in advance of the regular programme of the Survey of India at the cost of the Forest department. No. 3 Party will survey the Thingadôn reserve of 47 square miles, in the Lower Chindwin district, in the course of its regular programme.

No. 3 Party made no special surveys for the Forest department, but in the course of its ordinary operations surveyed 275 square miles of reserved forest on the 2-inch scale in the Pakôkku district, Yaw Forest division. Similarly No. 10 Party surveyed 219 square miles of reserved forests in the Ruby Mines district, and also 4.5 square miles on the 4-inch scale in the Pinkan reserve. No surveys of forests in this circle are included in the programme of the Survey of India for 1908-09.

33. *Bombay Presidency.*—An area of 555 square miles, falling within the *taluks* of the west Khândesh district, together with an additional area of 1.25 square miles in the east Khândesh district was surveyed on the 2-inch scale. In the Shirpur, Shâhâda, and Taloda (including Akhrâni ranges of the west Khândesh district) 423 linear miles of forest boundary survey were traversed on the 4-inch scale.

34. *Madras Presidency.*—No. 19 Party finished the 4-inch forest survey of the Ganjâm district, with an area of 39 square miles, thereby completing all the work required to be done by the Forest department on that scale. In South Canara, the same party traversed 23 linear miles of forest boundaries ; some 40 linear miles of undemarcated boundary still remain to be traversed. In South Malabar, the external boundaries of the following reserves were traversed, *viz.*, part of the new Amarapilam, Silent Valley, Attapadi Valley, blocks 1, 2, 3, 4, and part of 5. The following reserves were surveyed on the 2-inch scale, *viz.*, Erambadam, Kariam (partly), Muriat (partly), Kanakuth, Pokote, Panangode, Chattamburai, Nilambar, Arimbrakuth, Valuvâs Teri, Kurrampoya, Panakadan, and Beypore Tope, with an aggregate area of 26 square miles. In North Malabar the following reserves were surveyed on the 2-inch scale:—Edavankam, Kotiyur, Kamban malai, and Huntley. In North Coimbatore one newly demarcated forest boundary (Attikan Estate) was surveyed by a surveyor lent to the Forest department. In Coorg nearly the whole of the province was triangulated in advance of the 2-inch detail survey. In the Nilgiris, 2 square miles of the Murkurti Peak reserve was surveyed on the 2-inch scale.

#### CADASTRAL AND TRAVERSE SURVEYS.

35. No purely cadastral work was done in Bengal and Eastern Bengal, since this work is now done by the Settlement officers of these provinces. The cadastral establishment of No. 4 Party was handed over to the Settlement department on the last day of the survey year 1906-07.

36. Three parties were employed in the traversing of areas in Bengal and Eastern Bengal.

37. In Burma 970 square miles were cadastrally surveyed by No. 7 Party in the Thayetmyo, Pegu, Pyapôn, and Yamèthin districts, and 328 square miles were also traversed in Pegu and Yamèthin. The work assigned to this party having come to an end, it will be disbanded at the end of 1908, and all future revenue surveys will be carried out by the local Land Records department.

38. The total area traversed and surveyed cadastrally during the year is as follows:—

Provinces.	Traversing, sq. miles.	Cadastral survey, sq. miles.
Bengal . . . . .	3,609	...
Eastern Bengal . . . . .	2,694	...
Burma . . . . .	328	970

## CANTONMENT SURVEYS.

39. The survey of cantonments was continued by two small parties. The cantonments dealt with, 26 in number, belong to the Pesháwar, Ráwalpindi, Meerut, Lucknow, Poona, and Mhow Divisions and to the Bannu Brigade, and all were either entirely or practically completed. The surveys of cantonments were as formerly carried out on the 16-inch scale, the bázárs being surveyed on the scale of 64 inches = one mile, and the areas in acres surveyed were 36,497 and 571, respectively.

In addition a considerable amount of advance traversing was carried out in the bázárs of Secunderabad and Bolarum, which are to be surveyed next season.

## RESULTS.

40. The total outturn of detail topographical and forest surveys on all			
		Sq. miles.	scales is 35,968 square miles, against
4-inch scale	. . . . .	43	25,740 of the previous year. No surveys
2 " "	. . . . .	21,928	on a scale smaller than 1 inch = 1 mile
1½ " "	. . . . .	2,303	were carried out during the year except
1 " "	. . . . .	11,694	the area of 1,194 square miles mentioned
	TOTAL	35,968	under special operations, in the Lushai
			Hills. The total area triangulated and
			traversed for topographical or forest surveys is 37,396 and 1,489 square miles
			respectively, against 33,535 square miles for the previous year. The total area
			of cadastral surveys is 970 square miles and of the area traversed for this purpose
			is 6,631 square miles against 2,370 and 8,193 respectively for the previous year.

## HEAD-QUARTERS OFFICES, CALCUTTA.

41. The general superintendence of these offices continued under Colonel F. B. Longe, R.E., Surveyor General, up to February 1908, when he left India on leave, and Colonel S. G. Burrard, R.E., F.R.S., took over his duties. In January, the whole of the Map Reproducing and Issuing Offices were combined into one Map administrative charge, and placed under Major W. C. Hedley, R.E., as Superintendent, Publication, with the Assistant Surveyor General in charge Drawing Office and Assistant Surveyor General in charge Photo-Litho Office as his assistants. On the 1st of April Major Hedley returned to the executive charge of the Photo-Litho. Office and Colonel J. M. Fleming, I.A., who up to this, had held charge of the Surveyor General's and the Mathematical Instrument Offices, became Superintendent of Map Publication until he took leave on July 2nd, when Map Publication was placed under Major W. M. Coldstream, R.E. Major J. M. Burn, R.E., held charge of the Surveyor General's and Mathematical Instrument Offices from the 1st April to the close of the survey year.

42. *Map Publication Office.*—The re-organisation of the various Map Publication Offices was continued under Major Hedley, R.E., the officer lent by the Ordnance Survey for this purpose. He left India on the 26th of August, and his report on his work has been submitted to Government. In addition to many technical improvements introduced during his tenure of office the department is indebted to Major Hedley for new schemes of payment and to the grading of the establishments in the Photo-Litho. Office and Drawing Office.

These schemes strengthen the Surveyor General's control and enable him to reward good work, and will, it is believed, tend greatly to efficiency. At Major Hedley's suggestion a special grant has been sanctioned for the payment of overtime work. The need for payment of overtime work has been felt for some time, and without such payment it seems doubtful whether the department could have continued to meet extra-departmental demands and also to deal efficiently with the new standard sheets which are printed in colours.

43. The main work of the publication offices is the reproduction of our standard sheets. The number of new sheets received during the year under report, *i.e.*, up to September 30th, has been 230. Of these 103 have been printed, 22 are ready to print, 64 have been proved and are awaiting the return of the proofs from the circle offices, and in many cases from the Government of India and Local Governments, and 41 are in the various stages of reproduction preparatory

to proving. Although only about two-thirds of these maps are in colours this result may be considered satisfactory, especially when it is taken into consideration that of the 103 printed nearly all have been printed in the last seven months. The number of standard sheets we may expect in the year beginning 1st October 1908, may be taken as about 150, and there is every reason to believe that the reproducing offices will be able to deal in 1908-09 both with the majority of these and with those remaining from 1907-08. The heavy increase in work involved by the new system of publishing the sheets in the smaller size and in colours will be realised, when it is considered that under the old system the outturn of the year would have been published in about 75 sheets, which would each pass at most twice through the machine, instead as now of about 150 sheets, each of which must pass through the machine 5 and in many cases 6 times, *i.e.*, instead of 150 printings we must now undertake 750 or more printings. The quality of the standard sheets is improving as regards the drawing of the originals and their reproduction, and there is no reason why they should not eventually compare favourably with any maps of their class produced in other countries, but there is still room for improvement.

44. Of other important departmental maps, up to the present date, 23 sheets of the Map of India and adjacent countries on the  $\frac{1}{\text{million}}$  scale have been published, 5 are at press in different stages, and 16 are in hand in the various drawing offices. At the present rate we may hope to have these maps published for the whole of India some time in 1910. It was at first intended to engrave the  $\frac{1}{\text{million}}$  sheets at once, but the importance of bringing out an edition for the whole country at an early date, and the fact that for the greater part of India, the material available is from old surveys much out of date, have led to the decision to engrave only such sheets as could be compiled from modern surveys, and to push on the preparation of a preliminary edition of the whole map by photography.

As a preliminary edition (to be replaced when new material becomes available), is being compiled to meet a pressing want, and is being published by the most economical process, the standard aimed at cannot be the highest, but it is hoped it may meet immediate requirements.

45. Intimately connected with the decision to produce the  $\frac{1}{\text{million}}$  maps by photography, has been the decision to engrave the new degree sheets. So far, no degree sheets, based entirely on new surveys, have been submitted for publication, and the number of degree sheets that can be expected each year is not large. Each degree sheet includes 16 1-inch sheets, and they will be prepared after the publication of the component 1-inch sheets. Degree sheets compiled from the old surveys, would be little better than the atlas sheets on the same scale, which must remain our standard  $\frac{1}{4}$ -inch maps until they are gradually replaced. The style of the engraved degree sheets is not yet finally decided, and it is possible that the first few sheets engraved may be of a more or less experimental character.

46. The general maps of India, which the department maintains, were limited by the Survey Committee of 1904-05 to the following:—

1.	India on the scale of	32 miles = 1 inch	
2.	" "	64 " "	
3.	" "	80 " "	(as a railway map).
4.	" "	9 $\frac{1}{2}$ " "	
5.	" "	192 " "	
6.	" "	256 " "	

In addition to these, the 128-mile map is still maintained for departmental purposes. As mentioned in the last departmental report, a new engraved map on the 32-mile scale was commenced last year and work on this has made fair progress; about two thirds of the map has been compiled "*de novo*" and the remainder will be compiled during 1908-09. About one-third only has been cut on the copper. It is early yet to estimate the date of publication, as by the time the whole map is engraved many changes must be expected, and the process of final examination in so large a map is apt to be lengthy, but it is hoped that the map may appear during 1911. It is badly wanted, not only as a complete map in itself, but as the basis from which general maps of provinces, divisions, and other areas, can be rapidly and easily obtained. In the meantime, the old



map on the same scale has been brought up to date on stone and two editions have been published, one in skeleton outline and one in outline with hills in brown, and another edition in the authorised colours will be ready during 1908-09.

The old 64-mile map has been brought up to date on copper and a new edition published.

The plates of the 80-mile map, specially required for illustrating reports, are being corrected and a new railway map on this scale has been published for the Railway Board during the year.

The plates of the 96-mile map are being corrected; those of the 192-mile map have not yet been put in hand. The 256-mile map has been brought up to date and an edition will shortly be published.

It will be seen that the general maps are still far from completion, but satisfactory progress is being made.

47. Of late years, many of the old standard sheets have fallen out of print and although these sheets will all eventually be replaced by the new surveys, it is necessary to maintain our stocks in the meantime. During the year, the deficiencies in stock as regards Bombay have been made good, and a large number of old sheets of other provinces, for which there were urgent demands have been reprinted. The Drawing office and Photo-Litho. office between them turn out from 20 to 30 reprints *per mensem*.

48. A very large number of maps, plans, and diagrams, have been reproduced for other departments in the Photo-Litho. office. When the originals submitted have been at all suitable, all such work has been accepted. The number of unsuitably drawn maps submitted for reproduction continues to decrease. The Photo-Litho. office could deal with a still larger number of small extra-departmental maps than it now receives.

49. The Superintendent, Map Publication, is frequently asked to prepare special maps which involve re-drawing, and it has been found necessary to refuse a large percentage of such applications; the number accepted is, however, not much less than in former years. Among many such maps which have been prepared or corrected in the Drawing office during the year are Postal maps of Provinces, Gazetteer maps, Educational maps, special maps of Native States, Railway maps, and the Railway and Canal map.

50. *Drawing Office.*—The statement below shows generally the outturn of the office during the year. The office has benefited by the formation of a special compilation section under an experienced Provincial officer, which deals with the more important work, namely, the compilation of the new 32-mile map of India and of the preliminary edition of the  $\frac{1}{\text{million}}$  maps.

*Statement.*

Class of map.	Scale.	Number of sheets in hand during 1907-08.	Number published.
General maps of India . . . . .	1" = 32 miles to 1" = 256 "	56	16
India and adjacent countries . . . . .	$\frac{1}{\text{million}}$	34	7
Provincial maps . . . . .	Various	21	13
District maps . . . . .	$\frac{1}{4}$ ", $\frac{1}{2}$ ", and 1" = 1 mile.	24	12
Standard sheets . . . . .	Various	565	379

Class of map.	Scale.	Number of sheets in hand during 1907-08.	Number published.
Atlas sheets . . . . .	$\frac{1}{4}$ " = 1 mile	10	10
Administration Report maps .	Various	7	7
Plans of Cities and Cantons.	Various	1	...
Triangulation and Traverse charts.	Various	136	93
Index maps . . . . .	Various	26	15
Miscellaneous maps . . . . .	Various	50	21
Maps for other departments .	Various	196	59

51. *Engraving Office.*—The chief work of the office has consisted in the engraving of the new 32-mile map, the completion of those  $\frac{1}{\text{million}}$  maps on which some progress had been made and in which the material used was considered sufficiently good, the completion of the plates of 16-mile maps of Madras and Bengal, the correction of the plates of certain general maps, and the supply of transfers from copper plates to the Photo-Litho. office for the preparation of extra-departmental maps.

The outturn of the copper plate printing section is—59,153 prints.

52. *Photo-Litho. Office.*—The outturn of the last three years is shown in the statement below:—

Year.	Number of pulls of Maps and Plans.
1905-06 . . . . .	1,284,968
1906-07 . . . . .	1,123,001
1907-08 . . . . .	1,563,453

The number of maps printed during the year is as follows:—

Departmental Maps . . . . .	891
Extra-Departmental Maps . . . . .	1,175
Cadastral Plans . . . . .	792
TOTAL . . . . .	<u>2,858</u>

The arrears, if such a term can be applied to the cushion of work which it is necessary to keep in hand, in order that the various sections may work smoothly and methodically, are now small, and every effort is being made to reduce them to the minimum that will allow of efficient and economical working. The improvement during the year has been most marked in the negative touching section, one in which the work is difficult and requires highly skilled workmen, and which Major Hedley in his report last year termed the weak spot of the office. As mentioned above, though the office has not succeeded in publishing the whole number of new standards received up to date, it is believed that it is now in a position to deal with the yearly outturn of the field parties, and the quality of the work is steadily improving. The new scheme of grading and

paying the establishment was introduced in June and it is too early yet to report on the result.

53. During the year, new plant has been received for the preparation of half-tone blocks, and the office now deals rapidly and efficiently with work of this class. The increase in the demand for half-tone illustrations on the part of officials has been marked since the new plant has been brought into use.

54. The cost of the office during the year has been ₹1,88,666, including ₹21,612 supervision charges, ₹1,45,817 establishment charges, and ₹21,537 contingent charges, but excluding the cost of stores and plant obtained from England. The corresponding expenditure last year was ₹1,77,529. A sum of ₹49,828 has been recovered in cash or book debit payments for minor extra-departmental work, and the value of uncharged-for work done for the Government of India and for the department at office rates was ₹1,30,178.

55. *Map Record and Issue Office.*—The face value of the maps received for stock during the year amounts to ₹3,38,367; of this, ₹37,127 is the face value of maps printed at Dehra and in the Engraving office, the remainder is the face value of departmental maps printed in the Photo-Litho. office.

56. The number of original maps, volumes of computations, etc., received into store from other departments or branches of the office, was 7,708, and 4,925 were issued.

57. The number of maps issued during the year was 130,960, having an aggregate value of ₹1,28,910. Of this sum, the net total charges for maps supplied to Government officials on book debit amounted to ₹54,183, those to the India Office to ₹7,923, and to the agents, ₹4,773. The sum of ₹19,576 was realised in cash from sales to private individuals, and the value of the maps issued for departmental use was ₹42,455.

58. The transfer of the forest maps was steadily proceeded with during the year. The whole of the Madras forest sheets together with 49 sheets of the Punjab, making a total number of 41,942 copies, were despatched to the Officer in charge, Forest Map office, Dehra Dún, for storage.

59. The work of overhauling and re-registering the original maps and volumes has also been in hand. All the current fair sheets and plane-table sections have been re-registered and there now remains only the work of examining the coloured originals, corrected prints, etc., and of cataloguing and marking the triangulation angle books and field records. It is hoped to finish this work during next year.

60. The revision of the map catalogues was also taken in hand and a new general catalogue to replace the various catalogues previously in use, is in course of publication.

61. The new method of numbering the sheets of standard maps has necessitated the re-arrangement of storage accommodation for the printed maps. This work will eventually involve arrangements for some 7,000 maps, most of which will be published in editions of 500 copies and must proceed gradually, as the old maps are superseded by the maps of the new surveys.

62. *Mathematical Instrument Office.*—During the year under report, *i.e.*, from 1st April 1907 to 31st March 1908, there has been a decrease in the demands made on this office. For each of the last three years, *i.e.*, 1905-06, 1906-07, 1907-08, the value of instruments, etc., issued to public offices was ₹4,22,179, ₹3,82,345 and ₹3,66,334, the value of repairs to instruments received for repairs and returned in a serviceable condition was ₹41,818, ₹42,181, and ₹42,542, and the value of instruments received from Government officers when "no longer required" was ₹76,096, ₹38,128, and ₹70,486.

The book value of the stock of instruments, etc., in the serviceable store at the end of each of the last three years was ₹4,53,251, ₹5,35,535, and ₹7,62,415. The larger stock in hand at end of the year under report compared with the previous year is partly due to the falling off of issues and partly to the fact that most of the instruments in store are new, the old ones having been repaired and re-issued, and partly to the fact of the stock having run dangerously low in recent years.

The book value of the stock of instruments, etc., in the repairable store at the end of each of the last three years was ₹1,19,007, ₹1,12,389, and ₹98,578. As usual, no instruments for which there was demand were kept in the

repairable store for any length of time; they were sent to the workshop for repairs and transferred to the serviceable store for issue, as soon as possible.

Two "Profit and Loss" statements have been prepared for the year under report—one showing the results of the operations of the stores branch and the other of the workshop. The stores statement shows a nominal loss of ₹9,982 and the workshop statement a loss of ₹5,586. The value of the serviceable stock on hand on 31st March 1908 having been very large, the amount taken in the stores statement on account of  $3\frac{1}{2}$  per cent. on this value was correspondingly large, and this accounts for the loss. The loss in the workshop statement is only apparent; it is more than covered by the amount (₹9,206) paid during the year on account of grain compensation allowance to the men of the establishment.

The number of men and boys employed in the workshop at the end of each of the last three years was 421, 451, and 477.

The value of work done in the workshop during each of the last three years was ₹2,01,083, ₹2,16,730, and ₹2,54,916.

The value of the instruments, etc., manufactured in the workshop for the serviceable store during each of the last three years was ₹82,638, ₹87,588, and ₹1,11,901, and the value of instruments, etc., purchased locally for the serviceable store during each of the last three years was ₹17,810, ₹4,189, and ₹1,943.

The value of instruments, material, etc., obtained from England through the Director General of Stores, during each of the last three years was ₹2,87,740, ₹4,36,240, and ₹4,94,985.

During the year under report, the Secretary of State for India sanctioned the scheme appointing a Manager and two Assistant Managers to carry on the superintendence of the stores and workshops. The Manager was permitted to take privilege leave for 3 months combined with 2 months' deputation, in order that he might visit the principal manufacturers in England, from whom this office obtains its supplies, to enable him to study the latest developments. During Mr. Ferrier's absence, Mr. Woodhouse acted as Manager. Mr. Connell joined the office during the year as junior Assistant Manager.

The stock-taking of the serviceable and repairable stores was completed and statements made out showing excesses, shortages, and discrepancies. In future stock-taking will be carried out annually.

Great benefit was derived in one of the large rooms of the workshop from the introduction of large propeller fans for ventilation. In the worst weather the atmosphere was kept sweet and clean, enabling the men to work with far more energy than in previous years.

Great progress has been made in the quality of work turned out. During the year, the manufacture of a few reversible levels was started, but the work had to be put on one side when the usual rush of repair work came in. Several 5" Everest theodolites were also put in hand, one of which was finished; it is no doubt a success and proves that great progress has been made in the workshop during recent years.

A large number of self-centring theodolite stands were manufactured during the present year, and have been attached to old theodolites which were sent in from parties for that purpose.

The electric installation, which was completed during the previous year, has proved efficient.

A price list with reference numbers was published on the 1st April 1907. Another more complete one will be issued during the year 1909.

## BRANCH OFFICES.

### TRIGONOMETRICAL OFFICE.

63. Mr. J. Eccles, M.A., officiated as Superintendent, Trigonometrical Surveys, up to 11th November 1907, on which date he was relieved by Colonel S. G. Burrard, R.E., F.R.S.; Mr. Eccles again assumed superintendence from 27th February 1908 to 26th September in addition to his charge of the technical offices, while Colonel Burrard officiated as Surveyor General.

Mr. T. A. Pope in charge of the Forest Map office continued the superintendence of the Photographic office throughout the year.

Lieutenant C. M. Thompson, I.A., C. G. Lewis, R.E., J. H. Field, R.E., and A. H. Gwyn, I.A., who were appointed to the Survey of India as Assistant Superintendents during the year, were instructed in topographical and trigonometrical work. Of the five Sub-Assistant Superintendents appointed, one resigned and the others were put through a course of training during the year.

64. *Computing Section*.—The following computations were carried out in the Computing office for incorporation in the Synoptical Volume of the North-East Longitudinal series:—

- (a) Computations of latitudes, longitudes and azimuths of—
  - (1) Ayartoli tea-plantation triangulation.
  - (2) Mr. Barckley's and Colonel Tanner's points.
- (b) Computations of the heights of—
  - (1) Mussooree, Simla, Garhwál, and Siwálik triangulation.
  - (2) Gandak river Survey.
  - (3) Someshwar triangulation.
  - (4) Ragshi-Gwanagarh triangulation.
- (c) The azimuth list of the principal and secondary stations has been completed and that of the intersected points is nearing completion. The descriptions of the stations in the co-ordinate list have been compared against the angle books.

Rai Sahib Ram Singh's triangulation in northern Tibet and Chinese Turkestan, 1906, and Rai Sahib Natha Singh's observations in Nepal for heights were reduced.

Mr. Morton's work in Lushai and Captain Gibbon's work in Persia are in hand.

Miscellaneous computations for Colonel Burrard were done, and co-ordinates of a few points were altered from their former to a new origin.

The work of compiling the levelling volume has been continued, and all the bench-marks of India are being re-numbered by degree sheets.

Compilations of data for trans-frontier degree charts are progressing. These include a new numbering of the Himalayan and Trans-Himalayan peaks, as the existing system of nomenclature for peaks has for a long time been considered faulty and confusing. Colonel Montgomerie's system of giving a letter to each snowy range with serial numbers for peaks in that range is intelligible and scientific, but it has been found difficult in practice to say where one range ends, and another begins. So that even this system has not been free from confusion. But much greater confusion has been caused by the later procedure of giving the initial of an observer's name to the peaks he observes, *e.g.*, we may have in close proximity R23 representing the 23rd peak in Ryder's Tibetan triangulation and R101 representing the 101st peak in Robert's Darjeeling triangulation; advantage has therefore been taken of the numbering of the degree sheets to introduce a systematic numbering of the peaks.

Each degree sheet will have a corresponding chart; thus to "sheet 70 J" will correspond "chart 70 J". In each chart the peaks will be numbered serially thus  $\frac{\text{Pk. 1}}{70 \text{ J}}$ ,  $\frac{\text{Pk. 2}}{70 \text{ J}}$ , etc., and this enumeration is not to be modified when fresh peaks are observed. When a second edition of a chart is brought out with new peaks upon it, the numbering of the latter will be in continuation of the numbering in the first edition, that is, the original numbering of a peak will never be changed. When a peak has a well known name it will be put in brackets after the number, thus  $\frac{\text{Pk. 39}}{53 \text{ I}}$  (Leo Pargial.)

The sheet number at once roughly locates the position of the peak and in the corresponding chart will be found the latitude, longitude, and the height, if observed. It is hoped that this method will be free from the difficulties which beset the present system, and the co-operation of geographers and the public in general is invited.

The three first parts of the *Sketch of the Geography and Geology of the Himalaya Mountains and Tibet*, by Colonel Burrard, R.E., F.R.S., and Mr. H. H. Hayden, B.A., F.G.S., were printed and distributed. The publication of this book takes place at the close of the first century of geographical exploration in the Himalaya.

The printing of the Synoptical volume of the North-East Longitudinal series, and of Major Lenox-Conyngham's paper on *Pendulum Observations* and of the pamphlet on *Routes in the Western Himalayas, Kashmir, Punjab and Northern India* is fairly advanced.

During the year 40 officers were supplied with data from the records in this office.

The meteorological observations continued as usual.

The necessary professional aid in connection with the protection of stations was rendered to the office of the Superintendent, Trigonometrical Surveys.

Six hundred and forty-seven stations were repaired by the district officers at a cost of R4,570.

Out of 333 districts from which the reports are annually due, 6 failed to make returns.

The services of one computer were lent to the office of the Chief of the Staff at Simla for about 2 months.

65. *Drawing Section.*—In the Drawing office the following maps were either completely or partly drawn and sent to press:—

- (1) One Sind Level sheet.
- (2) Six Punjab Level sheets.
- (3) One triangulation chart.
- (4) Two maps for the Foreign Office.
- (5) Eight diagrams and maps for Major Lenox-Conyngham's paper on Pendulum observations (Professional paper No. 10).
- (6) Map of the Civil Station of Ráwalpindi showing the city, old and new cantonments.
- (7) Map of the Civil Station of Murree.
- (8) Plan of the Civil Station of Campbellpur.
- (9) Nine miscellaneous maps.

The following maps are nearly ready:—

- (1) One Punjab Level sheet.
- (2) Revision of the map of the Dehra Dún Municipality and Cantonment.
- (3) One 2-inch sheet No. 308 S. W. of the Punjab.

The following are still in hand:—

- (1) Sheets Nos. 52, 61, 62, and 77 of the Map of India and adjacent countries.
- (2) Forty-three triangulation charts of the North-East Longitudinal series.

The following are also in hand:—

- (1) New Index Chart to the Great Trigonometrical Survey of India.
- (2) Seven 'special' Charts connected with the triangulation charts of the North-East Longitudinal series.
- (3) Map of Northern Tibet and Western China, scale 4 miles = 1 inch in 13 sheets. Outline finished, hills remaining.
- (4) Sixty-four charts of the triangulation of the North-Western Himalaya series.
- (5) Sheets No. 82 of the Map of India and adjacent countries.
- (6) Sheet No. 70 (2nd edition), of the Map of India and adjacent countries.
- (7) Five Punjab Level sheets. Headings, footnotes (including symbols) and area statements, were completed on 163 maps which were also sent to press.

The proofs of all maps have been examined and corrections carried out as usual, and careful scrutiny given to all the printed copies before issue.

Four thousand one hundred and twenty-six maps were coloured.

For the future, the work of the Drawing office will, as hitherto, be confined to the drawing of the maps of India and adjacent countries, the level sheets, triangulation charts of the North-Eastern Longitudinal series for the Synoptical volume, triangulation charts, special maps (such as Dr. Stein's, Ram Singh's and Lal Singh's maps of Turkestan and Western China), geological maps, maps for professional papers, maps for the Chief of the Staff, miscellaneous maps and to the colouring of about four thousand maps during the year.

66. *Photo-zinco Section*.—One thousand four hundred and sixty-seven maps and diagrams were photographed against 1,177 during 1906-07 and 258,510 pulls taken against 223,186 in the same period.

The new lithographic machine press has been in full work throughout the year and was of the greatest service to the office. The principal work printed in it consisted of the new cantonment maps, many of them in two colours, of which 109,423 copies were printed off. A considerable number of Forest maps were also printed in it, and the saving of time effected thereby has been of much importance to the Forest department. It has been found necessary to retain in use most of the hand presses, not only for proving purposes, but also to enable the office to furnish the parties of the Northern Circle with reproductions of their fair maps and plane-table sections. The work has kept the four presses fully occupied throughout the year. It is expected that the new 2-inch standard forest maps will be printed at Dehra, as the forest details are to be inserted on them in the Forest Map office there and they will be stored in that office. If this is arranged, the photo-zinco section will shortly have as much work as it can undertake, and the question of increasing its printing capacity may have to be considered.

Instruction in map reproducing processes was given, as in previous years, to all the newly joined Imperial and Provincial officers during their course of instruction in the Survey School. As these officers are sent at once to field parties on the conclusion of their course of instruction, they would probably have no opportunities of acquiring this most useful knowledge later on.

The services of Sergeant Lucas, R.E., of the Photo-Litho. office of the Ordnance Survey engaged to assist Major Hedley, R.E., in the work of re-organisation of the reproducing offices were placed at the disposal of this office from 28th April to 25th September.

67. Photographs of the sun were taken on 309 days.

#### FOREST MAP OFFICE.

68. This office remained under the superintendence of Mr. T. A. Pope, Superintendent, 2nd grade, throughout the year.

During the year under report, 11,177 maps were issued to forest and other officials, and to the public. Last year, the number issued amounted to 11,100. Of the above number, 4,017 were coloured maps.

The principal mapping executed during the year comprised the usual 4-inch standard sheets of the Forest surveys, of which 78 were published and 25 were in the press at the close of the year, while 126 were in various stages of progress. These latter include 69 sheets of the second edition of the Kumaun-Garhwál series. Of the working-plan maps and other special maps prepared for the use of the Forest department, 22 were published, 9 were in the press, and 37 were being drawn at the close of the year. As there are no maps of the Madras Presidency showing the distribution of forests, a series of special district maps, on the 4-mile scale was commenced at the request of the Board of Revenue, Madras. Those of five districts were in hand at the close of the year, *viz.*, South Canara, Coimbatore, Tinnevely, Madura, and Cuddapah.

The large stock of computation volumes, charts and other records, now stored in the office has been arranged and stored in new racks. They are now being indexed but this cannot be completed until the remaining records are received from the Calcutta office. All the field sections surveyed by the Forest Survey branch have been bound up, numbered, and stored in tin tubes. Indexes of these are also in course of preparation.

The number of maps received for storage from Calcutta office was 56,020. A large number have yet to come and the erection of new racks to receive

them has gone on steadily throughout the year. When the office was built, it was not known that this large stock of maps would eventually be kept in it and sufficient accommodation was not provided for them. It is now evident that further space will have to be arranged for, in the near future.

The amount realised by the sale of maps, and for work done for the Forest department, amounted to ₹2,018, as against ₹1,750 last year. Of this amount ₹1,100 was adjusted by book debit.

### LOCAL DRAWING OFFICES.

69. *Mussooree Drawing Office.*—The Mussooree Drawing office was as last year, under the administrative charge of the Superintendent, Northern Circle.

#### Personnel.

##### Provincial Officers :

Messrs. R. R. Dickinson, in charge, and W. J. Cornelius (Retired Provincial Officers).

##### Subordinate Establishment :

3 permanent and 12 temporary Draftsmen and 1 Writer.

Four of the  $\frac{1}{\text{million}}$  sheets of India and adjacent countries, *viz.*, Nos. 17, 18, 29, and 33 were submitted to the Superintendent, Northern Circle, and forwarded to Calcutta for publication. Sheets 24 and 30 will be forwarded shortly, while Nos. 35 and 38 are in hand. The drawing of thirteen degree sheets was in hand, and the compilation of thirty-two sheets was either completed or in hand. The histories of forty-degree sheets were also commenced this year and are in progress. Eleven sheets of Dr. Sven Hedin's routes in Persia on a scale of 1" = 4 miles were also submitted for publication. Sheets I and II of the map of Turkestan, on a scale of 1 inch = 32 miles, were completed and sent for publication, and sheets III and IV are in hand. The total cost of the office for the year under report was ₹18,210.

70. *Burma Drawing Office.*—Mr. T. Shaw remained in charge throughout the season. He retired on superannuation pension on the 15th November 1907, but was re-employed for one year, which term has since been extended for another year. The office was employed in the same manner as in former seasons but the bulk of the work done was in connection with arrears of standard mapping of the various field parties which was very large. The fair drawing of both outline and hills of 16 sheets was done and of hills only 19 sheets, while the outline only of 6 sheets was fair drawn. Fifty-four standard maps received complete from the field parties were examined and 47 submitted for publication and blue prints of 28 outline sheets prepared by the Vandyke process, were supplied to the parties on drawing paper for the drawing of the hill sheets.

The outline of one degree sheet, 84 O was drawn and additions made to the hills of sheet 93 L. The total cost of the Burma Drawing office for the season was ₹14,814. The services of 10 draftsmen were lent to the field parties during the recess.

71. *United Provinces Drawing Office.*—This office was transferred in December 1907, from under the administrative control of the Deputy Surveyor General to that of the Superintendent, Northern Circle. Mr. J. M. Kennedy, Extra Assistant Superintendent, 2nd grade, remained in charge throughout the year, with Mr. F. W. Marten, Sub-Assistant Superintendent, 1st grade, as assistant. The subordinate establishment consisted of 13 draftsmen, 1 typer, and 2 computers.

Eighteen standard sheets or parts of sheets, *viz.*, 54  $\frac{1}{8}$ ,  $\frac{1}{9}$ ,  $\frac{1}{13}$ ,  $\frac{1}{15}$ ,  $\frac{1}{5}$ ,  $\frac{1}{13}$ ,  $\frac{1}{3}$ ,  $\frac{1}{4}$ ,  $\frac{1}{7}$ ,  $\frac{1}{8}$ ,  $\frac{1}{1}$ ,  $\frac{1}{5}$ , 63  $\frac{1}{12}$ ,  $\frac{1}{16}$ ,  $\frac{1}{1}$ ,  $\frac{1}{2}$ ,  $\frac{1}{6}$ ,  $\frac{1}{3}$ ,  $\frac{1}{7}$ ,  $\frac{1}{4}$ ,  $\frac{1}{8}$ ,  $\frac{1}{10}$ ,  $\frac{1}{14}$ ,  $\frac{1}{12}$ ,  $\frac{1}{12}$  were drawn and forwarded to Calcutta for publication. Six complete standard sheets are still in hand. Twenty-six traverse charts and two district maps (Bahraich and Gonda) were also submitted for publication. Eight traverse charts and two district maps are still in hand. The total cost of this office for the season was ₹19,010.

72. *Bengal Drawing Office (Imperial Sections.) (a) Standard Mapping.*—The following 20 standard maps on the 2 inches = 1 mile



scale, in 50 sections have been submitted for publication during the year:—72  $\frac{N}{3, 4, 7, 8}$ ,  $\frac{O}{1, 2, 3}$ , 79  $\frac{C}{2, 10, 13, 14}$ ,  $\frac{G}{1, 2, 6}$ ,  $\frac{I}{4}$  of two sections each and 79  $\frac{M}{1 \& 5, 2 \& 6, 3 \& 7, 4 \& 8, 12 \& 16}$  of four sections each. The drawing of sheets 72  $\frac{K}{11 \& 15}$ ,  $\frac{N}{11}$ ,  $\frac{O}{5, 6, 7}$  and 79  $\frac{J}{2, 3}$  is well advanced.

(b) *Traverse charts*.—This section was increased during the year and placed under a separate supervisor. Thirty-six charts of Orissa and 43 of North Bihár have been sent for publication during the year and 22 charts of North Bihár are nearing completion. The charts of Chota Nagpur will be commenced early next year.

### NEW STANDARD MAPS.

73. The following statement shows that the number of sheets surveyed is considerably more than the number fair drawn or published. This is mainly due to the field season being too prolonged and to the inexperience of the draftsmen employed on the fair mapping, but it is also due to the methods by which the new maps are prepared. In future it is hoped that there will be a great improvement in these respects. The methods are sound, but they take time to get into working order and the men have had little or no previous experience in them. The small number of maps published during the year is not due to any faulty re-organisation of the publication offices, but is due to these maps not yet having been submitted to the publication office or to their being sent in too late for publication before the end of the survey year, 30th September. It must be borne in mind that the recess season generally lasts till about the end of October and it is during this month or a little later that the sheets of any one year are submitted for publication. They consequently come into the following year's report.

At the same time it is thought that this return will be of interest on account of the information in a condensed form, which it gives to Local Governments.

Statement showing new 1-inch Standard Maps, surveyed, drawn, and published during 1907-08.

Local.	NEW 1-INCH STANDARD SHEETS SUBMITTED OR COMPILED.		NEW 1-INCH STANDARD SHEETS DRAWN.		NEW 1-INCH STANDARD SHEETS PUBLISHED.		REMARKS.
	Designation.	Total.	Designation.	Total.	Designation.	Total.	
Central and United Provinces, Berar, and Central India States.	S4 $\frac{L}{7, 8, 12, 16}$ 5 $\frac{P}{4, 7, 8, 12, 16}$	17	J 8	21	L $\frac{3, 4}{54}$	24	
.....	S5 $\frac{H}{4, 7, 8, 12, 16}$ 55 $\frac{I}{5, 6}$ 55 $\frac{M}{13}$	...	S4 $\frac{I}{7, 8, 12, 16}$	...	H	...	
.....	.....	...	S4 $\frac{N}{3, 4, 7, 8}$ 54 $\frac{O}{1, 5}$	...	J $\frac{K}{1, 12}$ 55 $\frac{K}{4, 8}$	...	
.....	.....	...	S5 $\frac{H}{4, 7, 8, 12, 16}$	...	L $\frac{G}{1, 5}$ 63 $\frac{G}{11}$	...	
.....	.....	...	S5 $\frac{J}{5, 6}$	...	K $\frac{9, 13, 14}{63}$	...	
.....	.....	...	63 $\frac{G}{1}$ 63 $\frac{I}{12}$	...	N $\frac{4, 8, 12}{63}$	...	
.....	.....	...	63 $\frac{J}{12}$	...	O $\frac{1, 2, 5, 9}{63}$	...	
Bombay Presidency	46 $\frac{O}{4, 8, 12, 16}$ 46 $\frac{K}{1, 2, 5, 6, 10, 14}$	10	46 $\frac{K}{10}$ 46 $\frac{O}{4, 8, 12, 16}$	5	K $\frac{3, 8}{46}$	2	
Madras	49 $\frac{M}{11, 13, 15, 16}$ 57 $\frac{H}{14}$ 58 $\frac{A}{1, 2, 3, 4, 5}$	10	49 $\frac{M}{11, 15, 16}$ 57 $\frac{H}{14}$	4	Nil	0	
Bengal	79 $\frac{C}{1, 2, 5, 6, 9, 10}$ 79 $\frac{G}{1, 2, 5, 6, 9, 10, 13}$	17	72 $\frac{N}{3, 4, 7, 8}$ 72 $\frac{O}{1, 2, 3}$	15	N $\frac{4}{72}$ O $\frac{72, 1, 2}{72}$	3	
.....	79 $\frac{F}{4, 8, 12, 16}$	...	79 $\frac{C}{2, 10, 13, 14}$	...	.....	...	
.....	.....	...	79 $\frac{G}{1, 2, 6}$ 79 $\frac{J}{4}$	...	.....	...	
Eastern Bengal and Assam.	78 $\frac{P}{1, 2, 3, 4, 5, 6, 7, 8, 11, 14}$	10	78 $\frac{P}{1, 2, 3, 4, 5, 6, 7, 8, 11, 14}$	10	Nil	0	
Burma	84 $\frac{K}{3, 4, 7, 8, 10, 11, 12, 15, 16}$	17	84 $\frac{K}{3, 7, 8, 10, 11, 12, 15, 16}$	16	L $\frac{3, 4, 5, 6, 7, 8, 9, 13}{84}$	27	
.....	84 $\frac{M}{2, 6, 10, 14}$ 93 $\frac{A}{1, 5}$ 93 $\frac{E}{4, 8}$	...	84 $\frac{M}{2, 6, 10, 14}$ 93 $\frac{A}{1, 5}$	...	N $\frac{84, 1, 8}{84}$	...	



## ESTABLISHMENT.

74. On completion of the period for which he was lent to the department by the Ordnance Survey of Great Britain, Major Hedley sailed for England on the 26th August 1908. During the time he was attached to the Survey of India, he displayed the greatest energy and interest in studying the map requirements of the country, in re-organising the map publication offices to suit these requirements and in adapting the *personnel* available in the department and capable of being recruited for it, to meet the changes which had been decided on in consequence of the recommendations of the Survey Committee of 1904-05. In this work he was loyally assisted by the Survey of India officers, who held charge of the various sections and also by the subordinates of the various offices. His proposals for the re-organisation of the offices as regards the pay and the duties of the staff were necessarily submitted towards the close of his stay in India, after he had acquired the necessary local knowledge, and though it has not been possible yet to give effect to all of them, it is hoped that with a few minor alterations they will soon be finally adopted.

That his work was eminently successful there can be no doubt, and the department owes a debt of gratitude to him for its thoroughness, and its business-like quality, and for the way in which he identified himself with the department generally, and sympathised with and allowed in his re-organisation for the difficulties under which work of this kind has to be carried out in India as compared with similar work in Europe. It is hoped that the benefits derived from his work will be permanent, and he carries with him the good wishes of the department on his return to England.

75. During the year under report the department has lost the services of two Imperial officers, *viz.*, by the retirement on account of ill health of Mr. B. G. Gilbert-Cooper and by the reversion to his regiment of Lieutenant R. S. M. Harrison, I.A.

The following officers have been appointed to the department :—

Mr. J. deG. Hunter as Mathematical Expert, Lieutenants J. A. Field, C. G. Lewis, A. A. Chase, R.E., and Lieutenants C. M. Thompson and A. H. Gwyn, I.A.

76. From the Provincial Service three officers have retired :—

Messrs T. Shaw, C. George, and G. A. Knight; two resigned :— Babu R. D. Sharma and Diwan G. L. Chopra; two died :—Messrs E. P. S. Hill and A. B. Smart, Junior. Six officers have been appointed to the Provincial Service as probationers.

## EXPENDITURE.

77. The total cost of the department for the Survey year ending 30th September 1908 is  $\text{R}33,12,702$  while that for the financial year ending 31st March 1908 is  $\text{R}33,42,728$  against an estimated cost for 1908-09 of  $\text{R}35,59,650$ .

78. The actual expenditure on topographical surveys for the survey year 1907-08 amounts to  $\text{R}16,04,831$  against  $\text{R}15,92,412$  for the previous year. The expenditure on topographical surveys compares very favourably with that of last year when it is compared with the areas surveyed, which were 35,968 square miles in 1907-08 as against 25,740 square miles in 1906-07. This is in a great measure due to the reduction in the scale of surveys of the work executed by several of the parties but is also due to the improvement in capacity of the surveyors themselves, which is largely owing to the increased number of Imperial officers employed with the parties and to the supervision in the field and in recess of the Circle Superintendents.

79. The cost of the trigonometrical parties has risen, from  $\text{R}2,89,939$  to  $\text{R}4,13,283$ , chiefly on account of the expansion of triangulation in Burma and Baluchistan; this, however, is a temporary and not a recurring increase.

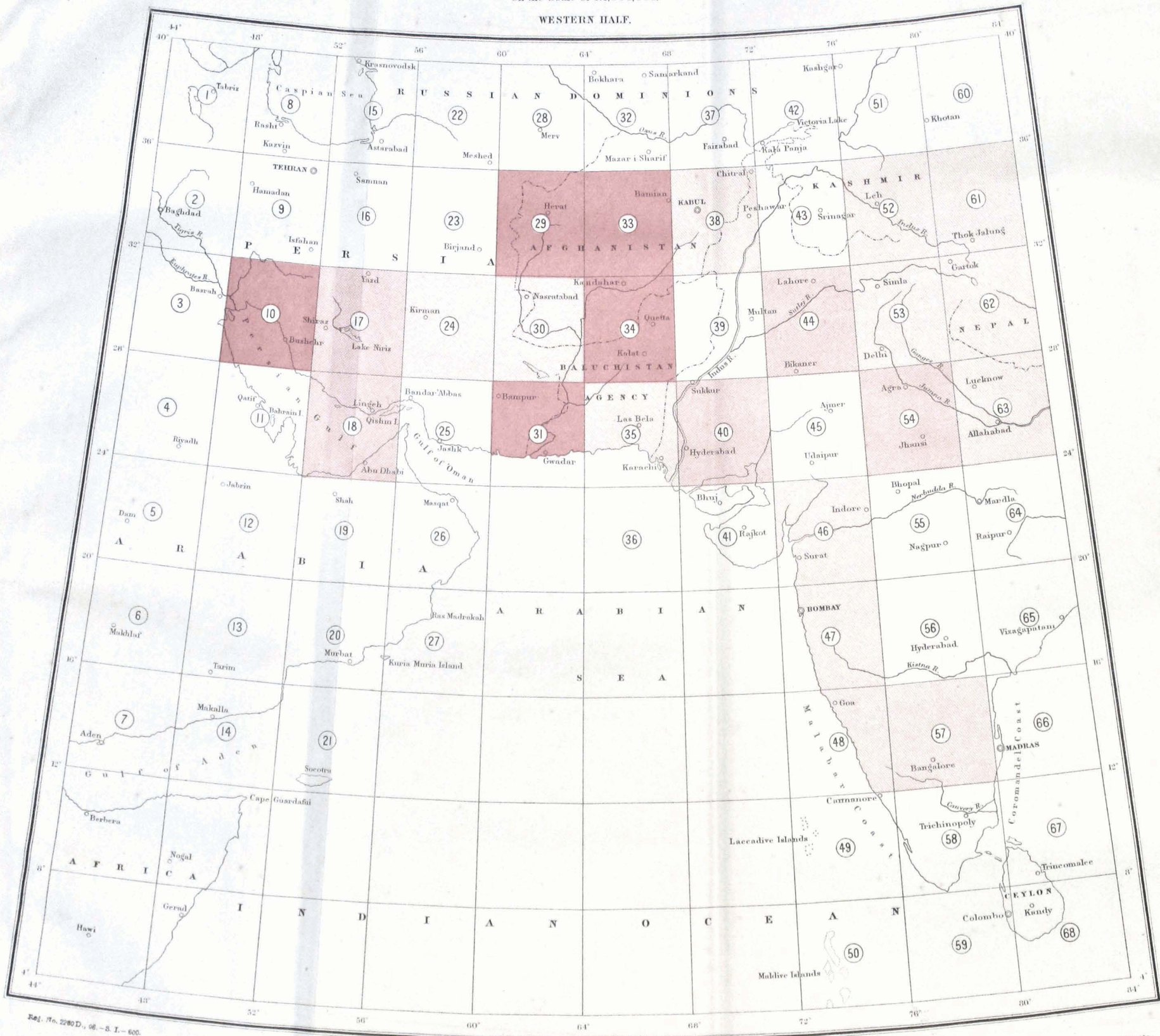
80. The cost of cantonment surveys for the year amounts to  $\text{R}52,906$  against  $\text{R}68,018$  last year, the decrease being due to the abolition of the third section on the completion of its work. The expenditure on the local drawing offices amounts to  $\text{R}53,412$  against  $\text{R}68,005$  for the previous year; the decrease is mainly due to the employment of retired Provincial officers on reduced pay in place of full pay officers.

81. The expenditure on cadastral operations in Burma amounts to  $\text{R}1,57,847$  against  $\text{R}1,74,290$  for the previous year. The only party employed on this work will be disbanded and there will be no expenditure under this head in future.

INDEX TO THE SHEETS OF THE  
INDIA AND ADJACENT COUNTRIES SERIES.

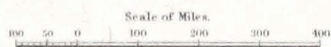
On the Scale of 1:1,000,000.

WESTERN HALF.



Reg. No. 2280 D., 66 - S. I. - 600.

Published under the direction of Colonel F. H. Longe, R. E., Surveyor-General of India,  
1909.



REFERENCES.

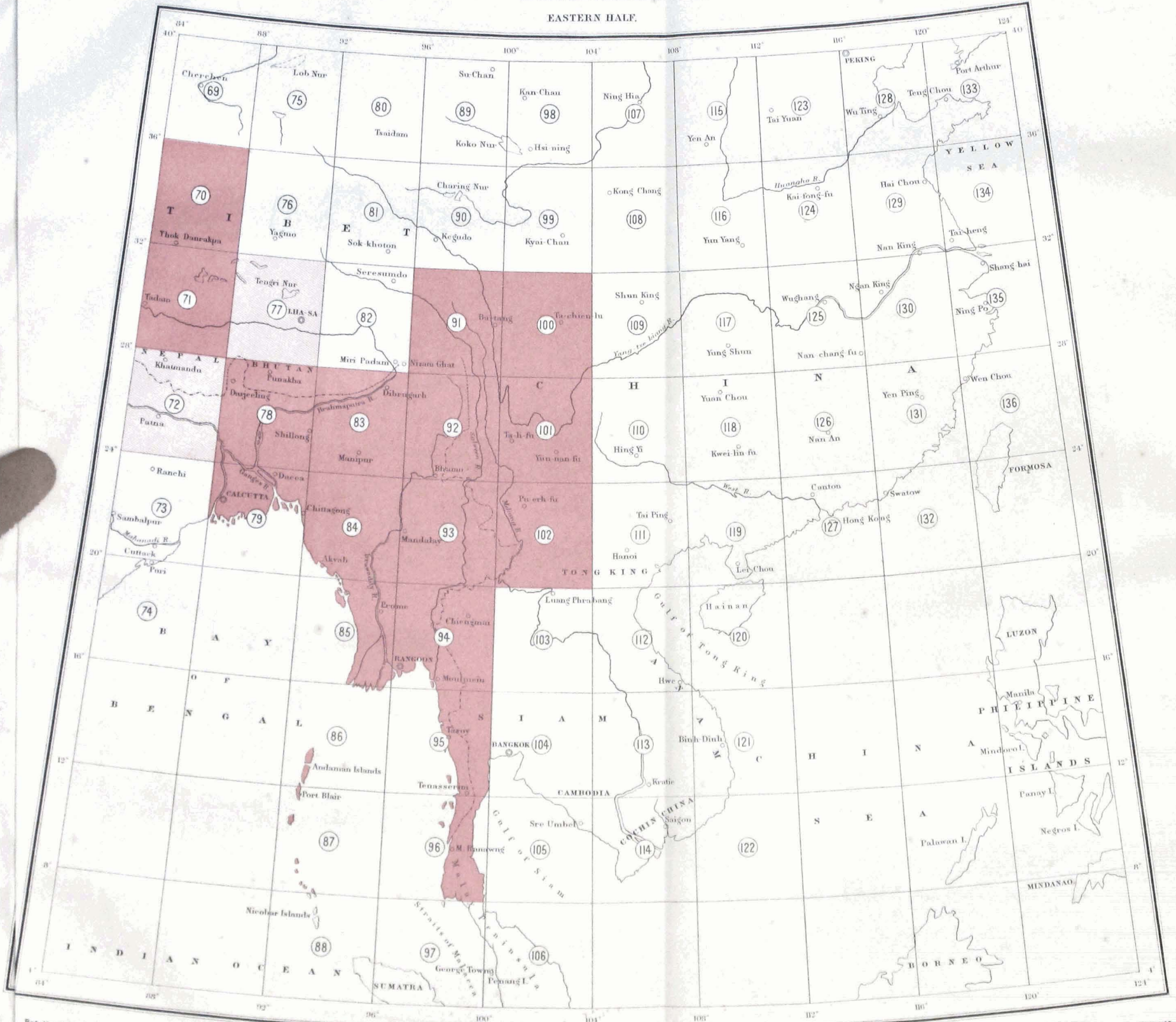
Sheets published	
" under publication	
" not published	

Litho. S. I. C., Calcutta.

INDEX TO THE SHEETS OF THE  
INDIA AND ADJACENT COUNTRIES SERIES.

On the Scale of 1:1,000,000.

EASTERN HALF.



Reg. No. 2580 D., 08.-F. I.-600.

Published under the direction of Colonel F. B. Lunge, R.E., Surveyor-General of India.  
1908

Scale of Miles.  
0 50 100 150 200 250 300

REFERENCES.

Sheets published .....  
" under publication .....

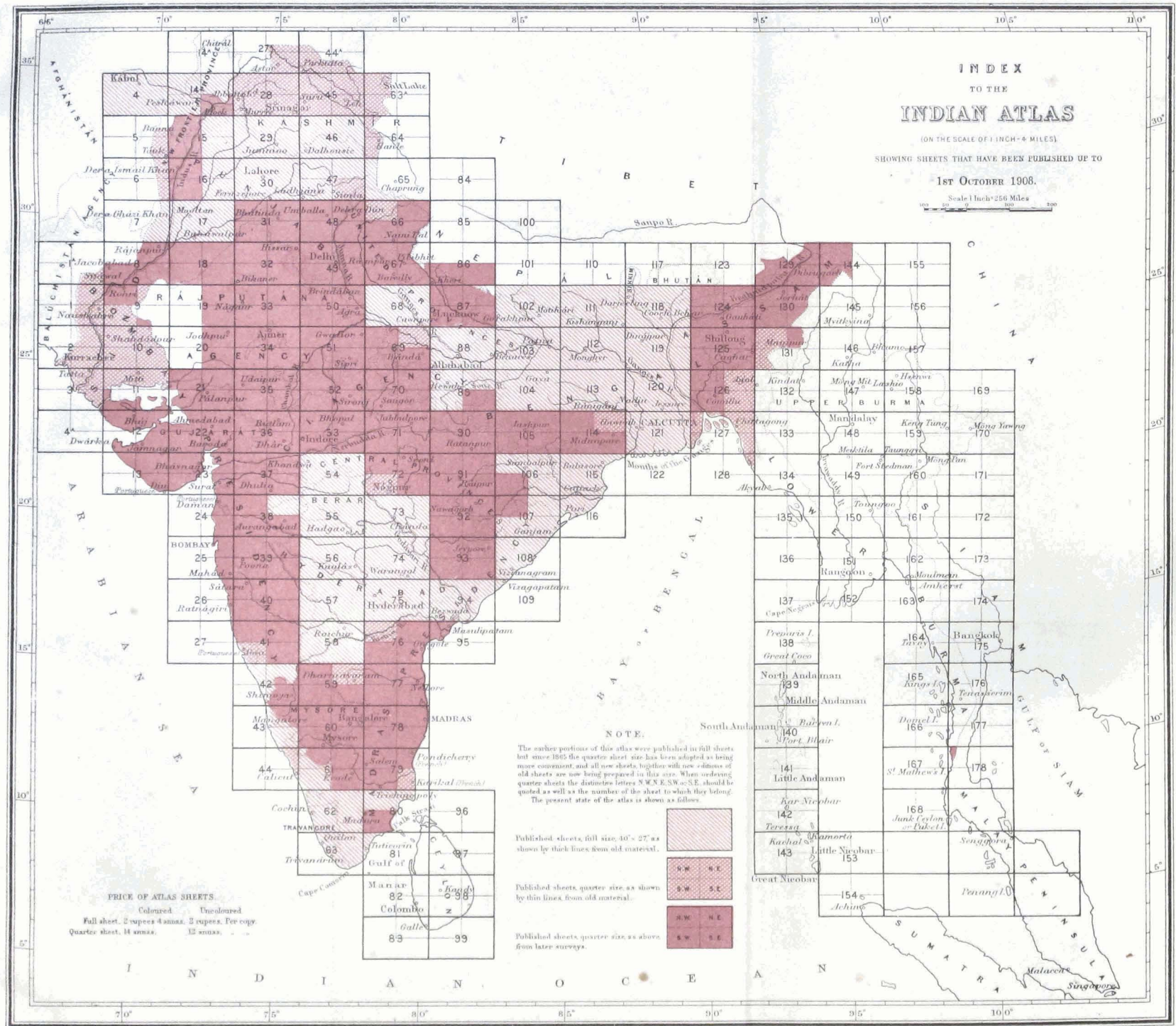
Litho. S. I. O. Calcutta

# INDEX TO THE INDIAN ATLAS

(ON THE SCALE OF 1 INCH = 4 MILES)  
SHOWING SHEETS THAT HAVE BEEN PUBLISHED UP TO

1st OCTOBER 1908.

Scale 1 Inch = 4 Miles  
0 40 80 120 160 200



NOTE.  
The earlier portions of this atlas were published in full sheets but since 1893 the quarter sheet size has been adopted as being more convenient and all new sheets together with new editions of old sheets are now being prepared in this size. When ordering quarter sheets the distinctive letters N.W.E. S.W. or S.E. should be quoted as well as the number of the sheet to which they belong. The present state of the atlas is shown as follows.

- Published sheets, full size, 20" x 27" as shown by thick lines, from old material.
- Published sheets, quarter size, as shown by thin lines, from old material.
- Published sheets, quarter size, as shown by thin lines, from later surveys.

PRICE OF ATLAS SHEETS.  
Coloured. Uncoloured.  
Full sheet, 2 rupees 4 annas. 2 rupees. Per copy.  
Quarter sheet, 14 annas. 12 annas.

**Erratum.**

*General Report on the Operations of the Survey of India  
Administered under the Government of India  
During 1907-08.*

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On page 24, part II, line 10, for the word "latter" read "former".



INDEX No. 1

Showing progress of publication  
up to 30th September 1908.

Key to Degree Sheets. Key to Standard Sheets.

A	E	I	M
B	F	J	N
C	G	K	O
D	H	L	P

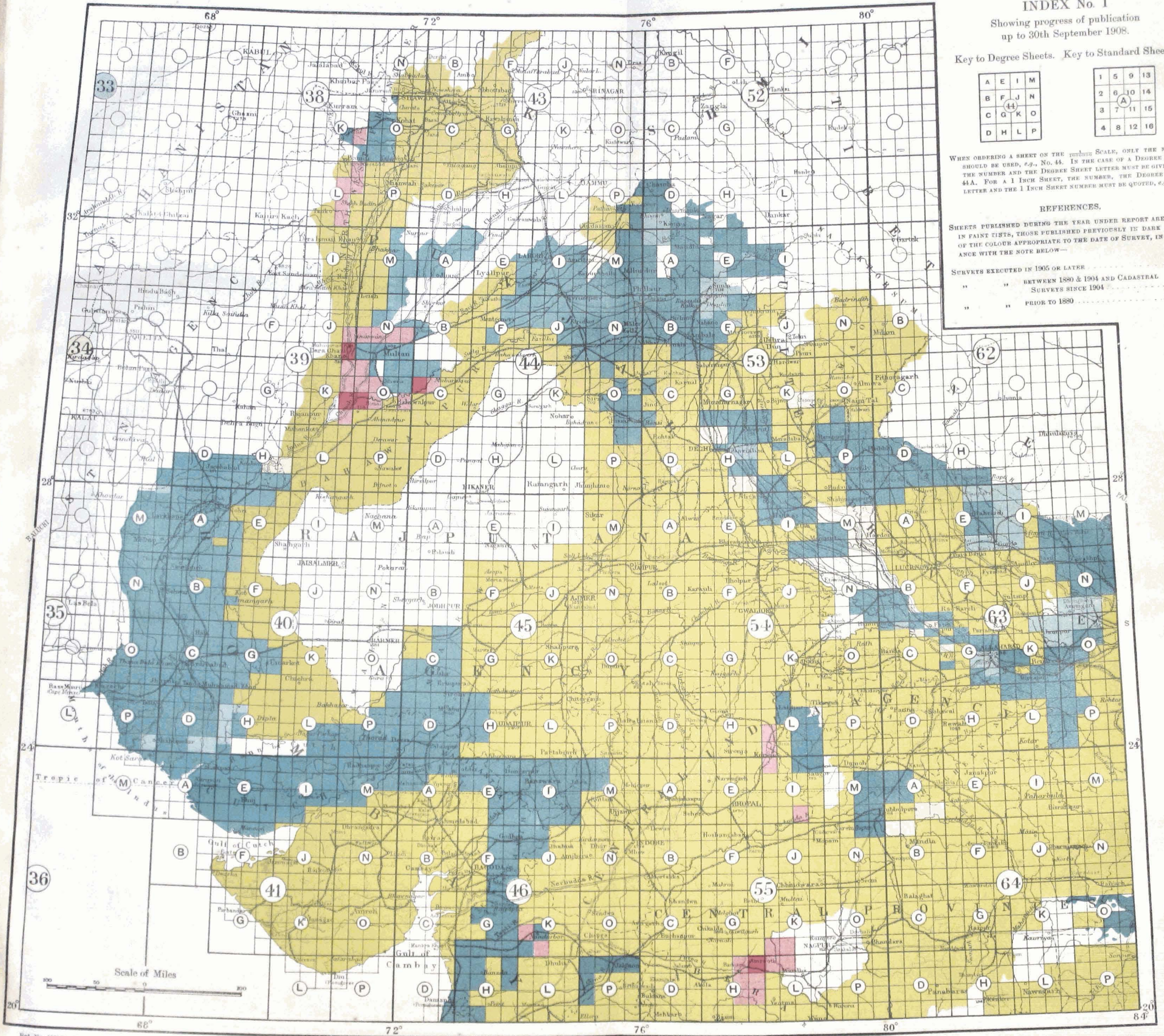
1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

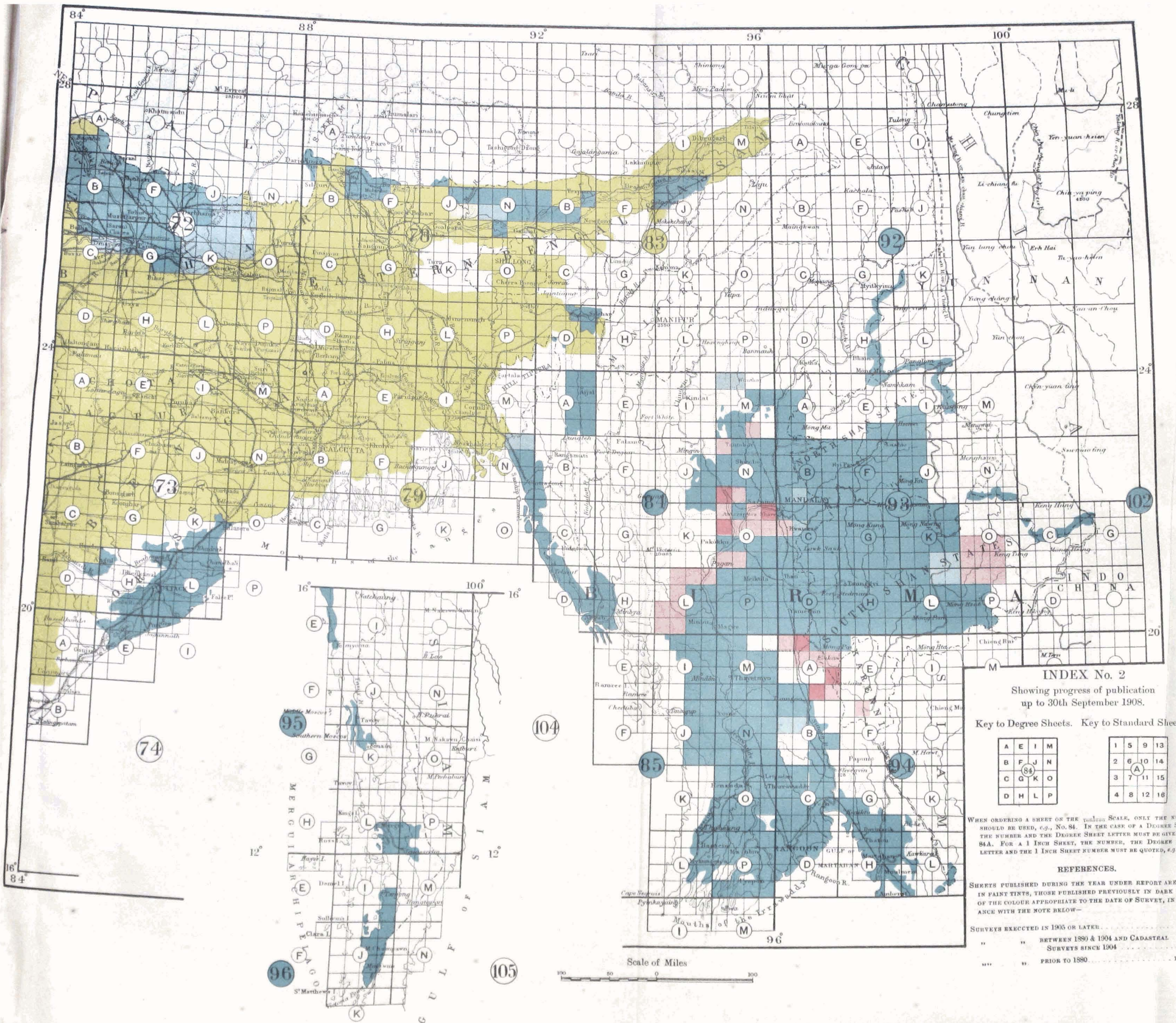
WHEN ORDERING A SHEET OF THE 1:50,000 SCALE, ONLY THE NUMBER SHOULD BE USED, e.g., No. 44. IN THE CASE OF A DEGREE SHEET, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN, e.g., 44A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED, e.g., 44 1/2.

REFERENCES.

SHEETS PUBLISHED DURING THE YEAR UNDER REPORT ARE SHOWN IN FAINT TINTS, THOSE PUBLISHED PREVIOUSLY IN DARK WASHES OF THE COLOUR APPROPRIATE TO THE DATE OF SURVEY, IN ACCORDANCE WITH THE NOTE BELOW—

- SURVEYS EXECUTED IN 1905 OR LATER . . . . . RED.
- " " BETWEEN 1880 & 1904 AND CADASTRAL SURVEYS SINCE 1904 . . . . . BLUE.
- " " PRIOR TO 1880 . . . . . YELLOW.





**INDEX No. 2**

Showing progress of publication  
up to 30th September 1908.

Key to Degree Sheets. Key to Standard Sheets

A	E	I	M
B	F	J	N
C	G	K	O
D	H	L	P

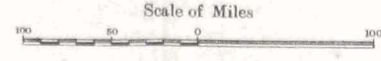
1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

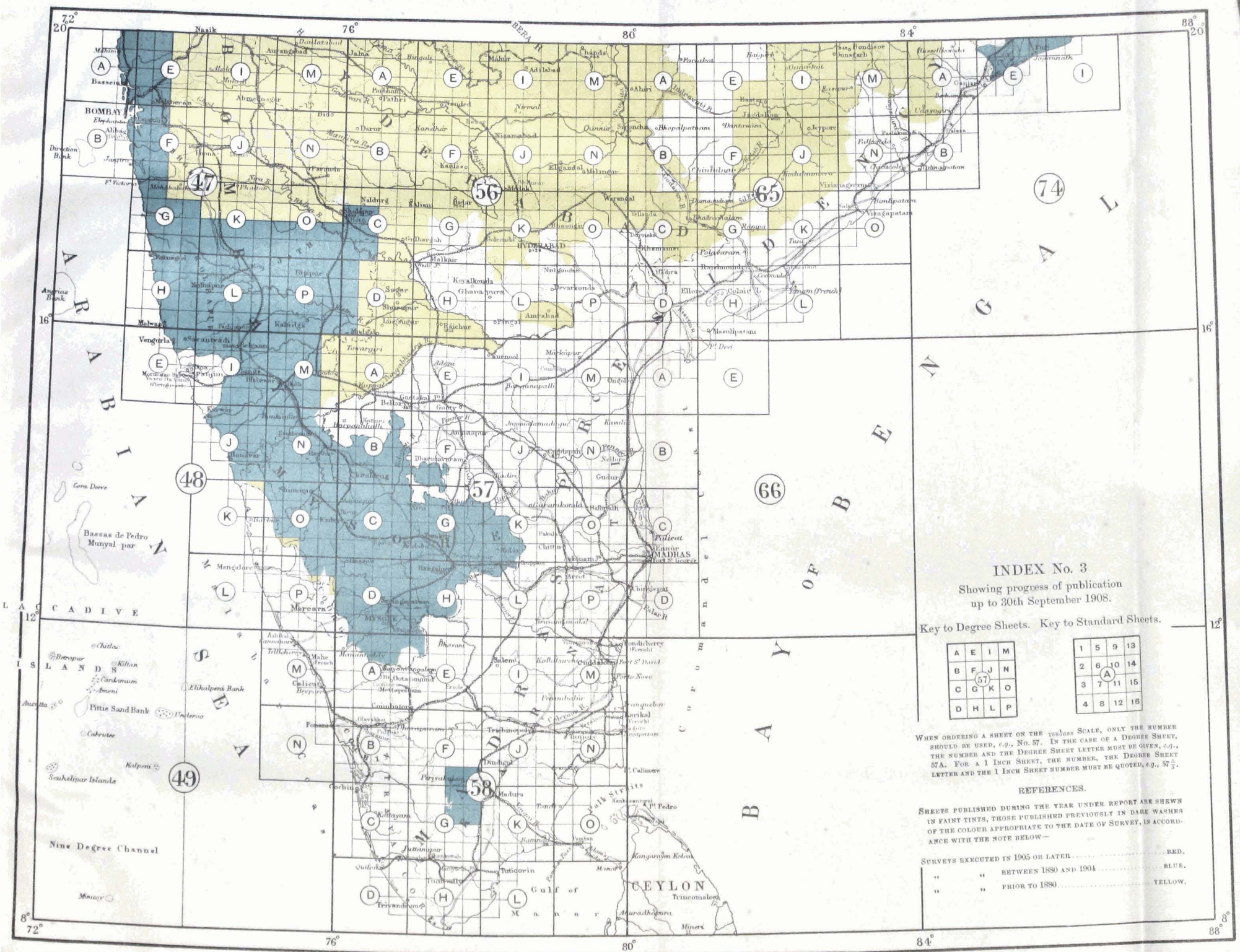
WHEN ORDERING A SHEET OF THE 1 INCH SCALE, ONLY THE NUMBER SHOULD BE USED, e.g., No. 84. IN THE CASE OF A DEGREE SHEET, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN, e.g., 84A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED, e.g., 84 1/4.

**REFERENCES.**

SHEETS PUBLISHED DURING THE YEAR UNDER REPORT ARE SHOWN IN FAINT TINTS, THOSE PUBLISHED PREVIOUSLY IN DARK WASHES OF THE COLOUR APPROPRIATE TO THE DATE OF SURVEY, IN ACCORDANCE WITH THE NOTE BELOW—

SURVEYS EXECUTED IN 1905 OR LATER. . . . . RED.  
 " BETWEEN 1880 & 1904 AND CADASTRAL SURVEYS SINCE 1904 . . . . . BLUE.  
 " PRIOR TO 1880 . . . . . YELLOW.





**INDEX No. 3**  
 Showing progress of publication  
 up to 30th September 1908.

Key to Degree Sheets. Key to Standard Sheets.

A	E	I	M
B	F	J	N
C	G	K	O
D	H	L	P

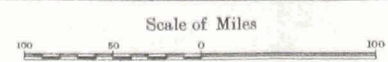
1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

WHEN ORDERING A SHEET OF THE COASTAL SCALE, ONLY THE NUMBER SHOULD BE USED, e.g., No. 57. IN THE CASE OF A DEGREE SHEET, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN, e.g., 57A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED, e.g., 57 1/2.

**REFERENCES.**

SHEETS PUBLISHED DURING THE YEAR UNDER REPORT ARE SHOWN IN FAINT TINTS, THOSE PUBLISHED PREVIOUSLY IN DARK WASHES OF THE COLOUR APPROPRIATE TO THE DATE OF SURVEY, IN ACCORDANCE WITH THE NOTE BELOW—

SURVEYS EXECUTED IN 1905 OR LATER	.....	RED.
" " BETWEEN 1880 AND 1904	.....	BLUE.
" " PRIOR TO 1880	.....	YELLOW.



## PART II.

## THE OPERATIONS OF FIELD PARTIES.

## TRIGONOMETRICAL SURVEYS.

## INDIA TRIANGULATION.

## NO. 24 PARTY.

82. The party was under the charge of Captain C. M. Browne, D.S.O.,

*Personnel.*

*Western Baluchistán detachment.*

*Imperial Officer :*

Captain C. M. Browne, D.S.O., R.E., in charge.

*Provincial Officers :*

Messrs F. W. Smith and G. A. Norman, and Babu Mohan Lal Arora, from 22nd August 1908.

*Burma detachment.*

*Imperial Officer :*

Lieutenant E. B. Cardew, R.E.

*Provincial Officers :*

Munshi Abdul Hai, and Mr. V. D. B. Collins.

*Northern Baluchistán detachment.*

*Imperial Officer :*

Lieutenant G. F. T. Oakes, R.E., from May 1908.

*Provincial Officers :*

Messrs. C. H. Tresham and V. P. Wainright.

figure Kopadhar-Pulchotau-Pragi-Kisanen Chapper) where an abnormal triangular error had been found in 1904-05. He then proceeded to Shuri where the work had been discontinued the previous year, arriving there on the 17th December; he observed an astronomical azimuth at Tuzgi. New stations were built at Borghar, Garrukki Gori, Maland Koh, Kacha Koh, Lar Koh, and at Koh-i-Malik Siah (trijunction point of Afghánistán, Persia, and Baluchistán). An astronomical azimuth was observed at Koh-i-Malik Siah.

Mr. Tresham having in the meantime triangulated to Robat, an astronomical determination of the latitude of Robat was made by the method of circum-meridional altitudes.

Field work was then closed and the detachment began its long return march of 400 miles to Nushki arriving there on the 10th May.

85. The Kalát series which has now been finished is approximately 480 miles long from its origin on the Indus to its terminus near Persia, and it embraces an area of 11,000 square miles within its triangles. It is of interest to compare the accuracy of this Kalát series, which is the latest triangulation of the Trigonometrical Survey of India, with the most recent geodetic work of other countries. The relative accuracies of different surveys may be compared by means of their respective probable errors, the smaller the probable error the greater the accuracy of the survey.

If, in any triangulation,  $N$  be the number of triangles, and  $\Sigma\Delta^2$  the sum of the squares of the triangular errors, and if  $E$  be the probable error of an observed angle, then  $E = \frac{2}{3} \sqrt{\frac{\Sigma\Delta^2}{3N}}$ .

This formula gives for the Kalát series

$$E = 0'' \cdot 21.$$

R.E., throughout the year under report and was divided into three detachments.

83. *Western Baluchistán.*—The programme was to complete the Kalát longitudinal series up to the Persian border. The detachment under Captain Browne assembled at Nushki on the 27th October and on the 4th November left for Padag.

84. Captain Browne revised the angles at two stations (Kopadhar and Pulchotau of the old

In the recent geodetic triangulation of Rhodesia

E was  $0''\cdot44$ .

In the triangulation of Cape Colony E was  $0''\cdot34$ , and in the triangulation on the 98th meridian of the United States of America, E was  $0''\cdot48$ .

The Kalát series has taken four years to complete, the observers being Captain H. H. Turner, R.E., and Captain C. M. Browne, D.S.O., R.E. Of the 51 triangles only three have an error exceeding  $1''$ .

Five astronomical azimuths have been observed at different points of the series; and, if we compare the astronomical values with the values computed from the triangulation, the latter are always found to be too large. The persistency of the excess is a warning to us that our computations are taking the triangulation too far to the north. The error of direction is being gradually accumulated as we get further from the centre of India, because our formulæ for triangulation are derived from a spheroid, which is appreciably smaller than the true figure of the earth.

The westernmost station of the Kalát series is Koh-i-Malik Siah, the trijunction point of India, Persia, and Afghánistán: this point is of interest both from its political importance and from its being the most westerly limit now reached by the Principal Triangulation of India. The astronomical azimuth at this place differs from the value computed through the triangulation by  $13''\cdot04$ , the largest positive difference that has been discovered during the Indian observations. The value of latitude, hitherto accepted for Koh-i-Malik Siah, was found to be  $1''\cdot84$  too great and the value of its longitude  $4''\cdot879$  too great; the position on the earth, assigned to Koh-i-Malik Siah, was thus 468 feet in error.

An interesting mountain fixed with care from no less than 10 stations was Koh-i-Taftan. Its summit is formed by two main peaks of nearly equal height, the southern and higher being still an active volcano in more or less constant eruption.

Koh-i-Taftan is a very conspicuous landmark being visible on clear days from the whole country within 150 miles radius: no point within 300 miles of it approaches it in altitude, and it is covered with snow for nearly the whole year.

Its distance from the sea (about 250 miles) is, it is believed, the greatest of any active volcano in the world.

The co-ordinates of the two main peaks of Taftan are (a) south-west peak, (active volcano), latitude  $28^{\circ} 36' 0''\cdot49$ , longitude  $61^{\circ} 10' 28''\cdot14$ , height 12,973; (b) north-east peak, latitude  $28^{\circ} 36' 28''\cdot63$ , longitude  $61^{\circ} 9' 54''\cdot00$ , height 12,935.

The geographical positions hitherto assigned to the peaks of Taftan were found by Captain Browne to be in error by over 600 feet, the old positions being north-east of the true.

To the north-west of Taftan are several extinct volcanoes, and the whole region is a most curious mixture of aqueous and igneous deposits. The volcano of Koh-i-Sultán, on which Captain Browne observed for 10 days in 1907, is dying, but is not quite "dead"; though its huge crater is now flooded with *débris* and silt, Captain Browne found his theodolite constantly disturbed by the tremors and pulsations of the mountain.

86. *Northern Baluchistán detachment.*—At Nushki Captain Browne was joined in May 1908 by Lieutenant Oakes and Mr. Wainright, and a new detachment was organised for work in the hot weather in Toba from men enlisted by Mr. Wainright with a nucleus of old men. Lieutenant Oakes took charge of this detachment.

87. *Northern Baluchistán detachment.*—Lieutenant Oakes commenced a new series of principal triangulation called the Northern Baluchistán series; he started observations from the side Zawa-Zibra of the Kalát longitudinal series and worked northwards to the Toba plateau; in Toba the series will turn to the north-east and will follow the Afghán boundary: it will eventually join the Great Indus series near Sheikh Budin, and will thus bring the immense frontier area between the Khojak and the Indus under the trigonometrical control of the principal triangulation of India. The stations for the first two figures north of Zawa-Zibra were built during 1906-07. The party assembled at Mastung road on the 13th May 1908, and started for Zawa on the 21st May. As the work is still in progress it is not possible to give a detailed account of the results.



91. In view of the employment in the near future of a 4-metre Standard Invar Bar for the measurement of geodetic bases in India, in place of the Standard 10-foot Bar A, the Superintendent of Trigonometrical Surveys considered it advisable to send the latter to Europe for comparison with the metre, and as a precautionary measure, to compare it at Dehra Dún with the Bars  $I_B$  and  $I_S$  before its despatch to Sèvres.

92. Forty-two sets of comparisons were made by Major Lenox-Conyngham and Captain Cowie between the Bars A and  $I_S$ , the temperature during the observations ranging from  $6^{\circ}.88$  above to  $5^{\circ}.37$  below  $62^{\circ}\text{F}$ . Thirty-eight sets of comparisons were made between A and  $I_B$ , the range of temperature being from  $7^{\circ}.13$  above to  $6^{\circ}.34$  below  $62^{\circ}$ . The results of the observations were—

$I_S$ —A at  $62^{\circ}\text{F}$ . =  $83^{\circ}.12$  millionths of a yard, the mean temperature of the observations being  $61^{\circ}.7$ .

$I_B$ —A at  $62^{\circ}\text{F}$ . =  $196^{\circ}.73$  millionths of a yard, the mean temperature of the observations being  $61^{\circ}.1$ .

000. The comparisons made in 1867 and 1870 gave as a mean value—

$I_S$ —A at  $62^{\circ}\text{F}$ . =  $82^{\circ}.52$  millionths of a yard, the mean temperature of observation being  $61^{\circ}.9$ .

The difference between the old and new values is thus, only  $0^{\circ}.60$  millionths of a yard, a quantity a little greater than one-six millionth part of the length of Bar A.

No direct comparison was made in 1870 between Bars A and  $I_B$ , but by combining Clarke's value of  $I_B$ — $I_S$ , determined about 1865 with the mean 1867—70 value of  $I_B$ —A, we can deduce a value for  $I_B$ —A.

Clarke's value of  $I_B$ — $I_S$  =  $131^{\circ}.46$  millionths of a yard.

1867-70 value of  $I_S$ —A =  $82^{\circ}.52$

Deduced value of  $I_B$ —A =  $213^{\circ}.98$  " "

The difference between the old and new values is, in this case,  $17^{\circ}.25$  millionths of a yard, or about one-two hundred thousandth part of the length of Bar A.

When we take into consideration the nature of the defining marks of Bar A, made about the year 1830, the close agreement between the old and new values must be looked upon as fortuitous to a great extent. The smallness of the differences given above is evidence that the length of the Bars have not altered materially since 1870.

93. On the conclusion of the comparisons at Dehra, Bar A was sent by the Superintendent, Trigonometrical Surveys, to Sèvres. The result of the comparisons carried out there have lately been received from M. Guillaume, Deputy Director of the Bureau International des Poids et Mesures. The value of Bar A in terms of the metre proved to be, at  $62^{\circ}\text{F}$ .

$3047^{\circ}.9988$  mm.

From Clarke's determination made about the year 1864,

Bar A at  $62^{\circ}\text{F}$ . =  $3.33331886$  standard yards.

Converting this into terms of the metre by means of the equivalent determined at the Bureau International des Poids et Mesures, M. Guillaume finds—

Bar A at  $62^{\circ}\text{F}$ . (1864) =  $3047^{\circ}.9841$  mm.

The difference between the old and new values is

$0^{\circ}.0147$  mm.

or about  $13^{\circ}.12$  millionths of a yard.

The differences shown above between the old and new values are, in every case, very small when it is considered how difficult it is to make an intersection, satisfying modern ideas of precision, of the defining marks of Bar A, which though held to be good at the time of its construction, must now be looked on as unsatisfactory in comparison with the best modern designs.

94. On conclusion of the comparisons between Bars A,  $I_B$  and  $I_S$ , normal latitude operations were undertaken by Captain Cowie in the country to the south and east of Deesa. Six principal stations were visited, four on the Abu meridional series and two at the junction of the Karachi longitudinal series and the Singi meridional series.

Mr. J. deG. Hunter, M.A., was with the party during the latter part of the season, and took a duplicate set of observations at the stations of Kárdo and Dhámanva.

95. The results of the season's work are tabulated below :—

TABLE.

Station.	Longitude.	Height above M. S. L.	Astronomical Latitude.	Seconds of Geodetic Latitude.	Deflection.
	° ' "	Feet.	° ' "	"	"
Moráli . . . . .	73 0	466	23 25 17.47	23.18	-5.71
Dhámanva . . . . .	72 33	399	23 32 2.66	8.40	-5.74
Kaináth . . . . .	73 1	1,385	23 51 14.99	23.79	-8.80
Kárdo . . . . .	72 46	807	23 57 2.17	10.02	-7.85
Lakarwás . . . . .	73 52	2,574	24 31 41.05	47.99	-6.94
Tiki . . . . .	73 53	2,369	24 55 34.52	38.24	-3.72

96. The season's programme was designed to throw light on questions concerning the abnormally high deflection found to exist at Chaniána, about 23 miles east of Deesa. The results given above show that to the south of Chaniána, we have the same decrease in the value of the deflection that occurs to the north and west. In every direction the northerly deflection is found to diminish rapidly. Captain Cowie draws the conclusion that the disturbing influence, to which the high value at Chaniána is due, originates "in a purely local cause, situated "either at the surface or at a small distance below it."

He is of opinion that, if a deflection still greater than that at Chaniána does exist, we shall have to look for it to the north-east of that station.

PENDULUM OPERATIONS.

No. 23 PARTY.

97. Between November 1907 and January 1908 this party was employed

*Personnel.*

*Imperial Officers :*

Major G. P. Lenox-Conyngham, R.E., in charge until 5th May 1908.

Captain H. M. Cowie, R.E., in charge from 6th May 1908.

Mr. J. deG. Hunter, M.A., under instruction (for part of the season).

*Provincial Officer :*

Babu Hanuman Prasad.

in co-operation with No. 22 Party in making comparisons between the standard Bar A and the reference Bars I<sub>B</sub> and I<sub>S</sub>. The results of the comparisons will be found in the report of the work of No. 22 Party. Between January and the end of the field season the party visited seven places in Southern

India and made determinations of the force of gravity, with the object of ascertaining whether in sub-montane tracts in the south of India, this force would be found to be in defect to the same degree as it is in the neighbourhood of the Himalayas.

98. In addition to the standardization observations made in Dehra at the commencement and the end of the field season, the pendulums were swung at the following stations :—

- Mysore . . . . .
  - Bangalore . . . . .
  - Kolar, Edgar Shaft, at the surface . . . . .
  - " " " at the bottom of the shaft
  - Ootacamund, on the Nilgiri Hills.
  - Yercaud, on the Shevaroy Hills.
  - Kodaikánal, on the Palni Hills.
  - Salem, at the foot of the Shevaroy Hills.
- } on the Mysore plateau.



99. The results of the season's work are given in the following table. The orographical corrections applied in computing the final values of  $g$  were found to be of significant amount at all stations except Bangalore and Mysore. Except in the case of Kodaikánal, these corrections are based on a detailed examination of the surface masses within 35 miles of the station. In the case of Kodaikánal this investigation was not possible beyond 1 mile from the station on account of the want of suitable maps.

TABLE.

STATION.	Latitude.	Height above Mean sea-level.	Observed value of gravity= $g$ .	$g$ reduced to sea-level = $g_0$ .	Theoretical value at sea-level= $\gamma_0$ .	$g_0 - \gamma_0$ .	Degree of compensation of visible masses.
	° ' "	Feet.	Dynes.	Dynes.	Dynes.	Dynes.	Per cent.
Mysore	12 18 52	2,501	978·045	978·191	978·236	-0·045	51
Bangalore	13 0 41	3,118	978·025	978·206	978·263	-0·057	52
Edgar Shaft underground	12 55 46	328	978·133	978·238	978·260	-0·022	...
Edgar Shaft surface.	12 55 47	2,945	978·076	978·247	978·260	-0·013	3
Ootacamund	11 24 37	7,395	977·735	978·171	978·203	-0·032	12
Yercaud	11 46 56	4,493	977·908	978·180	978·217	-0·037	23
Kodaikánal	10 13 50	7,665	977·643	978·092	978·164	-0·072	27
Salem	11 40 5	948	978·116	978·172	978·212	-0·040	120

100. The following conclusions may be drawn from the results of the table:—(a) The deficiency of gravity is considerably less at these stations than at places in the north of India which are similarly situated as regards height above mean sea level; (b) at the stations of Ootacamund, Yercaud, and Kodaikánal, situated on what may be termed "isolated" masses, the *degree* of compensation of the visible mass is much less than it is at stations on the extensive Himalayan mass; (c) at Bangalore and Mysore, situated on the plateau, the *degree* of compensation is considerably greater than at Yercaud, Kodaikánal and Ootacamund, which, though higher, are upon "isolated" masses. (The results at Kolar on the plateau do not, however, accord with those at Mysore and Bangalore).

Captain Cowie draws the general conclusion that the extent of the deficiency is independent of the height of the visible mass.

At Kodaikánal, only a little higher than Ootacamund, the degree of compensation is more than twice as great. At Yercaud, at rather more than half the height of Ootacamund, the compensation is almost twice as great. Had we found that the degree of compensation was a function of the height of the visible mass, we might have concluded that the attenuation of density causing these deficiencies of gravity occurred within the visible masses. As it is, we have been led to infer that it is principally the subjacent masses that affect the compensation of those visible at the surface.

101. The time observations were made satisfactorily throughout the season, by Babu Hanuman Prasad, using for the first time the new bent Transit Instrument. The average probable error, for the season, of a value of the clock rate was  $\pm 0^{\circ}014$ .

TIDAL AND LEVELLING OPERATIONS.

NO. 25 PARTY.

Personnel.

Imperial Officer :

Mr. C. F. Erskine, in charge.

Provincial Officers :

102. Mr. C. F. Erskine held charge of the party throughout the year.

Messrs. J. P. Barker, H. G. Shaw, E. H. Corridon, Munshi Syed Zille Hasnain, Mr. A. M. Talati, Mr. O. N. Pushong, Babu P. N. Sur and Mr. D. H. Luxa.

Subordinate Establishment.

1 Surveyor, 23 Computers and Recorders, 2 Native Artificers, 4 Tidal Observatory Clerks.

TIDAL OPERATIONS.

103. Observations were taken by means of self-registering tide-gauges during the year at the stations enumerated in the following list :—

STATIONS.	Date of commencement of observations.	Date of closing of observations.	Number of years of observations.	REMARKS.
1 Aden . . . . .	1879	Still working .	28	Property of Port Trust.
2 Karachi . . . . .	1881	" " .	27	
3 Bombay (Apollo Bandar) . . . . .	1878	" " .	30	
4 Bombay (Prince's Dock) . . . . .	1888	" " .	2	
5 Madras . . . . .	1880 restarted	1890 Still working .	10	
6 Kidderpore . . . . .	1895	" " .	13	
7 Rangoon . . . . .	1881	" " .	27	
8 Port Blair . . . . .	1880	" " .	28	

104. In addition to the above, readings to tide-poles were taken at Bhavnagar, Chittagong, Akyab, and Moulmein.

105. The eight tidal observatories at work were inspected during the year, and the registrations have been entirely satisfactory.

106. In the following tables are given the annual and decadal percentages of the predicted time and height errors of high and low water at open coast and riverain stations :—

Percentage of errors in Predicted Times and Heights at open coast stations from Automatic Registrations.

YEAR.	Number of Stations.	IN TIME.		IN HEIGHT.			
		Within 15 minutes of actuals.		Within 8 inches of actuals.		Within 1/2 of mean range at springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1898 . . . . .	9	74	70	96	96	95	95
1899 . . . . .	9	74	66	95	95	93	92
1900 . . . . .	11	66	60	93	88	93	89
1901 . . . . .	11	71	60	93	91	93	91
1902 . . . . .	9	76	67	94	95	96	96
1903 . . . . .	8	80	77	92	93	94	94
1904 . . . . .	6	82	75	99	98	96	96
1905 . . . . .	7	82	79	96	95	96	97
1906 . . . . .	6	85	81	96	97	94	95
1907 . . . . .	6	84	83	98	98	98	99
Average of 10 years . . . . .	8	77	72	95	95	95	94

*Percentage of errors in Predicted Times and Heights at Riverain stations  
from Automatic Registrations.*

YEAR.	Number of Stations.	IN TIME.		IN HEIGHT.			
		Within 15 minutes of actuals.		Within 8 inches of actuals.		Within $\frac{1}{16}$ of mean range at springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1898 . . . . .	2	53	59	71	61	90	91
1899 . . . . .	2	55	59	76	65	95	94
1900 . . . . .	2	59	62	70	57	89	87
1901 . . . . .	2	63	65	70	59	90	92
1902 . . . . .	2	63	54	76	53	96	90
1903 . . . . .	2	55	61	70	60	88	87
1904 . . . . .	2	45	61	72	65	94	95
1905 . . . . .	2	52	62	72	57	94	92
1906 . . . . .	2	59	53	74	64	92	95
1907 . . . . .	2	58	47	78	60	96	90
Average of 10 years . . . . .	2	56	58	73	60	92	91

107. The tidal observatory cabin at Moulmein was erected in August. The tide-gauge and other instruments will be installed before the end of the year and registrations will be commenced by 1st January 1909. Moulmein will then become a permanent tidal station.

#### LEVELLING OPERATIONS.

108. There were three detachments engaged on the levelling operations during the year under report.

109. No. 1 Levelling detachment was employed on revision levelling, the work executed by them being from Guntakal to Madras. Standard Bench-marks were connected at Cuddapah and Madras. The outturn amounted to 296 miles. The field season commenced on 11th October and ended on 13th April.

110. No. 2 detachment ran a line of levels from Ferozepore to Nágaur on the Jodhpur-Bikaner Railway. The Standard Bench-mark at Bikaner was connected *en route*. Three Great Trigonometrical Stations were connected. The Standard Bench-marks at Dera Ismail Khan and Multán were also connected with adjacent lines of levelling. The total outturn of levelling was 348 miles. The field season commenced on 12th October and ended on 12th April.

111. No. 3 detachment was employed on revisionary work between Kosgi and Guntakal, and between Bellary and Kárwár. This detachment also connected the Standard Bench-marks at Raichur and Bellary. The season's outturn amounted to 297 miles. The duration of the field season was from 12th October 1907 to 1st May 1908.

The total outturn of double levelling during the field season was 941 miles, in the course of which observations were taken at 12,094 stations. The Bench-marks determined were 8 Standard, 70 Embedded, 667 Inscribed, and 25 belonging to other departments.

Thirty-two Standard Bench-marks were erected and 13 connected, 15 are under construction, and 28 have been proposed for erection. During the past year 265 Bench-marks were reported as lost.

112. The old line of levels between Bombay and Madras, which was executed 30 years ago, exhibited a closing error of 2.98 feet, Madras being placed 2.98 feet higher by this levelling from Bombay than it had been shown to be by tidal observations taken in its own harbour. The 800 miles of levelling from

Madras to Bombay have now been revised, and the new revisionary line has closed at Madras with an error of +0.607 foot.

The closing error has thus been reduced by 2.37 feet, from 2.98 to 0.607. General Walker, who was Surveyor General of India from 1879 to 1883, always maintained that the discrepancy of 2.98 feet at Madras was due to a steady and imperceptible accumulation of levelling error: the recent revision has shown that his view was entirely correct, and has disproved the theory that the mean sea level at Madras was actually higher than at Bombay.

113. During the approaching field season of 1908-09, No. 1 Levelling detachment will be employed in connecting the Standard Bench-marks at Sátára, Belgaum, Bijápúr, Bangalore, Salem, Calicut, Trichinopoly, Negapatam, Madura, Tinnevely, and in Secunderabad, with adjacent lines of levels, and then on the Katni-Secunderabad line of levelling, commencing from Secunderabad.

114. No. 2 Levelling detachment will be employed in completing the Ferozepore-Ahmedabad line of levels, in running a short line of levels from Pálanpúr to Deesa, and in connecting the Standard Bench-marks at Jodhpur, Deesa, and Ahmedabad.

115. No. 3 Levelling detachment will be employed on the Katni-Secunderabad line of levelling commencing from Katni, and also in connecting the Standard Bench-marks at Saugor, Jubbulpore, Nágpur, Raipur, Biláspur, Sambalpur, Akola, and Hinganghát, with adjacent lines of levels.

116. In addition to the levelling executed during the field season by the three levelling detachments, the following minor lines of levels were completed:—

- (i) From Nojli Trigonometrical Survey to Myapore Canal Bungalow, Hardwár, 38 miles.
- (ii) From Great Trigonometrical Survey Office, Dehra Dún, to Kálsi Bridge, over the Jumna River, 31 miles.

117. The levels, used by the Survey of India, have shown themselves trustworthy instruments, but they are of ancient pattern, and since they were made, undoubted improvements have been devised. At the International Geodetic Conference, which met at Copenhagen in 1905, the Superintendent of the Geodetic Survey of the United States of America exhibited a new pattern of level, which seemed to be a great advance upon all previous patterns. Two of these American levels were bought for the Survey of India, and have been tried during the last two winters. The trials were entirely successful; and it will now be possible to work both more quickly and more accurately.

The device by which the speed of levelling can be increased is a very simple one: the telescope of the level is furnished with three intersecting wires instead of one. At each pointing of the level, the staff can thus be read in three places simultaneously, instead of in one. This arrangement dispenses with the necessity both of chaining from the level to the staff, and of reading the two faces of the staff. We can now deduce the distance of the staff from the readings of the wires upon it; and the risk of reading the staff incorrectly to a whole foot is entirely eliminated by the triplication of the wires. It was merely to obviate this risk that staves were originally given two differently graduated faces. The operation of reversing the faces of the staves greatly prolongs observations, and is a troublesome step, that the levelling officers will gladly see dispensed with.

The plan by which the accuracy of levelling can be increased has been designed to get rid of the errors, that are caused by the observer walking round his level, when he wishes to read the bubble after observing with the telescope. When an observer transfers his weight from one side of a level to another, the ground sinks as he approaches and recovers as he departs, and the bubble of the level responds to these disturbances. The observer is therefore always liable to read his bubble, when it is in a different position to what it was at the instant of his telescopic observation. In the American levels this liability to error has been eliminated: these levels are binoculars, and the two telescopes are viewed simultaneously; one telescope shows the image of the staff with the cross wires upon it, and the other telescope shows the image of the level bubble by reflection. It is easy now to watch both the staff and the bubble at the same instant.

## MAGNETIC OPERATIONS.

## NO. 26 PARTY.

118. *Field Operations. Work of the field detachments.*—During the year

*Personnel.**Imperial Officers :*

Captain R. H. Thomas, R.E., in charge up to 31st March 1908.  
Lieutenant H. J. Couchman, R.E., in charge from 1st April 1908.

*Provincial Officers :*

Mr. E. C. J. Bond, Mr. H. P. D. Morton, Babu R. P. Ray, Babu  
N. R. Mazumdar, and R. B. Mathur.

*Subordinate Establishments :*

2 Observers, 13 Recorders, 1 Computer, 2 Surveyors and 1 Writer.

work for three months in order to carry out some triangulation for the Chin-Lushai-Arakan boundary, and another, owing to the early break of the monsoon in South Burma, could not complete its programme. For these reasons the outturn of new stations, 80, was small compared with the 152 stations of the previous year.

The field season commenced on the 21st October 1907, and the party proceeded to recess quarters on the 4th May 1908.

119. *Work of the Imperial Officers.*—The Officer in charge, with his assistant, took observations at all the repeat stations and also at several old field stations, with a view to obtaining further values of the secular change in the magnetic elements. Comparative observations were also taken at the four observatories of the Survey, and at Alibág, to determine the differences from the Survey standard instruments at Dehra Dún.

The new Vertical Force magnets, referred to in the last report, were mounted at Barrackpore and Kodaikánal observatories in December 1907, and satisfactory determinations of their temperature co-efficients made, the values found being  $-3.0\gamma$  and  $+5.2\gamma$  per  $+1^\circ\text{F}$ . respectively.

120. *Total work to date.*—The total number of stations occupied to date is 1,214 with 22 repeat stations; observations have also been repeated at 31 old field stations.

121. *Work during recess.*—During the recess season the computation of the field work and the reduction and tabulation of the base station results for 1907 have been completed. The whole of the H. F. observations taken since the beginning of the survey have been re-computed by applying a mean value of  $m$ , (the moment of the magnet), to the value of  $\frac{m}{H}$  obtained in the deflection observation. The mean values of  $m$  have been obtained by dividing the values into groups and taking means of groups. Where the means of several groups agree a further mean has been taken and where not the individual values have been carefully scrutinized to discover when the change occurred. This re-computation was undertaken originally to improve the monthly mean values of the base lines of H. F. magnetographs, and as this was achieved, the method has been extended to all H. F. observations, and has provided new values of the instrumental differences, which will be used in the reduction.

The correction of the horizontal force and declination observations for diurnal variation and instrumental difference is being started, the repeat stations being dealt with first. The diurnal variation correction to be applied will be computed by the latitude formula mentioned in the last report, using the diurnal variation figures of the three nearest base stations, and taking a mean of the two values of the correction found. With regard to the instrumental correction in horizontal force it is to be noted that such correction cannot be expressed as a constant in absolute units, but is of the form,  $fH$ , and its amount will consequently vary slightly over the area of the survey.

Investigations into the question of the disturbance correction are still being made, but no satisfactory empirical formula, connecting these corrections at the base stations, has as yet been discovered, and it would seem that an approximate correction will have to suffice, for, at any rate, the horizontal force observations.

122. *The Base stations.*—With the exception of the Kodaikánal V. F. instrument the magnetographs have given good results throughout the year.

This instrument, however, still appeared to be unstable even after the mounting of the new magnet, and this is probably due to the very low value of dip,  $3^{\circ}$  N., found at this station. In taking dip observations in low magnetic latitudes, the difficulty of placing the dip circle in the magnetic east-west direction, when the needle assumes the vertical position, has always been experienced, a slight alteration in azimuth causing the needle to depart from the vertical. The case of the V. F. magnetograph at Kodaikánal is similar, a slight azimuthal displacement of the magnet, when lifted and lowered on the agate plane, causing it to take up a position sensibly inclined to that to which it has been brought by means of counterweights. The magnet has, however, been made more stable by lowering the small gravity bob and excellent results are now being obtained, and it is hoped that no further difficulties will be experienced. The base mirror of the declination magnetograph at Barrackpore has been renewed, the old one having been attacked by fungoidal growth.

123. *The mean values of the Magnetic elements at Observatories for 1907.*—The mean values of the magnetic elements at the four observatories of the survey for 1907 are as follows:—

Dehra Dún . . . . .	Lat. $30^{\circ} 19'$	Long. $78^{\circ} 3'$ .
Declination . . . . .	$2^{\circ} 38' \cdot 3$ E.	
Dip . . . . .	$43^{\circ} 36' \cdot 1$ N.	
H. F. . . . .	$33324$ C. G. S.	
V. F. . . . .	$31736$ C. G. S.	
Barrackpore . . . . .	Lat. $22^{\circ} 46'$	Long. $88^{\circ} 22'$ .
Declination . . . . .	$1^{\circ} 9' \cdot 9$ E.	
Dip . . . . .	$30^{\circ} 30' \cdot 2$ N.	
H. F. . . . .	$37288$ C. G. S.	
V. F. . . . .	$21967$ C. G. S.	
Toungoo . . . . .	Lat. $18^{\circ} 56'$	Long. $96^{\circ} 27'$ .
Declination . . . . .	$0^{\circ} 39' \cdot 3$ E.	
Dip . . . . .	$23^{\circ} 0' \cdot 7$ N.	
H. F. . . . .	$38754$ C. G. S.	
V. F. . . . .	$16461$ C. G. S.	
Kodaikánal . . . . .	Lat. $10^{\circ} 14'$	Long. $77^{\circ} 28'$ .
Declination . . . . .	$0^{\circ} 40' \cdot 7$ W.	
Dip . . . . .	$3^{\circ} 27' \cdot 2$ N.	
H. F. . . . .	$37431$ C. G. S.	
V. F. . . . .	$02259$ C. G. S.	

124. *The Isomagnetic charts.*—The three isomagnetic charts published in this report show the lines of—

- (1) Equal declination (isogonals)
- (2) Equal dip (isoclinals)
- (3) Equal horizontal force,

and are based on the uncorrected observations of the preliminary survey. They can, therefore, only be regarded as approximate, more especially as regards the size of the abnormal areas enclosed by "ring contours." The correct delineation of these areas must await the completion of the detail survey, and at present their locality is indicated only.

An approximate correction for secular change has been applied, and to minimise the effects of errors in this correction, the middle year of the survey, 1905, has been selected as the epoch.

The lines of equal secular change in declination are shown on the isogonal chart, except in Burma, where, at present, the data are insufficient. The secular changes in dip and in horizontal force have not as yet been determined with sufficient accuracy to enable the lines to be drawn.

In the declination chart, the chief point of interest is the very slow rate of change with latitude in Burma, as shown by the increased width of the belt  $1^{\circ}$  E to  $0^{\circ}$ . The agonic line which leaves India near Masulipatam apparently passes through Sumatra. It will be noticed that the declination varies little with change of longitude and the terrestrial isogonals will probably be found to run due east and west.

The dip chart calls for little comment as the isoclinals are extremely regular over the whole area. In dip the values which differ by more than  $1^{\circ}$  from the normal are very rare, whereas in declination they are fairly common. It will be

noticed that the magnetic equator cuts the extreme south of India and is at present slowly moving south.

The lines in the horizontal force chart are also regular, and there is little to note in the north of India. The lines in south India and Burma, however, call for some remark owing to the greater intensity of the horizontal force in the latter country. The magnetic equator crosses India along latitude  $9^{\circ}$ , and the horizontal force will presumably decrease as we proceed further south; the two southern belts in Burma must therefore disappear before they reach India, and the 0.385 and 0.395 lines must presumably be closed curves. This view is supported by the values of horizontal force found in Sumatra during the magnetic survey of the Dutch East Indies, those in the north of the island being about .391, and those in the centre .386.

125. *Work projected for 1908-09.*—During the next field season it is intended to begin the detail survey by examining a few of the more obviously disturbed districts in Rajputana and Central India. One such district occurs near Pokaran, in the Rajputana desert, where the declination alters by  $3^{\circ}$  in 40 miles, while another lies near the Nerbudda river south-west of Indore, where values of horizontal force of .32 C. G. S. and .38 C. G. S. have been found at contiguous stations, 35 miles apart, the normal value of the district being about .365 C. G. S. It is considered advisable to commence the detail survey in these abnormal localities, in order to gain experience in selecting stations which will reveal the loci of disturbance, and not to attempt, as yet, to portray the geological features of a district, which has not been shown as obviously abnormal by the uncorrected observations of the preliminary survey. The survey of the northern edge of the Deccan trap, mentioned in last year's report, will therefore be left for the present. Two detachments will be available for the detail survey throughout the field season. Two others will be employed in completing the preliminary survey of the coast of Burma for the greater part of the season, and will then assist in the detail survey.

126. A table showing the approximate preliminary values (uncorrected) at the field and repeat stations in 1907-08 is appended, together with a reference chart showing all the stations of observations to date.

*Abstract showing approximate magnetic values at stations observed at by No. 26 Party during season 1907-08.*

Serial No.	Name of station.	Survey No.	Latitude.	Longitude.	Dip.	Declination.	Horizontal Force.	REMARKS.
			° ' "	° ' "	° ' "	° ' "	C.G.S.	
1135	Mông Mā	3	22 45 10	98 16 10	30 52	E 0 52	0.3773	H. is derived from Mean M <sup>o</sup> . throughout.
1136	Mông Vai	4	22 25 30	98 2 30	30 18	" 0 53	0.3784	
1137	Mông Awt	5	22 2 20	98 22 30	29 32	" 0 51	0.3799	
1138	Hsupo	6	21 49 50	98 50 20	29 6	" 0 49	0.3806	
1139	Mông Ping	1	21 21 0	99 1 10	28 10	" 0 45	0.3823	
1140	Keng Tung	2	21 17 0	99 37 0	28 2	" 0 45	0.3820	
1141	Mông Vang	3	21 50 40	99 41 30	29 10	" 0 41	0.3802	
1142	Hsoplamsoplwe	4	21 23 40	100 14 20	28 16	" 0 44	0.3822	
1143	Nam Läng (Paliao).	1	20 49 50	100 20 50	27 7	" 0 47	0.3842	
1144	Mông Hai	2	20 46 10	99 48 10	26 59	" 0 45	0.3839	
1145	Mông Hsät	3	20 31 40	99 15 50	26 27	" 0 47	0.3845	
1146	Mông Tung	1	20 13 0	98 54 10	25 58	" 0 45	0.3850	
1147	Mông Htä	2	19 51 10	98 34 0	25 0	" 0 44	0.3860	
1148	Mông Pan	3	20 19 10	98 22 10	26 0	" 0 45	0.3845	
1149	Mông Nai	4	20 30 20	97 52 0	26 19	" 0 41	0.3843	
1150	Keng Tawang	5	20 45 10	98 18 10	26 51	" 0 45	0.3838	
1151	Mông Pu	6	20 54 40	98 44 30	27 15	" 0 48	0.3830	
1152	Wán Kawng	7	21 23 20	98 22 30	28 13	" 0 48	0.3820	
1153	Wán Hoko	8	21 0 10	97 57 0	27 22	" 0 44	0.3829	
1154	Wán Hohwe	9	21 9 0	97 34 40	27 39	" 0 46	0.3822	
1155	Nawnglayaw	10	21 38 20	97 44 30	28 38	" 0 47	0.3810	
1156	Man Li	11	22 5 50	97 31 30	29 38	" 0 48	0.3796	
1157	Kyawkkü.	17	21 48 20	96 59 10	29 0	" 0 48	0.3805	
1158	Lawk Sawk	18	21 14 40	96 52 30	27 52	" 0 45	0.3817	
1159	Taunggyi	7	20 46 30	97 2 50	26 53	" 0 49	0.3837	
1160	Kálaw	10	20 37 40	96 34 10	26 33	" 0 45	0.3835	
1161	Sillod	9	20 18 40	75 38 50	25 21	" 0 11	0.3690	
1162	Deulhát	10	20 32 0	76 7 10	26 10	" 0 33	0.3647	

Statement showing approximate magnetic values at stations observed at by No. 26 Party during season 1807-08—contd.

Serial No.	Name of station.	Survey No.	Latitude.		Longitude.		Dip.		Declination.		Horizontal Force.		REMARKS.	
			°	'	°	'	°	'	°	'	C.G.S.			
1163	Mehkar . . .	11	20	9	10	76	35	10	25	48	E	0	47	0.3656
1164	Chikni . . .	13	20	5	0	77	53	30	25	6	"	0	51	0.3708
1165	Boraghat . . .	13	21	31	40	84	33	30	28	15	"	0	59	0.3750
1166	Bonágarh . . .	14	21	49	0	84	57	30	28	54	"	0	25	0.3729
1167	Pal-Lahára . . .	6	21	25	50	85	11	30	27	51	"	0	31	0.3739
1168	Tálcher . . .	7	20	57	10	85	14	30	27	2	"	0	58	0.3768
1169	Kantolo . . .	7	21	7	20	85	37	40	27	54	"	0	45	0.3735
1170	Gutgaon . . .	8	21	24	10	85	53	20	27	52	"	0	52	0.3753
1171	Keotijhar . . .	9	21	37	40	85	35	30	28	15	"	0	49	0.3740
1172	Jainágarh . . .	10	22	4	10	85	40	40	29	8	"	1	4	0.3727
1173	Chabassa . . .	11	22	32	30	85	48	30	30	9	"	1	10	0.3707
1174	Rairangpur . . .	12	22	15	20	86	11	0	29	45	"	0	58	0.3720
1175	Kasmi . . .	13	21	50	0	86	15	10	28	14	"	0	18	0.3789
1176	Baripáda . . .	14	21	55	50	86	43	0	29	5	"	0	33	0.3737
1177	Dantan . . .	7	21	56	10	87	16	40	29	10	"	0	53	0.3726
1178	Ccntai . . .	8	21	46	40	87	44	30	28	30	"	0	44	0.3759
1179	Balikuda . . .	8	20	8	30	86	16	10	25	9	"	0	28	0.3809
1180	Chandbali . . .	9	20	46	10	86	43	40	26	42	"	0	19	0.3797
1181	Amarpur . . .	11	23	32	0	91	39	30	32	7	"	1	2	0.3727
1182	Singurajabari . . .	12	24	8	0	91	53	50	33	17	"	1	7	0.3709
1183	Silghata . . .	7	22	12	20	92	8	30	29	38	"	0	57	0.3767
1184	Golabari . . .	13	23	5	0	91	58	50	31	17	"	1	3	0.3743
1185	Nandgaon . . .	12	27	42	50	77	23	10	39	22	"	2	8	0.3447
1186	Palwal . . .	13	28	8	50	77	19	50	40	7	"	2	13	0.3425
1187	Tamu . . .	7	24	12	50	94	19	0	33	34	"	0	58	0.3712
1188	Lénácot . . .	8	23	54	30	93	47	50	32	50	"	1	7	0.3724
1189	Turizán . . .	9	23	35	30	93	41	30	32	15	"	1	6	0.3732
1190	Fort White . . .	10	23	14	50	93	46	30	31	35	"	1	16	0.3740
1191	Tao . . .	7	22	45	50	93	11	20	30	43	"	0	56	0.3759
1192	Háka . . .	8	22	38	30	93	37	20	30	32	"	0	59	0.3756
1193	Kán . . .	9	22	24	40	94	6	20	30	7	"	0	53	0.3777
1194	Sihaug . . .	10	22	51	0	94	3	20	31	4	"	0	50	0.3767
1195	Moulmein . . .	1	16	29	40	97	37	30	17	45	"	0	36	0.3926
1196	Thátón . . .	2	16	55	10	97	20	20	18	36	"	0	36	0.3918
1197	Kyaikto . . .	1	17	18	40	97	1	0	19	26	"	0	37	0.3923
1198	Thaungbyin . . .	10	19	55	20	96	31	10	25	4	"	0	42	0.3851
1199	Thitkyeit . . .	11	19	37	50	96	40	30	24	34	"	0	40	0.3860
1200	Pinlaung . . .	12	20	7	50	96	46	50	25	29	"	0	40	0.3845
1201	Loiput . . .	8	20	17	30	97	18	40	25	51	"	0	45	0.3845
1202	Mawkmai . . .	9	20	13	10	97	43	30	25	45	"	0	44	0.3848
1203	Ta-Sup-Teng . . .	10	19	51	20	97	45	10	25	0	"	0	40	0.3857
1204	Namon . . .	11	19	21	40	97	30	50	23	58	"	0	43	0.3872
1205	Loikaw . . .	12	19	40	20	97	13	10	24	36	"	0	42	0.3863
1206	Kreuko . . .	13	19	15	10	97	2	30	23	48	"	0	43	0.3867
1207	Pazaung . . .	2	18	52	10	97	18	40	22	56	"	0	47	0.3882
1208	Salween . . .	3	18	27	0	97	21	40	21	57	"	0	39	0.3893
1209	Papun . . .	4	18	3	20	97	27	20	21	16	"	0	43	0.3886
1210	Maipali . . .	5	17	30	50	97	38	40	20	1	"	0	36	0.3908
1211	Hlaingbwe . . .	6	17	7	0	97	40	10	19	7	"	0	40	0.3914
1212	Mergui . . .	1	12	26	50	98	38	50	8	35	"	0	32	0.3965
1213	Palaw . . .	2	12	58	0	98	44	20	9	52	"	0	31	0.3967
1214	Shintabi . . .	1	14	29	10	98	10	0	13	17	"	0	37	0.3955
Old Stations re-observed.														
46	Ruk . . .	3	27	48	20	68	38	20	39	21	E	2	7	0.3354
92	Kundian . . .	4	32	27	30	71	28	20	47	31	"	3	26	0.3107
98	Amritsar . . .	7	31	38	10	74	51	30	45	33	"	2	55	0.3233
105	Sachin . . .	9	21	4	40	72	52	40	27	13	"	0	28	0.3054
130	Ajmer . . .	3	26	27	30	74	38	30	37	12	"	1	57	0.3462
170	Kirkee . . .	2	18	33	30	73	50	0	22	21	"	0	9	0.3668
177	Wádi Junction . . .	1	17	3	0	77	0	0	18	44	"	0	13	0.3758
186	Arkonam . . .	5	13	5	10	79	40	20	10	4	W	0	27	0.3835
199	Cannanore . . .	5	11	52	30	75	22	0	7	32	"	0	27	0.3819
216	Miraj . . .	1	16	49	10	74	38	10	19	4	"	0	4	0.3771
232	Delhi . . .	2	28	40	20	77	14	20	40	57	E	2	2	0.3405
335	Trichinopoly . . .	2	10	47	30	78	40	40	4	51	W	1	3	0.3312
355	Bellary . . .	2	15	8	50	76	55	30	14	31	"	0	23	0.3766
373	Jána . . .	4	19	51	50	75	53	0	24	52	E	0	47	0.3704
376	Nander . . .	1	19	9	30	77	18	10	23	56	"	0	12	0.3715
384	Bezwada . . .	1	16	31	0	80	36	50	17	34	W	0	18	0.3814
481	Allahabad . . .	7	25	27	30	81	49	20	35	25	E	1	26	0.3582
480	Monghyr . . .	8	25	23	10	86	27	50	35	25	"	1	21	0.3620
494	Sainthia . . .	3	23	56	50	87	41	20	33	54	"	1	8	0.3680
500	Sini . . .	1	22	47	0	85	56	50	30	21	"	1	3	0.3730

H. is derived from Mean M<sup>c</sup>. throughout.



Abstract showing approximate magnetic values at stations observed at by No. 26 Party during season 1907-08—concl'd.

Serial No.	Name of station.	Survey No.	Latitude.	Longitude.	Dip.	Declination.	Horizontal Force.	REMARKS.
			° / ' "	° / ' "	° / '	° / '	C.G.S.	
522	Bhatni . . .	3	26 23 0	83 55 40	37 12	E 1 38	0'3560	H. is derived from Mean M. <sup>o</sup> throughout.
545	Bina . . .	4	24 10 50	78 11 0	33 13	" 1 9	0'3602	
557	Indore . . .	1	22 42 10	75 52 40	30 26	" 0 57	0'3650	
573	Cawnpore . . .	4	26 27 0	80 21 0	37 21	" 1 50	0'3534	
579	Sutna . . .	1	24 34 20	80 50 0	34 13	" 1 27	0'3598	
692	Balalore . . .	4	21 30 30	86 54 40	28 8	" 0 46	0'3759	
699	Berhampore . . .	1	19 18 10	84 48 40	23 32	" 0 24	0'3804	
710	Cumbum . . .	6	15 35 50	79 6 40	15 46	" 0 3	0'3777	
761	Khairi . . .	3	22 55 20	81 52 50	30 39	" 1 3	0'3665	
765	Raipur . . .	5	21 15 50	81 38 20	27 51	" 0 43	0'3700	
775	Kamptee . . .	8	21 12 30	79 12 40	27 34	" 0 51	0'3682	
1026	Rangamati . . .	3	22 38 10	92 11 50	30 23	" 1 0	0'3760	

## Repeat Stations.

Serial No.	Name of Station.	Latitude.	Longitude.	Dip.	Declination.	Horizontal Force.	REMARKS.
		° / ' "	° / ' "	° / '	° / '	C.G.S.	
I	Udaipur . . .	24 35 33	73 41 57	33 49	E 1 24	0'3530	H. is derived from Mean M. <sup>o</sup> throughout.
II	Karachi . . .	24 49 50	67 2 2	34 14	" 1 40	0'3457	
III	Quetta . . .	30 11 52	67 0 20	43 7	" 2 58	0'3232	
IV	Bahawalpur . . .	29 23 27	71 40 37	42 9	" 2 51	0'3318	
V	Rawalpindi . . .	33 35 16	73 3 6	48 18	" 3 42	0'3122	
VI	Bharatpur . . .	27 13 27	77 29 28	38 42	" 1 59	0'3458	
VII	Bangalore . . .	12 59 35	77 35 58	9 48	W 0 37	0'3811	
VIII	Dharwar . . .	15 27 20	74 59 35	15 23	" 0 13	0'3761	
IX	Porbandar . . .	21 38 20	69 37 6	28 45	E 1 13	0'3000	
X	Fyzabad . . .	26 47 27	82 7 40	37 54	" 1 48	0'3529	
XI	Sambalpur . . .	21 28 3	83 58 24	27 52	" 0 49	0'3725	
XII	Waltair . . .	17 42 57	83 19 1	21 12	" 0 15	0'3785	
XIII	Darjeeling . . .	26 59 49	88 16 39	38 18	" 1 36	0'3570	
XIV	Gaya . . .	24 46 30	84 58 54	34 16	" 1 9	0'3659	
XV	Secunderabad . . .	17 27 11	78 29 16	20 11	" 0 18	0'3792	
XVI	Bhusaval . . .	21 2 46	75 47 18	26 59	" 0 50	0'3680	
XVII	Jubbulpore . . .	23 8 57	79 56 44	31 2	" 1 3	0'3643	
XVIII	Tavoy . . .	14 4 50	98 12 30	12 19	" 0 31	0'3957	
XIX	Lashio . . .	22 56 47	97 44 40	31 16	" 0 47	0'3762	
XX	Akyab . . .	20 7 53	92 53 18	25 29	" 0 45	0'3838	
XXI	Silchar or Cachar . . .	24 49 43	92 47 21	34 43	" 1 13	0'3692	
XXII	Dibrugarh . . .	27 29 24	94 55 40	39 30	" 1 19	0'3587	

NOTE.—The above values of Dip, Declination and Horizontal Force are uncorrected for secular change, diurnal variation, instrumental differences, etc., and are to be considered preliminary values only. Where blanks occur, values have already been found during previous field seasons, or the observations have not been completed.

The Survey numbers refer to the published chart: thus No. 33 3 denotes No. 3 station, the spherical coordinates of whose centre are 26° North Latitude and 76° East Longitude.

All Longitudes are referable to that of Madras Observatory taken at the value 83° 14' 47" East from Greenwich.

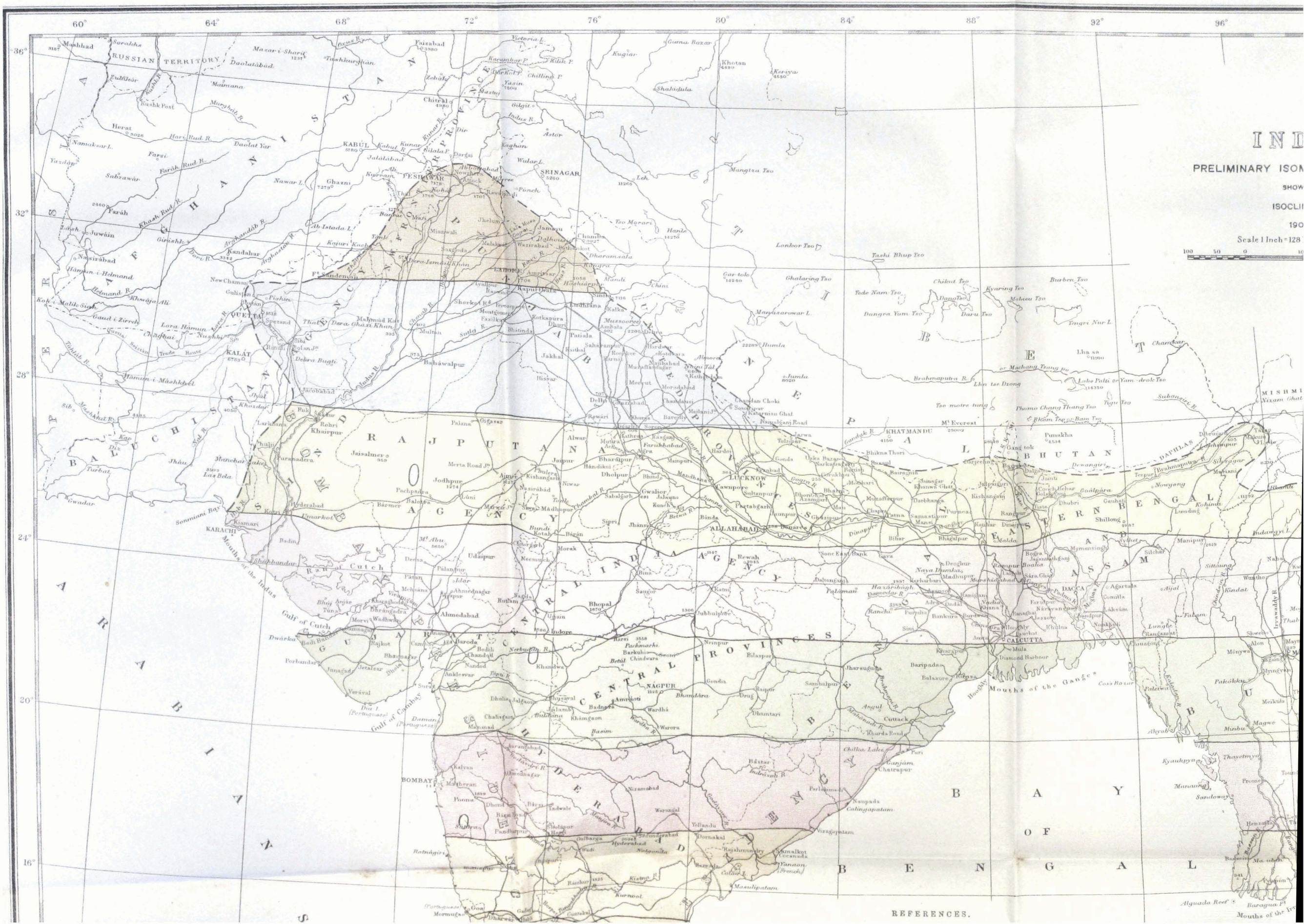




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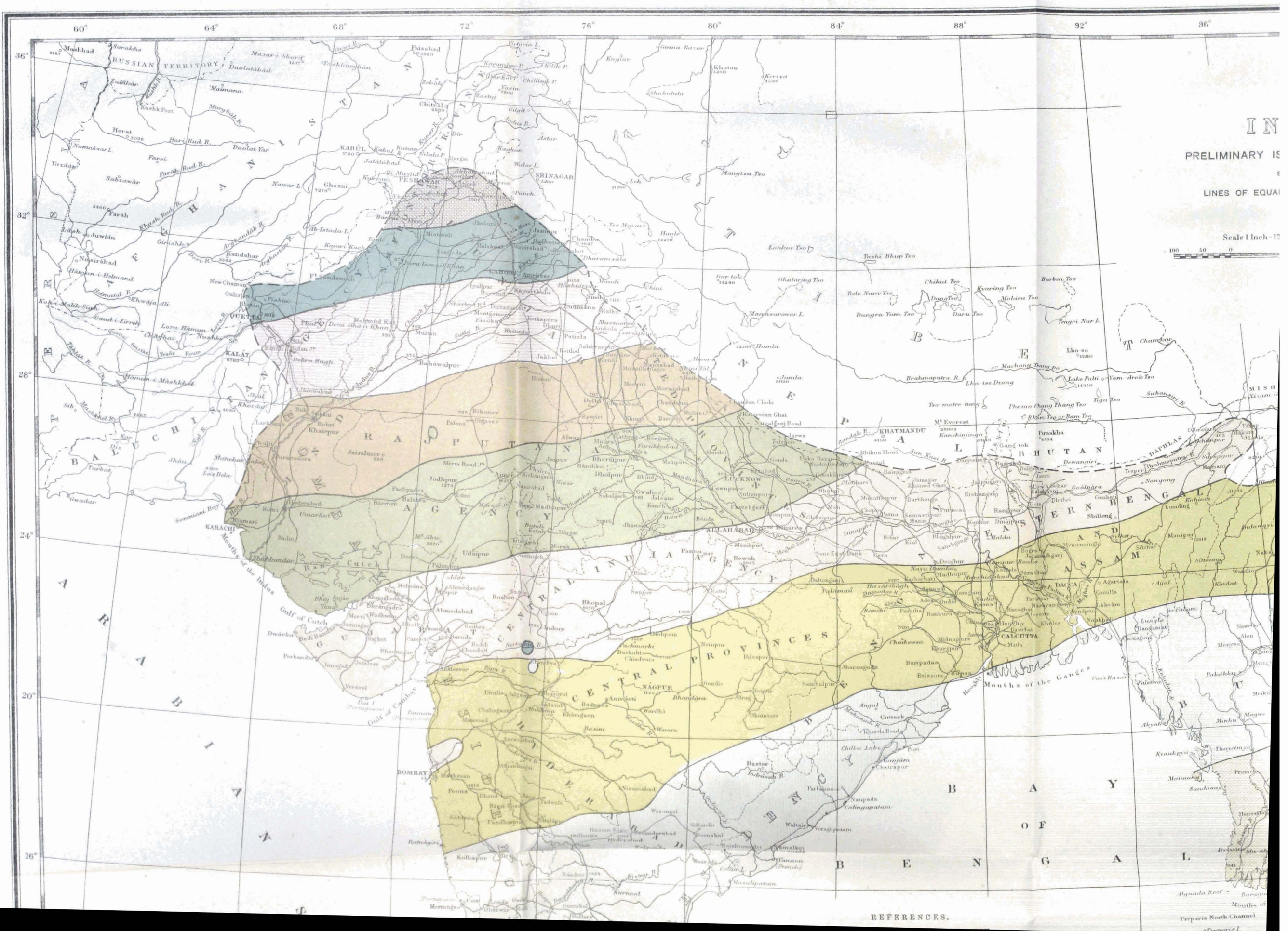
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REFERENCES.



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REFERENCES.

Preparis North Channel  
Aquila Reef

TOPOGRAPHICAL SURVEYS.

CENTRAL AND UNITED PROVINCES AND CENTRAL INDIA STATES.

NO. 1 PARTY (*vide* INDEX MAP NO. 1).

117. The party was employed in completing to margin standard sheets of which the Central Provinces portion only had been surveyed, and the contouring of which required revision.

*Personnel.*

*Imperial Officers :*

Lieutenant M. N. MacLeod, R.E., in charge up to 2nd April 1908.  
Lieutenant K. W. Pye, R.E., in charge from 3rd April 1908.

*Provincial Officers :*

Messrs. F. S. Bell, F. P. Walsh, W. Skilling, C. Litchfield, H. W. Biggie, B. M. Berrill, and R. E. Saubolle, Babu Munshi Lal.

*Subordinate establishment :*

46 Surveyors, etc.

128. Field work commenced on the 1st of November and continued till the middle of May, by which date the programme was completed with the exception of a small area in one sheet.

129. The outturn of the surveyors has continued to improve with a few exceptions, and that of the whole party has increased notwithstanding the reduction in numbers. The number 46 shown in the margin was

the strength of the surveyors, etc., on taking the field. Of these, one surveyor died, two were discharged for irregular conduct, one retired voluntarily, and one was discharged as unlikely to become efficient.

130. The greater part of the area surveyed consisted of revision survey in the Central and United Provinces. The remainder, entirely new survey, lay in the Central India States. The country surveyed was of varying description, consisting of steep jungle-clad hills from 150 to 300 feet in height, generally flat-topped, and lying for the most part in the Saugor and Hatta *tahsils*. To the north-west of the Sunár river in the Damoh district there was flat or gently sloping ground covered with jungle, while in the Khurai *tahsil* of the Saugor district there were extensive flat grass lands and cultivated plains.

Four large rivers, the Bina, Biás, Sunár, and Birma, flow through the work.

131. The outturn of the season and cost-rates per square mile are as follows :—

	Square miles.	₹
Re-survey on 1-inch scale of Central India States	35 <sup>1</sup>	12'4
Re-survey on 2-inch scale of Central India States	177	25'4
Revision survey on 2-inch scale	2,619	17'3
Fair mapping	3,264	5'0

The area surveyed lay in sheets 54  $\frac{L}{7, 8, 12, 16}$ , 54  $\frac{P}{4, 7, 8, 12, 16}$ , 55  $\frac{I}{5, 6}$  and 55  $\frac{M}{9, 13}$ .

132. The total cost of the party for the year under report was ₹1,01,348.

133. Triangulation on a large scale was undertaken for the first time for some years. The country triangulated was for the most part thickly wooded, and much clearing was found necessary, several sorts of double trestles or stands of kinds to raise the theodolite above the jungle were tried with varying success. The wooded nature of the country made the work slow and restricted the outturn, but an area of 2,274 square miles was completed at a cost of ₹9'9 per square mile including computation.

134. The boundaries of 86 villages with a total length of 433 miles were traversed for the Local Government, at a cost of ₹4,105, and 203 miles of traversing for topographical requirements were carried out, at a cost of ₹4,107 including computation.

135. The average outturn per man per month in each class of work was as follows :—

New survey 1 inch = 1 mile—16'6 square miles, with 15 fixings and 3 heights per square mile.

New survey 2 inch=1 mile—7.4 square miles, with 27 fixings and 7 height per square mile.

Revision 2 inch=1 mile—17.9 square miles, with 12 fixings and 5 heights per square mile.

Triangulation—114 square miles.

Traversing topographical—22.6 linear miles with 4 stations per mile.

Traversing cadastral—23.7 linear miles with 7 stations per mile.

136. The attitude of the villagers particularly in the Saugor district was far from friendly, and much difficulty was often experienced in obtaining assistance and supplies. In the Panna State, however, the officials showed great courtesy and willingness to help all round, and no difficulties were consequently experienced.

137. The mapping was not quite completed during the recess, but sheets  $54 \frac{L}{7, 8, 12, 16}$ ,  $4, 8, 12, P$ ,  $55 \frac{I}{5, 6}$  and  $55 \frac{M}{13}$  will be sent in for publication early in the field season, and it is hoped to submit sheets  $54 \frac{P}{7, 16}$  for publication early in 1909. Triangulation charts await further triangulation before completion. The computations of triangulation required for next season's work were completed, and the remainder will be completed during the field season.

138. The party was inspected by the Deputy Surveyor General during the field season, and was under his direct supervision for a portion of the recess.

139. Next season supplementary triangulation will be carried out in sheets—

$$64 \frac{A}{4, 8, 11, 12, 15, 16}, 55 \frac{M}{4, 6, 7, 8}, 55 \frac{I}{14, 15, 16},$$

and re-survey and revision in sheets— $64 \frac{A}{1, 5, 9, 10, 13, 14}$ ;  $55 \frac{M}{1, 2, 3, 5}$  and part of  $55 \frac{M}{9}$ ,  $55 \frac{I}{10}$ ,  $55 \frac{N}{5}$ .

## BERAR.

### NO. 2 PARTY (*vide* INDEX MAP NO. 1).

140. The party was constituted as in previous years as an instructional one and was employed on the continuation of the topographical survey of Berar on the scales of 1 and 2 inches = 1 mile.

#### *Personnel.*

#### *Imperial Officers:*

Captain H. Wood, R.E., in charge, Lieutenant R. Foster, I.A., from 3rd October to 3rd December 1907, Lieutenant J. A. Field, R.E., from 12th May 1908.

#### *Provincial Officers:*

Messrs. A. Ewing, C. J. Veale, and E. A. Meyer and 15 Probationers.

#### *Subordinate Establishment:*

7 Soldier Surveyors, 3 Surveyors, 2 Clerks, 1 Computer, 1 Hospital Assistant.

and  $55 \frac{L}{3, 4, 7, 8}$ . The country required careful reconnaissance as most of that in sheet 55H was very flat with no commanding features, while that in sheet 55L was in many places heavily wooded. The average number of square miles to each point trigonometrically fixed is 3.9.

142. The detail survey of 1,316 square miles was carried out. Sheets  $55 \frac{H}{4, 7, 8, 12, 16}$  were completed and sheet  $55 \frac{H}{3}$  was partially surveyed. Rather more than half the area was on the scale of 2 inches = 1 mile, the remainder being on the scale of 1 inch = 1 mile. The average monthly outturn per man per month was 7.8 and 20.2 square miles of detail survey on the two scales respectively.

143. The country surveyed on the 2-inch scale was very difficult for untrained men. It consisted of very broken hills covered with forest sufficiently

dense to prevent the view of anything more than a few chains distant. That surveyed on the 1-inch scale was on the other hand very easy, being undulating country with very little detail and plenty of easily distinguishable natural features.

144. The boundaries of all A and B class forest reserves which fell in the area of detail survey were traversed by the plane-table, and plotted on the scale of 4-inches to the mile. The total length of such traverses was 286 miles. Field work closed on the 2nd May 1908.

145. The total cost of the party for the season under report was ₹95,347.

146. The fair mapping of all the sheets completely surveyed (sheets 55  $\frac{H}{4, 7, 8, 12, 16}$ ) was finished during the recess, as also the computation of the triangulation, and the fair maps will shortly be submitted for publication.

147. During the month of January Mr. Kenny while engaged on triangulation work, had the misfortune to be involved in a *fracas* with some villagers, and was compelled to shoot one in self-defence. Mr. Kenny, it is, however, satisfactory to mention, was subsequently exonerated from all blame and commended for his forbearance, while the punishment subsequently inflicted on his assailants will, it is hoped, prevent such attacks in future. With this exception, however, the relations with the villagers were good in the area surveyed, and the authorities assisted in every way.

148. The party was inspected by the Deputy Surveyor General both during the field season and in recess.

149. Next season it is proposed to turn the party into an ordinary topographical one, and the survey of sheets 55  $\frac{H}{1, 2, 3, 5, 6}$  and 55  $\frac{L}{2, 3}$  is to be completed on the 1-inch scale, and sheets 55  $\frac{K}{11, 12, 15, 16}$  are to be triangulated in advance.

## BOMBAY PRESIDENCY.

### NO. 17 PARTY (*vide* INDEX MAP NO. 1).

150. This party was divided into three camps, under Messrs. Norman, Wilson, and Anderson, and the three detachments left Poona for the field about 12th November 1907 and returned

#### *Personnel.*

##### *Imperial Officer:*

Mr. B. G. Gilbert-Cooper, in charge from 1st June 1908 to 29th July 1908.

##### *Provincial Officers:*

Mr. S. F. Norman (Senior), in charge up to 31st May 1908, and from 30th July 1908, Messrs. J. H. Wilson, P. R. Anderson, F. B. Kitchen, and C. O. Picard, Babus A. K. Mitra, and P. C. Mitra.

##### *Subordinate Establishment.*

30 Surveyors, 2 Clerks, and 1 Hospital Assistant.

to recess quarters on 1st June 1908, a somewhat longer field season than usual; this being necessary to complete the survey of the country known as Akhráni, a mountainous and desolate tract of the Sâtpudas, notoriously malarious, and which it is inadvisable to enter before February.

151. The operations of the party comprised—

- (1) Revision, on scale 2 inches = 1 mile, of sheets 46  $\frac{O}{4, 8, 12, 16}$  amounting to 1,108 square miles.
- (2) The re-survey, on scale 2 inches = 1 mile, of sheets 46  $\frac{K}{1, 5, 10, 14}$  and parts of 46  $\frac{K}{2, 6}$  amounting to 1,250 square miles.
- (3) Forest boundary surveys on the scale 4 inches = 1 mile amounting to 423 linear miles.
- (4) Supplementary triangulation over sheets 46  $\frac{O}{9, 10, 11, 13, 14, 15}$  and 46  $\frac{P}{1, 2, 5, 6, 9, 10, 13, 14}$  for 1-inch scale detail surveys, amounting to 3,375 square miles.



152. The following table shows in detail the outturn with cost-rates for the year under report, and for purposes of comparison those of the preceding year are also given:—

Description of Survey.	OUTTURN SQ. MILES.		COST-RATES PER SQ. MILE.	
	1906-07.	1907-08.	1906-07.	1907-08.
Triangulation 1" = 1 mile . . . . .	2,155	3,375	₹5.5	₹3.0
Topography revision survey 2" = 1 mile . . . . .	2,292	1,108	15.6	18.0
Topography re-survey 2" = 1 mile . . . . .	348	1,250	31.6	32.7
Skeleton forest boundary survey 4" = 1 mile (linear miles).	140	423	4.7	7.2

The area triangulated is largely in excess of last season's owing to the fact that it was done for 1-inch scale surveys while that for the previous season was done for work on the 2-inch scale, and for this reason no comparison can be made of cost-rates. The area of revision survey completed this season is less than half of the area done last season, and the cost-rate is slightly in excess. But this is more apparent than real, as last year's area contained 364 square miles of forest that had been previously surveyed on scale 4 inches = 1 mile, and being of recent survey it required but little revision. Had this area been excluded the cost-rate for last year would have amounted to ₹19.5 per square mile. This season's cost-rate therefore bears favourable comparison with that of the previous year. The area of re-survey is largely in excess of last year's and the cost-rates are almost identical, and this is satisfactory considering the nature of the country which was the most trying and difficult that the party has yet had to contend with.

153. The total cost of the party for year under report amounts to ₹80,556.

154. The area under re-survey embraced 554 square miles of reserved forest (which had not been previously surveyed on any larger scale) and included in—

	Square miles.
Taloda (including Akhráni) . . . . .	384
Sháháda . . . . .	57
Shirpur . . . . .	113

while the forest area under revision was insignificant, amounting to only 0.87 square miles.

The skeleton forest boundary survey was as follows:—

	Linear miles.
Taloda (including Akhráni) . . . . .	327.8
Sháháda . . . . .	58.7
Shirpur . . . . .	36.0

155. The detail surveys were tested in the field by 714 linear miles of chain *partial*, in addition to *in situ* examinations, which had to be largely resorted to over the area under re-survey, owing to the rugged nature of the country. The detail survey on 2-inch scale was tested by 1 linear mile of check line to 3.3 square miles surveyed. The averages for the revision and re-survey work out as follows:—

	Square miles, daily.	Square miles, monthly.	No of fixings per square mile.
Revision . . . . .	0.69	15.2	17
Re-survey . . . . .	0.47	10.3	31

156. During the recess the mapping has made good progress, and every effort has been made to reduce the arrears of Forest mapping pertaining to season 1905-06. It is hoped that before the close of this recess 23 sections on the scale 4 inches = 1 mile, pertaining to the Sátára district will be submitted for publication, leaving 22 sections in all to be completed and published next year.

In addition, the drawing of the 10 standard sheets on a scale of 2 inches = 1 mile, is well in hand, and sheets  $46 \frac{K}{10}$ ,  $46 \frac{O}{4, 8, 12, 16}$ , will be submitted for publication early in November. The remaining sheets  $46 \frac{K}{1, 2, 5, 6, 14}$  will, it is hoped, be sent in during the field season.

157. The arrears of computations have been cleared off, and the computation of the season's triangulation will be fully completed before the party leaves recess quarters.

158. The health of the party in the plains was excellent, but in other places there was a good deal of malarial fever.

159. The Deputy Surveyor General inspected the party on several occasions during the months of September and October 1908.

160. The programme for 1908-09 comprises:—

Revision survey on scale 1 inch = 1 mile of sheets  $46 \frac{K}{9, 13}$ , and portions of sheets  $46 \frac{O}{1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15}$ , amounting to about 3,190 square miles

Re-survey, on scale 2 inches = 1 mile, of the forest areas in sheet  $46 \frac{O}{2, 3, 7, 11, 15}$ , amounting to about 675 square miles.

Boundary survey on scale 4 inches = 1 mile, of such forests as falls within sheets  $46 \frac{O}{2, 3, 7, 11, 15}$ , and supplementary triangulation of sheets  $46 \frac{P}{3, 4, 7, 8, 11, 12, 15, 16}$ , amounting to about 2,230 square miles.

BURMA.

NO. 3 PARTY (*vide* INDEX MAP NO. 2).

161. The recess office at Bangalore closed on the 12th November 1907 and re-opened there again on the 26th June 1908, which gave the party another long field season. The original programme comprised the completion of degree sheet 84 K partly on the 1-inch and partly on the 2-inch scales but owing to several surveyors being absent on sick leave and two on deputation the party was only able to survey nine out of the twelve standard sheets allotted to it.

*Personnel.*  
*Imperial Officer:*  
 Captain C. P. Gunter, R.E., in charge.  
*Provincial officers:*  
 Messrs. W. M. Gorman, J. O'B. Donaghey, S. F. Norman (Junior), E. Claudius, and H. D. Stotesbury.

*Subordinate Establishment:*  
 23 Surveyors, 2 Traversers, and 4 Draftsmen.

162. The outturn and cost-rates of the party for the season under report were as follows:—

Nature of Survey.	Outturn, sq. miles.	Cost-rates per square mile.	REMARKS.
Triangulation . . . . .	1,070	R 22.3	} (a) Linear miles. Including mapping.
Traversing . . . . .	188 (a)	56.0 (a)	
Detail survey, 1-inch scale . . . . .	414	24.1	
"    "    supplementary, 1-inch scale	1,688	24.8	
"    "    2-inch scale . . . . .	299	88.0	
TOTAL DETAIL SURVEY . . . . .	2,401		

The average monthly outturn of a surveyor was 30 square miles for 1-inch survey, 25 for 1-inch supplementary survey, and 7 for 2-inch survey. Much of the cadastral survey on which the supplementary survey was based consisted merely of *kwin* boundaries without any detail, so that the survey was really a new one and the country was much more difficult than that in which the original survey was carried out; this accounts for the results not being better. An area

of 299 square miles of forest reserves was surveyed on the 2-inch scale and maps containing forest area will be published on that scale for the use of the Forest department.

The total cost of the party was at R1,13,490 for the year ending 30th September 1908.

163. At the request of the Government of Eastern Bengal and Assam, Surveyor Pertab Singh was deputed to accompany the Superintendent of the Lushai Hills on an expedition sent out for the purpose of defining the limits of the Lushai Hills, the Chin Hills, and the Arakan Hill tracts; he completed the survey of 1,194 square miles of hitherto unmapped country on the  $\frac{1}{4}$ -inch scale. Mr. Morton from No. 26 Party joined the expedition at a later date for the purpose of extending the triangulation.

164. The health of the party was good, although several members of it suffered from fever contracted in the previous season in the Salween valley. Heavy rains occurred during the last few weeks of the field season and retarded the work.

165. The area under survey was of varied character. In the south-east corner the country on both banks of the Irrawaddy consisted partly of open cultivated plains and partly of low bare ridges and undulating ground, cut up by innumerable streams; here the interesting ruins of old Pagan and the oil fields of Yenangyat are to be found. To the west and north-west the country rose gradually through the lower spurs and eastern slopes of the Chin Hills, on which a number of forest reserves are situated, up to the main range where an altitude of 8,000 feet was reached. The well known and prominent peak Mount Victoria, over 10,000 feet in height, lay a few miles to the west of the limits of the survey. The hills are thickly wooded and the forest reserves are much cut up by water-courses which rendered their survey, on the 2-inch scale, a very difficult and tedious operation.

166. The area surveyed was mapped on the  $\frac{1}{2}$ -inch scale for reduction to 1-inch standard sheets of which the following eight were completed and submitted for publication:— 84  $\frac{K}{3, 7, 8, 10, 11, 12, 15, 16}$  and sheet 84  $\frac{K}{4}$  will be fair drawn shortly.

167. The draftsmen of the party have now mastered the new system of mapping and the improvement in the quantity and quality of their work is marked.

168. The party was inspected in the field and in recess by the Superintendent in charge Burma Surveys.

169. Triangulation for next season's topography was carried out over 1,070 square miles. In the flat country to the east of the Chindwin river which covered about 700 square miles, it was also found necessary to supplement the triangulation by traversing, by which the heights of many prominent points were determined. As the party will be transferred to the Madras Presidency in season 1909-10, the triangulators will be attached to the Coorg detachment, and will carry out advance triangulation for the party in Coorg, Malabar, and South Canara. The programme of detail survey in Burma for the ensuing season consists of the 1-inch survey and supplementary survey of 3,032 square miles in sheets 84 J and 84 K chiefly in the Chindwin valley.

## UPPER BURMA.

### NO. 10 PARTY (*vide* INDEX MAP NO. 2).

170. The party left its recess quarters at Bangalore on the 6th of November 1907 and returned there on the 24th of June 1908. In future the party will recess at

#### *Personnel.*

##### *Imperial Officer:*

Captain A. A. McHarg, R.E., in charge.

##### *Provincial Officers:*

Messrs. P. J. Barrington, M. J. Sheehan, W. G. Jarbo, and E. M. Kennv, Munshis Asmat Ullah Khan and Abdul Rahim, K. S.

##### *Subordinate Establishment:*

24 Surveyors, 2 Traversers, 1 Computer, 1 Typist, 2 Clerks, 1 Hospital Assistant.

Bangalore on the 6th of November 1907 and returned there on the 24th of June 1908. In future the party will recess at Maymyo in Burma, and the loss of time spent on the journeys to and from Burma to Bangalore will be avoided.

171. The outturn and cost-rates of the party were as follows :—

Description of Survey.	Outturn, sq. miles.	Cost-rate per sq. mile.	REMARKS.
Triangulation . . . . .	3,337	₹ 6.49	
Traversing . . . . .	248 (a)	31.38 (a)	(a) Linear miles.
Detail survey, 1-inch scale . . . . .	1,707	34.17	
Supplementary survey " " . . . . .	887	19.90	The cost-rates include the cost of fair mapping.
Revision survey . . . . .	89	19.81	
Survey, 2-inch scale . . . . .	465	50.40	
" 4- " " . . . . .	4	56.00	
<b>TOTAL DETAIL SURVEY . . . . .</b>	<b>3,152</b>		

The average monthly outturn of a surveyor was 32.19 square miles for 1-inch, 57.12 for supplementary, and 11.16 for 2-inch surveys. Part of the supplementary survey consisted of area previously cadastrally surveyed on the 16-inch scale and part of forest reserves previously surveyed on the 4-inch scale; in the case of the latter, the old detail was generally accepted but the work had to be re-contoured. The cost-rate per square mile of the former class of supplementary survey was ₹23.5 for an area of 497 square miles, and of the latter ₹15.4 for an area of 390 square miles. For the most part, the cost-rates of this party compare very favourably with those of last year. The total cost of the party for the year ending 30th September 1908 was ₹1,33,045.

172. The detail survey was on the scale of 1 inch=1 mile with contours at 50 feet vertical interval, and 2 inches=1 mile for forest reserves, of which an area of 465 square miles was surveyed; special maps of this area on the scale of survey will be published for the use of the Forest department. Owing to sickness among the surveyors the party was unable, notwithstanding its long field season, to quite complete its programme, which was an ambitious one considering the strength of the party. The small area remaining over will be surveyed early next season, and will be mapped in the Burma Drawing office. The country under survey was of a very varied description. In Katha, Shwebo, and Upper Chindwin districts, falling principally in degree sheet 84 M, the country consisted partly of cultivated plains and partly of comparatively low hill ranges covered with jungle. In the north of the Ruby Mines district the area lay in the valleys of the Irrawaddy and Shweli rivers, and the country was generally undulating or flat with marshes and plains covered with a dense growth of *kine* grass. The survey of sheets 93  $\frac{E}{4.8}$  was taken up at the instance of the Geological Survey department on account of the important lead and silver mines occurring in them. These mines in former times had been worked by the Chinese who abandoned them after extracting all the silver they could find; a company has recently been formed with the immediate object of extracting the lead from the slag which lies in mounds near the old workings. A mineral line has been built connecting the mines with the Lashio branch of the Burma railways. These sheets comprise a portion of the Northern Shan States consisting of high steep jungle-covered hills inhabited chiefly by Kachins, Lihsaws, and Palaungs. The climate was trying and the health of the party was not good except in the Shan States. Three *khalasis* died of cholera on the voyage between Calcutta and Rangoon, on the way to the field.

173. The following eight sheets have been surveyed and drawn in the party on the  $1\frac{1}{2}$ -inch scale and will be submitted shortly for publication as 1-inch standard sheets, *vis.*—84  $\frac{M}{2, 6, 10, 14}$ , 93  $\frac{A}{1, 5}$ , and 93  $\frac{E}{4, 8}$ . The remaining 4 sheets, *vis.*, 84  $\frac{M}{1, 5, 9, 13}$  will be completed in the Burma Drawing office and also sheet 84  $\frac{1}{15}$  of which only a portion, consisting entirely of reserve forest, has been surveyed on the 2-inch scale and will be drawn for publication on that scale. The failure to complete the mapping was due chiefly to the short recess season which consisted of a little over four months. The computations of the traversing and triangulation have been completed, and good progress has been made in the preparation

of triangulation charts. The party was inspected in the field and in recess by the Superintendent in charge Burma Surveys.

174. The programme for 1908-09 consists of the completion of the detail survey on the 1-inch scale in degree sheets 84 M and 93 A. Forests occurring in the programme which have already been surveyed on the 4-inch scale will be supplemented and contoured on the 1-inch scale and new forests will be done on the 2-inch scale. The Mosit reserve in the Bhamo district which lies outside the programme will be surveyed at the expense of the Forest department. Triangulation will be extended into degree sheet 92 H.

### SHAN STATES, BURMA.

#### NO. 11 PARTY (*vide* INDEX MAP NO. 2).

175. The recess quarters of the party, which were at Bangalore during the previous year, were transferred to Maymyo, which is on the whole, the most convenient recess quarters for parties working in Burma. The newly erected head-quarter offices of the Burma Police have been placed at the disposal of the department and Nos. 10 and 11 Parties will occupy them in future. The journey from Bangalore to the field occupied seven to eight weeks. Field work was not commenced until the middle of December and the field season lasted for about four and a half months.

176. The outturn and cost-rates of the party were as follows:—

Nature of survey.	Outturn, sq. miles.	Cost-rate per sq. mile.	REMARKS.
Triangulation . . . . .	3,800	₹ 8'9	Inclusive of mapping.
Detail survey, 1½-inch scale . . . . .	2,303	44'9	

The average daily outturn of a surveyor was 1'19 square miles. As it was too late to change the scale in this party the survey was carried out on the 1½-inch scale as in the previous year with contours at 50 feet vertical interval. The outturn on the 1½-inch scale has proved to be only 10% less than on the 1-inch in similar country. The quality of the work, triangulation, topography, and mapping is good and the surveyors are rapidly adapting themselves to the new conditions.

The total cost of the party for the year under report amounted to ₹1,41,591 including ₹2,198 on account of the training school at Bangalore.

177. The health of the party was fairly good. The climate in the low country along the Siamese frontier and in the Me-kong valley, the mean level of which was between 1,500 and 2,000 feet above sea-level, was trying. Smoke and haze interfered considerably with the work during February and March. Heavy rain was met with during the return journey to Maymyo which was a trying one. There were the usual cases of malarial fever; two surveyors died at their homes during recess and two menials during the field season.

178. The area surveyed was situated in the Keng-Tung State on the borders of Siam and of the *Province du haut Me-kong* in French Indo-China. In the north the hills rose to over 6,000 feet and were covered with open pine forest. Further south near the Siamese frontier the hills were not so high or steep as in the north and open grassy plains were met with. The country surveyed was well populated by many different tribes. Communications were good, as in this corner of the Shan States several main trade routes meet. Steamers have ascended the Me-kong as far as Tang-aw (latitude 21°40'), but the regular service stops at Ban Hwé Sai, the head-quarters of the *Province du haut Me-kong*



necessary in the greater part of the State. The work was found on the whole very good, except in the more thickly-wooded portions, and its revision will be easy and comparatively inexpensive. Owing to the difficult nature of the country the cost-rate of the 2-inch survey is high. That of 4-inch forest survey is very high, but is due to the small area dealt with and to the fact of the forest being situated in a remote part of the country (Ganjám), to and from which the transit charges were unusually heavy. The total cost of the party for the year ending 30th September 1908 was Rs 1,22,816.

185. Except on the Malabar coast the health of the party was not good. There was much fever among the men working in Ganjám and in the Wynaad, not only during the field season, but after the return of the party to recess quarters. One surveyor and two *khalásis* died during the year. The climate on the coast was pleasant enough though hot; both there and in the Wynaad, early rains in April and May interfered considerably with the work.

186. The country topographically surveyed was situated in the Malabar and Nilgiri districts and in the Mysore State. It consists of a wide level strip along the coast, of a portion of the Wynaad (a plateau 3,000 feet above sea-level which forms a continuation of the Mysore plateau), and part of the high range of the Western *ghats*. The coastal tracts, although containing extensive rice plains and backwaters, present the appearance when viewed from above, of a sea of coconut palms. The Wynaad is scantily populated and covered with dense jungle; it has an unenviable reputation for being one of the most malarious tracts in Southern India. The higher *ghats* form a bold rocky barrier and the scenery is extremely beautiful. Notwithstanding its natural beauties and interesting inhabitants, the country being so thickly wooded is a tedious one to survey except on the higher hills. The position of each house has to be fixed as it would be misleading to attempt to block the villages in the usual conventional way. The standard sheets surveyed during the year were 49  $\frac{M}{11, 13, 15, 16}$  and 58  $\frac{A}{1, 2, 3, 4, 5}$ . Sheet 57  $\frac{H}{14}$ , comprising an area of 289 square miles in the Salem district, was also surveyed and mapped by a small training detachment of 14 native surveyors under Mr. G. T. Hall, a retired Provincial officer. The detachment was broken up on 30th September and the men transferred to other parties.

187. The mapping of this party is very backward and only 3 maps, 49  $\frac{M}{11, 15, 16}$ , have been completed and forwarded to the reproducing offices. The following sheets were drawn in outline only:—49  $\frac{M}{13}$  and 58  $\frac{A}{4}$  on the 2-inch scale and 58  $\frac{A}{1, 2, 3, 5}$  on the  $1\frac{1}{2}$ -inch for reduction to 1-inch. The drawing of the hill sheets will be taken in hand by the Burma Drawing office and it is hoped that all will be forwarded to Calcutta for publication by May 1909.

188. Triangulation was carried southward from latitude  $11^\circ$  through the Coimbatore district into Cochin and Travancore States. Nearly the whole of the province of Coorg and a small area in the Salem district were also triangulated. The boundaries of all forests which occurred in the area under survey were traversed by theodolite and also a portion of the Mysore-South Canara boundary. The computations of both triangulation and traversing are well advanced.

189. The party was inspected in the field and during recess by the Superintendent in charge Burma Surveys.

190. The programme for 1908-09 consists of the completion of degree sheets 58 A, 49  $\frac{N}{13, 14}$ , and 58  $\frac{B}{9, 13}$  in Mysore State and in the Nilgiri, Malabar, and Coimbatore districts. As more than half the total area of the Nilgiri district consists of reserved forests it has been decided to survey the whole of the district on the 2-inch scale; the densely populated coastal tracts will also be surveyed on that scale and the remainder of the area on the 1-inch scale. The portion of the Mysore State occurring in the programme will be revised on the 1-inch scale. Triangulation will be carried into Travancore State and it is hoped that sheets 58 B and C will be completed.

## EASTERN BENGAL AND ASSAM.

NO. 20 PARTY (*vide* INDEX MAP NO. 2).

191. Pending the final formation of Circles, the recess quarters of the party continued at Bangalore. Field work was commenced in the end of November 1907 and closed in the middle of May 1908 giving a field season of a little under six months.

*Personnel.**Imperial Officer :*

Major A. Mears, I.A., in charge.

*Provincial Officers :*

Messrs. P. F. Prunty, C. C. Byrne, J. H. Williams and L. Williams, Babu Pramadarajan Ray, and Munshi Amjad Ali.

*Subordinate Establishment :*

30 Surveyors, 5 Traversers, 3 Computers, 3 Draftsmen, 2 Writers, 1 Hospital Assistant.

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

Nature of Survey.	Outturn, sq. miles.	Cost-rates per sq. mile.	REMARKS.
Triangulation . . . . .	1,731	R 12'8	(a) Linear miles.
Traversing . . . . .	620 (a)	20'90 (a)	
Detail survey—			Cost-rates are inclusive of mapping.
Survey on the 2-inch scale . . . . .	2,590	27'20	
Revision survey on the 2-inch scale . . . . .	307	28'10	
Supplementary survey on the 2-inch scale . . . . .	238	12'26	
TOTAL (DETAIL SURVEY)	3,135		

The scale of survey was 2 inches = 1 mile and the average monthly outturn of a surveyor was 20·4 square miles for original survey, 11·5 for revision survey, and 23·0 for supplementary survey. The reason for the slow progress of revision survey was the difficult and intricate nature of the ground which consisted of low bamboo-covered hills, while the remaining area was for the most part level cultivated country.

193. The total cost of the party for the year ending 30th September 1908 was R1,18,471.

194. On account of the intricate nature of the country and the number of villages, the survey was carried out on the scale of 2 inches = 1 mile with contours at vertical intervals of 50 feet. The revision survey was done in the field on blue prints of the original survey made in 1881-83 by Colonel Woodthorpe and Major Badgely. The general features were found to be accurate and were as a rule accepted by the surveyors, but the contouring had to be done *de novo*. The supplementary survey was done over blue-print reductions of the 16-inch cadastral sheets; the details were tested and found to be accurate but had to be supplemented by more careful surveys of village sites and of new roads.

195. The health of the party was on the whole very good. Two traversers died during the recess season and seven *khalásis* in the field.

196. The area topographically surveyed comprised portions of districts Sylhet, Tippera, and Mymensingh and of the Native State of Hill Tippera. The country was for the most part flat and open, closely cultivated and densely populated. It was intersected by numerous water-courses and tidal creeks, the major portion of the area being only 40 to 50 feet above mean sea level. The villages were for the most part surrounded by gardens thickly planted with bamboos, palms, and mangoe trees. One of the chief features of Sylhet is the great number of *bils*, some of which are large open sheets of water, while others are so overgrown with different kinds of reeds as to be practically impenetrable. The inhabitants, while not actually interfering with the work, evidently viewed the survey operations with suspicion and as a rule afforded little assistance or information to the surveyors. Supplies were plentiful but expensive and labour was scarce.



197. Ten standard sheets were surveyed and drawn on the 2-inch scale, and will be submitted for publication before the end of the year, namely,

78  $\frac{P}{1, 2, 3, 4, 5, 6, 7, 8, 11, 14}$ .

198. The triangulation was connected with the Eastern Frontier G.T. Series and with No. 6 Party's triangulation of 1897-99. All computations have been completed and the results are satisfactory. The traversing was carried out with the object of furnishing additional heights in the area cadastrally surveyed and extra points for the plane-table in the low and thickly-wooded valleys where objects could not be fixed by the triangulator.

199. The party was inspected by the Superintendent in charge Burma Surveys in the field and in recess.

200. The programme for 1908-09 consists of the completion of the detail survey of sheet 78 P on the 1-inch and 2-inch scales and the detail survey on the 2-inch scale of sheets 83  $\frac{D}{10, 11, 14, 15}$  in which large forest reserves are situated. The triangulation and traversing of sheet 83 D north of latitude  $24^{\circ} 15'$  will also be completed. It is not proposed to carry the survey to the south of that latitude at present, as the country there is very thinly populated and not of much importance.

NORTHERN CIRCLE.

NO. 9 PARTY (*vide* INDEX MAP NO. 1).

201. This party continued the work on which it was employed during the preceding season in and about Dera Gházi Khan district of the Punjab.

*Personnel.*

*Imperial Officers :*

Lieutenant E. C. Baker, R.E., in charge up to 24th April 1908, and from 14th September 1908.

Lieutenant F. J. M. King, R.E., in charge from 25th April 1908 to 13th September 1908.

*Provincial Officers :*

Messrs. J. A. Freeman, H. C. W. Stotesbury, D. K. Rennick, R. C. Hanson, and H. W. McDonald.

*Subordinate Establishment :*

24 Surveyors, 3 Computers, 2 Writers, and 4 Soldier Surveyors.

This consisted of original topographical surveys on the scale of 2 inches = 1 mile, and 1 inch = 1 mile, for publication on the 1-inch scale.

202. The work in the hills was based on last season's triangulation and in the plains on traverses executed in 1872-75. 2-inch reductions of the old 4-inch riverain maps were utilised to a certain extent for the work in the plains.

203. The field office opened at Dera Gházi Khan on 27th October 1907 and closed on 15th April 1908.

204. The outturn of the party for the season is as follows :—

Original 1-inch survey . . . . .	1,542.6 square miles.
"    2    "    "    . . . . .	77.4    "
TOTAL . . . . .	<u>2,313.0</u> "

The 1-inch work comprised the whole of standard sheets 39  $\frac{J}{2, 3, 4, 6, 7, 8}$  and the 2-inch " " " " " " " " 39  $\frac{J}{9, 10, 11}$ .

Minor and tertiary triangulation was carried through standard sheets 39  $\frac{I}{3, 4, 7, 8}$  and 39  $\frac{J}{1, 5}$  ; a total area of 1,534.04 square miles.

205. The cost-rates for survey are —

	Per square mile.
	R
2-inch original survey . . . . .	22.1
1- " " " . . . . .	27.5
Triangulation . . . . .	5.7
Mapping . . . . .	6.4

The cost of 1-inch exceeds that of the 2-inch work, as the 1-inch work was all in hilly country where transport allowances and warm clothing charges were very high, while the 2-inch work was in the plains. The total cost of the party for the year under report was R85,163.

206. During recess, all the nine standard sheets surveyed during the year, *viz.*, 39  $\frac{J}{2, 3, 4, 6, 7, 8, 9, 10, 11}$  and also sheet 39  $\frac{K}{1}$  (surveyed during 1906-07) were drawn and forwarded to the Superintendent, Northern Circle, for submission to the reproducing offices.

207. The character of the ground surveyed was varied. Sheets 39  $\frac{J}{2, 3, 4, 6, 7, 8}$  consisting of very hilly, broken country rising from 600 feet above sea level in the east to 7,000 feet in the west. The plain country in sheets, 39  $\frac{J}{9, 10, 11}$  lying just to the west of the Indus is flat and sandy, and except for a strip of country along the Indus is extremely dry.

208. The party was inspected in the field by the Superintendent, Northern Circle, in December 1907, and March 1908.

209. The programme for next field season will be detail survey on the scale of 1 inch = 1 mile, in portions of sheets 39 I and J and triangulation in 39 I and E.

NORTHERN CIRCLE.

NO. 12 PARTY (*vide* INDEX MAP NO. 1).

210. Captain and Brevet-Major E. T. Rich, R.E., was in charge of the party for practically the whole year.

*Personnel.*

*Imperial Officers :*

Captain and Brevet-Major E. T. Rich, R.E., in charge, Captain L. C. Thuillier, I.A., from 1st August 1908. Lieutenant S. W. Hamilton, R.E.

*Provincial Officers :*

Messrs. W. Newland, F. H. Grant, and H. H. P. Butterfield, Munshis Rahamatulla, K.S., and Abdul Karim, and Babu Dhani Ram.

*Subordinate Establishment :*

27 Surveyors, Computers, Writers, etc., and 3 Soldier-Surveyors.

211. The party carried out the sanctioned programme in the Pesháwar and Hazára districts and a small portion of the Attock district, as follows :—

(a) A network of triangulation in the Hazára district over an area of 1,200 square miles.

(b) Detail survey on 2-inch scale of an area of 1,582 square miles.

212. The detail survey work was tested by 1,179 "in situ" fixings.

213. The cost-rates are as follows :—

	Per square mile,
	₹
2-inch detail survey . . . . .	34.8
Triangulation . . . . .	11.4
Fair mapping . . . . .	8.2

The cost-rate this season for 2-inch detail survey is satisfactory, being ₹19 per square mile lower than that of last year.

214. The total cost of the party for the season under report was ₹85,844.

215. The work in the field was closed on 15th June 1908 when the party returned to Mussooree for recess.

216. During the recess the following standard sheets surveyed during the year were drawn and forwarded to the Superintendent, Northern Circle, for submission to the reproducing offices : 38  $\frac{O}{5, 9, 13}$ , 43  $\frac{C}{1}$ .

Sheets 38  $\frac{N}{8, 12, 16}$  and 43  $\frac{B}{4}$  will be submitted in January 1909, but sheet 38  $\frac{N}{11}$  is retained for additional survey.

217. The health of the party during the field season was very satisfactory.

218. The party was inspected twice during the field season by the Superintendent, Northern Circle, and once during the recess by the Officiating Surveyor General and three times by the Superintendent, Northern Circle.

219. It will undertake next field season detail survey in sheet 43  $\frac{B}{8}$  (remainder), 43  $\frac{B}{7, 11, 12, 15, 16}$ , and western halves of 43  $\frac{F}{7, 8}$  and triangulation in the Hazára district.

## NORTHERN CIRCLE.

NO. 14 PARTY (*vide* INDEX MAP NO. 1).*Personnel.**Imperial Officers:*

Captain H. L. Crosthwait, R.E., in charge from 11th October 1907 to 5th May 1908. Lieutenant V. R. Cotter, I.A., in charge from 1st to 10th October 1907. Lieutenant O. H. B. Trenchard, R.E., in charge from 6th May 1908. Captain L. C. Thuillier, I.A., from 24th October 1907 to 13th April 1908.

*Provincial Officers:*

Messrs. T. W. Babonau, H. H. B. Hanby, H. B. Simons, C. West, A. B. Hunter, W. J. B. Miller, and F. C. Saint.

*Subordinate Establishment:*

38 Surveyors, etc.

220. The operations of the party lay in the Kohát and Attock districts.

221. The detail survey on the 2-inch scale of the whole of the Kohát district has now been completed, and also two complete standard sheets in the Attock district.

222. Operations in the field commenced in the middle of November 1907,

and the party returned to recess quarters in Mussooree about middle of May 1908.

223. The country surveyed was on the whole suitable for survey operations, being practically destitute of forest growth. Portions of the Kohát district are mountainous and difficult of access, but nearly the whole of the Attock district consists of undulating country, intersected by deep ravines. Owing to prevailing drought the surveyors experienced difficulty in obtaining water.

224. The area surveyed on a scale of 2 inches = 1 mile was 2,103 square miles.

225. The area triangulated amounted to 1,365 square miles, which with the balance of 1,705 square miles previously triangulated gives a total of 3,070 square miles available for survey during the coming season.

226. The cost-rates are as follows:—

	Per square mile.
	₹
Detail survey 2-inch scale . . . . .	30.5
Triangulation . . . . .	7.2
Mapping . . . . .	7.7

and the total cost-rate of ₹45.4 per square mile compares favourably with last year's rate of ₹57.5.

227. The total cost of the party for the year under report was ₹95,003.

228. The fair mapping of the following 11 standard sheets (drawn on the scale of 2 inches = 1 mile, for reduction to 1 inch = 1 mile, and surveyed during the year under report), was taken up during recess, *viz.*, 38

and 43  $\frac{C}{21,31}$ , and they will be forwarded to the Superintendent, Northern Circle, for submission to the reproducing offices in January and February 1909.

229. The party was inspected in the field by the Superintendent, Northern Circle, in December 1907.

230. The programme for the next field season provides for a continuation of the work in an easterly direction between the latitudes of 33° and 34°, to complete the detail survey of the Hazára district in degree sheet 43 C, and for triangulation in degree sheet 43 G.

## NORTHERN CIRCLE.

No. 18 PARTY (*vide* INDEX MAP No. 1).

231. The head-quarters of the party remained at Dera Ismail Khan throughout the field season, opening there on 11th November 1907.

*Personnel.**Imperial Officers :*

Captain E. A. Tandy, R.E., in charge.  
Lieutenant V. R. Cotter, I.A.

*Provincial Officers :*

Messrs. G. J. S. Rae, C. E. C. French, J. R. Newland, P. D. Simpson, and F. C. Pilcher, Babu Maya Das Puri, and Munshi Abdul Aziz.

*Subordinate Establishment :*

25 Surveyors, 13 Traversers, 17 Draftsmen, 10 Computers, 3 Writers, and 1 Hospital Assistant.

Indus on the scale 1 inch = 1 mile, starting in the centre of  $38 \frac{P}{7}$ , while two traversers were employed in sheets  $39 \frac{1}{13}$  and  $39 \frac{M}{1}$ . The sheets surveyed were  $38 \frac{L}{8, 15, 16}$ ,  $38 \frac{P}{3, 4}$ , and  $39 \frac{1}{13}$ .

233. On the completion of the triangulation in January, detail survey work was continued in sheets  $38 \frac{L}{3, 4, 7, 8}$ , and triangulation was carried on in sheets  $38 \frac{P}{1, 2, 5, 9, 10, 14}$ , and by the end of March work was started on the 1-inch scale in sheet  $39 \frac{1}{13}$ .

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

	Per square mile.
	₹
2-inch surveys 1,267 square miles at . . . . .	35°
1 " " 539 " : : : : .	7 4
Triangulation 1,712 " . . . . .	9 1

The rates for the two scales of survey are not fairly comparable as some of the 2-inch work was very difficult, while the 1-inch work was nearly all easy, falling in the bed of the Indus and involving no contouring.

235. The total cost of the party for the year under report was ₹1,24,401.

236. The largest monthly outturn of a surveyor on 2-inch work was 41 square miles in very open plains, the least being  $5\frac{1}{2}$  square miles. The average monthly outturn of 1-inch work was 42 square miles.

237. The traverse outturn was 462 linear miles at ₹7.4 per mile. It was only supplementary to points already existing, and included the taking of vertical angles to fix heights.

238. Surveyor Garjman Rai was employed from September 1907 to January 1908 in bringing up to date the maps of the country all round Simla, to facilitate the production of a special 1-inch map of that area. He was also employed from May to July 1908 in assisting local officials to fix a boundary in the Simla Hill station (Tehri-Garhwál, Keonthal, and Jaunsár).

239. Standard sheets  $38 \frac{L}{8, 16}$ ,  $38 \frac{P}{4}$ , and  $39 \frac{1}{13}$  were completed and forwarded to the Superintendent, Northern Circle, for submission to the reproducing offices, and  $38 \frac{L}{15}$  and  $38 \frac{P}{3}$  will be forwarded in January 1909.

240. *Bári Doáb Traverse.*—This was carried out under Mr. Rae, with head-quarters at Montgomery. Eleven traversers were originally allotted to this work, but during the season about half were gradually drafted away to meet the requirements of the Riverain section, thereby disturbing progress considerably. Difficulties in regard to transport and labour in the desert were again considerable. The outturn was about 1,000 linear miles of traverse, fixing nearly 400 bases. It is proposed to complete the remainder of the area next season.

241. *Riverain Work.*—This was continued by Babu Maya Das Puri with head-quarters at Lahore.

242. The Superintendent, Northern Circle, inspected the party in the field in December 1907 and April 1908, and frequently during the recess. It was also inspected by the Officiating Surveyor General in September 1908.

243. The programme for next season involves the completion of sheets 38  $\frac{L}{3, 4, 7}$ , 38  $\frac{P}{1, 2, 5, 6, 7, 8, 9, 10}$ , 39  $\frac{I}{5, 9}$ , and 39  $\frac{M}{1}$ . Of these sheets, 38  $\frac{L}{7}$  and 39  $\frac{I}{5, 9}$ , and the bed of the Indus, with all country east of it, will be surveyed on the 1-inch scale and triangulation and traverse will be carried out in sheets 38 P and 43 D.

NORTHERN CIRCLE.

TRAINING PARTY (*vide* INDEX MAP NO. 1).

244. The office in Dehra closed on 18th October 1907 and re-opened at Sohāwa railway station in the Jhelum district on 23rd October. Owing to a wagon containing the equipment of the party having broken down on the railway, field work was

*Personnel.*

*Provincial Officers:*

Mr. G. P. Tate in charge, and Mr. M. C. Petters.

*Subordinate Establishment:*

5 Instructors, 22 Surveyors, 2 Traversers, 1 Computer, and 2 Writers.

Sohāwa railway station in the Jhelum district on 23rd October. Owing to a wagon containing the equipment of the party having broken down on the railway, field work was

not commenced till middle of November.

245. A portion of Kashmir State was included in the season's outturn of work in sheet 43  $\frac{G}{12}$ .

246. The scale of survey was 2 inches=1 mile. Standard sheets 43- $\frac{G}{12}$  and 43  $\frac{H}{5}$  have been completed, but owing to the lack of finished draftsmen in the party they could not be fair drawn, but they together with 43  $\frac{H}{9}$  (surveyed in 1906-07) have been sent to the Superintendent, Northern Circle, for final preparation in his office during the winter of 1908-09.

247. An area of 487 square miles was surveyed on the 2-inch scale and 790 square miles triangulated. Cost-rates have been omitted as this is a training party.

248. The total cost of the party for the season under report was ₹41,307.

249. Degree sheets 43 C, D, G, and H were partly triangulated.

250. The health of the party was good throughout the year. It returned to recess quarters at Dehra on 15th May 1908, and will be broken up on 31st October 1908.

CADASTRAL AND TRAVERSE SURVEYS.

BENGAL AND EASTERN BENGAL (*vide* INDEX MAP NO. 2).

251. The operations in Bengal and Eastern Bengal were under the supervision of Captain F. C. Hirst, I.A., Officiating Superintendent, Provincial Surveys, Bengal, throughout the year. The work was carried out by three parties, two of which, in addition to traverse work, carried out topographical surveys.

252. The outturn for the year under report in square miles is as follows :--

	Bengal.	Eastern Bengal.
Traversing . . . . .	3,609	2,694
Topographical Surveys, 2"=1 mile . . . . .	1,440	...

No. 4 PARTY (BENGAL).

*Personnel.*

*Provincial Officers:*

Messrs. N. Bedford (in charge), E. G. Hardinge, O. J. H. Hart, and J. H. Johnson.

*Subordinate Establishment:*

1 Military Hospital Assistant, 7 Accountants and Writers, 29 Computers, Draftsmen, etc., 47 Traversers and Surveyors, and 640 Menials.

253. The party was employed on traverse work in the Patna, Shahabad, and Monghyr districts, and also carried out a number of petty surveys.

254. The outturn for the season with cost-rates per square mile is as follows :—

District.	Nature of operations.	Area in sq. miles.	Cost-rate per sq. mile.
			<b>R</b>
Patna . . . . .	Traverse . . . . .	1,142	41·0
Shahabad . . . . .	Do. . . . .	347	37·3
Various . . . . .	Petty surveys excluding linear relaying work.	42	...
	TOTAL	1,531	...
Monghyr . . . . .	Topographical survey 2" = 1 mile	183	40·8

255. The cost-rates are fair to good.

256. The total cost of the party for the year under report was R74,263.

257. The traversing has been suitably connected with the Great Trigonometrical Survey and proves well.

In the programme detailed in the table above, there were 32,792 theodolite stations which were marked by 5,349 stones at village trijunctions, 25,285 cylinders, 321 bricks, 27 iron pegs along the municipal limits, and 1,810 wooden pegs.

The Revenue Survey maps were used as guides in obtaining the boundaries. The traverse boundaries agree very well with the Revenue Survey boundaries.

The demarcation was generally found to be good.

258. The programme for next year is the traverse survey of about 1,600 square miles of the Shahabad district.

NO. 5 PARTY (BENGAL).

259. From the 1st November 1907 the head and traverse camps were amalgamated. Traverse operations were carried on in districts Ranchi, Midnapore, Singhbhum, and Manbhum. Besides these, a number of petty surveys were carried out.

*Personnel.*

*Provincial Officers :*

Messrs. C. S. Kraal (in charge), C. H. G. Johnson, and I. Newton.

*Subordinate Establishment :*

2 Supervisors, 6 Writers and Accountants, 29 Computers, Draftsmen, etc., 40 Traversers, and 629 Menials.

260. The outturn for the season with cost-rates per square mile is as follows :—

District.	Nature of operations.	Area in sq. miles.	Cost-rate per sq. mile.
			<b>R</b>
Ranchi . . . . .	Traverse . . . . .	1,208	34·3
Ranchi Municipality . . . . .	Ditto . . . . .	7	...
Midnapore . . . . .	Ditto . . . . .	211	33·1
Singhbhum . . . . .	Ditto . . . . .	14	35·6
Manbhum . . . . .	Ditto . . . . .	638	41·6
	TOTAL	2,078	
Mayurbhanja Dispute . . . . .	Ditto . . . . .	18	} Linear miles.
Sikkim Mining claims . . . . .	Ditto . . . . .	2	

The cost-rates are good, considering the scattered nature of the programme.

261. The total cost of the party for the year under report was R78,182.

262. The traverse work was connected with twelve stations of the Great Trigonometrical Survey. There were in all 45,513 theodolite stations. Of this

number 3,789 were trijunctions marked by stones, and the remaining 41,724 were marked by galvanized and baked clay cylinders, country stones, iron and wooden pegs and marks cut on rocks "in situ."

263. The demarcation in Midnapore district was fairly well done, but in the remaining districts no attempts were made to demarcate the village boundaries. Owing to the hilly and undulating nature of the country under survey the sub-tense bar was frequently used. As there were no old existing maps showing village boundaries, the villages were surveyed as pointed out by the inhabitants.

264. The programme for next year consists of about 300 square miles of traversing in the Manbhum and 1,300 in the Hazáribágh districts.

### NO. 6 PARTY (EASTERN BENGAL).

#### Personnel.

Messrs. A. W. Smart, (in charge), P. F. Delaney, L. B. Fitz-Gibbon, B. F. Cooper, O. E. C. Judd, T. F. Kitchen, C. A. O'Donel, O. J. H. Hart and P. E. Kennegy.

#### Subordinate Establishment :

1 Supervisor, 13 Writers and Accountants, 48 Computers and Draftsmen, 97 Traversers and Surveyors, 5 Hospital Assistants, and 1,486 Menials.

265. The party comprised two traverse and one traverse and topographical sections.

266. The outturn for the season with cost-rates per square mile is as follows:—

District.	Nature of operations.	Area in sq. miles.	Cost-rate per sq. mile.
Jalpaiguri . . . . .	Traverse . . . . .	1,395	47·8
Mymensingh . . . . .	Ditto . . . . .	876	56·1
Faridpur . . . . .	Ditto . . . . .	355	59·1
Dacca . . . . .	Ditto . . . . .	68	81·9
TOTAL . . . . .		2,694	
Khulna . . . . .	Traverse for Topography . . . . .	1,257	55·8
Do. . . . .	Topography 2" = 1 mile . . . . .	1,257	42·5

The above figures exclude work done in the relaying of the Jalpaiguri-Bhutan, Jalpaiguri-Cooch Behar boundaries, and certain miscellaneous work.

The cost-rates are good for the nature of the country dealt with, which with the exception of Mymensingh district was either very unhealthy or very low lying, and it contained certain "diaru" river-bed tracts. The rate for Mymensingh is high, because it includes the initial expenditure contingent on the organization of a new section which was formed in October 1907.

267. The total cost of the party for the year under report was Rs. 2,80,192.

268. The survey of the Sundarbans forests is now completed to the relief of all who were connected with it. As in previous years, food and water have been carried by a flotilla of launches and boats for the whole establishment. The system of survey used was that adopted in previous years.

269. Excluding the Sundarbans 42,168 points were marked as theodolite stations.

270. The programme for the next survey year is the continuance of the traverse survey of the Jalpaiguri, Mymensingh, and Dacca districts. It also includes an awkward river-bed programme in the lower reaches of the Ganges, Padma, and Meghna rivers.

UPPER AND LOWER BURMA.

NO. 7 PARTY.

271. The party was under the administrative charge of Lieutenant-Colonel P. J. Gordon, I.A., throughout the year.

Personnel.

Provincial Officers :

Messrs. O. D. Smart (in charge), C. G. Lee, C. S. Littlewood, and W. E. S. Swiney, Babu Jagadamba Prasad.

Subordinate Establishment :

10 Traversers, 10 Computers, 13 Draftsmen, 2 Typers, 4 Estimators, and 69 Field Surveyors.

The operations consisted of the completion of the cadastral survey in the Thayetmyo district and of that part of the Pyapôn district which had been traversed during the previous year,

and the traverse and cadastral survey of parts of the Yamèthin and Pegu districts. The programme was completed, and with it cadastral survey operations in Burma come to an end as far as the Survey of India is concerned, and the party will be broken up in November 1908.

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

Locale.	TRAVERSING.			DETAIL SURVEY.						REMARKS.	
	Kwins.	Square miles.	Cost per square mile including demarcation.	Kwins.	Sheets.	Fields.	Area in acres.	Area in square miles.	Cost per square mile.		Average size of field in acres.
Thayetmyo . . .	...	...	R	311	811	(b) 155,964	(b) 397,976	(c) 622	R	(a) 1'06	Scale 16 inches = 1 mile.
„ Water area.	...	...	...	...	...	...	9,650	15	104'4	1'06	
Pegu . . .	98	214	86	98	242	(b) 75,500	(b) 111,220	174	76'6	(a) 0'64	
„ Water area . . .	...	...	...	...	...	...	21,126	33	...	...	
Yamèthin . . .	137	114	187	137	211	(b) 29,350	(b) 73,062	114	149'2	(a) 0'53	
Pyapôn . . .	...	...	...	5	16	605	7,125	11	280'2	(a) 3'32	
„ Water area . . .	...	...	...	...	...	...	428	1	...	...	
	235	328	...	551	1,280	261,419	620,587	970	...	...	

(a) Calculated on the cultivated area only.  
 (b) Includes jungle.  
 (c) Includes jungle but excludes 25 square miles of forest reserve not mapped.

273. The party took the field in the middle of November 1907, and returned to recess quarters at Maymyo at the end of May 1908.

274. *Thayetmyo*.—An area of 637 square miles was surveyed on the 16-inch scale in the Allanmyo and Minhla townships; of this area only 241 square miles comprising 145,260 fields of an average size of 1'06 acres were cultivated. The remaining area, 396 square miles, consisted of water, hills, and jungle in which no detail except large streams and important cart-tracks were surveyed; in this country the traverse lines were as a rule upheld as *kwin* boundaries. The work was checked by 174 linear miles of test lines by officers of the party and 433 linear miles of independent test lines, giving an average of 2'5 linear miles of test survey to each square mile of cultivation; 927 linear miles of test lines were also run by native Inspectors in the same area. The average numbers of *amin* employed was 49 for 174 days, and the average daily outturn of each *amin* was 18 acres comprising 17 fields.



It was found necessary to run 14 linear miles of sub-traverses in this district, to include extensions of cultivation that had occurred since last year when the traversing of the district was done.

275. *Pegu*.—The work in Pègu district consisted of the traverse and cadastral survey of 207 square miles of newly-formed *kwins* in the Thanatpin township; of this area only 66 square miles comprising 66,531 fields of an average size of 0·64 acres, were cultivated. The whole area was surveyed in detail on the 16-inch scale and *kwin* boundaries were surveyed as demarcated on the ground. The work was checked by 23 linear miles of test lines by officers of the party, supplemented by 186 linear miles of independent lines, giving an average of 1·2 linear miles of test survey to each square mile mapped; 378 linear miles of test lines were also run by native Inspectors. The average number of *amins* employed was 25 for 50 days and the average daily outturn was 95 acres comprising 54 plots.

The traversing in this district covered an area of 214 square miles, and amounted to 635 linear miles. The theodolite was set up at 2,781 stations of which 2,201 were new and were marked with galvanized iron cylinders at an approximate cost of 5 annas per station. The origin of survey was—latitude  $17^{\circ} 00' 00''$  and longitude  $96^{\circ} 00' 00''$ .

276. *Yamèthin*.—The operations consisted of the traverse and cadastral survey of an area of 114 square miles of scattered blocks in the Pyinmana township; of this area only 21 square miles comprising 25,563 fields of an average size of 0·53 acres were cultivated, the remainder consisting of hills and jungle in which no detail was surveyed except large streams and important cart-tracks. The work was checked by 20 linear miles of test lines by officers of the party, and 114 linear miles of independent test lines, giving an average of 6·4 linear miles to each square mile of cultivation; 252 linear miles of test lines were also run in the same area by native Inspectors. The average number of *amins* employed was 19 for 59 working days, and the average daily outturn of each *amin* was 16 acres and 25 fields.

The traversing in the Yamèthin district consisted of 452 linear miles; double chaining was employed throughout as well as subtense bars for measurements when necessary. The theodolite was set up at 4,184 stations of which 3,610 were new and were marked with galvanized iron cylinders at an approximate cost of 13 annas per station. The work was connected with one trigonometrical station. The origin of survey was—latitude  $20^{\circ} 30'$  and longitude  $96^{\circ} 15'$ .

277. *Pyapôn*.—The cadastral survey consisted of an area of 12 square miles left over from last year's programme, owing to inundations late in the season.

278. The area surveyed in Thayetmyo consisted to a large extent of hills covered with scrub jungle. The cultivation consisted largely of *taung-ya* cultivation, where the fields have no defined boundaries and are usually allowed to lie fallow for several years. This caused considerable delay and difficulty to the surveyors and the field season was much prolonged in consequence. In Pegu the area surveyed consisted of land recently formed by the silting up of the Sit-tang river; a considerable stretch of land on the eastern or Thatôn bank has been eaten away, and a stretch of land ten miles in width has been added to the Pegu district. This area has been divided into *kwins* and is being rapidly taken into cultivation.

The area surveyed in Yamèthin consisted chiefly of hills and jungle; the *kwins* averaged less than a square mile a piece and were insufficiently demarcated and therefore troublesome to survey.

279. The cost-rates are on the whole fair. In Thayetmyo the cost-rate of cadastral survey was R104·4 per square mile which compares favourably with the rates in the same district for the previous year. In Pyapôn the cost-rate of cadastral survey was R280·2 as compared with R205 for the previous year. The small area surveyed accounts for the increase. In Pegu traversing cost R86 and cadastral survey R76·6 per square mile, which rates may be considered satisfactory. In Yamèthin, as anticipated, the rates are very high both for traversing and cadastral survey. This was due partly to the nature of the country, which was in a hilly and jungle-clad tract, but principally to defective demarcation which entailed much loss of time in determining where traverse lines should be run and where the *kwin* boundaries

should be. The *amins* in this district were paid fixed salaries instead of by contract.

280. The total cost of the party for the year under report was R1,57,847, inclusive of charges for instruments for the local Government.

281. The health of the party was generally good; 5 deaths occurred during the field season and 3 men were invalided.

282. The party was inspected by Colonel Gordon during the field season.

283. Forty traverse charts have been sent to press during the year. A considerable number of traverse charts will remain when the party is broken up, but it is not contemplated to complete these at present. All original traverse computations will be made over to the Deputy Commissioners of the districts to which they belong for safe custody, the original traverse field books being deposited in the Map Record office, Calcutta. The detail survey carried out by the party has been added to the original fair sheets of which reprints or new editions will be published and all 16-inch maps were completed and sent to press.

## CANTONMENT SURVEYS.

### NO. 1 SECTION.

284. During the season under report, this section was employed on the survey of the cantonments in portions of the Pesháwar, Ráwalpindi, Meerut and Lucknow divisions, and of Bannu in the Bannu brigade. Mr. F. S. Bell, Extra Assistant Superintendent, 4th grade, remained in charge till the 25th October, when he was relieved by Mr. E. G. Little, a retired officer of the Provincial service transferred from Bangalore, who carried on the duties till the end of the season.

285. The survey of the following cantonments was completed:—Nowshera Cavalry cantonment, Mardán, Abbottabad, Almora, Ranikhet (including Chaubattia), Naini Tál, Benares and Bannu, Landour and the 7 gallies (namely:—Baragali, Kálábágh, Ghora Dhaka and Khanspur, Changlagali, Khayragali and Barian) will be completed by the end of October. A small area added to Delhi by an extension of the boundary, was also surveyed.

286. The maps of Lansdowne, Almora, Shalijahanpur, and the bazaars of Ránikhet of Section No. 1, and Fort Saint George, Pallávaram, Cannanore, Trichinopoly, Poonamallee, and the bazaars of Bangalore of Section No. 3, were sent for publication, and those of Kasauli, Muttra, Lansdowne, and Ránikhet bazaars of Section No. 1, and Pallávaram, Trichinopoly, and Bangalore bazaars of Section No. 3 were published.

287. The areas surveyed during the season and the cost-rates were:—

	Acres.	Rupees per acre.
Triangulation . . . . .	2,264	0'45
Traversing . . . . .	12,894	0'45
Detail survey on 16-inch scale . . . . .	21,380	0'70
"    "    on 64- "    "    . . . . .	153	5'69
Mapping on 16-inch scale . . . . .	8,611	0'37
"    "    on 64- "    "    . . . . .	707	1'60

The cost of the 64-inch field work is high owing to the smallness of the area surveyed.

The average outturn per working day was —

Traversing, 8 angles and 82 chains—

Detail survey on 16-inch scale . . . . .	16 acres.
"    "    64- "    "    . . . . .	1'20 "

288. The total cost for this section for the year under report was R26,850.

289. The maps of the following cantonments:—Delhi, Sitápur, and Naini Tál and the remaining bazaar of Belgaum will be submitted for publication during October. The Deputy Surveyor General inspected this section during December 1907.

290. Next season it is proposed to survey the cantonments in Bengal.

## SECTION NO. 2.

291. This section was engaged on the completion of the surveys of the cantonments of the Poona and Mhow divisions, and remained in charge of Mr. L. Pocock, a retired officer of the Provincial Service, throughout the year under report. In all, nine cantonments were dealt with, the cantonments themselves being surveyed on the scale of 16 inches=one mile and their bazaars on the scale of 64 inches=one mile, while all were contoured with contours run at 5 feet vertical interval. The surveys on the cantonments of Nasirabad, Mount Abu, Neemuch, Aurangabad, and Ahmednagar commenced during the previous year were completed, and those of Jubbulpore, Mhow, Sehore, and Pachmarhi were undertaken and completed, with the exception of a small amount of contouring remaining to be finished in Jubbulpore and Pachmarhi, which will be finished during October, leaving no further work to be done in the two divisions.

292. The maps of seven cantonments, *viz.*, Devláli, Mount Abu, Ajmer, Nasirabad, Aurangabad, Ahmednagar, and Neemuch have been completed, and forwarded to the Trigonometrical Office for publication, and those of Mhow and Sehore have been far advanced.

293. The season's outturn and cost-rates are as under :—

		₹	
Traversing . . . . .	4,462 acres at 0.79 per acre.		
Detail survey including mapping and contouring . . . . .	on 16-inch scale . . . . .	15,117	1.16
Ditto ditto . . . . .	64 " " . . . . .	418	8.75
Ditto ditto . . . . .	scale 50 feet=1 inch . . . . .	34	12.91

Most of the traversing was done for the work on the scale of 1 inch=50 feet entailing very numerous stations, which accounts for the apparently enhanced cost.

294. The total cost for this section for the year under report was ₹23,662.

295. The average daily outturn of 16-inch survey was 15.3 acres, and of 64-inch 1.7 acres without contouring. With contouring, the outturn was 11.2 acres on the 16-inch scale. The cost-rate of the 16-inch survey without contouring was ₹0.54 per acre, and of the 64-inch ₹4 per acre.

296. The Deputy Surveyor General inspected the section at Poona in December 1907 and again in July 1908 at Pachmarhi. He also tested the work of the section in the field at Jubbulpore in January 1908, and in Pachmarhi in July 1908.

297. During next season the survey of the bazaars, 42 in number, of Secunderabad and Bolarum will be undertaken on a scale of 1 inch=50 feet, or 105.6 inches=one mile. A large amount of the necessary preliminary traverse has been completed, and 64 of the sheets have been plotted in readiness for the coming season's work. Thirty four and a half acres of detail survey have also been done. The area of the 42 bazaars is about 1,800 acres or approximately 3 square miles, which on the large scale required will fully occupy the section during the whole season.

Summary of the Outturn of work of the Field Parties during the year 1907-08.

TOPOGRAPHICAL SURVEYS.

Scale of Survey, inches = 1 mile.	Number of Party.	Local of Operations.	TRIANGULATION.											TRAVERSE.				DETAIL SURVEY.							
			Instrument used.	Diameter in inches.	Area in square miles.	Square miles to each point trigonometrically fixed.	Square miles to each height.	Minor.			Tertiary.			Intersected Points.	Area in square miles.	Linear miles of new chaining.	Number of stations at which the theodolite was set up.	Angular error per station in seconds.	Linear error per mile.	Area in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Number of "in situ" test fixings.	Linear miles of Forest boundary traverse.	
								Stations fixed.	Triangular error in seconds.	Error per mile in feet.	Stations fixed.	Triangular error in seconds.	Error per mile in feet.												Number of points fixed.
1	1	Central and United Provinces and Central India States.	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	351 <sup>(d)</sup>	15	...	...	...		
	2	Berar . . . . .	6	2,180	3.9	4.0	35	9.0	0.3	66	12.5	0.3	438	0.4	...	...	...	...	593	20	108	260	...		
	3	Upper Burma . . . . .	6	1,070	6.9	7.1	22	10.5	0.1	7	17.0	0.2	125	0.4	168	1,292	(b) (b)	{	414	16	25	104	...		
	9	Northern Circle . . . . .	6	1,534	6.2	6.9	...	...	...	19	6.0	0.2	223	0.8	...	...	...	...	1,543	12	7	465	...		
	10	Upper Burma . . . . .	6	3,337	4.5	4.7	25	6.7	0.1	21	7.7	0.1	667	0.6	...	...	...	{	1,707	15	169	1,085	...		
	17	Bombay Presidency . . . . .	6	3,375	...	...	...	...	...	115	8.0	0.5	552	0.9	...	...	...	{	69 <sup>(a)</sup>	...	...	...	...		
	18	Northern Circle . . . . .	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	887 <sup>(e)</sup>	...	...	...	...		
	19	Madras Presidency . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	539	11	...	...	...	
	20	Assam . . . . .	6	634	4.6	4.7	...	...	...	12	13.6	0.1	131	0.7	...	...	...	{	303	8	5	34	...		
																		{	302 <sup>a)</sup>	10	3	15	...		
1½	11	Southern Shan States . . . . .	6	3,800	4.4	4.5	62	10	0.2	...	...	...	(b) (b)	...	...	...	...	...	2,303	7	...	424	...		
2	1	Central and United Provinces and Central India States.	6 & 7	2,274	2.8	2.8	58	7.5	0.1	35	10.8	0.1	732	1.3	...	636	3,749	5.4	0.9	{	177 <sup>(d)</sup>	27	...	...	
	2	Berar . . . . .	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	723	56	370	935	...	
	3	Burma . . . . .	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	299	98	31	169	...	
	4	Bengal—Monghyr . . . . .	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	183	...	146	172	...	
	6	„ —Khulna . . . . .	5 & 6	...	...	...	...	...	...	...	...	...	...	1,257	...	...	...	...	...	1,257	...	1,119	...		
	9	Northern Circle . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	770	24	281	...	...	
	10	Upper Burma . . . . .	6	...	...	...	...	...	...	...	...	...	...	...	248	2,786	1.8	2.2	...	465	79	108	955	...	
	12	Northern Circle . . . . .	6	1,200	...	...	11	7.5	0.1	18	6.8	0.2	(b) (b)	...	...	...	...	...	...	1,582	28	...	...	...	
	14	„ „ . . . . .	6	1,365	2.8	2.8	...	...	...	39	6.3	0.2	442	0.4	...	...	...	...	...	2,103	20	...	579	...	
	17	Bombay Presidency . . . . .	6 & 7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	{	1,108 <sup>(a)</sup>	25	714	1,135	...	
	18	Northern Circle . . . . .	6	1,712	2.8	2.9	...	...	...	67	7.3	1.4	687	...	1,851	6,925 <sup>(c)</sup>	...	...	...	1,267	27	...	...	...	
	19	Madras Presidency . . . . .	6	5,581	3.7	3.7	30	6.2	0.1	85	8.6	0.2	1,355	(b)	...	267	3,671	1.4	1.4	{	1,441	33	100	577	...
	20	Assam . . . . .	6	1,097	3.0	3.0	...	...	...	25	7.3	0.1	280	0.7	232	620	4,156	3.5	2.3	{	71 <sup>(a)</sup>	3	6	3	...
		Northern Circle Training . . . . .	8	780	...	...	...	...	...	...	...	...	...	...	...	...	...	...	{	2,590	25	...	...	...	
		Southern Circle Training . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	{	307 <sup>(a)</sup>	43	747	637	...	
																		...	238 <sup>(c)</sup>	22	...	...	...		
																		...	467	...	...	...	...		
																		...	289	...	...	...	...		
3	2	Berar . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	122	186	
	10	Upper Burma . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	188	...	18	
	17	Bombay Presidency . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	42	
	19	Madras Presidency . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	39	75	57	117	

(a) Revision survey.  
(b) Computation incomplete.

(c) Supplementary survey.  
(d) Re-survey.

## Summary of the Outturn of work of the Field Parties during the year 1907-08.

## CADASTRAL SURVEYS.

Scale of Survey, inches = 1 mile.	Number of Party.	Locale of Operations.	TRAVERSING.					DETAIL SURVEY.				RECORD WRITING.				
			Instrument used. Diameter in inches.	Area in square miles.	Linear miles of new chaining.	Number of stations at which the theodolite was set up.	Angular error per station in seconds.	Linear error per mile.	Area in square miles.	Linear miles of test lines.	Number of villages.	Number of fields.	Average size of fields in acres.	Area in square miles.	Number of villages.	Number of fields.
16	4	Bengal, Monghyr . . . . .	5 & 6	42	129	615	...	...	...	...	...	...	...	...	...	...
		" Shahabad . . . . .	...	347	1,373	9,285	0'3	0'2	...	...	...	...	...	...	...	...
		" Patna . . . . .	...	1,142	4,977	32,239	0'3	0'2	...	...	...	...	...	...	...	...
	5	6	" Midnapore (Jhagran estate). . . . .	5 & 6	211	912	5,392	0'9	0'2	...	...	...	...	...	...	...
			Bengal, Singhbhum (Babhiram Tung) . . . . .	...	14	46	339	...	...	...	...	...	...	...	...	...
		Bengal, Ranchi . . . . .	...	1,208	3,760	24,612	0'6	0'5	...	...	...	...	...	...	...	
		Bengal, Manbhum (Baráhabhúm). . . . .	...	638	2,213	13,998	0'4	0'3	...	...	...	...	...	...	...	
		Bengal, Ranchi Municipality. . . . .	...	7	50	645	...	...	...	...	...	...	...	...	...	
		Burma, Thayetmyo . . . . .	6	...	14	127	...	...	637	1,534	311	1,55,964	1'06	...	...	...
	7	6	Eastern Bengal, Jalpaiguri. . . . .	5 & 6	1,395	3,596	21,098	1'3	0'3	...	...	...	...	...	...	...
			Eastern Bengal, Myensingh. . . . .	...	876	3,069	13,992	3'7	1'8	...	...	...	...	...	...	...
			Eastern Bengal, Faridpur. . . . .	...	355	1,303	5,961	2'0	2'7	...	...	...	...	...	...	...
			Eastern Bengal, Dacca. . . . .	...	68	319	1,477	4'0	4'5	...	...	...	...	...	...	...
	7	7	" Pega . . . . .	...	214	635	2,781	2'9	0'4	207	587	98	75,500	0'64	...	...
			" Yamethin . . . . .	...	114	5	4,184	3'0	0'5	114	386	137	29,350	0'53	...	...
			" Pyapón . . . . .	...	...	12	156	...	...	12	6	5	605	3'32	...	...

## SPECIAL SURVEYS.

Scale of Survey, inches = 1 mile.	Number of Party.	Locale of Operations.	SPIRIT LEVELLING OPERATIONS.		TRAVERSING.			DETAIL SURVEY.		RECORD WRITING.
			Miles levelled over.	Trigonometrical stations connected with.	Area in square miles.	Linear miles of new chaining.	Number of stations at which the theodolite was set up.	Area in square miles.	Linear miles of test lines.	Number of fields.
...	25	Tidal and Levelling . . . . .	941(a)	3	...	...	...	...	...	...
16 64	Detachment.	Cantonment Section No. I. . . . .	...	...	22	217	2,749	334	123'4	...
		Meerut and Lucknow Divisions . . . . .	...	...						
16 64	"	Cantonment Section No. II. . . . .	...	...	7	133	2,449	23'6	86'8	...
		Pcona and Mhow Divisions. . . . .	...	...						
105'6	Calcutta Suburbs Survey.	Port Commissioners' area . . . . .	...	...	2	67	2,876	2'0	...	5,346
39		Salt Lake area in Dhappa . . . . .	...	...	2	34	300	2'0	...	...
‡	3	Lushai Hills, Chin Hills and Arakan Hill Tracts. . . . .	...	...	...	...	...	1194	...	...

(a) Double Levelling.

Statement showing the cost-rate of work executed by the Field Parties during the year 1907-08.

Number of Party.	Name and <i>locote</i> of field operations.	COST-RATE PER SQUARE MILE.						Total cost for survey year ending 30th September 1908.
		Triangulation.	Traversing.	Detail survey and preparation of maps on scales of				
				1"	1½"	2"	4"	
	<b>Topographical Surveys.</b>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>
1	Central and United Provinces and Central India States.	9'9	9'5	12'4 (b)	...	{ 17'3 (a) 25'4 (b) }	...	1,01,348
2	Berar . . . . .	9'3	...	{ 24'4 (e) 11'5 (d) }	...	54'3 (c)	16'6 (c) (e)	95,347
3	Upper Burma . . . . .	22'3	...	{ 24'1 24'8 (f) }	...	88'0	...	1,13,490
6	Khulna (Sundarbans) . . . . .	...	55'8	...	...	42'5	...	
9	Northern Circle . . . . .	5'7	...	{ 27'5 (c) 6'4 (d) }	...	{ 22'1 (c) 6'4 (d) }	...	85,163
10	Upper Burma . . . . .	6'5	31'4 (e)	{ 34'2 19'9 (f) 19'8 (a) }	...	50'4	56'0	1,33,045
11	Southern Shan States . . . . .	8'9	...	...	44'9	...	...	1,41,591
12	Northern Circle . . . . .	11'4	...	...	...	{ 34'8 (c) 8'2 (d) }	...	85,844
14	" " . . . . .	7'2	...	...	...	{ 30'5 (c) 7'7 (d) }	...	95,003
17	Bombay Presidency . . . . .	3'0	...	...	...	{ 18'0 (a) 32'7 (b) }	...	80,556
18	Northern Circle (Dera Ismail Khan).	9'1	7'4 (e)	} 7'4	...	35'0	...	1,24,401
	" " Punjab rivers . . . . .	...	13'1 (c)					
	" " Bári Doáb . . . . .	...	26'2 (e)					
19	Madras Presidency . . . . .	3'5	46'8 (e)	{ 8'5 6'8 (a) }	...	{ 52'8 5'3 (a) }	326'0	1,22,816
20	Assam . . . . .	12'8	20'9	...	...	{ 27'2 28'1 (a) 12'3 (f) }	...	1,18,471
	Northern Circle Training . . . . .	9'1	...	...	...	45'8	...	41,307

(a) Revision Survey.  
 (b) Re-survey.  
 (c) Exclusive of mapping.  
 (d) Mapping charges only.  
 (e) Rate per linear mile.  
 (f) Supplementary Survey.

## Cadastral and Cantonment Surveys.

Number of Party.	Nature and scales of field operations.	COST-RATE per SQUARE MILE.					Completion of vernacular records.	Total cost of party inclusive of charges for instruments for Local Governments.
		Traverse.	Detail survey and preparation of maps on scale of					
			12"	16"	8"	64"		
	<b>Cadastral surveys.</b>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	
4	Monghyr, hill block . . .	40·8	...	...	...	...	...	74,263 (a)
	Patna . . . . .	41·0	...	...	...	...	...	
	Shahabad . . . . .	37·3	...	...	...	...	...	
5	Midnapore (Jhagran Estate).	33·1	...	...	...	...	...	78,182 (a)
	Singhbhum . . . . .	35·6	...	...	...	...	...	
	Ranchi . . . . .	34·3	...	...	...	...	...	
	Manbhum (Pargana Baráhabhúm).	41·6	...	...	...	...	...	
6	Jalpaiguri . . . . .	47·8	...	...	...	...	...	2,80,192
	Mymensingh . . . . .	56·1	...	...	...	...	...	
	Faridpur . . . . .	59·1	...	...	...	...	...	
	Dacca . . . . .	81·9	...	...	...	...	...	
7	Thayetmyo . . . . .	...	...	104·4	...	...	...	1,57,847
	Pyapôn . . . . .	...	...	280·2	...	...	...	
	Yamèthin . . . . .	187·1	...	149·2	...	...	...	
	Pegu . . . . .	85·7	...	76·6	...	...	...	
Detach- ment.	Cantonment No. I Section,	0·5 (b)	...	1·1 (c)	...	7·3 (c)	...	26,850
	Cantonment No. II Section,	0·8 (b)	...	1·2 (c)	...	8·8 (c)	...	23,662

(a) Includes certain charges for petty surveys.

(b) Cost per acre.

(c) Cost per acre including mapping.

INDEX No. 1

Showing progress of modern Topographical Surveys up to 30th September 1908.

Key to Degree Sheets. Key to Standard Sheets.

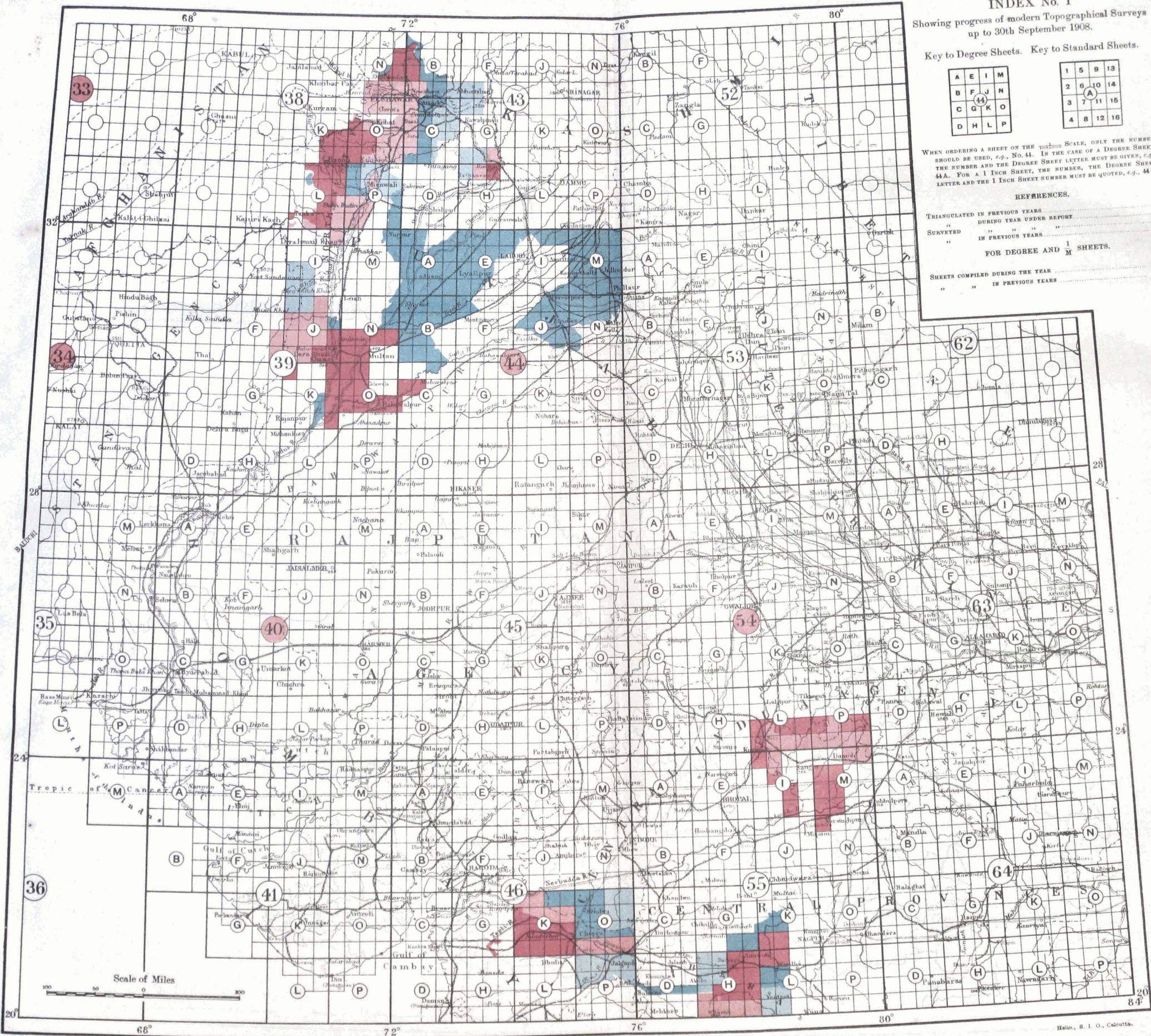
A	E	I	M
B	F	J	N
C	G	K	O
D	H	L	P

1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

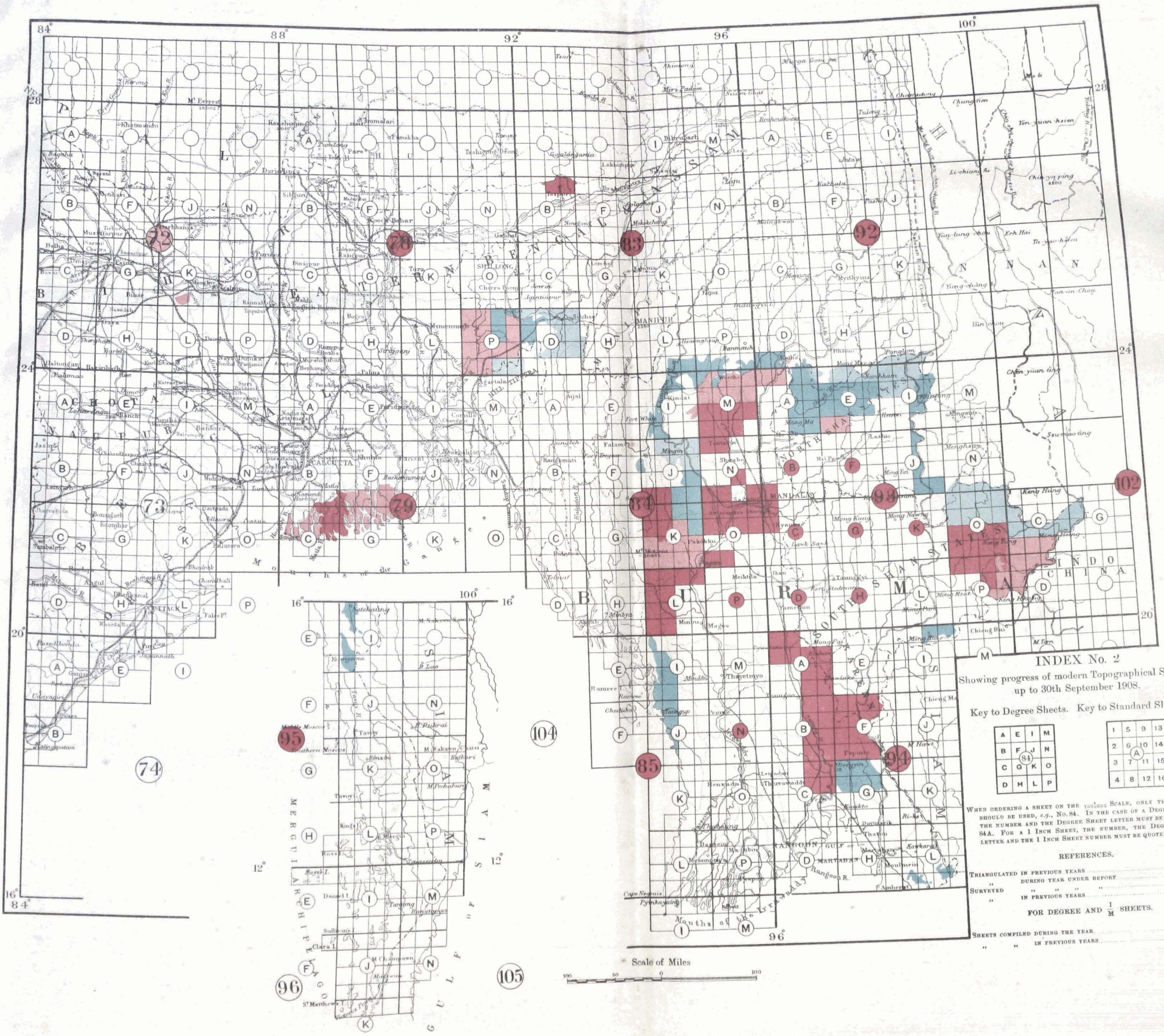
WHEN ORDERING A SHEET OF THE TOWN SCALE, ONLY THE NUMBER SHOULD BE USED, e.g., No. 44. IN THE CASE OF A DEGREE SHEET, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN, e.g., 44A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED, e.g., 44 5.

REFERENCES.

- TRIANGULATED IN PREVIOUS YEARS
- " DURING YEAR UNDER REPORT
- " SURVEYED
- " IN PREVIOUS YEARS
- " FOR DEGREE AND 1 M SHEETS.
- SHEETS COMPILED DURING THE YEAR
- " " IN PREVIOUS YEARS







INDEX No. 2

Showing progress of modern Topographical Surveys up to 30th September 1908.

Key to Degree Sheets. Key to Standard Sheets.

A	E	I	M
B	F	J	N
C	G	K	O
D	H	L	P

1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

WHEN ORDERING A SHEET ON THE 1:50,000 SCALE, ONLY THE NUMBER SHOULD BE USED, e.g., No. 84. IN THE CASE OF A DEGREE SHEET, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN, e.g., 84A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED, e.g., 84 1/4.

REFERENCES.

- TRIANGULATED IN PREVIOUS YEARS
- DURING YEAR UNDER REPORT
- SURVEYED IN PREVIOUS YEARS
- FOR DEGREE AND 1/4 SHEETS.
- SHEETS COMPILED DURING THE YEAR
- " " IN PREVIOUS YEARS.

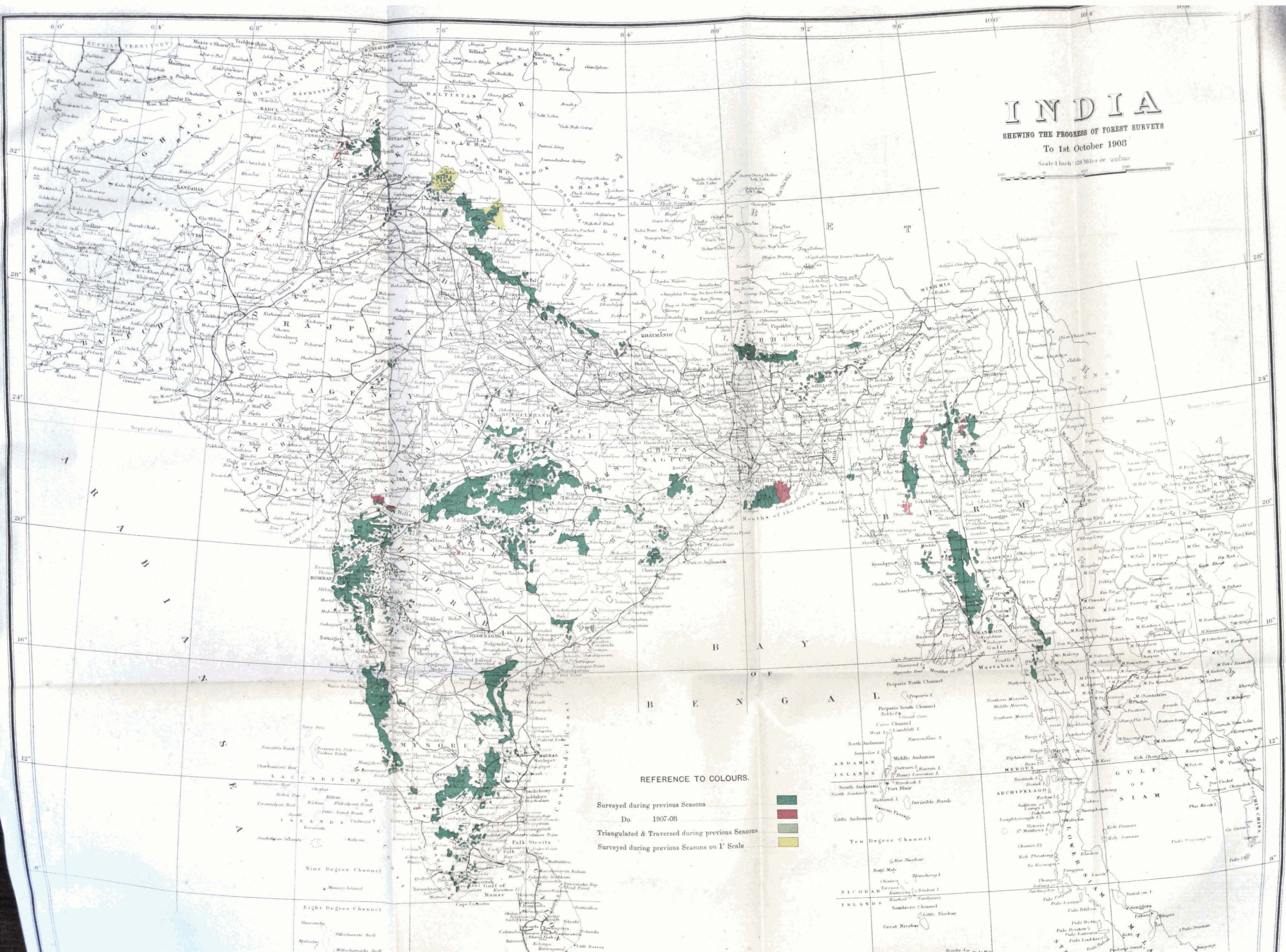




# INDIA

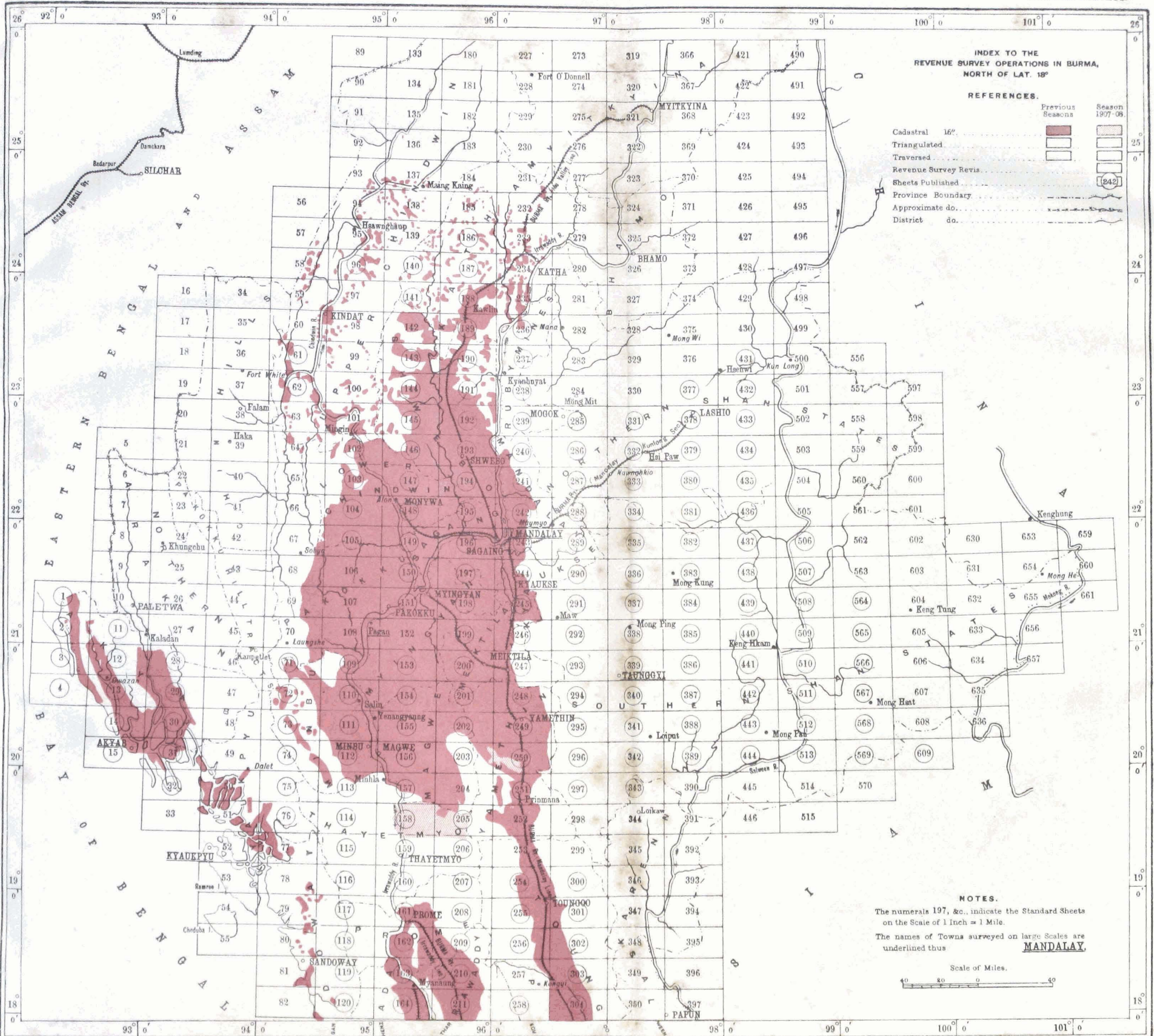
SHOWING THE PROGRESS OF FOREST SURVEYS  
To 1st October 1908

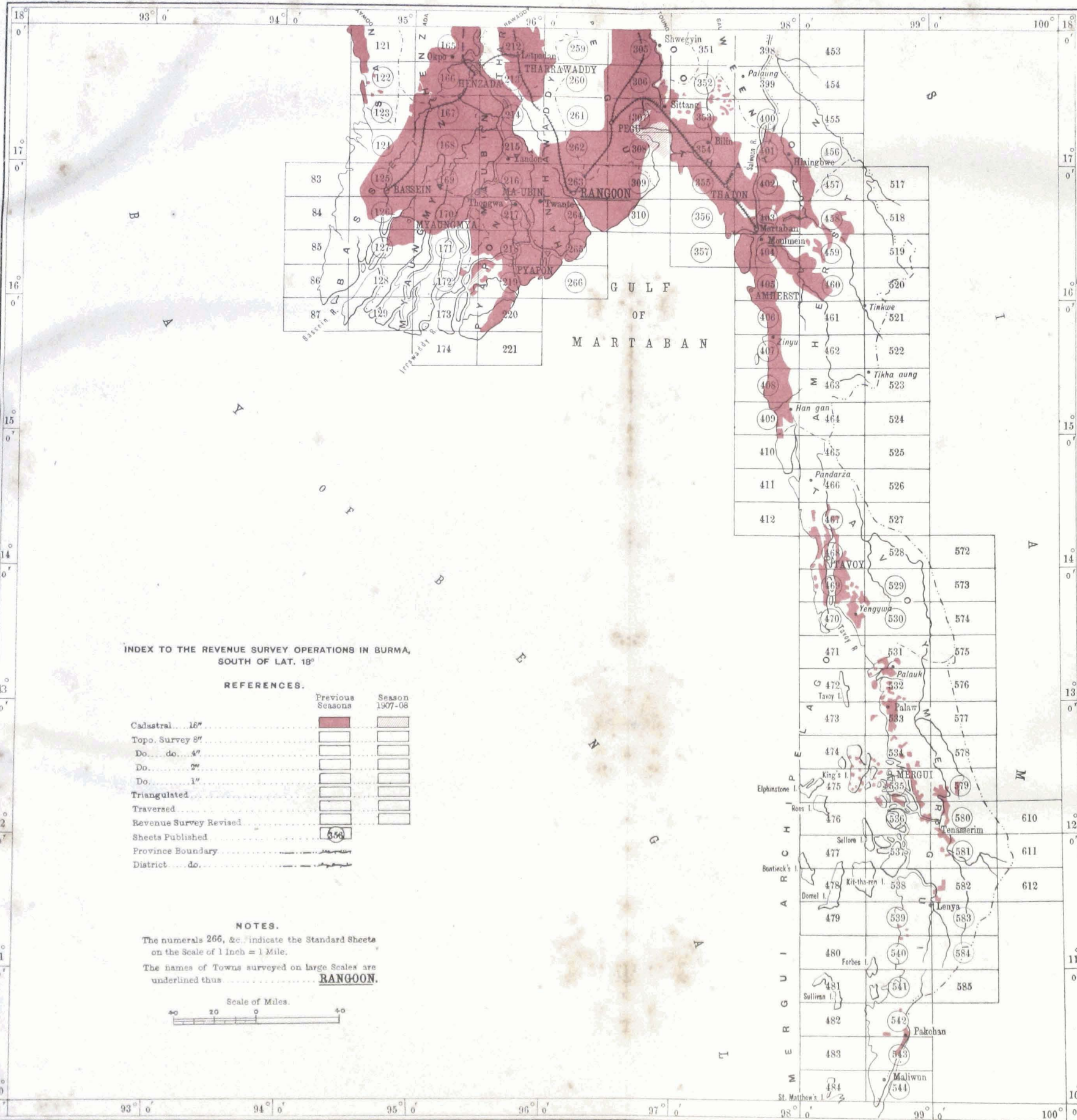
Scale 1 Inch = 28 Miles or 45000 Meters



### REFERENCE TO COLOURS.

- Surveys during previous Seasons
- Do. 1907-08
- Triangulated & Traversed during previous Seasons
- Surveys during previous Seasons on 1" Scale





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

REFERENCES.

	Previous Seasons	Season 1907-08
Cadastral 1/4" .....		
Topo. Survey 3/4" .....		
Do. do. 4" .....		
Do. do. 2" .....		
Do. do. 1" .....		
Triangulated .....		
Traversed .....		
Revenue Survey Revised .....		
Sheets Published .....		
Province Boundary .....		
District do. ....		

NOTES.

The numerals 266, &c. indicate the Standard Sheets on the Scale of 1 Inch = 1 Mile.  
The names of Towns surveyed on large Scales are underlined thus RANGOON.

