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SURVEY OF INDIA
GENERAL REPORT

1936



From 1st October 1935
To 30th September 1936

PUBLISHED BY ORDER OF
BRIGADIER H. J. COUCHMAN, D.S.O., M.C.,
SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office,
Survey of India,
CALCUTTA,
1936.

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LIEUT. GENERAL CHARLES REYNOLDS. (1758-1819)

SURVEYOR GENERAL, BOMBAY, 1796-1807.

(For biography, see page 2).

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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 Dün. (Tel. "Surtrig").
 " " Eastern Circle, * " " Shillong. (Tel. "Sureast").
 " O. C. No. 6 (South India) " " Bangalore. (Tel. "Surfield Six").
 " " Party,*
 " " No. 10 (Burma) " " Maymyo. (Tel. "Surfield Ten").
 " " Party,*

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 Dün*, who undertakes a good deal of 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 only, 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 Imperial 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 "Surreys"), as the Surveyor General of India is on tour during most of the year.

* Provinces and States in each Survey Circle.

- | | | |
|--|--|---|
| <p>1. FRONTIER Circle
 Kashmir and Jammu
 N. W. F. Province
 Baluchistän
 Punjab
 Punjab States
 Bikaner State
 Sind.</p> | <p>2. GEODETIC Branch
 United Provinces
 Central India
 Gwalior
 Ajmer-Merwara
 Delhi
 Rājputāna (excluding
 Bikaner).
 Baroda
 Bombay (Northern
 Division).
 States of Western
 India.</p> | <p>3. No. 6 (South
 India) Party.
 Madras
 Madras States
 Hyderabad
 Mysore and Coorg
 Bombay (Southern
 Division).</p> |
| <p>5. No. 10 (Burma) Party,
 Burma.</p> | <p>4. EASTERN Circle
 Central Provinces
 (including Berār).
 Bengal
 Bihār
 Assam and Sikkim
 Eastern States
 Orissa.</p> | |

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 to some extent 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 square degree, 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.

- | | |
|-----------------|---|
| <i>England.</i> | 1. Secy. 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. |
| <i>America.</i> | 3. C. S. Hammond & Co., 30 Church St., Hudson Terminal, New York, and 75 State St., Boston, Mass. |
| <i>Germany.</i> | 4. Dietrich Reimer, Berlin, S. W. 48. |
| <i>China.</i> | 5. French Book Stores, Grand Hotel de Pekin, Peiping. |

INDIA.

- | | |
|--------------------|---|
| <i>Agra.</i> | 1. English Book Depot, Tāj Road. |
| | 2. Indian Army Book Depot, Dayāl Bāgh. |
| <i>Ajmer.</i> | 3. Rājputāna Book House. |
| <i>Allahābād.</i> | 4. North India Christian Tract and Book Society. |
| <i>Ambāla.</i> | 5. Ram Chander & Sons. |
| | 6. English Book Depot, Ambāla Cantonment. |
| <i>Bangalore.</i> | 7. Raja Gopal Photo. Zinco. and Printing Works, Fort Bangalore. |
| <i>Bareilly.</i> | 8. London Book Depot. |
| <i>Baroda.</i> | 9. B. Parikh & Co., Māndvi Road. |
| <i>Bombay.</i> | 10. Thacker & Co. |
| | 11. D. B. Taraporevala Sons & Co. |
| | 12. King & Co., 213-215 Badri Mahal, Hornby Road. |
| <i>Calcutta.</i> | 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. |
| <i>Cawnpore.</i> | 20. Advani Brothers. |
| <i>Darjeeling.</i> | 21. Oxford Book & Stationery Co. |
| <i>Delhi.</i> | 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. |
| <i>Dum-Dum.</i> | 27. Indian Air Survey & Transport Ltd. |
| <i>Ferozepore.</i> | 28. English Book Depot, Wazir Ali Buildings. |
| <i>Indore.</i> | 29. The Manager, Dak Bungalow, Indore. |
| | 30. The Proprietor, Central India High Class Athletic Depot. |
| <i>Jhānsi.</i> | 31. English Book Depot. |
| <i>Karāchi.</i> | 32. Aero Stores, Napier Road. |
| <i>Kasauli.</i> | 33. Ram Chander & Sons. |
| <i>Kashmīr.</i> | 34. Cockburns Agency, Srīnagar. |
| | 35. D. G. Smith & Co., Srīnagar. |
| <i>Lahore.</i> | 36. Punjab Religious Book Society, Anārkali. |
| | 37. Standard Book Depot. |
| | 38. Oxford Book & Stationery Co. |
| <i>Lucknow.</i> | 39. Lucknow Publishing House, The Mall. |
| <i>Madras.</i> | 40. Higginbothams Ltd. |
| <i>Meerut.</i> | 41. Oxford Book & Stationery Co. |

(Continued Overleaf)

III. LIST OF AGENTS FOR THE
SALE OF MAPS—(Concl'd.)

INDIA.—(Concl'd.)

<i>Murree.</i>	42.	J. Ray & Sons, The Mall.
<i>Mussoorie.</i>	43.	The Mussoorie Book Society.
<i>Muzaffarpur.</i>	44.	Burman & Co.
<i>Nāgpur.</i>	45.	Superintendent, Govt. Printing, Book Depot.
<i>Ootacamund.</i>	46.	Higginbothams Ltd.
<i>Patna City.</i>	47.	K. P. Saxena & Co., Diwan Mohlla.
<i>Peshāwar.</i>	48.	Faqir Chand Marwah, Peshāwar Cantonment.
	49.	J. Ray & Sons, Arbab Road.
	50.	Sham Lal & Sons.
	51.	London Book Co. (India).
<i>Poona.</i>	52.	International Book Service, Deccan Gymkhana Colony.
<i>Quetta.</i>	53.	Standard Book Stall, Circular Road.
<i>Rangoon.</i>	54.	The Curator, Government Book Depot, Burma.
<i>Rāwalpindi.</i>	55.	J. Ray & Sons, 43 K & L, Edwardes Road.
<i>Simla.</i>	56.	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 wide-spread 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 about two thirds of the programme had been completed by 1936, 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, 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.

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

Nomenclature.—Although the terms "Irān" and "Irānian" are now to be used in all correspondence in supersession of "Persia" and "Persian" respectively, the latter are used throughout this report in order to conform with the maps published by the Survey of India, on which the old names are to be retained.

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C. Maps published on scales of 1-inch and $\frac{1}{2}$ -inch to one mile	"
D. Maps published on scales of $\frac{1}{4}$ -inch to one mile	"
E. India and Adjacent Countries Series, 1/M scale	"
F. Carte Internationale du Monde, 1/M scale	"
G. Southern Asia Series, 1/2M scale	"

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

1936

From 1st October 1935

To 30th September 1936

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 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 old 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 H. J. Couchman, D.S.O., M.C., held the post of Surveyor General throughout the year. Colonel S. W. S. Hamilton, D.S.O., officiated up to 1st November, while Brigadier Couchman was on leave.

The post of Assistant Surveyor General was held by Lt.-Colonel E. O. Wheeler, M.C., R.E., throughout the year.

3. The total cost of the Department for the year ending 31st March 1936, as compared with that of previous years, was as follows:—

	1933-34	1934-35	1935-36	REMARKS.
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>	
Gross actual cost ...	34,25,357(a)	34,42,523(b)	34,33,719†	(a) Including Rs. 1,08,290 for English Charges (High Commissioner) on Stores, and loss or gain by exchange. (b) Including Rs. 91,856 for do. do.
Deduct recoveries ...	12,55,341	10,95,885	10,25,593†	
Nett actual charges ...	21,70,016	23,46,638	24,08,126†	† These figures are not final.
<i>Total area of survey of all kinds completed during the year.</i>	Square miles.	Square miles.	Square miles.	* <i>Vide page 17</i>
	42,183	51,664	57,036*	

4. **Organisation.** A special party was formed in October 1935 under the charge of Captain J. B. P. Angwin, R.E., to assist the Sino-Burmese Boundary Commission. It was disbanded in June 1936.

A scale of pay for officers of the Indian Army of Indian domicile has been sanctioned and the scales for both R. E. and Indian Army officers have been extended to include the 3rd, 4th, and 5th years of Army Service.

The rates of special pay admissible to the Chief Draftsman and Head Draftsman in the H. Q. offices have been changed to Rs. 150 and Rs. 50 per month respectively.

The scale of pay of the post of Assistant Head Engraver when held by an officer of Indian domicile has been fixed at Rs. 200-30-500. The benefits of the Calcutta House Allowance Scheme are not admissible to such officers.

A competitive examination for entrance to the Class II Service was held in August at three centres, namely Calcutta, Dehra Dūn and Bangalore. Selection Boards, consisting of members of the Public Service Commission and officers of the Survey of India, interviewed prospective candidates during July.

5. Notable events of the Survey year.

The portrait of Lt.-General Charles Reynolds which forms the frontispiece to this volume is reproduced from a portrait by Raeburn, by the kind permission of Messrs. Asscher and Welker of London.

Charles Reynolds came out to Bombay as cadet in 1772 at the age of fourteen, and was appointed Ensign of Infantry from July 30th 1775.

From the start of his service he was almost continually on active service against the Mahrattas, up to the peace of 1782, and was several times wounded and mentioned in despatches.

He had already taken to surveying, being employed on a survey of the Broach pargannas, and he tells us that route surveys "to Dubhoy, Cambay, and Ahmedabad were taken by me for my own private satisfaction as opportunity occurred".

In 1783, in the war against Mysore, he commanded a detachment of six grenadier companies sent to join the Bombay force in Canara, where he became Secretary to General Mathews and Surveyor General to the Army, and surveyed part of Bednore above the Ghauts. He escaped being taken prisoner with General Mathews, but was shut up with Toriano's force throughout the siege of Onore (Honāvar, 1-inch sheet 48 J/7).

On his return to Bombay in 1784 he was employed on a survey of Bombay and Salsette, till early in 1785 when he was appointed Surveyor to a political mission which travelled across India from Surat to Calcutta. After this he was attached as Surveyor to the Resident with the Peishwa's court at Poona; his most remarkable achievement being to reach Masulipatam in 1788 *via* Nāgpur and Hyderābād, visit Madras, and return to Surat by another route.

On the outbreak of war against Mysore in 1790, Reynolds accompanied the Bombay force to Malabar as A. D. Q. M. G., in charge of the Intelligence Department, and at the conclusion of the campaign in 1792, he carried through a surveyed line from Seringapatam (57 D/11) *via* Hyderābād to Burhānpur (55 C/3).

In 1793 Reynolds visited Calcutta again, and obtained the authority of the Supreme Government to undertake a comprehensive "Map of Hindoostan", and also to make surveys in the Doāb and Rohilcund. Early in 1794 he was recalled to Bombay, and took no further active part in surveying; henceforth devoting himself to the compilation of his great map. He employed a large number of Indian surveyors, or rather explorers, who brought in to him at Surat a vast quantity of geographical material mostly in the form of routes, from Sind, the Punjab, and other little-known parts.

Reynolds became the first Surveyor General on the Bombay Establishment early in 1796, but continued to work single-handed till given three assistants in 1801; with their help he completed his map, and was able to leave India in February 1807, taking a special copy with him to present to the Court of Directors.

He was promoted Colonel on May 1st 1804, and Lt.-General in 1814; he died in England on June 24th 1819.

Reynolds' achievements were remarkable in that he worked for the most part without any European assistants, and almost entirely in foreign territories where survey could not be carried out openly. His maps were only superseded as these territories came under direct British influence many years later.

Quetta Earthquake.—

'E' Survey Company continues to live and work in tents and "Wāna huts" in Quetta. New offices for the Company are to be rebuilt on the old site.

Boundary Survey.—

At the instance of the Government of Bombay and of the Agent to the Governor General in Rājputāna, the demarcation of two disputed portions of the Sind-Jaisalmer boundary was undertaken on payment. The work was commenced on 31st January and completed on 24th February 1936.

At the request of the Agent to the Governor General, Eastern States, a part of the boundary between the States of Khairāgarh and Nāndgaon was demarcated, on payment (para. 95).

Conferences.—

While on leave in England Brigadier Couchman, D.S.O., M.C., and Captain Bomford, R.E., attended, as official delegates from India, the 3rd Conference of Empire Survey Officers held in London from the 23rd July to the 2nd August 1935. Captain Crone, R.E., also attended the Conference.

The following papers by officers of the Survey of India were read:—

"Geodetic Progress in India"—by Captain Bomford, R.E.

"Air Survey in Tripura State, Bengal, 1933-34" by Colonel Campbell, D.S.O.

"The use of High Oblique Air Photographs for Topographical Mapping"—by Captain Crone, R.E.

The Surveyor General and Lt.-Colonel Glennie, D.S.O., R.E., attended a Seismological Conference with the Director, Geological Survey and the Director-General of Observatories which was held in the Geological Survey Office, Calcutta, on the 18th January 1936 to frame proposals for a seismological organisation in India.

Exhibits.—

Under instructions from the Surveyor General, exhibits by the Photo.-Litho. Office illustrating methods of map production, and a selection of instruments illustrating the manufactures of the Mathematical Instrument Office, were sent on the 10th December to the Institution of Engineers (India), 8 Gokhale Road, Calcutta, for display at their annual Conversazione.

Colonel Hamilton, D.S.O., Director, Frontier Circle, participated in the opening ceremony of the Willingdon Air Station at Delhi in February and in company with Lieut. Jenney, R.E., Officer in charge, No. 18 (Air Survey) Party, arranged a display of Air Survey Exhibits.

Exploration.—

On return from deputation with the Visser Expedition, 1935, surveyor Muhammad Akram rejoined 'A' Company on the 29th October.

Khan Sahib Afraz Gul Khan, late Extra Assistant Superintendent of the Survey of India also accompanied this expedition.

During May and June 1935 the expedition explored the area lying in the great bend of the Shyok river between the junctions of that river with the Nubra and Galwān, thus connecting up with the area explored by the Visser expeditions of 1929 and 1930. During July and August 1935 the expedition moved across to the Shaksgam valley and by crossing the Kyagar Glacier succeeded in penetrating the hitherto unexplored portion of that valley which lies between the areas explored by Mason's expedition of 1926 and Younghusband's of 1899. The following is an extract from a telegram from Dr. Visser:—

“Surveyors mapped nearly whole region between Nubra and Shyok and that under greatest difficulties and dangers stop Shaksgam down to 14 miles below Gasherbrum Glacier. Both did splendid work”.

A total area of approximately 1,800 square miles was surveyed on half-inch scale, and is being incorporated in sheet Nos. 52 A, E, F & J and other maps affected.

The results of the Duke of Spoleto's surveys in the Karakoram in 1929, Messrs. E. Shipton and H. W. Tilman's sketch surveys in the neighbourhood of Nanda Devi and Badrināth in 1934, Colonel R. C. F. Schomberg's route survey in the Shingshal-Muztagh area in 1934 and Sir Eric Teichman's compass traverse of the motor route from Peking to Kāshgar in 1935 have been recently received and are being embodied in the sheets affected.

Exercises and Manœuvres.—

No. 18 (Air Survey) Party this year co-operated with the R. A. in an artillery practice with live ammunition at Nowshera for the purpose of instructing R. A. Officers in the use of the 1/25,000 Air Chart.

With reference to page 4 of the General Report 1935, Extracts from the Report on Air Survey Exercise, Nowshera, 1935 by Captain Crone, R.E., have now been published.

Lectures.—

Dr. A. M. Heron, D.Sc. (Edin.), F.G.S., F.R.G.S., F.R.S.E., Director, Geological Survey of India, and Lt.-Colonel Glennie, D.S.O., R.E., delivered lectures on “Earthquakes” to the members of the United Service Institution of India at the Gaiety Theatre, Simla on the 16th July. His Excellency the Viceroy and the Chief of the General Staff were present.

Lt.-Colonel Glennie also read a paper on “Subterranean rock formations in the north of India in relation to water-logging” at a meeting of the Research Committee of the Central Board of Irrigation on the 10th July.

The Officer in Charge, No. 18 (Air Survey) Party delivered a lecture on air surveys in war to the officers of the Northern Command Annual Intelligence Course.

Captain Crone delivered a lecture at the War Office Air Survey Exercise at Chatham in October on the Indian method of compiling high oblique air photographs, and conducted an exercise to demonstrate the method.

Adventures and Casualties.—

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

Colonel A. A. McHarg, D.S.O., late Director, who died in August 1936 at the age of 62.

Mr. A. A. Graham, Extra Assistant Superintendent, who died at Dehra Dūn on the 13th January 1936 at the age of 51.

Mr. F. R. Vandyke who died in London on the 24th June 1936, at the age of 70. Mr. Vandyke rendered 34 years of very distinguished service in the Photo.-Litho. Office; his name will long be remembered as the inventor of the Vandyke Process.

9 Lower Subordinates and 15 inferior servants died during the year under report.

Surveyor Fazl Elahi and four Khalasis narrowly escaped losing their lives when they were almost overwhelmed by a very severe snow storm on the Gangotri Glacier, in Tehri-Garhwāl. They were without food for 3 days struggling through snow, sometimes up to their waists.

Major Osmaston, accompanied by Mr. Eric Shipton, penetrated the "inner sanctuary" of Nanda Devi in the course of topographical surveys in the Kumāun Himālaya.

Distinguished visitors.—

The Hon'ble Sir Girija Shankar Bajpai, K.B.E., C.I.E., I.C.S., officiating Member of the Executive Council of the Governor General of India (Department of Education, Health and Lands), visited the Geodetic Branch Offices in Dehra Dūn on the 30th November 1935.

Dr. L. K. Hyder, C.I.E., Ph.D., Member of the Public Service Commission, visited the Headquarters Offices at Calcutta on the 15th January 1936.

6. Appreciations and Awards.

His Excellency the Viceroy and Governor General has been pleased to award the Kaiser-i-Hind Medal of the Third Class to Mr. Shahabuddin, Litho. Draftsman of "E" Company, for services rendered in connection with the Earthquake in Baluchistān, 1935.

The Surveyor General presented to Rai Sahib R. B. Mathur, B.A., the Sanad and insignia of his title on the 28th April.

Khan Sahib Afraz Gul Khan, a retired Class II officer who accompanied the Visser Expedition, 1935, has been awarded by Her Majesty the Queen of Holland the title and Insignia of a Chevalier of the Order of Orange Nassau in recognition of his work in the Karakoram.

Captain Bomford, R.E., has been elected a Fellow of the National Institute of Sciences of India and of the Royal Astronomical Society.

The following is an extract from a letter received by the Director, Frontier Circle from the Brigadier, R. A., Northern Command, regarding the results of the artillery practice at Nowshera:—

"I would like to record my appreciation of the great help and co-operation given by No. 18 (Air) Survey Company, in this exercise. They fitted in the production of the air chart as part of their annual training. The air chart they produced was not only of great value in this year's exercise, but will be used next year for the artillery brigades practising at Nowshera."

In connection with the opening of the Willingdon Air Station at Delhi, the following D. O. letter has been received by Colonel Hamilton from the Director, Civil Aviation:—

"This is just a line to offer you my thanks for the trouble you and your staff took to add to the interest of the opening ceremony by bring-

ing your exhibit of instruments and maps. It was one of the most interesting exhibits in the building and Jenney took endless trouble to make it interesting to every one. I am writing him a note, but I want to let you know that I am very grateful for the help of yourself and the Survey of India generally."

Mathematical Instrument Office.—

Among other special manufactures were the following:—

Twelve clinometers, of a new pattern, rigid, in wooden case, have been made up for test in the field.

The design of the folding pattern clinometer has also been improved, the folding vanes strengthened to prevent bending and the tilting screw fitted with a floating steel ball point working in a *Vee* slot to prevent lateral movement. The scales are now machine divided.

Further alterations are contemplated which include improved bubble adjustment, more positive stops for the open position of the vanes, larger cleats and the abolition of a degree scale.

Pantographs, in which the castors have been replaced by stainless steel ball bearing fittings, have also been designed. Two of these instruments have been issued for test.

One experimental scale, single, diagonal, 16" = 1 mile, and one experimental protractor, rectangular, 6" MK. IIIA, made of synthetic resin material, were sent to the Director of Land Records, Central Provinces, Nāgpur, and to the Commandant, Indian Military Academy, Dehra Dūn, respectively, for testing.

A brass sun dial, 18-inch diameter, was constructed for installation at the new Government House, Darjeeling.

A globe of 18-inch diameter, mounted on a pedestal, was made up to facilitate the recording of seismological disturbances at the Meteorological Office, Alipore.

One crinoline tape to measure 336 feet was made up for issue to the Superintending Engineer, Meghna Bridge Construction.

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

Class I Officers.—Major R. S. Wauchope, O.B.E., I.A., and Messrs. V. W. Morton, E. A. Meyer and P. Simpson, retired.

Messrs. L. Williams, M.B.E., and O. N. Pushong permanently promoted to Superintendents in Class I.

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

Mr. McCracken, M.B.E., confirmed as Superintendent in Class I.

Major Penney, R.E., promoted to Lt.-Colonel.

Captain Bomford, R.E., promoted to Major.

Mr. L. Williams, M.B.E., granted leave preparatory to retirement.

Lieutenants C. A. Biddle, R.E., and D. E. O. Thackwell, R.E., confirmed as Assistant Superintendents.

Class II Officers.—

Messrs. Grant and P. C. Mitra, B.A., substantively appointed to the posts of Chief Draftsman, Map Publication Office, and Head Draftsman, No. 1 Drawing Office, respectively.

Mr. A. A. Graham, died.

Miscellaneous appointments,—General Central Services Class II.—

Mr. A. R. J. Dalziel, Head Engraver, and Mr. L. H. Mordue, Assistant Manager, Photo.-Litho. Office, who were appointed on contract, have been confirmed in their appointments.

Mr. G. M. Dhara, officiating Registrar, was confirmed in his appointment.

Upper Subordinate Officers.—Five officers were appointed to the Upper Subordinate Service on probation and posted to the Geodetic Branch for training.

Mr. Lalbir Singh, retired.

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. Ajmer-Merwāra.

Cantonment and city surveys. Re-survey of Nasirābād Cantonment (p. 45).

10. Assam.

Correction surveys in Khāsi and Jaintia Hills district (p. 51).

Geodetic. Latitude and Longitude at 2 stations (p. 14).

Primary triangulation through Nāga Hills (p. 14).

Topographical surveys in Lushai Hills district (p. 51).

11. Baluchistan.

Cadastral surveys for town planning in Quetta City (p. 40).

Framework. Triangulation in Kalāt and Las Bela States (p. 40).

Traversing in Quetta City (p. 40).

Geodetic. Gravity at 11 stations (p. 14).

Levelling. Tertiary levelling in Quetta Cantonment (p. 40).

Topographical surveys in Kalāt and Las Bela States (p. 40).

12. Baroda.

Framework. Revision triangulation in Baroda (p. 44).

Levelling. High precision levelling in the back direction Surat to Baroda portion of the line Viramgām to Surat of the new geodetic level net (p. 15).

13. Bengal.

Framework. Triangulation and traverse in Chittagong and Noākhāli districts and Chittagong Hill Tracts (p. 51) and traverse in Mālda district (p. 47).

Topographical surveys in Chittagong district and Chittagong Hill Tracts (p. 51).

14. Bihār.

Forest surveys in Santāl Parganas district (p. 47).

Framework. Triangulation and traverse in Bhāgalpur, Purnea and Santāl Parganas districts (p. 47).

Topographical surveys in Bhāgalpur, Darbhanga, Monghyr, Patna and Purnea districts (p. 47).

15. Bombay.

Framework. Revision triangulation in Ahmadābād, Broach and Pānch Mahāls and Kaira districts (p. 44).

Geodetic. Latitude and longitude at 14 stations (p. 14).

16. Burma.

Framework. Triangulation and traverse in Toungoo and Yamethin districts, Karenni and Southern Shan States (p. 57).

Geodetic. Primary triangulation through Nāga Hills (p. 14).

Topographical surveys in Arakan Hill Tracts (p. 51) and in Kyaukse, Mandalay, Meiktila, Sagaing and Yamethin districts and the Northern and Southern Shan States (p. 57).

17. Central India.

Framework. Revision triangulation in Dewās, Dhār, Indore, Jaora, Jhābua, Piploda, Ratlām, Sailāna and Sitāmau States (p. 44).

Levelling. High precision levelling for new geodetic level net in the fore direction, from Nāgpur to Bhopāl and precise levelling Ghāzipur to Sironj portion of line Bagaha to Sironj run to determine the extents of disturbances caused by the earthquake of 15th January 1934 (p. 15).

18. Central Provinces.

Air survey in Nāgpur (p. 50).

Cantonment and city surveys. Re-survey of Jubbulpore Cantonment (p. 45).

Framework. Triangulation and traverse in Bilāspur district (p. 50).

Levelling. High precision levelling of the new geodetic level net in the fore direction, Thānegaon to Nāgpur portion of the line Dhūlia to Nāgpur, Nāgpur to Bhopāl, Nāgpur to Raipur and Raipur to Katghora portion of line Raipur to Daltonganj (p. 15). Levelling in Nāgpur (p. 50).

Topographical surveys in Bilāspur and Raipur districts (p. 49).

19. Delhi.

Correction surveys in Delhi (pp. 36, 43).

Geodetic. Gravity at 1 station (p. 14).

20. Eastern States.

Framework. Triangulation in Gāngpur, Patna, Raigarh and Sonapur States (p. 50).

Miscellaneous. Demarcation of the boundary between Khairāgarh and Nāndgaon States (p. 50).

Topographical surveys in Gāngpur, Patna, Raigarh, Rairākhhol, Sakti, Sārangarh and Sonapur States (pp. 49, 50) and in Kālāhandi State (p. 55).

21. Gujarāt States.

Framework. Revision triangulation in Bālāsīnor, Bāriya, Cambay, Chota Udaipur, Lūnāvāda and Sunth (Sant) States (p. 44).

22. Gwalior.

Framework. Revision triangulation in Gwalior (pp. 42, 44).

Levelling. High precision levelling for new geodetic level net in the fore direction, from Nāgpur to Bhopāl and precise levelling Ghāzīpur to Sironj portion of line Bagaha to Sironj run to determine the extents of disturbances caused by the earthquake of 15th January 1934 (p. 15).

23. Hyderābād.

Geodetic. Latitude and longitude at 13 stations (p. 14).

24. Kashmīr.

Geodetic. Gravity at 1 station (p. 14).

25. Madras.

Framework. Traverse in East Godāvāri and West Godāvāri districts (p. 55).

Geodetic. Latitude and longitude at 26 stations (p. 14).

Topographical surveys in Vizagapatam district (p. 55).

26. Mysore.

Correction surveys in Bangalore Guide Map area (p. 55).

Geodetic. Latitude and longitude at 11 stations (p. 14).

27. N. W. F. Province.

Air surveys in Mohmand and Tirāh Tribal territory, and North Waziristān Agency (p. 41).

Framework. Traversing and levelling for Cantonment survey of Abbottābād and Risālpur (p. 45).

Geodetic. Gravity at 6 stations (p. 14).

28. Orissa.

Forest surveys in Sambalpur district (p. 49).

Framework. Traverse in Koraput district (p. 55) and triangulation in Sambalpur district (p. 50).

Miscellaneous. Correction boundary survey of a part of proposed province boundary (p. 54).

Topographical surveys in Koraput and Ganjām districts (pp. 54, 55) and in Sambalpur district (p. 49).

29. Punjab.

Cantonment and city surveys. Re-survey of Dharmśāla Cantonment (p. 45).

Correction surveys in Ambāla (p. 43); in Gurgaon and Rohtak districts (pp. 36, 43); in Hissār district (p. 36); in Karnāl district (p. 43) and in Kalsia State (p. 43).

Framework. Traversing and levelling for cantonment surveys of Dharmśāla, Chaklala and Rāwalpindi Cantonments (p. 45).
Triangulation and Traversing in Attock, Dera Ghāzi Khān, Jhelum, Lahore and Miānwāli districts (p. 37).

Geodetic. Gravity at 7 stations (p. 14).

Riverain surveys in Lahore district (p. 38).

Special surveys in Attock, Jhelum, Lahore and Miānwāli districts (p. 37).

Topographical surveys in Dera Ghāzi Khān, Hissār, Kāngra, Karnāl and Rohtak districts (p. 36).

30. Punjab States.

Correction surveys in Dujāna and Jind States (p. 36) and in Sirmūr State (p. 43).

Framework. Triangulation and traverse in Bahāwalpur State (p. 37).

Geodetic. Gravity at 7 stations (p. 14).

Topographical surveys in Bahāwalpur State (pp. 36, 42); in Dujāna, Jind and Mandi States (p. 36).

31. Rājputāna.

Framework. Revision triangulation in Bānswāra, Dūngarpur, Jhālāwār, Pālanpur, Partābgarh, Sirohi and Udaipur (Mewār) States (p. 44).

Topographical surveys in Bikaner and Jaisalmer States (pp. 36, 42) and in Jodhpur (Mārwar) State (pp. 42, 43).

32. Sind.

Geodetic. Gravity at 3 stations (p. 14).

Levelling. Tertiary levelling in Karāchi district (p. 40).

Special surveys in Karāchi district for Headquarters, Western Command (p. 40).

Topographical surveys in Dādu and Lārkāna districts (p. 40) and in Sukkur district (p. 42).

33. States of Western India.

Framework. Revision triangulation in Bajāna, Bhaunagar, Idar and Limbdi States (p. 44).

34. United Provinces.

Cantonment and city surveys. Original survey of Lansdowne extended boundary (p. 45).

Correction surveys in Aligarh, Bulandshahr, Dehra Dūn, Muttra and Sahāranpur districts and Tehri-Garhwāl State (p. 43) and in Meerut district (pp. 36, 43).

Framework. Traversing and levelling for cantonment survey of Forest Research Institute, Indian Military Academy and Royal Indian Military College at Dehra Dūn (p. 45).

Forest surveys in Tehri-Garhwāl State (p. 43).

Levelling. Precise levelling Ghāzipur to Sironj portion of line Bagaha to Sironj run to determine the extents of disturbances caused by earthquake of 15th January 1934 (p. 15).

Topographical surveys in Garhwāl district and Tehri-Garhwāl State (p. 43) and in Meerut district (p. 36).

35. Yanam (French).

Framework. Traverse in Yanam (p. 55).

PART 2.—GEODETIC WORK.

III.—ABSTRACT OF GEODETIC OPERATIONS.

DIRECTOR:—{ Colonel C. G. Lewis, O.B.E., to 13-5-36.
Lt.-Colonel C. M. Thompson, I.A., from 14-5-36.

36. 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. 71-74).

Cantonment Surveys (paras. 75-79).

Training School (para. 119).

37. 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 1936.

38. Observatory Section.—Bi-weekly time observations were continued satisfactorily with Dr. Hunter's shutter transit and with the motor transit, and a record of the longitude of Dehra Dūn was maintained by the reception of wireless time signals from Bordeaux and Rugby.

The usual magnetic, seismographic and meteorological observations were made, and various instruments have been adjusted, cleaned and repaired.

39. Computing Section.—The rough graphical adjustment of minor triangulation in the area covered by the new series of grid pamphlets has been completed, except in certain military training areas which have now been begun.

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

The following publications have been printed at Dehra Dūn:—

(a) Geodetic Report 1935.

(b) Auxiliary Tables Part I (reprint).

One triangulation pamphlet has been reprinted, and addenda to three levelling and one triangulation pamphlets have been printed.

40. Tidal Section.—The tide-tables of the Indian Ocean for 1936 for 69 ports were prepared and published as usual in October 1935 and advance predictions for 14 ports for 1937 were despatched in September 1935 to the hydrographic departments of the U. K., United States and Japan for inclusion in their respective tide-tables.

Automatic registration of tides was continued at Aden, Karāchi, Bombay, Colombo, Dublat, Kidderpore and Rangoon. A self-recording gauge was also started at Vizagapatam on 24th April 1935. Tide-pole readings of high and low water during daylight only were continued at Bhāvnagar, Chittagong and Akyab; similar observations were also started at Shortt Island on 1st June 1935. The tidal observatories at Karāchi (March 1936), Bombay (May 1935 and February 1936) and Rangoon (May 1935 and 1936) were inspected by the respective port authorities.

41. Latitude and Longitude.—(No. 14 Party).—Observations for latitude and longitude were made by Rai Sahib R. B. Mathur with the prismatic astrolabe at 64 stations along two lines crossing Peninsular India from Bombay to Waltair and from Mangalore to Madras. The system of work was the same as that employed in previous years.

Observations of longitude for the formation of Laplace stations were also made at two stations of the Assam Valley triangulation series.

42. Gravity Observations.—(No. 14 Party).—Observations to determine the force of gravity were made at 36 stations in the Punjab, Punjab States, Delhi, Sind, Baluchistān, N. W. F. Province and Kashmir. The transport in Baluchistān was by two motor lorries of "E" Survey Company, and elsewhere by rail. The observer was Mr. M. N. A. Hashmie, B.A.

43. Triangulation.—(No. 15 Party).—Work was begun on a further extension of the Assam Longitudinal series, which reached longitude 95° E last year, in order to connect it with the Upper Irrawaddy and Mandalay meridional series in Burma. Work started in the Nāga Hills district south of Sibsāgar, and was carried ENE. into Nāga Tribal territory as far as meridian 96° E., whence it will turn due south to latitude 25° N., skirting the western edge of the Hukawng Valley.

The part of the series which was observed this year lies almost entirely in unadministered Nāga territory, a circumstance which added greatly to the expense and difficulty of the operations. An escort of military police was necessary, not only for the observing and reconnoitring detachments but also for five of the helio squads. The escort was provided by the 3rd and the 4th battalions of the Assam Rifles and consisted of 176 men commanded by Major L. C. Bull, M.C. Mr. E. T. D. Lambert, I.P. was also attached to the party as Political Officer.

The survey party consisted of Major G. H. Osmaston, M.C., R.E. in charge, with Mr. G. C. Aggarwala (U. S. S.) in charge of the reconnoitring detachment, two computers, and 62 inferior servants. 212 Nāga coolies were permanently engaged for transport, while local Nāgas (sometimes as many as 200 or 300) were engaged temporarily as required.

The Nāgas were friendly and appeared to welcome the arrival of the survey party, and to some extent desisted from their own quarrels in its immediate proximity. At the same time, their primitive habits still make it impossible to move about the country without adequate escorts.

Work started at the NW. end of the series on 28th October and proceeded as far as the turn southwards as fast as could be expected when working with escorts and cooly transport. The weather then became very bad and the observing detachment spent 13 days and 17 days on Tonyong and Lungwukaw Bum hill stations respectively, surrounded by

mist and snow. By the end of February the hot weather haze had begun, the rations of rear helio squads were exhausted, and work had to be closed. The party returned to Dehra Dūn *via* Rangoon, and arrived on 6th April.

Observations were made at 11 stations in all, using the large Wild theodolite, throughout, with an average triangular error of 0".83. Five other new stations have been reconnoitred and built, and it is hoped that the series will be completed during 1936-37.

44. Levelling.—(No. 15 Party).—*High Precision.*—Out of the total length of 15,800 miles of levelling of high precision required for the new geodetic level net of India, 95 miles were completed during 1935-36, by levelling in the back direction from Surat to Baroda, making a total of 9,150 miles completed up to date.

During 1935-36, 576 miles of single levelling on the high precision system was carried out in the fore direction only:—

In the Central Provinces.—

Thānegaon-Nāgpur	...	...	...	39 miles.
Nāgpur-Raipur	...	...	...	184 „
Raipur-Katghora	128 „

In the Central Provinces and Central India Agency.—

Nāgpur-Bhopāl	225 „
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Precise Levelling.—536 miles of precise levelling from Ghāzipur to Sironj, a portion of the line Bagaha-Sironj, was executed to determine by what amount, if any, the bench marks at Bagaha have been affected by the earthquake of 15th January 1934. Sironj being on the stable plateau of Central India is unlikely to have been affected by the earthquake.

No secondary or tertiary levelling was executed by the party in 1935-36.

PART 3.—TOPOGRAPHICAL WORK.

IV.—ABSTRACT OF TOPOGRAPHICAL WORK.

45. 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 1933 are therefore given.

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 cost, 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.

46. 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 1936, just 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 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 since 1931, the year of retrenchment, have been carried out at the rate of about 40,000 sq. miles per annum; on this basis, some 15 years are still required to complete the programme.

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.	$\frac{3}{4}$ and $\frac{1}{2}$ -inch scales.	$\frac{3}{8}$ and $\frac{1}{4}$ -inch scales.	TOTALS.
	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>
1905-33 ...	950,541*	187,199*	25,929	1,168,669*
1933-34 ...	24,796*	19,766	.....	38,562*
1934-35 ...	19,420*	29,753	.....	49,173*
1935-36 ...	18,790	18,553	15,706	53,049
Totals to 1936 ...	1,013,547	249,271	41,635	1,304,453
<i>Balance remaining</i>	<i>approximately 280,000</i>	<i>approximately 200,000</i>	<i>approximately 100,000</i>	580,187
Total programme				1,884,640

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

1935-36 ...	1,968	2,019	3,987
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* Revised figures.

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. —								
<i>Flat cultivated plains and sandy desert.</i>	$\frac{1}{4}$ -inch & 1-inch.	39 L ...	750	441	2'4	1'6	4'0	FRONTIER CIRCLE. No. 6 D. O. costs for examination and preparation of colour patterns of this unit:—Rs. 3,457. (a) Includes cost of computations done in the field.
<i>Cultivated valley with broken ravines.</i>	8-inch	43 C ...	11	24	97'0	30'2	127'2	
<i>Low rocky hills with deep ravines.</i>	100 feet to 1 inch.	38 P, 43 D, H ...	1,332 acres.	404	3'6 (a)	.....	3'6
<i>Flat cultivated plains</i>	1-inch	39 L ...	88 linear miles.	53 linear miles.	4'2 per	2'3 linear	6'5 per acre. mile.	
<i>Ditto</i>	8-inch	44 I ...	22 linear miles.	18 linear miles.	17'5 per	9'1 linear	26'6 per acre. mile.	
<i>Alluvial river banks</i>	.....	44 E, I, J ...	282 linear miles.	32 linear miles.	26'7 (a) per	..... linear	26'7 per acre. mile.
<i>Flat cultivated plains and sandy desert (partly rectangulated).</i>	$\frac{1}{4}$ -inch	39 L, P ...	4,188 miles.	111	3'6	1'9	5'5	
<i>Flat cultivated plains with sand dunes (rectangulated).</i>	1-inch	39 L ...	1,045	37	9'2	8'8	18'0	
	1-inch	44 O, P, 53 C	866	62	6'6	8'8	15'4	

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.—Concl'd.								
<i>Flat cultivated plains and low sandy hills (rectangular).</i>	1½-inch	Revision survey	212	50	Rs. 11'4	Rs. 8'8	Rs. 20'2	FRONTIER CIRCLE. <i>Contd.</i>
	1-inch	Re-survey	97	18	Rs. 13'1 (a)	Rs. 8'8 (a)	Rs. 21'9 (a)	
<i>Medium and high hills rising to 11,000 feet.</i>	1½-inch	Re-survey	156	282	Rs. 1'8	Rs. 8'8	Rs. 10'6	(a) Training Camp.
	1-inch	Correction survey	696	289	Rs. 1'1	Rs. 8'8	Rs. 9'9	
<i>Flat cultivated plains and low sandy hills (rectangular).</i>	1½-inch	Correction survey	2,136	6	Rs. 34'5	Rs. 34'3	Rs. 68'8	Military Estate.
	8-inch	Special survey	6	3'2	Rs. 151'5	Rs. 67'8	Rs. 219'3	Oil drilling lease.
<i>Flat cultivated plains</i>	8-inch	Special survey	11	77	Rs. 6'2	Rs. 3'1	Rs. 9'3	Salt Mines Development areas.
<i>Cultivated valley with broken ravines.</i>	8-inch	Special survey	1,332	...	Rs. 6'2	Rs. 3'1	Rs. 9'3	Salt Mines Development areas.
<i>Low rocky hills with deep ravines.</i>	100 ft. to 1 inch	Special survey	1,332	...	Rs. 6'2	Rs. 3'1	Rs. 9'3	Salt Mines Development areas.

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. 18 (Air Survey) Party.—								
<i>Steep partly wooded mountains (3,000 to 8,000 ft.).</i>	1-inch Original air survey	38 K ...	33	Rs. 61'7	<p>FRONTIER CIRCLE.— <i>Contd.</i></p> <p>No. 6 D. O. costs for examination and preparation of colour patterns of this unit:—Rs. 188.</p> <p>(a) The areas mapped include old ground surveys and new surveys from air photos.</p>
<i>Medium hills with open cultivated valleys.</i>	1-inch Original air survey	38 N ...	48	.....	Rs. 187'2	.....	.....
<i>Steep wooded mountains (3,000 to 10,000 ft.).</i>	1-inch Original air survey	38 H ...	21	.....	Rs. 152'3	.....	.....
<i>Steep broken hills (2,000 to 5,000 ft.).</i>	1-inch Revision air survey	38 O ...	95	.....	Rs. 22	.....	.....
<i>Medium hills with open cultivated valleys.</i>	1-inch Revision air survey	38 N ...	124	.....	Rs. 67'5	.....	.....
<i>Steep wooded mountains (3,000 to 10,000 ft.).</i>	1-inch Revision air survey	38 G ...	56	.....	Rs. 29	.....	.....
<i>Fair mapping</i>	1-inch Original and revision survey	38 K, N, O ...	444 ^(a)	.....	Rs.	26'1	.....

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.	
No. 6 Drawing Office.—								
<i>Map examination</i>	... 1-inch	Sq. m.	Rs.	Rs.	Rs.	FRONTIER CIRCLE.— Concl.
<i>Ditto</i>	... 3/4-inch	.....	.....	.....	.....	'18	.....
<i>Ditto</i>	... 1/25,000	.....	.....	.....	.....	'04	.....
<i>Ditto</i>	... 100 ft. to 1 inch	.....	.....	.....	.....	'10	.....
<i>Colour Patterns</i>	... 1-inch	.....	.....	.....	.....	'12	.....
<i>Ditto</i>	... 3/4-inch	.....	.....	.....	.....	per acre.	.....
<i>Ditto</i>	... 1-inch	.....	.....	.....	.....	'22	.....
<i>Ditto</i>	... 3-inch	.....	.....	.....	.....	'07	.....
<i>Ditto</i>	... 1-inch	.....	.....	.....	.....	'63	.....
<i>Ditto</i>	... 3-inch	.....	.....	.....	.....	2'88	.....
<i>Ditto</i>	... 1/25,000	.....	.....	.....	.....	'05	.....

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.— <i>55% occasionally heavily wooded open plains, 25% intricate wooded hills, 8% isolated rocky hills and small patches of open plains, 7% lightly wooded broken hills, 5% undulating sandy areas.</i> <i>High altitude Himālayas (8,000 to 23,000 feet).</i> <i>70% sand hills and undulating sandy areas, 25% open rocky plains and isolated rocky hills, 5% Kankar undulations.</i> <i>75% open arid plains and isolated rocky hills, 25% sand hills and undulating sandy area.</i>	$\frac{1}{2}$ -inch Revision of triangulation.	45 D, 46 A, B, E, F, I, M	Sq. m. 24,044	Sq. m. 1,235.8	Rs. 0.4	Rs. 0.2	Rs. 0.6	GEODETIC BRANCH. No. 2 D. O. cost for examination of sheets and preparation of colour patterns of this unit is Rs. 3.121.4.0 and the cost rates per 1 inch and $\frac{1}{2}$ inch sheets are Rs. 170.11.0 and Rs. 197.12.0 respectively.
	$\frac{1}{2}$ -inch Triangulation	53 I, J, M, N	Sq. m. 350	Sq. m. 119.4	Rs. 9.3	Rs. 3.0	Rs. 12.3	
	$\frac{1}{2}$ -inch Original survey ...	40 I, M, 45 A, B	Sq. m. 15,720	Sq. m. 200.3	Rs. 3.1	Rs. 0.6	Rs. 3.7	
	$\frac{1}{2}$ -inch Original survey ...	40 I, 45 B, C, E, F, I	Sq. m. 7,368	Sq. m. 105.7	Rs. 5.1	Rs. 2.8	Rs. 7.9	

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.	<p>GEODETIC BRANCH.— <i>Contd.</i> Risalpur. Rawalpindi & Chaklala Cantonments and the extended areas of Dehra Dün Cantonments comprising the Indian Military Academy, part of Royal Indian Military College. Excludes 12.4 linear miles for boundary traversing at Shäljahanpur, Roorkee, Naini Täl Cantonments and Forest Research Institute at Dehra Dün. Risalpur and Rawalpindi Cantonments Bázars. Abbottábád and Dharmshála Cantonments. Abbottábád and Dharmshála Cantonments Bázars.</p>
<i>Cantonments (Plains). 50% open and 50% congested, undulating and wooded in parts.</i>	16-inch Traverse	38 N, 43 B, G, 53 J	18,304	1,220'3	0'4	0'2	0'6	
<i>Cantonments (Plains). Fairly open to congestion.</i>	64-inch Traverse	38 N, 43 B, G	402	168'4	1'9	1'5	3'4	
<i>Cantonments (Hills). Steep hills, moderately wooded and interspersed with näläs.</i>	16-inch Traverse	43 F, 52 D ...	1,295	257'3	2'0	0'6	2'6	
<i>Cantonments (Hills). Fairly open to average congestion.</i>	64-inch Traverse	43 F, 52 D ...	19	71'2	5'2	3'0	8'2	

TABLE C.—Areas, out-turns and cost rates o 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.—Concid.									
	<i>Cantonments (Plains). 50% open and 50% congested.</i>	...	36 N, 43 B, G, 53 J	18,706	7,383.9	0.1	0.1	GEODETIC BRANCH.— <i>Concid.</i> Risalpur, Rāwalpindi and Chaklāla Cantonments and the extended areas of Dehra Dun Cantonment comprising Indian Military Academy and part of Royal Indian Military College. Abbotābad and Dharmsāla Cantonments. Lansdowne Cantonment Extension. Dharmsāla Cantonment. Nasirābad, part of Royal Indian Military College at Dehra Dun and Jubbulpore Cantonments. Dharmsāla Cantonment Bāzār. Nasirābad and Jubbulpore Cantonment Bāzār.
	<i>Cantonments (Hills). Steep hills, moderately wooded and interspersed with nālis.</i>	...	43 F, 52 D ...	1,314	1,877.1	0.2	.....	0.2
	<i>Cantonments (Hills). Open road areas.</i>	...	53 K ...	62	206.6	1.0	5.5	6.5	
	<i>Cantonments (Hills). Steep hills, moderately wooded and interspersed with nālis.</i>	...	52 D ...	351	108.6	6.8	2.7	9.5	
	<i>Cantonments (Plains). 60% open and 40% congested & undulating.</i>	...	45 J, 53 J, 55 M	12,943	205.9	1.7	1.5(a)	3.2	
	<i>Cantonments (Hills). Very open.</i>	...	52 D ...	4	24.0	20.8	9.0	29.8	
	<i>Cantonments (Plains). Congested areas.</i>	...	45 J, 55 M ...	297	14.3	20.4	12.8(a)	33.2	

(a) The areas mapped do not actually correspond with those surveyed but include mapping arrears completed in 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.	
No. 4 Party.—					Rs.	Rs.	Rs.	<p><u>EASTERN</u> <u>CIRCLE.</u></p> <p>No. 5 D. O. costs for mapping and preparation of colour patterns of this unit.—Rs. 994 (approx.).</p> <p>(a) Excludes officers & men under training.</p>
<i>Low hills, partly wooded ...</i>	1-inch	72 O	270	117'6	70	2'1	9'1	
<i>Plains, extensively cultivated and thickly populated and with fairly abundant tree growth.</i>	1-inch	72 N, O	3,711	72'8 linear miles.	4'4 per linear mile.	1'7	6'1	
<i>Ditto.</i>	1-inch	72 K	8,221	36'8	12'8	6'6	19'4	
<i>ditto.</i>	1-inch	72 K	1,078	30'3(a)	12'0	8'4	20'4	
<i>75% low hills covered with small forest trees and thick scrub jungle.</i>	1-inch	72 O, P	10	2'2	220'9	45'8	266'7	
<i>Low hills, partly wooded and partly open.</i>	4-inch							

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. 5 Party.— 60% low jungle covered hills and 40% open flat cultivated country. 20% medium jungle and 80% cultivation area near villages (traverse methods only were possible). 70% low jungle clad hills and 30% open cultivated plains. Nāgpur—60% congested city area and 40% open Civil Station area.	1-inch Triangulation	64 O, P ...	1,662	201	Rs. 3'1	Rs. 2'5	Rs. 5'6	EASTERN CIRCLE. — <i>Contd.</i> No. 5 D. O. costs for mapping and preparation of colour patterns of this unit:—Rs. 551 (approx.).
	1-inch Traverse	64 O ...	7 linear miles.	53 linear miles.	16'8 per linear mile.	12'5 linear mile.	29'3	
	..... Boundary demarcation and traverse	64 C ...	19 linear miles.	8 linear miles.	21'7 per linear mile.	1'2 linear mile.	22'9
	16-inch Levelling	55 O ...	67 linear miles.	39 linear miles.	3'9 per linear mile.	..... linear mile.	3'9

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. 5 Party.—(Contd.). <i>60% medium jungle clad hills and plains and 40% open cultivated flat country (survey by plane-table traverse with occasional resected firings in the jungle area).</i>	1-inch Original survey ...	64 0	4,170	26.5 ^(a)	Rs. 25.5	Rs. 9.6	Rs. 35.1	<p>EASTERN CIRCLE.— <i>Contd.</i></p> <p>(a) Excludes probationers and men under training.</p>
	1-inch Revision survey	64 0	259	31.6 ^(a)	Rs. 15.5	Rs. 3.9	Rs. 19.4	
Reserve forest blocks, medium jungle (survey chiefly by plane-table traverse).	4-inch Original survey ...	64 0	6	2.1	Rs. 66.6	Rs. 75.6	Rs. 142.2	

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.—(Concl'd.)								
	$\frac{1}{4}$ -inch	84 A ...	59.16 linear miles. 2,628	23.0 linear miles. 19.9	Rs. 29.70 per	Rs. 4.61 linear	Rs. 34.31 mile.	EASTERN CIRCLE. <u>Concl'd.</u>
	$\frac{1}{4}$ -inch	84 A, B ...			27.86	7.35	35.21	
	1-inch	84 B ...	277	13.6	40.63	19.58	60.21	
	1-inch	78 O ...	537	105.3	4.65	1.36 ^(a)	6.01	(a) One sheet only 78 O/14.

Flat jungle clad country ...

80% low undulating hills of an intricate character, mostly covered in dense scrub bamboo and tree jungle.
20% hills rising to 5,000 ft. covered with dense jungle and sparsely populated.

30% hills rising to 1,600 feet 70% intricate low undulating hills and plains, both covered with dense jungle with frequent Jhum cultivation.

Hills rising up to 6,000 feet with a great deal of Jhum cultivation.

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.	
No. 6 (South India) Party.—								<u>INDEPENDENT PARTIES.</u>
<i>Low undulations in cultivated plain.</i>	1-inch Triangulation	65 H, L ...	79	(a)	(a)	(a)	(a)	(a) Included under traverse.
<i>Flat irrigated coastal belt...</i>	1-inch Traverse	65 H, L ...	690 ^(b) linear miles.	104·0 linear miles.	13·64 per linear mile.	1·95 per linear mile.	15·59 per linear mile.	(b) 1,360 square miles.
<i>Flat forest plateau</i>	½-inch Traverse	65 I ...	125 ^(c) linear miles.	129½ linear miles.	13·49 per linear mile.	1·98 per linear mile.	15·42 per linear mile.	(c) 277 " "
<i>60% sparsely inhabited wooded hills and ridges with narrow cultivated valleys and peaks up to 4,000 feet.</i>	1-inch Original survey ...	65 M ...	3,366	18·5	27·82	14·21	42·03	

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. 6 (South India) Party.—Contd.								
30% wooded plateau. 10% cultivated river plains fringed with low wooded ridges. Traversing required in wooded plateau.	1-inch	65 N	15 ^(d) linear miles.	(e)	(e)	(e)	(e)	INDEPENDENT PARTIES.— <i>Contd.</i> (d) A portion of the proposed Orissa Province boundary. (e) Included under 1-inch original survey.
	‡-inch	65 N, 74 A, B	7 shts.	.....	.....	3.47	3.47	
	‡-inch	48 J, 65 J, K	3 shts.	.....	.....	0.88	0.88	
.....	Green Tree originals for Re-issues.	.....	4 shts.	.....	.....	182.5	182.5	per sht. per sheet.

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. 6 (South India) Party. — Concl'd.								
.....	.....	.....	24 shts.	.....	.....	.....	.....	INDE- PENDENT PARTIES.— <u>Concl'd.</u> Total cost of office copy corrections & miscellaneous drawing work Rs. 4,011.
.....	Preparation of Colour Patterns.	.....	.....	.....	.....	.....	.....
15% congested city area 10% city environs 75% open undulating plateau	3-inch Re-survey Revision survey	57 G, H 57 G, H	25 62	4.1 3.4	49.02	18.62 per sheet.	18.62 per sheet.	
No. 10 (Burma) Party. —								
Mainly wooded hills rising from 1,000 to 6,000 feet, and flat cultivated land in the valleys of the Samon and Sinthe rivers.	1-inch Triangulation	93 D, 94 A	5,225	363.3	4.26	1.95	6.21	(*) Area cannot be calculated in square miles.
Flat cultivated land	1-inch Traverse	93 D, 94 A	54 ^(*) linear miles.	38.7 linear miles.	37.72 per linear mile.	10.88 linear mile.	48.60	

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. 10 (Burma) Party.—Concl'd.									
	<i>High wooded hills rising to 5,000 feet and flat cultivated land in the valleys of the Irrawaddy, Pantawng and Samon rivers.</i>								
	Original survey ...	84 N, O, 93 B, C, D	4,968	53·6	20·31	6·27	26·58	INDEPENDENT PARTIES.—<u>Concl'd.</u>	
	<i>Reserved Forests in hills rising to 4,000 feet.</i>								
	Correction survey	93 C, D ...	386	52·6	10·95	6·27	17·22		
	Original survey ...	93 B, C ...	84	17·3	21·20	6·27	27·47		
	Compiled mapping	84 I ...	193	.....	.....	·46	·48
	ditto	84 E, F, J, K, 93 E, 94 C	18,811	.....	.....	·72	·72
	Preparation of Colour Patterns.	.....	22 shts.	.....	.....	161·95 per sht.	161·95 per sheet.
									Total cost of office copy corrections & miscellaneous work Rs. 14,091.

V.—SURVEY REPORTS, FRONTIER CIRCLE.

DIRECTOR :— { Colonel S. W. Sackville Hamilton, D.S.O., from 3-11-35 to 21-5-36.
 Colonel C. G. Lewis, O.B.E., from 22-5-36.
 Lt.-Colonel C. M. Thompson, I.A., to 2-11-35.

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

48. Training.—Two unclassified and one pupil draftsmen were recruited during the year.

Thirteen soldier surveyors were under training in 'A' Company during the field season, of whom two reverted to their regiments.

49. Special.—The Officer in charge, No. 18 (Air Survey) Party, co-operated with the R. A. in an Artillery Practice with live shell at Nowshera, for the purpose of instructing R. A. officers in the use of the 1/25,000 Air Chart. (p. 5).

The Director, Frontier Circle and the Officer in charge, No. 18 (Air Survey) Party, took part in the opening ceremony of the Willingdon Air Station at Delhi, where a collection of instruments and maps were exhibited (p. 4).

50. Areas surveyed.—

2,895 square miles of triangulation.

392 linear miles of traversing.

4,188 square miles of $\frac{1}{2}$ -inch original survey.

1,578 square miles of $\frac{3}{4}$ -inch original survey.

1,574 square miles of 1-inch original survey.

97 square miles of 1-inch resurvey.

156 square miles of $1\frac{1}{2}$ -inch resurvey.

866 square miles of 1-inch revision survey.

212 square miles of $1\frac{1}{2}$ -inch revision survey.

696 square miles of 1-inch correction survey.

2,136 square miles of $1\frac{1}{2}$ -inch correction survey.

17 square miles of 8-inch special survey.

825 acres of 32-inch original survey.

105 acres of 64-inch original survey.

1,666 acres of special survey on the scale of 100 feet to 1 inch.

By No. 18 (Air Survey) Party.—

102 square miles compiled (1-inch original survey).

275 square miles compiled (1-inch revision survey).

'A' Survey Company.

Officer Commanding.— { Lieut. C. A. Biddle, R.E., to 10-10-35.
 Lt.-Colonel O. Slater, M.C., R.E., from 11-10-35.

51. General.—The party continued surveys in the Dera Ghāzi Khān, Kāngra and Karnāl districts, in Bahāwalpur and Mandi States of the Punjab and in Jaisalmer State of Rājputāna.

Correction and revision surveys were carried out in Delhi Province and in Gurgaon, Hissār and Rohtak districts, in Dujāna and Jind States of the Punjab and in Bikaner State of Rājputāna and in Meerut district of the United Provinces.

Special surveys, which included triangulation and traverse, were carried out in Attock, Jhelum, Lahore and Miānwāli districts of the Punjab.

Triangulation and traverse for this season's survey were carried out in Dera Ghāzi Khān district and Bahāwalpur State of the Punjab.

Field headquarters opened at Jhelum on 21st October and closed on 15th April.

52. Personnel.—The average strength of the Company during the year was 2 Class I, 2 Class II, 6 U. S. officers, 41 Lower Subordinates and 13 soldier surveyors under training.

Lieut. C. A. Biddle, R.E., was transferred to No. 18 Party in October and was replaced by Lieut. D. E. O. Thackwell, R.E.

Lieut. D. E. O. Thackwell, R.E., was transferred to 'E' Survey Company in June and was replaced by Lieut. C. A. Biddle, R.E., from No. 18 Party.

Mr. Khushal Khan (U. S. S.) joined 'A' Company from 'E' Company in September.

Mr. Bashirullah Khan, B.sc. (U. S. S.) was transferred to No. 18 Party in May.

53. Areas surveyed.—

- 763 square miles of triangulation.
- 392 linear miles of traversing.
- 4,188 square miles of $\frac{1}{2}$ -inch original survey.
- 1,045 square miles of 1-inch original survey.
- 866 square miles of 1-inch revision survey.
- 97 square miles of 1-inch resurvey.
- 212 square miles of $1\frac{1}{2}$ -inch revision survey.
- 156 square miles of $1\frac{1}{2}$ -inch resurvey.
- 696 square miles of 1-inch correction survey.
- 2,136 square miles of $1\frac{1}{2}$ -inch correction survey.
- 17 square miles of 8-inch special survey.
- 1,332 acres of special survey on the scale of 100 feet to 1 inch.

54. Field work was organised as follows:—

Camp (1) under Mr. O. D. Jackson (Class II) with Mr. I. K. Ponnappa (U. S. S.) and 5 surveyors completed 1,562 square miles of 1-inch revision and correction and 2,348 square miles of $1\frac{1}{2}$ -inch revision and correction survey in sheets 44 O and P and 53 C, D & H.

The work was based on the 4-inch survey and rectangulation done by No. 23 Party in seasons 1932-1934 for the Bhakra Dam Irrigation Project. Areas already surveyed on the 4-inch scale were classified as correction whilst the remaining area, which had only been rectangulated, was classified as revision survey. The $1\frac{1}{2}$ -inch survey was arranged to permit of fair drawing being carried out simultaneously.

A drawing section of 7 surveyors and 1 draftsman also formed part of this camp and completed 6 sheets, which included 3 sheets surveyed during the field season.

Camp (2) under Rai Sahib Chuni Lal Kapur (Class II) with Mr. Khushal Khan (U. S. S.) and 13 surveyors completed 4,188 square miles of $\frac{1}{2}$ -inch and 1,045 square miles of 1-inch original survey in sheets 39 L and P.

Camp (3) under Mr. Sardar Khan (U. S. S.) with Mr. Mohd. Akbar (U. S. S.), 1 surveyor and 5 second year soldier surveyors completed 253 square miles of resurvey on the 1-inch and 1½-inch scales in sheet 53 A. Six first year soldier surveyors and one draftsman were under instruction and did independent work in the same area.

Camp (4) under Lieut. D. E. O. Thackwell, R.E., (Class I) with Mr. Bashirullah Khan (U. S. S.), 1 surveyor, 1 traverser and 3 computers completed the triangulation and detail survey on the scale of 100 feet to 1-inch of 1,332 acres in sheets 38 P and 43 D & H. The survey was done at the request of the Northern India Salt Revenue Department and covered three separate development areas. A close triangulation framework was necessary and the contouring was at 20 feet intervals. A report on the work has been submitted to the Salt Department.

Triangulation.—In addition to the triangulation mentioned immediately above Mr. Bashirullah Khan completed 750 square miles in sheet 39 L to supplement previous triangulation for surveys done during this season.

Lieut. D. E. O. Thackwell, R.E., completed 11 square miles of triangulation in sheet 43 C for detail survey to be carried out on the 8-inch scale. This survey was for a new oil drilling lease belonging to the Attock Oil Company, as mentioned below.

Traversing.—Mr. Bashirullah Khan completed 88 linear miles of traverse in sheet 39 L for surveys done during this season.

At the request of the Punjab Government 3 traversers and 3 computers were employed on relaying and checking the riverain base line stones falling along the Rāvi and Sutlej rivers in Lahore district. These stones were originally laid between 1911 and 1914 and many had been washed away by floods. It was found more economical to retrace the whole length of the bank rather than make small isolated traverses where the stones were known to be missing; and in the case of the Sutlej, the majority of the stones had to be realigned further away from the river bank. In all 282 linear miles of traverse were completed.

Special surveys.—In addition to the extra-departmental surveys mentioned above Mr. Mohd. Akbar surveyed on the 4-inch scale a small area on the Mandi-Suket boundary in sheet 53 E/3, where the boundary alignment drops from the main ridge to follow a stream. The old maps were on a scale insufficiently large to show fully the details of the head waters of the stream.

At the request of the Garrison Engineer, Lahore, a military estate of 6 square miles in sheet 44 I was surveyed on the 8-inch scale, 22 linear miles being traversed to provide the framework. No contouring was necessary and it was possible to use the field survey, after typing, as a fair drawing for reproduction.

During the summer months two surveyors were employed on the 8-inch detail survey, with contours at 10 feet intervals, of the Dhulian oil drilling lease for the Attock Oil Company. The work was similar to the survey of the nearby Khaur oil field, done in 1920-21, except that it was based entirely on triangulation instead of traversing and levelling. Some economy was thereby effected.

55. Recess duties.—Including 10 sheets of the Salt Mine Development areas the Company had a total of 37 sheets in hand. One section under Lieut. D. E. O. Thackwell, R.E., and afterwards Lieut. C. A. Biddle, R.E., was organised to deal with these 10 sheets as well as to train all the soldier surveyors in drawing and typing. Four other drawing sections under Messrs. O. D. Jackson, I. K. Ponnappa, Khushal Khan and Sardar Khan completed 24 sheets during recess.

Computations.—The plotting of some of the Kāngra traverse work mentioned in last year's report was not completed owing to the *musāvis* received from the Punjab Government being of incorrect size. This work together with other miscellaneous computations and work for next field season was completed by a section of 5 computers under Mr. Saiyid Irshad Ahmad. During the field season nearly all computers were away from headquarters on extra-departmental duties.

'E' Survey Company.

Officer Commanding.—
 { Major T. M. M. Penney, R.E., to 27-10-35.
 Lt. Colonel L. H. Jackson, I.A., from 28-10-35 to 27-7-36.
 Lt. J. S. O. Jelly, R.E., from 28-7-36.

56. General.—The party carried out topographical surveys in Kalāt and Las Bela States of Baluchistān, Dādu and Lārkāna districts of Sind, a cadastral survey for town planning in Quetta City and also a large scale survey near Karāchi. Field headquarters opened at Hyderābād (Sind) on the 15th October 1935 and closed on the 16th March 1936.

Work in recess included a heavy mapping programme. In addition, the following paid-for work was undertaken:—

(1) 32-inch and 64-inch surveys, involving theodolite traversing of Quetta City, for the Agent to the Governor General in Baluchistān.

(2) Tertiary levelling along certain roads with cross sections at every 100 feet in connection with the Quetta Cantonment Sewerage Scheme for the C. R. E. Reconstruction, Quetta.

(3) 100 feet to 1 inch survey (involving tertiary levelling) of a small area at Ghizri (Karāchi) for Headquarters, Western Command.

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

Lt.-Colonel L. H. Jackson, I.A. proceeded to Belgaum to attend the Senior Officers' School in July.

Lt. J. S. O. Jelly, R.E. proceeded on one month's leave in May.

58. Areas surveyed.—

2,132 square miles of triangulation.

1,578 square miles of $\frac{3}{4}$ -inch original survey.

529 square miles of 1-inch original survey.

825 acres of 32-inch original survey.

105 acres of 64-inch original survey.

334 acres of 100 feet to 1-inch original survey.

59. Field work was organised as follows:—

Camp (1) under Mr. Mohd. Najamuddin (Class II) with 6 surveyors completed the original survey of 177 square miles on $\frac{3}{4}$ -inch scale and 529 square miles on 1-inch scale in Dādu and Lārkāna districts in sheet 35 M.

Camp (2) under Mr. Chowdhury Mohd. Aslam (Class II) assisted by Mr. Chiragh Shah (U. S. S.) with 8 surveyors completed the original survey of 1,401 square miles on $\frac{3}{4}$ -inch scale in Kalāt and Las Bela States in sheets 35 J and 35 N.

Triangulation.—Lt. J. S. O. Jelly, R.E. triangulated 2,132 square miles for $\frac{3}{4}$ -inch survey in sheet 35 J.

Nature of country surveyed.—The country surveyed was typical Baluchistān country, bare rocky plains and steep intricate hills. The Sind area consisted for the most part of flat open plains. Throughout the whole area, the inhabitants were few and water was both scarce and brackish.

During recess a camp was organized under Mr. Chiragh Shah (U. S. S.) with 3 surveyors to carry out the large scale survey of Quetta municipal area involving 32 linear miles of theodolite traverse, and the survey of 105 and 825 acres on the 64-inch and 32-inch scales respectively. Mr. V. D. Chopra (U. S. S.) with 4 levellers completed 25 linear miles of levelling for the C. R. E. Reconstruction, Quetta, in connection with the Quetta Cantonment Sewerage Scheme, and Mr. Chowdhury Mohd. Aslam (Class II) with 2 surveyors completed 334 acres of survey on the scale of 100 feet to 1 inch with contours at 1 foot vertical interval for Headquarters, Western Command at Karāchi in sheet 35 P.

60. Office work.—1 surveyor and 1 draftsman under Mr. V. D. Chopra were employed on fair mapping and miscellaneous work throughout the field season. During recess fair mapping was divided into 2 sections; No. 1 section under Mr. Mohd. Najamuddin (Class II) consisted on an average of 4 draftsmen while No. 2 section under Mr. Chowdhury Mohd. Aslam (Class II) assisted by Mr. V. D. Chopra (U. S. S.) consisted on an average of 5 draftsmen. 7 fair sheets of arrears mapping were completed between the 2 sections throughout the year. The remaining staff was employed on the miscellaneous paid-for jobs mentioned above.

Lt. J. S. O. Jelly, R.E. supervised the Computing Section and the Reproduction Section in addition to computing part of his triangulation in 35 J.

Mr. 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, stock of maps, 'krab' files, indexes, etc.

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

No. 18 (Air Survey) Party.

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

62. General.—Recess and field headquarters remained at Murree and Risālpur respectively, the latter opening on 12th October 1935 and closing on 20th April 1936.



*Quetta Cantonment looking north from the Garrison Church.
Temporary Offices of 'E' Sierney Company in fore ground.*

63. Personnel.—The average strength of the party was 2 Class I, 2 Class II, 2 Upper Subordinate officers and 18 Lower Subordinates (excluding clerks and reproduction section personnel).

64. Areas surveyed.—

102 square miles compiled (1-inch original survey).

275 square miles compiled (1-inch revision survey).

65. Field work.—

430 square miles photographed vertically.

166 linear miles photographed obliquely.

No. 1 Wing Station, R. A. F., Kohat supplied vertical photographs with the F/8 camera of 250 square miles in tribal territory in sheet 38 H.

No. 20 (A. C.) Squadron, R. A. F., Peshawar supplied oblique photographs with the F/8 camera of 130 linear flying miles in tribal territory in sheets 38 H and L for height determination.

No. 2 Wing Station, R. A. F., Risalpur supplied vertical photographs with the F/8 camera of 180 square miles and oblique photographs of 36 linear flying miles in sheets 43 F and 38 N for the survey of the 1/25,000 Air Charts, mentioned in para. 69 below.

66. Compilation.—Compilation carried out was, for the greater part, the completion for contours of previously compiled outline compilations. Further control in 38 N obtained from triangulation and oblique survey necessitated considerable adjustment in areas already compiled. The area compiled for detail only was 137 square miles.

67. Office work.—An average of five draftsmen under Mr. N. C. Sen were employed on fair mapping and miscellaneous work throughout the year.

The fair mapping of nearly 2 fair sheets was completed.

68. Photographic Equipment and Instruments.—

Two more Zeiss and one M. I. O. folding mirror stereoscopes were received during the year and proved most useful. The M. I. O. instrument is up to the standard of the Zeiss and will be used in future.

69. Co-operation with the Army.—Three 1/25,000 Air Charts were compiled for use by the Royal Artillery.

Lieut. R. C. N. Jenney, R.E., delivered a lecture in Murree to the Northern Command Annual Intelligence Course.

70. Reproduction Section.—For detail of the work of the reproduction section see page 73.

VI.—SURVEY REPORTS, GEODETIC BRANCH.

No. 1 Party.

Officer in charge.— { Captain H. W. Wright, R.E., to 28-3-36.
Mr. A. J. A. Drake, D.C.M., from 29-3-36 to 20-4-36.
Major G. H. Osmaston, M.C., R.E., from 21-4-36.

71. General.—The party carried out operations in the Punjab States and Delhi, Rājputāna, Gujarāt States and Baroda, Central India and Gwalior, the United Provinces, the Bombay Presidency and Sind and in the States of the Western India Agency, in sheets 40 I & M, 45 A, B, C, D, E, F & I, 46 A, B, E, F, I & M, 53 F, G, H, I, J, M & N and 54 E & F.

Contributions were received during the year towards their share of the costs of the party survey programme from the states of Bānswāra, Gwalior, Indore, Jodhpur (Mārṅwār), Narsingharh and Tonk.

Arrangements were made by which Tehri-Garhwāl State paid for their state forest surveys.

Boundary work was taken up for Bharatpur, Jaisalmer and Jodhpur (Mārṅwār) States and the Bombay Government on payment.

Early in September personnel left recess headquarters at Mussoorie for Tehri-Garhwāl State to take up a topographical programme which, in three years, is expected to complete the modern surveys of the Kumaun, Garhwāl and Tehri Himālaya.

The field headquarters of the party opened on 12th October 1935 and, by permission of His Highness, was situated at Jodhpur.

Personnel.—The field strength of the party was 1 Class I, 3 Class II, 2 Class II probationers, 9 Upper Subordinate Officers, and 45 Lower Subordinates.

72. Areas surveyed.—

350 square miles of triangulation.

24,044 square miles of revision of triangulation.

102 square miles of 2-inch original forest survey.

2,175 square miles of 1½-inch original forest survey.

965 square miles of ¾-inch original survey.

7,368 square miles of ½-inch original survey.

15,720 square miles of ⅓-inch original survey.

Parts of 13 sheets of 1-inch correction surveys.

73. Field work was organized as follows:—

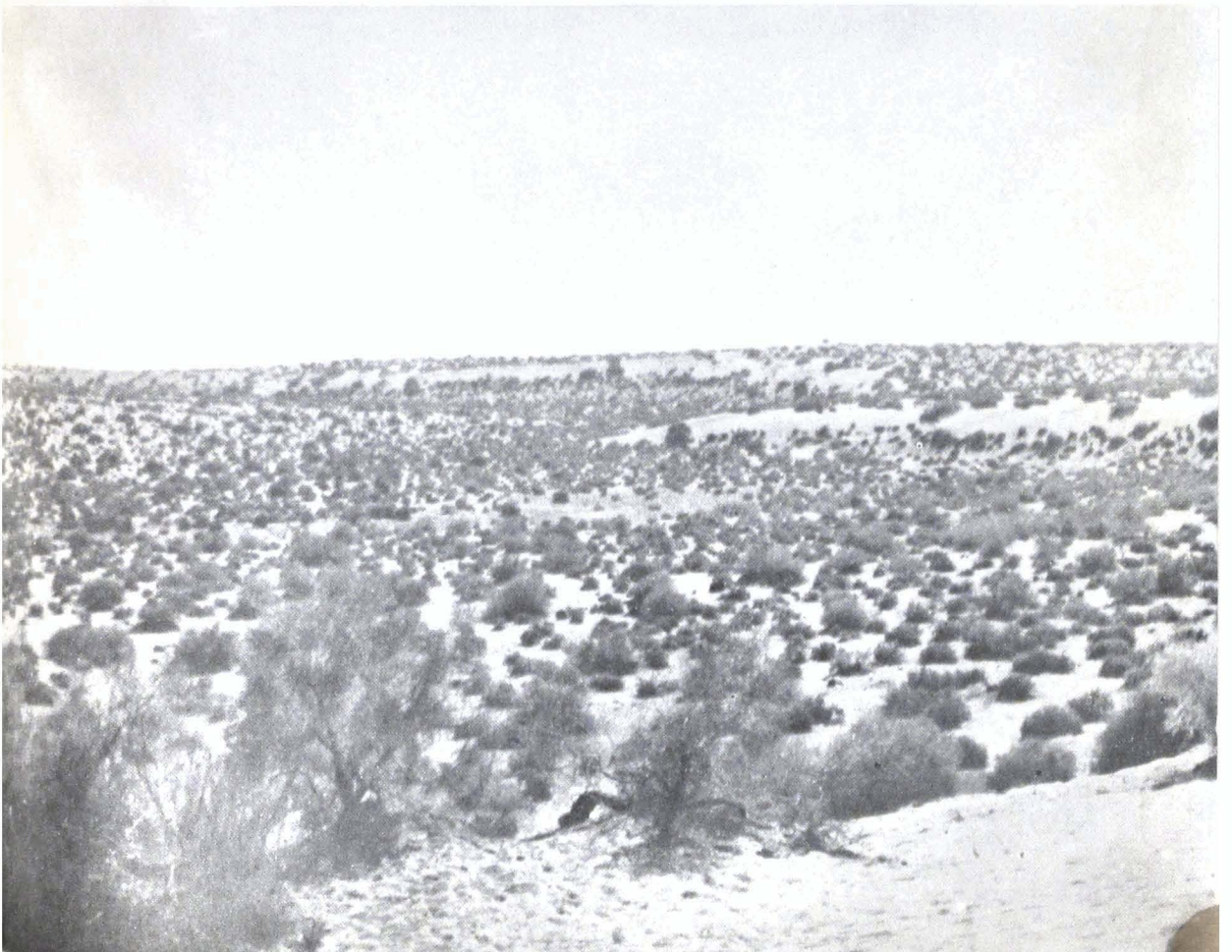
Camp (1).—*Desert areas.*—Mr. T. M. C. Alexander (Class II) with Mr. A. G. Qureshi (U. S. S.) and 18 surveyors completed the original survey of 4,231 square miles on the ½-inch and 8,298 square miles on the ⅓-inch scale in sheets 45 E, F & I and 40 I and M in Sukkur District (Sind) and the states of Bahāwalpur, Bikaner, Jaisalmer and Jodhpur (Mārṅwār).

Camp (2).—*Desert areas.*—Mr. M. W. Kalappa (U. S. S.) and 9 surveyors completed the original survey of 1,072 square miles on the ½-inch and 7,422 square miles on the ⅓-inch scale in sheets 45 A, B and C in the states of Bikaner, Jaisalmer and Jodhpur (Mārṅwār).

The part of the Great Indian or Thar Desert surveyed by these two camps is nearly unrelieved desert and arid sand hills abutting the Indus



Typical sandhills in the Great Indian Desert.





At the head of the Gansotri Glacier. Tehri-Garhwal.

River plain on the west, gradually ameliorating on the east towards Jodhpur (Mārwar) territory where a thin population of cultivators has taken the place of nomads and their flocks.

In sheets 40 I & M planetable surveys were based on framework provided in 1934-35 by the Hunter Short Base Traverse referred to in para. 71 of the General Report for 1935: as originally intended, this framework had to be supplemented by planetable framework, carried out by the planetablers on the same boards as they used for their subsequent detail surveys.

The sand hills, of which almost all support an established vegetation of tufted grasses and shrubs, and occasionally of small trees, rise in ordered conformations to a general maximum height of about 160 feet above the firm ground of the plain, which itself gradually rises towards Bikaner. There is evidence of sand hills having moved slightly, out not in very recent years when desert conditions appear to have become less severe.

Water for survey personnel and for their camel transport was generally scarce and bad, particularly after the surface supplies of the previous monsoon had become exhausted.

Camp (3).—Training Camp.—Mr. A. J. A. Drake (Class II) and Mr. B. B. Kuttappa (U. S. S.) with 2 Class II probationers, 2 U. S. officers and 4 Lower Subordinates under instruction, completed the original survey of 2,065 square miles on the $\frac{1}{2}$ -inch scale in sheets 45 B & F in Jodhpur (Mārwar) State.

Camp (4).—Himālaya.—This camp originally consisted of Mr. J. C. Ross (Class II) and 4 surveyors together with an allied camp consisting of Mr. I. D. Suri (U. S. S.) and one U. S. officer and 3 surveyors. They completed 965 square miles of original topographical surveys on $\frac{3}{4}$ -inch and 2,175 square miles of forest and topographical surveys on $1\frac{1}{2}$ -inch and 102 square miles on 2-inch scales in sheets 53 I, J, M & N in Garhwāl District and in Tehri-Garhwāl state.

Bad weather and visibility hampered surveyors during September and early October, and by the end of November cold winds made it necessary to evacuate personnel to the lower areas of the Tehri forest surveys.

In the spring the personnel, reinforced by one Class II probationer and 4 Lower Subordinates, returned to the glacier regions and the higher forests.

Monsoon conditions set in from 10th June, nearly 3 weeks earlier than expected. After this date clouds, rain and snow held up the planetablers and by the middle of July the camp was closed down. Survey of nearly the whole Bhāgirathi Valley was completed, including the Gangotri and tributary glaciers, but some area of the Jadh Ganga near Nelang and around Jannotri could not be finished.

Correction Surveys.—Mr. P. K. Chowdhury (U. S. S.) and surveyor Hari Singh carried out correction surveys in parts of 13 1-inch sheets in 53 F, G, H & J and 54 E, in the Punjab, Punjab States, Delhi and U. P.

Framework.—In the Gangotri Basin of the Tehri Himālaya in 53 I, J, M & N, Major G. H. Osmaston and Mr. J. C. Ross completed in the spring of 1936 about 350 square miles of original triangulation from

which points were used by the surveyors in May, June and July. The highest station occupied was at 21,000 feet on the summit of an unnamed peak NE. of the Satopanth Group.

Mr. Sheikh Alauddin (U. S. S.), Surveyor Najmul Husain and Traverser R. K. Saxena completed 24,044 square miles of revision framework in the districts of Ahmadābād, Broach & Pānch Mahāls and Kaira, and in the states of Bajāna, Bālāsīnor, Bānswāra, Bāriya, Baroda, Bhaunagar, Cambay, Chota Udaipur, Dewās, Dhār, Dūngarpur, Idar, Indore, Jaora, Jhābua, Jhālawār, Limbdi, Lūnāvāda, Pālanpur, Partābgarh, Piploda, Ratlām, Sailāna, Sirohi, Sitāmau, Sunth (Sant) and Udaipur (Mewār) in sheets 45 D and 46 A, B, E, F, I & M.

74. Recess duties.—Fair mapping of the Tehri State forest sheets was begun during the recess season; all other mapping was completed under Messrs. F. J. Grice and T. M. C. Alexander (Class II), B. B. Kuttappa and M. W. Kalappa (U. S. S.).

Framework was dealt with by a section under Mr. L. R. Howard (U. S. S.).

No. 20 (Cantonments) Detachment.

Officer in charge.—
 { Mr. A. A. Graham, to 1-1-36.
 Colonel C. G. Lewis, O.B.E., from 2-1-36 to 3-1-36.
 Mr. Moquimuddin Ansari, B.A., from 4-1-36 to 5-5-36.
 „ A. J. A. Drake, D.C.M., from 6-5-36.

75. General.—The detachment 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 the 14th October 1935 and closed on the 15th April 1936, field headquarters remaining at Dehra Dūn.

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

76. Areas surveyed.—

16-inch original survey.

Lansdowne extended boundary	62 acres.
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16-inch re-survey.

Dharmśāla Cantonment	351.0 acres.
Jubbulpore „	6,751.3 „
Nasirābād „	6,158.9 „
Dehra Dūn „ (Part R. I. M. College)		32.9 „

The above areas include overlaps.

64-inch re-survey.

Jubbulpore Cantonment Bāzārs ...	...	71.3 acres.
Nasirābād „ „ ...	...	225.4 „
Dharmśāla „ „ ...	...	3.8 „

77. Field work was organised as follows:—

Camp (1) with headquarters at Jubbulpore under Mr. J. A. Cabral (U. S. S.) with 8 surveyors and 2 traversers, and later reinforced by 3 surveyors from camp (2), completed the detail survey of Jubbulpore and part of R. I. M. College at Dehra Dūn and advance traversing and levelling of Abbottābād and Risālpur Cantonments and of the Indian Military Academy, the Royal Indian Military College and the boundary of the Forest Research Institute at Dehra Dūn.

Camp (2) with headquarters at Nasirābād under Mr. Bakhshi Harnam Singh (U. S. S.) with 9 surveyors and 2 traversers, completed the detail survey of Lansdowne extended boundary and Nasirābād and the advance traversing and levelling of Dharmśāla, Rāwalpindi and Chaklāla Cantonments.

Camp (3) under Surveyor Arthur Francis with one more surveyor completed the detail survey of Dharmśāla Cantonment.

78. Traversing and Levelling.—15·6 linear miles of traversing and 7·3 linear miles of levelling were completed for the current season's survey of Dharmśāla.

420·7 linear miles of traversing and 95·2 linear miles of levelling were completed for the next season's survey.

3·9 linear miles were traversed in connection with changes in the cantonment boundaries of Dehra Dūn, Naini Tāl, Roorkee and Shāhjahānpur.

Eleven range testing points were fixed at Dharmśāla at the request of the Station Staff Officer.

79. Recess duties.—Fair mapping was allotted to two main sections during recess under Messrs. J. A. Cabral and Bakhshi Harnam Singh (U. S. S.).

A section of 4 draftsmen under the supervision of the officer in charge was employed throughout the field season to deal with arrears of mapping.

48 sheets on the 16-inch scale and 11 sheets on the 64-inch scale of Barrackpore*, Bareilly*, Dehra Dūn*, Dharmśāla, Ishapore*, Jubbulpore, Lansdowne, Naini Tāl*, Nasirābād, Fort Sandeman and Shāhjahānpur* Cantonments and 9 sheets on the 128-inch scale of the Govt. orchard at Chaubattia were completed and sent for publication.

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

* Arrears mapping.

VII.—SURVEY REPORTS, EASTERN CIRCLE.

DIRECTOR:—{ Colonel J. D. Campbell, D.S.O., to 3-11-35.
Lt.-Colonel F. J. M. King, R.E., from 4-11-35.

80. 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.

81. Areas surveyed.—

- 2,628 square miles of $\frac{1}{2}$ -inch original survey.
- 7,668 square miles of 1-inch original survey.
- 1,078 square miles of 1-inch supplementary survey.
- 537 square miles of 1-inch correction survey.
- 259 square miles of 1-inch revision survey.
- 10 square miles of 4-inch forest survey.
- 6 square miles of 4-inch forest survey.
- 32 square miles of 16-inch special air survey.
- 3,687 square miles of triangulation.
- 3,711 square miles and 718 linear miles of traverse.
- 7 linear miles of traverse to supplement triangulation covering an area of about 363 square miles.
- 19 linear miles of boundary traverse.
- 67 linear miles of tertiary levelling for 16-inch air survey.

82. Air Survey.—The work done in connection with the air survey of Nāgpur City and its environs is described in No. 5 Party's report (p. 50).

83. Training.—In addition to the training of 5 probationers of Class II Service, there was a training camp in No. 5 Party for training backward surveyors of the Circle in the field.

No pupils were recruited during the year under report.

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

No. 4 Party.

Officer in charge.—{ Mr. J. McCracken, M.B.E., to 27-10-35.
Mr. C. H. Tresham, V.D., from 28-10-35.

85. General.—The party continued surveys on the 1-inch scale in Bhāgalpur, Darbhanga, Monghyr, Patna and Purnea districts of Bihār, in sheet 72 K, and carried out triangulation and traverse in advance for subsequent survey in Bhāgalpur, Purnea and Santāl Parganas districts of Bihār and Mālda district of Bengal, in sheets 72 N and O. In addition the special survey, on the 4-inch scale, of 7 forest blocks was undertaken in Santāl Parganas district.

Field headquarters opened at Bhāgalpur on 16th November 1935 and closed on 15th April 1936.

86. Personnel.—The field strength consisted of one Class I officer, 3 Class II officers, 3 Class II probationers under training, 2 Upper Subordinate officers, 29 surveyors, 3 traversers, 4 computers, 3 clerks and one store-keeper.

Messrs. M. M. Ganapathy and Abdul Ahad (Class II) were transferred to No. 12 Party in October 1935 and were replaced by Messrs. F. J. Grice and J. C. Berry (Class II).

Mr. J. L. Sahgal (Class II) proceeded on leave in November 1935.

Mr. F. J. Grice (Class II) was transferred to No. 1 Party in April 1936.

Messrs. A. R. Quraishi and Abdul Ahad (Class II) joined the Party in April 1936.

Mr. F. M. Hawley (Class II) proceeded on leave out of India in May 1936.

87. Areas surveyed.—

270 square miles of triangulation.

3,711 square miles of traverse.

3,221 square miles of 1-inch original survey.

1,078 square miles of 1-inch supplementary survey.

10 square miles of 4-inch forest survey.

88. Field work was organised as follows:—

Camp (1).—Mr. F. J. Grice (Class II) with 10 to 15 surveyors completed 1,609 square miles of original survey on the 1-inch scale in sheet 72 K in the Bhāgalpur, Darbhanga and Monghyr districts of Bihār.

Camp (2).—Mr. J. C. Berry (Class II) with 10 to 12 surveyors completed 539 square miles of supplementary survey and 805 square miles of original survey, on the 1-inch scale, in sheet 72 K in the Bhāgalpur, Monghyr and Purnea districts of Bihār. Also 10 square miles of forest survey on the 4-inch scale in sheets 72 O and P in the Santāl Parganas district of Bihār.

Camp (3).—Mr. F. M. Hawley (Class II) with 4 to 12 surveyors completed 539 square miles of supplementary survey and 807 square miles of original survey on the 1-inch scale in sheet 72 K in the Bhāgalpur, Monghyr and Patna districts of Bihār.

Camp (4).—Mr. J. R. Chibbar (U. S. S.) with Mr. A. P. Datta, B.Sc., (U. S. S.), 4 traversers and 3 computers completed 1,601 linear miles of theodolite traverse, covering an area of 3,711 square miles, for 1-inch surveys in sheets 72 N and O in the Bhāgalpur, Purnea and Santāl Parganas districts of Bihār and the Māl̄da district of Bengal. Mr. Datta also completed 270 square miles of triangulation in sheet 72 O in the Santāl Parganas district of Bihār.

89. Description of country.—

The Ganges flows through the area from west to east dividing it into two portions of very different character. The northern and larger portion is a flat alluvial plain traversed by innumerable shifting water courses and seamed by deserted channels. Many parts are low-lying,

swampy and liable to inundation during the monsoon rains. The south is also to a great extent alluvial, but the general level is higher and the surface more undulating; a large area is composed of the Kharagpur hills in the west and the Rājmahāl hills in the east.

With the exception of the hills, which are covered with small forest trees and scrub jungle, the greater portion of the area is extensively cultivated and thickly populated. The plains area is interspersed with trees, most of which are cultivated mangoes, especially around villages and along roads.

Railway communications are good but there are few motorable roads north of the river.

90. Miscellaneous.—

The health of the party was good. One khalasi died of cerebral malaria. At the commencement of the field season most of the men were inoculated against cholera.

91. Recess duties.—The 16 1-inch sheets and 7 4-inch forest blocks were fair-mapped during recess by three sections under Messrs. Berry, Quraishi and Abdul Ahad respectively.

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

No. 5 Party.

Officer in charge.— $\left\{ \begin{array}{l} \text{Captain J. B. P. Angwin, R.E., to 18-10-35.} \\ \text{Mr. W. H. Strong, M.B.E., from 19-10-35 to 6-11-35} \\ \text{Captain I. H. R. Wilson, R.E., from 7-11-35.} \end{array} \right.$

92. General.—Topographical survey on the scale of 1-inch to a mile was continued in the Raipur and Bilāspur districts of the Central Provinces, the Sambalpur district of Orissa, and in the Eastern States Agency. The whole of sheet 64 O was surveyed.

A 4-inch survey of 8 small isolated blocks of reserved forest was carried out for the Divisional Forest Officer, Sambalpur.

Triangulation for topographical survey was carried out in sheets 64 O and P and in the former a little traverse was carried out to supplement the triangulation. About 19 linear miles of boundary between the States of Khairāgarh and Nāndgaon were demarcated and traversed. About 67 linear miles of tertiary levelling were run to fix heights for the air survey of Nāgpur City; and the inking up of the rectified prints for the maps and line plans of this work was carried out on the ground, contours being entered where necessary.

Field headquarters remained at Raipur; the field season opened on 1st November 1935 and closed on 7th May 1936.

93. Personnel.—The field strength consisted of the officer in charge, 5 Class II officers, 2 Class II officers on probation, 7 U. S. officers, 26 surveyors, 1 traverser, 3 computers, 3 clerks and 1 store-keeper.

94. Areas surveyed.—

- 4,170 square miles of 1-inch original survey.
- 259 square miles of 1-inch revision survey.
- 6 square miles of 4-inch forest survey.
- 32 square miles of 16-inch special air survey.
- 1,662 square miles of triangulation for 1-inch survey.
- 7 linear miles of traversing to supplement triangulation, covering an area of about 363 square miles.
- 19 linear miles of boundary traverse.
- 67 linear miles of tertiary levelling for 16-inch air survey.

95. Field work was organized as follows:—

Camp (1).—Mr. W. H. Strong, M.B.E. (Class II) with 1 Class II probationer, 1 U. S. officer (from the middle of January to the beginning of April), and 7 surveyors carried out the original survey on 1-inch scale of 830 square miles in sheet 64 O, falling in Raipur and Bilāspur districts and in Sārangarh, Raigarh and Sakti States.

On return from leave at the beginning of March, Mr. R. N. Hastir (Class II) took over charge from Mr. W. H. Strong, M.B.E., who, after a period of inspection in Camps (3) and (4), was transferred to No. 12 Party.

All the surveyors in this camp were under training.

Camp (2).—Mr. C. T. Hurley (Class II) with 1 U. S. officer and 6 surveyors carried out the original survey on 1-inch scale of 1,109 square miles in sheet 64 O falling in Sambalpur district, and in Sonepur and Rairākhhol States. One 1st class surveyor carried out the 4-inch survey of 7 forest blocks falling in this area. In February the camp was reinforced by 1 computer who was employed on planetabing, and later 1 U. S. officer was added on completion of his triangulation.

Camp (3).—Mr. M. A. Khan (Class II) with 1 U. S. officer and 3 surveyors carried out the original survey on 1-inch scale of 570 square miles and revision survey on 1-inch scale of 259 square miles in sheet 64 O falling in Sambalpur district and Raigarh and Gāngpur States. Towards the end of the field season the camp was reinforced by 1 traverser, withdrawn from the Nāgpur Air-Survey Detachment, and 1 U. S. officer both of whom were employed on planetabing.

Work in this camp was delayed owing to the slow rate of progress in the jungle clad plains area, and was not completed till May 11th.

Camp (4).—Mr. K. C. Gosain (Class II) with 4 surveyors completed the original survey on 1-inch scale of 829 square miles in sheet 64 O falling in Sambalpur and Bilāspur districts, and in Sārangarh and Raigarh States. 1 U. S. officer joined in the middle of January, after completion of his triangulation, but after about a month's work went sick and was on sick leave till the close of the field season.

Towards the end of the field work, this camp was reinforced by 1 Class II probationer and 1 surveyor from Camp (1).

Camp (5).—Mr. G. H. Khan (Class II) with 1 Class II probationer and 4 surveyors completed 832 square miles of original survey on 1-inch scale in sheet 64 O falling in Raipur and Sambalpur districts, and in

Sārangarh, Sonepur and Patna States. One 1st class surveyor carried out the 4-inch survey of 1 forest block falling in this area.

Triangulation.—Messrs. N. C. Naug, S. B. P. Mathur, and Mohabat Ali (U. S. S.) completed the triangulation of 1,662 square miles in sheets 64 O and 64 P falling in Bilāspur and Sambalpur districts, and Raigarh, Gāngpur, Sonepur and Patna States. About 7 linear miles of traverse was run in 64 O to supplement the triangulation.

Khairāgarh-Nāndgaon Boundary.—At the request of the Agent to the Governor-General, Eastern States, Mr. G. S. Sidhu (U. S. S.) was deputed to relay some 19 linear miles of boundary between the States of Khairāgarh and Nāndgaon, falling in sheet 64 C/15. The boundary was relayed in accordance with the boundary line shown on the 2-inch to 1 mile map, sheets 368 and 371, of 1871-72. The same method was used as for the Surguja and the Khairāgarh-Chhuikhadān boundary demarcations in the two previous years *i.e.* pillar positions for the new boundary were fixed by planetable traverse, and after erection of the pillars a theodolite traverse was run along the new portion of the boundary.

Nāgpur Air Survey.—Mr. Muzaffar Husain (U. S. S.) with 1 surveyor, 1 traverser, 1 leveller and 2 draftsmen completed the ground work for the 16-inch Nāgpur Air Survey maps and line plans. This consisted of—

- (a) 67 linear miles of tertiary levelling, run to fix spot heights in the congested city areas, and to control the contouring of the more open areas.
- (b) Inking up and contouring 22 blue-toned 16-inch rectified enlargements on correctostat paper, comprising 6 sheets of the city area. Inking up on blue-toned photographs allows the production of drawing blue prints by direct photography.
- (c) Tracing line plans from 34 16-inch rectified enlargements (black prints) of an area of about 18 square miles surrounding the city.

96. Description of country.—The area under survey consisted in the main of medium jungle clad hills and partly cultivated, partly jungled plains. In sheet 64 O/10 the hills were covered with very dense bamboo jungle.

97. Miscellaneous.—On the whole the health of the party was good, though in the latter part of the field work there was a certain amount of sickness among the surveyors in Camps (1) and (4). Unusually consistent rains in February and March kept the weather cool till the beginning of April, but in the last month of the field work the heat became severe. Preliminary editions of a good many sheets, which it was hoped might be of some help, proved too inaccurate to be utilised, with the result that the general outturn was lower than originally anticipated. This led to the field work being finally closed about 3 weeks later than is normal.

98. Recess duties.—There were 4 fair-mapping sections under Messrs. M. A. Khan, K. C. Gosain, G. H. Khan and R. N. Hastir (all Class II) respectively, which completed the drawing of the 16 sheets

surveyed. In addition Mr. C. T. Hurley (Class II) was in charge of the training of backward typers and draftsmen; he also supervised the drawing of the Nāgpur air survey work (6 16-inch sheets and 13 16-inch line plans) and of the 4-inch forest work. All these were completed by the end of recess. The computation section under Mr. G. S. Sidhu (U. S. S.) completed all the triangulation computations in hand, and also the traverse computations for the Khairāgarh-Nāndgaon boundary work.

No. 12 Party.

Officer in charge.— { Captain R. H. Sams, B.Sc., R.E., to 19-4-36.
Mr. W. H. Strong, M.B.E. from 20-4-36 to 17-7-36.
Lt.-Colonel. T. M. M. Penny, R.E., from 18-7-36.

99. General.—The survey operations of the party for this season in sheets 84 A, B and 78 O included the completion of the survey of the Lushai Hills district of Assam on the $\frac{1}{2}$ -inch scale, the survey on the 1-inch and $\frac{1}{2}$ -inch scales of portions of Chittagong district and Chittagong Hill Tracts of Bengal, the survey of a small portion on the $\frac{1}{2}$ -inch scale of Arakan Hill Tracts of Burma and some correction survey on the 1-inch scale in the Khāsi and Jaintia Hills district of Assam.

Triangulation and traverse for future survey were carried out in Noākhāli and Chittagong districts and Chittagong Hill Tracts of Bengal, in sheets 79 N, 84 A, B, and C.

The field headquarters of the party opened at Rāngāmāti on 30th October 1935 and closed at Chittagong on 11th April 1936.

100. Personnel.—The strength of the party was 1 Class I, 4 Class II, 4 Upper Subordinate officers, and 41 Lower Subordinates, including 32 surveyors.

101. Areas surveyed.—

- 2,628 square miles of $\frac{1}{2}$ -inch original survey.
- 277 square miles of 1-inch original survey.
- 537 square miles of 1-inch correction survey.
- 1,755 square miles of triangulation for 1-inch survey.
- 718 linear miles of traversing.

The triangulation was connected to the Burma Coast G. T. series No. 52, 1864—82 and the traverse with the triangulation of the present and previous years carried out by the party. Some spirit level benchmarks on line No. 77 F were picked up during the triangulation.

102. Field work was organised as follows.—

Camp (1) under Mr. M. M. Ganapathy (Class II) with Mr. N. C. Roy (U. S. S.) and 8 surveyors, completed 1,125 square miles of original survey on the $\frac{1}{2}$ -inch scale in sheet 84 B.

Camp (2) under Mr. K. L. Dhawan (Class II) with Mr. S. K. Guha (U. S. S.) and 11 surveyors, completed 680 square miles of original survey on the $\frac{1}{2}$ -inch scale in sheet 84 A.

Camp (3) under Mr. A. Ahad (Class II) and 8 surveyors, completed 649 square miles of original survey on the $\frac{1}{2}$ -inch scale in sheet 84 B.

Camp (4) under Mr. A. R. Quraishi (Class II) and 5 surveyors together with four surveyors from *Camp (2)* who were transferred after February 15th, completed original survey of 277 square miles on the 1-inch scale and 174 square miles on the $\frac{1}{2}$ -inch scale, in sheet 84 B. Blue print reductions on the 1-inch scale for the portion in Chittagong district were utilised to advantage. The material for these blue prints was obtained from the 4-inch sheets compiled from the 16-inch revenue surveys of 1888—93, and from the 4-inch air surveys of the hilly portions of Chittagong district.

On return to recess the correction survey of 537 square miles on 1-inch scale in sheets 78 O/14 & 15 was carried out under Mr. K. L. Dhawan (Class II) with 1 U. S. officer and 3 surveyors, during April and May.

Triangulation.—Mr. Hari Singh (U. S. S.) completed the triangulation for 1-inch survey of 1,755 square miles in sheet 79 N. The islands in this sheet were fixed by connecting them by triangulation to the mainland. Permanent marks and stations were established on each island.

Traverse.—59.16 linear miles of river traverse in 84 A/S.W. to provide control for plane-table traverse in an area of flat jungle devoid of triangulated points was carried out early, computed, and data supplied to *Camp (2)* before the end of December. Rigorous traverse, including traverse lines to test the old revenue survey as to its suitability for future 1-inch surveys, was carried out in 84 B and C. Test lines were also run in 79 N. A total of 718 linear miles of traverse lines was completed by the party.

103. Description of country.—The area surveyed in *Camp (1)* lies mainly in the south of the Lushai Hills in the country known as Lakher, while a portion to the west lies in Chittagong Hill Tracts and includes a large tract of the Rankiang and Thega Reserve Forests.

The country is divided by parallel ranges of hills rising in the eastern half up to 5,000 feet in height. The rivers and side streams draining the area are most intricate in character. The entire area is covered in dense jungle, a large portion of which is virgin forest. Due to the sparseness of the population *jhūms* are comparatively few and the communications are poor.

The area of *Camps (2), (3), and (4)* lies almost entirely in Chittagong Hill Tracts and includes in the north a large portion of the Kasalong Reserved Forest. It consists mostly of low undulating hills drained by intricate systems of tortuous streams. *Jhūm* cultivation is extensive and this fact considerably helped the survey, which was otherwise handicapped by the intricate nature of the country and the dense scrub or high grass that exists on old *jhūm* land and the dense forest that fills up the remainder. A few main tracks, numerous footpaths and the larger streams form the means of communication, which presented little difficulty.

104. Miscellaneous.—

Health.—Several cases of severe malaria and a mild form of pneumonia occurred during the season; one khalasi died of malignant

malaria in the Lushai Hills. One khalasi was drowned while bathing in a small stream.

Weather.—Throughout the season the weather remained fair.

Fauna.—In the South Lushai Hills most kinds of big game are to be found except buffaloes. Herds of wild elephant exist in the south west corner of the Lakher country, while tiger, panther, sambhar, and barking deer are also very numerous.

Little game but barking deer is to be found in the area surveyed in Chittagong Hill Tracts except in the Kāsālong Reserved Forest, where there are numerous wild elephants.

Jungle fowl and pigeon were also seen in great numbers throughout the area.

105. Recess duties.—The party was organised in two drawing sections under Messrs. K. L. Dhawan and M. M. Ganapathy.

The three $\frac{1}{2}$ -inch sheets and one 1-inch sheet surveyed during the field season were fair mapped.

The corrections surveyed in sheets 78 O/14 and 15 were incorporated in the fair sheets on $\frac{1}{2}$ -inch scale, which were then submitted for publication.

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.

106. 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.— { Mr. B. T. Wyatt, v.D., up to 10-10-35.
 { Major G. W. Gemmell, I.A., from 11-10-35.

107. General.—The majority of the party was employed during a five months field season between 7th November 1935 and 31st March 1936 on 1-inch original survey in Orissa, Madras and Eastern States Agency and on triangulation and traverse for control of future surveys in Orissa and Madras. Field head-quarters was situated at Vizianagaram.

Four surveyors were employed on 3-inch revision survey of the Bangalore Guide Map area from November 1935 to May 1936.

On the conclusion of 1-inch survey, the field party returned to Bangalore and was employed during the ensuing recess on the fair drawing of the field survey programme and on the computation of triangulation and traverse observations.

A section was employed throughout the year at Bangalore on compiled mapping, preparation of colour guides for sheets under publication, computations and maintenance of records.

The party was inspected in recess by the Surveyor General and in the field by the Director, Eastern Circle.

108. Personnel.—The strength of the party on the 1st October was 5 Class II officers including 1 officer on leave, 7 Upper Subordinate officers, and 65 Lower Subordinates, including 53 surveyors.

Major G. W. Gemmell, I.A., was posted to the party on return from leave on 11th October. Mr. M. D. Nangia, B.A., (Class II) rejoined at Bangalore from extended leave on 30th January. Two surveyors seconded from 'A' Company for training in hill surveys joined the field party in November. Mr. B. T. Wyatt, v.D., (Class II) proceeded on 5 months' leave ex-India on 1st June 1936.

109. Areas surveyed.—

3,366 square miles of 1-inch original survey.

25 square miles of 3-inch resurvey previously surveyed on 1-inch scale.

62 square miles of 3-inch revision survey.

15 linear miles of boundary survey.

79 square miles of triangulation for subsequent 1-inch survey.

815 linear miles of traversing for control of 1,637 square miles of future 1-inch and $\frac{1}{2}$ -inch surveys.

110. Field work was organized as follows:—

Camp (1).—Mr. P. A. Thomas (Class II) with 1 U. S. officer and 11 surveyors completed the 1-inch original survey of 840 square miles in sheet 65 M in the Ganjām and Koraput districts of Orissa.

Camp (2).—Mr. Muhammad Abdul Azim, I.D.S.M., (U. S. S.) with 11 surveyors completed the 1-inch original survey of 841 square miles in sheet 65 M in the Ganjām and Koraput districts of Orissa and Kālāhandi State of the Eastern States Agency.

Camp (3).—Mr. B. T. Wyatt, v.D., (Class II) with 1 U. S. officer and 11 surveyors completed the 1-inch original survey of 842 square miles in sheet 65 M in the Ganjām and Koraput districts of Orissa and the Vizagapatam district of Madras.

Camp (4).—Mr. M. R. Nair, B.A., (Class II) with 1 U. S. officer till 16th January (when he was invalided out of the area), and 11 surveyors completed the 1-inch original survey of 843 square miles in sheet 65 M in the Koraput district of Orissa, the Vizagapatam district of Madras and Kālāhandi State of the Eastern States Agency.

Four surveyors under the supervision of an officer of the compiled mapping section at Bangalore carried out the 3-inch survey, part resurvey and part revision, of the Bangalore City, Civil and Military Station and surrounding country.

Triangulation and traverse.—Messrs. H. N. Murti Rao, B.A., and A. Shamanna (U. S. S.) completed 79 square miles of triangulation and 1,637 square miles of traverse in sheets 65 I, H and L in the Koraput district of Orissa, Yanam (French) and the East Godāvāri and West Godāvāri districts of Madras for future survey on 1-inch and $\frac{1}{2}$ -inch scales.

111. Description of country.—The country surveyed in Orissa and Kālāhandi State varied from cultivated riverain plains at about 1,000 feet elevation to hilly, picturesque and well-watered uplands often heavily wooded and with peaks up to 4,000 feet. It is undeveloped country and communications on the whole are poor. The party was almost entirely dependent on coolie transport for the movement of baggage and equipment.

The hills and lower valleys are inhabited by primitive tribes, generally cheerful people who lead a simple and undisciplined existence. They cultivate paddy in terraced fields in the valleys and clear and burn surrounding hillside forests for other crops.

112. Miscellaneous.—

Health.—The whole area is intensely malarious and black-water fever is prevalent. No period is considered free from the possibility of infection, but the healthiest periods are during the rains when mosquito breeding places are flushed out and between January and March when the same places have dried up. In spite of the issue of *Quinine* and *Atebrin* and instructions in prophylactic measures, the field party suffered severely from malaria from the commencement of the field season. One U. S. officer and two surveyors had been invalided out of the area by 25th February and with few exceptions all officers and surveyors suffered from fever or sickness of one kind or another.

Game.—Due to the general scarcity of game, local tigers are casual man-eaters. In parts of the Kāshipur Zamīndāri of Kālāhandi State and the adjoining Rāyagada tāluk of Orissa, villages were found deserted on account of their depredations. A small herd of elephants was encountered in Balliguda tāluk and tiger, panther, bison, bear, sambhur and cheetal were seen.

Climate.—From November to February the climate in the riverain plains and uplands was pleasant. Day temperatures were not high and nights in the uplands were distinctly cold. In March the day temperature rose in the plains but at no time became intolerable, and nights remained cool.

113. Recess duties.—The fair mapping of the twelve 1-inch sheets was organized in 3 sections under Class II officers assisted by U. S. officers. Mr. B. T. Wyatt (Class II) supervised the work of these sections till he proceeded on leave. The compiled mapping section under Mr. E. N. Natesan, B.A., (Class II) assisted by 2 U. S. officers and composed of 5 draughtsmen and 9 surveyors, maintained the progress of compiled mapping and commenced the fair drawing of the 3-inch Bangalore Guide Map.

The computations of triangulation and traverse required for the control of survey during the following field season were completed.

No. 10 (Burma) Party.

Officer in charge.— $\left\{ \begin{array}{l} \text{Lt.-Col. F. B. Scott, I.A., to 26-4-36.} \\ \text{Mr. F. W. Smith, from 27-4-36 to 10-5-36} \\ \text{and 4-6-36 to 2-9-36.} \\ \text{Capt. J. B. P. Angwin, R.E., from 11-5-36 to 3-6-36} \\ \text{and from 3-9-36.} \end{array} \right.$

114. General.—The party continued surveys on the 1-inch and 1½-inch scales in Upper Burma and the Northern and Southern Shan States. The party headquarters remained at Maymyo.

115. Personnel.—The field strength was one Class I, 4 Class II and 4 U. S. officers and 35 Lower Subordinates.

In addition a Drawing Section consisting of 10 draftsmen, 3 surveyors and 1 computer, in charge of one Class II officer, remained in Maymyo to carry on the compiled mapping of the party.

One U. S. officer and one surveyor were withdrawn from the field on the 20th January as reinforcements for the Sino-Burmese party and another surveyor was transferred to the Sino-Burmese party on the 20th February.

Lt.-Col. F. B. Scott was transferred to Calcutta to be Director, Map Publication, on the 26th April. Captain J. B. P. Angwin, R.E., was posted to the party on the 11th May from the Sino-Burmese party. The charge was temporarily held by Mr. F. W. Smith from 27th April to 10th May and during the period Capt. Angwin was on leave from 4th June.

116. Areas surveyed —

5,225 square miles of triangulation for 1-inch detail survey.

54 linear miles of traversing.

4,968 square miles of 1-inch original survey.

34 square miles of 1½-inch original survey.

386 square miles of 1-inch correction survey.

117. Field work was organised as follows:—

Camp (1).—Mr. F. W. Smith (Class II) with 10 surveyors completed the 1-inch original survey of 1,613 square miles and 1-inch correction



Chin Khalasis, No. 10 (Burma) Party.
Khond Khalasis, No. 6 (S. I.) Party.



survey of 54 square miles in sheets 93 C and D, in Meiktila and Yamethin districts and the Southern Shan States.

Camp (2).—Mr. C. S. McInnes (Class II) with Mr. Khan Muhammad (U. S. S.) as Assistant Camp Officer and 5 surveyors completed the 1-inch original survey of 640 square miles and the 1½-inch original survey of 34 square miles in sheets 84 N, 84 O, 93 B and 93 C, in Kyaukse, Mandalay and Sagaing districts.

Camp (3).—Mr. C. P. E. Davenport (Class II) with 9 surveyors, reinforced by 3 more surveyors towards the end of the field season, completed the 1-inch original survey of 1,552 square miles and 1-inch correction survey of 111 square miles in sheet 93 C, in Kyaukse and Meiktila districts and the Southern Shan States.

Camp (4).—Mr. D. N. Saha (Class II) with 9 surveyors completed the 1-inch original survey of 1,162 square miles and 1-inch correction survey of 220 square miles in sheet 93 C, in Kyaukse, Mandalay and Sagaing districts and the Northern and Southern Shan States.

Nature of country.—In the west, the country consists of densely populated flat cultivated plains with the Irrawaddy River flowing through the north-west corner. It is traversed throughout its length, from north to south, by the main Rangoon-Mandalay railway line. In the middle and in the east the country consists of high hills, wooded and open, rising to over 7,000 feet above sea-level and is sparsely populated. In the south-east there are two broad valleys fairly densely populated and in the extreme south-east is the Inle Lake. Communications are good on the east and west but poor in between, along the main range of hills.

Triangulation.—Messrs. A. K. Sen Gupta, H. K. Kar, A. K. Talapatra (U. S. S.) and surveyors Iqbal Muhammad and S. M. Bukari completed the triangulation of 5,225 square miles in sheets 93 D and 94 A, in Toungoo and Yamethin districts, and the Karenni and Southern Shan States. Mr. A. K. Sen Gupta was recalled and transferred to the Sino-Burmese party on the 20th January and surveyor Iqbal Muhammad became seriously ill at the beginning of the season and did not return to the field. In consequence the triangulation programme had to be curtailed.

Theodolite traverse.—Messrs. H. K. Kar, A. K. Talapatra and surveyor S. M. Bukari carried out 54 linear miles of traversing to supplement the triangulation.

118. Recess duties.—Fair mapping was divided into three sections under Messrs. F. W. Smith (assisted by Mr. A. K. Sen Gupta), C. P. E. Davenport and D. N. Saha. All surveys were fair mapped on the appropriate scale during the year. The Computing Section was in the charge of Mr. Khan Muhammad. The Drawing Section, under Mr. C. S. McInnes, carried out compiled mapping throughout the year.

IX.—MISCELLANEOUS SURVEY REPORTS.**Training School, Dehra Dūn.**

Officer in charge.—Mr. M. M. Mudaliar, M.A.

119. *Upper Subordinate Service Probationers.*—Five probationers were appointed in November. They were put through a course of plane-tabling on the 4-inch and 2-inch scales with short periods allotted to triangulation and traversing.

During the recess they received instruction in all branches of survey work.

Mr. Mudaliar, with the co-operation of an Assistant Record Officer from the U. P., carried out an experimental survey by range-finder of the terraced fields in Rājpur and about the Kiarkuli village near Mussoorie with a view to the possible adoption of this method in cadastral surveys.

MAP PUBLICATION AND
OFFICE WORK REPORT.

PART 4.—MAP PUBLICATION AND OFFICE WORK.

From 1st April 1935 to 31st March 1936.

X.—INTRODUCTION AND PERSONNEL.

120. 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.

121. 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.

122. Personnel.—

Calcutta. Director, Map Publication.

Lt.-Col. F. J. M. King, R.E., to 31-10-35.

Lt.-Col. E. O. Wheeler, M.C., R.E., from 1-11-35 to 6-11-35.

Colonel J. D. Campbell, D.S.O., from 7-11-35.

Chief Draftsman—Mr. F. H. Grant, to 29-6-35 and from 16-12-35.

“ “ “ P. C. Mitra, B.A., from 30-6-35 to 15-12-35.

No. 1 Drawing Office.

O.C. Mr. A. K. Mitra, B.S., to 29-6-35.

“ “ F. H. Grant, from 30-6-35 to 15-12-35.

“ “ L. Williams, M.B.E., from 16-12-35.

II “ P. C. Mitra, B.A., H. D.
to 29-6-35 and from 16-12-35.

“ “ J. C. St. C. Pollett, H. D.
from 30-6-35 to 15-12-35.

“ “ A. F. Murphy.

“ “ D. N. Bauerjee, L.C.E.

“ “ B. N. Saha, M.Sc.

U.S. “ Kodandera Ganapathy Mandanna.

“ “ Pratul Chandra Sen Gupta, B.Sc.,
from 14-10-35.

“ “ Girija Sonker Bagchi.

“ “ Atul Chandra Maulick.

“ “ Suresh Chandra Chatterjee, B.Sc.

“ “ Nirmal Chandra Sen, B.Com.
to 21-10-35.

Engraving Office.

Mr. A. R. J. Dalziel, Head Engraver

“ F. E. Selfe, Asstt. “ “

Photo.-Litho. Office.

O.C. Major G. F. Heaney, R.E.

Managers & Assistant Managers.

Mr. S. Colquhoun, Manager, Litho.
to 13-10-35 and from 5-11-35 to 24-3-36.

“ L. H. Mordue, Offg. Manager, Litho.
from 14-10-35 to 4-11-35.

“ “ “ Manager, Litho.
from 25-3-36.

“ “ “ Asstt. Manager, Litho.
to 13-10-35.

“ “ “ “ Litho.
from 5-11-35 to 24-3-36.

“ F. R. Vandyke, Manager, Photo.

“ K. L. Dev, Asstt. Manager, Photo.

“ L. J. Vallis, Offg. Asstt. Manager, Litho.
from 14-10-35 to 4-11-35.

“ G. Thomas, Offg. Asstt. Manager, Litho.
from 25-3-36.

Map Record and Issue Office.

O.C. Mr. E. A. Meyer, to 15-6-35.

“ “ O. N. Pushong, from 16-6-35.

Mathematical Instrument Office.

Mr. S. Woodhouse, Superintendent in charge,
to 3-4-35.

“ R. C. Malcolm, F.R.M.S., F.R.Met. Soc.,
Offg. Supdt., from 4-4-35.

“ R. C. Malcolm, F.R.M.S., F.R.Met. Soc.,
Asstt. Supdt., to 3-4-35.

“ A. Lacamp, Asstt. Supdt.

Dehra Dūn. Director, Geodetic Branch.

Colonel C. G. Lewis, O.B.E.

No. 2 Drawing Office.

- O.C. Mr. V. W. Morton, to 9-4-35.
 " " O. N. Pushong, from 10-4-35 to 4-6-35.
 " " M. M. Mudaliar, M.A.,
 from 5-6-35 to 17-11-35.
 " " D. K. Rennick, M.B.E., from 18-11-35.
 II " Moquimuddin Ansari, B.A., to 3-1-36.
 " " N. S. Harihara Iyer.
 " " Jugal Behari Lal, from 10-9-35.
 U.S. " A. A. S. Matlub Ahmad,
 from 1-5-35 to 4-10-35.
 " " Abdul Ghani Qureshi, to 21-9-35.
 " " N. M. Bopaiiah, from 1-8-35.

Forest Map Office.

- C.D. Mr. F. C. Pilcher.
 U.S. " B. B. Shome.

Computing & Tidal Party.

- O.C. Captain G. Bomford, R.E., to 3-4-35.
 " Lt.-Col. E. A. Glennie, D.S.O., R.E.,
 from 4-4-35.

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 6-6-35 and from 3-11-35.
 Lt.-Col. C. M. Thompson, I.A.,
 from 7-6-35 to 2-11-35.

No. 6 Drawing Office.

- O.C. Lt.-Col. C. M. Thompson, I.A.,
 to 5-6-35 and from 30-9-35.
 " Major G. H. Osmaston, M.C., R.E.,
 from 6-6-35 to 29-9-35.

SURVEY SECTION.

- II Mr. Duni Chand Puri.
 " " H. M. Critchell.
 " " Chowdhuri Mohd. Aslam, B.A.,
 to 1-4-35.
 " " B. N. Murthy, B.Sc.
 U.S. " Ghulam Hasan.
 " " Lalbir Singh, C.H.
 " " Muzaffar Husain, C.H.,
 from 15-6-35 to 20-10-35.
 " " Om Parkash Anand, from 12-4-35.

ARMY SECTION.

Captain T. A. Whitmarsh.

Shillong. Director, Eastern Circle.

- Colonel J. D. Campbell, D.S.O.,
 to 3-11-35.
 Lt.-Col. F. J. M. King, R.E.,
 from 4-11-35.

No. 5 Drawing Office.

- O.C. Mr. P. Simpson, to 16-6-35.
 " " F. J. Grice, from 17-6-35 to 27-10-35.
 " " J. McCracken, M.B.E., from 28-10-35.
 II " A. R. Quraishi, B.A., to 30-9-35.
 U.S. " M. M. Shah.
 " " A. K. Maitra, B.A., from 25-8-35.

Bangalore. No. 6 (South India) Party.

- O.C. Major W. J. Norman, M.C., R.E.,
 up to 3-8-35.
 " " G. W. Gemmell, I.A., from 11-10-35.
 II Mr. B. T. Wyatt, V.D., O.C.,
 from 4-8-35 to 10-10-35.
 " " E. N. Natesan, B.A.
 " " M. D. Nangia, B.A.
 " " M. R. Nair, B.A.
 " " P. A. Thomas.
 U.S. " H. Narasimha Murthi Rao, B.A.
 " " Mohabat Lal Kohli.
 " " Muhammad Abdul Azim, C.H., I.D.S.M.
 " " K. B. Muthanna.
 " " Muhammad Mustafa.
 " " A. Shamanna.
 " " C. H. Fernandez up to 13-7-35.
 " " M. A. Faruquie, B.A.

Maymyo. No. 10 (Burma) Party.

- O.C. Lt.-Col. F. B. Scott, I.A.
 II Mr. F. W. Smith.
 " " C. S. McInnes.
 " " C. P. E. Davenport.
 " " D. N. Saha.
 U.S. " Khan Muhammad, C.H.
 " " A. K. Sen Gupta, to 19-1-36.
 " " H. K. Kar.
 " " A. K. Talapatra.
 " U On Ba, to 16-10-35.

XI.—PUBLICATIONS AND ISSUES.

123. **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 1935-36.

Class of maps.	Scale.	New publica- tions.	Revised editions, new edi- tions and reprints.	Number of copies printed.	Value. Rs.
GENERAL MAPS.		<i>Departmental.</i>			
Maps of India	Various	1	1	6,947	9,411
GEOGRAPHICAL MAPS.					
Southern Asia Series	1:2 million	2	...	821	1,642
India and Adjacent Countries Series	1:1 million	1	10	5,785	9,057
Carte Internationale du Monde	1:1 million	...	7	2,241	4,642
TOPOGRAPHICAL MAPS.					
Quarter-inch, Modern	1" = 4 miles	13	30	27,007	40,745
" (Prel.)	Ditto	...	2	1,180	1,961
" (Provl.)	Ditto	...	6	1,455	1,476
Half-inch, Modern	1" = 2 miles	33	17	24,716	49,483
One-inch, Modern	1" = 1 mile	88	149	157,502	2,45,568
" (Prel.)	Ditto	3	9	6,831	11,139
" (Provl.)	Ditto	...	1	4,880	4,880
Old style maps	Various	...	18	3,208	4,708
SPECIAL MAPS.					
Manceuvre and Radius maps ...	Various	...	7	4,758	11,780
Provincial maps	Ditto	1	2	933	1,937
City & Town Guide maps	Ditto	3	...	1,050	925
Index maps	Ditto	...	68	58,064	5,834
Miscellaneous maps	Ditto	25	9	12,977	6,819
Total ... ..	.....	165	336	320,355	4,12,008
		<i>Extra-departmental.</i>			
Maps	Various	108	39	45,005	15,089
Plans and diagrams	Ditto	75	1	85,828	8,938
Illustrations ... ..	.....	91	1	24,283	4,288
Miscellaneous ... ..	.....	46	7	11,992	2,754
Total ... ..	.....	320	48	117,108	31,064
Grand Total ... ..	.....	485	384	437,463	4,43,072

Portion of 1/4-inch sheet, 1935.





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

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
<i>Departmental.</i>					
Cantonment maps ...	Various	12	63	8,676	5,499
Forest maps ...	4"=1 mile	...	1	55	58
Miscellaneous ...	Various	25	45	21,913	7,107
Total ...	...	37	109	30,644	12,664
<i>Extra-departmental.</i>					
Maps ...	Various	31	3	5,108	3,265
Plans and diagrams ...	"	12	7	7,600	919
Charts ...	"	2	10	1,425	265
Forest maps ...	"	9	3	2,358	2,889
Total ...	...	54	23	16,491	7,338
Grand Total ...	...	91	132	47,135	20,002

Table I (c)—Maps published at Quetta.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
<i>Departmental.</i>					
Maps ...	Various	22	2	77	666
Plans and diagrams ...	"	1	8	223	162
Charts } Forms }	"	1	7	1,242	186
Total ...	...	24	12	1,542	966
<i>Extra-departmental.</i>					
Maps ...	Various	20	57	3,818	3,201
Plans and diagrams ...	"	3	1	1,274	1,127
Charts } Forms }	"	3	6	6,918	217
Total ...	...	26	64	12,005	4,545
Grand Total ...	...	50	76	13,547	5,511

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

Class of maps.	Scale.	New publica- tions.	Reprints and new editions.	Number of copies printed.	Value. Rs.
<i>Departmental.</i>					
Maps ...	Various	...	...	1,071	2,027
Plans and diagrams ...	„	...	...	456	541
Charts } Forms }	„	...	...	9,124	528
Total ...	...	...	...	10,651	3,096
<i>Extra-departmental.</i>					
Maps ...	Various	...	...	1,318	207
Plans and diagrams ...	„	...	...	981	419
Total ...	...	...	...	2,299	626
Grand Total ...	...	...	...	12,950	3,722

Table II.—Abstract of Modern Topographical Maps.

	One-inch maps.	Half-inch maps.	Quarter-inch maps.
Topographical maps published in 1935-36	88	38	18
Do. do. published in previous years	3,568	1,038	348
Total published ...	3,651	1,066	361
Number of sheets in India ...	6,218	1,630	450

NOTES.—

Calcutta.—In addition to the work shown in Table I(a), 146,030 copies of 340 maps were gridded during the year.

Dehra Dūn.—In addition to the work shown in Table I(b) above, 4,327 prints of 969 originals, consisting of plane-table sections, triangulation charts and forest maps, etc. were printed.

Table III.—Letterpress publications.

(a) PUBLISHED AT CALCUTTA.

1. General Report of the Survey of India, 1935. (425).*
2. Supplement to the Survey of India Reports, 1935. (125).

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

Table III (Concl'd.).

(a) PUBLISHED AT CALCUTTA.—Concl'd.

8. Survey of India Notes,—issued monthly. (2,750).*
4. List of Maps Published,—issued monthly. (4,400).
5. Supplementary List of Maps Published,—issued quarterly. (2,000).
6. Index to Annual Reports of the Survey of India, 1904-05 to 1926-27. (400).
7. Handbook of Topography, Chapter V (4th Edition). (500).
8. Ditto ditto Chapter VI (7th Edition). (600).
9. Ditto ditto Chapter VI (Appendix 'D'). (600).
10. Instructions to Planetablers, 1935. (1,000).
11. Correction slips to Handbooks of Topography, Border Specimen, Conventional Signs, &c. (12,400).
12. Miscellaneous. (2,155).
13. Calendars for 1936. (1,650).

(b) In hand at Calcutta.

1. *Handbook of Topography, Chapter XI (Sections I-II-III).*
2. *Correction slips to Handbooks of Topography, Border Specimen, Conventional Signs, &c.*
3. *Government of India Orders—Bound Volume.*
4. *Index to Government of India Orders—Bound Volume.*
5. *Map Sales Book.*
6. *Miscellaneous.*

(c) PUBLISHED AT DEHRA DŪN.

1. Geodetic Report, 1934. (850).
2. Tide Tables for the Indian Ocean, 1936. (1,200).
8. Tide Tables, Hooghly River, 1936. (150).
4. Do. Rangoon, 1936. (800).
5. Do. Bombay, 1936. (900).
6. Triangulation Pamphlets. (400).
7. Addenda to Levelling Pamphlet 98. (120).
8. Addendum to Triangulation Pamphlet 84 G & 84 H. (100).
9. Annual Provision and Maintenance Returns of 71 districts. (1,775).
10. Correction slips to Handbooks and Pamphlets, &c. (5,290).
11. Extracts from Report on Air Survey Exercise, Nowshera, 1935 (Gestetnered). (120).
12. Lists of Bench Marks. (20).
13. Miscellaneous. (386,384).

(d) In hand at Dehra Dūn.

1. *Geodetic Report, 1935. (350).*
2. *Tide Tables for the Indian Ocean, 1937. (1,300).*
3. *Handbook of Topography Chapter II (Constitution and Duties of a Survey Party). (330).*
4. *Auxiliary Tables, Part I. (200).*
5. *Addenda to Levelling Pamphlets 46 and 40. (200).*
6. *Addendum to Levelling Pamphlet 47. (100).*
7. *Miscellaneous. (9,550).*

124. Map Issues.—From Table IV below it will be seen that the total sales by the entire Department during the year 1935-36 were 633,714 copies, value Rs. 2,45,919, as against 445,617 copies, value Rs. 2,29,865, sold during the previous year.

* Numbers in brackets after each em denote the number of copies printed.

The Map Record and Issue Office's total sales of departmental maps were 159,180 copies valued at Rs. 1,69,029 as against 129,745 copies valued at Rs. 1,45,567, sold during the previous year.

The total number of extra-departmental maps issued by the Map Record and Issue Office was 433,093 copies as against 265,815 copies issued during the previous year.

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 30,569 copies, value Rs. 48,397.

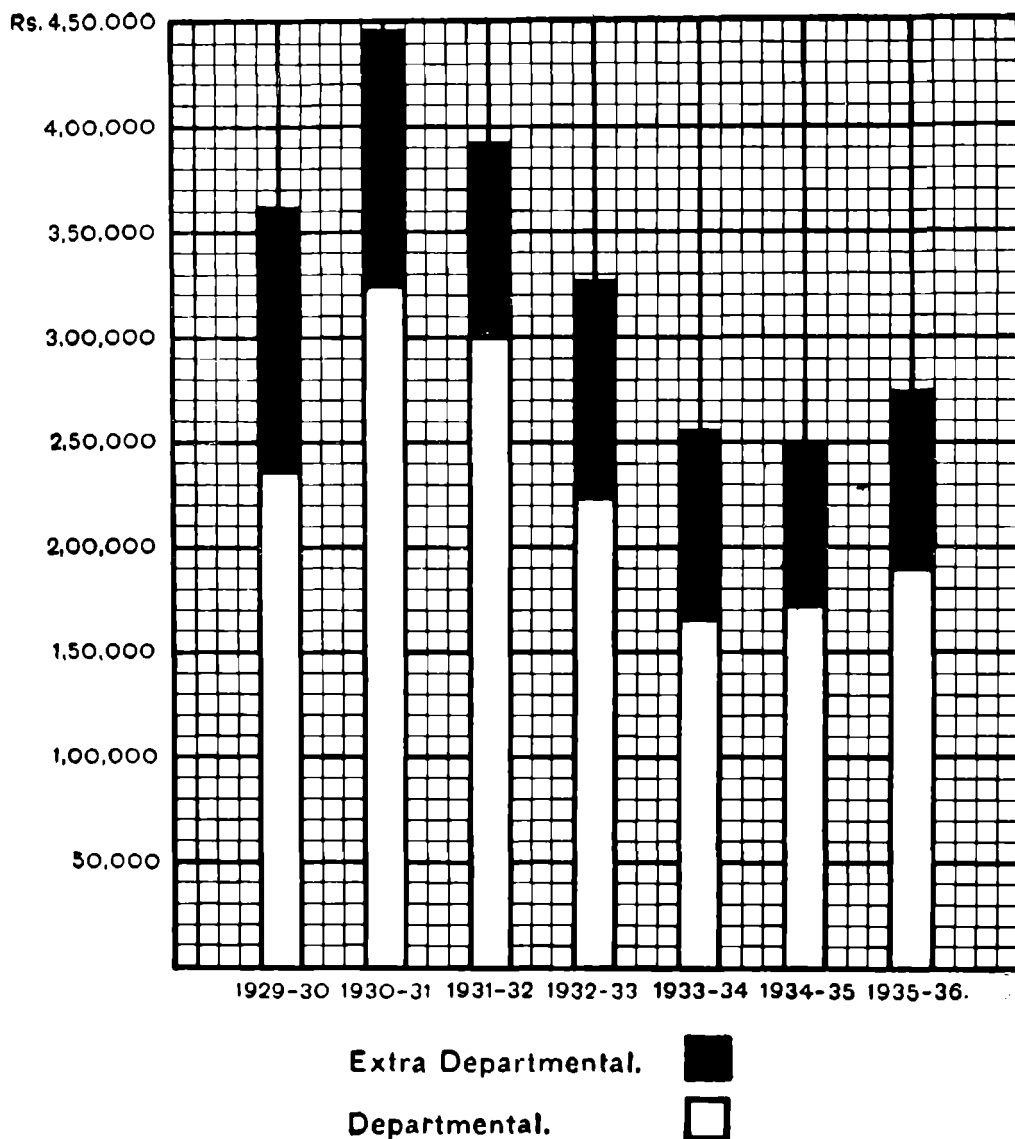
Table IV.—Maps issued by Survey units.

D=Departmental. X=Extra-departmental.	SALES.								FREE ISSUES. Number of copies.	
	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.		
Calcutta	D	28,120	30,379	103,787	98,264	27,273	40,386	159,180*	1,69,029*	13,397
	X	374,721	30,073	21,293	5,125	37,079	11,271	433,093	46,469	1,808
Dehra Dūn	D	1,390	3,416	8,089	6,759	1,751	1,466	11,230	11,641	2,443
	X	8,706	4,039	2,465	1,051	440	1,163	11,611	6,253	37
Simla	D	110	281	15	40	499	951	624	1,272	412
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Murree or Jhelum ("A" Company)	D	13	20	9	8	28	36	50	64	446
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Quetta ("E" Company)	D	309	504	904	973	61	100	1,274	1,577	180
	X	7,040	1,722	3,700	1,689	11	15	10,751	3,428	.....
Bisalpur Cantonment (No. 18 Party)	D	.....	.....	.....	.....	.....	.....	.....	.....	10,651
	X	.....	.....	2,299	626	.....	.....	2,299	626	.....
Bangalore	D	596	984	223	330	912	1,463	1,731	2,777	255
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Shillong	D	479	805	44	76	207	366	730	1,247	1,904
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Maymyo	D	478	744	382	350	281	444	1,141	1,538	284
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	...	421,962	72,967	143,210	1,15,291	68,542	57,661	633,714	2,45,919	31,817

* Excludes 30,569 copies of maps, value Rs. 48,397, 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

1929-36.



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

125. Map Record and Issue Office.—The volume of work in the Map Record and Issue Office has greatly increased. Against 15,414 letters received in 1933 and 15,434 in 1934, 16,535 were received in 1935.

Excluding the value of maps held by the Circle Offices, the approximate value of the Map Record and Issue Office stock on 31-3-36, including

those stocked in the Branch Office, Calcutta, and held by the Curator, Government Book Depot, Burma, was Rs. 36,29,947.

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

44,578 superseded copies of 327 different maps were removed from stock. Of these 3,830 copies were sold at a nominal value to the Bengal and the Bihār and Orissa Drawing Offices for departmental use; the remaining copies were utilised for packing purposes after cancellation.

As in previous years, the Army still continues to top the list of purchasers.

From a classification of issues, it is found that the percentages of sales of departmental maps work out as below :—

ARMY	...	...	...	65 %
PUBLIC	...	...	...	17 %
OTHER GOVT. DEPTS.	...	...	...	18 %

PUBLICATIONS AND ISSUES.

Table V. Stock of Maps. This table gives the stock of maps as it stood on 31st March 1936.

Class of maps.	CALCUTTA.				DEHRA DUN.		SHILLONG.		SIMLA.		JHELM AND MURREE.		QUETTA.		MAYMYO.		BANGALORE.		RANGOON AGENCY.		TOTAL.	
	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.	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 ...	10,900	19,331	22	42	195	890	...	...	46	92	40	97	62	124	...	...	30	60	...	...	11,295	20,136
1/M India and Adjacent Countries ...	33,992	54,274	208	341	1,720	2,838	168	252	262	412	184	285	376	564	297	447	419	718	469	704	38,095	60,835
1/M Carte Internationale du Monde	3,685	7,588	15	30	121	242	50	100	43	86	12	24	18	86	...	...	58	153	52	110	4,049	8,369
Two-inch maps ...	10,852	31,399	...	...	7,990	16,614	351	623	...	...	...	...	...	...	...	...	...	...	...	...	19,193	48,636
One-inch maps ...	1,325,249	19,95,669	4,239	6,215	50,415	75,487	24,912	37,218	8,688	5,569	8,991	5,987	2,240	3,360	22,701	33,340	4,517	6,954	13,584	20,301	1,455,386	21,90,100
Half-inch maps ...	406,444	8,09,978	1,007	1,977	12,354	24,374	5,809	11,618	580	1,170	1,132	2,264	991	1,982	3,924	7,678	1,412	2,925	4,429	8,858	438,082	8,72,824
Quarter-inch maps ...	264,220	3,89,210	641	649	7,638	11,148	2,797	4,196	1,059	1,616	902	1,353	2,221	3,331	2,209	3,117	587	797	1,896	2,844	284,170	4,18,460
General maps of India ...	14,926	25,069	56	122	391	504	37	205	59	149	18	39	40	60	9	36	71	157	...	...	15,631	26,340
Provincial and District maps of India	5,939	18,112	24	84	299	748	635	1,045	44	136	17	29	5	5	14	21	52	247	...	...	7,029	20,422
Cantonment and Town maps (Special and Guide).	52,392	1,29,741	74	132	14,576	29,276	459	979	280	1,650	633	1,281	82	237	96	305	222	470	65	477	69,079	1,64,548
Manœuvre and Radius maps ...	7,120	16,472	9	25	114	245	...	...	16	39	114	204	...	...	79	140	95	203	...	...	7,547	17,328
Miscellaneous maps ...	78,154	85,514	16	144	5,990	6,643	172	128	486	850	24	56	73	146	6	6	27	14	2,678	4,335	87,626	97,836
TOTALS ...	2,213,873	35,82,357	6,311	9,961	101,803	1,68,504	35,320	56,864	6,563	11,768	7,267	11,618	6,108	9,845	29,329	45,090	7,485	12,698	23,128	37,629	2,437,182	39,45,834

XII.—WORK OF DRAWING OFFICES.

126. Tables VI to VIII give an abstract of new maps, reprints and new editions completed for publication, as well as those in hand during the year, for the whole department.

127. **No. 1 Drawing Office, Calcutta.**—It is proposed to abolish the 32-mile map of India and Adjacent Countries and to bring out a map on the 40-mile scale, utilising the revised compilation of the 32-mile map, which has made good progress.

The following maps, which are in hand, are making satisfactory progress:—

- (a) The revised edition of the 50-mile Road Map of India.
- (b) The new style Province Maps.
- (c) The revised edition of the 128-mile map of India.
- (d) A reissue of the 50-mile Wall Map.
- (e) A Crop Atlas of India for the Director General of Commercial Intelligence & Statistics.
- (f) A Telegraph Map of India for the Director General of Posts & Telegraphs.

Engraving Office:—An improved method of transferring work from one engraved plate to another, with improved accuracy and great saving of time, has been introduced in the Engraving Office during the year under report.

The engraved plate, from which the work is to be transferred, is filmed over with wax, and a sheet of celluloid is placed over it and burnished. This process transfers the wax film to the celluloid, except where the engraved lines occur, which remains blank. The celluloid is then placed in exact position over the copper plate on which the details are to be entered and the wax film again transferred. This leaves an exact image of the engraved lines in clear copper, and the rest of the plate covered with wax. Fumes of sulphide of ammonia are then passed over the plate, which deeply oxidizes the exposed parts only, thus providing an exact facsimile of the engraving for the engraver to work upon.

In addition to ordinary Departmental work, certificates were engraved for His Excellency The Viceroy and for Air Marshal Sir Edgar Ludlow-Hewitt. These certificates were for presentation to units and individuals for services rendered during and after the Quetta Earthquake of 31st May 1933. The number of engraved certificates printed is as follows:—

26 on vellum.

418 on Milbourne hand made paper.

128. **No. 2 Drawing Office, Dehra Dūn.**—The 8-mile map of Nepal mentioned in the report for 1934-35 has been published.

The revised edition of the 1/2½ M. map of "The Himālaya Mountains and Surrounding Regions" is near completion. The map has been brought up to date from the latest exploration surveys and is intended for use as a wall map. The title of the new edition will be, "The Highlands of Tibet and Surrounding Regions."

The sheets falling in areas covered by 1/M sheets Nos. 9, 10 and 17, transferred to the Geodetic Branch in connection with the re-issue of Persia sheets, mentioned in the report for 1934-35, are being brought up to date from office copy corrections. Of these, 17 sheets have been corrected, 3 for immediate publication and 14 for re-issue when required.

Original survey records prior to 1905, beyond the limit of regular survey, have been returned to the Directors, Frontier Circle and Eastern Circle after extracting the information on 1/M Index to Exploration surveys.

129. Forest Map Office, Dehra Dūn.—This office, which is maintained by contribution from all Provincial Governments except Assam, Bihār and Orissa, and the Punjab, continues to meet all demands from these Governments for forest maps. Its main work is the fair drawing of working plan maps, the preparation of new editions of forest maps and the upkeep of their office copies. In addition, 2 sheets comprising 1-inch working plan maps were prepared for Kashmir State.

130. 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 map sales 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 stock of Survey of India maps for issue within the department and for sale to the public. Two new double-tiered sets of steel shelves were purchased for the storage of Cantonment plans.

The physical verification of stock was commenced in October and carried out systematically throughout the remaining six months of the year.

131. No. 6 Drawing Office, Simla.

Survey Section.—

- (1) The examination of party sheets will continue to be heavy until the parties get level with their arrears of mapping.
- (2) 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 were arranged and indexed.
- (b) New registers of records, which are being prepared to complete No. 6 Drawing Office's reorganisation, could not be entirely checked until the data issued to other units and branches are returned by the latter.
- (c) On urgent requisition 7 old style one-inch sheets, with the corners of main rectangles marked thereon from the rectangulation data by No. 24 Party of season 1926-30, were supplied to the

Executive Engineer, Development and Research Division, Irrigation Branch, Karāchi, Sind.

- (d) 16 green tree sheets for modernizing reissues were drawn and submitted for publication. This special work has necessitated allocating two draftsmen to cope with it.
- (e) The fair originals of the Quetta Cantonment Map corrected by O. C. 'E' Company were examined and submitted to the Geodetic Branch.

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 Government Departments.

The work of the Army Section continues to increase since the installation of the Machine Press and it has been found necessary for the staff to work at high pressure in an attempt to meet increasing demands.

WORK OF DRAWING OFFICES.

Table VI.—New maps.

Figures in italics denote work in hand.

	TOPOGRAPHICAL.								GEOGRAPHICAL.								GENERAL AND SPECIAL.								ACCESSORY.			MISCELLA.											
	1-inch.		1/2-inch.		1/4-inch.		1/8-inch.		1/M.		CARTE INTERNATIONALE.		1/2M.		Guide.	Special.	Province.	India.	Forest.	CANTONMENT SHEETS.		Gridding.	Shading.	Colour Patterns.	Indexes.	Char.													
	Helio.	En-graved.	Helio.	En-graved.	Helio.	En-graved.	Helio.	En-graved.	Helio.	En-graved.	16-inch.	64-inch.																											
No. 1 Drawing Office— Including Engraving Office	4	2	4	5	1	2(a)	1(b)	108	2	192	34	40	5					
Geodetic Branch— No. 2 Drawing Office	...	2	5	2	7(c)	3(d)	1	1	2(e)	1(f)	1(g)	3	26	9	20	...	6					
Forest Map Office					
Parties	...	7	4	8	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1(h)	...	...	...	...	10	12	2	2	...	...	...	...	...	
Eastern Circle— No. 5 Drawing Office	8	25	5	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	2	...	...	69	3	...	...	1		
Parties	...	35	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Frontier Circle— No. 6 Drawing Office	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	1	...	...	52	5	...	...	...			
Parties	...	14	3	7	2	...	...	...	...	...	...	...	...	...	1(i)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
No. 6 (S. I.) Party	...	19	...	4	...	4	...	...	...	...	...	...	...	1(k)	...	...	...	...	...	...	...	...	...	...	...	2	...	...	43	2	...	...	...			
No. 10 (Burma) Party	...	8	...	10	...	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	...	...	...	...		
Total	...	89	14	48	38	9	22	3	...	1	5	1	1	...	1	3	1	2	1	2	1	10	12	2	2	133	7	192	34	244	24	20	...	7
Total to date	...	3,785	1,130	368	56	26	1	21	9	8			
Total for India	...	6,218	1,630	450	104	41	22			

References.

<p>Scales:—<i>x</i>-inch means <i>x</i> inches to 1 mile.</p> <p><i>x</i>-mile " 1 inch to <i>x</i> miles.</p> <p>1/M means 1:1 million or 1'014 inches to 16 miles.</p> <p>1/2M " 1:2 " " " " 32 "</p>	<p>(a) Baluchistān, Mysore & Coorg.</p> <p>(b) Kashmir and Jammu.</p> <p>(c) Includes one Provisional issue (black and brown).</p> <p>(d) Special Nepāl maps.</p> <p>(e) Lucknow and Bombay Guide maps, scale 4"=224=1 mile and 2"=534=1 mile respectively.</p> <p>(f) Map of the Shingshāl Mustāgh area scale 1"=4 miles.</p> <p>(g) Map of the Highlands of Tibet and Surrounding Regions, scale 1"=014=40 miles.</p>	<p>(h) Udaipur Guide map, scale 4"=1 mile.</p> <p>(i) Includes 9 sheets of 128-inch map of Government Orchard Chaubattia and 14 sheets of 16-inch Quetta Cantonment Skeleton map.</p> <p>(j) Bikaner and Surrounding Country.</p> <p>(k) Warangal Fort map, scale 1"=400 feet.</p>
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Table VII.—Miscellaneous.

<p>No. 1 Drawing Office—</p> <p>Originals corrected against press order proof ... 43</p> <p>Mosaic (congregated maps prepared for photography) ... 32</p> <p>Circles, and Parties, sheets examined and corrected ... 144</p> <p>Grid originals scrutinized and corrected ... 48</p> <p>Grid cutting lines on originals drawn or checked ... 109</p> <p>Exploration Krab indexes duplicated from D. G. B's indexes ... 114</p> <p>Shaded originals amended ... 19</p> <p>Miscellaneous cases ... 358</p> <p>Office copies corrected from various sources ... 5,706</p>	<p>No. 2 Drawing Office—</p> <p>Mosaics (congregated rough maps prepared for photography) ... 2</p> <p>Areas extracted, No. of sheets ... 21</p> <p>Party sheets examined, corrected and submitted for publication ... 14</p> <p>Green tree originals prepared ... 4</p> <p>Grid cutting lines on originals drawn and checked ... 13</p> <p>Party sheet completed ... 1</p> <p>Old surveys Krab files (indexes prepared) ... 22</p> <p>Administrative partitions in Persia (indexes prepared) ... 36</p> <p>Specimen of provisional sand example drawn ... 1</p> <p>Specimen of High mountain features drawn ... 1</p> <p>Miscellaneous cases ... 369</p>	<p>Forest Map Office—</p> <p>Standard indexes completed ... 44</p> <p>Sheets coloured for indents ... 83</p> <p>Areas extracted, No. of sheets ... 24</p> <p>Original corrected ... 1</p> <p>No. of sheets passed for publication ... 12</p> <p>No. 6 Drawing Office—</p> <p>One-inch sheets examined ... 32</p> <p>Half-inch " " ... 7</p> <p>Special map " " ... 1</p> <p>No. 10 (Burma) Party—</p> <p>Map mounting (booklets) ... 273</p> <p>" " (plain) ... 110</p> <p>Green tree originals for re-issues ... 1</p>
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XIII.—PRINTING AND MISCELLANEOUS.

XIII.—PRINTING AND MISCELLANEOUS.

132. The Photo.-Litho. Office, Calcutta.—There has been little change in the volume of work passing through the office since last year. A thorough examination has been made of cost rates and it is hoped that revised rates now under consideration may result in an increase of work from other Government Departments.

Experiments have been carried out during the year with the object of overcoming distortion in originals and also of reducing the amount of "duffing" for colour separation required in reproducing standard topographical maps. Promising lines for further investigation have opened up, but the experiments have not yet reached finality. The new methods referred to last year for preparing drawing blue prints from plane-table sections have been employed again with complete success and have now become standard practice.

A Zeiss Tessar Achromat F. 9. lens with stainless steel reflecting mirror has been purchased. This lens allows the use of larger apertures than have been previously possible and so has shortened exposure times. The use of a mirror in place of a prism gives improved definition and by absorbing less light also reduces exposure.

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. 3,38,385	Rs. 3,50,100	4,943	6,072	770	1,786	3,722,673

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

PROCESS ENGRAVING SECTION.					TYPE PRINTING SECTION.		
HALF-TONE WORK.		LINE WORK.		PHOTO-GRAYURES.			
Blocks prepared.	Impressions pulled.	Blocks prepared.	Impressions pulled.	Plates prepared.	Items or pages published.	Copies printed.	Impressions pulled.
241	28,880	32	8,480	Nil	1,831	728,290	1,291,209

**133. OUT-TURN OF ENGRAVING OFFICE COPPER PLATE
PRINTING SECTION.**

IMPRESSIONS PULLED.				
Photogravures.	Chromo Paper.	Transfer.	Miscellaneous.	Total.
3	584	249	4,718	5,554

134. Photo-Zinco-Section, Dehra Dūn.—The printing plant of this section consisting of one rotary and two flat-bed machines (only one of which is in operation at a time), an offset press and three hand-presses, was in continuous operation during the year, printing cantonment and forest maps, diagrams, charts, Bhakra Dam sheets, the Bombay Guide Map, the skeleton maps of Nepāl and of Quetta and the Quetta Civil Station map, as shown in Table I(b).

The Empire Arc Lighting unit consisting of four single arc lamps on two tripod stands was received from Messrs. Hunter Penrose Ltd., England.

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

The new process camera in conjunction with arc lamps has been found most efficient, and better blue prints are being produced. It is unlikely that really satisfactory blue prints will be made in this party, until it is equipped with a mechanical graining machine.

Two D. E. handpresses, one Furnival portable handpress and one Imperial handpress are now in use in the party.

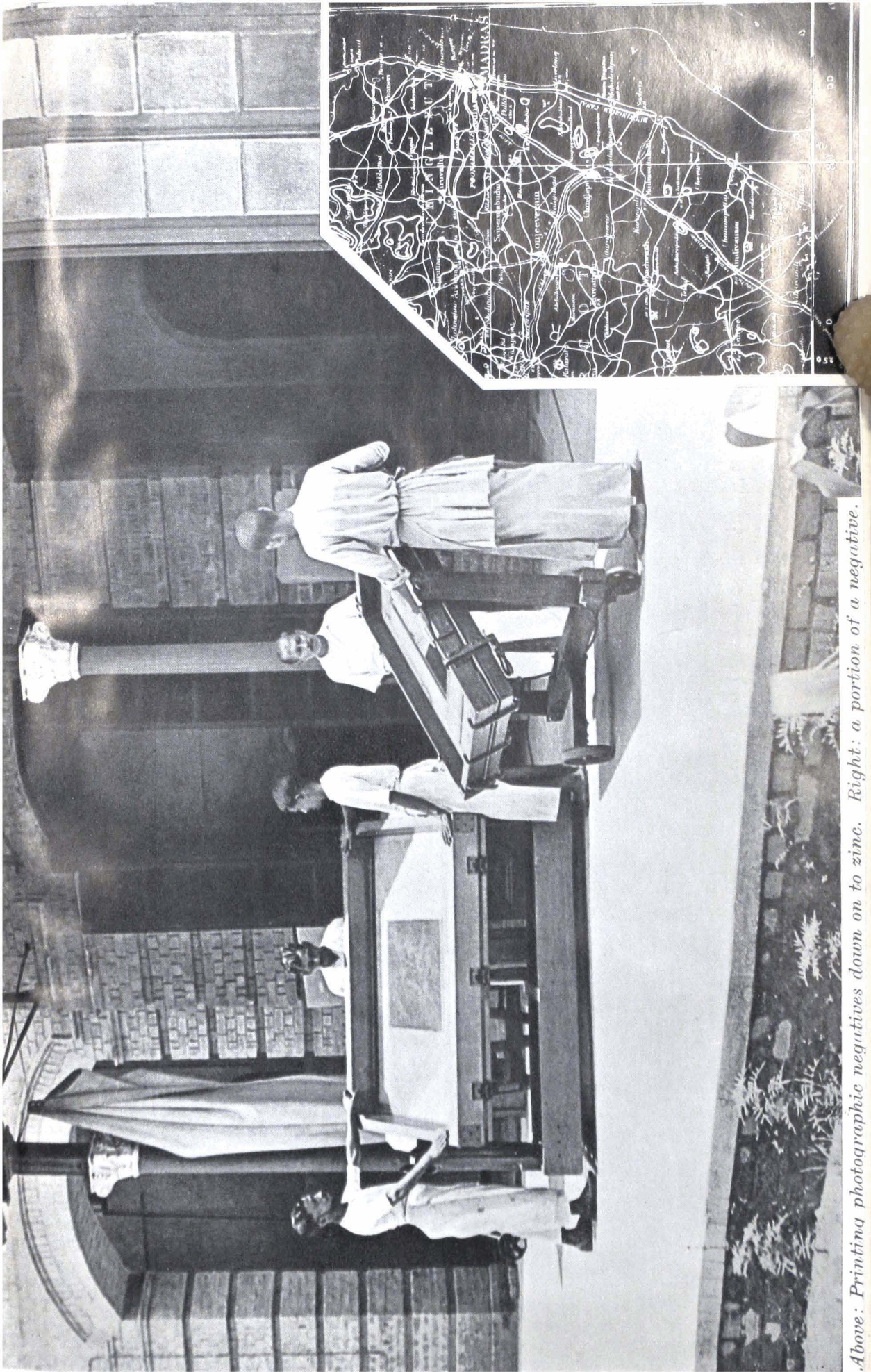
Reproduction of originals received :—

In one colour	...	...	...	161
In two colours	...	...	...	10
In three „	...	...	...	7
In four „	...	...	...	1
			TOTAL	179
Vandyke and helio plates prepared	...	...	...	150
Prints pulled	...	...	...	12,950

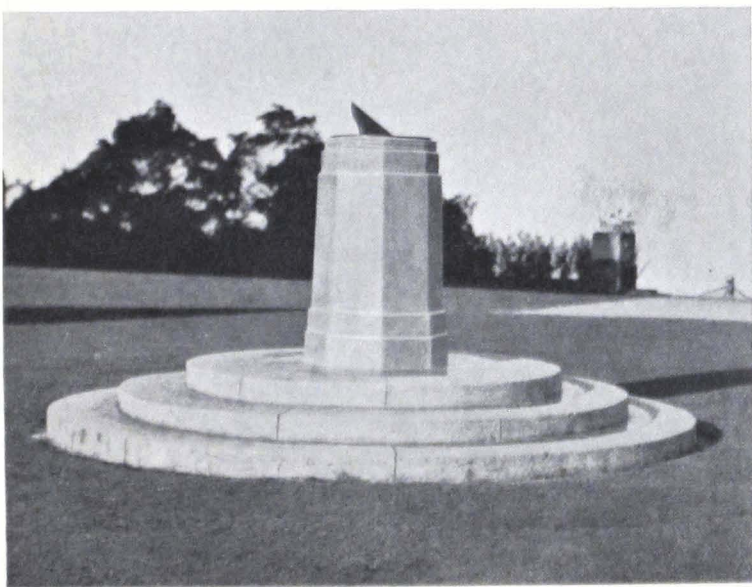
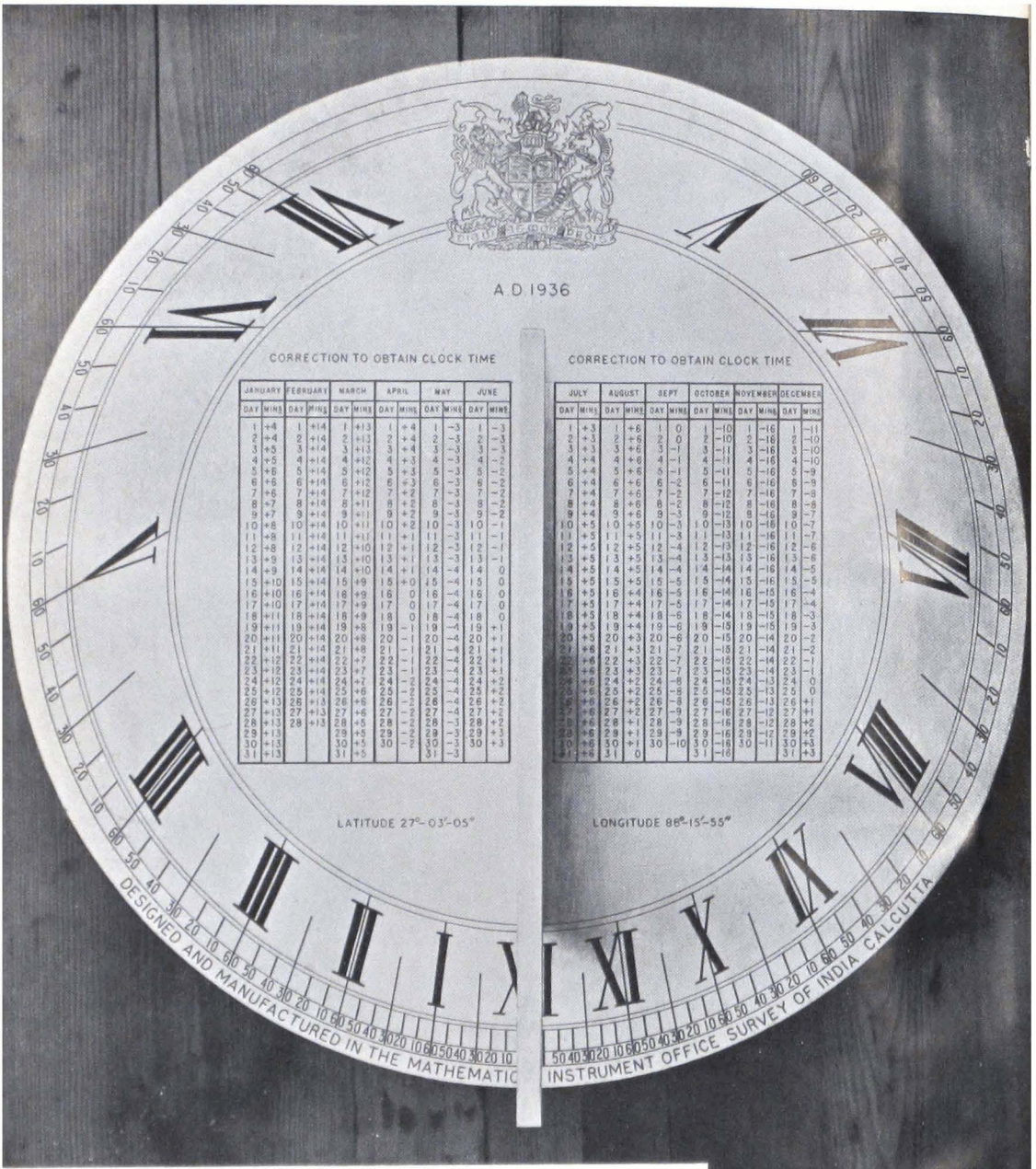
136. 'E' Survey Company, Quetta.—For about half the year the full Reproduction Section was employed mostly on extra-departmental work. For the remainder of the year only about three men of this section were continuously employed, the remainder being sent on leave. In spite of this there was an increase of Rs. 1,640 in the value of extra-departmental work carried out during the year due chiefly to heavy demands for maps etc. following the Quetta Earthquake.

There are now in the Company 1 offset Rotary Printing Machine, 1 Duplicating Press, 4 Hand Presses and 2 Portable Presses, but since the Quetta Earthquake only one Hand Press has been in use.

Reproduction of originals received:—			
In one colour	...	...	95
In two colours	...	...	21
In three colours	...	...	8
In four colours	...	...	2
		TOTAL	<u>126</u>
Vandyke and helio plates prepared	...	...	117
Prints pulled	...	...	<u>7,887</u>



Above: Printing photographic negatives down on to zinc. Right: a portion of a negative.



Sundial manufactured in the Mathematical Instrument Office and installed in the new Government House, Darjeeling.

XIV.—MATHEMATICAL INSTRUMENT OFFICE.

137. During the year under review the M. I. O. has been subjected to heavy retrenchment as a result of the withdrawal of Army Ordnance Repairs. These normally amounted to 60% of the total repair work. It is now the intention of the Army Ordnance Dept. to undertake this highly specialised work at their own arsenals.

The retrenchment in staff involved the dismissal of 62 workmen on 1st March 1935 and the transfer of two clerks.

Notwithstanding the heavy retrenchment, the result of the year's working shows a satisfactory increase. The total sales show an increase of about Rs. 50,000/- and the total work done covering the manufacture of new instruments, repairs to order and reconditioned instruments for issue amounts to Rs. 2,79,764 being Rs. 17,548 in excess of last year.

The manufactures and repairs covered the usual wide range of scientific instruments associated with the M. I. O., the principal items being as under:—

Manufactures.

Drawing boards	... 217	Pantographs	... 11
Plane-tables	... 77	Sight rules	... 97
Stands for plane-tables	... 64	Leather cases for tapes	... 726
Covers for plane-tables	... 166	Ferrotypes-printing frames	6
Haversacks	... 228	Set Squares ebonite	... 1,150
T-squares	... 228	Do. celluloid	... 396
Levelling staves	... 294	Masons levels	... 304
Head stereoscopes	... 47	Protractors of sorts	... 476
Straight edges	... 30	Scales of sorts	... 3,085
Umbrellas	... 61	Steel band chains	... 43
Raingauges	... 195	Measuring chains	... 203
Receivers zinc	... 204	Pins for chains	... 1,714
Funnels	... 121		
Prismatic compasses with stands.	58		

Repairs.

Levels with stand	... 274	Drawing-Instrument boxes.	235
Theodolites with stand	... 90	Clinometers modified & rigid "Survey pattern".	150

Repairs.—(Concl'd.).

Pantographs	... 14	Microscopes	... 98
Levelling staves	... 139	Clocks	... 25
Plane-tables with stands	29	Watches	... 81
Head stereoscopes	... 5	Planimeters	... 75
Compasses of sorts	... 965	Bubble tubes	... 50
Binoculars	... 183	Hydrometers	... 128
Telescopes	... 33	Parallel rules	... 70
Measuring tapes	... 633	Barometers	... 12
Station Pointer	... 10	Hygrometers	... 15
Micro. objectives	... 24		

Demands on the Optical Repair Section were less owing to the loss of the Army Ordnance work, but during the year 400 prism surfaces were reworked, polished and figured. In addition, the following were manufactured:—

Lenses	... 550	Prisms	... 182
Reflecting mirrors	... 254	Agate knives for chemical balances.	12
Glass diaphragms	... 816	Stainless steel mirrors	... 15
Compass glasses	... 643	Colour filters	... 150

Repairs included a number of sphygmomanometers, colorimeters, ophthalmoscopes, aero-compasses, phorometers, quartz wedges, auroscopes and polariscopes.

In the Glass Graduating Section 728 excise jars, 351 rain measuring glasses, $\frac{1}{2}$ -inch and 1-inch, were graduated.

The Glass Blowing Section manufactured 388 thermometers and repaired 157 thermometers of various types, also 329 glass spirit bubbles and 12 factory pattern hygrometers.

The certification of aero-compasses used in private aircraft for compliance with specification was undertaken at the request of the Director of Civil Aviation. The standard tests are applied to these compasses after necessary repairs and certificates are issued.

The manufacture of quartz wedges has been introduced in the Optical Department at the request of the Professor of Geology, Presidency College, Calcutta. This requires optical work of very high accuracy and satisfactory results have been achieved.

Arrangements have been made for the repair and adjustment of polariscopes and polarimeters as there is no other concern in India able to undertake this work. There has been a large increase in the use of these instruments in India owing to the expansion of the sugar industry, which requires such apparatus for the measurement of the optical rotary power of solutions.

The use of extruded metals in the manufacture of drawing instruments and rectangular compasses was introduced with a view to making a reduction in manufacturing costs.

The manufacture and supply of stores to the Director of Contracts, Simla, shew a reduction during the year owing to their greater imports from abroad of instruments formerly manufactured in the M. I. O., but the following were made up and supplied during the year:

- 70 Compasses prismatic liquid Mk. II, Barker's pattern.
- 17 T-squares mahogany 36" to specification.
- 32 Drawing Boards Imperial to specification.
- 390 Scales mathematical.
- 6 Scales builders and a large number of spare parts.

Special instruments and experimental work during the year under review included the following:—

- (a) White bakelite scales for the O. C., D. O., Calcutta and D. G. B., Dehra Dūn, for trial and report.
- (b) One rigid pattern clinometer of new design, 10 inch base, for D. E. C., for trial and report.
- (c) Twelve clinometers M. I. O. rigid pattern, in case, for Nos. 1 & 5 Parties.
- (d) Pantographs in which the castor and joints were fitted with stainless steel ball bearing fittings to promote smoother motion.
- (e) About 130 Survey of India clinometers, folding pattern, were improved to overcome certain disadvantages in design. The folding vanes were made of channel section to prevent bending and the tilting screw fitted with a floating steel ball point working in a "V" slot to prevent any lateral movement. The scales are now machine divided to improve accuracy. Further alterations are contemplated such as an improved bubble, more positive stop for the open position of the vanes, improved vertical guide, abolition of the degree scale and introduction of larger cleats.
- (f) Two stands for Furnival hand presses for O. C. "E" Coy. and O. C. No. 18 (Air Survey) Party.
- (g) One collimator for binoculars for the I. G., Cossipore.
- (h) Three Hunter Short Base apparatus complete with accessories, one for Sino-Burmese Party and 2 for D. E. C.
- (i) Two grid plates for parallax measuring board for O. C. No. 18 (Air Survey) Party.
- (j) One plan (photo enlarging) board for O. C., P. L. O.
- (k) One grease worker to the design of the Institute of Petroleum Technologists for the Controller of Stores, G. I. P. Ry., Parel.
- (l) One experimental scale single diagonal 16 inches to 1 mile, made of synthetic resin material to overcome the variability of celluloid hitherto employed, was made up for test and sent to the Director of Land Records, Nāgpur. A satisfactory report has since been received.
- (m) One experimental protractor rectangular 6 inches Mk. IIIA, made of synthetic resin material for the Indian Military Academy, Dehra Dūn. This scale is still under test.
- (n) An horizontal brass sundial, 18 inches diameter, was designed and made up for installation in Government House, Darjeeling, see illustration facing page 75.

- (o) A globe, 18 inches diameter, mounted on a pedestal, displaying earthquake regions, was specially constructed for the Meteorological Department, Alipore, Calcutta, to facilitate the location of seismological disturbances.

Issues by the Store Section amounted to over 40,000 instruments.

The total value of instruments and materials held in Serviceable, Repairable and Material Stores has been reduced through issues by Rs. 49,255/-.

The clerical section dealt with 17,956 letters and the accounts section with 4,823 invoices.

The value of orders, issues and repairs from the various Government Departments during the year is noted below:—

	Rs.
Survey of India	49,461
P. W. Departments	97,940
Army Departments (Military Engineering Services, etc.).	58,907
Railway Departments	36,702
Medical ,,	7,877
Forest Departments	14,130
Education Departments	4,223
Other Civil Departments	48,892
Government Officers etc. on payment	32,451
TOTAL	3,50,583

During the year all manufacture and repair work outstanding prior to the year 1935-36 was completed.

In the Workshops, defective shafting was repaired and ball bearing plunger blocks introduced in addition to other renovations. The Paint Spraying Section was removed to the Paint Shop and a suction booth designed and installed for this work.

Under instructions from the Surveyor General certain selected instruments made up in M. I. O. were sent on the 10th December to the Secretary, Institute of Engineers (India), Calcutta, as exhibits of Survey instruments manufactured in India.

The D. M. P. (Col. J. D. Campbell, D.S.O.) inspected the M. I. O. in November 1935.

The Surveyor General (Brigadier H. J. Couchman, D.S.O., M.C.) inspected the M. I. O. on 27th March.

Army surplus and obsolescent stores were sold on behalf of the Director of Contracts, Simla, and a sum of Rs. 1,168/10 was realised. Surplus and obsolescent stores and scrap materials belonging to the M. I. O. were disposed of, and a sum of Rs. 3,474 realised.

Fire drill and inspection of Fire appliances were carried out monthly during the year under review. All fire extinguishing apparatus was inspected by an officer of the Fire Brigade on the 8th of February 1936.

138. The following comparative table shows the amount of work done and the reduction of stocks in relation to previous years.

Sale.	1933-34.	1934-35.	1935-36.
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>
1. Total value of stores issued ...	1,93,785	2,01,410	2,51,756
<i>Out-turn in Works:—</i>			
2. Total value of manufacture of new instruments and components—	88,700	1,00,887	1,09,651
3. „ value of repairs to orders— ...	1,30,648	1,39,119	98,826
4. „ value of instruments reconditioned for issue— ...	15,382	16,168	64,434
5. „ of adjustment and cleaning charges ...	4,977	6,042	7,284
6. „ of work done in the Workshop as per items 2 to 5 above— ...	2,39,707	2,62,216	2,80,195
7. <i>Book value of stock in—</i>			
(a) Serviceable store ...	3,66,279	3,30,666	3,02,100
(b) Repairable „ ...	1,62,064	1,56,999	1,46,006
(c) Material „ ...	1,65,131	1,48,387	1,36,625
8. <i>Value of new instruments—</i>			
(a) Purchased locally ...	39,737	44,611	47,491
(b) Imported through the Stores Department, London ...	8,211	9,650	4,585
9. Value obtained by sale of obsolescent and condemned stores ...	4,919	13,136	3,474
10. <i>Employees—</i>			
(a) Total number of employees on register on 31st March— ...	388	323	336
(b) Cost of employees in workshop including pension contribution	1,47,506	1,49,829	1,38,428

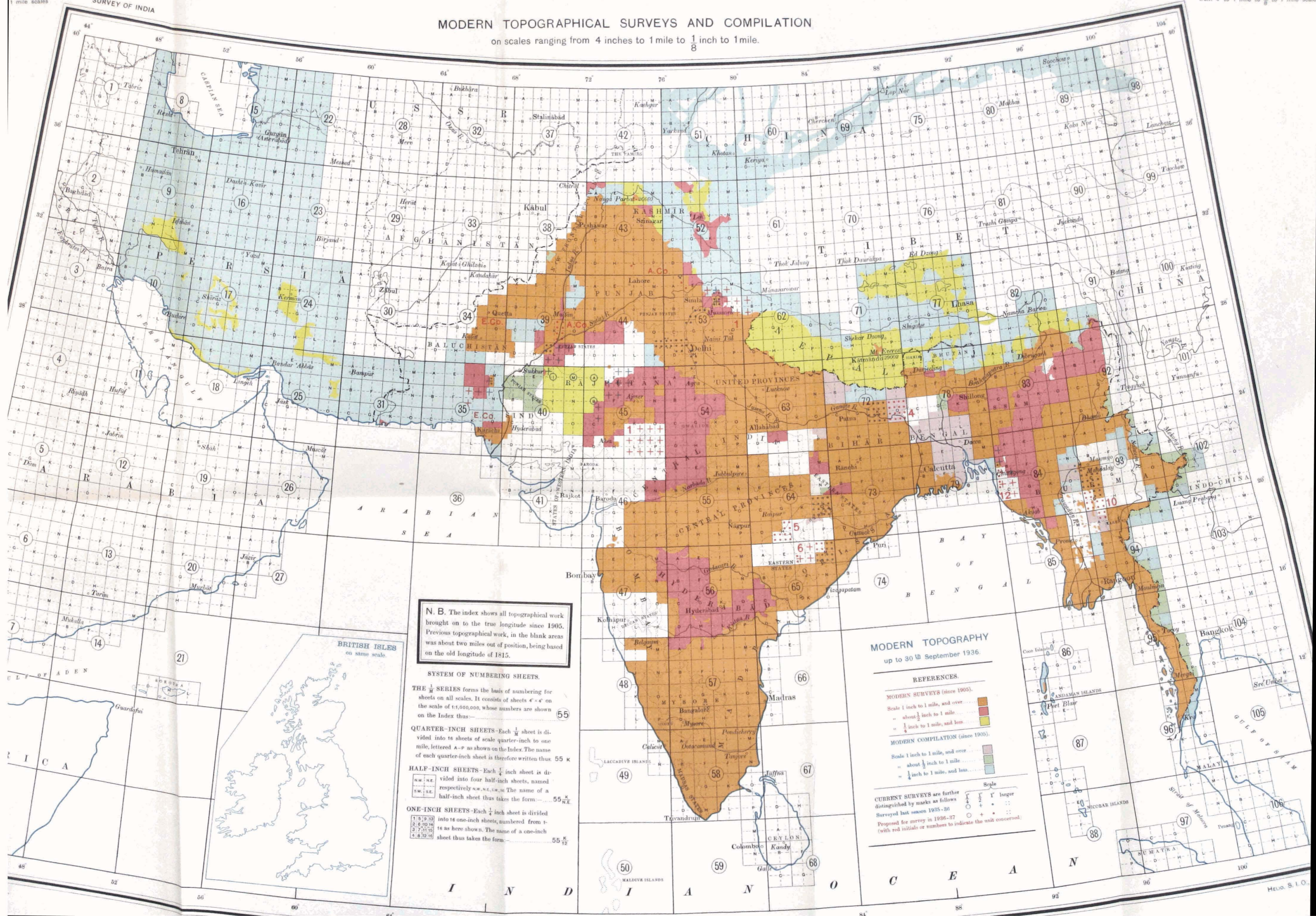
INDEX MAPS

A. Modern Topo. surveys and compilation	...	...	...	<i>At End.</i>
B. Seasons of survey and revision	...	...	...	" "
C. Maps published on 1 inch and $\frac{1}{2}$ inch scales	...	...	...	" "
D. " " " $\frac{1}{4}$ inch scale	...	...	...	" "
E. The India and Adjacent Countries Series, 1/M scale		...	...	" "
F. Carte Internationale du Monde, 1/M scale	...	...	...	" "
G. The Southern Asia Series, 1/2M scale	...	...	...	" "

1 mile scales
SURVEY OF INDIA

MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION

on scales ranging from 4 inches to 1 mile to 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 1/4" SERIES forms the basis of numbering for sheets on all scales. It consists of sheets 4" x 4" on the scale of 1:1,000,000, whose numbers are shown on the Index thus: 55
QUARTER-INCH SHEETS—Each 1/4" 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 1/4" 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 K.N.E.
ONE-INCH SHEETS—Each 1/4" 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 K.12

MODERN TOPOGRAPHY

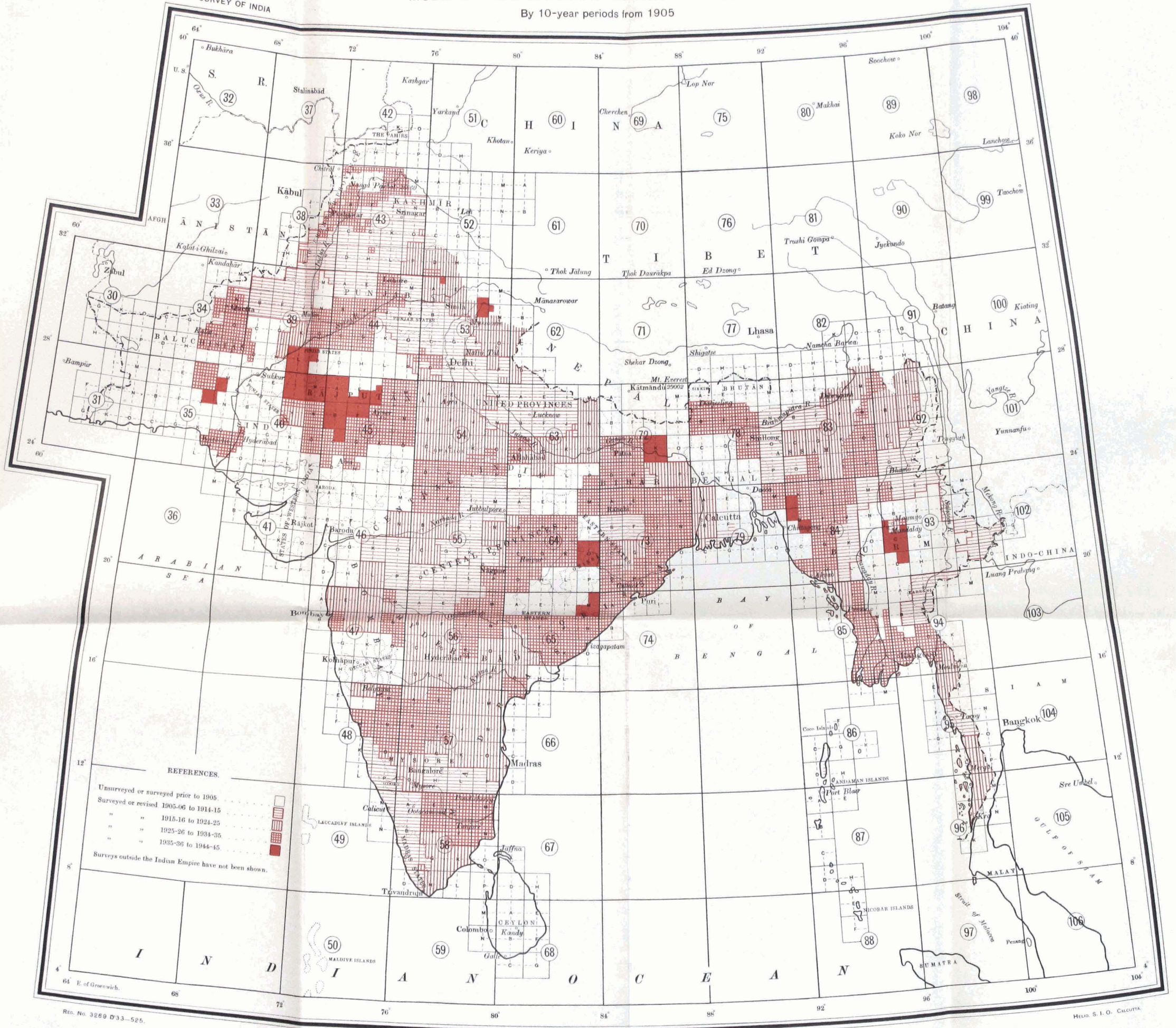
up to 30th September 1936.

REFERENCES.
MODERN SURVEYS (since 1905).
Scale 1 inch to 1 mile, and over: [Red]
" about 1/2 inch to 1 mile: [Orange]
" 1/4 inch to 1 mile, and less: [Yellow]
MODERN COMPILATION (since 1905).
Scale 1 inch to 1 mile, and over: [Light Blue]
" about 1/2 inch to 1 mile: [Light Green]
" 1/4 inch to 1 mile, and less: [Light Purple]
CURRENT SURVEYS are further distinguished by marks as follows:
Surveyed last season 1935-36: [Red circle]
Proposed for survey in 1936-37: [Red cross]
(with red initials or numbers to indicate the unit concerned).

MODERN TOPOGRAPHICAL SURVEY AND REVISION

By 10-year periods from 1905

SURVEY OF INDIA



REFERENCES.

- Unsurveyed or surveyed prior to 1905
 - Surveyed or revised 1905-06 to 1914-15
 - Surveyed or revised 1915-16 to 1924-25
 - Surveyed or revised 1925-26 to 1934-35
 - Surveyed or revised 1935-36 to 1944-45
- Surveys outside the Indian Empire have not been shown.

Scale of Index 1:12 Million.

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

MAPS PUBLISHED

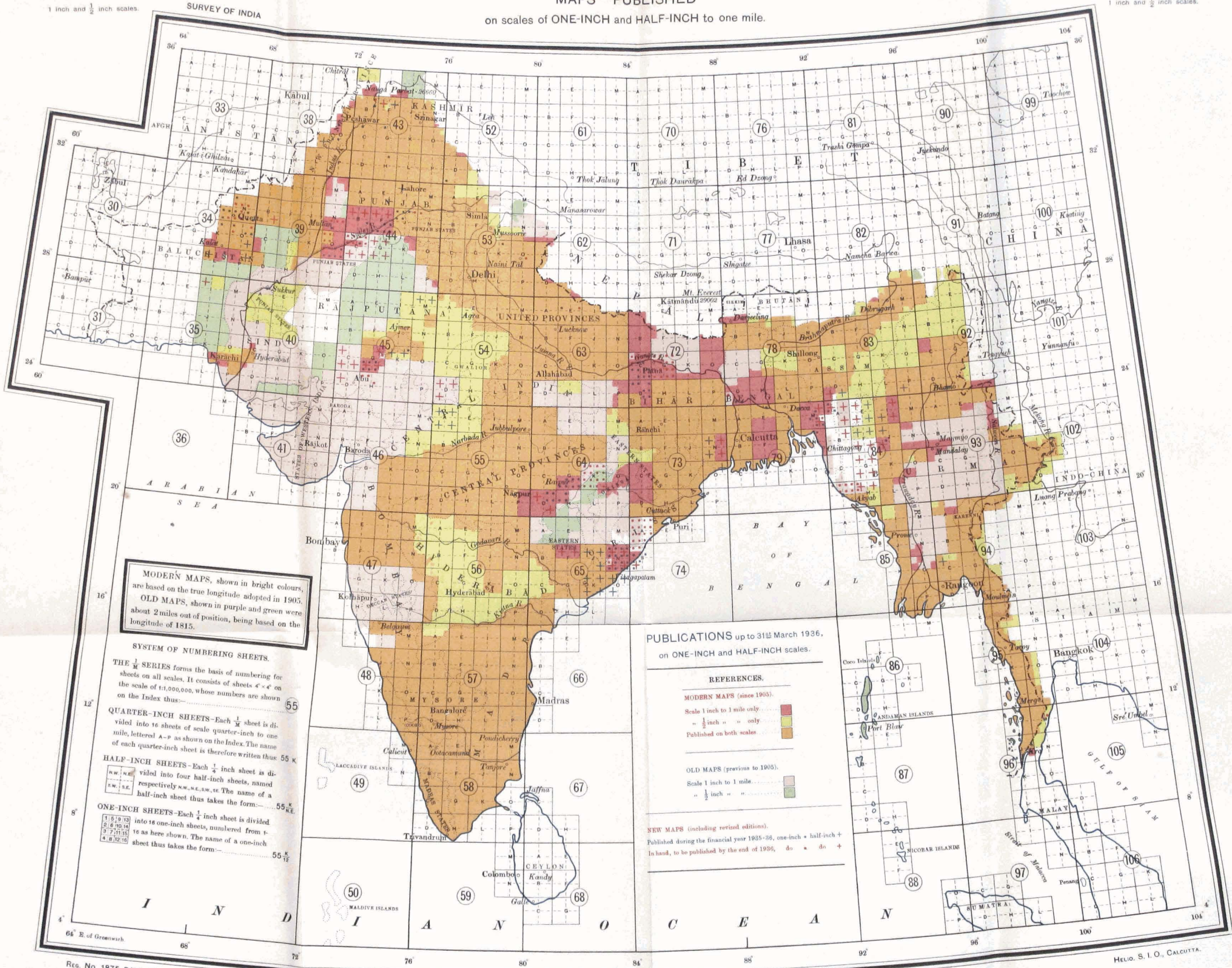
1 inch and 1/2 inch scales.

MAPS PUBLISHED

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

MAPS PUBLISHED

1 inch and 1/2 inch scales.



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 1/4 SERIES forms the basis of numbering for sheets on all scales. It consists of sheets 4" x 4" on the scale of 1:1,000,000, whose numbers are shown on the Index thus— 55
QUARTER-INCH SHEETS—Each 1/4 inch 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 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 K N.E.
ONE-INCH SHEETS—Each 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 K 12

PUBLICATIONS up to 31st March 1936, on ONE-INCH and HALF-INCH scales.

REFERENCES.
 MODERN MAPS (since 1905).
 Scale 1 inch to 1 mile only: [Red box]
 " 1/2 inch " " only: [Green box]
 Published on both scales: [Orange box]
 OLD MAPS (previous to 1905).
 Scale 1 inch to 1 mile: [Purple box]
 " 1/2 inch " " : [Green box]
 NEW MAPS (including revised editions).
 Published during the financial year 1935-36, one-inch + half-inch + in hand, to be published by the end of 1936, do. * do. +

Rec. No. 1875 D'25. 525.

HELO. S. I. O., CALCUTTA.

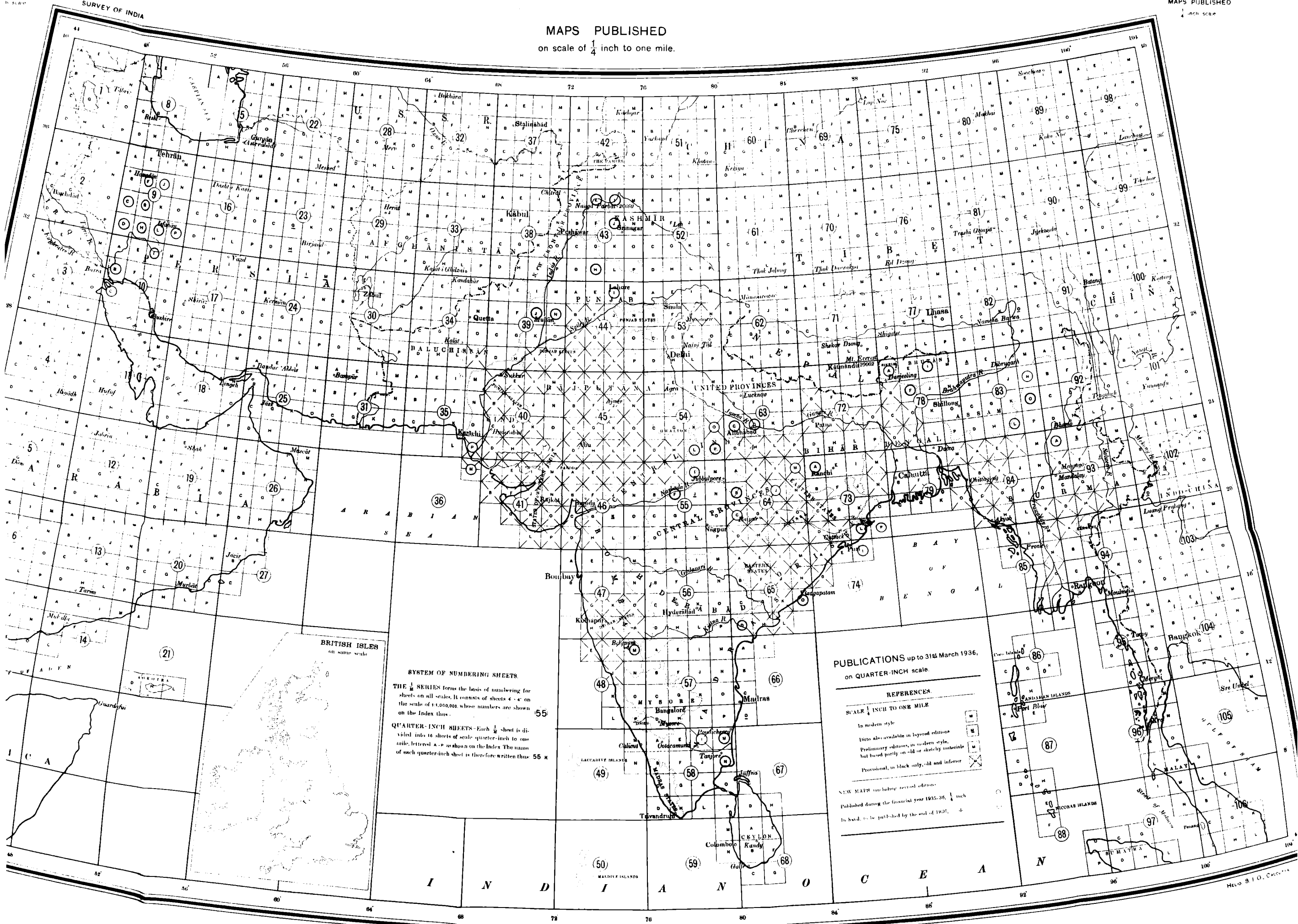


Published under the orders of Brigadier H. J. Couchman, D. S. O., M. C., Surveyor General of India, 1936.

SURVEY OF INDIA

MAPS PUBLISHED

on scale of 1/4 inch to one mile.



BRITISH ISLES

on same scale

SYSTEM OF NUMBERING SHEETS

THE 1/4 SERIES forms the basis of numbering for sheets on all scales. It consists of sheets 4' x 4' on the scale of 1:1,000,000, whose numbers are shown on the Index thus: 55

QUARTER-INCH SHEETS—Each 1/4 sheet is divided into 16 sheets of scale quarter-inch to one mile, letters 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 1936, on QUARTER-INCH scale.

REFERENCES

SCALE 1/4 INCH TO ONE MILE

- In modern style
- In older style
- Also available in larger editions
- Preliminary editions, in modern style, but based partly on old or sketchy materials
- Provisional, in black only, old and inferior

NEW MAPS (including revised editions):
 Published during the financial year 1935-36, 1/4 inch
 In hand, to be published by the end of 1936: 4

Scale of Index 1:12 Million.

INDEX TO THE MAPS OF THE
INDIA AND ADJACENT COUNTRIES SERIES

on the Scale of 1 Million or 1:104 inches to 16 miles.

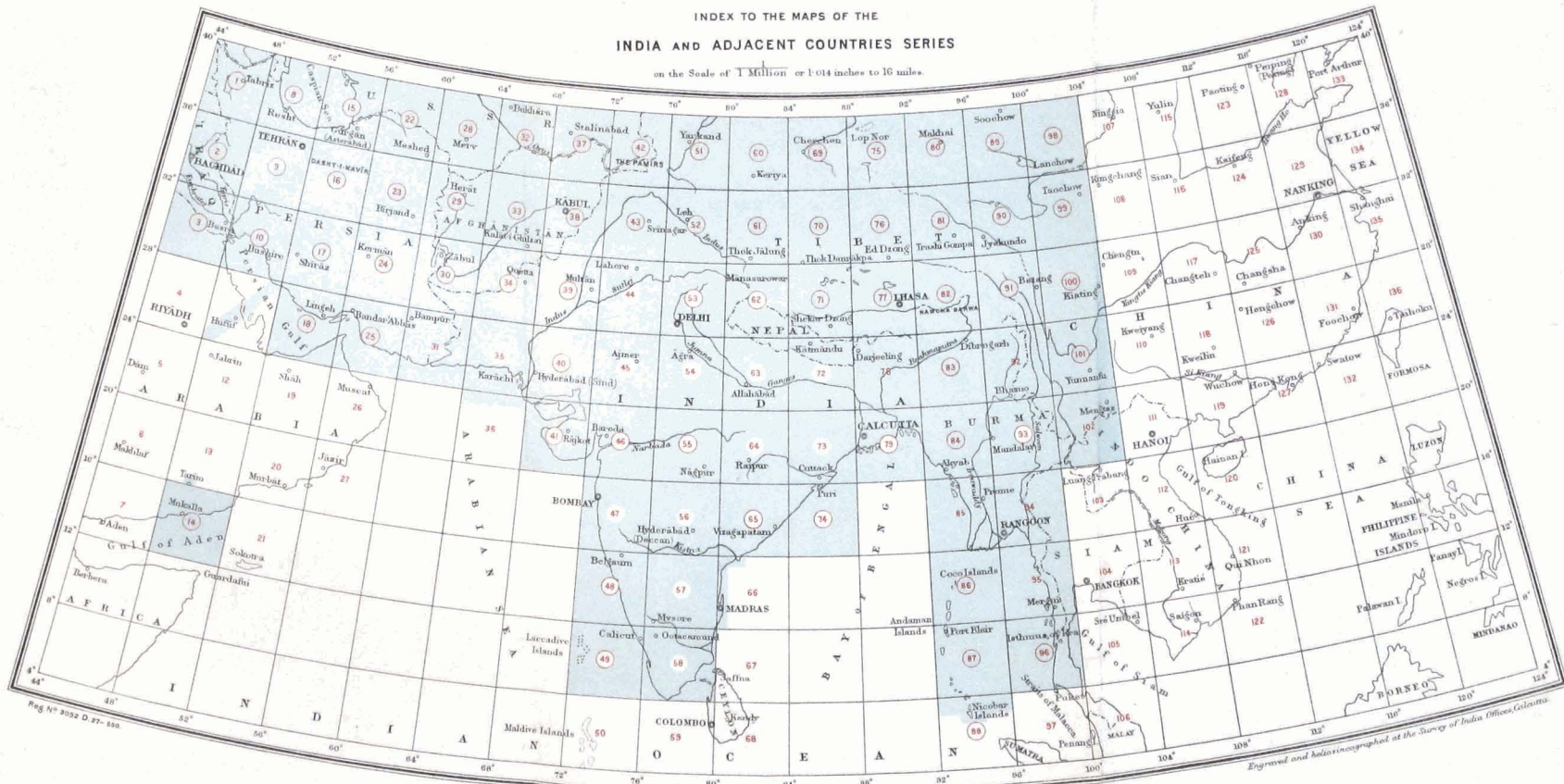


Fig No 3032 D 27-350

Engraved and heliogravured at the Survey of India Office, Calcutta.

Published under the direction of Brigadier H.J. Couchman, D.S.O., M.C., Surveyor General of India, 1936.

FOR THE YEAR 1935-36.

REFERENCE

Helio Engr.

Maps published Ordinary Edition only

.. .. Ordinary & Limited Editions

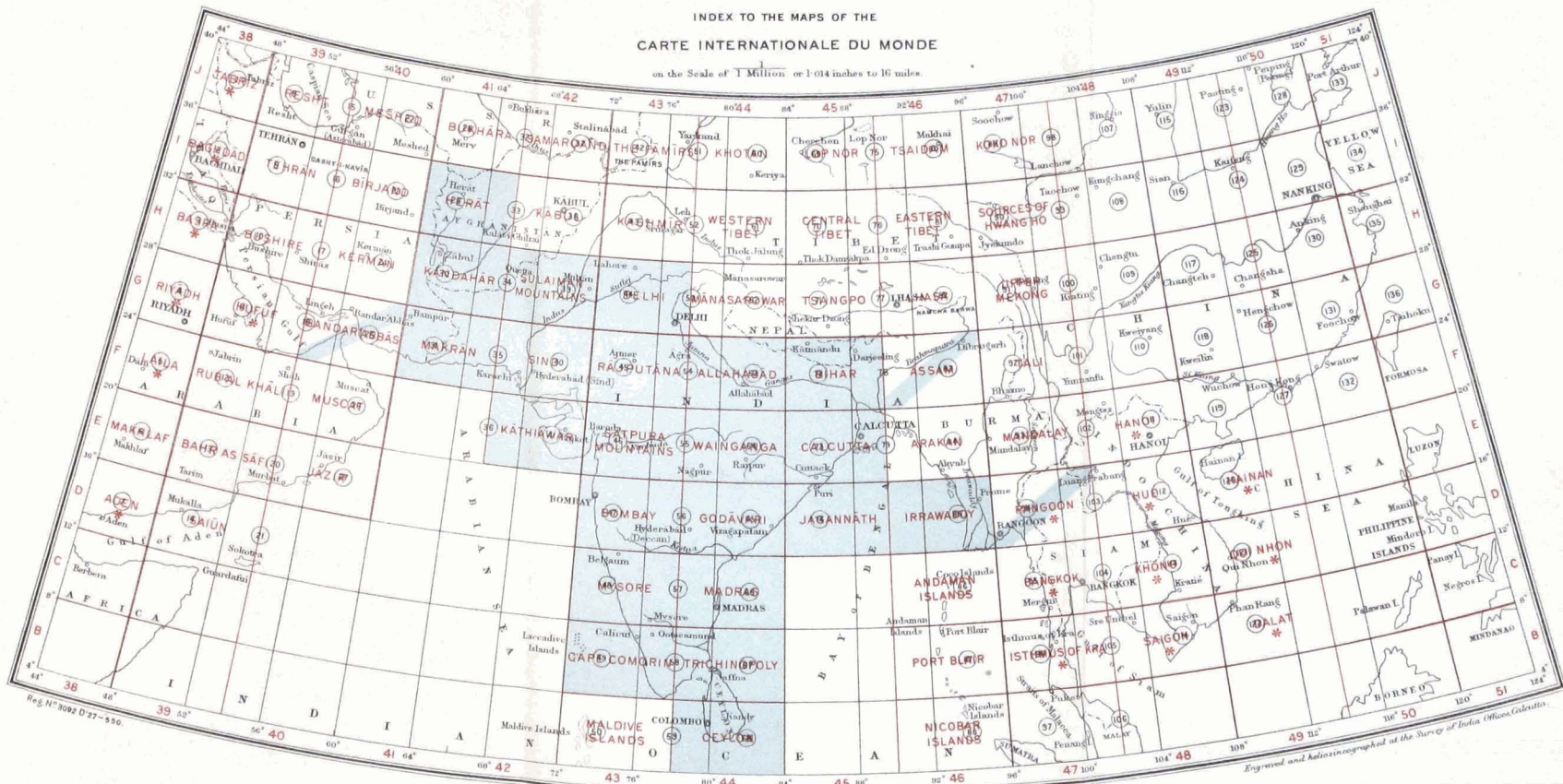
.. in hand



Sheets published during the financial year 1935-36—Rev. ed. 40, 55 and 57 & 66.

INDEX TO THE MAPS OF THE
CARTE INTERNATIONALE DU MONDE

on the Scale of 1 Million or 1:64 miles to 16 miles.



Published under the direction of Brigadier H.J. Couchman, D.S.O., M.C., Surveyor General of India, 1936.

Scale of Index 30 Million
Miles 0 200 400 600 Miles

FOR THE YEAR 1935-36.
REFERENCE

Maps published:
 in hand:
 published by other countries:

INDEX TO THE MAPS OF THE
SOUTHERN ASIA SERIES
ON THE Two Million SCALE



Reg. No. 2022 D. 27-550

Engraved and halotintographed at the Survey of India Office, Calcutta.

Published under the direction of Brigadier H. J. Conclunan, D.S.O.M.C., Surveyor General of India, 1936.

Scale of Index 40 Million



FOR THE YEAR 1935-36.

REFERENCE

	India	Engl.
Maps published (Ordinary & Layered Ed.)		
in hand		

Maps published during the financial year 1935-36—Gulf of Aden.

PUBLICATIONS AND ISSUES.

Table V. Stock of Maps. This table gives the stock of maps as it stood on 31st March 1936.

Class of maps.	CALCUTTA.				DEHRA DŪN.		SHILLONG.		SIMLA.		JHELMUM AND MURREE.		QUETTA.		MAYMYO.		BANGALORE.		RANGOON AGENCY.		TOTAL.	
	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.	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 ...	10,900	19,831	22	42	195	890	...	...	46	92	40	97	62	124	...	...	30	60	...	...	11,295	20,186
1/M India and Adjacent Countries ...	33,992	54,274	208	341	1,720	2,838	168	252	262	412	184	285	376	564	297	447	419	718	469	704	38,095	60,835
1/M Carte Internationale du Monde	3,685	7,588	15	30	121	242	50	100	43	86	12	24	18	36	...	...	53	153	52	110	4,049	8,369
Two-inch maps ...	10,852	81,399	...	...	7,990	16,614	351	628	...	...	...	...	...	...	...	...	...	...	...	...	19,198	48,636
One-inch maps ...	1,325,249	19,95,669	4,289	6,215	50,415	75,467	24,912	37,218	8,688	5,569	8,991	5,987	2,240	3,360	22,701	33,840	4,517	6,954	13,584	20,301	1,455,386	21,90,100
Half-inch maps ...	406,444	8,09,978	1,007	1,977	12,354	24,374	5,809	11,618	580	1,170	1,132	2,264	991	1,982	3,924	7,678	1,412	2,925	4,429	8,858	438,082	8,72,824
Quarter-inch maps ...	264,220	3,89,210	641	849	7,638	11,148	2,797	4,196	1,059	1,615	902	1,353	2,221	3,331	2,209	3,117	587	797	1,896	2,844	284,170	4,18,460
General maps of India ...	14,926	25,069	56	122	391	504	67	205	59	149	18	38	40	60	8	36	71	157	...	...	15,631	26,340
Provincial and District maps of India	5,939	18,112	24	84	299	748	635	1,045	44	136	17	29	5	5	14	21	52	247	...	...	7,029	20,422
Cantonment and Town maps (Special and Guide).	52,392	1,29,741	74	132	14,576	29,276	459	979	280	1,650	833	1,281	82	237	96	305	222	470	65	477	69,079	1,64,548
Manœuvre and Radius maps ...	7,120	16,472	9	25	114	245	...	...	16	39	114	204	...	...	79	140	95	203	...	...	7,547	17,328
Miscellaneous maps ...	78,154	85,514	16	144	5,990	6,848	172	128	486	850	24	56	73	146	6	6	27	14	2,878	4,335	87,626	97,836
TOTALS ...	2,213,873	35,82,357	6,311	9,961	101,803	1,68,504	35,320	56,864	6,563	11,768	7,267	11,618	6,108	9,845	29,329	45,090	7,485	12,698	23,128	37,629	2,437,182	39,45,894