QB
296
I38

GENERAL REPORT

ON THE

OPERATIONS

OF THE

Survey of India

DURING THE SURVEY YEAR

1912-13.

PREPARED UNDER THE DIRECTION OF

COLONEL S. G. BURRARD, C.S.I., R.E., F.R.S.,

SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office, Survey of India,

CALCUTTA,

1914.

Price Two Rupees or Three Shillings.

GENERAL REPORT

ON THE

OPERATIONS

OF THE

Survey of India

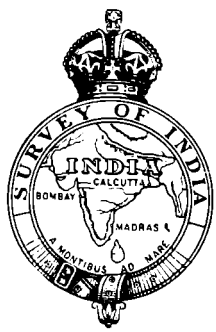
DURING THE SURVEY YEAR

1912-13.

PREPARED UNDER THE DIRECTION OF

COLONEL S. G. BURRARD, C.S.I., R.E., F.R.S.,

SURVEYOR GENERAL OF INDIA.



Printed at the Photo.-Litho. Office, Survey of India,

CALCUTTA,

1914.

QB 296
.I38

PRINTED AT THE
PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, SURVEY OF INDIA,
14, WOOD STREET,
CALCUTTA.

GENERAL REPORT

SURVEY OF INDIA

1912-13.

AGENTS FOR THE SALE OF INDIAN OFFICIAL PUBLICATIONS.

LONDON.

A. CONSTABLE & Co., 10, Orange Street, Leicester Square, W.C.

P. S. KING & SON, 2 and 4, Great Smith Street, Westminister, S.W.

KEGAN PAUL, TRENCH, TRÜBNER & Co., 68, Carter Lane, E.C.

B. QUARITCH, 11, Grafton Street, New Bond Street, W.

HENRY S. KING & Co., 65, Cornhill, E.C.

GRINDLAY & Co., 54, Parliament Street, S.W.

T. FISHER UNWIN, 1, Adelphi Terrace, W.C.

W. THACKER & Co., 2, Creed Lane, Ludgate Hill, E.C.

LUZAC & Co., 46, Great Russell Street, W.C.

EDINBURGH.

OLIVER AND BOYD, Tweeddale Court.

DUBLIN.

E. PONSONBY, LTD., 116, Grafton Street.

OXFORD.

B. H. BLACKWELL, 50 and 51, Broad Street.

CAMBRIDGE.

DEIGHTON, BELL & Co., Trinity Street.

ON THE CONTINENT.

FRIEDLÄNDER & SOHN, 11, Carl-Strasse, Berlin, N.W., 6.	Germany.
OTTO HARRASSOWITZ, Leipzig	Germany.
KARL W. HIERSEMANN, 29, Königsstrasse, Leipzig	Germany.
ERNEST LEROUX, Rue Bonaparte, Paris	France.
MARTINUS NIJHOFF, The Hague	Holland.

FOR MAPS ONLY.

LONDON.

EDWARD STANFORD, LTD., 12-14, Long Acre, W.C.

INDIA.

THACKER, SPINK, & Co., Nos. 5 and 6, Government Place, North, Calcutta.

NEWMAN & Co., No. 4, Dalhousie Square, Calcutta.

THE SECRETARY, SCHOOL BOOK SOCIETY, No. 309, Bow Bazar Street, Calcutta and Dacca.

RAI SAHIB M. GULAB SINGH & SONS, No. 76, Lower Circular Road, Calcutta and Lahore.

THACKER & Co., LD., Bombay.

D. B. TARAPOREVALA, SONS & Co., Bombay.

HIGGINBOTHAM & Co., Madras.

PROPRIETOR, MAFASILITE PRINTING WORKS, Mussoorie.

SUPERINTENDENT, GOVERNMENT PHOTO-ZINCOGRAPHIC DEPARTMENT, Poona.

THACKER, SPINK & Co., Simla.

MRS. C. WINTER, The Picture-Gallery, Srinagar.

PREFACE.

This report is intended to be general and concise. More detailed descriptions and discussions of results will be found in Volumes IV and V of the "Records of the Survey of India, 1911-12-13 and 1912-13, respectively."

CONTENTS.

PART I.

ADMINISTRATION.

PART II.

SURVEY WORK IN THE FIELD.

I.—TOPOGRAPHICAL SURVEYS.

II.—GEOGRAPHICAL SURVEYS.

III.—FOREST SURVEYS.

IV.—CANTONMENT SURVEYS.

V.—TRIGONOMETRICAL SURVEYS.

PART III.

OFFICE WORK.

I.—HEADQUARTERS OFFICES.

II.—DEHRA DŪN OFFICES.

III.—CIRCLE AND LOCAL DRAWING OFFICES.

PART IV.

WORK FOR OTHER GOVERNMENT DEPARTMENTS.

INDEX MAPS

bound at the end of this report.

1 Index to modern Surveys, Northern Circle.

2 ,, ,, ,, Southern ,,

3 ,, ,, ,, Eastern ,,

4 Index to the publication of modern sheets of the one-inch map of India, Northern Circle.

5 ,, ,, ,, ,, ,, Southern ,,

6 ,, ,, ,, ,, ,, Eastern ,,

7 Index to the publication of preliminary editions of the sheets of the one-inch map of India, Northern Circle.

8 ,, ,, ,, ,, ,, ,, Southern ,,

9 ,, ,, ,, ,, ,, ,, Eastern ,,

10 Index to the publication of Degree Sheets, Scale $\frac{1}{4}$ inch = 1 mile.

11 Index to the publication of Sheets of the "India and Adjacent Countries" Series, Scale $\frac{1}{1,000,000}$.

12 Index Chart to the Great Trigonometrical Survey.

GENERAL REPORT

ON THE

Operations of the Survey of India

DURING THE SURVEY YEAR

1912-1913.

PART I.

ADMINISTRATION.

1. This report deals with the operations of the Survey of India for the survey year commencing the 1st October 1912 and ending the 30th September 1913.

2. Colonel S. G. Burrard, C.S.I., R.E., F.R.S., the Surveyor General, administered the department until the 16th April when he went on leave and Colonel T. F. B. Renny-Tailyour, C.S.I., R.E., officiated as Surveyor General for the remainder of the year.

3. Lieutenant-Colonel P. J. Gordon, I.A., retired on the 23rd of September, and Lieutenant C. F. Nation, R.E., reverted to Military Duty with effect from the 2nd November. Three new Imperial Officers were appointed, namely, Lieutenants R. L. Almond, R.E., H. E. Roome, R.E., and H. M. McKay, R.E.

No Provincial officers were recruited.

4. During the year the Provincial Service reorganisation scheme was sanctioned, introducing, besides other benefits, an incremental time scale of pay combined with charge allowances and the granting of executive charges to Provincial officers.

Two new parties were created from the 1st March, *viz.*, No. 19 (Base Line) and No. 20 (Cantonment), and the six drawing offices were numbered and all are now executive charges. The drawing offices are now No. 1 (Calcutta), No. 2 (Dehra Dūn), No. 3 (Mussoorie), No. 4 (Bangalore), No. 5 (Shillong), No. 6 (Simla).

Two of the three posts of Survey Instructor were abolished.

5. The cost of the department for the financial year ending the 31st March 1913 was Rs. 33,74,174 against an estimated cost of Rs. 37,29,520.

6. The distribution of the officers in the various offices and parties is shown in the accompanying list.

DISPOSITION OF OFFICERS,

1912-13.

Circle or Branch.	Administrative Officer.	Party or Office.	Locality.	Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinate Establishment.	Remarks.
MAP PUBLICATION.	Colonel S. G. Burrard, C.S.I., R.E., F. R. S., *Surveyor General*, up to 16th April 1913, Colonel T. F. B. Renny-Tailyour, C.S.I., R.E., *Offg. Surveyor General*, from 17th April 1913.	.....	Calcutta ...	.....	.....	.....	.....	
		Surveyor General's Office and Mathematical Instrument Office.	Calcutta ...	Lieutenant J. A. Field, R.E.	.....	.....	.....	
		No. 6 Drawing Office (Simla)	Simla ...	Major H. L. Crosthwait, R.E., Captain M. N. MacLeod, R.E.	Messrs. A. A. Graham, F. C. Saint, W. H. Strong.	.....	6 European draftsmen, 25 Indian draftsmen, 4 printers.	
	Major W. M. Coldstream, R.E., *Superintendent, Map Publication* up to 3rd July 1913, Major M. O'C. Tandy, R.E., *Offg. Superintendent, Map Publication* from 4th July 1913.	Map Publication Office.	Calcutta ...	.....	Mr. M. Gastaud.	.....	....	
		No. 1 Drawing Office.	Calcutta ...	Major M. O'C. Tandy, R.E., Captain C. M. Thompson, I.A., Captain F. F. Hunter, I.A.	Messrs. J. O. Greiff, C. Litchfield, Jagdamba Prasad, C. C. Byrne, P. L. Causley, A. B. Hunter, J. R. Newland, P. Simpson, P. N. Sur, E. J. H. Hanby, Abdul Hai.	.....	.....	
		Map Record & Issue Office.						
		Engraving Office.						
		Photo.-Litho. Office.	Calcutta ...	Captain C. M. Thompson, I.A., Captain S. W. S. Hamilton, R.E.	.....	.....	.....	

Major C. H. D. Ryder, D.S.O., R.E., up to 16th April 1913, Major C. L. Robertson, C.M.G., R.E., from 17th April, *Superintendent, Northern Circle.*	No. 3 Drawing Office.	Mussoorie ...	...	Messrs. B. R. Hughes, J. A. Freeman, M. C. Petters, H. C. H. Cooper, B. M. Berrill.	Mr. Husain Buksh, K. S. *(Retired 31-7-13.)*	52 Clerks, Draftsmen, &c.
	No. 1 Party ...	Kashmīr ...	Major F. W. Pirrie, I.A., Major A. A. McHarg, R.E., Lieut. K. Mason, R.E.	Messrs. H. H. B. Hanby, E. B. West, D. K. Rennick, R. C. Hanson, W. J. B. Miller.	Messrs. Sher Jang, K. B., Natha Singh, R. S., Lal Singh, R. B., Paras Ram, Jamna Prasad.	32 Surveyors, &c.
	No. 2 Party ...	Punjab ...	Major E. A. Tandy, R.E., Lieut. A. A. Chase, R.E.	Messrs. F. B. Powell, J. A. Freeman, Kanak Singh, R. E. Saubolle, E. C. O'Sullivan, J. McCraken, H. T. Hughes, J. A. Calvert.	....	55 Surveyors, &c.
	No. 3 Party ...	Punjab and U. P.	Captain M. N. MacLeod, R.E., Lieut. A. A. Chase, R.E., Lieut. F. B. Scott, I.A., Lieut. R. S. Wahab, I.A.	Messrs. J. O. Greiff, W. J. Newland, E. J. Biggie, A. C. Bose, P. A. T. Kenny, A. J. A. Drake, F. H. Grant, F. J. Grice, Moqimuddin.	Messrs. Mahomed Lutf Ali, Mahindur Singh	61 Surveyors, &c.
	No. 4 Party ...	United Provinces	Captain L. C. Thuillier, I.A.	Messrs. H. W. Biggie, G. J. S. Rae, C. E. C. French, J. C. C. Leurs, G. E. R. Cooper, Duni Chand Puri.	Mr. Mohammad Husain Khan.	58 Surveyors, &c.
	No. 20 Party ...	Central Provinces	.....	Messrs. A. Ewing and C. E. C. French	Mr. Dharmu ...	12 Surveyors, &c.
	Riverain Detachment.	Punjab ...	.....	Messrs. Maya Das Puri, R. S., Moqimuddin.	Mr. Chuni Lal Kapur.	77 Surveyors, Traversers, &c., 155 Tahsildars, Kānungos, Patwāris, &c.

Circle or Branch.	Administrative Officer.	Party or Office.	Locality.	Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinate Establishment.	Remarks.
SOUTHERN.	Colonel T. F. B. Renny-Tailyour, C.S.I., R.E., up to 15th April 1913, Lieutenant-Colonel F. W. Pirrie, I.A., from 16th April 1913, *Superintendent, Southern Circle.*	No. 4 Drawing Office.	Bangalore ...	.....	Messrs. A. Ewing, J. H. Nichol, Balaji Dhondiba Mandhre.	Mr. B. V. Narayana Rao.	34 Draftsmen, &c., and 16 pupils.	
		Training Section.	Bangalore ...	.....	Messrs. W. M. Gorman, P. Kennegy ...	Messrs. P. S. Vengusvami, G. Hanumanta Rao.	1 Surveyor & 14 pupils.	
		No. 5 Party ...	Central Provinces.	Captain E. C. Baker, R.E., Captain K. W. Pye, R.E., Lieut. R. S. Wahab, I.A.	Messrs. F. P. Walsh, J. H. S. Wilson, S. S. McA'Fee Fielding, C. West, F. C. Pilcher, Munshi Lal, C. O. Picard.	Messrs. Eknath Buttu, Ram Narayan Hastir.	29 Surveyors, &c., 4 pupils.	
		No. 6 Party ...	Berār and Hyderābād.	Major H. Wood, R.E., Lieut. C. G. Lewis, R.E.	Messrs. E. A. Meyer, F. B. Kitchen, R. B. Gildea, J. O'C. Fitzpatrick, A. J. Moore, A. V. Dickson.	Messrs. Lachman Daji Jadu, R. B., Dharmu.	30 Surveyors, &c., 3 pupils.	
		No. 7 Party ...	Madras, and Mysore.	Captain J. D. Campbell, R.E.	Messrs. J. O'B. Donaghey, P. R. Anderson, H. D. W. Stotesbury, Haji Abdul Rahim, K. B., H. H. P. Butterfield, J. C. St. C. Pollett.	Mr. K. Mandanna	28 Surveyors, &c., 1 pupil.	
		No. 8 Party ...	Madras and Travancore.	Captain C. M. Browne, D.S.O., R.E., Captain R. Foster, I.A.	Messrs. W. F. E. Adams, S. F. Norman, J. H. Williams, M. Mahadeva Mudaliar, Balaji Dhondiba Mandhre, M. S. Ganesa Aiyar.	Messrs Anantarao Dhondiba Mandhre, R. S., K. Narayanasvami Chetti.	32 Surveyors, &c., 4 pupils.	
EASTERN.	Bt.-Col. G. B. Hodgson, I.A., till April 27th, Lieut.-Colonel C. H. D. Ryder, D.S.O., R.E., from April 28th, *Superintendent, Eastern Circle.*	No. 5 Drawing Office.	Shillong, Assam.	Major C. P. Gunter, R.E., Captain O. H. B. Trenchard, R.E., Captain G. F. T. Oakes, R.E., Lieut. P. G. Huddleston, R.E.	Messrs. P. J. Barrington & E. Claudius	Mr. Abdul Hakk, K. S.	41 Surveyors, draftsmen, &c.	
		No. 9 Party ...	Bihār & Orissa.	Capt. R. H. Phillimore, R.E.	Messrs. Dhani Ram Verma, E. Claudius, B. C. Newland, A. K. Mitra, W. P. Hales, F. Byrne, D. N. Banerjee.	Messrs. Dalbir Rai, M. R. Mazumdar.	31 Surveyors, &c., 2 pupils, 5 Soldier Surveyors.	
		No. 10 Party ...	Upper Burma ...	Major E. T. Rich, R.E., Captain E. B. Cardew, R.E., Lieut. W. E. Perry, R.E.	Messrs. J. Smith, P. Williams, W. G. Jarbo, H. B. Simons, V. W. Morton, Asmat-Ullah Khan, K. S., C. B. Sexton, A. F. Murphy.	Mr. Hayat Muhammad, K. S.	29 Surveyors, &c., 5 pupils.	
		No. 11 Party ...	Lower Burma ...	Captain L. G. Crosthwait, I.A., Lieut. H. E. Roome, R.E.	Messrs. J. Smith, C. Litchfield, C. S. Littlewood, A. M. Talati, T. P. Dewar, H. St. J. Kenny, A. J. Booth, R. M. Wyatt.	Mr. Raghubar Datt Thaplyal.	31 Surveyors, &c.	
		No. 12 Party ...	Assam ...	Major A. Mears, I.A., Captain G. F. T. Oakes, R.E.	Messrs. W. Skilling, Pramadaranjan Ray, R. S., E. M. Kenny, Amjad Ali, L. Williams, P. C. Mitra, H. H. Creed.	Messrs. Nanak Chand Puri, Sajoni Kumar Ghosal.	33 Surveyors, &c., 4 pupils, 4 Soldier Surveyors.	

Lieut.-Colonel G. P. Lenox-Conyngham, R.E., *Superintendent of the Trigonometrical Survey.*	Trigonometrical Survey Office.	Dehra Dūn ...	Mr. J. de Graaff Hunter, M. A., Lieut. K. Mason, R.E., Lieut. R. L. Almond, R.E., Lieut. H. M. McKay, R.E.	Messrs. Syed Aulad Hossein, K. B., H. A. Charrier, Hanuman Prasād.	Messrs. Sarat Kumar Mukerji, Ram Singh, R. S., Satish Chandra Mukharji, Lakshmi Dutt Joshi, and Govind Ram Kala.	.....
	No. 2 Drawing Office.	Dehra Dūn ...	Lieut. F. J. M. King, R.E. ...	Messrs. O. C. Ollenbach, E. C. J. Bond, H. C. W. Stotesbury.	Mr. Ram Singh, R. S.	.....
	No. 13 Party ...	Dehra Dūn ...	Major H. L. Crosthwait, R.E., Capt. V. R. Cotter, I.A.	.. ...	Mr. Bidhu Bhusan Shome.	1 Computer.
	No. 14 Party ...	U. P., Rājputāna, & C. I.	Capt. H. J. Couchman, R.E.	Messrs. Hanuman Prasād, O. N. Pushong.	.....	4 Computers.
	No. 15 Party ...	Madras, Kashmīr, Bombay, Bengal, & C. P.	Major H. McC. Cowie, R.E., Lieut. K. Mason, R.E.	Messrs. C. H. Tresham, V. D. B. Collins, V. P. Wainright, G. A. Norman, B. T. Wyatt, C. S. McInnes, Abdul Karim, N. S. Harihara Iyer.	Mr. Jugal Behari Lal.	21 Computers, &c.
	No. 16 Party ...	Indian Ports ...	.....	Messrs. H. G. Shaw, Syed Aulad Hossein, K. B., Syed Zille Hasnain.	.....	20 Computers, &c.
	No. 17 Party ...	Burma and Punjab.	Captain V. R. Cotter, I.A., Lieut. A. A. Chase, R.E.	Messrs. H. G. Shaw, O. N. Pushong, D. H. Luxa, T. F. Kitchen, F. W. Smith, O. D. Jackson, Jiya Lal, N. N. Chuckerbutty.	Messrs. Ram Singh, R. S., K. K. Das.	14 Computers, &c.
	No. 18 Party ...	India & Burma.	Capt. R. H. Thomas, R.E.	Messrs. H. P. D. Morton, Rama Prasād Ray, N. R. Mazumdar, Raj Bahadur Mathur.	Mr. Bidhu Bhusan Shome.	19 Recorders, &c.
	No. 19 Party ...	India & Burma	Major H. McC. Cowie, R.E., Major E. A. Tandy, R.E., Lieut. A. A. Chase, R.E.	.....	.....	.....
	Forest Map Office.	Dehra Dūn ...	Lieut. F. J. M. King, R.E. ...	Messrs. J. H. Nichol, O. C. Ollenbach.	.....	.....

PART II.

SURVEY WORK IN THE FIELD.

I.—TOPOGRAPHICAL SURVEYS.

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

7. *No. 1 Party.*—This Party continued its field operations in the Kashmīr and Jammu State throughout the year. An area of 3,091 square miles in the Pūnch State, the Mīrpur, Riāsi, and Jammu districts was surveyed on the 1-inch scale, the country varying from the low flat plains bordering on the Gujrāt district of the Punjab, to the high ranges of the Pīr Panjāl. In addition, areas of 684 and 1,036 square miles on the $\frac{1}{2}$-inch and $\frac{1}{4}$-inch scales were revised in the open mountainous tracts of the Gilgit and Ladākh districts respectively, bordering on those areas surveyed last year. The head-quarters of the Party were retransferred from Srīnagar (Kashmīr) to Mussoorie in April 1913.

8. *No. 2 Party.*—No. 2 Party surveyed 36 1-inch sheets giving an area of 9,245 square miles. Most of this was revision of existing 1-inch maps in Lahore, Ferozepore, Ludhiāna, Hissār and neighbouring districts, and in Farīdkot and Māler Kotla States; also new survey in the western portions of the Phūlkiān States; all plains. There was 1 sheet of revision survey in the Siwāliks, on the border of Hoshiārpur district, which was partly hills and partly plains, and revised on a variety of existing scales. Except for this the country was plain and fairly open, with slight undulations and sandy outcrops in the southern parts. No contouring or height work was attempted in the plains, a fair number of heights indicating the general line of the country being subsequently abstracted from the maps of the Irrigation Department. Ferozepore cantonment and a few important towns were surveyed on a slightly larger scale in order to secure full detail for the 1-inch maps.

A small six-inch survey of Māler Kotla and environs was paid for by Māler Kotla State. A man was sent to the Dera Ghāzi Khān neighbourhood to sketch in the great alterations due to the movements of the Indus, for incorporation in the new degree sheet of that area.

9. *No. 3 Party.*—This Party was originally intended for work in the United Provinces in continuation of last year's programme, but was moved into the Punjab for special surveys, required by the Irrigation Department. It surveyed a total area of 7,724 square miles, of which 4,960 square miles was 1-inch revision survey, and 2,764 square miles 1-inch survey. The former comprised parts of the districts of Ambāla and Karnāl, and the latter the eastern portions of the Phūlkiān States, of Patiāla, Nābha, and Jīnd. To supply data for the new survey, a traverse section of this Party ran traverses over an area of 6,058 square miles in the Phūlkiān States. With the exception of the foot hills of the Punjab, Siwāliks in the North, the country was flat alluvium, much irrigated and generally wooded. The old 1-inch maps utilised for the revision survey, except for the village sites, were not of much assistance. The new maps show a large amount of detail.

10. *No. 4 Party.*—This Party surveyed an area of 5,460 square miles in the districts of Bahraich, Gondā, Lucknow, Bāra Bankī, Rāe Barelī, Fatehpur, Fyzābād, Sultānpur, Partābgarh and Hardoī. The country surveyed consisted chiefly of flat plains, well cultivated and covered with an abundance of artificial groves. The rivers Ganges, Gogrā, Gumtī and Rāptī ran through portions of the work.

The Cantonment Section was transferred to No. 20 Party from 1st August and the work of this section is reported under Section IV (Cantonment Surveys).

11. *The Punjab Riverain Detachment.*—This detachment continued the work of traversing and laying down base lines. 319 linear and 394 square miles of main traverse, and 3,256 linear and 808 square miles of minor traverse were run. 13,833 theodolite stations were fixed in the area, under water action of the rivers Sutlej, Rāvi, Chenāb, and Jhelum in districts Ferozepore, Lahore, Siālkot, Gujrāt, and Shāhpur, and 588 corners of 196 squares were demarcated with permanent mark-stones on both banks of the Sutlej (districts Montgomery and Ferozepore), Chenāb (districts Gujrāt and Siālkot), and the Jhelum (districts Shāhpur and Jhelum) to serve as bases for the future demarcation of boundaries in the bed of these rivers. 3,496 plotted and 697 boundary "*masāris*" (settlement mapping sheets) of 407 villages were completed and 49 4-inch sheets were traced, and supplied in time to the Settlement Officers of Ferozepore, Lahore, Siālkot, Gujrāt, and Shāhpur. Besides these, 363 miscellaneous traces were prepared, and all the traverse stations marked during the season were plotted on 51 4-inch sheets. Three 4-inch riverain boundary sheets were plotted and compiled, 2 sheets finally completed, and 4 sheets typed.

12. The 25 acre rectangular survey was carried over the remaining tract commanded by the Lower Bāri Doāb Canal in continuation of the last year's work. Fourteen thousand, six hundred and twenty seven 25 acre rectangles were broken. Nearly 56 per cent. of the work was tested by the tahsildārs, naib tahsildārs, and the survey officers, and 16 per cent. was checked with theodolite traverse. 1,059 linear miles were traversed, and 3,895 theodolite stations were fixed. This work is now completely finished.

13. The Khushāb *Thal* (sandy area) survey was suddenly taken up during February 1913 at the special request of the Punjab Government. 1,967 linear and 1,070 square miles were traversed, and 3,808 theodolite stations laid out. 258 dressed stones and 84 iron tubes were embedded on certain selected stations to facilitate future survey and demarcation of fields and boundaries. 591 plotted *masāris* on the scale of 12 inches to one mile were supplied to the Settlement Officer, Shāhpur, early in September 1913.

In addition to the above, 604 *masāris* of 36 villages (scale 8 inches to one mile) were reduced to the scale of 4 inches to one mile. The boundaries of these villages were compiled on 29 4-inch sheets showing discrepancies of over two chains, and their traces prepared on 63 *masāris* for the Settlement Officer, Shāhpur.

14. With a view to assist the Settlement Officer, Dera Hamīrpur and to utilize the experience thus gained for the cadastral surveys of tahsils Pālampur, Kāngra and Nūrpur, the Kāngra work was experimentally started during the middle of April 1913. 637 linear and 81 square miles were triangulated and traversed and 1,840 stations fixed with theodolite. 784 plotted *masāris* of 256 *tikās* (sub-villages) were supplied to the Settlement Officer, Dera Hamīrpur. The experiment has proved successful, and work will be commenced in the three tahsils during next field season.

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

15. *No. 5 Party.*—No. 5 Party surveyed an area of 3,690 square miles in the Hoshangābād, Narsinghpur, Betūl, Chhindwāra, Nāgpur, Bhandāra, Seonī and Bālāghāt districts of the Central Provinces and triangulated an area of 4,972 square miles in Hoshangābād, Narsinghpur, Betūl, Chhindwāra, Seonī, Bhandāra, Bālāghāt, Nāgpur and Wardhā districts of the Central Provinces and in the Amraotī district of Berār. The nature of the country surveyed varied from the steep and wooded hills on the north of the Sātpurā plateau to the flat and undulating cultivated lands in the Nāgpur plain.

16. *No. 6 Party.*—No. 6 Party surveyed an area of 3,028 square miles in the Yeotmāl, Akola and Buldāna districts of Berār and in the Adilābād, Nānder and Parbhani districts of Hyderābād and triangulated an area of 2,795 square miles in the East Khāndesh districts of Bombay, in the Buldāna and Akola districts of Berār and in the Parbhani and Nānder districts of Hyderābād. The country was of an intricate nature similar to that surveyed in previous years. The $\frac{1}{2}$-inch survey of Hyderābād State was commenced and the increased out-turn of the party is due to the rapidity of survey on this scale.

17. *No. 7 Party.*—No. 7 Party surveyed an area of 5,017 square miles in the Malabar, South Kanara, Salem, Coimbatore and North Arcot districts of Madras, and in the Bangalore, Kolār and Mysore districts of Mysore, and triangulated 4,642 square miles in the Salem, Chittoor and North and South Arcot districts of Madras. The country surveyed was very varied in character. It includes the flat intricate coast, the undulating jungle-clad foot-hills of the Western Ghāts, the densely wooded, hilly country on both banks of the Cauvery river and the open undulating Mysore plateau.

18. *No. 8 Party.*—No. 8 Party surveyed an area of 1,614 square miles and traversed 205 linear miles in the Malabar and Madura districts of Madras and in Travancore State. Along the sea coast the country is covered with dense cocoanut groves and paddy cultivation which is flooded for the greater part of the year. On leaving the sea coast the country gradually changes in character and is at first undulating and densely populated and cultivated with scrub or tree jungle on the low hills. Further inland the cultivation and inhabitants are less and the forest areas become more numerous and denser with open grassy tops to the high hills. The work in such country was of necessity slow, difficult and expensive.

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

19. *No. 9 Party.*—No 9 Party surveyed an area of 4,030 square miles in Singhbhūm and Rānchī districts and in the Feudatory States of Orissa. Of this area 1,189 square miles in the Feudatory States were surveyed on the $\frac{1}{2}$-inch scale, and 30 square miles of reserved forest in Singhbhūm district were surveyed on the 2-inch scale; the remaining area was surveyed on the 1-inch scale. The country surveyed was mostly wooded and hilly, but on the Rānchī plateau, undulating and well cultivated. 253 linear miles of forest boundaries were traversed by theodolite within Singhbhūm district. Triangulation was carried out in districts Hazāribāgh, Monghyr, Bhāgalpur and Santāl Parganas.

20. *No. 10 Party.*—No. 10 Party surveyed an area of 2,496 square miles, in the Myitkyinā district of Upper Burma, including 24 square miles of country beyond the Burma-China frontier and in unadministered territory which were sketched; 2,700 square miles were triangulated and traversed in the Myitkyinā district and 207 linear miles of forest boundary traverse were completed. The country surveyed varied from the level plains round Myitkyinā and Talawgyi on both sides of the Irrawaddy which were less than 500 feet above sea level, to the high hills along the Burma-China Border some of which were over 12,000 feet high and covered with snow during the winter months. Both plains and hills were thickly wooded and it was difficult to get any views of the surrounding country except where ground had been cleared for cultivation.

In April a drawing office was opened in Maymyo for the preparation of degree sheets of Burma and of special maps dealing with the Burma frontier such as those surveyed with Political Missions, &c.

One Upper Subordinate and three surveyors were attached to Political Missions during the field season.

21. *No. 11 Party.*—No. 11 Party surveyed an area of 1,960 square miles in the Tavoy district of the Tenasserim division of Lower Burma and triangulated an area of 3,929 square miles in the same district and in the north of the Mergui district. The country surveyed varying from mangrove swamps to hills rising to 6,800 feet lay between the sea coast and the Siamese frontier, the greater part of it being thinly populated or entirely uninhabited. The work also included the North and Middle Moscos Islands, which lie from fifteen to twenty miles off the coast. Owing to a hot and damp climate with an average annual rainfall of 230 inches the evergreen jungle is very dense and often impenetrable ; this, together with scarcity of labour, supplies, local transport and communications made survey work slow and difficult.

Six Superintendents of the Burma Land Records Department were attached to the party for training in plane-tabling for two months each.

One surveyor was attached to the North Burma Exploration Survey Detachment and another was employed on reconnaissance work under an officer of the Intelligence Branch of the Army Department.

22. *No. 12 Party.*—No. 12 Party surveyed an area of 3,374 square miles in the Kāmrūp, Darrang and Nowgong districts of Assam and carried out triangulation and traversing over an area of 4,500 square miles. The above area includes 43 square miles of reserved forest surveyed on the 2-inch scale. The country under survey consisted principally of the alluvial plains of the Brahmaputra which, where not under cultivation, are covered with high grass and scattered tree jungle interspersed with immense swamps and "bils"; the balance of the area consisted of hills for the most part densely wooded.

TOPOGRAPHICAL SURVEYS.

Table showing Out-turns and Costs.

1912-1913.

1	2	3	4	5	6	7	8	9	10	11	12
Circle.	Party.	Locality.	Character of Ground.	Type of Survey.	Scale.	Out-turn. Survey.	Total Out-turn of Survey on all scales.	Difference from 6,000 square miles per party. (*a*)	Total cost.	Cost-rate per square mile. Survey and Mapping.	REMARKS.
						Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Rs.*	*Rs.*	
N.	No. 1	Kashmir State ...	Mostly hilly and wooded ...	Survey ...	1-inch	3,091	4,811	—1,189	1,12,659	23·4	
				Revision Survey	½-inch	684					
				Revision Survey	¼-inch	1,036					
N.	No. 2	Punjab ...	Partly plains, partly Siwalik hills.	Revision Survey	1-inch	6,331	9,245	+3,245	1,11,252	12·0	
				Survey ...	1-inch	2,661					
			Plains fairly open, no heights or contours.	Revision Survey	2, 3 & 4-inch.	253					
N.	No. 3	Punjab and U. P. ...	Flat Alluvium ...	Survey ...	1-inch	2,764	7,724	+1,724	1,42,734	18·5	
				Revision Survey	1-inch	4,960					
N.	No. 4	United Provinces ...	Plains wooded and open ...	Resurvey and supplementary survey.	1-inch	5,460	5,460	—540	96,477(*b*)	17·7	(*b*) Excluding cost of Cantonment Section, Rs. 18,620 (*vide* table on p. 18).
			Totals, Northern Circle ...	.....	...		27,240	+3,240	4,63,122	17·00	

(*a*) The figure 6,000 (square miles) from which differences are shown in column 9 is the full out-turn per party which it is hoped to attain in the future.

TOPOGRAPHICAL SURVEYS.

Table showing Out-turns and Costs.—(Contd.)

1912-13.

1	2	3	4	5	6	7	8	9	10	11	12
Circle.	Party.	Locality.	Character of Ground.	Type of Survey.	Scale.	Out-turn. Survey.	Total Out-turn of Survey on all scales.	Difference from 6,000 square miles per party. (*a*)	Total cost.	Cost-rate per square mile. Survey and Mapping.	REMARKS.
S.	No. 5	Central Provinces	Varied, wooded hills and cultivated plains.	Survey ..	1-inch	2,575	3,690	—2,310	1,13,888	30·9	
			Wooded hills ...	Revision Survey	1-inch	1,115					
S.	No. 6	Berār & Hyderābād ..	Varied, open plains undulating plateau intricate forest-clad hills.	Survey ...	½-inch	1,086	3,028	—2,972	99,631	32·9	
			Open undulating plains with deep ravines.	Survey ...	1-inch	1,508					
			Intricate ground with thin forest.	Survey ...	2-inch	434					
S.	No. 7	Madras & Mysore ...	High forest-clad hills and undulating open plateau.	Survey ...	1-inch	652	5,017	— 983	87,694	17·5	
				Revision Survey	1-inch	4,040					
			Flat coast, low jungle clad foot-hills.	Survey ..	1½-inch	312					
				Survey ...	2-inch	13					
S.	No. 8	Madras & Travancore	Flat enclosed coast country	Survey ...	1½-inch	256	1,614	—4,386	1,32,777	82·3	Very difficult country.
			Open hills, forest and flat enclosed.	Survey ...	1-inch	1,358					
			Totals, Southern Circle ...	.....	.....	....	13,349	—10,651	4,33,990	32·51	

E.	No. 9	Bihār & Orissa ...	Wooded hills and undulating plateau.	Supplementary Survey.	1-inch	2,303	4,030	—1,970	1,03,135	25·5	
			Thickly wooded hills ...	Revision Survey	1-inch	476					
			Open undulating ground ...	Survey ...	1-inch	32					
			Wooded undulating ground with hills.	Revision Survey	½-inch	1,189					
			Thickly wooded hills ..	Survey ...	2-inch	30					
E.	No. 10	Upper Burma ...	Mostly hilly and thickly wooded.	Survey ...	1-inch	2,347	2,472(c)	—3,528	1,33,466(d)	53·9	(b) Trans-border reconnaissance. (c) Excluding reconnaissance survey. (d) Excludes Rs. 36,238 expended on exploration surveys, forest boundary surveys and Maynyo Drawing Office. Cost-rate is high owing to difficult nature of ground and expense of transport.
				Reconnaissance Survey.	1-inch	24(b)					
				Survey ...	2-inch	125					
E.	No. 11	Lower Burma ...	Densely wooded; partly undulating, partly steep hills.	Survey ...	1-inch	1,745	1,960	—4,040	1,36,638(e)	69·7	(e) Excluding Rs. 14,449 on instruction and reconnaissance.
				Survey ...	2-inch	215					
E.	No. 12	Assam ...	Partly open plains and grass jungle, partly densely wooded hills.	Survey ...	1-inch	935	3,374	—2,626	1,38,006(f)	40·9	(f) Excludes Rs. 2,154 for special forest survey but includes Rs. 2,865 expenditure on traversing forest boundaries. (g) Excludes 6 square miles of special forest survey.
				Revision Survey	1-inch	116					
				Supplementary Survey.	1-inch	2,286					
				Survey ...	2-inch	37(g)					
			Totals, Eastern Circle ...	...	..	.....	11,836	—12,164	5,11,245	43·19	
			GRAND TOTALS ...	...	...	.....	52,425	—19,575	14,08,357	26·86	

(a) The figure 6,000 (square miles from which differences are shown in column 9 is the full out-turn per party which it is hoped to attain in the future.

Table showing progress of Topographical Surveys, 1905 to 1913.

Survey year.	Scale.	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
		Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*
1905-06	1-inch and 2-inch	5,995	1,660	10,322	17,977
1906-07	do.	7,277	7,666	8,659	23,602
1907-08	do.	14,530	9,256	12,431	36,217
1908-09	do.	17,957	12,526	11,542	42,025
1909-10	do.	23,833	12,532	9,736	46,101
1910-11	do. and 1½-inch	27,528	13,171	9,218	49,917
1911-12	do.	23,852	9,115	(a)10,654	43,621
1912-13	do. and ½-inch	27,240	13,349	11,836	52,425
Areas completed to date		148,212	79,275	84,398	311,885
Total areas included in topographical programme.	Total of 1-inch & ½-inch work allotted.	750,000	542,800	528,800	1,821,600
Approximate areas remaining for Survey	Total of 1-inch & ½-inch work still remaining.	601,788	463,525	444,402	1,509,715

(a) The area reported in 1911-12, wrongly included 1,628 square miles surveyed by No. 11 Party on ½-inch scale.

NOTE 1.—As was suggested in the note on page 12 of the General Report of the Survey of India for 1910-11, the question of reducing the scale of survey in certain regions has now been considered, and the half-inch scale has been accepted for a larger area than was contemplated in the original topographical programme. The exact figures showing the areas allotted to 1-inch and ½-inch surveys, respectively, are not to hand as yet, and only the total figures for both scales can be shewn.

The reasons for this reduction of the scale of survey are as follows:—(1) to enable the completion of the survey programme to be carried out by 1935 if possible, (2) to reduce the expenses of survey in hilly, desert or other depopulated regions, where the one-inch scale for maps seems at present unnecessary.

NOTE 2.—The figures showing the total areas included in the topographical programme of the circles and the areas remaining for survey are liable to future correction, (1) because the limits of the several circles have not been everywhere settled, (2) because in some small areas surveys are not found up to standard and require revision. These areas get unavoidably included both in the totals for the year of actual survey and in the totals for the year in which the revisionary survey takes place, and the figures thus become slightly incorrect.

II.—GEOGRAPHICAL SURVEYS.

23. A large amount of exploration on the North East frontier was carried out during 1911-12 and 1912-13.

24. The detachment under Lieutenant Lewis, R.E., with the Miri Mission in 1911-12 surveyed 2,000 square miles in the basin of the Subansirī and its affluents the Khru and Kamla Rivers and fixed a large number of peaks on the main Himālayan range.

25. In the Abor country during 1911-12 and 1912-13 a detachment under Captain Trenchard, R.E., surveyed the whole valley of the Dihāng and its tributaries up to Latitude 29°30′ (except the headwaters of the Siom River); an area of 6,500 square miles. A large number of peaks on the main Himālayan range were also fixed, including one of over 25,500 feet.

26. The detachment under Major Gunter, R.E., with the Mishmi Mission explored the Luhit River up to the neighbourhood of Rimā in 1911-12 and surveyed the whole of the basin of the Dibāng River and its tributaries in 1912-13, completing an area of 8,848 square miles, and fixed a large number of peaks on the main Himālayan range.

27. The detachment under Captain Cardew, R.E., which accompanied the North Burma Missions of 1911-12 and 1912-13 surveyed an area of 10,000 square miles, nearly completing the exploration of the Irrawaddy basin. Surveyors also accompanied the late Captain Pritchard in both seasons, and including their work, a total area of well over 30,000 square miles of hitherto unexplored country has been surveyed on the $\frac{1}{4}$-inch scale.

III.—FOREST SURVEYS.

28. During the year 1912-13, the forest surveys have, as usual, been carried out by the Topographical parties of the Survey of India. In the majority of cases, the surveys were executed on the scale of two inches to the mile but in some few instances, the work was done on the one-inch scale. A considerable extent of forest boundaries was also surveyed on the scale of 4 inches to the mile. The revision of certain areas previously surveyed on the 4-inch scale by the old Forest Survey Branch was also effected.

Northern Circle.

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

Southern Circle.

30. *Central Provinces. (Berār Circle).*—No. 6 Party continued the topographical survey of Berār and Hyderābād. All A and B class forests, and C class forests over one square mile in area falling in the area under survey and in six of the sheets to be surveyed in the next and following seasons were surveyed on the 2-inch scale.

With the approval of the Chief Conservator of Forests, no theodolite boundary traverses were carried out, but all the reserve boundaries were surveyed by plane-table traverse on the 4-inch scale; this ensured better agreement with the topographical details. The survey of all the forests in Yeotmāl district was completed and work was also done in Akola and Buldāna districts. The old 4-inch map of Gerumātergaon reserve in Buldāna was too inaccurate to be utilised and a new 2-inch survey was commenced. The area of forests surveyed on the 2-inch scale amounted to 375·6 square miles and the plane-table boundary surveys amounted to 984·8 linear miles.

31. *Madras Presidency.*—No. 7 Party in the course of its ordinary operations carried out the survey on the 2-inch scale of the Mambetta reserve and Doddasampagai extension of Kollegāl division amounting to 11·6 square miles. No new boundary traverses were carried out.

Eastern Circle.

32. *Bihār and Orissa.*—In the course of its regular operations, No. 9 Party surveyed an area of 30 square miles of protected forests, on the 2-inch scale and 32 square miles on the 1-inch scale, in the Singhbhūm and Chaibāsa divisions; and theodolite traverses amounting to 253 linear miles, were run round the boundaries of all the blocks over 1 square mile in area which have not been previously surveyed. The survey of all the forests in the Singhbhūm forests division and of such forests of the Chaibāsa division as fall in the Singhbhūm district, has now been completed.

33. *Upper Burma (Northern Circle).*—During the year under report, No. 10 Party surveyed the Maingna, Zigyun, Talawgyi and Kawan reserves in the Myitkyinā division, amounting to 116½ square miles, on the 2-inch scale and part of the Padaung game reserve, area 27 square miles, on the 1-inch scale. In addition to these, 207 linear miles of boundary survey was completed round the Maingna, Talawgyi, Kawan, Namkwin and part of Padaung reserves. The Conservator of Forests, Northern Circle, agreed to the survey of the Padaung reserve being done on the 1-inch scale instead of the 2-inch scale, as it is only reserved as a game sanctuary and not for timber preservation.

34. *South Tenasserim Division (Tenasserim Circle).*—Parts of the Heinzē and Kaleinaung reserves amounting to 212 square miles and the whole of Pandin-In reserve, area 3 square miles, were surveyed by No. 11 Party on the 2-inch scale and their boundaries, 59½ linear miles, were traversed by theodolite.

35. *Assam.*—No. 12 Party surveyed the Darranga, Khalingduar and its extension and Singri Hill reserves, on the 2-inch scale in course of its ordinary operations. In addition to this, the two small reserves of Hājo and Sildar Hill surveyed on the 1-inch scale last year, were at the special request of the Conservator of Forests, Western Circle, resurveyed on the 2-inch scale. The total area thus surveyed amounted to 37 square miles. An area of some 6 square miles was also surveyed on this scale in the Upper Dehing reserve (western block) and its boundary, 50 linear miles, traversed on the 4-inch scale. This being a special survey, its cost will be borne entirely by the Forest Department. Sonaikusi and Kolahat reserves, area 44 square miles, which were previously surveyed on the 4-inch scale by the old Forest Survey Branch, were revised on the 1-inch scale, as the contouring and heights were found unreliable. The artificial boundaries only of the following reserves, amounting to 167½ linear miles, have been traversed on the 4-inch scale, during the year under report:—Khalingduar Extension, Singri Hill, Jungthung, Chelabor, Sildharampur, Laokhawa and Kaziranga.

IV.—CANTONMENT SURVEYS.

36. *No. 20 Party (Cantonment).*—During the year this Party was formed to survey cantonments and towns on large scales, and also to train soldier surveyors who after a further training in this party, are to be transferred to the Military Works Department to revise and keep up to date all cantonment plans completed by the Survey of India Department.

37. From 1st August 1913, the Cantonment Section of No. 4 Party was converted into this new Party, and its strength was increased by recruiting pupil surveyors and by the transfer of a Provincial Officer and an Upper Subordinate from other parties.

38. During the year the cantonment section and the party completed the survey of Quetta Cantonment, Quetta Civil Station and Quetta Fort, which were then in hand, and also completed an extension of 8·25 square miles of the Delhi New Cantonment Area which was surveyed the year previous for the Town-planning Committee, and in addition surveyed Saugor Cantonment and its bazaars, and also triangulated Guna.

39. The mapping of Quetta Cantonment, Quetta Civil Station and Quetta Fort is in hand and will soon be sent for publication.

The programme for the ensuing year is the survey of Guna, Kamptee, and Rājkot cantonments and also other additional cantonments which may be required by the Director-General of Military Works.

Table showing out-turn and cost-rates of Cantonment Surveys, 1912-13.

Cantonments.	Class of Survey.	Scale.	Out-turn. Acres.	Total cost.	Cost-rate per acre. Survey and mapping.	Remarks.
				Rs.	*Rs.*	
Delhi ...	Survey ...	4″=1 Mile	5,280	22,144*	0·50	*Includes Rs. 18,620 cost of Cantonment Section of No. 4 Party prior to the formation of No. 20 Party.
Quetta and Saugor ...	Re-survey	16″=1 Mile	6,164		2·75	
Saugor ...	,,	64″=1 Mile	95		6·37	
			11,539			

V.—TRIGONOMETRICAL SURVEYS.

GEODETIC SURVEY.

(a).—Astronomical Latitudes.

40. *No. 13 Party.*—As no Officer was available, no Astronomical Latitudes were observed during the field season 1912-13.

(b).—Pendulum Operations.

41. *No. 14 Party.*—No. 14 Party made pendulum observations at 14 stations along a line stretching from Bhopāl to Bulandshahr, thus filling in the gap between Major Lenox-Conyngham's work from Mussoorie to Meerut and Captain Cowie's observations in the Central Provinces. The table annexed gives the results of the observations. These results are not comparable with those of previous years, as we have now begun to use a new formulæ for computing γ_0 The results at all stations are, however, being published in a new Professional Paper.

The stations Bhopāl to Guna form part of the "hidden chain" or belt of high density and the existence of two other small belts is indicated by the Hayford residuals.

42. The results of the investigation into the theory of isostatic compensation appear to show that the Himālaya are not completely compensated and further that the partial compensation beneath them extends beyond their foot into the plain. This investigation is not yet complete.

43. Comparative observations between the Indian pendulums and those of the De Filippi expedition have lately been made at Dehra Dūn. The results, when available, will give an independent determination of the value of gravity at this, our base station.

For Summary of results, see page 20.

PENDULUM OPERATIONS.

Summary of Results.

1912-13.

Stations.	Latitude. ϕ	Longitude.	Height.	Computed value of gravity at sea level. γ_0*	Corrections for Height.	Corrections for Mass (Bouguer).	Corrections for Mass (Hayford).	γ_0 corrected for height. γ_A	γ_0 corrected for height and Mass (Bouguer). γ_B	γ_0 corrected for height and Mass (Hayford). γ_C	Observed value of gravity. g.	$g-\gamma_A$	$g-\gamma_B$	$g-\gamma_C$
	° ′ ″	° ′ ″	*Feet.*	*Dynes.*	*Dynes.*	*Dynes.*	*Dynes.*	*Dynes.*	*Dynes.*	*Dynes.*	*Dynes.*	*Dynes.*	*Dynes.*	*Dynes.*
Bhopāl ...	23 15 58	77 25 00	1,630	978·835	−0·153	+0·055	+0·007	978·682	978·737	978·689	978·711	+0·029	−0·026	+0·022
Kalīānpur ...	24 7 11	77 39 17	1,763	978·892	−0·165	+0·059	+0·011	978·727	978·786	978·738	978·777	+0·050	−0·009	+0·039
Bīna ...	24 10 41	78 11 46	1,355	978·896	−0·127	+0·046	±0·000	978·769	978·815	978·769	978·795	+0·026	−0 020	+0·026
Guna ...	24 38 48	77 19 13	1,569	978·928	−0·147	+0·053	+0·007	978·781	978·834	978·788	978·807	+0·026	−0·027	+0·019
Lalitpur ...	24 41 29	78 24 26	1,199	978·931	−0·112	+0·040	−0·003	978·819	978·859	978·816	978·814	−0·005	−0·045	−0·002
Sīpri ...	25 25 52	77 39 25	1,533	978·982	−0·144	+0·052	+0·009	978·838	978·890	978·847	978·876	+0·038	−0·014	+0·029
Jhānsi ...	25 27 2	78 33 43	858	978·983	−0·080	+0·029	−0·007	978·903	978·932	978·896	978·910	+0·007	−0·022	+0·014
Gwalior ...	26 13 57	78 12 49	658	979·039	−0·062	+0·022	−0·012	978·977	978·999	978·965	978·958	−0·019	−0·041	−0·007
Dholpur ...	26 42 1	77 54 47	577	979·072	−0·054	+0·019	−0·015	979·018	979·037	979·003	978·999	−0·019	−0·038	−0·004
Agra ...	27 10 20	78 1 7	535	979·107	−0·050	+0·018	−0·018	979·057	979·075	979·039	979·056	−0·001	−0·019	+0·017
Muttra ...	27 28 25	77 41 48	562	979·129	−0·053	+0·019	−0·019	979·076	979·095	979·057	979·072	−0·004	−0·023	+0·015
Hāthras ...	27 36 52	78 3 22	587	979·139	−0·055	+0·020	−0·020	979·084	979·104	979·064	979·075	−0·009	−0·029	+0·011
Alīgarh ...	27 53 32	78 0 31	612	979·160	−0·057	+0·021	−0·021	979·103	979·124	979·082	979·075	−0·028	−0·049	−0·007
Khurja ...	28 14 19	77 51 53	649	979·186	−0·061	+0·022	−0·024	979·125	979·147	979·101	979·082	−0·043	−0·065	−0·019

* $\gamma_0 = 978{\cdot}030\ (1 + 0{\cdot}005302\ sin.^2\phi - 0{\cdot}000007\ sin.^2 2\phi)$.

TRIANGULATION (*vide* index map No. 12).

44. During 1912-13 No. 15 Party was employed in extending Principal and Secondary Triangulation.

(a).—Principal Triangulation.

(i).—The Sambalpur Series. This meridional series was continued from Latitude 22°, to which the operations of 1911-12 had carried it, and extended southwards through Sambalpur, the Orissa Feudatory States, and Khondmāls into Ganjām, reaching a Latitude of 19° 40′. Three more figures remain still to be observed before the series will be complete.

(b).—Secondary Triangulation.

(ii).—The Manipur Series. This series was commenced. It will connect the Assam Valley Series, in the neighbourhood of Golāghāt, with the northern end of the Manipur Meridional Series, a little to the west of Homalin.

(iii).—The Khandwā Series. This series along the parallel of 22° approximately, between the Khanpisura Series in the neighbourhood of Khandwā, and the Great Arc Series near Badyūr, was fully completed.

(iv).—The Akola Series. A commencement was made on this meridional series which, it is intended, shall connect the Khandwā Secondary Series with the Bhīr Secondary Series in Longitude 76° 30′.

(v).—Bombay City and Island Operations. The triangulation commenced in 1911-12 to provide a basis for a large detail survey, was completed and supplemented by precise traverse work. About two fifths of the proposed traverse lines still remain to be completed.

(vi).—Kashmīr Secondary Operations. The triangulation commenced in the Summer of 1912 for the purpose of forming a connection between the Indian and Russian Systems of triangulation was completed in the Summer of 1913.

This series runs from Gilgit up the Hunza valley, over the Kilik pass, and across the Taghdumbash-Pāmir to the Beyik pass near which the Russian stations are situated.

The table below gives details regarding the work on the different series :—

SUMMARY OF PARTICULARS.

	TRIANGULATION.				TRAVERSE.
	PRINCIPAL.	SECONDARY.			
	Sambalpur.	Kashmir.	Khandwa.	Bombay.	Bombay City.
No. of Stations observed at ...	19	12	22	69	.....
,, ,, ,, newly fixed	17	.....	20	.....	.....
,, ,, ,, built	17	.....	20	.....	.....
Length of triangulation completed in miles	167	50	141	*(net-work)*	.....
Length of triangulation remaining to be done	52	110	.....	.....	.....
Area of triangulation in sq. miles ...	5,014	650	1,710	(*a*) 79·95 (*b*) 15·36	.....
Theodolite used ...	T. & S.'s 12″ Micromr. No. V	T. & S.'s 6″ Micromr. No. 1403	T. & S.'s 8″ Micromr. No. 1315	T. & S.'s 8″ Micromr. No. 1055	T. & S.'s 8″ Micromr. No. 1316
Number of triangles observed ...	19	11	22	84	.....
,, astronomical azimuths observed	2	.....	.....	.....	.....
Maximum triangular error	0″·564	3″·96	3″·78	4″·30	.....
Average triangular error	0″·185	1″·47	1″·41	1″·95	.....
Mean closing error in Lat. ...	.....	.....	0″·465	...	.....
,, ,, ,, Long. ...	.....	.....	0″·241	.....	.....
,, ,, ,, height ...	.....	.....	1·9 feet	.....	.....
,, ,, ,, azimuth ...	.....	.....	2″·424	.....	.....
,, ,, ,, log side, the unit being the seventh place of decimal ...	.....	.....	239	.....	.....
TRAVERSE.					
Precision of results highest ...	.....	.....	.....	.....	1 60,000
,, ,, average ...	.....	.....	.....	.....	1 12,000
Number of Stations	.....	.....	.....	.....	307
Total No. of miles of chaining ...	.....	.....	.....	.....	34·437
		Average height of stations above mean sea level, 14,706 feet.		(*a*) Framework. (*b*) Internal	

TIDAL OPERATIONS.

45. *No. 16 Party.*—Observations were taken by means of self-registering tide-gauges during the year, at the stations given in the following list :—

	Stations.	Date of commencement of observations.	Date of closing of observations.	Number of years of observations.	Remarks.
1	Aden	1879 ...	Still working	34	
2	Karāchi ...	1868 ...	1880	*13 } 46	* Small tide-gauge working.
3	Bombay (Apollo Bundar) ...	1881 ...	Still working	33 }	
4	Bombay (Prince's Dock) ...	1878 ...	,,	35	
5	Madras ...	1888 ...	,,	25	
		1880	1890	10 } 28	
		Restarted 1895	Still working	18 }	
6	Kidderpore	1881 ...	,,	32	
7	Rangoon	1880 ...	,,	33	
8	Moulmein ...	1880 ...	1886	6 } 10	
		Restarted 1909	Still working	4 }	
9	Port Blair	1880 ...	,,	33	

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

The 9 tidal observatories at work were inspected during the year and the registrations have, on the whole, been satisfactory, except at Madras, where the passage between the sea and the tide-gauge well was completely blocked with sand and the tidal observatory stopped working from the 10th August 1913. A new observatory at Madras is being built, but it was not ready by the 30th of September 1913.

Tidal observations during the coming year will be continued at all the above observatories.

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

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

Year.	Number of stations.	In Time.		In Height.			
		Within 15 minutes of actuals.		Within 8 inches of actuals.		Within $\frac{1}{10}$ of mean range at springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1903	8	80	77	92	93	94	94
1904	6	82	75	99	98	96	96
1905	7	82	79	96	95	96	97
1906	6	85	81	96	97	94	95
1907	6	84	83	98	98	98	99
1908	6	84	81	98	97	99	99
1909	6	85	86	97	97	97	98
1910	6	81	83	98	98	95	96
1911	6	81	81	98	99	97	98
1912	6	82	82	97	98	97	98
Average of 10 years		83	81	97	97	96	97

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

Year.	Number of stations.	In Time. Within 15 minutes of actuals.		In Height. Within 8 inches of actuals.		Within $\frac{1}{10}$ of mean range at springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1903	2	55	61	70	60	88	87
1904	2	45	61	72	65	94	95
1905	2	52	62	72	57	94	92
1906	2	59	53	74	64	92	95
1907	2	58	47	78	60	96	90
1908	2	58	52	77	60	97	92
1909	3	61	59	69	65	93	92
1910	3	57	52	63	71	89	94
1911	3	65	51	68	66	90	90
1912	4	70	58	74	62	94	91
Average of 10 years	...	58	56	72	63	93	92

LEVELLING OPERATIONS.

47. *No. 17 Party.*—Three detachments were employed on levelling operations during the past season.

48. *No. 1 Levelling Detachment* was employed *(a)* on the completion of the line Sargodha-Multān, *(b)* on a revision of the old line of levels Multān-Māhiwāla T. S., *(c)* on a revision of the old line Ambāla-Meerut-Delhi, along the main road, *(d)* on new levelling from Delhi along the road to Muttra, *(e)* on new levelling from Murree along the tonga road to Srīnagar (Kashmīr), with branch lines emanating from Srīnagar to Palgam *viâ* Islāmābād, *to the Sind Valley, towards Bandapur, towards Shupiyan.*

The out-turn amounted to 629 miles, and the heights of 8 primary, and 555 secondary bench-marks determined, including 5 Principal stations of the Great Trigonometrical Survey.

The line Sargodha-Multān completes the circuits, (1) Multān-Khemwāla-Segra-Darya Khān-Khushāb-Sargodha-Multān, 450 miles in length, and (2) Multān-Sargodha-Lahore-Ferozepore-Murghai-Khemwāla-Multān, a length of 795 miles, the closing errors being respectively 0·095 and 0·190 of a foot.

The new line Delhi-Muttra also completes the circuit Delhi-Meerut-Hāthras-Muttra-Delhi, the closing error being 0·158 of a foot in a length of 272 miles. These errors are deduced from differences of unadjusted orthometric heights.

49. *No. 2 Levelling Detachment* was employed on new levelling on the line *(a)* Comilla-Chittagong by road, *(b)* Brāhmanbāria-Pāchuriā, partly by road and partly along the railway line, crossing by the "Target" method the Meghnā, Lakhya and Dhaleswari rivers, and the Padmā or Ganges river by the "Vertical Angles" method, *(c)* Pāchuriā-Barisāl, by road and across country.

The out-turn amounted to 354 miles, and 18 primary, and 277 secondary bench-marks were connected, including 8 Principal stations of the Great Trigonometrical Survey.

In addition to the above, about 35 miles of single levelling were carried out at Darjeeling in the cantonments of Takdah and Lebong, and in the Happy Valley landslip area.

The line (1) Brāhmanbāria-Pāchuriā completes the circuit Porādaha-Pārvatīpur-Gauhāti-Akhaura-Pāchuriā-Porādaha, with a closing error of 2·706 feet, accepting the orthometric values of Porādaha and Pārvatīpur *as published in Great Trigonometrical Volume XIX B.* The length of the circuit is 824 miles. The line (2) Comilla-Chittagong connects Pārvatīpur with the tidal bench-mark at Chittagong with an error of 1·082 feet, in a length of 643 miles, assuming that mean water level is 0·3 of a foot above mean sea level.

This shows that the greater portion of the error, *e.g.*, 1·624 feet in line (1), is on the line Akhaura-Porādaha, and may be due to errors in the single levelling from Pāchuriā to Porādaha which is to be revised by double levelling in the coming field season, and in the river crossings. For line (2) the most likely places for error to have crept in, are the river crossing at Dhubri, crossed by the "Tide-pole" method only, which is to be repeated by the "Vertical Angles" and "Target" methods, and the hill section over the Khāsi hills.

50. *No. 3 Levelling Detachment* was employed on new levelling in Burma, *(a)* from Henzada to Bassein along the left bank of the Ngawun river, *(b)* from Pegu to Mokpalin by road and railway, with branch lines along the Pegu-Sittang Canal, *(c)* from Prome to Taundwingyi *viâ* Allanmyo by road.

The out-turn amounted to 310 miles. The heights of 4 primary, and 220 secondary bench-marks were determined.

51. A section of No. 17 Party laid down on the ground and erected pillars on the new boundary between Naini Tāl District and Nepāl State, and also made a survey of the above boundary together with the boundary between Pilībhīt District and Nepāl State, the settlement of which is now under discussion.

MAGNETIC SURVEY.

52. *No. 18 Party.*—Two detachments, each under a Provincial officer, were employed on field work: they were engaged partly on detail survey and revision of the work of season 1901-02 and partly on revisiting repeat stations.

The officer in charge inspected Barrackpore and Toungoo base stations, observed at repeat stations and subsequently carried out a preliminary magnetic survey of Ceylon.

During the season the values of the magnetic elements were determined at the following:—

58 repeat stations.
19 old stations (revised).
42 new stations in Ceylon.
3 new stations in India.
20 new detail stations.

53. *Work during recess.*—The computation of the previous season's field work and the tabulation of the base station results for 1912 have been completed: the latter have for the first time been derived from the measurement of all available days instead of from only 5 quiet days per month as heretofore. One section has been employed throughout the year on the reduction of the declination data, which will shortly be completed.

The mean values of the magnetic elements for base stations for 1912 are as follows:—

Observatory.	Latitude & Longitude.	Dip.	Declination.	H. F.	V. F.
	° ′ ″	° ′	° ′	C. G. S.	C. G. S.
Dehra Dūn ...	30 19 19 N / 78 3 19 E	N 44 8·9	E 2 25·9	·33218	·32244
Barrackpore ...	22 46 29 N / 88 21 39 E	N 30 50·7	E 0 44·0	·37369	·22316
Toungoo ...	16 55 45 N / 96 27 3 E	N 23 3·1	E 0 13·1	·38889	·16548
Kodaikānal ...	10 13 50 N / 77 27 46 E	N 3 59·1	W 1 5·8	·37543	·02616

BASE LINE OPERATIONS.

54. *No. 19 Party.*—This party was only instituted on the 1st March 1913, and since the Base Line apparatus had not yet been received from England only a small amount of preliminary work in this connection has been possible.

In the meanwhile the officer in charge has been occupied in preparing further materials for marshalling the whole evidence of Indian geodesy in relation to problems concerning the constitution of the earth's crust.

PART III.

OFFICE WORK.

I.—HEADQUARTERS OFFICES.

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

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

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

(*b*)—Topographical maps on the scale of $\frac{1}{2}$ inch = 1 mile.

(*c*)—Topographical maps on the scale of $\frac{1}{4}$ inch = 1 mile.

(*d*)—Geographical maps on the one-millionth scale.

(*e*)—General maps on small scales.

(*f*)—Special maps.

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

56. *(a) The map of India on the scale of 1 inch = 1 mile.*—During the year 152 sheets of the new map have been received for publication and 222 sheets have been published.

All the areas surveyed up to the end of 1911-12 for the preparation of the new one-inch map of India have been published in the form of 1-inch sheets with the following exceptions.—30 sheets, including an area of approximately 8090·576 square miles; of these 30 sheets 29 are undergoing publication and the drawing of the other is in progress. The sheets of 1912-13 will begin to come in for publication early in 1913-14.

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

Year.	1-Inch Sheets Published.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
1905-06	...	...	...	...
1906-07	4	1	...	5
1907-08	16	15	22	53
1908-09	35	39	68	142
1909-10	72	41	69	182
1910-11	51	39	25	115
1911-12	68	33	58	159
1912-13	104	60	58	222
Total printed	350	228	300	878
Total in programme	2,160	2,067	2,101	6,328
Number remaining for publication	1,810	1,839	1,801	5,450

58. One change which affects both the utility and appearance of the one-inch map has been introduced by the decision to shade the hills on sheets of mountainous country. This adds somewhat to the labour and time required for reproduction but a glance at the new one-inch sheets in the neighbourhood of Srinagar, Kashmīr, (*e.g.*, sheet No. 43 $\frac{J}{16}$), will show that the change is decidedly an improvement.

59. In addition, 29 one-inch sheets prepared from modern revenue surveys have been received for publication, and 20 have been published as preliminary editions. Four special editions of one-inch sheets showing village boundaries have also been published.

60. To maintain the existing stocks, or to give effect to important changes due to the development of communications, &c., 10 modern, 4 preliminary and 38 old style one-inch sheets have been reprinted.

61. *(b) The half-inch map.*—So far only 2,959 square miles have been surveyed for the preparation of $\frac{1}{2}$-inch maps. The whole of this survey has been done during the field season of 1912-13 and the sheets should be received for publication in 1913-14.

62. *(c) The map of India on the scale of $\frac{1}{4}$ inch = 1 mile,* (vide *Index map No. 10*).—This map is prepared in "degree sheets" which include 1°×1°, or the area covered by 16 one-inch sheets.

The following table shows the progress made in publication :—

Years of Publication.	Degree Sheets published.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
1911-12	2	1	1	4*
1912-13	3	1	1	5
Totals	5	2	2	9
Approximate number of degree sheets in India	170	140	140	450

* Only one sheet, the only one then published with hills shown by layers, was shown in the corresponding table on page 22 of the General Report for 1911-12. It has now been decided to include in this table all degree sheets prepared from modern surveys.

63. It has been decided to show the hills on degree sheets by a combination of contours, hill shading and layers. Small stocks of copies with the hills shown by contours and layers alone, (for scientific purposes), and with shade and contours alone will also be printed. Of the 9 modern degree sheets published, three are in accordance with these decisions.

64. Pending the preparation of the new degree sheets from modern surveys, 17 degree sheets have been prepared and published during the year from the maps of old surveys, 194 Atlas sheets and 6 district maps on the same scale have been reprinted including one new edition.

65. *(d) Geographical Maps on the one-millionth scale.*—The decision to produce these maps in layers, to which reference was made in para. 60 of the General Report of the department for 1911-12, has affected the output of the sheets of the India and Adjacent Countries Series to some extent. Four new sheets have been published during the year, 5 old sheets have been reprinted and the contouring of a few of the sheets already published as well as of the new sheets in hand is in progress.

66. One Indian sheet of the International Map of the World, scale 1:1,000,000 is in hand and will be published in 1914. (See paras. 61 and 62 of the General Report for 1911-12).

67. (*e*) *Small scale general maps.*—The engraved plates of the new 32-mile Map of India and Adjacent Countries have been completed. An outline edition without hills and a layered edition are being printed.

68. A new Railway Station Map on the scale of 32 miles to 1 inch showing every railway station in India and a new edition of the Railway, Road and Canal Map of India on the same scale have been published during the year. The last Annual edition of the Railway Administration Map of India, scale 64 miles to 1 inch, showing information up to the 1st of April 1913 was produced in May.

69. The first sheet, 'Southern Persia', of the Southern Asia Series of sheets on the scale of 1 : 2 million has been published. The 'Northern Persia' sheet is under publication and the fair drawing of the two other sheets, ('Afghānistān' and 'Baluchistān'), which include parts of Persia is in hand. The publication of the 'Southern Persia' sheet marks a new departure in the style of Indian Geographical maps. On it the heights above and below mean sea level have been shown by layers of colours and the hills have been shaded. A special experimental edition in different layer colouring and without shaded hills has also been printed as opinions of scientists differ regarding the advantage of shading hills on layered maps.

70. (*f*) *Special Maps.*—As usual a very large number of special maps and plans, diagrams and illustrations have been prepared for the different departments of Government, for Army Head Quarters and for officials throughout India, (see Part IV).

71. The number of maps issued during 1912-13 is considerably in excess of previous years, (see report of the Map Record and Issue Office on page 30), and there are other indications of a gradual but steady increase in the use of maps both for Government and private purposes in India.

72. The following departmental pamphlets have been printed at Calcutta this year:—

(*i*) A consideration of the contour intervals and colour scales best suited to Indian $\frac{1}{M}$ maps, by Captain M. O'C. Tandy, R.E.

(*ii*) Notes on the Vandyke or direct zinc process, compiled in the Photo.-Litho. Office under the direction of Colonel T. F. B. Renny-Tailyour, C.S.I., R.E.

A list of the departmental publications printed at Dehra during the year is given on page 35 in the report of the Dehra Office.

MAP RECORD AND ISSUE OFFICE.

73. The gross face value of the maps received from the printing offices during the year amounted to Rs. 3,18,793. This sum includes Rs. 14,392 and Rs. 5,809, the face value of maps printed in the Engraving Office and at Dehra Dūn respectively.

74. The following table shows the maps printed and received and their face values :—

Class of maps.	Scale.	Number of different maps of each class received.		Value.
		New Publications.	New Editions.	
				Rs.
(I) Geographical maps—				
(*a*) Maps of India	Various	2	1	29,900
(*b*) Southern Asia Series	1:2,000,000	1	.....	1,800
(*c*) India and Adjacent Countries ...	1:1,000,000	4	5	4,253
(II) Topographical maps—				
Degree Sheets.				
(*d*) Modern	1 inch = 4 miles	5	2	4,758
(*e*) Preliminary & Provisional ...	Do.	.....	1	1,700
(*f*) From Atlas Material	Do.	17	.....	5,100
(III) 1-inch sheets—				
(*g*) Modern	1 inch = 1 mile	222	10	1,18,675
(*h*) Do. (Preliminary Editions) ...	Do.	20	4	8,300
(*i*) Do. (Village Boundaries) ...	Do.	4	.....	1,600
(IV) Old Style Sheets	(2 inch = 1 mile to 1 inch = 8 miles)	8	38	20,088
(V) Atlas of India Series	1 inch = 4 miles	.....	194	42,542
(VI) Provincial Maps	(1 inch = 16 miles to 1 inch = 32 miles)	3	3	3,525
(VII) District Maps	1 inch = 4 miles	...	6	2,400
(VIII) Administration Report Maps	1 inch = 8 miles	.....	20	900
(IX) Plans of Cities and Cantonments	Various	3	5	10,150
(X) Triangulation and Traverse Charts	Do.	1	1	92
(XI) Index Maps	Do.	34	3	2,518
(XII) Miscellaneous Maps	Do.	263	11	60,492
Total ...	.....	587	304	3,18,793
Corresponding figures for 1911-12 ...	.....	611	311	2,28,331

75. The total number of printed maps issued during the year was 327,311 of an aggregate value of Rs. 1,69,760. The details of the sales were as follows :—

Sales to	Number of maps.	Values.
		Rs.
Government officials	220,384	75,547
India Office	2,279	2,561
Departmental issues	71,051	62,371
Private individuals	28,957	24,503
Agents	4,640	4,778
Totals for 1912-13 ...	327,311	1,69,760
Corresponding totals for 1911-12 ...	288,633	1,39,270

No. 1 DRAWING OFFICE.

76. The Drawing Office continued its normal work of compiling and supplying material for the engraving of all the general small scale maps of the department and the fair drawing of such of them as are printed by heliozincography, the maintenance and correction of the record copies of all the maps of the department and the bringing up to date of old maps which had to be reprinted. During the year work was done on 29 sheets of the India and Adjacent Countries Series, on the scale of $\frac{1}{1,000,000}$, on 4 sheets of the Southern Asia Series, on the scale of $\frac{1}{2,000,000}$, and on 41 sheets of the General maps of India on various scales.

77. The preparation of degree sheets from old atlas sheets has been continued and 30 such sheets have been taken in hand.

Of maps, on various scales, which had to be reprinted, 105 were worked on during the year.

Corrections or additions were made to 60 sheets, on various scales, which had been drawn by parties or circles.

Of index maps, provincial and district maps, and large scale plans of cities and cantonments, 109 have been in hand and 40 sheets of miscellaneous specimens, symbols, &c., for departmental use were also worked on. A large amount of extra departmental mapping in 49 sheets has been undertaken; included in this were a new edition of the Postal Map of the United Provinces, Maps of Fort William and of Tenasserim, also many maps and plans for Census Officials, Railways, Telegraph, Educational and other authorities. (See pages 42, 43.)

The examining section has dealt with 637 cases during the year in addition to a great deal of miscellaneous work.

78. The work of the 'office copy' or record section continued to be heavy, new railways and canals and additions to main roads, and changes in boundaries, were marked on the record copies of the maps of the department; this work affected 3,069 sheets, 1,111 new record copies were examined and filed during the year and 23,833 coloured maps examined before issue to the public.

In addition to this normal work of the office copy section, 114 pages of traverse data were supplied to Settlement Officers, Engineers and others, attested traces of certain large scale surveys were supplied for use in court proceedings and information regarding systems of survey, boundaries, &c., were supplied to settlement, political, cantonment, departmental and other officers.

ENGRAVING OFFICE.

79. The new 5th edition of the 32-mile Map of India, in 12 sheets, was completed during the year.

Corrections have been made to the 64, 96, 128, 192 mile maps of India and a new map on the 128-mile scale has been published.

The engraving of the first degree sheet, 38 N, based upon surveys subsequent to 1905, was practically completed and this map will be published early in 1914.

Work was continued on five sheets 34, 47, 53, 83, 94 of the $\frac{1}{1,000,000}$ series and on one sheet of the International Map on the same scale. In addition, work was put in hand on sheet 63, and plates for colour printing of sheets 47, 53, 63 of the $\frac{1}{1,000,000}$ scale begun.

Numerous provincial, miscellaneous, and index maps have been prepared or corrected. Index maps for the whole of India and Adjacent Countries will be completed in 1913.

PHOTO.-LITHO. OFFICE.

80. There has been an increase of both departmental and extra departmental work during the year and this has been satisfactorily dealt with, a comparatively small expenditure on overtime charges having been incurred.

Two hundred and fifty-two sheets in modern form were published, including preliminary and provisional editions, new publication and reprint editions to replenish stock. Of these 233 were in colours (222 new sheets, 1 preliminary sheet and 10 reprints) and the number of new 1-inch sheets published shows an increase of 63 over 1911-12 and of 42 over any former year.

The total number of impressions pulled exceeds that of any former year by four lakhs.

81. Good progress has been made and much experience gained in the matter of printing layered maps. Among the minor improvements in this direction has been that obtained by etching the successive plates in relief. Six layered maps have been printed and published during the year and three sheets of the 32-mile layered map of India have been proved.

82. A few changes of importance have been made in the Photo. Branch. The conversion of the large camera to carry the Zeiss "Planar" lens purchased last year to an iron base stand has enabled that lens to be brought into use, while the strengthening of the floor with iron girders below the runners of the camera stands has done away with the vibration which formerly gave trouble.

No changes have been made in the methods and formulæ with the exception of the introduction of a screen photogravure process which has been found useful for certain subjects.

The installation of electric light throughout all sections of the office now enables all hands to work at night should it at any time be found necessary to do so.

During the year under report the Stores Section of the Office has been reorganised. The section is, however, working under a disadvantage owing to the very restricted accommodation for stores.

TABULAR STATEMENT OF OUT-TURN OF PHOTO.-LITHO OFFICE.

1	2	3	4	5	6	7	8	9
Year.	Cost of office.	Value of out-turn at cost-rates.	Recovered in cash or by book-debit.	Number of impressions pulled. *	Number of maps printed.			Remarks.
					Depart-mental.	Extra depart-mental.	Total.	
	Rs.	*Rs.*	*Rs.*					
1910-11 ...	1,64,193	1,77,900	50,693	1,383,147	2,559	1,104	3,663	
1911-12 ...	1,47,867	2,01,394	24,904	1,564,496	2,686	1,263	3,949	
1912-13 ...	1,61,699	2,39,940	27,214	1,966,458	3,656	2,010	5,666	

* This as in statements of previous years only includes litho. impressions.

In addition, there were 51,370 half-tone pulls and 530,280 line-block pulls, (chiefly Weather Charts).

as against { 60,056 ,, ,, and 437,820 ,, ,, in 1911-12.
{ 102,900 ,, ,, and 111,300 ,, ,, in 1910-11.

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

The Type Section published 8,408 pages or items, 1,343,465 copies, 2,608,591 impressions.

as against { 7,988 ,, or ,, 1,131,012 ,, 2,014,766 ,, in 1911-12.
{ 14,604 ,, or ,, 1,235,161 ,, 2,104,755 ,, in 1910-11.

MATHEMATICAL INSTRUMENT OFFICE.

83. During the year under report, *viz.*, from 1st April 1912 to 31st March 1913, there was a shrinkage in the demands made on this office, compared with those of the preceding year, as the following table shows with the result that against a profit of Rs. 6,204 exhibited by the Profit and Loss statement of 1911-12, that for 1912-13 shows a loss of Rs. 7,055, which, however, includes over Rs. 5,500 loss on the sale of unsuitable hydrometers.

Value of Instruments issued to Public Officers.

1910-11.	1911-12.	1912-13.
Rs.	*Rs.*	*Rs.*
2,65,184	3,25,633	2,81,315

84. On the other hand, there was a marked improvement, as the ollowing table will show, in the value of the work done, and the Profit and Loss statement shows a gain of Rs. 2,887 against the loss of Rs. 4,718 shown by that for 1911-12.

Value of work done in the workshop.

1910-11.	1911-12.	1912-13.
Rs.	*Rs.*	*Rs.*
2,01,329	1,74,871	2,15,328

85. The following figures show the number of employés at the end of each of the last 3 years:—

Number of employés at the end of each of the last three years.

1910-11.	1911-12.	1912-13.
318	330	338

86. The following table shows the average number of employés and their pay:—

Average number of employés and their pay.

1910-11.	1911-12.	1912-13.
296 at Rs. 59,836	297 at Rs. 62,981	301 at Rs. 68,625

87. It may be noted that as pointed out in the previous years' reports, certain standing charges (representing supervision, rent, interest on plants and material, depreciation, clerical labour, &c.), have got to be incurred irrespective of the work coming to the office, and consequently, the so-called profit and loss in connection with the working of the Mathematical Instrument Office depends on the demands received for instruments to be supplied, and for work to be done. In calculating profit and loss a percentage is allowed to be taken as credit (25 over book value in the case of issues and 10 in the case of work done), and an increase of demands means an increase in the amount of this percentage, resulting in probably a gain; and a shrinkage of demands means a reduction in the amount of the percentage, resulting in probably a loss, the standing charges remaining the same in both cases. Increased debit has arisen of late years, due to the necessity of writing down prices, which mean decrease and loss.

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

	1910-11.	1911-12.	1912-13.
	Rs.	*Rs.*	*Rs.*
Total issues to Public Offices as shown in the Profit and Loss statements of stores.	2,65,185	3,25,633	2,81,315
Value of repairs to instruments received for repairs and returned in a serviceable condition.	64,156	55,941	64,452
Value of instruments received from Government Officers when no longer required.	33,428	37,228	57,267
Book value of the stock of instruments, &c., in Serviceable Stores.	9,20,925	7,46,047	6,45,081
Book value of the stock of instruments, &c., in Repairable Stores.	69,371	70,460	72,452
Total value of work done in the Workshop ...	2,01,330	1,74,871	2,15,328
Value of instruments manufactured in workshop for Serviceable Stores.	61,698	61,431	71,188
Value of instruments purchased locally ...	2,880	4,578	6,206
Value of instruments and materials obtained from England through the Director General of Stores.	40,844	47,148	57,647

89. 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 2nd stock-taking of the repairable stores, however, was done in April 1913 instead of in March.

90. Apart from the ordinary repairs and manufactures, the following few special works done may be mentioned :—

(a) New pattern of brass sight rules and rectangular compasses were made up, and were reported on favourably. More have been indented for the coming season.

(b) Aluminium plane-tables were made for use during the last field season, but they did not prove successful owing to the aluminium bracings not being sufficiently strong to resist sag caused by the Surveyors' weight on the edge of the table. Several more aluminium plane-tables have been made up for trial again during the coming season, with the bottom strengthened in different ways to eliminate the above defect. One has been strengthened with Duralumin.

(c) Two experimental aluminium G. T. staves were constructed to a specification by the Superintendent of the Trigonometrical Survey.

(d) For the coming season, an experimental water level for use with G. T. staves has been constructed to a design by Captain V. R. Cotter, I.A.

(e) Some telescopic clinometers have been made up to a design sent in by the Superintendent, Southern Circle.

(f) Trial is being given to the skim-milk product called 'Syrolit', as a substitute for ebonite and ivory, for set squares and scales.

II.—DEHRA DŪN OFFICES.

SPECIAL OPERATIONS.

91. The new apparatus for the comparison of standards of length has arrived, and is now in process of erection.

92. A portable mast, 150 ft. high, was made and erected in the Survey Office compound. The mast was primarily designed to support an electrical apparatus for the determination of air temperature at various heights, which is now being made in London, but it would also be suitable for supporting a wireless telegraphy aerial, or to serve as a triangulation signal.

93. The daily meteorological observations were continued as usual up to December 1912. From 1st January 1913 the readings of the earth thermometers have been discontinued, and the readings of the barometer and of air-temperatures are being taken once daily, at 2 p. m. standard time, instead of twice as heretofore. Simultaneous readings have been taken at Mussoorie to give data for temperature gradient and refraction.

94. During the year under report the Seismograph has worked satisfactorily; a list of the earthquakes recorded in 1912-13 is published in the Records of the Survey Department, Vol. V.

95. Photographs of the sun have been taken on 339 days, the sun being obscured by clouds on the remaining days.

COMPUTING OFFICE.

Geodetic work.

96. Numerous computations comprising conversion of co-ordinates for trans-frontier degree triangulation charts; computations in connection with Professional Paper No. 14; deduction of dynamic and orthometric heights of levelling lines Khushāb to Lahore, Amkhās to Multān, Sargodha to Multān, Multān to Māhiwāla and Prome to Rangoon; adjustment of Bhīr, Villupuram and Khandwā secondary series, reduction of latitude observations taken by Lieutenants Almond and McKay at seven stations between Dehra Dūn and Mussoorie, and the preparation of certain tables for the Records have been carried out.

97. Thirteen spirit levelling pamphlets and 27 triangulation charts passed through press; data for 40 charts were compiled and compared.

The following publications have been printed :—

(*a*) "A note on the representation of Hills" by Major F. W. Pirrie, I.A.

(*b*) Departmental Paper No. 1. "A consideration of the most suitable form of type for use on maps", by Captain M. O'C. Tandy, R.E.

(*c*) Departmental Paper No. 2. "A review of the boundary symbols used on maps of various countries," by Captain M. O'C. Tandy, R.E.

(*d*) Departmental Paper No. 3. "Extract from the new map of Italy, scale 1:100,000", by Luigi Giannitrapani. (Translated from the Italian, by Major W. M. Coldstream, R.E.).

(*e*) Departmental Paper No. 4. "A report on the practice of town surveys in the United Kingdom and its application to India", by Major C. L. Robertson, C.M.G., R.E.

(*f*) "The Thompson Stereo-plotter and its use, with notes on the field work", by Lieutenant K. Mason, R.E.

(*g*) Professional Paper No. 14. "Formulæ for Atmospheric Refraction and their application to Terrestrial Refraction and Geodesy", by J. deGraaff Hunter, M.A.

Data from the original records were supplied to 50 officers, and a large number of requisitions for forms were attended to.

Geographic Work.

98. Some topographical triangulation has been finally adjusted and more work of this sort is in hand.

The 4th Edition of "Routes in the Western Himālaya and Kashmīr" is in course of preparation.

Preservation of Trigonometrical Stations.

99. 1,266 stations were repaired by the district officers at a cost of Rs. 6,205-8-10. Out of 347 districts from which reports are annually due, 18 failed to make returns.

No. 2 DRAWING OFFICE.

100. The following table shows the volume of work undertaken :—

Class of maps.	Number of sheets in hand.	Number of sheets drawn and sent to press.
Scientific diagram Layer System, 1 inch=8 Miles ...	.....	1
Geographical maps, Layer System, scale $\frac{1}{1,000,000}$ ...	3	.....
Do. do. 1 inch=32 Miles	.....	6
Do. do. smaller scale ...	3	1
Miscellaneous indexes, plans and diagrams, &c. ...	13	6
Levelling charts	.....	11
Chart of Triangulation, degree sheets	25	17
Extra departmental maps, plans, indexes, &c. ...	1	6

PHOTO.-ZINCO. SECTION.

101. 1,973 maps and diagrams were photographed during the year against 1,550 in 1911-12.

The number of impressions pulled was 236,766 against 289,116 in the previous year. The lithographic machine was employed throughout the year in printing the maps of Dr. Stein's exploration, Forest maps, triangulation and levelling charts. The last sheet of Dr. Stein's maps was completed at the end of May.

The letter-press was employed throughout the year in printing departmental forms, the number of impressions pulled was 377,027 against 265,615 in the previous year.

FOREST MAP OFFICE.

102. The total number of maps issued, both to officials and the public, during the year amounted to 9,607, a decrease of 846 on last year's total. The gross face value of these maps was Rs. 17,223 and the net amount realised from sales was Rs. 3,191. Of this amount Rs. 2,067 was recovered by book-debit and Rs. 1,124 by cash from sales to private individuals and trading companies. The total sum realised from sales in the previous year was Rs. 2,681, so that in actual sales there has been an increase of Rs. 510 during the year under review. The number of maps and field sections received for storage during the year was 6,099, besides 259 computation volumes, angle-books and traverse field-books and 73 triangulation and traverse charts.

103. The following table shows, in abstract form, the work dealt with by the Office :—

Class of map.	Number of Sheets.		
	In hand.	Drawn and sent to press.	Published.
1-inch, 2-inch, and 4-inch maps of Forest Surveys	194	62	82
Provincial, Divisional, and District Forest maps	11	4	5
Working Plans and Miscellaneous maps ...	8	24	30
Totals ...	216	90	117

III.—CIRCLE AND LOCAL DRAWING OFFICES.

No. 3 DRAWING OFFICE (NORTHERN CIRCLE).

104. The routine work of the office was the final examination of 1-inch sheets, drawn by the various parties in the circle; and the drawing of degree sheets.

The following were finally examined and sent for publication during the current year:—69 1-inch sheets, 3 degree sheets and one cantonment map.

At the end of the year under report there were 11 degree sheets in hand, but no arrears of 1-inch drawing, of sheets which had been surveyed in 1911-12.

No. 4 DRAWING OFFICE (SOUTHERN CIRCLE).

105. Thirty-four 1-inch sheets were received from field parties and out of these thirty-three were finally examined and sent for publication and only one sheet was with held pending settlement of some questions regarding details and boundaries. The only sheet reported as surveyed in 1911-12 which was not submitted for publication before 30th September 1913 was 58 $\frac{B}{12}$.

Three degree sheets were completed and sent for publication and seven more were in hand at the close of the survey year. Twelve pupil draftsmen were trained and assistance was given to parties to complete their current season's mapping.

106. The Photo.-Zinco. Section undertook the photographic and zincographic work required by the circle and the following is a summary of the work done:—

Number of reproductions to full scale	1
Enlargements	121
Reductions	213
Vandyked	67
Total ...	402

No.5 DRAWING OFFICE (EASTERN CIRCLE).

107. The chief work of the office during the year was the examination of the parties' one-inch sheets and the drawing of degree sheets.

In addition to the draftsmen lent to the parties during the recess season six draftsmen were permanently transferred to form the nucleus of a drawing office in Maymyo attached to No. 10 Party. It is intended that in future that office will draw all Burma degree sheets.

During the year 57 one-inch sheets were submitted for publication including 4 sheets which were completed to margin from additional material in this office. In addition 10 degree sheets were drawn in this office and submitted for publication, three contain material from old surveys which were completed to margin and on one sheet stump shading was executed.

One cantonment sheet was submitted to the Superintendent of the Trigonometrical Survey.

26 degree sheets are now in hand; of these seventeen cover the areas recently surveyed in years 1911—13 by the Abor, Mishmi and Miri Mission and Exploration parties: it is intended to publish these in degree sheet form in addition to the various special provisional maps already prepared.

BIHĀR AND ORISSA DRAWING OFFICE.

(Standard Mapping Section).

108. The following 29 one-inch maps with a mapped area of 5,879·40 square miles have been submitted during the year for the publication of a preliminary edition of each:—Nos. 64 O/13, 72 C/14, 72 G/7, 11, 15, 72 L/11, 12, 15, 16, 72 O/12, 16, 72 G/10 & 14, (old No. 145 in four sections completed to margin), 73 C/1, 4, 5, 7, 72 P/3 to 15, the last thirteen, *i.e.*, P/3 to 15, have also been submitted for the preparation of prints for supplementary survey.

109. The following 35 one-inch sheets which have been completed for surveyed areas are being withheld until the cadastral maps of districts Jalpaigurī, Gayā, Palāmau, Hazāribāgh, Mānbhūm and the neighbouring districts of the United Provinces are received:—

63 O/7, 8, 11, 14, 15, 63 P/5, 6, 10, 14, 64 O/9, 10, 72 C/2, 6, 8, 10, 11, 12, 15, 16, 72 D/1, 2, 5, 72 G/3, 4, 8, 12, 16, 72 H/13, 73 I/1, 2, 3, 9, 13, 78 B/6, 8.

110. The following 58 one-inch sheets representing an area of 9,247·36 square miles are being got ready for publication either of a preliminary edition or for revision survey:—

63 O/12, 16, 63 P/9, 13, 64 K/12, 16, 64 L/9, 13, 64 O/4, 6, 7, 8, 11, 12, 14, 15, 16, 64 P/1, 5, 72 C/3, 4, 7, 73 A/11, 12, 15, 16, 73 C/2, 3, 73 E/1 to 16, 73 J/1, 2, 3, 5, 6, 7, 10, 11, 12, 14, 15, 16, 73 M/1, 5.

111. The following examination, correction and colouring work has also been completed:—

(*a*) 26 uncorrected proofs of one-inch sheets have been examined and corrected.

(*b*) Fiscal limits and cultivation have been coloured on 48 unpublished black prints of one-inch sheets.

(*c*) 24 published black prints of one-inch sheets have been coloured.

112. The drawing of the following maps has also been completed in the Standard Mapping Section:—

(*a*)	Darjeeling Municipality ...	...	60-inch map.
(*b*)	„ „ ...	...	10 „ „
(*c*)	„ „ ...	...	20 „ „
(*d*)	Map of Happy Valley survey, Darjeeling	...	20 „ „
(*e*)	Lebong Cantonment map survey	...	30 „ „
(*f*)	Takdah „ „ „ ...	...	30 „ „

(*a*) to (*c*) were prepared for the Darjeeling Municipality and will be paid for by that body.

(*d*) is being prepared for the Public Works Department, and will be paid for by that department.

(*e*) and (*f*) are being prepared under the orders of the Surveyor General for the Military Department, and will be paid for by the Surveyor General.

PART IV.

WORK FOR OTHER GOVERNMENT DEPARTMENTS.

113. As in previous years, the Riverain Detachment of the Northern Circle was exclusively employed on the Riverain traverse and rectangular surveys required by the Punjab Government (*vide* page 8).

114. At the request of the Māler Kotla Durbar, a 6-inch survey of Māler Kotla and environs was carried out by No. 2 Party and the cost of this survey, *viz.*, Rs. 600, was borne by the above State.

The area surveyed was 10·50 square miles.

115. No. 20 party (cantonment) has been organised and is at present devoting its time to making surveys of different military cantonments required by the Army Department. Its report will be found on page 18.

116. An officer has been deputed to the Bombay Government to carry out the survey of an experimental area of 200 acres in Bombay so that experience may be gained to prepare an estimate of the time and cost of surveying the whole city.

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

118. Various forest surveys were carried out for Local Governments, &c. (*vide* page 16).

119. An officer of No. 11 Party was employed in giving practical training in topographical surveying to six superintendents of the Burma Land Records Department in two batches for two months each.

120. Traces of the area surveyed by No. 11 Party as it progressed and several copies of blue print enlargements of plane-table sections, mounted and inked up, were supplied to the Deputy Commissioner of the Tavoy district for allotting mining concessions and settling disputes.

121. The series of secondary triangulation in Kashmīr for the purpose of connecting with the Russian triangulation, was completed during the year (*vide* page 21).

122. Exploration work for the Foreign and Political, and Army Departments was continued on the North East Frontier by the Abor, Mishmi and North Burma Exploration Survey Detachments (*vide* page 15). Captain Morshead accompanied Captain Bailey of the Foreign and Political Department on his journey up the Tsan Po.

123. The boundary between Nepāl and British territory along the Sārdā River was surveyed and demarcated as described in para. 51, page 24.

124. A surveyor accompanied the late Captain Pritchard and Captain Waterfield on their journey from Assam to Burma through Hkamti Long.

125. Heights observed in Arabia by Captain Leachman of the General Staff were reduced by the Computing Office, Dehra Dūn.

126. Certain computations were done for the Commissioner of Settlement and Land Records, Burma.

127. The geographical co-ordinates of a number of places in India were supplied to the office of the Connaissance des Temps, Paris.

128. The remainder of the maps of Dr. Stein's Explorations in Chinese Turkestān and Western China, 1906—08, were completed and reproduced at Dehra Dūn.

129. A section of No. 6 Drawing Office (Simla) is employed solely on miscellaneous work for the Military and Foreign and Political Departments, and has turned out a large number of maps.

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

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

Public Works Department, Government of India.

Home Department, Government of India

Finance Department, Government of India.

General Officers Commanding, Divisions and Brigades.

The Director-General of Military Works.

The Director-General of Commercial Intelligence.

The Director-General of Observatories.

The Director-General of Archæology in India.

The Director-General, Indian Medical Service.

The Director, Geological Survey of India.

The Director, Botanical Survey of India.

The Director of Land Records, Punjab.

The Consulting Architect to the Government of India..

The Officer on Special Duty for Enquiry into Prices.

The Engineer Officers on Special Duty, Delhi.

The Chief Inspector of Mines in India.

The Indian Museum.

The Superintendents, Government Printing.

The Superintendent, Hindu and Buddhist Monuments.

The Controller of Patents and Designs.

The Great Indian Peninsula Railway.

The East Indian Railway.

The Bengal-Nagpur Railway.

The Eastern Bengal State Railway.

The Bengal and North-Western Railway.

The Karāchi Extension Railway Survey.

Sanitary Commissioners.

The Census Commissioner for India.

Chief Engineers.

Forest Department.

Police Department.

Post and Telegraph Department.

Agricultural Department.

Government Epigraphist.

The Inspector-General of Civil Hospitals.

The Military Secretary to His Excellency the Viceroy.

The Revenue and Judicial Commissioner, Baluchistān.

Linguistic Survey in India.

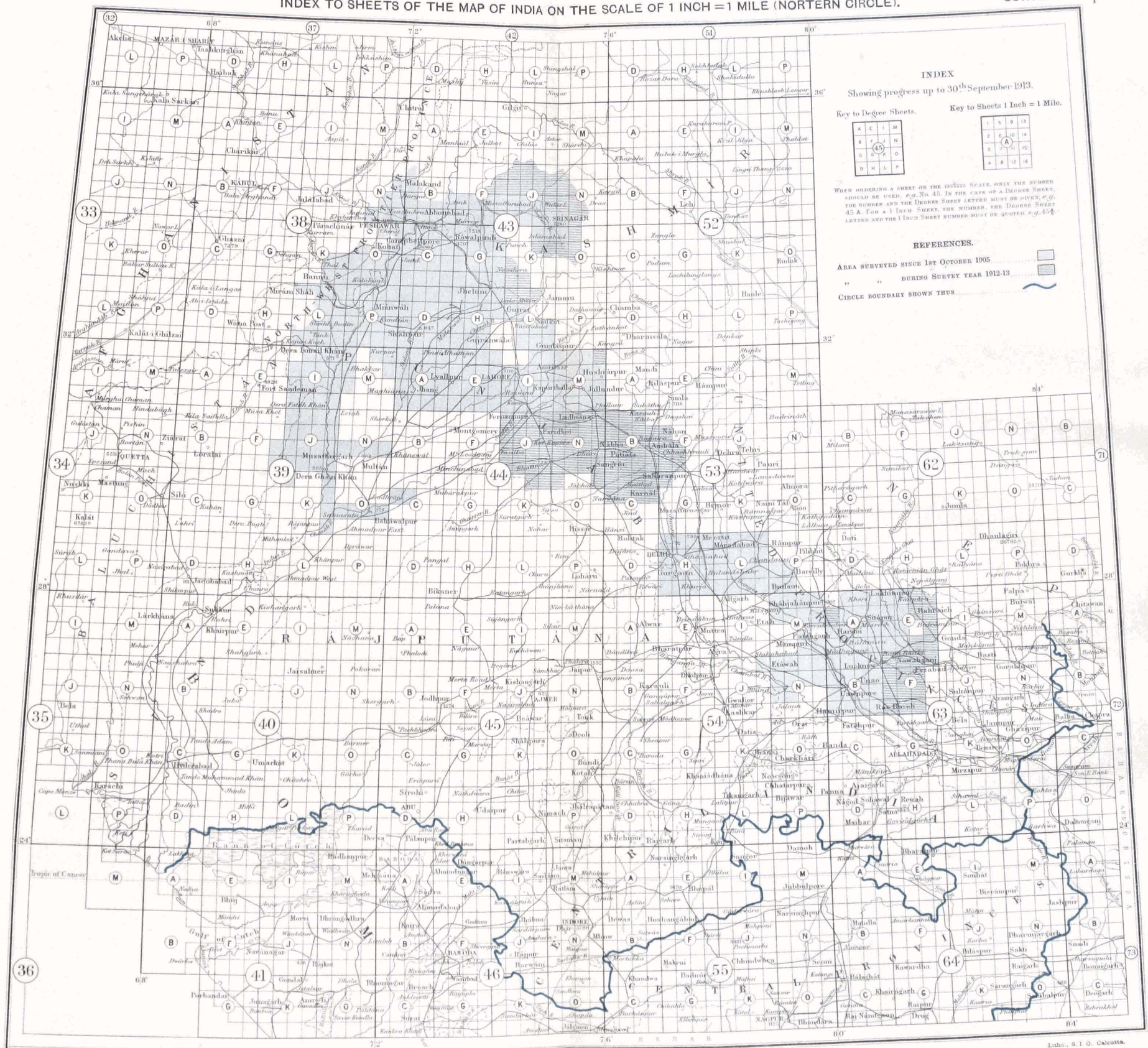
Civil Engineering College, Sibpur.

Gun and Shell Factory, Cossipore.

Coronation Durbar Committee.

Some work was also done for various public bodies and societies.

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



Reg. No. 2741 D., 13.—1,200.
Litho., S. I. O. Calcutta.

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

INDEX

Showing progress up to 30th September, 1913.

Key to Degree Sheets.

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

(58)

Key to Sheets 1 Inch = 1 Mile.

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

(A)

When ordering a sheet on the inches Scale, only the number should be used, *e.g.* No 58. In the case of a Degree Sheet, the number and the Degree Sheet letter must be given, *e.g.* 58 A. For a 1 Inch Sheet, the number, the Degree Sheet letter and the 1 Inch Sheet number must be quoted, *e.g.* 58/4.

REFERENCES.

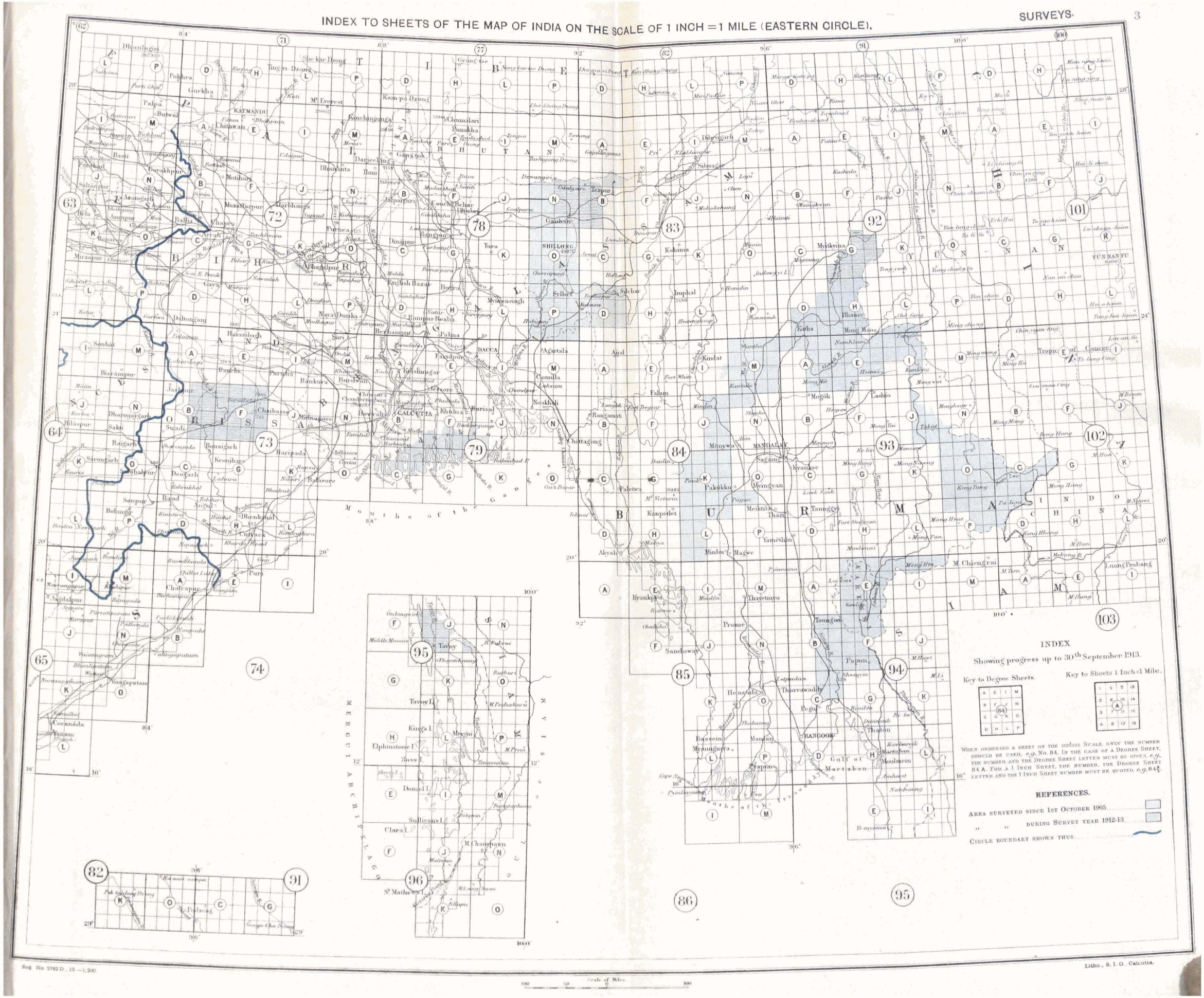
Area surveyed since 1st October 1905 .....

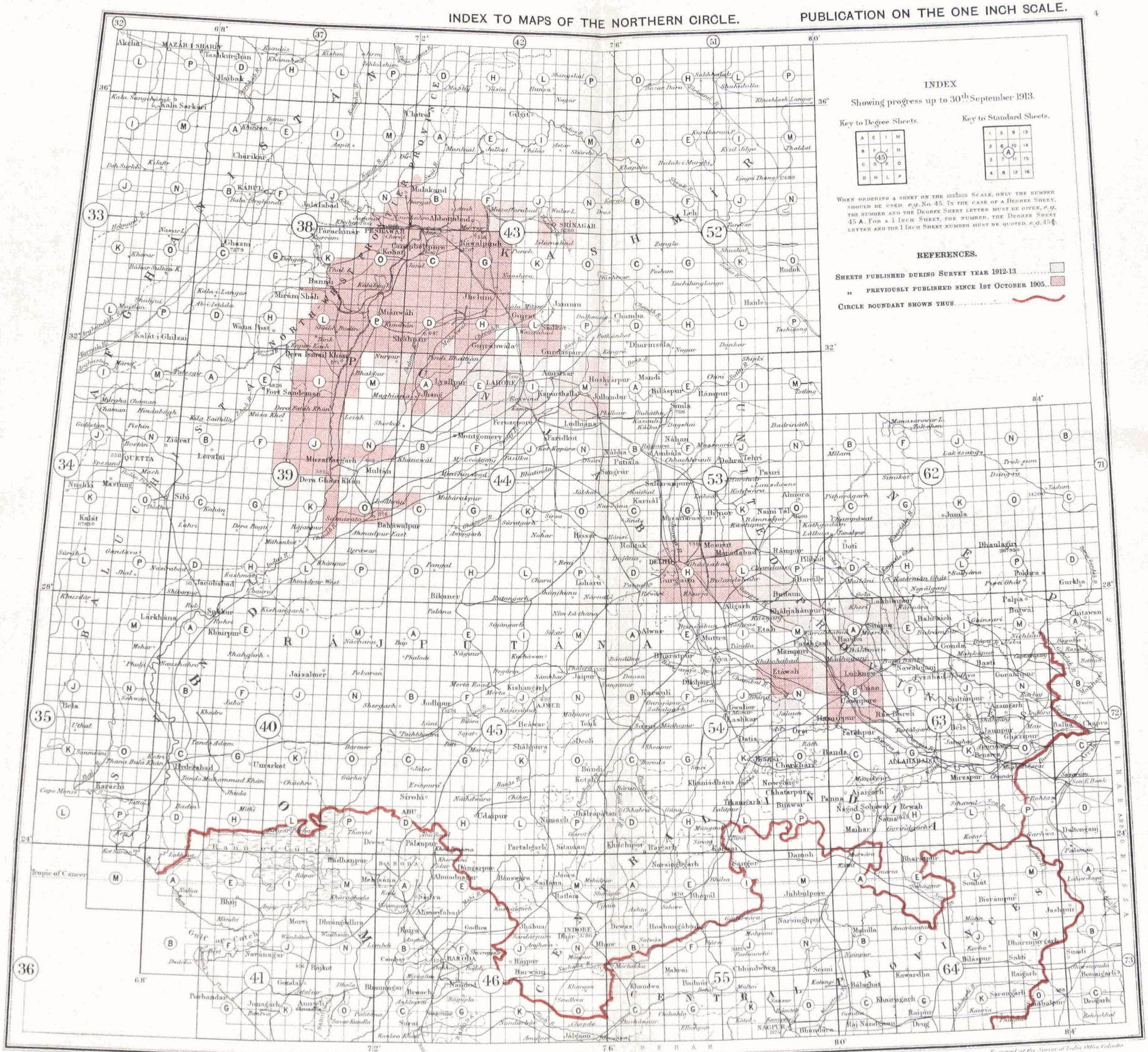
" " during Survey year 1912-13 .....

Circle boundary shown thus .....

Engraved at the Survey of India Office, Calcutta.
Litho., S. I. O., Calcutta.
Reg. No. 2863 D., 13.-1200.

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



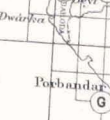

INDEX
Showing progress up to 30th September 1913.
Key to Degree Sheets.
Key to Standard Sheets.
When ordering a sheet on the 1/250000 Scale, only the number should be used, e.g. No. 45. In the case of a Degree Sheet, the number and the Degree Sheet letter must be given, e.g. 45 A. For a 1 Inch Sheet, the number, the Degree Sheet letter and the 1 Inch Sheet number must be quoted, e.g. 45 A/5.
REFERENCES.
Sheets published during Survey year 1912-13.
" previously published since 1st October 1905.
Circle boundary shown thus.
Tropic of Cancer
Scale of Miles.
Engraved at the Survey of India Office, Calcutta.
Litho., S. I. O., Calcutta.
Reg. No. 2947 D., 13.—1,200.

INDEX

Showing progress up to 30th September, 1913

Key to Degree Sheets.

Key to Standard Sheets.



When ordering a sheet on the Inches Scale, only the number should be used, *e.g.* No 58. In the case of a Degree Sheet, the number and the Degree Sheet letter must be given, *e.g.* 58 A. For a 1 Inch Sheet, the number, the Degree Sheet letter and the 1 Inch Sheet number must be quoted, *e.g.* 58 $\frac{A}{8}$.

REFERENCES.

Sheets published during Survey year 1912-13.....

" previously published since 1st October 1905.....

Circle boundary shown thus.....

Reg. No. 2947 D., 13.—1,200.

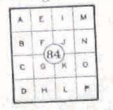
Engraved at the Survey of India Office, Calcutta.

Litho., S. I. O., Calcutta.

INDEX

Showing progress up to 30th September 1913

Key to Degree Sheets.



Key to Standard Sheets.

When ordering a sheet on the 1 inch Scale, only the number should be used, *e.g.* No. 84. In the case of a Degree Sheet, the number and the Degree Sheet letter must be given, *e.g.* 84 A. For a 1 Inch Sheet, the number, the Degree Sheet letter and the 1 Inch Sheet number must be quoted, *e.g.* 84 $\frac{5}{3}$.

REFERENCES.

Sheets published during Survey year 1912-13.....

" " since 1st October 1905.....

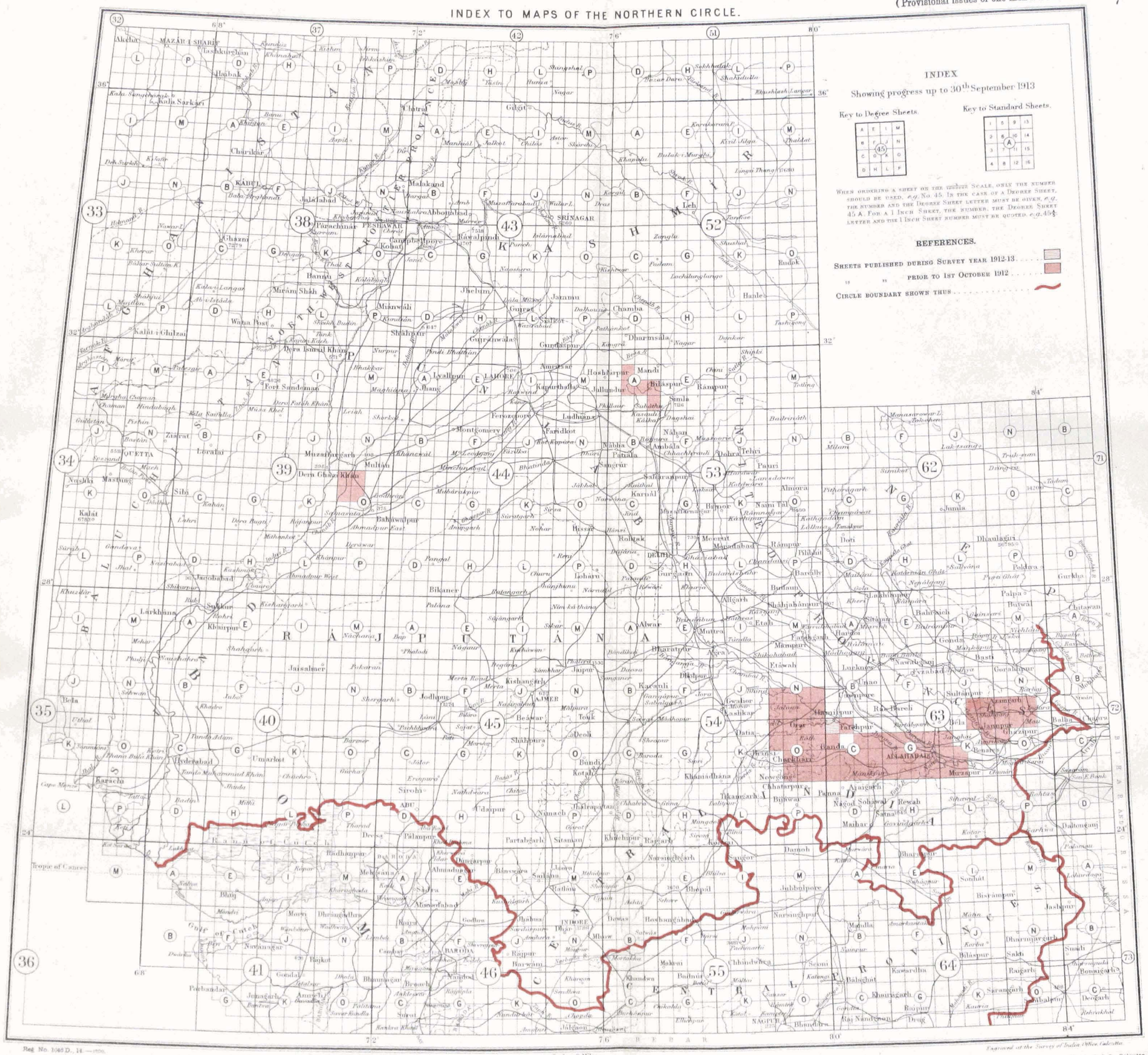
Circle boundary shown thus.....

Reg. No. 2947 D., 13.—1,900.

Engraved at the Survey of India Office, Calcutta.

Litho. S. I. O., Calcutta.

INDEX TO MAPS OF THE NORTHERN CIRCLE.



(Provisional issues of one-inch sheets)

INDEX TO MAPS OF THE SOUTHERN CIRCLE.

INDEX

Showing progress up to 30th September, 1913

Key to Degree Sheets.

Key to Standard Sheets.

When ordering a sheet on the 4 miles Scale, only the number should be used, *e.g.* No 58. In the case of a Degree Sheet, the number and the Degree Sheet letter must be given, *e.g.* 58 A. For a 1 Inch Sheet, the number, the Degree Sheet letter and the 1 Inch Sheet number must be quoted, *e.g.* 58 $\frac{A}{5}$

REFERENCES.

Sheets published during Survey year 1912-13 .....

" " prior to 1st October 1912 .....

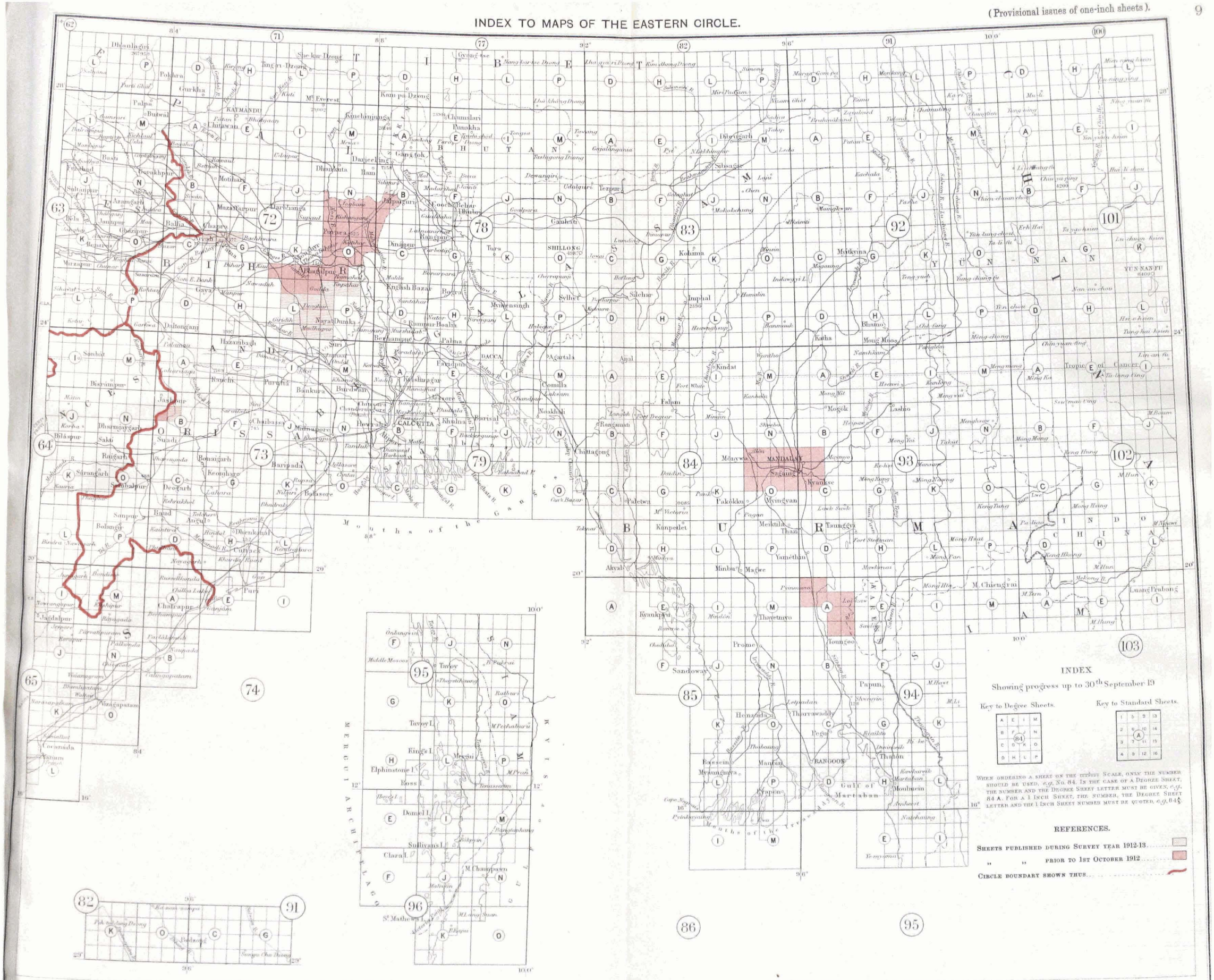
Circle boundary shown thus .....

Reg No. 1046 D., 14 — 1200.

Engraved at the Survey of India Office, Calcutta.

Litho., S. I. O., Calcutta.

INDEX TO MAPS OF THE EASTERN CIRCLE.



Reg No. 1040 D., 14.—1,200.
Engraved at the Survey of India Office, Calcutta.
Litho., S. I. O., Calcutta

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

(55)

The numbers of the sheets of the 1:1,000,000 series are shewn thus ..... (55)

REFERENCES

Degree sheets from old material published prior to Sept. 30, 1912 .....
" " " during current year .....
" from new material published prior to Sept. 30, 1912 .....
" " " during current year .....

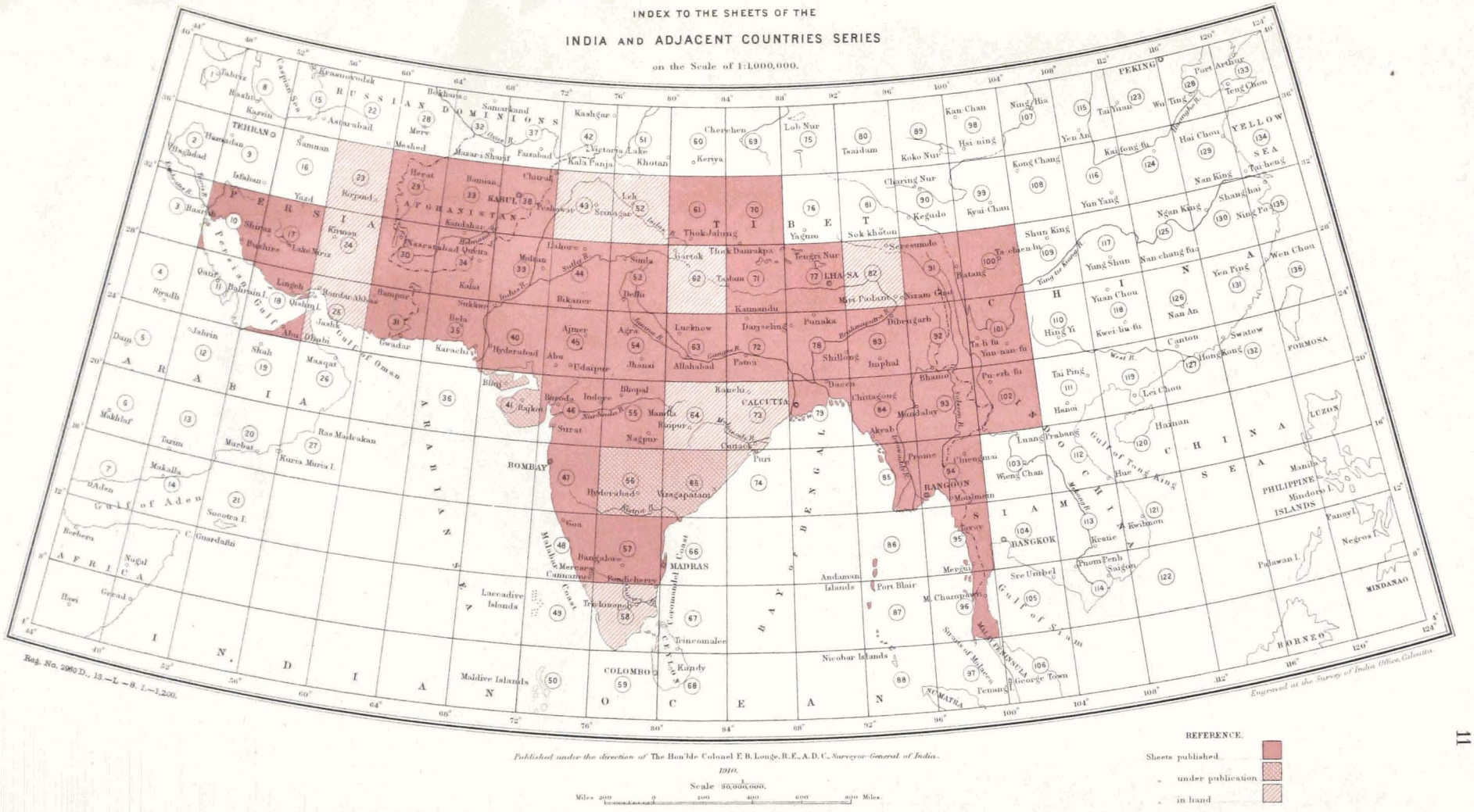
Published under the direction of Colonel S. G. Burrard, R.E., F.R.S., *Officiating Surveyor General of India.*

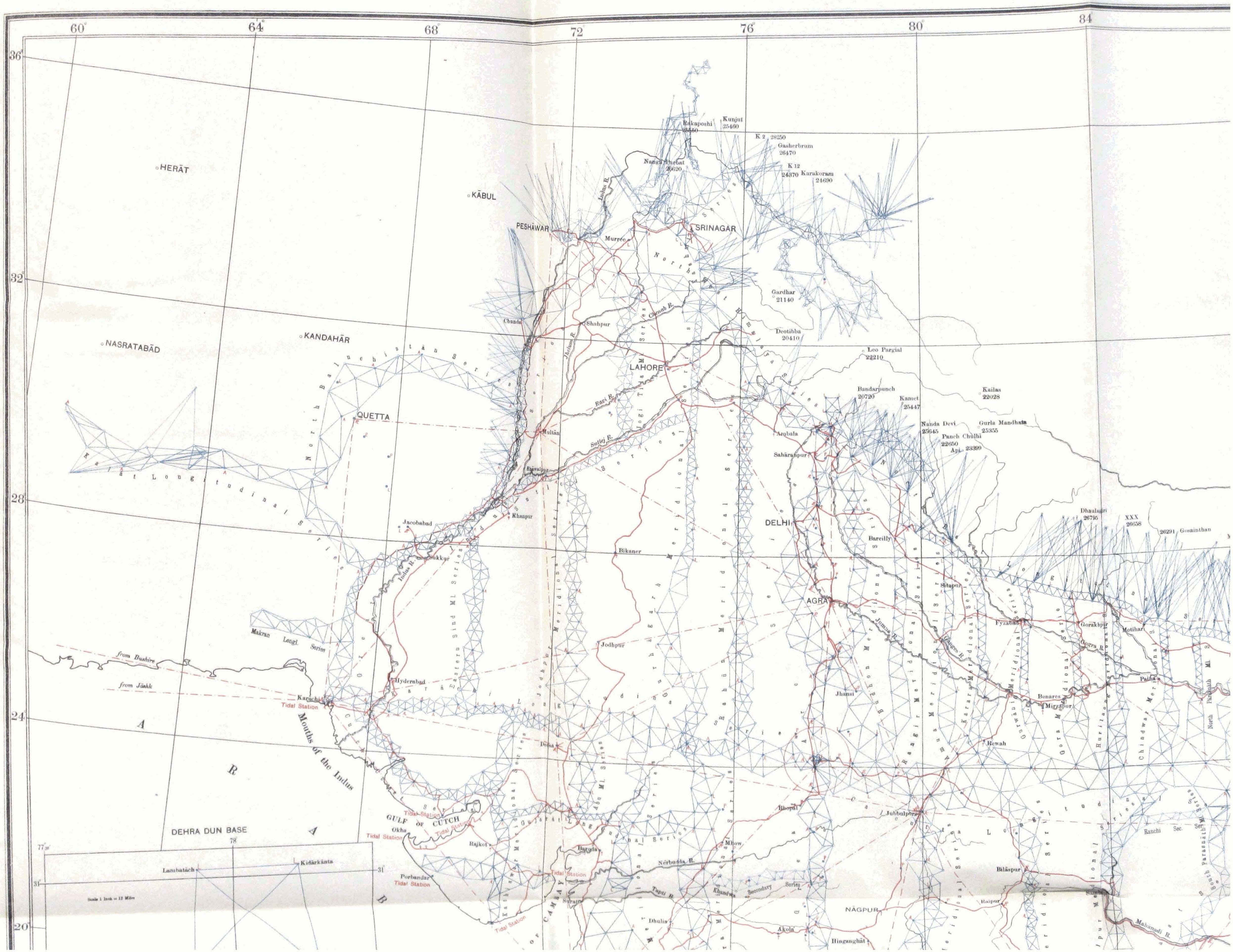
1913

Litho., S. I. O., Calcutta.

Note. The Longitudes refer to the Greenwich Meridian.

Scale 1 Inch=192 Miles or 12 Degrees.


INDEX TO THE SHEETS OF THE
INDIA AND ADJACENT COUNTRIES SERIES
on the Scale of 1:1,000,000.
RUSSIAN DOMINIONS
PERSIA
AFGHANISTAN
TIBET
CHINA
ARABIA
INDIA
BAY OF BENGAL
ARABIAN SEA
INDIAN OCEAN
TEHRAN
KABUL
LHASA
CALCUTTA
BOMBAY
MADRAS
COLOMBO
RANGOON
BANGKOK
PEKING
Port Arthur
YELLOW SEA
FORMOSA
PHILIPPINE ISLANDS
LUZON
MINDANAO
BORNEO
Andaman Islands
Nicobar Islands
Laccadive Islands
Maldive Islands
Singapore
Penang
George Town
Port Blair
Aden
Gulf of Aden
Gulf of Oman
Persian Gulf
Red Sea
Gulf of Siam
Straits of Malacca
MALAY PENINSULA
SUMATRA
Engraved at the Survey of India Office, Calcutta.
Reg. No. 2010 D., 13.—L—8. 1.—1,200.
REFERENCE.
Sheets published.
" under publication.
" in hand.
Published under the direction of The Hon'ble Colonel F. B. Longe, R.E., A.D.C., Surveyor-General of India.
1910.
Scale 1/1,000,000.
Miles 200 0 200 400 600 800 Miles.


60°
64°
68°
72°
76°
80°
84
36°
32°
28°
24°
20°
HERĀT
KĀBUL
PESHĀWAR
SRINAGAR
Rakaposhi 25550
Kunjut 25460
K 2 28250
Gasherbrum 26470
Nanga Parbat 26620
K 12 24370
Karakoram 24690
Murree
Gardhar 21140
Deotibba 20410
Leo Pargial 22210
Shahpur
NASRATABĀD
KANDAHĀR
LAHORE
Bandarpunch 20720
Kamet 25447
Kailas 22028
QUETTA
Multān
Ambala
Sahāranpur
Nanda Devi 25645
Panch Chulhi 22650
Api 23399
Gurla Mandhata 25355
Khanpur
Jacobabad
DELHI
Bareilly
Dhaulagiri 26795
XXX 26658
26291 Gosainthan
Bikaner
Sukkur
Sitapur
AGRA
Fyzabad
Gorakhpur
Motihari
Makran Longl. Series
from Bushire
from Jāshk
Hyderabad
Jodhpur
Patna
Karachi
Tidal Station
Jhansi
Benares
Mirzapur
Mouths of the Indus
Rewah
A
R
A
B
DEHRA DUN BASE
Lambatāch
Kidārkānta
GULF OF CUTCH
Okha
Tidal Station
Rajkot
Baroda
Bhopal
Jubbulpore
Mhow
Nerbudda R.
Porbandar
Bilāspur
Ranchi Sec. Ser.
Surat
Tapti R.
Dhulia
Akola
NĀGPUR
Hinganghāt
Raipur
Mahanadi R.
Indus R.
Chenab R.
Jhelum R.
Ravi R.
Sutlej R.
Jumna R.
Ganges R.
Gogra R.
North Baluchistān Series
Kalāt Longitudinal Series
Great Longitudinal Series
Gujarāt Longl. Series
Eastern Sind Ml. Series
Jodhpur Meridional Series
Abu Ml. Series
Great Arc Meridional Series
Chandwar Meridional Series
Gora Meridional Series
Karara Meridional Series
Rangir Meridional Series
Secondary Series

LIBRARY OF CONGRESS
0 003 532 987 0

GENERAL REPORT

ON THE

OPERATIONS

OF THE

Survey of India

DURING THE SURVEY YEAR

1912-13.

PREPARED UNDER THE DIRECTION OF

COLONEL S. G. BURRARD, C.S.I., R.E., F.R.S.,

SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office, Survey of India,

CALCUTTA,

1914.

Price Two Rupees or Three Shillings.