SURVEY OF INDIA

GENERAL REPORT

1937

From 1st October 1936
To 30th September 1937

PUBLISHED BY ORDER OF

BRIGADIER C. G. LEWIS, O.B.E.,

SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office,
Survey of India,
CALCUTTA,
1937.

Price One Rupee Eight Annas or Two Shillings and Six Pence.

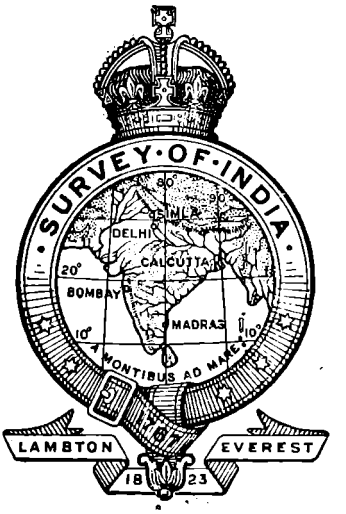
BRIGADIER SIR HAROLD JOHN COUCHMAN, D.S.O., M.C.

SURVEYOR GENERAL OF INDIA, 1933-37.

SURVEY OF INDIA

GENERAL REPORT

1937



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NOTICES

I. Work done by the Survey of India.

II. How to obtain maps and other publications.

III. List of Agents for the sale of maps.

I. WORK DONE BY THE SURVEY OF INDIA

APPLICATION FOR SURVEYS OF ANY KIND, whether for private or Government purposes, should be made to the following officers:

The Director,	Frontier Circle,	*Survey of India,	Simla.	(*Tel.* "*Surfrontier*").
,,	,,	Geodetic Branch,*	,,	,,	Dehra Dūn. (*Tel.* "*Surtrig*").
,,	,,	Eastern Circle,*	,,	,,	Shillong. (*Tel.* "*Sureast*").
,,	O. C.	No. 6 (South India) Party,*	,,	,,	Bangalore. (*Tel.* "*Surfield Six*").
,,	,,	No. 10 (Burma) Party,*	,,	,,	Maymyo. (*Tel.* "*Surfield Ten*").

FOREST AND CANTONMENT SURVEYS, LEVELLING, TRIANGULATION AND TIDE-TABLES. Advice in regard to these, and on scientific questions, is obtainable from the *Director, Geodetic Branch, Survey of India, Dehra Dūn*, who undertakes levelling and similar work for municipalities and engineering projects, on payment. (*Telegrams* "*Surtrig*").

MAPS AND ILLUSTRATIONS can be printed by the *Director, Map Publication, Survey of India, 13 Wood Street, Calcutta*, for Government Departments and the public, and special maps can also sometimes be prepared, on payment. (*Telegrams* "*Surpub*").

THE MATHEMATICAL INSTRUMENT OFFICE, Survey of India, 15, Wood Street, Calcutta, is a well equipped Government Factory which supplies, manufactures, and repairs all kinds of Surveying, Drawing, Optical, Meteorological, and Medical instruments. It also manufactures special instruments for experimental purposes and receives back surplus instruments on valuation, from all Government Departments, whether Central or Provincial.

The Price List, Rules and Regulations and Forms for Indents, Repairs and Deposits are supplied gratis on application. (*Telegrams* "*Surinst*").

GENERAL ENQUIRIES should be addressed to the Assistant Surveyor General, 13, Wood Street, Calcutta. (*Telegrams* "*Surveys*"), as the Surveyor General of India is on tour during most of the year.

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* *Provinces and States in each Survey Circle.*

1. *FRONTIER Circle*
   Kashmīr and Jammu
   N. W. F. Province
   Baluchistān
   Punjab
   Punjab States
   Bikaner State
   Sind.

2. *GEODETIC Branch*
   United Provinces
   Central India
   Gwalior
   Ajmer-Merwāra
   Delhi
   Rājputāna (excluding Bikaner).
   Baroda
   Bombay (Northern Division).
   States of Western India.
   Andaman and Nicobar Islands.
   Gujarāt States.

3. *No. 6 (South India) Party.*
   Madras
   Madras States
   Hyderābād
   Mysore and Coorg
   Bombay (Southern Division).

4. *EASTERN Circle*
   Central Provinces (including Berār).
   Bengal
   Bihār
   Assam and Sikkim
   Eastern States
   Orissa.

5. *No. 10 (Burma) Party.*
   Burma.

II. HOW TO OBTAIN MAPS AND OTHER PUBLICATIONS

SURVEY OF INDIA MAPS are obtainable from the Map Office, 13, Wood Street, Calcutta (*Tel.* "*Surmaps*"). Also from the Agents listed in Notice III and from the Directors of Survey Circles. A MAP CATALOGUE, which itself forms a useful atlas of India and surrounding countries, can be obtained for *Re. 1/-* (*post free*).

FOREST AND CANTONMENT MAPS are obtainable from the Map Office, Survey of India, Dehra Dūn. (*Tel.* "*Surtrig*").

GEOLOGICAL MAPS are prepared by and can be obtained from the Director, Geological Survey, Calcutta.

SURVEY PUBLICATIONS OTHER THAN MAPS, as outlined below, are obtainable through the Director, Geodetic Branch, Survey of India, Dehra Dūn, who will supply a full Catalogue *gratis* on application. The Catalogue is also included in the Annual Geodetic Report.

(*a*) *Trigonometrical data.* Triangulation pamphlets, each covering one degree square, giving descriptions, positions, and heights of triangulated points and other data, with chart. Levelling pamphlets, each covering $4^{\circ} \times 4^{\circ}$, giving descriptions and heights of Bench-marks, with chart.

(*b*) *Tidal Predictions*, published annually in advance as *Tide-Tables of the Indian Ocean.* These tables contain predictions for 41 Indian and Burmese ports, and for 28 other ports in various parts of the world.

(*c*) *Geodetic works of Reference*—The G.T.S. series of twenty-one large quarto volumes describing in detail the geodetic operations of the Great Trigonometrical Survey from 1800. Detailed accounts are given of the Base-line measurements, of the reduction of the Geodetic Triangulation treated in five portions, of the early Pendulum observations, of Telegraphic Longitude and Astronomical Latitude operations, of Tidal observations, and of Levelling of high precision.

(*d*) *Historical, and General Reports*, including the "Memoirs on Indian Surveys" by Sir Clements Markham and C.E.D. Black: also Annual Reports, Narrative Reports, Record Volumes, and the annual Geodetic Reports.

(*e*) *Miscellaneous.* Papers on Geodesy, Exploration, etc. including a "Sketch of the Geography and Geology of the Himālaya Mountains and Tibet" (in 4 parts) revised in 1933.

III. LIST OF AGENTS FOR THE SALE OF MAPS

OUT OF INDIA.

England.	1.	Secretary to the High Commissioner for India, (Genl. Deptt.), India House, Aldwych, London, W. C. 2.
	2.	Sifton Praed & Co. Ltd., The Map House, 67 St. James's Street, London, S. W. 1.
America.	3.	C. S. Hammond & Co., 30 Church St., Hudson Terminal, New York, and 75 State St., Boston, Mass.
Germany.	4.	Dietrich Reimer, Berlin, S. W. 48.
China.	5.	French Book Stores, Grand Hotel de Pekin, Peiping.

INDIA.

Āgra.	1.	English Book Depot, Tāj Road.
	2.	Indian Army Book Depot, Dayāl Bāgh.
Ajmer.	3.	Rājputāna Book House.
Allahābād.	4.	North India Christian Tract and Book Society.
Ambāla.	5.	Ram Chander & Sons.
	6.	English Book Depot, Ambāla Cantonment.
Bangalore.	7.	Raja Gopal Photo. Zinco. and Printing Works, Fort Bangalore.
Bareilly.	8.	London Book Depot.
Baroda.	9.	B. Parikh & Co., Māndvi Road.
Bombay.	10.	Thacker & Co.
	11.	D. B. Taraporevala Sons & Co.
	12.	King & Co., 213-215 Badri Mahal, Hornby Road.
Calcutta.	13.	W. Newman & Co., 3 Old Court House Street.
	14.	Automobile Association of Bengal, 40 Chowringhee.
	15.	City Map Agency, Govt. Book Depot, 8 Hastings St.
	16.	Oxford Book & Stationery Co., 17 Park St.
	17.	Thacker Spink & Co., 3 Esplanade East.
	18.	Kali Charan & Co., B. 40-41 Municipal Market.
	19.	Royal Book Store, B. 48 Municipal Market.
Cawnpore.	20.	Advani Brothers.
Darjeeling.	21.	Oxford Book & Stationery Co.
Delhi.	22.	Oxford Book & Stationery Co., Kashmīr Gate.
	23.	Oxford Book & Stationery Co., Connaught Place, New Delhi.
	24.	Ramesh Book Depot and Stationery Mart.
	25.	J. M. Jaina & Brothers, Mori Gate.
	26.	Bhawnani & Sons, Connaught Place, New Delhi.
Dum Dum.	27.	Indian Air Survey & Transport Ltd.
Ferozepore.	28.	English Book Depot, Wazir Ali Buildings.
Indore.	29.	The Manager, Dak Bungalow.
	30.	The Proprietor, Central India High Class Athletic Depot.
Jhānsi.	31.	English Book Depot.
Jubbulpore.	32.	Crown Book Depot, East St.
Karāchi.	33.	Aero Stores, Napier Road.
Kasauli.	34.	Ram Chander & Sons.
Kashmir.	35.	Cockburns Agency, Srīnagar.
	36.	D. G. Smith & Co., Srīnagar.
Lahore.	37.	Punjab Religious Book Society, Anārkali.
	38.	Standard Book Depot.
	39.	Oxford Book & Stationery Co.

(Continued Overleaf)

III. LIST OF AGENTS FOR THE SALE OF MAPS—(*Concld.*)

INDIA.—(*Concld.*)

Lucknow.	40.	Lucknow Publishing House, The Mall.
Madras.	41.	Higginbothams Ltd.
Meerut.	42.	Oxford Book & Stationery Co.
Mhow.	43.	British Book Depot, Main Street.
Murree.	44.	J. Ray & Sons, The Mall.
Mussoorie.	45.	The Mussoorie Book Society.
Muzaffarpur.	46.	Burman & Co.
Nāgpur.	47.	The Superintendent, Govt. Printing, Book Depot.
Ootacamund.	48.	Higginbothams Ltd.
Patna City.	49.	K. P. Saxena & Co., Diwan Mohlla.
Peshāwar.	50.	Faqir Chand Marwah, Peshāwar Cantonment.
	51.	J. Ray & Sons, Arbab Road.
	52.	Sham Lal & Sons.
	53.	London Book Co. (India).
Poona.	54.	International Book Service, Deccan Gymkhana Colony.
Quetta.	55.	Standard Book Stall, Circular Road.
Rangoon.	56.	The Curator, Government Book Depot, Burma.
Rāwalpindi.	57.	J. Ray & Sons, 43 K & L, Edwardes Road.
Simla.	58.	Oxford Book & Stationery Co.

PREFACE

THE HISTORY AND WORK OF THE SURVEY OF INDIA.

The first authoritative map of India was published by D'Anville in 1752, when the exploration of the then unknown India was still largely in French hands. It had been compiled from routes of solitary travellers and rough charts of the coast.

The Survey of India may be said to have been founded in 1767—ten years after the battle of Plassey—when Lord Clive formally appointed Major James Rennell, the first Surveyor General of Bengal, at that time the most important of the East India Company's possessions, though there were earlier settlements in Madras and Bombay.

Rennell's maps were originally military reconnaissances and latterly chained surveys based on astronomically fixed points, and do not pretend to the accuracy of modern maps of India based on the rigid system of triangulation commenced at Madras in 1802 and since extended over and beyond India. Even now however the *relative* accuracy of these old maps makes them valuable in legal disputes, as for instance in proving that the holding of a Bengal landowner was a river area at the time of the Permanent Settlement of 1793, so that he is debarred from its benefits.

From these beginnings, this department has gradually become primarily responsible for all topographical surveys, explorations and the maintenance of geographical maps of the greater part of Southern Asia, and also for geodetic work.

Geodesy means the investigation of the size, shape and structure of the earth, and the geodetic work of the department consists of primary (or geodetic) triangulation, latitude, longitude and gravity determinations. From these the exact "figure" of the earth is obtained, whereby points fixed by triangulation can be accurately located on its curved surface. This system of fixed points holds together all topographical and revenue surveys, and the existence of such a system from the early days of the department has avoided the embarrassments caused in other countries where isolated topographical surveys have been started without a rigid framework, with the inevitable result that they could not be fitted together.

A geodetic framework is therefore essential in any large survey, but there are a number of other activities, all of these ultimately utilitarian, which can be suitably combined with it and the following are some of those which have been carried out in India:

Precise levelling for the determination of heights;

Tidal predictions and publication of Tide-Tables for forty-one ports between Suez and Singapore;

The Magnetic survey;

Observation of the direction and force of gravity;

Astronomical observations to determine latitude, longitude and time;

Seismographic and meteorological observations at Dehra Dūn.

Indian geodesy has disclosed widespread anomalies of the gravitational attraction in the earth's crust which have recently led to a reconsideration of the whole theory of isostasy. Systematic gravity investigations, which may be said to have been initiated in India, are now being carried out intensively in all civilized countries.

Topographical Surveys.—In the past this department used to carry out the large scale revenue surveys for most of India, and was still conducting this work for Central and Eastern India and Burma in 1905.

Though revenue survey is primarily a record of individual property boundaries and is unconcerned with the surface features, ground levels and exact geographical position essential to a topographical survey, it was on the whole found economical to carry out both surveys together.

By 1905 however, the small scale topographical surveys compiled from the large scale revenue maps had fallen seriously in arrear, owing to the relatively slower pace and incompleteness of the latter, on which "waste" non-revenue-paying areas are normally shown blank.

An authoritative Survey Committee appointed by the Government of India considered the position in 1905. It was feared that a separation of the topographical and revenue surveys might result in a wasteful duplication of work and two overlapping but mutually discrepant systems of mapping. These objections were met by a ruling that the basis of both systems of survey should be identical and provided either by the Survey of India or under its supervision.

Subject to this principle, the remaining revenue surveys were handed over to the provinces, who had always paid for them as part of the overhead charges of revenue collection, and the Survey of India was enabled to concentrate its energies on a complete new series of modern topographical maps in several colours on the 1-inch to 1-mile scale.

This new series had been rendered necessary by the natural demand for more detailed information to be shown on maps, especially as regards the portrayal of hill features by contours, proper classification of communications and—more recently—air traffic requirements.

It was intended that this 1905 survey should be completed in twenty five years, and then revised periodically every thirty years. Owing however to the war and more recent retrenchments, only a little over two thirds of the programme had been completed by 1937, in spite of the reduction of scale for the less important areas.

Although new surveys are carried out every year, covering from thirty to sixty thousand square miles—an area roughly that of England—the maps of a large part of the country are still over 50 years old, printed mostly in black only, and have hill features shewn by roughly sketched form lines or hachures; such changes in town sites, canals and communications as have been embodied in them have not been surveyed on the ground, but are entered from data gathered from outside sources.

Owing to the serious financial situation in 1931, the establishment of the department was severely cut down and its annual expenditure halved, in consequence of which the modern survey of India cannot now be completed before 1950.

The obsolescence of the present series of modern maps of India is shewn in Index B at the end of this report.

Large Scale Surveys.—Surveys and records of international, state and provincial boundaries have always formed an important item of topographical work, and in recent years numerous Guide Maps have been published of important cities and military stations where the 1-inch to 1-mile scale is inadequate.

Miscellaneous.—While expending on topographical and geodetic work all funds allotted by imperial revenues, the department is prepared to undertake or aid local surveys, on payment by those concerned, such as

Forest and cantonment surveys;
Riverain, irrigation, railway and city surveys;
Surveys of tea gardens and mining areas, with such control levelling as is necessary for these operations.

Administrative assistance is also given, and executive officers lent, in aid of the revenue surveys of various provinces and states.

The Printing Offices at Calcutta and Dehra Dūn are always at the disposal of other Government departments and the public, for such work as the printing of special maps, illustrations for reports and all diagrams for patents.

The Mathematical Instrument Office of this department assists all Government departments, as well as non-officials, by maintaining up-to-date instrumental and optical equipment and by manufacturing and repairing instruments which would otherwise have to be replaced from abroad.

Military Requirements and Air Survey.—The Department is also responsible for all survey operations required by the army, and is in a position to meet the rapidly increasing complexity of modern military requirements, especially in air survey.

In view of its high military importance, air survey work for civil purposes is receiving all possible assistance, and continuous research is being carried on in the latest methods of mapping from photographs taken from the ground and in the air.

The flying and photography for air mapping done by this department are at present carried out by the Royal Air Force or the Indian Air Survey Company, a commercial firm with headquarters at Dum-Dum.

Administration is in the hands of the Surveyor General under the Education, Health and Lands Department of the Government of India.

The Headquarters Office is at Calcutta under the Assistant Surveyor General, and there are four Directors, one for the Map Publication and other technical offices at Calcutta, and three for three of the five Survey of India Circles into which the country is divided; the other two Circle areas (covering Burma and South India) are administered personally by the Surveyor General, who, since the separation of Burma from India on 1st April 1937, continues to exercise administrative and technical control over the Survey of India party working there pending the ultimate development by Burma itself of a topographical and geodetic Survey Department.

Of the three Circle Directors, one also administers the Geodetic Branch at Dehra Dūn in addition to his topographical survey Circle.

CONTENTS.

ILLUSTRATIONS.

GLOSSARY.

Scales are referred to as follows:—

(*i*) by their representative fraction, *e.g.* "1/25,000",

(*ii*) *for scales which are multiples of 1/1,000,000*—"1/M scale", "1/6M scale" &c., which mean "1/1,000,000 scale", "1/6,000,000 scale" &c.,

(*iii*) *for scales smaller than 4 miles to one inch*—"50-mile scale", "8-mile scale" &c., which mean "scale of 50 miles to one inch", "scale of 8 miles to one inch" &c.,

(*iv*) *for scales of and larger than 4 miles to one inch*—"¼-inch scale", "½-inch scale", "4-inch scale", "16-inch scale" &c., which mean "scale of ¼ inch to one mile" &c., &c.

Serial numbering of Survey of India maps.

Sheets 65, 78 &c. are sheets on the 1/M scale;

Sheets 65 K, 78 F &c. are ¼-inch sheets;

Sheets 65 K/N.W., 78 F/S.E. &c. are ½-inch sheets;

Sheets 65 K/1, 78 F/16 &c. are 1-inch sheets.

The system of numbering is fully explained in the Indexes at the end of this report.

Abbreviations.—U. S. S. denotes Upper Subordinate Service.

L. S. S. denotes Lower Subordinate Service.

U. S. Officer denotes Upper Subordinate Officer.

L. S. Officer denotes Lower Subordinate Officer.

P. L. O. denotes Photo.-Litho. Office (Calcutta).

P. Z. Section denotes Photo.-Zinco Section (Dehra Dūn).

D. O. denotes Drawing Office.

F. O. U. O. denotes "For Official Use Only".

SURVEY OF INDIA

GENERAL REPORT

1937

From 1st October 1936

To 30th September 1937

INTRODUCTION AND SUMMARY.

1. Annual Reports are now published in two separate volumes namely:—

The *Geodetic Report.*

The *General Report.*

These reports cover the survey year, which ends on 30th September, except that *Part 4* (Map Publication and Office Work) of the latter is for the financial year, which ends on 31st March.

The *Geodetic Report* contains full details of all scientific work.

The *General Report* includes an abstract of the *Geodetic Report* (in *Part 2*), and full details of the survey operations of the ordinary field units (*Part 3*) as well as drawing, map publication, and instrument manufacture (*Part 4*). Abstracts II and IV (*vide* Table of Contents) summarize the detailed reports of *Part 3* and enable the reader to select those which are of special interest to him.

The progress of "*modern*" (*i.e.* since 1905) topographical surveys made by this Department, and of compilations made from our own or other material, is illustrated in *Index A* at the end of this report, while *Index B* indicates the obsolescence of modern surveys. The remaining indexes show all the standard maps which have been published up to date on the various scales. It will be seen from *Index C* that the areas within the Indian Empire which are blank on *Index A* are actually almost entirely covered by topographical maps. These maps are however from material based on the old longitude of 1815, which was over 2 miles out, and are drawn in the old style; they are consequently excluded from *Index A*.

2. General.—Brigadier Sir Harold John Couchman, D.S.O., M.C., held the post of Surveyor General up to 5th June 1937 when he proceeded on leave preparatory to retirement, and was succeeded by Colonel C. G. Lewis, O.B.E.

The post of Assistant Surveyor General was held by Lt.-Colonel E. O. Wheeler, M.C., R.E., up to 9th January 1937, and thereafter, by Lt.-Colonel T. M. M. Penney, R.E.

3. The total cost of the Department for the year ending 31st March 1937, as compared with that of previous years, was as follows:—

	1934-35	1935-36	1936-37	REMARKS.
	Rs.	*Rs.*	*Rs.*	
Gross actual cost ...	34,42,523(*a*)	34,88,115(*b*)	34,82,856†	(*a*) Including Rs. 91,856 for English Charges (High Commissioner) on Stores, and loss or gain by exchange.
Deduct recoveries ...	10,95,885	10,24,892	10,60,863†	(*b*) Including Rs. 54,396 for do. do.
Nett actual charges ...	23,46,638	24,63,223	24,21,993†	† These figures are not final.
Total area of survey of all kinds completed during the year.	Square miles. 51,664	Square miles. 57,036	Square miles. 37,670*	* *Vide* page 15

4. Organisation.—Under the orders of the Government of India a survey party designated the Sino-Burmese Boundary Party was formed with effect from the 1st November 1936 under the charge of Captain J. B. P. Angwin, R.E., for employment with the Sino-Burmese Boundary Commission, 1936-37. It was disbanded on the 31st July 1937.

At the request of the Chief of the General Staff, a Field Survey Section under the command of Lieut. J. S. O. Jelly, R.E., was sent on active service to Waziristān reporting to Headquarters, Wazirforce at Bannu on the 9th June 1937.

The special pay of the post of the Officer in Charge, No. 20 (Cantonment) Detachment has been increased from Rs. 50 to Rs. 100 per mensem.

5. Notable events of the Survey year.

On the separation of Burma from India on the 1st April 1937, No. 10 (Burma) Party was placed on foreign service conditions, the entire cost of the party being borne by the Government of Burma. The Surveyor General of India continued however to exercise technical and administrative control.

Air Surveys.—At the request of Messrs. Tata Iron and Steel Company Ltd the survey of 22 square miles of Jamshedpur Town on the scale of 16 inches to 1 mile was undertaken.

Boundary Survey.—

Captain D. R. Crone, R.E., demarcated about twelve miles of the boundary between Sirmūr and Jubbal States of the Punjab Hill States Agency, Punjab States between 28th April and 14th May 1937.

At the request of the Malguzar of Kumarmara village (Raipur District) a part of the boundary of the village was demarcated, on payment.

Conferences.—

While on inspection of No.18 (Air Survey) Party during December 1936 Colonel Hamilton, D.S.O., Director, Frontier Circle, visited the Headquarters of various formations, civil and military in the mobilization area in connection with the future programme of surveys by "A" Company and No. 18 (Air Survey) Party on the North-West Frontier and in the Mobilization area.

Lt.-Colonel Glennie, D.S.O., R.E., attended a meeting of the Technical Sub-committee of the Central Quetta Reconstruction Committee held at Delhi on the 18th December 1936.

Exploration.—

Surveyor Asghar Ali was deputed during June to accompany Colonel Schomberg's Expedition, 1937 to explore the area lying to the east and north-east of Leh and also to the south-east towards Gartok where maps are at present sketchy and unreliable.

The original records of the ¼-inch exploratory survey carried out by Surveyor Muhammad Ayub Khan, who accompanied Sir Aurel Stein, in connection with his archæological explorations in Īrān have been received and are being embodied in S. Īrān and N. Īrān 1/2M sheets.

Adventures and Casualties.—

The Surveyor General deeply regrets to record the following deaths:—

Colonel T. F. B. Renny-Tailyour, C.B., C.S.I., late Superintendent, who died in Scotland in June 1937 at the age of 74.

Mr. F. N. Murphy, late Manager, Photo.-Litho. Office, who died in England on the 12th February 1937 at the age of 65.

Mr. G. C. Swiney, late Extra Assistant Superintendent in the old Provincial Service, who died at Bangalore on the 23rd March 1937 at the age of 88.

Mr. S. C. Aratoon, Assistant Manager, Photo.-Zinco. Office, Dehra Dūn who died in Calcutta on the 1st April 1937 while on leave on medical certificate at the age of 53.

Mr. I. D. Suri, Sub-Assistant Superintendent, who died of heart failure on the 9th October 1936 at the age of 29 at a camp of No. 1 Party in the Arwa Valley, about three stages beyond Badrināth in the Garhwāl Himālayas.

Surveyor Mian Muhammad who was killed on the 24th May 1937 by a fall while working on the Kosa Glacier.

7 Lower Subordinates and 18 inferior servants died during the year under report.

Distinguished visitors.—

Sir James Pitkeathley, C.M.G., C.I.E., C.V.O., D.S.O., A.M.I.E.E., M.I.Mech.E., M.I.E. (Ind), Chief Controller of Stores, Indian Stores

Department, visited the Mathematical Instrument Office on the 15th March 1937 and discussed with the Surveyor General and the Superintendent, Mathematical Instrument Office matters relating to purchase and manufacture of stores by that office. He inspected its optical and thermometer glass blowing workshops.

Mr. M. W. Yeatts, I.C.S., Deputy Secretary to the Government of India, Department of Education, Health and Lands visited the Geodetic Branch Offices in Dehra Dūn on the 8th June 1937.

Miscellaneous.—

Messrs. G. Entrop and N. Entrop, two Dutchmen who successfully made the voyage from Amsterdam to Java in a fifteen foot canoe, halted at Cox's Bāzār, the headquarters of No. 12 Party, on the 10th November 1937 and were provided with maps and advice for the portion of their journey from there to Victoria Point. Instead of going all the way round by the coast by Pagoda Point to Rangoon as they, in ignorance, had intended doing and during which they would probably have been wrecked, they were told about and persuaded to take firstly the inland water way down the Nāf and Mayu Rivers to Akyab, reached by short cross country portages at Ukhia Ghāt and Maungdaw and secondly the overland route from Taungup to Padaung and thence by the Irrawaddy to Rangoon.

6. Appreciations and Awards.

His Majesty the King, Emperor of India, has been graciously pleased to confer the honour of Knighthood on Brigadier Harold John Couchman, D.S.O., M.C., Surveyor General of India.

His Majesty the King has graciously approved the award of the Founder's Gold Medal of the Royal Geographical Society to Colonel C. G. Lewis, O.B.E., for his surveys in the Miri Mission 1911-12, in 'Irāq and Syria 1918-19, and on the Afghān and Turco-'Irāq Boundary Commissions; for the Air Survey of the Irrawaddy Delta 1924, and for his promotion and encouragement of the exploration and survey of the Himālayas.

His Excellency the Viceroy and Governor-General has been pleased to confer the undermentioned titles as a personal distinction upon the following officers of the Department:—

(*i*) The title of Rai Sahib upon Mr. Gunamay Dhara, Registrar.

(*ii*) The title of Ahmudangang-Tazeik-ya-Min upon U On Ba, Sub-Assistant Superintendent.

A/Sergeant H. W. Herbert attached to the Army Section of No. 6 Drawing Office has been awarded the Long Service and Good Conduct Medal with gratuity under Army Order 195 of 1936.

Surveyor Muhammad Ayub Khan, C.H., has been awarded the "Back Grant" of the Royal Geographical Society for his surveys on three expeditions in East Īrān, 1931-34 under the leadership of Sir Aurel Stein.

The following is an extract from the introductory section of Sir Aurel Stein's paper "An Archæological Tour in the Ancient Persis":—

"But above all I am sincerely grateful to that good fortune which assigned to me Surveyor Muhammad Ayub Khan, a very experienced and most willing assistant."

"The map reproduced shows the results of the plane-table survey carried out by Surveyor Muhammad Ayub Khan. The work was rendered difficult by the scarcity of trigonometrically fixed points and was often exacting, owing to trying climatic conditions. In addition to this mapping work and to the making of numerous detailed plans of ancient sites my indefatigable Pathan companion gave ever efficient help in all practical tasks connected with excavations, camp arrangements etc."

The following is an extract from a telegram received by the Officer in Charge Sino-Burmese Boundary Party from the Senior British Commissioner, Burma Boundary Commission:—

"Understand Neutral Commissioner congratulated your party and thanked them for willing help. British Commission wish to congratulate you and your assistants on most successful conclusion of two most arduous seasons. Anything attained by Commission is attained through this work".

The following is an extract of a letter from the Government of Burma, Defence Department, to the Senior British Commissioner, Sino-British Boundary Commission, in connection with the report of the Survey Party for the season 1936-37.

"His Excellency the Governor desires that his high appreciation of the work of Captain Angwin and his Survey Party should be conveyed to Captain Angwin".

The following is an extract from a letter received by the Director, Frontier Circle, from Captain L. A. G. Pinhey, I.A., Additional Political Agent, Quetta, appreciating the work of Mr. Chiragh Shah, C.H., Sub-Assistant Superintendent, in charge Quetta City Survey:—

"The Survey Party worked under considerable difficulties and discomfort in all weathers, and largely due to Mr. Chiragh Shah's excellent supervision, the work was completed in much shorter time than was originally anticipated. He showed great tact in dealing with the public and worked very well in conjunction with my special Tehsildars, as a result of which the Civil Government has been put to far less expense than was expected."

Mathematical Instrument Office.—

A folding mirror stereoscope for examination of air survey photographs was made up by the Mathematical Instrument Office for the Officer in Charge, No. 18 Party and has been found to be very satisfactory.

A considerable number of these instruments have been ordered by the R. A. F.

7. Personnel.—Casualties, retirements, promotions and other changes were as follows:—

Class I Officers.—Brigadier Sir Harold John Couchman, D.S.O., M.C., and Mr. L. Williams, M.B.E., retired.

Colonel Lewis, confirmed as Surveyor General and granted the temporary rank of Brigadier.

Lt.-Colonel Thompson, I.A., confirmed as Director and promoted to Colonel.

Mr. M. M. Mudaliar, M.A., promoted to Superintendent in Class I.

Captain Wright, R.E., promoted to Superintendent.

Lieutenants R. A. Gardiner, R.E., R. C. A. Edge, R.E., and Gurdip Singh, I.A., joined the Department as Assistant Superintendents (on probation).

Lt.-Colonel F. J. M. King, R.E., promoted to Colonel.

Major Norman, M.C., R.E., promoted to Lt.-Colonel.

Lieutenants C. A. K. Wilson, R.E., and R. C. N. Jenney, R.E., promoted to Captains.

Class II Officers.—

Mr. N. D. Joshi, promoted from the Upper Subordinate Service to Class II.

Seven probationers, confirmed. Three probationers, appointed. One resigned.

Miscellaneous appointments,—General Central Services Class I.—

Mr. S. Woodhouse, retired.

Mr. R. C. Malcolm, confirmed as Superintendent, Mathematical Instrument Office.

Miscellaneous appointments,—General Central Services Class II.—

Mr. H. J. Peychers, 2nd Division Assistant, promoted to Assistant Manager, Photo.-Zinco. Office.

Mr. K. L. Dev, Assistant Manager, Photo.-Litho. Office, confirmed.

Mr. S. C. Aratoon died.

Upper Subordinate Officers.—One Geodetic Computer was appointed.

Computer Jagdish Behari Mathur and Surveyor Arthur Francis, C.H., promoted to the Upper Subordinate Service.

Khan Muhammad, C.H., retired.

Mr. I. D. Suri died.

II. ABSTRACT OF SURVEYS IN EACH PROVINCE AND STATE.

8. The prime duties of the Survey of India are geodetic, topographical, and geographical, but the department is also developing co-operation with local survey agencies, with a view to mutual economy, and is now doing a considerable amount of miscellaneous outside work on payment, besides advising and assisting Provincial Governments with local and settlement surveys as required.

The following abstract shows the nature and *locale* of the field operations actually carried out by the department during the past year, grouped under the following sub-heads:

Air Surveys.	Geodetic.
Boundary Surveys.	Levelling.
Cadastral Surveys.	Miscellaneous.
Cantonment and City Surveys.	Railway Surveys.
Correction Surveys.	Riverain Surveys.
Exploration.	Special Surveys.
Forest Surveys.	Topographical Surveys.
Framework.	Training.

If a province or state is not mentioned, no work has been done there during the year under report.

9. Assam.

Framework. Reconnaissance for triangulation in Goālpāra district and Gāro Hills (p. 46).

Geodetic. Occupation of two stations in unadministered territory in the Nāga Hills by lamp squads for primary triangulation in Burma (p. 12). Gravity observations at 26 stations (p. 12).

10. Baluchistān.

Cadastral surveys for town planning in Quetta City (p. 34).

Framework. Triangulation in Kalāt and Las Bela States (p. 34).
Traversing in Las Bela State (p. 34).

Levelling. Precise levelling from Sukkur to Chaman to determine what changes in level, if any, had been caused by the earthquake of 31st May 1935 (p. 13).

Topographical surveys in Kalāt and Las Bela States (p. 34).

11. Bengal.

Framework. Triangulation and traverse in Chittagong, Mymensingh, Noākhāli, and Rangpur, and Chittagong Hill Tracts districts (p. 47).

Geodetic. Gravity observations at 17 stations (p. 12).

Levelling. Precise levelling (on the system of fore and back levelling) at Calcutta in connection with the construction of the new bridge at Howrah (p. 53).

Topographical surveys in Chittagong and Chittagong Hill Tracts districts (p. 46) and Mālda district (p. 42).

12. Bihār.

Air survey in Jamshedpur (p. 45).

Framework. Traverse in Bhāgalpur, Darbhanga and Muzaffarpur districts (p. 42) and Jamshedpur (p. 45).

Geodetic. Gravity observations at 3 stations (p. 12).
Magnetic observations at 176 stations (p. 12).

Levelling in Jamshedpur (p. 45). High precision levelling of the new geodetic level net in the fore direction from Katghora to Daltonganj, part of line Raipur to Daltonganj (p. 13).

Special survey. Rapid contour survey in Mānbhūm district (p. 45).

Topographical surveys in Bhāgalpur, Purnea and Santāl Parganas districts (p. 42).

13. Bombay.

Miscellaneous. Fixing of positions of wireless stations at Ahmadābād and Bombay (p. 37).

14. Burma.

Forest surveys in Akyab district (p. 50).

Framework. Triangulation and traverse in Pegu, Thaton, Toungoo and Yamethin districts and Karenni and the Southern Shan States (p. 50).

Geodetic. Primary triangulation from the tribal area NW. of the Hukawng Valley southwards as far as the hills SW. of the Indawgyi Lake (p. 12).

Topographical surveys in Akyab district and Arakan Hill Tracts (p. 46); in Meiktila, Toungoo and Yamethin districts and in Karenni and the Southern Shan States (p. 50).

15. Central India.

Levelling. High precision levelling of the new geodetic level net in the back direction of line Bhopāl to Nāgpur (p. 13).

Topographical surveys in Indore, Jaora and Sitāmau States (p. 39).

16. Central Provinces.

Boundary demarcation in Raipur district (p. 45).

Levelling. High precision levelling of the new geodetic level net in the back direction (*i*) of line from Bhopāl to Nāgpur and (*ii*) from Katghora to Bilāspur, part of line Raipur to Daltonganj (p. 13).

Topographical surveys in Drug district (p. 44); in Raipur district (pp. 44,48).

17. Eastern States.

Framework. Triangulation in Baudh, Kālāhandi, Patna and Sonepur States (p. 45).

Levelling. High precision levelling of the new geodetic level net in the fore direction, from Katghora to Daltonganj and in back direction from Katghora to Bilāspur, both being parts of line Raipur to Daltonganj (p. 13).

Topographical surveys in Bastar State (pp. 44,48); in Kānker State (p. 44); in Kālāhandi State (p. 48).

18. Gwalior.

Topographical surveys in Gwalior (p. 39).

19. Hyderābād.

Miscellaneous. Fixing of position of wireless station at Trimulgherry (p. 37).

20. Madras.

Framework. Traverse in Kistna and West Godāvari districts (p. 49).
Miscellaneous. Correction survey on Madras-Orissa boundary (p. 48).

21. Nepāl.

Geodetic. Magnetic observations at 29 stations (p. 12).

22. N. W. F. Province.

Air surveys in Tribal Territory (Mohmand and Dīr, Swāt and Chitrāl Agency), North and South Waziristān Agencies, Dīr Swāt and Chitrāl Agency and Kohāt district (p. 35).
Cantonment and city surveys. Re-survey of Abbottābād Cantonment (p. 40).
Framework. Traversing and levelling for cantonment survey of Mardān, Kohāt and Peshāwar Cantonments (p. 40).

23. Orissa.

Framework. Triangulation in Ganjām district (p. 45).
Miscellaneous. Correction survey on Orissa-Madras boundary (p. 48).
Topographical surveys in Koraput district (pp. 45, 48).

24. Punjab.

Air survey in Attock district (p. 35).
Cantonment and city surveys. Re-survey of Rāwalpindi and Chaklāla Cantonments (p. 40).
Framework. Triangulation and traversing in Dera Ghāzi Khān district (p. 33).
Riverain surveys in Amritsar district (p. 33).
Topographical surveys in Dera Ghāzi Khān, Gujrānwāla, Muzaffargarh and Siālkot districts (p. 32).

25. Punjab States.

Topographical surveys in Bahāwalpur, Mandi and Suket States (p. 32); in Bāghal, Bhajji, Bilāspur and Tehri States of the Punjab Hill States Agency (pp. 32, 37).

26. Rājputāna.

Cantonment and city surveys of Partābgarh town (p. 37).
Miscellaneous. Fixing of position of wireless station at Jodhpur (p 37).
Topographical surveys in Būndi, Jhālawār, Kotah, Partābgarh, Tonk and Udaipur (Mewār) States (p. 39).

27. Sind.

Air survey in Karāchi district (p. 34).
Correction surveys in Karāchi Guide Map areas (p. 34).
Framework. Triangulation for the provision of ground control and the collection of ground information for air survey in Karāchi district (p. 34).
Levelling. Precise levelling from Sukkur to Chaman to determine the changes in level caused by the earthquake of 31st May 1935 (p. 13), and for the use of the Sind Irrigation Department (p. 53).

28. United Provinces.

Cantonment and city surveys in and around Naini Tāl (pp. 37, 39); original survey of the Indian Military Academy, and skeleton plot of the Forest Research Institute boundary at Dehra Dūn and re-survey of the 4 cantonment bāzārs at Cawnpore (p. 40).

Framework. Traversing and levelling for Cantonment survey of the Indian Military Academy, and the skeleton plot of the Forest Research Institute boundary at Dehra Dūn, the Cantonment bāzārs at Cawnpore, the boundary of the notified area, Rikhikesh (pp. 40-41), and in and around Naini Tāl (p. 37).

Geodetic. Gravity observations at 1 station (p. 12).

Miscellaneous. Fixing of ranges for small arms at Rānikhet (p. 37).

Topographical surveys in Almora and Garhwāl districts (pp. 37-38) Revision surveys in Garhwāl district (p. 38).

PART 2.—GEODETIC WORK.

III.—ABSTRACT OF GEODETIC OPERATIONS.

DIRECTOR:—Colonel C. M. Thompson, I.A.

29. General.—Besides geodetic work, the Director, Geodetic Branch, administers at Dehra Dūn *No. 2 Drawing Office*, the *Forest Map Office*, a *Printing Section* and a *Photo.-Zinco. Section*, whose work is reported in Part 4 of this report, and also the following survey operations, which are reported in other parts of the General Report:—

Topographical Survey carried out by No. 1 Party (paras.65—71).
Cantonment Surveys (paras. 72—76).
Training School (paras. 119—122).

30. Geodetic.—Purely geodetic operations include miscellaneous computations and research, preparation and publication of records, observatory work (astronomical, magnetic, seismological and meteorological), the measurement of geodetic bases, principal triangulation, geodetic levelling, precise latitudes, longitudes, azimuths, gravity determinations in all parts of India, and prediction of tides at 41 eastern ports between Suez and Singapore.

These operations are fully described in the annual Geodetic Report of the Survey of India which contains complete index maps and detailed results. The following is a brief abstract of the geodetic operations described in the Geodetic Report of 1937.

31. Observatory Section.—The usual magnetic, seismographic and meteorological observations have been carried on, and the record of the longitude of Dehra Dūn has been maintained by bi-weekly transit observations. Dr. J.de Graaff Hunter has designed and sent from England a new form of relay for his shutter transit, which has been brought into use.

An observatory has been built at Āgra, in the compound of the Meteorological Department Upper Air Observatory, where a programme of observation of latitude variation has been started.

32. Computing Section.—The graphical adjustment of minor triangulation in military training areas for which grid triangulation pamphlets are required has been completed.

A readjustment of the primary triangulation of India and Burma has been started. This readjustment makes use of base lines, Laplace stations and new series which have been observed since the first adjustment was made in about 1880. Except in Burma, there is no intention of using the revised values for mapping purposes, the object of the readjustment being to ascertain the degree of accuracy of the values at present accepted, and to provide new values for scientific purposes. In Burma, where much new work has been done, it may be necessary to adopt new values, but these will not be available for some years, pending the completion of field work still in hand.

Assistance has been given to Nos. 1, 14 and 15 Parties in the computation of their field work.

The following publications have been prepared for the press and printed at Dehra Dūn:—

(*a*) Geodetic Report 1936.
(*b*) Levelling Pamphlet 43 (reprint).
(*c*) Auxiliary Tables Part III (6th edition).
(*d*) Levelling Handbook (3rd edition).
(*e*) Addenda to 4 triangulation pamphlets.

33. Tidal Section.—The tide-tables of the Indian Ocean for 1937 for 69 ports were prepared and published as usual in October 1936, and advance predictions for 15 ports for 1938 were despatched in September 1936 to the hydrographic departments of the U. K., United States and Japan for inclusion in their respective tide-tables.

The tide-tables for 1938 were published in September 1937, and advance predictions for 1939 were despatched in the same month.

Automatic registration of tides was continued at Aden, Karāchi, Bombay, Vizagapatam, Dub'āt, Calcutta and Rangoon. Reports are no longer received from Colombo. Daylight tide-pole readings were continued at Bhāvnagar, Shortt Island (until July 1936), Chittagong and Akyab. The Rangoon gauge has been temporarily moved from Brooking Street to Sule Pagoda Wharf.

34. Gravity Observations.—(No. 14 Party).—Observations to determine the force of gravity were made at 47 stations in Bengal, Assam, Bihār and U. P. Transport was by rail. The observer was Mr. M. N. A. Hashmie.

35. Magnetic Observations.—(No. 14 Party).—The magnetic dip and horizontal force was observed at 205 stations spaced at one mile intervals along two north and south lines crossing the epicentral area of the 1934 Bihār earthquake. The observer was Mr. Shyam Narain.

36. Triangulation.—(No. 15 Party).—Connection was successfully completed this year between the Assam Longitudinal Series, which last year reached the unadministered Nāga territory N. W. of the Hukawng Valley, the Upper Irrawaddy Series and the Mandalay Meridional Series.

The observing detachment marched from Kamaing in Upper Burma through the Hukawng and Taro Valleys to the Sangpan Range, where observations commenced on 3rd December. They were accompanied by an escort of 30 Kachin Sepoys, provided by the Burma Military Police, Myitkyina. Two Lamp squads for stations on the Pātkai range marched up from the Assam side of the border, with an escort of 65 riflemen of the 4th Battalion Assam Rifles under the Command of Captain F. G. C. Macartney, I.A.

The survey party consisted of Captain C. A. K. Wilson, R.E., in charge, with Computers S. C. Dhar and Padam Singh and 61 inferior servants. Surveyor S. N. Sharma carried out reconnaissance duties.

The country traversed by the series comprised the lofty Sangpan Range in unadministered Nāga territory, the densely forested Kachin highlands south west of the Hukawng Valley, the Indawgyi, the largest lake in Burma, the almost uninhabited Laisai tract, and the Shan State

of Singkaling Hkāmti. The average elevation of stations was about 4,600 feet. The area has a variety of mineral deposits and includes the famous Jade Mines area of the Upper Uyu.

Permanent mule transport was used, but boats, elephants, carts, and local coolie labour all had to be employed at various times. The local inhabitants, principally Kachin, though rather independent and much addicted to opium, were helpful.

During December and January work was hindered to some extent by dense clouds on the hills flanking the Tanai Hka (Chindwin River). Rain fell in February, and apparently is to be expected at that time of year. The haze also started at the end of February, but occasional rain-storms enabled the observations to proceed. The health of the party was very good. There were a few cases of scabies, which is rife among the Kachins. Insects, particularly leeches, blood-blister flies and bamboo ticks, were troublesome.

Observations were concluded on 21st March and the observing detachment arrived back in Dehra Dūn on 4th April.

Observations were made at 11 stations in all, using the Precision Wild Theodolite throughout, with an average triangular error of 0″·56.

37. Levelling of High Precision.—(No. 15 Party).—Out of the total length of 15,800 miles proposed for the new geodetic level net of India, 9,430 miles have been completed up to date, 280 miles having been done in the back direction during 1936-37, in the line from Bhopāl to Nāgpur and in the Katghora to Bilāspur portion of the line Raipur-Daltonganj.

During 1936-37, 183 miles of single levelling for the geodetic level net was also carried out in the fore direction in the Katghora to Daltonganj portion of the line Raipur-Daltonganj.

Precise Levelling.—From Sukkur to Chaman revision of part of line 101 and the whole of line 54 A and new levelling from Quetta to Chaman, total 343 miles, was done in order to find out the disturbance caused by the earthquake of 31st May 1935.

Miscellaneous Levelling.—Reports will be found under Section IX of this report (p. 53).

PART 3.—TOPOGRAPHICAL WORK.

IV.—ABSTRACT OF TOPOGRAPHICAL WORK.

38. The following tables indicate the progress achieved to date in the topographical survey programme assigned to the Department in 1905 and give details of the work done in the year under report.

Table A shows the area of survey completed on various scales since 1905, as well as the approximate balance which remains to complete the contoured topographical survey of India. The figures which were entered in the report for 1930-31 were found on re-examination to be inaccurate, and to be incapable of calculation by 5 year periods for separate scales; consolidated figures from 1905 to 1935 are therefore given. These figures also include the area of survey work done in Burma prior to separation. Now however that Burma has been separated from India, though the Survey of India will probably continue to survey Burma for some time to come, the work there will no longer form part of its functions as a department of the Indian Government. The total area of survey work in Burma has therefore been shown separately and the area surveyed in Burma each year after 1st April 1937, the date of Burma's separation, will be shown separately in future.

Table B shows the area revised during the year under report.

Table C shows in detail the survey operations carried out during the year under report, together with their cost rates. While every attempt is made to calculate the cost rates accurately, it is extremely difficult to allocate "overhead charges" fairly to the various classes of work, and rates of pay etc., will vary with the locality; the cost rates shown in the table must therefore be considered to be approximate. For this reason, a column showing "out-turn" is included in the table, which those familiar with survey organization will find very useful in estimating costs in subsequent years.

The costs, shown for mapping and computations are those incurred in the party etc., offices only, except where otherwise stated; publication charges, if required, may be ascertained from the Director, Map Publication, at Calcutta.

39. Progress.—In the second page of the preface to this report will be found a brief outline of the scope of the topographical surveys of the department. The hopes expressed in 1905—that modern maps on the 1-inch scale would be available for the entire Indian Empire within 25 years—are still far from realization in 1937, a little over half the total area of India having been completed on that scale. In 1913, when it was realized that for various reasons it would be impossible to complete the 1-inch surveys in the time allotted, a scheme for the reduction of the scale of survey in the less populous areas was sanctioned by the Secretary of State.

In spite of the reductions in scale however, only a little over two thirds of the country is as yet covered by modern maps. The tendency to revert to the 1-inch scale in special circumstances, such as in areas of more than ordinary military, geological or engineering importance, the necessity which frequently arises to resurvey on the 1-inch scale areas

already surveyed on smaller scales, as they grow in importance, the necessity for the comparatively frequent revision of existing surveys in the more populous areas and lastly but by no means least important, the recent urgent necessity for economy; all these factors have conspired to delay still further the completion of the programme even as amended in 1913.

Original surveys in India since 1931, the year of retrenchment, have been carried out at the rate of about 36,000 sq. miles per annum; on this basis, some 14 years are still required to complete the programme.

The average out-turn for Burma has been about 4,500 square miles and the area remaining for survey is 63,818 square miles which represents at above rate another 14 years' work.

The present position of the mapping of India is shown in the first two *Index Maps* at the end of this volume.

Table A.—Progress of Topographical Surveys since 1905.

Survey years.	1-inch and larger scales.	¾ and ½-inch scales.	⅜ and ¼-inch scales.	TOTALS.
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*
1905—35 ...	994,757	230,718	25,929	1,251,404
1935-36 ...	18,790	18,553	15,706	53,049
1936-37 ...	**14,585**	**19,738**	.....	**34,323**
Totals to 1937 ...	**1,028,132**	**269,009**	**41,635**	**1,338,776**
Deduct areas for Burma to 1937.	**155,148**	**43,555**	.....	**198,703**
Totals for India to 1937 ...	**872,984**	**225,454**	**41,635**	**1,140,073**
Balance remaining	*approximately 200,000*	*approximately 180,000*	*approximately 100,000*	*482,847*
Total programme				**1,622,920**

Table B.—*Revision and Resurvey of above work during the year.*

India 1936-37, ...	**3,210**	**137**	.....	**3,347**

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
'A' Company.—			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.**
Undulating sandy plain ...	1-inch **Triangulation**	39 K ...	130	162	6·2	1·2	**7·4**	No. 6 D. O costs for examination and preparation of colour patterns of this unit:—Rs. 2,952.
Ditto ...	1-inch **Traverse** ...	39 J, K ...	105 linear miles.	83 linear miles.	12·0 per	2·9 linear	**14·9** mile.	
Alluvial river banks ...	..... **Settlement Traverse**	44 I, M ...	221 linear miles.	53 linear miles.	20·3 per	4·9 linear	**25·2** mile.	
Flat cultivated plains ...	**1-inch** Re-survey ...	39 K, 43 L ...	2,326	30	12·7	11·1	**23·8**	
Medium and high hills rising to 10,000 feet.	**1½-inch** Re-survey ...	53 E ...	254	13	42·4	(b) (c)	.....	(a) Training Camp.
		53 A ...	254	(a)	(a)	(c)	(a)	(b) Being mapped in No. 6 D. O
Fair mapping ...	**1-inch** Correction survey	44 E ...	759					(c) Mapping not completed.
	1-inch Correction and revision survey.	38 P, 44 O, P, 53 C.	1,292	(d)	(d)	6·5	**6·5**	(d) Field work done in previous years.
	1½-inch Correction and revision survey.	44 P ...	261					

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** *Contd.*
'E' Company.—								
Intricate, steep, bare, and broken hills.	..... **Triangulation**	35 K ...	2,578	515·6	4·4	0·2	**4·6**	No. 6 D. O. costs for examination and preparation of colour patterns of this unit:—Rs. 472.
Mangrove swamp ...	..... **Triangulation**	35 P ...	377	209·4	8·9	1·4	**10·3**	
Open plain interspersed with sand mounds and tamarisk jungle.	..... **Traverse** ...	35 K ...	254 linear miles.	46·5 linear miles.	27·2 per	4·5 linear	**31·7** mile.	
Very steep, broken, intricate, and barren hills.	¾-inch Original survey	35 J ...	2,132	33·5	29·5	(a)	.....	(a) Mapping not yet started.
Open level plain ...	3-inch Correction survey	35 P ...	92	32·5	9·4	(a)	.....	
Level plain	32-inch Special survey ...	34 N ...	109 acres.	99·1 acres.	10·9 per acre.	(b)	.....	(b) Not to be mapped.
Ditto	64-inch Special survey ...	34 N ...	70 acres.	11·4 acres.	94·1 per acre.	(b)	.....	
					(Air survey compilation)			
Mangrove swamp ...	1-inch Original air survey	35 P ...	283	.....	.....	2·1 approx.	.....	
Fair mapping open plains ...	1-inch Original air survey	39 D ...	262	(c)	(c)	12·6	.....	(c) These sheets were surveyed prior to the year under report.
Bare broken hills ...	¾-inch Original survey...	35 I, J ...	2,123	(c)	(c)	7·4	.....	
Partly hill, partly plain	1-inch Original survey...	35 M ...	530	(c)	(c)	14·3	.....	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.		Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
						Field work.	Mapping or computations.	Total.	
				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** *Contd.*
No. 18 (Air Survey) Party.—						(Air survey compilation).			
Steep partly wooded mountains (5,000 to 8,000 ft.).	**1-inch**	Original air survey	38 G ...	10	.....	28·5	.....	.....	
Steep partly wooded mountains and broken hills (3,000 to 10,000 ft.).	**1-inch**	Original air survey	38 H ...	33	.....	141·8	.....	.....	
Broken hills (3,000 to 7,000 ft.).	**1-inch**	Original air survey	38 L ...	60	.....	28·0	.....	.....	
Flat plain and steep mountains (3,000 to 8,000 ft.).	**1-inch**	Original air survey	38 N ...	50	.....	82·4	.....	.....	
Steep partly wooded mountains (5,000 to 8,000 ft.).	**1-inch**	Revision air survey	38 G ...	48	.....	27·4	.....	.....	
Steep partly wooded mountains and broken hills (3,000 to 10,000 ft.).	**1-inch**	Revision air survey	38 H ...	186	.....	23·1	.....	.....	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs. (Air survey compilation).	Rs.	Rs.	**FRONTIER CIRCLE.—** ***Contd.***
No. 18 (Air Survey) Party.—*Concld.*								
Medium hills (2,000 to 5,000 ft.).	**1-inch** Revision air survey	38 N ...	16	.....	163·6	.....	.....	
Broken plain and foothills (1,000 to 3,000 ft.).	**1-inch** Revision air survey	38 O ...	98	.....	49·6	.....	.....	
Steep mountains (3,000 to 8,000 ft.).	**1-inch** Sketch air survey	38 G ...	21	.....	30·3	.....	.....	No. 6 D. O. costs for examination and preparation of colour patterns of this unit:—Rs. 449.
Fair mapping ...	**1-inch**	38 K, N, O ...	540[a]	.....	.....	23·9	.....	(a) The area mapped includes old ground survey and new surveys from air photographs.

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** *Concld.*
No. 6 Drawing Office.—								
Map examination ...	**1-inch** Sheets ...	.....	.....	.....	.....	·18	.....	
Ditto ...	**½-inch** Sheets ...	.....	.....	.....	.....	·05	.....	
Ditto ...	**100 ft. to 1 inch** Salt Mine Sheets	.....	.....	.....	.....	·12 per acre.	.....	
Ditto ...	**8-inch** Oil Field Sheets	.....	.....	.....	.....	5·00	.....	
Ditto ...	**1/25,000** Special map ...	.....	.....	.....	.....	·63	.....	
Ditto ...	**8-inch** Special map ...	.....	.....	.....	.....	·02 per acre.	.....	
Colour Patterns ...	**1-inch** Sheets ...	.....	.....	.....	.....	·27	.....	
Ditto ...	**½-inch** Sheets ...	.....	.....	.....	.....	·04	.....	
Ditto ...	**1/25,000** Special map ...	.....	.....	.....	.....	·96	.....	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.		Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
						Field work.	Mapping or computations.	Total.	
No. 1 Party.—				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**GEODETIC BRANCH.**
High altitude Himālaya (8,000 to 23,000 feet).	¾-inch	Original survey ...	53 I, M, N, 62 B.	2,386	46·2	33·3	11·1	**44·4**	No. 2 D. O. cost for examination of sheets and preparation of colour pattern of this unit :— Rs. 764-2-0.
Ditto.	.....	*Wild* photography (Nanda Devi).	53 N, 62 B ...	70	.....	71·9	.....	**80·5**	
Ditto.	1-inch	Photo.-survey ...		70	.....	.....	8·6		
Medium and high altitude Himālaya (6,000 to 19,000 feet).	¾-inch	Revision survey...	53 N ...	137	55·2	3·5	.....	**3·5**	
75% undulating country, 25% scrub covered plateaux.	½-inch	Original survey ...	45 K, L, O, P	9,121	79·8	4·8	2·1	**6·9**	
Partābgarh Town, 10% congested, 90% open.	32-inch	Special survey ...	.....	1,026[a] acres.	122·2	4·1	6·0	**10·1**	(a) In town area (about 103 acres) only streets and gullies surveyed.
Naini Tāl Town, wooded hills (6,000 to 8,000 feet).	8-inch	Original survey ...	53 O ...	5	0·7	842·4[b]	368·0	**1,210·4**	(b) Includes cost of additional 6 sq. miles of supplementary survey.

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each Description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
No. 20 (Cantonments) Detachment.—			Acres.	Acres.	Rs.	Rs.	Rs.	**GEODETIC BRANCH.— *Contd.***
Cantonments (Plains). Congested to fairly open in parts.	16-inch **Traverse** ...	38 N, O, 43 B	9,810	1,058·6	0·6	0·5	**1·1**	Peshāwar, Kohāt, and Mardān excluding 24·0 linear miles for boundary traversing at Nowshera, Lahore, Rikhikesh, and Cawnpore.
Cantonments (Plains). Congested.	64-inch **Traverse** ...	38 N, O, 43 B, 63 B.	241	45·5	3·8	2·5	**6·3**	Peshāwar, Kohāt, Mardān, and Cawnpore.
Cantonments (Plains). Congested to fairly open in parts.	16-inch **Levelling** ...	38 N, O, 43 B	9,810	8,408·6	0·1	.....	**0·1**	Peshāwar, Kohāt, and Mardān.
Cantonments (Plains). Fairly open and undulating.	**16-inch** Original survey ...	53 J ...	318	144·5	1·4	1·2	**2·6**	Indian Military Academy, (Dehra Dūn Cantonment).
Cantonments (Plains). Heavily congested to open areas.	**16-inch** Re-survey ...	43 G ...	10,112	184·8	1·8	1·5[a]	**3·3**	Rāwalpindi and Chaklāla.

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Acres.	Acres.	Rs.	Rs.	Rs.	**GEODETIC BRANCH.—*Concld.***
No. 20 (Cantonments) Detachment.—*Concld.*								
Cantonments (Hills). Open to fairly intricate with average congestion.	**16-inch** Re-survey ...	43 F ...	1,616	137·7	3·3	2·1[a]	**5·4**	Abbottābād.
Cantonments (Plains). Congested to fairly open in parts.	**64-inch** Re-survey ...	43 G, 63 B ...	372	12·4	25·4	12·1[a]	**37·5**	Rāwalpindi and Cawnpore.
Cantonments (Hills). Open to average congestion.	**64-inch** Re-survey ...	43 F ...	13	11·5	27·8	9·4[a]	**37·2**	Abbottābād.

(a).—The areas mapped do not actually correspond with those surveyed but include mapping arrears completed in the period under report.

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.**
No. 4 Party.—								
Plains, extensively cultivated and thickly populated and with fairly abundant tree growth.	1-inch **Traverse** ...	72 F, J ...	3,866	68·6 linear miles.	4·1	2·3	**6·4**	No. 5 D. O. costs for mapping and preparation of colour patterns of this unit :— Rs. 600 (approx.).
Ditto.	**1-inch** Original survey	72 O ...	3,969	34·7	13·2	8·8	**22·0**	
Low hills, partly wooded ...	**1-inch** Original survey	72 O ...	330	24·3	24·4	13·2	**37·6**	
No. 5 Party.—								
60% medium jungle covered hills and plains and 40% open flat cultivated country.	1-inch, ½-inch } **Triangulation**	64 P ...	3,067	265·2	5·0	2·2	**7·2**	No. 5 D. O. costs for mapping and preparation of colour patterns of this unit :— Rs. 595 (approx.).
Jamshedpur—15% jungle clad undulating country, 50% open cultivated country and 35% town area.	16-inch **Triangulation**	73 J ...	62	58·1	9·2	·9	**10·1**	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.—Contd.**
No. 5 Party.—*(Contd.).*								
Jamshedpur—30% congested town area and 70% open suburban area.	16-inch **Traverse** ...	73 J ...	44 linear miles.	22·0 linear miles.	9·6	4·7	**14·3**	
Ditto.	16-inch **Levelling** ...	73 J ...	138 linear miles.	25·9 linear miles.	5·6	.....	**5·6**	
Kumarmara—70% jungle covered plains and 30% open cultivated country (demarcated by plane-table traverse).	16-inch **Boundary demarcation.**	64 H ...	5 linear miles.	21·4 linear miles.	46·0	.....	**46·0**	
Dimna—60% open jungle clad undulating area and 40% cultivated flat country.	4-inch **Special survey**	73 J ...	5	21·4	16·6	.....	**16·6**	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.—** *Contd.*
No. 5 Party.—*(Concld.).*								
75% dense and medium jungle clad hills and plains and 25% open cultivated area (survey by plane-table traverse in the jungle and by resection in the cultivated area).	**1-inch**	Original survey ... 64 H ...	3,067	25·3	26·8	11·4	**38·2**	
Jamshedpur—30% congested town area and 70% open suburban area.	**16-inch**	Special air survey 73 J ...	22	1·5	460·8	214·5	**675·3**	
No. 12 Party.—								
70% hills rising up to 1,800 feet along coastal plains, 30% sea and islands.	1-inch	**Triangulation supplementary.** 79 N ...	540	145·9	6·29	3·09	**9·38**	No. 5 D. O. costs for mapping and preparation of colour patterns of this unit Rs. 233 (approx.).
25% hills rising up to 500 feet, 75% rivers and flat cultivated plains.	1-inch	**Triangulation Reconnaissance only.** 78 G ...	900	750·0	0·95	.....	**0·95**	

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
No. 12 Party.—*(Concld.).*			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.—*Concld.***
Rigorous traversing mostly in flat cultivated plains along sea coast and on islands.	1-inch **Traverse** ...	79 N ...	629·26 linear miles.	39·17 linear miles.	13·12	6·40	**19·52**	
Ditto.	1-inch **Traverse** ...	79 O ...	97·88 linear miles.	71·71 linear miles.				
Hills rising to 4,000 feet covered with dense forest and sparsely populated.	½-inch Original survey ...	84 B, C ...	3,295	27·4	27·04	5·33	**32·37**	
70% intricate low undulating hills rising to 2,000 feet covered with dense jungle with frequent jhūm *cultivation, 30% open cultivated plains densely populated.*	**1-inch** Original survey ...	84 B, C ...	1,101	17·0	32·19	12·86	**45·05**	60% done on blue prints.
Undulating low hills covered with open scrub and tree jungle.	**4-inch** Special forest survey	84 C ...	1·4	1·6	242·86	221·43	**464·29**	Paid for work.

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of Work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.**
No. 6 (South India) Party.—								
Flat irrigated coastal belt ...	1-inch **Traverse** ...	65 H ...	787[a] linear miles.	56·8 linear miles.	10·44 per	5·63 linear	**16·07** mile.	(a) Over an area of approx. 2,327 sq. miles.
60% wooded hills and ridges rising to 5,000 feet with narrow cultivated valleys. 40% flat undulating wooded and cultivated plateau.	**1-inch** Original survey ...	65 I, M ...	1,681	16·2	27·58	12·73	**40·31**	
40% wooded hills and ridges, 40% open cultivated plateau. 20% gently undulating wooded and cultivated plateau.	**½-inch** Original survey ...	65 I ...	2,804	34·6	16·20	3·21	**19·41**	
....	**1-inch** Correction survey	65 J, M, N ...	178[b] linear miles.	.....	5·82 per	..... linear	**5·82** mile.	(b) Undemarcated portion of the Orissa Province boundary.

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.—*Contd.***
No. 6 (South India) Party.—*Concld.*								
....	**1-inch** Correction survey mapping.	43 D ...	.....	.....	.....	12·08	**12·08**	
....	**3-inch** Guide Map ...	57 G, H ...	.....	.....	.....	96·93	**145·95** (a)	(a) Includes cost of field work reported in 1936.
....	**½-inch** Compiled mapping	43 D, 74 A, B	.....	.....	.....	1·95	**1·95**	
....	**¼-inch** Compiled mapping	65 F, J, K ...	.....	.....	.....	0·36	**0·36**	
....	Colour patterns...	.....	.....	.....	.....	144·2 per sheet.	**144·2 per sheet.**	Total cost of office copy correction and miscellaneous drawing Rs. 19,827.

TABLE C.—Areas, out-turns and cost rates of Surveys, Computations and Mapping.

Party. Class of Work.			Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
						Field work.	Mapping or computations.	Total.	
				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.—Contd.**
No. 10 (Burma) Party.—									
Hills from 500 to 4,000 feet on both sides of the valley of the Sittang river, covered with dense jungle.	1-inch	**Triangulation**	94 A, B, C ...	4,656	291	3·85	1·23	**5·08**	Required supplementing by traverse.
Cultivated plains and low jungle covered hills.	1-inch	**Traverse** ...	94 A, B ...	347·4 linear miles.	35·4 linear miles.	32·20	9·25	**41·45**	Traversing was to supplement triangulation, so areas cannot be given.
Low hills covered with dense jungle.	4-inch	**Traverse** ...	94 C ...	0·8	.....	300·00	.....	**300·00**	Includes computations.
55% sparsely populated jungle covered hills over 3,000 feet; 17% low jungle covered hills; 28% cultivated plains and open undulating plateau.	**1-inch**	Original survey ...	93 D, 94 A ...	3,931	29·1	22·76	6·94	**29·70**	

TABLE C.—Areas, out-turns and Cost rates of Surveys, Computations and Mapping.

Party	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.—*Concld.***
No. 10 (Burma) Party.—*Concld.*								
Jungle covered hills up to 4,000 feet.	**1-inch** Correction survey	93 D ...	534	62·3	10·08	6·94	**17·02**	
Dense jungle	**4-inch** Special forest survey.	94 C ...	0·8	.....	531·25	56·25	**587·50**	
Fair mapping	**¼-inch** Compiled mapping	84 E, F, I, J, 93 J, 94 F.	16,969	.....	.....	.....	**0·81**	
....	..... Preparation of colour patterns.	.....	28 sheets.	.....	.....	175·04 per sheet.	**175·04 per sheet.**	Total cost of office copy corrections & miscellaneous work Rs. 12,660.

V.—SURVEY REPORTS, FRONTIER CIRCLE.

DIRECTOR:— Colonel C. G. Lewis, O.B.E., to 23-10-36.
Lt.-Colonel E. A. Glennie, D.S.O., R.E., from 24-10-36 to 31-10-36.
Colonel S. W. Sackville Hamilton, D.S.O., from 1-11-36.

40. Summary.—The units administered by the Frontier Circle were 'A' and 'E' Companies, No. 18 Party, and No. 6 Drawing Office.

41. Training.—Twelve soldier surveyors were under training in 'A' Company during the field season of whom three reverted to their regiments.

42. Special.—The Director, Frontier Circle, visited the Headquarters of various formations, civil and military in the mobilization area in connection with the future programme of surveys of 'A' Company and No. 18 (Air Survey) Party in the North-West Frontier Province and in the mobilization area (p. 3).

The Officer in charge, No. 6 Drawing Office attended a meeting of the Technical Sub-committee of the Central Quetta Reconstruction Committee held at Delhi on the 18th December 1936 (p. 3).

43. Areas surveyed.—

3,085 square miles of triangulation.
359 linear miles of traversing.
221 linear miles of settlement traverse.
2,132 square miles of $\frac{3}{4}$-inch original survey.
2,326 square miles of 1-inch resurvey.
508 square miles of $1\frac{1}{2}$-inch resurvey.
92 square miles of 3-inch correction survey.
109 acres of 32-inch special survey.
70 acres of 64-inch special survey.

Air survey compilation by 'E' Company and No. 18 (Air Survey) Party.—

436 square miles compiled (1-inch original survey).
348 square miles compiled (1-inch revision survey).

'A' Survey Company.

Officer Commanding.— Lt.-Colonel O. Slater, M.C., R.E., to 29-5-37.
Lieut. C. A. Biddle, R.E., from 30-5-37 to 22-8-37.
Capt. J. B. P. Angwin, R.E., from 23-8-37.

44. General.—The party continued surveys in the Amritsar, Dera Ghāzi Khān, Gujrānwāla, Muzaffargarh and Siālkot districts of the Punjab, Bahāwalpur, Mandi, and Suket States of the Punjab States and Bāghal, Bhajji, and Bilāspur of the Punjab Hill States Agency.

Field headquarters opened at Jhelum on 16th October 1936 and closed on 14th April 1937.

45. Personnel.—The average strength of the party during the year was 2 Class I, 2 Class II, 5 U. S. officers, 37 Lower Subordinates and 12 soldier surveyors under training.

Mr. Duni Chand Puri (Class II) joined "A" Company from No. 6 Drawing Office in October 1936.

Mr. Khushal Khan (U. S. S.) was transferred to No. 6 Drawing Office in June 1937.

46. Areas surveyed.—

130 square miles of triangulation.
105 linear miles of traversing.
221 linear miles of settlement traverse.
2,326 square miles of 1-inch resurvey.
508 square miles of 1½-inch resurvey.

47. Field work was organised as follows:—

Camp (1) under Lieut. C. A. Biddle, R.E. (Class I) with Mr. I. K. Ponnappa (U. S. S.) and 12 to 15 surveyors completed 2,074 square miles of 1-inch resurvey in sheet 39 K.

Camp (2) under Mr. Khushal Khan (U. S. S.) and 3 surveyors completed 254 square miles of 1½-inch resurvey in sheet 53 E.

Camp (3) under Mr. Sardar Khan (U. S. S.) with Mr. Mohd. Akbar (U. S. S.), 1 surveyor, 1 draftsman and 6 second year soldier surveyors completed 254 square miles of 1½-inch resurvey in sheet 53 A.

Two first year soldier surveyors and one pupil were under instruction and did independent work in the same area.

In addition to the above 1 surveyor completed 252 square miles of 1-inch resurvey in sheet 43 L.

Framework.—Mr. I. K. Ponnappa (U. S. S.) and traverser Dial Singh completed 130 square miles of triangulation and 105 linear miles of traverse in sheets 39 J and K to supplement the framework for this season's and next season's area.

Traversing.—At the request of the Punjab Government one traverser was employed on relaying and checking riverain base line stones in Amritsar district. In all 221 linear miles of traverse was completed.

48. Office work.—During the field season two drawing sections of an average strength of 13 surveyors and draftsmen under Mr. O. D. Jackson (Class II) and Mr. D. C. Puri (Class II) completed 12 sheets of arrears fair mapping including two 8-inch sheets of the Dhullian oil drilling lease for the Attock Oil Company. During recess four drawing sections completed 15 sheets which included arrears from correction surveys of previous years. Hence total out-turn during the year was 27 sheets.

'E' Survey Company.

Officer Commanding.—{Lieut. J. S. O. Jelly, R.E., to 6-12-36.
{Lt.-Colonel L. H. Jackson, I.A., from 7-12-36.

49. General.—The party carried out surveys in Kalāt and Las Bela States of Baluchistān, and Karāchi district of Sind, and also a cadastral survey for town planning in Quetta City.

Field headquarters opened at Karāchi on the 20th October 1936 and closed on the 20th April 1937. Camp (1) remained in the field until the end of April.

50. Personnel.—The average strength during the year was 2 Class I officers, 2 Class II, 3 Upper Subordinate officers and 16 Lower Subordinates (excluding 3 clerks, 2 computers and 15 reproduction section personnel).

Lieut. J. S. O. Jelly, R.E. was transferred to No. 18 Party from 24th May 1937.

51. Areas surveyed.—

2,955 square miles of triangulation.
254 linear miles of traverse.
2,132 square miles of ¾-inch original survey.
92 square miles of 3-inch correction survey.
109 acres of 32-inch special survey.
70 acres of 64-inch special survey.
283 square miles compiled from air photographs (1-inch original survey).

52. Field work was organised as follows :—

Camp (1) under Lieut. D. E. O. Thackwell, R.E., from the 9th October 1936 and under Lieut. J. S. O. Jelly, R.E., from the 26th November 1936, with 5 surveyors completed the original survey of 1,063 square miles on the ¾-inch scale in Kalāt and Las Bela States in sheet 35 J. This camp was later reinforced by 2 extra surveyors.

Camp (2) under Mr. Chowdhury Mohd. Aslam (Class II) with 5 surveyors completed the original survey of 1,069 square miles on the ¾-inch scale in Kalāt State.

Quetta Survey Detachment under Mr. Chiragh Shah (U. S. S.) with 3 surveyors completed the special survey of 109 and 70 acres on the 32-inch and 64-inch scales respectively in Quetta City by the 10th January 1937. This detachment then joined the Company at Karāchi.

One surveyor completed 92 square miles of correction survey on the 3-inch scale with the object of bringing the 3-inch Guide Map of Karāchi up to date. This work was carried out under the direct supervision of the Officer Commanding and was completed by the 19th January 1937.

Triangulation.—Mr. Mohd. Najamuddin (Class II) triangulated 2,578 square miles for ¾-inch survey in Kalāt and Las Bela States in sheet 35 K. Mr. Chiragh Shah (U. S. S.) triangulated 377 square miles for the provision of ground control for air survey in sheets 35 P/2 and 6. *Pari passu* with his triangulation, he collected the necessary ground information.

No. 31 (A. C.) Squadron, R. A. F., Karāchi supplied vertical photographs with the F/8 camera of 377 square miles in Karāchi district in sheet 35 P.

Traverse.—Mr. L. R. Howard (U. S. S.) traversed 163 square miles, involving 254 linear miles of theodolite traverse, in Las Bela State in sheet 35 K.

Mr. Chiragh Shah traversed 12 linear miles in Karāchi district in sheet 35 P in conjunction with his triangulation.

53. Office work.—3 surveyors under Mr. V. D. Chopra (U. S. S.) were employed on fair mapping and miscellaneous work throughout the

Cave Dwellings at Gondrani, Las Bela.

field season. During recess, fair mapping was divided into 3 sections. No. 1 section under Mr. Mohd. Najamuddin (Class II) consisted on an average of 5 surveyors, No. 2 section under Mr. Chowdhury Mohd. Aslam (Class II) consisted on an average of 4 surveyors and No. 3 section under Mr. V. D. Chopra (U. S. S.) consisted on an average of 4 surveyors. 6 fair sheets of arrears mapping were completed throughout the year.

Mr. V. D. Chopra in addition to his other duties was employed on sorting out, bringing up to date and listing the records of the Company, including office copies, stocks of maps, "Krab files", indexes &c.

54. Reproduction Section.—This section under Litho.-draftsman Shahabuddin was employed on miscellaneous work throughout the year.

No. 18 (Air Survey) Party.

Officer in charge.—Captain R. C. N. Jenney, R.E.

55. General.—Recess and field headquarters remained at Murree and Risālpur respectively, the latter opening on 16th October 1936 and closing on 12th April 1937.

56. Personnel.—The average strength of the party was 1 Class I, 3 Class II, 3 Upper Subordinate officers, and 19 Lower Subordinates (excluding clerks and reproduction section personnel).

57. Areas surveyed.—

153 square miles compiled (1-inch original survey).
348 square miles compiled (1-inch revision survey).

58. Field work.—

242 square miles photographed vertically.
385 linear miles photographed obliquely.

No. 1 (Indian) Wing Station, R. A. F., Kohāt supplied vertical photographs with the F/8 camera of 242 square miles in tribal territory in sheet 38 H and oblique photographs with the F/8 camera of 385 linear flying miles in tribal territory in sheets 38 G, H, and L for height determination.

Vertical and oblique photography in tribal territory in sheet 38 N, which was to have been carried out by No. 2 (Indian) Wing Station, R. A. F., Risālpur, could not be undertaken owing to technical and political reasons.

59. Compilation.—Compilation was carried out in sheets 38 G, H, L, N, and O. A large part of the work was the contouring by the oblique method of previously compiled outline compilations in sheets 38 G, H, and N. The area compiled for detail only was 172 square miles.

60. Office work.—On the average, five draftsmen under Mr. N. C. Sen were employed on fair mapping and miscellaneous work throughout he year.

5 fair sheets were completed and submitted for publication during the year.

61. Photographic Equipment and Instruments.—
The box of the M. I. O. folding mirror stereoscope was redesigned, in collaboration with S. M. I. O., to form a level table when opened out, with provision for holding down photographs under examination. The change was made to make the instrument more suitable for use by the army in the field and appears to have fulfilled its object.

A Brunsviga Twin 13.Z. calculating machine was received during the year.

62. Co-operation with the Army and R. A. F.—
At the request of the Chief of the General Staff a Field Survey Section was formed under the command of Lieut. J. S. O. Jelly, R.E., for employment in the operations on the N. W. Frontier (Wazīristān) with 2 surveyors, one computer, 25 I. O. R's, and 6 followers.

The Section reported complete at Bannu on 9th June and moved to Dosalli on 10th June. Captain R. C. N. Jenney, R.E., was appointed to command the Survey Depot at Murree in addition to his duties as O. C. No 18 Party.

On July 12th, 13th, 14th and 15th Captain R. C. N. Jenney, R.E., explained methods of air survey to parties of pilots and air gunners from the R. A. F. Hill Depot, Lower Topa.

63. Examination of Frontier Surveys.—The collection of data for this work commenced last year was continued this year and work completed to date, submitted to the Director, Frontier Circle. The area covered included all tribal territory and adjacent administered areas in the N. W. F. P., excluding Dīr, Swāt, and Chitrāl Agency, and North and South Waziristān which latter could not be undertaken due to military operations.

64. Reproduction Section.—For detail of the work of reproduction section see page 67.

VI.—SURVEY REPORTS, GEODETIC BRANCH.

No. 1 Party.

Officer in charge.—{Major G. H. Osmaston, M.C., R.E., to 10-6-37.
Capt. D. R. Crone, R.E., from 11-6-37.

65. General.—The party carried out operations in Central India, Gwalior, Punjab States, Rājputāna, and the United Provinces in sheets 45 K, L, O, and P, 53 I, M, N, O, and 62 B.

The party also carried out survey, including preliminary triangulation, for the production of a Guide Map of Naini Tāl and, at the request of the Partābgarh State Durbar, a large scale survey of Partābgarh Town on payment.

Other operations carried out, on payment, consisted of fixing points for testing range-finders at Rānikhet and the positions of wireless stations at Trimulgherry, Ahmadābād, Bombay, and Jodhpur.

Contributions were received during the year towards their share of the cost of the party survey programme from the States of Bānswāra, Bharatpur, Gwalior, Indore, Jodhpur (Mārwār), Partābgarh, and Tonk, and final payment received from Tehri (Garhwāl) State for their state forest surveys. Surveys in the Himālayas were continued in Tehri State, and Garhwāl and Almora districts in sheets 53 I, M, N, and 62 B.

Owing to weather conditions survey operations in high mountain areas are possible only during spring and autumn, hence personnel took the field from September to November 1936 and again from April to June 1937.

The field headquarters of the Party opened at Dehra Dūn on 29th October 1936 and closed there on 6th April 1937, when it moved to Mussoorie for the recess.

The fair mapping of the Tehri State special forest maps and Himālayan topographical sheets was continued at Dehra Dūn under Messrs. F. J. Grice, J. C. Ross, P. S. Shinghal, and K. A. Sheikh (Class II).

66. Personnel.—The field strength of the party was 1 Class I, 2 Class I probationers, 5 Class II, 4 Upper Subordinate officers, 2 Upper Subordinate probationers, and 45 Lower Subordinates.

67. Areas surveyed.—

1,026 acres of 32-inch original survey.
5 square miles of 8-inch original survey.
70 square miles of 1-inch original photo-survey.
2,386 square miles of $\frac{3}{4}$-inch original survey.
137 square miles of $\frac{3}{4}$-inch revision survey.
9,121 square miles of $\frac{1}{2}$-inch original survey.

68. Field work was organized as follows:—

Himālayas.—Autumn (1936) season.

Camp (1) consisting of Mr. K. A. Sheikh (Class II) with 2 surveyors completed 260 square miles of original survey on the $\frac{3}{4}$-inch scale in sheet 53 N in the Kedārnāth area including the catchments of the Kāli and Madhyamaheshwar rivers above Ukhimath.

Camp (*2*) consisting of Mr. I. D. Suri (U. S. S.) with 5 surveyors completed 416 square miles of original survey on the $\frac{3}{4}$-inch scale in sheets 53 M and N. The area includes the whole catchments of the Saraswati, Arwa and Alaknanda rivers above Māna. This camp which contained several men new to high mountain conditions was seriously handicapped by the death of Mr. Suri on 9th October 1936, soon after the surveyors had reached their areas.

Camp (*3*) consisting of Mr. J. N. Kohli (U. S. S.) with 2 surveyors completed 368 square miles of original survey on the $\frac{3}{4}$-inch scale in sheets 53 I, M, and N to complete the northern area of Tehri State up to the Tibetan frontier in the Nelang area and also a small area near Jamnotri.

Camp (*4*) consisting of Mr. J. C. Ross (Class II) with 1 Class II, 1 U. S. S., and 4 surveyors completed 345 square miles of original survey on the $\frac{3}{4}$-inch scale in sheet 53 N in the area south and west of Trisūl. The catchment areas of the Birehīganga, Nandākini, and Kālīganga rivers were completed but bad weather and disaffection amongst the local coolies prevented the head waters of the Pindar river from being completed.

Major Osmaston assisted by Mr. E. Shipton completed 117 square miles of $\frac{1}{2}$-inch reconnaissance survey round Nanda Devi in sheets 53 N and 62 B. Major Osmaston took photographs from twelve photo-theodolite stations in the Nanda Devi "inner sanctuary" which provide material for mapping 70 square miles of the basin.

Mr. Shipton also took photographs for the mapping of about 38 square miles in the Rinti Nāla. The remainder of the Rishiganga catchment area was completed by Surveyor Fazal Elahi by planetabling on $\frac{3}{4}$-inch scale (102 square miles).

Weather.—The camps and Major Osmaston left Mussoorie at the end of August 1936 *i.e.* towards the end of the monsoon and proceeded to the field. Cloudy conditions with frequent heavy rain and snowfalls continued till the middle of September. From then the weather gradually cleared up, but it was not till the middle of October that really good weather was experienced south of the Great Himālaya Range.

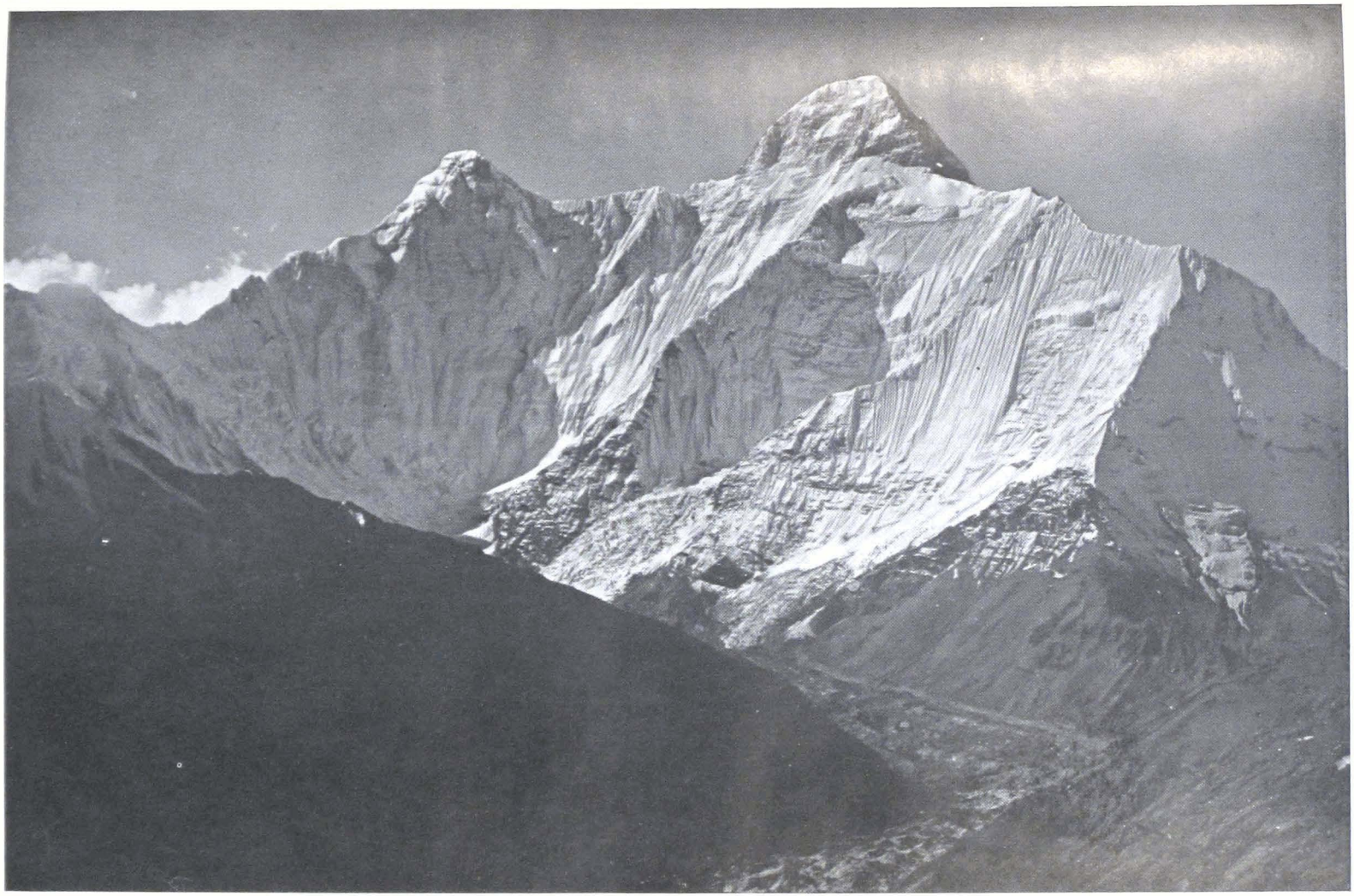
The inhabitants of the higher villages from which the majority of coolies was drawn, leave for lower altitudes, because of the cold, about the middle of November. The period for survey after the monsoon is therefore very limited. The camps returned to Dehra Dūn in November.

Himālayas.—Spring (1937) season.—Survey personnel left Dehra Dūn early in April 1937.

Camp (*1*) consisting of Mr. J. C. Ross (Class II) with 5 surveyors completed 519 square miles of original survey and 137 square miles of revision survey on the $\frac{3}{4}$-inch scale in sheet 53 N.

Camp (*2*) consisting of Mr. J. N. Kohli (U. S. S.) with 3 surveyors and 2 R. E. officers on probation completed 344 square miles of original survey on the $\frac{3}{4}$-inch scale in sheet 53 N.

Surveyor Bhola Datta surveyed 134 square miles on the $\frac{3}{4}$-inch scale in sheets 53 N and 62 B thus completing the area left unsurveyed by camp (4) in November, 1936.



Nanda Devi.

Mr. P. S. Shinghal (Class II) with 3 surveyors completed 5 square miles of original survey on the 8-inch scale of Naini Tāl town and cantonment areas and surrounding country in sheet 53 O/7.

Rājputāna, Central India and Gwalior.—

Camp (*5*) consisting of Mr. T. M. C. Alexander (Class II) with Messrs. A. G. Qureshi and M. W. Kalappa (U. S. S.) as assistants with 2 U. S. S. probationers and 29 Lower Subordinates completed 9,121 square miles of original survey on the ½-inch scale in the States of Būndi, Gwalior, Indore, Jaora, Jhālawār, Kotah, Partābgarh, Sītāmau, Tonk, and Udaipur (Mewār) in sheets 45 K, L, O and P.

This camp also completed 1,026 acres of special survey on the 32-inch scale, with contours at 5 feet intervals of Partābgarh city and surroundings.

69. Extent and nature of country.—

Himālayas.—The work was centred on Joshīmath and consisted of the Alaknanda valley up to Badrīnāth and also the Dhauliganga and tributary valleys as far as the Niti pass on the Tibetan border.

This area included the well known peaks of Nilkanta, Kāmet, Māna, Gauri Parbat, Hāthi Parbat, and Dūnagiri. Most of the higher areas were practically unexplored and many new features were surveyed for the first time.

The country above 8,000 feet is snowbound and uninhabited in the winter months, but well-built villages exist up to 11,000 feet and grazing grounds up to 14,000 feet are visited in the summer.

Rājputāna, Central India and Gwalior.—

The country consisted mainly of low hill ranges and plateaux covered with scrub jungle and rather arid cultivated plains.

In general, rocks lie on or close to the surface of the ground, there is little soil and the majority of water courses are dry and water is scarce. Water is obtained from wells and in some parts the shortage is overcome by damming the streams.

There are few good roads and although many cart tracks exist, there are many places where these do not cross the steep hill scarps and coolies have to be used.

70. Miscellaneous.—A few cases of malaria occurred in the Central India camp but otherwise the health was good.

In the Himālayas the altitude put a number of the older khalasis out of action. The health of the surveyors was, on the whole, good though one or two suffered from stomach troubles and lack of sleep. Mr. I. D. Suri (U. S. S.) died on the 9th October 1936 on a glacier near the source of the Arwa river from heart failure. He was engaged at the time in inspecting the work of one of his surveyors.

Surveyor Miān Muhammad was killed on the 24th May by falling into a crevasse while working in the Kosa Glacier.

One khalasi and two coolies died.

71. Recess duties.—Fair mapping of the Himālayan and Tehri-Garhwāl State forest sheets was continued and the fair mapping of the area surveyed by camp (5) and the Naini Tāl Guide Map was taken up.

70 square miles of the Nanda Devi basin was surveyed from photographs on the 1-inch scale by the Canadian method by Captain Crone and Surveyors Bhola Datta and Rai Singh.

No. 20 (Cantonments) Detachment.

Officer in charge.—Mr. A. J. A. Drake, D.C.M.

72. General.—The detachment re-surveyed cantonments and their bāzārs on the 16-inch and 64-inch scales respectively, in accordance with the programme approved by the Engineer-in-Chief and the Defence Department.

The field season commenced on 19th October 1936 and closed on 30th April 1937, field headquarters remaining at Dehra Dūn.

Personnel.—The field strength, excluding the officer in charge, was 3 U. S. Officers and 30 Lower Subordinates, including 4 draftsmen, 4 computers and 2 clerks employed at field headquarters.

73. Areas surveyed.—

16-inch original survey.

Indian Military Academy and skeleton plot of Forest Research Institute boundary, Dehra Dūn.	318·0 acres.

16-inch re-survey.

Rāwalpindi Cantonment	6,494·4 acres.
Chaklāla ,, ...	3,617·4 ,,
Abbottābād ,, ...	1,615·9 ,,

The above areas include overlaps.

64-inch re-survey.

Rāwalpindi Cantonment Bāzārs	230·1 acres.
Abbottābād ,, ,, ...	13·2 ,,
Cawnpore ,, ,, (showing Holdings).	142·4 ,,

74. Field work was organised as follows:—

Camp (1) with headquarters at Chaklāla and later at Cawnpore under Mr. J. A. Cabral (U. S. S.) with 1 U. S. Officer, 7 surveyors and 2 traversers, completed the detail survey of Chaklāla, Abbottābād, the bāzārs at Cawnpore, and the advance traversing of the bāzārs at Cawnpore. The detail survey of the Indian Military Academy at Dehra Dūn was completed by 2 surveyors before the commencement of the field season under the supervision of Mr. J. A. Cabral (U. S. S.) from recess headquarters.

Camp (2) with headquarters at Rāwalpindi under Mr. Bakhshi Harnam Singh (U.S.S.) with 10 surveyors and 2 traversers, completed the detail survey of Rāwalpindi and the advance traversing and levelling of Mardān, Kohāt and Peshāwar Cantonments.

75. Traversing and Levelling.—39·8 linear miles of traversing and 1·7 linear miles of levelling were completed for the current season's survey at Cawnpore and Rāwalpindi.

229·7 linear miles of traversing and 62·9 linear miles of levelling were completed for the next season's survey.

16·1 linear miles were traversed in connection with changes of cantonment boundaries of Lahore and Cawnpore, and the position of a new boundary pillar was fixed at Nowshera.

7·9 linear miles were traversed at Rikhikesh to fix the boundary of the Notified Area at the request of the President of the Committee. The northern portion of this boundary was not fixed as it is still in dispute.

Nine range testing points were fixed at Mardān at the request of the Officer Commanding, Guides Cavalry (10th Q. V. O., F. F.).

76. Recess duties.—Fair mapping was allotted to two main sections during recess under Messrs. J. A. Cabral and Bakhshi Harnam Singh, the latter also supervising the computation section.

A section of 4 draftsmen and 4 computers under the supervision of the Officer in charge, was employed throughout the field season to deal with arrears of mapping and computations of the advance frame work.

30 sheets on the 16-inch scale and 9 sheets on the 64-inch scale of Jubbulpore*, Nasīrābād*, Dehra Dūn*, Fort Sandeman*, Dharmsāla*, were completed and sent for publication, while 20 sheets on 16-inch scale and 16 sheets on 64-inch scale of Rāwalpindi, Chaklāla, Abbottābād and Cawnpore and of the Indian Military Academy with a skeleton boundary plot of the Forest Research Institute, comprising the current season's mapping were partially completed.

The computations of the traversing and levelling carried out in the season were also completed during recess.

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* Arrears mapping.

VII.—SURVEY REPORTS, EASTERN CIRCLE.

DIRECTOR:—Colonel F. J. M. King, R.E.

77. Summary.—The units administered by the Eastern Circle were Nos. 4, 5 and 12 Parties, and No. 5 Drawing Office.

The Director, Eastern Circle, also acted as technical adviser to the Government of Assam till 31st March 1937.

78. Areas surveyed.—

3,295 square miles of ½-inch original survey.
8,467 square miles of 1-inch original survey.
5 square miles of 4-inch special survey.
1·4 square miles of 4-inch special forest survey.
22 square miles of 16-inch special air survey.
5 linear miles of boundary demarcation by planetable traverse.
3,067 square miles of triangulation.
3,866 square miles and 727 linear miles of traverse.
540 square miles of supplementary triangulation.
62 square miles of triangulation for 16-inch special air survey.
44 linear miles of traverse for 16-inch special air survey.
138 linear miles of tertiary levelling for 16-inch special air survey.
900 square miles of reconnaissance.

79. Air Survey.—The work done in connection with the air survey of Jamshedpur is described in No. 5 Party's report (p. 45).

80. Training.—There were 5 probationers of Class II Service under training all of whom were confirmed in their appointments. Also 3 U. S. probationers who were transferred to this Circle, were under training.

No pupils were recruited during the year under report.

81. Special.—The Director, Eastern Circle, inspected No. 6 (S.I.) Independent Party in the field.

No. 4 Party.

Officer in charge.—Mr. C. H. Tresham, V.D.

82. General.—The party continued surveys on the 1-inch scale in Bhāgalpur, Purnea and Santāl Parganas districts of Bihār and Mālda district of Bengal in sheet 72 O, and carried out traverse in advance for subsequent survey in Bhāgalpur, Darbhanga and Muzaffarpur districts of Bihār in sheets 72 F and J.

Field headquarters opened at Bhāgalpur on 16th November 1936 and closed on 14th April 1937.

83. Personnel.—The field strength consisted of one Class I officer, 4 Class II officers, 4 Upper Subordinate officers, 3 Upper Subordinate probationers under training, 25 surveyors, 3 traversers, 5 computers, 3 clerks and one store-keeper.

Messrs. J. L. Sahgal and G. H. Khan (Class II) joined the party in October 1936.

Messrs. A. R. Quraishi and Abdul Ahad (Class II) were transferred to No. 12 Party in October 1936.

Mr. F. M. Hawley (Class II) rejoined from leave out of India in November 1936.

84. Areas surveyed.—

3,866 square miles of traverse.

4,299 square miles of 1-inch original survey.

85. Field work.—was organised as follows:—

Camp (1).—Mr J. L. Sahgal (Class II), assisted by Mr. G. H. Khan (Class II) up to 31st January 1937, with 1 U. S. officer, 1 U. S. probationer and 9 to 10 surveyors completed 1,592 square miles of original survey on the 1-inch scale in sheet 72 O in Bhāgalpur and Purnea districts of Bihār and Mālda district of Bengal.

Camp (2).—Mr. J. C. Berry (Class II) with 1 U. S. officer, 1 U. S. probationer and 7 to 8 surveyors completed 1,366 square miles of original survey on the 1-inch scale in sheet 72 O in Bhāgalpur, Purnea and Santāl Parganas districts of Bihār and Mālda district of Bengal.

Camp (3).—Mr. F. M. Hawley (Class II) with 1 U. S. officer, 1 U. S. probationer and 7 to 8 surveyors completed 1,341 square miles of original survey on the 1-inch scale in sheet 72 O in Bhāgalpur and Purnea districts of Bihār.

Camp (4).—Mr. J. R. Chibbar (U. S. S.) to 6th February 1937 and Mr. G. H. Khan (Class II) from 7th February 1937 with 4 traversers and 4 computers completed 1,372 linear miles of theodolite traverse, covering an area of 3,866 square miles, for 1-inch surveys in sheets 72 F and J in Bhāgalpur, Darbhanga and Muzaffarpur districts of Bihār.

86. Description of country.—

The Ganges flows through the area from west to south-east dividing it into two parts which present very different characteristics. South of the river the Rājmahāl hills rise steeply from the plain to a height of about 2,000 feet above sea-level. West of these hills the country falls away in undulations broken by isolated hillocks and ridges. North of the river is a flat alluvial plain intersected by rivers and innumerable natural drainage channels. Parts are low-lying and are never completely dry.

With the exception of the hills the greater part of the area is extensively cultivated and thickly populated. Road and railway communications are good.

87. Miscellaneous.—

The health of the party was fairly good. There wer a few cases of malaria and two khalasis died.

88. Recess duties.—The 16 1-inch sheets surveyed during the field season were fair-mapped during recess by three sections under Messrs. J. L. Sahgal, J. C. Berry and F. M. Hawley respectively.

Traverse computations were completed under Mr. G. H. Khan.

No. 5 Party.

Officer in charge.— Captain I. H. R. Wilson, R.E., to 13-11-36, and from 26-4-37.
Lt.-Colonel F. B. Scott, I.A., from 14-11-36 to 9-4-37.
Mr. B. N. Saha, M.Sc., from 10-4-37 to 25-4-37.

89. General.—Topographical survey on the scale of 1-inch to a mile was continued in the Drug and Raipur districts of the Central Provinces, the Koraput district of Orissa and in the Eastern States Agency, in sheet 64 H.

Triangulation for topographical survey was carried out in the Ganjām district of Orissa and in the Eastern States Agency in sheet 64 P. Some triangulation was done to connect the existing traverse data of Jamshedpur town to Survey of India triangulation. About 138 linear miles of tertiary levelling was run to fix heights for the air survey of Jamshedpur town, and about 44 linear miles of traversing covering about 22 square miles was run to fix points in the same area. Inking up of the rectified prints for the maps of this area was carried out on the ground, contours being entered where necessary. In addition a special rapid contour survey of a small area near the Dimna nala, north of Jamshedpur, was carried out.

About 5 linear miles of the village boundary of Kumarmara in the Dhamtari Tahsīl of Raipur district was demarcated.

Field headquarters remained at Raipur; the field season opened on 6th November 1936 and closed on 14th April 1937.

90. Personnel.—The field strength consisted of the officer in charge, 6 Class II officers, 6 U. S. officers, 25 surveyors, 1 traverser, 3 computers, 3 clerks and 1 store-keeper.

91. Areas surveyed.—

3,067 square miles of 1-inch original survey.
22 square miles of 16-inch special air survey.
5 square miles of 4-inch special survey.
5 linear miles of boundary demarcation by planetable traverse.
3,067 square miles of triangulation for ½-inch and 1-inch survey.
62 square miles of triangulation for 16-inch special air survey.
138 linear miles of tertiary levelling for 16-inch special air survey.
44 linear miles of traversing for 16-inch special air survey.

92. Field work was organised as follows:—

Camp (1).—Mr. B. N. Saha (Class II) with Mr. K. C. Gosain (Class II) up to 11th January 1937, and 8 surveyors completed 835 square miles of original survey on 1-inch scale in sheet 64 H falling in Drug and Raipur districts, and Kānker State. The surveyors in this camp were under training.

Camp (2).—Mr. C. T. Hurley (Class II) with Messrs. A. R. Khan and S. B. P. Mathur (U. S. S.) and 9 surveyors completed 1,116 square miles of original survey on 1-inch scale in sheet 64 H falling in Drug district and Kānker and Bastar States.

Camp (3).—Mr. M. A. Khan (Class II) with Messrs. I. H. Naquvi and G. S. Sidhu (U. S. S.) and 7 surveyors completed 1,116 square miles of original survey on 1-inch scale in sheet 64 H falling in Raipur (C. P.) and Koraput (Orissa) districts and in Kānker and Bastar States.

Triangulation.—Messrs. H. H. Phillips and Tirlochan Singh (Class II) and Mr. Mohabat Ali (U. S. S.) completed the triangulation of 3,067 square miles in sheet 64 P falling in Ganjām district and in Baudh, Kālāhandi, Patna and Sonepur States.

Jamshedpur Air Survey.—Mr. Muzaffar Hussain (U. S. S.) with 3 surveyors, 1 traverser and 1 computer completed the groundwork for the 16-inch special air survey map of Jamshedpur. This consisted of.—

(*a*) 62 square miles of triangulation to connect the traverse framework to survey triangulation.

(*b*) 138 linear miles of tertiary levelling run to fix spot heights in the congested town area, and to control the contouring of the more open areas.

(*c*) 44 linear miles of traverse covering about 22 square miles.

(*d*) Inking up and contouring 61 16-inch rectified blue-toned enlargements on correctostat paper, comprising 12 sheets of the town and surrounding country. Inking up of blue-toned enlargements enables drawing blue prints to be prepared by direct photography.

In addition to this at the request of the Tata Iron & Steel Company Limited, one surveyor was deputed to carry out a rapid contour survey on 4-inch scale (10 feet interval) of an area of about 5 square miles near the Dimna nala in the Mānbhūm district, just north of Jamshedpur.

Kumarmara boundary demarcation.—At the request of the Malguzar of Kumarmara village (Raipur district) Mr. G. S. Sidhu (U. S. S.) was deputed to relay about 5 miles of the boundary of the village, falling in sheet 64 H/13. This was done by planetable traverse on the 16-inch scale, the line being relayed from the boundary shown on a trace of an old settlement map.

93. Description of country.—The area under survey consists mostly of flat-topped hills and undulating ground covered with fairly dense jungle, interspersed with patches of cultivation in which the tree growth is often as dense as in uncultivated areas. The difficulty of making fixings by resection necessitated a great deal of plane-table traversing, and progress was consequently slow. The northernmost portion of the area is an open cultivated plain.

94. Miscellaneous.—The health of the party was not good except in camp (1) which was working in the early part of the season in the open northern plain. A large proportion of the personnel who commenced work in jungle-clad area suffered from malaria.

95. Recess duties.—The party was organised in two drawing sections under Messrs. C. T. Hurley and M. A. Khan (both Class II), which completed the drawing of the 11 sheets surveyed. Mr. B. N. Saha (Class II) was in charge of the drawing hall and typers, and he also supervised the drawing of the Jamshedpur air survey work which was carried out under Mr. Muzaffar Husain (U. S. S.). All the fair drawing was completed by the end of recess. The computation section under

Mr. G. S. Sidhu (U. S. S.) till 15th July 1937, and then under Mr. S. B. P. Mathur (U. S. S.) completed all the triangulation computations in hand. Messrs. H. H. Phillips and Tirlochan Singh (Class II) and Mr. Mohabat Ali (U. S. S.) completed their own triangulation computations.

No. 12 Party.

Officer in charge.— Lt.-Colonel T. M. M. Penney, R.E., to 3-1-37.
Captain I. H. R. Wilson, R.E., from 4-1-37 to 25-4-37.
Mr. W. H. Strong, M.B.E., from 26-4-37 to 18-5-37.
Captain R. H. Sams, R.E., from 19-5-37.

96. General.—The survey operations of the party in sheets 84 B and 84 C included the survey of parts of Chittagong district and Chittagong Hill Tracts of Bengal on the 1-inch and ½-inch scales, part of Akyab district and the completion of the Arakan Hill Tracts of Burma on the ½-inch scale; also 1·4 square miles of 4-inch special forest surveys in Akyab district.

Triangulation and traverse for future 1-inch surveys were carried out in Noākhāli and Chittagong districts and Chittagong Hill Tracts of Bengal in sheets 79 N and O and reconnaissance for triangulation in 1937-38 in Goālpāra district and Gāro Hills of Assam.

The field headquarters of the party opened at Cox's Bāzār on 4th November 1936 and closed on 9th April 1937.

97. Personnel.—The strength of the party was 1 Class I, 8 Class II (including 3 under training), 4 Upper Subordinate officers and 45 Lower Subordinates including 34 surveyors.

98. Areas surveyed.—

3,295 square miles of ½-inch original survey.
1,101 square miles of 1-inch original survey.
1·4 square miles of 4-inch special forest survey.
540 square miles of supplementary triangulation for 1-inch survey.
727 linear miles of traversing.
900 square miles of reconnaissance.

The triangulation was necessary to supplement parts of last season's work, which was not considered sufficient.

99. Field work was organised as follows.—

Camp (1).—Mr. W. H. Strong, M.B.E. (Class II) with Mr. M. M. Ganapathy (Class II) as instructor to three Class II officers under training, and 6 surveyors completed 1,109 square miles of original survey on ½-inch scale in sheet 84 C. Of this area, 1·4 square miles was also completed on the 4-inch scale as a special forest survey.

Camp (2).—Mr. K. L. Dhawan (Class II) with 8 surveyors completed 1,105 square miles of original survey on ½-inch scale in sheet 84 C.

Camp (3).—Mr. A. R. Quraishi (Class II) with Mr. S. K. Guha (U. S. S.) and 9 surveyors completed 553 square miles of original survey on the 1-inch scale and 553 square miles on the ½-inch scale in sheet 84 C.

Camp (4).—Mr. A. Ahad (Class II) with Mr. A. P. Datta (U. S. S.) and 11 surveyors, completed 548 square miles of original survey on the 1-inch scale and 528 square miles on the ½-inch scale in sheet 84 B.

In camps (3) and (4) blue print reductions on the 1-inch scale of part of Chittagong district were utilised to advantage. The material for these blue prints was obtained from the latest Thāna maps on the 1-inch scale and from the 4-inch air surveys of the hill portions of Chittagong district.

Triangulation.—Mr. Hari Singh (U. S. S.) carried out supplementary triangulation of some 540 square miles in sheet 79 N and reconnaissance of 900 square miles for triangulation to be done in 1937-38 in sheet 78 G.

Traverse.—Rigorous traverse was carried out over the whole of sheets 79 N and O for the 1-inch survey for season 1937-38.

A total of 727 linear miles of traverse was completed by the party.

100. Description of country.—The area surveyed in Camps (1) and (2) fell mainly in Burma—the Arakan Hill Tracts and Akyab district. The western portion fell in Chittagong Hill Tracts, a large part of which consisting of the reserved forests of Mātāmuhari, Rankhiang, and Sangu.

The country is divided by parallel ridges running north and south and rising from sea level to about 4,000 feet. There were no topographical intricacies in the country but the entire area was covered with dense jungle.

There was a fair amount of *jhūm* land which was a great help to surveyors but there were practically no communications.

Camps (3) and (4) area lay in the foot hills of the Chittagong Hill Tracts and the open plains of Chittagong district. The drainage in the foot hills was tortuous and much traversing was necessary. There was a quantity of *jhūm* land which helped the work, and communications were fairly good.

101. Miscellaneous.—

Health.—There were several cases of severe malaria and most of the men in the party had had an attack or two sometime during the season. In Camp (1) an interpreter died very suddenly from some form of stomach complaint which may have been cholera.

Weather.—Throughout the season the weather remained fair.

Fauna.—Most of the area abounded with big game, herds of wild elephants were seen, and in the Chittagong Hill Tracts and Burma there were also tiger, leopard, bear, and the smaller species of deer.

Jungle fowl and pheasants in profusion were to be found in the hills and snipe and duck in the low country in Chittagong district.

102. Recess duties.—The party was organised in two drawing sections under Messrs. A. R. Quraishi and A. Ahad (both Class II).

Mr. W. H. Strong, M.B.E. (Class II) was in charge of the drawing hall, and supervised the work of the two drawing sections.

The four ½-inch sheets, four 1-inch sheets and the two small blocks of reserved forest surveyed during the season were fair mapped.

The computations for the triangulation and traverse carried out during the field season were completed by the end of recess.

VIII.—SURVEY REPORTS, INDEPENDENT PARTIES.

103. Nos. 6 (South India) and 10 (Burma) Independent Parties were administered directly by the Surveyor General. Their mapping and survey areas were approximately the same as those of the former Southern and Burma Circles respectively, abolished in 1932.

No. 6 (South India) Party.

Officer in charge.—Major G. W. Gemmell, I.A.

104. General.—The Party continued surveys on 1-inch and ½-inch scales in Orissa and Bastar and Kālāhandi States of Eastern States Agency. Theodolite traverse was completed for the control of next season's 1-inch survey in Madras. Party field head-quarters was at Vizianagaram.

105. Personnel.—Field strength was 1 Class I, 3 Class II and 6 U. S. S. officers, 43 surveyors and an attached Military Sub-Assistant Surgeon.

The strength of the permanent Drawing Section at Bangalore engaged on compiled mapping, computing, and miscellaneous drawing was 1 Class II and 2 U. S. S. officers, 5 draftsmen, 9 surveyors, and 2 computers.

Mr. N. S. Harihara Iyer (Class II) joined the Party at Bangalore on 27th March 1937 from No. 2 Drawing and Forest Map Office.

Mr. M. D. Nangia (Class II) proceeded on 5 months leave *ex*-India on 20th April 1937.

One U. S. S. officer joined the Party from No. 1 Party and one U. S. S. officer was transferred to No. 10 (Burma) Party.

106. Areas surveyed.—

1,681 square miles of 1-inch original survey.
2,804 square miles of ½-inch original survey.
178 linear miles of boundary survey.
787 linear miles of theodolite traverse for control of approximately 2,327 square miles of future 1-inch survey.

107. Field work was organised as follows:—

Camp (1).—Mr. M. D. Nangia (Class II) with 1 U. S. S. officer and 12 surveyors completed original survey on 1-inch scale of 561 square miles of Bastar State and Koraput district of Orissa in sheet 65 I. Also, original survey on ½-inch scale of 561 square miles of Koraput district of Orissa in sheet 65 I.

Camp (2).—Mr. M. R. Nair (Class II) and 7 surveyors completed original survey on ½-inch scale of 1,123 square miles of Kālāhandi State and Koraput district of Orissa in sheet 65 I.

Camps (3) & (4).—Mr. Muhammad Abdul Azim, I.D.S.M. (U. S. S.) and Mr. K. B. Muthanna (U. S. S.) with 8 surveyors completed original survey on ½-inch scale of 1,120 square miles of Kālāhandi State, Koraput district of Orissa and Raipur district of Central Provinces in sheet 65 I.

Bison head Maria dancers.

Camp (5).—Mr. P. A. Thomas with 1 U. S. officer and 16 surveyors completed original survey on 1-inch scale of 1,120 square miles of Kālāhandi State and Koraput district of Orissa in sheet 65 M.

Traverse.—Messrs. M. L. Kohli, K. B. Muthanna and A. Shamanna (U. S. S.) completed 787 linear miles of theodolite traverse in the Kistna and West Godāvari districts of Madras.

108. Description of country.—The country surveyed consists for the most part of sparsely inhabited wooded hills with narrow cultivated valleys extending into cultivated and in parts heavily forested riverain plain. Water is generally plentiful. Communications are poor. Such roads as have been built avoid the hills where coolie transport has to be depended on entirely for the transport of baggage.

109. Miscellaneous.—The whole area is malarious. No period is considered entirely free from the possibility of infection. Local opinion favoured the period November to March as the best survey period in the open riverain plain and January to April as the best period in the hills. The programme of work was arranged accordingly. *Quinine* prophylactic measures were taken. Some members of the Party again suffered from malaria, but the sick figures showed an improvement on the previous year when the general health of the Party was poor.

110. Recess duties.—Fair mapping of the season's original survey was completed by two Sections under Mr. M. R. Nair, and Mr. P. A. Thomas. A Section under Mr. N. S. Harihara Iyer assisted by Messrs. Muhammad Abdul Azim, I.D.S.M., and K. B. Muthanna re-drew 7 Frontier Circle 1-inch sheets which had been corrected in the field by 'A' Company. Mr. N. S. Harihara Iyer also supervised the work of the Computing Section. The Drawing Section under Mr. E. N. Natesan, completed the fair mapping of the Bangalore Guide Map and was engaged on compiled mapping throughout the year.

No. 10 (Burma) Party.

Officer in charge.—{Capt. J. B. P. Angwin, R.E., to 6-11-36.
Major G. F. Heaney, R.E., from 7-11-36.

111. General.—The party continued topographical surveys on the 1-inch scale in Upper Burma and the Southern Shan States. A small reserved forest extension in Pegu district was also surveyed on the 4-inch scale.

Party headquarters opened at Meiktila on 19th November and closed on 5th May.

After the separation of Burma from India on April 1st the party was paid for entirely by the Government of Burma; but the Surveyor General of India continued to exercise technical and administrative control.

112. Personnel.—The field strength consisted of 1 Class I, 3 Class II, 3 Upper Subordinates, and 28 Lower Subordinates. In addition a Drawing Section consisting of 1 Class II Officer, 10 draftsmen, 4 surveyors, and 1 computer remained behind in Maymyo in the compiled mapping section of the party. Of these, 4 surveyors would normally

have been on the field strength but had to remain behind to complete the previous season's primary mapping which had been delayed on account of the claims to personnel of the Sino-Burmese Boundary Survey Party.

In March it became evident that the triangulation being carried out for next season's work would require considerable supplementing by traverse. A traverse camp was therefore formed under Mr. A. K. Sen Gupta (U. S. S.) who had been left in Maymyo for the first part of the season, and at the same time two surveyors and a computer were called out to the field from Maymyo to assist traversing and to help on topographical work which was rather behindhand.

113. Areas surveyed.—

4,656 square miles of triangulation for 1-inch survey.
11 linear miles of traversing for 4-inch special forest survey.
347 linear miles of traversing for 1-inch survey.
3,931 square miles of 1-inch original survey.
534 square miles of 1-inch correction survey.
0·8 square miles of 4-inch special forest survey.

114. Field work was organised as follows:—

Camp (1).—Mr. F. W. Smith (Class II) and 10 surveyors completed the 1-inch original survey of 1,678 square miles in Karenni, the Southern Shan States, Toungoo and Yamethin districts in sheets 93 D and 94 A.

Camp (2).—Mr. C. P. E. Davenport (Class II) and 9 surveyors completed the 1-inch original survey of 1,192 square miles and 1-inch correction survey of 204 square miles in Yamethin district and the Southern Shan States in sheet 93 D.

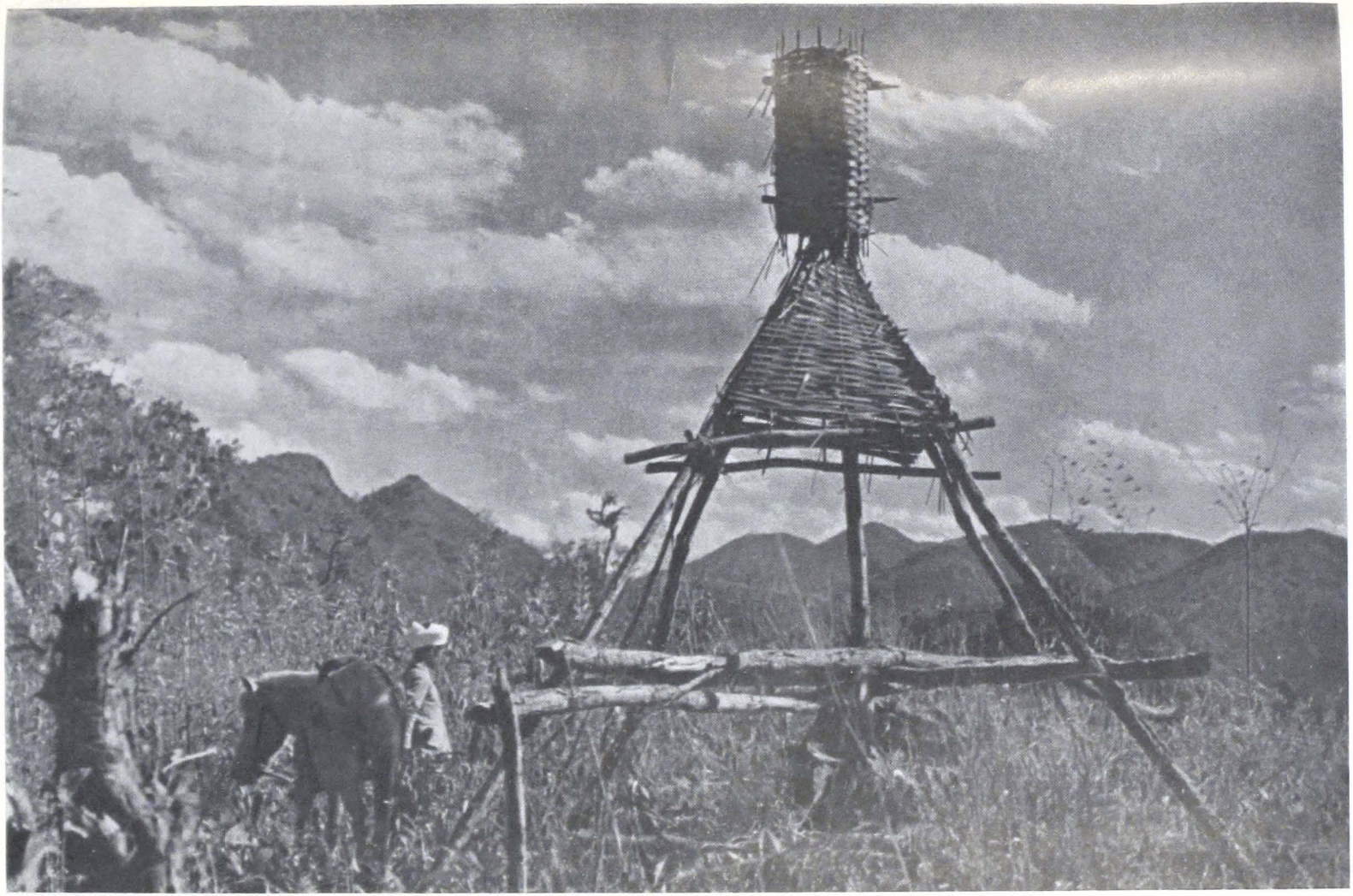
Camp (3).—Mr. D. N. Saha (Class II) with 8 surveyors completed the 1-inch original survey of 1,061 square miles and 1-inch correction survey of 330 square miles in Meiktila and Yamethin districts and the Southern Shan States in sheet 93 D.

Mr. A. K. Talapatra surveyed the Salu Extension Reserve Forest in Pegu district (0·8 square miles) on a scale of 4-inches to a mile in sheet 94 C.

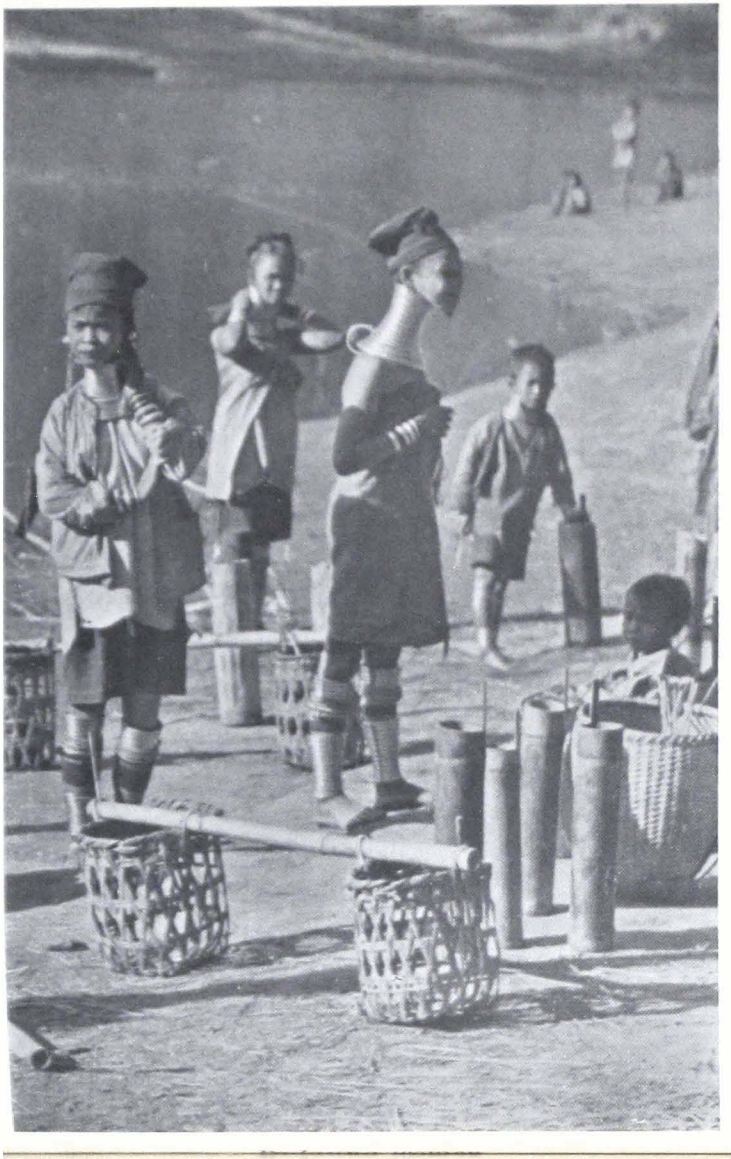
Traversing.—In March a traverse camp was formed. Mr. A. K. Sen Gupta was in charge and was assisted by one traverser and one computer and the four triangulators referred to below. The function of this section was to fix points by traverse to supplement the work of triangulators in sheets 94 A and B. In doing this 347 linear miles of traversing were run, for the most part through low hills covered with dense jungle.

In addition to the above Mr. A. K. Talapatra ran 11 linear miles of traverse to provide a frame work for his 4-inch survey in the Salu Extention Reserve Forest.

Triangulation.—Messrs. H. K. Kar, A. K. Talapatra (U. S. S.) and surveyors Iqbal Muhammad and Saiyid Muhammad Bukari carried out 4,656 square miles of triangulation for 1-inch surveys in sheets 94 A, B and C. Much of the country consisted of low hills covered with dense jungle with practically no outstanding features, so their work required considerable supplementing by traverse. Part of this has been carried out this season and the remainder will be completed early next season.



Minor Triangulation Beacon, Southern Shan States.



115. Description of country.—The area surveyed consisted of plains, foothills, and a portion of the south-west corner of the Shan plateau. The plains were typical of the dry belt of Burma—cultivated areas interspersed with scrub jungle—and presented no features of special interest. Large areas of the foothills were uninhabited and covered with nearly impenetrable jungle through which surveyors had laboriously to cut their way. Food supply, transport, and, late in the season, water supply, were all difficult and costly to arrange. On the Shan plateau there was much open ground, some of which provided easy surveying, but much of it was very intricate and called for very careful work. The underlying rock here is a very porous limestone which seldom holds water. The result is that over large areas normal drainage systems, consisting of streams along the main valleys fed by tributaries from the surrounding hills, do not exist. What few streams there are disappear into the ground and appear again later in the most unexpected way, and large areas consist of a maze of "devil's cauldrons". These vary in size from pot holes a few yards in diameter to regular internal drainage systems some miles in extent. To get the topography correct the surveyor cannot rely on fixing the main features from a distance and "sketching" in the rest, but must go carefully over every piece of his ground. The rocky peaks which are a feature of this country had enabled triangulators to fix numerous excellent points; but in spite of the ease with which they could obtain fixings the progress of surveyors was necessarily slow.

The southern portion of the Inle lake in Yawnghwe State, falls in the area under survey. According to the old maps its southern end in 1895 was at Nanpan. Since then a large area of the valley of the Balu Chaung has been flooded and perennial water now reaches to the vicinity of Mwepaung about ten miles further south.

According to local report this flooding took place about twenty years ago and must have resulted in the loss of a great deal of valuable rice land. The newly flooded land is covered with tall grass through which the old channel of the Balu Chaung provides a wide channel of clear water.

116. Miscellaneous.—Health on the whole was good in spite of the evil reputation which the foothills have for malaria. This is probably accounted for partly by the early finish of the previous rains which resulted in the country being drier than usual, and partly by not commencing work in the worst areas till late in the season.

This early close of the rains also had its disadvantages, as burning for *taungyia* clearings began earlier than usual. By early February triangulators in the low country were having difficulties with the smoke haze, though this did not become serious in the higher parts of the area till the beginning of March. In the latter half of April, early and heavy rain removed the smoke entirely but also hindered the completion of work in camps (1) and (2) which did not return to recess till near the end of May.

117. Recess duties.—Fair mapping was divided into three sections under Messrs. F. W. Smith, C. P. E. Davenport and D. N. Saha. Owing to the late return of the party from the field it would have been impossible to complete the mapping of all areas surveyed without assistance

from the Drawing Section. Pending the decision of the future policy in Burma regarding compiled mapping, much of the normal work of this section was fortunately in abeyance during recess; so part of its personnel was available for primary mapping.

Traverse and triangulation computations were carried out under the direction of Mr. A. K. Sen Gupta

IX.—MISCELLANEOUS SURVEY REPORTS.

No. 15 Party (Triangulation and Levelling).

Officer in charge.—Capt. C. A. K. Wilson, R.E.

118. Other work done by this party is described in paras. 36-37. 68 miles of precise levelling in Sind was carried out for the Sind Irrigation Department and 4½ miles by high precision system at Calcutta for the Engineers of the New Howrah Bridge.

Training School, Dehra Dūn.

Officer in charge.—{Mr. M. M. Mudaliar, to 6-11-36. Charge held by D. G. B., from 7-11-36 to 20-12-36. Mr. B. T. Wyatt, V.D., from 21-12-36.}

119. *Class I Probationers.*—Lieuts. R. A. Gardiner, R.E., and R. C. A. Edge, R.E., joined the Training School in November and December 1936 respectively. After receiving a course of instruction in plane-tabling, on large scale and then on the 2-inch and ½-inch scales with short periods allotted to triangulation, traversing, levelling and astronomy &c., they were transferred to No. 1 Party in March 1937 for work in the High Himālayas during the spring season. Lieut. Gurdip Singh, I.A. joined the school in April 1937.

120. *Class II Probationers.*—Three probationers were appointed in January 1937. One resigned his appointment in May 1937.

121. *Upper Subordinate Service Probationers.*—One Geodetic Computer was appointed in February 1937.

122. The above Class I, I.A., Class II, and U. S. S. probationers also underwent a course of plane-tabling on large scale and then on the 4-inch and 2-inch scales with short periods allotted to triangulation, traversing, levelling, astronomy &c.

During recess they received instruction in computing, drawing, reproduction and other branches of survey work.

PART 4.—MAP PUBLICATION AND OFFICE WORK.

From 1st April 1936 to 31st March 1937.

X.—INTRODUCTION AND PERSONNEL.

123. Index maps C to G, at the end of this Report, form the most important adjunct to *Part 4*, as they show the progress of publication to date for all standard series of modern maps, excluding transfrontier work.

124. Letter press.—Apart from *Sections X* (Introduction) and *XIV* (the annual report of the Mathematical Instrument Office), *Part 4* is divided into three main Sections:—

Section XI shows all publications and map issues for the year.

Section XII shows all the fair drawing, whether completed for publication or still in hand, carried out by the various drawing offices and field parties.

Section XIII describes the work of the printing and miscellaneous offices, excluding that of the Computing and Tidal Party, whose work is of a geodetic character and is published in full in the annual Geodetic Report.

125. Personnel.—

Calcutta. Director, Map Publication.

Colonel J. D. Campbell, D.S.O., to 8-5-36 and from 4-11-36.
Lt.-Col. F. B. Scott, I.A., from 9-5-36 to 3-11-36.

Chief Draftsman—Mr. F. H. Grant, to 15-8-36 and from 9-11-36.
,, ,, ,, P. C. Mitra, from 16-8-36 to 8-11-36.

No. 1 Drawing Office.

O.C. Mr. L. Williams, M.B.E., to 15-8-36.
,, ,, F. H. Grant, from 16-8-36 to 8-11-36.
,, ,, M. M. Mudaliar, M.A., from 9-11-36.
II ,, P. C. Mitra, B.A., H. D., to 15-8-36 and from 9-11-36.
,, ,, J. C. St. C. Pollett, H. D., from 16-8-36 to 8-11-36.
,, ,, J. C. St. C. Pollett, to 15-8-36, and from 9-11-36.
,, ,, A. F. Murphy.
,, ,, D. N. Banerjee, L.C.E.
,, ,, B. N. Saha, M.SC., to 7-11-36.
,, ,, R. N. Hastir, from 14-9-36.
U.S. ,, Kodandera Ganapathy Mandanna.
,, ,, Pratul Chandra Sen Gupta, B.SC.
,, ,, Girija Sonker Bagchi.
,, ,, Atul Chandra Maulick.
,, ,, Suresh Chandra Chatterjee, B.SC.
,, ,, Nagendra Chandra Naug, from 3-12-36.

Engraving Office.

Mr. A. R. J. Dalziel, Head Engraver, to 20-5-36 and from 21-3-37.
,, F. E. Selfe, Head Engraver, from 21-5-36 to 20-3-37.
,, F. E. Selfe, *Asstt.* Head Engraver, to 20-5-36 and from 21-3-37.
,, G. J. Shaha, *Asstt.* Head Engraver, from 21-5-36 to 20-3-37.

Photo.-Litho. Office.

O.C. Major G. F. Heaney, R.E., to 24-10-36.
,, Lt.-Col. W. J. Norman, M.C., R.E., from 25-10-36.

Managers & Assistant Managers.

Mr. S. Colquhoun, Manager, Litho., from 18-10-36.
,, L. H. Mordue, Offg. Manager, Litho., to 17-10-36.
,, ,, Asstt. Manager, Litho., from 18-10-36.
,, F. R. Vandyke, Manager, Photo.
,, K. L. Dev, Asstt. Manager, Photo.
,, G. Thomas, Offg. Asstt. Manager, Litho., to 17-10-36.

Map Record and Issue Office.

O.C. Mr. O. N. Pushong.

Mathematical Instrument Office.

Mr. S. Woodhouse, Superintendent (on leave preparatory to retirement).
,, R. C. Malcolm, F.R.M.S., F.R.Met. Soc., Offg. Supdt.
,, A. Lacamp, Asstt. Supdt.

Dehra Dūn. Director, Geodetic Branch.

Colonel C. G. Lewis, O.B.E., to 13-5-1936.

Lieut.-Colonel C. M. Thompson, I.A., from 14-5-36.

No. 2 Drawing Office.

O.C. Mr. D. K. Rennick, M.B.E.
II ,, Moquimuddin Ansari, B.A., from 6-5-36.
,, ,, N. S. Harihara Iyer, to 25-3-37.
,, ,, Jugal Behari Lal.
U.S. ,, N. M. Bopaiah.

Forest Map Office.

II Mr. F. C. Pilcher, *C.D.*
U.S. ,, B. B. Shome.

Computing & Tidal Party.

O.C. Lt.-Col. E. A. Glennie, D.S.O., R.E., to 29-4-36
,, Major G. Bomford, R.E., from 30-4-36.

Photo.-Zinco. Section.

Mr. S. C. Aratoon.

Letterpress Printing Section.

Mr. H. H. Williams.

Simla. Director, Frontier Circle.

Colonel S. W. Sackville Hamilton, D.S.O., to 21-5-36 and from 1-11-36.

Colonel C. G. Lewis, O.B.E., from 22-5-36 to 23-10-36.

Lieut-Colonel E. A. Glennie, D.S.O., R.E., from 24-10-36 to 31-10-36.

No. 6 Drawing Office.

O.C. Lt.-Col. C. M. Thompson, I.A., to 5-5-36.
,, Lt.-Colonel E. A. Glennie, D.S.O., R.E., from 6-5-36.

SURVEY SECTION.

II Mr. Duni Chand Puri, to 6-10-36.
,, ,, H. M. Critchell.
,, ,, Chuni Lal Kapur, from 21-9-36.
,, ,, B. N. Murthy, B.Sc.
U.S. ,, Ghulam Hasan.
,, ,, Lalbir Singh, to 1-5-36.
,, ,, G. C. Aggarwala, B.A., from 18-4-36.
,, ,, Om Parkash Anand, to 6-10-36.

ARMY SECTION.

Captain T. A. Whitmarsh, H. D., to 7-3-37.
S/C J. G. Wilson, H. D., from 8-3-37.

Shillong. Director, Eastern Circle.

Lt.-Col. F. J. M. King, R.E.

No. 5 Drawing Office.

O.C. Mr. John McCraken, M.B.E.
U.S. ,, M. M. Shah.
,, ,, A. K. Maitra, B.A.

Bangalore. No. 6 (South India) Party.

O.C. Major G. W. Gemmell, I.A.
II Mr. N. S. Harihara Iyer, from 27-3-37.
,, ,, E. N. Natesan, B.A.
,, ,, M. D. Nangia, B.A.
,, ,, M. R. Nair, B.A.
,, ,, P. A. Thomas.
U.S. ,, H. Narasimha Murti Rao, B.A.
,, ,, Mohabat Lal Kohli.
,, ,, Muhammad Abdul Azim, I.D.S.M.
,, ,, K. B. Muthanna.
,, ,, B. B. Kuttappa, from 21-10-36.
,, ,, Muhammad Mustafa.
,, ,, A. Shamanna.
,, ,, M. A. Faruquie, B.A.

Maymyo. No. 10 (Burma) Party.

O.C. Lt.-Col. F. B. Scott, I.A., to 26-4-36.
,, Mr. F. W. Smith, from 27-4-36 to 10-5-36 and 4-6-36 to 2-9-36.
,, Capt. J. B. P. Angwin, R.E., from 11-5-36 to 3-6-36 and 3-9-36 to 6-11-36.
,, Major G. F. Heaney, R.E., from 7-11-36.
II Mr. F. W. Smith.
,, ,, C. S. McInnes.
,, ,, C. P. E. Davenport.
,, ,, D. N. Saha.
U.S. ,, Khan Muhammad, to 14-3-37.
,, ,, A. K. Sen Gupta, from 4-6-36.
,, ,, H. K. Kar.
,, ,, A. K. Talapatra, B.A.
,, U On Ba, from 4-6-36 to 31-10-36.
,, Mr. U. D. Mamgain, B.Sc., from 4-6-36 to 31-10-36.

XI.—PUBLICATIONS AND ISSUES.

126. Publications.—The publications of the Department for the year are shown in the following three tables, of which Table I shows map publications at the various presses, Table II shows the progress made in publication of modern topographical maps, and Table III shows the more important letterpress publications.

Table I *(a)*—Maps published at Calcutta, during the year 1936-37.

Class of maps.	Scale.	New publications.	Revised editions, new editions and reprints.	Number of copies printed.	Value. Rs.
	Departmental.				
GENERAL MAPS.					
Maps of India	Various	1	6	12,450	14,501
GEOGRAPHICAL MAPS.					
Southern Asia Series ...	1:2 million	1	...	328	656
India and Adjacent Countries Series	1:1 million	1	15	7,458	12,058
Carte Internationale du Monde	1:1 million	...	3	674	1,448
TOPOGRAPHICAL MAPS.					
Quarter-inch, Modern ...	1″= 4 miles	4	38	20,003	30,575
,, (Prely.) ...	Ditto	...	3	899	1,217
,, (Provl.) ...	Ditto	...	7	1,688	1,718
Half-inch, Modern ...	1″=2 miles	45	26	35,170	71,061
One-inch, Modern ...	1″=1 mile	69	145	132,009	2,03,484
,, (Prely.) ...	Ditto	2	8	4,438	6,436
,, (Provl.) ...	Ditto	1	4	6,965	10,181
Old style maps	Various	...	18	3,863	5,629
SPECIAL MAPS.					
Provincial maps	Various	2	4	2,569	5,047
City & Town Guide maps ...	Ditto	2	4	2,365	4,575
Index maps	Ditto	...	59	43,087	4,851
Miscellaneous maps ...	Ditto	25	27	19,212	4,550
Total ...	.....	**153**	**367**	**293,178**	**3,77,987**
	Extra-departmental.				
Manœuvre and Radius maps ...	Various	3	14	14,761	44,629
Other maps	Ditto	211	24	168,408	27,392
Plans and diagrams ...	Ditto	45	...	7,054	1,505
Illustrations	.....	230	...	64,169	12,197
Miscellaneous	.....	53	3	19,833	4,571
Total ...	.....	**542**	**41**	**274,225**	**90,294**
Grand Total ...	.....	**695**	**408**	**567,403**	**4,68,281**

NOTES.—*Calcutta.*—In addition to the work shown in Table I(*a*), 140,578 copies of 319 maps were gridded during the year.

Reg. No. 1416. D. 37—425.

Portion of half-inch Sheet, 1934.

Heliozincographed at the Survey of India Offices, Calcutta.

Table I(b)—Maps published at Dehra Dūn.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
		Departmental.			
Cantonment maps ...	Various	11	38	10,378	4,545
Forest maps ...	,,	...	28	1,513	1,705
Miscellaneous ...	,,	26	64	30,487	11,532
Total ...	...	**37**	**130**	**42,378**	**17,782**
		Extra-departmental.			
Maps	Various	20	10	14,910	4,865
Plans and diagrams ...	,,	66	5	16,687	2,508
Charts	,,	10	13	2,428	411
Forest maps ...	,,	24	...	3,462	6,091
Total ...	...	**120**	**28**	**37,487**	**13,873**
Grand Total ...	...	**157**	**158**	**79,865**	**31,655**

NOTES.—*Dehra Dūn.*—In addition to the work shown in Table I(*b*) above, 4,284 prints of 565 originals, consisting of plane-table sections, triangulation charts and forest maps, &c. were printed.

Table I(c)—Maps published at Quetta.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
		Departmental.			
Maps	Various	16	36	255	725
Plans and diagrams ...	,,	3	...	38	43
Charts } Forms }	,,	15	27	4,799	605
Total ...	...	**34**	**63**	**5,092**	**1,373**
		Extra-departmental.			
Maps	Various	25	30	3,130	4,135
Plans and diagrams ...	,,	4	1	324	126
Charts } Forms }	,,	2	3	393	45
Total ...	...	**31**	**34**	**3,847**	**4,306**
Grand Total ...	...	**65**	**97**	**8,939**	**5,679**

Table I *(d)*—Maps published at Murree and Risalpur Cantonment.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
		Departmental.			
Maps	Various	...	...	773	1,626
Charts, Forms } including panoramas	,,	...	...	9,487	673
Total ...	...	...	...	**10,260**	**2,299**
		Extra-departmental.			
Maps	Various	...	...	1,513	1,651
Charts, Forms } including panoramas	,,	...	...	2,297	
Total ...	...	...	...	**3,810**	**1,651**
Grand Total ...	...	...	...	**14,070**	**3,950**

Table II.—Abstract of Modern Topographical Maps.

	One-inch maps.	Half-inch maps.	Quarter-inch maps.
Topographical maps published in 1936-37	69	45	4
Do. do. published in previous years	3,651	1,066	361
Total published ...	**3,720**	**1,111**	**365**
Number of sheets in India ...	**6,218**	**1,630**	**450**

Table III.—Letterpress publications.

(a) PUBLISHED AT CALCUTTA.

1. General Report of the Survey of India. 1936. (425).
2. Supplement to the Survey of India Reports, 1936. (125).
3. Survey of India Notes,—issued monthly. (3,250).
4. List of Maps Published,—issued monthly. (5,200).
5. Supplementary List of Maps Published,—issued quarterly. (2,000).
6. Government of India Orders—Bound Volume. (330).
7. Survey of India—Ministerial and Lower Subordinate Establishment, 1936. (85).
8. Survey of India—Security Bond. (100).
9. Corrigenda to Regulations—applicable to Officers of the Survey of India, 1914. (450).

Note.—Numbers in brackets after each item denote the number of copies printed.

Table III *(Concld.).*

(a) PUBLISHED AT CALCUTTA.—*Concld.*

10. Correction slips to Handbooks of Topography, Border Specimen, Map Catalogue, etc. (33,003).
11. Calendars for 1937. (1,650).
12. Miscellaneous. (1,369).

(b) In hand at Calcutta.

1. *Handbook of Topography, Chapter X.*
2. *Correction slips to Handbooks of Topography.*
3. *Circular Orders, etc.*
4. *Miscellaneous.*

(c) PUBLISHED AT DEHRA DŪN.

1. Geodetic Report, 1935. (350).
2. Tide Tables for the Indian Ocean, 1937. (1,300).
3. Tide Tables, Hooghly River, 1937. (275).
4. Do. Bombay, 1937. (875).
5. Do. Rangoon, 1937. (800).
6. Auxiliary Tables, Part I. (200).
7. Handbook of Topography, Chapter II (Constitution and Duties of a Survey Party). (330).
8. Survey of the Salt Department Development Areas at Khewra, Makrach and Kalabagh. (100).
9. Triangulation Data 53J for Training School. (60).
10. Addenda to Levelling Pamphlets 40, 46, 47, 53 and 54. (460).
11. Addendum to Geodetic Report VIII. (100).
12. Annual Preservation and Maintenance Returns. (205).
13. Correction slips to Handbooks and Pamphlets, &c. (1,820).
14. Lists of Bench Marks. (24).
15. Miscellaneous. (191,059).

(d) In hand at Dehra Dūn.

1. *Geodetic Report, 1936.*
2. *Tide Tables for the Indian Ocean, 1938.*
3. *Levelling Pamphlet 43.*
4. *List of Bench Marks.*
5. *Miscellaneous.*

Note.—Numbers in brackets after each item denote the number of copies printed.

127. Map Issues.—From Table IV below it will be seen that the total sales by the entire department during the year 1936-37 were 456,141 copies, value Rs. 2,91,232, as against 633,714 copies, value Rs. 2,45,919, sold during the previous year.

The Map Record and Issue Office's total sales of departmental maps were 192,564 copies, valued at Rs. 1,97,263, as against 159,180 copies, valued at Rs. 1,69,029, sold during the previous year.

The total number of extra-departmental maps issued by the Map Record and Issue Office was 218,290 copies, valued at Rs. 50,477.

The number of maps transferred to the High Commissioner for India, the Curator, Government Book Depot, Rangoon, Burma, and the Circle Offices for stock and issue were 40,044 copies, valued at Rs. 58,592.

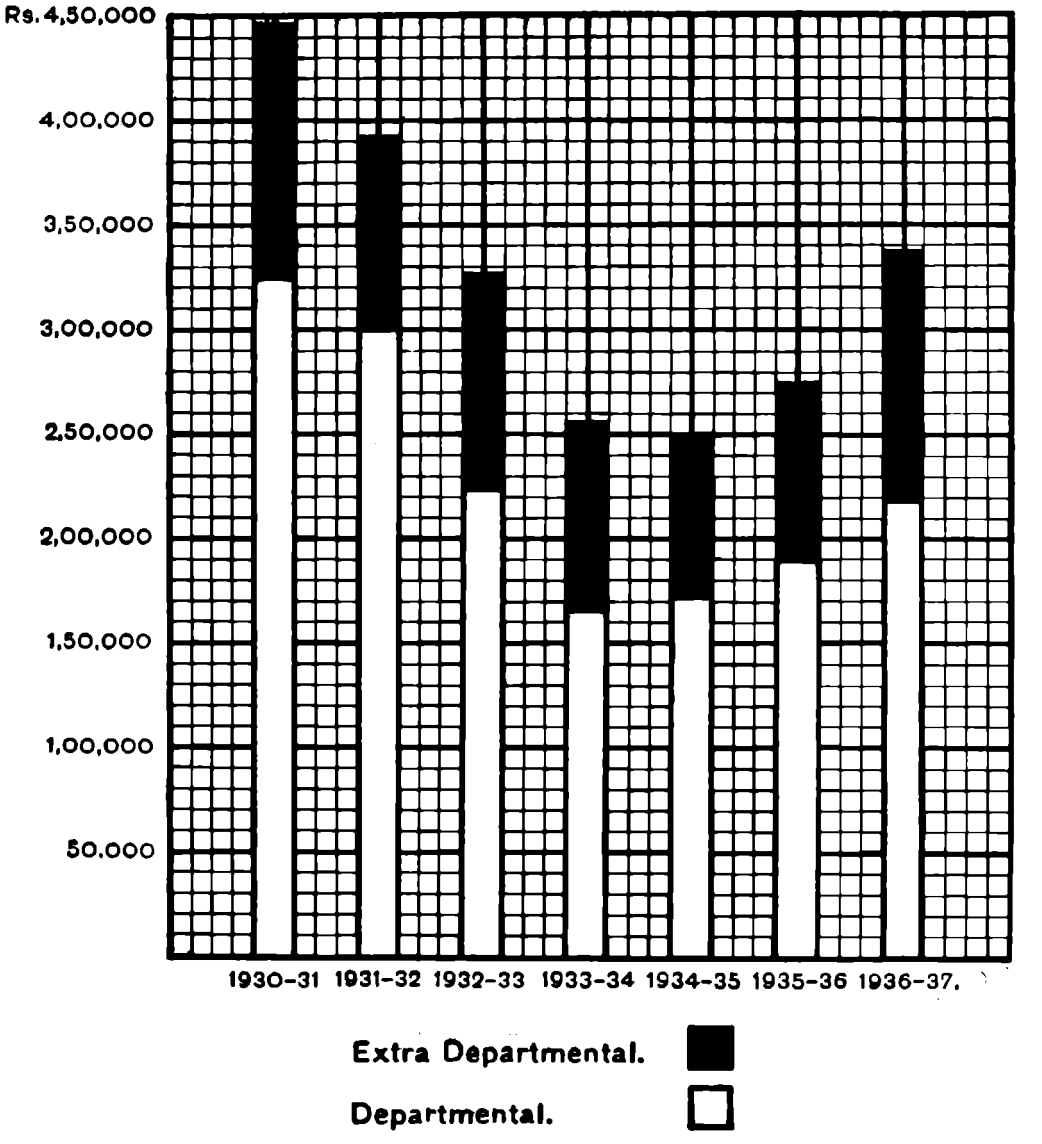
Table IV.—Maps issued by Survey units.

D=Departmental. X=Extra-departmental.		SALES.								FREE ISSUES.
		Government Officials.		Army and Royal Air Force.		Public.		Total.		
		Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.
Calcutta	D	26,523	29,565	134,151	1,24,777	31,890	42,921	192,564*	1,97,263*	11,308
	X	192,934	34,746	20,962	12,325	4,394	3,406	218,290	50,477	3,655
Dehra Dûn	D	2,662	5,048	6,605	4,238	833	1,198	10,100	10,484	1,559
	X	11,074	7,246	7,392	8,593	1,598	782	20,064	16,621	13
Simla	D	133	235	11	11	222	348	366	594	533
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Murree and Jhelum ("A" Company)	D	10	16	13	19	13	19	36	54	205
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Quetta ("E" Company)	D	491	792	1,495	1,745	52	89	2,038	2,626	340
	X	2,473	3,033	944	856	86	62	3,503	3,951	.....
Bisalpur Cantonment (No. 18 Party)	D	.....	.....	.....	.....	.....	.....	.....	.....	10,260
	X	.....	.....	3,810	1,651	.....	.....	3,810	1,651	.....
Bangalore	D	453	736	294	398	893	1,205	1,640	2,339	328
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Shillong	D	358	652	63	69	225	399	646	1,120	761
	X	.....	.....	.....	.....	506	1,012	506	1,012	.....
Maymyo	D	510	868	1,757	1,691	311	481	2,578	3,040	256
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	...	237,621	82,937	177,497	1,56,373	41,023	51,922	456,141	2,91,232	29,218

* Excludes 40,044 copies of maps, value Rs. 58,592, issued by the Map Office, Calcutta to the High Commissioner for India, the Curator, Government Book Depot, Burma and the Survey Circles and Parties, for stock and sale.

PROGRESS OF MAP SALES

1930—37



The above diagram represents the aggregate sales of the whole Department.

128. Map Record and Issue Office.—The volume of work in the Map Record and Issue Office has greatly increased. Against 15,434 letters received in 1934 and 16,535 in 1935, 16,910 were received in 1936.

Excluding the value of maps held by the Circle Offices, the Curator, Government Book Depot, Rangoon, Burma and the Branch Agency at

Calcutta, the approximate value of the Map Record and Issue Office stock on 31st March 1937, was Rs. 35,91,338.

Physical verification of stock was carried out at convenient intervals throughout the year by the Officer-in-Charge, Map Record and Issue Office.

From the percentages of sales of departmental maps as noted below, it will be seen that the Army and the Royal Air Force still continue to be the largest purchasers.

ARMY AND ROYAL AIR FORCE	...	...	70 %
GOVERNMENT OFFICIALS	...	...	13 %
PUBLIC	...	...	17 %

Table V. Stock of Maps. This table gives the stock of maps as it stood on 31st March 1937.

Class of maps.	CALCUTTA.				DEHRA DŪN.		SHILLONG.		SIMLA.		JHELUM AND MURREE.		QUETTA.	
	M. R. I. O.		BRANCH AGENCY.											
	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.
1/2M Southern Asia Series ...	10,311	18,236	23	44	201	402	...	...	86	172	39	94	70	140
1/M India and Adjacent Countries ...	32,736	52,511	206	338	1,560	2,593	185	275	532	848	149	224	389	583
1/M Carte Internationale du Monde	3,455	7,232	19	42	331	662	50	100	61	122	10	20	18	36
Two-inch maps	8,048	23,199	...	...	4,904	7,356	351	623	...	...	...	...	...	...
One-inch maps	1,322,986	19,93,810	4,191	6,152	49,204	73,686	26,255	39,382	15,307	22,819	3,554	5,331	2,379	3,568
Half-inch maps	420,516	8,37,529	1,028	2,017	12,445	24,593	6,014	12,028	3,015	6,047	989	1,978	1,003	2,006
Quarter-inch maps	255,303	3,75,855	650	860	7,206	10,810	2,647	4,011	3,624	5,227	786	1,179	1,990	2,985
General maps of India ...	16,657	25,587	69	121	401	581	67	205	96	232	10	47	44	66
Provincial and District maps of India	5,787	16,192	30	102	297	806	635	1,045	60	186	41	47	13	13
Cantonment and Town maps (Special and Guide).	51,215	1,22,770	52	117	20,135	40,231	459	980	464	2,524	910	1,386	62	266
Manœuvre and Radius maps ...	11,273	37,115	8	22	114	246	...	...	40	104	81	210	...	...
Miscellaneous maps	72,592	81,302	12	128	5,936	6,457	172	128	515	1,035	10	20	105	210
TOTALS ...	2,210,879	35,91,338	6,288	9,943	102,734	1,68,423	36,835	58,777	23,800	39,316	6,579	10,536	6,073	9,873

ves the stock of maps as it stood on 31st March 1937.

UTTA.		DEHRA DŪN.		SHILLONG.		SIMLA.		JHELUM AND MURREE.		QUETTA.		MAYMYO.		BANGALORE.		RANGOON AGENCY.		TOTAL.	
BRANCH AGENCY.																			
Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.	Number of copies in stock.	Present Face Value Rs.
23	44	201	402	...	...	86	172	39	94	70	140	...	...	24	53	...	...	10,754	19,141
206	338	1,560	2,593	185	275	532	848	149	224	389	583	363	544	435	715	248	379	86,808	59,010
19	42	331	662	50	100	61	122	10	20	18	36	...	...	49	90	198	297	4,191	8,601
...	...	4,904	7,356	351	623	...	...	...	...	...	...	...	...	...	...	...	...	13,303	31,178
4,191	6,152	49,204	73,686	26,255	39,382	15,307	22,819	3,554	5,331	2,379	3,568	21,721	31,819	4,639	6,842	16,720	25,080	1,466,956	22,08,489
1,028	2,017	12,445	24,593	6,014	12,028	3,015	6,047	989	1,978	1,003	2,006	3,966	7,810	1,272	2,689	4,667	9,334	454,915	9,06,081
650	860	7,206	10,810	2,647	4,011	3,624	5,227	786	1,179	1,990	2,985	2,243	3,058	527	660	2,126	3,189	277,102	4,07,884
69	121	401	581	67	205	96	232	10	47	44	66	5	60	93	249	...	...	17,442	27,148
30	102	297	806	635	1,045	60	186	41	47	13	13	23	46	117	295	171	447	7,174	19,179
52	117	20,135	40,231	459	980	464	2,524	910	1,386	62	266	115	575	492	953	331	1,838	74,285	1,71,140
8	22	114	246	...	...	40	104	81	210	...	...	175	327	79	177	...	...	11,770	38,201
12	128	5,936	6,457	172	128	515	1,035	10	20	105	210	...	...	208	576	...	...	79,550	89,856
6,288	9,943	102,734	1,68,423	36,835	58,777	23,800	39,316	6,579	10,536	6,073	9,873	28,611	44,239	7,935	13,299	24,461	40,064	2,454,195	39,85,808

XII.—WORK OF DRAWING OFFICES.

129. No. 1 Drawing Office, Calcutta.—To replace the 32-mile Map of India and Adjacent Countries, a map on the 40-mile scale based on the revised compilation of the 32-mile map is under drawing.

The new style Province Maps of Baluchistān and Burma have been published, those of Hyderābād and Kashmīr and Jammu are under publication, and those of Bengal and Bihār are in hand.

18 of the 19 maps of the Crop Atlas of India for the Director General of Commercial Intelligence and Statistics have been published and information is awaited for the completion of the 19th.

A Telegraph Map of India for the Director General of Posts and Telegraphs is under publication, proofs having been forwarded to him for approval.

A map showing the approximate boundaries of the new Province of Orissa and a map of India showing Salt Industries, on scale 1 inch to 80 miles for the Central Board of Revenue, New Delhi, were published.

The following maps are also in hand:—

(1) The revised edition of the 50-mile Road Map of India.
(2) A re-issue of the 50-mile Wall Map of India and Adjacent Countries.
(3) A Map of India showing Provinces, States and Districts, on scale 1 inch to 70 miles.
(4) The annual re-issue of the Railway Map of India, on scale 1 inch to 67 miles.
(5) A re-issue of Bradshaw's Map of India, on scale 1 inch to 80 miles.

Engraving Office:—In addition to ordinary Departmental work, Letters of Appointment were engraved and printed for His Excellency The Viceroy, and His Excellency The Commander-in-Chief.

Certificates of Honour were also engraved and printed for the Inspector General of Police, Bengal.

The engraving was commenced on a Panoramic View of the Himālayan Ranges to be erected in the grounds of the Viceregal Lodge, Simla. This work is being engraved on cupro nickel silver, a non-tarnishable metal, so as to withstand all weather conditions.

130. No. 2 Drawing Office, Dehra Dūn.—The 2/5M wall map of "The Highlands of Tibet and Surrounding Regions" embodying the latest exploration surveys, is under publication in the Photo.-Zinco. Office, Dehra Dūn.

Of the Īrān ¼-inch sheets transferred to Geodetic Branch, 9 sheets have been brought up to date against office copy corrections and 3 sheets are in hand for re-issue as required.

Four 1-inch special Manœuvre and Training maps were prepared from print originals and copies supplied to the Headquarters, Meerut District.

The survey and mapping of 1/M sheet 52 (LEH) and of its component sheets having been placed under the Director, Frontier Circle, all records concerning the sheets were listed and transferred to the

Frontier Circle with the exception of those relating to sheets 52 A, E, F, G, J, K, M and N which are in hand in this office and will be transferred on completion. These sheets are being redrawn with the exception of 52 G and M which are being brought up to date and are not for re-issue at present.

131. Forest Map Office, Dehra Dūn.—This office, which is maintained by contribution from all Provincial Governments except Assam, Bihār, Orissa and Punjab, continues to meet all demands from these Governments for forest maps. Its main work is the fair drawing of working plans and new editions for various forest officers and upkeep of their office copies. In addition a 1-inch working plan in 1 sheet was prepared for Kashmīr and Jammu State.

132. Map Record and Business Section, Dehra Dūn.—This section continues to be responsible for the storage, despatch and sales of publications and forms, and the collection of bills for all supplies and extra-departmental work carried out by the Geodetic Branch. It stores all originals of departmental maps published in the Geodetic Branch and of cantonment and forest maps with their published prints, and carries a small stock of Survey of India maps for issue within the department and for sale to the public.

133. No. 6 Drawing Office, Simla.

Survey Section.—

(*1*) The following work was done in addition to that reported in Tables VI to VIII:—

Indexes.—A large number of miscellaneous indexes were prepared.

General.—(*a*) Frontier Circle records received from parties and other circles were arranged and indexed.

(*b*) On urgent requisition, 21 one-inch sheets (6 old style and 15 new style) with the corners of the main rectangles marked thereon from the rectangulation data by No. 24 Party in seasons 1926—30 were supplied to the Executive Engineer, Development and Research Division, Karāchi, Sind.

(*c*) 187 tracings of index maps showing base line stones were prepared and supplied to the Director of Land Records, Lahore.

(*d*) Fair originals of sheets 43 H/4, 7, 12 were corrected and the outline of sheet 38 P/4 was redrawn, new material provided by correction survey being incorporated in these sheets. Green tree originals for these sheets were also prepared.

Army Section.—

During the past year the Army Section was employed in the compilation, drawing and reproduction of maps, plans and diagrams for the Army and various other Departments of the Government of India.

An important addition to the Army Section is the installation of a complete equipment for vandyke work.

A second electrically driven hand press has been set up.

The output of the Army Section remains the same as during last year.

Table VI.—New maps.

Figures in italics denote work in hand.

	TOPOGRAPHICAL.								GEOGRAPHICAL.								GENERAL AND SPECIAL.																ACCESSORY.						MISCELLANEOUS.					
	1-inch.		½-inch.		¼-inch.		⅛-inch.		1/M.				Carte Internationale.				1/2 M.				Guide.		Special.		Province.		India.		Forest.		Cantonment Sheets.				Gridding.		Shading.		Colour Patterns.		Indexes.		Charts.		Vario
									Helio.		En-graved.		Helio.		En-graved.		Helio.		En-graved.										16-inch.		64-inch.													
No. 1 Drawing Office— Including Engraving Office	...	*3*	...	...	...	*4*	...	...	...	...	...	...	...	...	...	*5(a)*	...	...	...	*1(b)*	...	...	...	...	1 (c)	*1(d)*	...	*1(e)*	...	...	...	...	...	...	99	*3*	174	*23*	82	*5*	1	...	...	...	52	
Geodetic Branch—																																													
No. 2 Drawing Office ...	1	*7*	...	*1*		*10*	...	...	...	*1*	...	...	...	...	...	...	...	*1*	...	...	...	...	...	*1(g)*	...	...	...	...	...	...	...	...	...	...	6	...	...	...	39	*4*	69	...	29	*9*	25	
Forest Map Office ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	31	*9*	...	...	53	
Parties	3	*1*	4	*16*	...	*4*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*18(h)*	10(i)	*1*	1	...	...	...	...	...	...	...	...	...	...	...	36	
Eastern Circle—																																													
No. 5 Drawing Office ...	...	*1*	18	*10*	2	*8*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	*2*	1	...	56	*8*	...	...	6	*2*	...	
Parties	34	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Frontier Circle—																																													
No. 6 Drawing Office ...	...	...	...	*2*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...	...	...	38	*1*	...	...	...	...	...	
Parties	4	*4*	3	*4*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13(f)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
No. 6 (S. I.) Party ...	12	...	...	*5*	1	*5*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*2(k)*	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	10	*1*	...	...	...	...	...	
No. 10 (Burma) Party ...	19	...	...	...	1	*3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...	15	...	...	...	...	...	...	
Total ...	73	*16*	28	*38*	4	*34*	...	...	...	*1*	...	...	...	...	...	*5*	...	*1*	...	*1*	...	*2*	13	*1*	1	*1*	...	*1*	8	*18*	10	*1*	1	...	125	*5*	175	*23*	240	*19*	101	*9*	35	*11*	166	
Total to date ...	**3,858**		**1,158**		**372**		.....		**56**		**26**		**1**		**21**		**9**		**8**		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....	
Total for India ...	**6,218**		**1,630**		**450**		.....		**104**				**41**				**22**				.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....	

References.

Scales:—*x*-**inch** means *x* inches to 1 mile.

x-**mile** „ 1 inch to *x* miles.

1/M means 1:1 million or 1·014 inches to 16 miles.

1/2M „ 1:2 „ „ „ „ 32 „

(*a*) Includes one sheet suspended under S. G's. order.
(*b*) Sheet suspended under S. G's. order.
(*c*) Kashmīr and Jammu.
(*d*) Bihār.
(*e*) 40 mile—Wall map of India in eight sections.
(*f*) Provisional Issue sheet 53/N in black and brown.
(*g*) Map of the "Highlands of Tibet and Surrounding Regions," scale 2/5M.
(*h*) 2-inch special forest maps for Tehri State.
(*i*) Includes one 32-inch map.
(*j*) Kālābāgh Salt Mine (3 sheets), Makrach Salt Mine (3 sheets), Khewra Salt Mine (4 sheets), Dhullian Oil Field (2 sheets), Rakh Baikunth (1 sheet).
(*k*) Warangal Fort map, scale 1″=400 feet and Bangalore Guide map, scale 3″=1 mile.

Table VII.—Miscellaneous.

No. 1 Drawing Office—

P. O. P. prepared for plate correction, and original corrected against P. O. P.	22
Mosaics (congregated maps prepared for photography)	42
Circle and Party sheets examined and corrected ...	150
Grid originals scrutinized and corrected	31
Grid cutting lines on originals drawn and checked ...	63
Shaded originals amended	25
Miscellaneous cases	164
Office copies corrected from various sources ...	4,565
Stock copies of map corrected	10,300

No. 2 Drawing Office—

Mosaics (congregated rough maps prepared for photography)	12
Party sheets examined, corrected and submitted for publication	13
Grid cutting points on mosaics and originals drawn and checked	11
Miscellaneous cases	14

Forest Map Office—

Standard indexes completed	14
Sheets coloured for indents	32
Areas extracted, No. of sheets	5
Originals corrected	63
No. of sheets passed for publication	68
Miscellaneous cases	17

No. 5 Drawing Office—

Nāgpur Air Survey 16-inch sheets	6
Do. do. Line Plans ...	13
One-inch sheets examined	34
Half-inch sheets examined	3
Four-inch sheets examined	8
One-inch green tree originals drawn for re-issues ...	8
Quarter-inch green tree originals drawn for re-issues ...	2
1/M Road map of Eastern States (in two parts) ...	1
1/M Map of Tripura State	1

No. 6 Drawing Office—

One-inch sheets examined	19
Half-inch „ „	3
Special maps examined	13
Green tree originals drawn for re-issues	6

No. 6 (S. I.) Party—

Green tree originals drawn for re-issues	9
1½-inch mosaics for ¾-inch mapping material ...	12

No. 10 (Burma) Party—

Map mounting (booklets)	314
„ „ (plain)	329
Green tree originals drawn for re-issues	6

Table VIII.—Re-issues.

New editions—Slight alterations. *Revised editions—Considerable changes.*

Figures in italics denote work in hand.

	TOPOGRAPHICAL.														GEOGRAPHICAL.										GENERAL AND SPECIAL.																OFFI
	Modern, including preliminary editions.								Old, including provisional issues.						1/M India and Adjacent Countries.				1/M Carte Internationale.				1/2M Southern Asia Series.				Guide.		District.		Province.		India.		Forest.		Cantonment Sheets.				Various.		Nev
	1-inch.		½-inch.		¼-inch.		⅛-inch.		1-inch.		½-inch.		¼-inch.		Helio.		Engraved		Helio.		Engraved		Helio.		Engraved												16-inch.		64-inch.				
No. 1 Drawing Office including Engraving Office—																																									
New editions	59	*23*	18	*8*	13	*6*	...	...	13	*1*	2	...	6	...	2	*1*	3	*1*	...	...	2	*3*	...	...	...	...	...	...	...	...	3	*1*	...	...	...	...	...	...	2	...	264
Revised „	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*1*	2	*11*	...	...	1	*5(a)*	...	...	...	...	...	*1*	...	...	1	...	...	*3*	...	...	...	...	...	12	...	
Geodetic Branch—																																									
New editions	1	*5*	2	*4*	...	*2*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	24	*29*	...	...	1	...	...	...	190
Revised „	1	*2*	...	...	11	*12*	...	...	...	...	...	...	...	...	...	*8*	...	...	...	...	...	...	...	*2*	...	...	...	...	...	...	...	...	...	...	16	*23*	3	*4*	...	...	
Eastern Circle—																																									
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	107
Revised „	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Frontier Circle—																																									
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	45
Revised „	18	*28*	...	*4*	...	...	...	...	...	...	...	...	...	...	...	*3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
No. 6 (S. I.) Party—																																									
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33
Revised „	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
No. 10 (Burma) Party—																																									
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	35
Revised „	...	...	...	...	3	*1*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Totals ...	**85**	***58***	**20**	***16***	**27**	***21***	...	...	**13**	***1***	**2**	...	**6**	...	**2**	***13***	**5**	***12***	...	...	**3**	***8***	...	***2***	...	...	...	***1***	...	...	**1**	...	**3**	***4***	**24**	***29***	**16**	***23***	**4**	***4***	**14**	...	**674**

(a) Includes one sheet suspended under S. G's. order.

XIII.—PRINTING AND MISCELLANEOUS.

XIII.—PRINTING AND MISCELLANEOUS.

134. The Photo.-Litho. Office, Calcutta.—The amount of work passing through the office shows little variation. The new cost rates have been brought into force but they do not differ very considerably from the old ones.

Experiments with a view to overcoming or preventing distortion and speeding up or avoiding "duffing" are continuing.

COST AND OUT-TURN OF PHOTO.-LITHO. OFFICE.

Expenditure.	Value of out-turn at office rates.	Negatives prepared.	Zinc plates prepared.	Maps printed.		Impressions pulled.
				Departmental.	Extra-departmental.	
Rs.	Rs.					
3,38,684	3,44,880	4,704	5,939	758	1,529	4,022,024

INDEPENDENT OUT-TURN OF THE PROCESS ENGRAVING AND TYPE PRINTING SECTIONS.

Process Engraving Section.					Type Printing Section.		
Half-tone work.		Line work.		Photo-gravures.			
Blocks prepared.	Impressions pulled.	Blocks prepared.	Impressions pulled.	Plates prepared.	Items or pages published.	Copies printed.	Impressions pulled.
375	65,531 (Impressions of 270 blocks).	51	4,840 (Impressions of 12 line blocks).	1	1,750	1,100,272	2,201,415

OUT-TURN OF ENGRAVING OFFICE COPPER PLATE PRINTING SECTION.

Impressions Pulled.				
Photogravures.	Chromo Paper.	Transfer.	Miscellaneous.	Total.
494	292	236	6,927	7,949

135. Photo.-Zinco.-Section, Dehra Dūn.—The printing plant of this section consists of one Rotary and two flat-bed machines (only one of which is in use at a time). The above as well as an offset press and three hand presses were in continuous operation during the year printing cantonment and forest maps, diagrams, charts, Guide-maps of Udaipur and Dum Dum, Training and Manœuvre maps of Dehra Dūn, Roorkee, Meerut and Jhānsi as shown in Table I(*b*).

136. No. 18 (Air Survey) Party, Murree and Risālpur.—The Reproduction Section was employed on miscellaneous work throughout the year.

An improved method of reproducing maps in two colours direct from the air survey compilation on Kodatrace has been developed. Detail to be printed in the first colour (usually black) is inked up in black on the compilation while detail to be printed in the second colour (usually contours in brown) is inked up using an opaque white ink. The compilation is photographed, firstly pinned up on a white back ground and secondly pinned up on a dull black back ground. From the first negative the black or outline printing plate is produced by the helio process and from the second negative the brown or contour printing plate is produced by the vandyke process.

From a single original perfect registration of the two colours is ensured by this method. Two Air Charts for the School of Artillery, Kakul, were printed by this method and no duffing or touching up of the negatives or the printing plates was required.

When two or more compilations are to be combined, outline and contour negatives are mosaiced separately on two glass plates on which the grid is ruled up in blue. Headings, borders, footnotes &c. are completed on the outline mosaic. Very quick and effective reproduction of a training map from 3 originals for H. Q. Meerut District was carried out by this method.

Several published sheets in the frontier areas which are otherwise accurate and not due for revision and of which the Army hold large stocks have become out of date owing to new road construction. The expense of a new edition, for this reason only, generally prevents replacement of stocks, yet the showing of these roads is very necessary. To meet this contingency experiments have been carried out in surprinting new roads on existing published sheets. This has proved successful and is being carried out for stocks of certain sheets held by Headquarters, Peshāwar District.

There has been a large demand by the Army for prints of certain panorama photographs, taken with the "Cirkut" camera during operations. As some of these panoramas are over 6 feet long and the available printing frame considerably less, a method of printing on a continuous strip of bromide paper by successive exposures of half the negative at a time was developed. The change in density at the exposure junction is hardly perceptible.

The following presses are in use in 18 Party:—

Two D. E. handpresses.

One Imperial handpress.

One Furnival Portable handpress—23 inches × 21 inches.

Reproduction of originals received :—

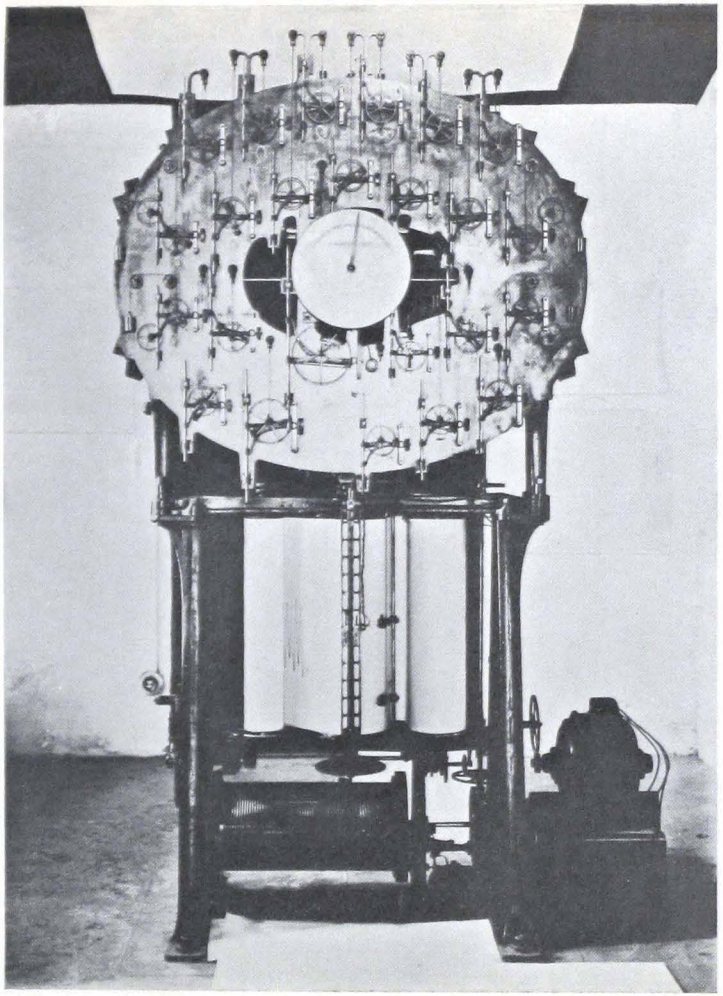
In one colour	...	...	...	144
In two colours	...	...	...	41
In three ,,	...	...	...	3
In four ,,	...	...	...	1
		TOTAL	...	189
Vandyke and helio plates prepared			...	134
Prints pulled	...	...	...	14,070

137. "E" Survey Company, Quetta.—During the year under report the full Reproduction Section was employed mostly on extra-departmental work, the biggest job being the printing of the large scale ward maps for the Additional Political Agent, Quetta, at a total cost of Rs. 2,500. The total value of the extra-departmental work carried out was Rs. 4,306/2/- which approximates to the value of such work carried out last year.

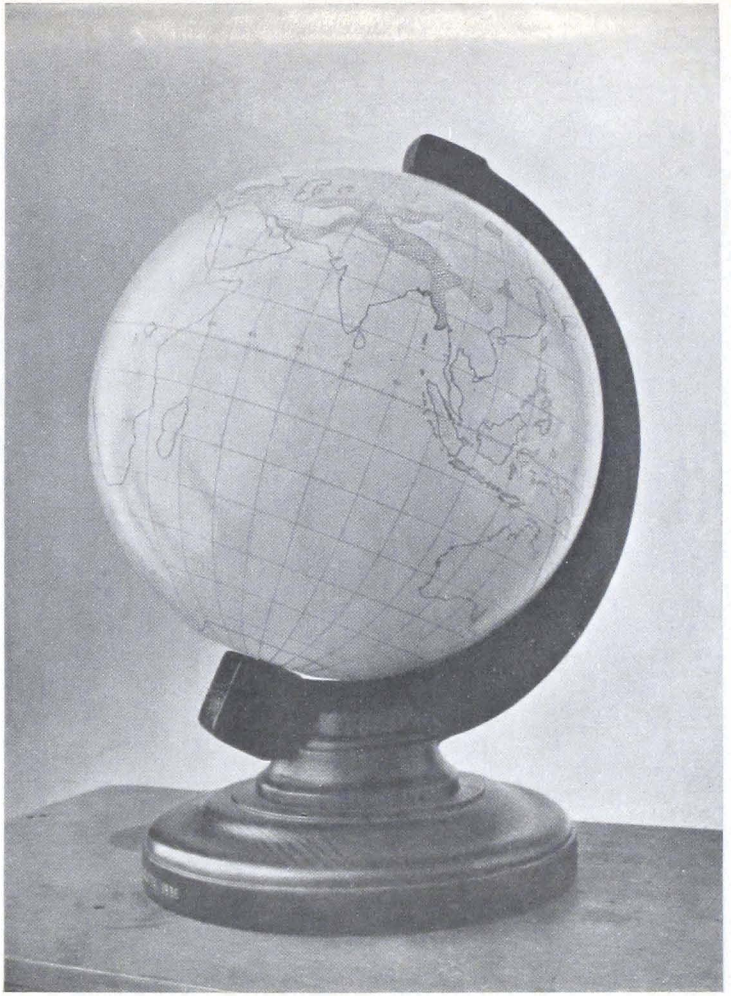
There are now in the Company one offset Rotary Printing Machine, one Duplicating Press, four Hand Presses and four Portable Presses, but since the earthquake only two Hand Presses and one Duplicating Press have been in use.

Reproduction of originals received:—

In one colour	...	...	...	97
In two colours	...	...	...	60
In three ,,	...	...	...	4
In four ,,	...	...	...	1
		TOTAL	...	162
Vandyke and helio plates prepared			...	168
Prints pulled	...	...	...	10,055



Tide Predicting Machine, Dehra Dūn.



Globe manufactured in the Mathematical Instrument Office for the Meteorological Office, Alipore.

XIV.—MATHEMATICAL INSTRUMENT OFFICE.

138. During the year under review the sale of instruments approximated to that of last year but the total value of repair work received shows a slight decrease.

The repairs and manufactures during the year covered the usual wide range associated with the M. I. O. The chief items are as follows:—

Manufactures.

T-squares	230	Clinometers modified pattern.	140
Levelling staves	158	Clinometers rigid pattern	8
Drawing boards	127	Survey umbrellas	30
Haversacks	233	Straight edges	17
Plane-tables	65	Protractors	379
Stands for plane-tables	63	Scales of sorts	4,170
Covers	120	Sight rules	198
Folding mirror stereoscopes.	70	Measuring chains of various lengths.	118
Head stereoscopes	47	Steel band chains	43
Raingauges	94	Printing frames	14
Measure glasses	384	Washing Tubs zinc lined	4
Graduated glass jars	120	Set squares celluloid	262
Prismatic compasses with stand.	32	Do. ebonite	1,256
Leather cases for tapes	2,051	Pantographs	6
Masons levels	240	Brass Hydrometers	8

Repairs.

Levels	312	Hydrometers	21
Theodolites	114	Station Pointers	9
Binoculars	225	Quintants	23
Microscopes	135	Sextants	5
Levelling staves	100	Rules parallel	40
Watches	103	Thermometers	257
Clocks	14	Baros. mercurial	11
Chronometers	5	Planimeters	9
Compasses prismatic	137	Hygrometers	8
Drawing-Instrument boxes.	108	Sphygmomanometers	5

Repairs.—(Concld.).

Measuring tapes ...	598	Opthalmoscopes ...	2
Pantographs ...	10	Bubble tubes ...	71

The Optical Repair Section re-worked and re-polished 227 lenses and 211 Prism. surfaces and repaired 162 microscope objectives. In addition, the following were manufactured:—

Lenses	332	Diaphragms ...	580
Prisms.	66	Reflecting mirrors ...	250
Cover glasses ...	399	Stainless steel mirrors ...	58
Colour glasses ...	151		

Repairs to sphygmomanometers, colorimeters, epidiascopes, polarimeters, laryngoscopes, electrical opthalmometers, spectroscopes and planimeters were also completed.

In the Glass Graduating Section 384 Rain measuring glasses, ½-inch and 1-inch, and 120 glass jars for excise purposes were graduated.

The Glass Blowing Section manufactured 180 thermometers, 39 hygrometers, factory pattern, 8 hydrometers and 358 glass spirit bubbles, and repaired and adjusted 396 thermometers of various types, 106 hydrometers, 14 wooden stereoscopes and 37 hygrometers. Several aerocompasses were repaired and certificates issued on completion.

The following stores were manufactured and supplied to Military Departments, during the year under review:—

70 Drawing boards.
112 T-squares mahogany 36″ to specification.
131 Scales mathematical.
82 Set squares transparent celluloid of sorts.
221 ,, ebonite of sorts.
110 Celluloid sheets transparent $13\frac{1}{4}'' \times 9\frac{1}{2}'' \times .06''$.
18 ,, ,, ,, $11'' \times 8\frac{1}{2}'' \times .015''$.
100 Japanned tin boxes for drawing instruments.
10 Bubbles spirit circular cases Mk. II.
5 Pencil legs for Compass drawing shifting leg Mk. II.
5 Compasses bow pencils spring Mk. IV.
5 ,, ,, pens Mk. III.
189 Tangent sight scales for machine guns.
324 Labels metal instructional.
367 Plates ,, ,,
35 Radium filled Index glasses for Compass liquid Cavalry.
40 Face glasses.
7 Position Finders Mk. II socket bulb holder.
3 Keys compasses Mk. II.
77 Thermometers of various types.

The manufacture of the following special instruments was completed during the year under review:—

1. Two Base measuring Apparatus, Hunter's, in box for the D. E. C.
2. One Crinoline tape to measure 336 ft. for the Superintending Engineer, Megna Bridge Construction.

3. Seventy folding mirror stereoscopes for the Civil and Military Departments, chiefly for the latter.
4. One Ghat Tracer, improved pattern, fitted with steel balls and ball race for compliance with an indent.
5. Several Standard Yards were made up and graduated during the year.
6. One Polishing machine of new design for the Director, Geological Survey, Calcutta.
7. One Panorama plate for the Viceregal Lodge.
8. Two Stands for Furnival hand press for "A" and "E" Coys.

On behalf of the Secretary and Curator, the Victoria Memorial Hall, Calcutta, several historical Surveying instruments were reconditioned.

Several new machines for Milling, Planing and Grinding and also Screw cutting lathes were purchased and set up during the year, as many of the existing ones are old and defective.

Sir James Pitkeathley, Chief Controller of Stores, I. S. D., visited the M. I. O. on the 15th March 1937 and discussed with the S. G. and the Superintendent matters relating to purchase and manufacture of stores by this office. He inspected the Optical and Thermometer glass blowing departments.

Issues from Serviceable Store amounted to 39,215 instruments. The Stores Section dealt with 28,747 requisitions from Workshop.

The Clerical Section dealt with 19,652 letters and the Accounts Section with 5,023 invoices and bills and 1,321 bills for the purchase of instruments and materials. The number of contingent bills drawn during the year amounted to 255 against 190 in the previous year.

The value of instruments issued to and repairs carried out, for the various Government departments during the year is as below:—

	Rs.
Survey of India	60,907
P. W. Departments	78,497
Army Department	46,100
Railway Departments	26,958
Medical ,, ...	13,132
Forest Departments	16,829
Education Departments	6,491
Other Civil Departments	38,034
Government Officers etc. on cash payment ...	44,597
TOTAL ...	3,31,545

All manufacture and repair works numbers outstanding prior to the year 1936-37 have been completed.

During the year under review 2,798 instruments have been deposited by various Government Departments as no longer required. These will be reconditioned for re-issue to indenting officers. Credit afforded by this office for the above instruments returned on deposit amounted to Rs. 22,389/5/-.

Obsolescent and army surplus stores were disposed of on behalf of the Director of Contracts, Simla, and a sum of Rs. 2,507/5/3 was realised. Instruments to the value of Rs. 1,257/- were taken over by this office on valuation from the Director of Contracts, Simla.

Surplus and obsolescent stores and scrap materials belonging to this office were sold and a sum of Rs. 3,773/13/- was realised.

Fire Drill and inspection of Fire appliances were carried out monthly as usual.

139. The following comparative table shows the amount of work done:—

Sale.	1934-35.	1935-36.	1936-37.
	Rs.	*Rs.*	*Rs.*
1. Total value of stores issued ...	2,01,410	2,51,756	**2,46,192**
Out-turn in Works:—			
2. Total value of manufacture of new instruments and components—	1,00,887	1,09,651	**1,31,765**
3. ,, value of repairs to orders— ...	1,39,119	98,826	**81,585**
4. ,, value of instruments reconditioned for issue— ...	16,168	64,434	**57,762**
5. ,, value of adjustment and cleaning charges	6,042	7,284	**3,839**
6. ,, value of work done in the Workshop as per items 2 to 5 above—	2,62,216	2,80,195	**2,74,951**
7. *Book value of stock in—*			
(*a*) Serviceable store	3,30,666	3,02,100	**3,15,206**
(*b*) Repairable ,, ...	1,56,899	1,46,006	**1,50,148**
(*c*) Material ,, ...	1,48,387	1,36,625	**1,43,937**
8. *Value of new instruments—*			
(*a*) Purchased locally	44,611	47,491	**59,668**
(*b*) Imported through the Stores Department, London ...	9,650	4,585	**12,396**
9. Value obtained by sale of obsolescent and condemned stores ...	13,136	3,474	**3,773**
10. *Employees—*			
(*a*) Total number of employees on register on 31st March— ...	328	336	**344**
(*b*) Cost of employees in Workshop including pension contribution	1,49,829	1,38,428	**1,42,551**

INDEX MAPS

SURVEY OF INDIA

MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION

on scales ranging from 4 inches to 1 mile to $\frac{1}{8}$ inch to 1 mile.

N. B. The index shows all topographical work brought on to the true longitude since 1905. Previous topographical work, in the blank areas was about two miles out of position, being based on the old longitude of 1815.

SYSTEM OF NUMBERING SHEETS.

THE $\frac{1}{M}$ SERIES forms the basis of numbering for sheets on all scales. It consists of sheets 4° × 4° on the scale of 1:1,000,000, whose numbers are shown on the Index thus:— 55

QUARTER-INCH SHEETS—Each $\frac{1}{M}$ sheet is divided into 16 sheets of scale quarter-inch to one mile, lettered A–P as shown on the Index. The name of each quarter-inch sheet is therefore written thus: 55 K

HALF-INCH SHEETS—Each $\frac{1}{4}$ inch sheet is divided into four half-inch sheets, named respectively N.W., N.E., S.W., S.E. The name of a half-inch sheet thus takes the form:— $55\frac{K}{N.E.}$

ONE-INCH SHEETS—Each $\frac{1}{4}$ inch sheet is divided into 16 one-inch sheets, numbered from 1–16 as here shown. The name of a one-inch sheet thus takes the form:— $55\frac{K}{12}$

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

BRITISH ISLES on same scale.

MODERN TOPOGRAPHY

up to 30th September 1937.

REFERENCES.

MODERN SURVEYS (since 1905).

Scale 1 inch to 1 mile, and over
" about $\frac{1}{2}$ inch to 1 mile
" $\frac{1}{4}$ inch to 1 mile, and less

MODERN COMPILATION (since 1905).

Scale 1 inch to 1 mile, and over
" about $\frac{1}{2}$ inch to 1 mile
" $\frac{1}{4}$ inch to 1 mile, and less

CURRENT SURVEYS are further distinguished by marks as follows

Scale	$\frac{1}{4}$"	$\frac{1}{2}$"	1" larger
Surveyed last season 1936-37	○	+	•
Proposed for survey in 1937-38	○	+	•

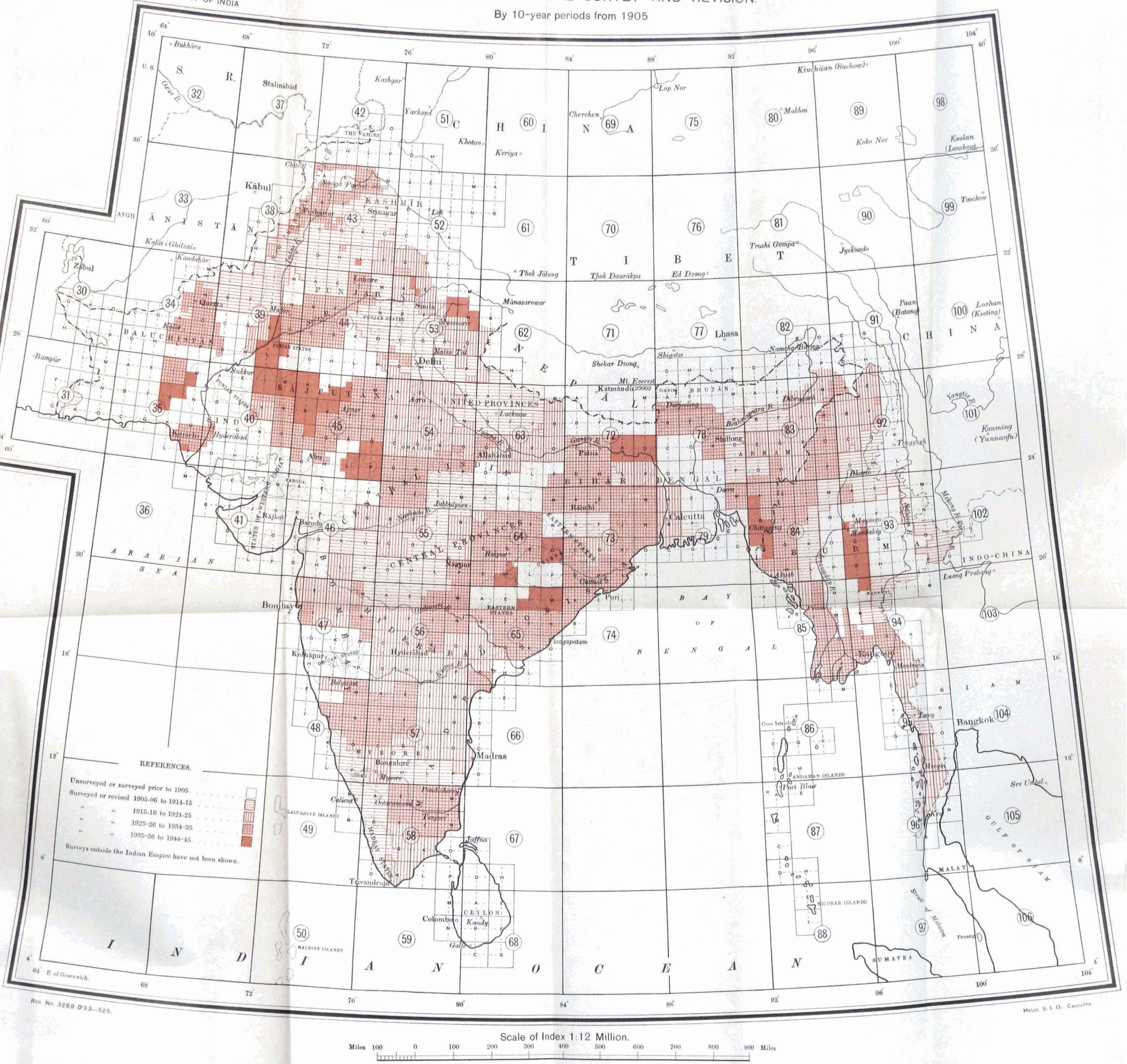
(with red initials or numbers to indicate the unit concerned.)

HELIO. S. I. O., CALCUTTA

SURVEY OF INDIA

MODERN TOPOGRAPHICAL SURVEY AND REVISION.

By 10-year periods from 1905



REG. NO. 3269 D'33—525.

HELIO. S. I. O. CALCUTTA.

Published under the orders of Brigadier H. J. Couchman, D. S. O., M. C., Surveyor General of India, 1937.

MAPS PUBLISHED
1 inch and ½ inch scales.

MAPS PUBLISHED

on scales of ONE-INCH and HALF-INCH to one mile.

MAPS PUBLISHED
1 inch and ½ inch scales.

SURVEY OF INDIA

MODERN MAPS, shown in bright colours, are based on the true longitude adopted in 1905.
OLD MAPS, shown in purple and green were about 2 miles out of position, being based on the longitude of 1815.

SYSTEM OF NUMBERING SHEETS.

THE $\frac{1}{M}$ SERIES forms the basis of numbering for sheets on all scales. It consists of sheets 4° × 4° on the scale of 1:1,000,000, whose numbers are shown on the Index thus:— 55

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ONE-INCH SHEETS—Each $\frac{1}{4}$ inch sheet is divided into 16 one-inch sheets, numbered from 1–16 as here shown. The name of a one-inch sheet thus takes the form:— 55_{12}^{K}

PUBLICATIONS up to 31st March 1937, on ONE-INCH and HALF-INCH scales.

REFERENCES.

MODERN MAPS (since 1905).
Scale 1 inch to 1 mile only
" ½ inch " " only
Published on both scales

OLD MAPS (previous to 1905).
Scale 1 inch to 1 mile
" ½ inch " "

NEW MAPS (including revised editions).
Published during the financial year 1936-37, one-inch * half-inch +
In hand, to be published by the end of 1937, do. * do. +

Scale of Index 1:12 Million.

Miles 100 0 100 200 300 400 500 600 700 800 900 Miles

Published under the orders of Brigadier H. J. Couchman, D. S. O., M. C., *Surveyor General of India, 1937.*

Reg. No. 1875 D'25. 525.

Helio. S. I. O., Calcutta.

IAPS PUBLISHED
$\frac{1}{4}$ inch scale.

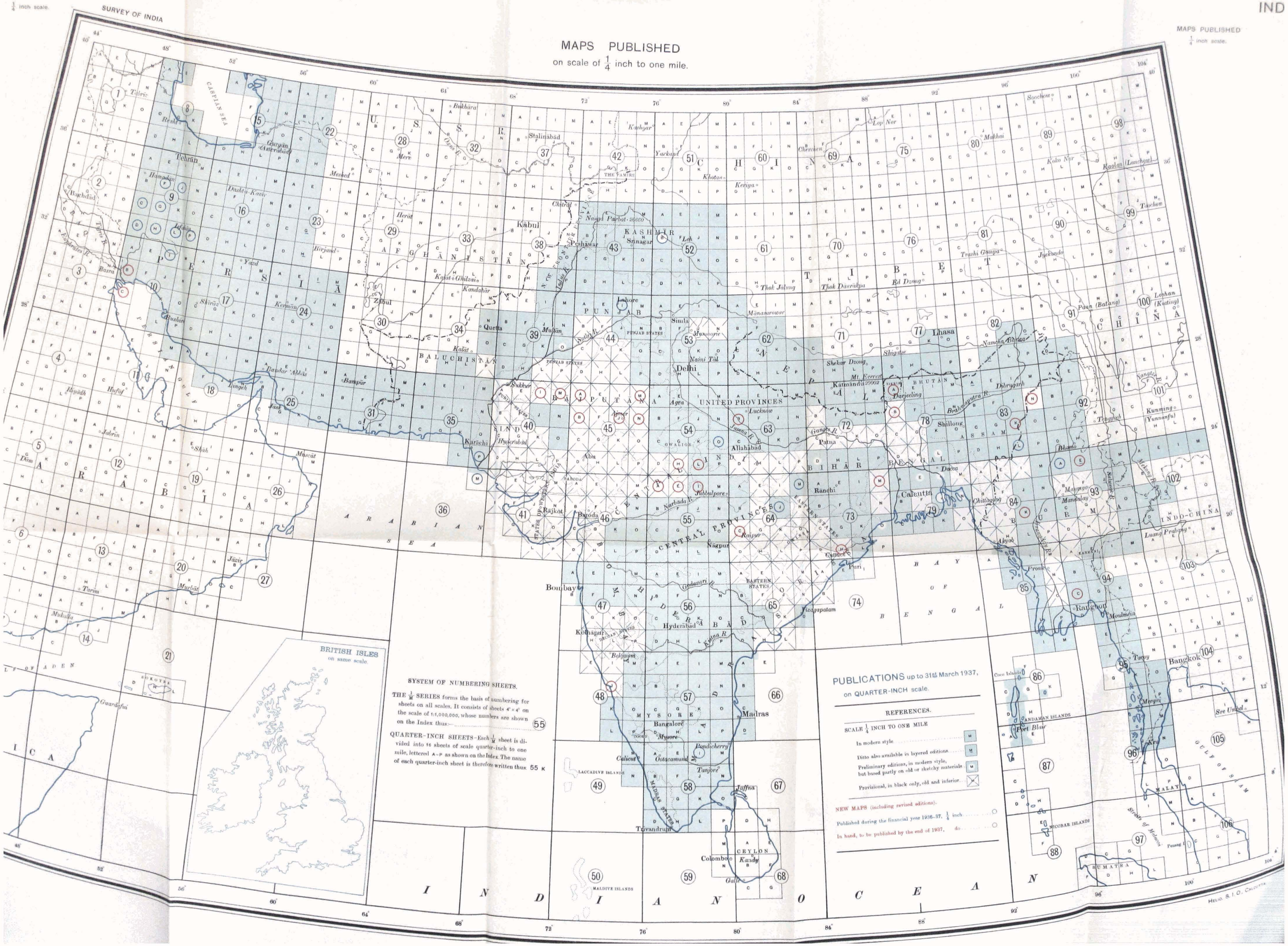
IND

MAPS PUBLISHED
$\frac{1}{4}$ inch scale.

SURVEY OF INDIA

MAPS PUBLISHED

on scale of $\frac{1}{4}$ inch to one mile.



SYSTEM OF NUMBERING SHEETS.

THE $\frac{1}{M}$ SERIES forms the basis of numbering for sheets on all scales. It consists of sheets 4° × 4° on the scale of 1:1,000,000, whose numbers are shown on the Index thus:— .... ㊺

QUARTER-INCH SHEETS—Each $\frac{1}{M}$ sheet is divided into 16 sheets of scale quarter-inch to one mile, lettered A–P as shown on the Index. The name of each quarter-inch sheet is therefore written thus: 55 K

PUBLICATIONS up to 31st March 1937, on QUARTER-INCH scale.

REFERENCES.

SCALE $\frac{1}{4}$ INCH TO ONE MILE

In modern style .... M

Ditto also available in layered editions .... M

Preliminary editions, in modern style, but based partly on old or sketchy materials .... M

Provisional, in black only, old and inferior .... ☒

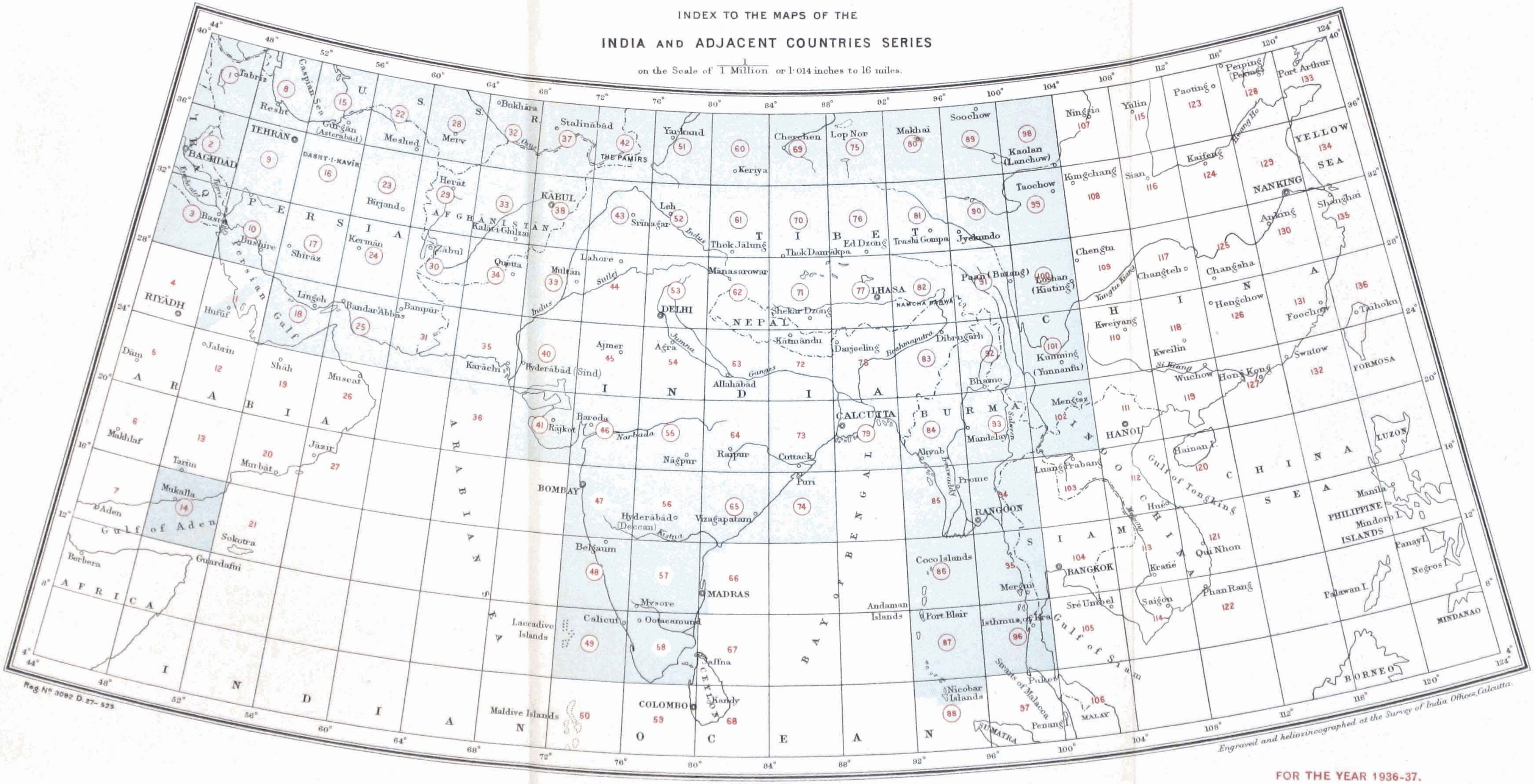
NEW MAPS (including revised editions).

Published during the financial year 1936-37, $\frac{1}{4}$ inch .... ○

In hand, to be published by the end of 1937, do .... ○

HELIO. S.I.O. CALCUTTA.

INDEX E



Published under the direction of Brigadier H. J. Couchman, D.S.O., M.C., *Surveyor General of India*, 1937.

Scale of Index 1/30 Million

Miles 200 0 200 400 600 800 Miles.

FOR THE YEAR 1936-37.

REFERENCE

	Helio	Engd.
Maps published, Ordinary Edition only		
„ „ Ordinary & Layered Editions		
„ in hand		

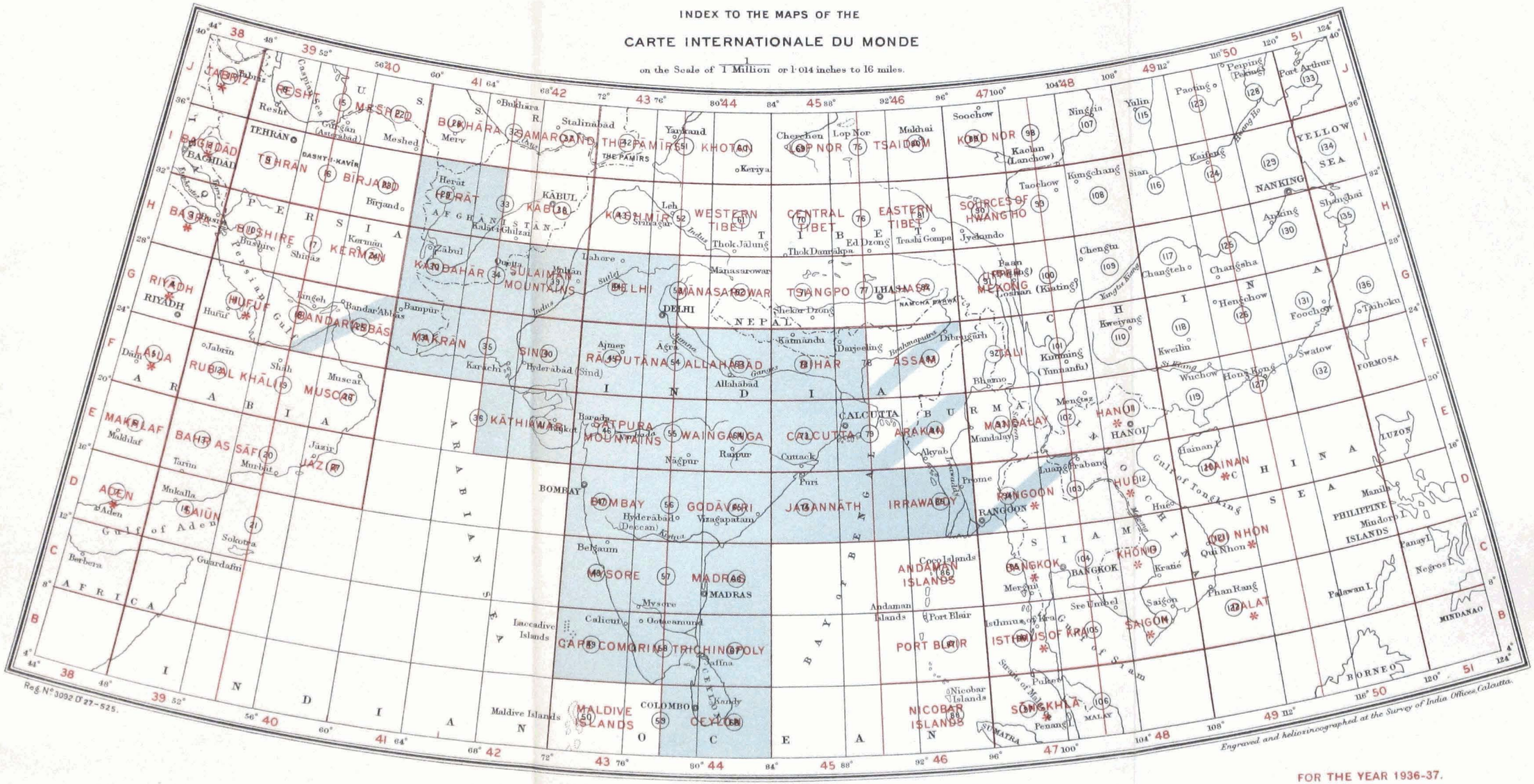
Sheets published during the financial year 1936-37:—Rev. edn. 56.

INDEX F

INDEX TO THE MAPS OF THE

CARTE INTERNATIONALE DU MONDE

on the Scale of $\frac{1}{1\text{ Million}}$ or 1·014 inches to 16 miles.



Published under the direction of Brigadier H.J. Couchman, D.S.O., M.C., *Surveyor General of India,*
1937.

Scale of Index $\frac{1}{30\text{ Million}}$

Miles 200 0 200 400 600 800 Miles.

Engraved and heliozincographed at the Survey of India Offices, Calcutta.

Reg. N° 3092 D 27-525.

FOR THE YEAR 1936-37.

REFERENCE

Maps published

" in hand

" published by other countries *

INDEX G


INDEX TO THE MAPS OF THE
SOUTHERN ASIA SERIES
ON THE 1/Two Million SCALE
CAUCASUS
TRANS-CASPIA
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LAKE BALKASH
CHINESE TURKISTAN
WEST MONGOLIA
EAST MONGOLIA
TURKEY
MESOPOTAMIA
SYRIA
NORTH PERSIA
AFGHANISTAN
KASHMIR
NORTH TIBET
KOKO-NOR
PEKING
NEJD
SOUTH PERSIA
BALUCHISTAN
DELHI
NEPAL
BRAHMAPUTRA
YUNNAN
CENTRAL CHINA
SOUTH EAST ARABIA
KĀTHIĀWĀR
BOMBAY
CALCUTTA
RANGOON
HONG KONG
CHINA SEA
MECCA
GULF of ADEN
ARABIAN SEA
BAY of BENGAL
MADRAS
ANDAMAN
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BORNEO
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Miles 200 0 200 400 600 800 1000 Miles
FOR THE YEAR 1936-37.
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