

Survey of India. Hc-40

GENERAL REPORT,
1916-17.

From 1st October 1916
To 30th September 1917.



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

PRINTED AT THE PHOTO-LITHO. OFFICE, SURVEY OF INDIA,
CALCUTTA,
1918.

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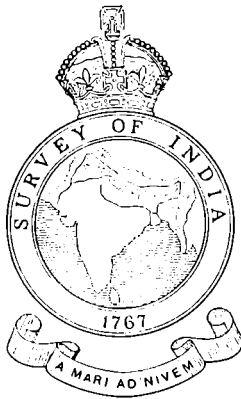
Hc 40

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14, WOOD STREET,
CALCUTTA.

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1. Modern surveys and publication, Northern Circle.
2. " " " " Southern "
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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.

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(114)

Survey of India.
GENERAL REPORT,
1915-16.

ERRATUM.

Page 15, para. 34, line 2—
For "4-inch" read "2-inch".

GENERAL REPORT,
1916—17.

From 1st October 1916
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PART 1.—GENERAL REMARKS.

I.—INTRODUCTION.

1. The main parts of this report, as shewn in the "Contents" on the opposite page, are *Part 2—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 XI 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 32,750* square miles; and that this brings the total progress since 1905 to 471,583* square miles, leaving 1,350,017 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 34 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.

*This however excludes 431 square miles previously surveyed on a smaller scale.

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*This however excludes 431 square miles previously surveyed on a smaller scale.

6. The following events are notified:—

- (a) Two Imperial Officers have reverted from temporary military duty and a third officer, who also reverted, has since been recalled to military duty. Four Provincial Officers have reverted from military duty.
- (b) Owing to the shortage of officers the field work of the whole department was again considerably curtailed.
- (c) The Survey party under an Imperial Officer which accompanied the field-force in Mesopotamia continued survey operations there.
- (d) A Survey party under an Imperial Officer was sent to work with the Russian Forces in Western Persia.
- (e) Another Survey party under an Imperial Officer was ordered to carry out survey operations in Persia.
- (f) A Survey detachment in charge of a Provincial Officer was sent to Salonika to serve under an Imperial Officer on military duty there.
- (g) A Survey detachment under a Provincial Officer was attached to the Waziristān Field Force from June to August 1917.
- (h) An officer of the Upper Subordinate Service was employed on the Makrān Border Mission from November 1916 to April 1917.
- (i) The Mathematical Instrument Office assisted in receiving, registering and valuing binoculars offered by the public in response to the appeal of His Excellency the Commander-in-Chief in India.
- (j) A standing Committee of Adjustment was formed to deal with the estates of deceased Military Officers of the Survey of India.
- (k) Tide Tables for the Port of Basrah, containing predictions of high and low water from 1st September 1917 to 31st December 1918, were prepared from tide-pole readings supplied by the General Staff and sent to the Director of Inland Water Transport, Basrah.
- (l) The Government of India have asked the Survey Department to make a resurvey of the Mayo Salt Mine at Khewra and this will be undertaken during season 1917-18.
- (m) A piece of land has been acquired in Dehra Dūn as the site of the new Head Quarter Offices to take the place of those now located in Calcutta.
- (n) The Royal Geographical Society of London awarded the Murchison Grant for 1917 to Rai Bahadur Lal Singh in recognition of his valuable work in Central Asia under Sir Aurel Stein.

II.—ADMINISTRATION AND PERSONNEL.

7. The actual cost of the department for the financial year ending 31st March 1917 and of the 2 previous years is shown below:—

	1914-15.	1915-16.	1916-17.	REMARKS.
	Rs.	Rs.	Rs.	
Gross actual cost ...	33,32,541	30,08,348	33,16,541*	* These figures are not final.
Deduct receipts and credits	9,48,397	8,35,359	15,04,386*	
Net actual cost ...	23,84,144	21,73,009	18,12,155*	

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 Brevet-Major (Temporary Lieutenant-Colonel) A. A. Chase, D.S.O., R.E., died on 11th March from wounds received in action. Captain E. B. Cardew, R.E., who had been reported as wounded and missing on 26th September 1915 was reported as having been killed in action presumably on or after the 25th idem. The number of Imperial Officers temporarily reverted to military duty on account of the war at the end of the Survey year is 28* and the total casualties to date in killed, or died of wounds are 8. Colonel R. A. Wauhope, C.B., C.M.G., C.I.E., R.E., (Retired), has been re-employed temporarily from 1st June 1916.

In the Provincial Service Messrs. A. Ewing, M. Gastaud, H. G. Shaw and F. B. Powell retired, of whom the three first named officers have been re-employed; Mr. P. Kenney resigned. Mr. T. P. Dewar who was employed under the Government of Burma has returned to the Survey of India. The number of officers of the Provincial Service on deputation to military duty at the end of the Survey year is 15. Of the total number of officers accepted by the Army Department one has been killed in action and five have reverted to the Survey of India.

In the Upper Subordinate Service 3 officers retired, 2 probationers resigned, 8 probationers were confirmed, 1 probationer was appointed and 2 surveyors and 1 computer were promoted into this service from the Lower Subordinate Service.

The total strength of the department at the close of the Survey year was 46* Imperial Officers, 116† Provincial Officers and 54 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 18 Imperial Officers and 101† Provincial Officers including those attached to Overseas Survey Parties, the remainder being on military duty.

10. The Sind-Sāgar Party was formed for the execution of rectangulation as a basis for the Punjab Government's Sind-Sāgar Canal and Colonization Project, No. 4 Party being amalgamated with this party.

No. 20 Party was transferred from the administrative control of the Superintendent, Northern Circle and was placed under that of the Superintendent, Southern Circle.

* Including 2 officers who were on deputation to the Government of Bengal.

† Excluding officers re-employed.

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

<i>Companion of the Order of the Indian Empire.</i> —	Brevet.-Colonel F. W. Pirrie, I.A.
<i>Companions of the Distinguished Service Order.</i> —	Major A. A. McHarg, R.E. Major K. W. Pye, R.E. Major H. T. Morshead, R.E.
<i>Bar to the Distinguished Service Order.</i> —	Major S. W. S. Hamilton, D.S.O., R.E.
<i>Awarded the Military Cross.</i> —	Major M. N. MacLeod, R.E., Captains K. Mason, R.E., and H. E. Roome, R.E.
<i>Bar to the Military Cross.</i> —	Brevet-Major F. P. Nosworthy, M.C., R.E.
<i>Awarded the Order of St. Stanislas, 3rd class with Crossed Swords.</i> —	Major A. A. McHarg, D.S.O., R.E.
<i>Promoted to Brevet-Colonel.</i> —	Lieutenant-Colonel F. W. Pirrie, I.A.
<i>Promoted to Brevet-Lieutenant-Colonel.</i> —	Major C. P. Gunter, R.E.
<i>Promoted to Brevet-Major.</i> —	Captains A. A. Chase, D.S.O., R.E. and F. P. Nosworthy, M.C., R.E.
<i>Mentioned in despatches.</i> —	Brevet-Colonel F. W. Pirrie, C.I.E., I.A. (fourth time). Major G. A. Beazeley, R.E. Major H. Wood, R.E. • Brevet-Lieut.-Colonel C. M. Browne, D.S.O., R.E. (third time). Captain E. C. Baker, R. E. (died of wounds). Major H. J. Couchman, M.C., R.E. Major H. T. Morshead, D.S.O., R.E. Captain G. F. T. Oakes, R.E. (died of wounds). Brevet-Major (Temporary Lieut.-Colonel) A. A. Chase, D.S.O., R.E. (twice during the year)—since killed. Brevet-Major F. P. Nosworthy, M.C., R.E. (twice). Mr. A. J. Booth. Mr. Laltan Khan (second time).

The following draftsmen of the Army Section of No. 6 Drawing Office (Simla) have been promoted in recognition of their services in India in connection with the war :—

Conductor R. Graham to be Assistant Commissary with the honorary rank of Lieutenant.

Sub-Conductor W. Smith to be Conductor.

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

TABLE I—DISPOSITION OF OFFICERS, 1916-17.

SURVEYOR GENERAL OF INDIA—Colonel Sir Sidney G. Buzard, 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 L. C. Thuillier, I.A.			
No. 6 Drawing Office, Simla.	Major C. J. Arbery	Mr. Dhani Ram Verma " Asmat-ullah Khan, K.S. " A. B. Hunter		5 European Draftsmen. 4 Printers. 3 Clerks. 20 Indian Draftsmen.
Basrah Survey Party	Rt.-Colonel F. W. Pirrie, C.I.E., I.A. Major G. A. Brazzley, R.E. Captain W. E. Perry, R.E.	Mr. J. McCracken " F. C. Picher " W. H. Strong " A. J. Booth " J. C. St. C. Pollett	Mr. Nanak Chand Pari " Bhamba Ram " Annada Prasad Ghosh	27 Surveyors, &c.
Persian Survey Party.	Major E. T. Rich, R.E.	Mr. A. F. Murphy	Mr. Sher Jung, K.B.	4 Surveyors.
Western Persia Survey Party.	Major H. McC. Cowie, R.E. Captain W. E. Percy, R.E.	Mr. D. K. Rennie	Mr. Hamid Gul " Lalton Khan	4 Surveyors.
Salonika Survey Detachment.		Mr. H. B. Simons	Mr. Jamma Prasad, R.S.	8 Surveyors.
SUPERINTENDENT. MAP (Lieut.-Colonel W. M. Coldstream, R.E. (Temporarily reverted to military duty). PUBLICATION—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. Lieut.-Colonel A. Mears, I.A.	Mr. P. Williams " M. C. Petters " Jagdamba Prasad " Abinash Chunder Bose " C. West " P. Simpson " Priya Nath Sur " D. K. Rennie " A. A. Gadlam " T. F. Kitchin " H. H. P. Butterfield " Jiya Lal Sahgal		
Photo.-Litho. Office, Calcutta.	Major H. McC. Cowie, R.E. Captain F. J. M. King, R.E. " C. G. Lewis, R.E.			
Mathematical Instrument Office, Calcutta.	Mr. A. Ferrier			
Bengal & Bihar & Orissa Drawing Office, (Imperial Standard Mapping Section).		Mr. E. G. Hardinge " P. Simpson		
SUPERINTENDENT.) NORTHERN CIRCLE)—Lieut.-Colonel C. L. Robertson, C.M.G., R.E.				
	<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	Mr. Inam Din	30 Draftsmen, &c.
No. 1 Party, Kashmir and Jammu State, Punjab and N. W. F. Province.		Mr. B. R. Hughes " G. J. S. Rae " H. P. D. Morton " P. A. T. Kenny " R. C. Hanson	Mr. Sher Jung, K.B. " Natha Singh, R.S. " Hamid Gul " Jagdeesh Prasad Vastav	36 Surveyors, &c.
No. 2 Party, Punjab, Rajputana and Delhi Province.		Mr. T. W. Babonau " F. B. Powell " R. E. Saubolle " J. H. Johnson " J. A. Culvert	Mr. Chuni Lal Kapur " Ghulam Hasan	26 Surveyors, &c.
No. 3 Party, United Provinces and Punjab.		Mr. H. H. B. Hanby " E. J. Biggie " A. M. Tulati, L. C. E. " H. T. Hughes " G. E. R. Cooper " Moqinuddin	Mr. Muhammad Husain " Amir Abdul Salam Matlub Ahmad	54 Surveyors, &c.
No. 4 Party, United Provinces.	Major H. L. Crosthwait, R.E.	Mr. H. W. Biggie " J. A. Freeman " J. C. C. Leurs " E. C. O'Sullivan " F. J. Grice " Duni Chand Pari	Mr. Mohammad Husain Khan " Daulat Ram Volra	23 Surveyors, &c.
Sind-Sagar Party, ... United Provinces.	Major H. L. Crosthwait, R.E.	Mr. J. C. C. Leurs " F. J. Grice	Mr. Mohammad Husain Khan " Nubidad Khan	18 Surveyors, &c.
Riverain Detachment, Punjab.		Mr. Maya Das Pari, R.S.	Mr. Parna Ram " Jamma Prasad, R.S. " Mahomed Latif Ali " Lakshmi Dutt Joshi " Vidya Dhor Chopra	4 Surveyors, &c.
Tank Survey Detachment, Waziristan.		Mr. P. A. T. Kenny " Duni Chand Pari		2 Surveyors.

TABLE I—(Continued).—DISPOSITION OF OFFICERS, 1916-17.

SUPERINTENDENT, SOUTHERN CIRCLE }—Colonel T. F. B. Remy-Taillyour, C.S.I., R.E.		Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinates, &c.
No. 4 Drawing Office, Bangalore.		Mr. J. H. Nichol	Mr. B. V. Narayam Rao	33 Draftsmen, &c.	
		.. P. P. Walsh			
		.. S. F. Norman			
No. 5 Party, Berar, Central India and Central Provinces.		Mr. P. R. Anderson	Mr. Damodar Khadilkar	22 Surveyors, &c.	
		.. C. West			
		.. Haji Abdul Rahim, K.N.			
		.. F. H. Graut			
No. 6 Party, Bombay, Hyderabad and Madras.		Mr. J. O'B. Donaghey	Mr. Eknath Baltu	38 Surveyors, &c.	
		.. E. A. Meyer	.. Ram Narayan Hastir		
		.. P. C. Pilscher	.. Nabilad Khan		
		.. Musli Lal, B.A.	.. Masud Khan		
		.. P. W. Smith			
		.. M. S. Ganesa Aiyar			
		.. K. S. Gopalachari, B.A.			
No. 7 Party, Madras.		Mr. W. M. Gorman	Mr. Abdul Hakk, K.S.	39 Surveyors, &c.	
		.. H. B. Simons	.. Kolandera Mandanna		
		.. V. W. Morton	.. P. S. Venguswami		
		.. H. H. P. Butterfield	.. Shih Lal		
		.. B. T. Wyatt	.. H. Namsinhamurti Rao		
		.. N. S. Havihava Iyer	.. Shukh Muhammad Sabik		
			.. E. N. Natesan, B.A.		
			.. Palu Behari Roy		
			.. Jitendra Mohan Mukerji		
No. 8 Party, Madras.		Mr. W. F. E. Adams	Mr. Anantamo Dhondiba	26 Surveyors, &c.	
		.. M. Mahadeva Mudaliar, M.A.	.. Maudhre, R.S.		
			.. K. Narayanaswami Chetti		
No. 20 Party, Rawalpindi, Chitral, Drush, Ghazrat, Jehlum, Sialkot, Pajal, Dharmasala, Channan, Jhangsi, Deoli, Nowmuh, Nasirabad, Ahmadnagar, Drazinda, Jandola, Jatta and Zam Cantonments.		Mr. A. Ewing	Mr. Dharma	25 Surveyors, &c.	
		.. O. D. Jackson			
Training Section, Mysore.		Mr. S. S. McA'F. Fielding	Mr. Hari Ram Chandra	11 Surveyors, &c. and Pupils.	
		.. S. F. Norman	.. Jogalekar		
			.. G. K. Narasimha Ayyangar	} Under training.	
			.. K. R. Venkata Rao		
			.. Afraz Gul Khan		
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. J. H. S. Wilson		24 Draftsmen, &c.	
		.. E. Claudius			
No. 9 Party, Bengal, Bihar and Orissa.		Mr. J. Smith	Mr. Ram Singh	27 Surveyors, &c.	
		.. Dhani Ram Verma	.. Amalya Charn Ghosh		
		.. A. B. Hunter	.. Gopal Lal Mitra		
		.. B. C. Newland			
		.. Amar Krishna Mitra			
No. 10 Party, Upper Burma.	Major E. T. Rich, R.E.	Mr. M. C. Potters	Mr. Hayat Muhammad, K.S.	23 Surveyors, &c.	
		.. W. G. Jarbo	.. Maing Kyaw Nyein		
		.. H. H. Creed	.. Dhirendra Nath Saha		
		.. A. V. Dickson	.. Ram Prasad, R.S.		
		.. Dhirendra Nath Banerjee, L.C.E.			
No. 11 Party, Upper and Lower Burma.		Mr. J. O. Greiff	Mr. Lachman Daji Jadu, R.B.	30 Surveyors, &c.	
		.. C. E. C. French	.. Dalbir Rai		
		.. O. J. H. Hart	.. Pratul Chandra Sen Gupta, B. Sc.		
		.. T. P. Dewar			
		.. C. O. Picard			
No. 12 Party, Assam.	Lieut.-Colonel A. Mears, I.A.	Mr. H. W. Biggie	Mr. Girija Sonker Bagebi	35 Surveyors, &c.	
		.. E. G. Hardinge			
		.. Pramadaranjan Ray, R.S.			
		.. E. M. Kenny			
		.. Prafulla Chandra Mitra, B.A.			

TABLE I—(Concluded).—DISPOSITION OF OFFICERS, 1916-17.

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. ...hope, C.B., C.M. ... R.E.		Mr. H. A. Charrier		
Computing Office	Mr. J. deGraaff Hunter, M.A. Major H. McC. Cowie, R.E.		Mr. Hanuman Prasad	Mr. Sarat Kumar Mukerji	51 Computers, &c.
No. 2 Drawing Office and Forest Map Office, Dehra Dun.	Major H. H. Turner, R.E.	Mr. O. C. Ollenbach " C. C. Byrne " H. C. W. Stotesbury " O. N. Pushong " F. H. Grant " F. B. Kitchen " Abdul Karim, B.A. " F. J. Grice		Mr. Lal Singh, R.E. " Ram Singh, R.S.	89 Draftsmen, &c.
No. 13 Party, (Astronomical).	Colonel G. P. Lenox-Conyngham, R.E. Major H. H. Turner, R.E. Major H. McC. Cowie, R.E.				2 Computers, &c.
No. 14 Party, (Pendulum).	Colonel G. P. Lenox-Conyngham, R.E. Major H. McC. Cowie, R.E.				2 Computers, &c.
No. 15 Party, (Triangulation).	Mr. J. deGraaff Hunter, M.A.	Mr. H. G. Shaw " L. Williams " Raj Bahadur Mathur, B.A.		Mr. Jugal Behari Lal	9 Computers, &c.
No. 16 Party, (Tidal).		Mr. Syed Anlad Hossein, K.B. " O. C. Ollenbach " Syed Zille Hasnain			20 Computers, &c.
No. 17 Party, (Leveling).		Mr. H. G. Shaw " D. H. Luxa " Raj Bahadur Mathur, B.A. " G. A. Norman " Abdul Karim, B.A. " F. J. Grice " N. N. Chuckerbutty, L.C.E.		Mr. Satish Chandra Mukerjee	12 Recorders, &c.
No. 18 Party, (Magnetic).		Mr. E. C. J. Bond " Rama Prasad Ray, B.A. " N. R. Mazumdar " Raj Bahadur Mathur, B.A.		Mr. Karua Kumar Das, B.A. " Bidhu Bhusan Shome	2 Magnetic Observers. 12 Computers, &c.
No. 19 Party, (Base Line).		Mr. E. C. J. Bond " O. N. Pushong			3 Computers, &c.

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PART 2.—WORK OF FIELD PARTIES, &c.

I.—TOPOGRAPHICAL SURVEYS.

13. 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 600,000 square miles are likely to be surveyed on the half-inch or smaller scale.

Table II.—Progress of Topographical Surveys since 1905.

Survey year.	Scales of Survey.	Northern Circle.	Southern Circle.	Eastern Circle.	TOTALS.
		<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>
1905-06 ...	Mostly 2-inch and 1-inch	6,278	1,660	10,322	18,260
1906-07 ...	ditto ...	7,519	7,666	8,659	23,844
1907-08 ...	ditto ...	14,530	9,256	12,431	36,217
1908-09 ...	ditto ...	18,624	12,526	11,542	42,692
1909-10 ...	Mostly 1-inch ...	23,833	12,532	9,736	46,101
1910-11 ...	ditto ...	27,528	13,171	9,218	49,917
1911-12 ...	ditto ...	23,852	9,115	10,654	43,621
1912-13 ...	Mostly 1-inch and $\frac{1}{2}$ -inch	28,192	13,349	11,836	53,377
1913-14 ...	ditto ...	25,052	15,844	14,890	55,786
1914-15 ...	ditto ...	12,334	19,286	5,056	36,676
1915-16 ...	ditto ...	8,168	17,243	6,931	32,342
1916-17 ...	ditto ...	11,689	11,338	9,723	32,750
Total Areas completed to date ...		207,599	142,986	120,998	471,583
Approximate areas for the whole topographical programme.		750,000	542,800	528,800	1,821,600
Approximate areas remaining for survey.		542,401	399,814	407,802	1,350,017

Table III.—OUT-TURNS and COSTS of Topographical Surveys, 1916-17.

PARTY and LOCALITY.		OUT-TURNS.		COST OF SURVEY AND MAPPING.		REMARKS.			
Character of Country.	Scale and Class of Survey.	Areas on each Scale.	Totals on all Scales.	Total costs.	Cost-rates.				
No. 1 Party—Kashmīr, Jammu State, Punjab and North-West Frontier Province.		Sq. miles.		Rs.	Rs. per sq. mile.	NORTHERN CIRCLE.			
Irrigated plains and barren stony waste.	4-inch Original Military Survey	208	4,219	1,02,700 (a)	24.3				
Mountainous with well-wooded valleys and intricate foot hills.	1-inch Original Survey ...	2,677							
Cultivated plains, partly canal irrigated.	1-inch Resurvey ...	1,056							
Broken hilly ground and well-wooded	1-inch Supplementary Survey ...	278							
No. 2 Party—Punjab, Rajputāna and Delhi Province.		Sq. miles.		Rs.	Rs. per sq. mile.		(a) Includes Rs. 450 on account of establishment employed on mapping work in Basrah Survey Party but excludes Rs. 168 debitabte to the Tharoch State.		
Cultivated plains and sand hills with rocky outcrops.	1-inch Revision Survey ...	199	2,981	67,568 (b)	22.7				
	1-inch Original Survey ...	1,092							
	½-inch Original Survey ...	1,622							
	4-inch Revision Survey ...	64							
Atwar town	1½-inch Original Survey ...	4				(b) Excludes Rs. 85 debited to the Executive Engd. near, Lower Bari Doab Canal.			
No. 3 Party—United Provinces and Punjab.		Sq. miles.		Rs.	Rs. per sq. mile.	(c) Excludes Rs. 25,170 debitabte to the Forest Department and Rs. 1,969 debitabte to the Settlement Officer, Gorakhpur.			
Open and wooded plains and wooded hills.	1-inch Resurvey ...	2,619	2,863	84,020 (c)	29.3				
Wooded hills	2-inch Original Survey ...	11							
Open plains and undulating	3-inch Original Special Survey...	56							
Ditto ditto	3-inch Supplementary Special Survey.	56							
Densely wooded hills	4-inch Original Special Forest Survey.	118							
Wooded hills	4-inch Supplementary Special Forest Survey.	3							
No. 4 Party—United Provinces.		Sq. miles.		Rs.	Rs. per sq. mile.		(d) Includes cost of 5,235 square miles of mapping for village boundary editions of 1-inch maps.		
Plains fairly dense with mango tops	1-inch Resurvey ...	1,329	1,329	41,987 (d)	31.6				
Tānk Survey Detachment—Waziristān.		Sq. miles.		Rs.	Rs. per sq. mile.			(e) Of Plane-tabling only.	
Rocky barren hills from 1,200 to 8,000 feet in altitude.	1-inch Original Survey ...	297	297	6,745 (e)	22.7 (e)				
TOTALS, NORTHERN CIRCLE:— 11,689 sq. m. Rs. 3,03,020 Cost-rate 25.9									
No. 5 Party—Berār, Central India and Central Provinces.		Sq. miles.		Rs.	Rs. per sq. mile.	SOUTHERN CIRCLE.			
Well wooded cultivated plains	1-inch Original Survey ...	274	831	25,989 (f)	31.3				
Wooded intricate hills	1-inch Revision Survey ...	557							
No. 6 Party—Bombay, Hyderabad and Madras.		Sq. miles.		Rs.	Rs. per sq. mile.				(f) Excludes Rs. 13,969, cost of ½-inch mapping.
Varied, mostly undulating	½-inch Original Survey ...	5,045	7,333	1,08,784	14.8				
Undulating and cultivated	1-inch Original Survey ...	1,857							
Wooded flat-topped hills	1½-inch Resurvey ...	431(g)							
No. 7 Party—Madras.		Sq. miles.		Rs.	Rs. per sq. mile.		(g) This area had been previously surveyed on a smaller scale.		
Varied	1-inch Original Survey ...	3,108	3,312	1,05,009	31.7				
Wooded intricate hills	1-inch Supplementary Survey	24							
Wooded, undulating and hilly	2-inch Original Survey ...	65							
Ditto	4-inch Original Survey ...	115							
No. 8 Party—Madras.		Sq. miles.		Rs.	Rs. per sq. mile.	(h) Excludes Rs. 21,467, cost of ½-inch mapping.			
High wooded and low intricate hills	1-inch Original Survey ...	293	293	28,638 (h)	97.7				
TOTALS, SOUTHERN CIRCLE:— 11,769 sq. m. Rs. 2,68,414 Cost-rate 22.8									

Table III—(Concluded).—OUT-TURNS and COSTS of Topographical Surveys, 1916-17.

PARTY and LOCALITY.		OUT-TURNS.		COST OF SURVEY AND MAPPING.		REMARKS.
Character of Country.	Scale and Class of Survey.	Arens on each Scale.	Totals on all Scales.	Total costs.	Cost- rate.	
		Sq. miles.		Rs.	Rs. per sq. mile.	EASTERN CIRCLE.
No. 9 Party—Bengal, Bihār and Orissa.						
Flat and cultivated plains in Bengal, wooded hills and plains in Bihār and Orissa.	1-inch Original Survey	1,681	1,681	42,560 (i)	25.3	(i) Includes costs of computations and preparation of traverse charts but excludes Rs. 20,592 cost of half inch mapping and Rs. 416 cost of Sibsigar-Darrang boundary survey.
No. 10 Party—Upper Burma.						
High hills densely wooded	1/2-inch Original Survey	2,140	3,454	1,36,499 (j)	39.5	(j) Includes Rs. 10,384 cost of instruction camp.
Ditto ditto	1-inch Original Survey	1,238				
Ditto ditto	1-inch Revision Survey	16				
Ditto ditto	2-inch Original Survey	60				
No. 11 Party—Upper and Lower Burma.						
Densely wooded hills and swamp vegetation.	1-inch Original Survey	2,213	2,709	1,72,244 (k)	63.6	(k) Includes cost of Mymyo Drawing Office.
Densely wooded hills	1-inch Revision Survey	318				
High hills densely wooded	2-inch Original Survey	178				
No. 12 Party—Assam.						
Plains, partly under cultivation and partly densely wooded.	1-inch Original Survey	1,747	1,879	1,19,919	63.8	
Densely wooded plains and low hills.	2-inch Original Survey	132				
TOTALS, EASTERN CIRCLE:—		9,723 sq. m.		Rs. 4,71,222	Cost-rate 48.5	
GRAND TOTALS:—		33,181 sq. m.		Rs. 10,42,656	Cost-rate 31.4	

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

14. No. 1 Party.—This party surveyed an area of 4,011 square miles on the scale of 1 inch = 1 mile in parts of Kashmir—Jammu and Chamba States, and in the districts of Gurdāspur, Hoshiāpur and Kāngra of the Punjab.

The country surveyed varied from 850 to 15,300 feet in altitude, and consisted of well cultivated plains and intricate foot hills, and mountainous well-wooded valleys.

An area of 208 square miles was surveyed on the scale of 4 inches = 1 mile in the Peshāwar district of the North-West Frontier Province for military purposes (*vide* page 17).

15. No. 2 Party.—This party surveyed a total area of 1,291 square miles on the scale of 1 inch = 1 mile in the Gurgaon district, and the Nābha, Jind and Patiāla States, of the Punjab, and in the Alwar, Bharatpur and Jaipur States of the Central India Agency; also areas of 4 square miles on the 1½-inch scale in the State of Alwar, 1,622 square miles on the half-inch scale in the States of Alwar, Bharatpur and Jaipur, and 64 square miles on that of 4 inches = 1 mile of Imperial Delhi and Delhi New Cantonment.

The country surveyed was hilly with a good number of sand hills.

In addition, triangulation and traversing of 950 square miles and 189 linear miles respectively were carried out for current one-inch detail survey in portions of Alwar, Bharatpur, Jaipur and Patiāla States.

16. No. 3 Party.—This party surveyed a total area of 2,751 square miles in the Budaun, Bareilly, Garhwāl, Morādābād, Naini Tāl, Pilibhit and Shāhjahānpur districts of the United Provinces and Rāmpur State (Rohilkhand). Of this area, 2,619 square miles were resurveyed on the one-inch scale, 11 square miles were surveyed on the two-inch scale, 3 square miles (of the Mukteswar reserved forest) were supplemented on the four-inch scale, and 118 square miles were surveyed on the four-inch scale. The two last mentioned were special forest surveys (*vide* page 16). In addition, 1,588 square miles and 588 linear miles were respectively triangulated and traversed in advance with the object of extending survey operations into these areas in subsequent years.

The nature of the country varied in character and may conveniently be divided into three belts; fairly open and well cultivated plains in the south, densely wooded hills in the north, with the well-wooded and low-lying tracts of the Tarai and Bhābar in the centre.

An area of 112 square miles was also surveyed in the Attock district of the Punjab, (*vide* page 17).

17. No. 4 Party.—A section of this party surveyed an area of 1,329 square miles on the scale of 1 inch = 1 mile in the districts of Gorakhpur and Basti of the United Provinces in continuation of last year's programme. The continuity of well cultivated fields is broken by village-sites, numerous orchards of mango trees and the treeless and flood-swept tracts on both banks of the Rāpti and Aui rivers. The Rāpti river traverses almost the whole length of country surveyed.

18. Tānk Survey Detachment.—This detachment surveyed an area of 297 square miles in Southern Waziristān on the scale of 1 inch = 1 mile.

The country surveyed varied from 1,200 to 8,000 feet in altitude, and consisted of barren rocky hills; the only water obtainable lay in a few of the larger *nālas*.

The survey was based on previously executed triangulation.

19. Recess Work.—The fair-mapping of the following numbers of sheets of the current and previous season's survey remained for completion on 30th September 1917 :—

Sheets on the half-inch scale	2
Sheets on the one-inch scale	52
Forest Survey sheets on the two-inch scale	7
Special four-inch surveys for publication on the two-inch and four-inch scales ...	10

The backwardness of fair-mapping has been due partly to the very late return from the field of Nos. 1 and 3 Parties, and partly to the reduction in the establishment of No. 4 Party on amalgamation with the Sind-Sāgar Party. No. 2 Party has failed to deal with its current mapping.

Half-inch mapping from published modern one-inch sheets, or from old trans-frontier half-inch maps, is dealt with on page 39.

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

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

21. No. 5 Party.—This party surveyed an area of 831 square miles on the one-inch scale in the Akola and Amraoti districts of Berār and in the Betāl and Nimār districts of the Central Provinces, and triangulated an area of 412 square miles in the Hoshangābād district of the Central Provinces and in the Bhopāl State of Central India. The country surveyed consists of jungle-clad hills and of well-wooded, cultivated plains. The majority, including the head-quarters, of the party remained at Bangalore throughout the year and was principally employed on the fair-mapping of half-inch sheets compiled from published sheets of the one-inch map.

22. No. 6 Party.—This party surveyed an area of 7,333 square miles on different scales in the Sholāpur and Bijāpur districts and the Akalkot, Kurandvād and Sāngli States of Bombay and in the Osmānābād, Bīdar, Gulbarga, Medak, Atrāf-i-balda, Nalgonda and Mahbūbnagar districts of Hyderābād, and triangulated an area of 13,280 square miles in the Bijāpur and Dhārwar districts of Bombay, in the Bellary district of Madras and in the Gulbarga, Raichūr, Atrāf-i-balda and Mahbūbnagar districts of Hyderābād. The country surveyed is undulating and highly cultivated in the Bombay area, the Hyderābād portion consists of wooded, rocky hills and scattered boulders interspersed with areas of cultivation and low scrub jungle.

23. No. 7 Party.—This party surveyed an area of 3,312 square miles on various scales in the Nellore, Chittoor and Chingleput districts of Madras, triangulated an area of 6,994 square miles in the Kurnool, Cuddapah, Guntūr and Nellore districts of Madras, and traversed 132

linear miles in the Nellore district. The country surveyed includes a portion of the eastern slopes of the Eastern Ghāts and of the undulating ground extending, in an expanse of wooded and cultivated lands broken at long intervals by detached knolls, from the foot of these Ghāts to the sea coast.

24. No. 8 Party.—This party surveyed an area of 293 square miles on the one-inch scale in the Tinnevely district and the Travancore State of Madras, triangulated 1,630 square miles in the Madura and Rāmnād districts of Madras, and traversed 258 linear miles in the Tinnevely district. The country surveyed comprises an unexplored portion of the Pandalan hills; the country is for the most part covered with evergreen forest with dense undergrowth, there are little or no means of communication, and transport and labour are extremely difficult to obtain as men from the low country will not enter this area. The survey was difficult and entailed considerable hardships on the members of the party concerned. The majority, including the head-quarters, of the party remained at Bangalore throughout the year and was principally employed on the fair-mapping of half-inch sheets compiled from published sheets of the one-inch map.

25. Training Section.—This section took the field in the Kolār and Tumkūr districts of Mysore. 3 upper subordinates and 10 lower subordinates received instruction in topographical surveying.

26. Recess Work.—The whole of the area surveyed this year should be fair-mapped by the end of 1917.

27. The report on cantonment surveys, undertaken by No. 20 Party, is entered on page 18.

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

28. No. 9 Party.—This party surveyed an area of 1,362 square miles on the one-inch scale in the Murshidābād, Nadiā and Burdwān districts of Bengal, and an area of 319 square miles on the same scale in the Monghyr and Bhāgalpur districts of Bihār and Orissa. The country surveyed in Bengal is low-lying and nowhere is it even 50 feet above sea-level. Except along the Bhāgirathi or Hooghly river and other large streams where villages cluster thickly on both banks, the country consists of large open tracts of rice cultivation sparsely dotted with villages and clumps of trees. In Bihār the general level of the country is 500 feet, but a range of hills rising at its highest point to 1,600 feet crosses the area from south-west to north-east, the hills being forest clad and the plains cultivated in parts with dry cereals chiefly dhal and mustard.

29. No. 10 Party.—This party surveyed an area of 3,454 square miles on different scales in Myitkyinā and Putao districts of Upper Burma and triangulated an area of 4,752 square miles in advance for detail surveys on the scales of one inch and half inch to the mile. The country surveyed was densely wooded and ranged in altitude from 600 feet in the valley of the Mali Hka to 11,300 feet in the Kumon Bum forming the watershed between the Mali Hka and Chindwin rivers. There are no roads and villages over large areas lying along the eastern slopes of Kumon Bum.

30. No. 11 Party.—No. 11 party surveyed a total area of 2,709 square miles, of which 2,213 square miles were on the one-inch scale, 178 square miles on the two-inch, and 318 square miles one-inch revision survey. In the Mergui district and Archipelago 4,075 square miles were triangulated.

The work lay in the valley of the Tenasserim, and the extreme north of the Archipelago in the Mergui district. From the sea littoral to the main watershed, forming the administrative boundary between Burma and Siam, the country varied from dense mangrove swamps intersected by numerous creeks, to steep hills rising to an elevation of 4,000 feet, covered with almost primeval tree growth, intermixed with dense areas of bamboo and cane.

The two-inch survey, and part of the revision, were respectively carried out in the district of Kyaukse, and in the district of Mandalay and the Northern Shan States; the country consisting of well cultivated areas in the latter, and of fairly steep hills densely wooded in the former.

31. No. 12 Party.—This party surveyed 1,747 square miles on the one-inch scale, and 132 square miles of reserved forests on the two-inch scale in the districts of Lakhimpur and Sibsāgar and the North-East Frontier Tract, Central and Eastern Sections. 466 linear miles of traversing, covering an area of 1,111 square miles east of the area surveyed, was also carried out to provide points for detail survey in 1917-18.

Generally speaking the whole area over which survey and traverse operations were extended is well-wooded, tree, cane, and high grass jungle being interspersed with numerous tea gardens and rice cultivation. The country comprises the alluvial plains of the Brahmaputra which is the principal river in the area.

32. Recess work.—There were no arrears of mapping of the previous season's survey on 30th September 1917, but of the current season's survey 6 sheets remain unfinished, these sheets will be completed before 31st December next.

II.—FOREST SURVEYS.

33. Details of the topographical surveys of reserved forests executed by field parties of the Survey of India are given below. The surveys were mostly on the two-inch scale, but in special cases the four-inch and one-inch scales were used. Boundary surveys on the four-inch scale were also made where required.

NORTHERN CIRCLE.

34. **Kumaun Forest Circle, United Provinces** (*Nainī Tal District Forests*).—Twenty-four blocks covering an area of 72·063 square miles in the Peora, Bhowāli, Manora and Barhon Forest Ranges were surveyed on the four-inch scale, and a revision survey on the same scale of 2·906 square miles in the Latauli Block was also carried out for the Imperial Bacteriologist, Mukteswar. Preliminary to future surveys on the four-inch scale an area of 95 square miles was triangulated in advance, and 342 linear miles were traversed.

(*Southern Garhwāl Forest Division*).—About 3 square miles were surveyed on the two-inch scale.

SOUTHERN CIRCLE.

35. **Madras Forests** (*Nellore District*).—Two extensions of the Velikonda Block in the Rāpūr Tāluk and one in the Udayagiri Tāluk covering an area of 114·537 square miles were surveyed on the four-inch scale, and sixteen blocks in the Rāpūr Tāluk, two in the Gūdūr Tāluk and two in the Nellore Tāluk, covering an area of 64·592 square miles were surveyed on the two-inch scale. Theodolite traverses were also carried out along portions of the Velikonda reserve where no traverse data of the Madras Revenue Survey were available.

EASTERN CIRCLE.

36. **Assam** (*Eastern Forest Circle*).—The Panidilingia, Dirai, Abhaipur, and Sola reserves, covering an area of 86·26 square miles in the Sibsaḡar district and the Jokai, Dihingmukh and Dibru reserves covering an area of 45·66 square miles in the Lakhimpur District were surveyed on the two-inch scale. Portions of the boundaries of the Sola, Jokai, Dibru and Upper Dihing (east block) forests were traversed and plots of these will be prepared in due course.

37. **Burma** (*Northern Forest Circle, Myitkyinā Forest Division*).—An area of 59·8 square miles of the Mokso extension which is to form part of the Indawgyi reserve was surveyed on the two-inch scale.

(*Meiktila Forest Division*).—The remaining portion of the Yeyaman reserve covering an area of 177·75 square miles was surveyed on the two-inch scale.

(*Southern Forest Circle, Tenasserim Forest Division*).—An area of 71·16 square miles in the Auckland Bay reserve was surveyed on the one-inch scale, and the survey of the Sandawut Forest was completed, but as the boundary of the reserve has not been demarcated its area cannot be definitely ascertained.

III.—CANTONMENT AND LARGE-SCALE SURVEYS.

38. No. 1 Party.—During the year under report a detachment was employed on military surveys, on the scale of 4 inches = 1 mile, of an area of 208 square miles round Peshāwar, in the North-West Frontier Province.

The country surveyed was for a great part highly irrigated and intersected by numerous branches of the Kābul river, while, on the west, it was a barren stony waste cut up by innumerable ravines.

The fair map, consisting of 6 sheets, each drawn in 2 halves on the scale of survey for publication primarily on that of 2 inches = 1 mile, is at present under preparation in the party.

The cost-rate of survey works out at Rs. 70·7 per square mile, and that of mapping at about Rs. 23 per square mile.

39. No. 2 Party.—This party carried out the first of the biennial revisions of the four-inch maps of Imperial Delhi and the Delhi New Cantonment during the year under report. The area dealt with amounted to 64 square miles. This revision disclosed very considerable changes since the execution of the original survey on the same scale. These changes were due, partly to demolitions and to new lays-out and new construction, and partly to extensive levelling operations. These latter necessitated an entire recontouring of most of the area of the Imperial City. Observations, with a view to the determination and elimination of an error in the geographical position of the detail of the original map, were also undertaken, as well as a careful traverse survey of the eastern boundary of the Delhi Province on the left bank of the Jumna river.

40. No. 3 Party.—During the year under report the party carried out a survey, partly original and partly supplementary, of some 112 square miles of country near Campbellpore in the Attock district of the Punjab.

This survey was executed on the scale of 3 inches = 1 mile. It was called for urgently and at very short notice by the military authorities, for the purpose of an Artillery Practice Camp, and was put through in 22 days.

The fair map is being drawn for publication in the Northern Circle Drawing Office.

41. The Punjab Riverain Detachment.—The detachment continued the work of traversing, and laying down base lines. 977 linear miles of main circuits and 2,246' linear miles of minor traverses were run; 1,359 theodolite stations of the former and 8,535 of the latter were fixed in the area under water action of the rivers Indus, Chenāb, Rāvi, and Jumna in districts Dera Ghāzi Khān, Muzaffargarh, Multān, Ambāla and Sahāranpur. 537 corners of 179 squares were demarcated with permanent mark-stones on both banks of the Indus and Jumna rivers in districts Dera Ghāzi Khān, Muzaffargarh, Ambāla and Sahāranpur. These are to serve as bases for the future survey and demarcation of boundaries and fields in the beds of the rivers. 1,231 plotted and 355 boundary *masāvis* (settlement mapping sheets) on the scales of $\frac{1}{2,640}$ (Dera Ghāzi Khān) and $\frac{1}{2,280}$ (Ambāla), and 31

four-inch sheets were traced and supplied in time to the Settlement Officers. Besides these 191 miscellaneous traces were prepared and all the traverse stations marked during the year were plotted on 30 four-inch sheets. 5 riverain boundary sheets, (scale 4 inches to a mile), of the Beās (districts Kāngra and Hoshiārpur) were typed and finally examined.

The work was continued in the Kāngra district during the year. 414 traverse stations were computed and plotted on 2 four-inch sheets; the computation volumes of Pālampur, Kāngra and Nūrpur have to a great extent been completed. 1,187 plotted *masāvis* of 59 *tikās* (sub-villages) and 102 enlarged boundary *masāvis* of 32 villages of the Beās, on the scale 20 and 40 *karms* (one *karm*= 57.5 inches) to an inch, and 18 traces of 18 sheets, on the scale 4 inches to a mile, were supplied to the Settlement Officer, Kāngra. Besides these 10 miscellaneous traces were prepared.

The computation volumes of the Simla district were completed during the year.

The Kāngra Road Survey was carried on in continuation of the last year's programme with the object of co-ordinating the road and settlement boundaries. 43.30 miles of road, from mile No. 48 to 53.28, from mile No. 94 to 91.72, and from mile No. 89 to 53.26, were surveyed. 840 points were fixed with theodolite and 55 linear miles traversed. 29 sheets (scale 200 feet to an inch) of the main road, and 23 sheets (scale 50 feet to an inch) of 20 *bāzārs*, surveyed last year, were plotted, typed, examined and supplied to the Executive Engineer, Provincial Division, Kāngra, together with copies of *khavnās* (records of rights) relating to the same. 27 sheets (scale 200 feet to an inch) of the main road and 5 sheets (scale 50 feet to an inch) of 5 *bāzārs*, surveyed this year, are also almost ready and will be supplied to the Executive Engineer early during next winter. Besides these 7 indexes of last year's work and 5 of that of this year were prepared on the scale 4 inches to a mile.

At the end of August 1917 some traversing was undertaken for a three-inch military survey close to Campbellpore. 18 linear miles were run and the heights of traverse stations fixed.

42. No. 20 Party.—During the year under report, the party was employed on the survey of the cantonments and military stations of Rāwalpindi, Chitrāl, Drosh, Ghairat, Jhelum, Siālkot, Topa, Dharnsāla, Chaman, Jhānsi, Deoli, Neemuch, Nasirābād, Ahmadnagar, Drazinda, Jandola, Jatta, and Zām on the sixteen-inch scale, and on the survey of the *bāzārs* of Rāwalpindi, Jhelum, Siālkot, Topa, Jhānsi, Deoli, Neemuch, Nasirābād and Ahmadnagar on the scale of 64 inches to 1 mile. The triangulation and traversing of Chitrāl, Drosh, Ghairat, Dharnsāla, Jhānsi, Deoli, Nasirābād, Ahmadnagar, Drazinda, Jandola, Jatta, and Zām were completed during the year. Jhānsi and Ahmadnagar have been traversed in advance for the year 1917-18.

Twenty-six fair sheets have been submitted for publication, sixty-five fair sheets are remaining and will be sent for publication by July 1918.

This party was transferred from the Northern to the Southern Circle from 1st April 1917.

Out-turn and cost-rates of Cantonment Surveys, 1916-17.

Cantonments.	Scales.	Out-turns.	COST OF SURVEYING AND MAPPING.	
			Total cost.	Cost-rates.
Rūwalpindi, Chitrāl, Drosh, Ghairat, Jhelum, Siālkot, Topa, Dharnsāla, Chaman, Jhānsi, Deoli, Neemuch, Nasirābād, Ahmadnagar, Drazinda, Jandola, Jatta and Zūn ...	16-inch	<i>Acres.</i> 23,859	<i>Rs.</i> 45,619	<i>Rs. per acre.</i> 1'9
Rūwalpindi, Jhelum, Siālkot, Topa, Jhānsi, Deoli, Neemuch, Nasirābād and Ahmadnagar...	64-inch	630	8,190	13'0
		24,489	53,809	

Alphabetical List of Cantonments and Military Stations surveyed and published in modern style, on the scale of 16 inches = mile, up to 1916-17.

- | | |
|-------------------------------------|------------------------------|
| (1) Bannu Cantonment. | (10) Landour Cantonment. |
| (2) Dehra Dūn do. | (11) Meerut do. |
| (3) Fort Lockhart do. | (12) Quetta do. |
| (4) Guna do. | (13) Quetta Civil Station. |
| (5) Hangu do. | (14) Rājkot Cantonment. |
| (6) Hāpur (Babugarh) Remount Depôt. | (15) Māranpur Remount Depôt. |
| (7) Jullundur Cantonment. | (16) Sanāwar Cantonment. |
| (8) Kālka do. | (17) Saugor do. |
| (9) Kamptee do. | (18) Thal do. |

IV.—TRIGONOMETRICAL SURVEYS.

GEODETTIC OPERATIONS.

43. No. 13 Party.—Astronomical Latitudes.—No latitude operations were undertaken, there being no officer available. The establishment of the party was employed at head-quarters.

The marking of Longitude Stations by means of suitably inscribed slabs was continued.

44. No. 14 Party.—Pendulum Observations.—No observations were made, as no officer was available. The establishment of the party was employed at head-quarters.

45. No. 15 Party.—Triangulation.—During the year under report the following series of triangulation were carried out:—

(a). *The Madura Series. (96).*

The building of this series, which lies along the parallel of 10° , between the Great Arc and South-East Coast Series, was completed in season 1911-12, *vide* General Report for that year.

The observations had not been taken up earlier, as the stations at the eastern end of the series lay in low flat country, covered with extensive palm groves and other large trees, which necessitated the use of a special trestle for the theodolite, and high masts for signals. These were constructed last year and the observations were carried out successfully, the series being completed by the first week of February 1917.

(b). *The Bāgalkot Series. (97).*

This series, which emanates from a side of the Mangalore Meridional Series, and extends along the parallel of 16° , to its junction with the Naldrug Series, was built and the observations satisfactorily completed.

The table below gives details regarding the triangulation.

PARTICULARS OF TRIANGULATION DURING 1916-17.

	Madura Series.	Bāgalkot Series.
Number of stations observed at	12	14
" " newly fixed	8	10
" " " built ... ..	.....	10
Length of triangulation completed in miles	68	102
" " " still remaining to be done ... ..	.....	.....
Area of triangulation in square miles	781	1,400
Theodolites used	T. & S., 8", Nos. 1,055, 1,311	T. & S., 8", No. 1,311
Number of triangles observed	10	13
" " " astronomical azimuths observed ... ..	.....	.....
Maximum triangular error	4"68	2"17
Average	1"53	1"02
Mean errors in clos- ing on the South. { in Latitude	+0"01	—0"06
" " " " Longitude	—0"09	—0"09
" " " " Height in feet ... ..	.....	—0'5 feet
" " " " Azimuth	+3"2	—1"13
" " " " log. side (the unit being the " " " " seventh place of decimals).	—205	—68
Value of m	1'148	0'701
" " " M°	1'53	0'83

**Id*e Records of the Survey of India, Vol. IX, page 137.

46. No. 16 Party.—Tidal Operations.—During the year under report tidal registrations were carried out by means of self-registering tide-gauges at the stations given in the following list:—

Stations.	Date of commencement of observations.	Date of closing of observations.	Number of years of observations.	REMARKS.
1. Aden	1879 ...	Still working	38	} 50 } 32 } 14 } 14
2. Karāchi	1868 ...	1880	13	
	1881 ...	Still working	37	
3. Bombay (Apollo Bandar)	1878 ...	"	39	
4. Bombay (Prince's Dock)	1888 ...	"	29	
	1880 ...	1890	10	
5. Madras	Restarted 1895	Still working	22	
6. Kidderpore	1881 ...	"	36	
7. Rangoon	1880 ...	"	37	
	1880 ...	1886	6	
8. Moulmein	Restarted 1909	Still working	8	
9. Port Blair	1880 ...	"	37	

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

From March 1916 hourly readings of a tide-gauge at Basrah, which was erected there by the military authorities, were supplied to this department. As soon as the readings for a whole year were available, they were reduced by the method of harmonic analysis, and the constants thus deduced were forwarded in April 1917 to the National Physical Laboratory, Teddington, England, where tidal predictions were made from them with the aid of the tide-predicting machine lodged there. One set of the predictions were received from the Laboratory on the 6th of August 1917. With this material, tide-tables for the port of Basrah from 1st September 1917 to 31st December 1918 were printed in the office of the Trigonometrical Survey at Dehra Dūn, and a supply of the same was despatched to the Director, Inland Water Transport, Basrah on 3rd September 1917.

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

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

Owing to constant silting at the tidal observatory at Kidderpore and the difficulty of maintaining free communication between the sea and the tide-gauge well, the Port Commissioners of Calcutta built a new observatory in deeper water about 30 feet N.E. of the old observatory. In April 1917 the tide-gauge was removed from the old observatory and installed in the new one, where it has been working since.

In the following table are given the actual 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 $\frac{1}{15}$ of mean range at springs.	Within 15 minutes of actuals.		Within 8 inches of actuals.	Within $\frac{1}{5}$ of mean range at springs.		
									H.W.—L.W.	H.W.—L.W.
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		
1916	6	81 82	96 97	96 99	3	81 68	73 62	93 87		
Average of ten years	...	82 83	97 98	97 98	...	67 58	72 63	93 90		

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

The out-turn, including branch lines, amounted to 540 miles of double levelling. The heights of 4 principal stations of the Great Trigonometrical Survey, and 10 primary and 627 secondary bench-marks were determined.

(a).—*In Bengal.*

Revision from Chāmpdāni to Burdwān along the Grand Trunk road. This line was originally levelled in 1862-63.

New levelling from Barākar to Burdwān along the Grand Trunk road. This completes the line from Benares to Burdwān.

New levelling from Dāmodar river to Barākar along the main road from Purūlia. This line is a continuation of that from Aurangābād *via* Daltonganj, Rānchi and Purūlia to Barākar.

(b).—*In Bihār and Orissa.*

New levelling from Aurangābād *via* Daltonganj, Rānchi and Purūlia to the Dāmodar river along the main roads. This line was carried on to Barākar.

New levelling from Barhi *via* Hazāribāgh to Rānchi along the P.W.D. road.

A detachment was engaged in the Sind-Sāgar Doāb on the selection and building of the stations of the triangulation required for the control of the rectangle survey of that tract. In all 51 stations were built and 6 Tower Stations of the Great Trigonometrical Survey repaired. The distance covered was about 195 linear miles. The work comprised a series between Klushāb and Leiah with a branch towards Mīānwāli; the series will eventually be extended to the south towards Muzaffargarh

48. No. 19 Party.—Base Line Operations.—No Base Line work was practicable during the year, owing to the deficiency of officers.

Triangulation.—The detachment which carried out the traverse of the boundary of the Imperial Delhi Area last season was employed this year in the execution of a net-work of minor triangulation to provide points for the revision of the four-inch maps of Delhi and its vicinity. The triangulation embraces an area of 324 square miles between Latitudes $28^{\circ} 30'$ and $28^{\circ} 47'$ and Longitudes $77^{\circ} 0'$ and $77^{\circ} 20'$.

Work during recess season.—The detachment was employed for a month and a half in preparing a synopsis of the triangulation for publication and was then broken up and its members transferred to other offices and parties.

MAGNETIC SURVEY.

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

No field observations were taken during the year.

Reports on the condition of the pillars of all the permanently marked repeat stations in India and Burma are being received yearly from the district officers and it is satisfactory to note that the pillars are all in good preservation.

Reduction of observations to epoch.—The reduction of the magnetic elements of all the field and repeat stations in India, Burma and Ceylon to the epoch 1909.0 was continued during the year and is nearing completion. The Declination and Horizontal Force data are ready for publication but, as the reduction of the Dip is well advanced, it is now considered desirable to await the completion of the latter and to publish all the magnetic elements of the field and repeat stations together. With the published values of these elements will be included the average annual change of each element at the field and repeat stations for each of the two periods 1901 to 1909.0 and 1909.0 to 1914. There will also be issued the monthly mean values of the elements at the observatories and a set of isomagnetic charts, as well as a set of charts showing graphically the monthly mean values and annual change of each element at the observatories from 1901 to 1909.0 and 1909.0 to 1914, *i.e.*, the average annual change will be given separately for each of the periods preceding and following the beginning of January 1909, the selected epoch of the survey, which is the date nearest to the point where an appreciable change is indicated in the curve of secular variation: the sections of the curve, prior to and subsequent to 1909.0 respectively are approximately straight lines, indicating that the annual change was nearly uniform both before and after 1909.0 but that its value altered at that epoch.

The magnetic elements at observatories.—The computation and tabulation of the provisional values of Declination, Dip, Horizontal Force and Vertical Force for the three observatories (Dehra Dūn, Toungoo and Kodaikānal) for 1916 have been completed; the mean values of these elements for the year 1916 derived from all days, excluding those of great disturbance, are given in the table below.

MEAN VALUES OF THE MAGNETIC ELEMENTS AT OBSERVATORIES IN 1916.

Observatory.	Latitude & Longitude.	Dip.	Declination.	Horizontal Force.	Vertical Force.
	" " "	" "	" "	C. G. S.	C. G. S.
Dehra Dūn ...	{ 30 19 19 N } { 78 3 19 E }	N 44 37·9	E 2 11·0	·33050	·32627
Toungoo ...	{ 18 55 45 N } { 96 27 3 E }	N 23 8·5	W 0 8·4	·39018	·16676
Kodaikānal ...	{ 10 13 50 N } { 77 27 46 E }	N 4 22·4	W 1 27·9	·37633	·02878

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PART 3.—OFFICE WORK.

I.—HEAD QUARTER OFFICES.

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

50. The most noticeable features in the work of the Map Publication Offices during the year are:—

- (a) The large increase of work done in the Photo.-Litho. Office, the number of pulls and maps printed again being an easy record, the number of pulls on the machine and hand presses being 3,954,954 as against 2,975,149 last year and the finished maps printed being 1,080,573 as against 735,999 last year. As the machine power only increased 6 per cent. these results were accomplished by constant overtime work; they were caused entirely by increased military demands.
- (b) The work in the Photo.-Litho. Office is reflected in the increased issues of maps in the Map Record and Issue Office 685,206 copies as against 437,131 last year. The work of this office is also largely increased by the demand for maps mounted on cloth and folded.
- (c) The large increase in issues and in work done in the Mathematical Instrument Office is due entirely to compliance with military demands.

51. 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 smaller scales.
- (g)—Special maps.

52. (a) Topographical maps on the scale of 1 inch to 1 mile.—During the year 64 modern sheets have been received and 85 have been published. The corresponding figures for the previous year being 128 and 204 respectively. This large reduction is due to certain parties surveying on the half-inch scale and to reduction of field work owing to the war.

The one-inch sheets of all areas surveyed up to 30th September 1915 have been published; of the sheets surveyed up to 30th September 1916, 54 remain to be published.

Index maps Nos. 4 to 6 at the end of this report show the progress made in the publication of the modern one-inch 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
1916-17	23	40	22	85
Total Published	626	422	430	1,479
No. of 1-inch sheets which will not be published whose area is covered by published $\frac{1}{2}$ -inch sheets	...	30	...	30
Approximate number of 1-inch sheets in India	2,160	2,067	2,101	6,328
Approximate number remaining for publication	1,534	1,614	1,671	4,819

In addition to the above out-turn of modern one-inch sheets, 14 sheets prepared from modern revenue surveys have been received for publication, and 13 published as preliminary editions pending their topographical revision at some future date; these sheets are now published in colours (*vide* Index maps No. 7 and No. 8); special editions of 30 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, 61 modern one-inch and 60 old style sheets on various scales have been reprinted. The increase in reprints mentioned in last year's report continues.

53. (b) Topographical Maps on the scale of $\frac{1}{2}$ inch to 1 mile. (*Vide* Index map No. 9).—These form one of the most important series, as it has been decided that they should form the tactical map of India. The table below gives the annual output of sheets:—

Year.	Drawn from component one-inch sheets.	Surveyed on $\frac{1}{2}$ -inch scale.	Total.
1914-15	...	1	1
1915-16	21	4	25
1916-17	50	6	56
Totals	71	11	82

54. (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° of latitude and 1° of longitude, or the area covered by 16 one-inch sheets, or four half-inch sheets.

The following table shows the progress made in publication of sheets within India :—

Years of Publication.	NUMBER OF DEGREE SHEETS PUBLISHED.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
1911-12	2	1	4	7
1912-13	3	1	1	5
1913-14	4	3	2	9
1914-15	1	3	3	7
1915-16	.....	1	4	5
1916-17	1	.....	2	3
Totals	11	9	16	36
Approximate number of degree sheets in India	170	140	140	450

The number of these sheets received for publication is now very small and will not increase until considerable progress has been made with the half-inch sheets, the intention in future being to draw "degree sheets" from reductions of the 4 component half-inch instead of the 16 one-inch sheets. Pending the preparation of these sheets from modern surveys 29 "degree sheets" have been published during the year as provisional issues; these are merely extracts from the engraved Atlas sheets (which will be gradually superseded) brought up to date as far as possible.

55. (d) Geographical Maps on the one-millionth scale. (about 16 miles to 1 inch). (*Vide* Index map No. 11).—During the year 12 sheets of this series were published, either new or in new style to supersede old editions, a considerable increase over previous years. Engraved editions of this series follow after the helio-zincographed editions. Several sheets which were published when this series was first commenced are now being modernised, so that the whole of the series may be of uniform style, and can be joined together or form a basis of maps of Provinces.

56. (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. Two sheets N. E. 44 and N. D. 44 have been published during the year. The sheets of this series are engraved.

57. (e) Geographical Maps on the two-millionth scale. (about 32 miles to 1 inch).—No sheets of this series were published this year, but good progress has been made in the drawing of two sheets for Assam and Bombay.

This series will in time supersede the Map of India and Adjacent Countries, scale 32 miles to 1 inch, of which the layered edition has made good progress and will be published in 1917-18.

58. (f) General Maps on smaller scales.—The new map of India on the four-millionth scale to replace the 64 miles = 1 inch map has made good progress and it is hoped will be published in 1917-18.

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

The annual edition of the Railway Administration map, the triennial Railway, Road and Canal map, and a new map of the Province of Bihar and Orissa were also published.

59. (g) Special maps.—These are very numerous and include a geological map of Mysore, which necessitated many printings, many Artillery Practice Camp maps, a large scale map of Simla and various manœuvres and special maps for the General Staff, as well as maps for other departments and Local Governments.

60. Map Record and Issue Office.—The face value of maps received during the year under report, from the printing offices amounted to Rs. 5,09,155. This sum includes Rs. 7,435 and Rs. 6,384, the value of maps printed in the Engraving and Dehra Dūn Offices respectively.

Details of the classes of maps published during the year and their face value are given in Table IV on page 34.

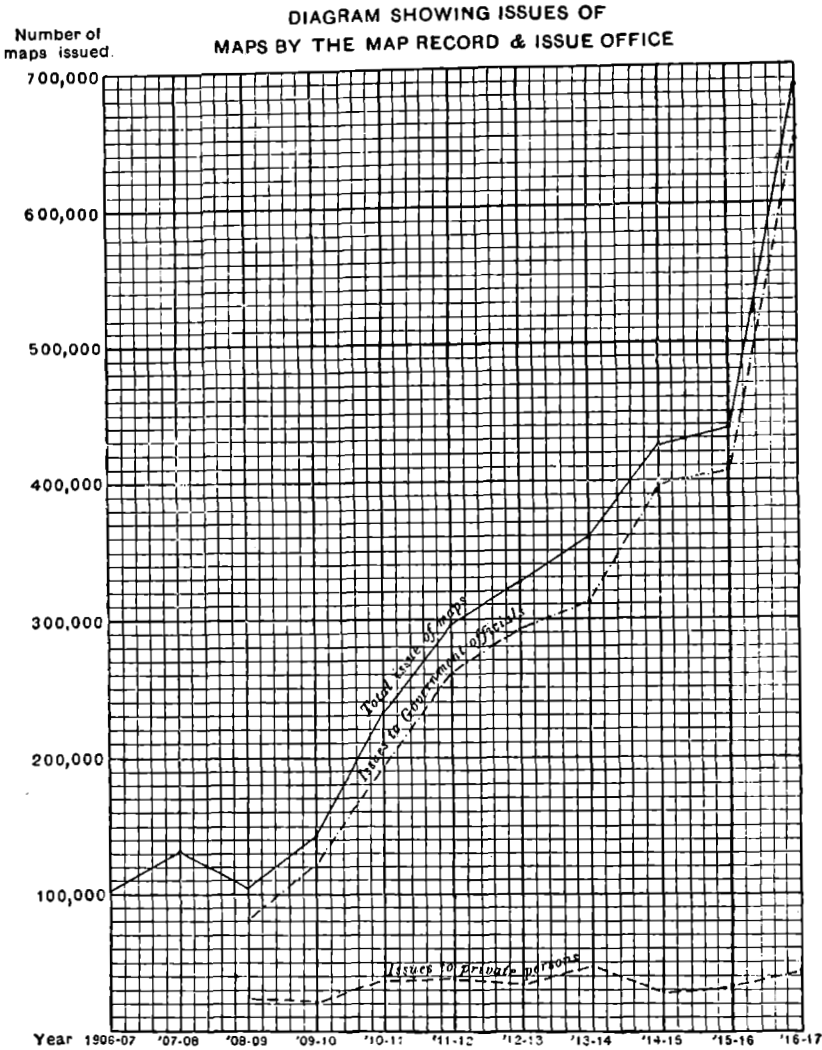
The total number of maps issued from the office during the year was 685,206 of an aggregate value of Rs. 3,44,398.

The details are as follows:—

	<i>Government Officials.</i>	<i>India Office.</i>	<i>Departmental Issuues.</i>	<i>Private Individuals.</i>	<i>Map Agents.</i>	Totals for 1916-17.	<i>Totals for 1915-16.</i>
No. of maps	578,357	3,623	62,526	37,731	2,969	685,206	437,131
Value Rs.	2,65,568	3,995	37,675	34,578	2,582	3,44,398	2,17,853

The number of maps, covered by 1,765 separate orders, supplied to the military authorities was 465,740 of an aggregate value of Rs. 2,18,649-8-0.

The number of maps issued during the past year shows a very considerable increase, being 248,075 in excess of the year 1915-16 and if compared with the issues of the preceding ten years shows an increase of over six-fold. The major portion of this increase is due to the larger number of maps issued to Government officials which, during the year under report, totalled 644,506. There is, however, a distinct improvement in the sales to private individuals and map agents who took 40,700 copies as compared with 31,139 in 1915-16. The diagram on opposite page illustrates the issue figures during the past eleven years:—



The building of the new racks for maps in one of the map store-rooms, has been completed, these racks when full will accommodate the usual stock of 1,386 modern size sheets.

61. No. 1 (Head Quarters) Drawing Office.—Four sheets of the India and Adjacent Countries Series on the one-millionth scale have been completed and sent for publication. In view of towns and village sites being now classified according to their administrative importance, the style and size of the lettering in which their names appear varies accordingly. Four sheets, previously published, have been altered to accord with this classification and have been submitted for reprint, a further three sheets are being similarly dealt with. Four of the above mentioned sheets have been combined and published separately to form a map of the jute-growing districts. Three other sheets of this series are in various stages of compilation. The drawing of the "Madras sheet" of the Southern Asia Series, two-millionth scale, is nearly completed, that of the "Bombay sheet" is well advanced and the rough compilation and drawing of the "Calcutta sheet" of the same series has been started.

Patterns have been prepared for six sheets of the one-millionth India and Adjacent Countries Series for engraved editions. Patterns of six sheets of the one-millionth International Series, in which the values of heights and contours are in metres, were supplied to the Engraving Office and those of four other sheets are in hand. The compilation of the four-millionth map of India, which will supersede the present 64-mile map, has been completed and the material supplied to the Engraving Office. One degree sheet (scale $\frac{1}{4}$ inch to 1 mile) has been drawn and will shortly be submitted for publication. Nine sheets on the half-inch scale have been completed during the year and the drawing of three sheets is well advanced, they will be ready for publication early in December 1917.

The Mapping and Reprint Sections completed 35 degree sheets based on old Atlas sheets and 22 are in hand. These degree sheets are printed in black and classed as "Provisional Issues", they are brought up to date as regards railways, roads, canals, &c., from material supplied from extra-departmental sources. They will eventually be superseded by modern degree sheets in colours when the area comprising them comes under revision survey. A Provincial map of the Punjab, on the one-millionth scale, has been completed except for final examination and will shortly be sent to press, this map is drawn in the same style as, and based on, the one-millionth sheets covering the same area. Final corrections and additions were carried out on the new layered edition of the 32-mile map of India. The 32-mile Railway, Road and Canal map of India which was last revised in 1912 was corrected up to March 1916. The 64-mile map of India, showing railways open and under construction, was corrected up to March 1917 and various small scale maps of India were brought up to date. The originals of 136 maps on various scales have been brought up to date for the supply of reprints. Five small scale Administration report maps have been drawn and a considerable number of special military and extra-departmental orders have been carried out in this section. In addition a large number of maps drawn in circle offices and field parties have passed through the Drawing Office for minor corrections.

The Office Copy Section continues to maintain a complete record of all alterations and additions to published maps brought to notice by the local authorities, so that this information may be incorporated in new editions of maps. Such additions and corrections have been carried out on 3,055 maps. Office copies of 795 new maps have been made during the year to record similar changes. In addition this section has dealt with various questions relating to Revenue Survey maps, it has also supplied copies of original records to Government officials and private individuals requiring them.

The Examining Section has dealt with 420 cases during the year in addition to a considerable amount of miscellaneous work.

62. Engraving Office.—During the year under report three maps of the one-millionth India and Adjacent Countries Series, one International map on the same scale and one degree sheet were completed and transfers from the engraved plates supplied to the Photo-Litho. Office. Eight International and three one-millionth maps are in hand of which three International and two one-millionth sheets are approaching completion.

The engraving of the new map of India on the scale of one over four-million, referred to in last year's report, has made good progress and it is hoped to supply transfers to the Photo.-Litho. Office by the end of December 1917. This map comprises four sheets and will be printed in three colours black, blue and brown, so that twelve copper plates are involved.

The periodic correction of the plates of the small scale maps of India, of Districts and of Index Charts has been carried out during the year. In this connection it was found necessary to engrave 2 new District maps, the plates of which had become obsolete.

All the plates of the 32-mile map of India have been revised and transfers supplied for reproduction.

The following maps were corrected on the copper plates:—The Provincial map of Mysore and Coorg, scale one inch to 16 miles, 30 Districts, 28 Indexes, one International and 6 Atlas of India sheets, the latter being revised for a reprint to replenish stock.

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. Miscellaneous work in the shape of engraving military manual scales, pocket compass cards, symbol guide cards, &c., was carried out.

In the *Printing Section* of this office 40,148 impressions were pulled as against 23,656 last year. Of this number 19,755 were for extra-departmental orders.

In the *Steel Facing Section* 300 plates were dealt with.

63. Photo.-Litho. Office.—The year 1916-17 has witnessed a steady increase in the demand for maps by the military authorities both for the use of the Expeditionary Forces and for use in India. This increase has resulted in the out-turn for the year constituting a record. Any future increase in the out-turn of the office can only be accomplished by an increase in the overtime employed on the Litho. machines so long as this branch of the office continues to be run by one "shift" of men, the alternative being to obtain more machines.

During the period under report 1,080,573 finished maps and diagrams were printed in the machine presses as against 735,999 during 1915-16. On an average between three and four printings were required to produce each finished copy, as was the case last year. The highest monthly out-turn was attained in March 1917 when 153,230 completed copies were produced on the machine presses.

Ten Litho. machine presses ran for the whole year. The total machine power was therefore 120 machine months as against 112 machine months for the previous year. There has thus been an increase of 6·7% in the utilised machine power.

The fifteen hand presses produced 40,235 impressions.

About 19% of the total out-turn represented maps printed for the department while the remaining 81% was composed of work done for the army and other departments.

The work done for the department includes 92 new and 139 reprint editions of modern style *one-inch sheets* in colours. Preliminary editions of 13 one-inch sheets were printed in colours, black and brown or black, and *Village Boundary editions* were published of 30 modern one-inch sheets. The total number of modern one-inch sheets printed or reprinted during the year was 281. Of the *half-inch series* 79 new sheets were printed in colours and 9 sheets were reprinted.

During the year 72 new quarter-inch *degree sheets* were printed, 29 being "Provisional Issues". In addition 78 degree sheets were reprinted either in colours, black and brown or black. Reprint editions of 2 *Atlas of India sheets* were also published.

Of old style sheets 60 were reprinted on the one-inch, half-inch and quarter-inch scales.

The *Negative and Retouching Sections of the Photo. Branch* have dealt with 4,452 and 4,778 negatives respectively as against 3,784 and 4,112 negatives last year. The *Helio and Vandyke Sections* have together turned out 7,496 plates as against 5,333 plates during 1915-16.

In the matter of methods and processes several important improvements have been brought into use. Transfers from engraved tint plates have been practically superseded by zinc tint plates etched in relief which are prepared in the Litho. Branch. This is the outcome of the investigations undertaken by Mr. Vandyke and referred to in last year's General Report.

A new method has been devised and taken into general use for the preparation of layer tint plates. By this method all tints are produced photographically by means of the half-tone screen at a considerable saving of time and labour as compared with the methods in use up till now. Green and yellow plates for forest and cultivation are now prepared photographically directly from the colour patterns prepared by Circle and Drawing Offices.

The *Photo. Engraving Section* during the year prepared 33 photogravure plates, 427 half-tone blocks and 316 line blocks, a total of 776 blocks and plates as against 692 during 1915-16. From the half-tone and line blocks an aggregate of 755,324 impressions were pulled compared with 980,593 impressions pulled during last year.

The *Type Printing Section* set up 8,216 pages of matter of which in all 1,311,014 copies were printed, 2,051,347 impressions being pulled.

Out-turn of Photo.-Litho. Office during 1916-17.

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>			
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
1916-17	1,79,661	3,47,271	36,009	793	3,391	4,184

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.
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
1916-17	3,954,954	115,486	639,838	8,216	1,311,014	2,051,347

64. Mathematical Instrument Office.—During the year from 1st April 1916 to 31st March 1917, there was an increase in the demands made on this office (*vide* item 1 in para. 2) as well as in the value of work done (*vide* item 6 in para. 2), and there was respectively a profit of Rs. 69,785 and Rs. 44,439 against a loss of Rs. 6,145 and Rs. 30,421 in the year 1915-16.

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

	1914-15.	1915-16.	1916-17.
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>
1. Total issues to Public Offices as shown in the Profit and Loss statements of stores.	4,16,642	2,51,818	5,52,655
2. Value of repairs to instruments received for repairs and returned in serviceable condition.	66,793	52,535	58,423
3. Value of instruments received from Government Officers when no longer required.	50,924	54,411	77,147
4. Book value of the stock of instruments, &c., in Serviceable Stores.	5,06,865	5,68,631	4,73,155
5. Book value of the stock of instruments, &c., in Repairable Stores.	62,347	70,896	1,15,805
6. Total value of work done in the Workshop ...	2,44,054	1,96,704	2,99,531
7. Value of instruments manufactured in the Workshop for Serviceable Stores.	87,421	71,641	1,76,119
8. Value of instruments purchased locally ...	9,792	11,255	1,09,039
9. Value of instruments and materials obtained from England through the Director General of Stores.	2,78,380	1,69,073	1,01,744
10. Average No. of employees and their pay ...	No. 317 } Rs. 80,917 }	No. 337 } Rs. 91,654 }	No. 353 } Rs. 1,02,664 }

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.

the work
performed.

Table IV.—Departmental Publications, Calcutta, 1916-17.

Note.—For special publications at Dehra Dūn, *vide*, pages 35 to 38.

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	.....	8	2,085	13,067
Southern Asia Series	1:2,000,000	.....	5	8,220	24,660
India and Adjacent Countries	1:1,000,000	7	9	15,244	15,244
Do. (International Series)	1:1,000,000	2	.....	600	600
TOPOGRAPHICAL MAPS.					
<i>DEGREE SHEET SERIES.</i>					
Modern	1 $\frac{1}{4}$ miles	43	72	117,676	1,17,676
From Atlas material	Do.	29	6	10,955	10,055
<i>HALF-INCH SERIES.</i>					
Modern	1 $\frac{1}{2}$ miles	84	9	80,528	80,278
<i>ONE-INCH SERIES.</i>					
Modern	1 $\frac{1}{2}$ mile	92	139	132,362	1,31,112
Do. (Preliminary Editions)	Do.	13	7	8,360	7,960
Do. (Village Boundary Editions)	Do.	.....	30	3,000	6,000
Old Style Sheets	(1 $\frac{1}{2}$ mile) 1 $\frac{1}{2}$ miles & 1 $\frac{1}{4}$ miles	.....	60	10,425	15,487
MISCELLANEOUS.					
<i>Atlas of India Series</i>	1 $\frac{1}{4}$ miles	.....	15	1,440	1,080
<i>Provincial Maps</i>	Various	1	3	400	1,175
<i>District Maps</i>	1 $\frac{1}{4}$ miles	.....	7	1,350	1,600
<i>Administration Report Maps</i>	(1 $\frac{1}{8}$ miles to 1 $\frac{1}{16}$ miles)	1	45	2,500	938
<i>Plans of Cities and Cantonments</i>	Various	79	14	8,031	10,051
<i>Index Maps</i>	1 $\frac{1}{32}$ miles	.....	26	25,150	4,748
<i>Miscellaneous Maps</i>	Various	410	138	258,707	67,424
Totals for 1916-17 ... ..	.....	761	593	686,133	5,22,155
Corresponding totals for 1915-16 ... ..	.....	1,356	494	626,321	.....

LETTERPRESS.

1. Survey of India. General Report, 1915-16. Price *Rs.* 2 or 2s-8d.

II.—DEHRA DŪN OFFICES.

TRIGONOMETRICAL SURVEY OFFICE.

65. Computing Office.—As forecast in last year's report the simultaneous reduction of the Burma Quadrilateral comprising the Burma Coast, the Mandalay Meridional, the Mandalay Longitudinal, the Manipur Meridional and the Manipur Longitudinal Series was finished during the year; and the adjustment of the Assam Valley, the Kohimā, Cāchār, Nāgā Hills, Gāro Hills and the Khāsi and Jaintiā Hills Series was also completed. A preliminary adjustment of co-ordinates of stations of the Great Salween and the Upper Irrawaddy Series was carried out. The values of the heights of the secondary stations of the Great Arc Series, Section 18°—24°, were revised and brought into accordance with the revised heights of the principal stations of the same series. The observed azimuths at Poshkar and Gogipatri were revised. A considerable portion of the old triangulations executed in Baluchistān in seasons 1877—79 and 1887—89 by Captain Rogers and Messrs. Torrens and MacNair was readjusted in final terms. The heavy computations necessitated in preparing Professional Paper No. 16 and Part II of the Auxiliary Tables, 5th edition, were partly completed.

The following lines of levelling executed in 1914-15 but of which the final reduction has been held over till now, pending the receipt of additional data, have now been reduced;

(1) Benares to Barākar, (2) Bāgalkot to Bijāpur, (3) Howrah to Chāmpdāni and (4) Bankipore to Bihā.

The computation and adjustment of lines of levels having been transferred to No. 17 Party, the Computing Office will not as a rule undertake this work in future. The services of the office, however, may be requisitioned under emergent circumstances. '*Vide* Trigonometrical Survey Order No. 214, dated 23rd July 1917'.

The reduction of simultaneous psychrometric observations at Dehra and Mussoorie was completed, and a number of investigations into the variation of refraction was carried out. Computations in connection with the traverse survey of New Delhi and the Nasirābād Cantonment were performed.

A list of all the protected stations of the Indian triangulation with their co-ordinates and other connected information is being compiled.

Requisitions for data were received from 24 departmental and non-departmental officials. In some cases, these requisitions could be met by supply of printed publications, in others it was necessary to extract the required information from manuscript records.

A large number of requisitions for forms was complied with.

121 Triangulation pamphlets were compiled and compared during the year, 90 were passed through the press and 104, including last year's undistributed pamphlets, were distributed.

Levelling Pamphlets Nos. 34 and 39 (Indian Series) and Nos. 93, 94 and 95 (Burma Series, final edition), Records of the Survey of India Volumes VIII and X and Tide Tables for the Port of Basrah, 1917-18, were bound in book form and distributed.

A portion of Rai Bahadur Lal Singh's work in Central Asia carried out while accompanying Sir Aurel Stein was revised.

Tables of clock rate corrections in connection with wireless longitudes were prepared.

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

- (1) Triangulation Pamphlets 90.
- (2) Levelling Pamphlets Nos. 93, 94 and 95.
- (3) Tide Tables for the Port of Basrah.
- (4) Professional Paper No. 16—pages 105 to end.
- (5) Records of the Survey of India, Vol. X, 1915-16.

Observatories.—Meteorological observations were continued as usual.

The Omori Seismograph has been working satisfactorily throughout the year. Two tremors of considerable intensity were recorded on 21st and 30th January 1917.

Photographs of the sun were taken on 322 days during the year, the sun being obscured on the remaining days. An unusually large sun spot was observed from 6th to 15th February 1917.

Preservation of Trigonometrical Stations.—1,046 stations were repaired by district officers at a cost of Rs. 5,263-12-2. Out of 357 districts from which the reports are annually due, 32 failed to make returns.

66. No. 2 (Dehra) Drawing Office.—During the year under report the work in this office was carried out by 5 sections.

(1) *Triangulation Section.*—Owing to the shortage of officers, the Triangulation, Cantonment, Half-inch and Miscellaneous Sections were amalgamated.

Only one half-inch sheet remains to be sent for publication, and no more will be taken up in this office.

(2) *Compilation Section.*—The rough compilation on the 12-mile scale of only four sheets of the area previously allotted to No. 2 Drawing Office up to Longitude 104°, remains in hand; none of the sheets east of Longitude 104° have yet been taken up. The compilation on the two-millionth scale of the Himalayan map, which will be published on the three-millionth scale, has now been taken up.

(3) *Stein Section.*—The compilation of the 49 sheets comprising Sir Aurel Stein's explorations in 1900-01, 1906-08 and 1913-15 has been practically completed; of these 5 sheets have been fair-mapped and sent for publication.

(4) A small section was employed, under the direct supervision of the Officer in charge, on the fair-mapping of the Mesopotamian sheets to be published on the half-inch scale. Four sheets were sent for publication.

(5) Throughout the year a section was employed under Colonel R. A. Wauhope, C.B., C.M.G., C.I.E., R.E., on the maps of Southern Arabia; all the area surveyed on the half-inch scale around Aden has now been mapped on that scale, and special surveys on larger scales, made during the operations of the Aden Boundary Commission and hitherto unpublished, have been mapped on the scale of survey.

Three sheets on the one-millionth scale, including the provinces of Asir, Yemen and Hadhramaut have been drawn and the two latter are under publication.

Photo-Zinco Section.—During the year 1916-17 the work undertaken comprised:—

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

During the year under review Mr. Vandyke was deputed to this office to instruct the Photo.-Zinco. Section in the process of transferring from plate to plate. This process has been in use since then and has worked well.

More accommodation has been provided for the retouchers and duffers which was much needed.

The new Graining and Litho. machines, which were erected during the early part of the year, have worked well.

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

Years.	No. of Subjects.	No. of Negatives.	No. of Pulls.	No. of Chocolate and Cyanotype prints.
1914-15	1,898	2,267	345,526	663
1915-16	2,065	1,717	307,357	1,209
1916-17	1,302	1,600	287,514	571

The following is a summary of the work of the office during the year 1916-17 :—

Class of map.	Sheets sent for publication.	Sheets remaining in hand.	REMARKS.
Rough compilation of map of Tibet for publication on the scale of $\frac{1}{4,000,000}$...	1	.....	Hill and skeleton.
Geographical maps, $\frac{1}{1,000,000}$ scale. (Fair sheets) ...	8	10	
Geographical maps, $\frac{1}{1,000,000}$ scale. (Rough compilation) ...	.....	4	
Geographical maps, $\frac{1}{3,000,000}$ scale. (Rough compilation) ...	.....	4	Himalayan map.
Sir Aurel Stein's exploration in Chinese Turkistān and Kansu in 1900-01, 1906-08 and 1913-15, for publication on the $\frac{1}{500,000}$ scale ...	5	44	The publication of these sheets is in abeyance pending Sir Aurel Stein's personal scrutiny of the originals on his return to India.
Regions between Lch and Karghalik mapped by Sir F. de Filippi's expedition in 1913-15, for publication on the $\frac{1}{500,000}$ scale ...	2	.....
Degree Triangulation Charts of India ...	101	7	
Miscellaneous maps ...	19	.....
Cantonment plans (corrections for 1916) ...	188*	5	* Corrections for 1916 carried out on 74 Cantonments and sheets stored away.
Cantonment plans (corrections for 1917) ...	28†	78	† Corrections for 1917 carried out on 14 Cantonments and sheets stored away. 34 Cantonments in hand.
Half-inch sheets ...	12	1	
Half-inch sheets of Mesopotamia ...	4	10	
Miscellaneous Extra-departmental maps ...	59	12	
Addendum to Levelling Charts Nos. 39, 93 and 94 ...	3	.....

67. Forest Map Office.—16,023 maps, diagrams and lists valued at Rs. 23,406, were issued during the year, an increase of 6,916 maps, &c., and Rs. 7,757 over the figures for last year. The net amount realised by sales to the public, was Rs. 1,038 for 669 maps, and by book-transfer Rs. 2,216 for 2,175 maps, &c.

In addition 1,120 reductions of 122 maps were supplied to the Survey of India, and 14,724 maps, &c., were received for storage. The increase in the issue of maps is due to more efficient handling, the result of the separation of the technical work in connection with the drawing and publication from that of the storage and issue of maps.

The maps prepared by the Forest Map Office fall into five classes, viz:—

- (a) Reprints of Forest maps with corrections to date.
- (b) Forest editions on the two-inch scale of modern one-inch sheets.
- (c) Maps of Forest Circles and Divisions.
- (d) Special maps to illustrate working plans, &c.
- (e) Maps and diagrams to illustrate administrative reports, &c. of the Forest Department.

The following table shows the number of sheets dealt with during the year:—

Class of map.	In hand on 1st October 1916.	Received during the year 1916-17.	Drawn and sent for publication.	In hand on 30th September 1917.	Published during the year 1916-17.
(a) ...	113	43	53	103	18
(b) ...	88	51	35	104	43
(c) ...	36	1	7	30	2
(d) ...	6	76	66	16	68
(e) ...	22	5	13	14	8
TOTALS ...	265	176	174	267	139

III.—CIRCLE AND LOCAL DRAWING OFFICES.

68. No. 3 Drawing Office (Northern Circle).—During the year under report 25 one-inch sheets, out of the 37 previously surveyed and drawn by parties, were submitted for publication. The remainder are under correction in the Drawing Office and parties. Two one-inch sheets were corrected and brought up to date in the Drawing Office, for purposes of reprint, and are not included in the above number.

The proofs and colour patterns of 68 sheets, comprising one-inch, half-inch sheets, the sheets of the Simla 150 feet to the inch map, and Simla Guide Map (8 inches to the mile), were prepared and returned to the Superintendent, Map Publication, leaving a balance of colour patterns of 1 half-inch and 9 one-inch sheets still in hand.

Half-inch sheets compiled from the published sheets of modern one-inch and old style half-inch maps.—2 half-inch sheets were drawn in the Circle Drawing Office and submitted for publication, and 17 were received from the parties. Of these latter 13 had been sent for publication and 4 were undergoing correction at the end of the year.

On the basis of the one-inch sheets published up to 30th September 1917, there now remain for completion in the Northern Circle 133 half-inch sheets of the kind under consideration. Of this number, the fair-mapping of 27 sheets is in hand in the Drawing Office and parties, and the material for the preparation of 18 more is held in reserve for future requirements.

The above numbers do not include 10 sheets which are being, or are to be, drawn in No. 1 Drawing Office, nor 12 similarly allotted to No. 2 Drawing Office.

Hill-shaded sheets.—Hill-shaded sheets of 7 one-inch and 19 half-inch sheets were prepared and sent for publication, leaving in hand for hill-shading a balance of 8 one-inch and 2 half-inch sheets.

Special maps.—20 sheets of the Simla 150 feet to 1 inch map, 14 of which were drawn in No. 3 Drawing Office, were submitted for publication. A Guide Map of Simla was also drawn in this office in two sheets on the scale of 10 inches = 1 mile for publication on that of 8 inches = 1 mile.

Miscellaneous.—Traverse plots of stations of 23 *mauzas* consisting of 52 sheets, scales 16 and 32 inches to a mile, of Gondā district, were prepared for, and sent to, the Deputy Commissioner, Gondā. The cost of the preparation of these was lodged in the local treasury to the credit of the department.

69. No. 4 Drawing Office (Southern Circle).—During the year 31 one-inch sheets and 9 half-inch sheets, which had been surveyed and fair-mapped by parties, were finally examined and submitted for publication. At the end of the year every sheet, the survey of which was completed during the previous years, had been submitted.

Half-inch sheets compiled from published sheets of the one-inch map.—7 sheets were fair-mapped and submitted for publication and 13 sheets, which had been fair-mapped by parties, were finally examined and submitted for publication. At the end of the year 14 sheets were being fair-mapped in this office, 22 sheets were being fair-mapped by the parties and 12 sheets, the component one-inch sheets of which had been published, had not been commenced.

Quarter-inch sheets compiled from the published sheets of the half-inch map.—1 sheet was fair-mapped and submitted for publication. At the end of the year 3 sheets were being fair-mapped and 1 sheet, the component half-inch sheets of which had been published, had not been commenced.

The examination and colouring of the proofs of 63 sheets and the hill-shading of 49 sheets were completed and returned to the Superintendent, Map Publication.

A number of pupils were instructed in fair-drawing.

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

70. No. 5 Drawing Office (Eastern Circle).—During the year 23 one-inch sheets were received from the parties and 19 were submitted for publication; 19 unpublished proofs were received and 17 were examined, coloured, hill-shaded and sent for publication.

Half-inch sheets compiled from the published sheets of the one-inch map.—25 sheets were completed during the year and 23 have been submitted for publication; 21 unpublished proofs were received, 10 of these were coloured, examined, hill-shaded and submitted for publication.

Quarter-inch sheets compiled from the published sheets of the one-inch and half-inch maps.—5 sheets were completed in the Circle Drawing Office, and were submitted for publication.

All arrears pertaining to the preparation of colour patterns of one-inch sheets of the previous year were completed and submitted for publication.

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 2 sheets not received from parties.

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

The *Army Section* has dealt with the preparation of maps and plans for the use of the Army in India while the *Survey Section* has been employed on the preparation of trans-frontier maps on the 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.

72. Bengal and Bihār and Orissa Drawing Office.—(*Imperial Standard Mapping Section*). This office continued under the direction of the Director of Surveys, Bengal, and is occupied in the drawing of one-inch sheets mainly from cadastral work and from four-inch thāna maps; these are published as preliminary editions pending their revision by the topographical survey. These sheets are however now being made as complete as possible by the addition of the hills and waste land areas from old maps and they are being published in colours. These two improvements for a short time reduced the out-turn, which has now again reached the normal.

In Bihār and Orissa 20 sheets were submitted for publication, of which 14 were new and 6 had previously been published, but were now re-submitted with hills and waste lands added.

In Bengal 12 new sheets were submitted for publication.

PART 4.—WORK FOR OTHER GOVERNMENT DEPARTMENTS. 71

73. Northern Circle.—*No. 3 Party* carried out a theodolite traverse of 183 linear miles for the Settlement Officer, Gorakhpur and furnished this officer with plot sheets on the scale 16 inches to a mile, for 38 villages.

Sind-Sagar Party.—This party was formed on 15th June 1917 by the transfer of selected members of No. 4 Party to it, for the purpose of carrying out the rectangulation of the Sind-Sagar Doab in connection with the irrigation and subsequent colonization of that area. Its activities during the year under report have been confined to the preparations for the commencement of its work, and to training its establishment.

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 17 and 18.

74. Southern Circle.—The survey of cantonments and military stations was continued by No. 20 Party. The details of the work are given on pages 18 and 19.

The special survey on the scale of 1½ inches to a mile of reserved forests in the Hyderābād State was continued. No. 6 Party surveyed an area of 431 square miles and triangulated an area of about 350 square miles. The cost of this work is being borne by the Nizām's Government.

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

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

75. Map Publication Offices.—A very large proportion of the work of the Photo-Litho. Office is for other Government offices, only 19% of their out-turn this year being departmental, a special feature being the large amount of work done for the General Staff owing to the war. The usual large number of weather charts was printed, as well as ruled paper for officers' note books in large quantities, and for the Archaeological and other departments photogravure and half-tone photographs were also reproduced. The Drawing Office prepared Railway, Manœuvre, Postal and many other special maps, while the Map Record and Issue Office's main work is the issue of maps to other departments.

76. Mathematical Instrument Office.—The manufacture of heliographs and prismatic compasses Mark VII was continued during this year in larger quantities than in the previous year and practically all repair and manufacture work of a civil nature was stopped to facilitate military needs.

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

77. Trigonometrical Survey.—The Punjab Government having decided to undertake the Great Indus-Jhelum Project for the irrigation of the Sind-Sagar Doab, asked for triangulation to serve as the basis for the lay-out of the tract in rectangles according to the established system of that Province, and a beginning was made with the reconnaissance of the northern part of the area and with the building of the stations.

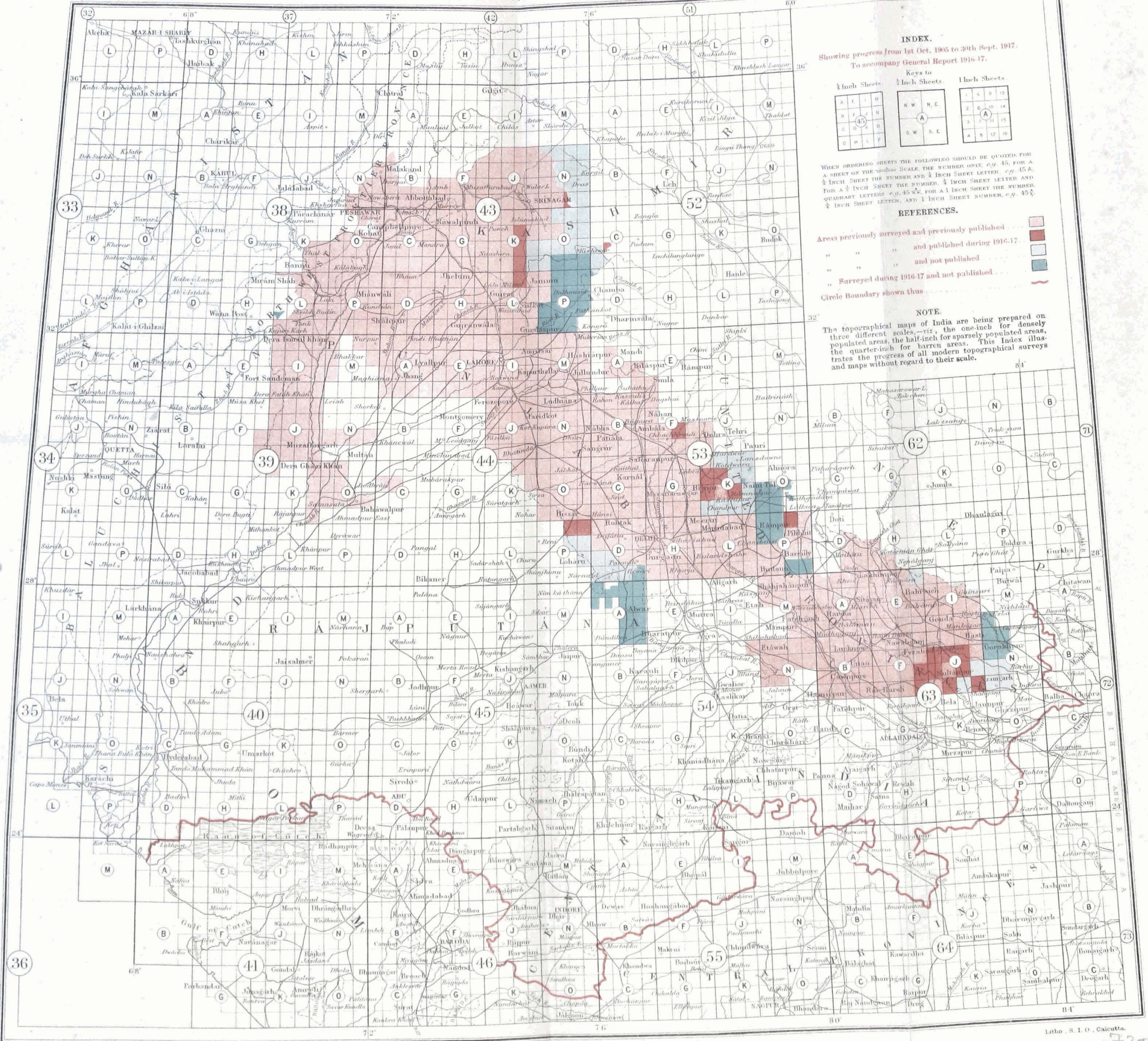
78. Dehra Dun Offices.—A large number of maps were produced for other departments of Government, particularly for the General Staff. The demands for maps of the Forest Department, which are continually on the increase, were met to the utmost extent of its capacity by the Forest Map Office.

The Computing Office complied with many requisitions for data,

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 TO SHEETS OF THE MAP OF INDIA (NORTHERN CIRCLE).



INDEX.

Showing progress from 1st Oct. 1916 to 30th Sept. 1917.
To accompany General Report 1916-17.

Keys to

1 Inch Sheets.	1/2 Inch Sheets.	1 Inch Sheets.
A E I M B F N C G O D H P	N.W. N.E. A S.W. S.E.	1 5 9 13 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 VARIOUS SCALES:—FOR THE NUMBER ONLY, e.g. 45, FOR A 1/2 INCH SHEET THE NUMBER AND 1/2 INCH SHEET LETTER, e.g. 45 A, FOR A 1 INCH SHEET THE NUMBER, 1/2 INCH SHEET LETTER AND QUARTER LETTER, e.g. 45 A, FOR A 1 INCH SHEET THE NUMBER, 1/2 INCH SHEET LETTER AND 1 INCH SHEET NUMBER, e.g. 45 A.

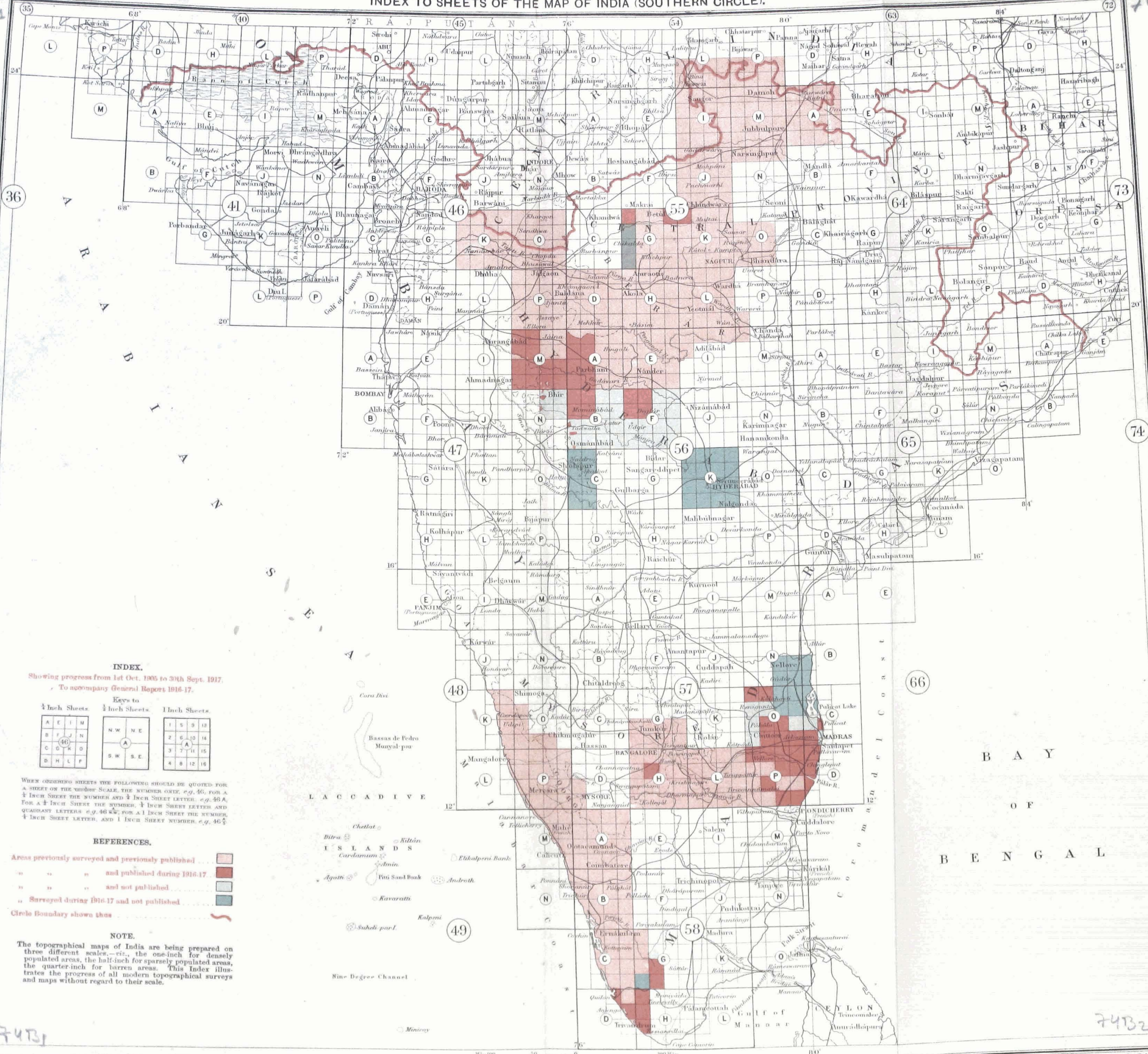
REFERENCES.

- Areas previously surveyed and previously published
- " " and published during 1916-17.
- " " and not published
- " Surveyed during 1916-17 and not published

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.

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



INDEX.

Showing progress from 1st Oct. 1905 to 30th Sept. 1917.
To accompany General Report 1916-17.

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

WHEN ORDERING SHEETS THE FOLLOWING SHOULD BE QUOTED FOR A SHEET ON THE THREE SCALE, -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.

REFERENCES.

- Area previously surveyed and previously published
- Area previously surveyed and published during 1916-17
- Area previously surveyed and not published
- Area surveyed during 1916-17 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.

74A2

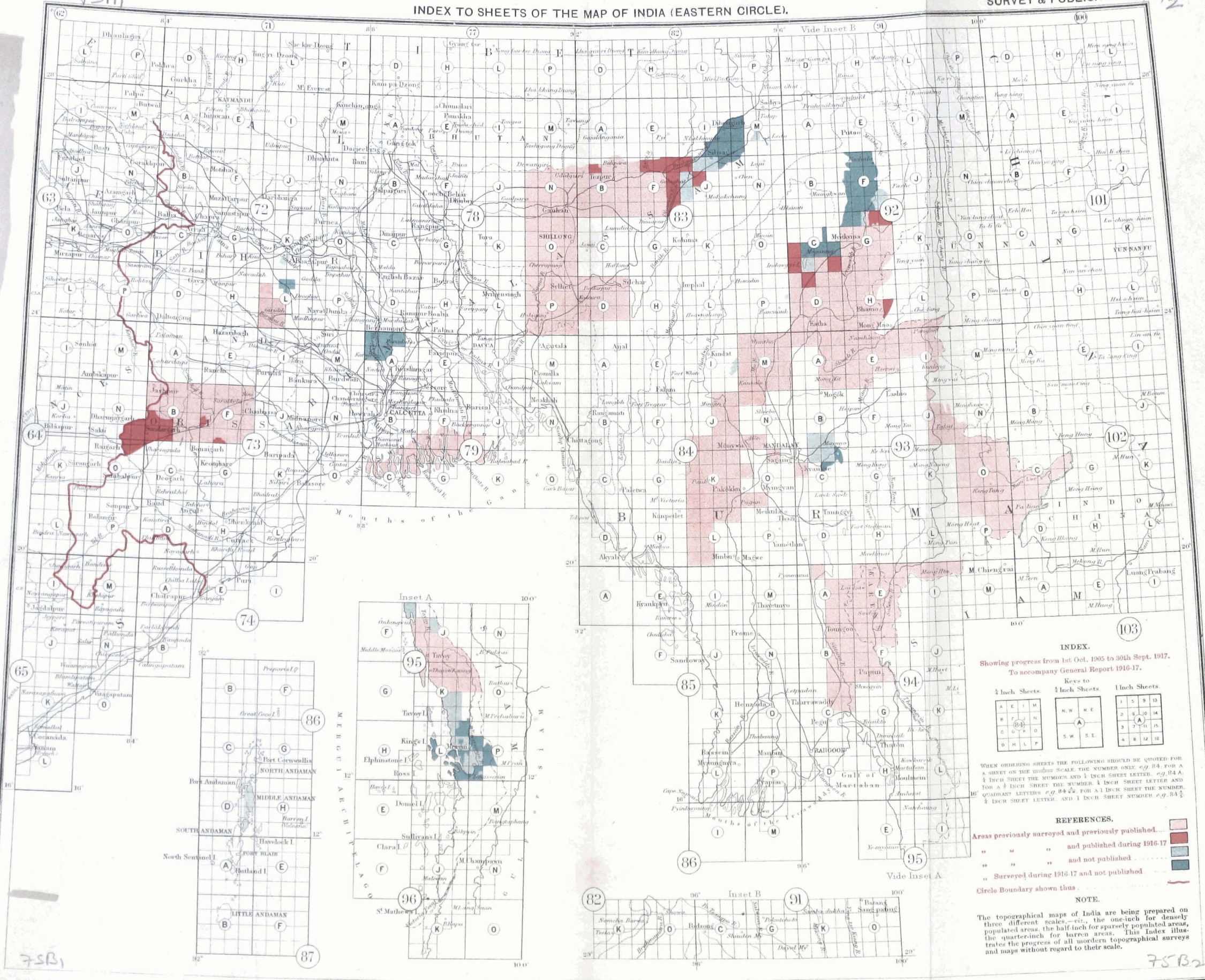
74A2

74

66

74B2

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



INDEX.
 Showing progress from 1st Oct. 1905 to 30th Sept. 1917.
 To accompany General Report 1916-17.

Keys to

1/2 Inch Sheets.	1/4 Inch Sheets.	1 Inch Sheets.
A E I M	N W N E	1 5 9 13
B F J N	O A	2 6 10 14
C G V O	P S W S E	3 7 11 15
D H L F		4 8 12 16

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

REFERENCES.

- Areas previously surveyed and previously published.
- " " " and published during 1916-17.
- " " " and not published.
- " " " surveyed during 1916-17 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.

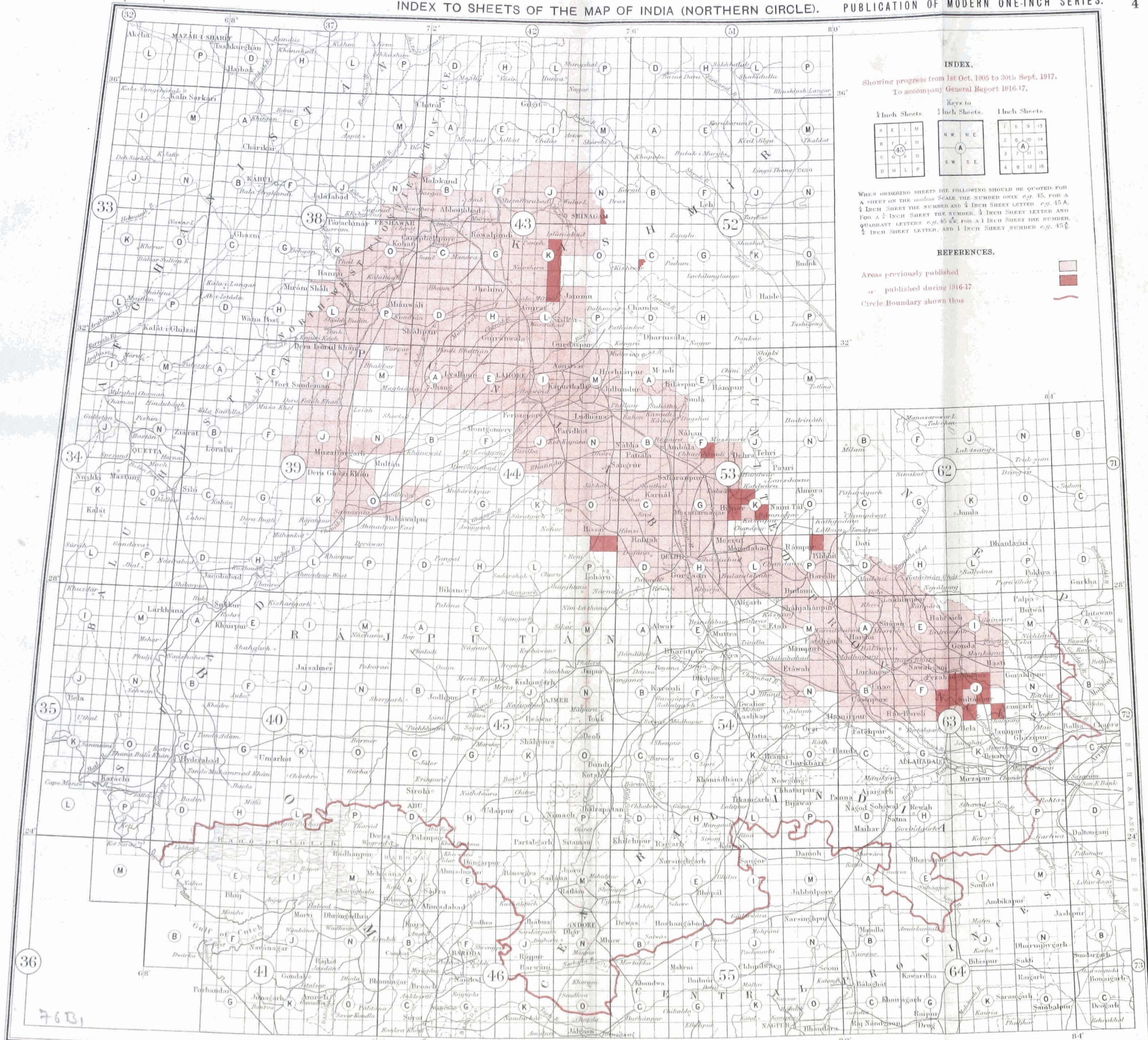
76A1

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

PUBLICATION OF MODERN ONE-INCH SERIES.

4

76A2



INDEX.

Showing progress from 1st Oct. 1905 to 30th Sept. 1917.
To accompany General Report 1916-17.

Keys to
1/4 Inch Sheets.

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

Keys to
1/2 Inch Sheets.

N	W	N	E
A			
S	W	S	E

Keys to
1 Inch Sheets.

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

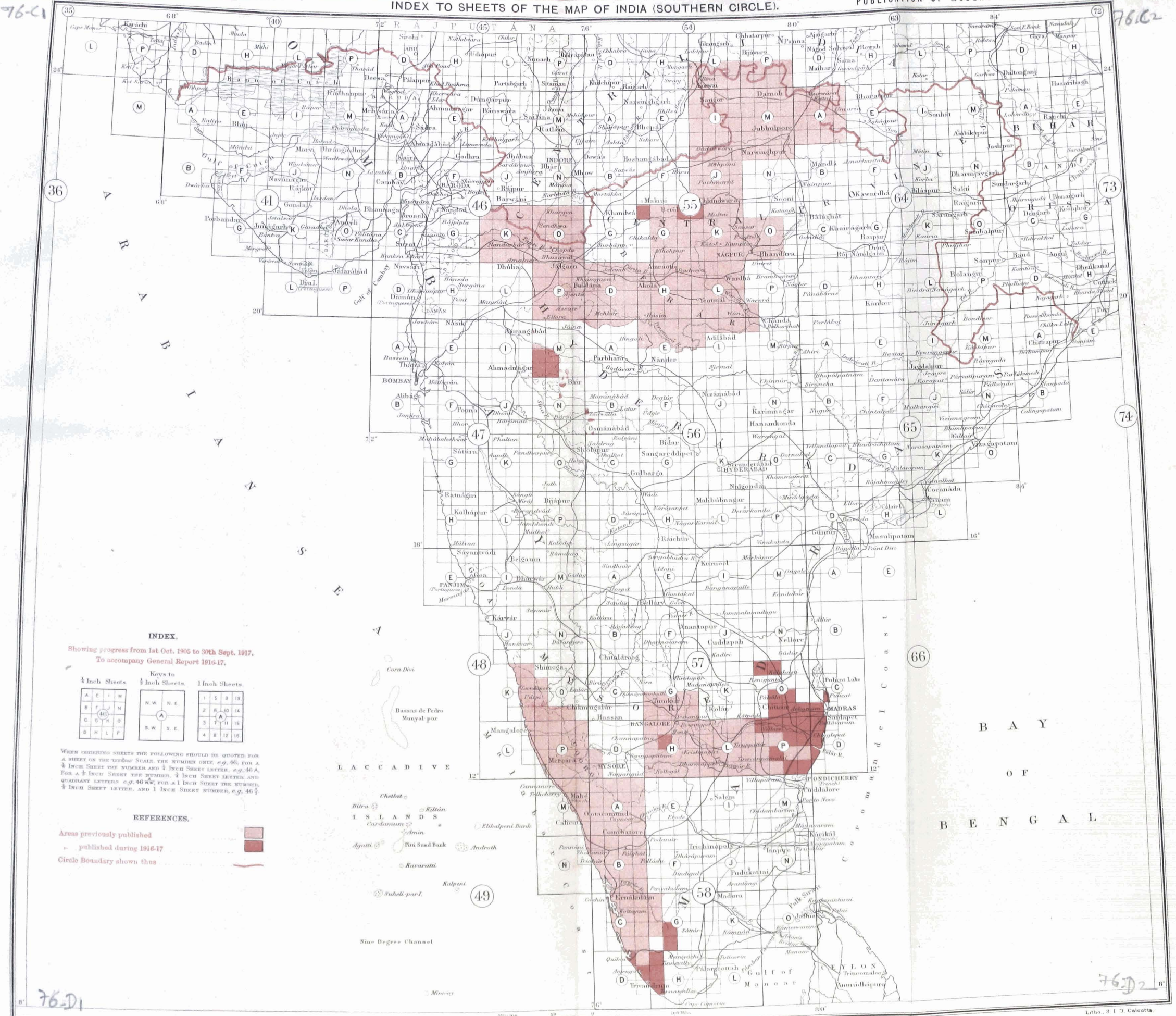
WHEN ORDERING SHEETS THE FOLLOWING SHOULD BE QUOTED: FOR A SHEET ON THE COMMON SCALE THE NUMBER ONLY e.g. 45. FOR A 1/4 INCH SHEET THE NUMBER AND 1/4 INCH SHEET LETTER e.g. 45 A. FOR A 1/2 INCH SHEET THE NUMBER, 1/2 INCH SHEET LETTER AND QUADRANT LETTERS e.g. 45 E. FOR A 1 INCH SHEET THE NUMBER, 1/2 INCH SHEET LETTER, AND 1 INCH SHEET NUMBER e.g. 45 E.

REFERENCES.

Areas previously published
published during 1916-17
Circle Boundary shown thus



76B2



INDEX.

Showing progress from 1st Oct. 1935 to 30th Sept. 1917.
To accompany General Report 1916-17.

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

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

REFERENCES.

Areas previously published
published during 1916-17
Circle Boundary shown thus



LA ACCADIVE

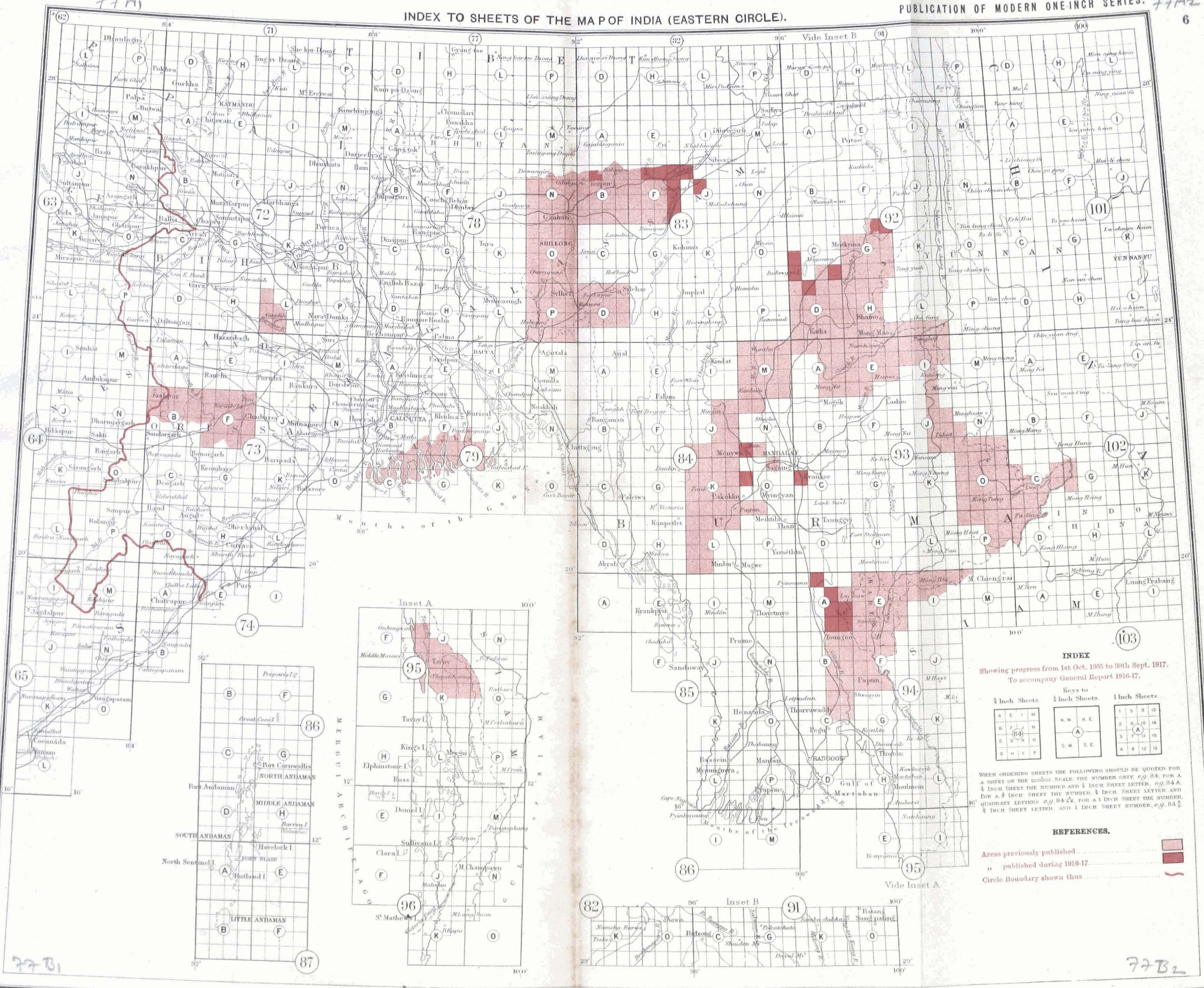
Chelak
Kiltan
Rittan
Curdumun
Amin
Ethalpeni Banks
Androth
Kavaratti
Subah parl.
Kulpeni

Sine Degree Channel

B A Y
O F
B E N G A L

76-D1

76-D2



INDEX
 Showing progress from 1st Oct. 1905 to 30th Sept. 1917.
 To accompany General Report 1916-17.

Keys to

1/2 Inch Sheets	1/4 Inch Sheets	1 Inch Sheets
A E I M	N W R E	1 5 9 13
B F J N	A	2 6 10 14
C G K O	S W S E	3 7 11 15
D H L P		4 8 12 16

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

REFERENCES.

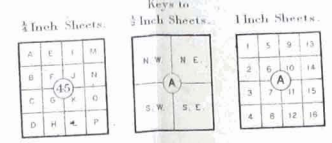
- Areas previously published ■
- " published during 1916-17 ■
- Circle Boundary shown thus ○

77B1

77B2

INDEX TO SHEETS OF THE MAP OF INDIA (NORTHERN CIRCLE) (PROVISIONAL ISSUES OF ONE-INCH SHEETS).

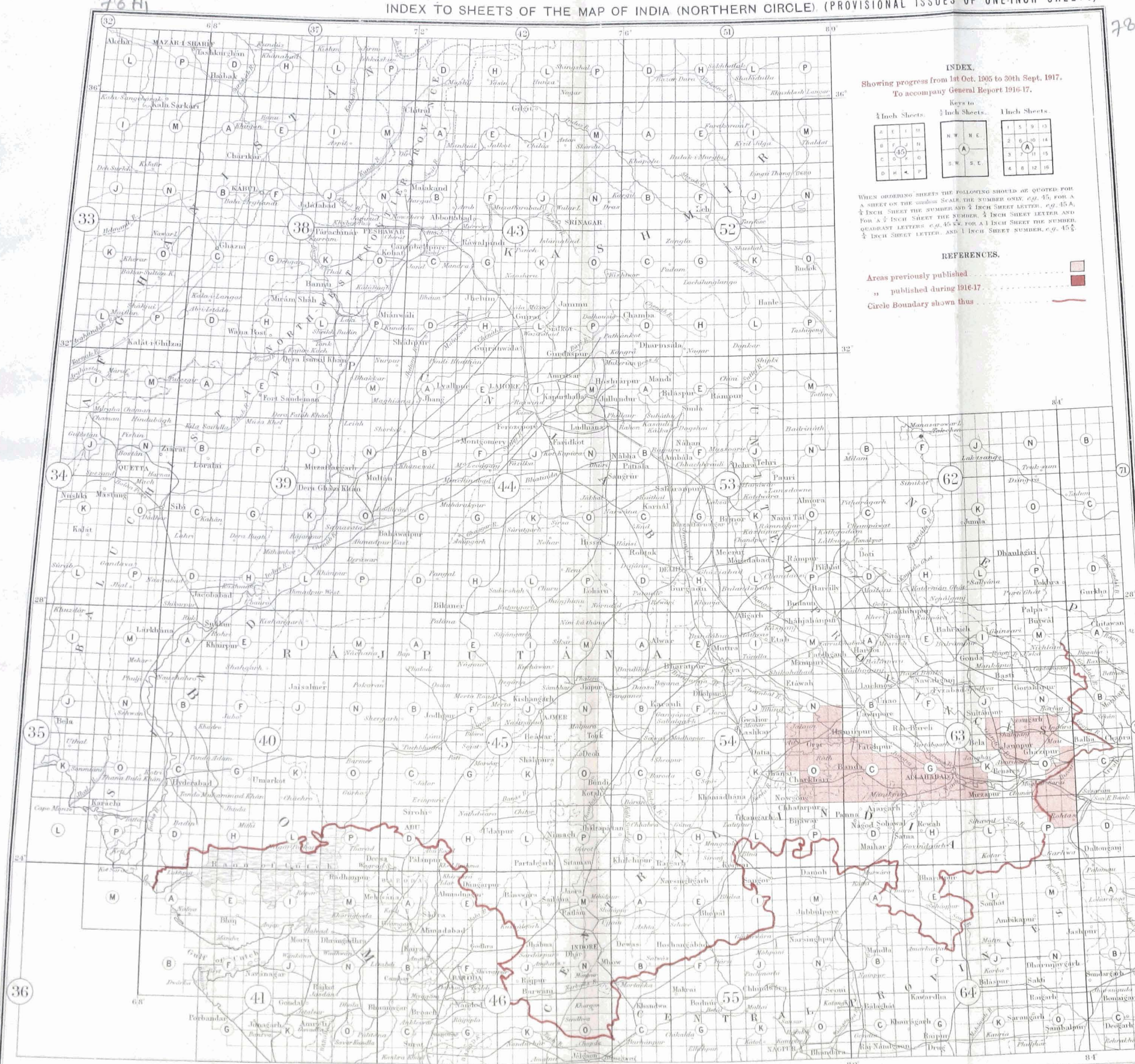
INDEX.
Showing progress from 1st Oct. 1905 to 30th Sept. 1917.
To accompany General Report 1916-17.



When ordering sheets the following should be quoted for a sheet on the various scales, e.g. 45, for a 1/2 inch sheet the number and 1/2 inch sheet letter, e.g. 45 A, for a 3/4 inch sheet the number, 3/4 inch sheet letter and, for a 1 inch sheet the number, quadrant letter, and 1 inch sheet number, e.g. 45 E, 1/2 inch sheet letter, and 1 inch sheet number, e.g. 45 E.

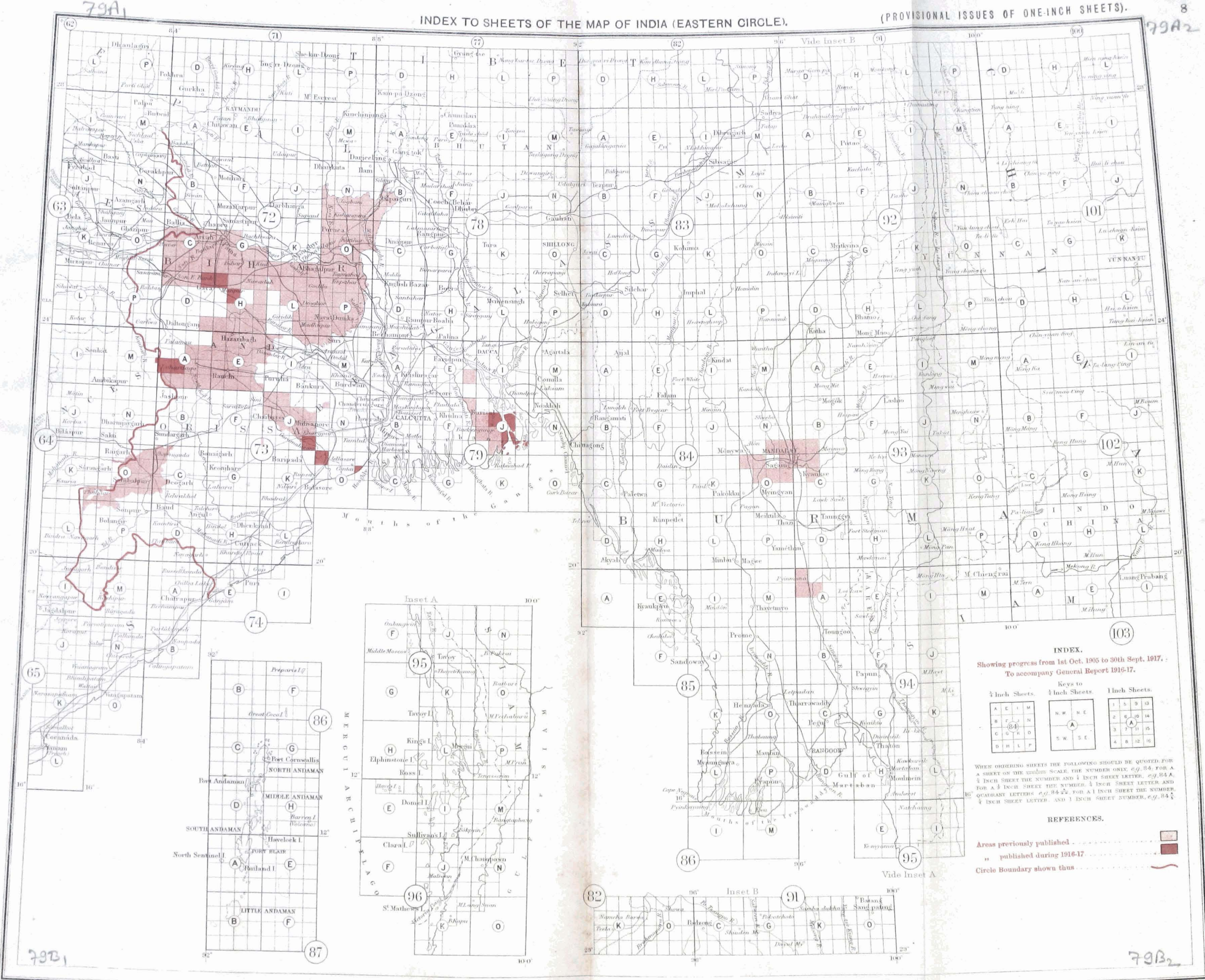
REFERENCES.

- Areas previously published
- published during 1916-17
- Circle Boundary shown thus



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

(PROVISIONAL ISSUES OF ONE-INCH SHEETS).



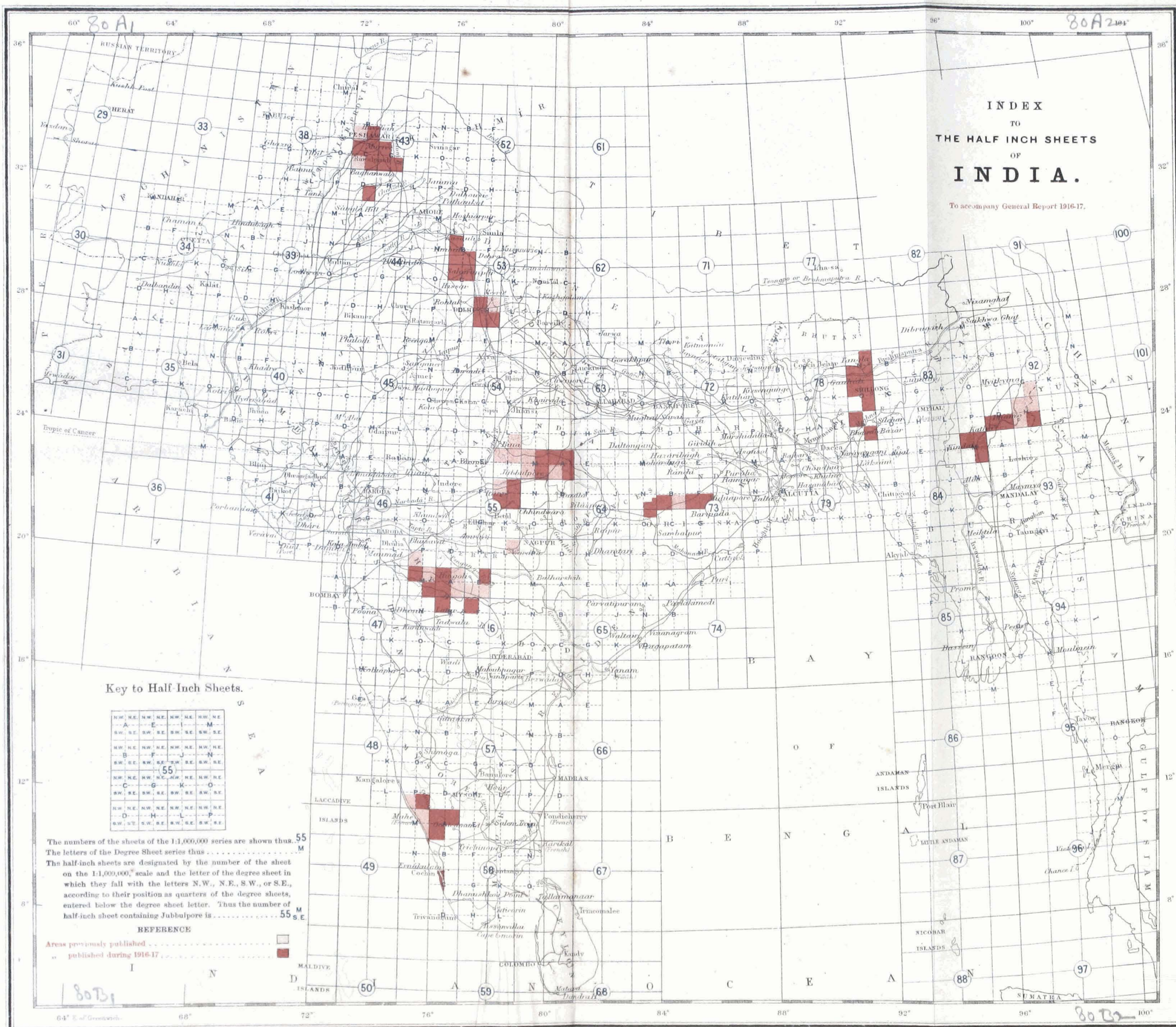
INDEX. Showing progress from 1st Oct. 1905 to 30th Sept. 1917. To accompany General Report 1916-17.

Table with 3 columns: 1/2 Inch Sheets, Keys to 1/2 Inch Sheets, 1 Inch Sheets. Includes grid letters and numbers.

When ordering sheets the following should be quoted for a sheet on the double scale, the number only, e.g. 84 for a 1/2 inch sheet the number and 1/2 inch sheet letter, e.g. 84 A, for a 1 inch sheet the number, 1 inch sheet letter and quadrant letters, e.g. 84 22 for a 1 inch sheet the number, 1/2 inch sheet letter, and 1 inch sheet number, e.g. 84 2.

REFERENCES.

- Areas previously published
published during 1916-17
Circle Boundary shown thus



INDEX
TO
THE HALF INCH SHEETS
OF
INDIA.

To accompany General Report 1916-17.

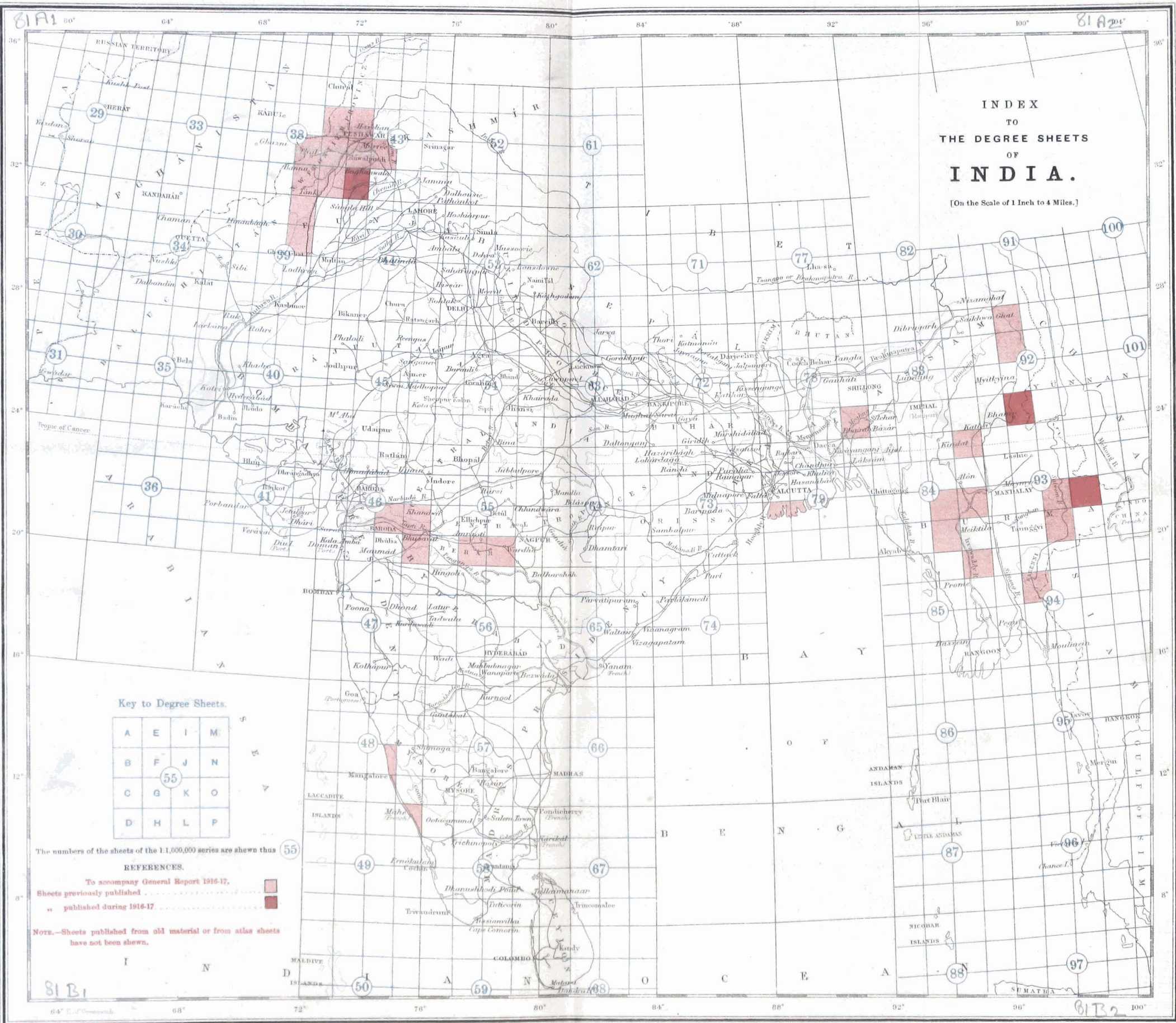
Key to Half-Inch Sheets.

N.W.	N.E.	N.W.	N.E.	N.W.	N.E.
A	E	A	E	M	M
S.W.	S.E.	S.W.	S.E.	S.W.	S.E.
B	F	B	F	N	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	C	G	O	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	D	H	P	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 M
The letters of the Degree Sheet series thus
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 Jubbulpoor is 55 S.E.

REFERENCE

Areas previously published
.. published during 1916-17.



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 1916-17,
- Sheets previously published
- published during 1916-17

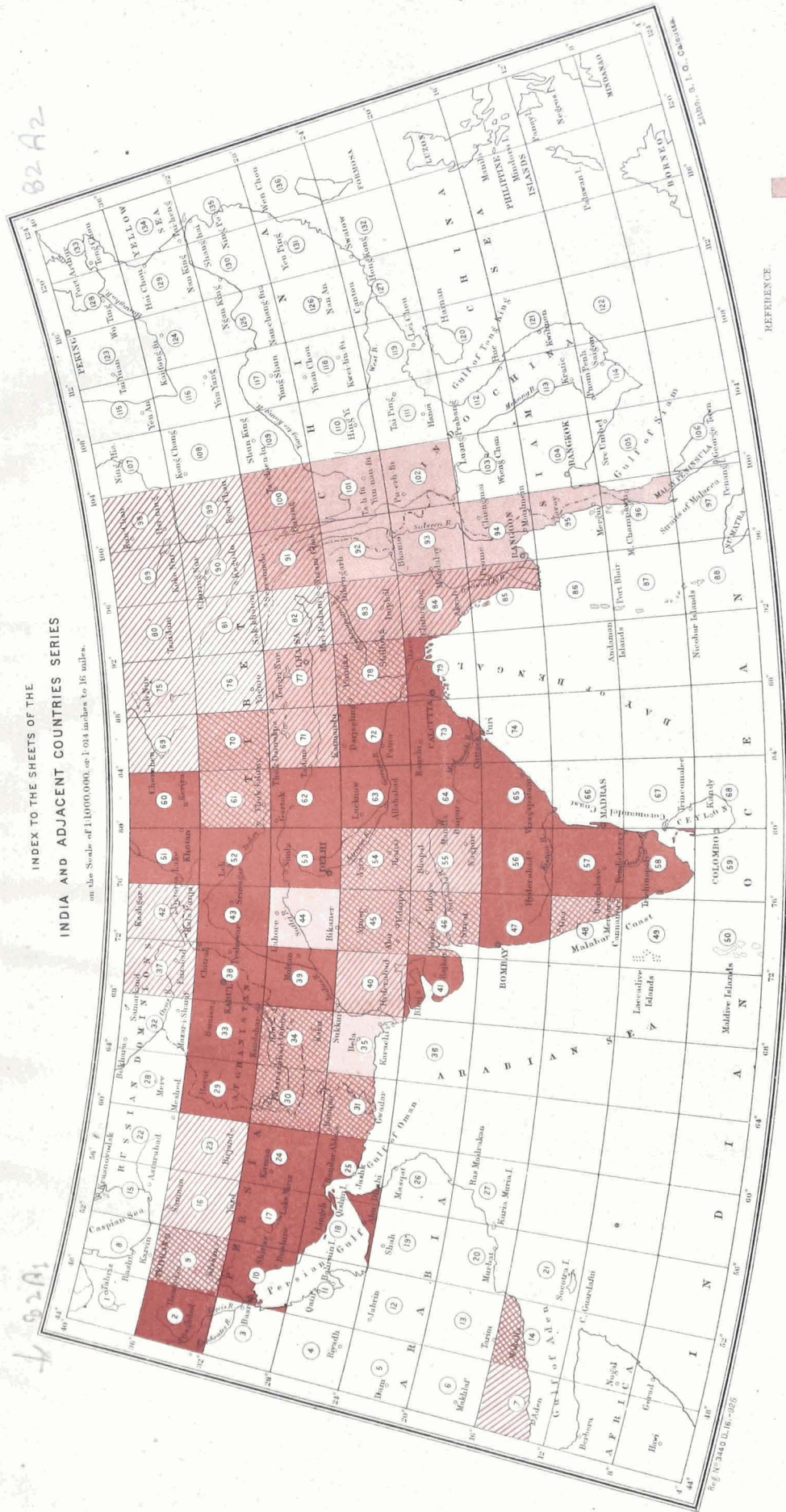
Note.—Sheets published from old material or from atlas sheets have not been shown.

82-A2

82-A1

INDEX TO THE SHEETS OF THE INDIA AND ADJACENT COUNTRIES SERIES

on the Scale of 1:1,000,000, or 1:64 inches to 16 miles.



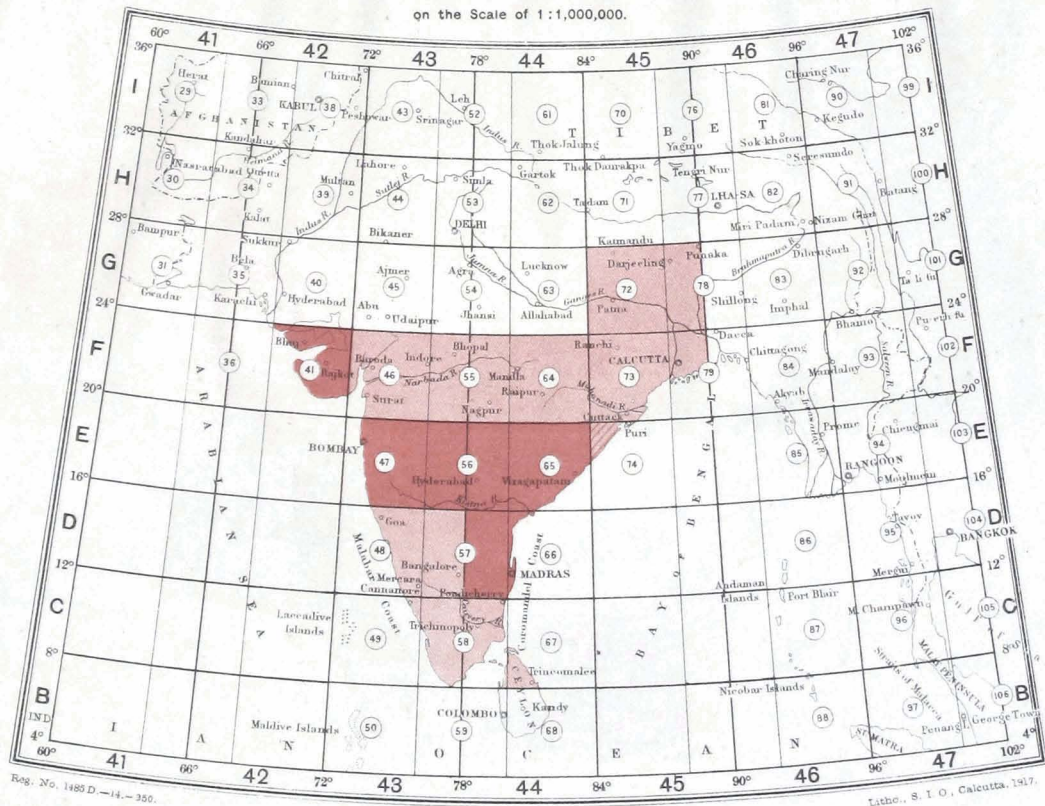
REFERENCE.

- Sheets published without contours & layers
- with contours & layers
- under publication
- in hand.

Scale: 1:1,000,000.
Miles 0 100 200 300 400 500
Nautical Miles 0 100 200 300 400 500

To accompany General Report 1916-17.

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



Reg. No. 1485 D-14.-350.

Litho. S. I. O. Calcutta. 1917.

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.

Scale 1:1,000,000.
 Miles 0 100 200 300 400 500

83A

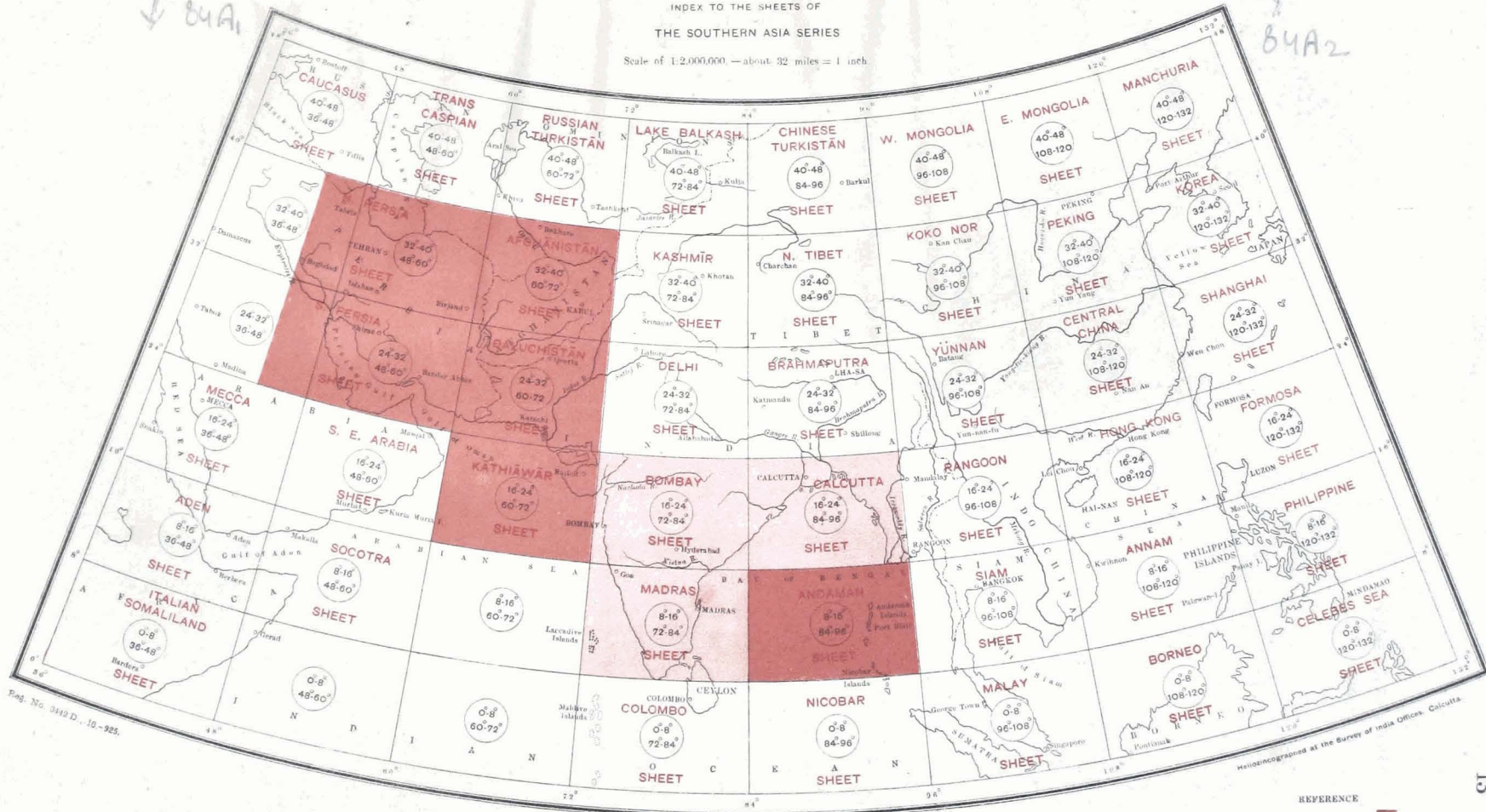
REFERENCE

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

To accompany General Report 1916-17.

INDEX TO THE SHEETS OF
THE SOUTHERN ASIA SERIES

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



Eng. No. 3449 D. 10-925.

Hydrographical at the Survey of India Offices, Calcutta.

REFERENCE

- Sheets published:
- under publication:
- in hand:

To accompany General Report 1915-17.

