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GENERAL REPORT

ON THE

OPERATIONS

OF THE

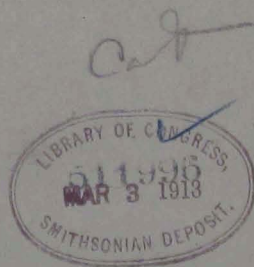
Survey of India,

DURING THE SURVEY YEAR

1910-11.



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,
1912.

Price Two Rupees or Three Shillings.

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PRINTED AT THE
PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, SURVEY OF INDIA,
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1910-II.

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PREFACE.

This report is intended to be general and concise. More detailed descriptions and discussions of results will be found in the Volume, "Records of the Survey of India, 1910-11."

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- 3 " " " Eastern "
- 4 Index to the publication of modern sheets of the one-inch map of India, Northern Circle.
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- 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
1910-1911

PART I.

ADMINISTRATION.

1. This report deals with the operations of the Survey of India for the year ending 30th September 1911.
2. The Honorable Colonel F. B. Longe, C.B., R.E., A.D.C., administered the Department till the 24th October, when he went on leave pending retirement, and Colonel S. G. Burrard, C.S.I., R.E., F.R.S., officiated as Surveyor General for the remainder of the year.
3. In January 1911 the N. W. Frontier Drawing Office was transferred to Simla, and in April the drawing office of the Chief of the General Staff was amalgamated with it, under the name of the "Simla Drawing Office."
4. The Burma Drawing Office was amalgamated with the office of the Superintendent, Eastern Circle.
5. No new Imperial Officers were appointed during the year under report, but 4 probationers were appointed to the Provincial Service (new).
6. No. 9 Party although nominally in the Eastern Circle continued to work under the direction of the Superintendent, Northern Circle; it will, however, in future, be under the Superintendent, Eastern Circle.
7. The cost of the department for the financial year ending 31st March 1911. was Rs. 33,47,212, against an estimated cost of Rs. 34,56,050.
8. The distribution of the officers in the various offices and parties is shown in the accompanying list.

**DISPOSITION OF OFFICERS,
1910-11.**

Circle.	Administrative Officer.	Party or Office.	Locality.	Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinate Establishment.	REMARKS.
	The Hon'ble Colonel F. B. Longe, C.B., R.E., A.D.C., up to 24th October 1910.	.....	Calcutta	.....	.....	.....	.....
	Colonel S. G. Burrard, C.S.I., R.E., F.R.S., from October 25th.	Surveyor General's Office and Mathematical Instrument Office.	Calcutta	Captain R. H. Thomas, R.E., Captain M. N. MacLeod, R.E., Captain F. F. Hunter, I.A.	.....	.....	.....
		Simla Drawing Office.	Simla	Major H. I. Crossway, R.E., Captain M. N. MacLeod, R.E., Lieut. F. G. Huddleston, R.E.	Messrs. J. P. Barker, H. T. Hughes, F. C. Saint.	.....	.....
		Map Publication Office.	Calcutta	.....	Mr. M. Gastaud	.....	.....
	Lieut.-Col. G. P. Lenox-Conyngham, R.E., till March 2nd 1911, Major W. M. Coldstream, R.E., from March 3rd 1911, Superintendent, Map Publication.	Drawing Office } Map Record & Issue Office. }	Calcutta	Captain M. O'C. Tandy, R.E. Captain O. H. B. Treachard, R.E.	Messrs. C. A. Norman, P. J. Barrington, J. O. Greiff, Jagdauba Prasad, H. A. Charrier, P. L. Gwastey, J. R. Newland, P. Simpson, P. N. Sur, J. Hiekie (re-employed), E. B. West, E. J. Hanby.	.....	.....
		Engraving Office.						
		Photo.-Litho. Office.	Calcutta	Captain O. H. B. Treachard, R.E., Captain A. H. Gwyn, I.A., Lieut. K. W. Fye, R.E.	.....	.....	.....

Northern Circle Drawing Office	Mussoorie	.....	Messrs. G. P. Tate, R. Waller-Senior, B. R. Hughes, H. G. Shaw, M. C. Petters, E. C. J. Bond.	Husain Buksh, K. S.	44 Clerks, Draftsmen, &c.
No. 1 Party	Kashmir	Major C. H. D. Ryler, D.S.O., R.E., Lt.-Major E. T. Rich, R.E., Lieut. J. D. Campbell, R.E., Lieut. A. A. Chase, R.E., Lieut. K. Mason, R.E.	Messrs. T. W. Babonau, H. H. B. Hanby, E. B. West, D. K. Rennick, R. C. Hanson, W. J. B. Miller, W. P. Hales, Jiya Lal.	Sher Jaang, K. B., Nutha Singh, R. S., Lal Singh, R. B., Mahindar Singh, Mohammed Husain Kunn.	25 Surveyors, &c.
No. 2 Party	Punjab	Lt.-Major E. T. Rich, R.E., Capt. M. N. MacLeod, R.E., Lieut. J. D. Campbell, R.E., Lieut. C. M. Thompson, I.A.	Messrs. T. W. Babonau, F. B. Powell, W. Newland, Subadar Kannk Singh, Messrs. R. E. Saubolle, E. C. O'Sullivan, J. McCruken, Jiya Lal.	Chuni Lal Kapoor, Mahindar Singh.	42 Surveyors, &c.
No. 3 Party	Punjab and U. P.	Capt. A. McHarg, R.E., Lieut. A. A. Chase, R.E., Lieut. R. S. Vahab, I.A.	Messrs. B. M. Barrill, A. C. Rose, P. A. T. Kenny, H. C. W. Stotesbury, E. C. Newland, A. J. A. Drake, F. H. Grant, F. J. Grace, J. A. Calvert.	Mahomed Latif Ali.	44 Surveyors, &c.
No. 4 Party	United Provinces	Captain L. C. Thuillier, I.A., Lieut. F. B. Scott, I.A.	Messrs. G. J. S. Rar, H. W. Biggie, C. E. C. French, A. B. Hunter, G. E. R. Cooper, F. E. R. Calvert, Moqimuddin.	Vidya Nath Suri, Mahammad Husain Khan.	69 Surveyors, &c.
No. 9 Party	Punjab	Major G. A. Beazley, R.E.	Messrs. J. A. Freeman, W. Newland, Dhiani Kun, F. Byrne, P. A. T. Kenny, H. C. W. Stotesbury, D. K. Rennick, J. McCruken, A. K. Mitra, A. J. A. Drake, Abdul. Aziz, H. H. P. Butterfield, W. P. Hales, F. J. Grace.	Gopal Singh, R. B., Dalbir Rai.	60 Surveyors, &c.
Riverain Detachment.	Punjab	.....	Messrs. Maya Das Puri, Moqimuddin	Chuni Lal Kapoor.	75 Traversers, Computers, &c., 53 Tehsildars, Patwaris, &c.
United Provinces Drawing Office.	Mussoorie	.....	M. J. M. Kennedy	.....	21 Draftsmen, Clerks, &c.

Colonel W. J. Bythell, R.E., Superintendent, Northern Circle.

Includestablishment of Cantonment Section No. 1.

This Party was transferred to Eastern Circle from 1st April 1911.

PART I.

Circle.	Administrative Officer.	Party or Office.	Locality.	Imperial Officers.	Provincial Officers.	Upper Subordinates.	Lower Subordinate Establishment.	REMARKS.	
SOUTHERN.	Bt.-Col. T. F. B. Renny-Tallyour, C.S.I., R.E., up to 23rd March 1911, and from 23rd September 1911. Lt.-Col. P. J. Gordon, I.A., from 24th March 1911 to 22nd September 1911, Superintendent, Southern Circle.	Southern Circle Drawing Office.	Bangalore	.....	Messrs. A. Ewing, Abdul Rahim, K.S.	Mr. B. V. Narayana Rao.	30 Draftsmen, &c.	
		Southern Circle Training Section.	Bangalore	.....	Messrs. J. Smith, Abdul Rahim, K.S.	Messrs. Jugal Behari Lal, Ram Narayan Hastir, B. P. Muthannab, K. Mandannan.	9 Surveyors, &c.	
		No. 5 Party	Central Provinces & Central India.	Maj. C. L. Robertson, C.M.G., R.E., Lieut. C. F. Nation, R.E.	Messrs. F. P. Walsh, C. Litchfield, S. N. McAfee, F. Fielding, C. West, Munshi Lal, F. C. Pitcher, E. J. Hanby, F. C. Saint.	Mr. Eknath Bartu.	32 Surveyors, &c.		
		No. 6 Party	Bombay, Central Provinces, Berar and Hyderabad.	Capt. H. Wood, R.E., Capt. F. F. Hunter, I.A., Lieut. K. W. Pyye, R.E., Lieut. A. H. Gwynn, I.A., Lieut. J. A. Field, R.E.	Messrs. Amar Sing, J. H. S. Wilson, P. R. Anderson, E. A. Meyer, F. B. Kitchen, R. B. Gildea, J. O. C. Fitzpatrick, A. J. Moore.	Mr. Dharmu	41 Surveyors, &c.		
		No. 7 Party	Bombay, Madras, Mysore & Coorg.	Lieut.-Colonel P. J. Gordon, I.A., Capt. C. P. Gunter, R.E., Lieut. K. W. Pyye, R.E., Lieut. A. H. Gwynn, I.A.	Messrs. W. M. Gorman, J. O. B. Donaghey, H. D. W. Scotsbury, A. K. Mitra, H. H. P. Butterfield, J. C. St. C. Pollet.	Mr. Abdul Hakk	26 Surveyors, &c.		
		No. 8 Party	Madras	Captain C. M. Browne, D.S.O., R.E., Lieut. S. W. S. Hamilton, R.F.F., Lieut. C. G. Lewis, R.E.	Messrs. W. F. E. Adams, E. J. Figgie, S. F. Norman, M. Mahadevu Mudaliar, C. O. Picard, Balaji Dhondiba, M. S. Ganesa Aiyar.	Mr. Anantaro Dhondiba.	30 Surveyors, &c.		
		Eastern Circle Drawing Office.	Shillong, Assam.	.....	Messrs. P. J. Barrington and E. M. Kenny.	Raghubar Datt Thaplyal, Motindra Kanjan Mazumdar.	3 Surveyors, 6 Draftsmen, 10 pupil Draftsmen, 1 pupil Surveyor, 8 Clerks.	
		No. 9 Party (in Northern Circle)	
		No. 10 Party	Upper Burma	Captain E. C. Baker, I.E., Lieut. W. E. Perry, R.E.	Messrs. O. D. Stuart, F. S. Bell, P. Williams, C. S. Littlewood, W. G. Jarbo, Asmatallah Khan, W. H. Strong, C. B. Sexton.	Lachman Daji Jadu, R.S., Hayat Munhamud, B. C. H. Collins.	40 Surveyors &c., 6 pupils.		
		No. 11 Party	Southern States.	Capt. R. H. Phillimore, R.E., Lieut. J. A. Field, R.E.	Messrs. V. W. Morton, T. P. Dewar, A. A. Graham, H. St. J. Kenny, A. J. Booth, R. M. Wyatt.	25 Surveyors, &c. and 3 pupils.	

EASTERN.

No. 12 Party ...	Assam ...	Major A. Mears, I.A., Lieut. G. E. T. Oakes, R.E.	Major A. Mears, I.A., Lieut. G. E. T. Oakes, R.E.	Messrs. W. Skilling, C. C. Byrne, Prauedaranjan Roy, J. H. Williams, Amjed Ali, L. Williams, P. C. Mitra, H. H. Creed.	Nanakchand Furi.	40 Surveyors, &c. and 1 pupil.	
Trigonometrical Surveys Office.	Dehra Dûn ...	J. de G. Hunter, Esq., M.A.	J. de G. Hunter, Esq., M.A.	Messrs. J. P. Barker, J. H. Nichol, Anlad Hussein, O. C. Ollenbach, H. A. Charrier, A. V. Dickson, N. N. Chuckerbutty, A. F. Murphy, D. N. Banerji.	Ram Singh, R. S., Sarat Kumar Mukerji.	.....	Special estab- lishment.
No. 13 Party ...	Sind and Balu- chistan.	Major H. L. Crosthwait, R.E.	Major H. L. Crosthwait, R.E.	<i>Nil.</i>	Bidhu Bhusan Shome.	2 Computers, &c.	
No. 14 Party ...	Burma ...	Major E. A. Tandy, R.E., Capt. H. McC. Cowie, R.E.	Major E. A. Tandy, R.E., Capt. H. McC. Cowie, R.E.	Mr. Hanuman Prasad	<i>Nil.</i>	4 Computers, &c.	
No. 15 Party ...	Upper Burma, Kashmir, Assam	Major H. H. Turner, R.E., Lieut. E. B. Cardew, R.E., Lieut. F. J. M. King, R.E., Lieut. H. E. Bell, R.E., Lieut. K. Mason, R.E.	Major H. H. Turner, R.E., Lieut. E. B. Cardew, R.E., Lieut. F. J. M. King, R.E., Lieut. H. E. Bell, R.E., Lieut. K. Mason, R.E.	Messrs. H. B. Simons, C. H. Tresham, Abdul Hai, V. D. B. Collins, F. W. Smith, G. A. Norman, B. T. Wyatt, Abdul Karim, K. S. Gopulachari, V. P. Vainwright, C. S. McInnes.	Bidhu Bhusan Shome.	21 Computers, &c.	
No. 16 Party ...	Indian Ports ...	Major J. M. Burn, R.E.	Major J. M. Burn, R.E.	Messrs. H. G. Shaw, Syed Zille Hasmain.	<i>Nil.</i>	20 Computers, &c.	
No. 17 Party ...	Bombay, Madras, Panjab & Assam.	Lieut.-Col. P. J. Gordon, I.A., Lieut.-Col. G. P. Lenox- Conyngham, R.E.	Lieut.-Col. P. J. Gordon, I.A., Lieut.-Col. G. P. Lenox- Conyngham, R.E.	Messrs. E. H. Corridon, A. M. Talati, O. N. Fushong, D. H. Luxa, T. F. Kitchen, O. D. Jackson.	Karuna Kumar Das.	9 Computers, &c.	
No. 18 Party ...	India ...	Capt. R. H. Thomas, R.E., Capt. H. J. Couchman, R.E., Lieut. H. T. Morshead, R.E.	Capt. R. H. Thomas, R.E., Capt. H. J. Couchman, R.E., Lieut. H. T. Morshead, R.E.	Messrs. E. C. J. Bond, H. P. D. Morton, Rama Prasad Ray, N. R. Mazumdar, Bai Bahadur Mathur.	<i>Nil.</i>	19 Computers, &c.	
Forest Map Office.	Dehra Dûn ...	Major J. M. Burn, R.E.	Major J. M. Burn, R.E.	Messrs. A. Descubes (re-employed), J. H. Nichol.	<i>Nil.</i>	<i>Nil.</i>	

Colonel S. G. Burrard, C.S.I.,
R.E., F.R.S., till October
24th, J. Eccles, Esq.,
M.A., from October 25th,
Superintendent, Trigonometrical Surveys.

PART II.

SURVEY WORK IN THE FIELD.

I.—TOPOGRAPHICAL SURVEYS.

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

9. *No. 1 Party.*—This party remained in recess quarters at Mussoorie during the winter, and left for the field in Kashmír in March. Field work was started about the middle of the month, and by the end of September an area of 3,514 square miles had been surveyed on the 1-inch scale in the Jhelum Valley; the country surveyed varying from the level swampy valley, to the high ranges of the Pír Panjál and Káj Nág.

10. *No. 2 Party.*—No. 2 party surveyed an area of 1,026 square miles on the 2-inch scale* in the Salt Range, and one of 4,971 square miles on the 1-inch scale in the Attock, Jhelum, Sháhpur, Gujránwála, Gujrát and Sialkot districts of the Punjab and in the native state of Jammu. With the exception of the Salt Range, the country surveyed lay in level plains, well cultivated, and intersected by the Jhelum, Chenáb and Rávi rivers, and by numerous irrigation canals.

11. *No. 3 Party.*—This party surveyed a total area of 6,282 square miles, of which 5,955 square miles were 1-inch revision survey, 65 square miles 2-inch revision survey and 262 square miles 1-inch supplementary survey. The 2-inch survey comprised the city of Delhi and its environs, and a special guide map of this area has been drawn on that scale. The 1-inch survey comprised parts of the Delhi and Gurgaon districts of the Punjab, and parts of the Meerut, Aligarh, Morádábád, Budaun and the whole of the Bulandshahr districts of the United Provinces. With the exception of the Ridge at Delhi and its continuation to the south, the country was flat, with a gradual slope of about 18 inches to the mile and an average height of 650 feet above sea level; between the Jumna and Ganges rivers it was much cut up by canals. In both methods of 1-inch survey, every use was made of the old 1-inch maps based on cadastral surveys, and the majority were found extremely good. Their use greatly facilitated progress, and the resulting maps show a large amount of detail.

12. *No. 4 Party.*—No. 4 party surveyed an area of 6,048 square miles in the districts of Lucknow, Unao, Cawnpore and Etáwah, with portions of districts Hardoi, Rái Baréli, Farrukhábád, Mainpuri, Agra, Hamírpur, Jalaun and of Gwalior State. The country surveyed consisted chiefly of flat plains, well cultivated and covered with an abundance of artificial groves. The rivers Ganges, Jumna and Chambal ran through portions of the work, and there the country was much cut up by deep ravines. A traverse section of this party ran traverses (to supplement older work) over an area of 6,236 square miles. The Cantonment Section surveyed the Cantonments of Dargai, Malakand, Chakdarra, Hyderábád (Sind), and Loralai, and additions were made to previous surveys of Risalpur and Allahábád. Maps of eight Cantonments were sent for publication, *viz.*, Dum Dum, Meerut, Lucknow, Fort Sandeman, Dargai, Malakand, Chakdarra and Allahábád.

Proofs of eight cantonment maps were received for colouring, *viz.* Dharm-sála, Shillong, Dum Dum, Meerut, Dargai, Malakand, Chakdarra and Lucknow.

13. *No. 9 Party.*—No. 9 party surveyed an area of 5,687 square miles on the 1-inch scale in the Jhang, Miánwáli, Sháhpur, Lyallpur, Gujránwála, Lahore and Montgomery districts of the Punjab. The country surveyed was generally flat, and varied from low rolling sand-hills covered with scanty scrub and a few

* At the request of the Punjab Government.

stunted trees, to the fertile, well watered and closely cultivated lands of the Chenáb colony in the Lyallpur district. In this party considerable use was made of the *patwari's* maps, which were pantographed down, and the reductions transferred to the plane-table sections.

14. *The Punjab Riverain Detachment.*—This detachment continued the work of traversing and laying down base lines for the future demarcation and survey of riverain boundaries, and for the general co-ordination of the cadastral surveys of the Punjab Government. The original programme was modified, and traversing was carried out for cadastral surveys on the rivers Sutlej, Beás, Jhelum, and Chenáb, and for riverain boundaries on the Jumna and Indus. 436 linear miles of main traverse and 1,844 miles of minor traverse were completed along these rivers and 456 base lines were laid down with permanent mark-stones.

15. 1,806 "*musaris*" were plotted, in addition to 372 which showed riverain boundaries. 101 4-inch sheets were traced and 21 were compiled.

16. The above were for the Settlement Department, and for the riverain, 5 4-inch sheets were compiled, 21½ finally examined, and 9¾ typed. This detachment also carried out a special survey on the scale of 4 inches to the mile, at the request of the Assistant Commanding Royal Engineer, along the Indus near Dera Ismail Khán—an area of 53 square miles being traversed and plane-tabled, and the work being completed with some difficulty on the 22nd October 1911.

17. About the middle of January 1911, orders were received from the Punjab Government for the resumption of the Lower Bári Doáb 25-acre Rectangular Survey, which had been in abeyance since 1909. Work was started on the 14th February, closed on the 10th June, and re-started on the 1st September with an increased staff. In all 4,164 rectangles were broken and 140 linear miles of traversing were completed. The operations will extend over an area of some 2,500 square miles, which will eventually be commanded by the Lower Bári Doáb canal.

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

18. *No. 5 Party.*—No. 5 Party surveyed an area of 5,166 square miles in the Jubbulpore, Damoh, Saugor, Narsinghpur, Seoná, Mandlá and Hoshangábád districts of the Central Provinces and in the Bhopál State of Central India; and triangulated 2,512 square miles in the Narsinghpur, Hoshangábád, Chhindwára and Betúl districts of the Central Provinces and in the Gwalior and Bhopál States of Central India. The nature of the country surveyed varied from the cultivated plains in the neighbourhood of the Narbadá River to the densely wooded slopes ascending to the Pachmarhí plateau.

19. *No. 6 Party.*—No. 6 Party surveyed an area of 3,074 square miles in the East Khándesh district of Bombay, in the Wardhá and Chánda districts of the Central Provinces, in the Yeotmál district of Berár and in the Aurangábád and Adilábád districts of Hyderábád; it triangulated an area of 3,360 square miles in the Yeotmál and Akola districts of Berár and in the Adilábád and Purbhani districts of Hyderábád, and it traversed 804 linear miles of forest boundaries and in the Santa Cruz Cantonment.

The country surveyed was of a varied nature, a large proportion being fairly open and easy; certain areas were however covered with dense scrub jungle, and here work was necessarily slow.

20. *No. 7 Party.*—No. 7 Party surveyed an area of 3,628 square miles in the North Kanara district of Bombay, in the South Kanara district of Madras, in Mysore and in Coorg, and triangulated an area of 1,769 square miles in the Coimbatore and Salem districts of Madras. The country surveyed was very varied in character; the low-lying and intricate coast line was connected by undulating ground with the high Western Ghats, beyond which was the Mysore plateau. The country was on the whole difficult to work in.

21. *No. 8 Party.*—No. 8 Party surveyed an area of 1,287 square miles in the Malabar district and in the Cochin and Travancore States of Madras, and triangulated an area of 279 square miles and traversed 84 linear miles in the

Travancore State of Madras. The country surveyed in the plains consisted of paddy fields surrounded by dense groves of palms, and in the hills, of forest which became denser as the elevation increased. Survey work was slow, laborious and expensive.

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

22. *No. 9 Party.*—No. 9 Party was transferred to the Eastern Circle from 1st April 1911, and triangulated an area of 3,575 square miles in the Singhbhúm district of Bengal for the detail survey of next season on the 1-inch scale. The country was for the most part hilly and covered with dense forest.

23. *No. 10 Party.*—No. 10 Party surveyed an area of 2,798 square miles in the districts of Bhamo and Myitkyiná, and in Môngmit State of Upper Burma, including 75 miles of the Burma-Yünnan frontier; 290 square miles of country beyond the frontier were sketched. 3,625 square miles were triangulated and traversed in the Kathá, Bhamo, and Myitkyiná districts. The country lay in the valley of the Irrawaddy, near the gorges of the third defile, and extended eastwards through the Kachin hills to the Chinese frontier. The hills though high and wooded were not difficult to survey, but in the low valleys heavy mist in the early morning and the thickness of the jungle delayed progress.

24. The cantonment section completed the survey of Rangoon cantonment and the mapping of all cantonments which was in hand at the close of last season; it was disbanded at the end of May 1911, having completed all the cantonment surveys that had been asked for.

25. The Land Records Training Section continued its work of giving practical training in cadastral surveying to superintendents of the Burma Land Records Department, and to probationers who had already gone through a preliminary course of instruction at Dehra Dún. The course lasted 9 months for superintendents and 12 months for probationers, during which period the pupils carried out traversing, 16-inch cadastral survey, and 64-inch town survey, as well as the computations, mapping, and area calculations involved.

26. Three surveyors of No. 10 party were attached to political missions, and carried out reconnaissance surveys of 3,735 square miles on the $\frac{1}{2}$ -inch and $\frac{1}{4}$ -inch scales. The work was fair-drawn during the recess, partly by the party and partly by the Simla Drawing Office.

27. *No. 11 Party.*—No. 11 Party surveyed an area of 3,229 square miles in the southern portion of the Shan States of Mông Pan and Mawkmai, and in the Karenni State of Kantaráwadi. Work lay mostly beyond the Salween and was limited towards the south and east by Siam. Triangulation was completed over an area of 1,100 square miles in Mông Pai and Mawkmai States and in Karenni, and also over 750 square miles in the Salween district.

The country was very steep, rough and rocky, communications were difficult, and inhabitants and supplies scarce. The hills were not heavily wooded except in a few patches.

28. *No. 12 Party.*—No. 12 Party surveyed an area of 3,191 square miles in the Khási and Jaintia Hills, Sylhet and Kámrup districts of Assam, and carried out triangulation and traversing over an area of 4,040 square miles. The above area includes 26 square miles of reserved forest surveyed on the 2-inch scale. The country under survey consisted mainly of open, grassy, undulating hills with occasional pine forests; the lower slopes of these hills were as a rule thickly wooded; the remainder of the area comprised flat and cultivated plains, here and there covered with dense grass and tree jungle.

TOPOGRAPHICAL SURVEYS.
Table showing Outturns and Costs.

1910-1911.

Circle	Party.	Locality.	Character of Ground.	Type of Survey.	Scale.	Outturns.		Total Outturn of Survey on all scales.	Difference from 6,000 square miles per party. (d)	Total cost.	Cost rate per square mile Survey and Mapping.	REMARKS.
						Survey.	Mapping.					
1	2	3	4	5	6	7	8	9	10	11	12	13
N.	No. 1	Kashmir State	Kashmir valley to high mountains.	Survey	1 inch	3,514	.....	3,514	-2,486	Rs. 1,10,162	31.3	Excluding Rs. 3,840 on field service press-experiments.
N.	No. 2	Punjab	{ Dead level plains Hilly and cut up by numerous deep ravines.	{ Survey Survey	{ 1 inch 2 inch	{ 4,971 1,026	5,997	5,997	-3	1,33,724	20.6	Excluding Rs. 3,909 on special Dera Ismail Khan Survey (b).
N.	No. 3	Punjab and U. P.	{ Flat open country Delhi city and Ridge and environs.	{ Revision Survey Do. do. Supplementary Survey.	{ 1 inch 2 inch 1 inch	{ 5,855 65 262	6,282	6,282	+282	1,05,872	16.9	
N.	No. 4	United Provinces	Plains and broken ground	{ Survey Supplementary Survey.	{ 1 inch 1 inch	{ 4,834 1,114	4,616(b)	6,048	+48	1,06,814(c)	17.7	(b) Area drawn but fair mapping not yet submitted. (c) Excluding Rs. 13,848 on cantonment surveys.
N.	No. 9	Punjab	Flat open, partly desert	{ Survey Supplementary Survey.	{ 1 inch 1 inch	{ 3,480 2,207	.....	5,687	-313	96,277(d)	16.9	(d) Final mapping not yet completed
			Totals, Northern Circle (d)	.....	...	.....	16,895	27,528	-2,472	5,42,849	19.7	
S.	No. 5	Central Provinces and Central India.	{ Open cultivated plains Cultivated plains and wooded hills.	{ Survey Survey Revision Sur- vey.	{ 1 inch 14 inch 1 inch	{ 874 1,373 2,919	2,962	5,166	-834	1,06,642	20.6	
S.	No. 6	{ Bombay, Central Provinces, Benar and Hyderabad.	{ Dense scrub jungle Varied	{ Survey Survey Revision Sur- vey.	{ 2 inch 1 inch 1 inch	{ 81 2,223 770	3,349	3,074	-2,926	1,13,507	36.9	

S. No. 7	Bombay, Madras, Mysore, & Coorg.	Partly open, partly hilly and wooded. Flat open with tidal creeks Bold, forest clad hills (Hilly forest	Survey Survey Revision Survey Survey	1 inch 1½ inch 1 inch 2 inch	734 556 1,783 553 910 81 296	2,926	3,628	-2,372	93,641	25.6
S. No. 8	Madras	Part flat enclosed, part hilly forest. Flat enclosed Part flat enclosed, part hilly dense forest.	Survey Survey Survey	1 inch 1½ inch 2 inch		2,677	1,287	-4,713	1,16,486	90.3
		Totals, Southern Circle	.....	...	.....	11,913	13,171	-10,829	4,30,276	32.7
E. No. 10	Upper Burma	All densely wooded Partly flat and partly hilly.	Survey Survey	2 inch 1 inch	183 2,613	3,026(c) (f)	2,798	-3,202	1,40,146(g)	50.1
E. No. 11	Southern Shan States and Kareuni.	Steep, rocky hills, lightly wooded.	Survey	1 inch	3,229	3,229(f)	3,229	-3,771	1,45,153	44.9
E. No. 12	Khasi and Jaintia Hills and Sylhet and Kámrúp Districts of Assam.	Hilly and wooded Open plains Forest in hills dense in parts.	Survey Supplementary Survey Survey	1 inch 1 inch 2 inch	2,720 445 26	3,191(f)	3,191	-2,809	1,50,477	47.2
		Totals, Eastern Circle	.....	...	.....	9,446	9,218	-6,782	4,33,776	47.3
		GRAND TOTALS	.....	...	.....	38,254	49,917	-22,083	14,08,901	38.2

(c) Includes area surveyed the previous season.

(f) Mapping not completed till November 1911.

(g) Excluding Rs. 41,395 on reconnaissances and contourment surveys (h).

(a) The figure 6,000 square miles from which differences are shown in column 10 is the full outturn per party which it is hoped to attain in the future.
(h) For details see the Volume "Records of the Survey of India, 1910-11".

Table shewing progress of Topographical Surveys, 1905 to 1911.

Outturns in square miles.

Survey year.	Scale.	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
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
Areas completed to date	.....	97,120	56,811	61,908	215,839
Total areas included in topographical programme.	1 inch	620,000	542,800	528,800	1,691,600
	½ inch	130,000	.....	.....	130,000
Approximate areas remaining for Survey	1 inch	522,860	465,989	466,892	1,455,761
	½ inch	130,000	.....	.....	130,000

Note.—The question of reducing the scale of Survey in certain regions is under consideration. If it is found that the scale can be safely reduced for any considerable areas, the completion of the topographical programme within the settled period of 25 years from 1905 will become more probable.

II.—FOREST SURVEYS.

29. The Forest Surveys of the year were carried out, in every case, by the particular topographical parties in whose spheres of operations the forests lay. The surveys were for the most part on the 2-inch scale; but some were on the 1-inch scale, and forest boundary surveys on the 4-inch scale were carried out over a considerable area.

Northern Circle.

30. *Punjab*.—No. 2 Party surveyed an area of 219 square miles of forests, including reserved, unclassified forests, and "rakhs," in the districts of Jhelum, Attock, Sháhpur, Sialkot, and Gujrát. These were partly on the 2-inch and partly on the 1-inch scale.

31. No. 9 Party surveyed an area of 326 square miles on the 1-inch scale in the Sháhpur, Lahore, Montgomery, Gujránwála, and Lyallpur districts. The country surveyed was quite flat, and the forests consisted of open forest or scrub jungle; while in the Sháhpur district rolling sand hills predominated. No boundary traverses were run.

Southern Circle.

32. *Central Provinces. (Berár Circle)*.—In the course of the topographical survey of Berár, No. 6 Party surveyed on the 2-inch scale 81 square miles of A, B, & C class forests falling in the Yeotmál district. The boundaries of all the above forests had previously been rigorously traversed by theodolite and plotted on the 4-inch scale. In addition 566 linear miles of theodolite boundary traverse of A, B, & C class forests were traversed in advance for next year's survey; 41 linear miles traversed last year will also be available.

Eastern Circle.

33. *Burma*.—No. 10 Party.—The following twelve forest reserves fell within the area under survey, and were surveyed on the 2-inch scale: Taung-balaung and Vya Hatha in the Myitkyiná forest division; and in the Bhamo forest division Bum Sawn, Teinthaw, Moman, Singlum, Lungyá, Kadawtaung, Si-u, Namik, Namkao, and the proposed reserves of Naunghu and Namme. The Naunghu reserve was settled so recently that traverse operations were hampered through lack of proper demarcation, and as the Namme reserve had not yet been settled or demarcated, considerable difficulty was met with, both by traversers and detail surveyors, in locating the proposed boundary. The total area surveyed by No. 10 Party amounted to 183 square miles.

34. No. 11 Party carried out 76 linear miles of theodolite boundary traverse of the Tambpak forest in the Southern Shan State of Hsa-htung.

The detail survey of this forest will be executed next year on the 2-inch scale.

35. *Eastern Bengal and Assam*.—The survey on the 2-inch scale of the Nongkyhllen reserve, situated in the Khási and Jaintia Hills division, was taken up and completed by No. 12 Party. This reserve embraces an area of 26 square miles, and contains a fair amount of Sal timber. In parts very dense and high grass jungle was encountered, which retarded the work.

III.—TRIGONOMETRICAL SURVEYS.

GEODETIC SURVEY.

(a).—Astronomical Latitudes.

36. *No. 13 Party.*—No. 13 Party was employed on latitude observations. Of the ten stations visited, six were situated in Baluchistán and Sind, Khojak being the most northerly and Sultán ka Gót near Shikárpur, the most southerly: the remaining four were situated in the Siwálíks. The results of the observations are given in the following table:—

Station.		Height.	Longitude.	Geodetic latitude.	Astronomical latitude.	A—G.
		Ft.	° ' "	° ' "	° ' "	"
Baluchistán & Sind.	Khojak	7,851	66 37	30 51 24·85	20·21±0·061	-4·64
	Quetta	5,500	67 3	11 57·37	55·91±0·098	-1·46
	Mach	3,522	67 21	29 52 31·51	20·46±0·058	-11·05
	Dasti	316	67 56	0 29·93	27·61±0·058	-2·32
	Dumb	183	68 17	28 15 21·09	18·30±0·048	-2·79
	Sultán-ka-Gót	213	69 39	4 9·41	8·05±0·045	-1·36
Siwálíks.	Lachkua	2,674	78 2	30 4 34·24	5·31±0·050	-28·90
	Hatni	3,096	77 59	13 1·52	31·93±0·096	-29·59
	Bullawalla	2,432	77 49	6 51·29	22·32±0·058	-28·97
	Shorpur	2,916	77 58	13 44·43	15·30±0·073	-29·13

A negative value of (A—G) denotes a northerly attraction of the plumb-line.

37. The noteworthy features of the results are the smallness of the values of (A—G) at all the Baluchistán and Sind stations; and the equality of the values at the four Siwálík stations. There is a visible excess of mass to the immediate north of the first three Siwálík stations, and no such excess in the case of the fourth station.

(b.).—Pendulum Operations.

38. *No. 14 Party.*—No. 14 Party carried out pendulum operations in Burma, at eleven stations, fairly evenly distributed between Mogok in the north and Rangoon and Bassein in the south.

In the table below are shown the stations visited and the results obtained. The usual procedure was followed in carrying out the observations, four pendulums being swung at each place, and as a rule four complete sets of night and day observations were made, each set being preceded and followed by star observations for the determination of clock rate.

TABLE.

Stations.	Latitude.	Longitude.	Height above M. S. L.	Observed <i>g</i> .	Correction for Height.	Correction for Mass.	Correction for Terrain.	Corrected for Height only.	Corrected for Height and Mass.	Corrected for Height Mass and Terrain.	γ .	μ - γ .	μ - γ .
	° ' "	° ' "	feet.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
Rangoon	16 47 55	96 9 8	164	978.467	+0.015	-0.006	0	978.482	978.476	978.476	978.434	+0.048	+0.042
Prome	18 49 40	95 13 40	101	978.543	+0.009	-0.004	0	978.532	978.548	978.548	978.541	+0.011	+0.007
Henzada	17 39 17	95 27 18	46	978.481	+0.004	-0.002	0	978.485	978.483	978.483	978.478	+0.007	+0.005
Bassein	16 47 11	94 44 6	23	978.475	+0.002	-0.001	0	978.477	978.476	978.476	978.433	+0.044	+0.043
Toungoo	18 55 50	96 27 3	159	978.558	+0.015	-0.006	0	978.573	978.567	978.567	978.547	+0.026	+0.020
Pyinmana	19 44 25	96 11 56	409	978.578	+0.038	-0.014	+0.001	978.616	978.602	978.603	978.593	+0.023	+0.010
Meiktila	20 51 26	95 51 58	799	978.617	+0.074	-0.028	0	978.691	978.663	978.663	978.658	+0.033	+0.005
Mandalay	21 59 44	96 6 28	244	978.714	+0.023	-0.009	+0.001	978.737	978.728	978.729	978.728	+0.009	+0.001
Maymyo	22 1 13	96 28 24	3,495	978.490	+0.326	-0.122	0	978.816	978.694	978.694	978.730	+0.086	-0.036
Mogok	22 54 51	96 29 51	3,685	978.539	+0.343	-0.129	+0.003	978.882	978.753	978.756	978.787	+0.085	-0.031
Myingyan	21 28 56	95 23 50	248	978.690	+0.023	-0.009	0	978.713	978.704	978.704	978.696	+0.017	+0.008

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

39. The work of No. 15 Party included principal and secondary triangulation and the selection of sites for base lines.

(a).—*Principal Triangulation.*

(i).—*The Upper Irrawaddy Series* was continued from the side Maru-Matu Bum in a northerly direction up to parallel $25^{\circ} 30'$, where it bent eastward. Owing to bad weather conditions, the intention of making a junction with the Mandalay meridional series has had to be postponed (*vide* index chart Great Trigonometrical Survey).

(ii).—*The Great Salween Series.* Work on this series had been in abeyance since April 1909. It was continued this season from the side Loi Lung—Loi Danwa, first easterly and then south-easterly, following the eastern boundary of Burma.

(iii).—*The Kashmir Principal Series* was extended from the base Choti-wála—Ratha Pahar towards the north. After completion of the triangulation, reconnaissance was carried out, to decide on the route by which the Indian triangulation should be joined up with that of Russia. Three routes were examined, and the one selected was through the Hunza valley.

(iv).—*Revision of heights on the Great Arc Series.* Some discrepancies of heights having been found to exist on this series, it was decided to commence a revision of all stations south of latitude 24° . Observations were carried out at 12 stations and the heights of 10 old ones revised.

In addition 3 of the stations which were found to have been destroyed were rebuilt.

(b).—*Secondary Triangulation.*

(v).—*The Mawkmai Series* running through the Southern Shan States was completed during the year; it closed on the Monghsat Secondary Series.

(vi).—*The Gáro Hills Series* emanates from the Brahmaputra Meridional Series and was intended to be a westward extension of the Khási Hills Series. Owing, however, to bad weather and sickness, the junction was not effected.

(vii).—*The Jaintia Hills Series* is a continuation of the Khási Hills Series eastward.

(viii).—*Secondary work in Kashmir.* In order to locate the peak Teram Kangri and to determine its height, a short length of triangulation has been run from Montgomery's Kashmir Series, northwards up the Nubra valley.

This triangulation places Teram Kangri 3 miles south-east of the position assigned to it by Dr. Longstaff. The height obtained from observations of vertical angles is approximately 24,500 feet, and is smaller than Dr. Longstaff's value by over 2,000 feet.

(c).—*Base Lines.*

(ix).—Two sites for the measurements of base lines were selected and prepared, one near Bhamo about 9 miles long, and another at Prome 13 miles long.

ABSTRACT OF TRIANGULATION.

	PRINCIPAL.			SECONDARY.		
	(i) Upper Irrawaddy.	(ii) Great Salween.	(iii) Kashmir principal.	(v) Mawkmai.	(vi) Gáro Hills.	(vii) Jaintia Hills.
No. of Stations observed at	8	5	4	15	11	24
.. .. newly fixed	4	4	4	11	9	23
.. .. provisionally fixed	4	3	2	..	..	..
.. .. built	5	6	2	1	12	..
Length of triangulation completed in miles.	80	74	64	58	60	78
Area of triangulation in sq. miles	1,760	2,200	680	500	703	473
Average triangular error	0".875	0".753	0".606	2".44	1".57	1".36
	for 10 triangles.	for 9 triangles.	for 8 triangles.	for 18 triangles.	for 6 triangles.	for 23 triangles.
No. of Astronomical azimuths observed.	1	1	0	..	..	..

TIDAL OPERATIONS.

40. *No. 16 Party.*—Observations were taken by means of self-registering tide-gauges during the year, at the stations enumerated 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	32	* Small tide-gauge. Property of Port Trust.
2 Karachi	1868	1880	13	
3 Bombay (Apollo Bandar)	1881	Still working	31	
4 Bombay (Prince's Dock)	1878	Still working	33	
5 Madras	1838	Still working	23	
6 Kidderpore	1890	1890	10	
7 Rangoon	Restarted 1895	Still working	16	
8 Port Blair	1881	Still working	30	
9 Moulmein	1880	1880	31	
	Restarted 1909	Still working	6	
			2	

41. In addition to the above, readings to tide-poles were taken at Bhávnagar, Chittagong, and Akyab.

42. The 9 tidal observatories at work were inspected during the year, and the registrations have been satisfactory.

43. In the following tables are given the annual and decadal percentages of the predicted time and height errors of high and low waters at open coast and riverain stations.

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.
1901	11	71	60	93	91	93	91
1902	9	76	67	94	95	96	96
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	84	98	97	99	99
1909	6	85	86	97	97	97	98
1910	6	81	83	98	98	95	96
Average of 10 years		81	78	96	96	96	96

Percentage of errors in Predicted Times and Heights at riverain 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.
1901	2	63	65	70	59	90	92
1902	2	63	54	76	53	96	90
1903	2	55	61	70	60	88	87
1904	2	45	61	72	65	94	95
1905	2	52	62	72	67	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
Average of 10 years		57	57	72	61	93	92

LEVELLING OPERATIONS.

44. *No. 17 Party.*—Three detachments were employed as in the preceding years.

(i). No. 1 was employed in the Bombay Presidency, between Bombay and Dhárwár; its outturn amounted to 376 miles, and it laid down and connected 114 benchmarks. The circuit Mormugao, Belgaum, Hubli, Kárwár, Mormugao was completed, closing with an error of 308 feet.

(ii). No. 2 detachment levelled from Gauhati to Dibrugarh and from Gauhati to Dumepep. The total length levelled was $362\frac{3}{4}$ miles, and the heights of 111 benchmarks were determined.

(iii). No. 3 levelling detachment was employed on levelling from Ambála to Solon in the Himalayas, from Dera Ismail Khán to Chunda on the Bannu Road, from Dargá Khán *viá* Rawalpindi to Murree, and from Nowshera to Risalpur cantonment. The outturn amounted to 408 miles, and 107 benchmarks were connected.

45. Bench-marks have now been fixed on the Lesser Himalayan Range on seven different lines: namely—

Tindharia,	Mussoorie,
Naini Tal,	Solon,
Lansdowne,	Dharamkot,
Murree,	

and the new line from Dera Ismail Khán to Chunda gives a valuable connection with the Trans-Indus mountains.

MAGNETIC SURVEY.

46. *No. 18 Party.*—Four detachments, each under a Provincial officer, were employed.

47. One detachment was employed in re-observing a number of selected old field stations, the sites of which were permanently marked for future occupation. A second detachment carried out a detailed survey of the Bengal coal field, in response to numerous requests for accurate values of magnetic declination. The third detachment had been allotted to the magnetic survey of the Andaman and Nicobar Islands, for which the census operations appeared to offer a favourable opportunity. The arrangements, however, fell through, and after observing at Port Blair and 3 new stations in the Andamans, the detachment was employed on detail survey in Bengal. The fourth detachment was employed on office duties during the cold season and proceeded to Kashmir in April 1911. 29 new stations were observed, the detachment returning to recess in July.

48. The officer in charge observed at 22 repeat stations and made comparative observations at the 4 survey base stations and at Alibag magnetic observatory. During the season full sets of magnetic observations were taken at 109 new stations, while 56 old field stations and 23 repeat stations were re-occupied.

49. *Work during recess.*—The computation of the previous season's field work and the reduction and tabulation of the base station results for 1910 have been completed. The computation of a new series of selected quiet days, for which traces are available at all the survey base stations, has also been completed.

The investigation of the instrumental differences from the standard in H. F. has been continued but is not yet completed.

50. The mean values of the magnetic elements at the various observatories for 1910 are as follows:—

Observatory.	Latitude.	Longitude.	Dip.	Declination.	H. F.	V. F.
	° ' "	° ' "	° ' "	° ' "	C. G. S.	C. G. S.
Dehra Dún	30 19 19	78 3 19	N 43 54·8	E 2 31·9	·33257	·32019
Barrackpore	22 46 29	88 21 39	N 30 42·2	E 0 55·5	·37329	·22168
Toungoo	18 55 45	96 27 3	N 23 2·1	E 0 24·9	·38801	·16498
Kodaikānal	10 13 50	77 27 46	N 3 45·2	W 0 55·0	·37485	·02459

PART III.

OFFICE WORK.

I.—HEADQUARTERS OFFICES.

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

51. The classes of maps for the publication of which the office is responsible may be enumerated as follows:—

(a)—The map of India on the scale of 1 inch=1 mile.

(b)—The map of India on the scale of $\frac{1}{4}$ inch=1 mile.

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

(d)—Small scale geographical maps.

(e)—Special maps.

52. The first duty of the office is to reproduce and print the 1-inch and $\frac{1}{4}$ -inch maps of India, prepared by the field parties and circle offices from the topographical surveys now in progress.

53. (a) *The map of India on the scale 1 inch = 1 mile.*—During the year 111 sheets of the new 1-inch map have been received from Circle Offices for publication, and 115 have been reproduced and printed.

54. Index maps Nos. 4, 5, and 6 at the end of this report show the progress of the publication of the 1-inch map, and the table below gives the annual outturn of its sheets since the modern survey was begun.

TABLE.*

Year.	STANDARD SHEETS PRINTED.			
	Northern Circle.	Southern Circle.	Eastern Circle.	Total.
1905-06	...	...	...	...
1906-07	4	1	...	5
1907-08	16	13	22	51
1908-09	35	39	68	142
1909-10	72	41	69	182
1910-11	51	39	25	115
Total printed	178	133	184	495
Total in programme	2,160	2,067	2,101	6,328
Number remaining for publication	1,982	1,934	1,917	5,833

55. In addition, 30 sheets based on revenue surveys or on topographical surveys executed before 1st October 1905 have been received from the Northern Circle and Bengal Drawing Office for publication and 26 have been published as preliminary editions in modern form during the year, *vide* index maps Nos. 7, 8, and 9.

56. To maintain the existing stock of 1-inch sheets, or to give effect to important alterations due to the development of communications, 114 sheets on the 1-inch scale have been reprinted with minor alterations.

57. (b) *The map of India on the scale of $\frac{1}{4}$ inch = 1 mile.*—Of the sheets of the new $\frac{1}{4}$ inch map of India in “degree sheet” form, only two were received for publication in 1910-11; both of these required certain references and alterations and could not be published before the close of the year, *vide* index map No. 10.

* The figures shown in the similar table on page 20 of the General Report for 1909-10 have been altered as certain sheets had been omitted from that report.

58. Each "degree sheet" includes the area covered by 16 one-inch sheets, and its preparation is necessarily delayed until the component 1-inch sheets are available. A considerable number of the sheets are however now in course of preparation in the circle offices, and material for the preparation of all degree sheets of which the component 1-inch sheets have been received, has been supplied to the circle drawing offices.

59. Pending the preparation of the new map, 16 sheets on the scale of $\frac{1}{4}$ inch = 1 mile have been prepared and published at headquarters from the maps of old surveys. Five of these were printed during the year.

60. (c) *Geographical maps on the one-millionth scale.*—Next to the duty of publishing the immediate results of the topographical surveys, the most important work of the offices consists in the preparation of the Map of India and Adjacent Countries on the scale of $\frac{1}{1,000,000}$ and of the general small-scale maps.

61. Index map No. 11 at the end of this report shows the progress made as regards the $\frac{1}{1,000,000}$ sheets; four new sheets have been published and reprints with minor alterations made of six sheets.

62. (d) *Small scale Geographical maps.*—A new "Railway, Road and Canal Map of India" on the scale of 32 miles = 1 inch has been prepared and published at the instance of the Railway Board. It was based upon the fourth edition of the Map of India and Adjacent Countries (32 miles = 1 inch).

63. The compilation and engraving of the new Map of India and Adjacent Countries on the scale of 32 miles = 1 inch has made fair progress. As mentioned in last year's general report, the decision to include Tibet and other north-eastern areas has necessarily postponed the completion of the map, but 11 out of the 12 sheets are now almost finished.

64. The new engraved index maps are in hand; of 42 which cover the Indian area two have been completed during the year, and twenty are being compiled and engraved, leaving eighteen still to be taken up.

65. (e)—*Special Maps.*—A large number of special maps have been prepared for the different departments of the Indian Government. Among these may be mentioned the new 64-mile Railway Administration Map which will be revised and published annually and a railway map for the Coronation Durbar, of which 150,000 copies were printed.

66. Towards the close of the year several maps for census purposes and a considerable number of maps and plans for the Coronation Durbar have been put in hand.

DRAWING AND ENGRAVING OFFICES.

67. These offices have made fair progress in the compilation, drawing, examination and engraving of the geographical maps and special maps.

68. The drawing office dealt with 97 one-inch and $\frac{1}{4}$ -inch modern sheets which required slight additions or corrections before publication, and prepared 150 old 1-inch and $\frac{1}{4}$ -inch sheets for reprinting.

69. Among the maps, the engraving of which has been completed during the year, are the plans of Calcutta on the scale of 6 inches = 1 mile, in four sheets.

70. The number of copper-plate impressions pulled has been 36,432, and the electrotype section has dealt with 247 plates.

PHOTO.-LITHO. OFFICE.

71. The experiments with three-colour photography as described in last year's report are still in progress. It is believed that the method may prove of use in the production of "layered" maps, which show heights above sea level by means of layers of different shades of colour.

72. During the year only 141 sheets in modern standard form were published; this is a decrease of 75 from 1909-10. The decrease was due to a falling off in the number of sheets received from circle offices for publication, which accounts for the diminished outturn of the office.

73. There has been a small increase in the number of extra-departmental maps, &c., received for publication, but the office could still deal with a considerably larger number.

The office sent an exhibit to the United Provinces Exhibition at Allahabad during the cold weather and was awarded the 'Grand Prix' for "Photo.-mechanical Printing Processes and Maps."

74. The following table shows the cost and outturn of the office for the past three years:—

1	2	3	4	5	6	7	8
Year.	Cost of office.	Value of outturn at cost rates.	Recovered in cash or by book debit.	Number of impressions pulled.	NUMBER OF MAPS PRINTED.		
					Departmental.	Extra departmental.	Total.
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>				
1908-09	158,643	172,234	42,531	1,506,607	2,047	726	2,773
1909-10	154,494	213,894	51,586	1,574,180	2,697	1,053	3,750
1910-11	164,193	177,900	50,693	1,383,147	2,559	1,104	3,663

MAP RECORD AND ISSUE OFFICE.

75. The gross face value of the maps received from the printing offices during the year amounted to Rs. 2,27,431. This sum includes Rs. 16,214-8-0 and Rs. 15,238-8-0, the values of maps printed in the Engraving Office and at Dehra Dún respectively.

76. 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 and New Editions.	Reprints.	
				<i>Rs.</i>
Geographical maps	Small	3	2	8,985
India and Adjacent Countries	1 1,000,000	6*	6	4,700
Degree sheets, &c.	1 inch = 4 miles	24	.....	10,200
Standard sheets (in modern form)	1 inch = 1 mile (1 inch = 16 miles)	141	.....	17,469
Provincial maps	1 inch = 32 miles	.....	1	1,850
District maps	1 inch = 4 miles	6	4	3,300
Atlas sheets	1 inch = 4 miles	.....	168	26,461
Standard sheets (old style)	1 inch = 1 mile	29	85	47,245
Administration Report maps	1 inch = 8 miles	.....	34	553
Plans of Cities and Cantonments	Various	15	5	15,755
Triangulation and traverse charts	Various	44	.....	1,120
Index maps	Various	12	4	1,690
Miscellaneous maps	Various	256	16	24,103
Totals for 1910-11 ... ..	.....	541	325	2,17,431
Corresponding totals for 1909-10 ... ..	.....	482	412	3,40,000

* Includes engraved editions of two sheets formerly published as helio'd editions.

77. The total number of printed maps issued during the year was 2,30,948 of an aggregate value of Rs. 1,27,167. The details of the sales were as follows:—

Sales to	Number of maps.	Value.
		<i>Rs.</i>
Government officials	151,790	46,628
India Office	2,468	3,509
Departmental issues	39,580	46,772
Private individuals	31,661	23,831
Agents	5,449	6,424
Totals for 1910-11	230,948	1,27,167
Corresponding totals for 1909-10	142,421	1,24,858

MATHEMATICAL INSTRUMENT OFFICE.

78. During the last year there was an increase in the demands made by Government departments on the store and workshop sections into which this office is divided. The result of the increased demand is that the store section shows a loss of Rs. 6,891 as compared with a loss of Rs. 20,176 last year and the workshop section shows a profit of Rs. 10,673 as compared with a loss last year of Rs. 15,270.

79. It must be borne in mind that this office is some what similar to a retail establishment with the difference that it issues stores to Government departments at their net value and in its yearly profit and loss account it takes as a credit 25 per cent. of the value of the stores issued, whereas a commercial firm would charge double this percentage in order to cover the costs of supervision, rent, interest on plant and stores, depreciation and clerical labour. The Mathematical Instrument Office therefore in its yearly profit and loss accounts shows a total loss or profit according to whether the demands made on it by Government departments have been small or great, as the percentage charged on the net value of the stores issued are not sufficient to cover the standing charges in bad years. A full statement of the accounts is given in the Volume "Records of the Survey of India, 1910-11."

80. A new price list revised and corrected up to April 1st, 1911 has been issued.

Apart from ordinary repairs and manufactures, the following special works were completed:—

- (1) A metal stand for a new 36" x 36" camera.
- (2) A transparency carrier for use with the above camera.
- (3) A new system of collimating and adjusting of telescopes and binoculars has been finally introduced during the year, and has proved satisfactory.
- (4) A second small motor has been attached to the scale dividing machine, to drive a small circular saw of fine gauge, as a substitute for the ordinary point dividing tool. This has proved very successful.
- (5) A light field litho. press was designed and constructed. It has been favorably reported on but has not yet been finally sanctioned.

II.—DEHRA DÚN OFFICES.

SPECIAL OPERATIONS.

81. During the year the building for the base line observatory and seismograph house was completed. The main part of the building now awaits the arrival of the new standards and comparators from England. In a smaller room an Omori horizontal pendulum seismograph has been installed; but considerable difficulty has been met with in the working of this instrument owing to its extreme sensitivity. It is hoped though that when a proper protective case, to keep off air currents and insects, has been fitted, it will prove satisfactory. The zero of the instrument so far has not remained steady.

82. The clockwork for rotating the drum did not work well, and a tide-gauge clock has now been fitted with satisfactory results. Records are now being taken daily and several small earthquakes have been recorded.

83. Photographs of the sun were taken on 328 days of the year, the sun being obscured by clouds on the remaining days.

84. Meteorological observations have been continued throughout the year.

COMPUTING SECTION.

85. The chief points of interest in the work of this section are as follows:—

Geodetic work.

86. The final deduction of heights of all bench-marks in India has been completed and the results incorporated in Volumes XIX. A and XIX. B. These volumes together with Volume XIX have been distributed. The preparation of pamphlets giving all bench-marks falling in 4°-squares of latitude and longitude has been taken up, and two of these pamphlets have been completed and distributed.

87. Mr. Shaw's Professional Paper on Refraction has been printed.

Geographical work.

88. Numerous computations in connection with Trans-Frontier Degree Triangulation Charts have been made, and Captain Robinson's triangulation computations have been completed.

89. A large amount of topographical triangulation has been adjusted.

90. Barometric heights and latitudes observed by several travellers and explorers have been worked out.

91. Papers on Rectangular Co-ordinates by Mr. Eccles, and on Barometers by Mr. Hunter have been printed, and tables computed for them. Experimental computations in connection with refraction and with the variation of magnetic elements with geographical position have been made.

Preservation of trigonometrical stations.

92. 924 Stations were repaired by the district officers at a cost of Rs. 5,724-1-11. Out of 340 districts from which reports are annually due, 11 failed to make returns.

DRAWING SECTION.

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

Class of map.	Number of sheets in hand.	Number of sheets drawn and sent to press.
Scientific diagrams and charts	<i>Nil</i>	2
Geographical maps, $\frac{1}{1,000,000}$ scale	5	2
Do. do. smaller scale	2	0
Miscellaneous indexes and plans	6	13
Triangulation Charts	42	71
Levelling Charts	8	2
Special maps for Doctor Stein	17	77
Total	80	167

PHOTO.-ZINCO. SECTION.

94. 1,844 maps and diagrams were photographed, against 1,750 in 1909-10. The number of impressions pulled was 294,118 against 302,909 in the previous year. The lithographic machine was employed throughout the year printing the maps of Doctor Stein's exploration, cantonment maps, forest maps, and triangulation and levelling charts.

FOREST MAP OFFICE.

95. The number of maps issued to Forest and other officials and to the public during the year was 17,312, which is an increase of 7,750 over last year. The amount realized by sales amounted to Rs. 1,724 against Rs. 1,555 in the previous year. Of this amount Rs. 1,060 was adjusted by book debit and Rs. 664 accrued from sales to private individuals and trading companies.

96. 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.
Standard maps of Forest Surveys	96	33	74
Special maps of India... ..	.....	.....	3
Provincial, Divisional, and District Forest maps	16	4	5
Working Plans and Miscellaneous maps ... ..	.....	3	5
Total	112	40	87

III.—CIRCLE AND LOCAL DRAWING OFFICES.

NORTHERN CIRCLE DRAWING OFFICE.

97. The normal main work of the office was the examination of standard sheets drawn by the various parties, the drawing and examination of sheets which the parties (either from insufficient establishment or owing to a short recess season) had been unable to undertake, the preparation of special editions of standard sheets, and the drawing of degree sheets. The office also undertook the drawing of certain sheets of the $\frac{1}{M}$ series, until the 1st of January when they were made over to the Simla Drawing Office; and the examination of standard sheets prepared in the United Provinces Drawing Office.

98. The following is a summary of the work in hand and sent to press:—

Class of map.	Scale.	Number of Sheets.	
		In hand	Sent to press.
Standard sheets	1 inch = 1 mile	30	71
Degree sheets	1 inch = 4 miles	10	2
Miscellaneous maps	300 feet = 1 inch	1	2
Cantonment maps	16, 64, 48 & 12 inch	3	8

UNITED PROVINCES DRAWING OFFICE.

99. This office, also under the Superintendent, Northern Circle, continued its work of compiling and drawing 2-inch standard maps, for reduction to 1-inch, from old cadastral surveys, and in preparing traverse charts. Sheets were drawn in both the old and new styles. In all 19 sheets were compiled and submitted for publication, and 26 traverse charts were completed. 7 standard sheets and 21 traverse charts remain to be completed.

SOUTHERN CIRCLE DRAWING OFFICE.

100. The final examination of 35 standard sheets was completed, and the fair drawing of 6 degree sheets was commenced. Considerable assistance was given to the parties, with a view to enabling them to complete their current mapping.

101. The Photo.-zinco. section undertook all the photographic and Vandyke work required by the parties.

EASTERN CIRCLE DRAWING OFFICE.

102. This office was formed at the commencement of the season under report, having hitherto formed part of what is now the Southern Circle Drawing Office. It was transferred from Bangalore to Shillong in September 1910.

103. The following table shows the work performed during the year. Owing to the large number of 1-inch standard sheets submitted in an unfinished state by the field parties, and to the want of sufficient trained establishment, the mapping of degree sheets has been in abeyance.

Standard sheets, &c., received from field parties, surveyed in season 1909-10.

	No. of Party.	Complete.	Incomplete.	Total.	Drawn in D. O.	Forwarded to Calcutta for Publication.	REMARKS.
Standard sheets.	10	9	8	17	.....	12	
	11	5	8	13	3	9	
	12	2	9	11	.....	8	
	Totals ...	16	25	41	3	29	

BENGAL DRAWING OFFICE.

(Standard Mapping Section).

104. The standard mapping section of this office continued its work of compilation of standard sheets from modern cadastral surveys for publication as preliminary editions.

105. 79 standard sheets were dealt with, and 25 have been sent for publication. Of these 16 were compiled specially for supplementary survey by No. 9 Party during the coming field season.

106. A certain amount of work was done for the Map Publication Office, namely:—

- (a) Fiscal limits and cultivation were colored on 19 black prints;
- (b) 9 uncorrected proofs were examined and corrected;
- (c) 15 published proofs of standard sheets not printed in colours were coloured as office copies.

PART IV.

WORK FOR OTHER GOVERNMENT DEPARTMENTS.

107. As usual during the year much special work was done for other departments. Instances already mentioned in this report are:—Forest Surveys (page 13), Riverain work in the Punjab (page 8), Cantonment Surveys (pages 7, 8, 9, 27).

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

108. Surveyors from several parties were attached to missions on the North-western and Eastern frontiers, and executed reconnaissance surveys for the Foreign and Army Departments.

109. In Travancore State the Periyár catchment area was surveyed for irrigation purposes on the 2-inch scale.

110. The reproduction for other departments of maps, plans and illustrations that do not require redrawing, 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 maps.

111. During the year special drawing and compilation has been done for the following:—

The Government of India, chiefly for the Foreign Department.

Local Governments.

The Chief of the General Staff.

The Coronation Durbar Committee.

The Railway Board.

The Census Commissioners and Local Census Superintendents.

The Post Master General.

The Director of Meteorological Observatories.

Maps, plans, or illustrations were reproduced for the following in addition:—

The Forest Department.

The Department of Agriculture.

The Government Architect.

The Sanitary Commissioner with the Government of India.

The Geological Survey.

The Telegraph Department.

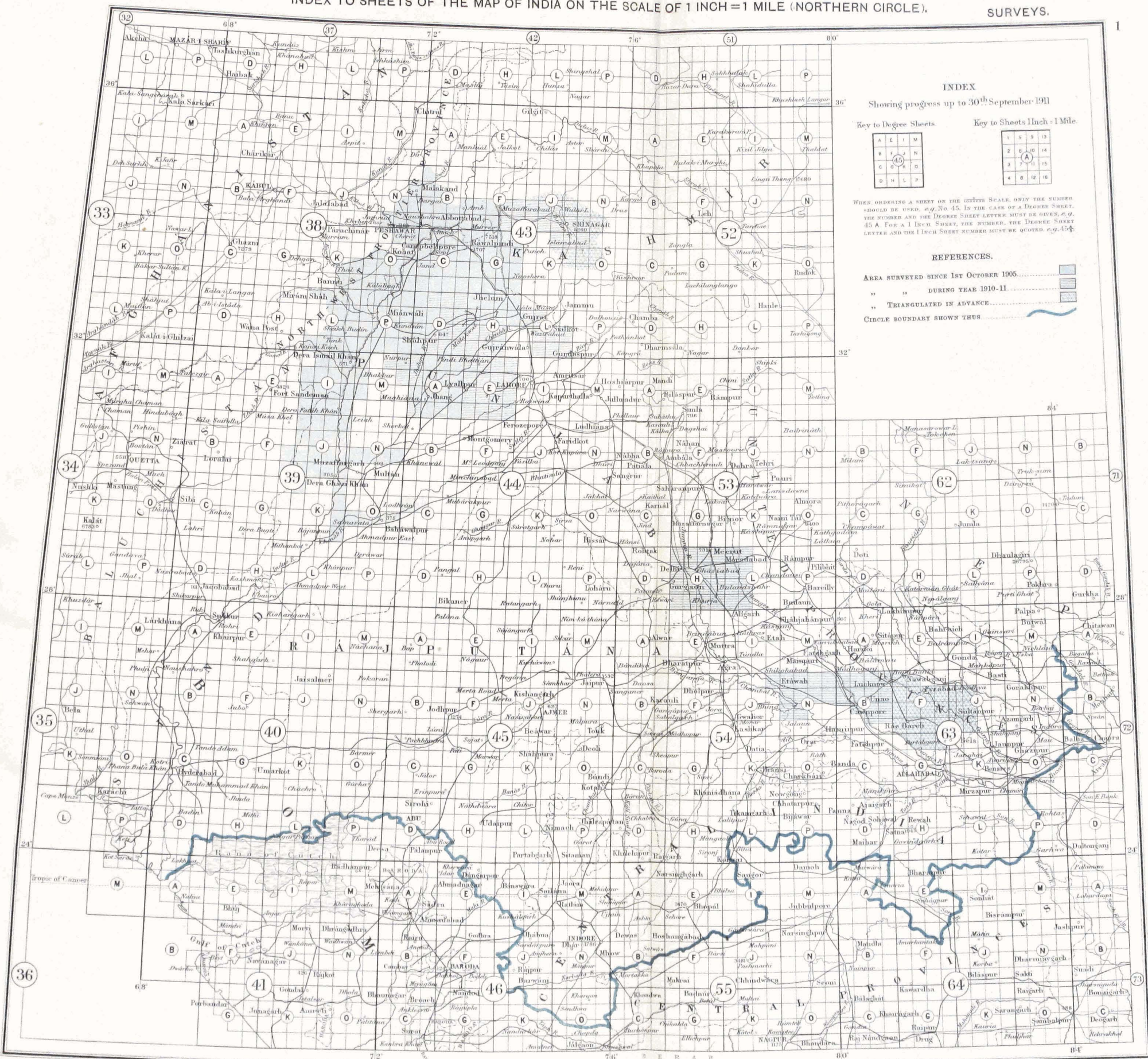
The Military Works Services.

The Indian Museum.

112. Some work was also done for societies such as the Astronomical Society of India, the Asiatic Society of Bengal and the Photographic Society of Bengal.

113. The preparation of the maps on the scale of 4 miles = 1 inch of Dr. Stein's explorations in Chinese Turkestan and Western China, 1906—08, is in hand at Dehra Dún.

114. A section of the Simla Drawing Office is employed solely on miscellaneous work for the Chief of the Staff, and has turned out a large number of maps and sketches.



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Showing progress up to 30th September 1911

Key to Degree Sheets.

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

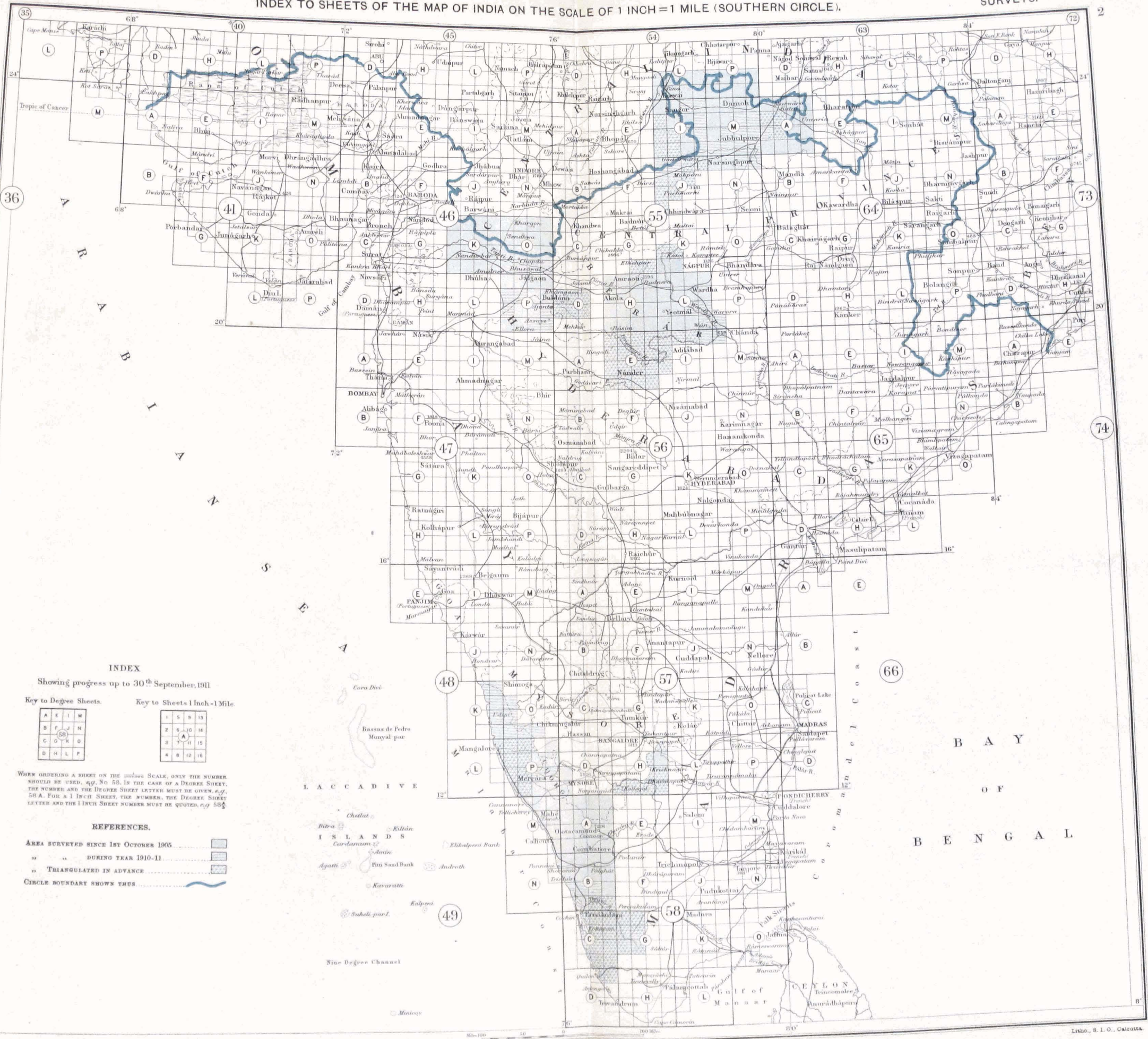
Key to Sheets 1 Inch = 1 Mile

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

When ordering a sheet on the degree scale, only the number should be given, e.g. 30 45. In the case of a degree sheet, the number and the degree sheet letter must be given, e.g. 45 A. For a 1 inch sheet, the number, the degree sheet letter and the 1 inch sheet number must be given, e.g. 45 45 A.

REFERENCES.

- AREA SURVEYED SINCE 1ST OCTOBER 1905.....
- " " DURING YEAR 1910-11.....
- " TRIANGULATED IN ADVANCE.....
- CIRCLE BOUNDARY SHOWN THUS.....



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Showing progress up to 30th September, 1911

Key to Degree Sheets.

A	E	I	M
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D	H	L	P

Key to Sheets 1 Inch-1 Mile

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

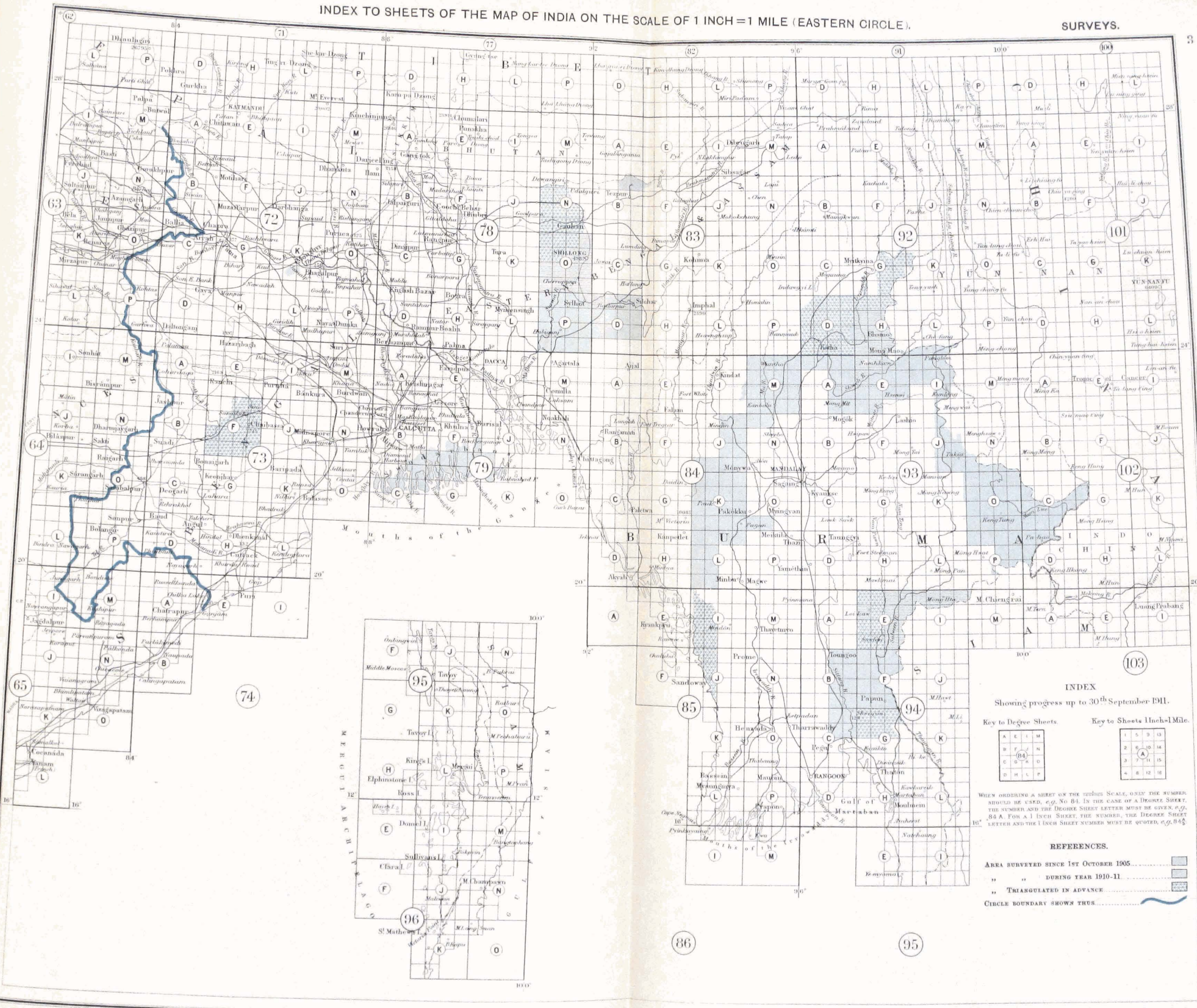
When ordering a sheet on the Indian Scale, only the number should be used, e.g. No 58. In the case of a Degree Sheet, the number and the Degree Sheet letter must be given, e.g. 58A. For a 1 Inch Sheet, the number, the Degree Sheet letter and the 1 Inch Sheet number must be quoted, e.g. 58A.

REFERENCES.

- AREA SURVEYED SINCE 1ST OCTOBER 1905
- " " DURING YEAR 1910-11
- " TRIANGULATED IN ADVANCE
- CIRCLE BOUNDARY SHOWN THUS

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

SURVEYS.



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Showing progress up to 30th September 1911.

Key to Degree Sheets. Key to Sheets 1 Inch=1 Mile.

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

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

WHEN ORDERING A SHEET OF THE TITHE SCALE, ONLY THE NUMBER SHOWN BY THE CIRCLE, e.g. No 84. IN THE CASE OF A DEGREE SHEET, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN, e.g. 84 A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED, e.g. 84 E.

REFERENCES.

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

" " DURING YEAR 1910-11. [Dotted Box]

" TRIANGULATED IN ADVANCE. [Hatched Box]

CIRCLE BOUNDARY SHOWS THUS. [Blue Circle]

INDEX TO MAPS OF THE NORTHERN CIRCLE.

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Showing progress up to 30th September 1911

Key to Degree Sheets.

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

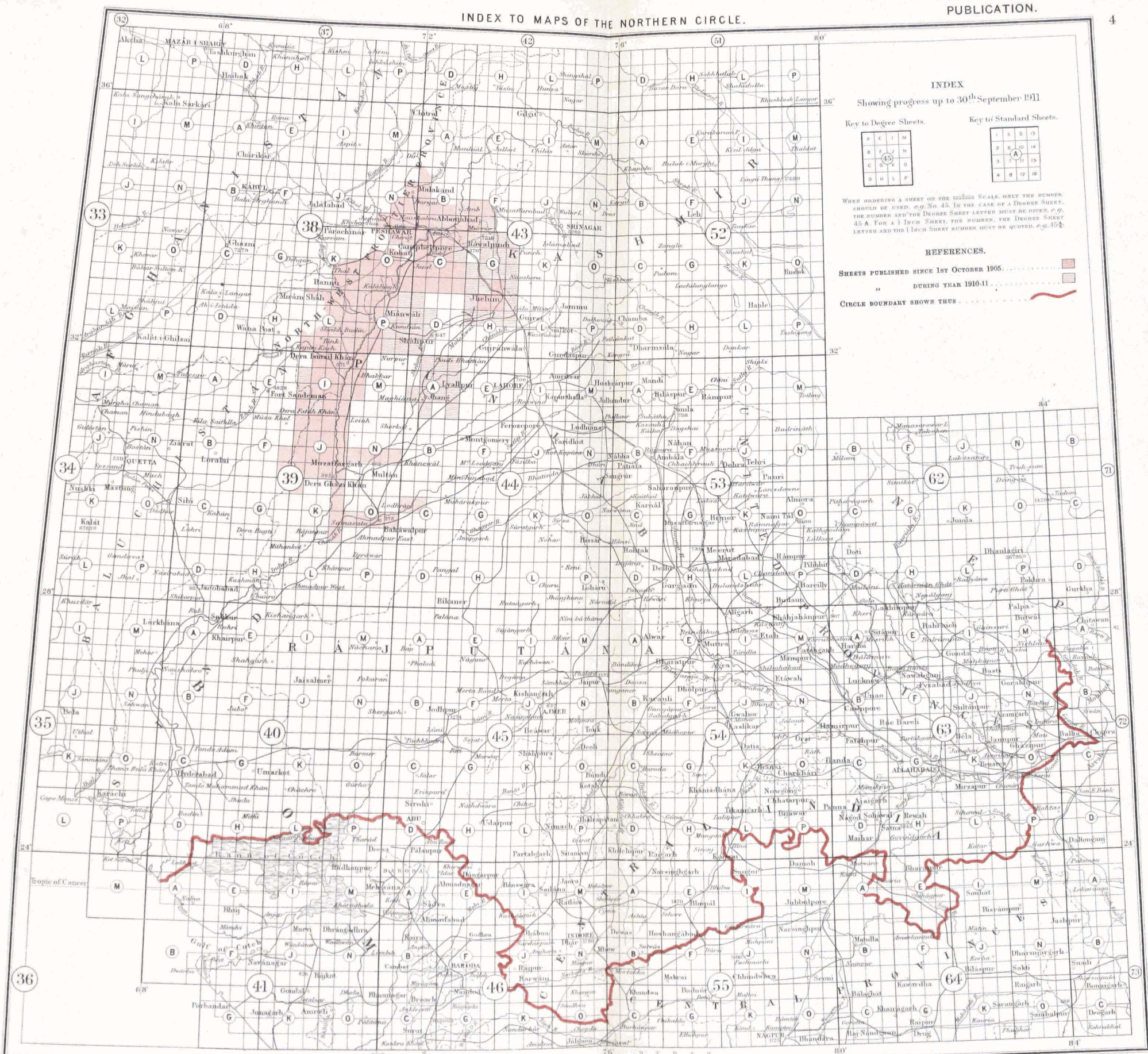
Key to Standard Sheets.

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

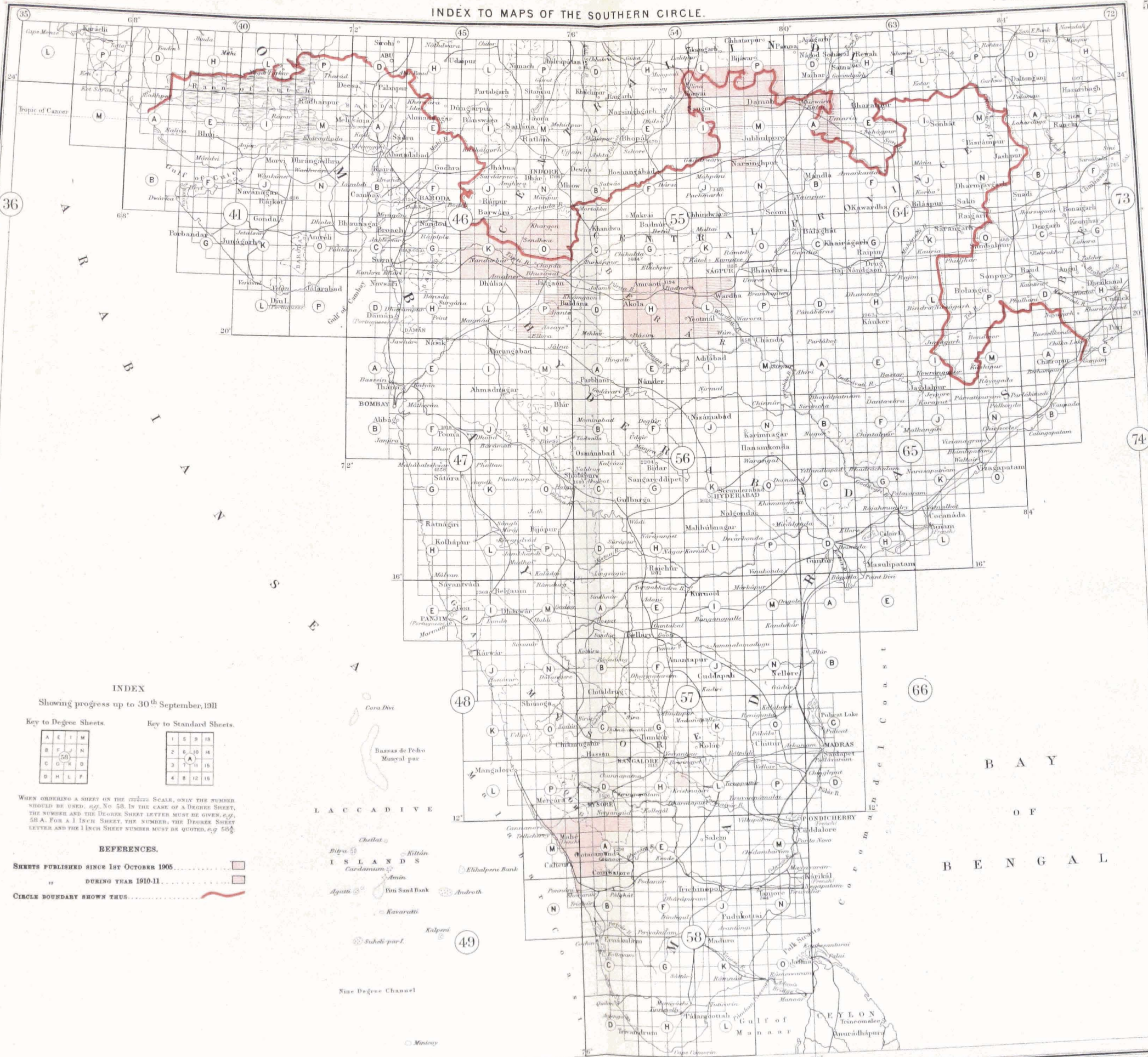
When ordering a sheet of the **WAGNER SCALE**, ONLY THE NUMBER SHOULD BE USED, e.g. No. 45. In the case of a **DEGREE SHEET**, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN, e.g. 45 A. For a 1 Inch Sheet, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 Inch SHEET NUMBER MUST BE QUOTED, e.g. 45 E.

REFERENCES.

- SHEETS PUBLISHED SINCE 1ST OCTOBER 1905. ■
- " DURING YEAR 1910-11. ■
- CIRCLE BOUNDARY SHOWS THUS —



INDEX TO MAPS OF THE SOUTHERN CIRCLE.



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Showing progress up to 30th September, 1911

Key to Degree Sheets.

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B	F	J	N
C	G	K	O
D	H	L	P

Key to Standard Sheets.

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

WHEN ORDERING A SHEET ON THE DEGREE SCALE, ONLY THE NUMBER SHOULD BE USED; e.g. No. 5B. IN THE CASE OF A DEGREE SHEET, THE NUMBER AND THE DEGREE SHEET LETTER MUST BE GIVEN; e.g. 5B A. FOR A 1 INCH SHEET, THE NUMBER, THE DEGREE SHEET LETTER AND THE 1 INCH SHEET NUMBER MUST BE QUOTED; e.g. 5B A.

REFERENCES.

- SHEETS PUBLISHED SINCE 1st OCTOBER 1905.
- " " DURING YEAR 1910-11.
- CIRCLE BOUNDARY SHOWN THUS.

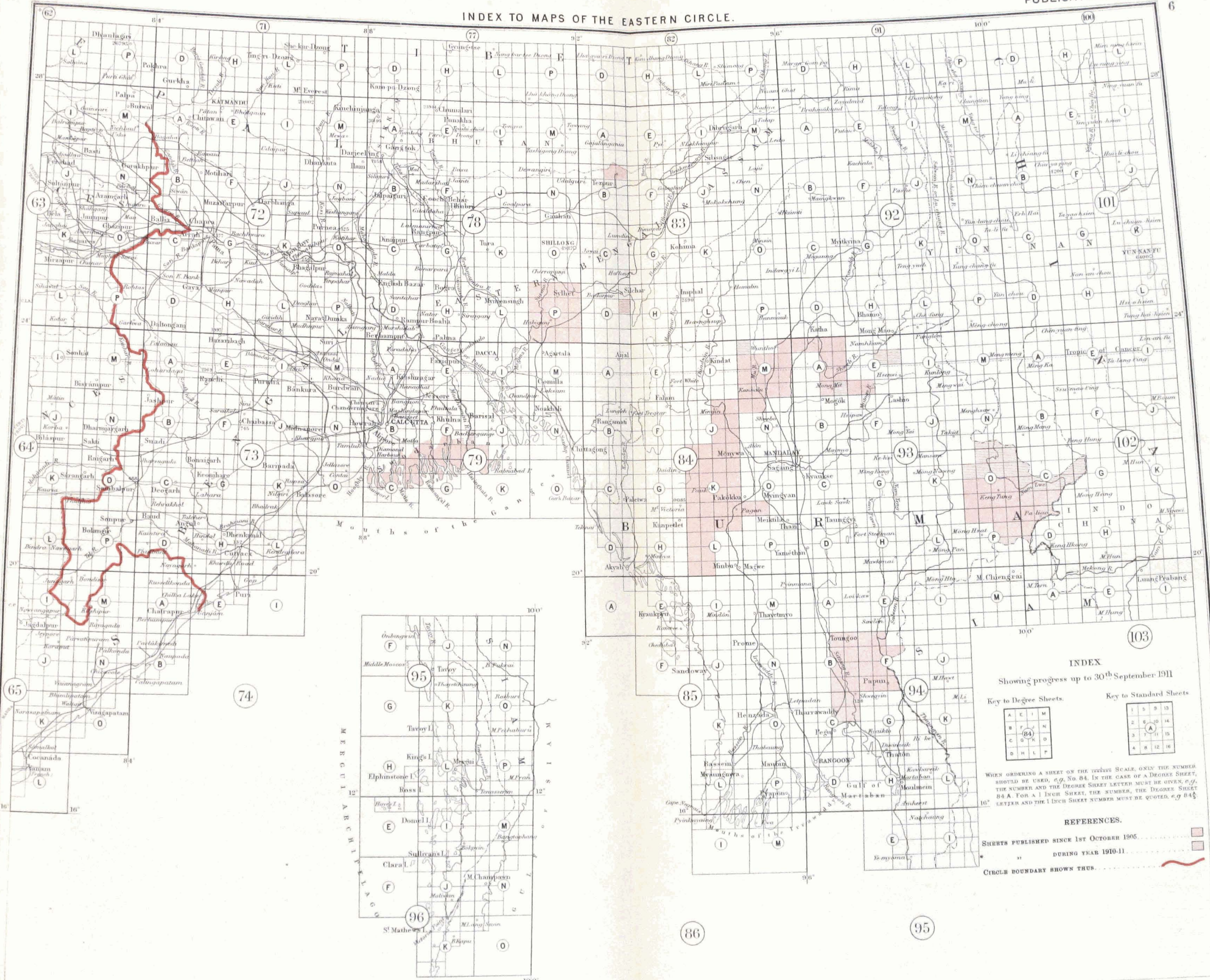
LACCA DIVE

- Chelatt
- Bilva
- Kittan
- Cardamum
- Amin
- Agatti
- Pin Sand Bank
- Androth
- Kavaratti
- Kolpni
- Subah par-I
- Sine Degree Channel
- Mintoy

66

B A Y
O F
B E N G A L

INDEX TO MAPS OF THE EASTERN CIRCLE.



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Showing progress up to 30th September 1911

Key to Degree Sheets.

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D	H	L	P

Key to Standard Sheets

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

WHEN ORDERING A SHEET OF THE DEGREE 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 F.

REFERENCES.

SHEETS PUBLISHED SINCE 1ST OCTOBER 1905.

DURING YEAR 1910-11.

CIRCLE BOUNDARY SHOWS THIS.

INDEX TO MAPS OF THE NORTHERN CIRCLE.

(Provisional issues of one-inch sheets).

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Key to Degree Sheets

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

Key to Standard Sheets

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

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

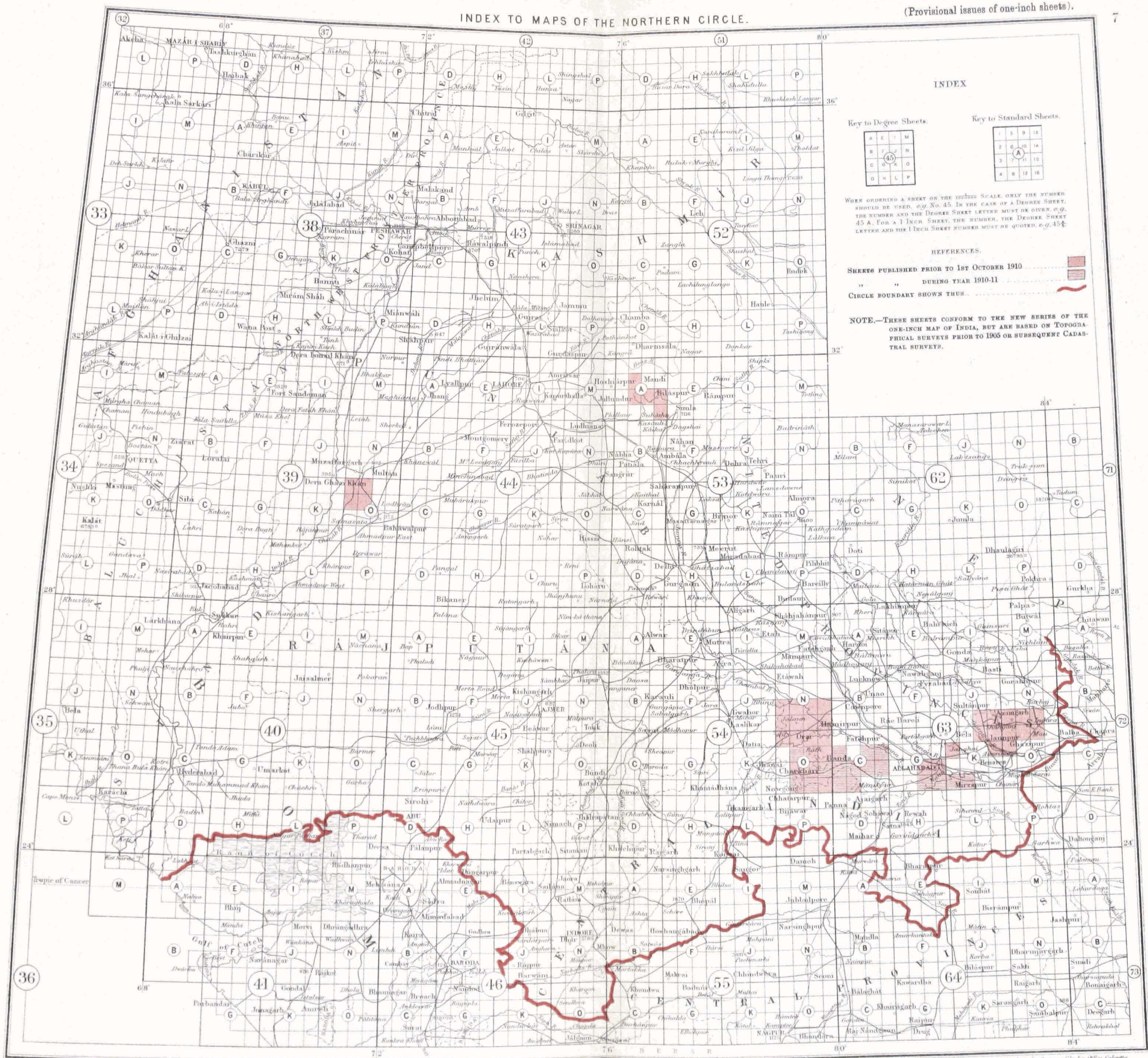
REFERENCES.

SHEETS PUBLISHED PRIOR TO 1ST OCTOBER 1910

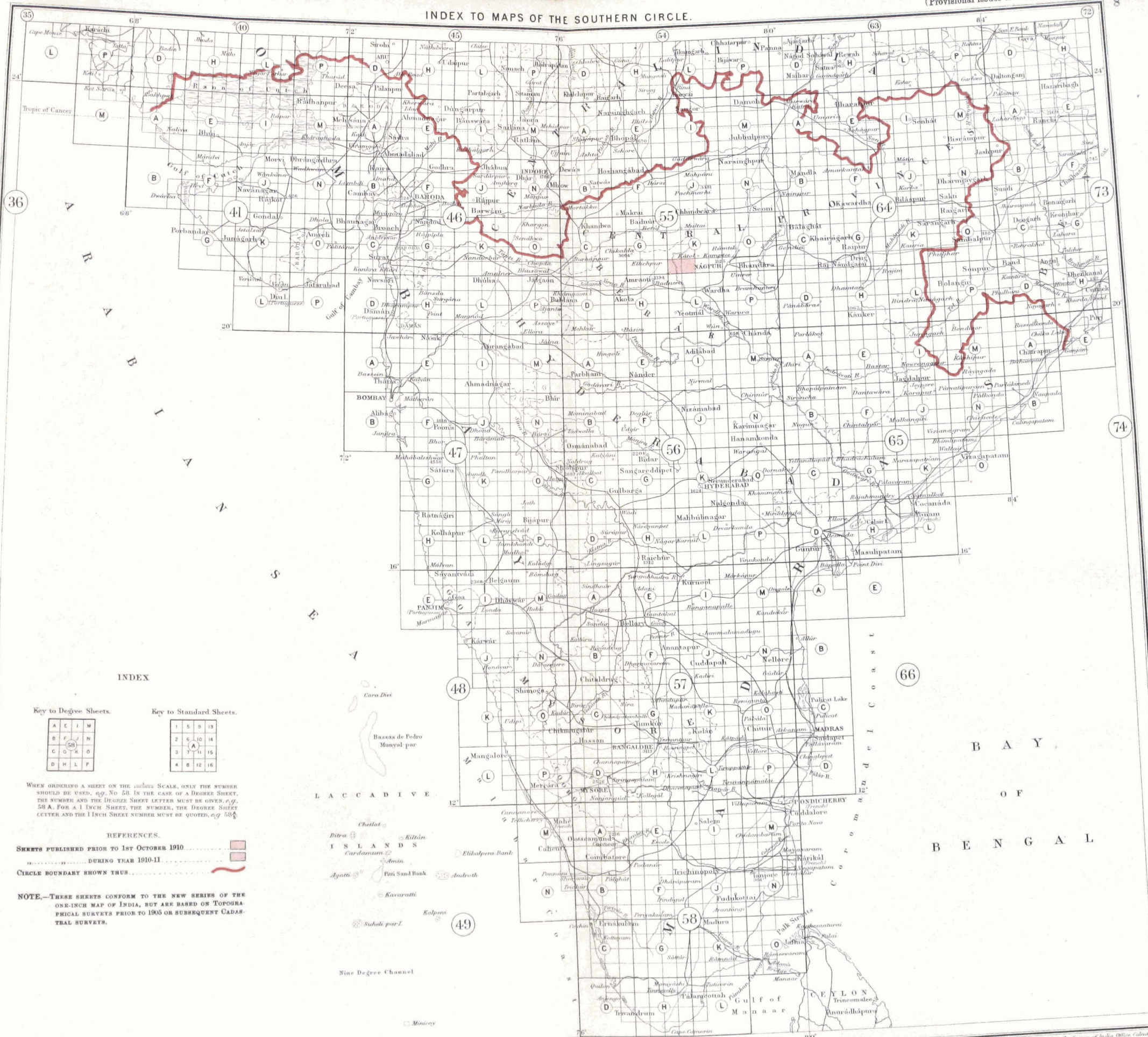
" " DURING YEAR 1910-11

CIRCLE BOUNDARY SHOWN THUS

NOTE.—THESE SHEETS CONFORM TO THE NEW SERIES OF THE ONE-INCH MAP OF INDIA, BUT ARE BASED ON TOPOGRAPHICAL SURVEYS PRIOR TO 1905 OR SUBSEQUENT CADASTRAL SURVEYS.



INDEX TO MAPS OF THE SOUTHERN CIRCLE.



INDEX

Key to Degree Sheets.

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Key to Standard Sheets.

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

WHEN ORDERING A SHEET ON THE *INDEX* SCALE, ONLY THE NUMBER SHOULD BE USED, 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 A.

REFERENCES.

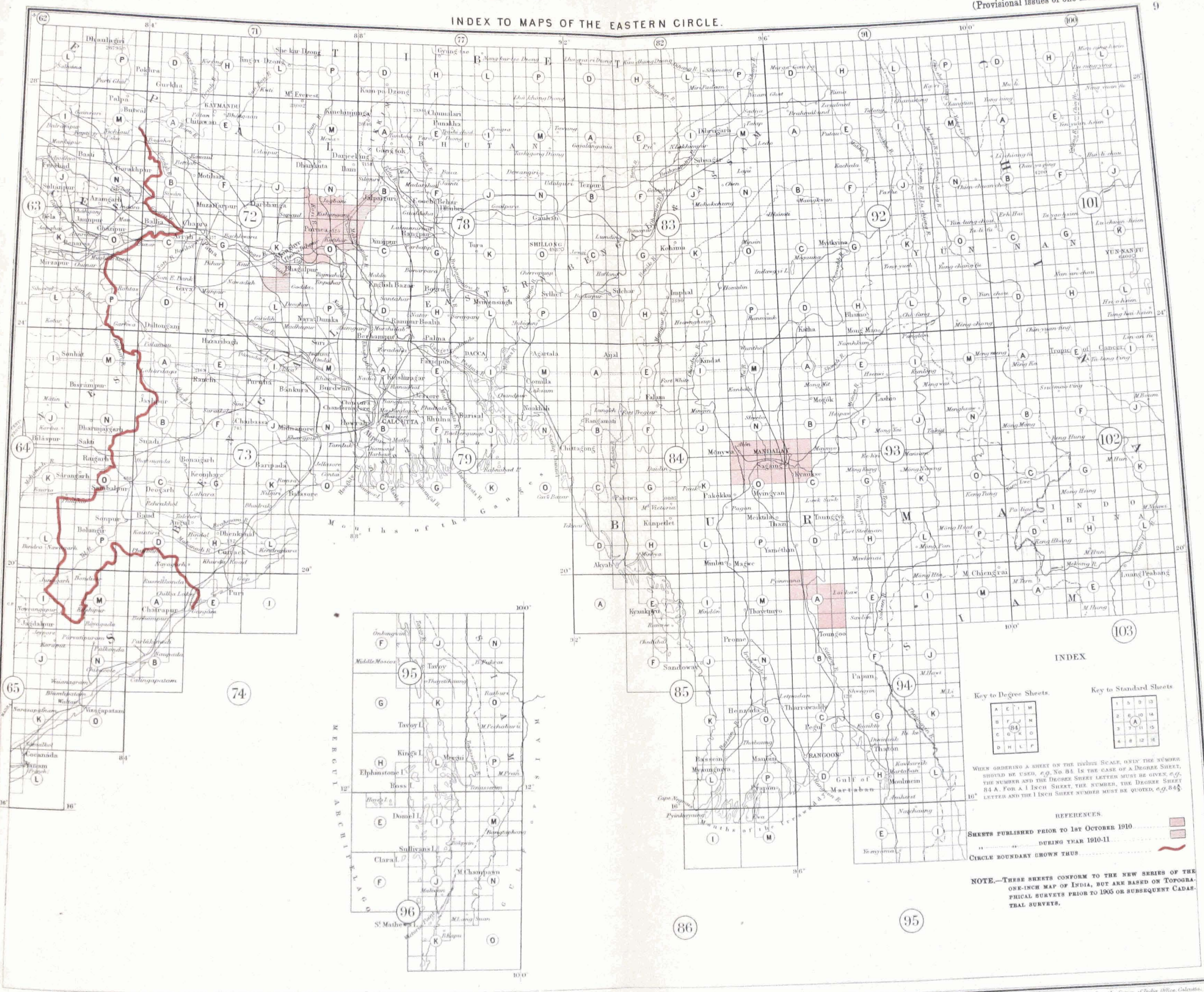
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Key to Degree Sheets.

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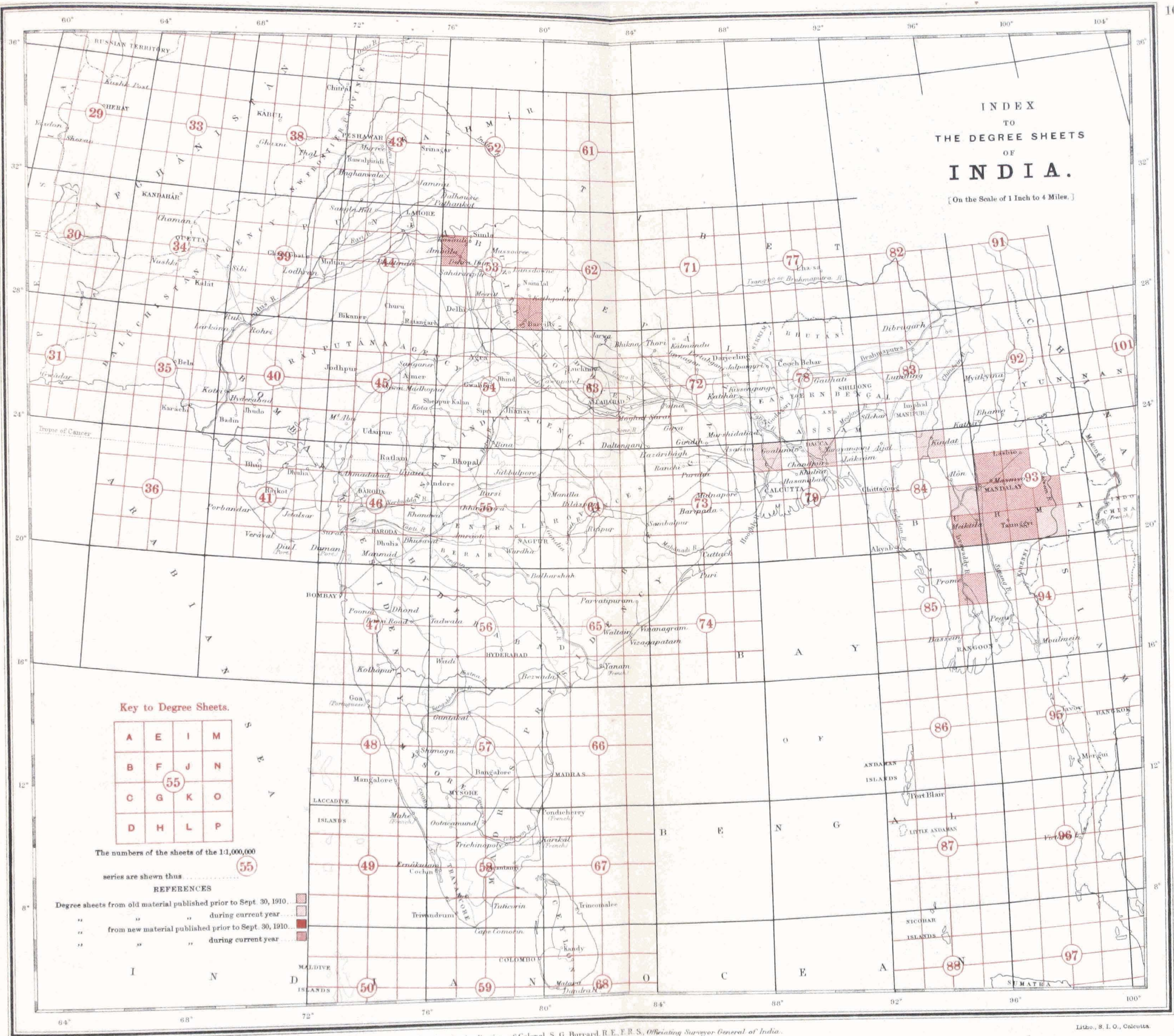
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INDEX
TO
THE DEGREE SHEETS
OF
INDIA.
[On the Scale of 1 Inch to 4 Miles.]



Key to Degree Sheets.

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

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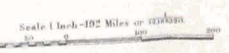
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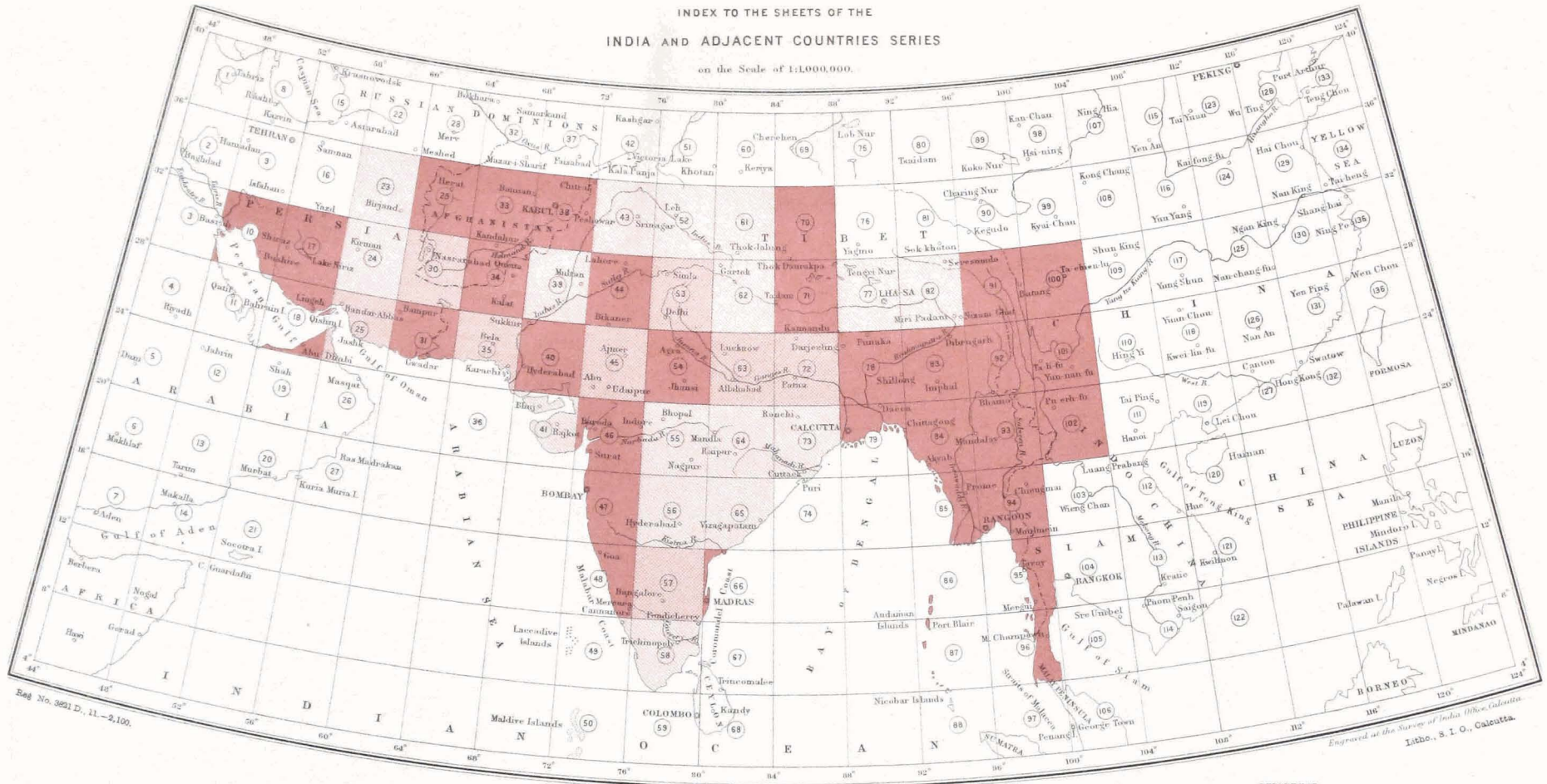
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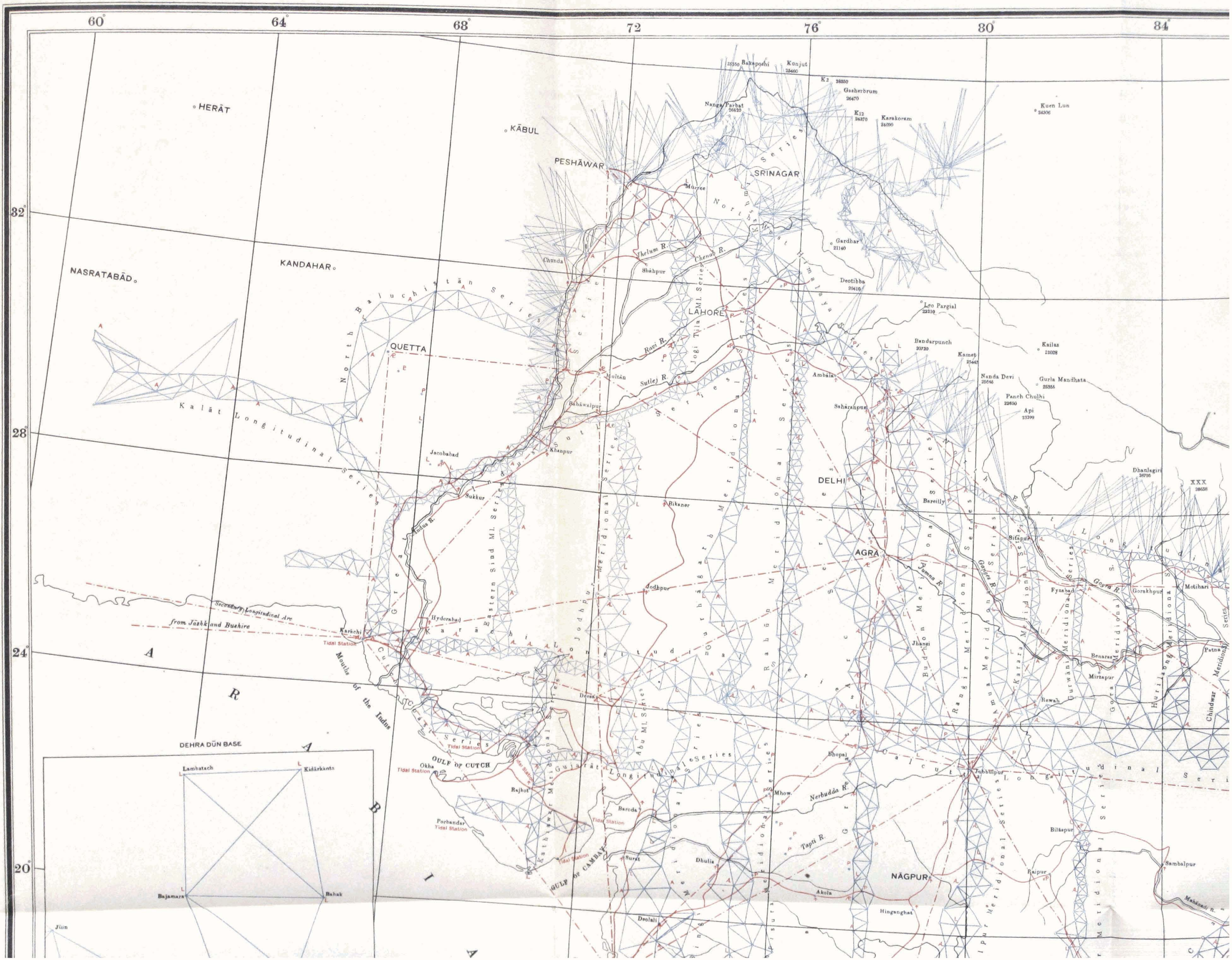
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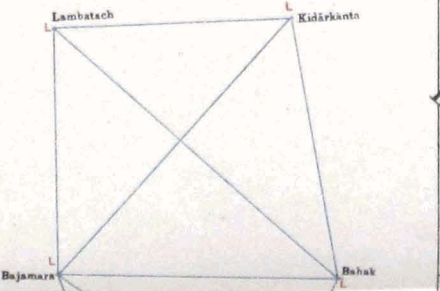
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GENERAL REPORT

ON THE

OPERATIONS

OF THE

Survey of India,

DURING THE SURVEY YEAR

1910-11.



PREPARED UNDER THE DIRECTION OF

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