SURVEYING FROM A MACHĀN. ORISSA.

SURVEY OF INDIA

GENERAL REPORT

1938

From 1st October 1937
To 30th September 1938

PUBLISHED BY ORDER OF

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

SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office,
Survey of India,
CALCUTTA,
1938.

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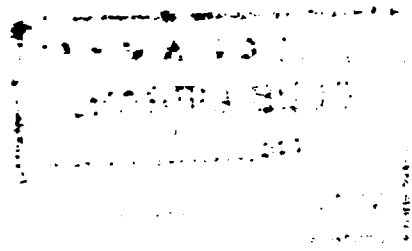

I. WORK DONE BY THE SURVEY OF INDIA

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

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

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

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

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

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

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

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* *Provinces and States in each Survey Circle.*

1. *FRONTIER Circle*
   Kashmīr and Jammu
   Gilgit Agency
   N. W. F. Province
   Baluchistān
   Punjab
   Punjab States
   Sind
   Bīkaner State (Rājputāna).

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

3. *No. 6 (SOUTH INDIA) Party.*
   Madras
   Madras States
   Hyderābād
   Mysore and Coorg
   Bombay (Southern Division).
   Deccan States.

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

5. *BURMA SURVEY Party.*
   Burma.

II. HOW TO OBTAIN MAPS AND OTHER PUBLICATIONS

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

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

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

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

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

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

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

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

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

III. LIST OF AGENTS FOR THE SALE OF MAPS

OUT OF INDIA.

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

INDIA.

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

(Continued Overleaf)

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

INDIA.—(*Concld.*)

Lahore.	40.	Standard Book Depot.
—(Concld.)	41.	Oxford Book & Stationery Co.
	42.	U. P. Malhotra & Co.
Lucknow.	43.	Lucknow Publishing House, The Mall.
Madras.	44.	Higginbothams Ltd.
Meerut.	45.	Oxford Book & Stationery Co.
Mhow.	46.	British Book Depot, Main Street.
Murree.	47.	J. Ray & Sons, The Mall.
Mussoorie.	48.	The Mussoorie Book Society.
Muzaffarpur.	49.	Burman & Co.
Nāgpur.	50.	The Superintendent, Govt. Printing, Book Depot.
Ootacamund.	51.	Higginbothams Ltd.
Patna City.	52.	K. P. Saxena & Co., Diwan Mohlla.
Peshāwar.	53.	Faqir Chand Marwah, Peshāwar Cantonment.
	54.	J. Ray & Sons, Arbab Road.
	55.	Sham Lal & Sons.
	56.	London Book Co. (India).
Poona.	57.	International Book Service, Deccan Gymkhana Colony.
Quetta.	58.	Standard Book Stall, Circular Road.
Rangoon.	59.	The Curator, Government Book Depot, Burma.
Rāwalpindi.	60.	J. Ray & Sons, 43 K & L Edwardes Road.
Simla.	61.	Oxford Book & Stationery Co.
	62.	Idandas Book Co., The Mall (Exchange).

PREFACE

THE HISTORY AND WORK OF THE SURVEY OF INDIA.

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

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

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

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

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

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

Precise levelling for the determination of heights;

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

The Magnetic survey;

Observation of the direction and force of gravity;

Astronomical observations to determine latitude, longitude and time;

Seismographic and meteorological observations at Dehra Dūn.

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

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

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

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

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

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

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

It was intended that this 1905 survey should be completed in twenty five years, and then revised periodically every thirty years. Owing however to the war and more recent retrenchments, rather over two thirds of the programme had been completed by 1938, in spite of the reduction of scale for the less important areas.

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

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

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

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

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

Forest and cantonment surveys;

Riverain, irrigation, railway and city surveys;

Surveys of tea gardens and mining areas, with such control levelling as is necessary for these operations.

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

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

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

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

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

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

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

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

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

CONTENTS.

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

1938

From 1st October 1937

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INTRODUCTION AND SUMMARY

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

The *Geodetic Report.*

The *General Report.*

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

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

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

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

2. General.—BRIGADIER C. G. LEWIS, O.B.E., held the post of Surveyor General.

The post of Assistant Surveyor General was held by LT.-COLONEL T. M. M. PENNEY, R.E., up to 29th March 1938, by CAPTAIN C. A. K. WILSON, R.E., up to 10th May 1938, by LT.-COLONEL E. O. WHEELER, M.C., R.E., up to 17th July 1938, and thereafter by MAJOR G. F. HEANEY, R.E.

3. The total cost of the Department for the year ending 31st March 1938, as compared with that of previous years, was as follows:—

	1935-36	1936-37	1937-38	Remarks.
	Rs.	*Rs.*	*Rs.*	
Gross actual cost ...	34,88,115(*a*)	35,66,128(*b*)	35,32,155†	(*a*) Including Rs. 54,396 for English Charges (High Commissioner) on Stores, and loss or gain by exchange.
Deduct recoveries ...	10,24,892	10,60,863	12,90,079†(*c*)	(*b*) Including Rs. 83,272 for do. do.
				(*c*) The increase in recoveries is due mainly to the entire cost of surveys in Burma having been paid for by that country since 1-4-37
Nett actual charges ...	24,63,223	25,05,265	22,42,076†	† These figures are not final.
	Square miles.	Square miles.	Square miles.	
Total area of survey of all kinds completed during the year.	57,036	37,670	38,559*	* *Vide* page 16

4. Organisation.—The designation of No. 10 (Burma) Party was changed to "Burma Survey Party, Survey of India" from the 1st October 1937.

The field survey section which was formed for employment with Wazirforce in June 1937 was disbanded on 15th December 1937 and its personnel were posted to No. 18 (Air Survey) Party, Survey of India.

The Government of India have sanctioned the creation of a temporary post of Chief Supervisor in the Mathematical Instrument Office on a pay of Rs. 400 per mensem for a period of sixteen months from 1st April 1938.

A detachment designated the "Lahore Survey Detachment" was formed with effect from the 1st August 1938 to undertake large scale survey of the Lahore urban area for the Punjab Government. The detachment has been placed under the administrative control of the Director, Frontier Circle.

5. Noteworthy events of the Survey year.—

Air Surveys.—At the request of the Estate Engineer, Bettiah Rāj Estate, Champāran, Bihār, the survey of about 10 square miles of Bettiah Town on the scale of 16 inches to 1 mile was undertaken.

A detachment of No. 5 Party has completed the fair drawing of the 12 sheets of the 16-inch Air Survey Map of Jamshedpur, covering an area of about 31 square miles, the air photography of which was carried out by the Indian Air Survey and Transport Company. The company had also laid down the traverse control, since the Jamshedpur town authorities had originally intended to carry out the mapping themselves. The detachment also carried out a rapid contour survey to delineate the drainage basin of the Dimna Nāla (near Jamshedpur) in connection with a water works scheme.

Conferences.—The Surveyor General attended a conference at Delhi which was held on the 14th and 16th December 1937 to determine the future policy of the Survey of India with regard to maps on the scale of 1/million.

Subject to confirmation by the Government of India, the conference accepted the departmental view that, with the object of accelerating production and of keeping these maps reasonably up to date, it was necessary to abandon the India and Adjacent Countries Series of 1/M maps and retain only the International Series. It was decided that maps of this series would be produced in three editions, International, Aeronautical, and Unlayered; the last would fulfil the functions of the abandoned I. & A. C. Series. The style and functions of the 1/M Provincial Map Series were also discussed and it was decided that one of the chief uses of these maps would be as road maps. The deliberations of the conference were chiefly devoted to matters of detail arising out of these changes.

LIEUT.-COLONEL T. M. M. PENNEY, R.E., Assistant Surveyor General, represented the Department as a member of the reception committee of the Indian Science Congress Jubilee Session in Calcutta. He also attended a meeting of the Geographical Section of the Congress on the 5th January 1938 when the teaching of geography in schools was discussed, and explained to the members the steps being taken by the Survey of India for the supply of maps to educational institutions.

6. Explorations.—MR. ERIC SHIPTON and MR. MICHAEL SPENDER arrived at Dehra Dūn from their expedition to the Karakoram and Shaksgam regions in October 1937. Their work, in which they were assisted by MR. TILMAN and by MR. AUDEN of the Geological Survey of India, includes about 1,200 square miles of plane-table survey on the half-inch scale and 800 square miles of reconnaissance survey and single picture photo-survey from ground stations. The Aghil pass was crossed and mapped, and a major glacier north of the main watershed was explored to its head, while several new passes were found and crossed. MR. SHIPTON proceeded to England, but MR. SPENDER remained at Dehra Dūn for about 4 months compiling, plotting, and adjusting the surveys, which will be embodied in quarter-inch sheets 42 P, 43 M, 51 D and 52 A.

The original survey records of SURVEYOR ASGHAR ALI, who was deputed during June 1937 to accompany COLONEL R. C. F. SCHOMBERG'S Expedition to explore the area lying to the east and north-east of Leh, have been received and are being embodied in ¼-inch sheets 52 M and 52 N.

MR. F. LUDLOW'S route report and sketches of his expedition in Tibet, 1935, falling in ¼-inch sheets 82 H and 82 L, have been received and adjusted with the adjoining details.

The original records of Mr. RONALD KAULBACK'S Survey in Tibet, falling in 1/M sheets 82 and 91, carried out in 1935-36, have been received and are being incorporated in 1/2M Yunnan sheet.

DR. WILHELM FILCHNER, the German explorer, arrived at Dehra Dūn *via* Leh, on the 8th October 1937 after his adventurous expedition through Turkistān, in the course of which he and his interpreter HERR HAACK were held as prisoners in Khotan for seven months. He also visited the Headquarters offices in Calcutta on 22nd October 1937 before returning to Dehra Dūn where he undertook the compilation of the results of his journey which included magnetic observations, astronomical and wireless positions, route surveys, &c. A lecture on his last two expeditions to Mongolia was delivered by him at the Dehra Dūn Club on the 3rd December 1937, illustrated by lantern slides prepared from his photographs at the Geodetic Branch Office. In his lecture he thanked the Survey of India for the assistance given him and the Director, Geodetic Branch for helping him to translate and prepare his lecture. DR. FILCHNER left Dehra Dūn on the 22nd December 1937 for Germany.

SURVEYOR K. S. LOVERWELL was deputed from October to December 1937 to accompany the punitive expedition under the Deputy Commissioner, Nāga Hills District, to Nokhu and other villages, and carried out survey operations on half-inch scale in Control and Tribal areas adjoining Nāga Hills district of Assam.

7. Adventures and Casualties.—The Surveyor General deeply regrets to record the following deaths:—

COLONEL E. T. RICH, C.I.E., late R.E. and formerly Director, Survey of India, who died in London at the age of 63.

LIEUT.-COLONEL F. C. HIRST, I.A., of the old Imperial Service of the Survey of India, (transferred to the Govt. of Bengal in 1914) who died on 19th May 1938 in London at the age of 63.

RAI BAHADUR LAL SINGH, late Sub-Assistant Superintendent, who died in Gujrānwāla district on 31st May 1938 at the age of 75.

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

LIEUTENANT L. H. WILLIAMS, R.E., while employed on triangulation in Sikkim was struck by lightning at about 2 A.M. on the 12th September 1938 when camped at Endong peak, at a height of about 12,000 feet. The lightning set fire to his sleeping bag and his left arm was severely burnt before MR. ABDUL AHAD, who was fortunately in the same camp, was able to rescue him with the help of some khalasis. LIEUTENANT WILLIAMS was at once removed to Darjeeling and admitted to the Eden Hospital for treatment.

SURVEYOR IQBAL MUHAMMAD employed on traverse work was struck by lightning on May 2nd 1938 while at work in Pegu District, Burma. He was severely burnt and had to be removed to hospital immediately; but has since made a complete recovery.

A Burman coolie while out at work with a traverser on 12th April 1938 in the jungle in Pegu District, Burma was killed by a tiger. His body was found the next day.

8. Distinguished visitors.—On 26th December 1937 the delegates from the British Association to the Indian Science Congress Jubilee Session visited Dehra Dūn. A party of about twenty, including SIR JAMES JEANS, the President, spent the morning at the Survey of India Offices, and were entertained to lunch, after which they motored up to Mussoorie. A party of delegates also visited the Survey of India Latitude Variation Observatory at Āgra on December 23rd.

The HON'BLE SIR GIRJA SHANKAR BAJPAI, K.B.E., C.I.E., I.C.S., Secretary to the Government of India, Department of Education, Health and Lands, visited the Geodetic Branch offices at Dehra Dūn on the 19th April 1938.

MR. M. W. YEATTS, C.I.E., I.C.S., Joint Secretary to the Government of India, Department of Education, Health and Lands, visited the Mathematical Instrument Office on the 17th March 1938 and the Photo.-Litho. Office on the 18th and discussed matters connected with the organisation of those offices.

The members of the Geographical Section of the Indian Science Congress Jubilee Session visited the headquarters offices at Calcutta on the 7th January 1938 and were shown round the Mathematical Instrument Office and the Photo.-Litho. Office. Several articles manufactured in the Mathematical Instrument Office were exhibited.

9. Awards and Appreciations.—His Imperial Majesty The King, Emperor of India, has been graciously pleased to give orders for the following appointment to the Most Excellent Order of the British Empire:—

CAPTAIN J. B. P. ANGWIN, R.E.—To be M.B.E. Fifth Class in the Military Division in recognition of his services in the Wa States in connection with the Sino-Burmese Boundary Commission, 1935—37.

His Excellency the Governor of Burma has awarded a certificate of honour and a silver watch to each of the following officers of the Department in recognition of the services rendered by them in the Wa States in connection with the operations of the Sino-Burmese Boundary Commission, 1935—37:—

(1) MR. ABANI KUMAR SEN GUPTA, Sub-Assistant Superintendent.
(2) MR. UMA DAT MAMGAIN, Sub-Assistant Superintendent.
(3) SURVEYOR SHIROMANI SHARMA.
(4) SURVEYOR MAUNG THEIN.

The name of SURVEYOR KHUSHAL SINGH has been specially brought to the notice of his Excellency the Governor of Burma for similar services.

The Government of India have sanctioned the grant of a special increment of Rs. 30 per mensem to MR. U. D. MAMGAIN with effect from the 1st August 1937 as a reward for meritorious service in the Wa States, with the Sino-Burmese Boundary Commission.

SUB-CONDUCTOR A. E. NORMAN, Draftsman, No. 6 Drawing Office, has been awarded the Long Service and Good Conduct Medal (Military) without gratuity.

The following letter has been received by the Director, Geodetic Branch, from SIR JAMES JEANS, the President of the Indian Science Congress Jubilee Session:—

"May I be allowed to thank you most sincerely, in the name of the visiting British and foreign scientific delegates, for the generous aid which you extended to the party. We have first to express our gratitude for the opportunity afforded to some of us to visit the Latitude Variation Observatory at Āgra, where MR. MATHUR was most kind and helpful. We have further to thank you for your generous hospitality in Dehra Dūn, and for the most interesting visit which you enabled us to pay to the Geodetic Branch."

The following is an extract from a letter of appreciation received by the Director, Geodetic Branch, from the General Secretary, Indian Science Congress Association:—

"The Executive Committee of the Indian Science Congress Association at its meeting held in Calcutta on January 31st unanimously recorded a hearty vote of thanks to you expressing their grateful appreciation of the excellent arrangements made in connection with the visit to Dehra Dūn and Mussoorie of the British and non-British delegates invited from abroad to attend the Silver Jubilee Session of the Congress.

I should mention in this connection that I received great help from MR. MATHUR of the Latitude Variation Observatory, Āgra, on the occasion of the visit of the party to the observatory."

The following is the text of a letter of appreciation from the Secretary to the Hon'ble the Resident for the Punjab States, Lahore:—

"I am directed to state that the Hon'ble the Resident has been authorised by his Excellency the Crown Representative to convey to CAPTAIN D. R. CRONE his appreciation of his services rendered by him in connection with the demarcation of the Sirmūr-Jubbal boundary. His work was well done in accordance with the orders conveyed to him and his report was a particularly able and thorough one, while his comments on the Sirmūr Memorandum were equally admirable."

The following letter has been received by the Officer Commanding 'E' Company from the Commandant, Staff College, Quetta:—

"I am very grateful for the assistance you gave us in the recent Intelligence Exercise. Your lecture and your subsequent discussions with students were most valuable.

I understand that other officers of the Survey of India helped you in your preparatory work and I should be glad if you would convey my thanks to them also."

The following is the text of a letter of appreciation received by the Officer in charge, No. 18 Party, from the Political Agent, Dīr, Swāt and Chitrāl Agency, Malakand:—

"I am writing to inform you that MIAN CHIRAGH SHAH of the Survey Department has carried out the triangulation in Dīr State limits according to plan. It is regretted that he encountered innumerable difficulties including the removal of his bench marks by the tribes, &c. He however exercised considerable tact and I consider that his work and perseverance is deserving of special credit, and that it should be brought to the notice of the Director General."

The following is an extract from a letter received by the Officer in charge, No. 12 Party, from the Deputy Commissioner, Nāga Hills district,

Assam, appreciating the work of SURVEYOR K. S. LOVERWELL accompanying the punitive expedition to Nokhu and other villages under him during 1937:—

"SURVEYOR K. S. LOVERWELL has been of the greatest assistance to MAJOR GERTY and myself during the recent transfrontier tour. Throughout he has shown the utmost energy and keenness and the revised maps will in future be extremely useful. It would have been impossible to choose a better man for the work."

His Excellency the Governor of Assam and the Government of India have also appreciated the surveyor's work.

The following is the text of a letter received by the Director, Eastern Circle, from the Chief Town Administrator, the Tata Iron and Steel Coy., Ltd., Jamshedpur, in connection with the Aerial Survey of Jamshedpur:—

"We hereby wish to place on record our appreciation of the efficient and expeditious manner in which the Survey Party under MR. MUZAFFAR HUSSAIN carried out the survey of Jamshedpur town and also thank the Printing and Lithographing Department for the quick production of both the proof and final copies of the Jamshedpur Survey maps."

In a German Broadcast reported by the British Broadcasting Corporation on the 8th February 1938, DR. FILCHNER acknowledged the help he had received from the officers of the Survey of India during his travels last year.

The following is an extract from a letter of appreciation received by the Officer in charge, Map Record and Issue Office, from the Chief Engineer, Indian Posts and Telegraphs Department, New Delhi:—

"I have the honour to convey the thanks of the Director General to you for the great trouble taken by you and your office to produce a really satisfactory Telegraph Map of India."

10. Mathematical Instrument Office.—Two sets of Hardy Type Boundary Friction Oil Testers and one Bearing Metal Brinell Hardness Testing Machine were made up in compliance with the demand received from the Chief Controller, Standardization, Central Standard Office for railways, New Delhi/Simla, for issue to the Test House, Alipore and the University Chemical Laboratory, Lahore.

One steel straight-edge, 10 feet long, 4 inches wide and 1 inch thick, was trued up for the Howrah Bridge Commission. This was done by the auto collimation method and the greatest error over the whole length was found to be less than half of one thousandth of an inch (*i.e.* ·0005).

Four large steel set squares were completed for the New Howrah Bridge Commissioners. These set squares were 4½ ft., 3 ft. 2½ ins., 2½ ft., and 1 ft. 9½ ins., respectively.

One Test Type Apparatus and one Sterilizer were manufactured and supplied to the Eye Infirmary, Medical College Hospitals, Calcutta.

One Neon Tube Ignition Indicator was made up and supplied to the Superintendent, Government Test House, Alipore.

One Lummer Brodhum Photometer Head was made up for the Executive Engineer, Electrical Division, Calcutta.

One Fibre Rigidity Tester and two Ballastic Fibre-Strand Testers were made up and supplied to the Indian Central Jute Committee, Calcutta.

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

Class I Officers.—COLONELS S. W. S. HAMILTON, D.S.O., and C. M. THOMPSON, I.A., retired.

COLONEL F. J. M. KING, granted leave preparatory to retirement.

LT.-COLONEL F. B. SCOTT, I.A., promoted to Colonel.

LT.-COLONEL L. H. JACKSON, I.A., promoted to Bt.-Colonel.

CAPTAINS J. B. P. ANGWIN, M.B.E., R.E., D. R. CRONE, R.E., and H. W. WRIGHT, R.E., promoted to Major.

LIEUTENANTS J. S. O. JELLY, R.E., C. A. BIDDLE, R.E., D. E. O. THACKWELL, R.E., D. M. CLEMENTI, R.E., and R. T. L. ROGERS, R.E., promoted to Captain.

LT.-COLONELS F. B. SCOTT, I.A., and L. H. JACKSON, I.A., promoted to Director.

CAPTAINS I. H. R. WILSON, R.E., and R. H. SAMS, R.E., promoted to Superintendent.

LIEUTENANTS GAMBHIR SINGH, I.A., RAJINDER SINGH KALHA, I.A., D. M. CLEMENTI, R.E., R. T. L. ROGERS, R.E., and L. H. WILLIAMS, R.E., joined the Department as Assistant Superintendents (on probation).

Class II Officers.—MESSRS. P. C. MITRA and F. C. PILCHER retired.

Miscellaneous appointments.—General Central Services, Class II.—MR. S. COLQUHOUN, granted extension of service for one year.

RAI SAHIB G. M. DHARA, granted leave preparatory to retirement.

CAPTAIN (DEPUTY COMMISSARY) T. A. WHITMARSH of the Survey Section, I. U. L., promoted to Major (Commissary).

Upper Subordinate Officers.—MR. B. B. SHOME retired.

MR. C. H. FERNANDEZ resigned.

II. ABSTRACT OF SURVEYS IN EACH PROVINCE AND STATE.

12. The primary survey 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 localities of the field operations carried out by the department during the past year, grouped under the following sub-heads:

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

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

13. Assam.

Framework. Triangulation and traverse in Gāro Hills and Goālpāra districts (p. 47).

Geodetic. Gravity repeat observations at 2 stations (p. 13). Primary triangulation, re-observations of old stations of the Assam Longitudinal Series between Gauhāti and Goālpāra (p. 14).

Topographical surveys in the Control and Tribal areas adjoining Nāga Hills district (p. 48).

14. Baluchistān.

Geodetic. Gravity observations at 20 stations including 1 repeat station (p. 13).

Topographical surveys in Kalāt and Las Bela States (p. 36).

15. Bengal.

Framework. Triangulation and traverse in Bogra, Dināj pur, Mymensingh, Rājshāhi, and Rangpur districts and Cooch Behār State (p. 47).

Geodetic. Gravity observations at 4 stations including 3 repeat stations (p. 13). Reconnaissance for a primary traverse in Jessore and Faridpur districts (p. 14).

Topographical surveys in Chittagong and Noākhāli districts and Chittagong Hill Tracts (p. 47).

16. Bihār.

Air survey in Bettiah town (p. 45).

Framework. Traverse in Bettiah town, and Champāran, Muzaffarpur and Sāran districts (p. 45).

Geodetic. Gravity repeat observation at 1 station (p. 13).

Levelling in Bettiah town (p. 45) and Champāran, Muzaffarpur and Sāran districts (p. 45). High precision levelling from Katghora to Daltonganj (p. 14).

Topographical surveys in Bhāgalpur, Darbhanga and Purnea districts (p. 44).

17. Bombay.

Framework. Triangulation and traverse in Belgaum, Bijāpur, Dhārwār and North Kanara districts (p. 51).

Topographical surveys in Broach and Pānch Mahāls district (p. 40).

18. Burma.

Framework. Triangulation and traverse in Henzada, Pegu, Prome, Tharrawaddy, Thaton, Thayetmyo, Toungoo and Yamethin districts (p. 53).

Geodetic. Latitude observations at 48 stations (p. 13). Longitude observations at 42 stations (p. 13).

Topographical surveys in Akyab district (p. 47); in Toungoo and Yamethin districts, and Karenni and the Southern Shan States (p. 53).

19. Central India.

Topographical surveys in Indore and Jhābua States (p. 40). Survey for a military training map at Bhopāl (p. 41).

20. Central Provinces and Berār.

Framework. Triangulation in Chānda district (p. 47).

Levelling. High precision levelling (*i*) from Akola to Nāgpur (*ii*) from Nāgpur to Raipur and (*iii*) from Katghora to Daltonganj and Raipur to Bilāspur, and (*iv*) from Raipur to Pāl Lahara (p. 14).

Topographical surveys in Raipur district (pp. 46, 47, 50).

21. Delhi.

Geodetic. Gravity repeat observation at one station (p. 13).

22. Deccan States.

Framework. Triangulation in Kolhāpur, Jamkhandi, Mudhol, Aundh, Sāngli, Kurandvād, Rāmdurg and Jath States (p. 51).

23. Eastern States.

Framework. Triangulation in Bastar State (pp. 47, 51).

Levelling. High precision levelling (*i*) from Katghora to Daltonganj (*ii*) from line Nāgpur to Raipur and (*iii*) from Raipur to Pāl Lahara (p. 14).

Topographical surveys in Patna State (p. 46); in Bastar State (p. 50).

24. Gujarāt States.

Topographical surveys in Sant, Sanjeli and Bāria States (p. 40).

25. Madras.

Topographical surveys in East Godāvari, West Godāvari and Kistna districts (p. 50).

26. N. W. F. Province.

Air surveys in North and South Wazīristān Agencies (p. 37).

Cantonment and city surveys. Survey and resurvey of Mardān, Peshāwar, Risālpur and Syce Mandi (Risālpur) Cantonments (p. 42).

Framework. Triangulation in Dīr State (p. 37). Traverse in Dera Ismāil Khān district (p. 35).

27. Orissa.

Framework. Triangulation in Koraput district (p. 51).

Levelling. High precision levelling from Raipur to Pāl Lahara (p. 14).

Topographical surveys in Koraput district (pp. 46, 50) and in Sambalpur district (p. 46).

28. Punjab.

Framework. Traversing and levelling for Cantonment survey of Siālkot Cantonment (p. 43). Traversing in Dera Ghāzi Khān, Miānwāli and Muzaffargarh districts (p. 35).

Geodetic. Gravity observations at 9 stations (p. 13).

Riverain surveys in Jhelum district (p. 35).

Topographical surveys in Dera Ghāzi Khān, Muzaffargarh and Kāngra districts (p. 34).

29. Punjab States.

Geodetic. Gravity observations at 5 stations (p. 13).

Topographical surveys in Mandi State (p. 34) and in Tehri-Garhwāl State (p. 39).

30. Rājputāna.

Geodetic. Gravity observations at 14 stations (p. 13).

Topographical surveys in Bānswāra, Dūngarpur, Jodhpur (Mārwār), Kushālgarh and Udaipur (Mewār) States (p. 40).

31. Sind.

Air survey in Karāchi district (p. 36).

Framework. Triangulation for the provision of ground control, and the collection of ground information for air survey in Karāchi district (p. 36). Traversing and levelling for Cantonment survey of Drigh Road (p. 43).

Topographical surveys in Dādu and Karāchi districts (p. 36) and in Thar Pārkar district (p. 40).

32. States of Western India.

Topographical surveys in the Rann of Cutch (p. 40).

33. United Provinces.

Cantonment and city surveys in and around Dehra Dūn (p. 41).

Miscellaneous. 128-inch extra-departmental survey in Dehra Dūn (p. 42).

Topographical surveys in Garhwāl district (p. 39) and in Sahāranpur and Dehra Dūn districts (p. 41).

PART 2.—GEODETIC WORK.

III.—ABSTRACT OF GEODETIC OPERATIONS.

DIRECTOR:—{Colonel C. M. Thompson, I.A., to 20-7-38.
{Lt.-Colonel E. O. Wheeler, M.C., R.E., from 21-7-38.

34. 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. 70—74).
Cantonment Surveys (paras. 75—79).
Training School (paras. 124—126).

35. 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 1938.

36. Observatory Section.—The usual magnetic, seismographic and meteorological observations have been carried on, and the record of the longitude of Dehra Dūn has been maintained by bi-weekly transit observations.

The first year's observations of latitude variation at Āgra show the same surprisingly large amplitude as was found at Dehra Dūn.

37. Computing Section.—The readjustment of the primary and secondary triangulation has been completed so far as it is at present intended to take it. Revised values of scale, azimuth and position have been obtained at 100 series' junctions, between which the separate series will be adjusted when the new adjustment is made the basis of the survey. This change is likely to be postponed until circumstances make it possible to adopt the International spheroid instead of Everest's, which is unlikely to happen for very many years to come. Results in Assam and Burma are still provisional.

The probable errors of the primary and secondary triangulation have been investigated. It is concluded that the length and breadth of India have been measured with probable errors of about 1 part in 500,000, or of 20 feet in 2,000 miles.

The field work of the Latitude and Longitude detachment of No. 14 Party, and of the Triangulation detachment of No. 15 Party has been computed.

Investigations have been made regarding the anomalies of magnetic force associated with underground bodies of magnetic rock.

Hayford anomalies have been computed at 200 latitude, longitude and azimuth stations.

The following publications have been prepared for the press:—

(*a*) Geodetic Report 1937.
(*b*) Professional Paper No. 28. "The Readjustment of the Indian Triangulation".
(*c*) Professional Paper No. 29. "Magnetic Anomalies".

38. Tidal Section.—The tide-tables of the Indian Ocean for 1939 for 68 ports were prepared and published in September 1938. Predictions for Perim have been discontinued.

Automatic tidal registrations were continued at Aden, Karāchi, Bombay, Vizagapatam, Dublāt, Calcutta, and Rangoon. The observatory at Aden was damaged by a storm on the 1st July 1937. It was repaired and restarted on the 9th July. In addition, daylight tide-pole readings of high and low water were continued at Bhāvnagar, Chittagong, and Akyab.

At the request of Morvi State, an analysis of one year's observations at Navlakhi has been undertaken on payment and predictions for this port will be included in the annual tables for 1940.

The routine methods of prediction have been overhauled, and the strength of the section has been reduced.

39. Latitude and Longitude.—(No. 14 Party).—Observations for latitude or longitude (generally both) were made with the prismatic astrolabe by Major D. R. Crone, R.E. at 49 stations along a line running southwards from near Mandalay to near Victoria Point. The existence of a very large southerly rise of the geoid in this area is confirmed. The system of work was the same as that employed in previous years. Transport was by motor lorry, and by boat south of Mergui.

The longitude observations contribute to the formation of three new Laplace stations.

40. Gravity Observations.—(No. 14 Party).—Observations to determine the force of gravity were made at 48 stations in Bengal, South-west Baluchistān, the Punjab, and Rājputāna. Two old stations in Baluchistān and Delhi were also reobserved. The observer was Mr. M. N. A. Hashmie.

In Baluchistān and between Bīkaner and Bahāwalpur transport was in two hired motor lorries. The latter journey, across the desert, was accomplished with some difficulty. Elsewhere transport was by rail.

At the beginning of the season, 6 of the previous season's stations in Assam, Bengal and Bihār were revisited to trace changes which had then occurred in the lengths of the pendulums. The changes were satisfactorily located.

Spirit levelling was carried from Bahāwalpur to Bīkaner to provide heights for the pendulum stations, which would otherwise have been unobtainable.

In co-operation with the Geological Survey and the Burmah Oil Company, investigations are in hand regarding the effect of known geological abnormalities on the intensity of gravity.

41. Triangulation.—(No. 15 Party).—The triangulation programme this year consisted of the re-observation of old triangles of the Assam Longitudinal Series between Gauhāti and Goālpāra. It was found in 1934, when the new series running eastwards to the Nāga Hills was commenced, that the angles then observed west of the starting side did not agree with the old values observed prior to 1860. It was, therefore, supposed that the stations in this area had been disturbed by the 1897 earthquake, and this year's observations were made for the purpose of connecting the new series with the undisturbed part of the old series further to the west.

The area covered by this year's work included the south edge of the Khāsi-Gāro plateau and the flat swampy ground on both sides of the Brahmaputra. Tower stations were unnecessary as numerous small wooded hills exist in this part of the Brahmaputra valley.

The monsoon continued late this year and there was much fog, especially near the river. As, however, the sides were short, averaging about 15 miles or less, observations were able to proceed even in bad weather conditions. East to west communications were good, as the Assam Trunk Road runs parallel to the series. Once away from the road a little difficulty was experienced, and local inhabitants in the plains area were occasionally unwilling to help.

The detachment consisted of Captain C. A. K. Wilson, R.E., in charge, with computer Padam Singh recording, while Mr. G. S. Sidhu (U. S. S.), assisted by computer S. C. Dhar performed reconnaissance and station building duties. 55 inferior servants were employed.

It was found that many of the old stations had been completely destroyed by the local inhabitants. These were on low hills much used for grazing and cultivation.

The health of the detachment was better than might have been expected in this very unhealthy area and there were only a few cases of malaria.

Observations commenced on October 27th and were concluded on December 16th. 13 stations were occupied, using the Precision Wild Theodolite No. 59, with an average triangular error of 0·64 seconds.

Mr. P. K. Chowdhury (U. S. S.) with 7 inferior servants reconnoitred the route proposed for a primary traverse to replace the old East Calcutta Longitudinal Series.

42. Levelling of High Precision.—(No. 15 Party).—Out of the total length of 15,800 miles proposed for the new geodetic level net of India, 10,023 miles have been completed up to date, 593 miles having been done in the back direction during 1937-38 in the lines from (i) Katghora to Daltonganj, and Raipur to Bilāspur, (ii) Nāgpur to Raipur and (iii) Akola to Nāgpur.

During 1937-38, 266 miles of single levelling for the new geodetic level net were also carried out in the fore direction from Raipur to Pāl Lahara.

PART 3.—TOPOGRAPHICAL WORK.

IV.—ABSTRACT OF TOPOGRAPHICAL WORK.

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

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

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

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

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

44. 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 1938, rather over half the total area of India having been completed on that scale. In 1913, when it was realized that for various reasons it would be impossible to complete the 1-inch surveys in the time allotted, a scheme for the reduction of the scale of survey in the less populous areas was sanctioned by the Secretary of State.

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

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

Original surveys in India since 1931, the year of retrenchment, have been carried out at the rate of about 36,000 sq. miles per annum; on this basis, some 13 years are still required to complete the programme.

The average out-turn for Burma has been about 4,500 square miles and the area remaining for survey is 58,607 square miles which represents at above rate another 13 years' work.

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

Table A.—Progress of Topographical Surveys since 1905.

Survey years.	1-inch and larger scales.	¾ and ½-inch scales.	⅜ and ¼-inch scales.	TOTALS.	REMARKS.
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Sq. miles.*	
1905—35 ...	994,757	230,718	25,929	1,251,404	Areas in India and Burma.
1935—37 ...	33,476*	38,291	15,706	87,473*	Areas in India and Burma.
1937-38 ...	**15,806**	**12,356**	**3,313**	**31,475**	Area in India only.
Totals to 1938 ...	**1,044,039***	**281,365**	**44,948**	**1,370,352***	.....
Deduct areas for Burma to 1937	**155,148**	**43,555**	.....	**198,703**	.....
Totals for India to 1938 ...	**888,891***	**237,810**	**44,948**	**1,171,649***	*Revised figures.
	approximately.	*approximately.*	*approximately.*		
Balance remaining for India ...	*180,000*	*170,000*	*100,000*	*451,392*	.....
Total programme for India ...	.....	.....	.....	**1,623,041**	.....

Progress of Topographical Surveys in Burma since 1905.

1905—37 ...	155,148	43,555	.....	198,703	.....
1937-38 ...	**3,954**	**456**	.....	**4,410**	.....
Totals for Burma to 1938 ...	**159,102**	**44,011**	.....	**203,113**	.....
Balance remaining for Burma ...	.....	.....	.....	*58,607*	.....
Total programme for Burma ...	.....	.....	.....	**261,720**	.....

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

India 1937-38 ...	**2,647**	**27**	.....	**2,674**	.....

Note. No resurveys or revision surveys were done in Burma in 1937-38.

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

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.**
'A' Company.—								
Undulating sandy plain ...	1-inch **Traverse** ...	39 I, M ...	385 linear miles.	115·5 linear miles.	3·0 per	3·0 linear	**6·0** mile.	No. 6 D. O. costs for examination and preparation of colour patterns of this unit:—Rs. 2,579.
Alluvial river banks ...	..... **Settlement Traverse**	43 D, G, H ...	216 linear miles.	78·0 linear miles.	11·4 per	6·0 linear	**17·4** mile.	
Flat cultivated plains ...	**1-inch** Resurvey ...	39 J ...	2,054	31·5	12·4	11·0	**23·4**	
Medium broken hills rising to 5,000 feet.	**1½-inch** Resurvey ...	53 A ...	253	5·4	56·5	(*a*)	.....	(*a*) Fair drawing in hand.
Fair mapping ...	**1-inch** Correction survey	38 P, 44 E ...	2,277	.....	.....	(*b*)	(*b*)	(*b*) Mapping covers more than one survey year, so no cost can be given.
	1-inch Correction survey	38 P, 43 D ...	1,504	.....	.....	(*c*)	(*c*)	(*c*) In hand.
	1½-inch Resurvey ...	53 A ...	254	.....	.....	(*b*)	(*b*)	

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

Party.	Class of work.		Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
						Field work.	Mapping or computations.	Total.	
				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** *Contd.*
'E' Company.—									
Flat, swampy, intersected by tidal creeks and partly covered with mangrove trees.	.....	**Triangulation**	35 P ...	420	221·1	14·9	(b)	.....	No. 6 D. O. costs for examination and preparation of colour patterns of this unit:—Rs. 485.
Very steep, broken, intricate and barren hills.	¾-inch	Original survey ...	35 J, K, O ...	2,183	36·9	21·0	.....	.....	(a) These sheet were surveyed prior to the year under report.
Flat, swampy, intersected by tidal creeks and partly covered with mangrove trees.	1-inch	Original air survey (Air survey compilation).	35 P ...	68	.....	3·0	.....	.....	(b) Not yet completed.
Built up hill area ...	64-inch	Special survey ...	34 N ...	79 acres.	47·4 acres.	15·8 acres.	(c)	.....	(c) Not to be mapped.
Fair mapping.—									
Bare broken hills ...	¾-inch	Original survey...	35 I, J, O ...	1,351	(a)	(a)	9·1	.....	
Flat plain partly open and partly covered with mangrove trees.	1-inch	Original air survey	35 P ...	341	(a)	(a)	9·3	.....	
Open level plain ...	1-inch	Correction survey	35 P ...	92	(a)	(a)	20·8	.....	

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

Party.	Class of work.	Sheet Nos. or Locality.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** *Contd.*
No. 18 (Air Survey) Party.—								
Steep mountain (3,000 to 10,000 feet).	1-inch **Triangulation**	Tribal territory	1,000	.....	6·7	.....	.....	
Steep partly wooded mountains and broken hills (3,000 to 8,000 feet).	**1-inch** Original air survey	Ditto	53	.....	(Air survey compilation). 39·5	.....	.....	
Steep partly wooded mountains and broken hills (3,000 to 10,000 feet).	**1-inch** Original air survey	Ditto	138	.....	55·8	.....	.....	
Broken hills (3,000 to 7,000 feet).	**1-inch** Original air survey	38 L ...	94	.....	59·8	.....	.....	
Steep partly wooded mountains and broken hills (3,000 to 10,000 feet).	**1-inch** Revision air survey	Tribal territory	134	.....	38·7	.....	.....	
Broken hills (5,000 feet) ...	**1-inch** Revision air survey	38 L ...	5	.....	170·2	.....	.....	

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

Party.	Class of work.		Sheet Nos. or Locality.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work excluding pupils and men under training.			Remarks.
						Field work.	Mapping or computations.	Total.	
				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** ***Contd.***
No. 18 (Air Survey) Party.—*Concld.*						(Air survey compilation).			
Steep partly wooded mountains and broken hills (3,000 to 8,000 feet).	**1-inch**	Provisional air survey.	Tribal territory	164	.....	25·8	.....	.....	
Steep partly wooded mountains (5,000 to 8,000 feet).	**1-inch**	Sketch air survey	Ditto	29	.....	31·7	.....	.....	
Low broken hills and plains	**1-inch**	Ground verification survey.	Ditto	200	.....	0·6	.....	.....	No. 6 D. O. costs for examination and preparation of colour patterns for this unit:—Rs. 559.
Fair mapping ...	**1-inch**	.....	38 O and tribal territory.	675[a]	.....	.....	15·1	.....	(a) The area mapped includes old ground surveys and new surveys from air photographs.

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

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**FRONTIER CIRCLE.—** *Concld.*
No. 6 Drawing Office.—								
Map examination	... **1-inch** Sheets ...	.....	.....	.....	.....	·4	.....	
Ditto	... **½-inch** Sheets ...	.....	.....	.....	.....	·1	.....	
Colour Patterns	... **1-inch** Sheets ...	.....	.....	.....	.....	·3	.....	
Ditto	... **½-inch** Sheets ...	.....	.....	.....	.....	·06	.....	

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

Party.	Class of work.		Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
						Field work.	Mapping or computations.	Total.	
No. 1 Party.—				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**GEODETIC BRANCH.**
High altitude Himālayas (10,000 feet to 25,000 feet).	¾-inch	Original survey ...	53 N, 62 B ...	254	54·7	41·3	35·0	**76·3**	No. 2 D. O. costs for examination of sheets and preparation of colour pattern of this unit :— Rs. 1,477-6-0.
Medium altitude Himālayas (4,000 feet to 16,000 feet).	¾-inch	Revision survey...	53 N ...	27	35·2	10·0	.....	**10·0**	
60% sandhills and undulating sandy areas; 40% open arid plains and isolated rocky hills.	¼-inch	Original survey ...	40 K, L, P ...	3,313	141·0	5·5	·3	**5·8**	
60% sandhills and undulating sandy areas; 10% rocky hills; 30% flat bare plain (Rann of Cutch).	½-inch	Original survey ...	40 K, L, P, 45 D.	7,055	99·3	6·0	3·2	**9·2**	
60% undulating plains and cultivation; 20% lightly wooded broken hills; 20% wooded areas.	½-inch ½-inch	Original survey ... Original survey ...	46 I ... 46 E ...	1,636 9	61·8	11·8	2·1	**13·9**	

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.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**GEODETIC BRANCH.—Contd.**
No. 1 Party.—*Concld.*								
50% undulating plains and cultivation; 30% lightly wooded broken hills; 20% wooded areas.	**1-inch** Original survey...	46 I ...	547	24·0 *(a)*	20·1	9·7	**29·8**	*(a)* Includes men under training.
	1-inch Resurvey ...	55 E ...	105	27·8	19·8	.....	**19·8**	
50% medium wooded Himālayas; 30% low broken jungle covered hills; 20% cultivated plains.	**1-inch** Correction survey	53 F, J ...	418	145·8	1·4	.....	**1·4**	
5% congested city; 12% cantonment and residential; 83% wooded hills and cultivated plains.	**3-inch** Revision survey	53 J ...	96	4·8	73·0	.....	**73·0**	

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

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Acres.	Acres.	Rs.	Rs.	Rs.	**GEODETIC BRANCH.—** *Contd.*
No. 20 (Cantonments) Detachment.—								
Cantonments (Plains). Fairly open to average congestion in parts and undulating with small hillocks.	16-inch **Traverse** ...	35 P, 43 L ...	15,590	2,024·7	0·4	0·3	**0·7**	Drigh Road and Siālkot Cantonment excluding 3·0 linear miles for boundary traversing at Mardān and Rāwalpindi Cantonments.
Cantonments (Plains). Average congestion and open in parts.	64-inch **Traverse** ...	35 P, 43 L ...	188	66·4	3·1	3·3	**6·4**	Drigh Road and Siālkot Cantonment.
Cantonments (Plains). Fairly open to average congestion with 50% undulating ground.	16-inch **Levelling** ...	35 P, 43 L ...	15,590	10,876·7	0·1	0·0	**0·1**	Drigh Road and Siālkot Cantonment.
Cantonments (Plains). Fairly open with undulating ground, interspersed with small nālās and water channels.	**16-inch** Original survey ...	38 N ...	1,434	243·1	0·6	0·4	**1·0**	Peshāwar Cantonment (Danger Zone Area).

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

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Acres.	Acres.	Rs.	Rs.	Rs.	**GEODETIC BRANCH.—** *Concld.*
No. 20 (Cantonments) Detachment.— *Concld.*								
Cantonments (Plains). 30% congested, 20% average congestion and 50% open areas	**16-inch** Resurvey ...	38 N, O, 43 B	17,058	234·0	1·5	1·2*(a)*	**2·7**	Peshāwar, Risālpur and Mardān Cantonments.
Cantonments (Plains). 60% open and 40% average congestion.	**64-inch** Original survey ...	38 N ...	18	21·6	10·0	2·4	**12·4**	(Syce Mandi) Risālpur Cantonment Bāzār.
Cantonments (Plains). 20% congested, 30% average congestion and 50% open areas.	**64-inch** Resurvey ...	38 N, O, 43 B	357	27·3	8·7	13·2*(a)*	**21·9**	Peshāwar, Risālpur and Mardān Cantonments Bāzārs.
Civil Areas (Plains). Boundary survey only.	**128-inch** Original survey ...	53 J ...	3	18	7·3	.....	**7·3**	Bungalows Nos 44, 44A and 46, E. C. Road, Dehra Dūn.

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

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

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.**
No. 4 Party.—								
Bettiah—Fairly open town	16-inch **Traverse** ...	72 B ...	60·4 linear miles.	64·7 linear miles.	18·0*(a)*	.....	**18·0**	
Plains, extensively cultivated and thickly populated with fairly abundant tree growth.	1-inch **Traverse** ...	72 B, F ...	1,310·5 linear miles.	79·1 linear miles.	11·2	6·8	**18·0**	No. 5 D. O. costs for mapping and preparation of colour patterns of this unit :— Rs. 353 (approx.).
Ditto.	1-inch **Levelling** ...	72 B, F ...	237·5 linear miles.	54·4 linear miles.	13·9*(a)*	.....	**13·9**	
Bettiah—Fairly open town	16-inch **ditto** ...	72 B ...	29·0 linear miles.	36·3 linear miles.	23·6*(a)*	.....	**23·6**	*(a)* Includes cost of computations.
Ditto.	**16-inch** Special air survey	72 B ...	9·7	2·2	400·4	367·5	**767·9**	

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.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.—** *Contd.*
No. 4 Party.—*(Concld.).*								
Plains, extensively cultivated and thickly populated with fairly abundant tree growth	**1-inch** Original survey	72 J, N ...	4,156(a)	32·2	14·3	9·9	**24·2** (b)	(a) Includes an area of 355 square miles done by probationers. (b) Excludes cost for training probationers.
No. 5 Party.—								
90% dense jungle clad plains with a few isolated hills and small ridges, and 10% open country.	1-inch **Triangulation**	65 A ...	2,243	236·1	4·5	1·5	**6·0**	No. 5. D. O. costs for mapping and preparation of colour patterns of this unit :—Rs. 394 (approx.).
75% dense and medium jungle clad hills and plains with high grass and 25% open cultivated area (survey by plane-table traverse in the jungle and by resection in the cultivated areas).	**1-inch** Original survey	64 H, L ...	3,342	24·4	22·8	8·9	**31·7**	

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.—				Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**EASTERN CIRCLE.—** *Concld.*
25% hills rising to 500 feet. 75% riverain area and flat cultivated plains.	1-inch	**Triangulation**	78 G ...	675	311·6	3·8	2·4	**6·2**	
Rigorous traversing in flat cultivated open plains.	1-inch	**Traverse** ...	78 C, G ...	1,116 linear miles.	64·7 linear miles.	8·7	4·9	**13·6**	No. 5 D. O costs for mapping and preparation of colour patterns of this unit:— Rs. 289 (approx.).
80% hills rising to 2,500 feet covered with dense forest 20% cultivated plains.	½-inch	Original survey ...	84 C ...	555	31·8	17·6	*(a)*	**17·6**	*(a)* Mapping not yet started.
25% low intricate undulating hills rising to 1,500 feet covered with dense jungle. 75% congested cultivated plains densely populated.	1-inch	Original survey ...	79 N, O, 84 C	3,139	24·6	20·2	10·9	**31·1**	30% on blue prints from 4-inch air surveys.
40% residential and 60% bāzār area of Chittagong.	2-inch	Original survey ...	79 N ...	4·9	3·9	55·9	.....	**55·9**	For mapping on 1-inch scale.
Wooded and grassy hills rising to 12,000 feet.	½-inch	Correction survey	83 J, K, N, O	200	260	3·2	.....	**3·2**	Nokhu expedition. The survey operations were restricted to the movements of the column and escorts. Not to be mapped.

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

Party.	Class of Work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.**
No. 6 (South India) Party.—								
Sparsely inhabited and densely forested plateau.	1-inch **Traverse** ...	48 I ...	257[a] linear miles.	47·9 linear miles.	14·49 per	7·89 linear	**22·38** mile.	(a) Over an area of approximately 494 sq. miles.
Sparsely inhabited and densely forested hills and low ridges.	1-inch **Triangulation**	48 I ...	1,067	186·1	11·67	1·28	**12·95**	
Open undulating plateau with occasional bare ridges, low hills and widely separated villages.	1-inch **Triangulation**	47 P ...	3,990	819·9	1·21	0·13	**1·34**	Stations and points of old triangulation were identified and old triangulation supplemented where necessary.
Sparsely inhabited undulating wooded and cultivated plateau.	1-inch **Triangulation**	65 E ...	280	152·7	(b)	(b)	(b)	(b) Cost included in cost rate of 1-inch original survey in 65 E.

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

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.—*Contd.***
No. 6 (South India) Party.—*Contd.*								
20% low gently undulating cultivated plain with palmyra palms and occasional scrub jungle. 80% flat irrigated and densely populated riverain plain and coastal belt.	**1-inch** Original survey ...	65 H, L ...	4,024	27·3	16·95	10·69	**27·64**	
Sparsely inhabited, undulating wooded and cultivated plateau.	**1-inch** Original survey ...	65 E ...	280	19·0	24·97	10·69	**35·66**	
40% densely wooded undulating plateau. 30% undulating wooded and cultivated plateau. 30% wooded ghāt and low sparsely inhabited forested hills.	**½-inch** Original survey ...	65 I ...	1,120	27·2	18·00	4·24	**22·24**	

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

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.—*Contd.***
No. 6 (South India) Party.—*Concld.*								
.....	... ½-inch Compiled mapping	74 A, B ...	.....	.....	.....	1·95	**1·95**	
.....	... ¼-inch Compiled mapping	65 N, 74 A, B	.....	.....	.....	1·57	**1·57**	
.....	... . Colour patterns...	.....	.....	.....	.....	263·00 per sheet.	**263·00 per sheet.**	Total cost of office copy corrections and miscellaneous drawing Rs. 29,949.

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

Party.	Class of Work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.—*Contd.***
Burma Survey Party.—								
Low jungle covered hills	**Triangulation**	85 M ...	2,246	321	3·96	1·02	**4·98**	
Low jungle covered hills	**Traverse** ...	94 B, C ...	630·9 linear miles.	18·2 linear miles.	42·56	9·62	**52·18**	
Cultivated plains	**Traverse** ...	85 N, O, 94 B, C	558·9 linear miles.	76·7 linear miles.	16·42	9·62	**26·04**	
Jungle covered hills up to 4,000 feet.	**1-inch** Original survey ...	94 A ...	1,361	29·0	19·75	15·80	**35·55**	
Low jungle covered hills ...	**1-inch** Original survey ...	94 A, B ...	1,121	12·5	40(a)	15·80	**55·80**(a)	(a) Approximate (separate records were not kept during the field season).
Cultivated plains ...	**1-inch** Original survey ...	94 A, B ...	628	33·0	30(a)	15·80	**45·80**(a)	

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

Party.	Class of work.	Sheet Nos.	Areas in sq. miles (or acres) of each description of work.	Out-turn of field work per man per month.	Cost rate per Sq. M. (or Acre) of each description of work, excluding pupils and men under training.			Remarks.
					Field work.	Mapping or computations.	Total.	
			Sq. m.	Sq. m.	Rs.	Rs.	Rs.	**INDEPENDENT PARTIES.—*Concld.***
Burma Survey Party.—*Concld.*								
Low jungle covered hills ...	**1-inch** Supplementary survey	94 A, B ...	795	21·0	20(a)	15·80	**35·80(a)**	(a) Approximate. In the Tables C of the General Report for 1934, 1936, 1937 areas called Correction Survey and Resurvey have been included. These so-called Correction Surveys and Resurveys comprised inking in in the field of reductions of large scale post-1905 contoured surveys, under processes similar to that now described in para. 120.
Fair mapping	**¼-inch** Compiled mapping	84 G, H, I, 93 J, 94 F.	12,336	.....	.....	0·70	**0·70**	
....	Preparation of colour patterns.	.....	20 sheets.	.....	.....	294·45 per sheet.	**294·45 per sheet.**	Total cost of office copy corrections and miscellaneous work Rs. 16,262.

V.—SURVEY REPORTS, FRONTIER CIRCLE.

DIRECTOR:—{ Lt.-Colonel E. A. Glennie, D.S.O., R.E., from 1-10-37 to 19-10-37.
{ Colonel J. D. Campbell, D.S.O., from 20-10-37.

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

46. Training.—Thirteen soldier surveyors were under training in 'A' Company during the field season of whom one reverted to his regiment.

47. Special.—The Director, Frontier Circle, attended a conference at Delhi to determine the future policy of the Survey of India with regard to maps on the scale of 1/Million. He visited the Headquarters of Northern Command at Rāwalpindi and discussed the survey requirements of the army. While on tour at Quetta during January 1938 he discussed the reconstruction of 'E' Company's building destroyed in the earthquake, at a conference of the Secretary, P. W. D. Baluchistān, and other civil and military authorities.

48. Areas surveyed.—

1,420 square miles of triangulation.
385 linear miles of traversing.
216 linear miles of settlement traverse.
2,183 square miles of $\frac{3}{4}$-inch original survey.
2,054 square miles of 1-inch resurvey.
253 square miles of $1\frac{1}{2}$-inch resurvey.

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

353 square miles compiled (1-inch original survey).
139 square miles compiled (1-inch revision survey).

'A' Survey Company.

Officer Commanding.—Major J. B. P. Angwin, M.B.E., R.E.

49. General.—The party carried out surveys in Dera Ghāzi Khān, Kāngra and Muzaffargarh districts and Mandi State of the Punjab.

Field headquarters opened at Lahore Cantonment on 22nd October 1937 and closed on 16th April 1938.

50. Personnel.—The average strength of the party during the year was 1 Class I officer, 3 Class II officers, 4 U. S. officers, 42 Lower Subordinates and 13 soldier surveyors under training.

Messrs. Tirlochan Singh and N. D. Joshi (Class II) joined the party in October.

Computer Joti Sarup was on loan to the Sind Government from 13th December to 21st April for computation and relaying of missing rectangulation stones in the Heran Tract.

51. Areas surveyed.—

385 linear miles of traversing.
216 linear miles of settlement traverse.
2,054 square miles of 1-inch resurvey.
253 square miles of 1½-inch resurvey.

52. Field work was organized as follows:—

Camp (1) under Mr. Tirlochan Singh (Class II) with Mr. Muhammad Akbar (U. S. S.) and 12 surveyors completed 2,054 square miles of 1-inch resurvey in sheet 39 J.

Camp (2) under Mr. N. D. Joshi (Class II) with Mr. Sardar Khan (U. S. S.), 10 surveyors and 4 second year soldier surveyors completed 253 square miles of 1½-inch resurvey in sheet 53 A/9. 4 of the above surveyors received training in hill surveys in sheet 53 A/10 for part of the season.

This camp also contained 4 first year soldier surveyors and 3 pupil draftsmen under instruction and, for a short time, Mr. Irshad Ahmad (U. S. S.).

Framework.—Traverser Dial Singh completed 385 linear miles of traverse in sheets 39 I and M to supplement framework for next season's work.

Traversing.—At the request of the Punjab Government, Traverser Dial Singh was employed on relaying and checking base line stones in the Jhelum district. In all 216 linear miles of traverse was completed and 116 missing base line stones were embedded.

Verification surveys.—One surveyor was employed on verification of certain detail in sheets drawn during the winter from correction surveys of previous years. Some boundaries were also verified by him on the ground.

Two surveyors were employed during April and May, after the close of the field season, on revision of the Lahore Guide Map. The revision was done on special prints on various types of non-distorting field sections, with the object of testing the permanence of printing and quality of the mounting under hot weather conditions.

Large scale survey of the urban areas of Lahore.—Estimates were prepared for the formation of a special detachment for carrying out survey of 5,823 acres on scale 40 feet to 1 inch and 15,930 acres on scale 100 feet to 1 inch for preparation of a record of property rights in Lahore urban areas. Up to 31st July this detachment remained under the orders of the Officer Commanding 'A' Company.

53. Office work.—During the field season one drawing section of an average strength of 10 surveyors and draftsmen under Mr. D. C. Puri (Class II) assisted by Mr. I. K. Ponnappa (U.S.S.) completed 6 sheets of arrears of fair mapping from correction surveys of previous years. During recess 3 drawing sections completed 12 fair sheets which included arrears from correction surveys and 1 sheet hastily drawn for No. 18 Party. The total out-turn during the year was 19 sheets. Various drawing experiments were also carried out.

Mr. Irshad Ahmad (U.S.S.) with 2 computers completed the computations of all traverse carried out during the season.

'E' Survey Company.

Officer Commanding.—Lieut.-Colonel L. H. Jackson, I.A., to 2-10-37.
Captain H. W. Wright, R.E., from 3-10-37 to 1-4-38.
Mr. Muhammad Najamuddin, from 2-4-38 to 22-4-38.
Lieutenant R. A. Gardiner, R.E., from 23-4-38.

54. General.—The Company carried out surveys in Kalāt and Las Bela States of Baluchistān and Dādu and Karāchi districts of Sind. Field headquarters opened at Karāchi on 23rd October 1937 and closed on 11th April 1938. The triangulation camp remained in the field until the beginning of June 1938.

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

(*1*) Fixing of points by triangulation for range taker's test ranges for the 4th (Quetta) Infantry Brigade.

(*2*) Verification of the Quetta Cantonment boundary pillars for the Quetta Cantonment Board.

(*3*) Spirit levelling the 6,270 feet contour demarcating the Hanna Lake boundary for the Quetta Cantonment Board.

55. Personnel.—The average strength during the year was 1 Class I officer, 2 Class II officers, 2 Upper Subordinate officers and 16 Lower Subordinates (excluding 3 clerks, 2 computers and 15 reproduction section personnel). Mr. Mohd. Najamuddin (Class II) proceeded on 4 months leave from the 9th May 1938.

56. Areas surveyed.—

420 square miles of triangulation.
2,183 square miles of ¾-inch original survey.
68 square miles compiled from air photographs (1-inch original survey).

57. Field work was organized as follows:—

Camp (*1*) under Mr. Mohd. Najamuddin (Class II) with 4 surveyors completed the original survey of 719 square miles on the ¾-inch scale in Kalāt and Las Bela States in sheet 35 J. This camp was later reinforced by 2 extra surveyors.

Camp (*2*) under Mr. Chowdhury Mohd. Aslam (Class II) with 7 surveyors completed the original survey of 1,464 square miles on the ¾-inch scale in Kalāt and Las Bela States of Baluchistān, and Dādu and Karāchi districts of Sind in sheets 35 J, K and O.

Triangulation.—Mr. L. R. Howard (U. S. S.) triangulated 420 square miles for the provision of ground control for air survey in sheets 35 P/3, 7 and 8. and one surveyor collected the necessary ground information in these sheets. Photography was completed by 31 (AC) Squadron, R. A. F. Karāchi about the middle of January. All triangulation stations and points were postpointed on the photographs on the ground.

58. Office work.—4 surveyors under Mr. V. D. Chopra (U. S. S.) were employed on fair mapping and miscellaneous work throughout the field season. During recess, fair mapping was divided into two sections.

A TRIANGULATION STATION, WAZĪRISTĀN, DURING MILITARY OPERATIONS.

No. 1 under Mr. Chowdhury Mohd. Aslam (Class II) consisted on an average of 6 surveyors, and No. 2 under Mr. V. D. Chopra (U. S. S.) consisted on an average of 9 surveyors. 2 fair sheets of arrears mapping and 3 of current mapping were completed throughout the year.

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

No. 18 (Air Survey) Party.

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

60. General.—Recess and field headquarters remained at Murree and Risalpur respectively, the latter opening on 22nd October 1937 and closing on 18th April 1938.

61. Personnel.—The average strength of the party was 2 Class I, 3 Class II, 3 Upper Subordinate officers and 21 Lower Subordinates (excluding clerks and reproduction section personnel).

62. Areas surveyed.—

1,000 square miles of triangulation.
285 square miles compiled (1-inch original survey).
139 square miles compiled (1-inch revision survey).
164 square miles compiled (1-inch provisional survey).

63. Field work.—

522 square miles vertical photography.
136 linear miles oblique photography.

No. 1 (Indian) Wing Station, R. A. F., Kohāt supplied vertical photographs of 250 square miles and oblique photographs of 11 linear flying miles in tribal territory in sheet 38 L for height determination.

No. 2 (Indian) Wing Station, R. A. F., Risālpur supplied oblique photographs of 14 linear flying miles in tribal territory. The remaining vertical photography, which was to have been carried out again could not be undertaken for technical and political reasons.

64. Compilation.—Compilation of areas photographed in tribal territory was carried out under Khan Sahib Muhammad Hasan (Class II) assisted by Mr. E. R. Wilson (Class II). The area which was compiled for detail only was 66 square miles.

65. Office work.—Five draftsmen under Mr. Bashirullah Khan (U. S. S.) were employed on fair mapping and miscellaneous work throughout the year.

2 fair sheets were completed and submitted for publication during the year

66. Training.—During the year 1 Class I, 1 Class II, 1 Upper Subordinate officer and an average of 5 Lower Subordinates were under training in air survey.

67. Instruments.—A Stereocomparator, manufactured by the Cambridge Instrument Co., with optical work by Messrs. Ross, was received. This instrument will facilitate research into methods of air survey of areas sparsely controlled by triangulation.

68. Co-operation with the Army and R. A. F.—On the cessation of operations in Wazīristān, the Field Survey Section, Wazirforce, returned to Risālpur and was disbanded on 16th December 1937.

During recess parties of pilots and air gunners from the R. A. F. Hill Depot, Lower Topa, visited the office, where methods of air survey were demonstrated to them.

69. Reproduction Section.—For detail of the work of the reproduction section see page 71.

THE SWĀT RIVER DEBOUCHING INTO PESHĀWAR PLAIN.

A HIGH OBLIQUE PHOTOGRAPH USED FOR AIR SURVEY.

SURVEYING IN THE RANN OF CUTCH.

VI.—SURVEY REPORTS, GEODETIC BRANCH.

No. 1 Party.

Officer in charge.—{Major D. R. Crone, R.E., to 31-10-37.
{Major G. H. Osmaston, M.C., R.E., from 1-11-37.

70. General.—The party carried out topographical surveys in Bombay, Central India, Gujarāt States, Punjab States, Rājputāna, Sind, States of Western India, and the United Provinces, in sheets 46 I, 46 E, 55 E, 40 K, 40 L, 40 P, 45 D, 53 N, 53 J, 53 F and 62 B.

The programme also included revision for a new edition of the Dehra Dūn Guide Map and special maps for military training purposes; correction surveys in Dehra Dūn district and Tehri-Garhwāl State; and the following surveys, on payment:—

(*a*) A military training map, on the 1-inch scale in Bhopāl State, at the request of the Darbār.

(*b*) Certain correction surveys of the internal boundaries of Jodhpur (Mārwār) State.

(*c*) The preparation of a special map on the $\frac{1}{4}$-inch scale for Jodhpur (Mārwār) State.

Contributions were received during the year towards their share of the cost of the party survey programme from the States of Jodhpur (Mārwār), Indore, Bānswāra, Jaora, Ratlām and Partābgarh.

The field headquarters of the party opened at Ajmer on 13th November 1937 and closed there on 20th March 1938, when it moved to Mussoorie for the recess.

71. Personnel.—The field strength of the party was 1 Class I, 5 Class II, 5 Upper Subordinate officers, including 2 probationers, and 48 Lower Subordinates, including 4 clerks.

72. Areas surveyed.—

96 square miles of 3-inch revision survey.
547 square miles of 1-inch original survey.
418 square miles of 1-inch correction survey.
105 square miles of 1-inch resurvey.
254 square miles of $\frac{3}{4}$-inch original survey.
27 square miles of $\frac{3}{4}$-inch revision survey.
8,700 square miles of $\frac{1}{2}$-inch original survey.
3,313 square miles of $\frac{1}{4}$-inch original survey.

73. Field work.—

Garhwāl Camp. A small camp consisting of Mr. J. N. Kohli (U. S. S.) and three surveyors carried out 254 square miles of $\frac{3}{4}$-inch original survey in the Himālayas in sheets 53 N/NE and 62 B/NW and also 27 square miles of revision survey in sheet 53 N/NW. This completed the modern survey of Garhwāl district. The camp left Mussoorie at the end of August 1937 and returned to Dehra Dūn at the end of November, when it was re-formed and known as Camp (6) of Detachment III.

The area of original survey included the east and west slopes of Kāmet peak (25,447 feet) and the Hoti valley. Due to severe cold and lack of fodder for animals, all passes to Tibet close about 15th October and the higher villages are completely evacuated by about 20th October.

A heavy snowfall occurred from 14th to 16th September and another on 28th October, otherwise the weather was good.

Transport above 7,000 feet was mainly by coolies drawn from the higher villages beyond Joshimath, but yak and sheep were also very useful when coolies could not be obtained.

Personnel kept in very good health throughout, but there was one fatal accident when a khalasi slipped down an ice *couloir* and was killed.

Detachment I., under the Officer in charge of the party, consisted of two camps.

Camp (1) under Mr. P. S. Shinghal (Class II) with an average of 3 surveyors until January, and then under Mr. J. C. Ross (Class II) and later Mr. T. M. C. Alexander (Class II) with 5 additional surveyors from Detachment II. It completed 1,090 square miles of original survey on the ½-inch scale in sheet 46 I/NW in the States of Bānswāra, Dūngarpur and Udaipur (or Mewār).

Camp (2) under Mr. J. C. Ross (Class II) with 5 surveyors completed the original survey of 547 square miles on the 1-inch scale and 555 square miles on the ½-inch scale in sheets 46 I and 46 E in Broach and Pānch Mahāls district and the States of Bāria, Sanjeli, Sant, Indore, Jhābua, Bānswāra, Kushālgarh, and Dūngarpur.

The country consists of undulating jungle-covered hills and ravines interspersed with flatter cultivated areas.

The rainfall is meagre and the countryside dry and arid, water being stored in *bunded* tanks. Most of the streams dry up for several months in the year. With the exception of crocodile in the larger rivers and neighbouring tanks, the area is singularly devoid of game.

Health.—Malaria is prevalent till December and several men had attacks at the beginning of the season.

Detachment II., under Mr. T. M. C. Alexander (Class II), consisted of 3 camps, working in the Rājputāna and Sind deserts near the S. E. boundary of Jodhpur State.

Camp (3) under Mr. M. W. Kalappa (U. S. S.) with nine surveyors completed the original survey of 1,408 square miles on the ½-inch and 1,814 square miles on the ¼-inch scale in sheet 40 K in Jodhpur (Mārwār) State, and Thar Pārkar district of Sind.

On completion of the camp's programme, its surveyors were transferred to other camps and Mr. Kalappa proceeded to Mussoorie early in March to commence the mapping.

Camp (4) under Mr. K. A. Sheikh (Class II) with nine surveyors completed the original survey of 2,701 square miles on the ½-inch scale in sheets 40 K and L in Thar Pārkar district and Cutch State.

Camp (5) under Mr. A. G. Qureshi (U. S. S.) with nine surveyors completed the original survey of 2,040 square miles on the ½-inch and 1,499 square miles on the ¼-inch scale in sheets 40 L and P, and 45 D in Thar Pārkar district of Sind and Jodhpur (Mārwār) State.

Mr. T. M. C. Alexander (Class II) in addition to supervising the work of the camps of the detachment completed the survey of 906 square miles on the ½-inch scale of the Rann of Cutch area in sheet 40 L.

The country consists mainly of grass and scrub-covered sand-hills up to 250 feet in height but in sheets 40 K/NE and 40 L/SE suddenly changes

to hard bare ground and isolated rocky hills. A scrub-covered plain forms the delta of the Lūni River in sheet 40 P/NW. The sandhills are of the typical shapes formed by prevailing SW winds.

A large area of the Rann of Cutch falls in the southern portion of sheets 40 L and 40 P/NW; the Rann in these parts is mostly dry except for an area west of the Lūni delta. The surface of the Rann is only a few feet above sea level and extends for many miles as a perfectly level plain of sand or mud. Salt deposits occur in parts.

The most outstanding group of hills are those of Nagar Pārkar on the northern border of the Rann in sheet 40 L which rise abruptly to over 1,000 feet above the surrounding plain.

Chinkāra are very numerous over the whole of the sandy area and along the borders of the Rann of Cutch, in spite of there being no water for them to drink. The plains of the Lūni delta and the Nagar Pārkar *tahsil* teem with sand grouse; bustard and partridge are also common throughout the area. Those portions of the Rann of Cutch which are under water are alive with bird life including many pelican and thousands of flamingo.

Weather conditions are favourable for survey work from November to February and the country is healthy and free from malaria. After the middle of February the shallow wells dry up and the only water then obtainable in the desert areas is from wells, sometimes over 400 feet deep.

There are no tracks fit for wheels in the desert area and local camels were employed for transport. Supplies were only obtainable at larger villages.

Detachment III., under Mr. F. J. Grice (Class II); headquarters at Dehra Dūn.

Camp (*6*) under Mr. J. N. Kohli (U. S. S.) with 2 surveyors, later reinforced by 6 surveyors of Detachment II, completed 96 square miles of revision survey on the 3-inch scale and 418 square miles of correction survey on the 1-inch scale, in sheets 53J and F in Dehra Dūn and Sahāranpur districts and Tehri-Garhwāl State.

Camp (*7*). Towards the end of the field season a small camp, consisting of Mr. K. A. Sheikh (Class II) and three surveyors completed 100 square miles of resurvey in Bhopāl State on the 1-inch scale in sheet 55 E. This survey was required by the State for a special military map.

Drawing Section. During the winter a small drawing section at Dehra Dūn continued the plotting of Himālayan photo-surveys near Nanda Devi and the mapping of Himālayan sheets.

74. Recess duties.—The party was organized for recess into 3 main sections.

No. 1 Section under Mr. T. M. C. Alexander (Class II), assisted by Messrs. A. G. Qureshi and M. W. Kalappa (U. S. S.), undertook the mapping of the desert areas.

No. 2 Section under Mr. J. C. Ross (Class II) mapped the Himālayan areas.

No. 3 Section under Mr. P. S. Shinghal (Class II) mapped the areas falling in sheet 46 I.

Mr. F. J. Grice (Class II) was in charge of the mapping of the special Mārwār Map and exercised general supervision over the other sections until his transfer to the Frontier Circle at the beginning of July.

The following surveys were handed over to No. 2 Drawing Office for mapping:—

The Dehra Dūn Guide map.
Special Map for the Indian Military Academy.
Special military training map for Bhopāl.
Correction of sheets 53 J/3 and F/15.

No. 20 (Cantonments) Detachment.

Officer in charge.— { Mr. A. J. A. Drake, D.C.M., to 19-3-38.
Mr. W. H. Strong, M.B.E., from 20-3-38.

75. General.—The detachment resurveyed 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 18th October 1937 and closed on the 5th April 1938, field headquarters remaining at Dehra Dūn.

Personnel.—The field strength, excluding the officer in charge, was 2 U. S. officers and 32 Lower Subordinates, including 4 draftsmen, 5 computers and 2 clerks employed at field headquarters.

76. Areas surveyed.—

16-inch original survey.

Peshāwar Cantonment	1,433·5 acres.

64-inch original survey.

Syce Mandi (Risālpur)	17·7 acres.

128-inch original survey.

No. 44, 44 A and 46 E. C. Road, Dehra Dūn...	3·1 acres.

16-inch resurvey.

Mardān Cantonment	920·8 acres.
Peshāwar ,, ...	5,466·5 ,,
Risālpur ,, ...	10,670·8 ,,

The above areas include overlap.

64-inch resurvey.

Mardān Bāzār	13·8 acres.
Peshāwar Cantonment Bāzārs	*67·0 ,,
Risālpur ,, ,, ...	276·1 ,,

*Includes 4·6 acres overlap.

77. Field work was organized as follows:—

Camp (1) with headquarters at Peshāwar under Mr. Bakhshi Harnam Singh (U. S. S.) with 9 surveyors and 1 traverser completed the detail survey of Peshāwar Cantonment and the advance traversing and levelling of Drigh Road.

One computer was attached to the camp for training in plane-tabling.

Camp (2) with headquarters at Risālpur under Mr. A. Francis, C.H. (U.S.S.) with 9 surveyors and 2 traversers completed the detail survey

of Mardān and Risālpur Cantonments as well as a small estate in Dehra Dūn, and the advance traversing and levelling of Siālkot Cantonment.

78. Traversing and Levelling.—232·3 linear miles of traversing and 65·2 linear miles of levelling were completed for the next season's survey at Drigh Road and Siālkot.

Also 3·0 linear miles of traversing were done in connection with boundary alterations at Mardān and Rāwalpindi.

79. Recess duties.—Fair mapping was allotted to two sections during the recess under Messrs. Bakhshi Harnam Singh (U. S. S.), and A. Francis (U. S. S.), the former also supervising the computation section.

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

20 sheets on the 16-inch scale and 11 sheets on the 64-inch scale of *Abbottābād, *Cawnpore, *Chaklāla, *Dehra Dūn (I. M. A.), *Rāwalpindi Cantonments and Bāzārs were completed and sent for publication, while 21 sheets on the 16-inch scale and 19 sheets on the 64-inch scale of Mardān, Peshāwar and Risālpur Cantonments Bāzārs, comprising the current season's mapping were partially completed.

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

* Arrears mapping.

VII.—SURVEY REPORTS, EASTERN CIRCLE.

DIRECTOR:—{Colonel F. J. M. King, to 29-5-38.
{Colonel F. B. Scott, I.A., from 30-5-38.

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

81. Areas surveyed.—

555 square miles of ½-inch original survey.
200 square miles of ½-inch correction survey.
10,637 square miles of 1-inch original survey.
4·9 square miles of 2-inch original town survey for 1-inch mapping.
10 square miles of 16-inch special air survey.
2,918 square miles of triangulation.
2,427 linear miles of traverse.
60 linear miles of traverse for 16-inch special air survey.
29 linear miles of levelling for 16-inch special air survey.
238 linear miles of tertiary levelling for future 1-inch survey.

82. Air Survey.—The work done in connection with the air survey of Bettiah town is described in No. 4 Party's report (p. 45).

83. Training.—The numbers of probationers under training were as under:—

Class I Service	...	...	...	One.
Class II Service	...	...	...	Two.
U. S. Service	...	...	...	Three.

Two pupil surveyors were also 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. C. H. Tresham, V.D., to 31-3-38.
{Mr. A. J. A. Drake, D.C.M., from 1-4-38.

85. General.—The party continued surveys on the 1-inch scale in Bhāgalpur, Darbhanga and Purnea districts of Bihār in sheets 72 J and N, and carried out traversing in advance for subsequent survey in Champāran, Muzaffarpur and Sāran districts of Bihār in sheets 72 B and F.

About 60 linear miles of traversing covering about 10 square miles was run to fix points for the air survey of Bettiah town and about 29 linear miles of tertiary levelling was run to fix spot level heights in the same area (as contours were not shown).

Field headquarters opened at Bhāgalpur on 15th November 1937 and closed on 11th April 1938.

86. Personnel.—The field strength consisted of one Class I officer, 4 Class II officers, 2 Class II probationers under training, 3 Upper Subordinate officers, 3 Upper Subordinate probationers under training, 28 surveyors, 4 traversers, 5 computers, 3 clerks, and one store-keeper.

Messrs. F. M. Hawley and J. L. Sahgal (Class II) were transferred from the party in April and May 1938 respectively.

Mr. N. N. Chuckerbutty (Class II) joined the party in May 1938 from the Geodetic Branch to replace Mr. J. L. Sahgal transferred.

87. Areas surveyed.—

4,156 square miles of 1-inch original survey.
10 square miles of 16-inch special air survey.
1,311 linear miles of theodolite traverse for future 1-inch survey.
60 linear miles of theodolite traverse for 16-inch air survey of Bettiah town.
238 linear miles of tertiary levelling for future 1-inch surveys.
29 linear miles of levelling for 16-inch air survey of Bettiah town.

88. Field work was organized as follows:—

Camp (1).—Mr J. L. Sahgal (Class II) with 1 Class II probationer, 1 U. S. officer, 1 U. S. probationer, and 9 surveyors completed 1,551 square miles of original survey on the 1-inch scale in sheet 72 J in Bhāgalpur and Darbhanga districts of Bihār.

Camp (2).—Mr. J. C. Berry (Class II) with Mr. U. D. Mamgain (U. S. S.) as Assistant Camp Officer, 1 Class II probationer, 1 U. S. probationer, and 8 surveyors completed 1,272 square miles of original survey on the 1-inch scale in sheets 72 J and N in Bhāgalpur, Darbhanga and Purnea districts of Bihār.

Camp (3).—Mr. F. M. Hawley (Class II) with 1 U. S. probationer and 9 surveyors completed 1,333 square miles of original survey on the 1-inch scale in sheet 72 N in Purnea district of Bihār.

Mr. U. D. Mamgain (U. S. S.) was transferred to this camp from camp (2) towards the end of March with a view to taking over charge of the camp from Mr. Hawley who was under orders for transfer to Burma on completion of the field work.

Camp (4).—Mr. G. H. Khan (Class II) with 4 traversers and 5 computers one of whom was employed on levelling and traversing, completed 1,311 linear miles of theodolite traversing and 238 linear miles of tertiary levelling, covering an area of 3,847 square miles for future 1-inch surveys in sheets 72 B and F in Champāran, Muzaffarpur and Sāran districts of Bihār. One U. S. probationer was transferred to this camp from camp (3) from February and received training on traversing, levelling and computations.

89. *Bettiah Town Air Survey.*—Mr. Muzaffar Husain (U. S. S.) with 2 surveyors, 1 traverser and 1 leveller completed the ground work for the 16-inch special air survey map of Bettiah town. This consisted of.—

(*a*) 60 linear miles of traversing covering about 10 square miles.
(*b*) 29 linear miles of tertiary levelling run to fix spot level heights all over the area as no contours were shown.
(*c*) Inking up detail only of 20 16-inch rectified blue-toned enlargements on correctostat paper, comprising 4 sheets of the town and surrounding country. Inking up of blue-toned photographs enables drawing blue prints to be prepared by direct photography.

90. Description of country.—The area under survey is a flat alluvial plain, intersected by rivers and innumerable natural drainage channels; it is well populated, highly cultivated and interspersed with numerous *bāghs* and scattered trees. The Kosi River at present floods the area falling in the Supaul subdivision of Bhāgalpur district. This river is constantly changing its course and its present movement is westwards. The periodical flooding of the Kosi covers the ground with a thin layer of silt which destroys all cultivation and in the course of time the area is covered with high grass and reeds. The area previously affected is being gradually reclaimed now. Road and railway communications are good on the whole, but there are few motorable roads.

91. Miscellaneous.—In the area covered by the flooding of the Kosi, malaria is prevalent, but the health of the party was good on the whole.

92. Recess duties.—The 19 1-inch sheets surveyed during the field season were fair mapped during recess by three sections under Messrs. N. N. Chuckerbutty, J. C. Berry and G. H. Khan (all Class II) respectively.

The drawing of the Bettiah town air survey work was carried out under Mr. Muzaffar Husain (U. S. S.).

Traverse computations were completed under Mr. U. D. Mamgain (U. S. S.).

No. 5 Party.

Officer in charge.—Captain I. H. R. Wilson, R.E.

93. General.—Topographical survey on the scale of 1 inch to 1 mile was continued in the Raipur district of the Central Provinces, the Sambalpur and Koraput districts of Orissa, and in the Chhattīsgarh States (Eastern States Agency), in sheets 64 H and L.

Triangulation for topographical survey was carried out in the Chānda district of the Central Provinces, and in the Chhattīsgarh States, in sheet 65 A.

The field headquarters remained at Raipur and the field season opened on 8th November 1937 and closed on 14th April 1938.

94. Personnel.—The field strength consisted of 1 Class I officer, 4 Class II officers, 2 U. S. officers, 28 surveyors, 3 computers, 1 draftsman, 3 clerks, and 1 store-keeper.

95. Areas surveyed.—

3,342 square miles of 1-inch original survey.
2,243 square miles of triangulation for 1-inch survey.

96. Field work was organized as follows:—

Camp (1).—Mr. B. N. Saha (Class II) with 11 surveyors and 1 computer completed 1,324 square miles of original survey on the 1-inch scale in sheet 64 L falling in Raipur (C. P.) and Sambalpur (Orissa) districts, and in Patna State (Eastern States Agency). Two surveyors were transferred to No. 4 Party from 1st January and the camp was later reinforced by 1 surveyor from camp (3).

Camp (2).—Mr. C. T. Hurley (Class II) with Mr. A. R. Khan (U. S. S.) and 10 surveyors completed 1,184 square miles of original survey on the 1-inch scale in sheet 64 L falling in Raipur district (C. P.) and in Sambalpur and Koraput districts (Orissa). In February, the camp was reinforced by 1 surveyor from camp (3).

Camp (3).—Mr. H. H. Phillips (Class II) with 7 surveyors, 1 computer and 1 draftsman completed 834 square miles of original survey on the 1-inch scale in sheets 64 H and L falling in Raipur district (C. P.). In February, 2 surveyors were released to reinforce camps (1) and (2).

Triangulation.—Messrs. Mohd. Alauddin (Class II) and Mohabat Ali (U. S. S.) completed the triangulation of 2,243 square miles in sheet 65 A falling in Chānda district (C. P.) and in Bastar State (Eastern States Agency).

97. Description of country.—Except in sheets 64 H/13, which was open cultivated plains, and 64 L/9, 10 and 11 which were cultivated plains interspersed with jungle clad hills, the country consisted almost entirely of undulating country covered with fairly dense jungle and high grass. This includes the Sonābira plateau, which is about 40 miles long with a greatest width of some 12 miles and stands about 1,000 feet above the surrounding country. Most of the country had to be surveyed by traverse methods, and consequently progress was rather slow.

98. Miscellaneous.—The health of the party was good, though part of the area was reputed to be bad for black-water fever. Except for one case of chronic malaria there was little sickness.

One surveyor while on medical leave died on 22nd December 1937 and 2 khalasis while on duty died of malaria in the Raipur Hospital.

99. Recess duties.—The 12 1-inch sheets were fair mapped by 3 drawing sections under Messrs. B. N. Saha, D. N. Saha and H. H. Phillips (all Class II) respectively. The computing section under Mr. Mohd. Alauddin completed all work in hand, and Messrs. Mohd. Alauddin and Mohabat Ali computed their own triangulation.

No. 12 Party.

Officer in charge.—Captain R. H. Sams, R.E.

100. General.—The survey operations of the party in sheets 79 N, 79 O and 84 C included the survey of part of Noākhāli district, the completion of Chittagong district and Chittagong Hill Tracts of Bengal on the 1-inch and ½-inch scales, and the completion of Akyab district of Burma on the 1-inch and ½-inch scales.

During a punitive expedition under the Deputy Commissioner, Nāga Hills district in December, survey operations on the ½-inch scale were carried out in the Control and Tribal Areas adjoining the Nāga Hills district of Assam.

Triangulation and traverse for future 1-inch surveys were carried out in the Gāro Hills and Goālpāra districts of Assam, and in Bogra, Dināpur, Mymensingh, Rājshāhi and Rangpur districts of Bengal and Cooch Behār State of Eastern States Agency in sheets 78 C and G.

The field headquarters of the party opened at Chittagong on 28th October 1937 and closed on 11th April 1938.

101. Personnel.—The strength of the party was 1 Class I officer, 5 Class II officers, 5 Upper Subordinate officers, and 36 Lower Subordinates including 26 surveyors.

102. Areas surveyed.—

4·9 square miles of 2-inch original town survey for 1-inch mapping.
3,139 square miles of 1-inch original survey.
555 square miles of ½-inch original survey.
200 square miles aproximately of ½-inch correction survey.
675 square miles of triangulation for 1-inch survey, the reconnaissance of which had been completed last season.
1,116 linear miles of traversing.

103. Field work was organized as follows:—

Camp (1).—Mr. W. H. Strong, M.B.E., (Class II) and 10 surveyors completed 529 square miles of original survey on the 1-inch scale and 555 square miles of original survey on the ½-inch scale, in sheets 84 C and 79 O. This camp was closed at the end of February on Mr. Strong being transferred to the Geodetic Branch, and the suveyors were distributed to the other two camps.

Camp (2).—Mr. A. R. Quraishi (Class II) with Mr. A. P. Datta (U. S. S.) and Mr. C. H. Fernandez (U. S. S.) for two months only, and 8 surveyors completed 1,203 square miles of original survey on the 1-inch scale in sheet 79 N.

Camp (3).—Mr. A. Ahad (Class II) with Messrs. L. J. Bagnall and N. L. Gupta (both Class II), Mr. Hari Singh, for two months only, and Mr. S. B. P. Mathur (both U. S. S.), and an average of 13 surveyors completed 1,407 square miles of original survey on the 1-inch scale in sheets 79 N and O, as well as 4·9 square miles of Chittagong town survey on the 2-inch scale for 1-inch mapping.

In all camps field blue prints were utilised. The material for these blue prints was obtained from the Survey of India preliminary editions for the areas of plain in Noākhāli and Chittagong districts of Bengal, while for the hilly and heavily wooded portions of Chittagong district, 1-inch reductions from 4-inch air surveys were used and proved to be of great value.

Nokhu Expedition.—In December, Surveyor K. S. Loverwell accompanied the Nokhu punitive expedition to the Control and Tribal Areas adjoining the Nāga Hills district of Assam, and completed approximately 200 square miles of correction survey on the ½-inch scale in sheets 83 J, K, N and O.

Triangulation.—Mr. Hari Singh (U. S. S.) carried out triangulation of 675 square miles in sheet 78 G, the reconnaissance for which was completed by him in season 1936-37.

Traverse.—Rigorous traverse was carried out in sheets 78 C and G for 1-inch survey for season 1938-39.

A total of 1,116 linear miles of traverse was completed by the party.

104. Description of country.—The area surveyed by camp (1) in Chittagong district and Chittagong Hill Tracts of Bengal and in Akyab district of Burma consisted mostly of dense jungle clad hills, rising in Burma to 2,500 feet and included part of the Mātāmuhari Reserved Forest in Chittagong Hill Tracts. The hills were drained by intricate systems of *nālas* and divided by cultivated plains.

An area of coastal plain, interspersed with tidal creeks and channels, was also surveyed in Chittagong district.

In camp (2) the area in Noākhāli district of Bengal, consisted mostly of heavily populated cultivated plains, and included the survey of coastal areas and some large and small islands in the Bay of Bengal.

Camp (3) had considerable areas of low densely forest-clad hills with tortuous drainage systems and divided by broad and densely populated cultivated plains, in Chittagong district and Chittagong Hill Tracts.

Communications throughout were good, except in the eastern parts of the area of camps (1) and (3) where only coolie transport was available.

105. Miscellaneous.—

Health.—There were several cases of malaria, but on the whole the health of the party was good. One surveyor contracted black-water fever early in the season and was invalided from the area.

Weather.—Throughout the season remained fair.

Fauna.—A few traces of wild elephant and deer were found in the jungles of Chittagong Hill Tracts and Burma. Jungle fowl and pheasant abound in the hills of Chittagong district and snipe in certain coastal areas. A few duck were found in the islands of Noākhāli district.

106. Recess duties.—The party was organized in three drawing sections under Messrs. O. D. Jackson, A. R. Quraishi and A. Ahad (all Class II).

The 18 1-inch sheets surveyed during the season were fair mapped.

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

VIII.—SURVEY REPORTS, INDEPENDENT PARTIES.

107. No. 6 (South India) and Burma Survey (late No. 10 Burma) Independent Parties are administered directly by the Surveyor General. Their mapping and survey areas are approximately the same as those of the former Southern and Burma Circles respectively, abolished in 1932.

No. 6 (South India) Party.

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

108. General.—The party was engaged on 1-inch and ½-inch topographical surveys in Bastar State, Central Provinces, Madras and Orissa and also on triangulation and theodolite traverse for the control of next season's 1-inch survey in Bombay and the Deccan States. The camp allotted to work in Bastar State, Central Provinces and Orissa, took the field at the beginning of October. Triangulators, traversers and the remaining field personnel took the field at the end of November. Field headquarters was established at Nidadavolu in West Godāvari district on 26th November. All field personnel had returned to recess in Bangalore by the end of April.

109. Personnel.—Field strength was 2 Class I, 3 Class II and 6 U. S. officers and 42 surveyors.

The strength of the permanent Drawing Section at Bangalore engaged on compiled mapping, computing and miscellaneous drawing was 1 Class II and 2 U. S. officers, 5 draftsmen, 7 surveyors and 2 computers.

110. Areas surveyed.—

4,304 square miles of 1-inch original survey.
1,120 square miles of ½-inch original survey.
5,337 square miles of triangulation.
257 linear miles of traverse for control of approximately
494 square miles of future 1-inch survey.

111. Field work was organized as follows:—

Camp (1).—Mr. P. A. Thomas (Class II) with 1 U. S. officer and 12 surveyors completed 280 square miles of 1-inch original survey in Bastar State and in Koraput district of Orissa in sheet 65 E as well as 1,120 square miles of ½-inch original survey in Bastar State, in Raipur district of Central Provinces and in Koraput district of Orissa in sheet 65 I. 6 surveyors of this camp were subsequently transferred to camp (5).

Camp (2).—Mr. E. N. Natesan (Class II) with 9 surveyors completed 1,139 square miles of 1-inch original survey in Kistna and in West Godāvari districts of Madras in sheet 65 H.

Camp (3).—Mr. K. B. Muthanna (U. S. S.) with 5 surveyors completed 702 square miles of 1-inch original survey in Kistna and in West Godāvari districts of Madras in sheet 65 H.

Camp (4).—Mr. H. N. Murti Rao (U. S. S.) with 6 surveyors completed 757 square miles of 1-inch original survey in West Godāvari and in East Godāvari districts of Madras in sheet 65 H.

Camp (5).—Mr. M. R. Nair (Class II) with 1 U. S. officer, 10 surveyors and 6 surveyors transferred from camp (1) completed 1,426 square miles of 1-inch original survey in West Godāvari and in East Godāvari districts of Madras in sheets 65 H and L.

Triangulation.—Lt. R. C. A. Edge, R.E. (Class I), triangulated an area of 1,067 square miles in Belgaum, Dhārwār and North Kanara districts of Bombay in sheet 48 I. Mr. M. A. Azim, I.D.S.M. (U. S. S.), reconnoitred an area of 3,990 square miles in Belgaum and Bijāpur districts of Bombay and in the Deccan States in sheet 47 P. Stations and points of old triangulation were identified and flagged and the existing framework supplemented where found necessary. Mr. B. B. Kuttappa (U. S. S.), the Assistant Camp Officer of camp (1), triangulated the 280 square miles of Bastar State and Koraput district which was surveyed on 1-inch scale by this camp.

Traverse.—Mr. A. Shamanna (U. S. S.) supplemented Lt. Edge's triangulation by 257 linear miles of theodolite traverse in Dhārwār and North Kanara districts of Bombay in sheet 48 I.

112. Description of country.—In Bastar State and Orissa in sheets 65 E and I, the country surveyed is for the most part an undulating and densely wooded plateau at about 2,000 feet elevation. In the less densely wooded parts, a meagre population terraces the depressions and cultivates paddy in the early months of the cold weather when water is plentiful. There are occasional low hills which, with few exceptions, give only a very limited view of the surrounding country. These were of great assistance to surveyors, but for the most part detail had to be laboriously surveyed by plane-table traverses controlled by occasional fixings made in high tree machans. Outturn in consequence was restricted. In the east, the plateau gives way almost abruptly to lower ground in the Central Provinces and Orissa at about 1,000 feet elevation. The *ghāts* are thickly wooded, but hill tops are often bare and accessible and survey did not present serious difficulties. The lower ground consists of low wooded hills alternating with cultivated riverain plains.

In the Kistna, West Godāvari and East Godāvari districts of Madras in sheets 65 H and L the country varies from undulating uplands north of the Ellore Canal to a densely populated and highly irrigated riverain plain extending almost to the coast. At the mouths of the Godāvari are mangrove swamps. Survey in this area was carried out chiefly by systematic plane-table traverses controlled by the previous two seasons' theodolite traverse framework.

Framework operations were in two very different types of country. In the Bombay areas in sheet 47 P the country is dry, open and undulating. Such hills and ridges as exist are flat topped, villages being located in the intervening depressions where the only available water is to be found. The country presents no serious difficulties to the triangulator.

In the Belgaum, Dhārwār and North Kanara districts of Bombay in sheet 48 I the country is mainly densely wooded plateau and low hills to the Western Ghāts, where the plateau gives way through less heavily wooded hills to the Goanese plain below. The area is sparsely inhabited and malarious from the close of the S. W. monsoon to the end of December. The plateau presented great difficulties to the triangulator. There

are few conspicuous points except evergreen trees which do not show up well till late in the season and then only if in a patch of contrasting bare deciduous forest. Hills are flat topped, and clearing, even for station rays, is often difficult and expensive. An area of about 180 square miles in the Kālīnadi River basin has been reconnoitred only and left for triangulation next season before survey commences.

The traverser's difficulties were not unusual. There are numerous forest tracks which provided him with suitable lines, but as undergrowth in nearly all cases had to be cleared, his progress was slow.

113. Miscellaneous.—The health of the party was good in spite of the reputation for malaria which is held by the portions of Orissa and the North Kanara forests in which the party was employed. Normal precautions, including quinine prophylactic measures were taken and the few cases of malaria in Orissa were effectively treated in a local hospital with atebrin injections and plasmoquin. One khalasi died in Orissa of imported dysentery. A coolie engaged on jungle clearing in North Kanara died as a result of a fall from a tree and one khalasi died of cholera at party field headquarters in West Godāvari.

114. Recess duties.—Fair-mapping of the season's original survey was completed by 5 sections under Messrs. E. N. Natesan (Class II), P. A. Thomas (Class II), H. N. Murti Rao (U.S.S.), K. B. Muthanna (U.S.S.), and B. B. Kuttappa (U.S.S.). A section under Mr. B. N. Murthy (Class II) examined all primary mapping after submission by section officers. Mr. M. A. Azim, I.D.S.M. (U.S.S.), assisted in this section after computing his own triangulation. Mr. B. N. Murthy (Class II) supervised the work of the Computing Section under Mr. A. Shamanna (U.S.S.).

The Drawing Section under Mr. N. S. Harihara Iyer (Class II) assisted by Mr. Kohli (U.S.S.) and Mr. Cabral (U.S.S.) was engaged throughout the year on compiled mapping and miscellaneous duties connected with office copy corrections, records and map sales.

Burma Survey Party.

Officer in charge.—{Major G. F. Heaney, R.E., to 16-4-38.
{Major H. W. Wright, R.E., from 17-4-38.

115. General.—During a protracted field season, from November to June, the party carried out topographical surveys on the 1-inch scale of parts of the high Karen and Shan hills, the Sittang valley and the low forested hills of the Pegu Yomas, as well as triangulation and theodolite traversing for future surveys.

Party headquarters opened at Toungoo on the 16th November 1937 and closed on the 11th May 1938, but the field personnel were not finally withdrawn until the middle of June.

116. Personnel.—The initial field strength of the party was 1 Class I, 3 Class II and 5 U. S. officers, 37 surveyors, 2 computers, 4 clerks and 1 store-keeper. In addition, a Drawing Section under a Class II officer with 1 U. S. officer, 12 draftsmen, 1 clerk and 1 map records clerk, remained in Maymyo throughout the year. 2 draftsmen were invalided and 3 draftsmen were transferred from Calcutta in April 1938.

Mr. D. N. Saha (Class II) and Mr. S. K. Guha (U. S. S.) were invalided out of the area in December and March respectively, while Mr. F. M. Hawley and Mr. C. T. Hurley (Class II) joined the party in the field on 21st April 1938 and 2nd May 1938 respectively, and relieved Mr. C. P. E. Davenport (Class II) of the camps (4) and (3) respectively.

Major H. W. Wright, R.E., relieved Major G. F. Heaney, R.E., on 16th April; Mr. A. F. Murphy (Class II) relieved Mr. C. S. McInnes (Class II) of the charge of the Drawing Section in March 1938.

117. Areas surveyed.—

2,246 square miles of triangulation for 1-inch surveys.
1,190 linear miles of theodolite traversing for 1-inch surveys.
3,110 square miles of 1-inch original survey.
795 square miles of 1-inch supplementary survey.
305 square miles of survey of vegetation and perennial water in areas of previous modern forest surveys.

118. Field work was organized as follows:—

Camp (1).—Mr. H. M. Critchell (Class II) with 9 surveyors reinforced by one surveyor in April, completed 1,367 square miles of 1-inch original survey and 24 square miles of 1-inch supplementary survey in sheets 94 A and B in the Toungoo district, Karenni and the Southern Shan States.

Camp (2).—Mr. D. N. Saha (Class II), who on 13th December 1937 was invalided, and relieved by Mr. A. K. Sen Gupta (U. S. S.) with 13 surveyors decreased by one in November, and by another two in March, completed 1,034 square miles of 1-inch original survey and 480 square miles of 1-inch supplementary survey in sheet 94 A in the Toungoo and Yamethin districts and the Southern Shan States.

Camp (3).—Mr. A. K. Sen Gupta (U. S. S.) relieved by Mr. C. P. E. Davenport (Class II) in December 1937, with 1 U. S. officer and 10 surveyors increased to 12 in March, completed 709 square miles of 1-inch original survey and 291 square miles of 1-inch supplementary survey in sheets 94 A and B in the Toungoo district. Mr. C. T. Hurley relieved Mr. C. P. E. Davenport in May 1938.

Camp (4).—Mr. C. P. E. Davenport (Class II) relieved by Mr. F. M. Hawley (Class II) late in April 1938, with 3 U. S. officers, of whom one was invalided in March, and 7 Lower Subordinates including 2 computers reinforced by a third computer for 2½ months, completed 2,246 square miles of triangulation in sheet 85 M in the Prome, Thayetmyo, Toungoo and Yamethin districts and 1,190 linear miles of theodolite traversing, covering an area of 4,521 square miles in sheets 85 N and O, and 94 B and C in the Henzada, Pegu, Thaton, Tharrawaddy and Toungoo districts.

Three one-inch sheets of the area traversed in 94 B were surveyed during the season. Difficult and unhealthy country compelled the curtailment of the traverse programme.

119. Supplementary Surveys.—1-inch scale reductions of the outline of old style 4-inch scale Reserved Forest maps were printed in blue on the plane-table sections and outline detail checked by surveyors on the ground, where contouring was surveyed in original.

120. Incorporation of post-1905 surveys.—

Blue prints of post-1905 Reserved Forest maps on scale 4 inches to 1 mile with contouring were generalized and inked up and then reduced to scale 1½-inches to 1 mile. These reductions were printed in black and mosaiced.

Reductions on the 1-inch scale of the mosaics covering a total area of 305 square miles were then printed directly on to the planetable sections which were fully inked up in colours in the field in marginal adjustment with adjacent field surveys. The only original work required was the survey of perennial water and of vegetation. This class of work has not been included in table C.

121. Description of country.—The area surveyed comprises high forested hills rising to over 5,000 feet to the east, a flat narrow cultivated plain in the centre, and low densely wooded hills to the west. These low hills are very malarious, have very few paths and a sparse population, mainly Karens who change their village sites about every other year. This area had mostly to be surveyed by plane-table traversing, and presented difficulties in the obtaining of food and transport.

122. Miscellaneous.—

Health.—The health of the party was exceptionally bad, and 1 Class II officer, 1 U. S. officer, 1 surveyor and several of the Maymyo khalasis were invalided out of the area; while some surveyors and a large number of khalasis were admitted into the local hospitals.

Climate.—In the high hills it was cold in winter and fairly pleasant in summer, but in the remainder of the area the temperature rose above 104°F in the shade in the latter part of the season. Unseasonable rains resulted in the loss of many working days and the protraction of the field season into the monsoon caused difficulties and discomforts.

Burmanisation of Khalasis.—The recruitment of new men from India was discontinued experimentally. In addition to the usual recruitment of Burmans as temporary hands, a number of Burmese khalasis were, for the first time, recruited from Maymyo.

123. Recess duties.—The fair mapping of 9 out of the 15 1-inch sheets surveyed was carried out by three drawing sections under Messrs. H. M. Critchell (Class II), C. T. Hurley (Class II) and A. K. Sen Gupta (U. S. S.).

Mr. F. M. Hawley (Class II) was in charge of the Computation Section.

The Drawing Section under Mr. C. S. McInnes (Class II), and later under Mr. A. F. Murphy (Class II), carried out the preparaton of colour patterns and grid originals, reissue work, compiled mapping, maintenance of office copies and map record and issue duties.

Mr. H. M. Critchell (Class II) also supervised the preparation of reserved forest material for supplementary surveys and incorporation during 1938-39 field operations.

IX.—MISCELLANEOUS SURVEY REPORTS.

Training School, Dehra Dūn.

Officer in charge.— Mr. B. T. Wyatt, V.D., to 4-7-38.
Rai Sahib R. B. Mathur, from 5-7-38 to 15-9-38.
Charge held by D. G. B. from 16-9-38.

124. *Class I Probationers.*—After completing his course of instruction in field and recess work in the Training School, Lieut. Gurdip Singh, I.A., was transferred to No. 5 Party (E. C.) during April 1938, for further training. Lieuts. Gambhir Singh, I.A., and Rajinder Singh Kalha, I.A., joined the Training School in November 1937, Lieut. D. M. Clementi, R.E., in March 1938, Lieuts. R. T. L. Rogers, R.E., and L. H. Williams, R.E., in April 1938.

The latter Class I I.A. and R.E. probationers underwent a course of plane-tabling on a large scale and then on the 4-inch and 2-inch scales in the field. They also devoted short periods to triangulation, traversing, levelling, astronomy, etc.

During recess they were given instruction in computing, drawing, reproduction and other branches of survey work, I.A. candidates receiving some supplementary instruction in mathematics.

125. *Class II Probationers.*—Two probationers, after receiving a similar course of instruction, were transferred to No. 4 Party (E. C.) during October 1937 for further training.

126. *Upper Subordinate Service Probationers.*—After a course of instruction in field and recess work, the Geodetic Computer who was appointed in February 1937, was transferred to the Computing & Tidal Party in August 1937 for further training in geodetic work.

PART 4.—MAP PUBLICATION AND OFFICE WORK.

From 1st April 1937 to 31st March 1938.

X.—INTRODUCTION AND PERSONNEL.

127. 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.

128. 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.

129. Personnel.—

Calcutta. Director, Map Publication.

Colonel J. D. Campbell, D.S.O., to 8-10-37.
Lt.-Col. L. H. Jackson, I.A., from 9-10-37 to 28-2-38.
Colonel F. B. Scott, I.A., from 1-3-38.

Chief Draftsman—Mr. F. H. Grant, to 8-12-37 and from 15-1-38.
,, ,, ,, P. C. Mitra, from 9-12-37 to 14-1-38.

No. 1 Drawing Office.

O.C. Mr. M. M. Mudaliar, M.A., to 1-3-38.
,, Lt.-Col. L. H. Jackson, I.A., from 2-3-38.
II Mr. P. C. Mitra, B.A., H. D., to 1-8-37, from 9-10-37 to 8-12-37 and on 15-1-38.
,, ,, J. C. St. C. Pollett, H. D., from 2-8-37 to 8-10-37, from 9-12-37 to 14-1-38 and from 16-1-38.
,, ,, ,, ,, to 17-4-37 and from 19-5-37.
,, ,, A. F. Murphy, to 28-2-38.
,, ,, D. N. Banerjee, L.C.E.
,, ,, M. M. Ganapathy, B.A., from 23-4-37.
,, ,, Mahboob Alam Khan, B.Sc., from 22-11-37.
,, ,, R. N. Hastir.
U.S. ,, Kodandera Ganapathy Mandanna, to 11-12-37 and from 14-3-38.
,, ,, Pratul Chandra Sen Gupta, B.Sc.
,, ,, Girija Sonker Bagchi, to 21-8-37 and from 9-11-37.
,, ,, Atul Chandra Maulick.
,, ,, Suresh Chandra Chatterjee, B.Sc.
,, ,, Nagendra Chandra Naug, to 11-12-37 and from 3-1-38.

Engraving Office.

Mr. A. R. J. Dalziel, Head Engraver.
,, F. E. Selfe, Asstt. Head Engraver, to 14-11-37 and from 29-11-37.
,, G. J. Shaha, Offg. Asstt. Head Engraver, from 15-11-37 to 28-11-37.

Photo.-Litho. Office.

O.C. Lt.-Col. W. J. Norman, M.C., R.E.

Managers & Assistant Managers.

Mr. S. Colquhoun, Manager, Litho.
,, F. R. Vandyke, Manager, Photo., to 15-9-37 and from 8-12-37 to 2-1-38.
,, L. H. Mordue, Offg. Manager, Photo., from 29-1-38.
,, ,, ,, Asstt. ,, Litho., to 21-4-37.
,, H. G. Phillips, Offg. Asstt. Manager, Litho., from 22-4-37.
,, K. L. Dev, Asstt. Manager, Photo.

Map Record and Issue Office.

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

Mathematical Instrument Office.

Mr. S. Woodhouse, Superintendent, retired, from 4-8-37.
,, R. C. Malcolm, F.R.M.S., F.R. Met. soc., Offg. Supdt., to 3-8-37.
,, ,, ,, ,, Supdt., from 4-8-37 to 29-3-38.
,, A. Lacamp, Offg. Supdt., from 30-3-38.
,, ,, ,, Asstt. Supdt., to 29-3-38.

Dehra Dūn. Director, Geodetic Branch.

Colonel C. M. Thompson.

No. 2 Drawing Office.

O.C. Mr. D. K. Rennick, M.B.E.
II ,, Moquimuddin Ansari, B.A.
,, ,, Jugal Behari Lal.
,, ,, K. C. Gosain, from 8-4-37.
U.S. ,, N. M. Bopaiah.

Forest Map Office.

II Mr. F. C. Pilcher, C.D., to 30-9-37.
,, ,, F. W. Smith, from 4-9-37 (C.D. from 1-10-37).
U.S. ,, B. B. Shome, to 8-11-37.
,, ,, N. C. Roy, from 18-7-37.

Computing & Tidal Party.

O.C. Major G. Bomford, R.E.

Photo.-Zinco. Section.

Mr. S. C. Aratoon, to 1-4-37.
,, H. J. Peychers, from 2-4-37.

Letterpress Printing Section.

Mr. H. H. Williams.

Simla. Director, Frontier Circle.

Colonel S. W. Sackville Hamilton, D.S.O., to 30-9-37.
Lieut-Colonel E. A. Glennie, D.S.O., R.E., from 1-10-37 to 19-10-37.
Colonel J. D. Campbell, D.S.O., from 20-10-37.

No. 6 Drawing Office.

O.C. Lt.-Col. E. A. Glennie, D.S.O., R.E., to 12-11-37.
,, Lt. D. E. O. Thackwell, R.E., from 13-11-37.

SURVEY SECTION.

II Mr. H. M. Critchell, to 30-9-37.
,, ,, Chuni Lal Kapur, R.S.
,, ,, B. N. Murthy, B.Sc.
,, ,, M. D. Nangia, B.A., from 20-8-37.
,, ,, Tirlochan Singh, C.E., from 3-9-37 to 8-10-37.
U.S. ,, Ghulam Hasan.
,, ,, Khushal Khan, from 13-6-37.
,, ,, G. C. Aggarwala, B.A.

ARMY SECTION.

Captain T. A. Whitmarsh, H.D., from 22-2-38.
S/Cdr. J. G. Wilson, H.D., to 21-2-38.

Shillong. Director, Easter Circle.

Colonel F. J. M. King.

No. 5 Drawing Office.

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

Bangalore. No. 6 (South India) Party.

O.C. Major G. W. Gemmell, I.A.
I Lieut. R. C. A. Edge, R.E., from 2-9-37.
II Mr. N. S. Harihara Iyer.
,, ,, E. N. Natesan, B.A.
,, ,, M. D. Nangia, B.A., to 19-4-37.
,, ,, M. R. Nair, B.A.
,, ,, P. A. Thomas.
U.S. ,, H. Narasimha Murti Rao, B.A.
,, ,, J. A. Cabral, from 28-9-37.
,, ,, Mohabat Lal Kohli.
,, ,, Muhammad Abdul Azim, I.D.S.M.
,, ,, K. B. Muthanna.
,, ,, B. B. Kuttappa.
,, ,, Muhammad Mustafa, to 11-6-37.
,, ,, A. Shamanna
,, ,, M. A. Faruquie, B.A.

Maymyo. Burma Survey Party.

O.C. Major G. F. Heaney, R.E.
II Mr. F. W. Smith, to 3-9-37.
,, ,, C. S. McInnes, to 21-3-38.
,, ,, A. F. Murphy, from 14-3-38.
,, ,, H. M. Critchell, from 21-10-37.
,, ,, C. P. E. Davenport.
,, ,, D. N. Saha, to 13-12-37.
U.S. ,, A. K. Sen Gupta.
,, ,, H. K. Kar.
,, ,, A. K. Talapatra, B.A.
,, ,, Muhammad Mustafa, from 28-6-37.
,, U On Ba, A. T. M., from 1-8-37.
,, Mr. S. K. Guha, from 9-9-37.

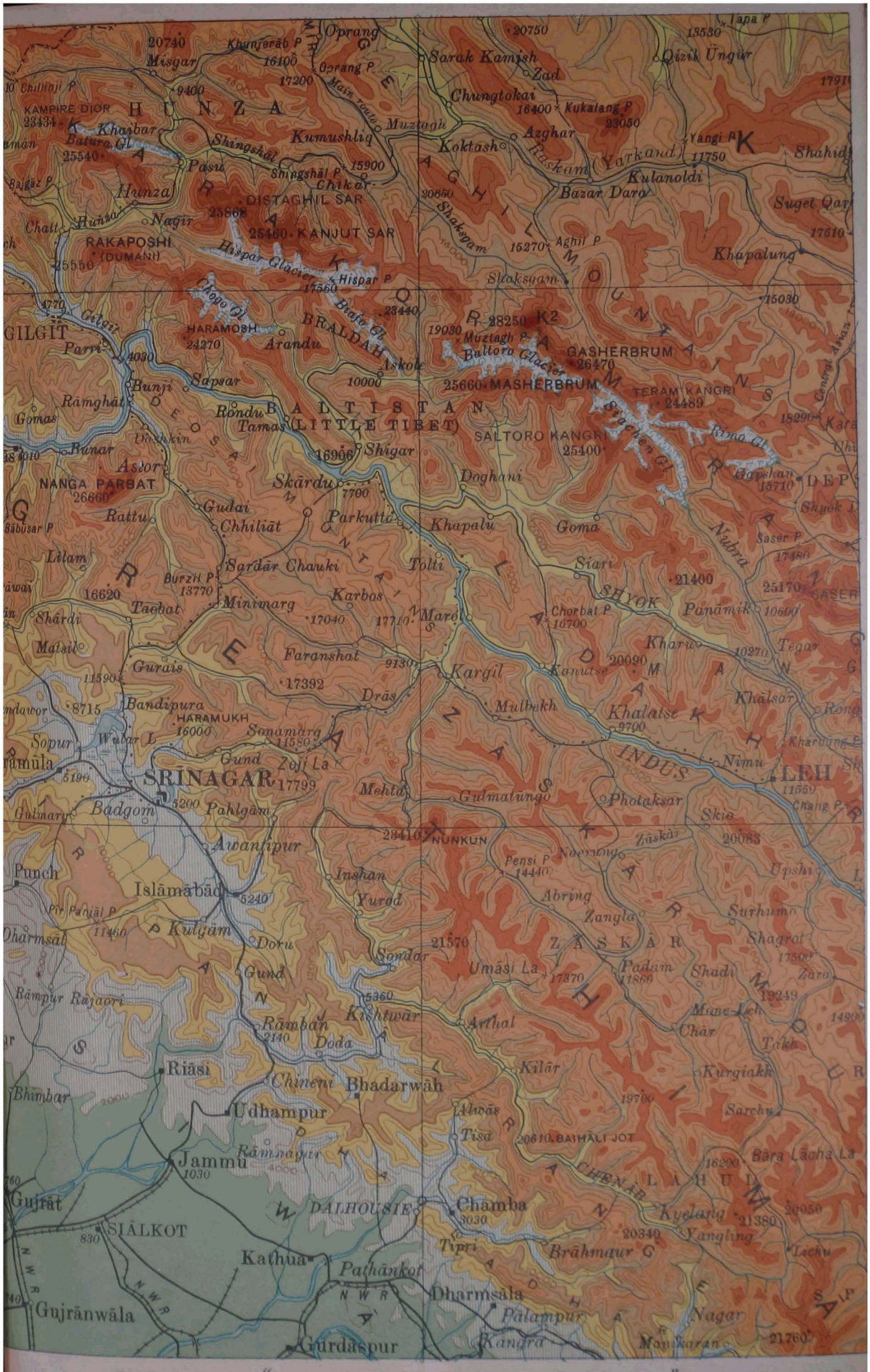
XI.—PUBLICATIONS AND ISSUES.

130. 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 1937-38.

Class of maps.	Scale.	New publications.	Revised editions, new editions and reprints.	Number of copies printed.	Value. Rs.
GENERAL MAPS.	*Departmental.*				
Maps of India	Various	1	3	7,854	9,759
GEOGRAPHICAL MAPS.					
Southern Asia Series ...	1:2 million	...	2	432	864
India and Adjacent Countries Series	1:1 million	1	27	10,998	17,461
Carte Internationale du Monde	,,	...	9	2,704	5,408
TOPOGRAPHICAL MAPS.					
Quarter-inch, Modern ...	1″=4 miles	16	33	22,660	34,773
,, (Prely.) ...	,,	1	...	428	642
,, (Provl.) ...	,,	...	2	622	622
Half-inch, Modern ...	1″=2 miles	36	13	24,861	49,985
One-inch, Modern ...	1″=1 mile	60	180	159,657	2,46,295
,, (Prely.) ...	,,	...	10	10,676	17,575
,, (Provl.) ...	,,	1	1	5,474	5,474
Old style maps	Various	...	2	429	705
SPECIAL MAPS.					
Provincial maps	Various	...	3	1,554	3,770
City & Town Guide maps ...	,,	...	2	1,106	2,712
Index maps	,,	3	56	41,645	3,806
Miscellaneous maps ...	,,	12	37	29,450	6,981
Total ...	.....	**131**	**380**	**320,550**	**4,06,632**
	Extra-departmental.				
Manœuvre and Radius maps ...	Various	.....	12	8,343	27,753
Other maps	,,	181	33	34,280	16,024
Plans and diagrams ...	,,	61	9	18,915	2,353
Illustrations	.....	257	1	60,893	9,373
Miscellaneous	.....	39	8	198,737	7,289
Total ...	.....	**538**	**63**	**321,168**	**62,792**
	Maps published for the Govt. of Burma.				
General & Geographical maps	Various	.....	1	219	463
Topographical maps ...	,,	20	9	11,443	15,551
Special maps	,,	.....	2	720	514
Total for Burma ...	.....	**20**	**12**	**12,382**	**16,528**
Total Extra-departmental	.....	**558**	**75**	**333,550**	**79,320**
Grand Total ...	.....	**689**	**455**	**654,100**	**4,85,952**

NOTES.—*Calcutta.*—In addition to the work shown in Table I(*a*), 16,295 copies of 165 maps were gridded during the year.



Portion of map "Highlands of Tibet & Surrounding Regions," 1936

Scale 1:2,500,000

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

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
		Departmental.			
Cantonment maps ...	Various	3	47	6,606	3,970
Forest maps ...	4″=1 mile	1	55	4,234	4,115
Miscellaneous ...	Various	31	77	38,945	14,193
Total ...	...	**35**	**179**	**49,785**	**22,278**
		Extra-departmental.			
Maps	Various	39	20	6,180	5,072
Plans and diagrams ...	,,	11	13	12,264	770
Charts	,,	...	17	2,052	276
Forest maps ...	,,	31	5	2,146	3,974
Total ...	...	**81**	**55**	**22,642**	**10,092**
Burma maps (Cantonment & Forest) ...	4″=1 mile	...	6	537	468
Total Extra-departmental ...	...	**81**	**61**	**23,179**	**10,560**
Grand Total ...	...	**116**	**240**	**72,964**	**32,838**

NOTES.—*Dehra Dūn.*—In addition to the work shown in Table I(*b*) above, 2,802 prints of 443 originals, consisting of plane-table sections, triangulation charts and forest maps, &c. were printed. 45 chocolate prints and 36 Bromide prints were also printed and 494 prints of 144 originals for Burma Survey Party.

Table I(*c*)—Maps published at Quetta.

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
		Departmental.			
Maps	Various	12	2	69	310
Plans and diagrams ...	,,	16	1	117	88
Charts / Forms	,,	12	19	4,136	474
Total ...	...	**40**	**22**	**4,322**	**872**
		Extra-departmental.			
Maps	Various	5	27	631	500
Plans and diagrams ...	,,	4	...	271	19
Charts / Forms	,,	2	...	190	11
Total ...	...	**11**	**27**	**1,092**	**530**
Grand Total ...	...	**51**	**49**	**5,414**	**1,402**

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

Class of maps.	Scale.	New publications.	Reprints and new editions.	Number of copies printed.	Value. Rs.
		Departmental.			
Maps	Various	...	...	901	1,401
Plans and diagrams ...	,,	...	...	.....	.....
Charts, Forms } including panoramas	,,	...	...	7,889	551
Total ...	...	...	...	**8,790**	**1,952**
		Extra-departmental.			
Maps	Various	...	...	2,762	656
Plans and diagrams ...	,,	...	...	.....	.....
Charts, Forms } including panoramas	,,	...	...	669	233
Total ...	...	...	...	**3,431**	**889**
Grand Total ...	...	...	...	**12,221**	**2,841**

Table II *(a)*—India—Abstract of Modern Topographical Maps.

	One-inch maps.	Half-inch maps.	Quarter-inch maps.
Topographical maps published in 1937-38	60	36	16
,, ,, published in previous years	3,132	922	308
Total published ...	**3,192**	**958**	**324**
Number of sheets in India ...	**5,185**	**1,344**	**377**

Table II *(b)*—Burma—Abstract of Modern Topographical Maps.

	One-inch maps.	Half-inch maps.	Quarter-inch maps.
Topographical maps published in 1937-38	18	1	.....
,, ,, published in previous years	588	189	57
Total published ...	**606**	**190**	**57**
Number of sheets in Burma ...	**1,033**	**286**	**73**

Table III.—Letterpress publications.

(a) PUBLISHED AT CALCUTTA.

1. General Report of the Survey of India: 1937. (425).
2. Supplement to the Survey of India Reports, 1937. (125).
3. Survey of India Notes,—issued monthly. (3,000).
4. List of Maps Published,—issued monthly. (4,800).
5. Supplementary List of Maps Published,—issued quarterly. (2,000).
6. Map Policy—Departmental Paper No. 16 of the Survey of India. (200).
7. Government of India Orders. (2,000).
8. Corrigenda to Government of India Orders. (700).
9. Correction slips to Handbooks of Topography, Border Specimen, Map Catalogue, etc. (48,353).
10. Calendars for 1938. (1,170).
11. Miscellaneous. (1,511).

(b) In hand at Calcutta.

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

(c) PUBLISHED AT DEHRA DŪN.

1. Geodetic Report, 1936. (350).
2. Tide Tables for the Indian Ocean, 1938. (1,200).
3. Tide Tables, Hooghly River, 1938. (275).
4. Do. Bombay, 1938. (875).
5. Do. Rangoon, 1938. (800).
6. Levelling Handbook VI. (250).
7. Secondary Levelling Pamphlets (Gestetnered). (140).
8. Addendum to Triangulation Pamphlets. (340).
9. Addendum to Geodetic Report, 1936. (100).
10. Correction slips to Handbooks of Topography and Pamphlets. (2,150).
11. Annual Returns. (100).
12. Notes for Survey Training School (Gestetnered). (200).
13. List of Bench Marks. (95).
14. Miscellaneous. (220,113).

(d) In hand at Dehra Dūn.

1. *Geodetic Report, 1937.*
2. *Tide Tables for the Indian Ocean, 1939.*
3. *Auxiliary Tables III.*
4. *Handbook of Topography, Chapter II.*
5. *Handbook of Topography, Chapter IX.*
6. *Levelling Pamphlets 43 and 41.*
7. *Supplement to Levelling Pamphlet 47.*
8. *Supplement to Geodetic Report, 1937.*
9. *Addenda to Levelling Pamphlets 78 and 79.*
10. *Takhtewālon Ke liye hidāyāt.*
11. *Miscellaneous.*

131. Map Issues.—From Table IV below it will be seen that the total sales by the entire department during the year 1937-38 were 721,992 copies, value Rs. 2,91,144, as against 456,141 copies, value Rs. 2,91,232, sold during the previous year.

The Map Record and Issue Office's total sales of departmental maps were 199,881 copies, value Rs. 1,96,302, as against 192,564 copies, value Rs. 1,97,263, sold during the previous year.

The total number of extra-departmental maps issued by the Map Record and Issue Office was 474,524 copies, value Rs. 52,900.

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

The number of maps transferred to the High Commissioner for India, London and the Circle offices for stock and issue was 31,995 copies, value Rs. 52,500 and as a result of separation of Burma 260,359 copies of maps and 3,996 copies of index charts relating to Burma were finally transferred to the Curator, Govt. Book Depot, Burma, Rangoon.

Table IV.—Maps issued by Survey units.

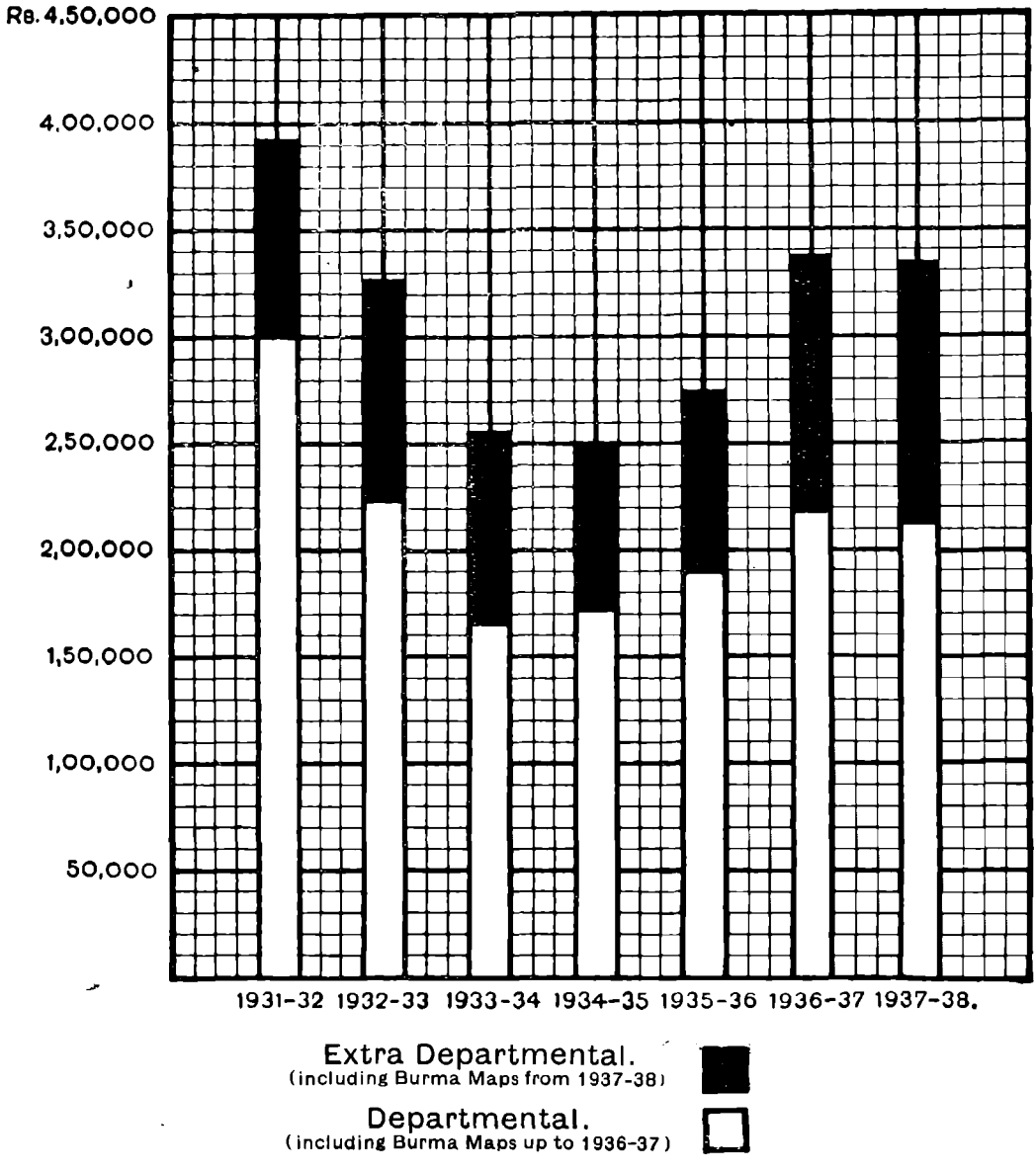
D=Departmental. X=Extra-departmental.	SALES.								FREE ISSUES.
	GOVERNMENT OFFICIALS.		ARMY AND ROYAL AIR FORCE.		PUBLIC.		TOTAL.		
	Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.
Calcutta D	25,304	25,407	1,34,303	1,17,155	40,274	53,740	199,881*	1,96,302*	12,970
X	389,424	33,239	15,846	10,955	69,254	8,706	474,524	52,900	6,628
Burma Maps X	12,382	16,528	.....	.....	.....	.....	12,382†	16,528	.....
Dehra Dūn D	1,449	4,118	2,917	2,857	925	1,400	5,291	8,375	7,215
X	16,352	5,031	1,868	1,456	571	795	18,791	7,282	4
Burma Maps X	27	41	.....	.....	.....	.....	27	41	.....
Simla D	251	407	6	20	182	321	439	748	493
X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Murree and Lahore ("A" Company) D	6	12	9	22	1	1	16	35	573
X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Quetta and Karāchi Cantonment("E" Company) D	373	598	1,731	1,458	62	104	2,166	2,160	251
X	480	328	139	115	473	87	1,092	530	.....
Murree and Risālpur (No. 18 Party) D	.....	.....	.....	.....	.....	.....	.....	.....	8,790
X	.....	.....	3,431	889	.....	.....	3,431	889	.....
Bangalore D	66	138	79	111	1,998	2,980	2,143	3,229	278
X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Shillong D	347	613	72	70	390	712	809	1,395	1,062
X	.....	.....	.....	.....	1,000	730	1,000	730	.....
Totals (excluding Burma maps).	434,052	69,891	160.401	1,35,108	115,130	69,576	709,583	2,74,575	38,264
Totals (Burma maps).	12,409	16,569	.....	.....	.....	.....	12,409	16,569	.....
Grand Total ...	446,461	86,460	160,401	1,35,108	115,130	69,576	721,992	2,91,144	38,264

* Excludes 31,995 copies of maps, value Rs. 52,500 issued by the Map Office, Calcutta to the High Commissioner for India and the Survey Circles and Parties, for stock and sale.

† Excludes 260,359 copies of maps and 3,996 copies of indexes transferred to the Curator, Government Book Depot, Burma, Rangoon by the Map Office, Calcutta.

PROGRESS OF MAP SALES

1931—38.



The above diagram represents the aggregate sales of the whole Department. These figures include the costs of maps supplied in various linen-backed styles.

132. Map Record and Issue Office.—Consequent on the separation of Burma this office was called upon to undertake a great deal of work in checking and transferring copies of Burma maps and index charts to the Curator, Government Book Depot, Rangoon.

There was a decrease of 3% in Military demands compared with those of the previous years but a satisfactory prospect for the future is

observed in a 4% increase in maps supplied to the Public. The number of letters received remained virtually the same.

Excluding the value of maps held by the Circle Offices, and the Branch Agency at Calcutta, the approximate value of the Map Record and Issue Office stock on 31st March 1938, was Rs. 31,84,223.

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

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

ARMY AND ROYAL AIR FORCE ...	67%
GOVERNMENT OFFICIALS ...	12%
PUBLIC	21%

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

Class of maps.	CALCUTTA.				DEHRA DŪN.	
	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 Valu Rs.
1/2M Southern Asia Series ...	9,388	16,545	10	19	203	406
1/M India and Adjacent Countries ...	26,158	41,838	192	313	1,419	2,403
1/M Carte Internationale du Monde	2,693	5,539	25	54	330	660
Two-inch maps	10,631	26,884	...	...	4,991	7,486
One-inch maps	1,164,175	17,61,152	4,243	6,255	48,203	72,432
Half-inch maps	371,883	7,41,119	967	1,901	12,336	24,642
Quarter-inch maps	217,222	3,22,366	655	879	6,870	10,110
General maps of India ...	14,159	21,974	85	148	394	456
Provincial and District maps of India	6,017	14,968	23	77	282	678
Cantonment and Town maps (Special and Guide).	48,208	1,10,224	75	128	26,853	53,627
Manœuvre and Radius maps ...	10,840	42,026	5	16	2,756	8,057
Miscellaneous maps	72,740	79,588	24	148	6,094	7,303
Totals ...	1,954,114	31,84,223	6,304	9,938	110,731	1,88,260

XII.—WORK OF DRAWING OFFICES

133. No. 1 Drawing Office, Calcutta.—The following maps have been published during the year under report:—

(*1*) A Political Map of India, showing the different political charges on a scale of 1 inch to 70 miles for the External Affairs Department of the Government of India.

(*2*) A Telegraph Map of India, on a scale of 1 inch to 32 miles, for the Director-General of Posts and Telegraphs.

(*3*) Province Maps of "Bengal" and "Hyderābād" on a scale of 1 : Million.

2. The following maps have been sent for publication:—

(*i*) A Map of India showing Provinces, States and Districts, on a scale of 1 inch to 70 miles.

(*ii*) A reissue of the 50-mile Wall Map of India & Adjacent Countries.

(*iii*) The 19th map completing the set of the Crop Atlas of India, on a scale of 1 inch to 160 miles, for the Director-General of Commercial Intelligence and Statistics.

3. The following maps are in hand:—

(*i*) Province Maps of "Kashmīr & Jammu" and "Bihār" on a scale of 1 : Million, and "Delhi" on a scale of 1 inch to 1 mile.

(*ii*) The revised edition of the 50-mile Road Map of India.

(*iii*) The 40-mile Map of India & Adjacent Countries, based on the revised compilation of the 32-mile Map of India which has ceased to be published.

(*iv*) The Carte Internationale du Monde Maps, on a scale of 1 : Million, of—

N. D-44—Madras.
N. E-45—Jagannāth.
N. F-42—Kāthiāwār.
N. H-43—Delhi.
N. G-44—Allahābād.

4. To avoid duplication of work in producing and maintaining two parallel series of maps in the Department on the same 1 : Million scale, *viz.*—the maps of the India & Adjacent Countries Series (Layered and Unlayered Editions) and the maps of the Carte Internationale du Monde Series, it was decided to give up the former and continue the latter in three editions—

(*i*) the layered edition conforming to the regular Carte Internationale du Monde Series,

(*ii*) the unlayered edition to serve the purpose of the superseded India & Adjacent Countries Series, and

(*iii*) the aeronautical edition showing all aeronautical information by a surprint over the layered edition.

Two sections of the Drawing Office were employed on this new mapping. In addition to carrying out a number of experiments in drawing for the Photo.-Litho. Office in the improved schemes of map

reproduction, these two sections were busy in preparing the preliminary charts and compilation for the 23 Carte Internationale du Monde sheets on a scale of 1 : Million allotted to this Drawing Office and in taking up the drawing of these sheets in batches.

Engraving Office:—In addition to ordinary Departmental work, the following special items of work were engraved—

(*1*) The Panoramic View of the Himālayan Ranges for the Viceregal Lodge at Simla was completed during the year.

(*2*) A new Certificate and Seal for the Imperial Agricultural Research Institute, New Delhi. 300 prints were supplied, the seal being embossed in red.

(*3*) Five new Commission Forms for different Officers of the Indian Army, the total number of prints supplied being 2,900.

(*4*) Two new Certificates of the Indian Order of Merit, one certificate being in English and Nagari, and the other in English and Urdu. 25 prints on parchment of each were supplied in black with an illuminated border in red.

The Engraving Office was also engaged during the year carrying out experiments for the Photo.-Litho. Office in engraving the alphabet in different sizes and forms in connection with the scheme of photo.-lettering to be introduced for maps in place of hand-typing.

134. No. 2 Drawing Office, Dehra Dūn.—The 2/5M layered wall map entitled "The Highlands of Tibet and Surrounding Regions" comprising latest exploration surveys has been published.

Of the Īrān $\frac{1}{4}$-inch sheets transferred to the Geodetic Branch, two sheets have been brought up to date against office copy corrections and Sir A. Stein's reconnaissance surveys carried out in 1935-36 for reissue as required. Nine sheets are in hand.

One $\frac{1}{4}$-inch special map of Garhwāl District, Bashahr and Tehri-Garhwāl States and Tibet was prepared and copies supplied to the Political Agent, Sikkim.

The existing originals of the 6-inch "Lay-out Plan of New Delhi" were corrected against corrections received from the Superintending Engineer, Central P. W. D., New Delhi, and the area of the Imperial Agricultural Research Institute drawn as an outrigger for supply of copies, and the plan is at present under publication.

65 Levelling charts of the Sutlej Valley Project lodged in No. 2 Drawing Office were transferred to No. 6 Drawing Office.

135. Forest Map Office, Dehra Dūn.—This office, which is maintained by contributions from the Provincial Governments of Bombay, Central Provinces and Berār, Madras and the United Provinces of Āgra and Oudh and the Government of Burma, continues to meet all demands from these Governments for forest maps. Its main work is the fair drawing of working plans and new editions for various forest officers and the maintenance of the office copies for these provinces, excluding Burma. In addition, it does paid-for-work for non-contributing provinces and Indian States.

136. Map Record and Business Section, Dehra Dūn.—This section continues to be responsible for the storage, despatch and

sales of publications and forms, and the collection of bills for all supplies and extra-departmental work carried out by the Geodetic Branch. It stores all originals of departmental maps published in the Geodetic Branch and of cantonment and forest maps with their published prints, and carries a small stock of Survey of India maps for issue within the department and for sale to the public.

137. No. 6 Drawing Office, Simla.—

Survey Section.—The following work was done in addition to that reported in Tables VI to VIII:—

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

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

(*b*) At the request of the Superintendent, Viceregal Estates, a trace of the Viceregal Lodge "Retreat", Mashobra, was prepared and a print prepared from it by the Vandyke process at the Army Section, was supplied to him.

(*c*) Old fair originals of sheets 38 O/9, 43 H/3, 15, 16 and 53 F/SW corrected from correction surveys, together with the newly prepared green tree originals of these sheets except 53 F/SW, were submitted to the Director, Map Publication.

(*d*) Sheet 38 P/2 (outline redrawn, old contour original corrected and green tree original newly prepared) was also submitted to The Director, Map Publication for publication.

(*e*) For reissues, sheet 38 P/3 was corrected and 17 green tree sheets were drawn and submitted to the Director, Map Publication.

Owing to the change in Map Policy, compiled mapping was dropped of all the half-inch sheets except those reported in Tables VI and VIII.

Five pupil draftsmen were entertained for training during the year under report.

This Section also carries a stock of Survey of India Maps for issue within the department and for sale to the public and other departments.

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

The output of work continues to increase.

The output of work from the Vandyke Section was highly satisfactory.

Certain important drawings were carried out during the year, including a special Map of India showing Civil Divisions, and a Map of India showing Railway Communications. Both these maps were drawn for and produced by the Vandyke process.

	TOPOGRAPHICAL.								GEOGRAPHIC						
	1-inch.		½-inch.		¼-inch.		⅛-inch.		1/M.	CARTE INTERNATIONAL					
									I. & A. C.	Layered.		Unlayered.		Aeronauti	
No. 1 Drawing Office—															
Including Engraving Office	...	...	...	...	...	...	...	...	...	...	...	6(a)	...	...	...
Geodetic Branch—															
No. 2 Drawing Office ...	1	6	...	1	9	4	...	...	1*	...	...	...	...	...	...
Forest Map Office ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Parties	1	...	20	12	4	...	...	...	...	...	...	...	...	...	...
Eastern Circle—															
No. 5 Drawing Office ...	2	...	8	2	6	7	...	...	...	...	...	...	...	...	...
Parties	30	1	1	3	...	...	...	...	...	...	...	...	...	...	...
Frontier Circle—															
No. 6 Drawing Office ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Parties	4	...	2	3	...	...	...	...	...	...	...	...	...	...	...
No. 6 (S. I.) Party ...	6	...	5	3	1	5	...	...	...	...	...	...	...	...	...
Burma Survey Party ...	16	...	...	...	2	3	..	...	...	...	...	...	...	...	...
Total ...	60	7	36	24	22	19	...	...	1	...	...	6	...	...	...

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

x-**mile** „ 1 inch to *x* miles.

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

1/2M „ 1 : 2 „ „ „ „ 32 „

(*a*) 1st
sty
(*b*) Bihār
(*c*) 40 mi
(*d*) Yunn
(*e*) Naini
(*f*) Tehri
(*g*) Dehr
Ac
Ins

Ta

No. 1 Drawing Office—

Originals corrected against press order proof ...	27
Stock copies of maps corrected	36,778
Miscellaneous cases	422
Mosaics (congregated maps prepared for photography)	7
Circle and Party sheets examined and corrected ...	120
Shaded originals amended	11
Grid originals & Grid cutting lines drawn on originals, examined and corrected.	69
Office copies corrected from various sources ...	3,588
Number of sheets corrected for preparation of fresh plates.	24

No. 2 Drawing Office—

Originals corrected against press order proof ...	1
Mosaics (congregated rough maps prepared for photography)	7
Grid cutting lines on originals drawn and checked ...	6
Party sheets examined, corrected and submitted for publication	30

No. 2 Dr
Copies of
Explorati
Miscellane
Green tree

Forest M
Standard
Sheets col
Areas extr
Originals
Miscellane
Number o

No. 5 Dr
Jamshedp
One-inch
Half-inch
Four-inch

Tabl

New editions—Slight alteratio

Figures in

	TOPOGRAPHICAL.																	
	MODERN, INCLUDING PRELIMINARY EDITIONS.								OLD, INCLUDING PROVISIONAL ISSUES.						1/M		CAR	
	1-inch.		½-inch.		¼-inch.		⅛-inch.		1-inch.		½-inch.		¼-inch.		I. & A. C.		Layer	
No. 1 Drawing Office including Engraving Office—																		
New editions	45	*29* (1)	12	*3*	8(2)	*7*	...	...	*7*	*4*	...	...	3	*7*	...	...	...	
Revised „	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	...	...	*1*
Geodetic Branch—																		
New editions	3	*2*	4	...	3	*2*	...	...	...	...	...	...	...	...	...	...	...	
Revised „	4	*3*	...	...	5	*16*	...	...	...	...	...	...	...	...	3	*5*	...	
Eastern Circle—																		
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Revised „	...	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	
Frontier Circle—																		
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Revised „	30	*26*	1	...	...	*2*	...	...	...	...	...	...	...	...	1	...	...	
No. 6 (S. I.) Party—																		
New editions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Revised „	7	...	...	*2*	...	...	...	...	...	...	...	...	...	...	...	...	...	
Burma Survey Party—																		
New editions	1	*3*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Revised „	...	*1*	...	...	...	*2*	...	...	...	...	...	...	...	...	...	...	...	
Totals ...	**90**	***64***	**17**	***5***	**19**	***29***	...	...	**7**	***4***	...	...	**3**	***7***	**10***	***5***	...	***1***

(1) Includes four preliminary editions.
(2) „ three „ „
(3) Compilation in new style.
(4) 6-inch Calcutta & Howrah guide map.

XIII.—PRINTING AND MISCELLANEOUS.

138. The Photo.-Litho. Office, Calcutta.—The amount of work received during the year was up to the average of the last few years but was well below the average of 1925—30 and the capacity of the office, though owing to military operations the number of sheets (68) printed in May 1937, constitutes a record for one month.

Elimination of Distortion. Attempts to eliminate distortion still continue. Nearly all plane-table sections are now temporarily mounted on metal. Where an un-distorted graticule or blue print had been put on these plane-table sections, they were returned to the P. L. O. at the end of the field season practically without distortion. The result was that they could be mosaiced by photo.-mechanical processes, with a great saving of time and labour. In other cases where the survey blue print was made from a distorted original, the distortion remained and caused further trouble.

It was decided not to mount paper on 3-ply wood or on "Masonite", a wood substitute, as they both distort in the climate of Bengal.

Attempts have primarily been made to mount paper on aluminium. The great trouble is that corrosion is liable to occur. This has been referred to the aluminium manufacturers who say that it is due to impurities in the paper while the paper makers state that the corroding ingredients are put into the paper to improve its lasting qualities and should not be omitted.

It was hoped that zinc would be a suitable substitute for aluminium but some sheets have since been found which have been in store for 18 years and they are very badly discoloured by corrosion.

A certain amount of success has been achieved with shellac as an adhesive but it has very definite limitations; it fails in great heat and also it is difficult to make it adhere evenly.

The experiments being carried out by the Ordnance Survey of drawing on an enamel surface on metal are being closely followed. There is, however, the danger that the enamel may strip off or discolour and it may therefore be somewhat risky to use it for permanent records. Another method which promises well is to put a non-corrosive surface on an aluminium plate and to draw direct on the metal.

New Apparatus and Buildings. The elimination of distortion so far achieved has been sufficient to show up the limitations of the photographic apparatus now in use in Calcutta. A higher standard of accuracy should be possible and is being aimed at. This will necessitate new cameras and new printing frames. It seems desirable to build new accommodation for the zinc printing and powder sections on the roof where they will be as free as possible from dust and will have good light.

Other very desirable improvements are air-conditioning of the printing hall and re-roofing it with a north light, re-roofing of the studios to reduce heat and a supply of really cold water for the dark rooms.

Photo.-lettering. Experiments have been carried out in "photo.-lettering" by means of which the names for entry on maps are produced photographically instead of from type. The system has been in use in America and Canada for some time and experiments on similar lines are being conducted in the Ordnance Survey in England. A lantern similar

to that used in Canada was constructed in the Mathematical Instrument Office but this was not entirely satisfactory as the spacing of the letters was wider than was desirable. A modified lantern using reflected instead of transmitted light has since been made in the Mathematical Instrument Office and is under trial. It is hoped that names will be more legible on maps when produced by this new method, which has also the great advantage of affording an unlimited choice of styles of lettering.

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

Expenditure.	Value of out-turn at office rates.	Negatives prepared.	Zinc plates prepared.	Maps printed.		Impressions pulled.
				Departmental.	Extra-departmental.	
Rs.	Rs.					
3,25,278	3,37,936	5,025	5,946	731	1,982	3,540,031

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

Process Engraving Section.					Type Printing Section.		
Half-tone work.		Line work.		Photogravures.			
Blocks prepared.	Impressions pulled.	Blocks prepared.	Impressions pulled.	Plates prepared.	Items or pages published.	Copies printed.	Impressions pulled.
335	51,813 (Impressions of 226 blocks).	95	11,600 (Impressions of 17 line blocks).	1	1,622	996,601	1,770,590

OUT-TURN OF ENGRAVING OFFICE COPPER PLATE PRINTING SECTION.

Impressions Pulled.				
Photogravures.	Chromo Paper.	Transfer.	Miscellaneous.	Total.
468	585	229	6,469	7,751

139. Photo.-Zinco. Section, Dehra Dūn.—The printing plant of this section consists of one rotary and two flat-bed machines (only one of which is in use at a time). An offset press and three hand presses were in continuous operation during the year printing cantonment and forest maps, diagrams, charts, the Lahore Guide Map and the Layered Map of Highlands of Tibet and Surrounding Regions, as shown in Table I(*b*).

An Apochromat Tessar F. 9 lens and prism have been purchased. This lens allows the use of larger apertures thus shortening exposures while at the same time giving good definition.

A flood-light reflector with switch diffuser and 500-Watt Nitraphot lamp for 220 volt alternating current was obtained. The lamp is being used in No. 2 Studio with good results.

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

Further surprinting of new roads was carried out for the Army.

An extension to the office at Risālpur was built to relieve the congestion in the Reproduction Section, where previously presses and the process camera were installed in one room. The extension was designed so that it forms a new room to take the process camera and a new dark room. A penthouse in the latter room projects into the former so that, when a long focus lens, plan board and plate carrier are procured, the two rooms will form a room camera.

The following presses are in use in 18 Party:—

Two D. E. handpresses.

One Imperial handpress.

One Furnival Portable handpress—23 inches × 21 inches.

Reproduction of originals received:—

In one colour	174
In two colours	25
In three ,, ...	12
Vandyke and helio plates prepared	129
Prints pulled	12,221

141. "E" Survey Company, Quetta.—During the year under report the value of the extra-departmental jobs carried out in the Reproduction Section of this unit was Rs. 1,995 against Rs. 4,306 for the previous year. The decrease in the value of the work done is due to the conditions created by the 1935 earthquake and a fire in September 1937, as a result of which no new jobs could be carried out by photography.

Since the earthquake only two hand presses and one duplicating press have been in use.

Reproduction of originals received:—

In one colour	90
In two colours	7
In three ,, ...	1
In four ,, ...	1
In five ,, ...	1
TOTAL ...	100
Vandyke and helio plates prepared	53
Prints pulled	5,530

XIV.—MATHEMATICAL INSTRUMENT OFFICE.

142. Manufactures, Repairs and Issues.—The year under review shows an increase over the previous year in the sale of instruments by Rs. 38,957, and in the value of work done by about Rs. 2,495.

As usual, the manufactures and repairs covered a wide range of scientific instruments the principal items being as under:—

Manufactures.

Plane-tables	210	Straight edges	13
Plane-table stands	118	Protractors	287
Plane-table covers	162	Scales & offsets boxwood	4,164
Haversacks	200	,, cardboard and mica.	2,508
Drawing boards	217	,, set boxwood	71
T-squares	159	Sight rules wooden and brass of sorts.	207
Stereoscopes folding mirror.	164	Steel band chains	171
Stereoscopes head type	7	Ferrotype printing frames	19
Survey umbrellas	40	Washing Tubs zinc lined	2
Glass jars	1,293	Set squares celluloid	438
Raingauges	118	,, ebonite	1,391
Measure glasses	340	,, set of 9	29
Prismatic compasses with stand.	37	Pantographs	20
Leather cases for tapes	2,293	Clinometers modified pattern, M. I. O.	150
Mason's levels	213		

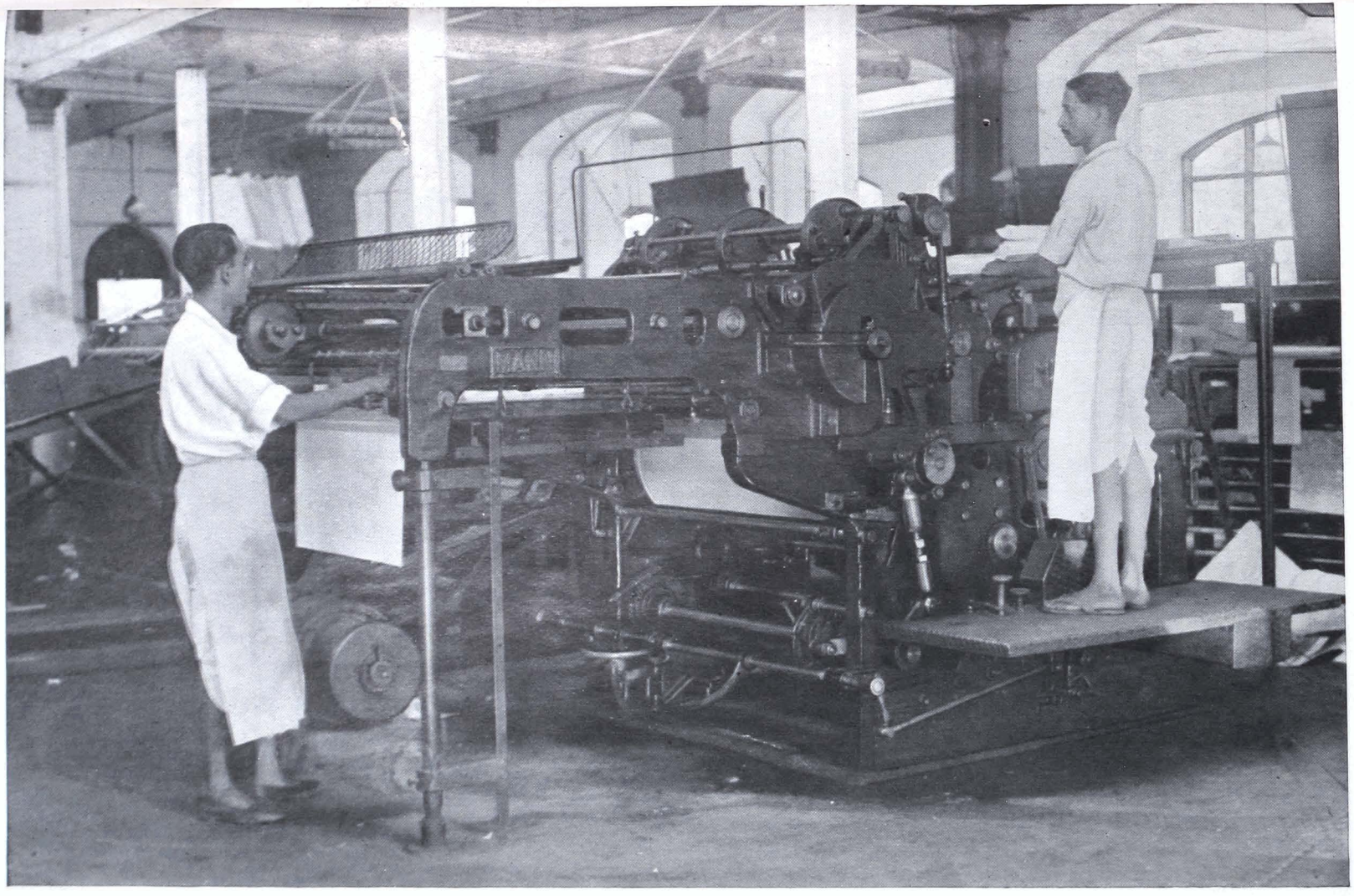
Repairs.

Levels with stand	281	Station Pointers	7
Theodolites ,,	95	Clinometers modified and rigid survey pattern.	13
Drawing-Instrument boxes.	162	Thermometers	44
Levelling staves	51	Parallel rulers	19
Measuring tapes	399	Hygrometers	42
Pantographs	13	Bubble tubes	64
Microscopes	69	Sphygmomanometers	2
Planimeters	71	Watches	63
Barometers	27	Clocks	29
Hydrometers	47		

During the year, the Optical Repair Section re-worked and re-polished 63 lenses and 139 prism. surfaces and repaired 38 microscope objectives and in addition manufactured the following:—

Lenses	1,414	Cover glasses	711
Prisms.	382	Diaphragm glasses	504
Colour glasses	350	Reflecting mirrors	227

Repairs to 3 baumanometers, an epidiascope, a keratometer, refractometers, a colorimeter and planimeters were completed.



A ROTARY OFFSET PRINTING MACHINE, PHOTO.-LITHO. OFFICE.

POLISHING MIRRORS IN THE MATHEMATICAL INSTRUMENT OFFICE.

The Superintendent, M. I. O. has been appointed by the Government of India to certify all Oil Flash Point Testing Apparatus and to be the Officer with whom all the Govt. standard instruments should be deposited. Eleven Testing offices throughout India and Burma have been supplied with certified apparatus.

At the request of the Secretary, Institution of Engineers (India) Ltd., No. 8 Gokhale Road, a selection of over 150 instruments was sent on 10th December 1937 as exhibits of Survey manufacture.

The new on-cost system has been introduced in the workshops with valuable results.

145. Summary.—The following comparative table shows the value of work done during the last three years. It will be noted that there has been a considerable increase during the year under report in the value of stores issued and in the output of the workshops.

	Sale.	1935-36.	1936-37.	1937-38.
		Rs.	*Rs.*	*Rs.*
1.	Total value of stores issued ...	2,51,756	2,46,192	**2,85,149**
	Out-turn in Works:—			
2.	Total value of manufacture of new instruments and components—	1,09,651	1,31,765	**1,69,952**
3.	„ value of repairs to orders— ...	98,826	81,585	**84,080**
4.	„ value of instruments reconditioned for issue— ...	64,434	57,762	**48,356**
5.	„ value of adjustment and cleaning charges	7,284	3,839	**5,582**
6.	„ value of work done in workshops as per items 2 to 5 above—	2,80,195	2,74,951	**3,07,970**
7.	*Book value of stock in—*			
	(*a*) Serviceable store	3,02,100	3,15,206	**2,79,009**
	(*b*) Repairable „	1,46,006	1,50,148	**1,41,308**
	(*c*) Material „	1,36,625	1,43,937	**1,07,089**
8.	*Value of new instruments—*			
	(*a*) Purchased locally	47,491	59,668	**69,913**
	(*b*) Imported through the Store Department, London ...	4,585	12,396	**25,722**
9.	Value obtained by sale of obsolescent and condemned stores ...	3,474	3,773	**2,433**
10.	*Employees—*			
	(*a*) Total number of employees on register on 31st March— ...	336	344	**376**
	(*b*) Cost of employees in workshops including pension contribution	1,38,428	1,42,551	**1,42,061**

In the Glass Graduating Section 1,087 excise jars and 437 rain measuring jars, ½″ and 1″, were graduated.

The Glass Blowing Section manufactured 301 thermometers, 67 factory pattern hygrometers and 372 glass spirit bubbles, and repaired and adjusted 189 thermometers, 47 hydrometers and 42 hygrometers.

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

164 Stereoscopes folding mirror without monoculars, M. I. O., improved pattern.
95 Drawing boards.
64 Thermometers.
381 Agate caps.
156 Celluloid sheets.
142 Set squares celluloid.
260 ,, ,, ebonite.
10 ,, ,, duralumin.
322 Scales.
30 ,, of sets.
4 Ferrotype printing frames.
192 Labels metal instructions.
46 Romers.
90 Plates instruction phonetic alphabet brass.
426 Covers compass glass.
2 Transmitters horizontal Mk. II to VI—telescopic socket bulb holder Mk. I with plug.
6 Position Finders telescope Mk. I with plug.
1 Compass prismatic liquid latest type Mk. II, Barker, with case and sling, M. I. O. make.
9 Compasses, pocket, Mk. VI.
66 T-squares of various sizes.

The following special instruments were manufactured during the year:—

1. One Reducing camera for the Photo.-Litho. Office.
2. One Instrument Sterilizer for the Eye Infirmary, Medical College Hospitals, Calcutta.
3. One Lummer Brodhun Photometer Head for the Executive Engineer, Electrical Division, Calcutta.
4. Two Oil Testing Hardy Type Apparatus for the Chief Controller of Standardization, Railway Board.
5. One each of Eye Test Apparatus for the Eye Infirmary, Medical College Hospitals, Calcutta, and the Mayo Hospital, Calcutta.
6. One sample box with grain and tola weights and scale for the Commissioner of Excise and Salt, Bengal.
7. One Neon Tube Ignition Indicator for the Superintendent, Government Test House, Alipore, Calcutta.
8. Apparatus for use with Brinnell Hardness Test for the Chief Controller of Standardization, Railway Department.
9. A special form of Camera for Chief Controller, Standardization, designed and manufactured for use in recording progressive weathering of paints.

Issues from Serviceable Stores amounted to over 36,228 instruments.

The Stores Section dealt with 16,634 requisitions from workshops.

The Clerical Section dealt with 18,064 letters and the Accounts Section with 5,284 invoices and bills and 1,854 bills and vouchers for the purchase of instruments and materials, etc.

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

	Rs.
Survey of India	48,553
P. W. Departments	83,511
Army Departments	52,185
Railways	37,364
Medical Departments	8,992
Forest Departments	16,068
Education Departments	10,795
Other Civil Departments	52,037
Government Officers, etc. on cash payment...	59,724
TOTAL ...	3,69,229

During the year 2,263 instruments have been deposited by various Govt. departments as no longer required. Credit afforded by this office for the above amounted to Rs. 8,870/13/-. These instruments will be reconditioned for re-issue.

Army surplus and obsolescent stores were sold on behalf of the Director of Contracts, Simla, and a sum of Rs. 1,531/6/- was realised.

Surplus and obsolescent stores and scrap materials belonging to this office were disposed of and a sum of Rs. 902/- realised.

143. Visits and inspections.—During the year the following visited the Mathematical Instrument Office and were shown round the workshops:

60 men of the 2nd Bn., K. O. S. B. in September 1937.

Prof. J. N. Mukerjee of the University College of Science, Calcutta, in September 1937.

25 students of the Ahsanullah School of Engineering, Dacca, who were in Calcutta on an educational tour, at the request of Mr. K. P. Roy, lecturer of the above institution, in October 1937.

Mr. A. C. Roy, Asstt. Inspector of Scientific Suplies in the Stores Department of the High Commissioner's Office, in October 1937.

The Geographical Section of the Science Congress, in January 1938.

Mr. M. W. Yeatts, C.I.E., I.C.S., Joint Secretary to the Govt. of India, Deptt. of Education, Health and Lands, inspected the M. I. O. on 17th March 1938.

144. Miscellaneous.—During the year several small machines were installed and the factory lay-out improved. Additional fans and lighting arangements in accordance with modern practice were also installed.

INDEX MAPS