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June 1915

Survey of India.
GENERAL REPORT,
1913-14.

From 1st October 1913
To 30th September 1914.



PREPARED UNDER THE DIRECTION OF
COLONEL SIR S. G. BARRARD, K.C.S.I., R.E., F.R.S.,
SURVEYOR GENERAL OF INDIA.

PRINTED AT THE PHOTO-LITHO. OFFICE, SURVEY OF INDIA,
CALCUTTA,
1915.

Price Two Rupees or Three Shillings.

India. *Survey of India.* Dept

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4. Index to the publication of modern one-inch sheets, Northern Circle.
5. " " " " " " " " Southern Circle.
6. " " " " " " " " Eastern Circle.
7. Index to the publication of provisional editions of one-inch sheets, Northern Circle.
8. " " " " " " " " Eastern Circle.
9. Index to the publication of Degree sheets, scale $\frac{1}{4}$ inch to 1 mile.
10. Index to the publication of sheets of the 'India and Adjacent Countries' Series, scale $\frac{1}{1,000,000}$, or about 16 miles to 1 inch
11. Index to the publication of Indian sheets of "La Carte Internationale du Monde" on the scale of $\frac{1}{1,000,000}$, or about 16 miles to 1 inch.
12. Index to the publication of sheets of the 'Southern Asia' Series, scale $\frac{1}{2,000,000}$, or about 32 miles to 1 inch
13. Index to the Great Trigonometrical Survey.

Survey of India.

GENERAL REPORT,

1913-14.

From 1st October 1913

to 30th September 1914.

PART 1.—GENERAL REMARKS.

I.—INTRODUCTION.

1. The main parts of this report, as shewn in the "Contents" on the opposite page, are *Part 2—Field Work*, summarising the operations of the field parties, grouped under appropriate headings; and *Part 3—Office Work*, which gives a brief account of the year's progress in the head-quarters and other offices. Fuller details of these operations are being published in Volume VII of the "Records of the Survey of India".

2. An abstract showing the progress of the topographical programme assigned to the department in 1905, may be found in Table II on page 7. From this it will be seen that the out-turn of new topographical survey during the current year was 54,359 square miles; and that this brings the total progress since 1905 to about 3,66,000 square miles, leaving about 14,55,000 square miles still to be done.

3. The first eight Index maps, at the end of the report, show the progress of this topographical programme. Two indexes for each circle give respectively the progress in survey and in publication; and a third index shows, in the case of the Northern and Eastern Circles, the publication of provisional issues of 1-inch maps compiled from miscellaneous materials.

4. The remaining 5 indexes at the end show progress of the smaller scale maps appertaining to the scheme, and also the main framework of triangulation on which the Survey of India is based.

5. Table IV on page 32 gives a list of the new publications of the Calcutta Offices during the year. A complete list of departmental publications, apart from maps, may be found in the Annual "Records Volume"; and lists of new maps are published quarterly by the department, as well as in the monthly "Notes of the Survey of India".

6. Progress in the Trigonometrical Branch can only be assessed by a study of the "Records Volume" and the special publications issued at Dehra Dūn. The General Report can attempt little more than a brief abstract of the *locale* and nature of the different operations.

7. Notable events of the Survey year were as follows:—

- (a) The return of Captains Bailey and Morshead from six months *exploration in the Eastern Himālayas*. This has added greatly to our geographical knowledge of these regions, besides clearing up all doubts as to the course of the Tsan-po or Brahmaputra river.
 - (b) A report on the *Magnetic Survey of India* was prepared by a special committee appointed by the Government of India for the purpose.
 - (c) New possibilities of scientific exploration have been opened up by the successful experiment of observing accurate differential *longitudes by wireless telegraphy* across the highest mountain ranges. This was effected by Cavaliere de Filippi's Italian expedition, in co-operation with our observatory at Dehra Dūn and the Lahore Radio Office.
 - (d) The department has now issued its first attempts at producing large *Orographical maps* on the system of coloured layers. These maps give a clearer idea of the main physical features of India and Adjacent Countries than the older maps did; and it is hoped that the experience gained in these first efforts, and the various criticisms they have elicited, may result in the further improvement of this difficult branch of Cartography.
 - (e) A commencement has been made in the new system of *keeping Cantonment maps up-to-date*, at the Dehra Dūn Office, by means of information to be supplied annually by the officers of the Military Works Services.
 - (f) Two Imperial Officers were deputed to work with the *Turco-Persian Frontier Commission*, and one to co-operate with Cavaliere de Filippi's expedition to the Karakoram.
 - (g) The department has completed a framework of high accuracy for the *Bombay City Survey*, and has lent two Provincial Officers to the Bombay Government to conduct the detail survey.
 - (h) The proposal to introduce the scale of $\frac{1}{4}$ inch to 1 mile for the tactical map of India has received strong support.
-

II.—ADMINISTRATION AND PERSONNEL.

8. The cost of the department for the financial year ending 31st March 1914 was Rs. 35,74,411, against an estimated cost of Rs. 36,23,910.

9. Colonel Sir Sidney G. Burrard, K.C.S.I., R.E., F.R.S., administered the department during the greater part of the year under report, having resumed charge on his return from leave, on the 15th December 1913, from Colonel T. F. B. Renny-Tailyour, C.S.I., R.E., who was Officiating Surveyor General of India up to that date.

10. Colonel G. B. Hodgson, I.A., Superintendent, retired on the 28th October. Lieutenant F. P. Nosworthy, R.E., was appointed to the department from the 1st November 1913, and Lieutenant L. H. Jackson, I.A., from the 7th September 1914.

There were six losses to the Provincial Service, by the death of Messrs. C. Litchfield and H. D. W. Stotesbury, and by the retirement of Messrs. P. L. Causley, Anjad Ali and Balaji Dhondiba Mandhre, and by the transfer of Mr. H. St. J. Kenny to the Federated Malay States. No Provincial Officers were recruited during the year.

11. The following honours were conferred on members of the department during the year:—

To be K.C.S.I.— Colonel S. G. Burrard, C.S.I., R.E., F.R.S., Surveyor General.

To be C.I.E.— G. B. Scott, Esq., (retired), Survey of India.

Title of Rai Bahadur.—Rai Sahib Chuni Lal Dey, Registrar.

Title of Rai Sahib.—Mr. Narendra Nath Mukerji, Head Accountant.

Mr. Hira Singh, Assistant S. T. S. Office.

12. The total strength of the department at the close of the Survey year was 50 Imperial Officers, 125 Provincial Officers and 31 Upper Subordinates, besides specialists, clerks, lower subordinates, and menials.

13. The following table shows the distribution of officers during the year, excluding those absent on leave throughout the year, or on deputation with local Governments. It will be noticed that several names occur more than once in the list, through the transfer of officers from one office to another. A few very temporary transfers in September, arising from changes due to the war, have been omitted.

TABLE I—DISPOSITION OF OFFICERS, 1913-14.

SURVEYOR GENERAL OF INDIA—		Colonel Sir Sidney G. Burrard, K.C.S.I., R.E., F.R.S., from 15th Dec. 1913. Colonel T. F. B. Renny-Tailyour, C.S.I., R.E., officiating to 14th Dec. 1913.			
		<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &c.</i>
Surveyor General's Office and Mathematical Instrument Office, Calcutta.	Captain J. A. Field, R.E.	.....	.....	.....	.....
No. 6 Drawing Office, Simla.	Major H. H. Turner, R.E. Captain M. N. MacLeod, R.E.	..... .....	Mr. A. A. Graham " F. C. Saint " W. H. Strong	.....	+ 6 European Draftsmen. 24 Indian Draftsmen and Clerks. 4 Printers.
Turko-Persian Frontier Detachment.	Lieut.-Colonel C. H. D. Ryder, D.S.O., R.E. Major H. M. Cowie, R.E.	..... .....	" Haji Abdul Rahim, E.D. " Mr. Sher Jang, E.D.	.....	Two Surveyors, &c.
SUPERINTENDENT MAP PUBLICATION—Major W. M. Coldstream, R.E.					
		<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &c.</i>
Map Publication Office, Calcutta.	.....	.....	Mr. M. Gastaud	.....	.....
No. 1 Drawing Office, Map Record and Issue Office and Engraving Office, Calcutta.	Major M. O'C. Tandy, R.E. Captain F. P. Hunter, I.A. Captain H. J. Couchman, R.E.	..... ..... .....	C. Litchfield " J. O. Greiff " T. W. Babonau " P. Williams " Jagdamba Prasad " C. G. Byrne " P. L. Causley, Retired from January 20th, 1914. " A. B. Hunter " P. Simpson " P. N. Sur " E. J. H. Hanby " F. E. R. Calvert	.....	.....
Photo-Litho. Office, Calcutta.	Capt. S. W. S. Hamilton, R.E.	.....	.....	.....	.....
Mathematical Instrument Office, Calcutta.	* Captain J. A. Field, R.E. Mr. T. A. Ferrier	..........	.....	.....	.....

* The Mathematical Instrument Office was transferred to the control of the Superintendent Map Publication from the 1st September 1914.

† Includes Army Section under Major C. J. Arbery.

TABLE I—(Continued).—DISPOSITION OF OFFICERS, 1913-14.

SUPERINTENDENT NORTHERN CIRCLE—		(Colonel W. J. Bythell, R.E.,—6th October 1913 to 30th Sept. 1914. Lieut.-Colonel C. L. Robertson, C.M.G., R.E.—1st to 5th Oct. 1913.)		
	<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &c.</i>
No. 3 Drawing Office, Mussoorie.		Mr. C. Litchfield (Died 1st September 1914)		45 Clerks, Surveyors and Draftsmen, &c.
		.. H. W. Biggie		
		.. J. A. Freeman		
		.. M. C. Petters		
		.. B. M. Berrill		
No. 1 Party, <i>Kashmir, Punjab and N.-W. P. Province.</i>	Major A. A. McHarg, R.E. Major M. O'C. Tandy, R.E. Lieutenant H. M. McKay, R.E.	Mr. H. H. B. Hanby .. P. A. T. Kenny .. E. B. West .. D. K. Rennie .. R. C. Hanson .. H. T. Hughes .. W. J. B. Miller	Mr. Sher Jung, K.B. .. Nafth Singh, R.S. .. Paris Ram .. Janna Prasad	34 Surveyors, &c.
No. 2 Party, <i>Punjab.</i>	Captain G. F. T. Oakes, R.E. Captain F. B. Scott, I.A.	Mr. B. R. Hughes .. T. W. Babonu .. F. B. Powell .. Kanak Singh .. R. E. Sanballe .. E. C. O'Sullivan .. J. H. Johnson .. F. W. Smith .. J. A. Calvert		41 Surveyors, &c.
No. 3 Party, <i>Punjab and United Provinces.</i>	Captain F. F. Hunter, I.A. Captain F. B. Scott, I.A.	Mr. J. O. Greiff .. J. A. Freeman .. E. J. Biggie .. A. C. Rose .. P. A. T. Kenny .. A. J. A. Drake .. F. H. Grant .. H. T. Hughes .. F. J. Grice .. Moqimuddin	Mr. Mahomed Lutf Ali .. Mahindar Singh .. Muhammad Husain	63 Surveyors, &c.
No. 4 Party, <i>United Provinces.</i>	Captain L. C. Thuillier, I.A. Captain R. Foster, I.A.	Mr. H. W. Biggie .. G. J. S. Rao .. J. C. C. Leirs .. G. E. R. Cooper .. Duni Chand Puri	Mr. Mohammad Husain Khan	46 Surveyors, &c.
No. 20 Party, <i>Guna, Kemptee, Rajkot, and Sitabaldi Fort.</i>		Mr. A. Ewing .. C. S. Lithewood	Mr. Dharmu	24 Surveyors, &c.
Riverain Detachment, <i>Punjab.</i>		Mr. Maya Das Puri, R.S.	Mr. Chuni Lal Kapur .. Mahindar Singh	79 Surveyors, &c. 12 Naib Tahsildars, Kannogs, &c.
Simla Survey Detachment, <i>Sindia.</i>		Mr. C. E. C. French	Mr. Paris Ram	14 Surveyors, &c.
SUPERINTENDENT SOUTHERN CIRCLE—		(Colonel T. F. B. Renny-Tailyour, C.S.I., R.E., 8th to 30th September 1914. Lieut.-Colonel F. W. Pirrie, I.A., up to 7th September 1914.)		
	<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &c.</i>
No. 4 Drawing Office, Bangalore.		Mr. J. H. Nichol .. F. P. Walsh	Mr. B. V. Narayana Rao .. H. Narasimhanurti Rao	36 Draftsmen, &c. 1 Surveyor and 13 Pupils.
No. 5 Party, <i>Central Provinces and Berar.</i>	Captain E. C. Baker, R.E. Lieutenant R. S. Wahab, I.A. Lieutenant R. L. Almond, R.E.	Mr. J. H. S. Wilson .. S. S. McAfee Fielding .. F. C. Pilscher .. Munshi Lal, B.A. .. C. O. Beard .. A. V. Dickson	Mr. Eknath Bhattu .. Ram Narayan Hastri	27 Surveyors, &c.
No. 6 Party, <i>Berber and Hyderabad.</i>	Major H. Wood, R.E. Captain K. W. Pye, R.E. Lieutenant C. G. Lewis, R.E.	Mr. E. A. Meyer .. Haji Abdul Rahim, K.B. .. F. B. Kitchen .. R. B. Gibber .. K. S. Gopalachari, B.A. .. J. O'U Fitzpatrick .. A. J. Moore	Mr. Damodar Kodlikur	32 Surveyors, &c.
No. 7 Party, <i>Madras and Mysore.</i>	Lieut.-Col. F. W. Pirrie, I.A. Captain J. D. Campbell, R.E.	Mr. J. O'R. Donoghue .. P. R. Anderson .. C. West .. H. D. W. Stotesbury (Died 30th October 1913) .. Haji Abdul Rahim, K.B. .. H. H. P. Butterfield .. J. C. St. C. Pollard	Mr. Abdul Hakk, K.S. .. Kozhambur Mandanna	28 Surveyors, &c.
No. 8 Party, <i>Madras.</i>	Capt. C. M. Browne, C.S.I., R.E.	Mr. W. F. E. Adams .. S. P. Norman .. J. H. Williams .. J. Kenney .. M. Mabaeva Mudaliar, B.A.	Mr. Anantaram Dhondiba .. Mandre, R.S. .. K. Narayanaswami Chetti .. P. S. Veengaswami	36 Surveyors, &c.

TABLE I—(Concluded).—DISPOSITION OF OFFICERS, 1913-14.

SUPERINTENDENT EASTERN CIRCLE—		Lieut.-Colonel C. H. D. Ryder, D.S.O., R.E., till 7th November 1913. Major A. Mears, I.A. 8th to 28th November 1913. Lieut.-Colonel C. L. Robertson, C.M.G., R.E., from 29th November 1913.		
	Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinates, &c.
No. 5 Drawing Office, Shillong.	Lieut. P. G. Huddleston, R.E.	Mr. P. J. Barrington " J. P. Barker		35 Surveyors, Draftsmen, &c.
No. 9 Party, Bihar and Orissa.	Captain R. H. Phillimore, R.E. " E. B. Cardew, R.E.	Mr. Dhani Ram Verma " B. C. Newland " L. B. Fitz-Gibbon " A. K. Mitra " W. P. Hales " V. P. Wainright " D. N. Banerjee, B.A.	Mr. Dalbir Rai " Ram Singh.	37 Surveyors, &c.
No. 10 Party, Upper Burma.	Major E. T. Rich, R.E. Captain L. G. Crosthwait, I.A. Lieut. W. E. Perry, R.E. " H. E. Roome, R.E.	Mr. J. Smith " W. G. Jarbo " H. H. Simons " V. W. Morton " Asmat-Ullah Khan, K.S. " C. B. Sexton " A. F. Murphy	Mr. Lachman Daji Jadu, R.B. " Hayat Muhammad, K.S. " Maung Kyaw Nyein	33 Surveyors, Draftsmen, &c., 6 Pupils.
No. 11 Party, Lower Burma.	Captain L. G. Crosthwait, I.A. Lieut. F. J. M. King, R.E.	Mr. A. M. Tulati " T. P. Dewar " F. E. R. Calvert " A. J. Booth " R. M. Wyatt	Mr. Raghbar Datt Thaplyal	29 Surveyors, &c.
No. 12 Party, Assam.	Major A. Mears, I.A. Lieut. P. G. Huddleston, R.E.	Mr. W. Skilling " Pramadarajan Ray, R.S. " E. Claudius " E. M. Kenny " Amjad Ali, Retired April 22nd 1914 " L. Williams " P. C. Mitra, B.A. " H. H. Creed	Mr. Namak Chand Puri, B.A. " Sajoni Kumar Ghosal	34 Surveyors, &c., 6 Pupils, 4 Soldier Surveyors.
Aka Promenade Detachment.	Lieut. P. G. Huddleston, R.E.			1 Surveyor.
Andamans Detachment.		Mr. E. Claudius		8 Surveyors.
SUPERINTENDENT OF THE TRIGONOMETRICAL SURVEY—		Lieut.-Colonel G. P. Lenox-Conyngham, R.E.		
	Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinates &c.
Trigonometrica Survey Office, Dehra Dun.	Mr. J. deGraaff Hunter, M.A.	Mr. H. A. Charrier " Hanuman Prasad	Mr. Sarat Kumar Mukerji	
Training School.	Lieut. A. A. Chase, R.E. " W. E. Perry, R.E. " F. P. Nosworthy, R.E.		Mr. Satish Chandra Mukharji " Lakshmi Dutt Joshi " Vidya Dhor Chopra " Mirza Mulummad Alisan " Lachman Das Sood	} Under training. Resigned 16th May 1914.
No. 2 Drawing Office and Forest Map Office, Dehra Dun.	Major H. H. Turner, R.E. " G. A. Deuzeley, R.E.	Mr. O. C. Ollenbach " E. C. J. Bond " H. C. W. Stotesbury " O. N. Pushong " Abdul Karim	Mr. Ram Singh, R.S.	
No. 13 Party, (Latitudes).	Captain V. R. Cotter, I.A.			3 Computers, &c.
No. 14 Party, (Pendulums).	Captain H. J. Couchman, R.E. " G. F. T. Oakes, R.E.	Mr. O. N. Pushong " C. S. McInnes		4 Computers, &c.
No. 15 Party, (Triangulation).	Major G. A. Deuzeley, R.E. " E. A. Tandy, R.E. " H. M. Cowie, R.E. Lieut. K. Mason, R.E.	Mr. C. H. Tresham " V. D. B. Collins " V. P. Wainright " L. Williams " G. A. Norman " B. T. Wyatt " C. S. McInnes " Abdul Karim " K. S. Gopalachari " A. J. Moore " N. S. Haribara Iyer	Mr. Jugal Behari Lal	24 Computers, &c.
No. 16 Party, (Tidal).		Mr. Syed Aulad Hossain, K.B. " Syed Zille Hasnain		20 Computers, &c.
No. 17 Party, (Leveling).		Mr. H. G. Shaw " D. H. Lavan " J. McCracken " T. F. Kitchen " M. S. Ganesan Aiyar " O. D. Jackson " Jyo Lal " N. N. Choukerbutty	Mr. Karuna Kumar Das, B.A.	12 Computers, &c.
No. 18 Party, (Magnetic).	Captain R. H. Thomas, R.E. Lieutenant K. Mason, R.E.	Mr. H. P. D. Morton " Rama Prasad Ray, B.A. " N. R. Mazumdar " Ruj Babadur Mathur, B.A.	Mr. Bidhu Bhusan Shome	18 Recorders, &c.
No. 19 Party, (Base Line).	Major E. A. Tandy, R.E. Lieut. A. A. Chase, R.E.			3 Computers, &c.
Exploration In Chinese, Turkistan with Count Filippide Filippi.	Major H. Wood, R.E.		Mr. Jumna Prasad	1 Surveyor.
Tibet In Central Asia with Sir Aurel Stein	Captain H. T. Morshead, R.E.		Mr. Lal Singh, R.B.	1 Surveyor.

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PART 2.—FIELD WORK.

I.—TOPOGRAPHICAL SURVEYS.

4. The two following tables show respectively the progress of the topographical programme assigned to the department in 1905, and the out-turns and costs of different parties during the year under report. They are followed by brief descriptions of the work of each topographical party.

Table II.—Progress of Topographical Surveys since 1905.

Survey year.	Scales of Survey.	Northern Circle.	Southern Circle.	Eastern Circle.	TOTALS.
		<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>
1905-06 ...	Mostly 2-inch and 1-inch	5,995	1,660	10,322	17,977
1906-07 ...	ditto ...	7,277	7,666	8,659	23,602
1907-08 ...	ditto ...	14,530	9,256	12,431	36,217
1908-09 ...	ditto ...	17,957	12,526	11,542	42,025
1909-10 ...	Mostly 1-inch ...	23,833	12,532	9,736	46,101
1910-11 ...	ditto ...	27,528	13,171	9,218	49,917
1911-12 ...	ditto ...	23,852	9,115	10,654	43,621
1912-13 ...	Mostly 1-inch and $\frac{1}{2}$ -inch	27,240	13,349	11,836	52,425
1913-14 ...	ditto ...	23,625	15,844	14,890	54,359
Total Areas completed to date ...		1,71,837	95,119	99,288	3,66,244
Approximate areas for the whole topographical programme.		7,50,000	5,42,800	5,28,800	18,21,600
Approximate areas remaining for survey.		5,78,163	4,47,681	4,29,512	14,55,356

Table III.—OUT-TURNS and COSTS of Topographical Surveys, 1913-14.

PARTY and LOCALITY. Character of ground. Scale and type of Survey.		OUT-TURNS.		TOTAL COSTS.		REMARKS.
		Areas of Survey.	Totals on all Scales.	Survey and Mapping.	Cost-rates.	
		<i>Sq. miles.</i>		<i>Rs.</i>	<i>Cost-rates. Rs.</i>	NORTHERN CIRCLE.
No. 1 Party—Kashmir, Punjab, and N.-W. F. Province.						
Open plains and wooded hills ...	1-inch Survey ...	2,652				
Jammu town and environs ...	2-inch Survey ...	33				
Mountains and fairly wooded ...	1/2-inch Revision Survey ...	125		1,10,403*		
Ditto ditto ...	1/4-inch Revision Survey ...	869	3,679		30'0	* Excludes Rs. 281, cost of work on field litho.-press.
No. 2 Party—Punjab.						
Plains, partly open, partly irrigated ...	1-inch Revision Survey ...	5,190		1,08,122		
Ditto ditto ...	1-inch Resurvey ...	1,514	6,704		16'1	
No. 3 Party—Punjab and United Provinces.						
Himalayan foot-hills and plains ...	1-inch Revision Survey ...	6,118		1,13,222		
Ditto ditto ...	1-inch Resurvey ...	84	6,202		18'3	
No. 4 Party—United Provinces and Nepal.						
Himalayan foot-hills and plains ...	1-inch Resurvey ...	4,726		97,637		
Ditto ditto ...	1-inch Supplementary Survey ...	2,314	7,040		13'9	
TOTALS, NORTHERN CIRCLE:—		23,625 sq. m.		Rs. 4,29,384		Cost-rate 18'2
		<i>Sq. miles.</i>		<i>Rs.</i>	<i>Cost-rates. Rs.</i>	SOUTHERN CIRCLE.
No. 5 Party—Central Provinces and Berar.						
Varied, jungle-covered hills, undulating plateau and open plains. (1-inch Survey ...	1-inch Survey ...	3,505		1,14,763		
	1-inch Revision Survey ...	637	4,142		27'7	
No. 6 Party—Berar and Hyderabad.						
Open plains, undulating, and hills ...	1/2-inch Survey ...	3,096				
Open undulating plains ...	1-inch Survey ...	2,268		89,513		
Intricate ground, with thin forest ...	2-inch Survey ...	171	5,525		16'2	
No. 7 Party—Madras and Mysore.						
Low forest-clad or rocky hills and open cultivated plains. (1-inch Survey ...	1-inch Survey ...	3,041				
	2-inch Survey ...	177		99,178		
Forest-clad hills ...	1-inch Supplementary Survey ...	1,393	4,611		21'5	
No. 8 Party—Madras.						
Forest-clad hills, inhabited valleys ...	1-inch Survey ...	1,223		1,27,462		
Flat enclosed coast country ...	1 1/2-inch Survey ...	343	1,566		81'4	Very difficult country.
TOTALS, SOUTHERN CIRCLE:—		15,844 sq. m.		Rs. 4,30,916		Cost-rate 27'2
		<i>Sq. miles.</i>		<i>Rs.</i>	<i>Cost-rates. Rs.</i>	EASTERN CIRCLE.
No. 9 Party—Bihar and Orissa.						
Undulating and wooded ...	1-inch Survey ...	560				
Undulating and open ...	1-inch Supplementary Survey ...	2,114				
Undulating forest ...	2-inch Survey ...	11		1,04,649		
Undulating and wooded ...	1-inch Revision Survey ...	1,695	4,380		23'9	
No. 10 Party—Upper Burma.						
Mostly hilly and thickly wooded ...	1-inch Survey ...	4,024				
Ditto ditto ...	1-inch Revision Survey ...	587				
Ditto ditto ...	1-inch Reconnaissance Survey ...	60 (a)		1,77,423 (b)		
Ditto ditto ...	2-inch Survey ...	92	4,703		37'7	(a) Trans-border, not included in total.
No. 11 Party—Lower Burma.						
Mostly hilly and densely wooded ...	1-inch Survey ...	2,437				
Ditto ditto ...	1-inch Revision Survey ...	62		1,45,896 (c)		
Ditto ditto ...	2-inch Survey ...	95	2,594		56'3	(b) Excludes Rs. 42,602, for forest boundary surveys and Maymyo Drawing Office.
No. 12 Party—Assam.						
Partly open plains and grass jungle, partly densely wooded hills. (1 inch Survey ...	1-inch Survey ...	1,421				(c) Excludes Rs. 3,506, for forest boundary survey.
	1-inch Revision Survey ...	66				(d) Includes 20 sq miles special forest survey.
	1-inch Supplementary Survey ...	1,348 (d)				(e) Includes Rs. 17,516, for special forest survey, debit-able to Forest Department.
	2-inch Survey ...	54		1,36,548 (e)		(f) Excluding cost of mapping, to be done by Forest Map Office.
	4-inch Special Forest Survey ...	22	2,911		46'9	
Andamans Detachment—Andaman Islands.						
Densely wooded hills and mangrove swamps. 2-inch Skeleton Survey (un-contoured.)	2-inch Skeleton Survey (un-contoured.)	302	302	23,692 (f)	78'5	
TOTALS, EASTERN CIRCLE:—		14,890 sq. m.		Rs. 5,88,208		Cost-rate 39'5
GRAND TOTALS:—		54,359 sq. m.		Rs. 14,48,508		Cost-rate 26'6

NORTHERN CIRCLE (*vide index map No. 1*).

15. No. 1 Party.—This Party surveyed a total area of 2,652 square miles in S. Waziristān and Dera Ismail Khān district of the N.-W. Frontier Province, Riāsi, Mirpur, Udhampur, Jammu and Jasrota districts and Pūnch State, in Kashmir and Jammu State, and Siākot district in the Punjab, on the 1-inch scale. An area of 33 square miles, comprising Jammu town and the intricate country in its vicinity, was surveyed on the 2-inch scale. In addition, revision work was carried on in Ladākḥ district, 125 square miles on the half-inch, and 869 square miles on the quarter-inch being returned.

16. No. 2 Party.—This Party surveyed a total area of 6,704 square miles on the 1-inch scale in the districts of Gujrāt, Gujrānwāla, Siākot, Lahore, Hissār, Karnāl, and Rohtak, and in the Phūlkiān States of Patiāla and Jind, all in the Punjab. The country surveyed was flat, canal irrigated and well cultivated.

In addition, triangulation and traversing of 2,280 square miles and 738 linear miles respectively, were carried out for future 1-inch detail survey in parts of the district of Gurgaon and in the Phūlkiān States of Patiāla, Nābha, Jind and in Alwar and Lohāru States.

The field headquarters of the Party was transferred from Ferozepore to Hissār.

17. No. 3 Party.—This Party surveyed a total area of 6,202 square miles of which 6,118 square miles were 1-inch revision survey and 84 square miles resurvey. The 1-inch resurvey comprised a small part of Tehri State bordering upon Dehra Dūn, while the revision comprised, in the Punjab, parts of the districts of Simla, Ambāla, Karnāl, and Rohtak, with parts of the following Simla Hill States:—Bhajji, Dhāmi, Keonthal, Koti, Bāghal, Baghāt, Nālāgarh, Kuthār, Bijā, Mailog and Kunihār, also parts of Suket, Sirmūr and Patiāla States; and in the United Provinces, parts of the districts of Dehra Dūn, Sahāranpur, Muzaffārnagar, Meerut and Garhwāl and parts of Tehri State.

The area surveyed consisted of the well cultivated and irrigated plains of the United Provinces and Punjab, parts of the intricate forest clad Siwālik Range, and portions of the outer Himālayas with a fringe of the sub-Himālayas. The principal rivers traversing the area surveyed are the Sutlej and Giri on the north, the Jumna on the west, and Ganges on the east.

The old 1-inch sheets were adjusted to plotted traverse data and the detail transferred to the plane-tables. In Dehra Dūn and the Siwālik Hills the old sheets were found to be inaccurate, but in the remainder of the area, except along the banks of rivers, water-courses and canals, they were of great assistance.

18. No. 4 Party.—This Party surveyed an area of 7,040 square miles consisting of 4,726 square miles new survey and 2,314 square miles supplementary survey, all on the 1-inch scale in the districts of Shāhjahānpur, Hardoi, Kheri, Gondā, Bahraich, Basti and Fyzābād of the United Provinces and Nepāl. The greater portion of the country consisted of highly cultivated plains covered with orchards; on the north, where the districts border on Nepāl, lies a fringe of dense jungle. The part of Nepāl surveyed north of Kheri and Bahraich districts, consisted of plains covered with dense jungle interspersed with patches of cultivation and intersected by numerous streams; that to the north of Gondā and Basti was steep hills rising to 3,000 feet, and covered in many places by thick jungle.

19. The work of the following parties, also belonging to this circle, is reported on pages 14 to 16. *No. 20 Party (Cantonment)*—Punjab Riverain detachment and Simla Survey detachment.

SOUTHERN CIRCLE (*vide index map No. 2*).

20. No. 5 Party.—No. 5 Party surveyed an area of 4,142 square miles in the Hoshangābād, Narsinghpur, Chhindwāra, Betūl, Nāgpur and Wardhā districts of the Central Provinces and in the Amraoti district of Berār, and triangulated an area of 5,796 square miles in the Betūl and Nimār districts of the Central Provinces and in the Amraoti and Akola districts of Berār. The nature of the country surveyed varied, it included the steep and wooded hills on the north of the Sātpurā plateau, the undulating and comparatively open plateau, the steep wooded drop off the south edge of the plateau and the flat or undulating cultivated plains below.

2. No. 6 Party.—No. 6 Party surveyed an area of 5,525 square miles in the Akola and Buldāna districts of Berār and in the Nānder and Parbhani districts of Hyderābād, and triangulated an area of 8,985 square miles in the Aurangābād, Bhīr, Parbhani and Osmānābād districts of Hyderābād and in the Ahmādnagar district of Bombay. The country was of a varied nature, parts of the northern area were intricate and similar to that surveyed in previous years, while towards the south and west it became more open and easy to survey. More than half the area under survey lay in Hyderābād and was surveyed on the $\frac{1}{2}$ -inch scale. This has resulted in a considerable increase in out-turn and a further increase is anticipated.

22. No. 7 Party.—No. 7 Party surveyed an area of 4,611 square miles, in the Salem, North Arcot, South Arcot and Chittoor districts of Madras and in the Kolar district of Mysore, and triangulated 5,226 square miles in the North Arcot, South Arcot, Chingleput and Chittoor districts of Madras and in French territory near Pondicherry. The country surveyed was very varied in character, it consisted of forest clad hills, lower rocky hills covered with scrub or almost devoid of vegetation and open cultivated plains.

23. No. 8 Party.—No. 8 Party Surveyed an area of 1,566 square miles in the Travancore State of Madras, triangulated 1,005 square miles in the Coimbatore, Madura, and Tinnevelly districts and in the Travancore State of Madras, and traversed 55 linear miles in the Travancore State of Madras. The country surveyed was very varied in character, ranging from the densely inhabited country on the coast to the unexplored portions of the Pandalam hills. The only knowledge of the latter was a note left by Lieutenants Ward and Connor many years ago, in which they said "the country consisted of high rugged mountains covered with a dark impenetrable forest wherein dwelt divers wild beasts". The survey was difficult and entailed considerable hardships on the members of the party.

EASTERN CIRCLE (*vide index map No. 3*).

24. No. 9 Party.—No. 9 Party surveyed an area of 4,380 square miles. Of the total area 2,674 square miles were surveyed on the 1-inch scale in Hazāribāgh and Rānchi districts and Jashpur State, 1,695 square miles on the $\frac{1}{2}$ -inch scale in Gāngpur and Bāura States and 11 square miles of forest survey was made on the 2-inch scale. The country surveyed in Rānchi and Jashpur mostly consists of numerous small plateaus falling away to the south to a series of undulating terraces separated by rugged scarps. In Gāngpur State the country is undulating and wooded, with rocky hill ranges. Triangulation was carried out over parts of the Santāl Parganas, about 3,432 square miles being covered; theodolite traverses were also made, amounting to 245 linear miles, for controlling future topographical work in Birbhūm and Murshidābād districts, and 108 linear miles of forest boundary survey in the Santāl Parganas and Hāzaribāgh.

25. No. 10 Party.—No. 10 Party surveyed in detail an area of 4,763 square miles, in the Kathā, Myitkyinā and Mandalay districts of Upper Burma, including 679 square miles of country beyond the Burma-China Frontier and in unadministered territory, of which 60 square miles were sketched. 6,150 square miles were triangulated in the Myitkyinā district, and 330 linear miles of forest boundary surveys were completed. The country surveyed varied from the low lying Kaukkwe valley in the Kathā district, which was less than 500 feet above sea level, to the high hills along the Burma-China Frontier, some of which were over 13,000 feet high and covered with snow during the winter months. Both plains and hills were thickly wooded, and it was difficult to obtain views of the surrounding country, except where ground had been cleared for cultivation.

26. No. 11 Party.—No. 11 Party surveyed an area of 2,594 square miles on the 1-inch and 2-inch scales in the Tavoy district of the Tenasserim division of Lower Burma, and triangulated 2,200 square miles in the Mergui district; 66.4 linear miles of theodolite traverse for forest boundary surveys were completed. The country was similar to that surveyed the previous year, but even less accessible. The area between the Siam Frontier and the main range, dividing the Tenasserim river drainage from the seaboard, consisted of steep densely wooded hills rising to nearly 7,000 feet with few inhabitants or communications, while the country along the sea coast was more open.

The area surveyed also included the South Moscos Islands.

27. No. 12 Party.—No. 12 Party surveyed an area of 2,911 square miles on all scales in the Darrang, Nowgong, Šibsāgar and Lakhimpur districts of Assam, and carried out 473 linear miles of traversing. The above area includes 54 square miles of reserved forests surveyed on the 2-inch scale, and 22 square miles of special 4-inch forest survey.

The country under survey consisted mainly of the plains of the Brahmaputra valley, which, where not under tea and other cultivation, are covered with trees and high grass, interspersed with numerous swamps and, "bils"; the remainder of the area comprised densely wooded hills rising to an elevation of about 4,000 feet.

One surveyor was attached for about a couple of months to the Akā Promenade Survey Detachment.

II.—FOREST SURVEYS.

28. During the year 1913-14, the forest surveys have, as usual, been carried out by the topographical parties of the Survey of India. In the majority of cases the surveys were executed on the scale of two inches to the mile, but in some few instances the work was done on the one-inch scale. A considerable extent of forest boundaries was also surveyed on the scale of four inches to the mile. The revision of certain areas previously surveyed on the four-inch scale by the old Forest Survey Branch was also effected.

 NORTHERN CIRCLE.

29. No forest surveys were carried out in this circle during the year under report.

 SOUTHERN CIRCLE.

30. Central Provinces. (Berār Circle).—Forest surveys on the scale of two-inches to the mile and plane-table boundary traverses on the scale of four-inches to the mile were continued by No. 6 Party in Berār.

In the Akola division, the Loni and Mohoja reserves were surveyed; and in the Buldāna division, the Gerumātergaon, Amdari, and other small reserves of the A, B and C classes were completed. The area surveyed on the two-inch scale amounted to 145.9 square miles and the four-inch plane-table boundary surveys to 397.9 linear miles.

31. Madras Presidency.—In the course of its ordinary operations, No. 7 Party surveyed on the two-inch scale, 6 reserved forests in the Salem district, and 16 in the North and South Arcot districts. The area of the former is 23.7 square miles and of the latter 146.3 and 6.9 square miles respectively. No new theodolite boundary traverses were executed, but the boundaries were checked as far as possible with the 8-inch Madras Revenue traverse maps in the field, and with one or two exceptions, they were all found to agree.

 EASTERN CIRCLE.

32. Bihār and Orissa.—During the year under report, No. 9 Party surveyed 11 square miles of reserved forest on the two-inch scale and traversed by theodolite 22 linear miles of forest boundaries in the Hazāribāgh district. In the Santāl Parganas, theodolite traverses of 86 linear miles were run round the boundaries of the 3 reserved forests in that district.

33. Upper Burma (*Northern Circle*).—No. 10 Party surveyed the Nansonti, Puga and part of the Nantan reserves in the Myitkyinā division, and parts of the Nami and Nansiaung forests in the Kathā division, amounting to 57 square miles on the two-inch scale.

Part of the Pidaung game reserve in the Myitkyinā district, area 164 square miles, was surveyed on the one-inch scale.

In addition to these, 159 linear miles of boundary survey were completed round the Nantan, Puga, Teinlon and part of the Nansonti reserves of the Myitkyinā division, and round parts of the Nami, Nansiaung, Manmaw, Nanhin, Mawhuk and Loinaw reserves of the Kathā division. The Conservator of Forests, Northern Circle, agreed to the survey of the Pidaung reserve being done on the one-inch scale, instead of the two-inch scale, as it is only reserved as a game sanctuary, and not for timber preservation.

34. Upper Burma (*Southern Circle*).—No. 10 Party surveyed the Maymyo reserve of the Mandalay division amounting to 34.7 square miles on the two-inch scale. In addition, 171 linear miles of boundary survey were run round the Maymyo, Taungbyo, Sakaungyi and part of the Zibingyi reserves of the Mandalay division.

35. Lower Burma (*Tenasserim Circle*).—No. 11 Party surveyed 95 square miles of the Mintha reserved forest on the two-inch scale, and the remainder of this reserve, together with the Western Hill Range and Taungbyouk reserved forests, on the one-inch scale. Part of the boundary of the Western Hill Range reserved forest, a distance of 54 linear miles (66.4 linear miles with connecting lines), was traversed by theodolite.

36. Assam.—No. 12 Party carried out, on the two-inch scale, the survey of the Chelabor, Sildharampur, Jungthung, Kukrakatā, Garumari and Bhomorāguri reserves in the course of its ordinary operations; the total area amounting to 34 square miles. In addition, the Laokhowa and Kaziranga game sanctuaries, situated within programme limits, were surveyed on the one-inch scale, this scale being considered sufficiently large to meet forest requirements. An area of 20 square miles on the two-inch and 22 square miles on the four-inch scale was completed in the Upper Dihing reserve and 90 linear miles of boundary and interior traversing was run in this and the Jaipur reserve; this survey being a special one, its cost is entirely borne by the Forest Department. The Dabakā, Suang, Bamoni and Diju Valley reserves, comprising an area of 66 square miles which had been surveyed on the four-inch scale in seasons 1904—06, were revised on the 1-inch scale as regards contouring and heights which were found to be faulty in parts.

37. Andaman Islands.—The Andamans Detachment executed the detailed skeleton survey on the scale of 2 inches = 1 mile of 302 square miles of reserved forest (mostly padauk) in the Middle Island of the Andaman Islands and ran 18 linear miles of theodolite traverse for the same purpose.

The survey was executed in continuation of that commenced during the preceding year by the Forest Department, employing surveyors of the Survey of India deputed to it for the purpose.

Operations during the year under report were carried out entirely by Survey of India agency.

III.—CANTONMENT AND LARGE-SCALE SURVEYS.

38. No. 20 Party (Cantonment).—During the year under report, it was employed on the survey of Guna, Kamptee, and Rajkot cantonments, and on Sitabaldi Fort. The triangulation and traversing of Meerut, and the triangulation of Dehra Dūn and Sanāwar have been completed in advance for season 1914-15. The contouring of Saugor was completed during the months of July, August, and September; and traverse work was started in Dehra Dūn in August. The fair mapping of Quetta, Quetta Civil Station, Quetta Fort, Saugor (out-line) and Guna has been sent for publication.

Since August 1913, the strength of the party has been increased by ten pupil surveyors, and three draftsmen. The training of the pupil surveyors has been systematically carried out, and next season there will be eight pupil surveyors quite capable of doing independent work. This will increase the out-turn of the party, and the work will be done at lower cost-rates.

The mapping of Kamptee, Sitabaldi Fort, and Rajkot is in hand, and will soon be sent for publication. The programme for the ensuing year is the survey of Meerut, Bābūgarh Stud Farm, Sahāranpur Remount Depôt, Dehra Dūn and Landour cantonments; and the triangulation and traversing in advance of Jullundur and Peshāwar for survey in 1915-16.

Out-turn and cost-rates of Cantonment Surveys, 1913-14.

Cantonments.	Scales.	Out-turn. Acres.	Total cost.	Cost-rates per acre. Survey and mapping.	REMARKS.
			<i>Rs.</i>	<i>Rs.</i>	
Guna, Kamptee, and Rajkot ...	16"=1 Mile	13,019	35,943'82	2'76	
Sitabaldi Fort ...	36"=1 Mile	175	878'81	5'02	
Guna, Kamptee, and Rajkot ...	64"=1 Mile	528	6,273'47	11'88	
		13,722	43,096'10		

39. The Punjab Riverain Detachment.—This Detachment continued the work of traversing and laying down base lines. 2,435 linear and 485 square miles of minor traverse were run. 10,471 theodolite stations were fixed in the area under water action of the rivers Sutlej, Rāvi, Chenāb and Jhelum. in districts Jullundur, Lahore, Siākot, and Gujrat. 726 corners of 242 squares were demarcated, in 401 square miles, with permanent mark-stones on both banks of the Rāvi (district Lahore), and the Jhelum (districts Gujrat, Jhelum and Shāhpur), to serve as bases for the future survey and demarcation of boundaries in the bed of these rivers. 2,151 plotted and 506 boundary “*masavis*” (settlement mapping sheets) of 309 villages were completed, and 33 four-inch sheets and 4 one-inch indexes were traced; all being supplied in time to the Settlement Officers of Jullundur, Lahore, Siākot and Gujrat. Besides these, 227 miscellaneous traces were prepared, and all the traversed stations marked during the season, were plotted on the four-inch sheets. 5 four-inch riverain boundary sheets were finally completed.

40. The Khushab Thal (sandy area) survey was carried on, in continuation of the last year's work. 103 linear and 200 square miles were traversed, and 180 theodolite stations laid out. 63 dressed stones, and 182 iron tubes were embedded over the whole of *Thal* in suitable places, to facilitate future survey and demarcation. 83 plotted and 5 boundary *masavis* and 16 four-inch traces showing compiled boundaries, were supplied to the Settlement Officer, Shāhpur.

41. The Kangra (tahsils Palampur and Kangra) special survey was commenced on the 15th December 1913, and was temporarily stopped in the middle of July 1914. 40 to 50 stations per square mile were laid out in the cultivated area. The scale of survey was generally 20 *karns*, or 150 feet to 1-inch. With a view to reduce the cost of the work, and save jungle clearing, the boundaries running in thick forests and along inaccessible snowy ranges were left out in 145 square miles of the Palampur tahsil, and are being enlarged from the topographical survey sheets. In all 3,393 linear and 400 square miles were traversed and triangulated. 16,827 theodolite stations fixed in 1,433 *tikas* (sub-villages) of the Palampur and Kangra tahsils, and 16 square miles of boundaries enlarged. 250 boundary *masavis* of 30 *tikas*, 5,881 plotted *masavis* of 1,224 *tikas*, and 31 four-inch sheets were completed.

42. Under orders of the Punjab Government the *25-acre Rectangular Survey* was started on the 21st February 1914 in the tract commanded by the *Upper Jhelum canal* along the Chenāb river in the districts of Gujrat and Shāhpur, and finished on the 12th June 1914. The detachment was required only to form blocks, subsequently to be split up by the Settlement Department into 25-acre rectangles. The northern and southern sides were demarcated at every 1,100 feet, and the eastern and western ones at every 990 feet, with permanent mark-stones and bricks.

Nearly the whole work was checked with a theodolite Traverse.

1,605 corners of the rectangles forming 38 blocks were demarcated covering 9,186 25-acre rectangles or 359 square miles. 663 linear miles were traversed, and 1,605 theodolite stations fixed.

43. Simla Survey Detachment.—This Detachment was formed during the year in order to comply with the needs of the Simla Municipality who urgently required a complete and up to date map, in connection with the improvement schemes of the station.

The area concerned lies within the limits of the Municipality, and comprises 8·386 square miles; country ranging from 6 to 8,000 feet above sea level, with heavily wooded spurs and intricate details over the inhabited portions.

44. During the course of the year the programme of work has been increased and includes the following:—

- (a) Large scale detailed plans of all *bazar* blocks in and around Simla.
- (b) Survey of extensions, outside Simla, on a scale of 8 inches to 1 mile.
- (c) Maps of forests lying in Koti State, (Simla)—Scale 4 inches to 1 mile.

During the year field surveys of 2,418 acres, or about half the station, have been completed, on a scale of $\frac{1}{1,500}$ or 125 feet to 1 inch.

No drawing has been taken in hand yet, as the surveyors, besides being continuously employed in out-door work, have prepared traces of field sheets, plans of *bazar* blocks, supply of heights and other information needed by officials dealing with the Simla Improvement Scheme.

IV.—TRIGONOMETRICAL SURVEYS.

GEODETTIC SURVEYS.

45. No. 13 Party.—Astronomical Latitudes.—This party was employed on latitude observations at 10 stations on the Western Ghats and the West-Coast, and at 4 stations in the United Provinces, as shown in the following list.

The observations were taken in hilly country or in the neighbourhood of hills, and therefore it is not possible to analyse the results until the effects of the attraction of the mountain masses have been computed.

An outstanding feature is the anomaly of the plumb-line deflections in the neighbourhood of Bombay. The pendulum observations have disclosed an excess in the intensity of gravity at Kolāba and a marked defect at Alibāg. This would lead one to expect that the plumb-line deflections at Alibāg and Kankeshwar would differ from that at Kolāba. We find, however, that the deflection in the meridian at both these stations is about 10 seconds North—just about the same as at Kolāba. Until more pendulum observations are made, no solution of this anomaly can be arrived at.

46. No. 14 Party.—Pendulum Operations—This party carried out pendulum observations, for measurement of the force of gravity, at 10 stations, along a line extending from Alibāg near Bombay, to Pāli in Mārwar, Rājputāna, as shown in the following list. The chief point of note in the results was a great change in the force of gravity between Alibāg and Kolāba. Neither the neighbouring topography, nor the latitude observations in the neighbourhood afford any explanation of this anomaly, so it has been decided to take further pendulum observations in this area. The preponderance of positive residuals in all the stations is noteworthy, and indicates a general excess in the force of gravity on the West-Coast.

List of Astronomical and Gravity stations, 1913-14.

ASTRONOMICAL LATITUDES.				GRAVITY OBSERVATIONS.			
Station.	Height.	Long.	Lat.	Station.	Height.	Long.	Lat.
	Fect.	° / ° /	° /		Fect.	° / ° /	° /
Panera ...	614	72 59	20 33	Alibag ...	12	72 52	18 39
Karanja ...	997	72 59	18 51	Daman ...	15	72 50	20 25
Alibag ...	10	72 52	18 39	Surat ...	30	72 48	21 10
Miryā ...	473	73 18	17 2	Bronch ...	51	72 59	21 42
Kumbhari ...	2,898	74 20	15 9	Baroda ...	109	73 11	22 19
Chaukola ...	2,794	73 59	15 56	Abmudabad ...	156	72 34	23 01
Mahabaleshwar	4,719	73 43	17 55	Deesa ...	465	72 12	24 15
Mira Dongar ...	1,863	73 12	18 41	Abu ...	3,836	72 43	24 36
Kalsubai ...	5,400	73 45	19 36	Erinpura ...	872	73 04	25 09
Godhna ...	846	77 57	29 37	Pali-Marwar ...	719	73 19	25 48
Mehesari ...	811	78 11	29 30				
Ranigarh ...	7,055	78 43	30 4				
Harpalsid ...	1,000	78 36	20 40				
Kankeshwar ...	1,260	72 58	18 44				

Also repeat observations at Dehra Dun at beginning and end of season.

TRIANGULATION.

47. No. 15 Party.—Was employed during the season in carrying out the following series of Principal and Secondary Triangulation:—

(a).—PRINCIPAL TRIANGULATION.

(i).—*The Sambalpur Series.*—The three figures required to complete the southern end of this series were observed. The total length of the completed series is 331 miles, and the final connection with the East-Coast series is very satisfactory.

(b).—SECONDARY TRIANGULATION.

(ii).—*Nāgā Hills Series.*—(Previously named the *Manipur Series*).—The connection of this series with the Manipur Longitudinal Series was completed. A large discrepancy in latitude was disclosed and is being made the subject of further investigation. The Assam earthquake of 1897 has made the interpretation of all results in this area very complicated.

(iii).—*Jaintiā Hill Series.*—The continuation of this old series to make connection with the new Nāgā Hills series was nearly completed in regard to building stations, but observations were only completed for the eastern half.

(iv).—*The Buldāna Series.*—(Previously named the *Akola Series*).—The northern half of this series carrying it down to latitude $20^{\circ} 12'$, was completed. This is all that is required for current topographical purposes, and the series will not be carried further at present.

(v).—*The Ashta Series.*—This connection between the Karāchi Longitudinal and Khandwā Series, along the meridian $76^{\circ} 30'$, was commenced, and completed with the exception of 36 miles at the north end.

(vi).—*The Naldrug Series.*—Was carried due south from the Bombay Longitudinal Series, along the meridian $76^{\circ} 30'$, down to latitude $15^{\circ} 30'$, whence it turned eastwards and was closed on the Great Arc Series, making a satisfactory connection.

(vii).—*Bombay City and Island Frame-work.*—The triangulation and traverse required as a basis for the new Bombay City Survey were completed, and all data supplied to the Superintendent of the City Survey. An analysis of the results shows that the desired accuracy of 1 in 10,000 was well maintained throughout the work.

Particulars of Triangulation during 1913-14.

	PRINCIPAL.		SECONDARY.				
	Sambalpur.	Nāgā Hills.	Jaintiā Hills.	Buldāna.	Ashta.	Naldrug.	
Number of Stations observed at	5	12	6	20	16	32	
" newly built	.....	1	14	20	19	28
Distance in miles completed ...	52	127	45	104	100	265	
Distance remaining to be done	.....	.....	57	.....	36	0
Area of triangulation in sq. miles	1,444	2,200	370	1,431	1,037	4,429	
Number of triangles observed ...	.....	9	4	18	14	32
" " Azimuths " ...	1	...	...	...	...	...
Maximum triangular error ...	0"316	4"26	No connection.	0"98	3"07	4"94	
Average " " "	0"119	1"23		0"44	1"07	2"16	
Mean closing error in latitude...	0"155	1"59		No connection.	No connection.	No connection.	0"15
" longitude	0"040	0"02					0"30
" height	2.5 ft.	11.9 ft.					10 ft.
" azimuth...	3"185	10"56	17"84				
Theodolite used ...	T & S 12-inch Mier. No. V.	T. & S. 12-inch Mier. No. III.	T. & S. 12-inch Mier. No. III.	T. & S. 8-inch Mier. Nos. 1311.	T. & S. 8-inch Mier. & 1316.	T. & S. 8-inch Mier. No. 956.	

TIDAL OPERATIONS.

48. No. 16 Party.—Observations were taken by means of self-registering tide-gauges during the year, at the stations given 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 ...	35	Small tide-gauge working.
2. Karachi ...	1868 ...	1880 ...	13	
	1891 ...	Still working ...	34	
3. Bombay (Apollo Bandar)	1878 ...	"	36	
4. Bombay (Prince's Dock)	1888 ...	"	26	
	1880 ...	1890 ...	10	
5. Madras ...	Restarted 1895	Still working	19	
6. Kidderpore ...	1881 ...	"	33	
7. Rangoon ...	1880 ...	"	34	
8. Moulmein ...	1880 ...	1886 ...	6	
	Restarted 1909	Still working	5	
9. Port Blair ...	1880 ...	"	34	

In addition to the above, tidal diagrams registered by a small river-gauge at Chittagong, and readings of high and low water taken during day-light on tide-poles at Bhaunagar and Akyab were supplied by the Port Officers concerned.

Tidal registrations at all the observatories now working have, on the whole, been carried out satisfactorily. The registrations at Madras which were stopped in August 1913, as stated in last year's report, were resumed at the old observatory in November 1913, owing to the accretion of sand, which blocked the passage between the sea and the observatory well, having been partially removed by the North-East monsoon. The erection of the new observatory at Madras was completed in February 1913 and tidal registrations were started in it on the 21st of the same month, when the old observatory was abandoned. All the above observatories were inspected during the year. Tidal observations during the coming year will be continued at the nine observatories now working.

49. In the following table are given the annual and decadal percentages of errors in the predicted times and heights of high and low water at all the stations where observations have been taken:—

Percentage of errors in predicted times and Heights

YEAR.	AT OPEN COAST STATIONS.					AT RIVERAIN STATIONS.						
	Number of stations.	IN TIME.		IN HEIGHT.			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.	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.	H.W.—L.W.
1904 ...	6	82 75	99 98	96 96	2	45 61	72 65	94 95				
1905 ...	7	82 79	96 95	96 97	2	52 62	72 57	94 92				
1906 ...	6	85 81	96 97	94 95	2	59 53	74 64	92 95				
1907 ...	6	84 83	98 98	98 99	2	58 47	78 60	96 90				
1908 ...	6	84 84	98 97	99 99	2	58 52	77 60	97 92				
1909 ...	6	85 86	97 97	97 98	3	61 59	69 65	93 92				
1910 ...	6	81 83	98 98	95 96	3	57 52	63 71	89 94				
1911 ...	6	84 84	98 99	97 98	3	65 51	68 66	90 90				
1912 ...	6	82 82	97 98	97 98	4	70 58	74 62	94 91				
1913 ...	6	83 82	97 97	98 99	4	68 55	70 58	94 88				
Average of ten years	...	83 82	97 97	97 98	...	59 55	72 63	93 92				

LEVELLING OPERATIONS.

50. No. 17 Party.—Three detachments were employed on levelling during the past season, as follows:—

51. No. 1 Levelling Detachment was employed in the Punjab on the lines (a) *new levelling* extending the line Ambāla-Solon to Simla along the tonga road and the "Mall," with branch lines to "Prospect Hill" and "Jakko",—and (b) on the *revisions* of the old lines Jagādhri-Ambāla-Ludhiāna and (c) Ferozepore-Lahore, by road.

This detachment also carried out in Baluchistān (d) *new levelling* extending the line Shikārpur-Jacobābād to Quetta, along the railway line as far as Sibi, and thence along the main road.

The out-turn of work amounted to 432 miles, and the heights of 15 primary, and 507 secondary bench-marks were determined, including 1 Principal Station of the Great Trigonometrical Survey.

52. No. 2 Levelling Detachment was employed in Bengal on *new levelling* on the lines (a) Mymensingh-Dacca, partly along the railway line and partly by road, (b) Howrah-Chāmpdāni by road, part of the line which will eventually be carried on to Benares, (c) Tindhāria-Darjeeling, with branch lines to the cantonments of Lebong and Takdah—and (d) on a *revision* of the old line of single levelling Pāchuriā-Porādaha along the railway line. This revision work disclosed an error of 1.784 feet in the old levelling.

In addition to the above, the Brahmaputra at Dhubri, Meghnā, Lakhyā, Dhaleswari, Padmā or Ganges rivers were again crossed; for the first four crossings, vertical angles were observed, and for the last the "Target" method was adopted.

The out-turn amounted to 223 miles including 11 miles of check levelling on the above-mentioned river banks; and 41 primary, and 194 secondary bench-marks were connected, including 3 Secondary Stations of the Great Trigonometrical Survey.

The revisionary line Pāchuriā-Porādaha closes the circuit Porādaha-Pārvatipur-Gaubāti-Akhaurā-Pāchuriā-Porādaha with a closing error of 1.084 feet, the length of the circuit being 824 miles.

53. No. 3 Levelling Detachment was employed in Burma on the line (a) Taunggyi-Thazi, by the P. W. D. unmetalled road to Tagundaing, and thence by the railway line to Thazi, (b) Magwe-Taungdwingyi, by the P. W. D. unmetalled road, (c) Mokpolin-Amherst, along the western embankment of the Sittang Canal to Kyaikto, and thence along the P. W. D. unmetalled road to Martaban, whence the levels were carried across the Salween river to Moulmein by vertical angles, and thence by P. W. D. road, *via* Mudon and Kwanhla to Amherst.

The out-turn amounted to 321 miles and the heights of 3 new and one old primary, and 93 new and 21 old secondary bench-marks were connected.

The line Magwe-Taungdwingyi completes the circuit Rangoon-Thazi (Meiktila Road)-Promé-Henzada-Rangoon, 882 miles in length, with a closing error of 0.287 of a foot.

54. Of these various lines of levelling two have been run from the plains to the hills, *viz*:—Thazi to Taunggyi in Burma, and Jacobābād to Quetta, in the Central Brāhui range, Baluchistān; and two are extensions further into the hills of lines emanating from the plains, *viz*:—Solon to Simla, and Tindhāria to Darjeeling, both in the Himālayas.

Introduction of a new System of Levelling.

55. The present system of levelling of precision in India is that initiated by General Walker in 1858. It is "*Simultaneous double levelling*". In this system each line is observed by two levellers working independently under practically identical conditions. Each line is divided into a number of sections according to the convenience of the work, and the total length of sections levelled in one direction is made equal to that done in the opposite direction.

At the International Geodetic Conference of 1912, a resolution was passed that in future there would be a new category of levelling to be called "*Levelling of high precision*", and that to qualify for this category each section of a line of levels must be levelled independently in both the *forward* and the *backward* directions on dates as widely different as possible, and that the errors calculated according to certain formulæ must not exceed certain limits.

The main object of this new system is to evaluate the systematic or cumulative error dependent on the direction in which the levellers move. In the "*Simultaneous double levelling*" this error cannot be evaluated, because every section is worked in the same direction, and not fore and back, by both levellers. It is, however, eliminated from the final result by the system of levelling alternate sections in opposite directions.

During the past season two lines were worked on the new system of "*fore and back double levelling*" viz:—Ferozepore to Lahore, and Jacobābād to Quetta. Each section was, however, levelled on the same day, a plan which, though not quite in accordance with the above resolution, has several points in its favour. Henceforward the system of "*fore and back double levelling*" will always be employed.

MAGNETIC SURVEY.

Committee on the present position of the Magnetic Survey.

56. At the suggestion of the Surveyor General a committee was appointed by the Government of India in March 1914 to consider the present position of the magnetic survey and advise as to the steps to be taken to complete it. The committee, consisting of Dr. G. T. Walker, C.S.I., F.R.S., as president, and Captain Thomas and Mr. J. deGraaff Hunter, of the Survey of India, as members, sat for a fortnight in March 1914.

The report of the committee will be published in extenso in the Records of the Survey of India; the main conclusions and recommendations may be summarised as follows:—

- (i).—The field work of the first general magnetic survey is complete and the work of reduction to epoch should now be pressed on.
- (ii).—The process of reduction usually followed may be simplified and the labour involved thereby considerably reduced.
- (iii).—The survey can be brought up to date at any future period by maintaining an adequate number of observatories in continuous operation and by preservation of the present repeat stations.

57. No. 18 Party (Magnetic).—As it was considered desirable to push on with the reduction of the mass of data already accumulated, detailed survey operations were discontinued, and field work was confined to observations at repeat stations for the determination of secular changes and comparisons of instruments at observatories. This work was carried out by two detachments under the Officer in charge and a Provincial officer.

In December 1913, however, the party was directed to carry out special detailed magnetic surveys in the districts of Poona, Nasik, and Ahmadnagar, in connection with the proposed establishment of one of the stations of the Imperial chain of wireless telegraphy. A third detachment under a provincial officer took the field for this purpose, but after completing work in the Poona district, amounting to 30 stations in all, instructions were received to discontinue the operations. It is difficult to draw any useful conclusions from the magnetic survey of a narrow belt of country where (as in this case) local disturbances of considerable magnitude are of frequent occurrence; within the limits of this survey, however, there was no evidence that the topographical features exerted any appreciable magnetic effect.

58. Work during recess.—The reduction and the tabulation of the data for the four survey base stations for 1913 have been completed. The mean values for the year 1913 derived from all days, excluding those of great disturbance, are given in the table below.

The computation of the field observations during 1913-14 has been completed, and that of the observatory work during 1914 has made good progress.

The reduction of the field observations in Horizontal Force to the selected epoch, has been put in hand; hitherto only the declination data have been dealt with.

59. Mean values of magnetic elements.—The mean values of the magnetic elements at the survey base stations for 1913 derived from "all" days, are as follows:—

Observatory.	Latitude & Longitude.	Dip.	Declination.	Horizontal Force.	Vertical Force.
	" " "	" "	" "	C. G. S.	C. G. S.
Dehra Dun ...	{ 30 19 19 N } { 78 3 19 E }	N 44 16.4	E 2 22.2	·33191	·32359
Barrackpore ...	{ 22 46 29 N } { 88 21 39 E }	N 30 54.8	E 0 38.0	·37388	·22387
Toungoo ...	{ 18 55 45 N } { 96 27 3 E }	N 23 5.0	E 0 7.8	·38963	·16605
Kodaikanal ...	{ 10 13 50 N } { 77 27 46 E }	N 4 5.5	W 1 11.2	·37553	·02686

BASE LINE OPERATIONS.

60. No. 19 Party.—During the year the various parts of the Bar Comparators, including the Standard Bars themselves, and of the apparatus for ascertaining the length of the wires which are used for field measurements, arrived from Europe. Some progress was made in the erection of both the Comparators, but as they cannot be used until electric power is available, and as the scheme for the supply of power to Dehra Dūn was not likely to be complete till the autumn of 1914, no great amount of labour was expended on them.

The officer in charge was employed at the Head Quarter Office of the Trigonometrical Survey under the orders of the Superintendent.

61. The set of Standard Bars received from Europe comprises the following:—

Pure Nickel Bar	...	1 metre in length.
Invar Bar	...	1 „ „ „
Nickel-Steel Bar	...	1 „ „ „
Invar Bar	...	4 metres „ „
Nickel-Steel Bar	...	4 „ „ „

The lengths and co-efficients of expansion of the 4-metre bars were determined at the National Physical Laboratory, Teddington; those of the 1-metre bars at the Bureau International des Poids et Mesures, Sevres. All the bars are of similar cross-section, the long ones being more massive than the others, and they were all constructed and graduated by the "Société Gènevoise des Instruments Scientifiques". Details of these lengths and co-efficients of expansion, are being published in Volume VII of the "Records of the Survey of India".

V.—GEOGRAPHICAL SURVEYS AND EXPLORATION.

62. The Italian Scientific expedition to the Karakoram.—Under the direction of Cavaliere F. deFilippi, after a visit to Dehra Dūn in August 1913 for comparison of instruments, proceeded to the Karakoram, *viâ* Kashmir and Leh. *Differential Longitudes* between Dehra Dūn and points on the upper reaches of the Indus as far as Leh, on both sides of the Karakoram Pass, and in Chinese Turkistān, were determined by the *simultaneous recording of wireless telegraphic signals sent out by the Lahore Radio-Office, combined with Astronomical observations.* The Government of India have given various facilities besides a monetary contribution to this expedition, and the results should prove of particular interest to geodesy and kindred sciences. Major H. Wood, R.E., proceeded to join the expedition in March 1914, and field work was closed in November 1914, by observations at Tashkent.

63. Sir Aurel Stein's archæological Expedition in Central Asia.—Two picked surveyors from the department remained with this expedition throughout the year, and are reported to have collected much geographical information of areas hitherto unexplored.

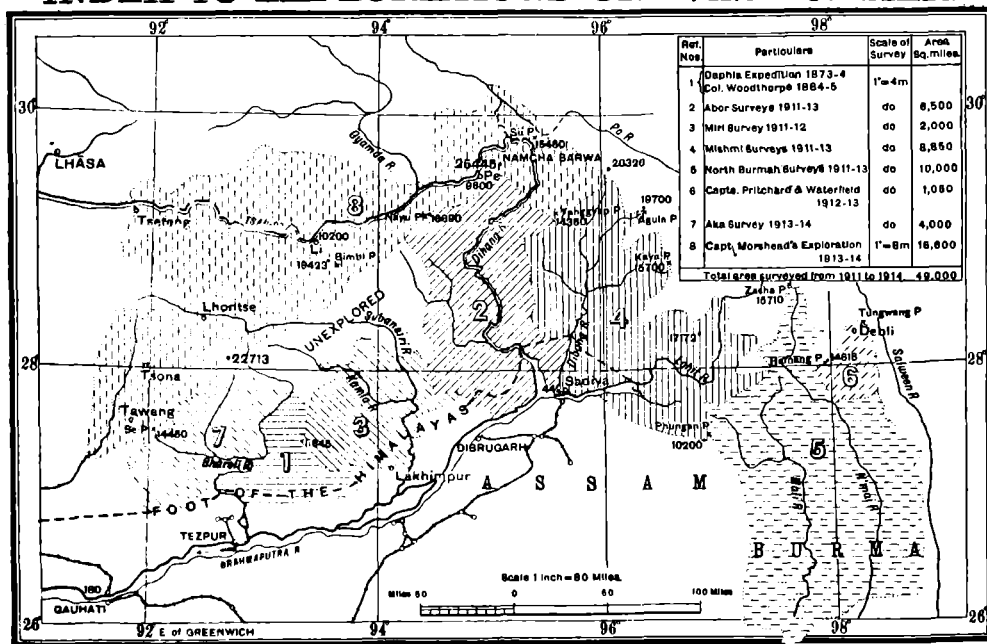
64. Eastern Himalayas.—Captain F. M. Bailey, I.A., with Captain Morshead, R.E., of the Survey of India, returned in November 1913 from 6 months' exploration in the neighbourhood of the unknown portions of the Tsan-po, or Upper Brahmaputra river. A general description and map of their journeys may be found in the "Geographical Journal" for October 1914. The work resulted in some 16,600 square miles of reconnaissance, together with much valuable information, in regard to an area hitherto almost unknown.

Though the great bend of the Tsan-po has been shifted some sixty miles eastward of its previously estimated position, the main fact of the identity of the Tsan-po with the Brahmaputra river has been fully established, and the results have justified the faith of the department in their explorer Kinthup, who traversed these regions in 1880—84. Another interesting discovery was that the highest peak of this region (Namcha Barwa 25,445 feet) is in the great bend of the Tsan-po—a fact whose probability had already been suggested by Sir Sidney Burrard in "The Geography and Geology of the Himalaya Mountains" (1907).

65. North-East Frontier.—Some additional exploration was carried out during the year under report, in continuation of that executed on the Northern Frontier of Assam during the two immediately preceding seasons. This was done under Lieutenant Huddleston, R.E., who accompanied a small political mission into the Aka country, lying to the west of the Abors and north and west of the Miris. With 2 Indian surveyors under him he succeeded in completing the survey and reconnaissance of 4,040 square miles of country, 3,400 square miles of which had hitherto been unsurveyed, and in forming a connection with the work of Captain Morshead along the water-shed of the Bhareli River System.

66. The index map below shows roughly the areas embraced in the various explorations on the North-East Frontier of India and North Burma during the past 3 years.

INDEX TO EXPLORATIONS ON N. E. FRONTIER.



PART 3.—OFFICE WORK.

I.—HEAD QUARTER OFFICES.

MAP PUBLICATION OFFICE (*vide* Index maps at end.)

67. The classes of maps, for the publication of which the Head Quarter Offices are responsible, may be enumerated as follows:—

- (a)—Topographical maps on the scale of 1 inch to 1 mile.
- (b)—Topographical maps on the scale of $\frac{1}{2}$ inch to 1 mile.
- (c)—Topographical maps on the scale of $\frac{1}{4}$ inch to 1 mile.
- (d)—Geographical maps on the one millionth scale, (about 16 miles to 1 inch).
- (e)—Geographical maps on the two millionth scale, (about 32 miles to 1 inch).
- (f)—General maps on small scales.
- (g)—Special maps.

The first duty of the offices is to publish the 1-inch, $\frac{1}{2}$ -inch and $\frac{1}{4}$ -inch maps prepared by the field parties and Circle drawing offices from the results of the topographical surveys now in progress.

68. (a) Topographical maps on the scale of 1 inch to 1 mile.

During the year 176 sheets have been received for publication and 158 have been published. The corresponding figures for the previous year were 152 and 222 respectively. The decrease in output is chiefly due to the fact that a large number of the sheets surveyed in 1912-13 were received too late for publication in 1913-14 and are still under publication.

Putting aside the sheets surveyed in Kashmir, where the season of field survey differed from that in other parts of India, the one-inch maps of all areas surveyed up to the 30th September 1913 have been published, with the exception of 57 sheets including an area of about 14,800 square miles; of these, 47 have been drawn and are under publication, and the remaining 10 have not yet been received from the Circle offices.

Index maps Nos. 4, 5 and 6 at the end of this report show the progress made in the publication of the modern one-inch sheets, and the table below gives the annual output of sheets since the modern topographical surveys were begun:—

Year.	NUMBER OF 1-INCH SHEETS PUBLISHED.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
1905-06	...	...	...	...
1906-07	4	1	...	5
1907-08	16	15	22	53
1908-09	35	39	68	142
1909-10	72	41	69	182
1910-11	51	39	25	115
1911-12	68	33	58	159
1912-13	164	60	58	222
1913-14	71	38	49	158
Total Published	421	266	349	1,036
Approximate number of 1-inch sheets in India	2,160	2,067	2,101	6,328
Approximate number remaining for publication.*	1,739	1,801	1,752	5,292

* These figures include large number of sheets in deserts, at high altitudes and in other thinly populated country of which maps on so large a scale as 1 inch to the mile are unlikely to be required.

No important changes in the style of the one-inch maps have been introduced during 1913-14.

In addition to the output of modern one-inch sheets mentioned above, 55 sheets prepared from modern revenue surveys have been received for publication, of which 51 have been published as preliminary editions pending their topographical revision at some future date, and 2 special editions of modern one-inch sheets have been prepared at the request of local Governments to show village boundaries.

To maintain stocks, or to give effect to important changes due to the development of communications, 6 modern one-inch sheets and 9 old-style sheets on various scales have been reprinted.

69. (b) Topographical maps on the scale of $\frac{1}{2}$ inch to 1 mile. At a conference held at Sinla in June 1914, over which the Chief of the General Staff presided, and at which the Surveyor General was present, it was resolved to represent to the Government the desirability of preparing a map of India on the scale of $\frac{1}{2}$ inch to 1 mile, for tactical purposes. Two half-inch sheets have been received for publication and several are being drawn.

70. (c) The map of India on the scale of $\frac{1}{4}$ inch to 1 mile. (*Vide* Index map No. 9). This map is prepared in "degree sheets" which include $1^{\circ} \times 1^{\circ}$, or the area covered by 16 one-inch sheets.

The following table shows the progress made in publication:—

Years of Publication.	NUMBER OF DEGREE SHEETS PUBLISHED.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
1911-12	2	1	1	4
1912-13	3	1	1	5
1913-14	4	3	2	9
Totals	9	5	4	18
Approximate number of degree sheets in India	170	140	140	450

Pending the preparation of the new degree sheets from modern surveys, 28 degree sheets have been published during the year as Provisional Issues. These have been prepared from the maps of old surveys.

Seventy-four Atlas sheets and 6 district maps on the same scale. ($\frac{1}{4}$ inch to 1 mile), have been reprinted.

71. (d) Geographical maps on the one millionth scale, (about 16 miles to 1 inch). (*Vide* Index map No. 10).

Almost the whole of India has now been mapped in the India and Adjacent Countries series of sheets on the scale of $\frac{1}{1,000,000}$. The more recently published sheets, including 3 new sheets published during the year, are contoured and printed with hypsometrical layers, and the other sheets will gradually be contoured and republished with hypsometrical layers. A few selected sheets of this series are being engraved.

The only important change introduced during the year in the design of these maps has been the adoption of the method of showing areas under perpetual snow and ice in white, with the addition of light shading.

The scale of altitude tints for the one millionth maps is still the subject of experiments. The results attained so far are satisfactory, but it is hoped that further improvement can be effected.

72. La Carte Internationale du Monde au 1,000,000^e.—

One Indian sheet namely, sheet North 43 E, (Bombay), has been engraved and published. (*Vide* Index map No. 11).

An International Committee, which assembled in London under the auspices of His Majesty's Government in November 1909, decided that it was desirable that an International Map of the World, on the scale of 1:1,000,000, should be produced in a uniform style, prescribed by the committee, and that the respective governments should prepare and publish the sheets of the map in which their territories were included. At that time the Government of India had already begun the preparation of its own series of maps on the 1:1,000,000 scale, and these differ in several important features from the International Map, more particularly in the size of the sheets which include $4^{\circ} \times 4^{\circ}$ instead of the $4^{\circ} \times 6^{\circ}$ of the International sheets, and in the use of the foot instead of the metre as the unit of height measurements. The Indian sheets could not be altered to agree with the International sheets, as they form the key to the whole system of numbering and arrangement of the Indian topographical maps, and because the heights and contour values must be shown on them in feet. In order, therefore, to conform to the international movement, it is necessary to produce the international sheets as a special series, in addition to, and after the production of, the corresponding sheets of the Indian series.

Several sheets of the International Map of the World have now been published; the Government of Great Britain has produced at least 3, including portions of the British Isles and Turkey; the French Government has produced one or more sheets of French territory; the Government of the United States one of a portion of New England. Most of these sheets differ in certain particulars from the specifications prescribed by the committee of 1909, and from each other. They have aroused much interest and discussion among geographers and map makers in all civilised countries.

In November 1913, the International Committee met again at Paris and passed a new series of resolutions regarding the project, under which several of the conventional signs and the system of layer colouring have been changed.

Sheet North 43 E, was engraved in accordance with the original specifications of 1909, but the scale of layer colouring applied to it is that prescribed by the Paris Committee of 1913. It has, for the Survey of India, an interest apart from its being the first International sheet the department has published. It is also the first engraved sheet produced at Calcutta in colours from separate colour plates, a process which in the climate of Bengal presents certain difficulties not met with to the same extent in Europe.

Three other sheets of the International Map of the World are now being engraved at Calcutta.

73. (e) Geographical Maps on the scale of $\frac{1}{2}$ Million, (about 32 miles to 1 inch). (*Vide* Index map No. 12).

Three sheets, "Northern Persia", "Afghānistān", and "Baluchistān", of the Southern Asia Series, scale $\frac{1}{2}$ Million, have been published during the year. These, together with the sheet "Southern Persia", previously published, will, when joined up, provide a modern map of Persia for which there has been a constantly increasing demand in recent years.

It has been decided to extend the mapping of this series over India. One sheet, Kāthiāwār, is being drawn and the compilations of three others, the 'Andamans', 'Bombay' and 'Madras' have been put in hand.

74. (f) General Maps on small scales.

The Map of India and Adjacent Countries 1913, scale 32 miles to 1 inch, in 12 sheets, has been published with hypsometrical layer colouring.

This is believed to be the largest layered map of its kind yet printed and it is now the most important geographical map of the Indian Empire. The numerous problems it has presented in connection with the selection of the altitude zones and their colouring have been solved with a certain measure of success, but it is believed that several improvements can be effected, and experiments are now in hand with this object in view.

The preparation of the Political Edition of the same map, which will not be layered but will be coloured to distinguish the various administrative areas, is at present in abeyance pending the receipt of orders from Government in regard to certain boundaries.

The annual edition of the Railway Administration Map of India, scale 64 miles to 1 inch, showing information up to the 30th June 1914, was produced in August, together with a special edition of the same map showing important works in progress.

75. (g) Special Maps:—A large number of special maps, plans, diagrams and illustrations have been prepared for the different departments of Government, for Army Head Quarters, and for officials throughout India. Among these may be mentioned the Peshāwar Divisional Manœuvre Map, scale 4 miles to 1 inch, and a map of the lay-out of Delhi, scale 4 inches to 1 mile.

Heavy calls on the map reproducing offices in connection with the war kept certain sections at work night and day during a part of August and September.

In addition, and in response to a wide demand on the part of the public, a series of war maps of Belgium and parts of France, Germany and Russia were produced on different scales; the sales of these maps had amounted to Rs. 22,000 by the end of the year.

76. The number of maps issued during 1913-14 (as shown at the foot of this page) is again in excess of those of previous years.

77. Map Record and Issue Office.—The gross face value of the maps received from the printing offices during the year amounted to Rs. 3,26,077. This sum includes Rs. 7,117 and Rs. 26,848 the face value of maps printed in the Engraving Office and at Dehra Dūn respectively.

Details of the numbers and classes of maps published during the year, and their face value are shown in Table IV on page 32.

The total number of printed maps issued during the year was 3,59,917 of aggregate value of Rs. 1,77,546.

The details of the sales were as follows:—

	<i>Government Officials.</i>	<i>India Office.</i>	<i>Deptl. Issues.</i>	<i>Private Individuals.</i>	<i>Map Agents.</i>	Totals for 1913-14.	Totals for 1912-13.
No. of maps	2,56,360	4,081	52,410	35,826	11,220	3,59,917	3,27,311
Value	- Rs. 71,253	Rs. 5,031	Rs. 52,612	Rs. 32,391	Rs. 16,259	Rs. 1,77,546	Rs. 1,69,760

78. No. 1 (Head Quarter) Drawing Office.—During the year under review, the office was engaged in compiling and drawing the $\frac{1}{M}$ India and Adjacent Countries series of maps. Layers were prepared for several sheets of which new editions were required, to make them conform to the latest style. Four sheets of the $\frac{1}{M}$ International series, in which heights are in metres, are in progress, and partly with the Engraving Office. The drawing of three sheets of the Southern Asia series, scale $\frac{1}{2\text{ Million}}$ (about 32 miles to 1 inch), was completed. General maps of India on various scales were also dealt with. Of these the most interesting is the new layered edition of the 1 inch=32 miles wall-map of India. This map displays, at a glance, the main topographical features of the Indian Peninsula and the Himālayas and the Tibetan Plateau.

The preparation of the Degree sheets (1 inch=4 miles) from the old Atlas sheets, where new material was not available, has been continued.

Thirty maps on various scales have been brought up to date for the purpose of providing reprints.

A large number of sheets drawn by field parties and circle offices have passed through the office for minor corrections, contouring and stump-shading, or for the preparation of the layered editions.

A section has been formed to deal with a new $\frac{1}{2}$ -inch series of maps to cover India. Two sheets are already well advanced and should be ready for publication in 1915.

Indexes, Provincial and District maps, large-scale plans of towns and cantonments, have also been in hand during the year.

Seventy-seven sheets of Extra-Departmental work were drawn. Among these were maps and plans for the Postal, Geological, Railway, and Settlement authorities, and also special manœuvre maps.

The work of the Office-Copy Section which records all new material that has come into existence since a map was published, dealt with over three thousand sheets inserting new railways, canals, main-roads, and changes of boundary. This information is brought to notice by local authorities. The material thus collected is inserted in the new editions of the smaller scale maps which may be called for. In addition to this work, the section examined nearly 6,000 coloured maps before they were issued to the public. Traverse data have also been supplied to Settlement Officers and Engineers to enable them to make maps and plans for special purposes. Another class of work is the preparation of attested true plans of large scale surveys for use in court proceedings.

79. Engraving Office.—The engraving of the International Map N. E. 43 on four separate plates for four-colour printing was completed during the year. This is the first engraved map in four colours that has been prepared in the office. Good progress is being made with the other International Sheets N. D. 44, N. E. 44 and N. F. 42. Two others will shortly be put in hand.

Ten sheets of the $\frac{1}{M}$ "India and Adjacent Countries" Series have been taken in hand, of which Nos. 47, 53 and 63 are nearing completion, while the others 39, 41, 46, 48, 49, 56 and 72 are in various stages.

Eleven Index maps to complete the series of indexes to standard sheets were completed. Four scales and five layer tints were engraved.

Corrections and additions have been made to the General maps of India, several Index charts, district maps and old $\frac{1}{M}$ maps, as well as to other miscellaneous plates.

A number of certificates and Commission forms for the Army Department in English, Urdu and Hindi were also engraved.

In the Copper-plate-printing Section over 31,000 impressions were pulled, including photogravure plates. Work in connection with the making of transfers for printing purposes has so largely increased, partly owing to the introduction of layered maps, that two new motor-driven presses have been brought out and will shortly be set up.

In the Electro-typing Section 185 plates were dealt with.

80. Photo-Litho. Office.—There has been a decrease in departmental work, due, in part, to the number of one-inch sheets in colours received for publication being considerably less than in 1912-13. The out-turn of Extra-Departmental work, however, shows a marked increase, and this has enabled the office to show an increase in the total number of maps printed during the year.

The total number of new *one-inch standard sheets* printed is 158. In addition 5 one-inch standard sheets in colours were reprinted to replenish stock, while of preliminary and provisional editions, 8 sheets were printed in black and brown, and 41 sheets in black only. These together bring the total number of sheets printed in modern form to two hundred and twelve, a decrease of 40 sheets as against 1912-13, but maintaining an increase of 23 sheets as compared with 1911-12.

Further progress has been made and experience gained in the manner and method of printing *layered maps*. The most important undertakings of the office have been the 32-mile layered map of India in 12 sheets, and sheet No. N. 43 E. of the International Layered Map of the World.

The total number of impressions pulled is 2,286,845, an increase of 320,387 over the previous out-turn of 1,966,458 in 1912-13, itself an increase of 401,962 over the preceding year.

There has been a very large increase in the number of sheets received for the reproduction of *half-tone hill-shading* the number of negatives having increased from 53 in 1911-12 and 42 in 1912-13 to 153 during the year under report.

A new "Levy" acid-blast *etching-machine*, to etch plates 27 inches by 24 inches for use with either nitric acid or perchloride of iron, is on order and is shortly expected from England. The machine is guaranteed to etch a flat tint of the above size quite evenly, and should prove a great boon to the office.*

One additional Double-Demy, flat-bed *printing machine* has been received from England and is now in process of erection, while one further Quad-Crown and one Quad-Demy machine are on order from Messrs. Mann & Co.; it is hoped that both will be received and erected in 1915, the latter at the beginning and the former towards the end of the year.

An indent has also been submitted for two new *graining machines*.

The *Stores Section*, re-organised in 1913, has worked in a satisfactory manner, and the improved system of book-keeping then introduced has materially added to its efficiency.

* This machine was lost on the S. S. "Chilkana", captured and sunk by the "Emden". Another has been ordered.

Out-turn of Photo-Litho. Office during 1913-14.

1	2	3	4	5	6	7	8
Year.	Cost of office.	Value of out-turn at cost-rates.	Recovered in cash or by book-debit.	Number of impressions pulled. (Litho. only here shown).	NUMBER OF MAPS PRINTED.		
					Departmental.	Extra-Departmental.	Total.
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>				
1911-12	1,47,867	2,01,394	24,904	15,64,496	2,686	1,263	3,949
1912-13	1,61,699	2,39,940	27,214	19,66,458	3,656	2,010	5,666
1913-14	1,67,801	2,40,721	33,468	2,286,845	2,965	2,779	5,744

In addition, there were 35,710 half-tone pulls and 875,000 line-block pulls, (chiefly Weather Charts), as against 51,370 ,, ,, and 530,280 ,, ,, in 1912-13. and 60,056 ,, ,, and 437,820 ,, ,, in 1911-12.

The output of the Type Section is not included in the above statement.

The Type Section published 6,403 pages or items, 12,03,242 copies, 21,32,159 impressions, as against 8,408 ,, or ,, 13,43,465 ,, 26,08,591 ,, in 1912-13. and 7,988 ,, or ,, 11,31,012 ,, 20,14,766 ,, in 1911-12.

81. Mathematical Instrument Office.—During the year, from 1st April 1913 to 31st March 1914, there has been a large increase in the demands made on this office (*vide* item No. 1 in the table below) with the result that, whereas there was a loss of Rs. 7,055 in the previous year's working of the 'Stores' department, there has been a net profit of Rs. 33,571 in that of the past year.

The improvement in the value of work done, which showed a profit of Rs. 2,887, in the 'Workshop' department for 1912-13, has been well maintained, the profit during the past year being Rs. 10,346.

Below are given the usual comparative figures for the last three years:—

	1911-12.	1912-13.	1913-14.
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>
1. Total issues to Public Offices as shown in the Profit and Loss statements of stores.	3,25,633	2,81,315	4,07,802
2. Value of repairs to instruments received for repairs and returned in a serviceable condition.	55,941	64,452	56,418
3. Value of instruments received from Government Officers when no longer required.	37,228	57,267	69,806
4. Book value of the stock of instruments, &c., in Serviceable Stores.	7,46,047	6,45,081	4,73,470
5. Book value of the stock of instruments, &c., in Repairable Stores.	70,460	72,452	67,299
6. Total value of work done in the Workshop ...	1,74,871	2,15,328	2,40,752
7. Value of instruments manufactured in Workshop for Serviceable Stores.	61,431	71,188	93,991
8. Value of instruments purchased locally ...	4,578	6,206	9,060
9. Value of instruments and materials obtained from England through the Director General of Stores.	47,148	57,647	89,213
10. Average No. of employés and their pay ...	No. 297 } Rs. 62,981 }	No. 301 } Rs. 68,625 }	No. 300 } Rs. 76,734 }

During the year the stock of all the three stores, (the Serviceable, the Repairable and the Material Stores), was twice taken and the discrepancies noticed have been adjusted.

Table IV.—Departmental Publications, Calcutta, 1913-14.

Note.—For special publications at Dehra Dun, *vide*, pp. 33, 34, and 35.

Class of Maps.	Scale.	NUMBER OF DIFFERENT MAPS OF EACH CLASS RECEIVED.		Number of copies printed.	Value.
		New Publications.	New Editions and reprints.		
GEOGRAPHICAL MAPS.					<i>Rs.</i>
Maps of India	Various	3	6	3,102	9,286
Southern Asia Series	1:2,000,000	3	2	6,600	19,800
India and Adjacent Countries	1:1,000,000	3	4	3,450	3,450
Do. (International Series)	1:1,000,000	1	.....	230	460
TOPOGRAPHICAL MAPS.					
<i>DEGREE SHEETS.</i>					
Modern	1"=4 miles	9	9	9,895	10,395
Preliminary and Provisional	Do.	.....	3	1,400	1,400
From Atlas Material	Do.	28	1	9,248	9,248
<i>ONE-INCH SHEETS.</i>					
Modern	1"=1 mile	158	6	83,814	82,164
Do. (Preliminary Editions)	Do.	51	.....	21,900	20,900
Do. (Village Boundary Editions)	Do.	2	.....	400	800
Old Style Sheets	{ 2"=1 mile to 1"=4 miles }	4	9	5,094	7,641
<i>Atlas of India Series</i>	1"=4 miles	.....	74	10,370	9,729
<i>Provincial Maps</i>	Various	.....	4	1,800	2,250
<i>District Maps</i>	1"=4 miles	1	6	2,300	2,300
<i>Administration Report Maps</i>	{ 1"=8 miles to 1"=16 miles }	.....	16	1,950	731
<i>Plans of Cities and Cantonments</i>	Various	5	.....	1,475	1,475
<i>Index Maps</i>	Do.	81	.....	1,42,764	35,798
<i>Miscellaneous Maps</i>	Do.	376	13	2,68,309	1,08,250
Totals for 1913-14 ... ..	.....	728	153	5,74,101	3,26,077
Corresponding totals for 1912-13 ... ..	.....	611	311	.....	2,28,331

LETTERPRESS.

1. Reproduction of Maps, Plans, Photographs, Diagrams and Line Illustrations. Photo-Litho. Office. *Price Rs. 3.*
2. Index to names appearing on the Northern Persia sheet of the Southern Asia Series. Scale $\frac{1}{2}$ M.
3. Index to names appearing on the Southern Persia sheet of the Southern Asia Series. Scale $\frac{1}{2}$ M.
4. Catalogue of Maps of the Bombay Presidency. *Price As. 4.*
5. Record Volume No. 3 for the year 1911-12. *Price Rs. 4.*
6. „ „ No. 4 „ 1911-12-13. *Price Rs. 4.*
7. „ „ No. 5 „ 1912-13. *Price Rs. 4.*
8. Report on Electro-typing. F. Harrison, Esq., Ordnance Department, Southampton.
9. Topo. Handbooks, Chapters Nos. 1, 2, 3, 6, 7 and 9. (*Reprints*).
10. Map Publication orders from 1st January 1908 to 1st June 1914.

II.—DEHRA DŪN OFFICES.

82. COMPUTING AND TECHNICAL OFFICES.—Comprising Computing Office, Type Printing Office, Stores and Workshop, Observatories.

Computing Office.—Among other work carried out by the Computing Office the following may be mentioned:—

Computations of graticules for maps, of dynamic and orthometric heights on the lines of levelling from Delhi to Muttra, Murree to Srinagar, Srinagar to Islāmābād, Islāmābād to Aishmakam, Srinagar to Chunar, Srinagar to Manasbal and Srinagar to Bugam: and also preparations for press of the lines Minbu to Paugma and Paugma to Salin. The investigation of large discrepancies in azimuth of Lambton's triangulation brought to notice by No. 15 Party. Computation of mean triangular error of all Principal and Secondary Series. Computation of azimuth observations made by Lieutenant Nosworthy at three stations near Dehra Dūn. Calculation of the azimuth of Cairo and Singapore from points in India, in connection with the selection of a site for a wireless station. Computations in connection with isostasy and changes in the earth's axes. Compilation of data for 44 triangulation charts. Adjustment of topographical triangulation and computation of Lieutenant Huddleston's triangulation in the Akā country. Extraction of data from records in response to a large number of various enquiries.

83. Printing Office.—The following publications were printed during the year:—

(1) Report of the Committee appointed by the Government of India to discuss the present state of the Magnetic Survey.

(2) Note in reply to Mr. Hayden's paper on the relationship of the Himālaya to the Indo-Gangetic Plain and the Indian Peninsula. *By Lieutenant-Colonel G. P. Lenox-Conyngham, R.E.*

(3) Note in vindication of Kinthup. *By Captain G. F. T. Oakes, R.E.*

(4) Departmental Paper No. 6.—Levelling of High Precision. *By M. Ch. Lallemand (Translated from the French. By J. deGraaff Hunter, M.A.)*

(5) Records of the Survey of India, Vol. VI.—Completion of the link connecting the triangulations of India and Russia.

(6) Spirit-levelling pamphlets No. 39 and new edition of Nos. 54 and 58.

(7) Large numbers of professional forms have also been printed, as the whole of these are now supplied from Dehra Dūn.

(8) The printing of the following publications is in hand:—

(a) Professional Paper No. 15.—Pendulum Operations in India, January 1908 to April 1913. *By Captain H. J. Couchman, R.E.*

(b) Departmental Paper No. 7.—The Bar Comparisons of 1907-8. *By Major H. M. Cowie, R.E.*

(c) Records of the Survey of India, Volume VIII.—Exploration in Tibet and neighbouring regions.

84. Stores and Workshops.—Experiments have been made with a trestle for triangulation in wooded country. The chief difficulty is to get rid of vibration and movements which disturb the instrument, and considerable progress has been made in overcoming this.

An instrument for calculating the attraction of mountain chains has been designed by Mr. deGraaff Hunter and made. A "versine staff", for reading the correction to chained lengths due to slope of ground, has been made to the design of Major E. A. Tandy, R.E.

85. Observatories.—*Meteorological observations* have been continued throughout the year as mentioned in para. 93 of last report. A partial reduction of these results has been made and the corresponding refractions computed. The result points to a regular seasonal change in refraction. Further observation is necessary to establish this.

The Omori Seismograph has been in action throughout the year, and a list of earthquakes recorded will be published in the Records of the Survey of India, Volume VII.

Photographs of the sun were taken on 333 days during the year, the sun being obscured by clouds on the remaining days.

In collaboration with the *Expedition of Cavalieri F. deFilippi* observations for longitude by means of wireless telegraphy have been made successfully. This is the first occasion on which wireless telegraphy has been employed in the department. Eight stations have been connected, viz.,—Skardu, Kargil, Lamayuru, Leh, Depsang Plains, Suget Karaul, Yarkand and Kashgar. The last three are beyond the Karakoram Range and previously some doubt was felt as to whether the signals could be received over a great mountain range. It is satisfactory to record that the signals were received clearly and without difficulty.

86. Preservation of Trigonometrical Stations.—778 stations were repaired by district officers at a cost of Rs. 3,772. Out of 352 districts from which reports are annually due, 13 failed to make returns.

87. No. 2 DRAWING OFFICE.—The following is a summary of the work of the office during the year 1913-14.

Class of map.	Sheets sent to press.	Remaining in hand.
Scientific Diagrams and Charts	5	Nil
Geographical maps $\frac{1}{1,000,000}$ scale	Nil	9
Do. smaller scale	10	12
Miscellaneous Indexes and Plans	2	14
Triangulation charts	17	28
Extra-Departmental maps	3	1
Cantonment maps	10	3
Total	47	67

88. Photozinc. Office.—During the year the lithographic machine was employed in printing standard and provisional Degree Sheets; sheets of the plan of the site of the new Capital at Delhi; Cantonment and Forest maps; Triangulation and Levelling Charts.

Abstracts of the work done in the Photozinc. Section during 1912-13 and 1913-14 are shown in the following table:—

Year.	Subjects.	Negatives.	Pulls.	Chocolate and Cyanotype prints.
1912-13 ...	1,973	1,909	2,36,766	1,039
1913-14 ...	2,046	2,376	2,44,140	1,695

The letter-press machine was employed in printing departmental forms, &c. It was transferred from this office to the Computing Office on the 31st August 1914.

89. Forest Map Office.—The total number of maps issued during the year, both to officials and the public, amounted to 6,441, a decrease of 3,166 on last year's total. The gross face value of these maps was Rs. 12,301 and the net amount realized from sales was Rs. 2,348 against Rs. 3,191 in the previous year. Of this amount, Rs. 1,552 was recovered by book-debit and Rs. 796 by cash from sales to private individuals and trading companies. The number of maps and field sections received for storage during the year was 6,746, besides 224 computation volumes, angle books and traverse field books and 61 traverse charts and plot sheets.

The following table shows the work dealt with:—

Class of map.	NUMBER OF SHEETS.		
	In hand.	Drawn and sent to press.	Published.
1-inch, 2-inch and 4-inch maps of Forest Surveys	285	62	35
Provincial, Divisional and District Forest maps ...	13	7	6
Working Plans and Miscellaneous maps ...	11	13	12
TOTALS ...	309	82	53

III.—CIRCLE AND LOCAL DRAWING OFFICES.

90. No. 3 Drawing Office (Northern Circle).—During the year 116 fair sheets were received in the Circle Drawing Office. The fair sheets included the maps of the "Sardā River-Nepāl boundary" series, which have been held in abeyance awaiting a decision regarding the boundary, and those of Māler Kotla and environs, which were examined and sent to press.

Altogether 101 fair sheets were sent to press during the year, made up of 88 current sheets and 13 which were received from parties in season 1912-13. The number of sheets in hand on the 30th September 1914 was 28.

100 proofs were received from the Superintendent, Map Publication during the year, and 67 were examined and returned to press. On the 30th September 1914 there were 34 proofs in hand.

During the year under report 4 Degree sheets were sent to press. On the 30th September 1914 there were 9 Degree Sheets in hand.

91. No. 4 Drawing Office (Southern Circle).—Forty-nine one-inch sheets and 1 half-inch sheet were finally examined, 3 preliminary one-inch sheets were re-drawn and the drawing of three degree sheets was completed. All these sheets were submitted for publication.

At the end of the year only 1 one-inch sheet of those surveyed up to the end of 1912-13 remained to be submitted for publication, and 6 preliminary one-inch sheets and 6 degree sheets were being re-drawn and drawn respectively.

A number of pupils were instructed in drawing and considerable assistance was given to parties to enable them to complete their drawing during the recess season.

The Photo-Zinco. Section undertook the photographic and zinco-graphic work required in the circle.

92. No. 5 Drawing Office (Eastern Circle).—The work of the Office during the year was the examination of the parties' one-inch sheets, 1 half-inch sheet, and the drawing of degree sheets.

In addition to the draftsmen lent to the parties during the recess season, one surveyor and one draftsman were transferred to No. 10 Party at Maymyo, for employment in the Degree Sheet Section of that party.

During the year 35 one-inch sheets, 1 half-inch sheet, and 1 degree sheet, were submitted for publication. One one-inch sheet has been withheld, owing to the examination being incomplete for want of one of its field sections, but will be submitted shortly.

One degree sheet has been sent for publication during the year. 36 degree sheets are now in hand. Several of these will shortly be ready for submission to Superintendent, Map Publication. These sheets were thrown back owing to want of draftsmen, caused by transfers to parties to help in the one-inch mapping. 10 of them are being drawn in the Degree Sheet Section of No. 10 Party at Maymyo, but it is proposed to discontinue work on 3 of them, as well as on 12 of those being drawn in No. 5 Drawing Office, in order to allow of a commencement being made in these offices at as early a date as possible with half-inch mapping.

Proof and colour patterns of 49 one-inch sheets and 4 degree sheets have been dealt with.

93. Bihār and Orissa Drawing Office.—(*Imperial Mapping Section*). The office submitted the fair drawings for the publication of 55 preliminary one-inch sheets covering an area of 10,810 square miles. The drawing of 11 other sheets is practically completed, but they have been retained pending references in connection with settlement operations, and that of 57 sheets is in hand. There remain 31 sheets in Bihār and Orissa, for which cadastral plans are available, the one-inch preliminary mapping of which has yet to be taken up.

The following special maps were also drawn:—

- (i).—Darjeeling Municipality, scale 20 inches to 1 mile, in 6 sheets.
- (ii).—Darjeeling, "The Happy Valley", scale 20 inches to 1 mile, in 1 sheet.
- (iii).—Darjeeling, (Central portion), scale 40 inches to 1 mile, in 2 sheets.
- (iv).—Darjeeling Bazar, Native Town and Lloyd's Botanical Garden, scale 60 inches to 1 mile, in 1 sheet.
- (v).—Lebong Cantonment, scale 30 inches to 1 mile, in 3 sheets.
- (vi).—Takdah Cantonment, scale 30 inches to 1 mile, in 6 sheets.

The first four of these maps were submitted for publication to the Director of Surveys, Bengal and Assam, and the last two to the Superintendent of the Trigonometrical Survey.

The Bihār and Orissa Drawing Office will be transferred at an early date to Bankipore, and arrangements have been made, with the approval of the Government of Bengal, for the accommodation of the Imperial Mapping Section of the office in the Bengal Drawing Office, where, together with a similar section which will shortly be formed to undertake the preliminary 1-inch mapping of Cadastral Surveys in Bengal, it will work under the supervision of the Director of Bengal Surveys.

PART 4.—WORK FOR OTHER GOVERNMENT DEPARTMENTS.

94. Northern Circle.—As in previous years the *Punjab Riverain Detachment* of the Northern Circle was exclusively employed on the Riverain Khushāb Thal and Kāngra Traverse and Triangulation and 25-acre rectangular surveys required by the Punjab Government (*vide* page 15).

No. 20 Party (Cantonment) has been employed during the year under report on the survey of the following Cantonments:— Guna, Kamptee, Rājkot and Sitābakti fort and also on the triangulation in advance. of Dehra Dūn and Sanāwar (*vide* page 14).

The Simla Survey Detachment was formed during the year and has been employed on the survey of Simla Municipality and suburbs (*vide* page 16).

95. Southern Circle.—During August and September 1914 Captain Browne with 3 surveyors, &c., surveyed the site for the *Kirkee Wireless Station* and marked the astronomical azimuths required for the aerials.

96. Eastern Circle.—Two probationary superintendents of the *Burma Land Records Department* were attached to No. 10 Party for training in survey for 8 months. They carried out 35 square miles of detail forest survey on the 2-inch scale, and 43 linear miles of theodolite traverse near Maymyo, which has been incorporated in the Revision survey of the locality now in course of execution.

97. General.—Two Imperial officers with a staff of surveyors were attached to the *Turko-Persian Frontier Commission*; and one to *Cavalier de Filippi's Scientific Expedition*, with other details as stated on page 23, of the Report.

Two Provincial officers have been lent to the Bombay Government for the *Bombay City Survey*.

Various *Forest Surveys* and forest maps were carried out for the Forest Department as usual.

The Mathematical Instrument Office supplies and repairs instruments for every Government Department in India, including the Army Department.

98. Map Publication Offices.—*The reproduction*, for other departments, of maps, plans, and illustrations that do not require to be redrawn, does not interfere with the normal work of the Survey of India and is always undertaken when asked for. On the other hand, the amount of drawing and compilation that can be done for extra-departmental purposes is limited, and is necessarily confined to urgently required and important work.

During the year maps, plans, or illustrations were reproduced for the following departments and offices:—

The Government of India	in the	Department of Revenue and Agriculture.
"	"	" " " Education Department.
"	"	" " " Army Department.
"	"	" " " Public Works Department.
"	"	" Bengal.
"	"	" The United Provinces.
"	"	" Punjab.
"	"	" Bihār and Orissa.
"	"	" Central Provinces.
"	"	" North-West Frontier Province.
"	"	" Delhi.

LIST OF INDEX MAPS.

1. Index to modern surveys, Northern Circle.
2. " " " " Southern Circle.
3. " " " " Eastern Circle.
4. Index to the publication of modern one-inch sheets, Northern Circle.
5. " " " " " " Southern Circle.
6. " " " " " " Eastern Circle.
7. Index to the publication of provisional editions of one-inch sheets, Northern Circle.
8. " " " " " " Eastern Circle.
9. Index to the publication of Degree sheets, scale $\frac{1}{4}$ inch to 1 mile.
10. Index to the publication of sheets of the 'India and Adjacent Countries' Series, scale $\frac{1}{1,000,000}$, or about 16 miles to 1 inch.
11. Index to the publication of Indian sheets of "La Carte Internationale du Monde" on the scale of $\frac{1}{1,000,000}$, or about 16 miles to 1 inch.
12. Index to the publication of sheets of the 'Southern Asia' Series, scale $\frac{1}{2,000,000}$, or about 32 miles to 1 inch.
13. Index to the Great Trigonometrical Survey.

INDEX

Showing progress up to 30th September 1914.

Key to Degree Sheets.

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

Key to Standard Sheets.

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

When ordering a sheet on the degree scale, only the number should be used, e.g. No. 45. In the case of a degree sheet, the number and the degree sheet letter must be given, e.g. 45 A. For a 1 inch sheet, the number, the degree sheet letter and the 1 inch sheet number must be quoted, e.g. 45 E.

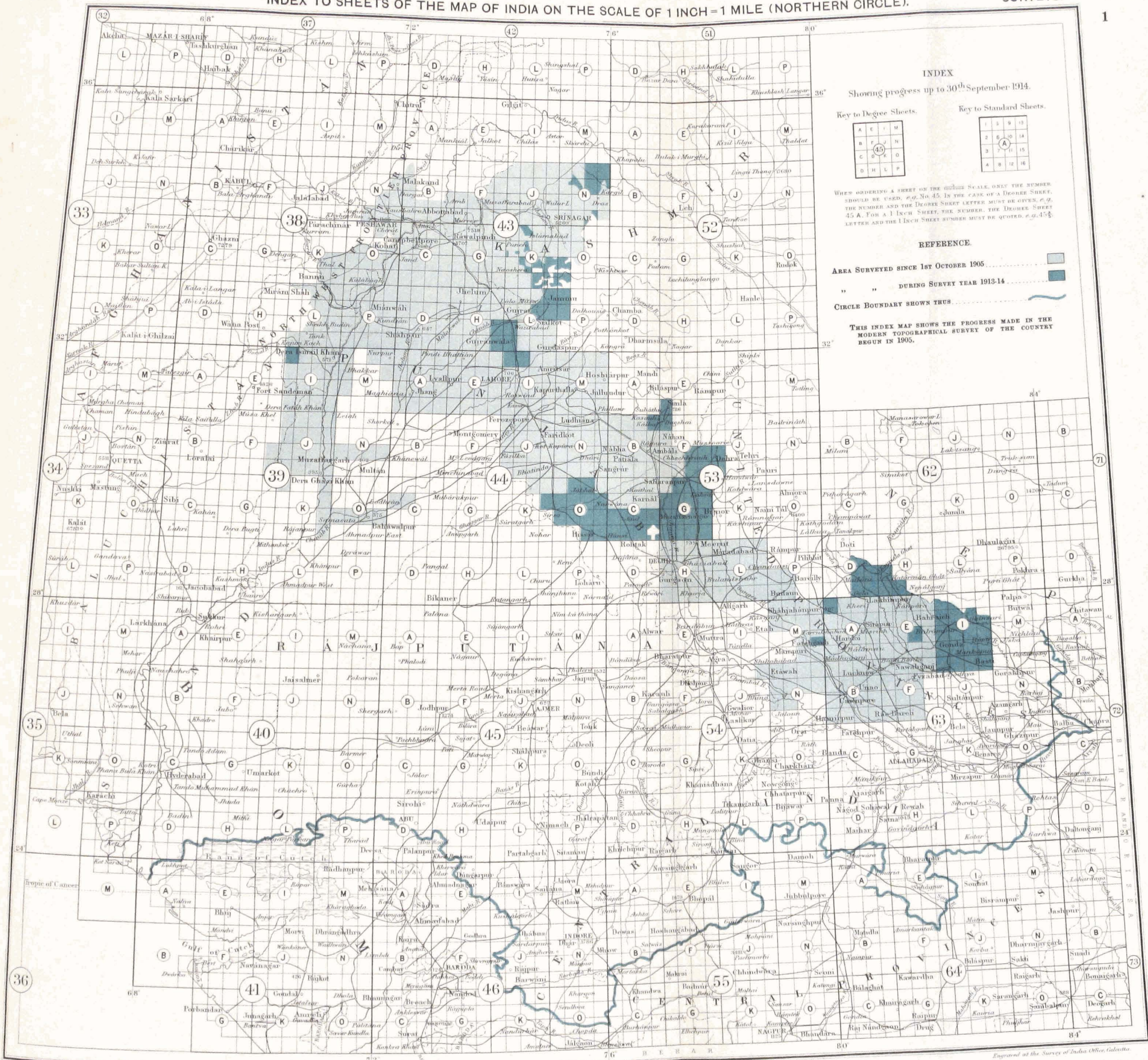
REFERENCE.

AREA SURVEYED SINCE 1ST OCTOBER 1905

" " DURING SURVEY YEAR 1913-14

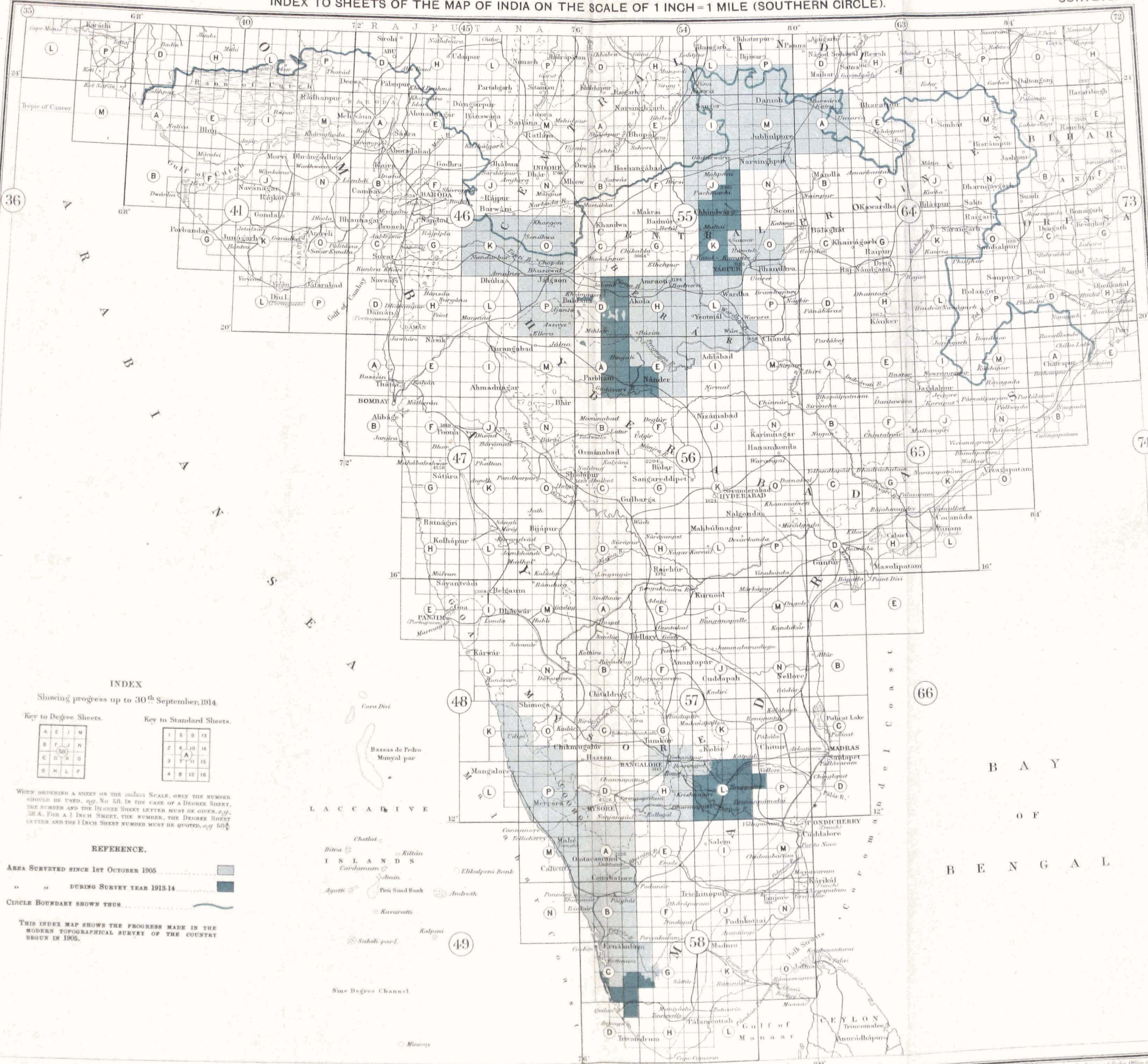
CIRCLE BOUNDARY SHOWN THUS

THIS INDEX MAP SHOWS THE PROGRESS MADE IN THE MODERN TOPOGRAPHICAL SURVEY OF THE COUNTRY BEGUN IN 1905.



INDEX TO SHEETS OF THE MAP OF INDIA ON THE SCALE OF 1 INCH = 1 MILE (SOUTHERN CIRCLE).

SURVEYS.



INDEX

Showing progress up to 30th September, 1914.

Key to Degree Sheets.

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

Key to Standard Sheets.

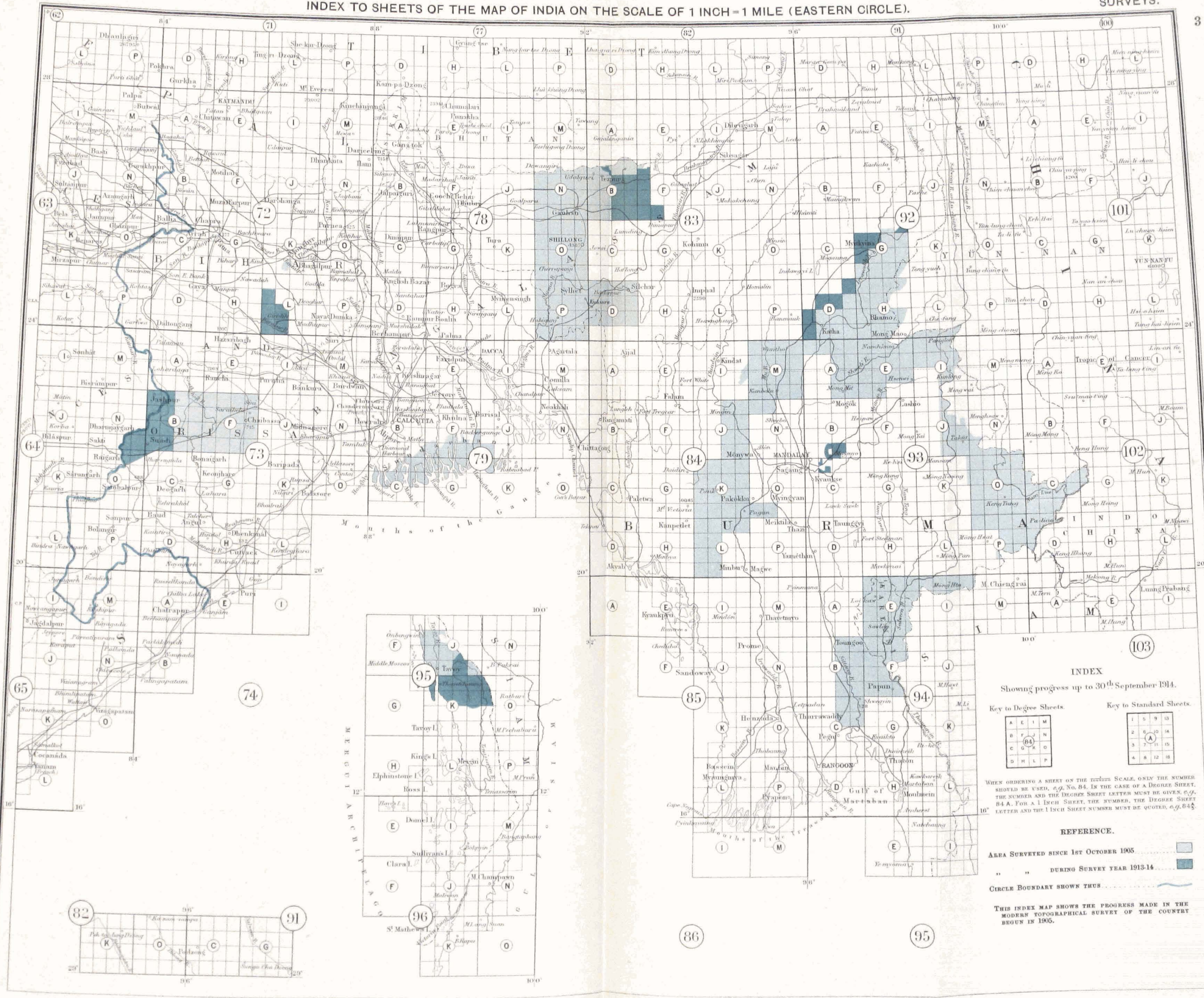
1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

When ordering a sheet on the *INDEX* Scale, only the number should be used, *eg.* No 58. In the case of a Degree Sheet, the number and the Degree Sheet letter must be given, *eg.* 58 A. For a 1 Inch Sheet, the number, the Degree Sheet letter and the 1 Inch Sheet number must be quoted, *eg.* 58 A.

REFERENCE.

- AREA SURVEYED SINCE 1ST OCTOBER 1905
- " " DURING SURVEY YEAR 1913-14
- CIRCLE BOUNDARY SHOWN THUS

THIS INDEX MAP SHOWS THE PROGRESS MADE IN THE MODERN TOPOGRAPHICAL SURVEY OF THE COUNTRY BEGUN IN 1905.



INDEX
 Showing progress up to 30th September 1914.

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. B4. IN THE CASE OF A DEGREE SHEET, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN, e.g. B4 A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED, e.g. B4 E.

REFERENCE.

AREA SURVEYED SINCE 1ST OCTOBER 1905. [Light Blue Shaded Box]

" " DURING SURVEY YEAR 1913-14. [Dark Blue Shaded Box]

CIRCLE BOUNDARY SHOWN THUS. [Dashed Circle]

THIS INDEX MAP SHOWS THE PROGRESS MADE IN THE MODERN TOPOGRAPHICAL SURVEY OF THE COUNTRY BEGUN IN 1905.

INDEX

Showing progress up to 30th September 1914

Key to Degree Sheets.

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

Key to Standard Sheets.

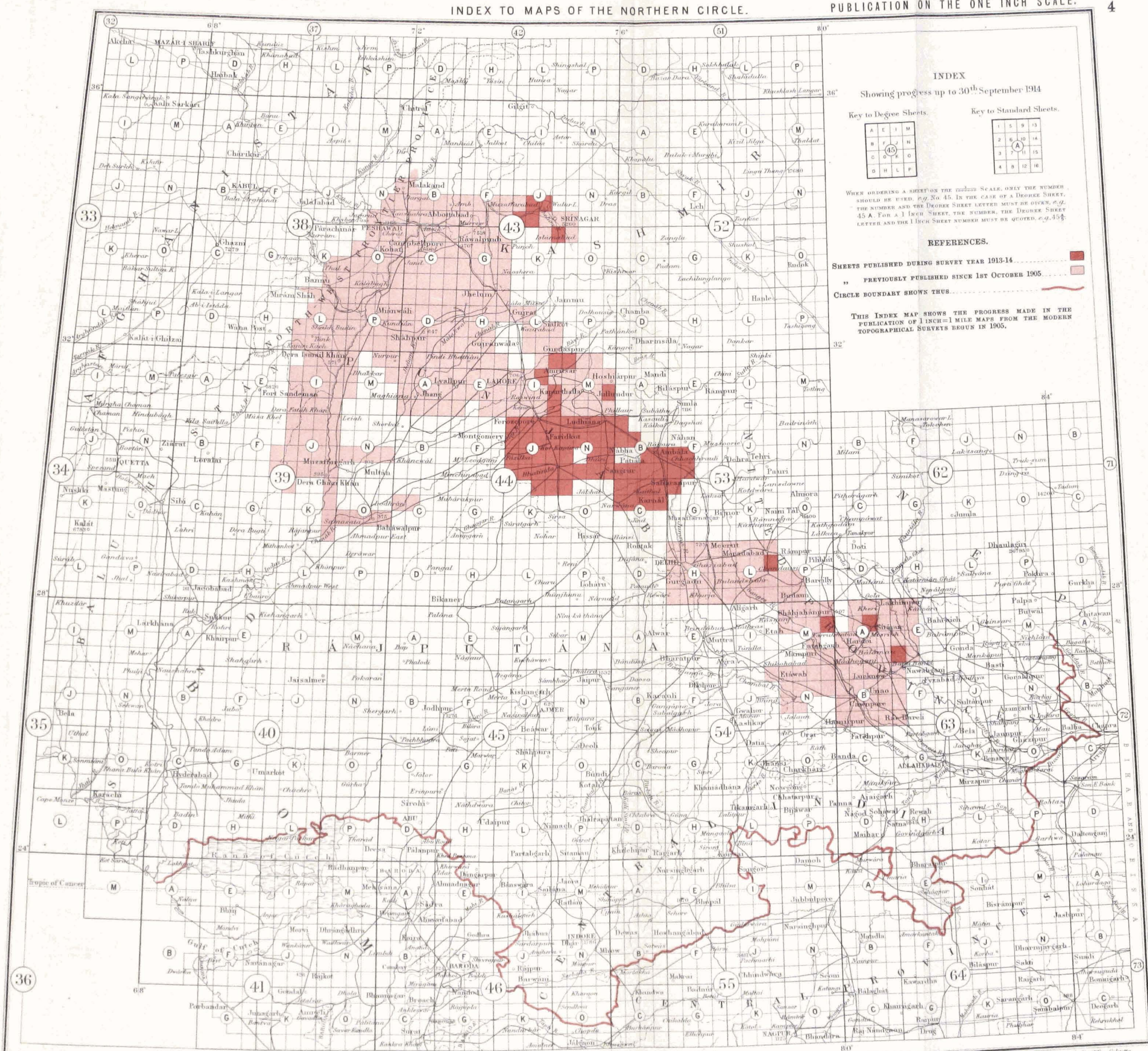
1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

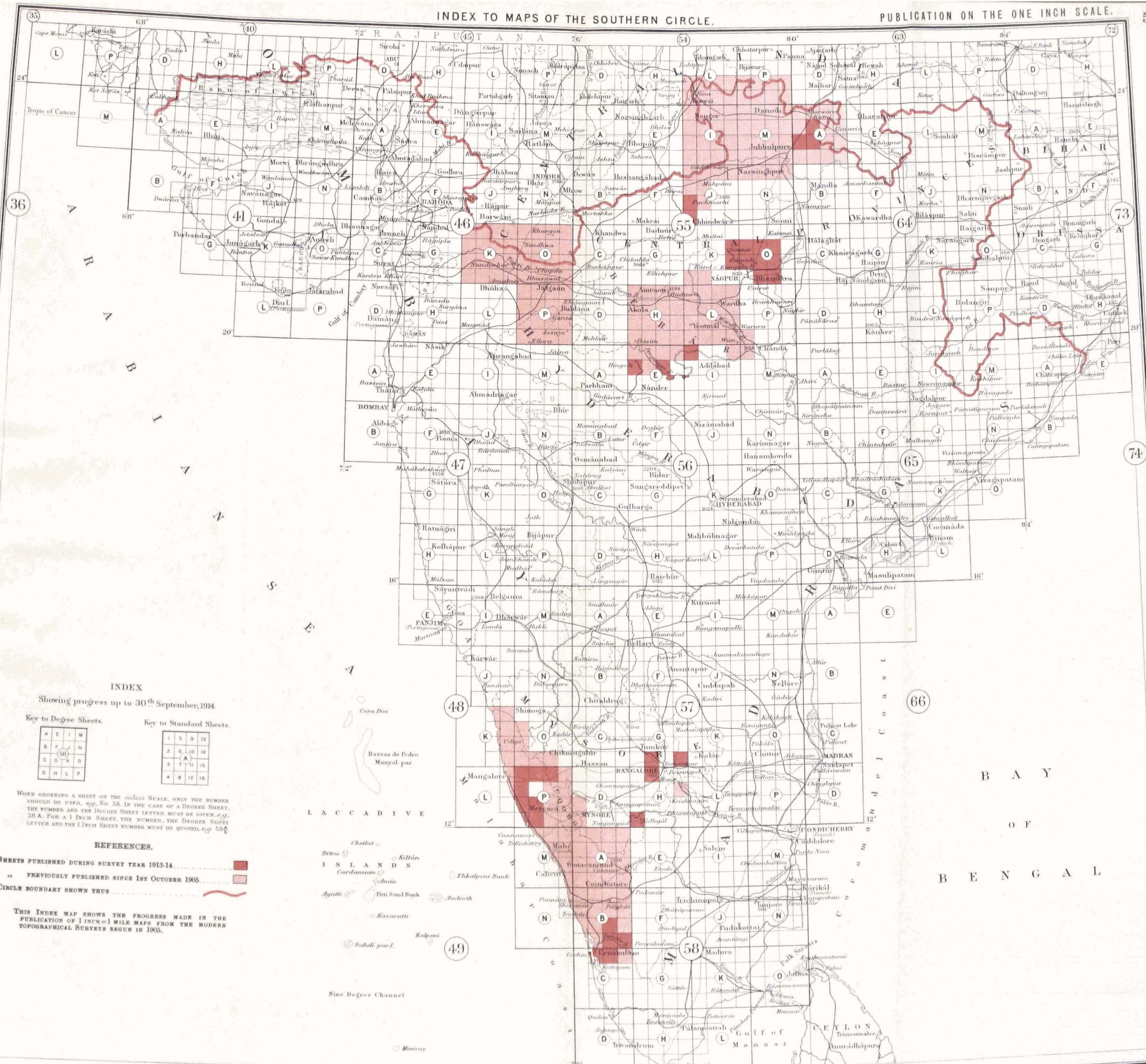
WHEN ORDERING A SHEET ON THE ONE INCH SCALE, ONLY THE NUMBER SHOULD BE USED. FOR NO. 45 IN THE CASE OF A DEGREE SHEET, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN, e.g. 45 A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE GIVEN, e.g. 45A.

REFERENCES.

- SHEETS PUBLISHED DURING SURVEY YEAR 1913-14. ■
- PREVIOUSLY PUBLISHED SINCE 1ST OCTOBER 1905. ■
- CIRCLE BOUNDARY SHOWN THUS. —

THIS INDEX MAP SHOWS THE PROGRESS MADE IN THE PUBLICATION OF 1 INCH=1 MILE MAPS FROM THE MODERN TOPOGRAPHICAL SURVEYS BEGUN IN 1905.





INDEX

Showing progress up to 30th September, 1914.

Key to Degree Sheets.

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

Key to Standard Sheets.

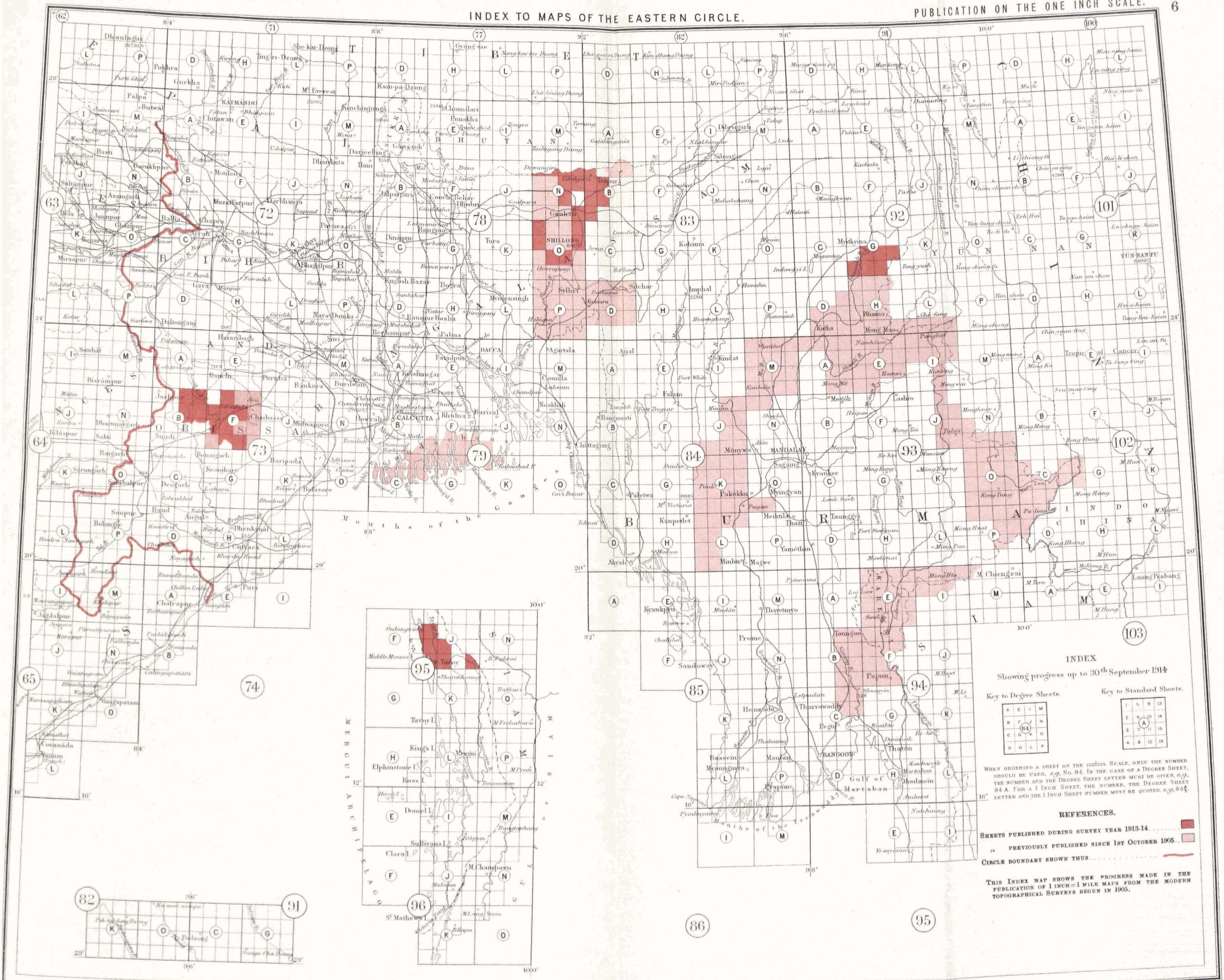
1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

When ordering a sheet on the *one inch* scale, only the number should be used, e.g., No 58. In the case of a *three inch* sheet, the number and the degree sheet letter must be given, e.g., 58 A. For a *1 inch* sheet, the number, the degree sheet letter and the *1 inch* sheet number must be quoted, e.g., 58 A.

REFERENCES.

- SHEETS PUBLISHED DURING SURVEY YEAR 1913-14
- PREVIOUSLY PUBLISHED SINCE 1st OCTOBER 1905
- CIRCLE BOUNDARY SHOWN THUS

THIS INDEX MAP SHOWS THE PROGRESS MADE IN THE PUBLICATION OF 1 INCH=1 MILE MAPS FROM THE MODERN TOPOGRAPHICAL SURVEYS BEGUN IN 1905.



INDEX
Showing progress up to 30th September 1914

Key to Degree Sheets.

A	C	I	M
B	F	J	N
(84)	G	K	O
D	H	L	P

Key to Standard Sheets.

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

WHEN ORDERING A SHEET ON THE ONE 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. 84 A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED, e.g. 84A.

REFERENCES.

SHEETS PUBLISHED DURING SURVEY YEAR 1913-14. ■

" PREVIOUSLY PUBLISHED SINCE 1ST OCTOBER 1905. ■

CIRCLE BOUNDARY SHOWN THUS

THIS INDEX MAP SHOWS THE PROGRESS MADE IN THE PUBLICATION OF 1 INCH=1 MILE MAPS FROM THE MODERN TOPOGRAPHICAL SURVEYS BEGUN IN 1905.

INDEX TO MAPS OF THE NORTHERN CIRCLE.

INDEX

Showing progress up to 30th September 1914

Key to Degree Sheets.

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

Key to Standard Sheets.

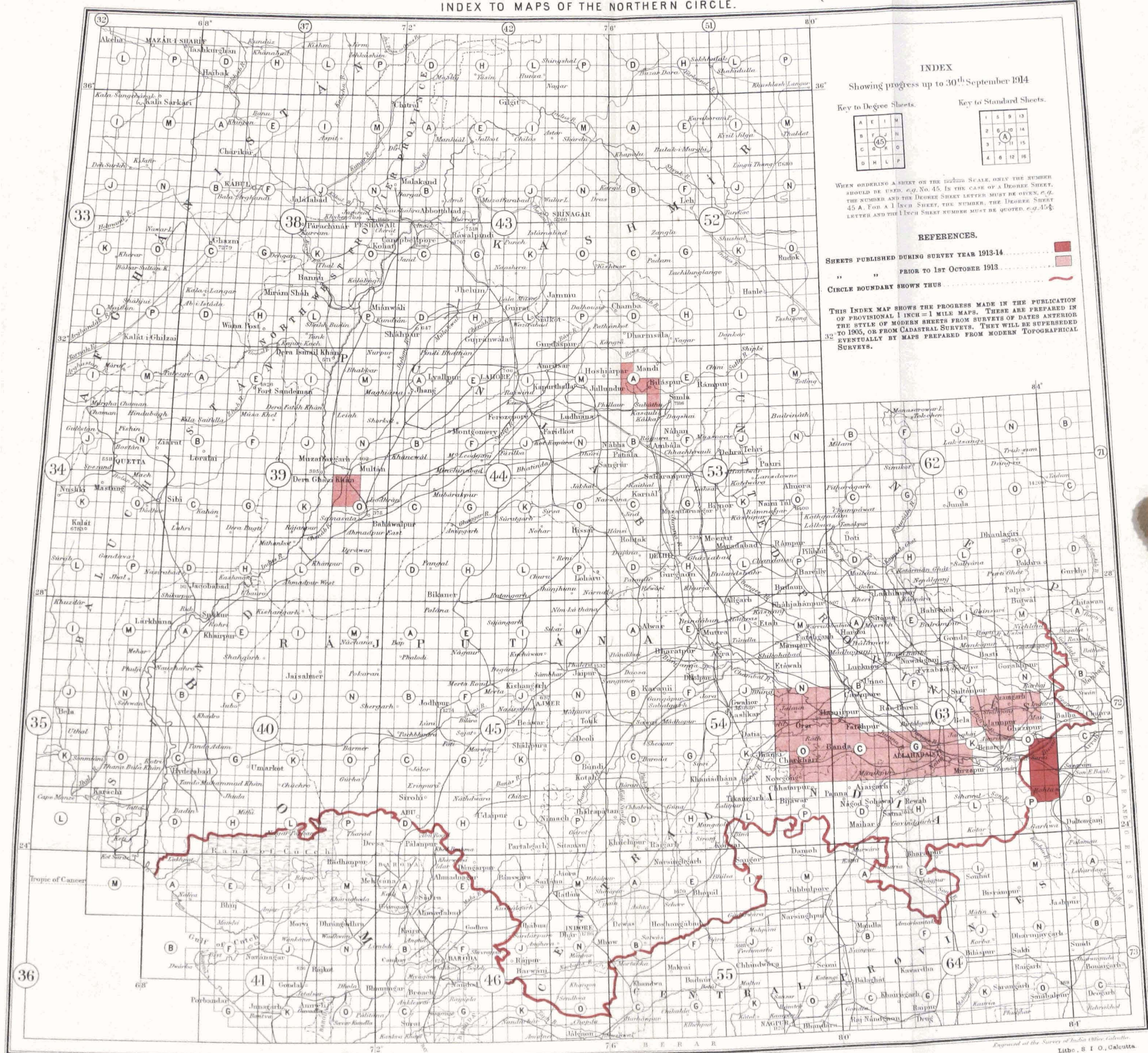
1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

When ordering a sheet of the 1:62,500 Scale, only the number should be used, e.g. No. 45. In the case of a Degree Sheet, the number and the Degree Sheet letter must be given, e.g. 45 A. For a 1 Inch Sheet, the number, the Degree Sheet letter and the 1 Inch Sheet number must be quoted, e.g. 45 A 15.

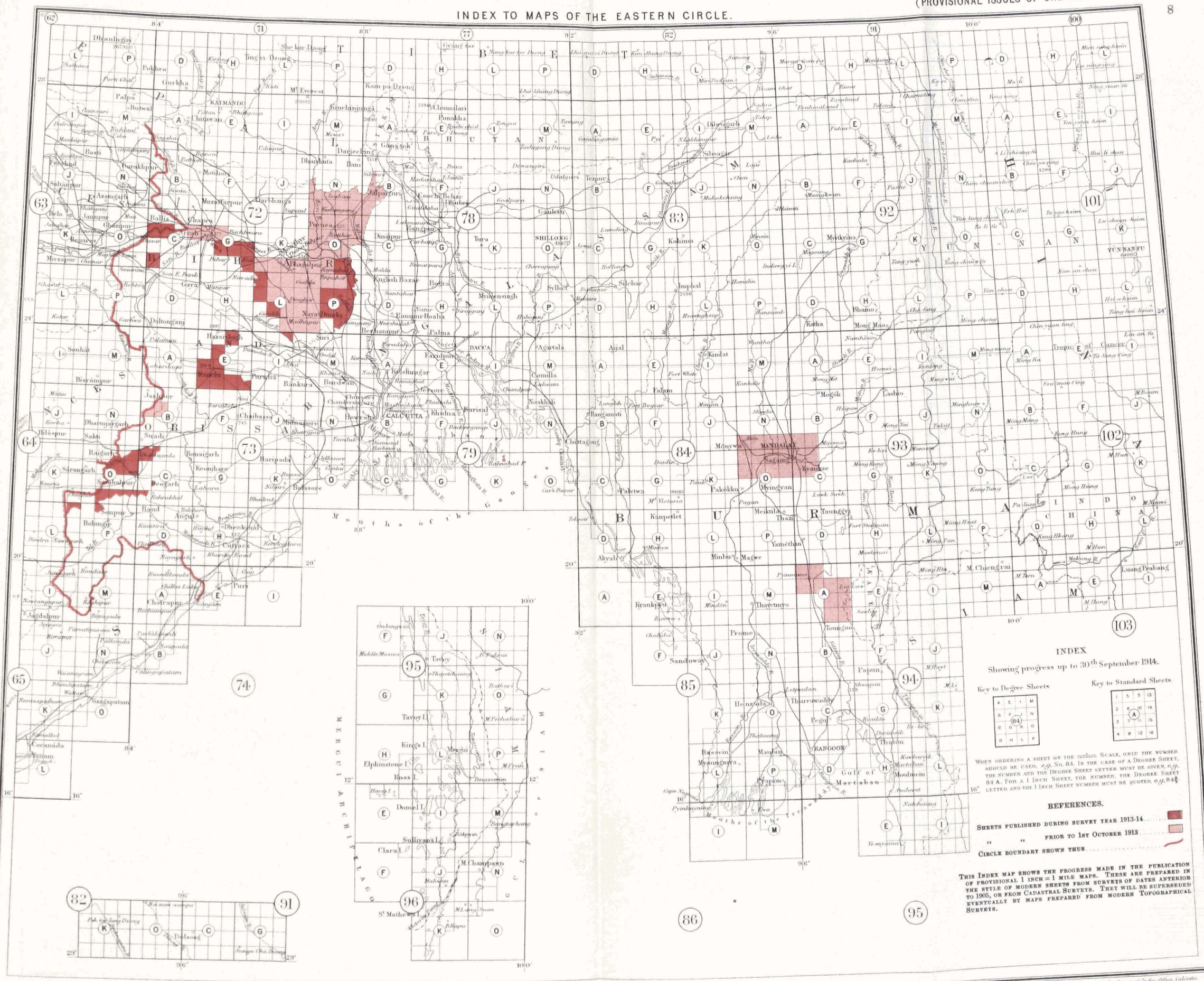
REFERENCES.

- SHEETS PUBLISHED DURING SURVEY YEAR 1913-14. ■
- " " " " PRIOR TO 1ST OCTOBER 1913. ■
- " " " " CIRCLE BOUNDARY SHOWN THUS —

THIS INDEX MAP SHOWS THE PROGRESS MADE IN THE PUBLICATION OF PROVISIONAL 1 INCH = 1 MILE MAPS. THESE ARE PREPARED IN THE STYLE OF MODERN SHEETS FROM SURVEYS OF DATES ANTERIOR TO 1905, OR FROM CADASTRAL SURVEYS. THEY WILL BE SUPERSEDED EVENTUALLY BY MAPS PREPARED FROM MODERN TOPOGRAPHICAL SURVEYS.



INDEX TO MAPS OF THE EASTERN CIRCLE.



INDEX Showing progress up to 30th September 1914.

Key to Degree Sheets

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

Key to Standard Sheets

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

WHEN ORDERING A SHEET ON THE $\frac{1}{62500}$ 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. 84 A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED, e.g. 84 E 16.

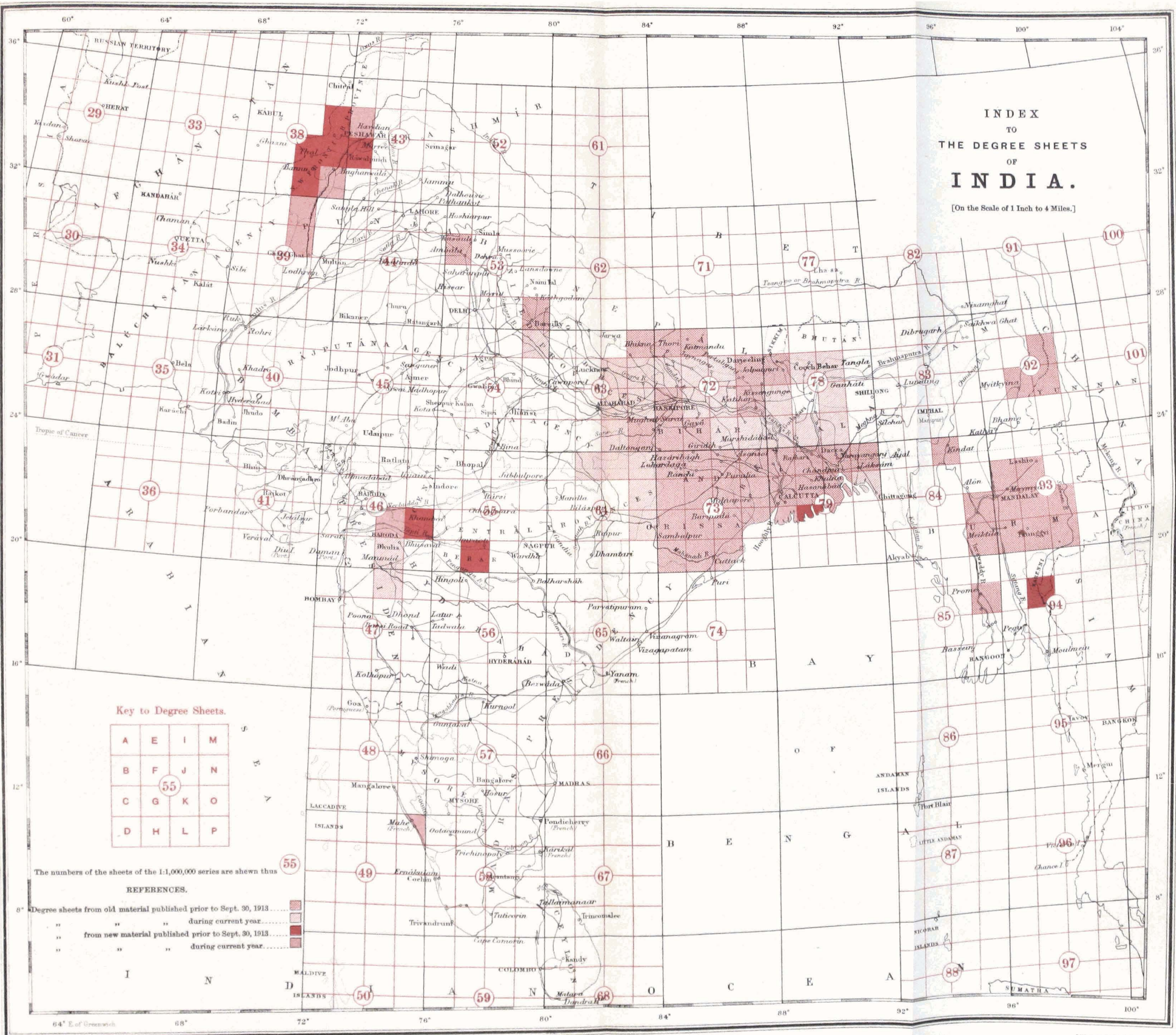
REFERENCES.

- SHEETS PUBLISHED DURING SURVEY YEAR 1913-14
- " " PRIOR TO 1ST OCTOBER 1913
- CIRCLE BOUNDARY SHOWN THUS

THIS INDEX MAP SHOWS THE PROGRESS MADE IN THE PUBLICATION OF PROVISIONAL 1 INCH = 1 MILE MAPS. THESE ARE PREPARED IN THE STYLE OF MODERN SHEETS FROM SURVEYS OF DATES ANTERIOR TO 1905, OR FROM CADASTRAL SURVEYS. THEY WILL BE SUPERSEDED EVENTUALLY BY MAPS PREPARED FROM MODERN TOPOGRAPHICAL SURVEYS.

INDEX
TO
THE DEGREE SHEETS
OF
INDIA.

[On the Scale of 1 Inch to 4 Miles.]



Key to Degree Sheets.

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

The numbers of the sheets of the 1:1,000,000 series are shown thus

REFERENCES.

° Degree sheets from old material published prior to Sept. 30, 1913 [light red shading]

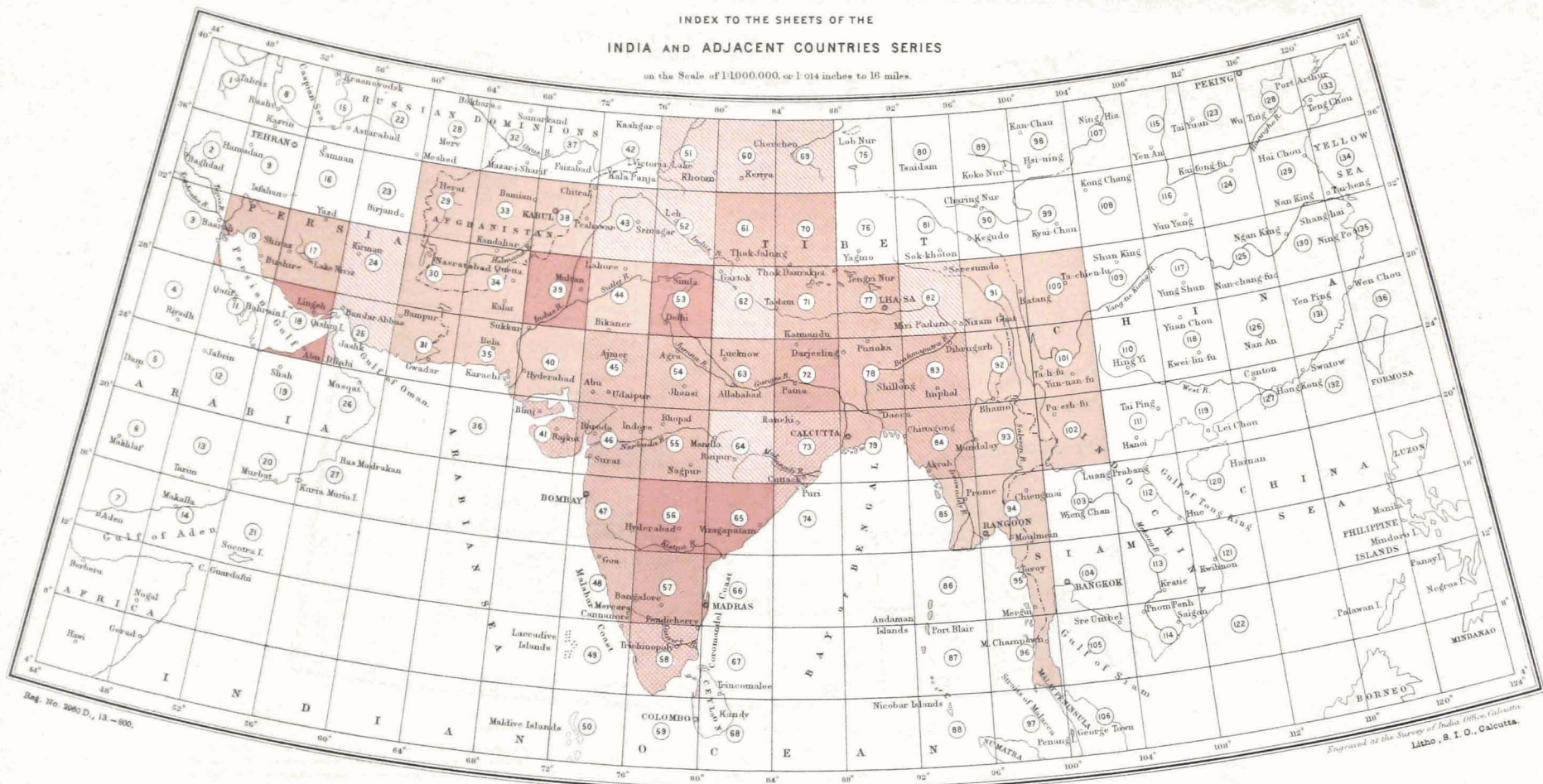
° " " " during current year [medium red shading]

° " from new material published prior to Sept. 30, 1913 [dark red shading]

° " " " during current year [darkest red shading]

INDEX TO THE SHEETS OF THE
INDIA AND ADJACENT COUNTRIES SERIES

on the Scale of 1:1,000,000, or 1/214 inches to 16 miles.



Published under the direction of Colonel Sir S. G. Burard, K.C.S.I., R.E., F.R.S., Surveyor General of India.

1914.

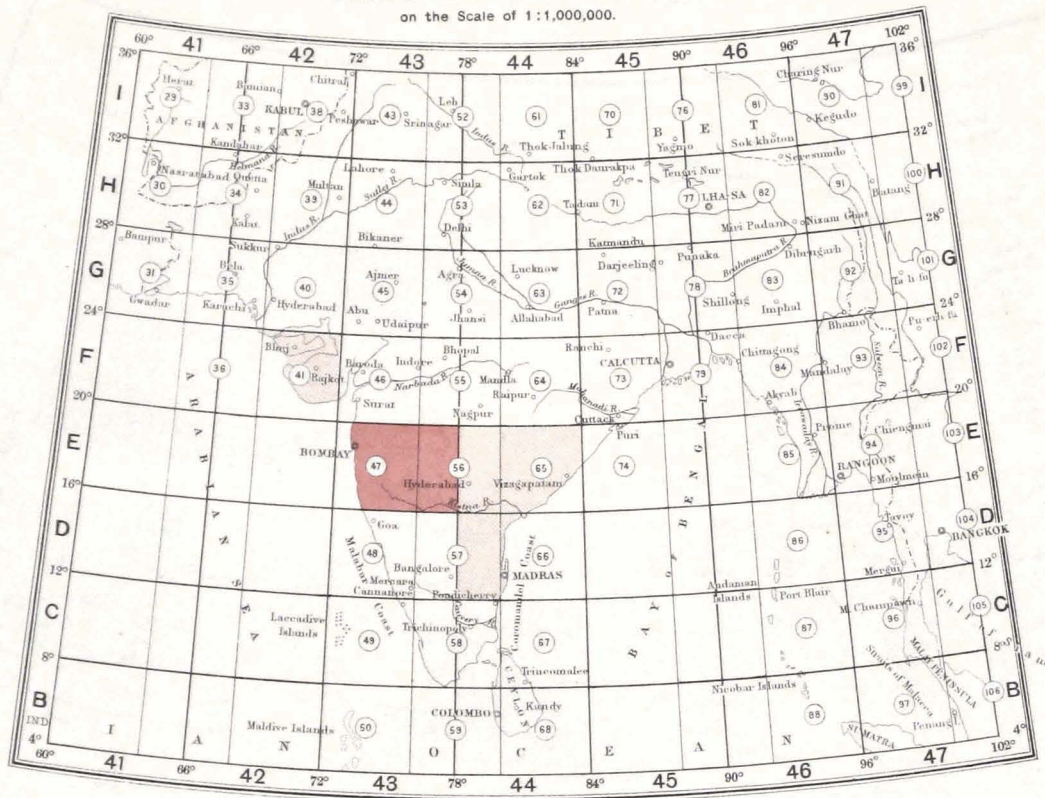
Scale 1:1,000,000.
Miles 200 0 200 400 600 800 Miles.

REFERENCE.

- Sheets published without contours & layers.
- " " with contours & layers.
- " " at press.
- " " in hand.

Engraved at the Survey of India Office Calcutta.
Litho, S. I. O., Calcutta.

INDEX TO THE SHEETS OF THE
CARTE INTERNATIONALE DU MONDE
 on the Scale of 1:1,000,000.



Published under the direction of Colonel Sir S. G. Burrard, K.C., S. I., R. E., F. R. S., Surveyor General of India.

1914.

Scale 1:1,000,000.

Miles 0 100 200 300 400 500 600

The thick lines show the margins of the sheets of the International Map of the World, Scale 1:1,000,000. Each sheet is designated by the letter N (Northern hemisphere), followed by the marginal letter and number corresponding to its position, e.g., the sheet which includes Bombay is N.E.43.

The figures in circles are the numbers of the sheets of the India and Adjacent Countries Series on the Scale of 1:1,000,000.

REFERENCE.

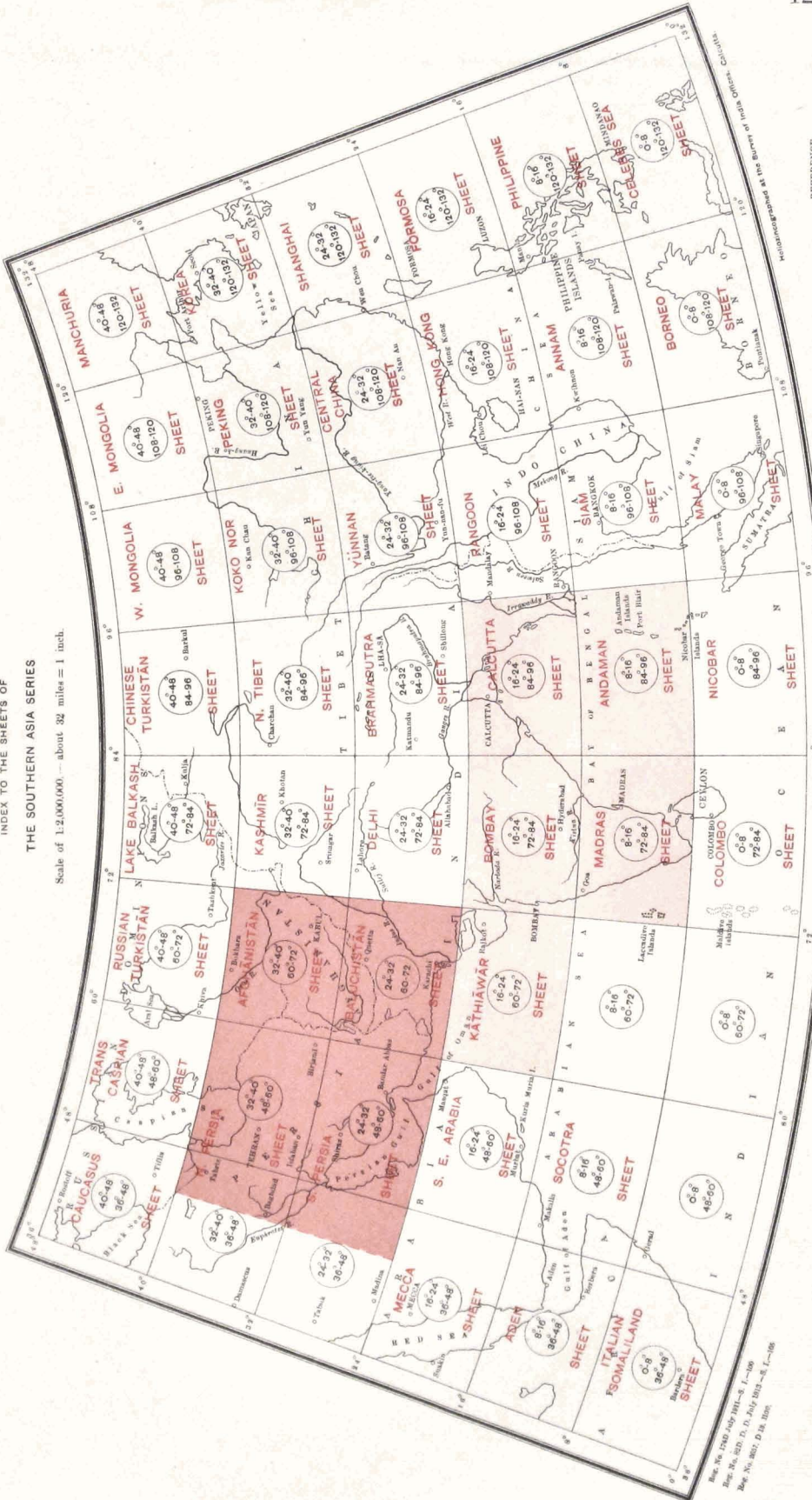
Sheets published

in hand



INDEX TO THE SHEETS OF
THE SOUTHERN ASIA SERIES

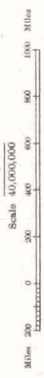
Scale of 1:2,000,000. — about 32 miles = 1 inch.



REFERENCE

Sheets published
 under publication
 in hand.

Published under the direction of Colonel Sir S. G. Barrett, K.C.S.I., R.E., F.R.S., Surveyor-General of India.



No. 1740 July 1911-5. 1-100
 No. 1820 D. O. July 1911-5. 1-100
 No. 1821 D. O. July 1911-5. 1-100

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Survey of India.
GENERAL REPORT,
1913-14.

From 1st October 1913
To 30th September 1914.



PREPARED UNDER THE DIRECTION OF
COLONEL SIR S. G. BURRARD, K.C.S.I., R.E., F.R.S.,
SURVEYOR GENERAL OF INDIA.

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CALCUTTA,
1915.

Price Two Rupees or Three Shillings.