

Survey of India.
GENERAL REPORT,
1915-16.

From 1st October 1915
To 30th September 1916.



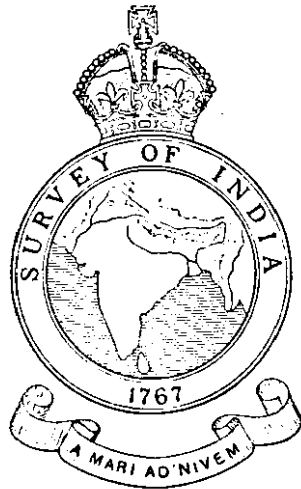
PREPARED UNDER THE DIRECTION OF
COLONEL SIR S. G. BARRARD, K.C.S.I., R.E., F.R.S.,
SURVEYOR GENERAL OF INDIA.

PRINTED AT THE PHOTO-LITHO. OFFICE, SURVEY OF INDIA,
CALCUTTA,
1917.

Price Two Rupees or Two Shillings and Eight Pence.

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PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, SURVEY OF INDIA,
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CALCUTTA.

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CONTENTS

		PAGE.	
PART 1.—GENERAL REMARKS—	I.—Introduction	1	
	II.—Administration and Personnel	3	
	TABLE I.—Disposition of Officers	5	
 PART 2.—WORK OF FIELD PARTIES, &c.—			
I.—TOPOGRAPHICAL SURVEYS	TABLE II.—Progress since 1905	9	
	TABLE III.—Out-turns and costs	10	
	Northern Circle	11	
	Southern Circle	12	
	Eastern Circle	13	
II.—FOREST SURVEYS.—	Northern Circle	15	
	Southern Circle	15	
	Eastern Circle	15	
III.—CANTONMENT AND LARGE-SCALE SURVEYS.—No. 1 Party	Cantonments	17	
	Punjab Riverain Detachment	18	
	Simla Survey Detachment	19	
	IV.—TRIGONOMETRICAL SURVEYS	Astronomical Latitudes	20
		Pendulum Observations	20
	Triangulation	20	
	Tidal Operations	20	
	Levelling	21	
	Base Lines	22	
	Magnetic Survey	22	
 PART 3.—OFFICE WORK—			
I.—HEAD QUARTER OFFICES	Map Publication Office	24	
	Map Record and Issue Office	26	
	No. 1 Drawing Office	27	
	Engraving Office	28	
	Photo.-Litho. Office	29	
	Mathematical Instrument Office	31	
	TABLE IV.—Publications during the year	32	
II.—DEHRA DŪN OFFICES.—	Trigonometrical Survey Office	33	
	No. 2 Drawing Office	34	
	Forest Map Office	36	
III.—CIRCLE AND LOCAL DRAWING OFFICES.—		37	
 PART 4.—WORK FOR OTHER GOVERNMENT DEPARTMENTS— 40			

INDEX MAPS (bound at end of Report).

1. Modern surveys and publication, Northern Circle.
2. " " " " Southern "
3. " " " " Eastern "
4. Publication of modern one-inch series, Northern Circle.
5. " " " " Southern "
6. " " " " Eastern "
7. " provisional editions of one-inch series, Northern Circle.
8. " " " " Eastern "
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13. " 'Southern Asia' series, scale $\frac{1}{2,000,000}$.
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1. The main parts of this report, as shewn 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 X 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 32,342 square miles; and that this brings the total progress since 1905 to 438,833 square miles, leaving 1,382,767 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 32 gives a list of the new publications of the Calcutta Offices during the year. A complete list of departmental publications apart from maps, may be found in the annual "Records 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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PART 1.—GENERAL REMARKS—	I.—Introduction	1
	II.—Administration and Personnel	3
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	Southern Circle	15
	Eastern Circle	15
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6. The following events are notified:—

- (a) Two more Imperial Officers have been reverted temporarily to military duty and the services of 2 more officers of the Provincial Service have been accepted by the Army Department during the year.
- (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 which accompanied the field-force in Mesopotamia continued survey operations there.
- (d) The superintendence of the Assam Provincial Surveys on its separation from the Bengal Surveys was taken over by the Survey of India as an experimental measure.
- (e) The control of the Magnetic Observatory at Kodaikānal was transferred from the Survey of India to the Meteorological Department.
- (f) The following instruments which are of historical interest but are no longer made use of in the Survey of India were presented to the Trustees of the Victoria Memorial, Calcutta, for exhibition in their Museum:—
 - (i) Troughton and Simms' Grand or 36-inch Theodolite. 1830-1873.
 - (ii) Waugh's 24-inch Theodolite No. 1. 1846.
 - (iii) Ramsden's Zenith Sector. 1802—1825.
- (g) Four plates and nine lithographic stones used in the production of the first stamps of India in 1854 were presented to the Royal Philatelic Society, London.
- (h) A new Population Map of India shewing the varying densities of the population by rectangular compartments was designed by Major E. A. Tandy, R.E.
- (i) A survey was made of the boundary of the Imperial area at Delhi.
- (j) The Hon'ble Sir James Meston, K.C.S.I., I.L.D., V.D., Lieutenant-Governor of the United Provinces visited the Survey of India Offices, Dehra Dūn on 14th July.
The Hon'ble Mr. Claude Hill, C.S.I., C.I.E., Member in charge Department of Revenue and Agriculture visited the Survey of India Offices, Dehra Dūn on 31st July.
The Hon'ble Mr. Mant, Secretary to the Government of India, Department of Revenue and Agriculture, visited the Survey of India Offices, Calcutta on 28th and 29th of January. He also visited the Survey of India Offices, Dehra Dūn on 27th and 28th March and on 31st July.

II.—ADMINISTRATION AND PERSONNEL.

7. The actual cost of the department for the financial year ending 31st March 1916 and of the 2 previous years is shown below:—

	1913-14.	1914-15.	1915-16.	REMARKS.
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>	
Gross actual cost ...	35,30,068	33,32,541	30,17,349*	
Deduct receipts and credits	9,35,982	9,48,397	8,47,459*	* These figures are not final.
Net actual cost ...	25,94,086	23,84,144	21,69,890*	

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 the following losses occurred:— Captains P. G. Huddleston, R.E., and J. A. Field, R.E., were killed in action on 25th March and 13th July respectively. Captains G. F. T. Oakes, R.E., and E. C. Baker, R.E., died on 15th July and 19th September respectively, from wounds received in action. Captain R. L. Almond, R.E., who had been reported as wounded and missing on or about 28th October 1914 was reported as having been killed on or about that date. Captain E. B. Cardew, R.E., was reported as wounded and missing on 26th September 1915. The total number of Imperial Officers temporarily reverted to military duty on account of the war is now 36 and the total casualties to date in killed, died of wounds or missing are now 7. Colonel W. J. Bythell, R.E., retired from the service on 23rd May 1916.

In the Provincial Service Mr. W. Skilling died on 9th October 1915, and Mr. T. Shaw, a retired officer who was re-employed on special duty in Assam, also died on 24th March 1916. Messrs. P. J. Barrington, and Kanak Singh retired; Mr. W. E. Johnson, who was employed under the Government of Burma and Mr. C. G. Lee, who was employed under the Government of Bengal also retired. Messrs. W. Newland and B. M. Berrill who are employed under the Government of Bombay are seconded in the Survey of India. Mr. O. J. H. Hart who was employed under the Government of Bengal has reverted to the Survey of India. The total number of officers of the Provincial Service whose services have been accepted by the Army Department is now 21. Out of these one has been killed in action and one has since reverted to the Survey of India.

In the Upper Subordinate Service 1 officer was discharged, 3 probationers were confirmed and 2 probationers were appointed, also 3 surveyors were promoted into this service from the Lower Subordinate Service.

Mr. R. Taylor, Manager, Photo. Section, Photo.-Litho. Office died on 11th October 1915. Senior Sub-Assistant Surgeon Thakur Singh, attached to the Trigonometrical Survey Office died on 14th May 1916. Mr. Hira Singh, Rai Sahib, Head Assistant, Trigonometrical Survey Office retired.

The total strength of the department at the close of the Survey year was 45 Imperial Officers, 120 Provincial Officers and 46 Upper Subordinates besides specialists, clerks, lower subordinates and menials; but the number of officers of the first two services actually employed in the department were 16 Imperial Officers and 101 Provincial Officers, the remainder being on military duty.

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

<i>To be Brevet Lieutenant-Colonel.</i> —	Major C. M. Browne, D.S.O., R.E.
<i>To be Companions of the Distinguished Service Order.</i> —	Captains S. W. S. Hamilton, R.E. and A. A. Chase, R.E.
<i>Military Cross.</i> —	Captain H. J. Couchman, R.E.
<i>Cross of "Chevalier de la legion d'honneur."</i> —	Brevet Lieut.-Colonel C. M. Browne, D.S.O., R.E.
<i>Mentioned in despatches.</i> —	Lieut.-Colonel F. W. Pirrie, I.A. (thrice mentioned).
	Major H. H. Turner, R.E.
	Brevet Lieut.-Colonel C. M. Browne, D.S.O., R.E. (twice mentioned).
	Captain E. B. Cardew, R.E.
	„ A. A. Chase, D.S.O., R.E.
	„ K. Mason, R.E.
	„ H. E. Roome, R.E.
	Surveyor Laltan Khan.
	„ Muhammad Khan.
<i>Insignia of "Officer of the Order of the Crown of Italy."</i> —	Major H. Wood, R.E.
<i>Kaisar-i-Hind Medal of the First Class.</i> —	Mr. F. R. Vandyke, Manager, Litho. Section, Photo.-Litho. Office, Calcutta,
<i>Kaisar-i-Hind Medal of the Second Class.</i> —	Mr. Sher Jang, Khan Bahadur, Sub-Assistant Superintendent, Upper Subordinate Service.
<i>Title of Rai Sahib.</i> —	Mr. Jamna Prasad, Sub-Assistant Superintendent, Upper Subordinate Service.
„ „	„ Ram Prasad, Sub-Assistant Superintendent, Upper Subordinate Service.
„ „	„ Ishan Chandra Deb, B.A., Head Computer, Trigonometrical Survey Office.

Mr. A. J. A. Drake, who is a member of the Mussoorie Volunteer Rifles and is employed on military duty, has been promoted to 2nd-Lieutenant in that corps and appointed a temporary Lieutenant in the Army.

Mr. J. C. St. C. Pollett, who is a member of the Bangalore Rifle Volunteers, has been promoted to 2nd-Lieutenant in that corps.

The medal for long service and good conduct was bestowed on Sub-Conductor W. Smith, (India Miscellaneous List), Draftsman, No. 6 Drawing Office, (Army Section).

The Volunteer Long Service Medal was bestowed on Messrs. H. W. Biggie, J. C. St. C. Pollett and R. C. Hanson.

11. The following table shows the distribution of officers during the year: the names of officers on deputation to local Governments are omitted. Several names occur more than once on account of transfers from one office to another:—

TABLE I—DISPOSITION OF OFFICERS, 1915-16.

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, &c.</i>
Surveyor General's Office.	Major C. P. Gunter, R.E. Major L. C. Thuillier, I.A.			
No. 6 Drawing Office, Simla.	Lieut.-Colonel C. L. Robertson, C.M.G., R.E. Major C. J. Arbery	Mr. Asmat-ullah Khan, E.S. " A. B. Hunter " A. A. Graham		*5 European Draftsmen. 4 Printers. 23 Indian Draftsmen and Clerks.
Basrah Survey Party	Lieut.-Colonel F. W. Pirrie, I.A. Major H. H. Turner, R.E. Captain W. E. Perry, R.E.	Mr. J. McCracken " B. T. Wyatt " W. H. Strong " A. J. Booth	Mr. Hamid Gul	22 Surveyors, &c.
SUPERINTENDENT, MAP PUBLICATION— { Lieut.-Colonel W. M. Coldstream, R.E. (Temporarily reverted to military duty). Lieut.-Colonel C. H. D. Ryder, C.I.E., D.S.O., R.E.				
	<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &c.</i>
Map Publication Office, Calcutta.		Mr. M. Gastaud		
No. 1 Drawing Office, Map Record and Issue Office and Engraving Office, Calcutta.	Major H. L. Crosthwait, R.E.	Mr. T. W. Babonau " P. Williams " M. C. Petters " Jagdamba Prasad " C. C. Byrne " A. C. Bose " P. Simpson " P. N. Sur " D. K. Rennick " A. A. Graham " Jiya Lal Sahgal		
Photo.-Litho. Office, Calcutta.	Major H. McC. Cowie, R.E.			
Mathematical Instrument Office, Calcutta.	Mr. T. A. Ferrier			
Bengal & Bihar & Orissa Drawing Office, (Imperial Standard Mapping Section).		Mr. E. G. Hardinge		
SUPERINTENDENT, NORTHERN CIRCLE— { Colonel W. J. Bythell, R.E., up to 22nd November 1915. Lieut.-Colonel C. L. Robertson, C.M.G., R.E., from 23rd November 1915.				
	<i>Imperial Officers.</i>	<i>Provincial Officers.</i>	<i>Upper Subordinates.</i>	<i>Lower Subordinates, &c.</i>
No. 3 Drawing Office, Mussoorie.		Mr. J. A. Freeman " E. B. West		26 Draftsmen, &c.
No. 1 Party, Kashmir and N. W. F. P.	Major E. A. Tandy, R.E.	Mr. B. R. Hughes " G. J. S. Rae " P. A. T. Kenny " R. C. Hanson	Mr. Sher Jang, K.B. " Natha Singh, R.S. " Nanak Chand Puri, B.A. " Jamna Prasad, R.S. " Hamid Gul " Jagdeesh Prasad Vastav—Under training.	38 Surveyors, &c.
No. 2 Party, Punjab and Rajputana.		Mr. B. R. Hughes " T. W. Babonau " F. B. Powell " Kanak Singh (Retired 21st March 1916) " R. E. Saubolle " J. H. Johnson " J. A. Calvert	Mr. Chuni Lal Kapur " Ghulam Hasan—Under training.	30 Surveyors, &c.
No. 3 Party, United Provinces.		Mr. H. H. B. Hanby " E. J. Biggie " A. M. Talati " H. T. Hughes " G. E. R. Cooper " Moqimuddin	Mr. Mahomed Lutf Ali " Muhammad Husain " Amir Abdul Salam Matlub Ahmad—Under training.	53 Surveyors, &c.
No. 4 Party, United Provinces and Nepal.		Mr. H. W. Biggie " H. P. D. Morton " J. C. C. Lears " Duni Chand Puri	Mr. Mohammad Husain Khan " Daulat Ram Vohra—Under training.	28 Surveyors, &c.
No. 20 Party, Peshawar, Rawalpindi, Bakloh, Jullundur, Sanawar, Simla, (N. I. Lines), Kalka, Fort Lockhart, Hangu, Thal, Bannu, Jhelum, Sialkot, Upper and Lower Topa, Chaman and Nimach.		Mr. A. Ewing " O. D. Jackson	Mr. Dharmu	23 Surveyors, &c.
Riverain Detachment, Punjab.		Mr. Maya Das Puri, B.S.	Mr. Paras Ram " Lakshmi Dutt Joshi " Vidya Dhor Chopra	74 Surveyors, &c. 6 Naib Tahsildars and Kanungoes, &c.
Simla Survey Detachment, Simla.		Mr. C. E. C. French " F. C. Saint	Mr. Imam Din " Jagdeesh Prasad Vastav " Ghulam Hasan " Amir Abdul Salam Matlub Ahmad " Daulat Ram Vohra	7 Surveyors. Under training.

* Includes Army Section.

TABLE I—(Continued).—DISPOSITION OF OFFICERS, 1915-16.

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 " P. R. Anderson		Mr. B. V. Narayana Rao	36 Draftsmen, &c.
No. 5 Party, Bevár, Central India and Central Provinces.		Mr. J. O'B. Donaghey " F. C. Pilcher		Mr. Damodar Khadilkar	19 Surveyors, &c.
No. 6 Party, Bombay and Hydrabad.	Major L. C. Thuillier, I.A.	Mr. P. R. Anderson " P. Kenney " E. A. Meyer " Haji Abdul Rahim, K.B. " F. B. Kitchen " Munshi Lal, B.A. " M. S. Ganesa Aiyar " J. C. St. C. Pollett " K. S. Gopalachari, B.A.		Mr. Eknath Battu " Ram Narayan Hastir " Nabadad Khan " Masud Khan	41 Surveyors, &c.
No. 7 Party, Madras.		Mr. W. M. Gorman " S. F. Norman " H. B. Simons " V. W. Morton " C. West " H. H. P. Butterfield " N. S. Haribara Iyer		Mr. Abdul Hakk, K.S. " Kodandera Maudanna " P. S. Vengasvami " Shib Lal " H. Narasimhamurti Rao " Shaikh Muhammad Salik " E. N. Natesan, B.A. " Pullu Behari Roy " Jitendra Mohan Mukerji	40 Surveyors, &c.
No. 8 Party, Madras.		Mr. W. F. E. Adams " M. Mahadeva Mudaliar, M.A.		Mr. Anantarao Dhondiba Mundhre, R.S. " K. Narayanasvami Chetti	27 Surveyors, &c.
Training Section, Mysore.		Mr. S. S. McA'F. Fielding		Mr. Hari Ram Chandra Jogalekar " G. K. Narasimha Ayyangar " K. R. Venkata Rao	20 Surveyors, &c. and Pupils. } Under training.
SUPERINTENDENT, EASTERN CIRCLE }—Lieut.-Colonel R. T. Crichton, C.I.E., I.A.		Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinates, &c.
No. 5 Drawing Office, Shillong.		Mr. P. J. Barrington, Retired 3rd July 1916 " J. H. S. Wilson " E. Claudius			22 Draftsmen, &c.
No. 9 Party, Bengal.		Mr. J. Smith " Dhani Ram Verma " E. M. Kenny " Amur Krishna Mitra		Mr. Dalbir Rai " Ram Singh " Amulya Charan Ghosh " Gopal Lal Mitra	26 Surveyors, &c. } Under training.
No. 10 Party, Upper Burma.	Major E. T. Rich, R.E.	Mr. W. G. Jarbo " H. B. Simons " A. V. Dickson " A. F. Murphy " Dharendra Nath Banerjee, L.C.E.		Mr. Hayat Muhammad, K.S. " Maung Kyaw Nyein " Dharendra Nath Saha " Ram Prasad, R.S.	27 Surveyors, &c.
No. 11 Party, Upper and Lower Burma.		Mr. J. O. Greiff " O. J. H. Hart " C. O. Picard " A. J. Moore		Mr. Lachman Daji Jadu, R.B. " Pratul Chandra Sen Gupta, B.Sc.—Under training.	28 Surveyors, &c.
No. 12 Party, Assam.	Lieut.-Colonel A. Mears, I.A.	Mr. Pramadarajan Ray, R.S. " B. C. Newland " Prafulla Chandra Mitra, B.A. " H. H. Creed		Mr. Girija Sonker Bagchi Under training.	42 Surveyors, &c.

TABLE I—(Concluded).—DISPOSITION OF OFFICERS, 1915-16.

SUPERINTENDENT OF THE TRIGONOMETRICAL SURVEY }—Colonel G. P. Lenox-Conyngham, R.E.		Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinates, &c.
Superintendent's Office.	(Attached) Colonel R. A. Wauhope, C.B., C.M.G., C.I.E., R.E.		Mr. H. A. Charrier		
Computing Office .	Mr. J. deGraaff Hunter, M.A.	Mr. Hanuman Prasad	Mr. Sarat Kumar Mukerji..... " Karuna Kumar Das, B.A.		63 Computers, &c.
No. 2 Drawing Office and Forest Map Office, Dehra Dun.	Major G. A. Beazeley, R.E.	Mr. T. W. Babonau	Mr. Lal Singh, R.B. " Ram Singh, R.S. " Janna Prasad, R.S.		
		" O. C. Ollenbach " C. C. Byrne " H. C. W. Stotesbury " O. N. Pushong " F. C. Saint " Abdul Karim, B.A.			
No. 13 Party,..... (Astronomical).	Colonel G. P. Lenox-Conyngham, R.E. Major H. H. Turner, R.E. Major G. A. Beazeley, R.E.				2 Computers, &c.
No. 14 Party,..... (Pendulums).	Colonel G. P. Lenox-Conyngham, R.E.				2 Computers, &c.
No. 15 Party,..... (Triangulation).	Mr. J. deGraaff Hunter, M.A....	Mr. L. Williams..... " G. A. Norman	Mr. Jugal Behari Lal.....		16 Computers, &c.
No. 16 Party,..... (Tidal).		Mr. H. G. Shaw			20 Computers, &c.
		" Syed Aulad Hossein, K.B. " Syed Zille Hasnain			
No. 17 Party,..... (Levelling).		Mr. H. G. Shaw	Mr. Karuna Kumar Das, B.A. ... " Satish Chandra Mukharji		11 Recorders, &c.
		" D. H. Luxa " T. F. Kitchen " Jijn Lai Sahgal " N. N. Chuckerbutty, L.C.E.			
No. 18 Party, (Magnetic).		Mr. E. C. J. Bond	Mr. Bidhu Bhusan Shome		3 Magnetic Ob- servers. 14 Computers, &c.
		" Ramu Prasad Ray, B.A. " N. R. Mazumdar " Raj Bahadur Mathur, B.A.			
No. 19 Party,..... (Base Line).		Mr. Syed Aulad Hossein, K.B. " E. C. J. Bond " O. N. Pushong			2 Computers, &c.
Exploration In Central Asia with Sir Aurel Stein.			Mr. Lal Singh, R.B.		1 Surveyor.

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

	<i>Page.</i>
I.—TOPOGRAPHICAL SURVEYS	—Table II, progress since 1905 ... 9 Table III, out-turns and costs ... 10 Northern Circle 11 Southern Circle 12 Eastern Circle 13
II.—FOREST SURVEYS	—Northern Circle 15 Southern Circle 15 Eastern Circle 15
III.—CANTONMENT AND LARGE-SCALE SURVEYS	—No. 1 Party 17 Cantonments 17 Punjab Riverain Detachment ... 18 Simla Survey Detachment ... 19
IV.—TRIGONOMETRICAL SURVEYS	—Astronomical Latitudes 20 Pendulum Observations 20 Triangulation 20 Tidal Operations 20 Levelling 21 Base Line Operations 22 Magnetic Survey 22

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 shewn 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 620,000 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
Total Areas completed to date ...		195,910	131,648	111,275	438,833
Approximate areas for the whole topographical programme.		750,000	542,800	528,800	1,821,600
Approximate areas remaining for survey.		554,090	411,152	417,525	1,382,767

Table III.—OUT-TURNS and COSTS of Topographical Surveys, 1915-16.

PARTY and LOCALITY. Character of Country. Scale and Class of Survey.		OUT-TURNS.		COST OF SURVEY AND MAPPING.		REMARKS.	
		Areas on each Scale.	Totals on all Scales.	Total costs.	Cost-rates.		
		Sq. miles.		Rs.	Rs. per sq. mile.	NORTHERN CIRCLE.	
No. 1 Party—Kashmīr, Jammu and North-West Frontier Province.							
Open, partly cultivated, plain and barren hills.	4-inch Military Survey ...	64	703	69,416 (a)	18·7	(a) Excludes Rs. 841 for Bikaner traverse and Rs. 619 for Tharoch Forest Survey or a total of Rs. 1,460 which will be recovered from the States concerned and refunded.	
Wooded valleys and mountainous and rugged hills.	1-inch Survey ...	588					
Ditto ditto	1/2-inch Revision Survey ...	51					
No. 2 Party—Punjab and Rājputāna.							
Sand hills with occasional rocky outcrops.	1-inch Survey ...	1,602	2,645	62,944 (b)	18·6		(b) Excludes Rs. 445 on account of cost of survey and mapping done for the Executive Engineer, Lower Bari Doab Canal, Balloke (Punjab), which will be refunded.
Ditto ditto	1-inch Revision Survey ...	1,043					
No. 3 Party—United Provinces.							
Open and wooded plains and wooded hills.	1-inch Revision Survey ...	2,152	3,088	1,10,334 (c)	32·2		(c) Includes Rs. 32,714 on account of cost of forest survey debitable to Rāmānagar and Kumaun Forests, United Provinces.
Wooded hills	2-inch Survey ...	391					
Ditto	4-inch Special Forest Survey ...	50					
Wooded hills and wooded plains	4-inch Supplementary Special Forest Survey.	495					
No. 4 Party—United Provinces and Nepāl.							
Densely forest-clad hills and fairly open plains.	1-inch Survey ...	130	1,732	51,010	16·8		
Fairly open plains	1-inch Resurvey ...	800					
Ditto	1-inch Revision Survey ...	802					
TOTALS, NORTHERN CIRCLE:—		8,168 sq. m.		Rs. 2,93,704	Cost-rate 21·6		
		Sq. miles.		Rs.	Rs. per sq. mile.	SOUTHERN CIRCLE.	
No. 5 Party—Becār, Central India and Central Provinces.							
Forest-clad hills	2-inch Survey ...	64	64	15,259 (d)	238·4	(d) Excludes Rs. 15,420, cost of 1/2-inch mapping, but includes cost of triangulation.	
No. 6 Party—Bombay and Hyderabad.							
Varied, mostly undulating	1/2-inch Survey ...	9,886	11,177	1,31,724	11·8		
Ditto ditto	1-inch Survey ...	1,261					
Rocky hills, wooded	1 1/2-inch Survey ...	30					
No. 7 Party—Madras.							
Rocky hills and cultivated plains	1-inch Survey ...	5,227	6,002	1,12,848	18·8		
Forest-clad hills	1-inch Supplementary Survey ...	715					
Wooded hills and Madras City	2-inch Survey ...	60					
No. 8 Party—Madras.							
		Nil.	Nil.	20,034 (e)	Infinity	(e) Excludes Rs. 20,615, cost of 1/2-inch mapping, but includes cost of triangulation.	
TOTALS, SOUTHERN CIRCLE:—		17,243 sq. m.		Rs. 2,79,865	Cost-rate 16·2		
		Sq. miles.		Rs.	Rs. per sq. mile.	EASTERN CIRCLE.	
No. 9 Party—Bengal.							
No. 10 Party—Upper Burma.						No detail survey was undertaken by this party.	
Mostly hilly and thickly wooded	1/2-inch Survey ...	300	2,857	1,54,892	54·2		
Ditto ditto	1-inch Survey ...	2,220					
Ditto ditto	1-inch Revision Survey ...	65					
Ditto ditto	1/2-inch Reconnaissance Survey ...	50					
Ditto ditto	2-inch Survey ...	222					
No. 11 Party—Upper and Lower Burma.							
Densely wooded hills and swamp vegetation.	1-inch Survey ...	1,382	1,795	1,22,697 (f)	68·3	(f) Excludes Rs. 15,394 on account of Maymyo Drawing Office but includes Rs. 18,296 for special forest survey debitable to Forest Department.	
High hills densely wooded	2-inch Survey ...	285					
Ditto ditto	4-inch Special Forest Survey ...	128					
No. 12 Party—Assam.							
Densely wooded hills and open high grass-covered plains.	1-inch Survey ...	1,805	2,279	1,32,761	58·3	(g) Includes 1·54 sq. miles of unreserved land.	
Densely wooded plains and hills	2-inch Survey ...	474 (g)					
TOTALS, EASTERN CIRCLE:—		6,931 sq. m.		Rs. 4,10,350	Cost-rate 59·2		
GRAND TOTALS:—		32,342 sq. m.		Rs. 9,83,919	Cost-rate 30·4		

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

13. No. 1 Party.—This Party surveyed an area of 639 square miles in the Udhampur district of Kashmir and Jammu State. Of this area, 588 square miles were of new survey on the 1-inch scale and 51 square miles were revision of the published Atlas sheets. The reduced area of survey is due to the curtailment of programme of field work.

The country surveyed varied from 5,000 to 18,000 feet in altitude and consisted of well wooded valleys, above which lay glaciers and, in places, inaccessible cliffs.

An area of 64 square miles was surveyed in the Peshāwar district, (*vide* page 17).

14. No. 2 Party.—This Party surveyed a total area of 2,645 square miles on the scale of one inch equal to one mile in the districts of Hissār, Rohtak and Gurgaon of the Punjab and in the States of Jind, Pataudi, Dujāna, Alwar, Bikaner, Jaipur, Lohāru, Nābha, and Patiala.

The country surveyed was undulating and was covered with sandhills and with occasional rocky outcrops.

In addition, triangulation and traversing of 1,260 square miles and 313 linear miles respectively were carried out for future half-inch detail survey in parts of Alwar, Bharatpur and Jaipur States.

The head-quarters of the party did not take the field.

15. No. 3 Party.—This Party surveyed an area of 3,088 square miles on all scales, in the Meerut, Bijnor, Morādābād, Almorā, Garhwāl and Naini Tāl districts of the United Provinces and Rāmpur State (Rohilkhand). Of the above area, 2,152 square miles were revision survey on the 1-inch scale, 391 square miles comprised a 2-inch survey of reserved forests and contiguous areas, and 50 square miles were a special 4-inch forest survey. For future special forest surveys on scale 4 inches to a mile, 260 square miles were triangulated, and 512 linear miles traversed in advance. 454 linear miles and 485 square miles were also traversed and triangulated respectively, in advance, for future 1-inch survey. A supplementary survey was also carried out over an area of 495 square miles, in the Rāmnagar Forest Division (Western Circle).

The southern half of the area surveyed is practically flat, except for the presence of a series of low sandy ridges; dense forest growth was met with along the foot-hills of southern Garhwāl, and in parts of the Kāshipur *tahsil* and Bhābar, of district Naini Tāl. The northern half consists of densely forest-clad and intricate hills, the greater part of which is reserved forests.

16. No. 4 Party.—Two detachments of this Party surveyed a total area of 1,732 square miles on the scale of 1 inch to 1 mile in the Azamgarh, Fyzābād, Gorakhpur, Bastī, Jaunpur, Sultānpur and Bahraich districts of the United Provinces, and in Nepāl State. The area in the United Provinces consists of flat plains which are well cultivated. Orchards containing mango trees are numerous, but there are no forests, though scrub growth occurs in some places. Village sites are numerous. The Gogrā river runs through a portion of the area that came under survey.

The area in Nepāl State, slightly over 100 square miles, lies in the *taraī* along the border of the Bahraich district, and consists of fairly open plains and low hills very densely clad on their lower slopes, the summits and upper slopes being covered in spear-grass.

In addition, an area of 107 square miles of triangulation was done in Nepāl to enable the detail survey to be carried out.

17. Recess Work.—Of the current and previous season's survey the fair mapping of 35 sheets for publication on the 1-inch scale and of 2 for publication on that of $\frac{1}{2}$ -inch, remain for completion on 30th September 1916; also that of 7 sheets of forest surveys for publication on the 2-inch scale.

Nos. 1, 2, 3 and 4 Parties have dealt during the year with 33 half-inch sheets drawn from published modern one-inch sheets, and of these, 7 sheets have been sent for publication. These numbers are additional to those of sheets dealt with, and sent for publication, by the Circle Drawing Office.

18. The cost-rates given in Table III against the parties of the Northern Circle have been based on detail survey and mapping of all kinds carried out during the year under report and on triangulation and traversing partly of previous seasons and partly of the current one. They have been swelled by the inclusion, in the expenditure of the parties, of the cost of carrying out the fair mapping of the Basrah Survey Party.

19. Particulars of further special work done by No. 2 Party is given on page 40, and of that done by No. 1 Party, No. 20 Party (Cantonment), the Punjab Riverain Detachment and the Simla Survey Detachment on pages 17 to 19.

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

20. No. 5 Party.—This Party surveyed an area of 64 square miles of reserved forests in the Buldana district of Berār and in the Nimār district of the Central Provinces, and triangulated an area of 3,853 square miles in the Bhopāl, Dhār and Indore States of Central India and in the Betūl, Hoshangābād and Nimār districts and the Makrai State of the Central Provinces. The country surveyed consists of wooded hills. The majority, including the head-quarters, of the party remained at Bangalore throughout the year and was principally employed on the fair-drawing of half-inch sheets compiled from one-inch maps.

21. No. 6 Party.—This Party surveyed an area of 11,177 square miles in the Ahmadnagar and Sholāpur districts of Bombay and in the Aurangābād, Bhīr, Bidar, Nānder, Nizāmābād, Osmānābād, and Parbhani districts of Hyderābād, and triangulated an area of 13,961 square miles in the Bijāpur and Sholāpur districts and the Akalkot State of Bombay and in the Atrāf-i-balda, Bidar, Gulbarga, Mahbūbnagar, Medak, Nalgonda and Osmānābād districts of Hyderābād. The country surveyed is of a varied nature, rising abruptly from the Godāvāri river into a range of rocky hills which slope away gently southwards to the well populated and undulating plains of the basins of the Bhīma and Mānjra rivers. The greater portion of the area surveyed is in Hyderābād and was mostly surveyed on the half-inch scale.

22. No. 7 Party.—This Party surveyed an area of 6,002 square miles in the Chingleput, Chittoor, Cuddapah, Madras, Nellore and North Arcot districts of Madras, and triangulated an area of 10,041 square miles in the Cuddapah, Guntūr, Kurnool and Nellore districts of Madras. The country surveyed includes portions of the Eastern Ghāts and of the cultivated plains of Madras along the sea coast. The confused hill system of the Eastern Ghāts consists of fairly high forest-clad hills, of lower rocky hills devoid of vegetation and of detached hills with low expanses of cultivation between them.

23. No. 8 Party.—This Party triangulated an area of 3,825 square miles in the Tinnevely and Rāmnād districts of Madras. The country triangulated was very flat and was intersected by a net work of bunds, dykes, supply channels and tanks, dense groves of trees surrounded many of the villages. The majority, including the head-quarters, of the party remained at Bangalore throughout the year and was principally employed on the fair-drawing of half-inch sheets compiled from one-inch maps.

24. Training Section.—This Section took the field in the Kolār district of Mysore. 19 pupil surveyors received instruction in topographical surveying.

25. Recess Work.—The whole of the area surveyed this year by the Southern Circle should be fair-drawn by the end of 1916.

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

26. No. 9 Party.—This Party traversed an area of 1,504 square miles in the Burdwān, Hooghly, Nadiā and Jessore districts in advance of detailed topographical survey. 2,707 points such as trees, temples, &c., were fixed by intersection with the theodolite from 1,589 stations along 682 linear miles of traverse. The traverse work was based on stations of the Calcutta Meridional Series of the Great Trigonometrical Survey. The country is flat and featureless except for the numerous *bils* and rivers that intersect it in all directions.

No detail survey was undertaken by the party during the year, but the greater portion of it was employed on half-inch mapping at Shillong.

27. No. 10 Party.—No. 10 Party surveyed an area of 2,857 square miles in the Kathā, Upper Chindwin, Myitkyinā and Putao districts of Upper Burma and the Tavoy and Mergui districts of Lower Burma, including 350 square miles in unadministered territory of which 50 square miles were reconnaissance survey, 2,000 square miles were triangulated in the Myitkyinā and Putao districts.

The country surveyed in Upper Burma consisted of thickly wooded hills rising over 4,000 feet above sea level and cut up by numerous low lying valleys.

In Lower Burma the country surveyed lay between the sea coast and the main range forming the western watershed of the Tenasserim river, together with a number of islands lying off the coast. It varied from the steep densely wooded hills along the Tenasserim watershed which were over 6,000 feet high, practically uninhabited, and with no communications, to the flat alluvial land covered with villages nearer the sea, whilst the sea coast was everywhere fringed with mangrove swamps.

28. No. 11 Party.—No. 11 Party surveyed, on the 1-inch scale, in the districts of Tavoy and Mergui, Lower Burma, an area of 1,312 square miles, specially required by the Burma Government, in connection with the Wolfram Mining Industry. 580 square miles were triangulated in the Mergui district. In the districts of Mandalay and Kyaukse, and the Northern Shan States, Upper Burma, an area of 483 square miles was surveyed. Of this area 70 square miles were surveyed on the 1-inch scale for the preparation of the Artillery Practice Camp Map, required by the General Staff, Burma Division: 285 square miles were of 2-inch survey, and 128 square miles special 4-inch scale survey, of reserved forests. The country surveyed varied in elevation from sea level in Mergui to 4,800 feet in Upper Burma, and was almost entirely covered with dense forest growth, and grass jungle, which made progress slow and difficult.

29. No. 12 Party.—No. 12 Party surveyed an area of 2,279 square miles on all scales in the Sibsāgar, Lakhimpur, Nāgā Hills and Darrang districts of Assam and carried out 884 linear miles of traversing. Of the above area 472 square miles comprised a 2-inch scale survey of reserved forests. The country under survey consists mainly of the alluvial plains of the Brahmaputra valley and a small portion of the Nāgā Hills which are densely wooded. In the plains considerable areas are devoted to the growing of tea and paddy; where not under cultivation the country is a mass of tree, cane and high grass jungle and is to a large extent flooded throughout the rainy season.

30. Recess work.—There were no arrears of mapping of the previous season's survey on 30th September 1916 but of the current season's survey 5 sheets remain to be completed as regards contours only.

Nos. 9 and 11 Parties have dealt with 49 half-inch sheets prepared from one-inch modern published sheets; 20 of these have been sent for publication. These numbers are additional to those being dealt with by the Circle Drawing Office. At the end of the year there were 39 sheets not yet taken up for which material (*i.e.*, modern published 1-inch sheets) is available.

II.—FOREST SURVEYS.

31. During the year 1915-16, the forest surveys have, as usual, been carried out by the topographical parties of the Survey of India. In the majority of cases the surveys were executed on the scale of 2 inches to the mile, but in some few instances the work was done on the 4-inch and 1-inch scales.

NORTHERN CIRCLE.

32. **Western Circle, United Provinces** (*Rāmnagar Forest Division*).—28 printed sheets of this division were revised, and roads, boundaries, &c., inserted; the area dealt with was 495 square miles.

33. **Kumaun Circle, United Provinces** (*Nainī Tāl District Forest Division*).—48·307 square miles of reserved forests were surveyed on the 4-inch scale, this area comprised the Kosi forest range and the Mahrora block of the China forest range. Latauli forest was also surveyed, for the Imperial Bacteriologist, on the 4-inch scale, area 1·4 square miles.

137 square miles were triangulated for future surveys on the 4-inch scale.

505 linear miles were traversed in connection with the Nainī Tāl district forests, for survey on the 4-inch scale.

(*Southern Garhwāl Division*).—158 square miles were surveyed on the 2-inch scale.

SOUTHERN CIRCLE.

34. **Central Provinces** (*Berār Circle*).—Five reserved forests, of a total area of 54 square miles, were surveyed on the 4-inch scale; a skeleton plane-table boundary survey of the outer boundaries, on the 4-inch scale, was also carried out.

The reserved forests surveyed are known as, Partabpur, Gogaipur and Jholpura-Dongarla, of the Nimār forest division, and Raipur block and Ambābārwa of the Buldāna forest division.

The detail and boundary surveys were carried out by plane-table interpolation and traversing, based on points fixed trigonometrically.

Trigonometrical heights were supplemented by heights obtained from observations taken with the clinometer.

35. **Madras Presidency**.—Seven reserved forests comprising a total area of 29·34 square miles were surveyed, on the 2-inch scale, by No. 7 Party, during the year. The names of the forests are as follows:—

Satyavedu and Ambakkam reserves in district Chingleput; Chittapāra Extensions A and E, B, C, and Basavāpalli Extension B, in Chittoor district; Thunakonda reserve in Cuddapah district.

Plane-table traversing was resorted to for main streams and forest boundaries, but interpolation based on trigonometrical points was obtainable everywhere.

EASTERN CIRCLE.

36. **Upper Burma** (*Northern Forest Circle*).—No. 10 Party surveyed the Indawgyi, Namma and part of the proposed Mokso reserves in the Myitkyinā division, and the Namaw and Nankobin reserves in the Mansi division, amounting to 222 square miles, on the 2-inch scale.

37. Upper Burma (*Southern Forest Circle*). (*Mandalay Division*).—No. 11 Party carried out the detail survey of the Baw and Baw Extension reserved forests on the special scale of 4 inches to the mile. The total area surveyed was 128 square miles, the cost, Rs. 18,296, is debitable to the Forest Department. In addition to the above, 116 square miles of survey on the 2-inch scale of the reserved forests of Taungbyo, Sakangyi, Zibingyi-Tonbo, Kywetnapa and Nyaungdauk, were carried out thus completing the survey of the forest areas round Maymyo and environs.

(*Meiktila Division*).—Detail survey on the 2-inch scale of a part of the reserved forest of Ye-amen, comprising an area of 169 square miles, was also undertaken; but the work was not completed owing to the party having to undertake special surveys in Mergui, in connection with the Wolfram Mining Industry.

(*Tenasserim Division*).—A total area of 128 square miles, in the reserved forests of Kaleinaung, Heinze and Panadaung, was surveyed on the 1-inch scale as part of the 1-inch programme of topographical surveys.

38. Assam.—No 12 Party carried out, in the course of ordinary topographical operations, the survey on the 2-inch scale of the Nāambar (balance), Rengmā, Diphu, Daiang (balance), Kākadangā, Desai Valley, Disai and Holongapar reserves, embracing an area of 472 square miles. In addition, in the Nāambar reserved forest, only that portion of the area thrown open for settlement (situated between the Horupani-Nāojān road and latitude $26^{\circ} 15' 0''$) was surveyed on the 1-inch scale, the Forest Department being of the opinion that this scale would meet all requirements.

The exterior artificial boundaries of the following reserves in the Sibsāgar and Lakhimpur districts, amounting to 128 linear miles, were traversed by theodolite on the 4-inch scale:—

Nāambar (part), Disai, Holongapar, Abhaipur, Panidihing, Droi and Dihingmukh.

The Sola reserved forest could not be traversed owing to a change in the position of its boundary which had not been demarcated, and the Jokai reserved forest was not traversed owing to bad weather.

39. Andaman Islands.—No forest surveys were carried out in the Andamans during the year under report.

III.—CANTONMENT AND LARGE-SCALE SURVEYS.

40. No. 1 Party.—During the year under report a detachment was employed on the survey of an area of 64 square miles on the scale of 4 inches to a mile near Shabkadar, in the Peshāwar district.

The country surveyed consisted of open, partly cultivated, plain, and barren hills.

The map was drawn in 3 sheets and was sent for publication.

The total cost was Rs. 11,486, and the cost-rate per square mile of survey and mapping was Rs. 179·5.

41. No. 20 Party (Cantonment).—During the year under report the Party was employed on the survey of the cantonments and military stations of Peshāwar, Rāwalpindi, Bakloh, Jullundur, Sanāwar, Simla (Native Infantry Lines), Kālka, Fort Lockhart, Hangu, Thal and Bannu on scale 16 inches to a mile; and on that of the bazars of Peshāwar, Rāwalpindi, Bakloh, Jullundur, and Bannu on scale 64 inches to a mile. The triangulation and traversing of Rāwalpindi, Fort Lockhart, Hangu and Thal was completed during the year; and Jhelum, Siālkot, Upper and Lower Topa, Chaman and Nīmach have been traversed in advance for season 1916-17.

Forty-two sheets of fair maps have been sent to Dehra Dūn for publication, and thirty are in hand, and will be completed and sent for publication by May 1917.

The proposed programme for the ensuing year is the completion of the detail survey of Rāwalpindi Cantonment and the execution of that of the cantonments and military stations of Jhelum, Siālkot, Topa, Drazinda, Jandola, Jatta, Zām Chitrāl, Upper Drosh and Lower Drosh, also the triangulation and traversing in advance of Nasirābād, Deoli and Jhānsi. There may be changes in the programme as it will be impossible to predict what the political condition will be on the Frontier when the survey of Chitrāl, Upper Drosh, Lower Drosh, Drazinda, Jandola, Jatta and Zām has to be done.

Out-turn and cost-rates of Cantonment Surveys, 1915-16.

Cantonments.	Scales.	Out-turn in acres.	Total cost. Rs.	Cost-rates per acre for survey and mapping. Rs.
Peshāwar, Rāwalpindi, Bakloh, Jullundur, Sanāwar, Kālka, Fort Lockhart, Hangu, Thal and Bannu ...	16"=1 mile	18,958	48,209·25	2·54
Peshāwar, Rāwalpindi, Bakloh, Jullundur and Bannu ...	64"=1 mile	343	4,809·00	14·02
Simla (Native Infantry Lines) ...	125 feet= 1 inch	1	467·00	467·00
		19,302	53,485·25	

Alphabetical List of Cantonments and Military Stations surveyed and published in modern style, on the scale of 16 inches = 1 mile, up to 1915-16.

- (1) Dehra Dūn Cantonment.
- (2) Guna do.
- (3) Hāpur (Babugarh) Remount Depôt.
- (4) Kālka Cantonment.
- (5) Kamptee do.
- (6) Landour do.
- (7) Meerut do.
- (8) Quetta do.
- (9) Quetta Civil Station.
- (10) Rājkot Cantonment.
- (11) Sahāranpur Remount Depôt.
- (12) Sanāwar Cantonment.
- (13) Saugor do.

42. The Punjab Riverain Detachment.—The Detachment continued the work of traversing, and laying down base lines. 155 linear, and 459 square miles of main circuits; and 751 linear, and 100 square miles of minor traverses were run; and 261 theodolite stations of the former and 4,170 of the latter, were fixed in the area under water action of the rivers Indus, Sutlej, Beās, and Chakki in Bahāwalpur State, and districts Dera Ghāzi Khān, Ambāla, Hoshiārpur, Kāngra, and Gurdāspur. 162 corners of 54 squares, and 48 traverse stations were demarcated in 100 square miles with permanent mark-stones on both banks of the Beās, and the Chakki in districts Kāngra, Hoshiārpur, and Gurdāspur to serve as bases for the future survey and demarcation of boundaries and fields in the bed of the rivers. 852 plotted, and 142 boundary *masāvis* (settlement mapping sheets) on the scales of $\frac{1}{2,280}$ (Ambāla), and $\frac{1}{2,300}$ (Kāngra), and 8 four-inch sheets were traced, and supplied in time to the Settlement Officers. Besides these 108 miscellaneous traces were prepared, and all the traverse stations marked during the year were plotted on 8 four-inch sheets. 504 *masāvis* of 106 *tikās* (sub villages) of districts Kāngra and Hoshiārpur were reduced with a pentagraph, 5 riverain boundary sheets were compiled, and 16 sheets typed on the scale 4 inches to a mile.

43. The Kāngra Special Survey was started on the 18th October 1915 under the usual conditions, in continuation of the last season's programme. 2,162 linear, and 300 square miles of the district area, were traversed, and triangulated; and 12,067 stations were fixed with theodolite in 575 *tikās* (sub villages). 3,542 plotted *masāvis* of 792 *tikās*, on the scales of 20, 40, and 80 *karams* (one *karam* = 57.5 inches) to an inch, and 17 traces on the scale of 4 inches to a mile, were supplied to the Settlement Officer, Kāngra. Besides these 56 miscellaneous traces were prepared, and all the traverse stations marked during the year were plotted on 22 four-inch sheets. The riverain work done in the Kāngra district on the Beās is given in para. 42.

44. The Simla work was commenced in the Kotgarh tract on the 2nd October, and was closed on the 30th November 1915. 1,066 linear, and 15 square miles were traversed, and triangulated; and 1,153 stations were fixed with theodolite. 256 plotted *masāvis* of 70 villages on the scale of 40 *karams* (one *karam* = 54 inches) to an inch, and 2 four-inch sheets were traced, and supplied to the Settlement Officer, Simla. Besides these 4 other miscellaneous sheets were prepared, and all the traverse stations marked during the year were plotted on one four-inch sheet.

45. At the special request of the Deputy Commissioner, Attock (Campbellpur) the *Khaur Special Survey* was taken up for the Attock Oil Company. Four adjoining squares, each of an area of 1 square mile, constituting the Government concession to the Company, were demarcated, and the contained area traversed and then surveyed in detail on the scale of 8 inches = 1 mile. The hills were sketched, and no regular contours were shown. The map was then traced, fair-drawn, and supplied to the Company within 3 months.

46. *The Kangra Road Survey* was carried on in continuation of the last year's programme with the object of avoiding boundary discrepancies as compared with the settlement maps. 41·6 miles of road, from mile No. 7 to mile No. 48·6, were surveyed. 556 points were fixed with theodolite, and 44 linear miles traversed. 63 sheets of the last year's work, and copies of the *khaskrās* (records of rights) were completed, and supplied to the Executive Engineer, Provincial Division, Kangra. The work surveyed this year is being plotted, and the sheets will be supplied to the Executive Engineer during the coming season.

47. With a view to test the area of grass land the *Lahore Cantonment Boundary Survey* was undertaken at the request of the Cantonment Magistrate, Lahore. In all 22 linear miles, containing 70 theodolite stations were traversed in 1,472 acres; and the boundaries of 8 plots of 1,190 acres surveyed. A trace of the map, on the scale 12 inches to a mile, showing the boundaries, areas, &c., was supplied to the Cantonment Magistrate, Lahore.

48. **Simla Survey Detachment.**—By the end of March 1916 the remnants of the field work had been completed, and the Detachment proceeded to Mussoorie to carry on the mapping. The fair drawings have been prepared with a view to the production of two separate sets of maps, to meet special and general requirements.

These are now nearing completion and it is hoped will be completed by the end of November 1916. The detachment will cease to exist from 12th October 1916.

Alphabetical List of Cantonments and Military Stations surveyed and published in modern style, on the scale of 16 inches = 1 mile, up to 1915-16.

- (1) Dehra Dūn Cantonment.
- (2) Guna do.
- (3) Hāpur (Babugarh) Remount Depôt.
- (4) Kālka Cantonment.
- (5) Kamptee do.
- (6) Landour do.
- (7) Meerut do.
- (8) Quetta do.
- (9) Quetta Civil Station.
- (10) Rājkot Cantonment.
- (11) Sahāranpur Remount Depôt.
- (12) Sanāwar Cantonment.
- (13) Saugor do.

42. The Punjab Riverain Detachment.—The Detachment continued the work of traversing, and laying down base lines. 155 linear, and 459 square miles of main circuits; and 751 linear, and 100 square miles of minor traverses were run; and 261 theodolite stations of the former and 4,170 of the latter, were fixed in the area under water action of the rivers Indus, Sutlej, Beās, and Chakki in Bahāwalpur State, and districts Dera Ghāzi Khān, Ambāla, Hoshiārpur, Kāngra, and Gurdāspur. 162 corners of 54 squares, and 48 traverse stations were demarcated in 100 square miles with permanent mark-stones on both banks of the Beās, and the Chakki in districts Kāngra, Hoshiārpur, and Gurdāspur to serve as bases for the future survey and demarcation of boundaries and fields in the bed of the rivers. 852 plotted, and 142 boundary *masāvis* (settlement mapping sheets) on the scales of $\frac{1}{2,250}$ (Ambāla), and $\frac{1}{2,300}$ (Kāngra), and 8 four-inch sheets were traced, and supplied in time to the Settlement Officers. Besides these 108 miscellaneous traces were prepared, and all the traverse stations marked during the year were plotted on 8 four-inch sheets. 504 *masāvis* of 106 *tikās* (sub villages) of districts Kāngra and Hoshiārpur were reduced with a pentagraph, 5 riverain boundary sheets were compiled, and 16 sheets typed on the scale 4 inches to a mile.

43. *The Kāngra Special Survey* was started on the 18th October 1915 under the usual conditions, in continuation of the last season's programme. 2,162 linear, and 300 square miles of the district area, were traversed, and triangulated; and 12,067 stations were fixed with theodolite in 575 *tikās* (sub villages). 3,542 plotted *masāvis* of 792 *tikās*, on the scales of 20, 40, and 80 *karams* (one *karam* = 57.5 inches) to an inch, and 17 traces on the scale of 4 inches to a mile, were supplied to the Settlement Officer, Kāngra. Besides these 56 miscellaneous traces were prepared, and all the traverse stations marked during the year were plotted on 22 four-inch sheets. The riverain work done in the Kāngra district on the Beās is given in para. 42.

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53. In the following table are given the annual and decadal percentages of errors in the predicted times and heights of high and low water at all the stations where observations have been taken 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.	Within 8 inches of actuals.	Within 1/10 of mean range at springs.	Within 15 minutes of actuals.	Within 8 inches of actuals.		Within 1/10 of mean range at springs.						
									H.W.—L.W.	H.W.—L.W.	H.W.—L.W.	H.W.—L.W.	H.W.—L.W.	H.W.—L.W.
1906	6	85	81	96	97	94	95	2	59	53	74	64	92	95
1907	6	84	83	98	98	98	99	2	58	47	78	60	96	90
1908	6	84	84	98	97	99	99	2	58	52	77	60	97	92
1909	6	85	86	97	97	97	98	3	61	59	69	65	93	92
1910	6	81	83	98	98	95	96	3	57	52	63	71	89	94
1911	6	84	84	98	99	97	98	3	65	51	68	66	90	90
1912	6	82	82	97	98	97	98	4	70	58	74	62	94	91
1913	6	83	82	97	97	98	99	4	68	55	70	58	94	88
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
Average of ten years	...	83	83	97	98	97	98	...	65	56	72	63	93	91

54. No. 17 Party.—*Levelling.*—Four detachments were employed on levelling operations during the past season.

The out-turn amounted to 828 miles including branch lines as detailed below. This includes 24 miles in Bahāwalpur State, 24 miles in Dholpur State and 53 miles in Gwalior State.

(a).—*In the Punjab.*

From Ambāla *via* Karnāl to Singhū along the Grand Trunk Road. This forms part of the line which was carried on to Delhi.

From Jhang *via* Fāzilka, Mandi Dabwāli, Sirsa, Hissār, and Rohtak to Bahādurgarh by road, crossing the Sutlej and Rāvi rivers en route. This line was carried on to Delhi.

The above lines traverse numerous canals and large irrigated tracts in this Province and will furnish additional data for irrigation and other purposes.

A branch line from Fāzilka to Amruka, which was continued to Sādikganj (Bahāwalpur State), was run in order to strengthen the connection of the Standard bench-mark at Sādikganj. The original connection made in 1909-10 was with one old bench-mark only. This was considered unsatisfactory, and was rejected.

(b).—*In the Delhi Province.*

From Singhū along the Grand Trunk Road to Delhi. This is part of the line which starts from Ambāla *via* Karnāl.

From Bahādurgarh to Delhi along the Rohtak-Delhi road. This line is a continuation of the portion from Jhang *via* Fāzilka, Hissār and Rohtak to Bahādurgarh

(c).—*In the United Provinces.*

Revision of the following lines:—

From Somna to Aligarh along the Grand Trunk Road and thence along the main road to Agra.

From Agra to the Bāngangā river. This line was carried on to Gwalior *via* Dholpur along the Agra-Bombay Trunk Road.

The above lines were originally levelled in 1861-62.

From Lucknow *via* Unao to Cawnpore by road. This line was originally levelled in 1868-69.

55. No. 19 Party.—Base Line Operations.—Owing to the deficiency of officers in the department, caused by the war, no Base Line work was undertaken during the year.

56. Traverse of the Boundary of the Imperial Delhi Area.—A small detachment was formed to run a traverse along the boundary of the Imperial Delhi Area, on the west side of the Jumna river. This was undertaken at the request of the Chief Engineer, Public Works Department, Delhi, for the accurate determination of the bearings and lengths of the 775 links into which the boundary, which is about 30 miles in length, is divided. In addition to this the 200 pillars which demarcate the thirteen unacquired portions of land termed "Islands" were connected to the traverse.

Before running the traverse a piece of triangulation, based on the side Pir Ghaib H. S.—Tal Katora h. s. of the Great Arc Meridional Series, was carried out for the purpose of fixing suitable points for the control of the traverse of the boundary and "Islands".

57. Work during recess season.—The detachment was employed during the recess season on the computation of the triangulation and traverse.

MAGNETIC SURVEY.

58. No. 18 Party.—Magnetic.—The three magnetic observatories, Dehra Dūn, Kodaikānal and Toungoo have continued in operation throughout the year.

The observatories were inspected by the officer in charge during the field season and a complete set of observations at each was taken by him for the yearly comparison of instruments. The Alibāg observatory was also visited for comparative observations.

59. Transfer of the Kodaikānal observatory.—It has been deemed advisable to place the Kodaikānal observatory under the control of the Meteorological Department, for a better supervision of the work of the observatory than is possible at so great a distance from the Survey Head Quarters at Dehra Dūn. With the approval of the Director General of Observatories and the sanction of the Government of India, the magnetic observatory and the observatory staff were transferred to the Meteorological Department on the 1st August 1916. The Director of the Kodaikānal observatory will continue to send the periodical returns of magnetic observations as usual, in original and duplicate, to the Officer in charge of No. 18 Party for the computation of the reduction of the observations and for record.

60. *Field work.*—Since the repeat stations of the Magnetic Survey will be visited for magnetic observations at intervals of 5 years only, no field observations were taken during the year. It was however, necessary for a detachment to proceed to Delhi to select a suitable site for a new repeat station, as the "Bela" land, on which the old site was situated, was being dug up under a scheme for grading the bank of the Jumna river. Comparative observations were taken by two observers at both the old and new sites, before the former was destroyed, to ensure a continuity of record for the determination of reliable secular change values for the locality.

61. *Work during recess season.*—The computation and tabulation of the Declination, Dip, Horizontal Force and Vertical Force for the three survey base stations (Dehra Dūn, Kodaikānal and Toungoo) for 1915 have been completed; the mean values of these elements for the year 1915 derived from all available days, excluding those of great disturbance, are given in the table below. From the beginning of 1915 the present values of the moments of inertia and the revised values of the distribution co-efficients have been used to determine the values of the Horizontal Force, consequently the values in these tables cannot be compared with the values published in previous years. Values, revised as above, for 1914 are included in the table below for comparison.

62. *Reduction of observations to epoch.*—The final reductions of the magnetic observations to the selected epoch have been proceeded with throughout the year and are making good progress. The reduction of the declinations at all field stations to that epoch is nearing completion and will it is expected be ready by the end of the year.

Mean values of the Magnetic Elements at Observatories.

Observatory.	Latitude & Longitude.	1915.				1914.	
		Dip.	Declina- tion.	Hori- zontal Force.	Vertical Force.	Hori- zontal Force.	Vertical Force.
	" " "	" " "	" " "	C. G. S.	C. G. S.	C. G. S.	C. G. S.
Dehra Dūn ...	{ 30 19 19 N 78 3 19 E }	N 44 30·6	E 2 15·5	·33083	·32522	·33134	·32427
Toungoo ...	{ 18 55 45 N 96 27 3 E }	N 23 7·2	W 0 3·1	·39005	·16653	·38965	·16621
Kodaikānal ...	{ 10 13 50 N 77 27 46 E }	N 4 17·0	W 1 22·8	·37614	·02817	·37604	·02753

PART 3.—OFFICE WORK.

I.—HEAD QUARTER OFFICES.

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

63. 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 one-millionth scale (about 1 inch to 16 miles).
- (e)—Geographical maps on the two-millionth scale (about 1 inch to 32 miles).
- (f)—General maps on small scales.
- (g)—Special maps.

64. (a) **Topographical maps on the scale of 1 inch to 1 mile.**—During the year 128 modern sheets have been received for publication and 204 have been published. The corresponding figures for the previous year being 207 and 154 respectively. The decrease in the former figure being due to smaller field outturn and the increase in the latter figure being due to the increased machine power now available.

Putting aside the sheets surveyed in Kashmir where the season of field survey differed from that in other parts of India, the one-inch maps of all areas surveyed up to 30th September 1914 have been published. Of the sheets surveyed up to 30th September 1915, 47 remain to be published.

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

Year.	NUMBER OF 1-INCH SHEETS PUBLISHED.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
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
Total Published ...	603	383	408	1,394
No. of 1-inch sheets which will not be published whose area is covered by published $\frac{1}{4}$ -inch sheets ...	...	14	...	14
Approximate number of 1-inch sheets in India ...	2,160	2,067	2,101	6,328
Approximate number remaining for publication ...	1,557	1,670	1,693	4,920

In addition to the above outturn of modern one-inch sheets, 26 sheets prepared from modern revenue surveys have been received for publication, and 27 published as preliminary editions pending their topographical revision at some future date (*vide* Index maps No. 7 and No. 8); special editions of 19 modern one-inch sheets have been published at the request of Local Governments to show village boundaries.

To maintain stocks or to give effect to important changes due to the development of communications, 27 modern one-inch and 43 old style sheets on various scales have been reprinted. The increase in the reprints of modern one-inch sheets is becoming marked, 6, 12, and 27 in the last three years; this increase will naturally continue and will add considerably to the work of the Photo.-Litho. Office.

65. (b) Topographical Maps on the scale of $\frac{1}{2}$ inch to 1 mile. (*Vide* Index map No. 9).—In addition to the areas which are being surveyed and published on the $\frac{1}{2}$ -inch scale, of which 4 sheets have been published this year making a total of 5 sheets, half-inch maps are also being prepared of all those areas already published on the 1-inch scale. 21 such sheets have been published and 60 are under publication, this branch of publication is therefore in full swing.

66. (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 $1^{\circ} \times 1^{\circ}$, or the area covered by 16 one-inch sheets.

The following table shows the progress made in publication:—

Years of Publication.	NUMBER OF DEGREE SHEETS PUBLISHED.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
1911-12	2	1	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
Totals	10	9	14	33
Approximate number of degree sheets in India	170	140	140	450

The number of these sheets received for publication has been much reduced since the introduction of the half-inch sheets. Pending the preparation of new degree sheets from modern surveys, 28 degree sheets have been published during the year as Provisional Issues; these are merely extracts from the engraved Atlas sheets, which will gradually be superseded, brought up to date as far as possible; consequently only 72 reprints of Atlas sheets were published during the year as compared to 137 in the previous year.

67. (d) Geographical Maps on the one-millionth scale, (about 16 miles to 1 inch). (*Vide* Index map No. 11).—During the year 6 new sheets of this series and engraved editions of three were published; the remainder should be published shortly. As the publication of this series has extended over many years, during which time constant improvements have been introduced, opportunity will be taken, when new editions are necessary, to make the whole series uniform, they can then be joined together when required or form a basis for Provincial maps. Several of these sheets are also being engraved.

68. (d) **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. F. 42 has been published during the year.

69. (e) **Geographical Maps on the two-millionth scale** (about 32 miles to 1 inch). (Vide Index map No. 13).—Two sheets, Kāthiāwār and Andamans, were published during the year and three are in hand.

70. (f) **General Maps on small scales.**—The Political edition of the Map of India and Adjacent Countries, scale 32 miles to 1 inch, in 12 sheets, was published and a commencement has been made with the hill shading for a shaded and layered edition.

The annual edition of the Railway Administration Map of India was published as usual. Two Provincial maps, Bihār and Orissa, and the Punjab, have made good progress.

71. (g) **Special maps.**—Many special maps, &c., have been prepared for the various departments of Government, both Imperial and Local, and for the General Staff.

72. The most noticeable features this year in the Map Publication Offices are:—

- (a) The large increase of pulls in the Photo.-Litho. Office, 33% over the previous record.
- (b) The steady and constant increase of maps issued by the Map Record and Issue Office.
- (c) The great increase in maps which are folded with stiffeners, with titles on the front and often indexes at the back, entailing a large increase of work.

73. **Map Record and Issue Office.**—The face value of maps received during the year under report, from the printing offices amounted to Rs. 4,89,206. This sum includes Rs. 5,344 and Rs. 59,494, the value of maps printed in the Engraving and Dehra Dūn Offices respectively.

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

The total number of maps issued from the Office during the year was 437,131 of an aggregate value of Rs. 2,17,853.

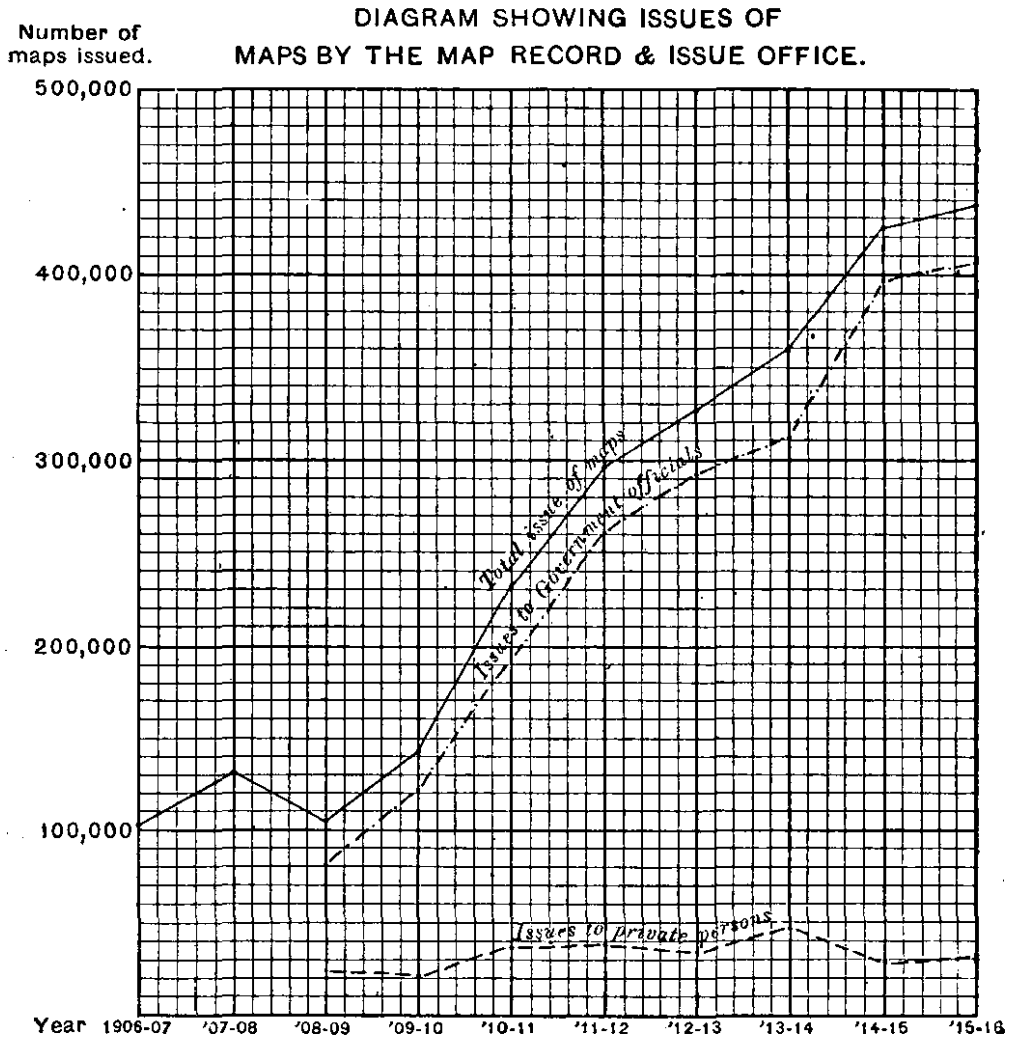
The details are as follows:—

	<i>Government Officials.</i>	<i>India Office.</i>	<i>Departmental Issues.</i>	<i>Private Individuals.</i>	<i>Map Agents.</i>	Totals for 1915-16.	<i>Totals for 1914-15.</i>
No. of maps	304,129	5,229	96,634	28,181	2,958	437,131	425,008
Value Rs.	1,10,660	6,835	74,554	23,077	2,727	2,17,853	1,78,958

The number of maps, covered by 1827 separate orders, supplied to the military authorities was 140,084 of an aggregate value of Rs. 79,652.

It may be noted, as showing the increased use to which the maps of India are being put, that in the Survey year 1906-07 the numbers issued by this office were 103,502 as compared with 437,131 issued last year, so that during the preceding ten years the numbers have increased more than four-fold. This increase is chiefly due to the larger number issued to Government officials which

last year totalled 405,992, while private persons, who in 1908-09 took 23,940 maps, only ordered 31,139 last year. From this it would appear that our maps do not receive the same appreciation from private individuals as from Government officials. The diagram below illustrates the figures for the last ten years:—



The building of the new racks for maps in one of the map store rooms, which was commenced during the year by the Mathematical Instrument Office, is practically complete and the racks will shortly be ready to accommodate a stock of 1,386 modern size sheets.

74. No. 1 (Head Quarters) Drawing Office.—Two sheets of the India and Adjacent Countries Series on the one-millionth scale were drawn and will be sent for publication shortly. Towns and village sites are now classified according to their administrative importance, and the style and size of the lettering of their names varies with their administrative importance and population. Four sheets which were published previous to this classification have been altered accordingly: one has been sent for reprint, and the remaining three should be completed by the middle of November 1916. Four other sheets of this series are in various stages of completion. The compilation and drawing of three sheets of the Southern Asia Series, two-millionth scale, are well advanced: one sheet should be ready for publication by the middle of next year.

The patterns of three sheets were prepared for the engraved edition of the one-millionth India and Adjacent Countries Series, and two are in hand. Two patterns of the one-millionth International Series, in which the values of heights and contours are in metres, were supplied to the Engraving Office, and the patterns of four other sheets are well advanced. The compilation of a large area for the four-millionth map of India, which is to supersede the present 64-mile map, has now been supplied to the Engraving Office.

The Mapping and Reprint Sections completed 20 degree sheets based on old atlas sheets, and 17 are in hand. These degree sheets are classed as "Provisional Issues" and printed in black. They have been brought up to date as regards railways, roads, canals, &c., from information supplied from extra-departmental sources. They will be eventually superseded by modern degree sheets in colours when the area comprising them comes under revision survey. The Provincial maps of the Punjab and Bihar and Orissa on the one-millionth scale were in hand the latter having been sent for publication, and that of Assam was brought up to date from the latest information available. These Provincial maps are in the same style as, and based on, the one-millionth sheets covering the same area. A Population Map of India, scale 180 miles to an inch, with surprint original to illustrate the co-operative credit statistics for 1914-15 was completed and published. The 32-mile Railway Station Map of India, which was last revised in 1912, has been corrected up to 31st March 1916. Patterns were supplied to the Engraving Office of the 32-mile map of India for the purpose of correcting the copper plates for the new edition of the political and layered editions of this map. The former was published during the year. The 64-mile map of India showing railways open and under construction was corrected up to March 1916. The originals of 127 maps on various scales have been brought up to date to supply reprints. In addition, a large number of maps drawn in circle offices and field parties have passed through the Drawing Office for minor corrections. A considerable number of special military orders were executed in this section.

Thirty-four sheets on various scales were stump-shaded and sent for printing, and 10 are in course of preparation.

Six maps of *the new half-inch series* were completed during the year. Four sheets in various stages of completion are expected to be ready for publication by March 1917.

The Office Copy Section continued to maintain a complete record of all alterations and additions since the date of survey that are brought to notice by the local authorities so that this information may be included in new editions of maps. Such additions and corrections have been carried out on 2,526 maps. Office copies of 746 new maps have been made during the year to record similar changes. In addition to this work the section had to deal with various questions regarding Revenue Survey maps. It also supplies copies of original records to Government officials and private individuals who may require them.

The Examining Section has dealt with 384 cases during the year in addition to a great deal of miscellaneous work.

75. Engraving Office.—In the course of the year under report three maps of the one-millionth India and Adjacent Countries Series and two International maps on the same scale were completed, and transfers from the engraved plates were supplied to the Photo.-Litho. Office. Six International and five one-millionth maps and one Degree sheet are in hand. Of these one International, three one-millionth and the Degree sheet are almost complete.

The engraving of the new map of India on a scale of one over four-million, which was referred to in last year's report, has made good progress. This map is in four sheets and as each of the sheets requires three copper plates for the black, blue and brown colours there are 12 plates involved.

During the year the periodic correction of the plates of the small scale maps of India and of Districts has been carried on. In this connection it was found necessary to engrave 3 new District plates owing to the redistribution of areas rendering the old maps obsolete. Also 2 new Index charts for the catalogue have been engraved.

All the plates of the 32-mile map of India used for the political and layered editions of this map have been revised and transfers supplied for reproduction.

The following maps were revised on the copper plates:—The Provincial map of Madras, scale one inch to 16 miles, Calcutta, scale 6 inches to 1 mile, 50 District maps, 34 Indexes and 24 Atlas of India sheets.

The revision of the latter was necessary before the sheets could be reprinted to replenish stock.

Among the miscellaneous work carried out may be mentioned the engraving of the table of Conventional Signs. The object in view being to improve, as much as possible, the patterns which draftsmen should follow in the drawing of original maps; it is considered this can be best achieved by engraving. A good deal of work was done in connection with the engraving of titles on photogravure plates which had been prepared in the Photo.-Litho. Office.

In the *Printing Section* of this office 23,656 impressions were made as against 30,872 last year. This decrease is due almost entirely to the fact that the Atlas sheets of India, which were formerly printed in this office are rapidly being replaced by the modern Degree Sheet Series, and the Provisional Issue Degree Sheets already referred to in the report of No. 1 Drawing Office. Of the impressions taken 8,215 were for extra-departmental orders, 1,165 Commission forms and 7,050 photogravures. A considerable numbers of engraved scales for various purposes were also printed.

In the *Steel Facing Section* 286 plates were treated.

76. Photo.-Litho. Office.—During 1915-16 there was a steady demand for maps for the use of Expeditionary Forces. This demand together with a large quantity of work required by departments other than the Survey of India resulted in a high outturn for the year.

The number of impressions pulled in the machine presses was 2,479,129 giving 735,999 finished maps and diagrams. From these figures it is seen that an average of between three and four printings has been required to produce each finished copy.

The corresponding figures for 1914-15 were 1,987,591 impressions and 730,917 copies. It will be noticed that, though the number of copies turned out in 1915-16 showed no large increase over the figure for the preceding year, yet the work that had to be done to produce that number of copies was much greater, the maps of 1914-15 having averaged between only two and three printings per sheet, a large proportion of the maps having been uncoloured. The highest monthly outturn was attained in January 1916, when 101,468 completed copies were produced.

Nine machine presses ran for the whole year and for a few months ten machines were working. The total machine power for the 12 months was 112 machine months as against 94 machine months for the previous year. There has thus been an increase of 19% in the utilised machine power. The tenth a Quad Crown by Mann & Co. was brought into use in March 1916.

During the year the office supplied one Double Elephant size hand press to the Expeditionary Forces. The remaining fifteen hand presses produced 19,656 proof impressions.

About 28% of the total outturn represented maps printed for the department while the remaining 72% was composed of work done for the Army and other departments.

The work done for the department includes 218 new and 23 reprint editions of modern style *one-inch maps* in colours. Preliminary editions of 31 sheets were printed in black or black and brown. This includes four sheets reprinted. Besides these 36 one-inch maps were reprinted in the old style. The total number of one-inch maps published during the year was thus 308. *Village Boundary editions* were printed of 19 modern one-inch sheets. Of the *new half-inch series*, 29 sheets were published in colours. No reprints have so far been issued of any sheets of this series. During the year 62 new quarter-inch *Degree sheets* were printed, 22 being Provisional editions. In addition 133 Degree sheets were reprinted either in colours or in black or black and brown. Reprint editions of 17 *Atlas of India sheets* were also published.

The *Negative and Retouching Sections of the Photo. Branch* have dealt with 3,784 and 4,112 negatives respectively, while the *Helio and Vandyke Sections* together turned out 5,333 plates.

In the matter of methods and processes, no great changes have been introduced but several modifications of existing methods have been effected. Mr. Vandyke has devoted himself to investigating the possibility of improving the printing and lasting qualities of the helio and to developing the methods of preparing tint and layer plates. The results of his work have been most successful and distinct improvements in the quality of the plates and the printed impressions have been attained.

The *Photo. Engraving Section* during the year prepared 20 photo-gravure plates, 531 half-tone blocks and 141 line blocks. From the half-tone and line blocks an aggregate of 980,593 impressions were pulled.

The *Type Printing Section* set up 5,383 pages of matter of which, in all, 1,143,075 copies were printed, 2,053,663 impressions being pulled.

Out-turn of Photo.-Litho. Office during 1915-16.

TABLE A.

1	2	3	4	5	6	7
Year.	Cost of office.	Value of out-turn at cost-rates.	Recovered in cash or by book-debit.	NUMBER OF MAPS PRINTED.		
				Departmental.	Other than Departmental.	Total.
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>			
1913-14	1,67,801	2,40,721	33,468	491	1,975	2,466
1914-15	1,56,515	2,81,146	36,847	597	2,168	2,765
1915-16	1,80,603	3,41,782	63,791	847	2,229	3,076

TABLE B.

1	2	3	4	5	6	7
Year.	Number of impressions pulled in Litho. Branch.	Number of half-tone impressions pulled.	Number of line-block impressions pulled.	TYPE SECTION OUT-TURN.		
				Pages or items published.	Copies printed.	Impressions pulled.
1913-14	2,286,845	35,710	875,000	6,403	1,203,242	2,132,159
1914-15	2,100,103	65,732	1,491,403	5,987	1,317,298	2,122,811
1915-16	2,975,149	86,373	894,220	5,383	1,143,075	2,053,663

77. **Mathematical Instrument Office.**—During the year from 1st April 1915 to 31st March 1916, there was a reduction 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 loss of Rs. 6,145 and Rs. 30,421 against a profit of Rs. 38,366 and Rs. 22,012 in the year 1914-15. The losses are however merely nominal, and are due to invoices for certain items of heavy work done in the Workshop and issued from the Serviceable Stores not having been drawn in 1915-16 but during the current official year, and hence the figures did not appear in the accounts for 1915-16.

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

	1913-14.	1914-15.	1915-16.
	Rs.	Rs.	Rs.
1. Total issues to Public Offices as shown in the Profit and Loss statements of stores.	4,07,802	4,16,642	2,51,818
2. Value of repairs to instruments received for repairs and returned in a serviceable condition.	56,418	66,793	52,535
3. Value of instruments received from Government Officers when no longer required.	69,806	50,924	54,411
4. Book value of the stock of instruments, &c., in Serviceable Stores.	4,73,470	5,06,865	5,68,631
5. Book value of the stock of instruments, &c., in Repairable Stores.	67,299	62,347	70,896
6. Total value of work done in the Workshop	2,40,752	2,44,054	1,96,704
7. Value of instruments manufactured in the Workshop for Serviceable Stores.	93,991	87,421	71,641
8. Value of instruments purchased locally	9,060	9,792	11,255
9. Value of instruments and materials obtained from England through the Director General of Stores.	89,213	2,78,380	1,69,073
10. Average No. of employees and their pay	No. 300 } Rs. 76,734 }	No. 317 } Rs. 80,917 }	No. 337 } Rs. 91,654 }

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

Table IV.—Departmental Publications, Calcutta, 1915-16.

Note.—For special publications at Dehra Dūn, *vide*, pages 33 to 37.

Class of Maps.	Scale.	NUMBER OF DIFFERENT MAPS OF EACH CLASS RECEIVED.		Number of copies printed.	Value.
		New Publications.	New Editions and Reprints.		
GEOGRAPHICAL MAPS.					
<i>Rs.</i>					
Maps of India	Various	3	4	1,820	8,530
Southern Asia Series	1:2,000,000	2	5	2,360	5,145
India and Adjacent Countries	1:1,000,000	5	4	7,805	7,805
Do. (International Series)	1:1,000,000	1	.....	300	300
TOPOGRAPHICAL MAPS.					
<i>DEGREE SHEET SERIES.</i>					
Modern	1"-4 miles	5	10	14,818	14,421
From Atlas material	Do.	28	23	15,169	15,019
<i>HALF-INCH SERIES.</i>					
Modern	1"-2 miles	25	.....	12,280	12,280
<i>ONE-INCH SERIES.</i>					
Modern	1"-1 mile	195	28	105,282	1,02,682
Do. (Preliminary Editions)	Do.	26	.....	13,000	12,250
Do. (Village Boundary Editions)	Do.	.....	19	1,900	3,800
Old Style Sheets	{ 1"-1 mile & 1"-4 miles }	.....	44	12,485	18,572
MISCELLANEOUS.					
Atlas of India Series	1"-4 miles	.....	72	8,585	8,967
Provincial Maps	Various	1	10	2,770	4,526
District Maps	1"-4 miles	.....	20	5,289	5,439
Administration Report Maps	{ 1"-8 miles to 1"-16 miles }	4	23	1,230	400
Plans of Cities and Cantonments	Various	9	3	924	5,756
Index Maps	Do.	20	26	25,038	5,584
Miscellaneous Maps	Do.	1,032	203	395,274	2,57,730
Totals for 1915-16 ... ..	.....	1,356	494	626,329	4,89,206
Corresponding totals for 1914-15 ... ..	.....	500	785	615,519	3,82,246

LETTERPRESS.

1. Survey of India. General Report, 1914-15. *Price Rs. 2.*
2. Records of the Survey of India, Volume VII, 1913-14. *Price Rs. 4.*
3. Do. do. do. IX, 1914-15. *Price Rs. 4.*

II.—*DEHRA DUN OFFICES.*

TRIGONOMETRICAL SURVEY OFFICE.

78. Computing Office.—The revisionary triangulation at the junction of the Burma Coast Series and the Manipur Meridional Series was completed in February 1916 by No. 15 Party and the adjustment of the Burma Quadrilateral, which was stopped pending the completion of the above, was resumed according to the new and short method referred to in the previous report. It is hoped that the adjustment will be finished in 1916, when it will be possible to proceed with the publication of the Burma triangulation pamphlets. The adjustment by the above method of the Ashta (No. 88), Naldrug (No. 90), Middle Godāvāri (No. 92), Rānchi (No. 83) and Sambalpur Meridional (No. 85) Series was effected.

The values of *M*, a criterion of the accuracy of triangulation, were revised; and the probable circuit errors of the five Indian Quadrilaterals computed and found to be in accordance with the actual errors.

Further computations in connection with Professional Paper No. 16, now in the press, were made during the year.

Computations of Dynamic and Orthometric heights of the following twelve lines of levelling were accomplished during the year:— Dacca to Mymensingh; Tindhāria to Darjeeling; Raichūr to Bāgalkot; Bareilly to Hāthras; Bareilly to Meerut; Ambāla to Meerut; Sargodha to Multān and Mahiwala; Solon to Simla; Ferozepore to Multān (Revised); Multān to Bahāwalpur; Jacobābād to Quetta; and Bellary to Gooty (Revised).

Elephant Point had hitherto been the levelling datum of the whole Burma Levelling, but a reconsideration of the results with two of the tidal observatories in Burma led to the adoption of Amherst as the level datum for Burma Levelling. This necessitated the recomputation and revision of all the Burma heights previously published, which were only provisional so far as the orthometric values were concerned. The orthometric reduction of the provisional values is now being effected, so that the resulting heights will not be modified for many years to come, probably not until a junction with the Indian Levelling is effected.

Graticule Tables, on the Modified Secant Conical and Polyconical Projection Systems, for Part I of the Auxiliary Tables, 5th Edition, (which is now in course of publication by parts) were computed and arranged.

A card index of the records has been begun and is nearly complete and all the records are now satisfactorily stored in suitable racks.

Data were supplied to ten departmental and non-departmental officers from the old manuscript records and in some cases such requisitions were met by a supply of printed data. A large number of requisitions for professional forms was attended to.

About 225 degree triangulation pamphlets in all were compiled and compared, 180 of them passed through press and 132 were distributed.

Addenda to Levelling Pamphlets Nos. 43, 47, 78 and 79; Five figure Tables of Log. Sines and Cosines; Auxiliary Tables, Part I (Graticule Tables), 5th Edition; Departmental Paper No. 7 and Record Volume VI were bound and distributed. Professional Paper No. 15, and Record Volume VIII in two parts, are in the hands of the binders and will shortly be out. A new stitching machine has greatly facilitated the work of the binding establishment.

The geodetic and astronomical observations of Rai Bahadur Lal Singh, Muhammad Yakub Khan and Muhammad Afraz Gul, who accompanied Sir A. Stein to Central Asia, were reduced.

79. Type Printing Office.—The following publications have been printed during the year :—

(1) Triangulation Pamphlets ...	...	180.
(2) Addendum to Levelling Pamphlet No. 39		
" " "		47
" " "		78
" " "		79

Levelling Pamphlet No. 34.

(3) Auxiliary Tables, Part I, 5th Edition.

(4) Professional Paper No. 16 pages 69—104.

80. Workshop.—A sensitive drilling machine has been received during the year. The integrator reported as under construction last year has been satisfactorily finished.

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

The Omori Seismograph has been working throughout the year. The local earthquake of 29th August 1916 dislocated it, so that no proper record was obtained. Other earthquakes were recorded.

Photographs of the sun have been taken on 339 days during the year, the sun being obscured on the remaining days.

82. Preservation of Trigonometrical Stations.—894 stations were repaired by the district officers at a cost of Rs. 4,653-2-1.

Out of 352 districts from which reports are annually due, 24 failed to make returns.

83. No. 2 (Dehra) Drawing Office.—During the year the work in this office was carried out by the following sections :—

- (a) Cantonment ;
- (b) Triangulation ;
- (c) Compilation and Half-inch ;
- (d) Miscellaneous.

A special section was also formed to deal with the mapping of the recent explorations by Sir A. Stein and Cavaliere de Filippi. This section was made up of draftsmen taken from the Half-inch and Cantonment sections, which were considerably reduced. A small section of draftsmen drawn from the Compilation section, was created to deal with the revision of the map of Arabia on the scale of 1 inch = 32 miles. This section was eventually taken over by Colonel Wauhope.

The following is a summary of the work of the office during the year 1915-16:—

Class of map.	Sheets sent to press.	Remaining in hand.	REMARKS.
Rough compilation of map of Tibet for publication on the scale of $\frac{1}{4,000,000}$...	3	1	Hill and skeleton.
Geographical maps, $\frac{1}{1,000,000}$ scale. (Fair sheets)	4	7	
Geographical maps, $\frac{1}{1,000,000}$ scale. (Rough compilation)		11	2 sheets for Southern Asia Series, scale $\frac{1}{2,000,000}$.
Miscellaneous Scientific diagrams and charts	6		
Preliminary degree triangulation charts ...	130	18	92 published.
Final degree triangulation charts ...	4	2	
Half-inch Series	9	9	Includes 4 sheets of Aden Survey.
Cantonment maps	• 74 Cantonments 196 Sheets.	47 Cantonments 108 Sheets.	• Completed and stored.
Explorers' route maps	12		
Index chart to the Great Trigonometrical Survey of India, $\frac{1}{3}$ million scale ...	4		
Levelling charts	3		
Regions between Leh and Karghalik mapped by Cavaliere de Filippi's expedition in 1913-15, for publication on the $\frac{1}{500,000}$ scale	2	Nil	Will be published in one sheet.
Sir Aurel Stein's exploration in Chinese Turkistān and Kansu in 1900-01, 1906-08, 1913-15, drawn on the scale of 6 miles to an inch for publication on the $\frac{1}{500,000}$ scale.		49	The compilation of these 49 sheets on the $\frac{1}{500,000}$ scale is completed and the fair mapping of ten sheets in hand.
Miscellaneous Extra-departmental maps ...		34	
Map of Arabia and Persian Gulf, scale 1 inch = 32 miles	4		

NOTE.—The following Index charts are in hand and copies will be available in January 1917.

- (1) Index to the Triangulation Degree Charts of India, scale 1 inch = 128 miles.
- (2) Index Chart to the Great Trigonometrical Survey of India, scale 1 inch = 96 miles.
- (3) India showing stations of observation of the Magnetic Survey, scale 1 inch = 96 miles.

(a) *Cantonment Section.*—The work in this section will in future be of rather a light nature as all the fair sheets have been brought up to date and there will only be the usual annual corrections to deal with.

(b) *Triangulation Section.*—The work of this section was greatly facilitated and expedited by Circular Order No. 185 (Professional) of the 22nd April 1915, which allowed of preliminary charts being prepared without reference to the Topographical Circles concerned.

(c) *Compilation Section.*—The compilation of the area allotted to No. 2 Drawing Office, viz:—Latitude 28° to 48° and Longitude 72° to 104°, has practically been completed on the 1 inch = 12 miles scale and will form the basis for the Himālayan map, and the maps of the $\frac{1}{1,000,000}$ and $\frac{1}{2,000,000}$ series.

(d) *Half-inch Section.*—In this section the work was hindered by the transfer of the section officer and by the removal of several draftsmen to form a section for the mapping of Sir A. Stein's explorations.

(e) The map of the de Filippi exploration, between Leh and Karghalik will be published in one sheet on the $\frac{1}{500,000}$ scale.

The new maps that are being drawn for Sir A. Stein will comprise his explorations during 1900-01, 1906--08 and 1913--15 and will be published in 49 sheets on the $\frac{1}{500,000}$ scale.

84. Photo.-Zinco. Section.—During the year 1915-16 the work undertaken comprised:—

- Forest maps;
- Cantonment maps;
- Triangulation charts;
- Levelling charts;
- Extra-departmental maps.

During the year under review a great number of degree sheets drawn in No. 6 Drawing Office have been reprinted for the Chief of the General Staff, Simla.

The following statement shows the work done in the Photo.-Zinco. Section for the past three years:—

Year.	No. of Subjects.	No. of Negatives.	No. of Pulls.	Chocolate and Cyanotype prints.
1913-14	2,046	2,376	244,140	1,695
1914-15	1,898	2,267	345,520	663
1915-16	2,065	1,717	307,357	1,209

One Graining and one Litho. machine have been received and are under erection.

The method of storing Register slips and proofs in the past was considered unsatisfactory and is now under revision.

85. Forest Map Office.—The total number of maps issued during the year, both to officials and the public, amounted to 9,107, a decrease of 8,848 on last year's total. The gross face value of these maps was Rs. 15,649, and the net amount realised from sales was Rs. 4,492, against Rs. 6,864 in the previous year. Of this amount, Rs. 3,252 was recovered by book-debit and Rs. 1,240 by cash from sales to private individuals and trading companies. The number of maps and field sections received for

storage during the year was 13,071, besides 24 computation volumes, traverse field books, and angle books, and 37 traverse charts and plot sheets.

The following table shows, in abstract form, the work dealt with by the office :—

Class of maps.	NUMBER OF SHEETS.		
	In hand.	Drawn and sent for publication.	Published.
1-inch, 2-inch and 4-inch maps of Forest Surveys	225	107	65
Special maps of India	...	...	2
Provincial, Divisional and District Forest maps	38	16	6
Working Plans and Miscellaneous maps	8	31	28
TOTALS	271	154	101

III.—CIRCLE AND LOCAL DRAWING OFFICES.

86. No. 3 Drawing Office (Northern Circle).—During the year 42 one-inch sheets previously surveyed and drawn by parties, and one other one-inch sheet brought up to date in the Drawing Office for reprinting, and not included in the above number, were submitted for publication.

The proofs and colour patterns of 64 sheets, including those of half-inch and quarter-inch sheets were prepared and returned to the Superintendent, Map Publication leaving a balance of colour patterns of 8 sheets still in hand.

Half-inch sheets compiled from modern one-inch and old style half-inch maps.—During the year 12 sheets were fair-drawn in the Drawing Office and parties of the Circle and submitted for publication.

On the basis of the one-inch sheets published up to 30th September 1916, there now remain for completion in the Northern Circle 139 half-inch sheets of the kind under consideration. Of this number, the fair-drawing of 34 sheets is in hand, and the material for the preparation of 20 more has been received.

The above numbers do not include 2 half-inch sheets in hand which are being drawn from original surveys on the half-inch scale; but do include the numbers dealt with under Part 2, Section I, page 12.

Quarter-inch sheets compiled from one-inch and half-inch maps.—During the year the fair-drawing of one sheet was completed and the sheet submitted for publication, leaving the fair-drawing of 5 sheets in hand and that of 3 sheets of which the component one-inch or half-inch sheets have been published, yet to be put in hand.

The layer guide of 38 O was prepared and submitted for the layered edition of this sheet.

Miscellaneous.—During the year the traverse plots of stations of 13 *mauzas* consisting of 24 sheets, scales 16 and 32 inches to a mile, of Gondā district, were prepared for, and sent to, the Deputy Commissioner, Gondā. The cost has been recovered.

87. No. 4 Drawing Office (Southern Circle).—During the year 56 one-inch and 5 half-inch sheets, which had been surveyed and fair-drawn by parties, were finally examined and submitted for publication. At the end of the year every sheet, the survey of which was completed during previous years, had been submitted.

Half-inch sheets compiled from one-inch maps.—8 sheets were fair-drawn and submitted for publication and 6 sheets, which had been fair-drawn by parties, were finally examined and submitted for publication. At the end of the year 9 sheets were being fair-drawn in this office, 20 sheets were being fair-drawn by parties and 28 sheets, the component one-inch sheets of which had been published, had not been commenced.

Quarter-inch sheets compiled from one-inch and half-inch maps.—No sheet was submitted for publication. At the end of the year 4 sheets, the component one-inch sheets of which had been published, were being fair-drawn and every sheet, the component half-inch sheets of which had been published, had been commenced.

The examination and colouring of the proofs of 76 sheets and the hill shading for 66 sheets were completed and returned to the Superintendent, Map Publication.

A number of pupils were instructed in fair drawing.

Considerable assistance was given to parties to enable them to complete their fair-drawing during the recess season.

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

88. No. 5 Drawing Office (Eastern Circle).—During the year, of 21 one-inch sheets which were received from the parties, 17 were submitted for publication; 16 unpublished proofs were received and 14 of these were examined, coloured, stump shaded originals prepared, and submitted for publication. 5 proofs of the previous year were similarly prepared and submitted.

Sixteen one-inch reprint cases were dealt with and 14 of these were submitted for publication, of these 11 unpublished proofs were received and 3 were completed and returned. The colour guides of two other were also prepared. The stump shaded originals of 8 are yet to be prepared.

Half-inch sheets compiled from one-inch maps.—17 were received from the parties, 14 were examined and sent for publication, 9 uncorrected proofs of these were received back for examination, preparation of colour guides and stump shaded originals and of these 2 were re-submitted.

Besides the foregoing 6 proofs of the previous year were prepared and submitted.

Quarter-inch sheets compiled from one-inch and half-inch maps.—One sheet was received in the drawing office. 6 were submitted for publication, 5 proofs were received and 2 were completed and re-submitted. The degree sheet (94 G) referred to last year as being incomplete, will shortly be submitted for publication, the references regarding its boundaries and forest limits have now been decided by the local authorities.

Of the one-inch sheets the survey of which was completed during the previous year all have been submitted for publication with the exception of 4 unavoidably detained for settlement of boundary questions, which have now been decided and the sheets will shortly be submitted.

89. 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 and reproduction 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 one-millionth, 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.

90. Bengal and Bihār and Orissa Drawing Office.—
(*Imperial Standard Mapping Section*). This office continued under the direction of the Director of Surveys, Bengal.

In Bihār and Orissa, 13 one-inch sheets were submitted for publication, 4 are nearly ready and 27 are in hand, only 8 sheets of this Province remaining to be taken up.

In Bengal 13 one-inch sheets were submitted for publication, 2 are nearly ready and 25 are in hand. Two changes regarding the maps prepared in this office have been introduced:—(a) in previous years all areas containing hills or waste land which were not surveyed were shown blank, in future these blanks will be filled up from old one-inch maps; this will reduce the outturn but the maps produced will be much more useful for general purposes; (b) these sheets being much nearer in quality to topographical maps than previously will therefore be published in colours.

PART 4.—WORK FOR OTHER GOVERNMENT DEPARTMENTS.

91. Northern Circle.—*No. 2 Party* carried out a survey on the four-inch scale of the head works of the Lower Bari Doab Canal for the Irrigation branch of the Punjab Public Works Department.

One surveyor was deputed for this work which was under execution from the 28th January 1916 to the end of the Survey year.

No. 20 Party (Cantonment).—This Party continued the survey of the Cantonments and Military stations of Upper India. The details of the work done by it are shewn on page 17.

Punjab Riverain Detachment.—As in previous years this Detachment was exclusively employed on local surveys in the Punjab. The details of the work done are shewn on pages 18 and 19.

Simla Survey Detachment completed the new large scale survey of the Simla Municipality, for details see page 19.

92. Southern Circle.—The special survey on the scale of 1½ inches to a mile of reserved forests in the Hyderābād State was commenced. *No. 6 Party* surveyed an area of 30 square miles and triangulated an area of about 200 square miles. The cost of this work is being borne by the Nizām's Government.

One surveyor of *No. 7 Party* was placed on deputation during the field season with the Madras Survey Department to survey disputed boundaries in the Parlākimedi Māliāhs of the Ganjām district of Madras.

One surveyor of *No. 8 Party* was placed on deputation during the field season with the Forest Department in Coorg to survey several forest plantations in the neighbourhood of Mercāra.

93. Eastern Circle.—At the request of the General Staff, Burma Division, *No. 11 Party* surveyed an area of 70 square miles about 25 miles due north of Maymyo, on 1-inch scale, for the preparation of the Artillery Practice Camp Map.

94. Map Publication Offices.—A large proportion of the work of the Photo-Litho. Office is for other Government departments; weather charts, photographs for the Archæological and other departments, plans, maps for the General Staff and many others were reproduced during the year, the increase of machines enabling the Survey of India to take up most of the work sent in. The Drawing Office also prepared Postal, Railway, Manceuvre, Artillery Practice and other maps, while the Map Record and Issue Office's main work is the issue of maps to other departments.

95. Mathematical Instrument Office.—Heliographs, watches, range finders, and periscopes, &c., have been issued and repaired in large quantities, and this office as usual supplied and repaired instruments for all Government offices, Provincial and Imperial.

96. Dehra Dun Offices.—A very accurate traverse of the boundary of the Imperial Delhi Area on the right bank of the Jumna was executed by *No. 19 Party* at the request of the Chief Engineer, Public Works Department, Delhi Province.

A considerable number of requisitions for data, particularly with regard to the most recent lines of levels, which have not yet been published, were complied with by the Computing Office.

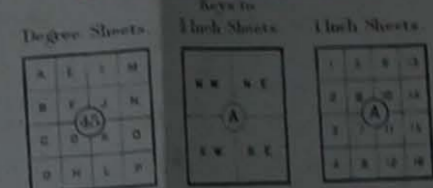
Five maps of various kinds were produced by *No. 2 Drawing Office* for other departments.

LIST OF INDEX MAPS.

1. Modern surveys and publication, Northern Circle.
2. " " " " Southern "
3. " " " " Eastern "
4. Publication of modern one-inch series, Northern Circle.
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.



INDEX
Showing progress from 1st Oct. 1905 to 30th Sept. 1916.
To accompany General Report 1915-16.



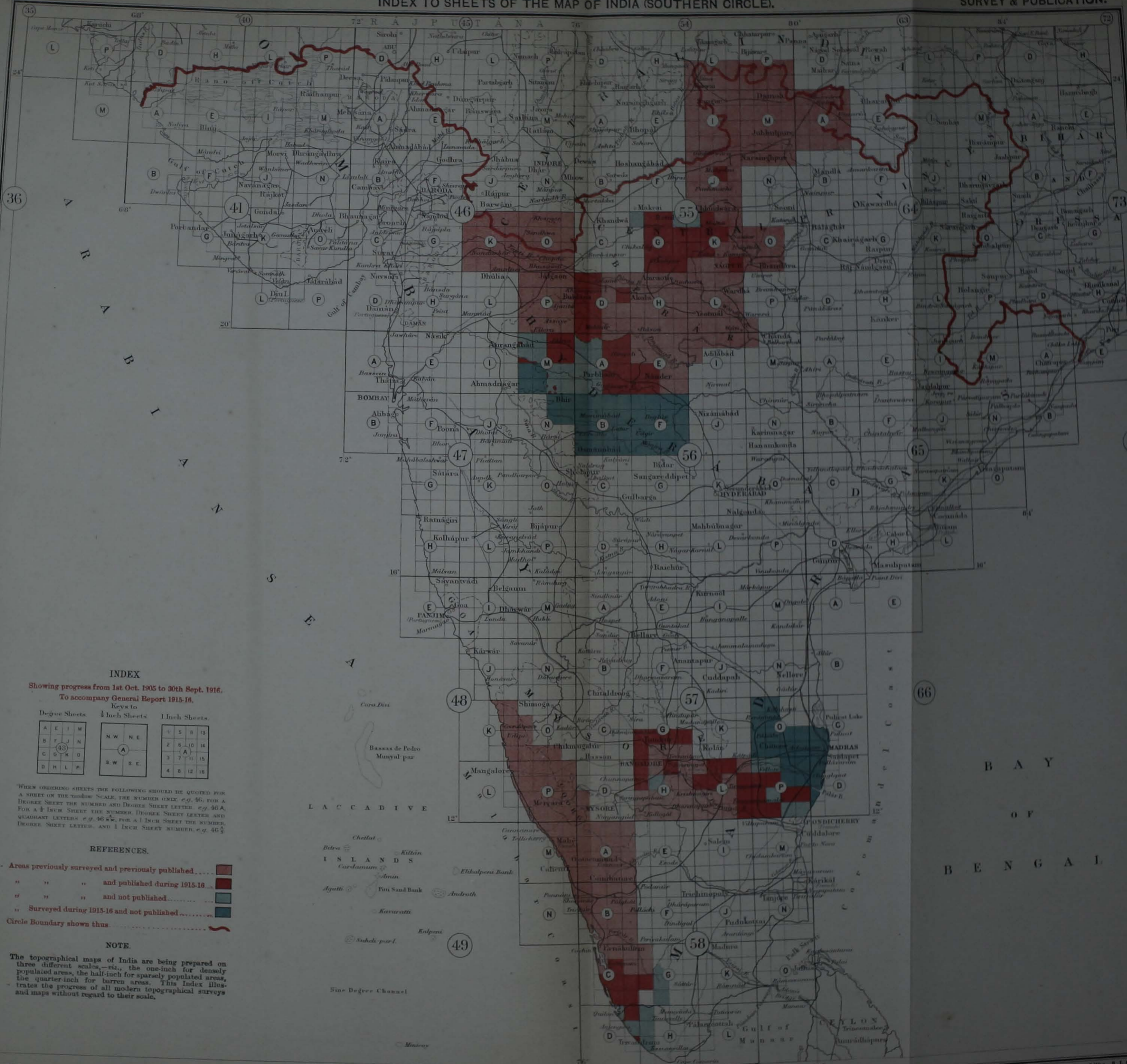
When ordering sheets the following order is quoted for a sheet on the double scale the number only, e.g. 45 for a Degree Sheet the number and degree sheet letter, e.g. 45 A for a 1/2 Inch Sheet the number, degree sheet letter and quadrant letter, e.g. 45 A C for a 1/4 Inch Sheet the number, degree sheet letter and 1/4 inch sheet number, e.g. 45 C 4.

REFERENCES.

- Areas previously surveyed and previously published
- " " " and published during 1915-16
- " " " and not published
- Surveyed during 1915-16 and not published
- Carets 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).



INDEX

Showing progress from 1st Oct. 1905 to 30th Sept. 1916.
To accompany General Report 1915-16.

Keys to

Degree Sheets.	1/2 Inch Sheets.	1 Inch Sheets.
A E I M	N W N E	1 5 8 13
B F J N	(A)	2 6 10 14
C D K O	S W S E	3 7 11 15
D H L P		4 8 12 16

When quoting sheets the following should be quoted for a sheet on the 1:50,000 scale, the number only, e.g. 46; for a degree sheet the number and degree sheet letter, e.g. 46 A; for a 1/2 inch sheet the number, degree sheet letter and quadrant letter, e.g. 46 A N; for a 1 inch sheet the number, degree sheet letter, and 1 inch sheet number, e.g. 46 1/2.

REFERENCES.

- Areas previously surveyed and previously published
- " " " and published during 1915-16
- " " " and not published
- " " " surveyed during 1915-16 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.

SURVEY & PUBLICATION
(Southern Circle).

INDEX TO SHEETS OF THE MAP OF INDIA (EASTERN CIRCLE).



INDEX.
 Showing progress from 1st Oct. 1905 to 30th Sept. 1916.
 To accompany General Report 1915-16.

Keys to 1 Inch Sheets

Degree Sheets	1 Inch Sheets	1 Inch Sheets
A E I M	N W N E	1 5 9 D
B F J N	O X O E	2 6 0 A
C G K O	P Y P E	3 7 1 B
D H L Q	Q Z Q E	4 8 2 C
		5 9 3 D

WHEN ORDERING SHEETS THE FOLLOWING SHOULD BE QUOTED FOR A SHEET OF THE **INDEX** SCALE FOR NUMBER ONLY, e.g. 84 FOR A 1 INCH SHEET THE NUMBER AND DEGREE SHEET LETTER, e.g. 84 A FOR A 1/2 INCH SHEET THE NUMBER, DEGREE SHEET LETTER AND QUARTER-DEGREE LETTER, e.g. 84 1/2 FOR A 1/4 INCH SHEET THE NUMBER, DEGREE SHEET LETTER AND 1/4 INCH SHEET NUMBER, e.g. 84 1/2 1

REFERENCES.

- Areas previously surveyed and previously published
- " " " and published during 1915-16
- " " " and not published
- " Surveyed during 1915-16 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 ONE-INCH PUBLICATION
(Northern Circle).

INDEX

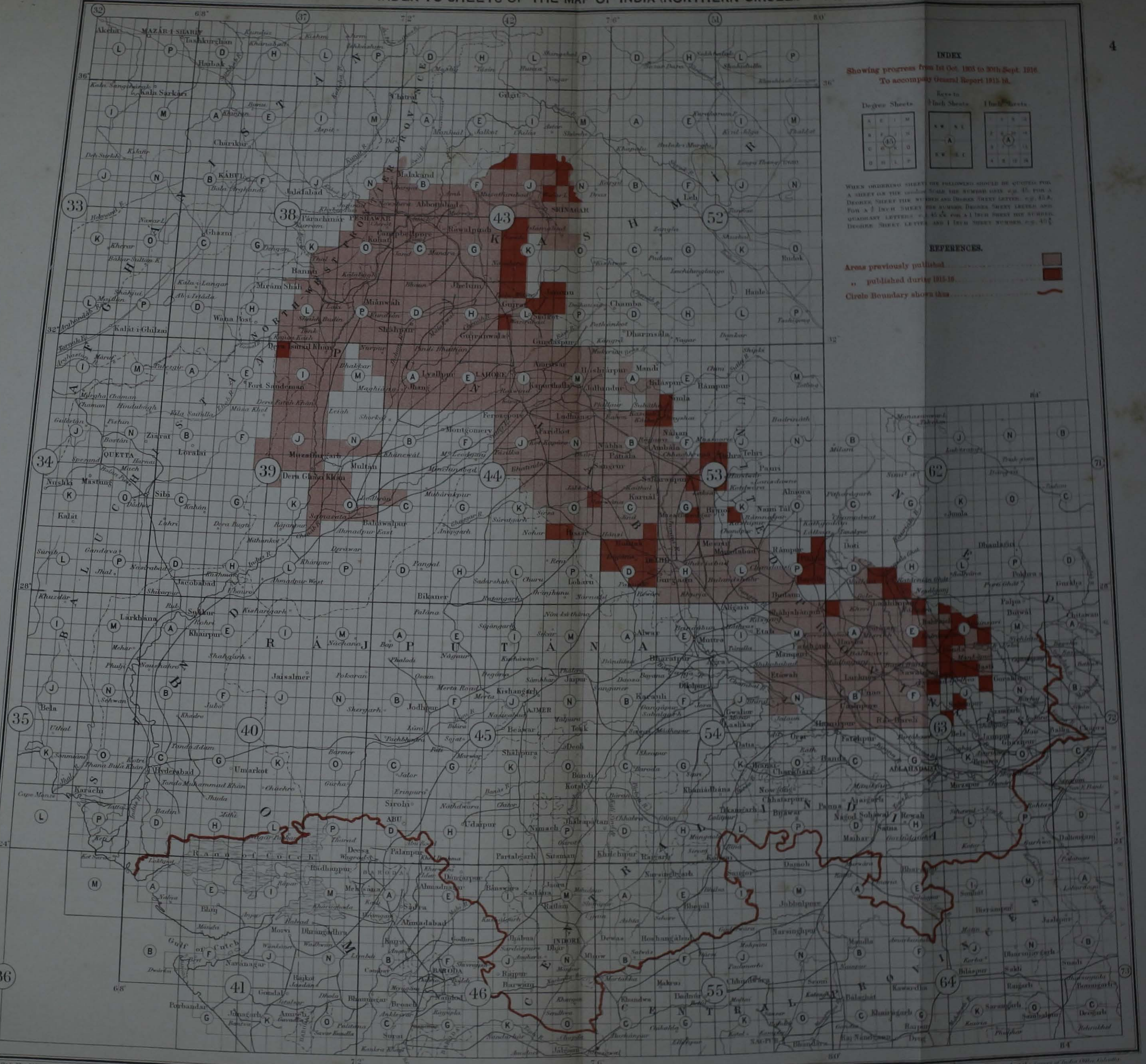
Showing progress from 1st Oct. 1933 to 30th Sept. 1934.
To accompany General Report 1933-34.



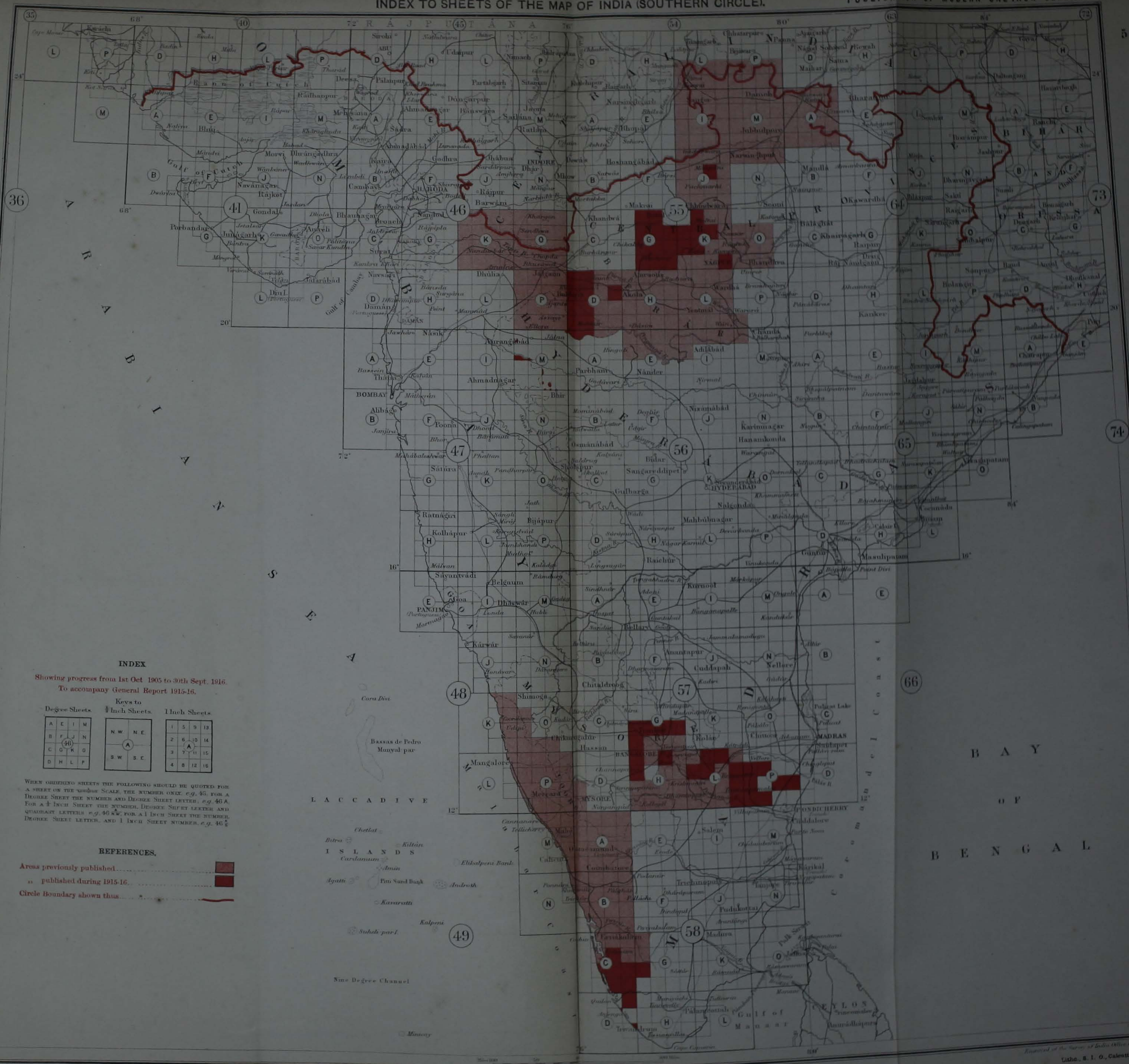
WHEN ORDERING SHEETS THE FOLLOWING SHOULD BE QUOTED FOR A SHEET OF THE MODERN SERIES: SHEET NO. 43 FOR A DEGREE SHEET THE NUMBER AND DEGREE LETTERS, e.g. 43 A, FOR A 1/2 INCH SHEET THE NUMBER, DEGREE LETTERS AND QUADRANT LETTERS, e.g. 43 A B, FOR A 1/4 INCH SHEET THE NUMBER, DEGREE LETTERS AND QUADRANT LETTERS AND 1/4 SHEET NUMBER, e.g. 43 A B C.

REFERENCES.

- Areas previously published
- .. published during 1933-34
- Circle Boundary shown thus



MODERN ONE-INCH PUBLICATION
(Southern Circle).



INDEX

Showing progress from 1st Oct 1905 to 30th Sept. 1916.
To accompany General Report 1915-16.

Keys to			
Degree Sheets.		1/2 Inch Sheets.	1 Inch Sheets.
A	E	I	M
B	F	J	N
C	G	K	O
D	H	L	P
NW NE		1 5 9 13	
SW SE		2 6 10 14	
		3 7 11 15	
		4 8 12 16	

When ordering sheets the following should be quoted for a sheet on the Indian Scale, the number only, e.g. 46, for a Degree Sheet the number and Degree Sheet letter, e.g. 46A, for a 1/2 Inch Sheet the number, Degree Sheet letter and quadrant letter, e.g. 46 NW, for a 1 Inch Sheet the number, Degree Sheet letter, and 1 Inch Sheet number, e.g. 46 1/2.

REFERENCES.

- Areas previously published.
- published during 1915-16.
- Circle Boundary shown thus.

MODERN ONE-INCH PUBLICATION
(Eastern Circle).

INDEX TO SHEETS OF THE MAP OF INDIA (EASTERN CIRCLE).



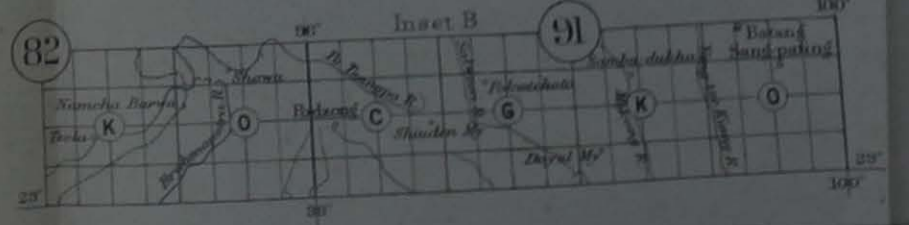
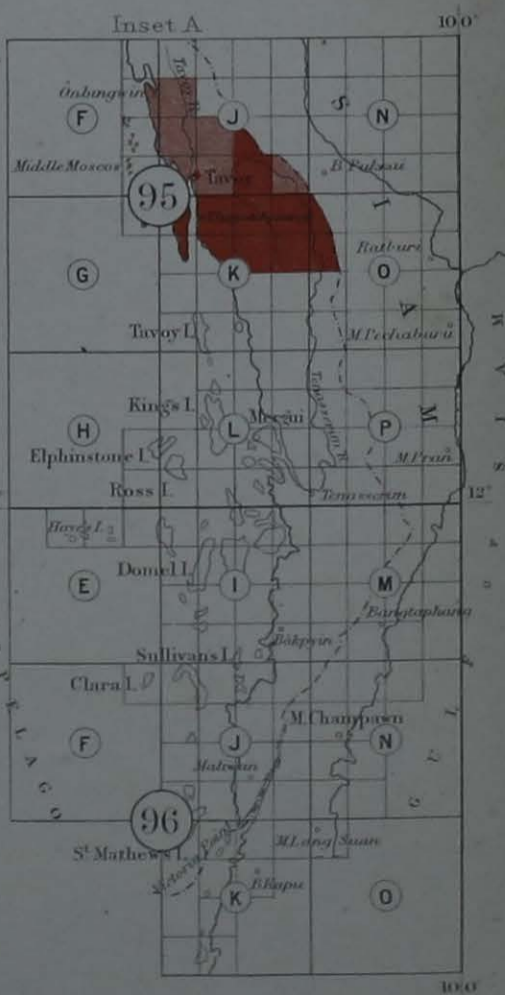
INDEX
 Showing progress from 1st Oct. 1905 to 30th Sept. 1916
 To accompany General Report 1915-16.

Degree Sheets	Keys to 1 Inch Sheets	1 Inch Sheets
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	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	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

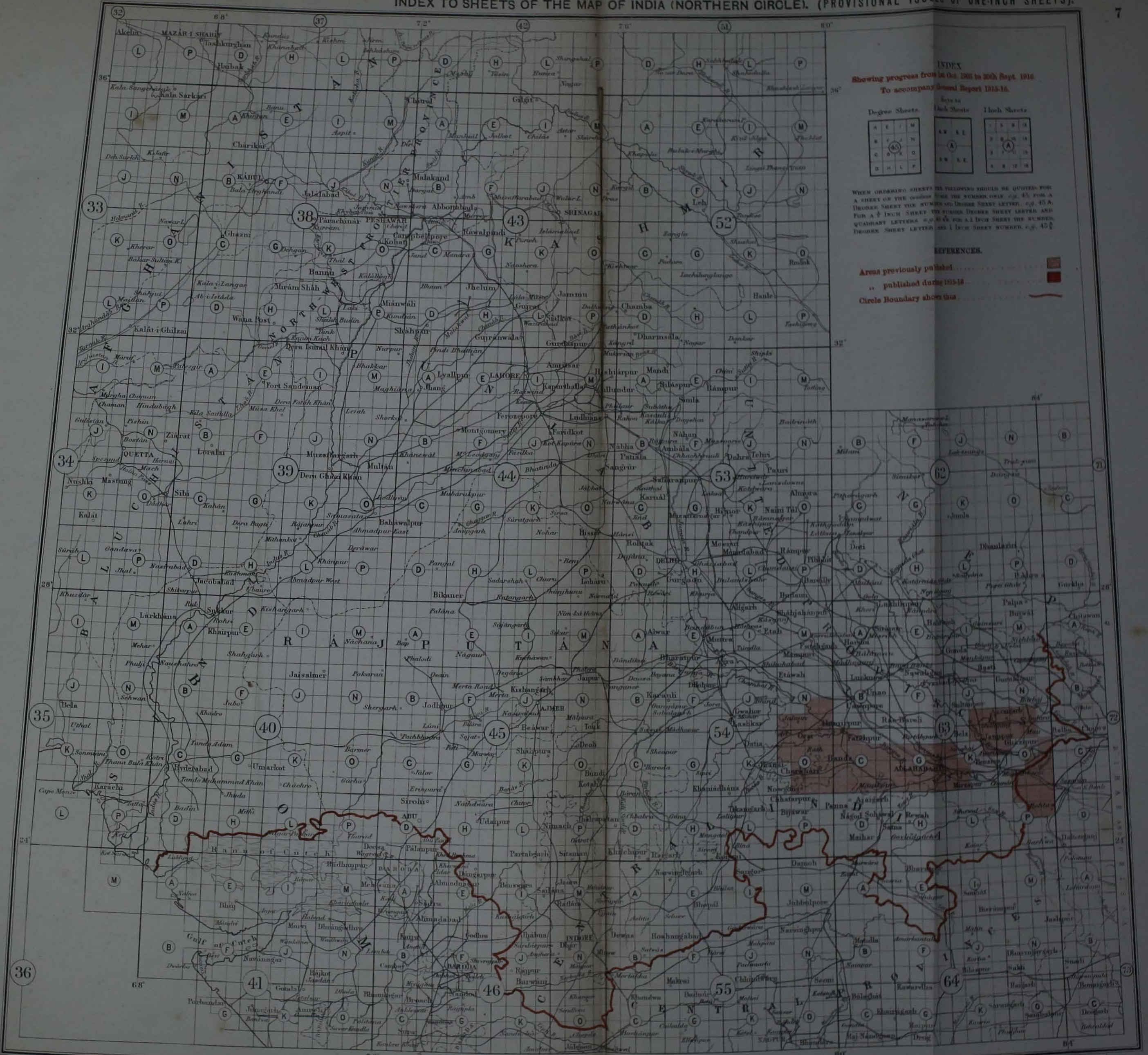
WHEN ORDERING SHEETS THE FOLLOWING SHOULD BE QUOTED FOR A SHEET OF THE 1 INCH SCALE THE NUMBER ONLY, e.g. 84, FOR A 1 INCH SHEET THE NUMBER AND DEGREE SHEET LETTER, e.g. 84 A, FOR A 2 1/2 INCH SHEET THE NUMBER, DEGREE SHEET LETTER AND QUARTER LETTER, e.g. 84 1/2, FOR A 1 INCH SHEET THE NUMBER, DEGREE SHEET LETTER AND 1 INCH SHEET NUMBER, e.g. 84 1/2.

REFERENCES.

- Areas previously published
- " published during 1915-16
- Circle Boundary shows thus



PROVISIONAL ONE-INCH PUBLICATION
(Northern Circle).



INDEX
Showing progress from 1st Oct. 1915 to 30th Sept. 1916
To accompany General Report 1915-16.

Degree Sheets	Half Sheets	Full Sheets																																								
<table border="1"> <tr><td>A</td><td>E</td><td>I</td><td>M</td></tr> <tr><td>B</td><td>F</td><td>J</td><td>N</td></tr> <tr><td>C</td><td>G</td><td>K</td><td>O</td></tr> <tr><td>D</td><td>H</td><td>L</td><td>P</td></tr> </table>	A	E	I	M	B	F	J	N	C	G	K	O	D	H	L	P	<table border="1"> <tr><td>A</td><td>E</td></tr> <tr><td>B</td><td>F</td></tr> <tr><td>C</td><td>G</td></tr> <tr><td>D</td><td>H</td></tr> </table>	A	E	B	F	C	G	D	H	<table border="1"> <tr><td>A</td><td>E</td><td>I</td><td>M</td></tr> <tr><td>B</td><td>F</td><td>J</td><td>N</td></tr> <tr><td>C</td><td>G</td><td>K</td><td>O</td></tr> <tr><td>D</td><td>H</td><td>L</td><td>P</td></tr> </table>	A	E	I	M	B	F	J	N	C	G	K	O	D	H	L	P
A	E	I	M																																							
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A	E	I	M																																							
B	F	J	N																																							
C	G	K	O																																							
D	H	L	P																																							

WHEN ORDERING SHEETS THE FOLLOWING SHOULD BE QUOTED FOR A SHEET OR THE NUMBER OF SHEETS ONLY, E.G. 45, FOR A DEGREE SHEET THE NUMBER AND DEGREE SHEET LETTER, E.G. 45 A, FOR A HALF SHEET THE NUMBER, DEGREE SHEET LETTER AND QUADRANT LETTER, E.G. 45 G, FOR A FULL SHEET THE NUMBER, DEGREE SHEET LETTER AND DEGREE SHEET NUMBER, E.G. 45 D.

REFERENCES.

- Areas previously published ■
- " published during 1915-16 ■
- Circle Boundary shows this ○

PROVISIONAL ONE-INCH PUBLICATION

(Eastern Circle).



INDEX
 Showing progress from 1st Oct. 1905 to 30th Sept. 1916
 To accompany General Report 1915-16.

Keys to

Degree Sheets	4 Inch Sheets	1 Inch Sheets
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	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	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

When ordering sheets the following should be quoted for a sheet of the double scale the number only, e.g. 84, for a degree sheet the number and degree sheet letter, e.g. 84 A, and for a 1 inch sheet the number, degree sheet letter and quadrant letter, e.g. 84 W, for a 1 inch sheet the number, degree sheet letter, and 1 inch sheet number, e.g. 84 2.

REFERENCES.

- Areas previously published
- published during 1915-16
- Circle Boundary shown thus

HALF INCH SERIES.

INDEX
TO
THE HALF INCH SHEETS
OF
INDIA.



To accompany General Report 1915-16.

Key to Half Inch Sheets.

N.W.	N.E.	N.W.	N.E.	N.W.	N.E.
A	E	I	M		
S.W.	S.E.	S.W.	S.E.	S.W.	S.E.
N.W.	N.E.	N.W.	N.E.	N.W.	N.E.
B	F	J	N		
S.W.	S.E.	S.W.	S.E.	S.W.	S.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.
N.W.	N.E.	N.W.	N.E.	N.W.	N.E.
D	H	L	P		
S.W.	S.E.	S.W.	S.E.	S.W.	S.E.

The numbers of the sheets of the 1:1,000,000 series are shown thus 55
The letters of the Degree Sheet series thus M
The half-inch sheets are designated by the number of the sheet on the 1:1,000,000 scale and the letter of the degree sheet in which they fall with the letters N.W., N.E., S.W., or S.E., according to their position as quarters of the degree sheets, entered below the degree sheet letter. Thus the number of half-inch sheet containing Jubbulpore is 55 M S.E.

REFERENCE.

Areas previously published 
.. published during 1915-16. 



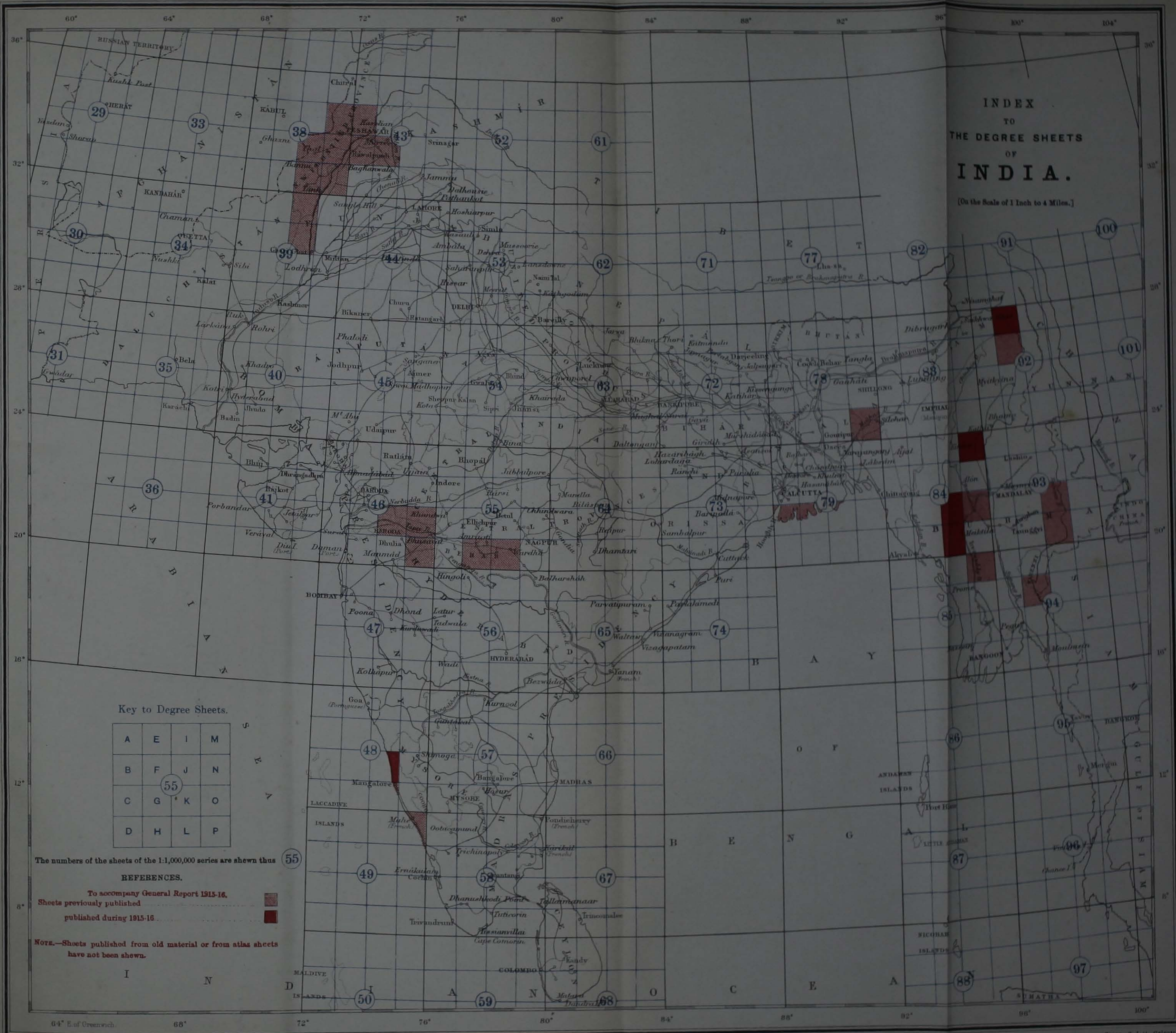
64° E. of Greenwich 68° 72° 76° 80° 84° 88° 92° 96° 100°

DEGREE SHEET SERIES

Scale 1 Inch to 4 Miles.

INDEX TO THE DEGREE SHEETS OF INDIA.

(On the Scale of 1 Inch to 4 Miles.)





Key to Degree Sheets.

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

The numbers of the sheets of the 1:1,000,000 series are shown thus **55**

REFERENCES.

- To accompany General Report 1915-16.
- Sheets previously published 
- published during 1915-16 

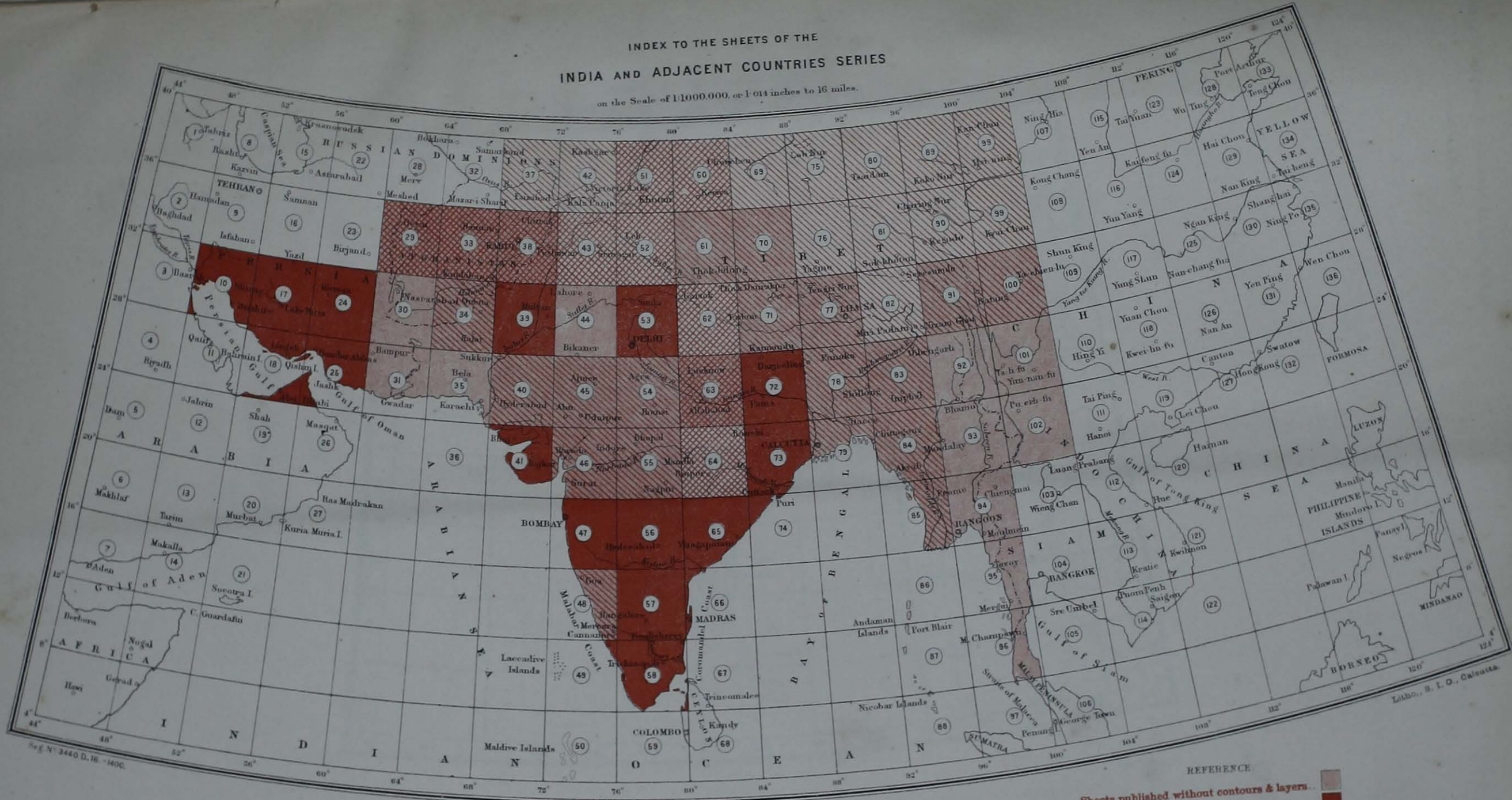
NOTE.—Sheets published from old material or from atlas sheets have not been shown.

INDIA AND ADJACENT COUNTRIES SERIES

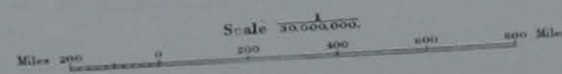
Scale 1:1,000,000.

INDEX TO THE SHEETS OF THE INDIA AND ADJACENT COUNTRIES SERIES

on the Scale of 1:1,000,000, or 1:14 inches to 16 miles.



Reg. N° 3440 D. 18. -1400.



REFERENCE

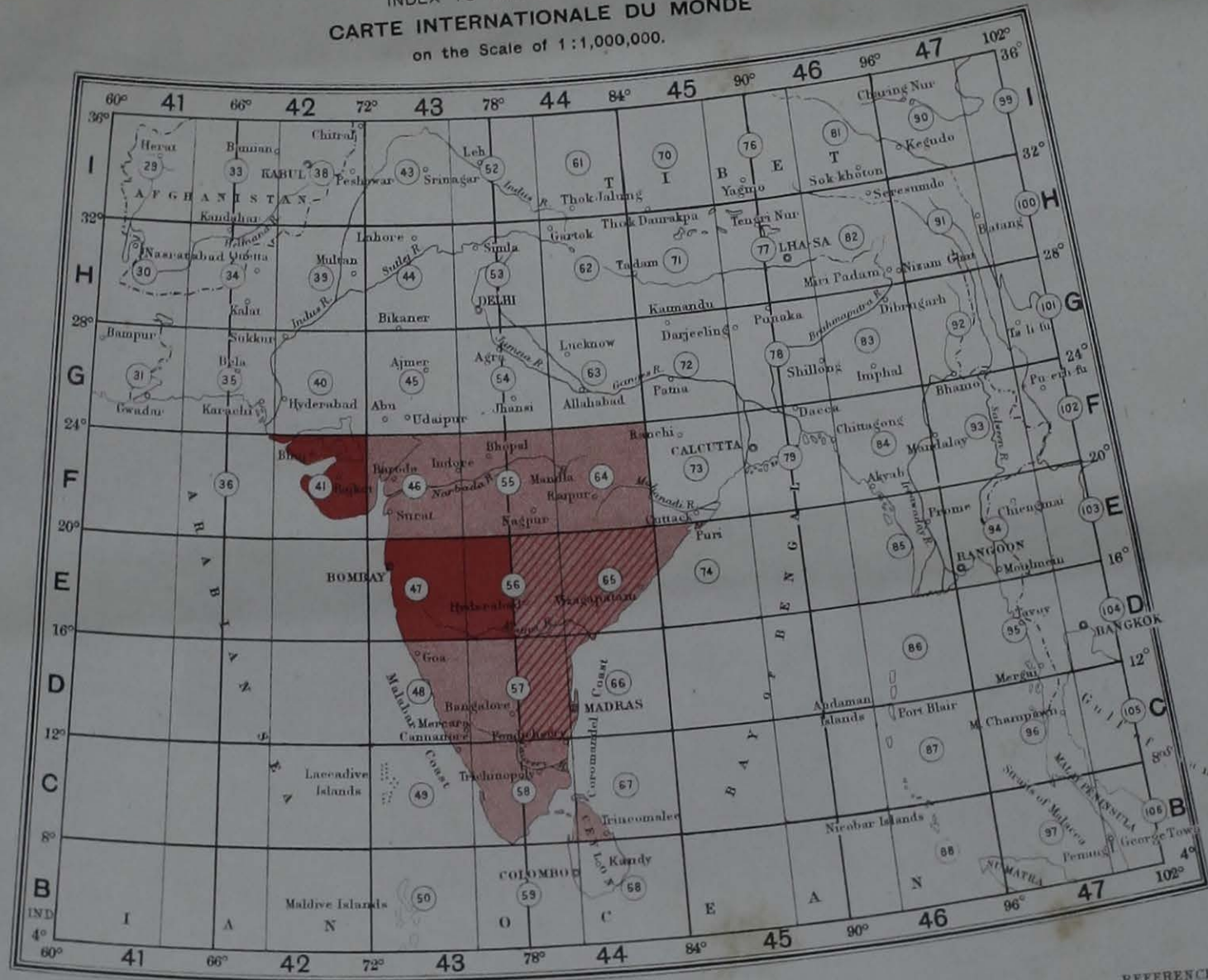
Sheets published without contours & layers . . .	□
“ “ with contours & layers . . .	■
“ under publication . . .	▨
“ in hand . . .	▤

To accompany General Report 1915-16.

INTERNATIONAL SERIES

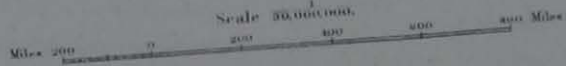
Scale 1:1,000,000.

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.

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



REFERENCE

Sheets published.....	
.. under publication.....	
.. in hand.....	

To accompany General Report 1915-16.

SOUTHERN ASIA SERIES

Scale 1:2,000,000.

Survey of India.
GENERAL REPORT,
1915-16.

From 1st October 1915
To 30th September 1916.



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

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