

# Survey of India.

## GENERAL REPORT,

### 1917-18.

From 1st October 1917

To 30th September 1918.

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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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PRINTED AT THE PHOTO-LITHO. OFFICE, SURVEY OF INDIA,  
CALCUTTA,  
1919.

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Two Rupees or Two Shillings and Eight Pence.

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5. " " " " Southern "
6. " " " " Eastern "
7. " provisional editions of one-inch series, Northern Circle.
8. " " " " Eastern "
9. " modern half-inch series for India.
10. " " quarter-inch " " "
11. " 'India and Adjacent Countries' series, scale  $\frac{1}{1,000,000}$ .
12. " Indian sheets of "La Carte Internationale du Monde," scale  $\frac{1}{1,000,000}$ .
13. " 'Southern Asia' series, scale  $\frac{1}{2,000,000}$ .
14. Progress of the Great Trigonometrical Survey.

# Survey of India.

## GENERAL REPORT,

1917—18.

From 1st October 1917

To 30th September 1918.

### PART 1.—GENERAL REMARKS.

#### I.—INTRODUCTION.

1. The main parts of this report, as shown in the "Contents" on the opposite page, are *Part 2—Work of Field Parties, &c.*, 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 XII 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 9. From this it will be seen that the out-turn of topographical survey during the current year was 24,779\* square miles; and that this brings the total progress since 1905 to 496,362 square miles, leaving 1,325,238 square miles still to be done.

3. The first three Index maps, at the end of the report, show the progress of this topographical programme both in survey and in publication in the three circles, while the remaining eleven indexes show the progress in publication of the various series of maps appertaining to the scheme, and also the main framework of triangulation on which the survey of India is based.

4. Table IV on page 33 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 of the Survey of India"; and lists of new maps are published quarterly by the department, as well as in the monthly "Notes of the Survey of India."

5. Progress in the Trigonometrical Survey can only be assessed by a study of the "Records of the Survey of India" 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.

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\*This however excludes 408 square miles previously surveyed on a smaller scale.

**6. The following events are notified:—**

- (a) Six Imperial Officers have reverted from temporary military duty.
  - (b) Owing to the shortage of officers the field work of the whole department was again considerably curtailed.
  - (c) The Survey party under an Imperial Officer (designated from 6th March 1918, Deputy Director of Surveys, Mesopotamian Expeditionary Force), which accompanied the field-force in Mesopotamia continued survey operations there.
  - (d) The Survey party under an Imperial Officer which was sent to Western Persia was amalgamated with the Survey party in Mesopotamia.
  - (e) The Survey party under an Imperial Officer which was ordered to carry out survey operations in Persia was disbanded.
  - (f) The Survey detachment in charge of a Provincial Officer which was sent to Salonika to serve under an Imperial Officer on military duty there, continued survey operations in that locality.
  - (g) A Survey detachment under a Provincial Officer attached to the Indian Army Reserve of Officers was despatched to East Africa for duty with Field Survey units of Royal Engineers.
  - (h) The General Officer Commanding, Northern Army, expressed his high appreciation of the unfailing promptitude with which maps were despatched by the Map Record and Issue Office, Calcutta.
  - (i) Lieut.-General Sir W. R. Marshall, K.C.B., K.C.S.I., Commanding-in-Chief, Mesopotamian Expeditionary Force, in his despatch dated the 15th April 1918 wrote as follows:—  

“The work performed by the Surveys has assumed very large proportions, but my demands have always been met in the most satisfactory manner, and the Map Compilation Section has been of the greatest assistance.”
  - (j) A committee has been appointed to consider and report upon certain questions with regard to the future work of the department, which were raised at the meeting held in the Trigonometrical Survey Office, Dehra Dūn, on the 29th March 1918, at which the Hon'ble Sir Claude Hill, K.C.S.I., C.I.E., Member of the Governor General's Council, presided and the Hon'ble Mr. R. A. Mant, Secretary to the Government of India, Department of Revenue and Agriculture, was present.
  - (k) The re-opening of recruitment for the Provincial Service and the appointment of five officers every alternate year subject to re-consideration in 1925, were sanctioned by the Secretary of State.
-

## II.—ADMINISTRATION AND PERSONNEL.

7. The actual cost of the department for the financial year ending 31st March 1918 and of the two previous years is shown below:—

	1915-16.	1916-17.	1917-18.	REMARKS.
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>	
Gross actual cost	30,08,348	32,93,109	38,15,068*	* These figures are not final.
Deduct receipts and credits	8,35,359	14,79,255	17,71,617*	
Net actual cost	21,73,009	18,13,854	20,43,451*	

8. Colonel Sir S. G. Burrard, K.C.S.I., R.E., F.R.S. administered the department throughout the year.

9. In the Imperial Service Colonel T. F. B. Renny-Tailyour, C.S.I., R.E., was granted an extension of service. The number of Imperial Officers temporarily reverted to military duty on account of the war at the end of the Survey year is 22.

In the Provincial Service Mr. A. Ewing (Retired) ceased to be re-employed. Mr. W. F. E. Adams died, Mr. J. Smith retired and Messrs. H. C. W. Stotesbury and T. P. Dewar resigned. The number of officers of the Provincial Service on deputation to military duty at the end of the Survey year is the same as that of last year, namely, 15.

In the Upper Subordinate Service 1 officer died and 2 officers retired.

The total strength of the department at the close of the Survey year was 46† Imperial Officers, 112‡ Provincial Officers and 51 Upper Subordinates besides specialists, clerks, lower subordinates and menials; but the number of officers of the first two services actually employed in the department, including those attached to Overseas Survey parties, but not the Provincial Officer attached to the Indian Army Reserve of Officers sent in charge of the Survey Detachment to East Africa, were 24 Imperial Officers and 97 Provincial Officers, the remainder being on military duty.

10. The following Honours were conferred on members of the department during the year:—

*Companions of the Order*

*of St. Michael and St.*

*George.*—

Brevet-Colonel F. W. Pirrie, C.I.E., I.A.

Brevet-Lieut.-Colonel C. M. Browne, D.S.O., R.E.

*Companion of the Order of*

*the Indian Empire.*—

Major E. T. Rich, R.E.

*Companions of the Dis-*

*tinguished Service*

*Order.*—

Lieut.-Colonel G. A. Beazeley, R.E.

Major (Temporary Lieut.-Colonel) M. O'C.

Tandy, R.E.

Major R. H. Phillimore, R.E.

Major M. N. MacLeod, M.C., R.E.

Major (Temporary Lieut.-Colonel) F. F.

Hunter, I.A.

Brevet-Major (Temporary Lieut.-Colonel) F. P.

Nosworthy, M.C., R.E.

† Excluding the officer re-employed.

‡ Excluding officers re-employed and on deputation to Local Governments.



- Bar to the Distinguished Service Order.*— Brevet-Major (Temporary Lieut.-Colonel) F. P. Nosworthy, D.S.O., M.C., R.E.
- Awarded the Military Cross.*— Captain W. E. Perry, R.E.
- Promoted to Brevet-Lieutenant-Colonel.*— Major H. Wood, R.E.  
Major A. A. McHarg, D.S.O., R.E.
- Promoted to Brevet-Major.*— Captain K. Mason, M.C., R.E.
- Mentioned in despatches.*— Brevet-Colonel F. W. Pirrie, C.M.G., C.I.E., I.A.,  
(twice during the year, altogether six times).  
Lieutenant-Colonel G. A. Beazeley, D.S.O., R.E.,  
(second time).  
Brevet-Lieut.-Colonel H. Wood, R.E., (second time).  
Brevet-Lieut.-Colonel C. P. Gunter, R.E.  
Major (Temporary Lieut.-Colonel) M. O'C. Tandy, D.S.O., R.E.  
Brevet-Lieut.-Colonel C. M. Browne, C.M.G.,  
D.S.O., R.E., (fourth time).  
Major M. N. MacLeod, D.S.O., M.C., R.E.  
Major (Temporary Lieut.-Colonel) F. F. Hunter, D.S.O., I.A.  
Brevet-Lieut.-Colonel S. W. S. Hamilton, D.S.O.,  
R.E., (second time\*<sup>†</sup>).  
Brevet Major K. Mason, M.C., R.E., (twice during  
the year, altogether thrice).  
Captain W. E. Perry, M.C., R.E.  
Brevet-Major (Temporary Lieut.-Colonel) F. P. Nosworthy, D.S.O., M.C., R.E., (fourth time<sup>†</sup>).  
Mr. J. McCracken, Extra Assistant Superintendent.  
Mr. W. H. Strong, Extra Assistant Superintendent.  
Mr. Nanak Chand Puri, B.A., Sub-Assistant Superintendent.  
Mr. Hamid Gul, Sub-Assistant Superintendent.  
Surveyor Ahmad Shah.  
Surveyor Sijawal Khan.  
Surveyor Mir Abdullah.
- Member of the Order of the British Empire.*— Commissary and Honorary Major C. J. Arbery.
- Title of Khan Sahib.*— Mr. Syed Zille Hasnain, Extra Assistant Superintendent.
- Fellowship of the Royal Society.*— Colonel G. P. Lenox-Conyngham, R.E.
- Fellowship of the Asiatic Society of Bengal.*— Colonel Sir S. G. Burrard, K.C.S.I., R.E., F.R.S.
- Specially promoted to be Assistant Commissary with the Honorary rank of Lieutenant.*— Late Conductor W. Fitch, Draftsman, of the Army Section of No. 6 Drawing Office, (Simla).

\* Major Hamilton was mentioned the first time in Field Marshal Sir Douglas Haig's despatch of 30th April 1916.

† Including the mention in Field Marshal Sir John French's despatch, dated the 14th January 1915.

*Services brought to the notice of the Government of India.—* Arbery, Commissary and Honorary Major C. J., Officer in charge, No. 6 Drawing Office (Simla).

Burrard, Colonel Sir Sidney G., K.C.S.I., R.E., F.R.S., Surveyor General of India.

Ferrier, Mr. T. A., Officer in charge, Mathematical Instrument Office.

Graham, Assistant Commissary and Honorary Lieutenant R., Draftsman, Army Section, No. 6 Drawing Office (Simla).

Greiff, Mr. J. O., Deputy Superintendent.

Ryder, Lieutenant-Colonel C. H. D., C.I.E., D.S.O., R.E., Superintendent.

Smith, Conductor W., Draftsman, Army Section, No. 6 Drawing Office (Simla).

*Honorarium of Rs. 1,000.—* Mr. S. Woodhouse, Works Manager, Mathematical Instrument Office, Calcutta.

II. The following table shows the distribution of officers during the year: The names of officers on deputation to Local Governments or military duty (except Lieutenant A. J. A. Drake, D.C.M.) or absent on long leave throughout the year are omitted

TABLE I—DISPOSITION OF OFFICERS, 1917-18.

SURVEYOR GENERAL OF INDIA—Colonel Sir Sidney G. Burrard, K.C.S.I., R.E., F.R.S.				
	<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &amp;c.</i>
Surveyor General's Office.	Lieut.-Colonel H. H. Turner, R.E. Lieut.-Colonel A. Mears, I.A.			
No. 6 Drawing Office, Simla.	Major C. J. Arbery.....	Mr. Dhani Ram Verma..... ,, Asmat-ullah Khan, K.S.		26 Draftsmen, &c.
Mesopotamian Survey Party.*	Lieut.-Colonel C. H. D. Ryder, C.I.E., D.S.O., R.E. Bt.-Colonel F. W. Pirrie, C.M.G., C.I.E., I.A. Lieut.-Colonel G. A. Beuzeley, D.S.O., R.E. Bt.-Lieut.-Colonel C. P. Gunter, R.E. Major E. T. Rich, C.I.E., R.E. L. C. Thuillier, I.A. L. G. Crosthwait, I.A. Mr. J. deGraaff Hunter, M.A. Major A. H. Gwyn, I.A. Captain C. G. Lewis, R.E. W. E. Perry, M.C., R.E.	Mr. S. S. McA'F. Fielding C. West E. C. O'Sullivan, D.C.M. D. K. Rennick F. B. Kitchen W. H. Strong A. J. Booth J. C. St. C. Pollett	Mr. Nanak Chand Puri, B.A. .... ,, Hamid Gul ,, Bhamba Ram ,, Annada Prasad Ghosh ,, Laltan Khan	39 Surveyors, &c.
Persian Survey Party. †	Major E. T. Rich, C.I.E., R.E. ....	Mr. A. F. Murphy .....	Mr. Sher'Jang, K.B. ....	2 Surveyors.
Western Persia Survey Party. ‡	Captain W. E. Perry, R.E. ....	Mr. D. K. Rennick .....	Mr. Hamid Gul .....	3 Surveyors. ,, Laltan Khan
East Africa Survey Detachment.		Lieutenant A. J. A. Drake, D.C.M. ( <i>Indian Army Reserve of Officers.</i> )	Mr. Ram Prasad, R.S. ....	5 Surveyors.
SUPERINTENDENT, MAP PUBLICATION—				
		Lieut.-Colonel W. M. Coldstream, R.E. ( <i>Temporarily reverted to military duty</i> ). Lieut.-Colonel C. H. D. Ryder, C.I.E., D.S.O., R.E. Lieut.-Colonel H. H. Turner, R.E.		
	<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &amp;c.</i>
Map Publication Office, Calcutta.		Mr. M. Gastand .....		
No. 1 Drawing Office, Map Record and Issue Office and Engraving Office, Calcutta.	Lieut.-Colonel H. H. Turner, R.E. Lieut.-Colonel A. Mears, I.A. Major E. T. Rich, C.I.E., R.E. O. H. B. Trenchard R.E.	Mr. P. Williams Jagdamba Prasad Abimash Chunder Bose C. West Priya Nath Sur A. A. Graham T. F. Kitchen H. T. Hughes H. H. P. Butterfield Jiya Lal Sahgal		
Photo.-Litho. Office, Calcutta.	Captain F. J. M. King, R.E. ....			
Mathematical Instrument Office, Calcutta.	Mr. T. A. Ferrier .....			
Bengal & Bihar & Orissa Drawing Office, (Imperial Standard Mapping Section).		Mr. P. Simpson ,, Priya Nath Sur		

\* Formerly known as the Basrah Survey Party.

† Disbanded in January 1918.

‡ Amalgamated with the Basrah (now Mesopotamian) Survey Party on 1st February 1918.

TABLE I —(Continued).—DISPOSITION OF OFFICERS, 1917-18.

		SUPERINTENDENT, NORTHERN CIRCLE			
		Lieut.-Colonel C. L. Robertson, C.M.G., R.E., upto 15th March 1918. Lieut.-Colonel C. H. D. Ryder, C.I.E., D.S.O., R.E., from 16th to 30th March 1918. Colonel G. P. Lenox-Conyngham, R.E., P.E.S., from 31st March to 9th April 1918. Lieut.-Colonel H. L. Crosthwait, R.E., from 10th April 1918.			
		Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinates, &c.
No. 3 Drawing Office, Mussoorie.			Mr. J. A. Freeman " E. B. West	Mr. Inam Din	29 Draftsmen, &c.
No. 1 Party, Punjab and N.W.F. Province.	Major E. A. Tandy, R.E.		Mr. B. R. Hughes " G. J. S. Rae " H. P. D. Morton " P. A. T. Kenny " R. C. Hanson " G. A. Norman	Mr. Shier Jang, K.B. " Jagdeesh Prasad Vastav " Afraz Gul Khan, Probationer.	48 Surveyors, &c.
No. 2 Party, Rajputana, United Provinces and Delhi Province.			Mr. T. W. Baboman " H. P. D. Morton " R. E. Saubolle " J. H. Johnson " J. A. Calvert " Duni Chand Puri	Mr. Ghulam Hasan " Daulat Ram Vohra	35 Surveyors, &c.
No. 3 Party, United Provinces.			Mr. H. H. B. Hanby " E. J. Biggie " A. M. Talati, L.C.E. " G. E. R. Cooper " Moqimuddin	Mr. Muhammad Husain " Amir Abdul Salam Matlub Ahmad	44 Surveyors, &c.
No. 4 Party,	Lieut.-Colonel H. L. Crosthwait, R.E. Bt. Lieut.-Colonel A. A. Melharg, D.S.O., R.E.		Mr. Dhani Ram Verma		1 Clerk.
Sind-Sagar Party, Punjab.	Lieut.-Colonel H. L. Crosthwait, R.E.		Mr. Dhani Ram Verma " J. C. C. Lears " F. J. Grice	Mr. Chuni Lal Kapur " Muhammad Husain Khan " Nabilad Khan	26 Surveyors, &c.
Riverain Detachment, Punjab.			Mr. Maya Das Puri, R.S.	Mr. Paras Ram " Ram Narayan Hastir " Lakshmi Dutt Joshi " Vidya Dhor Chopra	78 Surveyors, &c.
SUPERINTENDENT; SOUTHERN CIRCLE		Colonel T. F. B. Renny-Tailyour, C.S.I., R.E.			
		Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinates, &c.
No. 4 Drawing Office, Bangalore.			Mr. J. H. Nichol " F. P. Walsh " V. W. Morton " F. C. Pilcher	Mr. B. V. Narayana Rao	27 Draftsmen, &c.
No. 5 Party, Berar, Bombay, and Central Provinces.			Mr. P. R. Anderson " Haji Abdul Rahim, K.B.	Mr. Damodar Khadilkar	27 Surveyors, &c.
No. 6 Party, Hydrabad and Madras.			Mr. J. O'B. Donaghey " E. A. Meyer " Munshi Lal, B.A. " F. W. Smith " M. S. Ganesa Aiyar	Mr. Eknath Battu " Ram Narayan Hastir " K. Mandanna " Masud Khan	34 Surveyors, &c.
No. 7 Party, Madras.			Mr. W. M. Gorman " F. H. Grant " B. T. Wyatt " N. S. Harihara Iyer	Mr. Abdul Hakk, K.S. " P. S. Vengusvami " Shib Lal " Shaikh Muhammad Salik " E. N. Nutesan, B.A. " Pulin Behari Roy " Jitendra Mohan Mukerji	30 Surveyors, &c.
No. 8 Party, Madras and Mysore.			Mr. W. F. E. Adams (Died 26th January 1918). " C. E. C. French " V. W. Morton " M. Mahadeva Mudaliar, M.A.	Mr. K. Narayanasvami Chetti " H. Narasimhamurti Rao	29 Surveyors, &c.
No. 20 Party, Cantonments and Military Stations in 3rd, 4th, 5th, 6th, 7th and 9th Divisions.			Mr. A. Ewing (Ceased to be re-employed on 30th April 1918). " B. R. Hughes " F. C. Pilcher " O. D. Jackson	Mr. Dharmu " Jitendra Mohan Mukerji	25 Surveyors, &c.
Training Section, Mysore.			Mr. S. F. Norman	Mr. Hari Ram Chandra Jogulekar	18 Surveyors and Pupils.
Salonika Survey Detachment.			Mr. H. B. Simons	Mr. Janina Prasad, R.S.	8 Surveyors, &c.

TABLE I—(Concluded).—DISPOSITION OF OFFICERS, 1917-18.

SUPERINTENDENT, EASTERN CIRCLE		Lieut.-Colonel R. T. Crichton, C.I.E., I.A., up to 29th March 1918. Lieut.-Colonel C. L. Robertson, C.M.G., R.E., from 30th March to 7th May and from 20th June 1918. Lieut.-Colonel A. Mears, I.A., from 8th May to 19th June 1918.			
		<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &amp;c.</i>
No. 5 Drawing Office, Shillong.		Mr. J. H. S. Wilson " E. Claudius " E. M. Kenny			23 Draftsmen, &c.
No. 9 Party, Bengal.		Mr. J. Smith (Retired 14th September 1918). " E. J. Biggie " A. B. Hunter " B. C. Newland " Amar Krishna Mitra	Mr. Anulya Charan Ghosh " Gopal Lal Mitra		23 Surveyors, &c.
No. 10 Party, Upper Burma.		Mr. M. C. Petters " W. G. Jarbo " H. H. Creed " A. V. Dickson " Dharendra Nath Banerjee, L.C.E.	Mr. Hayat Muhammad, K.S. " Maung Kyaw Nyein (Retired 16th June 1918). " Dharendra Nath Saha " Ram Prasad, R.S.		23 Surveyors, &c.
No. 11 Party, Lower Burma.		Mr. J. O. Greiff " C. E. C. French " O. J. H. Hart " E. M. Kenny " C. O. Picard	Mr. Lachman Daji Jadu, R.B. (Retired 19th August 1918). " Dalbir Rai " Pratul Chandra Sen Gupta, B. Sc.		34 Surveyors, &c.
No. 12 Party, Assam, Sikkim and Bhutan.		Mr. H. W. Biggie " E. G. Hardinge " Pramadaranjan Ray, R.S. " Prafulla Chandra Mitra, B.A. " K. S. Gopalachari, B.A.	Mr. Girija Souker Bagchi		29 Surveyors, &c.
SUPERINTENDENT OF THE TRIGONOMETRICAL SURVEY		Colonel G. P. Lenox-Conyngham, R.E., F.R.S.			
		<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &amp;c.</i>
Superintendent's Office.	(Attached) Colonel R. A. Wauhope, C.B., C.M.G., C.I.E., R.E.	Mr. H. A. Charrier			
Computing Office	Major H. McC. Cowie, R.E.	Mr. Hanuman Prasad	Mr. Sarat Kumar Mukerji " Karuna Kumar Das, B.A.		41 Computers, &c.
No. 2 Drawing Office and Forest Map Office, Dehra Dun.	Colonel R. A. Wauhope, C.B., C.M.G., C.I.E., R.E.	Mr. O. C. Ollenbach " C. C. Byrne " H. C. W. Stotesbury (Resigned 16 March 1918). " Rama Prasad Ray, B.A. " O. N. Pushong " J. McCracken " Raj Bahadur Mathur, B.A. " Abdul Karim, B.A. " A. F. Murphy	Mr. Lal Singh, R.B. " Ram Singh, R.S.		103 Draftsmen, &c.
No. 13 Party, (Astronomical).	Major H. McC. Cowie, R.E.				1 Computer.
No. 14 Party, (Pendulum).	Major H. McC. Cowie, R.E.				1 Computer.
No. 15 Party, (Triangulation).	Major E. A. Tandy, R.E.	Mr. H. G. Shaw " L. Williams " Raj Bahadur Mathur, B.A. " Abdul Karim, B.A. " Narendra Nath Chuckerbutty, L.C.E.	Mr. Jugal Behari Lal		13 Computers, &c.
No. 16 Party, (Tidal).		Mr. O. C. Ollenbach " Syed Zille Hasnain, K.S.			20 Computers, &c.
No. 17 Party, (Levelling).		Mr. H. G. Shaw " D. H. Luxa " J. McCracken " Narendra Nath Chuckerbutty, L.C.E.	Mr. Satish Chandra Mukerjee		10 Computers, Recorders, &c.
No. 18 Party, (Magnetic).		Mr. E. C. J. Bond " Rama Prasad Ray, B.A. " Nikunjo Ronjon Mazumdar	Mr. Karuna Kumar Das, B.A. " Bidhu Bhusan Shome		2 Magnetic Observers. 12 Computers, &c.
No. 19 Party, (Base Line).	Major E. A. Tandy, R.E. " H. McC. Cowie, R.E. " E. T. Rich, C.I.E., R.E. Captain W. E. Perry, M.C., R.E.	Mr. E. C. J. Bond			2 Computers, &c.

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**PART 2.—WORK OF FIELD PARTIES, &c.**

I.—TOPOGRAPHICAL SURVEYS.

12. 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.

In 1913, the Secretary of State sanctioned a scheme for the reduction of the scale of survey of certain sparsely populated areas of India. This will greatly reduce the area of survey on the one-inch scale and consequently accelerate the rate of progress of topographical surveys shown in Table II below. In order to give a better idea of what work actually lies before the department, it may be remarked that of the area remaining for survey about 590,000 square miles are likely to be surveyed on the half-inch or smaller scale.

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	6,278	1,660	10,322	18,260
1906-07 ...	ditto ...	7,519	7,666	8,659	23,844
1907-08 ...	ditto ...	14,530	9,256	12,431	36,217
1908-09 ...	ditto ...	18,624	12,526	11,542	42,692
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	28,192	13,349	11,836	53,377
1913-14 ...	ditto ...	25,052	15,844	14,890	55,786
1914-15 ...	ditto ...	12,334	19,286	5,056	36,676
1915-16 ...	ditto ...	8,168	17,243	6,931	32,342
1916-17 ...	ditto ...	11,689	11,338	9,723	32,750
1917-18 ...	ditto ...	4,202	12,181*	8,396	24,779
<b>Total areas completed to date ...</b>		<b>211,801</b>	<b>155,167</b>	<b>129,394</b>	<b>496,362</b>
<b>Approximate areas for the whole topographical programme.</b>		<b>750,000</b>	<b>542,800</b>	<b>528,800</b>	<b>1,821,600</b>
<b>Approximate areas remaining for survey.</b>		<b>538,199</b>	<b>387,633</b>	<b>399,406</b>	<b>1,325,238</b>

\* Excluding 408 square miles previously surveyed on a smaller scale.

Table III.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1917-18.

PARTY and LOCALITY.  Character of Country.      Scale and Class of Survey.		OUT-TURNS OF PLANE-TABLING.		COSTS OF SURVEY INCLUDING MAPPING.		REMARKS.	
		Areas on each Scale of each Class.	Totals of areas on all Scales.	Total costs.	Cost-rates.		
		Sq. miles.		Rs.	Rs. per sq. mile.		
<b>No. 1 Party—Punjab and North-West Frontier Province.</b>						<b>NORTHERN CIRCLE.</b>	
Broken low hills ...	1-inch Original Survey ...	7	1,868	92,404 <sup>(a)</sup>	49·5		
Plains mostly cultivated but small portions wooded.	1-inch Revision Survey ...	847					
Broken Siwālik foot-hills and open valleys.	1-inch Supplementary Survey ...	1,207					
Partly Siwāliks, partly plains.	3-inch Original Survey Military	307					
<b>No. 2 Party—Rājputāna, United Provinces and Delhi Province.</b>						<b>(a)</b> Excludes Rs. 3,050 incurred for fair-mapping of 4 inches = 1 mile Military Survey at Peshāwar of which survey and portion of fair-mapping were carried out in previous season 1916-17.	
Narrow plains and hills of an intricate nature.	½-inch Original Survey ...	1,286	1,617	46,231 <sup>(b)</sup>	28·6		
Open plains and low hills	3-inch Original Survey Military	187					
High hills densely forest-clad	4-inch Supplementary Forest Survey.	144					
<b>No. 3 Party—United Provinces.</b>							
Wooded hills ...	1-inch Revision Survey ...	105	717	87,182 <sup>(d)</sup>	121·6		
Ditto ...	2-inch Original Survey ...	459					
Undulating and low wooded hills	3-inch Original Survey Military	31					
Wooded hills ...	4-inch Original Special Forest Survey.	122					
<b>TOTALS, NORTHERN CIRCLE:—</b>		<b>4,202 sq. m.</b>		<b>Rs. 2,25,817</b>		<b>Cost-rate 53·7</b>	
						<b>SOUTHERN CIRCLE.</b>	
<b>No. 5 Party—Berār, Bombay and Central Provinces.</b>							
Well-wooded cultivated plains ...	1-inch Original Survey ...	570	1,214	41,719 <sup>(f)</sup>	34·4		
Wooded intricate hills	1-inch Revision Survey ...	527					
Undulating	3-inch Original Survey Military	58					
Ditto ...	3-inch Resurvey Military ...	59 <sup>(e)</sup>					
<b>No. 6 Party—Hyderābād and Madras.</b>							<b>(e)</b> This area had been previously surveyed on a smaller scale. <b>(f)</b> Excludes Rs. 14,129, cost of ½-inch mapping.
Hilly and undulating	½-inch Original Survey ...	6,675	7,114	1,04,549	14·7		
Wooded hills	1½-inch Original Survey ...	138					
Ditto	1½-inch Resurvey ...	271 <sup>(e)</sup>					
Open and rocky hills	3-inch Resurvey Military ...	30 <sup>(e)</sup>					
<b>No. 7 Party—Madras.</b>							<b>(g)</b> Excludes Rs. 19,706, cost of ½-inch mapping.
Varied, mostly undulating	1-inch Original Survey ...	2,940	3,626	89,931	24·8		
Wooded and hilly	1-inch Supplementary Survey	478					
Wooded, undulating and low hills	2-inch Original Survey ...	163					
Wooded, undulating and hilly	4-inch Original Survey ...	45					
<b>No. 8 Party—Madras and Mysore.</b>							
High densely wooded hills and plains	1-inch Original Survey ...	432	635	85,734 <sup>(g)</sup>	56·3		
High wooded hills	1-inch Revision Survey ...	155					
Open and undulating	3-inch Resurvey Military ...	48 <sup>(e)</sup>					
<b>TOTALS, SOUTHERN CIRCLE:—</b>		<b>12,589 sq. m.</b>		<b>Rs. 2,71,933</b>		<b>Cost-rate 21·6</b>	

Table III.—(Concluded).—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1917-18.

PARTY and LOCALITY.		OUT-TURNS OF PLANE-TABLING.		COSTS OF SURVEY INCLUDING MAPPING.		REMARKS.		
Character of Country.	Scale and Class of Survey.	Areas on each Scale of each Class.	Totals of areas on all Scales.	Total costs.	Cost-rates.			
		Sq. miles.		Rs.	Rs. per sq. mile.			
<b>EASTERN CIRCLE.</b>								
<b>No. 9 Party—Bengal.</b>								
<i>Flat and cultivated plains</i>	... 1-inch Original Survey	2,184	2,218	73,804 (h)	28·3 (i)	(h) Includes a sum of Rs. 10,980 on account of special large scale surveys. (i) Has been arrived at after excluding the sum of Rs. 10,980 on account of special large scale surveys.		
<i>Ditto ditto</i>	... 1-inch Revision Survey	34						
<b>No. 10 Party—Upper Burma.</b>								
<i>Mountainous and densely wooded</i>	... ½-inch Original Survey	2,501	3,325	1,44,040 (j)	43·5		(j) Includes Rs. 14,322 cost of Instruction Camp.	
<i>Mountainous and densely wooded with intricate foot-hills.</i>	... 1-inch Original Survey	824						
<b>No. 11 Party—Lower Burma.</b>								
<i>High hills densely wooded without roads and villages.</i>	... 1-inch Original Survey	1,158	1,475	1,90,840 (k)	118·8			(k) The cost of drawing office during field season (Rs. 15,629) has been excluded in calculating cost-rate.
<i>High hills and low undulating ground densely wooded.</i>	... 2-inch Original Survey	282						
<i>Low hills and undulating plains densely wooded.</i>	... 4-inch Original Survey	35						
<b>No. 12 Party—Assam, Sikkim and Bhutan.</b>								
<i>Plains and hills, partly under cultivation and partly densely wooded.</i>	... 1-inch Original Survey	1,187	1,378	1,06,116	77·0			
<i>Densely wooded plains and hills</i>	... 2-inch Original Survey	191						
<b>TOTALS, EASTERN CIRCLE:—</b>		8,396 sq. m.		Rs. 5,15,400	Cost-rate 61·4			
<b>GRAND TOTALS:</b>		25,187 sq. m.		Rs. 10,13,150	Cost-rate 40·2			



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

**13. No. 1 Party.**—Surveyed an area of 1,561 square miles on the scale of 1 inch = 1 mile in parts of Chamba and Simla Hill States, and in the districts of Hoshiārpur, Kāngra and Jullundur of the Punjab. The country consisted of Himālayan foot-hills and adjacent plains.

Four Royal Artillery Practice Camps, comprising an area of 307 square miles, were surveyed on the scale of 3 inches = 1 mile in the vicinities of Peshāwar, Hoshiārpur and Quetta, two being near Quetta.

**14. No. 2 Party.**—Surveyed an area of 1,286 square miles on the half-inch scale in Jaipur and Alwar States (Rājputāna), and 144 square miles of forest survey on the 4-inch scale in Tehri State. Two Royal Artillery Practice Camps on the 3-inch scale, comprising an area of 187 square miles, were surveyed near Delhi and Roorkee for the military authorities.

Supplementary triangulation was carried over an area of 156 square miles for future forest surveys, and 175 linear miles of forest boundaries were traversed. The Artillery Practice Camps entailed supplementary triangulation over an area of 40 square miles, with 55 linear miles of traversing.

The Rājputāna area consisted of narrow valleys divided by rocky hills rising about 1,000 feet above them and covered with dense brushwood.

**15. No. 3 Party.**—Surveyed a total area of 686 square miles in the Naini Tāl, Garhwāl and Almorā districts of the United Provinces, of which 105 square miles was revision survey on the 1-inch scale, 459 square miles 2-inch forest survey, and 122 square miles 4-inch forest survey. The Royal Artillery Practice Camp, Kutwa, near Mirzāpur, comprising an area of 31 square miles, was surveyed on the 3-inch scale for the military authorities. In addition 1,122 square miles and 315 linear miles were respectively triangulated and traversed in advance.

The country surveyed was throughout hilly and densely wooded.

**16. No. 4 Party.**—Work was in abeyance during the year, the staff having been drafted to other parties.

**17. Training.**—Nine soldier-surveyors and fourteen pupils commenced training under No. 1 Party, of these 7 soldier-surveyors received instruction on the Artillery Practice Camp surveys near Quetta, and the remainder were put through a course of drawing.

**18. Recess Work.**—Fair-mapping has been impeded by special work on Artillery Practice Camp maps, and by the transfer of many of the best draftsmen to Mesopotamia and elsewhere.

The fair-mapping of the following sheets of the current and previous season's survey remained for completion on the 30th September 1918 :—

Sheets on the half-inch scale ...	...	4
Do. one-inch „ ...	...	37
Do. two-inch „ ...	...	12
Royal Artillery Practice Camp Maps ...	...	1

**19.** Particulars of special work done by Nos. 1, 2, 3, and the Sind-Sāgar Parties and by the Riverain Detachment, are given on pages 41 and 17.

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

**20. No. 5 Party.**—This party surveyed an area of 1,097 square miles on the one-inch scale in the Akola, Amraotī and Buldana districts of Berār and in the Nimār district of the Central Provinces, and triangu-

lated an area of 2,747 square miles in the Chhindwāra, Jubbulpore, Mandlā, Narsinghpur and Seoni districts of the Central Provinces. The country surveyed consists of well-wooded, cultivated plains and of jungle-clad hills. A portion, including the head-quarters, of the party remained at Bangalore throughout the year and was principally employed on the fair-mapping of half-inch sheets compiled from published sheets of the one-inch map.

In addition, the Royal Artillery Practice Camps of Aundh, 4th Division, an area of 58 square miles, and of Barelā, 5th Division, an area of 59 square miles, were surveyed on the three-inch scale for the military authorities.

**21. No. 6 Party.**—This party surveyed an area of 7,084 square miles on different scales in the Parbhani, Nānder, Bidar, Gulbarga, Medak, Atrāf-i-balda and Mahbūbnagar districts of Hyderābād, triangulated an area of 6,408 square miles in the Atrāf-i-balda, Mahbūbnagar, Nalgonda and Warangal districts of Hyderābād and in the Kistna district of Madras, and traversed 95 linear miles in the Bidar, Gulbarga and Atrāf-i-balda districts of Hyderābād. The country surveyed is hilly and undulating with cultivation except in the hilly portions.

In addition, the Royal Artillery Practice Camp of Kāpra, 9th Division, an area of 30 square miles, was surveyed on the three-inch scale for the military authorities.

**22. No. 7 Party.**—This party surveyed an area of 3,626 square miles on different scales in the Nellore and Cuddapah districts of Madras, and triangulated an area of 2,723 square miles in the Kurnool, Cuddapah and Anantapur districts of Madras. The country surveyed embraces a portion, mostly reserved forests, of the Eastern Ghāts and an undulating expanse of cultivated and wooded lands, studded with isolated hills, between the foot of these Ghāts and the sea-coast.

**23. No. 8 Party.**—This party surveyed an area of 587 square miles on the one-inch scale in the Tinnevelly district and the Travancore State of Madras, and traversed 741 linear miles in the Tinnevelly, Rāmnād and Madura districts and the Travancore State. The highlands of this area are a region of wild, rocky and mountainous forms, clothed with impenetrable forest and terminating abruptly in the fertile plains of the Tinnevelly district. The remote inaccessibility of the hill tracts and the absence of communications rendered the problems of survey, labour and transport most difficult, entailing considerable hardships on the members of the party. A portion, including the head-quarters, of the party remained at Bangalore throughout the year and was principally employed on the fair-mapping of half-inch sheets compiled from published sheets of the one-inch map.

In addition, the Royal Artillery Practice Camp of Rājankunti, 9th Division, an area of 48 square miles, was surveyed on the three-inch scale for the military authorities.

**24. Training Section.**—This section took the field in the Kolār district of Mysore. 17 pupil surveyors received instruction in topographical surveying.

**25. Recess Work.**—The whole of the area surveyed this year should be fair-mapped by the end of 1918-19.

**26.** The report on the survey of cantonments and military stations, undertaken by No. 20 Party, is entered on pages 17 and 18.

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

**27. No. 9 Party.**—The topographical survey executed by this party on the 1-inch scale lay in the Burdwān, Hooghly, Nadiā and Jessore districts of Bengal. Advance traversing of 2,020 square miles, for detail survey in 1918-19, or subsequent years, was also carried out in the Nadiā, Hooghly, Howrah, Jessore, Khulnā and Twenty-four Parganas districts of Bengal. The area surveyed and traversed consists of flat and well-cultivated plains cut up by numerous rivers and swamps and interspersed with well-wooded villages and clumps of trees. Villages cluster thickly on both banks of the Hooghly and all the large streams which flow through the work. The country is well provided with roads and railways.

**28. No. 10 Party.**—The districts of Upper Burma in which this party worked were those of Myitkyinā and Putao. In addition to the plane-tabling mentioned in Table III as having been completed by it, it also triangulated an area of 3,084 square miles in Putao district in advance for detail survey on the scales of one-inch and half-inch to the mile. The country surveyed in Putao district consisted of the high mountainous tract at the headwaters of the Irrawaddy river, and ranged in altitude from 1,200 feet to 19,000 feet above mean sea-level. There are no roads and villages over large areas of this tract, and below 15,000 feet the slopes are covered with dense forest-growth. In the Myitkyinā district, the area surveyed varies in elevation from 600 feet to 5,000 feet and is cut up by numerous low-lying valleys, heavily wooded.

A small detachment remained in Putao district during the summer to complete the detail survey of the higher region at the source of the Irrawaddy river.

**29. No. 11 Party.**—In addition to the execution of the area of plane-tabling shown in Table III, this party traversed 100 linear miles of forest boundary and ran 33 linear miles of other theodolite traversing for the purpose of fixing points in forest areas for the detail survey of those areas on the 2-inch and 4-inch scales. The 282 square miles and 35 square miles of plane-tabling on the 2-inch and 4-inch scales respectively constituted the detail survey of areas of reserved forest in the districts of Mergui, Tavoy, and Amherst.

2,780 square miles and 70 square miles of country in the Amherst district were triangulated in advance for purposes of detail survey in future years on the 1-inch and 4-inch scales respectively.

Generally speaking, the whole area, over which traversing and survey operations were extended, is densely wooded, the undergrowth consisting of tangled vegetation intermixed with cane and bamboo. The country comprised part of the upper valley of the Tenasserim river, and the upper reaches of the Tavoy river. In the Mergui district, except for a few Karen villages along the banks of the Tenasserim river, the country is uninhabited, and without roads of any description. Local labour throughout was most difficult to obtain, and the survey entailed considerable hardships on the members of the party.

**30. No. 12 Party.**—Of the area surveyed by this party on the 1-inch scale, 37 square miles lay on the Sikkim-Bhutān border, and were surveyed in connection with the settlement of a boundary dispute. The remainder lay in the districts of Lakhimpur and Sibsāgar and the Central and Eastern Sections of the North-East Frontier Tract of Assam, in which areas also lay the 2-inch surveys mentioned in Table III. These latter

were chiefly surveys of areas of reserved forest. 629 linear miles of traversing, covering an area of 1,519 square miles north of the Brahmaputra river in the district of Lakhimpur, was carried out to provide points for detail survey in 1918-19.

The area in Assam in which detail survey and traverse operations were carried out is covered for the most part by dense forest, consisting of trees and bamboos with undergrowth of scrub, cane and thorny creepers. It is interspersed with numerous tea gardens and rice cultivation, and, with the exception of a range of hills rising to 3,000 feet above sea-level lying within and along the southern limits of the area, and low hills in the south-west corner of the area which rise to 1,600 feet, is generally flat. The Brahmaputra, which is the principal river, flows through the northern half of the area. The area surveyed in Sikkim and Bhutan lies at altitudes varying from 6,000 to 12,000 feet above sea-level, and is densely clad in forest growth.

**31. Recess work.**—The fair-mapping of 2 sheets of which the survey had been completed prior to 30th September 1917 remained incomplete at the end of the year under report; while, of the sheets the survey of which had been completed during the latter year, all but 24 had been submitted by the parties for publication up to 30th September 1918.

Half-inch mapping from published modern 1-inch maps is dealt with on page 39.

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## II.—FOREST SURVEYS.

32. Details of the topographical surveys of reserved forests executed by field parties of the Survey of India for the year under report are given below. In the majority of cases the surveys were carried out on the scale of 2 inches to the mile but in special cases the four-inch and one-inch scales were used. Boundary surveys on the four-inch scale were made where required.

## NORTHERN CIRCLE.

33. **United Provinces. Kumaun Forest Circle.**—Detail surveys on the 4-inch scale were executed in the *Nainī Tāl Forest Division* (85 square miles), and on the 2-inch scale in the *West Almorā Forest Division* (47 square miles), in the *South Garhwāl Forest Division* (71 square miles), making a total of 203 square miles; an area of 240 square miles in the *East Almorā Forest Division* was also triangulated in advance for survey on the 2-inch scale.

**Western Forest Circle:**—In the *Chakratā Forest Division* a supplementary survey of 144 square miles on the 4-inch scale, of the *Louped Forests* in the Tehri-Garhwāl State, was completed; and, as a preliminary to a detail survey on the 4-inch scale, an area of 156 square miles of triangulation and 175 miles of boundary traversing were completed in the Bāwar, Dadi, Deoband, Deogarh and Raingarh Forest Ranges.

## SOUTHERN CIRCLE.

34. **Madras. Central Forest Circle.**—In the *Nellore District* an area of 45·858 square miles was surveyed on the 4-inch scale in the Udayagiri Velikonda Block and the Gundlakonda Reserve. In the same district the undermentioned areas were surveyed on the 2-inch scale:—Eight blocks in Udayagiri Tāluk (49·432 square miles), twelve blocks in the Atmakūr Tāluk (44·246 square miles), four blocks in the Kovūr Tāluk (15·710 square miles), and three blocks in the Rāpūr Tāluk (24·605 square miles) making a total of 133·993 square miles.

In the *Cuddapah District*.—An area of 30·190 square miles was surveyed on the 2-inch scale in two blocks of the Rāzampeta Tāluk.

## EASTERN CIRCLE.

35. **Assam. Eastern Forest Circle.**—In the *Lakhimpur District*, the Dibru, Padumoni, Bharjān, Barajān, Jaipur, Takowāni, Kākojān and Upper Dihing (East Block) Reserved Forests, covering an area of 184·85 square miles, were surveyed on the 2-inch scale, and 51·06 miles of boundaries were traversed.

In the *North-East Frontier Tract*, the Kumsong and Sadiyā East and West Reserved Forests, covering an area of 11·68 square miles, were surveyed on the 1-inch scale.

36. **Burma. Tenasserim Circle.**—In the *Ataran Forest Division*, an area of 34·76 square miles in the Kyunchaung, Megwa, Mezali and Thingannyinaung Reserves was surveyed on the 4-inch scale, and 67·53 miles of boundaries were traversed.

In the *Tenasserim Forest Division*, an area of 281·86 square miles in the Heinze and Kaleinaung Reserves was surveyed on the 2-inch scale, and 32·15 miles of boundaries were traversed.

### III.—CANTONMENT AND LARGE-SCALE SURVEYS.

**37. The Punjab Riverain Detachment.**—The detachment continued the work of traversing and laying down base lines. 440 linear, and 706 square miles of main circuits; and 3,904 linear, and 762 square miles of minor traverses were run; 780 theodolite stations of the former and 16,282 of the latter were fixed in the area under water action of 251 villages of the rivers Indus, Rāvi, and Sutlej in districts Dera Ghāzi Khān, Muzaffargarh, Multān, and Bahāwalpur State.

519 corners of 173 squares were demarcated in 1,181 square miles with permanent mark-stones on both banks of the Indus and the Rāvi, to serve as bases for the future survey and demarcation of boundaries and fields in the beds of the rivers. Some of the base lines on the Indus could not be fixed and were postponed to next season on account of the sites having been covered by floods.

2,935 plotted, and 816 boundary *masāvis* (settlement mapping sheets) on the scale of  $\frac{1}{2,640}$ , and 40 four-inch sheets were traced, and supplied in time to the Settlement Officers. Besides these, 377 miscellaneous traces were prepared, and all the traverse stations marked during the year were plotted on 58 four-inch sheets. The computation volumes still remain to be completed as the period of the recess is short.

Some of the Kāngra computation volumes have been completed and work in some still remains to be done.

**38. No. 15 Party (Triangulation).**—At the request of the Salt Department a large scale survey of the Mayo Salt Mine, Khewra (Punjab) was undertaken. Work was begun in November 1917 and finished in May 1918; it comprised the following operations:—

- (a) A survey on the scale of 100 feet to an inch of the hill over the mine with contours at 20 ft. vertical interval. The area of the survey is about 290 acres.
- (b) Triangulation to provide a framework for the above.
- (c) Traversing inside the mine. The total length of the traverses is about 17,500 feet.
- (d) Levelling for determining the heights of all the traverse and most of the triangulation stations and some bench-marks.
- (e) Detailed survey of three selected chambers inside the mine.
- (f) Astronomical observations for azimuth for the orientation of the map.

**39. No. 20 Party.**—During the year under report, the party was employed on the detail survey and mapping of the cantonments and military stations of Drosh, Chitrāl, Ghairat, Rāwalpindi, Topa, Jhelum, Siālkot, Dalhousie (Thatt Hill), Chaman, Manora, Neemuch, Deoli, Erinpura, Agar, Nasirābād, Jhānsi, Ahmadnagar, Aurangābād, New Delhi, Hosūr Remount Dépôt, Drazinda, Jatta, Zām and Jandola on the 16-inch scale and on the survey of the *bāzārs* of Rāwalpindi, Siālkot, Manora, Neemuch, Deoli, Erinpura, Agar, Nasirābād, Jhānsi, Ahmadnagar, Aurangābād and New Delhi on the 64-inch scale. The triangulation and traversing of Dalhousie (Thatt Hill), Manora, Erinpura, Agar, Aurangābād, Sātāra, New Delhi, Bellary and Hosūr Remount Dépôt were completed and the traversing of Secunderābād and Bolārum was commenced during the year. Forty-two fair sheets were submitted for publication during the year, and sixty fair sheets of cantonments and military stations and of *bāzārs*, the survey of which had been completed, were remaining at the end of the year.

The total out-turn of detail survey on the 16-inch scale was 26,527 acres and on the 64-inch scale was 314 acres. The total cost of surveying and mapping on the 16-inch scale was Rs. 50,870 and on the 64-inch scale was Rs. 6,632, and the cost-rate per acre was Rs. 1·9 and Rs. 21·1 respectively.

**Alphabetical List of Cantonments and Military Stations surveyed and published in modern style, on the scale of 16 inches = 1 mile, up to the end of 1917-18.**

- |                                     |                                   |
|-------------------------------------|-----------------------------------|
| (1) Bakloh Cantonment.              | (14) Peshāwar Cantonment.         |
| (2) Bannu do.                       | (15) Quetta do.                   |
| (3) Dehra Dūn do.                   | (16) Quetta Civil Station.        |
| (4) Fort Lockhart do.               | (17) Rājkot Cantonment.           |
| (5) Guna do.                        | (18) Rāwalpindi do.               |
| (6) Hangu do.                       | (19) Sahāranpur Remount Dépôt.    |
| (7) Hāpur (Bābūgarh) Remount Dépôt. | (20) Sanāwar Cantonment.          |
| (8) Jhelum Cantonment.              | (21) Saugor do.                   |
| (9) Jullundur do.                   | (22) Siālkot do.                  |
| (10) Kālka do.                      | (23) Simla Indian Infantry Lines. |
| (11) Kanptee do.                    | (24) Thal Cantonment.             |
| (12) Laniour do.                    | (25) Topa do.                     |
| (13) Meerut do.                     |                                   |

IV.—THE TRIGONOMETRICAL SURVEY.

GEODETTIC OPERATIONS.

40. No. 13 Party.—Astronomical. }  
 No. 14 Party.—Pendulum. } —War conditions still continuing during the

year under report, no latitude or pendulum operations were carried out and the personnel of these parties was employed at the Head-quarter offices and in continuing the calculation of the Hayford reduction for pendulum stations in India.

41. No. 15 Party.—Triangulation.—The party was employed in carrying out the following programme:—

(a). *Triangulation in the Sind-Sagar Doab.*

The Triangulation, which is in character midway between minor and secondary, comprises two main series, one extending from Sanāwān in Muzaffargarh district to Khushāb in Shāhpur district and the other from Leiah in Muzaffargarh district to Mianwāli, with two small connecting series. Altogether 56 new stations were built and observations were taken at 107 stations including those built last year.

The triangulation was connected with five sides of the Great Indus Series of the Principal Triangulation and the results proved satisfactory.

(b). *Survey of the Mayo Salt Mine, Kheura.*

This survey is mentioned on page 17.

The table below gives details regarding the triangulation:—

Number of stations observed at	...	...	...	107
" " " newly selected and built	...	...	...	56
Length of triangulation completed in miles	...	...	...	375
" " " remaining to be done	...	...	...	Nil
Area of triangulation in square miles	...	...	...	1,950
Number of triangles observed	...	...	...	114
Maximum triangular error	...	...	...	9"14
Average " "	...	...	...	2"39
Value of m	...	...	...	1'875
" " M	...	...	...	3'24
Theodolites used	...	...	...	T. & S., 6 inch micrometer Nos. 1,404, 1,097, 1,100 & 1,403.

42. No. 16 Party.—Tidal Operations.—During the year under report tidal registrations were carried out by means of self-registering tide-gauges 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	39	*With a small tide-gauge.
2. Karāchi	1868	1880	*13	
3. Bombay (Apollo Bandar)	1878	Still working	38	} 51
4. Bombay (Prince's Dock)	1881	"	40	
5. Madras	1888	"	30	} 33
	1880	1890	10	
6. Kidderpore	Restarted 1895	Still working	23	} 15
7. Rangoon	1881	"	37	
8. Moulmein	1880	"	38	} 15
	1880	1886	6	
9. Port Blair	Restarted 1909	Still working	9	} 38
	1880	"	38	

In addition to the above, the actual records of high and low water at Bhaunagar, Chittagong and Akyab were obtained from tide-pole readings taken during day-light by the Port Officers concerned.



Hourly readings of a tide-gauge at Basrah were supplied to this department throughout the year by the Director of Inland Water Transport, Mesopotamia. The readings for the year commencing 1st January 1917 were reduced by the method of harmonic analysis and the constants thus deduced were used in the computation of data for the tide-tables for Basrah for 1919. These data were forwarded on 10th April 1918 to the National Physical Laboratory, Teddington, England, where tidal predictions were made from them with the aid of the tide-predicting machine. A set of the predictions was received from the Laboratory on 29th August 1918. The tide-tables for Basrah for 1919 are being printed at the Trigonometrical Survey Office at Dehra Dūn and will be despatched to the Director of Inland Water Transport, Mesopotamia, in October 1918.

Tidal registrations at the 9 observatories now working have, on the whole, been carried out satisfactorily and will be continued during the coming year.

All the above observatories were inspected during the year under report.

43. In the following table are given the annual and decadal percentages of error in the predicted times and heights of high and low water at all the stations where observations have been taken by self-registering tide-gauges:—

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.	H.W.—L.W.	Within 8 inches of actuals.	Within 1% of mean range at springs.			Within 15 minutes of actuals.	Within 8 inches of actuals.	Within 1% of mean range at springs.		
					H.W.—L.W.	H.W.—L.W.				H.W.—L.W.	H.W.—L.W.	
1908	6	84 84	98 97	99 99	2	58 52	77 60	97 92				
1909	6	85 80	97 97	97 98	3	61 59	69 65	98 92				
1910	6	81 83	98 98	95 96	3	57 52	68 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				
1914	6	77 79	96 97	98 98	3	75 67	71 55	92 84				
1915	6	82 82	98 98	96 96	3	76 66	73 67	94 92				
1916	6	81 82	96 97	96 99	3	81 68	73 62	93 87				
1917	6	75 72	96 98	96 97	3	78 65	69 64	92 88				
Average of ten years	...	81 82	97 98	97 98	...	69 59	71 63	93 90				

44. No. 17 Party.—Levelling.—Two detachments were employed during the past season on levelling operations, the details of which are given below.

The out-turn, including branch lines, amounted to 285 miles of revisionary levelling and 152 miles of new levelling. The heights of 1 station of the Principal Triangulation and of 4 primary and 175 secondary new bench-marks were determined.

The revisionary levelling included:—(i) A line from Karamnāsā to Aurangābād. (ii) A line from Barākar to Burdwān along the Grand Trunk Road. These lines form parts of the Benares-Howrah line originally levelled in seasons 1913—17. (iii) A line from Ranchī *via* Purūlia to

Barākar along the main road. This line is part of the line from Aurangābād *via* Daltonganj, Rānchi, and Purūlia to Barākar originally levelled in 1916-17.

The above revisionary levelling was undertaken in order to investigate (a) the large discrepancy amounting to nearly 2 feet between the difference in the heights of Benares and Howrah as determined by the old levelling of 1863-65 and 1881-83, and the new levelling of 1913-17 respectively, and (b) to try and discover whether the large closing error of about one foot in the circuit Rānchi-Barākar-Barhi-Rānchi, 312 miles in length, which was completed in 1916-17, was due to the levelling on the Rānchi-Barākar line, as this line, in which there is a fall of 1774 feet, was deemed suspicious.

The results of the revisionary levelling do not however disclose any serious errors in the levelling operations carried out in seasons 1913-17. For present purposes therefore and until the new net of modern levelling can be treated as a whole the amount of error to be assigned to each line, in order to remove the circuit error mentioned above and the discrepancy between the old and new results, has been determined by the method of minimum squares; and along each line the assigned portion of error has been dispersed by applying to the heights of the bench-marks corrections proportional to their distances from the starting point.

*The new levelling* consisted of a line from Cawnpore *via* Kālpī and Orāi to Jhānsi, along the main road. This is a useful line both for geodetic and irrigation purposes.

**45. No. 19 Party.—Base Line Operations.**—Owing to the paucity of officers no Base Line work of any kind was undertaken during the year.

### MAGNETIC SURVEY.

**46. No. 18 Party.—Magnetic.**—The magnetic observatories at Dehra Dūn and Toungoo were inspected by the Officer in charge during the field season and a complete set of observations was taken at each for the comparison of instruments. The Alibāg and Kodaikānal observatories, under the Meteorological Department, were also visited for the same purpose.

A permanently marked repeat station was established this season at Galle on the south coast of Ceylon. This station will be of much value for the determination of the annual changes in the magnetic elements in the South of India and in Ceylon.

No other field observations were taken during the year.

In 1919-20 the 75 repeat stations in India, Burma and Ceylon will be revisited. Favourable reports of the good preservation of the permanently marked repeat stations continue to be received from the local officials annually so that it will be possible in future to occupy exactly the same spot at each visit and it is hoped in consequence that the annual changes will be obtained with even greater accuracy than in the past.

*Publication of the results of the Magnetic Survey.* The original scheme of the magnetic survey consists of a general survey, and a detailed survey of magnetically disturbed areas. The general survey comprises 74 repeat stations and 1351 field stations in India, Burma and Ceylon, at which observations have been taken during the years 1901 to 1915; the reduction of these observations to the epoch 1909·0 has been completed and will be published shortly. The publication will contain a brief account

of the work of the Magnetic Survey during 1901—1915, with relative tables, and maps showing the lines of equal declination, dip, horizontal force and total force and the lines of equal annual change for each of the three elements.

The detailed survey comprises 11 magnetically disturbed areas in which observations of declination, dip and horizontal force were taken at 407 stations; the reduction of the observations at these stations is in hand and will be published later on.

*The Magnetic elements at observatories.*—The computation and tabulation of the provisional values of declination, dip, horizontal force and vertical force for the three observatories (Dehra Dūn, Toungoo and Kodaikānal) for 1917 have been completed; the mean values of these elements for the year 1917 derived from all days, excluding those of great disturbance, are given in the table below:—

MEAN VALUES OF THE MAGNETIC ELEMENTS AT OBSERVATORIES IN 1917.

Observatory.	Latitude & Longitude.	Dip.	Declination.	Horizontal Force.	Vertical Force.
	"	"	"	C. G. S.	C. G. S.
Dehra Dūn ...	{ 30 19 19 N 78 3 19 E }	N 44 44·1	E 2 6·5	0·33010	0·3270
Toungoo ...	{ 18 55 45 N 96 27 3 E }	N 23 8·5	W 0 12·7	0·39037	0·16684
Kodaikānal ...	{ 10 13 50 N 77 27 46 E }	N 1 27·1	W 1 33·8	0·37661	0·029

## PART 3.—OFFICE WORK.

### I.—HEAD QUARTER OFFICES.

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

47. The work of the Map Publication Office for the year under review again shows a large increase on the previous year's out-turn:—

(a) In the Photo.-Litho. Office the number of pulls on the machine and hand presses reaches a combined total of 4,796,813, giving 2,976,929 completed maps printed. The respective figures for last year were 3,954,954 pulls and 1,080,573 completed maps. As there was no increase of machine power during the year, the increased out-turn is due to more efficient working and constant overtime.

The increased demand for maps was due almost entirely to military requisitions. In order that the office may more easily cope with the ever increasing work, it has been decided to obtain two rotary offset machine presses from England, and it is hoped that by the aid of these machines the rapidity of the actual printing of maps will be greatly increased. Several improvements were introduced in the Photo.-Litho. Office during the year in the method of reproducing maps; these have added to the efficiency of the work and at the same time made the reproduction more economical.

(b) The increase in the number of maps printed necessarily entails an increase in the work of the Map Record and Issue Office. The total issues of maps this year has amounted to 883,543 as against 685,206 last year. In the majority of these issues the maps have been folded with stiffeners. The Issue Section of this office will be thoroughly overhauled during the coming year and placed on a much more satisfactory basis.

(c) In addition to the ordinary routine work in the Drawing and Engraving Offices, a large amount of extra-departmental work has been carried out and the out-turn compares most favourably with previous years.

(d) In the Mathematical Instrument Office there has again been a very large increase of work. The total value of issues for the current year is more than 50% in excess and the value of work done is more than 10% in excess of the previous year.

The strain on all these offices has been very great, as the extra work has been carried out without any increase of personnel.

48. The classes of maps for the publication of which the Head Quarter Offices are responsible, are 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 1:1,000,000 scale (about 1 inch to 16 miles).  
 (e) Geographical maps on the 1:2,000,000 scale (about 1 inch to 32 miles).  
 (f) General maps on smaller scales.  
 (g) Special maps.

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

During the year 43 modern sheets have been published. This is a further reduction on last year and is due both to a congestion of urgent military work in the Photo.-Litho. Office and to a reduction of field work on this scale.

22 one-inch sheets of those surveyed up to the end of September 1916 and 84 sheets of those surveyed up to the end of September 1917 remain to be published.

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

Year.	NUMBER OF 1-INCH SHEETS PUBLISHED.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
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	104	60	58	222
1913-14	71	38	49	158
1914-15	97	48	9	154
1915-16	85	69	50	204
1916-17	23	40	22	85
1917-18	18	12	13	43
Total Published	644	435	443	1,522
Probable number of 1-inch sheets which will not be published owing to the area covered by them being included in the programme for sheets to be published on the $\frac{1}{2}$ -inch scale	911	564	473	1,948
Approximate number remaining for publication	597	1,030	1,121	2,748
Approximate number of public 1-inch sheets in India	2,152	2,029	2,037	6,218

In addition to the above, during the year 34 one-inch sheets, prepared from modern revenue surveys, have been published in colours pending their topographical revision. Village boundary editions of 2 modern one-inch sheets have been published at the request of Local Governments.

58 modern one-inch and 67 old style one-inch sheets were reprinted during the year.

(b) **Topographical Maps on the scale of  $\frac{1}{2}$  inch to 1 mile.**

Index map No. 9 shows the progress made in the publication of these sheets. These maps now form the tactical map of India having taken the place of the quarter-inch maps in this respect. They were commenced in 1914 and most of them are reductions from the one-inch map, but others are from direct half-inch surveys.

The table below gives the annual out-put of these sheets:—

Year.	Drawn from component one-inch sheets.	Surveyed on half-inch scale.	Total.
1914-15	...	1	1
1915-16	21	4	25
1916-17	50	6	56
<b>1917-18</b>	<b>59</b>	<b>6</b>	<b>65</b>
Totals	130	17	147

(c) **The map of India on the scale of  $\frac{1}{4}$  inch to 1 mile.** (*Vide* Index map No. 10).—This map is prepared in “degree sheets” which include  $1^\circ$  of latitude and  $1^\circ$  of longitude, *i.e.*, the area covered by 16 one-inch sheets, or four half-inch sheets.

The following table shows the progress made in publication of  $\frac{1}{4}$ ” sheets within India:—

Years of Publication.	NUMBER OF DEGREE SHEETS PUBLISHED.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
1911-12	2	1	4	7
1912-13	3	1	1	5
1913-14	4	3	2	9
1914-15	1	3	3	7
1915-16	.....	1	4	5
1916-17	1	.....	3	4
<b>1917-18</b>	.....	.....	<b>4</b>	<b>4</b>
Totals	11	9	21	*41
Approximate number of “degree sheets” in India	170	140	140	450

\* Eight of these are preliminary editions having been prepared from surveys executed prior to 1905 on various scales.

The production of the sheets on this scale is still delayed owing to the more urgent work on those of the half-inch scale.

26 sheets, prepared from the engraved quarter-inch Atlas sheets, have been brought up to date and published in black only as provisional “degree sheets” during the year.

With the exception of Rājputāna, Cutch and parts of Central India these provisional “degree sheets,” including those in hand, now cover practically the whole of India where modern “degree sheets” are not likely to be available in the near future.

(d) **Geographical Maps on the 1:1,000,000 scale.**—(about 16 miles to 1 inch). (*Vide* Index map No. 11).—During the year 13 sheets of this series were published, either new or in new style to supersede old editions.

**La Carte Internationale du Monde au 1,000,000’.**—(*Vide* Index map No. 12).—A full description of the genesis of this series was given in the General Report for 1913-14. One sheet, No. N.E. 45, of this series has been published during the year. The sheets of this series are engraved on copper and transferred to zinc for facility of printing.

(e) **Geographical Maps on the 1:2,000,000 scale.**—(about 32 miles to 1 inch). (*Vide* Index map No. 13).—No map of this series was published during the year. In future all maps of this series will be engraved; the series in time will supersede the Map of India and Adjacent Countries, scale 32 miles to 1 inch, the layered edition of which was republished during the year.

(f) **Geographical Maps on smaller scales.**—The new map of India on the 1:4,000,000 scale, to replace the 64 miles to 1 inch map has been held up owing to various causes, but the engraved plates are now practically ready and it is hoped to publish the map in 1919.

The plates of the other smaller scale maps maintained by the department have been corrected and kept up to date as far as possible.

The annual edition of the Railway Administration map was also published and the map of the Province of Bihār and Orissa was republished on scale 1 inch = 16 miles.

(g) **Special maps.**—Numerous special maps have been prepared for the General Staff, for Local Governments and other departments as well as a few for private individuals.

**49. Map Record and Issue Office.**—The total number of printed maps received from the Calcutta Printing Offices (including the Engraving Office) was 998,604 of which the face value amounted to Rs. 5,61,287. Details are given in Table IV. The number of maps printed at the Trigonometrical Survey Office, Dehra Dūn and received in this office was 8,204 of which the face value amounted to Rs. 7,692.

The total number of printed maps issued from this office was 883,543 of which the face value amounted to Rs. 2,88,038.

The details are as follows:—

	<i>Government Officials.</i>	<i>India Office.</i>	<i>Departmental Issues.</i>	<i>Private Individuals.</i>	<i>Map Agents.</i>	<b>Totals for 1917-18.</b>	<b>Totals for 1916-17.</b>
<b>No. of maps</b>	795,810	4,302	34,791	42,464	6,086	<b>883,543</b>	685,206
<b>Value Rs.</b>	2,12,861	5,981	29,814	33,276	6,106	<b>2,88,038</b>	3,44,398

The number of maps issued during the year shows a considerable increase even over the issues of 1916-1917; this increase however continues to be very largely due to ever growing demands of the Army, for whom a special reduction of 50% off the face value of maps has been made. The improvement in the sale of maps to private individuals and map agents which was noted last year continues. Arrangements for advertising the sale of maps have been started, in accordance with the orders of the Government of India, with a view to bring to the notice of the general public the fact that increasingly large numbers of modern maps are being published yearly and are available.

The new system of card-indexing receipts of maps in the *Print Section* of the Office, which was started during the year under report, has been completed; but it has been found necessary to extend this system to cover issues of maps from the *Section*. It is also hoped to extend the same system to the records in the *Original Section* in the near future.

The building of new racks for maps in the remaining map store rooms has been stopped owing to the decision to remove the Calcutta Offices to Dehra.

**50. No. 1 (Head Quarters) Drawing Office.**—*Compilation Section.* The preparation of the fair sheets of one of the 1:1,000,000 scale India and Adjacent Countries series has been under fair-drawing and the compilation of two other sheets of the same series has been in hand during the year under review.

Patterns for three new engraved sheets of the 1:1,000,000 scale India and Adjacent Countries series have been completed in full and supplied to the Engraving Office: while patterns have been partly supplied or are in hand for three other new engraved sheets and for three second editions of engraved sheets of the same series previously published.

Now that town and village sites and the size and style of lettering of all place names are classified to distinguish both their administrative importance and their population, certain engraved sheets of the 1:1,000,000 scale India and Adjacent Countries series have to be altered in accordance with this new classification, brought up to date and modernized for re-engraving. Patterns of four such sheets have been completed in full and supplied to the Engraving Office.

Patterns have also been completed and supplied to the Engraving Office for four new sheets of the 1:1,000,000 scale International series while for four other sheets of the same series layer guides have also been completed and supplied.

For the 1:2,000,000 scale Southern Asia series some of the outline-patterns have been prepared.

It has now been decided to engrave all the sheets of this series for which the Head Quarter Offices are responsible, so patterns are accordingly being prepared for engraving two other sheets which were previously being fair-drawn for reproduction by heliozincography.

For the new 1:4,000,000 scale engraved map of India colour guides and patterns for hill and range names have been completed.

Miscellaneous work includes the drawing of fair sheets of four new Town Guide maps of which two have been reproduced experimentally and the corrections found necessary for this new style of mapping are being carried out on all the fair sheets before final publication.

Hill-shaded originals have also been prepared for twelve maps on various scales.

*Half-Inch and Quarter-Inch Section.*—Fair sheets of three new half-inch sheets have been completed and sent to press. The fair sheets of all the old half-inch Sind Survey sheets have been cut up and "masked" for publication in 14 modern style half-inch sheets ("Preliminary Editions"). These fair sheets are only waiting for final corrections in certain particulars, which the Local Government has been asked to supply, before being completed and sent to press.

Fair sheets of two quarter-inch sheets have been drawn and sent to press for publication as "Preliminary Editions." Fair sheets of six other quarter-inch sheets (for publication as "Preliminary Editions") and of three quarter-inch sheets (for publication as "Provisional Issues") are in hand.

*Mapping and Reprint Sections.*—Fair sheets of 227 published maps (95 for general stock and 132 for special stock) on various scales have been corrected and brought up to date for reprint as against a total of 136 maps in 1916-1917.

Fair sheets of 185 maps on various scales, drawn by field parties or by other drawing offices, have also been corrected before final publication.

Of the quarter-inch sheets prepared from Atlas or other old quarter-inch material for publication as "Provisional Issues," the fair sheets of 25 sheets have been completed and sent to press, while 31 sheets are in hand; as



against the totals for 1916-1917 of 35 and 22 sheets respectively. Fair sheets of four new Provincial maps on various scales have been completed and sent to press.

A considerable amount of extra-departmental work has been carried out as usual for the Army, other Government departments and semi-official concerns. Such work includes the preparation of fair sheets for three new maps to illustrate the report of the Calcutta University Commission, for a new 80-mile railway map for the "Indian Bradshaw", for 26 special District maps to illustrate the progress of dacoity in Bengal, &c.; the usual annual revision of the fair sheets of the 64-mile Railway Map of India with corrections to March 1918; the revision of fair sheets for the 180-mile map of India illustrating statistics of co-operative credit societies and for the 128-mile map of India showing provincial headquarters of the Dufferin Fund, &c., &c.

*Office Copy Section.* Corrections and additions received from various local authorities have been recorded on the office copies of 3,022 published departmental maps on various scales for incorporation in future reprints of such maps. Office copies of 569 new departmental maps have been prepared for maintaining a similar record, and colour guides for boundaries, &c., have been prepared for 578 new maps.

Miscellaneous work includes the checking and recording of areas contained in one-inch and half-inch maps received in the Headquarter offices for publication, supplying copies of original records to Government officials on demand and to private applicants on payment, and dealing with questions concerning Revenue Survey maps.

*Examining Section.* 521 cases have been examined and passed as against a total of 420 cases in 1916-1917.

A very considerable amount of miscellaneous work on a variety of subjects connected with the examination of maps has also been dealt with.

**51. Engraving Office.**—The majority of the engravers have continued to be employed on engraving the 1:1,000,000 scale India and Adjacent Countries series and the International series of maps on the same scale.

All the plates of four new sheets of the 1:1,000,000 scale India and Adjacent Countries series and of three new sheets of the International series have been completed, and three sheets of the former series which were previously published as engraved editions have been brought up to date, modernized and the new plates engraved.

Work in hand at the end of the year under report comprises two new sheets of the 1:1,000,000 scale India and Adjacent Countries series, four new sheets of the 1:1,000,000 scale International series, and one modernized sheet of the former series. The plates of most of these sheets are nearing completion.

Of the 1:2,000,000 scale Southern Asia series, the plates of two sheets have been projected and portions of the outline have been drawn on them from patterns supplied by No. 1 Drawing Office. Further work on these plates has had to be suspended temporarily pending a decision as to the size and style of lettering to be used for the smaller place names on all the engraved sheets of this series.

Engraving of all the plates of each of the four sheets of the new 1:4,000,000 scale map of India was completed during February 1918, but further corrections to that part of this new map covered by the new Himalayan Map are awaited from No. 2 Drawing Office before the

plates can be finally completed and transfers supplied to the Photo.-Litho. Office.

Periodic corrections have been carried out on the plates of all the small scale maps of India, of District maps and of Index Charts; and, in addition, new plates have been engraved for three new District maps and the new 192-mile Index maps of Half-inch and Quarter-inch sheets.

Extra-departmental work carried out includes the engraving of several new plates for different kinds of scales required by the Army, engraving titles on photogravure plates which are prepared in the Photo.-Litho. Office, and various miscellaneous work.

In the *Printing Section* of the office 42,158 impressions were pulled as against 40,148 in 1916-17. Of this total 20,985 impressions were pulled for extra-departmental orders, such as photogravures, commission forms and certificates.

In the *Steel Facing Section* of the office 270 plates were dealt with.

**52. Photo.-Litho. Office.**—The year 1917-18 has again witnessed a large increase in the demand for maps by the military authorities. This increase has again resulted in the out-turn for the year constituting a record. This increase over the out-turn of 1916-17 was only accomplished by the employment of more overtime as was foreshadowed in this report last year. The employment of two shifts of men on the litho. machines to cope with future increased demands would be inadvisable as it would entail work being carried on by artificial light, which would render it very difficult to ensure the matching and evenness of colours. Two rotary offset machine presses have therefore been indented for from England and it is hoped that, with the help of these, the increased demands for maps may be met.

During the year under report 2,976,929 finished maps and diagrams were printed in the machine presses as against 1,080,573 during 1916-17. On an average less than two printings were required to produce each finished copy as compared with between three and four printings last year. This difference is due to the fact that during 1917-18 a very large number of diagrams in black only were printed as illustrations for various military hand and text books. The highest monthly out-turn was attained in February 1918 when 919,188 completed copies were produced on the machine presses.

Ten litho. machines ran for the whole year; there has therefore been no increase in the utilised machine power.

The fifteen hand presses produced 82,540 impressions against 40,235 in 1916-17.

About 21½% of the total out-turn represented maps printed for the department, while the remaining 78½% was composed of work done for the army and other departments.

The work done for the department includes 97 new and 132 reprint editions of modern style one-inch maps in colours. Preliminary editions of 37 one-inch maps were printed in colours, black and brown, or black only, while *Village Boundary editions* were published of 2 modern one-inch maps. The total number of modern one-inch maps printed or reprinted during the year was 268. Of the *half-inch series* 80 new sheets were printed in colours and 16 were reprinted.

During the year 17 new quarter-inch *degree sheets* were printed, 28 being "Provisional Issues". In addition 142 degree sheets were reprinted either in colours, black and brown, or black.

Of old style sheets 75 were reprinted on the one-inch, and quarter-inch scales.

The *Negative and Powder Process Sections of the Photo. Branch* have turned out 3,968 and 1,781 negatives respectively or a total of 5,749 negatives as against 4,452 produced by the *Negative Section* during 1916-17 before the *Powder Process Section* was formed. The *Retouching Section* dealt with 5,500 negatives as against 4,778 in 1916-17, while the *Helio. and Vandyke Sections* have together turned out 8,426 plates as against 7,496 during 1916-17.

The *Process Engraving Section* during the year prepared 25 photogravure plates, 223 half-tone blocks and 132 line blocks, a total of 380 blocks and plates as against 776 during 1916-17. From the half-tone and line blocks an aggregate of 1,418,321 impressions were pulled compared with 755,324 impressions pulled during last year.

The *Type Printing Section* set up 7,476 pages of matter of which, in all, 942,811 copies were printed, 1,677,147 impressions being pulled.

In regard to methods and processes several improvements have been introduced. A section which has already been mentioned above has been formed to work the "Powder Process" by means of which any number of reversed copies can be made of a negative. Its introduction has improved the quality of the maps, considerably lightened the work of the studio which was rapidly becoming congested, and reduced the cost of reproduction of coloured maps, and but for its introduction it would have been impossible to cope with all the demands for reprints for mobilisation purposes in anything like as short a time as that in which the work was actually carried out.

A very notable economy has been effected by this means, the saving on a whole year's working amounting to about Rs. 12,000.

During the past year Mr. Vandyke has introduced several improvements in the new method of preparing tint plates for layered maps, which was mentioned in this report last year; these improvements all tend towards the simplification of the method and effect a consequent cheapening of the work.

The following tables and diagrams illustrate the steadily increasing work of the office.

#### Out-turn of Photo.-Litho. Office during 1917-18.

TABLE A.

1	2	3	4	5			7
				NUMBER OF MAPS PRINTED.			
Year.	*Cost of office.	†Value of out-turn at cost-rates.	Recovered in cash or by book-debit.	Departmental.	Other than Departmental.	Total.	
	Rs.	Rs.	Rs.				
1915-16	1,80,603	3,41,782	63,791	847	2,229	3,076	
1916-17	1,79,661	3,47,271	36,009	793	3,391	4,184	
<b>1917-18</b>	<b>2,08,784</b>	<b>4,34,124</b>	<b>1,01,130</b>	<b>817</b>	<b>3,812</b>	<b>4,629</b>	

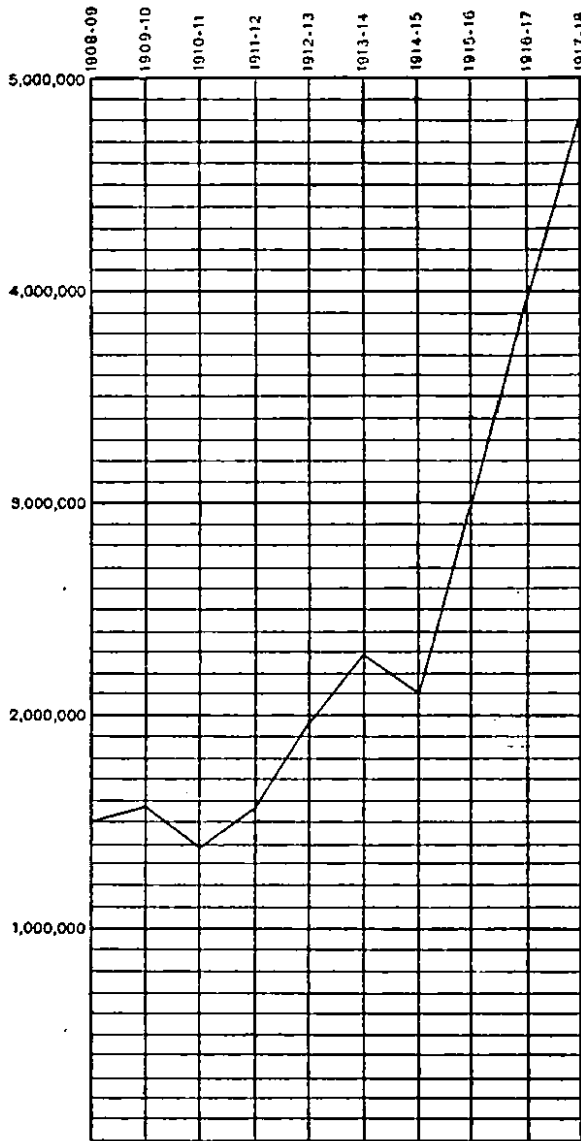
\* Does not include cost of chemicals, paper, &c., obtained from England.

† Does not include value of stores, &c., supplied to other departments nor the amount realised from the sale of unserviceable stores.

TABLE B.

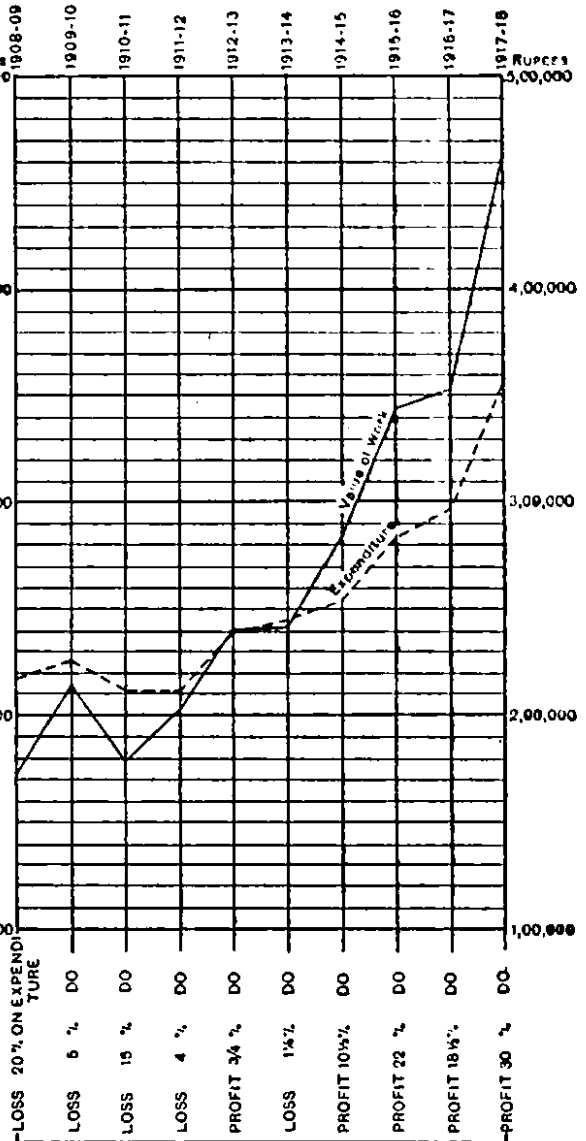
1	2	3	4	5			7
				TYPE SECTION OUT-TURN.			
Year.	Number of impressions pulled in Litho. Branch.	Number of half-tone impressions pulled.	Number of line-block impressions pulled.	Pages or items published.	Copies printed.	Impressions pulled.	
1915-16	2,975,149	86,373	894,230	5,383	1,143,075	2,053,663	
1916-17	3,954,954	5,486	639,838	8,216	1,311,014	2,051,347	
<b>1917-18</b>	<b>4,796,81</b>	<b>224,903</b>	<b>1,193,418</b>	<b>7,476</b>	<b>942,811</b>	<b>1,677,147</b>	

DIAGRAM SHOWING OUTTURN OF THE LITHO. BRANCH during the last ten years.



Number of impressions pulled in Litho. Branch shewn thus.....

DIAGRAM SHOWING PROFIT AND LOSS on the working of the whole office during the last ten years.



Total Value of Work Done shewn thus.....

Total Expenditure including cost of English stores, &c., shewn thus.....

53. **Mathematical Instrument Office.**—During the year from 1st April 1917 to 31st March 1918, there was an increase in the demands made on this office (*vide* item 1 in para. 2) as well as in the value of work done (*vide* item 6 in para. 2), and there was respectively a profit of Rs. 1,55,859 and Rs. 50,741 against a profit of Rs. 69,785 and Rs. 44,439 in 1916-17.

2. Below are given the usual comparative figures for the last 3 years:—

	1915-16.	1916-17.	1917-18.
	<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.	2,51,818	5,52,655	8,88,658
2. Value of repairs to instruments received for repairs and returned in serviceable condition.	52,535	58,423	53,133
3. Value of instruments received from Government Officers when no longer required.	54,411	77,147	85,209
4. Book value of the stock of instruments, &c., in Serviceable Stores.	5,68,631	4,73,155	3,92,268
5. Book value of the stock of instruments, &c., in Repairable Stores.	70,896	1,15,805	1,04,394
6. Total value of work done in the Workshop ...	1,96,704	2,99,531	3,41,627
7. Value of instruments manufactured in the Workshop for Serviceable Stores.	71,641	1,76,119	1,85,737
8. Value of instruments purchased locally ...	11,255	1,09,039	4,30,336
9. Value of instruments and materials obtained from England through the Director General of Stores.	1,69,073	1,01,744	66,380
10. Average No. of employees and their pay ...	No. * 404 Rs. 91,654	No. * 417 Rs. 1,02,664	No. 504 Rs. 1,33,719

\* Incorrectly given as 337 and 353 in the General Report for 1916-17.

3. During the year the stock of all the three stores, (the Serviceable, the Repairable and the Material Stores), was twice taken with one exception and the discrepancies noticed have been adjusted. The exception being the wood godown the stock of which could only be once taken.

Table IV.—Departmental Publications, Calcutta, 1917-18.

Note.—For special publications at Dehra Dūn, vide, pages 34 to 37.

Class of Maps.	Scale.	NUMBER OF DIFFERENT MAPS OF EACH CLASS RECEIVED.		Number of copies printed.	Value.
		New Publications.	Reprints and New Editions.		
<b>GEOGRAPHICAL MAPS.</b>					<i>Rs.</i>
Maps of India ... ..	Various	1	4	6,265	6,445
Southern Asia Series ... ..	1:2,000,000	.....	4	5,920	17,760
India and Adjacent Countries ... ..	1:1,000,000	2	25	28,756	28,756
Do. (International Series) ... ..	1:1,000,000	1	1	500	500
<b>TOPOGRAPHICAL MAPS.</b>					
<i>DEGREE SHEET SERIES.</i>					
Modern ... ..	1"-4 miles	17	134	1,82,160	1,82,160
From Atlas or other old Material ... ..	Do.	28	8	10,354	10,204
<i>HALF-INCH SERIES.</i>					
Modern ... ..	1"-2 miles	80	16	68,860	68,860
<i>ONE-INCH SERIES.</i>					
Modern ... ..	1"-1 mile	97	132	90,856	88,888
Do. (Preliminary Editions) ... ..	Do.	28	9	18,360	18,360
Do. (Village Boundary Editions) ... ..	Do.	.....	2	200	400
Old Style Sheets ... ..	Various	.....	67	17,855	26,492
<b>MISCELLANEOUS.</b>					
Atlas of India Series ... ..	1"-4 miles	.....	19	1,150	1,151
Provincial Maps ... ..	Various	2	3	2,230	2,554
District Maps ... ..	1"-4 miles	.....	4	1,400	1,500
Administration Report Maps ... ..	(1"-8 miles to 1"-16 miles)	3	57	3,250	1,219
Plans of Cities and Cantonments ... ..	Various	.....	2	700	650
Index Maps ... ..	Do.	4	65	1,16,762	29,241
Miscellaneous Maps ... ..	Do.	297	76	4,43,026	76,147
<b>Totals for 1917-18 ... ..</b>	.....	<b>560</b>	<b>628</b>	<b>998,604</b>	<b>5,61,287</b>
Corresponding totals for 1916-17...	.....	761	593	686,133	5,09,155

**LETTERPRESS.**

1. Survey of India. General Report, 1916-17. Price Rs. 2 or 2s-8ā
2. Topo. Hand-Book. Chapter XI. Geographical Maps, 1917. Price As. 4 or 4d.
3. Index to names appearing on Million sheet No. 10, 1917. Price As. 2 or 2d.

## II.—DEHRA DŪN OFFICES.

### TRIGONOMETRICAL SURVEY OFFICE.

**54. Computing Office.**—During the year the adjustment of minor stations and intersected points of the following Geodetic Series was carried out:—

- (1) Assam Longitudinal,
- (2) Assam Valley,
- (3) Nāgā Hills,
- (4) Kohimā,
- (5) Manipur Longitudinal,
- (6) Manipur Meridional,
- (7) Mandalay Longitudinal,
- (8) Mandalay Meridional,
- (9) Khāsi Hills, and
- (10) Jaintiā Hills.

In addition the adjustment of the Akā Triangulation and the pendent portion of the Assam Valley Series was completed. Corrections were applied to latitudes, longitudes, azimuths and log. sides of triangulation falling in some 40 Burma Degree Sheets, the pamphlets of which have been sent to press.

Further computations in connection with Professional Paper No. 16 and the Auxiliary Tables, part II, 5th Edition, were effected during the year. Computations of the humidity corrections to height deductions and of the Hayford reduction for gravity determinations were also carried out.

The adjustment of lines of levelling in hand last year and of the relevelled portion of old line No. 64 (Bareilly to Meerut) was completed. The Levelling Pamphlets for Degree Sheets 53 and 57 were brought up to date and corrected for publication as new editions.

The list of protected stations of the Indian Triangulation referred to in last year's report had to be postponed owing to lack of personnel.

Requisitions for data were received from 25 departmental and non-departmental officials. In many cases it was necessary to extract the required information from manuscript records—a work of some magnitude as the data required were sometimes very extensive, especially for areas in Burma.

It is hoped that with the publication of the Burma Triangulation Pamphlets the business of abstracting data from manuscript records will be greatly reduced.

A large number of requisitions for forms were complied with.

115 "Degree Sheet" Triangulation Pamphlets were compiled and compared during the year and fair progress was made in the assembly of triangulation data for areas adjacent to India, in Persia and Baluchistān. 75 Triangulation Pamphlets were published and 87 pamphlets, including last year's undistributed pamphlets, were distributed.

Editions of Levelling Pamphlets Nos. 85 and 92; Professional Paper No: 16, Records of the Survey of India, Vol. XI; and Tide Tables for the Port of Basrah, 1919, were bound and distributed.

*Type Printing Section.*—The following publications were printed during the year:—

- (1) 75 Triangulation Pamphlets,
- (2) Levelling Pamphlets 84, 85 and 92,
- (3) Tide Tables for the Port of Basrah, 1919.
- (4) Professional Paper No. 16,
- (5) Records of the Survey of India, Vol. XI,
- (6) Auxiliary Tables of the Survey of India. 5th Edition. Part II (Mathematical Tables),
- (7) Pamphlet on the transliteration of place names.

*Observatories.*—Meteorological observations were continued as usual.

The Omori Seismograph has been working satisfactorily throughout the year. Tremors of considerable intensity were recorded on the 15th August and on the 7th September 1918.

Photographs of the sun were taken on 348 days the sun being obscured on the remaining days of the year.

*Preservation of Trigonometrical Stations.*—1,013 stations were repaired by district officers at a cost of Rs. 4,564-2-3. Out of 359 districts from which reports were due. 11 failed to make returns.

**55. No. 2 (Dehra) Drawing Office.**—During the year under report the work in this office was carried out by four sections.

(1) *The Triangulation Chart and Cantonment Plan Section.*—In addition to ordinary and miscellaneous work 9 one-inch sheets of Tehri-Garhwāl were mapped and published and a map of Peshāwar City on the scale of 1 inch to 6 miles was drawn. 91 sheets of seven different cantonments were coloured.

(2) *The Compilation Section.*—The rough compilation on the 12-mile scale of only one sheet of the area allotted to No. 2 Drawing Office, up to East Longitude 104°, remains in hand; 4 sheets have been sent to the Superintendent, Map Publication, for publication, and the fair-mapping of the remaining 10 sheets is in progress. The compilation of the northern half of the Brahmaputra Sheet of the Southern Asia Series has been taken up. The fair-mapping of the Himalayan Map on the scale of  $\frac{1}{3}M$  is in progress.

(3) *The Stein Section.*—The fair-mapping of the sheets comprising Sir Aurel Stein's explorations in 1900-01, 1906-08 and 1913-1915 has been continued. 16 sheets have been sent to press; 17 sheets have been completed and are awaiting Sir Aurel Stein's approval and 14 sheets remain in hand.

(4) *The Half-inch Section.*—The  $\frac{1}{2}$ -inch sheet remaining in hand last year, namely, 53 $^L_{S.E.}$  was completed and published. The fair-mapping of the Mesopotamian sheets was commenced, but it was taken over by the Deputy Director of Surveys, Mesopotamia, during the year, and this section has again taken up the preparation of  $\frac{1}{2}$ -inch sheets of which 4 are in progress, namely:—63 $^F_{N.W., S.E., S.W., S.E.}$

Three sheets on the 1:1,000,000 scale of South-West Arabia, namely, those named, 'Asir, Yaman and Hadhramaut, respectively, have been published.



The following is a summary of the work of the office during the year 1917-18:—

Class of map.	Sheets sent for publication.	Sheets remaining in hand.	REMARKS.
Geographical maps, scale $\frac{1}{M}$ (Fair sheets)	7	10	
Geographical maps, scale $\frac{1}{M}$ (Rough compilation) ... ..	.....	3	
Geographical maps, scale $\frac{1}{3M}$ (Fair sheets)	.....	4	Himalayan map.
Geographical maps, scale $\frac{1}{2M}$ (Rough compilation) ... ..	.....	1	Brahmaputra sheet.
Sir Aurel Stein's exploration in Chinese Turkistān and Kansu in 1900-01, 1906-08 and 1913-15, for publication on $\frac{2}{M}$ scale	16	31	
Degree Triangulation Charts, scale 1 inch to 4 miles ... ..	64	17	
Miscellaneous maps ... ..	2	.....	
Cantonment plans (corrections for 1917) ...	125*	.....	*Corrections to originals of 44 Cantonments.
Cantonment plans (corrections for 1918) ...	21†	64	†Corrections to originals of 6 Cantonments completed, 32 Cantonments in hand.
Cantonment plans (colour guides) ..	91‡	.....	‡Colour guides prepared for 7 Cantonments.
Half-inch sheets ... ..	1	4	
Miscellaneous Extra-departmental maps ...	14	2	
Leveling Charts, scale $\frac{1}{M}$ ... ..	3	.....	
Index Charts ... ..	4	.....	

*Photo-Zinco. Section.*—During the year 1917-18 the work undertaken comprised:—

Cantonment Maps.  
 Triangulation Charts.  
 Forest Maps.  
 Extra-departmental Maps.  
 Maps of Arabia.

In the year under review the smaller of the two litho.-printing machines was dismantled and sent to Baghdad and Mr. C. F. Oddy, Zincographer, was deputed to accompany and re-erect it.

Four technical hands were lent to the Deputy Director of Surveys, Mesopotamia Expeditionary Force.

The "Powder process" for producing duplicates of negatives was introduced and very satisfactory results are being obtained.

The following table shows the work done in the last three years:—

Years.	No. of Subjects.	No. of Negatives.	No. of Pulls.	No. of Chocolate and Cyanotype prints.
1915-16 ...	2,065	1,717	307,357	1,209
1916-17 ...	1,302	1,600	287,514	571
1917-18 ...	1,130	1,719	345,776	127

**56. Forest Map Office.**—The work of this Office is performed by four sections as follows:—

(i) *The Drawing Section*, which prepares original drawings for reproduction, these fall into six classes, viz:—

- (a) Reprints of Forest maps with corrections to date of issue.
- (b) Forest editions on the two-inch scale of modern one-inch sheets.
- (c) Maps of Forest Circles and Divisions.
- (d) Special maps to illustrate working plans, &c.
- (e) Maps and diagrams to illustrate administration reports, &c.
- (f) Maps from special surveys, mostly on the four-inch scale.

The progress of this section for the year under report is shown in the table below:—

Class of map.	In hand on 1st October 1917.	Received during the year 1917-18.	Drawn and sent for publication during the year 1917-18.	In hand on 30th September 1918.	Published during the year 1917-18.
(a) ...	103	.....	88	15	58
(b) ...	104	20	53	71	48
(c) ...	30	4	14	20	21
(d) ...	16	23	30	9	23
(e) ...	14	1	11	4	10
(f) ...	.....	87	43	44	39
<b>TOTALS</b> ...	<b>267</b>	<b>135</b>	<b>239</b>	<b>163</b>	<b>199</b>

(ii) *The Portfolio Section*, in which all changes in forest boundaries are recorded on a set of maps specially kept for the purpose; this section prepared portfolio copies of 1,509 maps and carried out 972 corrections to forest maps during the year: 3,807 maps were also coloured by hand.

(iii) *The Map Record Section*, which is responsible for the storage and issue of maps and records. The number of maps, &c. received for storage was 24,357; and 20,173 maps, lists, and diagrams, valued at Rs. 25,283, were issued during the year; these figures show an increase of 4,150 maps, &c. and Rs. 1,877 over those for last year. The net amount realized by sales to the public of 1,375 maps was Rs. 2,025; an increase of 706 maps and Rs. 987 over the sales for last year. Book transfer sales to Government officers amounted to 9,086 maps valued at Rs. 9,449; an increase of 6,911 maps and Rs. 7,233 over the figures for last year.

In addition to the above, 1,587 traces, reductions, &c. of 179 sheets were supplied to the Survey of India.

(iv) *The Book-Binding Section*, which was formed in January to deal especially with work for the Forest Research Institute; 138 volumes were bound during the year at a cost of Rs. 365.

### III.—CIRCLE AND LOCAL DRAWING OFFICES.

**57. No. 3 Drawing Office (Northern Circle).**—During the year under report 30 one-inch sheets, out of the 67 previously surveyed, were drawn by parties and submitted for publication. In addition to these 3 one-inch sheets were brought up to date and completed to margin in the drawing office, while 3 other one-inch sheets were brought up to date, for purposes of reprint.

The proofs and colour patterns of 58 one-inch and half-inch sheets were prepared and returned to the Superintendent, Map Publication, leaving a balance of 13 colour patterns still in hand.

*Half-inch sheets compiled from modern one-inch and old style half-inch maps.*—11 half-inch sheets drawn in the Circle drawing office and 13 in the parties were submitted for publication during the year.

On the basis of the one-inch sheets published to 30th September 1918, there now remain for completion in the Northern Circle 145 half-inch sheets of the kind under consideration. Of this number the fair-mapping of 12 sheets is in hand in the drawing office and parties and the material for the preparation of 18 more is held in reserve for future requirements.

*Quarter-inch sheets compiled from one-inch and half-inch maps.*—During the year two quarter-inch sheets were fair-mapped in the Circle drawing office and submitted for publication. Three others were brought up to date for reprint purposes and returned to the Superintendent, Map Publication.

The colour patterns and layer guides of two quarter-inch sheets were also prepared and sent to the Superintendent, Map Publication.

*Royal Artillery Practice and Aviation Maps.*—Five Artillery Practice Camp maps and one Aviation map, were fair-mapped in the drawing office and parties and submitted to the Superintendent, Map Publication, with the colour patterns of the Royal Artillery Practice Camp maps.

*Hill-shaded sheets.*—The hill-shaded sheets of 38 maps on various scales were sent for publication during the year.

*Special maps.*—The Delhi and Vicinity map in four sheets on the 4-inch scale, which was added to and revised, was submitted for publication.

*Miscellaneous.*—The traverse plots of stations of 12 *mauzas* consisting of 18 sheets, scale 16 and 32 inches to a mile, of the Gondā district, were prepared for and sent to the Deputy Commissioner, Gondā, at his cost.

**58. No. 4 Drawing Office (Southern Circle).**—During the year 2 three-inch sheets, 23 one-inch sheets and 3 half-inch sheets, which had been surveyed and fair-mapped by parties, were finally examined and submitted for publication. At the end of the year 2 half-inch sheets, the survey of which was completed during the previous year, had not been submitted.

*Half-inch sheets compiled from published sheets of the one-inch map.*—10 sheets were fair-mapped and submitted for publication and 9 sheets, which had been fair-mapped by parties, were finally examined and submitted for publication. At the end of the year 9 sheets were being fair-mapped in this office, 24 sheets were being fair-mapped by the parties and every sheet, the component one-inch sheets of which had been published, had been commenced.

*Quarter-inch sheets compiled from published sheets of the half-inch map.*—2 sheets were fair-mapped and submitted for publication. At the end of the year 6 sheets were being fair-mapped and every sheet, the component half-inch sheets of which had been published, had been commenced.

The examination and the colouring of the proofs of 54 sheets and the hill-shading of 29 sheets were completed and returned to the Superintendent, Map Publication.

A number of pupils were instructed in fair-drawing.

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

**59. No. 5 Drawing Office (Eastern Circle).**—During the year 35 one-inch sheets and 3 half-inch sheets, drawn from recent surveys on these scales, were finally received in the drawing office from the parties of the circle as completed for publication. Of these, 26 one-inch sheets and 3 half-inch sheets were forwarded for publication, as well as 6 one-inch sheets which had been received from the parties during the preceding survey year. The remainder are under further correction.

*Half-inch sheets compiled from the published sheets of the one-inch map.*—The preparation of 14 of these sheets was in hand in the drawing office during the year, and of these, 4 were sent for publication, 6 were received from the parties of the circle, of these 3 were forwarded for publication and 3 still remain to be dealt with in the drawing office.

On the basis of one-inch maps published up to 30th. September 1918, there now remain for drawing in the Eastern Circle 77 half-inch sheets of this kind. Of this number, the fair-mapping of 21 is in hand in the drawing office and parties of the circle.

*Quarter-inch sheets compiled from the published sheets of the one-inch and half-inch maps.*—7 of these were submitted for publication. Work on 8 others was in progress in the Circle drawing office during the year, while that on 2 others, which had been commenced in No. 11 Party during previous years, remained in abeyance.

*Hill-shaded Sheets.*—6 of these on the one-inch scale, 17 on that of  $\frac{1}{2}$  inch = 1 mile and 8 on that of  $\frac{1}{4}$  inch = 1 mile were prepared and sent for publication, leaving in hand in the Circle drawing office a balance, on the three scales together, of 28 awaiting either commencement, completion or final examination.

*Layer Guides* of 9 quarter-inch sheets were completed and submitted for publication during the year. Work on 2 more had been commenced.

*Colour patterns and press order proofs* of 37 sheets, on the one-inch, half-inch and quarter-inch scales, were prepared and returned for publication, leaving a balance of 27 one-inch and 7 half-inch sheets in hand and in various stages of completion.

**60. No. 6 (Simla) Drawing Office.**—As during the previous year this office was organized in 2 sections.

The *Army Section* has dealt with the preparation of maps and plans for the use of the Army in India while the *Survey Section* has been employed on the preparation of trans-frontier maps on the 1:1,000,000, quarter-inch and half-inch scales.

Most of the work of the *Survey Section* has consisted in redrawing in modern style, and sometimes to a reduced scale, the maps already existing, with the incorporation of such additional information of recent date as may have been available.

61. Bengal and Bihār and Orissa Drawing Office.—  
(*Imperial Standard Mapping Section*). This office, under the direction of the Director of Surveys, Bengal, undertakes the drawing of one-inch sheets from Cadastral surveys and four-inch thāna maps. The former are reduced by pantograph and drawn on the two-inch scale for reduction, the latter are now being drawn on the 1½-inch scale on blue print reductions of the four-inch thāna maps pieced together: this method, which has superseded the old one of making two photographic reductions of the thāna maps before the fair-drawing was put in hand, should improve the out-put in future years.

In both cases the sheets are completed as far as possible by the addition of the hills and other detail from old topographical maps and are published in colours.

In Bihār and Orissa 14 new sheets and 10 new editions of old sheets, formerly published in black, were submitted for publication.

In Bengal 10 new sheets were submitted for publication.

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## PART 4.—WORK FOR OTHER GOVERNMENT DEPARTMENTS.

**62. Northern Circle. No. 1 Party.**—Four Royal Artillery Practice Camps were surveyed on the 3-inch scale of areas as follows:—Akora (near Peshāwar) 103 square miles, Hoshiārpur 61 square miles, and the Yāru and Bostān areas (near Quetta) 143 square miles. The two latter surveys were commenced in June and only completed in September, but the fair maps for Akora and Hoshiārpur have been duly submitted for publication.

*No. 2 Party.*—Two Royal Artillery Practice Camps on the 3-inch scale. One of 54 square miles south of Delhi (Tughlakābād), and one of 133 square miles in the neighbourhood of Roorkee.

The country surveyed consisted of undulating, cultivated land with low rocky hills devoid of trees in the former area, and in the latter of low-lying cultivated plain intersected by numerous streams from the Siwāliks.

The fair maps of Tughlakābād in one sheet, and of Roorkee in four sheets, have been submitted for publication.

This party traversed a part of the boundary of Chakrātā Cantonment at the cost of the Assistant Commanding Royal Engineer; and surveyors were lent to the Military Works Department at Dera Ismail Khān and Bandar Abbās in connection with road surveys.

*No. 3 Party.*—One Royal Artillery Practice Camp comprising an area of nearly 31 square miles was surveyed on the 3-inch scale at Kutwa, near Mirzāpur. The fair-mapping has been completed.

*Sind-Sāgar Party.*—This party executed the whole of the triangulation required for the rectangulation of the "Thal" area of the Sind-Sāgar Doāb, in districts Mīnwāli, Shāhpur, Jhang, and Muzaffargarh. The triangulation was based on a few secondary series carried out by No. 15 Party during the same season and covered the whole area of 7,430 square miles. 1,888 stations were temporarily marked by wooden stakes, and from these the corners of the nearest 4,000 acre rectangles will now be laid out.

The country largely consists of rolling sandhills with sparse vegetation. There are scattered patches of cultivation based on wells the water of which is generally brackish.

*Punjab Riverain Detachment.*—As in previous years this detachment was employed on local surveys in the Punjab. The details of the work done are given on page 17.

**63. Southern Circle.**—The survey of cantonments and military stations was continued by No. 20 Party. The details of the work are given on pages 17 and 18.

The survey of the Royal Artillery Practice Camps of Aundh, Barelā, Kāpra and Rājankunti was undertaken for the military authorities by Nos. 5, 6 and 8 Parties. The details of the work are given on page 13.

The special survey on the scale of 1½ inches to a mile of reserved forests in the Hyderābād State was continued. No. 6 Party surveyed an area of 409 square miles and triangulated an area of about 1,288 square miles. The cost of the work is being borne by the Nizām's Government.

A surveyor of No. 8 Party was placed on deputation during the field season with the Madras Forest Department to complete the survey of reserved forests on the eight-inch scale in the neighbourhood of Nilambūr in the Malabar district of Madras.

Section VI of the Tinnevely-Travancore boundary in Madras was identified and traversed by No. 8 Party.

**64. Trigonometrical Survey.**—The Mayo Salt Mine at Khewra (Punjab), was surveyed by No. 15 Party for the Salt Department, (*vide* page 17). This was a special work not properly belonging to the task of the Survey of India and its cost was defrayed by the Salt Department.

**65. Map Publication Offices.**—A very large proportion of the work of the Photo.-Litho. Office is for other Government offices, only 21½% of their out-turn this year being departmental, a special feature being the large amount of work done for the General Staff owing to the war. In addition to the usual large number of weather charts, a large number of Treasury Bill forms and about a quarter of a million skeleton border forms for Government Promissory Notes for the Second War Loan were printed. This latter form was designed in the Engraving Office by Mr. T. Chorlton. For the Archæological and other departments photo-gravure and half-tone photographs were also reproduced. The Drawing Office prepared Railway, Manœuvre, Royal Artillery Practice Camp and many other special maps.

**66. Mathematical Instrument Office.**—The manufacture of heliographs, prismatic compasses Mark VII, scales, protractors, &c., was continued throughout the year. Practically all repair and manufacture work of a civil nature was put aside. Large numbers of metre staves and chains were manufactured and the stock of levels and theodolites was depleted to meet Mesopotamia's demands.

This office also supplied instruments to many Government offices Provincial and Imperial.

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## LIST OF INDEX MAPS.

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1. Modern surveys and publication, Northern Circle.
2. " " " " Southern "
3. " " " " Eastern "
4. Publication of modern one-inch series, Northern Circle.
5. " " " " Southern "
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7. " provisional editions of one-inch series, Northern Circle.
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9. " modern half-inch series for India.
10. " " quarter-inch " "
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12. " Indian sheets of "La Carte Internationale du Monde," scale  $\frac{1}{1,000,000}$ .
13. " 'Southern Asia' series, scale  $\frac{1}{2,000,000}$ .
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Keys to

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B	F	J	N	A				5	6	7	8
C	G	K	O		A			9	10	11	12
D	H	L	P		B	C		13	14	15	16

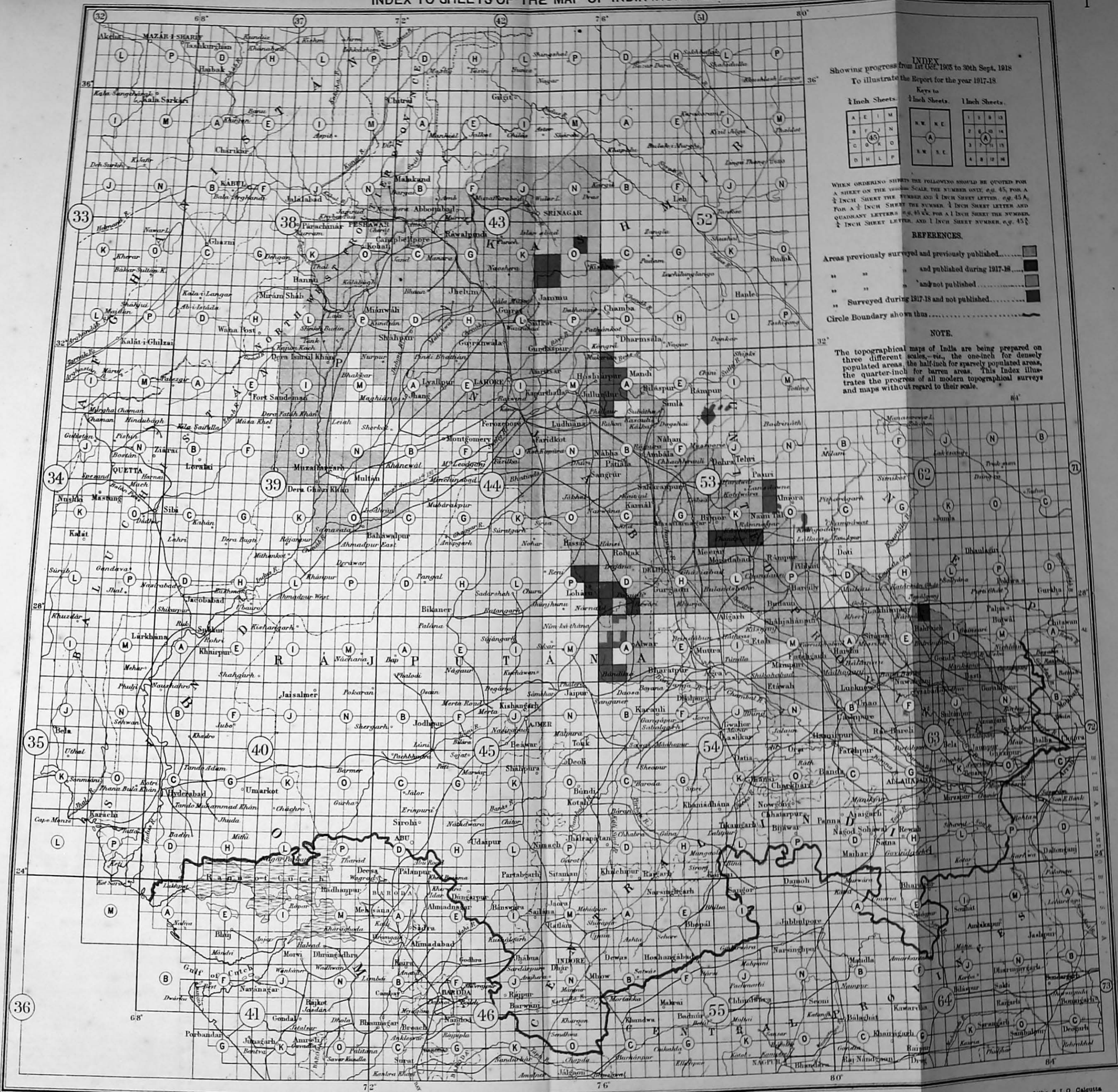
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REFERENCES.

- Areas previously surveyed and previously published.....
- " " " " and published during 1917-18.....
- " " " " and not published.....
- " " " " surveyed during 1917-18 and not published.....
- Circle Boundary shown thus.....

NOTE.

The topographical maps of India are being prepared on three different scales, viz., the one-inch for densely populated areas, the half-inch for sparsely populated areas, the quarter-inch for barren areas. This index illustrates the progress of all modern topographical surveys and maps without regard to their scale.



**MODERN SURVEY & PUBLICATION**  
(Northern Circle).



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B F J N	A	2 6 10 14
C G K O	SW S E	3 7 11 15
D H L P		4 8 12 16

When ordering sheets the following should be quoted for a sheet on the quarter-inch scale, the number only, e.g. 46, for a 1/2 inch sheet the number and 1/2 inch sheet letter, e.g. 46A, for a 1/4 inch sheet the number, 1/4 inch sheet letter and quadrant letters, e.g. 46 NW, for a 1 inch sheet the number, 1 inch sheet letter, and 1 inch sheet number, e.g. 46 2.

**REFERENCES.**

- Areas previously surveyed and previously published. [Shaded box]
- " " " and published during 1917-18. [Dark shaded box]
- " " " and not published. [Light shaded box]
- " " Surveyed during 1917-18 and not published. [Dark shaded box]
- Circle Boundary shown thus [Circle with dashed line]

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- Chellat
- Bitra
- ISLANDS
- Cardamum
- Agatti
- Pui Sand Bank
- Kavaratti
- Suhali par. I.
- Kalpeni
- Mineey

Nine Degree Channel

BAY OF BENGAL

**SURVEY & PUBLICATION**  
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B F J N	O A	5 6 7 8
C G K P	S W S E	9 10 11 12
D H L P		13 14 15 16

When ordering sheets the following should be quoted for a sheet of the above scale, the number only, e.g. 94, for a 1/4 inch sheet the number and 1/4 inch sheet letter, e.g. 94 A, for a 1/2 inch sheet the number, 1/2 inch sheet letter and 1/2 inch sheet letter, e.g. 94 A B, for a 1 inch sheet the number, 1 inch sheet letter and 1 inch sheet number, e.g. 94 1/2.

REFERENCES.

- Areas previously surveyed and previously published.....
- " " " and published during 1917-18.....
- " " " and not published.....
- " " surveyed during 1917-18 and not published.....
- Circle Boundary shown thus.....

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**MODERN SURVEY & PUBLICATION**

**(Eastern Circle).**



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A B C D E F G H I J K L M N O P Q R S T U V W X Y Z	N W N E A S W S E	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

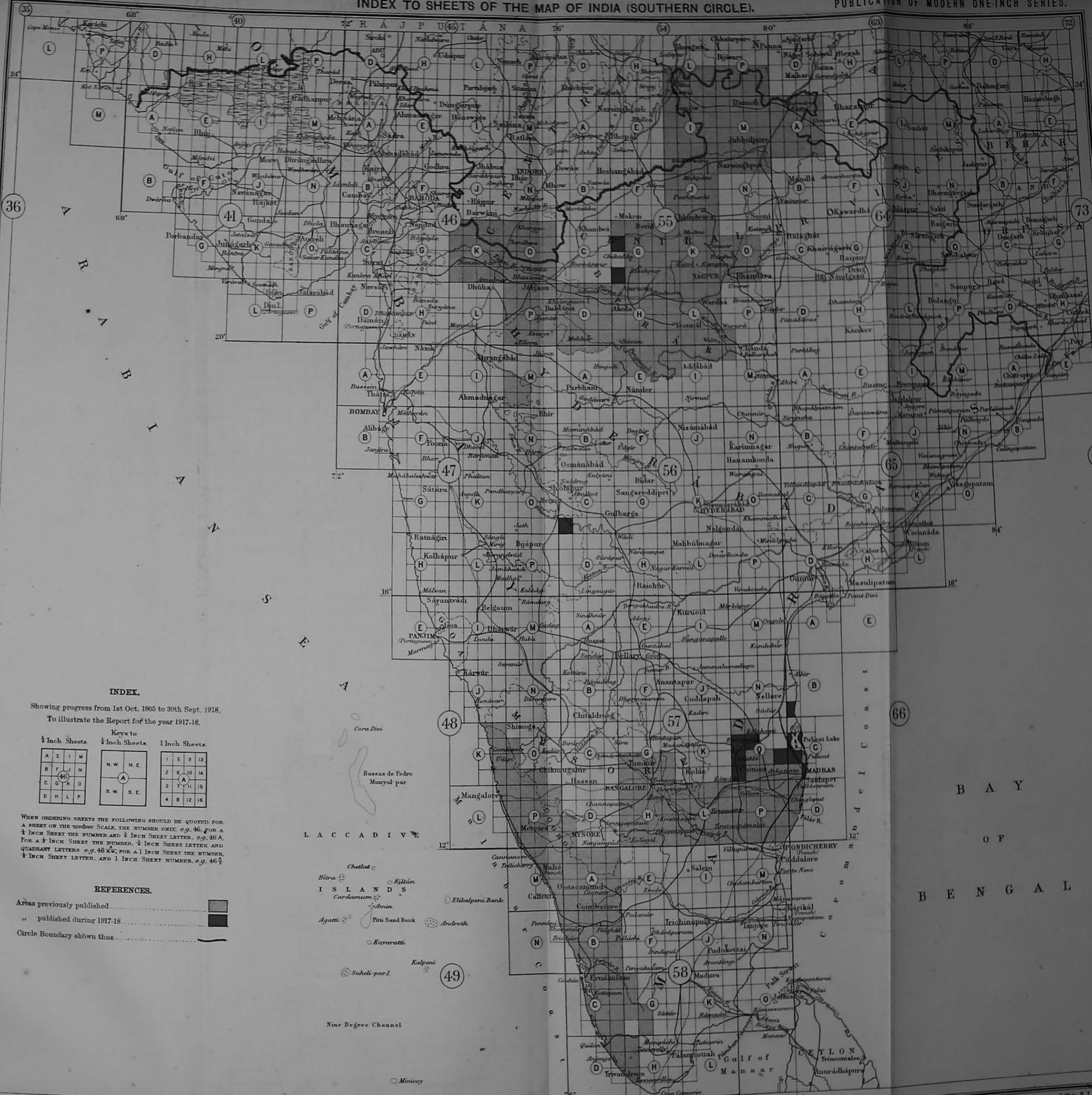
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REFERENCES.

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B	F	2	6
C	G	3	7
D	H	4	8
I	M	9	13
J	N	10	14
K	O	11	15
L	P	12	16

When ordering sheets the following should be quoted for a sheet on the quarter scale, the number only, e.g. 46, or a ½ inch sheet the number and ½ inch sheet letter, e.g. 46 A, for a 1 inch sheet the number, ½ inch sheet letter and quadrant letters, e.g. 46 K<sub>2</sub>, for a 1 inch sheet the number, ½ inch sheet letter, and 1 inch sheet number, e.g. 46 ½

**REFERENCES.**

- Areas previously published
- published during 1917-18
- Circle Boundary shown thus

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Pau Sand Bank  
Androth  
Kavaratti  
Suheli-par-I  
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Minicoy

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B F J H	O A	P G D A
C G T A D	S W S E	Q R T I L
H L L P		A B B B

WHEN ORDERING SHEETS THE FOLLOWING SHOULD BE QUOTED FOR A SHEET ON THE GROUND SCALE, THE NUMBER ONLY, e.g. 84, FOR A 1/4 INCH SHEET THE NUMBER AND 1/4 INCH SHEET LETTER, e.g. 84 A, FOR A 1/2 INCH SHEET THE NUMBER AND 1/2 INCH SHEET LETTER AND QUADRANT LETTERS, e.g. 84 W, FOR A 1 INCH SHEET THE NUMBER, 1/2 INCH SHEET LETTER, AND 1 INCH SHEET NUMBER, e.g. 84 W 1.

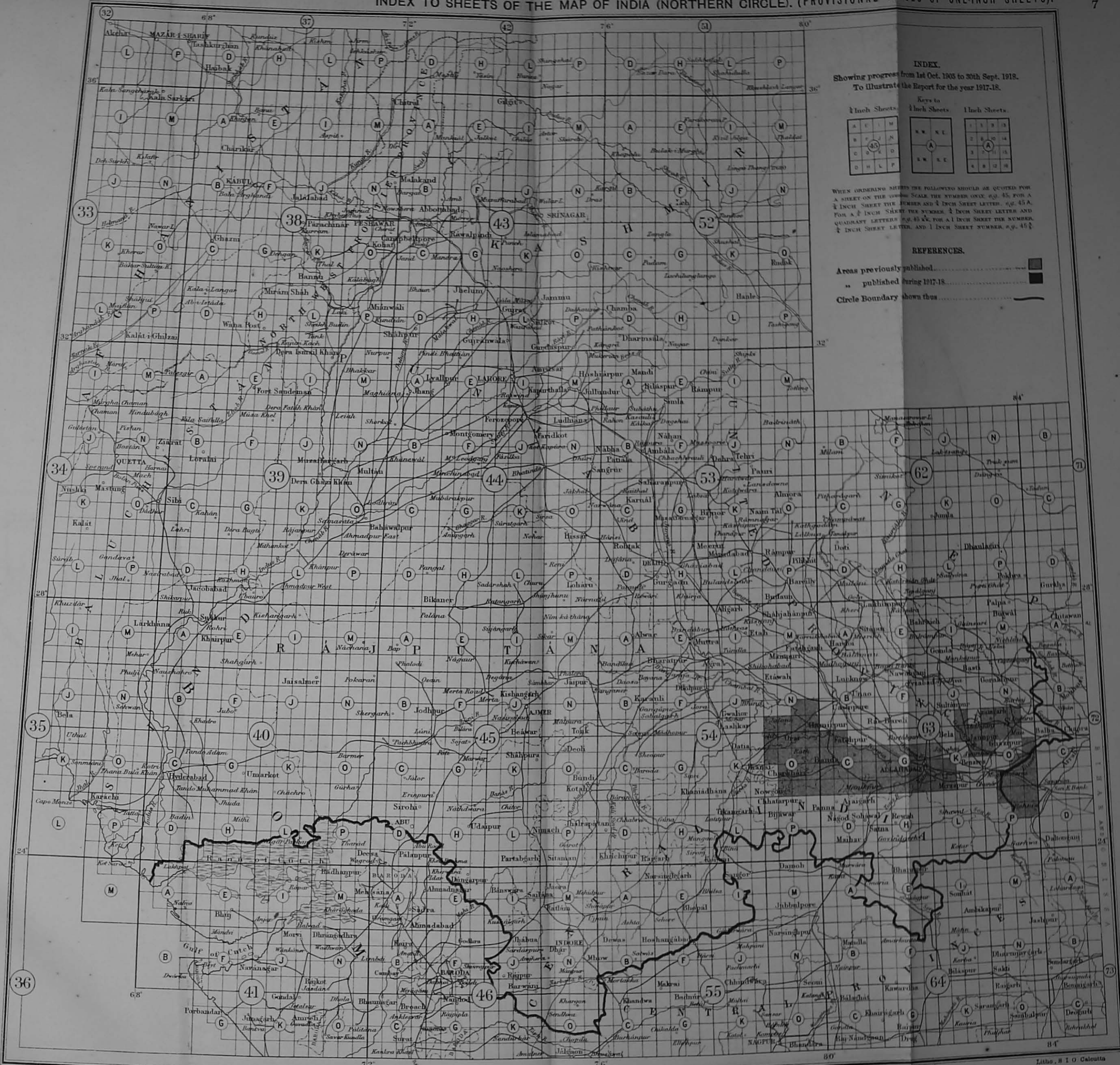
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.. published during 1917-18 . . . . .

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A I M B J N C O P D H L	K W X A	1 2 3 4 5 6 7 8 9

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" published during 1917-18 .....  
Crete Boundary shown thus .....



**PROVISIONAL ONE-INCH PUBLICATION**  
(Eastern Circle).

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TO  
MAPS ON THE SCALE 1 INCH = 2 MILES  
OF  
INDIA

To illustrate the Report for the year 1917-18.

Key to Half Inch Sheets.

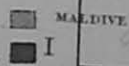
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A	E	I	M				
S.W.	S.E.	S.W.	S.E.	S.W.	S.E.	S.W.	S.E.
B	F	J	N				
S.W.	S.E.	S.W.	S.E.	S.W.	S.E.	S.W.	S.E.
C	G	K	O				
N.W.	N.E.	N.W.	N.E.	N.W.	N.E.	N.W.	N.E.
C	G	K	O				
S.W.	S.E.	S.W.	S.E.	S.W.	S.E.	S.W.	S.E.
D	H	L	P				
S.W.	S.E.	S.W.	S.E.	S.W.	S.E.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

NOTE

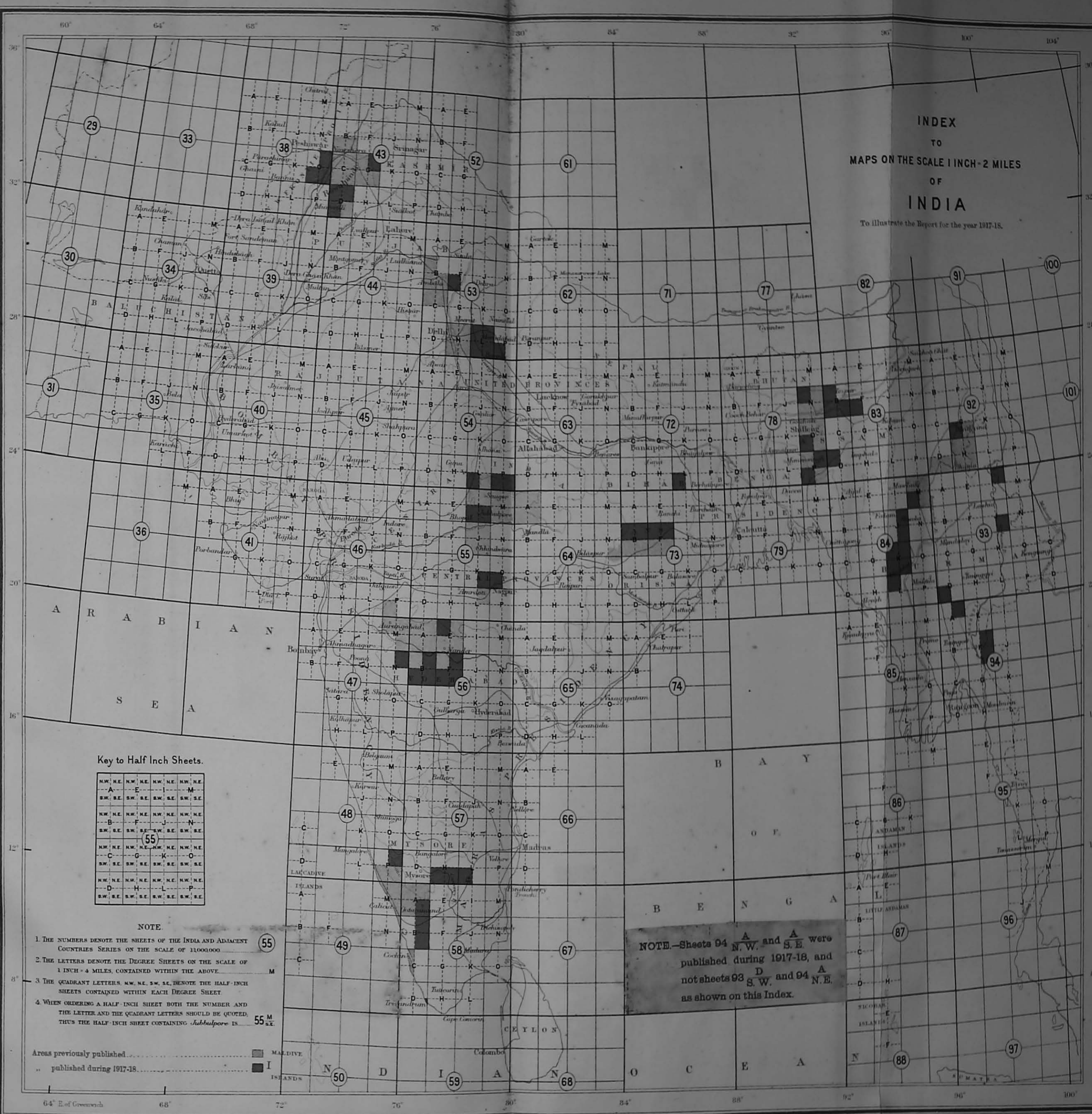
1. THE NUMBERS DENOTE THE SHEETS OF THE INDIA AND ADJACENT COUNTRIES SERIES ON THE SCALE OF 1:100,000.
2. THE LETTERS DENOTE THE DEGREE SHEETS ON THE SCALE OF 1 INCH = 4 MILES, CONTAINED WITHIN THE ABOVE.
3. THE QUADRANT LETTERS, N.W., N.E., S.W., S.E., DENOTE THE HALF-INCH SHEETS CONTAINED WITHIN EACH DEGREE SHEET.
4. WHEN ORDERING A HALF-INCH SHEET BOTH THE NUMBER AND THE LETTER AND THE QUADRANT LETTERS SHOULD BE QUOTED, THUS THE HALF-INCH SHEET CONTAINING *Subulpoore* IS 55<sup>M</sup><sub>SE</sub>.

Areas previously published

published during 1917-18

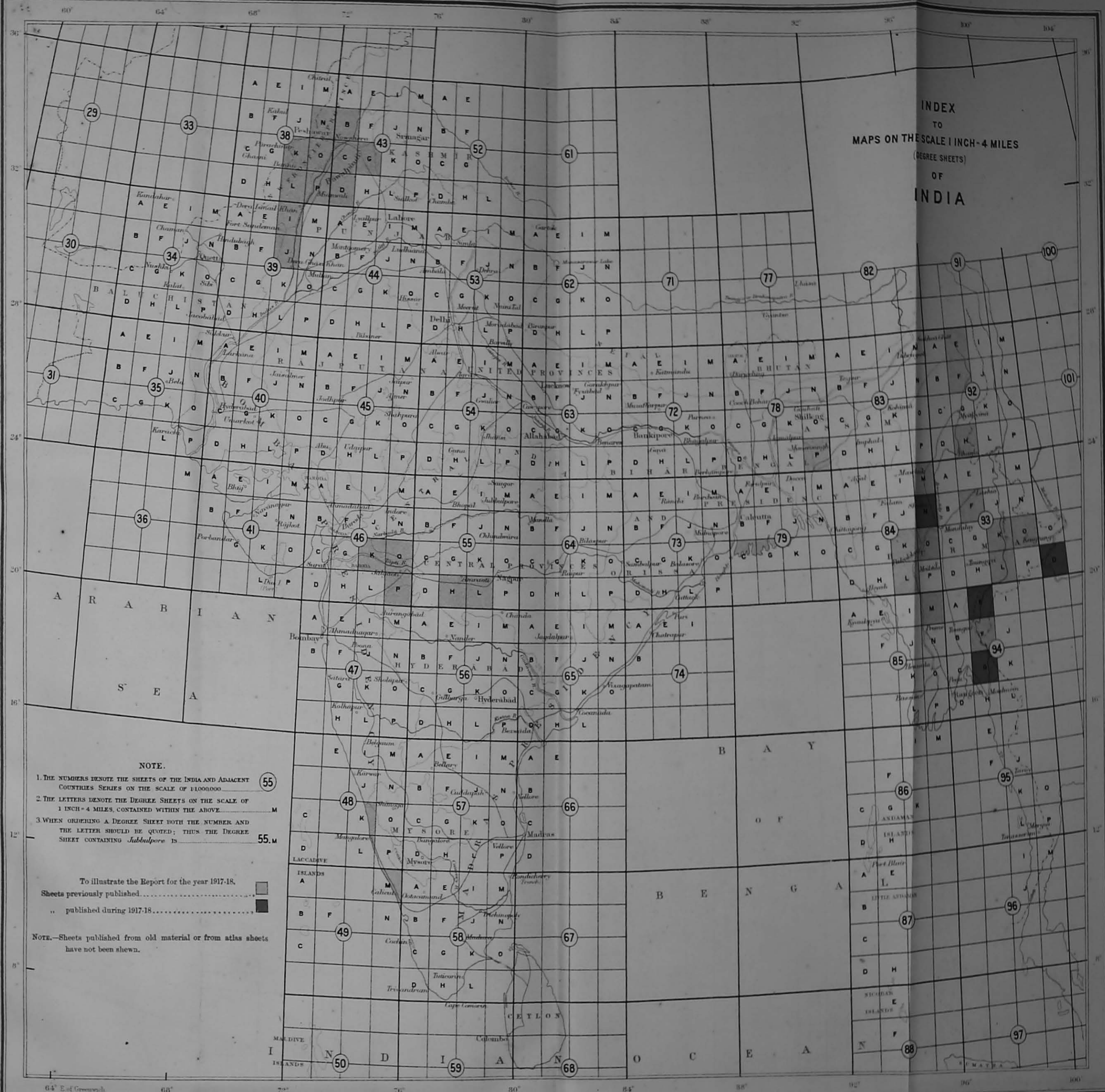


NOTE.—Sheets 94<sup>A</sup> N.W. and 94<sup>A</sup> S.E. were published during 1917-18, and not sheets 93<sup>D</sup> S.W. and 94<sup>A</sup> N.E. as shown on this Index.



**HALF INCH SERIES**

INDEX  
TO  
MAPS ON THE SCALE 1 INCH = 4 MILES  
(DEGREE SHEETS)  
OF  
INDIA



NOTE.

- 1. THE NUMBERS DENOTE THE SHEETS OF THE INDIA AND ADJACENT COUNTRIES SERIES ON THE SCALE OF 1:100,000
- 2. THE LETTERS DENOTE THE DEGREE SHEETS ON THE SCALE OF 1 INCH = 4 MILES, CONTAINED WITHIN THE ABOVE
- 3. WHEN ORDERING A DEGREE SHEET BOTH THE NUMBER AND THE LETTER SHOULD BE QUOTED; THUS THE DEGREE SHEET CONTAINING *Subulpoore* IS

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Sheets previously published.....

.. published during 1917-18.....

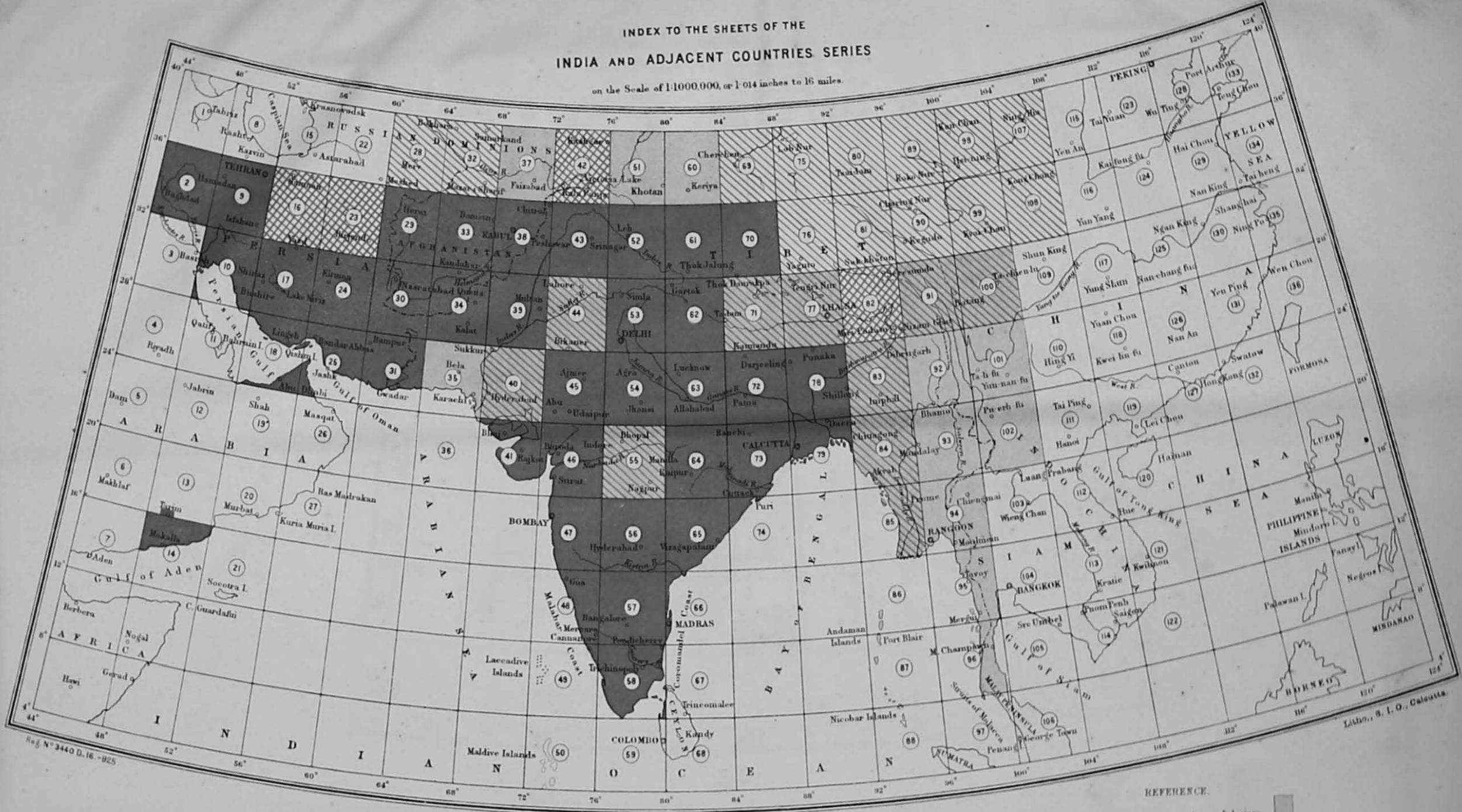
NOTE.—Sheets published from old material or from atlas sheets have not been shown.

**DEGREE SHEET SERIES**

Scale 1 Inch to 4 miles.

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

on the Scale of 1:1,000,000, or 1:014 inches to 16 miles.



Reg. N° 3440 D. 16 - 925

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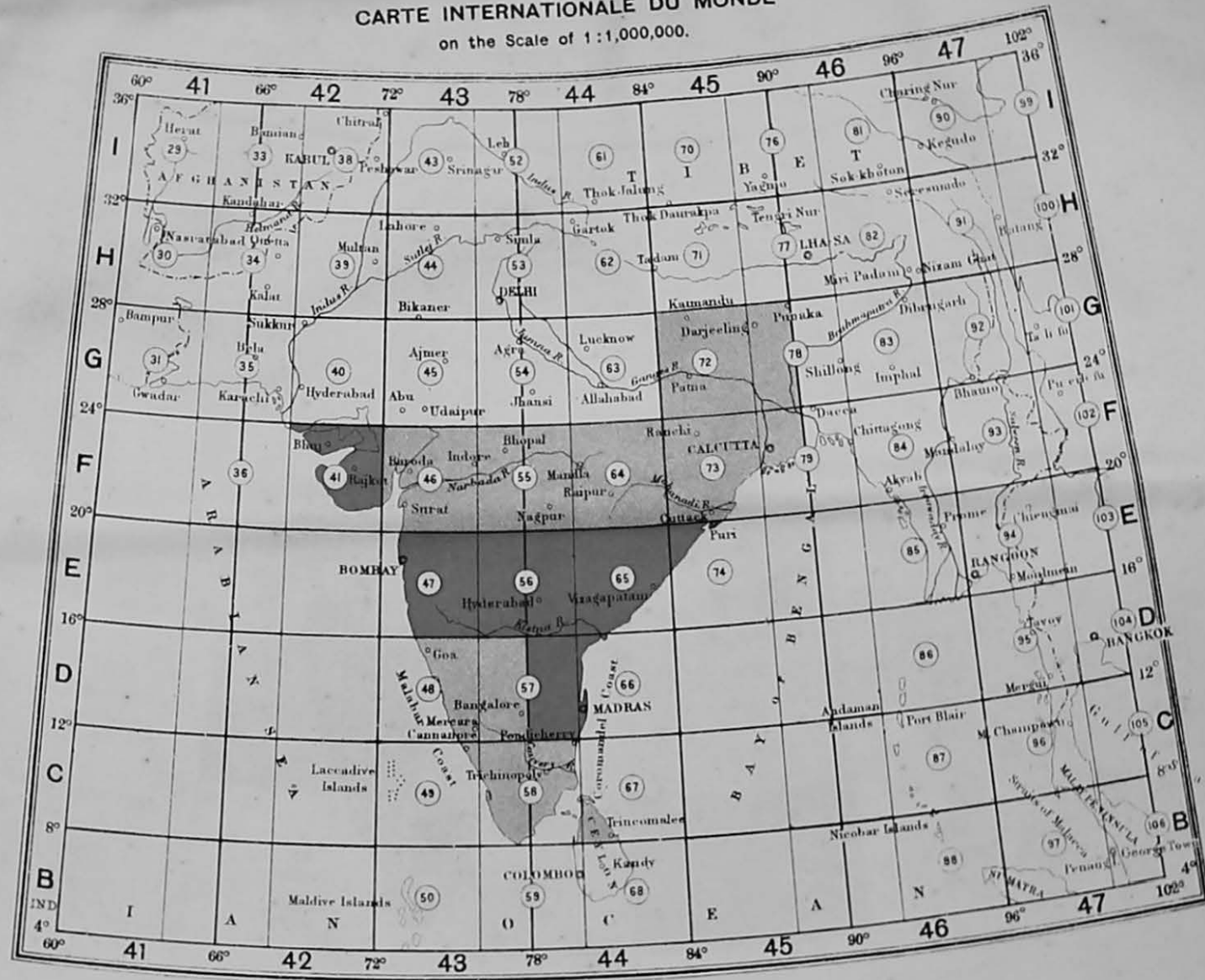
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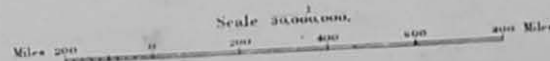
**Scale 1:1,000,000.**

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






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.

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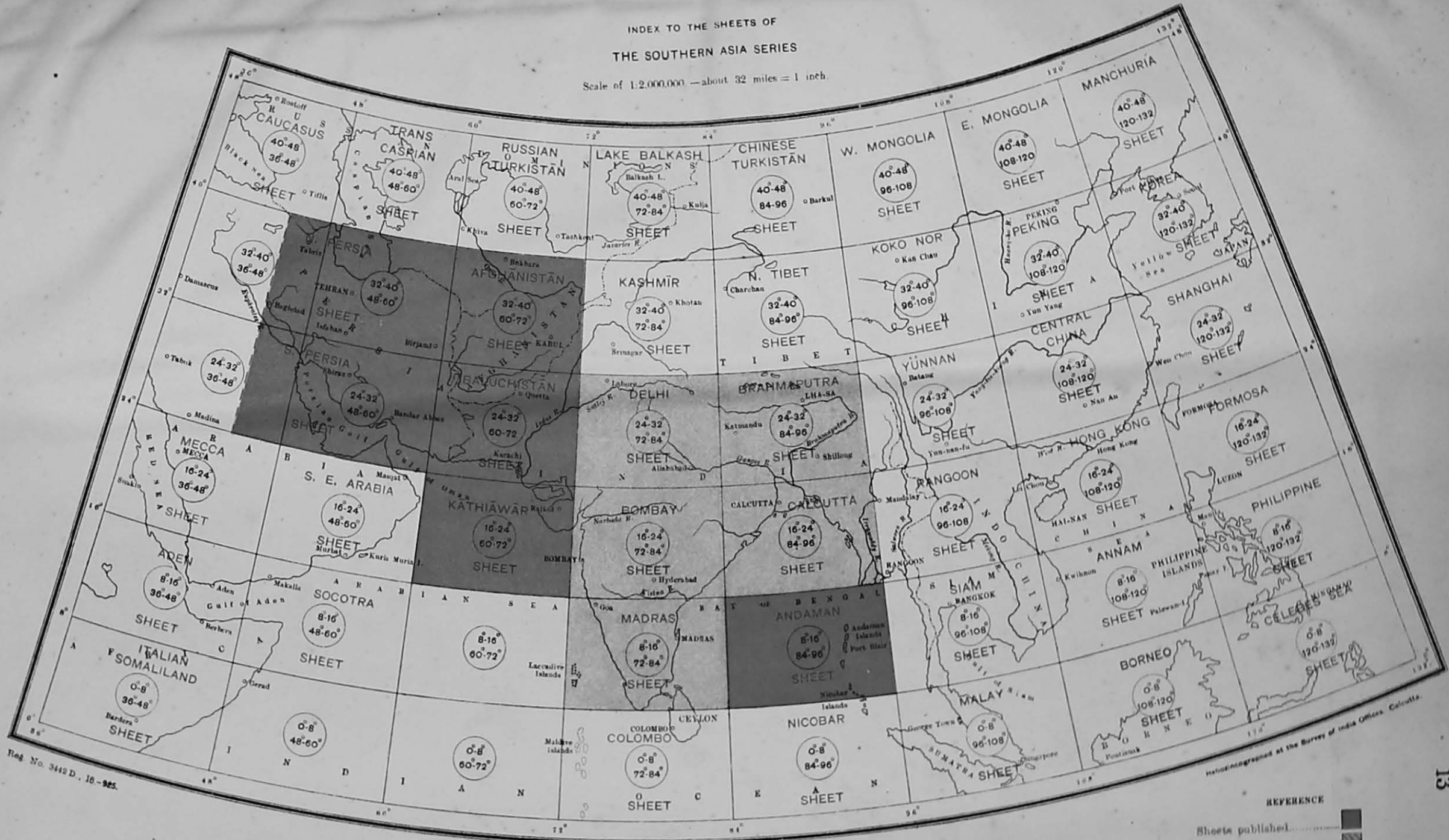


**INTERNATIONAL SERIES**

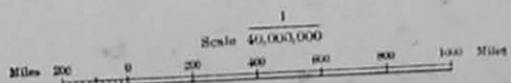
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