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SURVEY OF INDIA

GENERAL REPORT

1947



From 1st October 1946
To 14th August 1947

PUBLISHED BY ORDER OF
THE SURVEYOR GENERAL OF INDIA

PRINTED AT THE OFFICE OF THE GEODETIC & TRAINING CIRCLE,
SURVEY OF INDIA, DEHRA DUN, 1949.

Price Three Rupees or Five Shillings.



*Coat of Arms of
Rear Admiral
The Earl Mountbatten of Burma
K.G., P.C., G.M.S., F.R.S., M.P., C.B.E., V.C., K.C.B., D.S.O.*

*Plate - A Specimen of engraving work
done in the Survey of India.*

HOW TO OBTAIN ASSISTANCE FROM THE SURVEY OF INDIA

Applications for surveys of any kind whether for private or Government purposes should be made to one of the following officers :—

- (1) The Surveyor General of India, Old Secretariat, Delhi Civil Lines No. 2. (*Telegrams "SURVEYS"*).
- (2) The Director, Northern Circle, Survey of India, Dehra Dūn. (*Telegrams "SURNORTH"*).
- (3) The Director, Eastern Circle, Survey of India, Shillong. (*Telegrams "SUREAST"*).
- (4) The Director, Southern Circle, Survey of India, Bangalore. (*Telegrams "SURSOUTH"*).

Applications for maps may be made to the Director, Map Publication, Survey of India, Hathibarkala, Dehra Dūn (*Telegrams "SURPUB"*) and to any of the officers mentioned at (1), (3) and (4) above, or to recognized map agents.

Applications for tide-tables or geodetic and other survey data and enquiries on geophysical and geodetic subjects are to be addressed to the President, Geodetic and Research Branch, Survey of India, Dehra Dūn. (*Telegrams "SURSEARCH"*).

Provinces and States contained in each survey circle are as below :—

1. Northern Circle

Ajmer-Merwāra
Bhopal
Central Provinces
Delhi
East Punjab
East Punjab States Union
Greater Rajasthan
Himachal Pradesh
Kashmir & Jammu & Gilgit
Agency
Madhya Bharat
Matsya
United Provinces
Vindhya Pradesh.

2. Eastern Circle

Andaman and Nicobar
Islands
Assam
Bihar
Bhutan
Cooch Behar
Khasi States
Manipur State
Orissa
Sikkim
Tripura State
West Bengal.

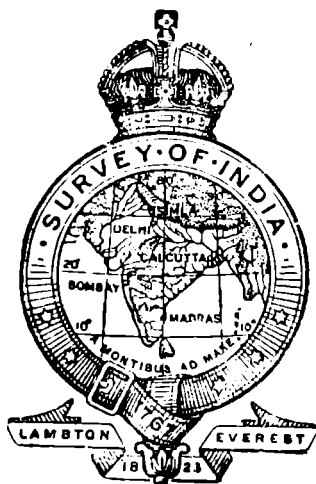
3. Southern Circle

Bombay
Coorg
Hyderabad
Kutch
Madras
Mysore
Saurashtra
Travancore & Cochin.

In general, preliminary applications or enquiries regarding survey work should be made to the Director in whose circle the area to be surveyed falls.

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FOREWORD

The publication of this General Report which is the first of its kind since the end of the second world war has, for a variety of causes, been very much delayed. It is hoped that its successor which will cover the period 15th August 1947 to 31st March 1949 will follow it in the fairly near future.

2. The States and Provinces and the organization of the Survey of India referred to in this report are as they existed prior to the partition of India. The only exception to this is that in the opening note "How to obtain assistance from the Survey of India" the names of Circles and the Provinces and States contained in each are as they exist at the time of going to press.

DELHI :
April 1949

G. F. HEANEY,
Brigadier,
Surveyor General of India.

GLOSSARY

Scales are referred to as follows :—

- (i) for Scales which are multiples of 1/1,000,000—“1/M scale”, “1/6 M scale” &c., which mean “1,000,000 scale”, “1/6,000,000 scale” &c.,
- (ii) 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.,
- (iii) for scales of and larger than 4 miles to one inch—“ $\frac{1}{4}$ -inch scale”, “ $\frac{1}{2}$ -inch scale”, “4-inch scale”, “16-inch scale” &c., which mean “scale of $\frac{1}{4}$ -inch to one mile” &c., &c.,
- (iv) other scales, by their representative fraction, e.g. “1/25,000”.

Serial Numbering of Survey of India maps

Sheets NE-43, NF-44 &c., are sheets on 1/M scale ; (International Numbering).
Sheets 65, 78 &c., are sheets on the 1/M scale ; (now superseded by above).
Sheets 65 K, 78 F &c., are $\frac{1}{4}$ -inch sheets ;
Sheets 65 K/N.W., 78 F/S.E. &c., are $\frac{1}{2}$ -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.

H.L.O. denotes Hathibarkala Litho Office (Dehra Dūn).

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

P.Z.O. denotes Photo.-Zinco. Office (Dehra Dūn).

D.O. denotes Drawing Office.

M.R.I.O. denotes Map Record & Issue Office.

A.I.D. denotes All India Development.

I.C.A.O. denotes International Civil Air Organisation.

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P R E F A C E

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.

Rennell's maps were at first 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 essential in any large survey, but there are a number of other activities, all of them 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 thirty-nine 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 in 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 by the Survey of 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 arrears, owing to the relatively slower pace and incompleteness of the latter, on which 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, which 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 and proper classification of communications.

It was intended that the survey begun in 1905 should be completed in twenty-five years, and then revised periodically every thirty years. Owing, however, to the 1914–1919 war and more recent retrenchments, only about three fourths of the programme had been

completed by 1939, in spite of a reduction of scale for the less important areas.

Although from 1905 to 1939 new surveys were 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.

During the 1939–1945 war, topographical survey work in India practically ceased, and since the conclusion of hostilities the main efforts of the department have been directed to large scale surveys for utilitarian purposes, such as dam sites and areas for irrigation, so that no appreciable progress has been made since 1939 in the 1905 topographical programme.

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 usually on scales of about 3 inches to the mile, where the 1-inch to 1-mile scale is inadequate.

In 1939, a large scale survey of Lahore on scales of 40 and 100 feet to the inch was undertaken, but owing to the war it was impossible to complete publication of all of the 587 sheets involved, until 1946.

Miscellaneous.—So far as work for the Central Government will permit, this department is prepared to undertake local surveys on payment for provinces, states, municipal and other local authorities and private firms; and will give advice as to the methods to be employed on such work. Surveys of the above description include:—

Forest and cantonment surveys.

Riverain and irrigation surveys.

Railway and city surveys.

Surveys of tea gardens and mining areas.

The department is also equipped to carry out lithographic printing and can undertake such work on payment. Requests for printing should be sent to the Director, Map Publication, Survey of India, Hathibarkala, Dehra Dūn, or Deputy Director, Eastern Circle, Survey of India, 13, Wood Street, Calcutta, when estimates of time and cost will be provided.

Air Survey.—The use of air photographs for survey purposes has become a normal practice and air survey is employed wherever it is considered advantageous to do so. The Survey of India has arranged with a company in India for the supply, on contract rates, of such photographs as it may require for survey purposes.

Air photographs in pairs for stereoscopic examination or made up in the form of mosaics are very often of value in inspecting sites prior to undertaking detailed survey operations, or may sometimes render these unnecessary. Any demands for air photographs or mosaics should be forwarded to the office of the Surveyor General in Delhi or to one of the Circle Directors who will give quotations.

It may be noted that under the orders of the Government of India all demands for air photography from departments of the Central Government must be placed through the Survey of India.

Military requirements.—Prior to the 1939–1945 war, the Survey of India was responsible for all survey operations required by the Army. During the war, a Military Survey Service was formed and this Service is likely to be retained by the Army in peacetime as a permanent measure. This arrangement will relieve the Survey of India of a considerable amount of responsibility for work for the Army, but as the Military Survey Service is likely always to be small, the Survey of India will still be called upon to do a large amount of map production for military purposes.

Civil Aviation.—With the establishment of an International Civil Aviation Organization, India will be required to keep up its share of certain international series of civil aviation maps and charts. Orders giving the specifications for these have not yet been finalized, nor has agreement been reached as to the share of mapping which will be undertaken by each of the member countries of the above Organization.

Administration.—The administration of the Survey of India is in the hands of the Surveyor General of India under the Ministry of Agriculture. The headquarters office of the Surveyor General of India is in the Old Secretariat at Delhi and is under the administration of the Deputy Surveyor General. A technical office is attached to this which can provide estimates and make arrangements for any urgent work. There is also a small map issue office in the Old Secretariat.

There were four regional Directors of Survey Circles in addition to a Director of Map Publication. The headquarters of the latter is in Dehra Dūn. There was also a Director, Military Circle who had a dual civil and military function, being also the Director of Survey, India Command.

The more purely geophysical and mathematical activities of the department were dealt with by the President, Survey Research Institute, Dehra Dūn, who exercised many of the functions formerly exercised by the Director, Geodetic Branch.

SURVEY OF INDIA GENERAL REPORT

1947

From 1st October 1946

To 14th August 1947

I. INTRODUCTION AND SUMMARY.

1. **Annual Reports.**—The publication of the two Annual Reports of the Survey of India namely, the Geodetic Report and the General Report was suspended in 1942 for the duration of the war. The publication of these reports is now resumed from this year in two separate volumes namely :—

(a) *The General Report.*

(b) *The Technical Report.*

These reports will in future normally cover the period of the financial year which begins on 1st April and ends on 31st March. The present reports, however, cover the period from 1st October 1946, to the 14th August 1947, after which date the partition of India was implemented.

The next reports will cover the period 15th August 1947 to 31st March 1949, and thereafter they will cover normal periods of one year as above. The period of the war and up to the 1st October 1946 will be covered by a Special War Report which is now being written in retirement by the late Surveyor General of India, BRIGADIER SIR OLIVER WHEELER, M.C.

The General Report includes an abstract as well as details of topographical and other surveys (in *Part I*), of drawing, map publication and office work, extra-departmental and commercial jobs (in *Part II*), and a brief narrative of Geodetic work preceded by an abstract (in *Part III*). The purpose of this report is to acquaint the Central Government, Provincial Governments, and interested sections of the general public in India and abroad, in plain language free from technicalities, with the activities of the Department during the period under review.

The Technical Report, arranged more or less on the lines of the General Report will contain figures for areas, out-turns and cost rates of surveys (including air surveys), details of surveys, scientific matters and geodetic operations, new technical methods, etc., emphasising the technical aspects of the work carried out, with indexes, photographs and illustrations. It is intended for departmental use as well as for distribution to other survey departments.

Part III of the Technical Report which deals with the Geodetic and Geophysical activities of the Department may be published as a separate volume.

There is also a supplement to the Technical Report for departmental use. This Technical Supplement, as its name implies, is merely to supply details which are of little general interest, but which are required departmentally to record the output of individuals. It will not be printed.

The progress of "modern" (i.e., since 1905) topographical surveys made by the 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. *Index C* shows Project Surveys in hand and the remaining indexes show all the standard maps which have been published up-to-date on various scales. It will be seen from *Index D* 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, are mostly uncontoured, are drawn in the old style and are many years out-of-date; they are consequently excluded from *Index A*.

2. Surveyor General's Office.—BRIGADIER G. F. HEANEY, C.B.E., who took over charge from BRIGADIER SIR OLIVER WHEELER, M.C., on the afternoon of 17th October 1946, held the post of Surveyor General of India throughout the rest of the period under report.

The post of Deputy Surveyor General was held by COLONEL G. F. HEANEY, C.B.E., up to 22nd October 1946, then by COLONEL J. B. P. ANGIN, M.B.E., up to 28th February 1947 and finally by LT.-COLONEL C. A. K. WILSON, O.B.E., R.E.

The posts of the Assistant Surveyor General (Organization) and the Assistant Surveyor General (Administration) were held during the year by RAI BAHADUR D. C. VERMA, M.B.E. and MR. J. L. SAHGAL respectively. The former's health however broke down in May 1947 and he was unable to return to duty and has since retired.

The post of the Survey Projects Officer was held by MR. E. R. WILSON throughout the period.

3. The total cost of the Department for the year ending 31st March 1947, as compared with that of previous years, was as follows :—

	1944-45	1945-46	1946-47	REMARKS
	<i>Rs.</i>	<i>Rs.</i>	<i>Rs.</i>	
Gross actual cost ..	63,12,598(a)	77,51,890†	85,31,682†	(a) Including Rs. 1,59,600 for English charges (High Commissioner) on Stores, and loss or gain by exchange, and Rs. 66,663 for sterling overseas pay, leave salary, family allotments, &c.
Deduct recoveries ..	25,95,145	36,43,965†	46,81,768†	
Nett actual charges..	37,17,453	41,07,925	38,49,914	† These figures are not final.

4. **Departmental Reorganisation.**—During the second world war, the normal civil activities of the Survey of India practically ceased and the whole effort of the Department was directed towards war work. The cessation of hostilities therefore found the Survey of India with large arrears of work to make up, such as replenishment of map stocks, revision of standard maps, completion of the programme of modern surveys and revision of those already out-of-date. At the same time it was faced with a new type of demand, often of extreme urgency, for large scale surveys for irrigation, power and other development projects. (*Index C* at the end of this report shows the location of these surveys).

Consequently a large expansion of the Survey of India was sanctioned by the Government of India in August 1946, and at the beginning of the period under review the Department had a bigger establishment than ever before and a programme of more varied and more urgently required surveys than had ever been its lot in the past.

The August 1946 expansion as a permanent measure was sanctioned on the basis of a strength of 24 Survey Parties (supported by the necessary drawing, computing, directing and headquarters offices) as follows :—

- (i) *Expanded and reorganized cadres of the Survey of India.*
Class I, Class II and Subordinate Supervisory Service.

Survey of India Class I

Surveyor General	1	
<i>Directors</i>		
Regional Directors	4	} .. 7
Deputy Surveyor General)	1	
with Director's status)		
Director, Map Publication	1	
Director, Geodetic Branch	1	

Superintendents

24 Parties	24	}	..	33
Drawing Offices	..	..	5	
Computing Office	..	..	1	
Assistant Director, Map Publication	..	..	1	
Map Record & Issue Office	..	..	1	
Assistant Surveyor General	1	}	..	22
<i>Assistant Superintendents</i>	..	..	..

Survey of India Class II

Extra Assistant Superintendents 85*

Subordinate Supervisory Services

Upper Subordinate Service	95*	}	..	150
Division II Draftsmen and Surveyors, etc., excluding Map Reproduction and Scientific Research Staff	55			

The Department was to be organized into 4 regional Circles each under a Director, designated the Frontier, Central, Eastern and Southern Circles. In addition there were to be two technical directorates and one Deputy Surveyor General with Director's status.

Survey Research Institute.—The abolition of the temporary post of Director, War Research and the creation of a permanent post of President, Survey Research Institute were sanctioned by the Government of India, with effect from 2nd December 1946.

The following permanent posts in the Survey Research Institute were sanctioned by the Government of India with effect from 1st March 1947 :—

- 1 post of Senior Scientific Officer.
- 4 posts of Junior Scientific Officer (later added to Class II Service).
- 4 posts of Scientific Assistants (later added to the U.S. Service).

Map Publication Office.—The following additional permanent posts in the Map Publication cadre were sanctioned by the Government of India with effect from 1st May 1947 :—

- 1 Deputy Director, Map Publication.
- 1 Chief Manager (General Central Service Class I).
- 2 Managers (General Central Service Class II).
- 4 Assistant Managers (General Central Service Class II).
- 1 Electrical Engineer (General Central Service Class II).

The creation of a permanent post in the Division II Technical Assistant, for the Letter Press Printing Office of the Geodetic Branch was also sanctioned by the Government of India.

Raising and Transfers of Units.—To meet the demands for Irrigation Project surveys, three new Parties Nos. 9, 10 and 11 raised during August–September 1946 in the Frontier Circle were transferred to the Eastern Circle. The headquarters of Nos. 9 and 11 Parties were eventually moved to Mussoorie and those of No. 10 Party to Kurseong owing to shortage of accommodation in Shillong.

No. E Party and the Punjab Irrigation Party were redesignated as “ No. 2 Party ” and “ No. 13 Party ” respectively with effect from 20th November 1946.

The Burma Survey Party was disbanded with effect from the afternoon of 15th January 1947. It had been kept in being after the evacuation of Burma in 1942 to maintain the accounts of personnel of that party.

The headquarters of No. 7 Party were transferred from Murree to Abbottabād with effect from 1st March 1947.

The Government of India approved of the permanent transfer of the headquarters of the Eastern Circle from Shillong to Calcutta with effect from 1st March 1947 or some later date.

The Map Publication offices at Calcutta were transferred from the administrative control of the Director, Map Publication to that of the Director, Eastern Circle, with effect from 1st March 1947.

No. 13 Party was transferred from the Frontier Circle to Geodetic Branch with effect from 1st August 1947.

The personnel of No. 4 Party were transferred from the Frontier Circle early in August 1947 to No. 15 Party under the Geodetic Branch, and the latter party became the training party for officers.

Two new parties designated No. 16 and 19 Parties were formed with their headquarters at Comilla and Murree respectively, with effect from 11th August 1947.

5. Noteworthy Events.—

Training of Afghan Officers.—On completion of training with the Survey of India, two Afghan officers out of the remaining batch of six officers returned to Afghanistan in October 1946.

Historical Records of the Survey of India.—The first volume of a series of Historical Records, prepared by COLONEL R. H. PHILLIMORE C.I.E., D.S.O., was published about the end of 1946. It covers the period upto 1800 and is a history of the period written from an unusual angle, which historians and surveyors alike will find of the greatest interest. It is available from the Director, Geodetic Branch, Survey of India, Dehra Dūn.

Manganese Reef.—The existence of a manganese reef in the Parsoda area (Nāgpur, C. P.) located in 1940–41 by observations with a Gradiometer, was confirmed by the President, Survey Research Institute, in January 1947 through observations with magnetic variometers.

Gravimeter.—A Frost Gravimeter, acquired from the Frost Gravimeter Surveys Inc., Oklahoma, U.S.A., was received in the Survey Research Institute, Dehra Dūn, towards the end of March 1947.

Communal Riots.—In March 1947, violent communal riots broke out in Rawalpindi and soon spread over the whole of the training area in Hazara district. All field work and training of personnel in outdoor work completely ceased for some time. Fortunately there were no casualties among Survey of India personnel.

Pay Commission.—The long awaited report of the Pay Commission was published in May 1947, but the application of the new pay structure to the officers and other personnel of the Survey of India still remained for consideration and final acceptance by the Government of India.

The terms "subordinate" and "inferior" with reference to services were abolished and replaced by "Class III" and "Class IV" respectively.

Partition of India.—To implement the partition of India into Pakistan and the Indian Union with effect from 15th August 1947, the valuation and division of assets of the Department, distribution of technical and office records, arrangements for final or provisional election of personnel for posting in Pakistan or in the Indian Union, etc., had to be completed with the utmost expedition. As this was a most formidable task, a committee consisting of COLONEL G. W. GEMMELL, I.A., Director, Military Circle, and MESSRS. M. D. NANGIA and A. R. QURAISHI representing respectively the rest of India and Pakistan interests was formed for this work. This committee submitted names of personnel for Pakistan and the rest of India as well as lists of files of interest to Pakistan by 15th July 1947. It continued to be engaged on allotment of plant and equipment between the two Dominions, until the end of the period under report.

MAJOR R. C. N. JENNEY, R.E., Director, Frontier Circle, and MAJOR R. T. L. ROGERS, R.E., Director, Eastern Circle, visited Delhi in July 1947, in connection with the setting up of survey organization in Eastern and Western Pakistan.

As a result of the proposed partition of India, two new Survey Parties designated Nos. 16 and 19 Parties were formed with effect from 11th August 1947 and placed under the administrative control of the Director, Frontier Circle, with headquarters at Murree. No. 16 Party was eventually transferred to Eastern Pakistan.

Conferences and Meetings.—MAJOR R. T. L. ROGERS, R.E., Director, Eastern Circle, met at Jogbani, the railhead, on 5th April 1947, DR. RAJENDRA PRASAD the Hon'ble Member for the Department of Food and Agriculture, and MR. C. H. BHABHA, the Hon'ble Member for the Department of Works, Mines & Power, Government of India, during their inspection of the Kosi Irrigation Project in North Bihar and Nepal. He explained to the Hon'ble Members the scope and purpose of the surveys being carried out for the Kosi Project and later received a personal letter of thanks from DR. RAJENDRA PRASAD, who stated that he was most interested in the work of the Survey of India.

A Directors' Conference was held by the Surveyor General of India at Dehra Dūn from 6th to 9th May 1947 inclusive to discuss the survey programme and the allocation of personnel and material to carry it out.

MR. B. L. GULATEE, M.A. (CANTAB.), President, Survey Research Institute, left India in the last week of May 1947, on deputation to the United Kingdom and the United States of America, to visit the U.S. Army Map Service in Washington and the Frost Gravimetric Surveys Inc. in Oklahoma, U.S.A., as well as various instrument manufacturing firms and scientific institutions there, and also to attend the Conference of British Commonwealth Survey Officers to be held in London in August 1947.

The Government of India selected the undermentioned officers of the Survey of India as their official delegates to the Conference of Commonwealth Survey Officers :—

COLONEL J. B. P. ANGWIN, M.B.E.

MAJOR I. H. R. WILSON, R.E.

MR. B. L. GULATEE, M.A. (CANTAB.).

The Government of India also approved of certain other officers of the Survey of India attending the Conference as visitors.

In July 1947, the Surveyor General of India accompanied by the Director, Eastern Circle, conferred with the Director of Land Records, Bengal, and the Chief Engineer, Bengal Irrigation (East) and discussed the effect of partition on various projects falling in East and West Bengal.

A Directors' Conference presided over by the Surveyor General of India was held in Delhi on 28th July 1947. The posting of Survey officers and other personnel to survey centres in Pakistan and rest of India and other matters connected with Pakistan were discussed.

6. Distinguished Visitors.—SIR CHARLES DARWIN, Director of the National Physical Laboratory, Teddington, England, visited the Survey Research Institute at Dehra Dūn on 12th January 1947.

DR. RAJENDRA PRASAD, the Hon'ble Member for the Department of Agriculture and Food, visited the Survey of India offices at Dehra Dūn, on the 29th of March 1947. He also met Class I and II officers of the Survey of India at Dehra Dūn at a tea party given in the Geodetic Branch compound by the Surveyor General of India on the 30th March. He received a deputation from the Lower Subordinate Service Association on the 31st March.

MR. KARL WEISSMANN, representing Henry Wild Survey Instrument Manufacturing Co., Ltd., Herrbrugg, Switzerland, visited the Survey Research Institute at Dehra Dūn, during April 1947, to inspect the Wild Autograph A5, which was partially erected in the Hunter Observatory and to advise on its repair.

The Chief Engineer, Bengal (West), Irrigation and Waterways Department, one of his Superintending Engineers (Tista Project) and the Superintendent, Mathematical Instrument Office, were conducted over the offices of No. 10 Party, Kurseong, by the Director, Eastern Circle, in June 1947. The Chief Engineer was most interested in the methods of preparation of the 4-inch irrigation maps of the Tista Commanded Area and he expressed great appreciation of the work of the Survey of India.

7. Awards.—His Majesty the King Emperor was graciously pleased to appoint COLONEL O. SLATER, M.C., late Director, Survey of India a 'Companion of the Order of the Indian Empire'.

His Excellency the Commander-in-Chief in India approved of the award of the MacGregor Medal to MAJOR P. A. THOMAS, and of a silver medal and Rs. 100 to SUBEDAR M. Z. A. QURESHI, for their outstanding work on the Indo-Persian triangulation connection made in 1944.

The following were mentioned in Despatches in recognition of their distinguished services in the Burma campaign :—

Corps of Royal Engineers

LIEUT.-COLONEL (TEMPY.) I. H. R. WILSON.
COLONEL (ACTING) C. A. K. WILSON, O.B.E.

Corps of Royal Indian Engineers

LIEUT.-COLONEL (ACTING) RAJINDER SINGH KALHA.
CAPTAIN (TEMPY.) JAMNA NARAIN SINHA.
SUBEDAR MUHAMMAD ZAFAR ALI QURESHI.
JEMADAR MADHWA NAND.
JEMADAR BACHAN SINGH.
JEMADAR S. M. HASHIM.
JEMADAR FATEH SINGH.

The Surveyor General was pleased to award to Clerk NAGENDRA KISHORE RAY, a commendation certificate in recognition of his courage and devotion to duty during the disturbances in Calcutta in August 1946.

The Chief Geophysicist of the Burma Oil Co. (Indian Concessions) Ltd. expressed warm appreciation of the services of MR. ALI TAYYAB, Topographical Assistant, who was deputed to that Company and who had been carrying out survey work with a Seismic field party in the Punjab.

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

Class I officers.—BRIGADIER SIR OLIVER WHEELER, M.C., COLONEL L. H. JACKSON, I.A. and MR. A. F. MURPHY retired. MR. MURPHY was temporarily re-employed.

COLONEL G. F. HEANEY, C.B.E., was regranted the temporary rank of BRIGADIER.

LT.-COLONEL G. W. GEMMELL, I.A., was promoted to COLONEL.

CAPTAIN GAMBHIR SINGH, I.A., and CAPTAIN RAJINDER SINGH KALHA, I.A., were promoted to MAJOR.

LT.-COLONEL C. A. K. WILSON, O.B.E., R.E., was confirmed as Director.

MR. C. P. E. DAVENPORT was confirmed as Superintendent.

MAJOR L. H. WILLIAMS, R.E., was granted leave preparatory to his reversion to the home establishment.

MESSRS. F. J. GRICE and A. F. MURPHY—re-employment was terminated.

MR. F. T. BAYLY, General Central Service Class I, was permitted to resign.

MR. H. M. CRITCHELL was released from military survey service and reverted to civil employment.

MR. B. L. GULATEE, M.A. (CANTAB.) was appointed as President, Survey Research Institute, (General Central Service Class I).

Class II officers.—MESSRS. B. B. KUTTAPPA, S. S. HASAN, N. N. DHAWAN, A. N. RAMANATHAN, N. C. SEN, A. C. MAULICK, I. K. PONNAPPA, J. N. KOHLI, K. N. DUGGAL, A. G. QURESHI,

A. K. TALAPATRA and C. B. MADAN were substantively promoted to Class II service.

MESSRS. D. BISWAS, M. ABBAS, J. E. DAVID, R. B. LAL, M. K. CHATARJI, B. R. SWARUP, K. S. SINGH, A. K. BHATTACHARJI, MOHD. RAFIQUE, V. P. SHARMA, A. K. SENGUPTA, S. A. N. RIZVI, A. N. GOSAIN, M. N. KUTTY, MAHINDAR SINGH, MOHD. ZAMAN MEHDI, N. A. QURESHI, C. SIVARAMAN, A. C. CHAWLA, G. N. DUBEY, G. B. DAS, AHMAD SAID, S. VAIKUNTANATHAN, K. G. RAMANNA were appointed against permanent vacancies in the Class II service.

MESSRS. A. R. QURAIISHI, F. M. HAWLEY, M. A. KHAN, E. R. WILSON, J. C. ROSS, H. H. PHILLIPS, N. C. SEN, K. B. MUTHANNA, I. K. PONNAPPA, H. S. RASSABY, A. N. RAMANATHAN were released from military service and reverted to civil employment.

MR. MOHD. ALAUDDIN was sent on deputation to the Land Record and Survey's Department, Bengal, for appointment as Officer-in-Charge, Bengal Traverse Party and Drawing Office.

MR. K. A. SHEIKH, B.SC., was transferred to Punjab Government.

MESSRS. O. D. JACKSON and H. C. W. STOTESBURY—re-employment was terminated.

MR. H. J. BARRETTO, Assistant Stores Officer and DR. Y. V. KATHAVATE, M.SC., PH.D., Metrological Assistant, (General Central Service Class II) resigned.

MESSRS. G. C. BANERJEE and GURCHARAN SINGH were appointed as Assistant Stores Officers in the General Central Service Class II.

Upper Subordinate officers.—MESSRS. H. N. MURTI RAO, A. SHAMANNA, P. C. SENGUPTA, H. K. KAR, M. A. AZIM, M. HUSAIN retired.

MESSRS. G. C. BAGCHI, P. C. SENGUPTA, H. N. MURTI RAO, H. K. KAR, BAKSHI HARNAM SINGH were re-employed as Topographical Assistants.

RAI SAHIB H. C. BANERJEE—re-employment was terminated.

MR. H. K. KAR resigned to take up an appointment as Assistant Superintendent in the Burma Survey Department.

MR. A. P. DATTA was transferred to the Assam Survey Department.

MR. E. J. A. FRANCIS was permitted to resign.

Miscellaneous.—14 Topographical Assistants, 1 Technical Assistant, 34 surveyors, 20 draftsmen, 41 clerks, 40 recordkeepers, 7 storekeepers, 8 computers and 10 reproduction personnel were released from military survey service and reverted to civil employment.

Deaths and accidents.—The Surveyor General regrets to record the following number of deaths during the period under report :—

Class III service—10

Class IV service— 4

Surveyor Jai Prakash employed on the Patiala State Project survey was struck by lightning on 28th April 1947, while at work in the Simla Hills. He was removed to Solon hospital and recovered in due course.

PART I—TOPOGRAPHICAL AND OTHER SURVEYS

II. ABSTRACT OF SURVEYS IN EACH PROVINCE AND STATE

9. Although the primary survey duties of the Survey of India are geodetic, topographical and geographical, the department has to undertake special surveys in connection with irrigation, hydro-electric, land reclamation and similar projects and to meet demands for large scale surveys of cities, cantonments and other industrially important areas. It has also to advise and assist Provincial and State authorities with local and settlement surveys as may be required.

The following sub-heads will show the nature of miscellaneous work and field operations generally carried out by the department :—

Air surveys	Geodetic work
Boundary surveys	Irrigation surveys
Cantonment surveys	Levelling
City surveys	Traversing
Exploration surveys	Topographical surveys
Forest surveys	Training
Framework	

An abstract of surveys in each province and state is alphabetically arranged and given below. If a province or state is not mentioned, no work has been done there, during the period under report.

10. Assam.

Framework. Height control in Lushai Hills district (p. 42).

11. Bengal.

Air survey in Chittagong Hill Tracts, Dinājpur and Jalpaiguri districts (pp. 37, 41).

Air and ground survey in Darjeeling and 24 Parganas districts (pp. 37, 41).

Framework.—Triangulation and height control in Chittagong Hill Tracts (pp. 41-42). Sub A.I.D. and control levelling in Dinājpur, Rangpur and Jalpaiguri districts (p. 37).

Levelling.—Stonelaying and tertiary levelling in Jalpaiguri, Dinājpur and Rangpur districts (p. 37).

Cantonment, city and airfield surveys. Surveys of Salus, Dudh-Kundi and Kalaikunda airfields near Kharagpur (pp. 29-30).

Frame work. Levelling for above (p. 30).

12. Bihār.

Air survey in Mānbhūm, Santāl Parganas, Hazāribāgh, Purnea and Bhāgalpur districts (pp. 35, 37, 42).

Air and ground survey in Hazāribāgh, Mānbhūm, Singhbhūm and Champāran districts (pp. 35, 41, 42).

Ground survey in Hazāribāgh district (p. 41).

Framework. Triangulation in Hazāribāgh and Singhbhūm districts (pp. 41-42). Triangulation and height control in Hazāribāgh, Mānbhūm and Santāl Parganas districts (pp. 41-42). Height control in Hazāribāgh district (p. 41). Planimetric and height control in Champāran, Purnea and Bhāgalpur districts (p. 35). Sub A.I.D. and control levelling in Purnea district (p. 35).

Levelling. Stonelaying and tertiary levelling in Purnea, Bhāgalpur and Champāran districts (p. 35).

Cantonment, city and airfield surveys. Surveys of Ranchi Dam site, Ranchi Military Camps and New Airfield (p. 30).

Framework. Levelling for the above and Chahra Airfield (Purulia) and traversing for Ranchi Military Camp and New Airfield, Ranchi (p. 30).

13. Bombay.

Cantonment, city and airfield surveys. Surveys of School of Military Engineering and Pioneer lines at Kirkee, Dighi area, Dehu Road and Kharakvasla near Poona, Aundh (hospital town), Poona and Deolali Cantonment (p. 30).

Framework. Traversing and levelling for the above and traversing for Dhond Cantonment (pp. 29-30).

Topographical surveys in Ratnagiri and Satara districts (pp. 45, 46).

Framework. Triangulation (re-heighting only) for above (p. 46).

14. Central Provinces and Berār.

Air survey in Bilāspur district (p. 41).

Air and ground survey in Nāgpur district (pp. 41-42).

Framework. Height control in Nāgpur district (pp. 41-42).

Cantonment, city and airfield surveys. Surveys of Jubbulpore Cantonment special area and Indian Infantry School (Saugor) (p. 30).

Framework. Traversing and levelling for the above (p. 30).

15. Deccan States.

Air survey in Aundh, Kolhapur and Sandur States (p. 44).

Framework. Plan and height control for above by traverse and triangulation (p. 45).

Topographical surveys in Kolhapur and other Deccan States (p. 46).

16. Delhi.

Air survey in suburbs of Delhi (p. 27).

Levelling in suburbs of Delhi (p. 27).

Framework. Triangulation and traverse in suburbs of Delhi to provide planimetric and height control for air survey (p. 27).

17. Eastern States Agency.

Air survey in Athgarh, Daspalla, Raigarh Sārangarh and Cooch Behār States (pp. 37, 41).

Framework. Triangulation and height control in Daspalla and Tripura States (p. 42). Sub A.I.D. and control levelling in Cooch Behār State (p. 37).

Planimetric and height control in Sonapur State (p. 39).

Levelling. Stonelaying and tertiary levelling in Cooch Behār State (p. 37).

18. Hyderābād State.

Cantonment, city and airfield surveys. Surveys of Begampet and Yaraguda R.A.F. accommodation (Secunderābād) (p. 30).

Framework. Traversing and levelling for the above and traversing for Secunderābād Cantonment (p. 30).

Air surveys for Tungabhadra Dam and Canal projects (p. 47).

Framework Planimetric and height control for above survey (p. 47).

19. Madras.

Cantonment, city and airfield surveys. Surveys of Keti and Avalanche Dam (Nilgiris, No. 4 Reserve Base depot in Avadi, Ammunition Storage at Gummudipundi and Arkonam airfield) (p. 30).

Framework. Traversing and levelling for the above (p. 30).

20. Nepāl.

Air survey in Morang, Udaipur Garhi and Saptari districts (p. 35).

Ground survey in Morang and Udaipur Garhi districts (p. 35).

Framework. Planimetric and height control in Morang and Saptari districts (p. 35). Triangulation in Morang, Chautara, Udaipur Garhi, Rāmechhāp, Sindhūli Garhi, Okhaldhunga and Dhan-kuta districts (p. 36).

Levelling. Stonelaying and tertiary levelling in Saptari and Morang districts (p. 35).

21. Orissa.

Air survey in Cuttack and Sambalpur districts (pp. 39, 41).

Framework. Planimetric and height control in Sambalpur district (p. 39).

Levelling. Stonelaying and tertiary levelling in Sambalpur district (p. 39).

22. Punjab.

Ground surveys. Chāndābandi work in Shakti-Maraur area, Kulu Tehsil of Kulu sub-division of Kangra district (pp. 17-18).

Cantonment and city surveys. Surveys of Ambala and Multan Cantonments (p. 30).

Framework. Traversing and levelling for Multan Cantonment and traversing for Rawalpindi Cantonment (pp. 30-31).

Rectangulation and tertiary levelling in Hissar district (p. 23).

23. Punjab States.

Air survey in Patiala State (pp. 27-28).

Framework. Triangulation in Patiala State to provide planimetric and height control for air survey (p. 27).

Rectangulation and tertiary levelling in Patiala State (p. 23).

24. Rājputāna.

A.I.D. survey in Jodhpur (Marwār) State (pp. 28-29).

Framework. Traversing in Udaipur city (p. 27).

25. Sind.

Cantonment and city surveys. Surveys of Karāchi Cantonment and Environs, and Drigh Road Cantonment (p. 30).

Framework. Triangulation, traversing and surveys of New Industrial area, Karachi. Traversing at Karachi Airport (p. 18).

26. United Provinces.

Cantonment and city surveys. Surveys of Meerut and Agra Cantonments, Hapur Remount Depot and Babina Camp (pp. 30-31).

Framework, Traversing and levelling for the above (p. 30).

Identification of planimetric control on air photography of Cawnpore area (p. 27).

III. SURVEY REPORTS, FRONTIER CIRCLE

DIRECTOR:— Major R. C. N. Jenney, R.E.

DEPUTY DIRECTOR:— { Major R. C. N. Jenney, R.E. to 7-11-46.
Major R. C. A. Edge, M.B.E., R.E. from 8-11-46 to 8-6-47
and from 9-7-47.
Major R. C. N. Jenney, R.E. from 9-6-47 to 8-7-47.

27. **Summary.**—The units administered by the Frontier Circle were :—

Nos. 2, 3, 4, 7, 13, 16, 18 and 19 Parties and No. 6 Drawing Office.

28. **Map Stores.**—Messrs. V. D. Chopra and K. B. Muthanna held the charge of original records and map stores upto 15th July 1947 and 12th August 1947 respectively. Mr. Ghulam Hasan took over the charge on the latter's transfer to India, prior to partition.

About a million maps were in store during the period.

REPRODUCTION SECTION

29. **Personnel.**—The average strength of the section was 1 Assistant Manager (Offg.) in charge of the section, two 2nd Division Reproduction Assistants (Offg.), 43 L.S.S., one Technical clerk and one storekeeper.

Complete Map Reproduction plant equipped with an Auto Feed Crabtree Machine was taken over by this section from No. 72, Base Map, Reproduction Group in October 1946. This plant was managed very successfully to cope with a heavy emergency printing demand from H.Q. Northern Command.

No. 6 DRAWING OFFICE

Officer in charge :— { Mr. M. D. Nangia to 31st July 1947.
Mr. A. Ahad from 1st August 1947.

30. **General.**—The charge of No. 6 Drawing Office was transferred from the Director Map Publication to the Director Frontier Circle with effect from 14th May 1947. The whole staff of No. 2 Party except the Officer in charge and the Reproduction Group was attached to No. 6 Drawing Office from 1st June 1947.

31. **Personnel.**—The average strength of the Drawing Office was 1 Class I officer, 1 Class II officer, 1 Upper Subordinate officer, 2 Topographical Assistants, 1 Division II draftsman and 36 other Class III personnel (including clerks and recordkeepers and excluding men under training).

32. **Office work.**—From 1st June 1947. 9 draftsmen and one 2nd Division draftsman were employed under Mr. A. R. Khan (U.S.S.) on fair mapping and miscellaneous work.

The Maintenance Section with an average of 2 Topographical Assistants, 2 surveyors and 3 recordkeepers was supervised by Mr. Jagan Nath up to 16th July 1947 ; Mr. V. D. Chopra up to 7th August 1947 and thereafter by Mr. Ghulam Hasan.

Two clerks and 11 recordkeepers were responsible for records, receipts and issues of published maps. Messrs V. D. Chopra and K. B. Muthanna respectively supervised till the charge was handed over to Mr. Ghulam Hasan on their transfer.

33. **Training.**—4 Class III personnel were under training as pupil draftsmen.

No. 2 PARTY

Officer in charge:—{ Mr. D. C. Puri to 8-8-47.
Mr. A. Ahad from 9-8-47.

34. **General.**—The Party remained as “E” Party till 20th November 1946 when it was redesignated as No. 2 Party.

There was no field work, but the headquarters remained at Risalpur from 12th November 1946 to 16th May 1947 ; part of the Drawing Section opened at Murree on 18th April and the remaining staff joined on 21st May 1947.

On transfer of No. 6 Drawing Office to the administrative control of the Director Frontier Circle, part of staff of No. 2 Party was attached to No. 6 Drawing Office with effect from 14th May 1947, and the entire drawing staff including that of Map Record and Issue Office was transferred from 1st June 1947. The reproduction group remained attached to the unit.

There was no field work in the party during the period under report. The personnel were mostly employed on the correction and modernization of fair originals for reissue and reprint cases, (according to Director, Map Publication’s Office Notes to meet Military and Civil demands).

In addition to this, other miscellaneous work, a description of which is given in para “Office Work”, was also done.

35. **Personnel.**—The average strength of the party up to 1st June 1947 was 1 Class I Officer, 1 U.S.S. Officer, 3 Topographical Assistants, 1 Division II (Offg.) draftsman and 25 Lower Subordinates (including 4 draftsmen under training, a clerk and two recordkeepers).

36. **Field work.**—Nil.

37. **Office work.**—The office work was organized as follows :—
Mr. A. G. Quraishi (Class II) up to 17th October 1946 and Mr. A. R. Khan (U.S.S.) from 18th October 1946 assisted by Draftsman Feroz Mohd. Khan (2nd Division Offg.) and an average of 10 draftsmen carried out the reissue or reprint of one-inch, half-inch and quarter-inch sheets on demand by the Director, Map Publication.

The following miscellaneous work was also done :—

- (a) Incorporation of office copy corrections and verification surveys for compilation of Hind 5014 Series maps and province map of Punjab and Punjab States and scrutiny of the Road Classification guides and Press Order Proofs of Hind 5014 Series maps falling in the Frontier Circle area.
- (b) Corrections of names in $\frac{1}{4}$ -inch map 39 P for the revised name guides of the Indian Gazetteers for Director of Survey (India Command).

38. **Maintenance Section.**—Mr. Jagan Nath, Topographical Assistant (Re-employed U.S.S.) with 2 surveyors, one draftsman and 2 recordkeepers carried out the maintenance of the Frontier Circle Records. This section was placed under the orders of Officer in charge, No. 18 Party from 17th February 1947 to 31st March 1947 when it was transferred again to No. 2 Party and was finally transferred to No. 6 Drawing Office from 1st June 1947.

39. **Reproduction work.**—Printing work was carried on under Mr. Bhagat Singh, in-charge of the Reproduction Group.

No. 3 PARTY (FORMERLY KULU SURVEY DETACHMENT)

Officer in charge:— $\left\{ \begin{array}{l} \text{Mr. D. C. Puri to 10-10-46.} \\ \text{Mr. M. D. Nangia from 11-10-46 to 8-12-46.} \\ \text{Major R. C. N. Jenney, R.E. from 9-12-46 to 19-12-46.} \\ \text{Mr. M. A. Khan from 20-12-46.} \end{array} \right.$

40. **General.**—(i) The unit was engaged on the following surveys of the Kulu Surveys.—Revision of unproved intersected points (Chāndās) continued up to the end of November 1946, and thereafter no Chāndābandi field work (fixing of theodolite marks by triangulation and supplementary traverse) was done up to May 1947.

(ii) The programme of the party from November 1946 to March 1947 was traversing and rectangulating of Crown waste land to be given to Jamali tribe on lease for cultivation in Jhatpat and Usta Muhammad tehsils of Nasirabad subdivision, Sibi district, Baluchistan in sheets 34 P and 39 D.

(iii) The party was employed chiefly on paid-for jobs for the Punjab and Sind Governments. The headquarters of the party remained at Murree.

(iv) Chāndābandi work was carried out in cultivated areas for cadastral survey for re-settlement purposes on the scale of 1 inch = 20 Karams (1 Karam = 56 inches) or approximately 57 inches to 1 mile, lying at a general height of about 10,000 feet above mean sea-level in the Sainj Khad in Shakti-Maraur area in Kulu tehsil in sheet 53 E, which had remained undone in 1946 due to early snowfall. This was taken up in May 1947 and completed in early July 1947.

(v) Survey of the new Industrial Area (Trans-Layari district) Karachi, in sheets 35 L/13 and 35 P/1 on scale 16 inches to 1 mile

with 1 foot contouring for publication on scale 32 inches to 1 mile, rectangulation to 10 acre squares and levelling was taken up. The final maps are required for siting factories. Survey of boundary only of a part of the area was also done. Survey of the new Industrial area, Karachi, commenced in June 1947 and continued during August 1947.

(vi) Compilation of Srinagar Town Guide map from air photographs taken on scale about 4 inches to 1 mile for publication on scale 3 inches to 1 mile. This was put in hand in May 1947; combination of strips was completed and inking of photographs was in hand when from about 3rd July 1947, no air surveyor being available, all work was suspended.

(vii) Fixing of positions of medium Frequency Direction Finding and Medium Frequency Beacon Stations at Karachi Airport.

41. **Personnel.**—(i) The average strength apart from the Officer in charge, up to 31st March consisted of:—

1 Class II Officer, 3 Topographical Assistants, 6 Traversers, 5 Rectangulators, 3 Computers for Chāndābandi work in the Punjab and for traversing and its computations and rectangulating in Baluchistan.

(ii) The average strength from 1st April to 14th August 1947 excluding the Officer in charge, consisted of:—

(a) 1 Class II Officer, 1 U.S.S. Officer, 2 Topographical Assistants, 1 Traverser, 3 Trav./Levellers, 1 Negative Retoucher employed as Rectangulator, 4 Surveyors and 2 Computers.

(b) 9 Computers, 3 Surveyors, 2 Draftsmen, 1 Plotter, 2 Clerks, 1 Storekeeper clerk were employed at party headquarters.

(c) 1 Topographical Assistant Mr. Ali Tayyeh, M.A., was placed on deputation to the Burma Oil Coy., (India Concessions) Ltd. and carried out survey with a Seismic field party in the Punjab from November 1946 to the end of April 1947.

42. **Areas surveyed.**—(a) 3 square miles of Chāndābandi work for the re-settlement of Kulu tehsil of Kulu sub-division of Kangra district, Punjab.

(b) The following work was completed up to 15th August 1947 in connection with the survey of New Industrial Area—Karachi.

(i) Triangulation of 5.5 square miles.

(ii) Traversing, rectangulation to 10 acre squares and levelling of 1,780 acres.

(iii) Survey on scale 16 inches to 1 mile with 1-foot contouring of 1,571 acres.

(iv) Survey of boundary only by triangulation and traversing of 2,377 acres.

43. **Field work.**—(a) *Chāndābandi in the Punjab.*—Trav/Leveller J. P. Nauriyal completed 3 square miles of Chāndābandi

work in high hills in Shakti-Maraur area, Kulu Tehsil of Kulu sub-division of Kangra district, Punjab.

(b) *Survey of the New Industrial Area—Karachi.* Mr. A. G. Quraishi, in charge of the Survey Detachment, with 1 Topographical Assistant, 1 Traverser, 3 Trav/Levellers, 1 Rectangulator and an average strength of 4 Surveyors, completed triangulation of 5.5 square miles, traversing, rectangulation to 10 acre squares and levelling of 1,780 acres and survey on scale 16 inches to 1 mile with 1-foot contouring, leaving hillocks and low ridges, of 1,571 acres; and survey of boundary only of 2,377 acres. The detachment carried out and computed 39.8 miles of traversing 65.7 miles of double tertiary levelling and 48.2 miles of single tertiary levelling.

Triangulation to control traversing emanated from Hunter Short Base extension at B hill station (Sheet 35 L/13) with observed azimuth, and was closed at A hill station (Sheet 35 L/13). The closing base was also checked by Hunter Short Base extension and azimuth observation.

Considerable inconvenience was experienced due to strong wind and frequent dust storms in the area.

(c) Mr. Ali Tayyeb, Topographical Assistant, with the help of one Trav/Leveller, carried out 6 linear miles of traversing to fix positions of Medium Frequency Direction Finding and Medium Frequency Beacon Stations at Karachi Airport.

44. Work at Party Headquarters.—Mr. Sultan Mahmud, (U.S.S.) assisted by 1 Topographical Assistant with 1 Air Surveyor, started compilation of Srinagar Town Guide map from air photographs, taken on scale about 4 inches to 1 mile, for publication on scale 3 inches to 1 mile. Mr. Sultan Mahmud proceeded on leave early in June and was subsequently transferred to No. 7 Party. Also, Mr. Ali Tayyeb, Topographical Assistant, left early in June with the detachment for survey of New Industrial Area—Karachi. Surveyor Rahim Shah carried on with the work until 3rd July, when he also left to join the Survey Detachment at Karachi and all work was stopped. By this time the combination of strips was completed and the inking of photographs was in hand.

Computer Kanshi Ram Saluja completed computations of the Chāndābandi observations done by Trav/Leveller J. P. Nauriyal.

Plotting of plot sheets on scale 4 inches to 1 mile for departmental use, and musavis on scale 1 inch = 20 Karams for supply to the Assistant Settlement Officer, Kulu was taken in hand during August.

No. 4 PARTY

Officer in charge:—
 { Mr. K. C. Gosain to 7-11-46.
 { Major R. C. A. Edge, M.B.E., B.E. from 8-11-46 to 10-2-47.
 { Mr. N. D. Joshi from 11-2-47 to 11-8-47.
 { Mr. G. H. Khan from 12-8-47 to 15-8-47.

45. General.—Up to 1st November 1946, the party was the basic survey training party for all officers, Topographical Assistants and Lower Subordinates of the Department and for certain Military Officers who were trained on behalf of the Director of Survey,

G.H.Q. (India). Thereafter, it became purely an officers' training party, basic training of the Lower Subordinates becoming the responsibility of No. 7 Party.

Party headquarters were at Abbottabad with field headquarters at Gazikot (near Mansehra) up to 19th October 1946, at Havelian up to 24th March 1947 and at Kakul from 25th March 1947 up to the end of July 1947.

After this, due to the partition of India, most of the personnel who had opted to work in the Indian Union were transferred to Dehra Dūn, and those who had opted to work in Pakistan were transferred to No. 7 Party at Kakul, and the nominal charge of the unit was handed over to O.C. No. 7 Party.

The superior personnel of the party were transferred early in August 1947 as under :—

1 Class I Officer, 1 Class II Officer, 6 Class II Probationers	} To No. 15 Party (G.B)
2 U.S.S. Officers, 24 Topographical Assistants, 1 Surveyor Instructor and 7 Lower Subordinates.	
2 Topographical Assistants and 2 Surveyor Instructors	
2 Surveyor Instructors	.. To No. 7 Party (F.C.)
1 Surveyor Instructor	.. To D.S.C.
2 Topographical Asistants	.. To No. 13 Party (G.B.)

46. **Communal Disturbances.**—Training during early part of the year 1947 was much interrupted by communal disturbances and in March 1947 general deterioration in the situation resulted in further field work being abandoned and all personnel were switched to air survey training within Kakul Cantonment.

47. **Personnel.**—The average strength of the permanent staff for basic field survey training and for officers training was 1 Class I Officer, 1 Class II Officer, 2 U.S.S. Officers, 6 Surveyor Instructors, 4 Clerks and 1 Storekeeper.

As the field training of the personnel was suspended due to disturbances in Hazara district, the strength of the Class IV servants was reduced to about 140.

48. **Training.**—Up to 1st November 1946, the following were trained in basic field survey :—

- 5 R.E. Officers.
- 2 Class II Probationers.
- 7 Topographical Assistants.
- 3 Computers.
- 33 Lower Subordinates.

The training syllabus and programme for these was designed to meet war time requirements and was therefore somewhat abbreviated by peace time standards. Periods of training were :—

- R.E. Officers .. 6 months.
- Class II Probationers .. 13 months.

Topographical Assistants 8½ months.
 Lower Subordinates .. 10 months.

After 1st November 1946, a new syllabus and a programme of 18 months were adopted for all officers. It included preliminary drawing, plane-tabling, triangulation, traversing, levelling, astronomical work, barometric heights, rectangulation and air survey. The following were under training on this syllabus at the end of the period under report :—

7 Class II Probationers (including 2 of No. 10 Party,
 E.C.)
 28 Topographical Assistants.
 3 Computers (including 1 of No. 12 Party,
 E.C.)
 6 Surveyors (including 4 of No. 7 Party,
 F.C.)

The following were also trained under No. 4 Party during the year :—

6 Afghan Officers :—These were attached to the party but were actually trained at Dehra Dūn.
 3 Jodhpur State Officers :—Trained in Hunter Short Base measurement and traversing.
 2 Class II Probationers.
 3 Topographical Assistants—in Air survey only.
 1 Temporary Computer.

49. **Air Photography.**—The whole of the training area consisting of about 1,000 square miles was air photographed so that ground and air survey training could be linked together.

No. 7 PARTY

Officer in charge :— { Mr. K. C. Gossain to 31-10-46.
 Mr. G. H. Khan from 1-11-46.

50. **General.**—Up to 31st October 1946, the party remained as survey training party with the object of providing special training for the large number of departmental personnel required for various project surveys to be undertaken throughout India as part of the post-war development programme.

From 1st November 1946 its role was changed and it became the long term training party for the L.S.S. surveyors (including Air Surveyors).

The Headquarters of the party remained at Murree up to 28th February 1947 when they shifted to Abbottabad, which is the permanent Headquarters of the party.

Field Headquarters were at Kakul up to 23rd October 1946 and from 27th March 1947 onwards. From 23rd October 1946 to 27th March 1947 they were at Havelian.

51. **Communal Disturbances.**—The work of the party was much interrupted by communal disturbances in Hazara. Tension created by tribal raids in Northern Hazara resulted in suspension

of field work for a few days in January and later in March, general deterioration in the communal situation throughout the Punjab and Hazara culminating in serious rioting and arson in Manshra, where the bulk of the trainees were camped, resulted in the suspension of field work for all except Muslims for the remainder of the year.

52. Personnel.—The strength of the party up to 31st October 1946 excluding the officer in charge and the trainees was :—

Class II Officer	..	..	1
U.S.S. Officer	..	..	1
Topographical Assistants	..	..	2
Clerks	..	..	2

The strength of the party from 1st November 1946 excluding the officer in charge and the trainees was :—

Class II Officer	..	..	1 up to 10-2-47.
„ „ Officer (Offg. )	..	..	1
U.S.S. Officers	..	..	3
L.S.S. (Surveyor Instructor )	..	..	14
Clerks	..	..	5

Personnel under training before partition transfers were affected, were :—

Pupil Surveyors	..	..	91
Irrigation Survey Trainees	..	..	65
Instructors & Adm. staff were :—			
Class II Officer (Offg. )	..	..	1
U.S.S. Officers	..	..	5
Topographical Assistants	..	..	2
Lower Subordinates..	..	..	16
Clerks and Store-keepers	..	..	5

53. Training.—Up to 31st October the following were trained in irrigation methods :—

Class II Officers	..	..	4
Class II Probationers	..	..	8
U.S.S. Officers	..	..	4
Topographical Assistants	..	..	20
L.S.S.	..	..	125
Class IV personnel	..	..	9 (Trained in levelling only).

The training included traversing and levelling (secondary and tertiary) and rectangulation by the normal ground method and also by a newly devised air survey method in which mark stones are laid at corners of an approximate 30 chains square grid. After laying they are exactly located on air photos, fixed in planimetry by air survey and subsequently heighted by single tertiary levelling.

From 1st November 1946 onwards, basic survey training of L.S.S. recruits was taken up. This was on a revised syllabus and programme, covering two years. It includes preliminary drawing and use of instruments, plane-tableing, large scale survey, levelling, rectangulation, fair drawing and either air survey or theodolite traverse depending on whether or not the trainee concerned is found to have

good stereoscopic vision. The syllabus is designed so that less promising surveyors may, if suitable, be trained purely as draftsmen.

Trainees joined in batches mostly during the period 30th October 1946 to 30th November 1946. They included some ex-soldier surveyors who had received some previous training with a view to their employment in Military Survey Units but who had been discharged from the Army as surplus at the end of the war. The programme for these was accelerated slightly. The total number of trainees in the party varied owing to irregular arrivals and some wastage. The maximum was 107 in February which decreased to 98 in March.

As stated, communal disturbances dislocated the programme in March. All except Muslims had to drop field work shortly after starting a course of 1/25,000 Plane-tabling and switched to fair drawing which could be carried out safely in Kakul Cantonment. 22 Muslims and 1 Christian continued the normal programme without incident.

54. **Air Photography.**—The whole of the training area consisting of about 1,000 square miles was air photographed so that ground and air survey training could be linked together. Enlarged prints on 1/25,000 scale are being supplied.

55. **Partition.**—1 U.S.S. and 5 L.S.S. instructors and 70 L.S.S. trainees, who were due for transfer to India on partition, were relieved during August.

56. **Training Syllabus.**—No change was made in the syllabus for pupil surveyors. A special 3 month syllabus was designed for the Irrigation Survey Course.

57. **Organization.**—Camp and Section Officers for training courses were as follows :—

1/25,000 Plane-tabling	..	Mr. Ghulam Hasan (U.S.S.).
Fair Drawing	..	K. S. Chiragh Shah (Offg. Class II).
		Mr. Manawar Khan, C.H. (U.S.S.).
		Mr. Amar Singh (U.S.S.).
Air Survey	..	Mr. Bashirullah Khan (U.S.S.).
		Mr. Manawar Khan I, C.H. (U.S.S.).
Irrigation Survey	..	K. S. Chiragh Shah (Offg. Class II).
		Mr. Bashirullah Khan (U.S.S.).
Computation	..	Mr. Sultan Mahmud (U.S.S.).

No. 13 PARTY

Officer in charge. :—Mr. Mohd. Najamuddin, B.A.

58. **General.**—This party which works for the Punjab Government continued the survey of the area covered by the Bhakra Dam Irrigation Project.

Recess and Field Headquarters were at Solon and Sirsa respectively.

The designation of the party was changed from Punjab Irrigation Party to No. 13 Party with effect from 20th November 1946.

59. **Personnel.**—The average field strength of the party apart from the Officer in charge was 2 Class II Officers (one of them was on probation), 3 U.S.S. Officers, 4 Topographical Assistants and 84 Lower Subordinates.

60. **Field work.**—The field work was organized as under :—

Camp I. Mr. Mohd. Sharif, (Class II) assisted by Mr. Amir Chand Chowla, (Class II Prob.) and one Topographical Assistant with 20 Lower Subordinates completed 380 sq. miles of 25 acre rectangulation in Hissar district and Patiala State in sheets 44 O and 53 C.

Camp II. Mr. Sheikh Alauddin (U.S.S.) assisted by one Topographical Assistant with 18 Lower Subordinates completed 431 sq. miles of 25 acre rectangulation in Hissar district and Patiala State in sheet 44 O.

Camp III. Mr. Dial Singh (U.S.S. Offg.) assisted by 2 Topographical Assistants with 18 Lower Subordinates completed 623 sq. miles of 25 acre rectangulation in Hissar district and Patiala State in sheets 44 K and 44 O.

Camp IV. Mr. Rustam Khan (U.S.S.) with 23 Lower Subordinates completed 1,298 sq. miles of tertiary levelling in Hissar district and Patiala State in sheets 44 O and 53 C.

61. **Area surveyed.**—1,434 sq. miles of rectangulation to 25 acre in Hissar district and Patiala State, in sheets 44 K and O and 53 C.

1,298 sq. miles of tertiary levelling in Hissar district and Patiala States in sheets 44 O and 53 C.

62. **Description of country.**—The country surveyed consists of flat cultivated plains, in few places interspersed with bushes and trees particularly round tanks and along canals. In the west it is open and sandy.

63. **Recess work.**—The fair mapping and compilation of field work 1946-47 comprising 70 sheets (4-inches = 1 mile) was taken in hand. Drawing of practically all the sheets was completed and 31 sheets were submitted for printing up to 14th August, 1947.

The above recess work was organized as under :—

Section I. Mr. Mohd. Sharif (Class II) assisted by one Topographical Assistant with 7 Computers completed the computations of mean sea-levels and recording of spot heights in books for all

- the 70 sheets in addition to the mosaicing for and completion of their 4-inch enlargements.
- Section II. Mr. Sheikh Alauddin (U.S.S.) assisted by one Topographical Assistant with 10 Draftsmen completed the drawing of 35, 4-inch contour sheets.
- Section III. Mr. Dial Singh (U.S.S. Offg.) assisted by one Topographical Assistant (up to 30th May 1947) with 10 Draftsmen completed the drawing of the remaining 35, 4-inch contour sheets.
- Section IV. Mr. Rustam Khan (U.S.S.) with 8 Draftsmen completed the preparation of 20 spot height charts on 4-inch scale up to 1st July 1947, after which this section was amalgamated with Section I, which completed the remaining spot height charts.
- Section V. Mr. A. C. Chowla (Class II Prob.) with one Topographical Assistant (up to 31st May 1947) and 3 Draftsmen was engaged on the scrutiny of computations, their recording in books and on charts and the examination of drawing sheets.

No. 16 PARTY

Officer in charge :—Major R. C. N. Jenney, from 11-8-47.

64. **General**.—A new party with headquarters at Comilla was formed from 11th August 1947, for the survey work in East Bengal (Pakistan). A small Reproduction Group and Map Record and Issue Office will also be attached with the unit.

Major R. C. N. Jenney, R.E. held charge of the party in addition to his own duties.

No. 18 PARTY

Officer in charge :—

{	Mr. N. D. Joshi to 7-11-46.
	Major R. C. A. Edge, M.B.E., R.E. from 8-11-46 to 10-2-47.
	Mr. N. D. Joshi from 11-2-47 to 16-2-47.
	Mr. N. D. Nangia from 17-2-47 to 31-7-47.
	Mr. A. R. Quraishi from 1-8-47 to 15-8-47.

65. **General**.—The party was employed on its normal air survey work up to 7th November 1946, the date from which this party's charge was taken over by Officer in charge, No. 4 Party in addition to the charge of the Deputy Director, Frontier Circle.

The recess headquarters remained at Havelian from 8th November 1946 to 16th February 1947 and at Risalpur from 17th February 1947 to 16th May 1947.

66. Personnel.—

1 Class II Officer, 1 U.S.S. Officer	} to 16-2-47.
1 Topographical Assistant, and 4 Lower	
Subordinates, excluding clerk.	

1 Class I Officer and 1 Clerk (with an attached establishment of 3 Topographical Assistants), 2 Surveyors and 1 Draftsman. } from 17-2-47.

67. **Office work.**—The work on the 4-inch Chenab Reservoir was completed and sheets were submitted for publication.

The following jobs were left unfinished to be taken up at a later date.

1. Air survey of N.-W. Frontier in sheets 38 H/7, 38 K/4 and 38 L/2, 3, 5 and 6 for the revision of 1-inch maps of the area.
2. Provisional air survey of Perso-Baluch area in sheets 30 C, D, G and H.
3. Marhu Pass (14,000 ft.) air survey on 4-inch scale for Road Development and ground survey on 16-inch scale of the Tunnel exit and entrance areas.
4. Sketch air survey on the Mohmand Presumptive Border on 1/25,000 scale.

All air survey work was stopped from 2nd November 1946 and all personnel were transferred to other units.

From 17th February 1947, the Maintenance Section of No. 2 Party with Mr. Jagan Nath (Topographical Assistant) as In-charge and 2 Surveyors and 1 Draftsman was employed on comparison of new office copies against the previous office copies to supersede the latter. About 200 office copies were completed during the period between 17th February and 31st March 1947.

No. 19 PARTY

Officer in charge :—Major R. C. N. Jenney, R.E. from 11-8-47 to 14-8-47.

68. **General.**—A new party with headquarters at Murree was formed from 11th August 1947. Major R. C. N. Jenney, R.E. held charge of the party in addition to his own duties.

IV.—SURVEY REPORTS, GEODETIC BRANCH

DIRECTOR:— { Lt.-Col. J. B. P. Angwin, M.B.E., R.E., to 12-10-46.
 { Major R. H. Sams, R.E., from 13-10-46.

69. **Summary.**—The units administered by the Geodetic Branch were No. 1 Party, No. 13 Party (from 1-8-47), No. 15 Party, No. 20 (Cantt.) Party, No. 2 Drawing Office, Map Record Office, Stores Office, Surveys, the Printing Office and the Photo-Zinco Office.

70. Areas surveyed.—

- 6·5 square miles of 6-inch original ground survey.
- 49·5 square miles of 6-inch original air survey.
- 37 square miles of 4-inch original air survey.
- 1·4 square miles of 32-inch original air survey.
- 16 linear miles of traverse.
- 37 linear miles of tertiary levelling.
- 30 square miles of supplementary triangulation for control of air survey.
- 22 linear miles of traversing for control of air survey.
- 94·4 square miles of 1-inch and larger scale revision survey.
- 12,491 acres of 8-inch survey.
- 740 acres of 10-inch survey.
- 43,504 acres of 16-inch survey.
- 1,552 acres of 32-inch survey.
- 101 acres of 64-inch survey.
- 485 acres of 100 ft. to an inch survey.
- 416 acres of 200 ft. to an inch survey.

No. 1 PARTY

Officer in charge :— { Captain Gambhir Singh, I.A., to 14-10-46.
 { Mr. K. L. Dhawan, from 15-10-46 to 14-4-47.
 { Captain Gambhir Singh, I.A., from 15-4-47 to 30-4-47.
 { Mr. F. M. Hawley, from 1-5-47 to 17-5-47.
 { Mr. A. R. Quraishi, from 18-5-47 to 31-7-47.
 { Mr. Suresh Prasad, from 1-8-47.

71. **General.**—The party had no normal programme but was employed on air surveys for various irrigation and other projects of the Central and Provincial Governments and for Indian States. The party headquarters remained at Dehra Dūn.

72. **Personnel.**—The average strength of the party was 1 Class I officer, 3 Class II officers, 3 Upper Subordinate officers, 1 Topographical Assistant and 27 Lower Subordinates.

Five of the Lower Subordinates were promoted to second division surveyors from the 1st May 1947.

73. Areas surveyed.—

- 6·5 square miles of 6-inch original ground survey.
- 49·5 square miles of 6-inch original air survey.
- 37 square miles of 4-inch original air survey.
- 1·4 square miles of 32-inch original air survey.
- 16 linear miles of traverse.
- 37 linear miles of tertiary levelling.
- 30 square miles of supplementary triangulation for control of air survey.
- 22 linear miles of traversing for control of air survey.

Revision survey.—1-inch and larger scale :—94·4 square miles.

74. Field work.—The field work was organized as follows :—

Camp (1).—Mr. A. N. Gossain (Class II Probationer) and 2 surveyors carried out $1\frac{1}{2}$ square miles of original ground survey on scale of 6 inches to 1 mile. Mr. Gossain carried out traversing for providing planimetric and height control for this ground survey and $19\frac{1}{2}$ square miles of air survey. The camp also completed ground verification and contouring of $19\frac{1}{2}$ square miles of air survey on 6 inches to 1 mile scale. All this work was in the neighbourhood of Delhi and Shahdara.

Camp (2).—Mr. Ahmad Said (Class II Probationer) with 5 surveyors completed original ground survey of 5 square miles on 6-inch to 1 mile scale and also ground verification and contouring of 30 square miles of air survey on 6-inch to 1 mile scale, in the vicinity of Mahrauli near Delhi. Mr. Said also carried out triangulation for providing control for the above survey.

Camp (3).—Mr. B. S. Chopra (U.S.S.) carried out traverse of 16 linear miles for Udaipur City improvement purposes.

Camp (4).—Mr. Said Hasan Khan (Topographical Assistant) carried out tertiary levelling of about 37 linear miles for Delhi Improvement Trust in the southern suburbs of Delhi.

Camp (5).—Mr. Suresh Prasad (Class II) and one surveyor carried out height control for 4-inch surveys of Patiala State, south of Kandaghāt, area 37 square miles.

Camp (6).—Mr. A. N. Gossain carried out triangulation and height control for 32-inch Dochi Dam survey of Patiala State, area about 1·4 square miles.

Camp (7).—Mr. B. S. Chopra (U.S.S.) completed identification of planimetric control on photography of Cawnpore, area about 40 square miles.

75. Recess duties.—There were two sections during recess, one section under Mr. A. N. Gossain (Class II Probationer) assisted by Mr. Govind Prasad (U.S.S.) and the other under Mr. Ahmad Said (Class II Probationer) assisted by Mr. Ratna Singh (U.S.S.). The following jobs of air survey were completed :—

19 sheets of Jawai River Irrigation project (Jodhpur State), scale 10 inches to 1 mile, in sheet 45 G.

2 sheets of Dochi Dam survey (Patiala State), scale 32 inches to 1 mile, in sheet 53 F.

3 sheets of 4-inch project survey (Patiala State) in sheets 53 E, F.

Contouring on a photo mosaic of Dochi Dam (Patiala State), scale 12 inches to 1 mile, in sheet 53 F.

Outline only of 8 sheets Delhi Development survey, scale 100 ft. to 1 inch, in sheet 53 H.

Outline only of 1 sheet of Konar Power house survey, scale 16 inches to 1 mile, in sheet 73 E.

No. 13 PARTY

Officer in charge :—Mr. Mohd. Najamuddin, B.A.

76. This party was under the Director, Frontier Circle up to 31st July 1947 and from 1st August 1947 was transferred to the control of the Director, Geodetic Branch. (For report, see page 22).

No. 15 PARTY

Officer in charge :— { Major J. S. O. Jelly, R.E., to 17-5-47.
Mr. F. M. Hawley, from 18-5-47.

77. **General.**—The activities of the party were concentrated on ascertaining the practical limits, speed and accuracy that could be obtained by the new method of carrying out precise traverse called 'All India Development' (A.I.D.) Survey, introduced for the first time in India in 1945, and if possible on establishing this method as a means of providing geodetic control. At the same time, the party had to find out final data required for the 8 A.I.D. marks established in the area in 1945-46.

To this end the training of the personnel continued at recess headquarters Dehra Dūn throughout the summer and autumn of 1946. The apparatus specially designed as a result of experience gained the year before was manufactured at the Ordnance Factory, Dehra Dūn. The calibration of the tapes for the work was carried out in the Survey Research Institute.

It was decided to re-measure about 80 miles of the precise traverse carried out in field season 1945-46 by No. 14 Party in Sheets 45 C and 45 G in the districts of Jālōr and Bāli in Jodhpur (or Mār wār) State, and thoroughly to check the accuracy of the work by geodetic triangulation.

The party established its field headquarters at Erinpura Road and commenced operations from 19th December 1946. The party returned to recess on 5th March 1947.

78. **Personnel.**—The field strength consisted of 2 Class I officers, 3 Class II officers on probation, an average of 5 Topographical Assistants, 1 Computer, 4 clerical assistants and 3 drivers for motor transport.

79. **Work completed.**— $81\frac{1}{2}$ miles of precision traverse involving 126 stations. Star observations for the determination of astronomical azimuth and longitude at 7 stations.

Geodetic triangulation involving 8 stations.

80. **Field work.**—The field work was organized as follows :—

The headquarters of the party remained at Erinpura Road throughout the field season. The party working as a detachment used there 15 cwt. weapon carriers as transport and moved camp every few days as the traverse proceeded.

The work was organized in four groups :—

Traverse Group.—Principal observer and recorder, base observer and recorder and reconnaissance officer.

Computation Group.—One officer in charge with one or more computers and computing officers.

Astro. Group.—One astro. observer and his recorder to carry out star observations and their computations as the work progressed.

Triangulation Group.—One observer and one recorder.

81. **Description of country.**—The country consisted of open flat plains, stony and sandy, sparsely cultivated with scrub and batches of trees. Low hills rising steeply 1000 to 2000 feet above the plain afforded good triangulation stations.

82. **Miscellaneous.**—The health of the party remained good. There were a few cases of mumps among the *khalāsis*. These cases were segregated and treated at the local hospital.

Motor transport could be used with advantage throughout the area and the three weapon carriers provided with their heavily ribbed tyres could be driven everywhere and were particularly useful in negotiating heavy sand.

83. **Recess Duties.**—On return to recess the traverse group carried out further test traverses on a stretch of specially selected open country west of Dehra Dūn, and completed a length of $20\frac{1}{2}$ miles of traverse. This was controlled by triangulation and levelling carried out at the same time.

The main object of these tests was to perfect the 'drill' for the traverse without the use of motor transport.

The field computations were checked and recomputed under the direction of Survey Research Institute; the base tapes were re-calibrated; further modifications in the design of the apparatus were carried out.

Major J. S. O. Jelly wrote a fully illustrated memorandum on the "A.I.D." Survey Method of Precise Traverse, which gives a complete description of the method and of the experience gained.

From 18th May 1947 the recess work of the party ceased and its personnel were transferred to other units.

No. 20 (CANTONMENT) PARTY

Officer in charge:— { Mr. T. M. C. Alexander to 6-4-47.
Mr. K. L. Dhawan from 7-4-47.

84. **General.**—The party surveyed cantonments and other military lands in all the Commands at different scales, in accordance with the programme approved by the Engineer-in-Chief, India and the Defence Department. The headquarters of the party remained at Dehra Dūn.

85. **Personnel.**—The average strength of the party, including the Officer in charge, was one Class I officer, two Class II officers, four Upper-Subordinate Officers, one Topographical Assistant and seventy-five Lower Subordinates.

86. **Areas surveyed.**—

8-inch survey	12491 acres.
10-inch survey	740 "
16-inch survey	43504 "
32-inch survey	1552 "
64-inch survey	101 "
100-feet to an inch survey	485 "
200-feet to an inch survey	416 "

87. **Field work.**—The field work was organized as follows :—

Camp (1). Under Mr. Bakhshi Harnam Singh (U.S.S.) with seven surveyors, one traverser, two computers and two draftsmen carried out surveys in Northern Command, with field headquarters at Karachi.

Camp (2). Under Mr. P. K. Chowdhury (U.S.S.) with four surveyors and two traversers, carried out surveys in Eastern Command with headquarters at Meerut.

Camp (3). Under Mr. A. Francis (U.S.S.) carried out surveys in Southern Command with seven surveyors, one draftsman and a computer, with field headquarters at Bangalore.

Camp (4). Under Mr. N. L. Gupta (Class II), with one topographical assistant, six surveyors, two traversers and a computer, carried out surveys for Eastern Command in Bengal, Bihar and Orissa with field headquarters at Calcutta which was later moved to Ranchi. Mr. A. J. Rao, Topographical Assistant took over charge of the camp from Mr. N. L. Gupta on 22nd February 1947 on Mr. Gupta's transfer from the party.

Camp (5). Under Mr. Lorind Chand (selected grade traverser) with three surveyors and two traversers carried out surveys in parts of Southern Command, with headquarters at Poona.

Camp (6). Under Mr. M. L. Kohli (U.S.S.) with four surveyors and two traversers carried out surveys in U.P. and C.P. with headquarters at Allahabād.

Camp (7). Under Mr. N. K. Sharma (selected grade traverser) with four traversers and a computer, provided framework for the surveys, executed by camp (3) in the Southern Command. This camp was disbanded during February 1947.

88. **Traversing and Levelling.**—646 linear miles of traversing and 755 linear miles of levelling were carried out during the year to provide control for the various survey jobs undertaken.

89. Besides the seven camps in the field, there were two sections at the Party headquarters at Dehra Dūn throughout the field season ; one drawing section under head-draftsman Latafat,

Husain with eight draftsmen undertook the fair drawing of Manora Cantonment and Bazar, Malir (South and North), Jubbulpore—Arsenal and Khamaria Factory ; the second section was a computing section under head-computer Padam Singh with four computers.

90. Recess duties.—The party was organized for recess into the following five sections.

No. 1 section under Mr. Bakhshi Harnam Singh (U.S.S.) responsible for the mapping of Ambala and Multan Cantonments.

No. 2 Section under Mr. P. K. Chowdhury (U.S.S.) responsible for the mapping of Jubbulpore Arsenal, Malir Cantonment, North and South Ordnance Factory Khamaria, Agra and Meerut Cantonments, and U.S. Airfield Agra.

No. 3 Section under Mr. A. N. Gossain (Class II) responsible for training of 6 officers.

No. 4 Section under Mr. Ratna Singh (U.S.S.) responsible for training of 10 surveyors.

No. 5 Section under 1st Class computer O. C. Dobhal in-charge Computing section.

STORES OFFICE, SURVEYS

Stores Officer :— { Mr. F. T. Bayly, Offg. to 5th January 1947.
Major L. H. Williams, R.E., from 6-1-47 to 16-6-47.
Mr. F. M. Hawley from 17-6-47.

91. **General.**—The procurement of instruments and equipment to meet the requirements of the department which had expanded during the period under report necessitated the placing of fairly heavy demands on the Director General, Industries and Supplies, New Delhi, and the Director General, India Store Department, London.

It was during this period that events led up to the partition of India into two separate Dominions of India and Pakistan. This entailed a division of all assets in the Survey of India, and affected the stock holdings in this office. Though no actual division of stores was done during the period under report, a great deal of planning was carried out and this created an extra strain on this organization.

92. **Personnel.**—Average strength of this office was :—

- 2 Class I Officers.
- 1 Class II (G.C.S.) Officer.
- 10 Division II personnel.
- 45 Other Class III personnel.
- 90 Class IV personnel.

V. SURVEY REPORTS, EASTERN CIRCLE

DIRECTOR:—{ Lt.-Colonel C. A. K. Wilson, O.B.E., R.E., to 17-2-47.
Major R. T. L. Rogers, R.E., from 18-2-47.

DEPUTY DIRECTOR:—{ Major R. T. L. Rogers, R.E., to 28-2-47.
Major R. S. Kalha, I.A., from 1-3-47 to 1-6-47 and from
2-9-47.
Mr. B. N. Saha, M.Sc., (Current duties) from 2-6-47 to
1-9-47.

93. **Summary.**—On the conclusion of the survey year ending with 14th August 1947, the Eastern Circle had under its administrative control Nos. 5, 9, 10, 11 and 12 (Air Survey) Parties, Engraving Office, Photo-Litho Office, Map Record and Issue Office and No. 5 Drawing Office

One Topographical Assistant while on deputation with the Geological Survey of India resigned and one surveyor on deputation with the Geological Survey of India died while on leave.

Twenty-five temporary surveyors on recruitment were transferred to the Frontier Circle for extensive field training.

Eight ex-soldier surveyors who had previous training in air survey were also entertained.

Thirty-two levellers and computers were recruited and trained for employment in the Irrigation Survey parties.

While employed on the Gumti Project in Tripura State Mr. B. S. Gill, Topographical Assistant, suddenly developed mental disorder and had to be evacuated from the field; he was later granted leave with and without pay to the maximum limit permissible and then discharged from the service.

94. **Areas surveyed.**—

- 238·4 sq. miles of 4-inch original air survey outline only.
- 0·466 sq. miles of 1/1000 ground survey.
- 33·4 sq. miles of 16-inch contour survey.
- 0·5 sq. miles of triangulation for 1/1000 scale survey.
- 1945 sq. miles of triangulation for 1-inch original survey, in Nepāl.
- 1123 sq. miles of triangulation for irrigation and other projects survey 4-inch and over.
- 1603 sq. miles of Sub A.I.D. traverse for planimetric control for 4-inch irrigation survey.
- 604 linear miles of traverse for Irrigation and Land Reclamation and Kosi Dam survey.
- 1013·3 linear miles of height control for 4-inch irrigation survey.
- 4813·2 linear miles of tertiary levelling for 4-inch irrigation and Railway Extension survey.
- 320 sq. miles of tertiary levelling for 4-inch irrigation survey.

- 173 linear miles of tertiary levelling for 16-inch Land Reclamation survey.
 567 sq. miles of supplementary height control.
 1295.8 sq. miles of stonelaying for 4-inch irrigation survey.
 1148.4 sq. miles of air survey for 4-inch irrigation survey.
 596 sq. miles of 4-inch revision (air and/or ground) survey.
 9 sq. miles of 4-inch original (air) survey.
 91 sq. miles of 6-inch revision (air and/or ground) survey.
 12 sq. miles of 16-inch (air and/or ground) survey.
 1 sq. mile of 32-inch revision (air) survey.

95. **Training.**—An average of 16 Class II Probationers was under training throughout the period under report.

A short air survey training course was run at Shillong during recess and the following were trained :—

Class II Probationers	..	..	2
Surveyors	..	..	3

In addition, one Construction Engineer and one surveyor of the East Indian Railway were trained in stereoscopic examination of air photographs.

No. 5 PARTY

Officer in charge :— { Lt.-Colonel C. A. K. Wilson, O.B.E., R.E. to 3-11-46.
 Mr. J. C. Ross., from 4-11-46 to 20-4-47.
 Mr. T. M. C. Alexander, from 21-4-47.

96. **General.**—The technical personnel of the unit, with the exception of the Drawing Section and the Computation Section transferred from No. 5 Drawing Office with effect from the 1st May 1947, were employed on various project works, both in field and in office under the Officer in charge No. 12 Party and details of the work carried out by them will be found in that Unit's report. (*See page 40*).

The Drawing Section was employed on work connected with the programme of No. 5 Drawing Office, the headquarters of which were transferred from Shillong to Calcutta with effect from the 5th May 1947.

The average strength of the party was 1 Class I officer, 3 Class II officers, 1 Class II probationer, 2 U.S.S. officers, 3 Topographical Assistants (including one belonging to No. 9 Party taken on loan), 1 Second Division surveyor, 1 Second Division draftsman, and 42 Lower Subordinates including 3 clerks.

97. **Computations.**—The Computing Section (which came under No. 5 Party from 1st May 1947), with Mr. A. K. Maitra (U.S.S.) as Section Officer and an average strength of 3 Topographical Assistants, 2 computers, and one surveyor, carried out miscellaneous computations, including provision of initial data to

all the field parties of the circle, computation of part of the project work done by No. 12 Party, and adjustment of various topographical data.

No. 9 PARTY

Officer in charge : — { Mr. J. C. Berry, to 14-4-47.
Mr. H. H. Phillips, from 15-4-47.

98. **General.**—The party was formed on the 9th September 1946, with its headquarters at Mansehra, N.W.F.P., under the control of the Director, Frontier Circle, but was transferred to the administrative control of the Director, Eastern Circle from the 28th September 1946 with its headquarters at Dehra Dūn. The party headquarters were again changed to Mussoorie from 2nd May 1947.

The party took the field on 15th October 1946 on the Kosi Irrigation Project surveys for the Central Waterways, Irrigation and Navigation Commission with its field headquarters at Purnea, Bihār.

For the 4-inch scale Kosi Irrigation survey, stonelaying (by the air method), precise traverse, secondary double tertiary and tertiary levelling were carried out in sheets 72 J & N in Purnea and Bhāgalpur districts of Bihār. Ground survey at 1/1000 scale in sheet 72 N was also carried out of the Kosi Dam site at Barahakshetra in Nepāl. For the proposed railway extension from Jogbani to the Kosi Dam site, a 4-inch scale formlined air survey was done covering 238.4 sq. miles in sheet 72 N on the same layout as for the irrigation sheets, and a few tertiary level lines were run in the area to control the formlining.

A contour survey at 16-inch scale in sheets 63 M and 72 A was done at Bagaha, Champāran district, Bihār for Land Reclamation purposes required by the Department of Agriculture, Government of Bihār.

Triangulation in Nepāl for topographical survey on the 1-inch scale in the Kosi Catchment areas was also carried out.

99. **Personnel.**—The strength of the party was 1 Class I officer, 2 Class II officers, 3 Class II probationers, 1 Upper Subordinate officer, 7 Topographical Assistants and 38 Lower Subordinates including 4 clerks.

100. Areas surveyed.—

238.4 sq. miles outline only of 4-inch scale Jogbani Railway Extension sheets by air survey.

0.466 sq. miles of 1/1000 scale ground survey at Kosi Dam site.

33.4 sq. miles of 16-inch scale contour survey for Bagaha Land Reclamation.

0.5 sq. miles of triangulation for 1/1000 Kosi Dam site survey.

1945 sq. miles of triangulation for 1-inch original survey in Nepāl.

228 miles of precise traverse for planimetric control for 4-inch scale irrigation surveys.

- 14 miles topographical traverse for Kosi Irrigation survey.
- 46 miles topographical traverse for Bagaha Land Reclamation survey.
- 2 miles topographical traverse for Kosi Dam survey.
- 158 miles of secondary levelling for height control for 4-inch scale irrigation survey.
- 208 miles double tertiary levelling for 4-inch scale irrigation surveys.
- 1921 miles of tertiary levelling for contouring of 4-inch scale irrigation surveys.
- 58 miles of tertiary levelling for contouring of 4-inch scale Jogbani Railway Extension survey.
- 173 miles of tertiary levelling for contouring of 16-inch scale Bagaha Land Reclamation survey.

101. **Field work.**—The field work was organized as follows :—

Camp (1) Mr. U. D. Mangain (Class II) up to 8-2-47 with Mr. Mahboob Alam (Class II Probationer) up to 5-2-47 and Mr. J. Chatterji (Class II) from 9-2-47 and with 13 surveyors (stone-layers) completed the stone-laying by the air method of 235.0 sq. miles (9 sheets) in the Kosi Irrigation area in sheets 72 J & N in Bhāgalpur & Purnea districts of Bihār and Saptari & Morang districts of Nepāl. They also carried out the ground verification of 238.4 sq. miles for the air survey of the area of the Jogbani Railway Extension in sheet 72 N in Purnea district of Bihār and Morang, Udaipur Garhi & Saptari districts of Nepāl.

Camp (2) Mr. M. A. Faruque (U.S.S.) with 24 levellers completed the tertiary levelling of 1921 miles in the stone-laid area, comprising 8½ irrigation sheets in sheets 72 J & N in Bhāgalpur & Purnea districts of Bihār and Saptari & Morang districts of Nepāl.

Camp (3) From 26-2-47, Mr. Mahinder Singh (Class II Probationer) provided control by triangulation and 3 surveyors completed 0.466 sq. miles of original ground survey at 1/1000 scale at the Kosi Dam Site at Barahakshetra, Nepāl in sheet 72 N in Morang and Udaipur Garhi districts of Nepāl.

Camp (4) From 18-2-47, Mr. S. A. N. Rizvi (Class II) assisted by Mr. R. D. Verma (Topographical Assistant) provided planimetric control, and 6 surveyors and 4 levellers completed 33.4 sq. miles of contour survey at the 16-inch scale in sheets 63 M and 72 A at Bagaha, Champāran district, Bihār, for the Land Reclamation project. This camp was in the field till July 1947 due to the high priority of this work.

Air Survey at Party Headquarters in Purnea. From 6-2-47, Mr. Mahboob Alam (Class II Probationer) with 4 air surveyors completed the air survey of the outline only of 238.4 sq. miles of Jogbani Railway Extension area (10½ sheets) in sheet 72 N in Purnea district of Bihār and Morang, Udaipur Garhi & Saptari districts of Nepāl.

102. **Nepāl Triangulation.**—Messrs. U. D. Mamgain, N. N. Dhawan and Sukhram Singh (all Class II) and later Mr. Mahinder Singh (Class II Probationer) and Mr. V. R. C. Shahane (Topographical Assistant) completed triangulation of 1945 sq. miles for 1-inch scale original survey in Nepāl in sheets 72 E, I, J, M & N in Morang, Chautara, Udaipur Garhi, Rāmechhāp, Sindhūli Garhi Okhaldhunga and Dhankuta districts of Nepāl.

103. **Recess duties.**—The party was organized into three sections, viz., an Air Survey Section under Mr. Mahboob Alam (Class II Probationer), a Drawing Section under Mr. L. R. Howard (U.S.S.) and a Computing Section under Mr. H. S. Iyer (Topographical Assistant). The Air survey of $8\frac{1}{2}$ sheets, 235 sq. miles, of 4-inch scale outline survey only of the Kosi Irrigation area, stone-laid and levelled in the field, was completed up to 14-8-47.

The fair-drawing of the outline originals only of 235 sq. miles of 4-inch scale Kosi Irrigation sheets, the fair drawing of outline and contour originals of 191.4 sq. miles, and outline only of 46.9 sq. miles for the 4-inch scale Jogbani Railway Extension were completed up to 14-8-47.

The fair-drawing of outline and contour originals of 0.20 sq. miles of 1/1000 scale Kosi Dam survey was completed up to 14-8-47.

The height computations for 5 sheets (135 sq. miles) of the Kosi Irrigation sheets (stone-laid and levelled in the field) were completed up to 14-8-47.

Nepāl triangulation was computed by Mr. Mahinder Singh (Class II Probationer) and by Messrs. U. D. Mamgain, N. N. Dhawan, Sukhram Singh (all Class II) and Mr. Shahane (Topographical Assistant) in their respective units.

Preliminary training of seven newly recruited tertiary levellers was also carried out during recess.

No. 10 PARTY

Officer in charge:— { Khan Sahib Chowdhury Muhammad Aslam, to 14-6-47.
Mr. S. C. Chatterjee, from 15-6-47.

104. **General.**—The party was formed on 30th August 1946 with its headquarters at Murree under the administrative control of the Director, Frontier Circle, with a view to its carrying out surveys in connection with the Tista Irrigation Project for the Government of Bengal. After initial training on irrigation methods had been imparted to the personnel, it was transferred to the Eastern Circle with change of headquarters to Shillong. Later, during the recess the party headquarters were shifted from Shillong to Kurseong in the Darjeeling district.

The requirement of the Bengal Irrigation Department was 4-inch maps with 1-foot contour interval of the area likely to be irrigated by a system of perennial canals, the water supply for which is to be obtained from the Tista River by constructing a high dam across it near Gielkhola and a barrage some four miles north of Jalpaiguri. The extent of such commanded area which covers a

part of Jalpaiguri district and almost the whole of Dinājpur, Rangpur, Bogra, Mālda and Rājshāhi districts of Bengal with a part of Cooch Behār State, is about 20,000 sq. miles.

105. Personnel.—The average field strength of the party was 1 Class I officer, 5 Class II officers including 4 probationers, 1 Upper Subordinate officer, 7 Topographical Assistants and 44 Lower Subordinates including 4 clerks. Besides the above there were 3 temporary computers and 7 record-keepers who were employed in computations and other miscellaneous jobs at the party headquarters.

106. Areas surveyed.—1375 sq. miles of 4-inch irrigation surveys. The various types of work completed were as follows :—

- 542 linear miles of traversing.
- 439 linear miles of control levelling.
- 315 sq. miles of Air survey.

107. Field work.—The field work was organized as follows :—

Camp (1). Under Mr. M. Alauddin (Class II) up to 31-12-46, and Mr. S. Q. Hasan (Class II) from 1-1-47, with four Class II probationers, 1 Topographical Assistant and 12 surveyors for traversing, air survey and stone-laying in sheets 78 B, C, F, in Jalpaiguri, Rangpur, Dinājpur districts of Bengal, Purnea district of Bihār and Cooch Behār State of the Eastern States Agency.

Camp (2).—Under Mr. A. P. Datta (U.S.S.) with 1 Class II probationer, 6 Topographical Assistants and 28 levellers for secondary, simultaneous double tertiary and tertiary levelling in sheet 78 B in Jalpaiguri, Dinājpur & Rangpur districts of Bengal and Cooch Behār State of the Eastern States Agency.

Four plane-tablers, under the supervision of Mr. S. Q. Hasan (Class II) completely revised the air survey contouring of the Gielkhola Dam, 32-inch scale in sheet 78 B in Darjeeling district carrying out original 10 feet contouring in some areas heavily shadowed on the photos. This Detachment worked until the end of June in order that the sheets could be printed during recess.

108. Description of country.—The area lay mostly in Jalpaiguri, Dinājpur, and Rangpur districts of Bengal with a small portion in Cooch Behār State. The area was dead flat cultivated plain with scattered huts having thick bamboo, mango and other tree groves at close intervals.

109. Miscellaneous.—The health of the party was good though parts of the area were notorious for malaria. With a liberal use of mepacrine tablets the incidence of malaria was kept very low. The party recessed at Kurseong which provided a cool, though wet, climate.

110. Recess duties.—19 four-inch irrigation sheets were fair-mapped by one Drawing Section (Air Photo) under Mr. S. Q. Hasan (Class II). Computing Section under Mr. D. Sen, Topographical

Assistant, completed all work in hand including plotting and typing of level charts of all the 19 sheets.

Preliminary training of ten newly recruited tertiary levellers was also carried out during recess.

No. 11 PARTY

Officer in charge.—Mr. M. M. Ganapathy.

111. General.—The party was formed on the 9th September 1946 with its headquarters at Murree under the administrative control of the Director, Frontier Circle and was transferred to the administrative control of the Director, Eastern Circle with effect from the 28th September 1946 with its headquarters at Dehra Dūn.

The party assembled in Sambalpur, Orissa, on 15th October 1946 for carrying out irrigation survey on the 4-inch to a mile scale in the commanded area of the Mahānadi (Hīrākud) Project. It was not however possible to start operations till 25th November 1946, when all the necessary equipment and instruments arrived. Moreover, the technical personnel, particularly the tertiary levellers, had to be given additional training under actual conditions on the ground of operations before they could be put on productive work. In addition to this training all preliminary work connected with stone-laying from air photographs was completed during this period.

112. Personnel. The average strength of the party was 1 Class I officer, 3 Class II officers, 1 Upper Subordinate officer, 6 Topographical Assistants, 1 temporary computer and 41 Lower Subordinates including 4 clerks.

113. Areas surveyed.—For 4-inch irrigation surveys, the various types of work completed were as follows :—

1005 sq. miles of triangulation.

208·3 linear miles of levelling framework.

2834·2 linear miles of tertiary levelling.

360 sq. miles of outline air survey.

114. Field work.—The field work was organized as follows :—

Camp (1).—Headquarters at Sambalpur. Camp Officer :—Mr. S. Q. Hasan (Class II) from 15-10-46 to 9-1-47; Mr. Phillips (Class II) from 10-1-47 to 28-3-47; Mr. M. Z. Mehdi (Class II Prob.) from 29-3-47 to 3-5-47.

Assistant Camp Officers :—Mr. S. R. M. Louis (Class II Probationer) and Mr. S. N. Roy (Topographical Assistant) from 25-11-46 to 1-3-47.

Triangulators :—Mr. K. S. Singh (Class II Probationer) from 20-11-46 to 28-2-47; Mr. S. R. M. Louis (Class II Probationer) and Mr. S. N. Roy (Topographical Assistant) from 1-3-47 to 3-5-47.

The following work was completed by the camp :—

(a) Supplementing the existing trig. control with additional points for control of air survey in sheets

64 O & 73 C in Sambalpur district of Orissa and Sonepur State of the Eastern States Agency.

(b) Stonelaying in an area of 51.2 sq. miles with an average strength of 7 stonelayers in sheets 64 O & 73 C in Sambalpur district.

(c) Air survey of 100 sq. miles in sheets 64 O & 73 C in Sambalpur district.

Camp (2).—Headquarters at Attabira. Camp Officer :—Mr. M. Z. A. Qureshi (U.S.S.).

Assistants :—Messrs. M. Z. Mehdi (Class II Probationer) and S. L. Bahl, Topographical Assistant.

Secondary and double tertiary levellers—Messrs. S. N. Sanyal, A. K. Roy, V. R. C. Sahane and G. L. E. Carrau, Topographical Assistants.

The camp completed tertiary levelling over an area of 326 sq. miles with an average strength of 22 levellers and 3 computers in sheets 64 O & 73 C in Sambalpur district.

In addition to the above work the party also completed some ground survey for No. 12 Party in connection with the extension of the Hirākud Reservoir in sheet 64 O in Sambalpur district. Mr. Louis (Class II Probationer) with an average strength of 6 surveyors completed this job in 13 days from 28th April to 11th May 1947 at the close of the field season.

115. *Description of country.*—The country was generally undulating with open cultivated areas in the hollows alternating with open areas of scrub and scattered trees on high ground.

116. *Miscellaneous.*—Health in the field was on the whole fair, thanks to a liberal supply of mepacrine. There were two casualties, one of a *khalāsi* who was drowned while bathing in a river and the other of a personal servant of a leveller who died of intestinal trouble.

117. *Recess duties.*—Recess work was organized as follows :—

Section I. with 2 air surveyors and 8 draftsmen for the survey and mapping of 8 irrigation sheets.

Section Officer :—Mr. M. Z. Mehdi (Class II Probationer) from 12-5-47 to 15-7-47.

Mr. Sukhram Singh (Class II) from 16-7-47 to 14-8-47.

Section II. with 2 air surveyors and 8 draftsmen for the survey and mapping of 8 irrigation sheets.

Section Officer—Mr. S. N. Roy (Topographical Assistant) from 12-5-47 to 10-7-47.

Mr. S. K. Guha (U.S.S.) from 11-7-47 to 14-8-47.

Computation Section with 2 computers and 4 levellers/computers for the computation of the tertiary levelling completed during the field season.

Section Officer—Mr. S. L. Behl (Topographical Assistant).

Training Section for the training of 8 pupil levellers.
Section Officer—Mr. G. L. E. Carrau (Topographical Assistant).

Air Survey Training Section for training 3 Topographical Assistants, Messrs. S. N. Sanyal, V. R. C. Sahane and A. K. Roy in air survey and carrying out photo marking for the next field season.

Section Officer—Mr. N. K. Basu (Topographical Assistant) who was temporarily attached to this party from 12 Party.

Computation of all triangulation carried out during the field season was carried out by Mr. P. N. Sanyal, Temporary Computer.

No. 12 PARTY

Officer in charge:— { Lt.-Colonel C. A. K. Wilson, O.B.E., R.E., to 9-10-46.
Mr. J. C. Ross, from 10-10-46.

118. **General**.—The party carried out ground control and large scale air and/or ground surveys and fair-mapping for various irrigation, flood control, hydro-electric, town extension, geological investigation and other similar projects in Assam, Bengal, Bihār, the Central Provinces, the Eastern States Agency, Orissa and Nepāl.

119. **Personnel**.—The average strength of the party was 1 Class I officer, 8 Class II officers, 3 Topographical Assistants and 20 Lower Subordinates including 4 clerks.

120. **Areas surveyed**.—

596 sq. miles of 4-inch revision (air and/or ground survey).

9 sq. miles of 4-inch original (air) survey.

91 sq. miles of 6-inch revision (air and/or ground) survey.

12 sq. miles of 16-inch revision (air and/or ground) survey.

1 sq. mile of 32-inch revision (air) survey.

118 sq. miles of triangulation (with or without supplementary height control).

567 sq. miles of supplementary height control only.

121. **Work at Headquarters**.—The party was organized into three Air Survey Sections, which were placed under Messrs. J. C. Sikka, N. C. Sen and N. N. Dhawan—all Class II Officers. Later, an Air Survey Training Section was also formed under Mr. R. S. Chugh (Class II).

The section under Mr. J. C. Sikka (Class II)—assisted by Lieut. N. K. Sen, R.I.E.—carried out the following:—

(a) 9 sq. miles of 4-inch original survey in sheet 72 N, (Chatra Gorge) in Nepāl.

(b) 363 sq. miles of 4-inch revision survey, of planimetry only, in sheets 55 K & O and 78 E & I, (Kamptee

and Bokāro Coalfields and Bokāro Reservoir) in Nāgpur and Hazāribāgh districts.

- (c) 45 sq. miles of 4-inch revision survey, in sheets 55 O (Kamptee Coalfield) and 73 E (Bokāro Reservoir) in Nāgpur and Hazāribāgh districts.
- (d) 4·8 sq. miles of 16-inch revision survey in sheets 64 O (Hirākud Dam) and 73 D (Tikarpāra Dam), in Sambalpur district and Daspalla State.

The section under Mr. N. C. Sen (Class II) carried out the following :—

- (e) 168 sq. miles of 4-inch revision survey in sheets 64 O and 73 C (Hirākud Reservoir), in Bilāspur and Sambalpur districts and Raigarh and Sāran-garh States.
- (f) 41 sq. miles of 6-inch revision survey, of planimetry only, in sheet 79 B (Hooghly Ship Canal) in 24 Parganas district.
- (g) 50 sq. miles of 6-inch revision survey in sheets 84 A & B (Karnaphuli Reservoir), in the Chittagong Hill Tracts and Lushai Hills district.
- (h) 2·6 sq. miles of 16-inch revision survey in sheet 73 H (Narāj Dam), in Athgarh State and Cuttack district.
- (i) 0·8 sq. miles of 32-inch revision survey in sheet 78 A (Tista High Dam), in the Darjeeling district.

The section under Mr. N. N. Dhawan (Class II) carried out the following :—

- (j) 4·4 sq. miles of 16-inch revision survey, of planimetry only, in sheet 73 J (Jamshedpur Town Extension) in Singhbhūm district.

An appreciable amount of work was also done by the Air Survey Sections in connection with the preparation of contoured mosaics, anaglyphs, etc.

122. Field work (done by Nos. 5 and 12 Parties, personnel, under the supervision of No. 12 Party) :—As field work had to be carried out in isolated areas scattered over North-East India, no field party headquarters were established for either No. 5 or 12 Party ; the several detachments were sent out independently and controlled from Shillong. Field work was commenced very late and extended up to June 1947.

The following triangulation (with or without supplementary height control) was carried out :—

- (a) By Mr. V. Krishnamurthy (Class II)—1·2 sq. miles in sheet 73 E (Bokāro Dam), in Hazāribāgh district.
- (b) By Mr. B. R. Swarup, (Class II)—2·1 sq. miles in sheet 84 B (Karnaphuli Dam), in the Chittagong Hill Tracts.

- (c) By Mr. Mohd. Abbas, (Class II)—12·3 sq. miles in sheets 73 D & I (Tikarpāra Dam and Bermobhāndaridah Gorge), in Daspalla State and Hazāribāgh district.
- (d) By Mr. S. Das Gupta (Offg. U.S.S.)—12·7 sq. miles in sheet 73 J (Jamshedpur Town Extension), in the Singhbhūm district.
- (e) By Messrs. B. S. Gill and T. K. Chatterjee (both Topographical Assistants)—4·5 sq. miles in sheet 79 M (Gumti Dam), in Tripura State.
- (f) By Messrs. K. N. S. Pillai, N. M. Das, T. K. Maitra, (all Topographical Assistants) and one surveyor—40·4 sq. miles in sheet 73 I (Konār Dam, Power House, Reservoir and Pipe Line), in the Hazāribāgh district.
- (g) By Second Division surveyor Sohan Singh—44·8 sq. miles in sheets 72 L and 73 I (Deolbāri Reservoir and Dam), in the Mānbhūm and Santāl Parganas districts.

The following supplementary height control only, was carried out :—

- (h) By Messrs. R. S. Chugh, D. Biswas and Mohd. Rafique, (all Class II)—197 sq. miles in sheets 84 A & B (Karnaphuli Reservoir) in the Chittagong Hill Tracts and Lushai Hills district.
- (i) By Mr. N. M. Das (Topographical Assistant)—190 sq. miles in sheets 55 K & O (Kamptee Coalfield), in the Nāgpur district.
- (j) By Mr. N. M. Das (Topographical Assistant), assisted by two surveyors—180 sq. miles in sheet 73 E (Bokāro Coalfield), in the Hazāribāgh district.

The following surveys were carried out :—

- (k) Mr. V. Krishnamurthy (Class II) with 8 surveyors, completed 226 sq. miles of 4-inch revision survey, of contours mainly, in sheets 73 E & I (Bokāro Coalfield); 13 sq. miles of 6-inch revision survey, mainly of contours in sheet 73 E (Bokāro Reservoir) and 1·2 sq. miles of 16-inch revision survey in sheet 73 E (Bokāro Dam), in the Hazāribāgh district. These areas were subsequently fair-mapped at party headquarters.
- (l) Mr. B. K. Satpathi (Class II Probationer), with 7 surveyors, completed 146 sq. miles of 4-inch revision survey, of contours mainly, in sheets 55 K & O (Kamptee Coalfield) in the Nāgpur district. This area was subsequently fair-mapped at party headquarters.
- (m) Mr. S. Das Gupta (Offg. U.S.S.) with 1 Topographical Assistant and 5 surveyors, completed 4·6 sq.

miles of 16-inch revision survey mainly of contours, in sheet 73J (Jamshedpur Town Extension) in the Singhbhūm district. This area was subsequently fair-mapped at party headquarters to provide a series of 99 ft. to 1-inch maps.

Computations of instrumental observations were done partly in the field and partly at headquarters, either by No. 12 Party or by Computing Section of No. 5 Party as convenient.

VI. SURVEY REPORTS, SOUTHERN CIRCLE

DIRECTOR :— { Major I. H. R. Wilson, R.E., to 6-7-47.
 { Mr. M. R. Nair, in charge current duties, from 7-7-47.

123. Summary.—The Southern Circle Directorate and No. 4 Drawing Office were sanctioned on a permanent basis with effect from 22nd August 1946. The units administered by the Circle were Nos. 6 and 8 Parties and No. 4 Drawing Office.

124. Areas surveyed.—

1427 Square miles of 1-inch original survey.

25 square miles of 6-inch air survey.

48 square miles of 3.85-inch photo-mosaic contouring.

2850 square miles of triangulation (re-heighting only)
for future surveys.

512 square miles of triangulation and traverse for
irrigation project.

283 square miles of secondary and tertiary levelling for
irrigation project.

28 square miles of triangulation and traverse for air
survey.

200 square miles of height control by clinometer and
aneroid for air survey.

125. Special.—Mr. B. B. Kuttappa with four assistants conducted a week's course, from 1-11-47 to 23-11-47, in air survey for a class of Civil Engineers at the College of Engineering, Poona.

No. 4 DRAWING OFFICE

Officer in charge :— { Mr. M. R. Nair, to 8-12-46.
 { Major I. H. R. Wilson, R.E., from 9-12-46 to 1-1-47.
 { Mr. M. R. Nair, from 2-1-47.

126. General.—An Air Survey Section was formed under the charge of Mr. B. B. Kuttappa (Offg. Class II) and under the direct technical control of the Director, to deal with the air surveys of the post-war development projects. This Air Survey Section was re-designated as H.Q. Section with effect from 1st January 1947 and formed the nucleus of the future Air Survey Party of the Circle.

Mr. M. W. Kalappa (Class II) took over charge of the H.Q. Section from Mr. B. B. Kuttappa on 31st March 1947.

127. Personnel.—The average strength consisted of 1 Class II Probationer, 1 Topographical Assistant, 5 Surveyors and 1 draftsman.

128. Areas surveyed.—25 square miles compiled and published on 6-inch scale of Atpadi Dam Sites (Aundh State) Radhanagari Reservoir (Kolhapur State) and Nari Halla Reservoir (Sandur State) in sheets 47 K, H, and 57 A respectively.

48 square miles of photo-mosaic of Chamajranagar-Mettupaliyam Railway contoured on 3.85-inch scale with contours at 250 ft. interval in sheets 57 A & E.

129. **Field work.**—1,973 square miles of vertical photography was carried out in sheets 47 E, 48 I, N, 57 A, H, 58 A, B, E.

28 square miles of plan and height control required for air survey compilation were carried out by triangulation and traverse in sheets 48 N, 57 A, H, and 58 B.

200 square miles of height control required for 25 ft. contouring of the 4-inch photo mosaic of Kalinadi Reservoir area were carried out by means of clinometric and aneroid barometric heights.

130. **Air survey training.**—A refresher air survey course for 1 month was conducted for 1 Class II officer, 3 Topographical Assistants, 1 Tempy. Computer and 2 L. S. S. officers of the Circle.

One draftsman of the S. I. Railway was given training in the interpretation of air photographs.

No. 6 PARTY

Officer in charge :—Mr. B. N. Murthy, B.Sc.

131. **General.**—The party completed its season's programme of 1-inch topographical surveys in Bombay, Kolhāpur and the Deccan States and triangulation (re-heighting only) in Bombay, Kolhāpur and Deccan States for the height control of next season's 1-inch survey. Field work commenced in the middle of November 1946, and all field personnel engaged on these surveys returned to recess in Bangalore by the end of April 1947. The party was administered throughout the season from Bangalore. The Officer in charge made tours of inspection in December 1946, January, February and March 1947. The Director, Southern Circle, also made a tour of inspection in 1947.

132. **Personnel.**—The average strength of the party was 1 Class I officer, 2 Class II officers, 1 Upper Subordinate officer, 2 Topographical Assistants and 19 Lower Subordinates. All the officers and surveyors were employed in the field during 1946-47 field season.

133. **Area surveyed.**—

1427 square miles of 1-inch blue print new survey.

2850 square miles of triangulation (re-heighting only) for future survey.

134. **Field work.**—The field work was organized as follows :—

Camp (1).—Mr. J. A. Cabral (Class II) with Mr. J. E. David (Class II) and 11 Surveyors carried out the 1-inch blue print new survey of 802 square miles of the Ratnāgiri and Sātāra districts of Bombay and of Kolhāpur State in sheet 47-H.

Camp (2).—Mr. Bashirullah Khan (U.S.S.) with Mr. P. N. Rao (Topographical Assistant) and 6 Surveyors carried out the 1-inch

blue print new survey of 623 square miles of the Ratnāgiri district of Bombay, of Kolhāpur State and of the Deccan States in 47 H.

Triangulation.—Mr. V. Raghavan, (Topographical Assistant) carried out the triangulation (re-heighting only) of 2850 square miles of the Ratnāgiri and Sātāra districts of Bombay, of Kolhāpur State and of Deccan States, in 47 G.

135. *Description of country*:—The country covered by the the 1-inch blue print new survey consists of three distinct belts namely, coastal area with cocoanut plantations, undulating area with sparsely cultivated patches and hilly area with fairly dense vegetation. The Western Ghats cut across the area surveyed.

136. *Recess duties.*—Two primary mapping sections under Messrs. J. A. Cabral (Class II) and Mr. I. K. Ponnappa (Class II) were engaged on the fair mapping of the 6 1-inch sheets, surveyed during the field season.

Mr. P. N. Rao (Topographical Assistant) was engaged on the computations of the season's triangulation (re-heighting) by Mr. V. Raghavan (Topographical Assistant).

The progress up to 14th August was 40% in the case of fair-mapping and 75% in the case of computations.

137. *Miscellaneous.*—Allocation of motor transport for field work was a special feature.

The health of the party was not good. There were several cases of serious illness amongst the senior surveyors who took the field soon after their release from the army.

There was a marked drop in the out-turn of field work owing to the following handicaps :—

Difficulty in procurement of rations and inadequacy of rations supplied.

Shortage of trained *khalāsis*. Owing to the absence of field work during the war period the old *khalāsis* of the department had procured other jobs and so new *khalāsis* had to be recruited and trained.

Lack of properly graded trained surveyors. The senior surveyors were too old for rapid work, and the strain of active service had also lowered their efficiency. The junior surveyors lacked the required training for productive work.

The communal tension in the country embarrassed the field personnel, though nothing untoward actually happened.

No. 8 PARTY

Officer in charge:—Mr. P. A. Thomas from 12-8-1946.

138. *General.*—With the post-war expansion of the department this party was formed in the Frontier Circle from 12th August 1946 to meet the increasing demands for irrigation project surveys. It was subsequently transferred to the Southern Circle from 29th September 1946 for work in connection with the Tungabhadra Project in Hyderabad State.

The present programme, which is expected to take over 3 years to complete, consists of the provision of planimetric and height control for the survey on 4-inch scale of 2345 sq. miles from air photographs and the production of 91 sheets on 4-inch scale in 2 colours with a contour interval of 5 feet. Incidental requirement is the laying of pillars at intervals of 1 furlong along spurs and streams over 2 miles in length and the heighting of these pillars correct to 0.1 foot (relative).

The area under survey lies entirely within Hyderabad State on the left bank of the Tungabhadra River and will be commanded by a main canal. This canal will issue from the dam under construction across the river near Hospet. As the river in this locality forms the boundary between the province of Madras and Hyderabad State, the Government of the former also participate in the construction of the dam but survey work for canalisation on the Madras side is in the hands of their own agency. The entire cost of the productive work of this party is therefore debitable to the Hyderabad Government.

After a brief period spent in assembling its personnel, procuring its equipments and making necessary field preparations in Bangalore, the party took the field in December 1946 and opened its field headquarters at Munirabad (M.S.M. Ry.) about 3 miles from the dam site.

139. Personnel.—The strength of the party consisted of 1 Class I officer, 2 Class II officers, 8 Topographical Assistants and 20 Lower Subordinates. Most of the personnel although somewhat trained in irrigation survey in Frontier Circle were new to the Department and had no previous experience of a field season.

140. Area surveyed.—The air photography of the whole area of the project had been completed by Messrs. Indian Air Survey and Transport, Dum Dum, on 2-inch scale in June 1946.

Planimetric control

(Triangulation and Traversing) was provided for the survey of 512 sq. miles.

Height control

(Secondary & tertiary levelling) was provided for the contouring of 283 sq. miles.

141. Field work.—New methods of work were devised to meet the particular requirements of the Superintending Engineer of the Project. As the requirements differed in many respects from those of similar projects undertaken in other Circles, inadequate previous training of the personnel necessitated giving them further instruction in the field in the methods specially required for this work.

A detailed description of the various methods has been given in the Technical Report.

Organization for field work was as follows :—

An advance party consisting of 3 Topographical Assistants carried out triangulation based on G.T. in Sheet 57 A to fix stations

on the perimeter of the work to which traverse lines would be connected.

Two Traverse Detachments, each consisting of 2 Topographical Assistants, carried out traverse by Hunter Short Base along the perimeter of the work and fixed stations and points to provide planimetric control for the air survey compilation.

Two secondary Levelling Detachments, one consisting of 2 Topographical Assistants and the other of 1 T/Computer and 1 Lower Subordinate carried out levelling along the lines of the traverse detachments heighting their stations and providing height control for the tertiary levelling on which contouring would be based.

The sub-camps consisting of 8 Lower Subordinates each under the supervision of 2 Topographical Assistants carried out detail work under the general supervision of 1 Class II officer.

Later 1 Class II Probationer and 1 Topographical Assistant carried out a height traverse by subtense bar in an area unsuited to Levelling or Traverse by Hunter Short Base or chain.

Two air surveyors and one computer remained in Party H.Q. carrying out preliminary air survey work and computing respectively.

142. Description of country.—The country comprising the greater part of the commanded area was an open and gently undulating plain, mostly of black cotton soil under cultivation of cotton and jawar. Numerous isolated rocky hills 200–300 feet high rise out of the plain, and rock and stone outcrops abound. An area of 25 sq. miles near the dam site is in complete contrast consisting of a mass of wild and rugged boulder formed hills with fairly dense scrub and scant cultivation in the valleys.

143. Miscellaneous.—Though the area generally is not very malarious, the belt of country about 4 miles wide adjoining the river bank is rather unhealthy during the first half of the field season. One area in particular in the region of Anegundi, (in Sheet 57 A/7), is particularly bad and all personnel who worked in or visited this locality suffered from a virulent form of malaria. There was also an outbreak of plague in the centre of the area necessitating inoculation of all personnel, as a preventive measure.

This was the first post-war field season and the difficulties resulting from war such as high prices, shortage of food stuff, labour and transport, and the uncertain political situation, only magnified the problems of all personnel already somewhat overawed by the new experience of their first field season.

In a predominantly jowar producing area, a factor introducing additional complication was the rationing of essential foodstuffs among the personnel most of whom were rice consumers.

A feature of considerable importance and advantage was the supply and use, for the first time, of motor transport for field work, in peace time, but much difficulty had to be faced for want of sufficient spare parts and tools. The supply of petrol coupons was somewhat difficult at the start but later became very satisfactory.

The laying of pillars at intervals in fields to form bench marks led to distrust and suspicion in the minds of villagers regarding sub-division and partition of their holdings and often resulted in tampering and destruction.

144. **Recess work.**—The party was organized for recess into 5 sections as follows :—

One Advanced Air Survey Section.

Two Air Survey Sections.

One Computing Section.

One Training Section.

The Advanced Air Survey Section under Mr. Husain Khan (Division II) carried out the air survey and mapping (detail and contouring) of 3 congested sheets.

The two Air Survey Sections under Messrs. M. C. K. V. Raja and R. S. Ramamoorthy, Topographical Assistants, under the supervision of Mr. G. E. Bower (Class II) carried out the air survey (detail only) of 6 sheets.

The Computing Section under Mr. B. P. Rao (T/Computer) completed the computations and records of all the traversing and levelling carried out during the field season.

The Training Section under Mr. C. Sivaraman (Class II) completed the training in elementary air survey of 3 Topographical Assistants and 11 Lower Subordinates.

Three Topographical Assistants underwent a course of advanced air survey training.

Eight Lower Subordinates underwent a course in elementary computing.

Five Topographical Assistants and 6 Lower Subordinates proceeded on a course in plane-tabling.

Due to the inexperience of personnel and the necessity for their training, the productive work of the party was not very high. Roughly speaking 50% of strength was only available for productive employment.

VII.—SURVEY REPORTS, MILITARY CIRCLE

DIRECTOR:—{ Colonel G. H. Ozmaston, M.C., to 5-7-47.
Colonel G. W. Gemmell, I.A. from 6-7-47.

ASSISTANT DIRECTOR:—{ Mr. C. T. Hurley, to 6-7-47.
Mr. N. L. Gupta, C.E., from 5-4-47 to 14-8-47.

145. **Summary.**—The Director, Military Circle, Survey of India, was also the Director of Survey, India Command. In the latter capacity he was head of the Military Survey Service of the Army in India, the work of which is not covered by this report.

The civil responsibilities of the Director, Military Circle during the period under report were small, except towards the close of the period when he was placed in charge of arrangements for Partition (*see page 6, para 5*).

The units administered by the Military Circle were—(1) Stores Office, Surveys (until 1st March 1947) and (2) Survey Training Centre.

STORES OFFICE, SURVEYS

146. **General.**—The Stores Office, Surveys, was placed under the Military Circle for convenience during the war when the bulk of survey supplies were received from military sources and the office served as the stores depot for supplying military survey units.

This arrangement ceased to have advantages after the conclusion of hostilities, and on 1st March 1947 the office was transferred to the administrative control of the Director, Geodetic Branch. (*see also page 31, para 91*).

SURVEY TRAINING CENTRE

Survey Training Officer:—{ Major J. Gidman, M.B.E., I.A. up to 1-12-46.
Major H. Bell, I.A., from 2-12-47 to 31-7-47.
Major Jiwan Singh, R.I.E. from 1-8-47.

147. **General.**—The function of the Survey Training Centre remained the same as last year namely to arrange for posting of the personnel released from the military survey service to their civil units.

148. **Personnel.**—The strength of the Survey Training Centre was 1 Class I officer and 8 clerks.

PART II.—MAP PUBLICATION AND OFFICE WORK

From 1st April 1946 to 14th August 1947

VIII.—INTRODUCTION

149. **Progress of Map Publication.**—Indexes D to G, at the end of this report, show the progress of surveys and publication of all standard series of modern maps, excluding those maps which are “Restricted” and not available for sale to the public.

150. **Work of Map Drawing and Printing Offices.**—The work of the drawing and printing offices of the Department for the period under report is described in three sections of Part II of this report, as follows :—

Section X (page 56) gives statistics of map publications, extra departmental printing undertaken and map issues.

Section XI (page 61) describes the work of the drawing offices and includes two tables which quantitatively summarize this work.

Section XII (page 63) describes the work of the printing offices.

151. **Map Publication Policy.**—The period under review was one of considerable activity in all branches of Map Publication. Demands for map drawing and reproduction for the army continued to be heavy and civil demands increased, especially as the date for the partition of India drew near. A large amount of publication work was also undertaken in connection with projects for the Central Waterpower, Irrigation and Navigation Commission.

At the end of the war, stocks of all maps had fallen very low and an urgent programme to replenish stocks was necessary. Owing to this urgency, the publication of departmental sheets was confined mostly to reprinting without any change in the body of the map. As an interim measure also, the war-time expedient of printing the standard topographical series in two or three colours continued.

It was, however, felt that at least one up-to-date map series for the whole of India, must be maintained and printed in full colours. With this in view the maintenance of the $\frac{1}{2}$ -inch compiled series was dropped and re-issues of the 1-inch series postponed till justified by revision surveys, so that most of the available drawing power of the department could be concentrated on the re-issue or re-compilation of the $\frac{1}{4}$ -inch series. A new colour scheme for the $\frac{1}{4}$ -inch series consistent with legibility and economy in printing was tried and adopted as an interim measure.

Recently there has been a great demand for up-to-date editions of Province maps which necessitated an examination of the existing procedure with a view to simplifying and accelerating it. A rapid

method to produce these maps directly from engraved prints of the 1/M "Carte Internationale du Monde" series was adopted with success. This has resulted in the saving of a considerable amount of drawing work.

Though the practice of having separate colour originals was not successful, separate name originals have come to stay. Experiments to find out the quickest and the most satisfactory method of preparing name originals were carried out. The war-time acquisition of a "Monotype Keyboard and Casting Machine" in the printing office, introduced the use of "Gill" type on our maps and proved to be invaluable in view of the difficult position regarding availability of imported type founts.

In order to utilize as fully as possible the map production plant and equipment installed during the war commercial and extra-departmental work has been undertaken to a large extent; and demands for lithographic printing from other departments have been encouraged so far as shortage of skilled personnel permit it.

After the cessation of hostilities, mobilized British photo-litho technicians employed during the war in the Hathibarkala printing offices were used to train Survey of India personnel in multicolour half-tone lithographic printing and in other processes which have not been previously used in our offices. Demands for lithographic printing work from other Government departments have been heavy and some of these have had to be refused through want of sufficient staff.

During the period under report, the printing work of the whole department was controlled by the Director Map Publication.

IX.—PERSONNEL

Dehra Dun. Director, Map Publication

Lt.-Col. G. W. Gemmell, I.A., to 22-6-46.
Lt.-Col. J. B. P. Angwin, M.B.E., R.E., from
23-6-46 to 17-8-46.
Major H. W. Wright, O.B.E., R.E., from
18-8-46 to 24-5-47.
Major Gambhir Singh, I.A., from 25-5-47.

Deputy Director, Map Publica- tion

Major R. C. N. Jenney, R.E., to 8-4-46.
Lt.-Col. G. W. Gemmell, I.A., from 9-4-46
to 14-5-46.
Major Gambhir Singh, I.A., from 1-5-47.

Officer on Special Duty

Captain L. H. Williams, R.E., to 6-6-46.

Executive Officer

Mr. N. N. Chuckerbutty, L.C.E., to 17-1-47
and from 28-2-47.

Assistant Director, Map Publica- tion (1)

Mr. M. M. Ganapatty, B.A., to 17-4-46.
Rai Sahib D. N. Banerji, L.C.E.,
from 18-4-46.

Assistant Director, Map Publica- tion (2)

Captain L. H. Williams, R.E., from 15-5-46
to 6-6-46.
Lt.-Col. G. W. Gemmell, I.A., from 7-6-46
to 22-6-46.
Mr. A. Ahad, B.Sc., from 23-6-46 to 31-7-47
Mr. M. D. Nangia, B.A., from 1-8-47.

No. 6 Drawing Office

Officer in charge—

Mr. F. J. Grice, from 1-4-46 to 14-5-46.
,, A. Ahad, B.Sc., from 15-5-46
to 18-6-46.
,, F. J. Grice, from 19-6-46 to 2-5-47.
,, A. K. Sen Gupta, C.H., from 3-5-47
to 13-5-47.

No. 1 Drawing Office*Officer in charge—*

- Mr. A. K. Sen Gupta, C.H., to 31-5-47.
 „ H. M. Critchell, from 1-6-47.

Class II O.C. Adm.—

- Mr. A. K. Sen Gupta, C.H., from 18-1-47
 to 27-2-47.

Class II—

- Mr. M. M. Ganapatty, B.A., to 13-5-46.
 „ A. Ahad, B.Sc., to 22-6-46.
 „ P. S. Shinghal, C.E., to 20-6-46.
 „ A. K. Sen Gupta, C.H., to 17-1-47,
 from 28-2-47 to 2-5-47 and from
 1-6-47 to 14-8-47.
 „ G. C. Aggarwala, B.A.
 „ J. N. Kohli, from 20-5-46.

Class II (Probationer)—

- Mr. K. Venkataraman, B.A., from 22-4-46.
 „ I. C. Dev, B.Sc. (Hons.),
 from 22-4-46.
 „ Muhd. Ishaq, B.A. (Hons.),
 from 22-4-46 to 14-8-47.

U.S.S.—

- Mr. Ghulam Hasan, to 10-12-46.
 „ G. S. Bagchi, to 3-9-46.
 „ N. C. Roy.
 „ J. R. Chibbar.
 „ B. P. Rudev, to 24-11-46.
 „ S. I. H. Naqvi, to 2-8-47.
 „ Jagan Nath, B.Sc., to 1-1-47.

Topo. Assistant—

- Mr. I. C. Dev, B.Sc. (Hons.), to 21-4-46.
 „ K. Venkataraman, B.A., to 21-4-46.
 „ Mohd. Ishaq, B.A. (Hons.),
 to 21-4-46.
 „ Mohd. Munir, B.A., to 14-8-47.
 „ K. R. Basu, to 31-7-46.
 „ P. C. Malik, B.Sc., from 23-6-47.

Photo-Litho Office (Hathibarkala)

*Chief Manager—*Mr. L. H. Mordue,
 from 1-5-47.

*Manager—*Mr. L. H. Mordue.

**Map Record & Issue Office
(Hathibarkala)**

*Chief Map Curator—*Mr. I. J. Mendes.

Works Office (Hathibarkala)

*Electrical Engineer—*Mr. A. L. Sood.

NOTE.—(i) The charge of No. 6 Drawing Office was transferred to Murree from 14th May 1947 and the charge of No. 1 Drawing Office was transferred from Calcutta to Hathibarkala, Dehra Dūn from 14th May 1947.

(ii) Calcutta offices were under the administrative control of the Director Map Publication

and under the direct control of the Deputy Director Map Publication up to 28-2-47. From 1-3-47 they transferred to the administrative control of the Director Eastern Circle. Personnel of the Calcutta offices, reported under Director Eastern Circle, are not repeated under Director Map Publication.

**Shillong. Director, Eastern
Circle**

Lt.-Col. D. R. Crone, C.I.E., O.B.E., R.E.,
 to 18-4-46.

Lt.-Col. C. A. K. Wilson, O.B.E., R.E.,
 from 19-4-46 to 17-2-47 in addition to
 the charge of No. 5 Party from 9-9-46
 to 3-11-46, the charge of No. 12 (A.S.)
 Party from 1-10-46 to 9-10-46 and the
 charge of No. 5 D.O. to 24-11-46.

Major R. T. L. Rogers, R.E., from 18-2-47.

No. 5 Drawing Office*Officer in charge—*

Lt.-Col. C. A. K. Wilson, O.B.E., R.E.,
 to 24-11-46.

Mr. K. C. Gossain, B.A., from 25-11-46
 to 4-5-47.

U.S.S.—

- Mr. A. K. Talapatra, B.A., to 30-4-47.
 „ A. K. Maitra, B.A., from 3-5-46
 to 30-4-47.

The charge of No. 5 Drawing Office was transferred to Calcutta on 5-5-47 but the two last named personnel remained in Shillong till the end of the period under report.

**Calcutta. Deputy Director,
Eastern Circle**

Major I. H. R. Wilson, R.E., to 18-4-46.
 Lt.-Col. C. A. K. Wilson, O.B.E., R.E.,
 from 19-4-46 to 5-9-46.

Major R. T. L. Rogers, R.E., from 6-9-46
 to 28-2-47.

Major R. S. Kalha, I.A., from 1-3-47
 to 1-6-47.

Mr. B. N. Saha, M.Sc., from 2-6-47 in addition to charge of M.R.I.O.

No. 1 Drawing Office*Officer in charge—*

Mr. C. P. E. Davenport, to 10-5-47.

Class II—

- Mr. S. C. Chatterji, B.Sc., to 10-5-47.
 „ P. C. Sen Gupta, B.Sc., to 10-5-47.

U.S.S.—

- Mr. N. C. Naug, to 10-5-47.
 „ H. K. Kar, from 24-3-47 to 13-4-47.
 „ Mohabat Ali, to 10-5-47.

Topo. Assistant—

Mr. H. K. Kar, from 14-4-47 to 10-5-47
(Re-employed).

No. 5 Drawing Office*Officer in charge—*

Mr. C. P. E. Davenport, from 11-5-47.

Class II—

Mr. S. C. Chatterji, B.Sc., from 11-5-47
to 5-6-47.
,, P. C. Sen Gupta, B.Sc., from 11-5-47.

U.S.S.—

Mr. N. C. Naug, from 11-5-47.
,, Mohabat Ali, from 11-5-47 to 14-8-47.

Topo. Assistant—

Mr. H. K. Kar, from 11-5-47 to 14-8-47
(Re-employed).
,, G. S. Bagchi, from 11-5-47.

Photo-Litho Office

*Manager—*Mr. K. L. Dev, to 15-8-47.

Asstt. Manager—

Mr. H. G. Phillips, to 14-8-47.
,, C. V. M. Hayman, to 15-8-47.

Map Record & Issue Office*Officer in charge—*

Mr. B. N. Saha, M.Sc., to 4-5-46.
Major R. S. Kalha, I.A., from 5-5-46
to 3-7-46 in addition as D.D.M.P.
Mr. B. N. Saha, M.Sc., from 4-7-46
to 15-8-47.

Engraving Office

Mr. A. R. J. Dalziel, Head Engraver,
from 1-4-46 to 23-4-47.
,, G. J. Saha, Offg. Head Engraver,
from 24-4-47 to 15-8-47.
,, G. J. Saha, Asstt. Head Engraver,
to 23-4-47.

**Dehra Dun. Director, Geodetic
Branch**

Colonel O. Slater, M.C., to 26-3-46.
Major J. S. O. Jelly, B.E.,
from 27-5-46 to 6-7-46.
Colonel O. Slater, M.C.,
from 7-7-46 to 17-8-46.
Lt.-Colonel J. B. P. Angwin, R.E.,
from 18-8-46 to 12-10-46.
Major R. H. Sams, R.E., from 13-10-46.

No. 2 Drawing Office*Officer in charge—*

Mr. A. F. Murphy, to 1-11-46.
,, R. L. Ghei, B.A.,
from 2-11-46 to 8-12-46.
,, A. F. Murphy,
from 9-12-46 to 10-5-47.

Mr. R. L. Ghei, B.A.,
from 11-5-47 to 13-5-47.
,, K. C. Gossain, B.A.,
from 14-5-47 to 15-8-47.

Class II—

Mr. R. L. Ghei, B.A.

U.S.S.—

Mr. S. B. P. Mathur, B.Sc.

Topo. Assistant—

Mr. Mustan Singh.
,, Gurcharan Singh.

Photo-Zinco Office*Officer in charge—*

Mr. W. Stopforth.

Letterpress Printing Section

Mr. H. H. Williams.

Forest Map & Map Record Office*Officer in charge—*

Mr. J. B. Lal, from 1-4-46 to 5-12-46.
Captain Gambhir Singh, I.A.,
from 6-12-46 to 27-12-46.
Mr. J. B. Lal, from 28-12-46.

U.S.S.—

Mr. A. S. Matlub Ahmed,
from 1-4-46 to 30-6-47.
,, S. C. Mukherjee, from 1-4-46.

**Bangalore. Director, Southern
Circle**

Major I. H. R. Wilson, R.E., to 6-7-47.
Mr. M. R. Nair, B.A., from 7-7-47.

No. 4 Drawing Office*Officer in charge—*

Major I. H. R. Wilson, B.E.,
from 19-4-46 to 10-5-46.
Mr. M. R. Nair, B.A.,
from 11-5-46 to 8-12-46.
Major I. H. R. Wilson, R.E.,
from 9-12-46 to 1-1-47.
Mr. M. R. Nair, B.A., from 2-1-47.

Class II—

Mr. J. A. Cabral, from 27-7-46 to 30-9-46.
,, B. B. Kuttappa, from 1-10-46.
,, M. N. Kutty, B.A., from 1-10-46.
,, M. W. Kalappa, B.A., 18-3-47.
,, K. B. Muthanna, from 13-8-47.

U.S.S.—

Mr. H. N. Murti Rao, B.A.,
from 19-4-46 to 14-2-47.
,, N. M. Bopaiah, from 19-4-46.
,, A. Shamanna,
from 25-8-46 to 15-1-47.
,, Hussain Khan,
from 1-10-46 to 30-4-47.

Mr. Mohammad Abdul Azim, I.D.S.M.
from 21-5-47.

Topo. Assistant—

Mr. R. Mariadass (Re-employed),
from 19-4-46.

„ H. N. Muri Rao (Re-employed),
from 15-2-47.

„ P. G. Balachandra Menon, B.A.
(Hons.), from 1-7-47.

„ S. Muthukrishnan, B.A.,
from 28-12-46.

Murree. Director, Frontier Circle

Major H. W. Wright, O.B.E., R.E.,
to 14-8-46.

Major R. C. N. Jenney, R.E.,
from 15-8-46.

Deputy Director, Frontier Circle

Major H. W. Wright, O.B.E., R.E.,
to 18-4-46.

Major R. C. N. Jenney, R.E.,
from 19-4-46 to 13-7-46, and from
5-9-46 to 7-11-46.

Major J. S. O. Jelly, R.E.,
from 14-7-46 to 4-9-46.

Major R. C. A. Edge, M.B.E., R.E.,
from 8-11-46.

Officer-in-charge, Administration

Mr. R. N. Hastir.

Officer-in-charge, Reproduction

Section

Mr. Bhagat Singh.



X.—PUBLICATIONS, EXTRA-DEPARTMENTAL PRINTING AND MAP ISSUES

152. **Publications and Extra-departmental Printing.**—The publications of the department during the period under report and printing done for other Government Departments and the public are summarized in the following tables :

Table I (*a*) Departmental maps.

Table I (*b*) Extra-departmental maps.

Table I (*c*) Litho-printing, other than maps.

The progress made up to the end of the period under report in publication of the main series of topographical and geographical maps produced by the Department is given in Table II. Table III shows the letterpress publications for the period.

PUBLICATIONS AND ISSUES

Table I(a)—Departmental Maps published

Class of maps	Scale	New Publications					Revised editions, new editions and reprints					Number of copies printed					Value Rupees			
		DEHRA DUN		CALCUTTA	MURREE	TOTAL	DEHRA DUN		CALCUTTA	MURREE	TOTAL	DEHRA DUN		CALCUTTA	MURREE	TOTAL	DEHRA DUN		CALCUTTA	MURREE
		Map Publication Office	Geodetic Branch	Eastern Circle	Frontier Circle		Map Publication Office	Geodetic Branch	Eastern Circle	Frontier Circle		Map Publication Office	Geodetic Branch	Eastern Circle	Frontier Circle		Map Publication Office	Geodetic Branch	Eastern Circle	
GENERAL MAPS																				
Maps of India	Various	..	..	..	..	3	..	2	..	5	14,095	..	5,000	..	19,095	18,165	..	5,000	..
GEOGRAPHICAL MAPS																				
Southern Asia Series ..	1 : 2 Million	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Carte Internationale du Monde ..	1 : 1 Million	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
International Civil Aviation Organization .. .. .	"	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
TOPOGRAPHICAL MAPS																				
Quarter-inch (Modern) ..	1" = 4 miles	..	..	..	..	6	27	95	..	128	42,569	1,15,704	2,24,619	..	3,82,892	54,632	1,15,704*	2,24,619*	..
.. (Preliminary ) ..	"	..	..	..	..	2	..	..	..	2	13,923	..	..	..	13,923	20,884	..	..	..
.. (Provisional ) ..	"	..	..	..	..	1	..	1	..	2	7,600	..	1,100	..	8,700	11,400*	..	1,100	..
Half-inch (Modern—Primary) ..	1" = 2 miles	..	..	..	..	19	29	9	..	57	72,472	82,049	43,400	..	1,97,921	72,472	82,049	43,400	..
One-inch (Modern) ..	1" = 1 mile	..	..	..	..	576	646	304	..	1526	14,57,842	17,85,487	8,17,172	..	40,60,501	14,57,842	17,85,487	8,17,172	..
Old Style (1" & ½" Primary) ..	Various	..	..	..	..	8	80	51	..	139	4,200	1,31,709	85,530	..	2,21,439	6,300*	1,31,709	85,530	..
SPECIAL MAPS																				
Province Maps and Maps of States	1 : 1 Million	..	..	..	..	..	..	5	..	5	..	..	5,655	..	5,655	..	..	15,246	..
City and Town Guide Maps ..	Various	..	..	..	..	1	..	15	..	16	1,561	..	50,790	..	52,351	3,903	..	1,16,293	..
Index Maps .. .. .	"	..	..	..	..	4	..	..	..	4	2,395	..	..	..	2,395	†	..	..	..
Miscellaneous Maps, Charts, Diagrams, etc. .. .. .	..	11	21	..	..	32	7	111	3	121	31,907	1,33,026	6,650	..	1,71,583	10,301	44,015	3,150	..
TOTAL .. .. .	..	11	21	..	..	32	627	893	485	2005	16,48,564	22,47,975	12,39,916	..	51,36,455	16,55,899	21,58,964	13,11,510	..

NOTE.—In addition to the printing summarized above the following miscellaneous departmental printing was also carried out:—

Office		Number of Originals for Litho reproduction	Number of prints	Number of Originals for half-tone reproduction, etc.	Number of prints
DEHRA DUN	Map Publication Office	1,030	1,932	707	4,610
	Geodetic Branch	961	3,702	..	..
CALCUTTA	Eastern Circle	1,604	12,755	..	..
MURREE	Frontier Circle	Data not available			

The above figures include preliminary materials prepared for use in surveying and mapping, e.g., black prints for mosaics, blue prints for fair mapping, etc.
 * Approximate since the stock consists of different styles of maps which vary in price.
 † For departmental use only.

PUBLICATIONS AND ISSUES

Table I(b)—Extra-departmental Maps printed

Class of Maps	Scale	New publications					Revised editions, New editions and reprints					Number of copies printed					Value Rupees			
		DEHRA DUN		CALCUTTA	MURREE	TOTAL	DEHRA DUN		CALCUTTA	MURREE	TOTAL	DEHRA DUN		CALCUTTA	MURREE	TOTAL	DEHRA DUN		CALCUTTA	MURREE
		Map Pub- lication Office	Geodetic Branch	Eastern Circle	Frontier Circle		Map Pub- lication Office	Geodetic Branch	Eastern Circle	Frontier Circle		Map Pub- lication Office	Geodetic Branch	Eastern Circle	Frontier Circle		Map Pub- lication Office	Geodetic Branch	Eastern Circle	Frontier Circle
PRINTED FOR THE DEFENCE FORCES																				
Geographical Maps																				
Hind 5000	1/M	1	..	..	..	1	6	1	3	..	10	68,590	16,083	37,200	..	1,21,873	25,722	6,031	13,950
Hind 1080	1/2 M	..	..	..	..	..	..	3	..	..	3	..	23,849	..	23,849	..	8,944	..	..
Other Hind Series	Various	9	3	1	..	13	11	..	..	..	11	1,47,818	23,118	8,500	..	1,79,436	55,431	8,669	3,187
Special Maps																				
Manoeuvre and Radius Maps	Various	..	..	..	..	..	..	..	3	..	3	..	..	2,450	..	2,450	..	..	4,765
Cantonment Maps	"	..	8	..	8	8	..	31	..	..	31	..	5,616	..	5,616	..	9,020	..	..
Miscellaneous Maps	"	26	..	97	123	102	..	..	..	..	102	7,00,403	..	1,04,465	..	8,04,868	2,59,331	..	76,135
Plans and Diagrams .. .. .	"	..	..	110	110	..	..	..	..	..	..	..	..	1,41,075	..	1,41,075	..	..	27,395
Total		36	11	208	255	119	35	6			160	9,16,811	68,666	2,93,690		12,79,167	3,40,484	32,664	1,25,432	
PRINTED FOR OTHER DEPARTMENTS OF THE CENTRAL AND PROVINCIAL GOVERNMENTS																				
Maps for Irrigation, Hydro- electric and other projects	4" = 1 mile	..	20	7	27	..	15	..	..	..	15	..	2,11,222	11,300	..	2,22,522	..	80,385	9,248
Do. Do.	2" = 1 mile	..	..	4	4	..	..	..	..	..	..	..	..	2,000	..	2,000	..	..	2,626
Do. Do.	Various	29	..	20	49	..	..	..	..	..	..	20,225	..	8,715	..	28,940	7,727	..	9,984
Large scale Town Maps .. .. .	"	..	..	7	7	..	..	..	..	..	..	..	..	17,700	..	17,700	..	..	1,324
Forest Maps .. .. .	"	..	..	..	..	..	146	..	..	..	146	..	16,070	..	16,070	..	16,727	..	..
Miscellaneous Maps, Plans, Charts and Diagrams	"	104	135	3,175	3,414	27	11	..	..	..	38	1,86,237	61,423	95,315	..	3,42,975	36,804	22,215	37,238
Total		133	155	3,213	3,501	27	172	..			199	2,06,462	2,88,715	1,35,030		6,30,207	44,531	1,19,327	60,420	
PRINTED FOR COMMERCIAL FIRMS AND THE PUBLIC																				
Miscellaneous Maps, Plans, Charts and Diagrams		14	..	123	137	10	..	..	..	..	10	60,88,857	..	1,25,525	..	62,14,382	78,731	..	71,080
Total		14	..	123	137	10	..	..			10	60,88,857	..	1,25,525		62,14,382	78,731	..	71,080
TOTAL		183	166	3,544	3,893	156	207	6			369	72,12,130	3,57,381	5,54,245		81,23,756	4,63,746	1,51,901	2,56,932	

Data not available

Data not available

Data not available

Data not available

PUBLICATIONS AND ISSUES

Table I(c)—Litho-printing other than maps

Items	Number of items printed					Number of colours printed					Number of copies printed					Value Rupees						
	DEHRA DUN		CALCUTTA	MURREE	TOTAL	DEHRA DUN		CALCUTTA	MURREE	TOTAL	DEHRA DUN		CALCUTTA	MURREE	TOTAL	DEHRA DUN		CALCUTTA	MURREE	TOTAL		
	Map Pub- lication Office	Geodetic Branch	Eastern Circle	Frontier Circle		Map Pub- lication Office	Geodetic Branch	Eastern Circle	Frontier Circle		Map Pub- lication Office	Geodetic Branch	Eastern Circle	Frontier Circle		Map Pub- lication Office	Geodetic Branch	Eastern Circle	Frontier Circle			
DEPARTMENTAL WORK																						
Posters .. .. .	..	..	..		..	..	..	..		..	..	..	..	..	..	..	..	..	..
Booklets .. .. .	..	..	..		..	..	..	..		..	..	..	..	..	..	..	..	..	..
Miscellaneous	4	..	82		86	..	..	1		1	2,472	..	94,049	96,521	802	..	3,825		4,627	
Total	4	..	82		86	..	..	1		1	2,472	..	94,049	96,521	802	..	3,825		4,627	
EXTRA-DEPARTMENTAL WORK FOR OTHER CENTRAL AND PROVINCIAL GOVERNMENTS DEPARTMENTS																						
Posters	53	..	..	Data not available	53	2*	..	..	Data not available	2*	2,75,109	..	..	2,75,109	59,592	..	..	Data not available	59,592
Booklets
Miscellaneous	26	..	2,521		2,547	1*	..	1*		2*	19,70,090	..	2,25,591	21,95,681	1,25,249	..	6,237		1,31,486			
Total	79	..	2,521		2,600	3*	..	1*		4*	22,45,199	..	2,25,591	24,70,790	1,84,841	..	6,237		1,91,078			
EXTRA-DEPARTMENTAL WORK FOR COMMERCIAL FIRMS AND THE PUBLIC																						
Posters .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Booklets	4	..	1	5	..	..	1	1	19,040	..	2,000	21,040	23,803	..	40	23,843				
Miscellaneous .. .. .	..	..	4	4	..	..	1	1	..	..	254	254	..	..	40	40			
Total	4	..	5	9	..	..	2	2	19,040	..	2,254	21,294	23,803	..	80	23,883				
TOTAL FOR EXTRA-DEPARTMENTAL LITHO-PRINTING OTHER THAN MAPS																						
	83	..	2,526	2,609	3	..	3	6	22,64,239	..	2,27,845	24,92,084	2,08,644	..	6,317	2,14,961						

* Average colour printing.

Table II—Progress in Publication of Modern Topographical and Geographical Maps

	INDIA			INDIA AND ADJACENT TERRITORIES			
	1"=1 Mile	1"=2 Miles	1"=4 Miles	1/M			1/2M
				Carte Inter- nationale du Monde	International Civil Aviation Organization Maps	Province and State Maps	Southern Asia Series
Maps Published							
Primary ..	3,355	266	24				
Compiled ..		757*	325	42		19	15
Remaining (Approx.)							
Primary ..	745	97	6				
Compiled ..			76	7			5
Total (Approx.)	4,100	1,420	431	49		19	20

Note :—(1) In the Carte Internationale du Monde series are also included those sheets of the modified international style on 1:M scale which have been published for the defence services and aviation but which have not as yet been issued in regular international style.

(2) The numbers of sheets remaining for completion are calculated on the total areas shown in the indexes relevant to each series given in the Survey of India map catalogue.

* This series has since been abandoned.

Table III—Letterpress Publications

(a) PUBLISHED AT DEHRA DUN

1. Grid data Triangulation Pamphlets—(14 kinds).
2. Tide Table Bombay 1947.
3. Tide Tables Indian Ocean 1948.
4. List of Publications, Survey of India.
5. Tide Table Rangoon 1947.
6. Levelling Pamphlet 84.
7. Supplement to Survey Research series, Pamphlet No. 1, Part I
8. Survey Research Series, Pamphlet No. 1, Part I.
9. Levelling Pamphlet 46.
10. Triangulation in Afghanistan.
11. Memoirs of Survey Research Institute, Vol. I, No. 1.

Table III (*Concl'd.*)

(b) IN HAND AT DEHRA DUN

1. Technical Instruction No. 3.
2. Levelling Pamphlet 64.
3. Civil Activities Report Survey of India, 1945-46.
4. Levelling Pamphlet 65.
5. Levelling Pamphlet 73.
6. Silviculture Research Code, Vol. I.
7. War Research Series Pamphlet No. 1, Part I.
8. Corrections to Survey Service Pocket Book.
9. Grid Data Triangulation Pamphlets (9 kinds).
10. Corrections to Research Series, Pamphlet No. 9.
11. Corrections to Topo Handbooks (2 kinds).
12. Air Survey for Development.
13. Addendum and corrections to Grid Data Triangulation Pamphlets (2 kinds).
14. Addendum to Levelling Pamphlet 53.
15. Departmental Paper No. 17.
16. Tide Table Indian Ocean 1949.
17. Tide Table Hooghly River 1948.
18. Tide Table Bombay 1948.
19. Tide Table Rangoon 1948.

(c) PUBLISHED AT CALCUTTA

1. Map Catalogue, Public Edition.
2. Half-tone block Anaglyphs.
3. O.H.M.S. Slips.
4. Form O.164.
5. Form O. 166.
6. Requisition Book.
7. Letter head M.R.I.O.
8. Cash Memo. Original and Duplicate.
9. Loose leaf ledger.
10. Railway Chalan Form.
11. Model Copy Book.
12. Addl. Register slips.
13. Letter Head.
14. Map Bundle Label.
15. Map Card.
16. Store Ledger Issue, Receipt.
17. Economy slips.
18. Calcutta and Howrah Guide Map-Alphabetical Index to names.
19. Annual correction to the set of Maps.
20. M.R.I.O. Register of Original form, etc.
21. Slip of Map Catalogue.

(d) IN HAND AT CALCUTTA

1. Miscellaneous Departmental Forms.
2. Special Footnotes, etc.

Outturn of Letterpress Printing Sections

Section	Items of pages published	Copies printed	Impressions pulled
Dehra Dun ..	960	17,02,787	20,23,614
Calcutta ..	762	3,17,198	6,17,592
TOTAL ..	1,722	20,19,983	25,41,206

153. **Map Issues.**—The issues of both departmental and extra-departmental maps made during the period under report by the various Survey of India offices are shown in Table IV below. Table V, which follows, gives the stocks of maps held on 14 August 1947, of both departmental maps and extra-departmental maps normally stocked for sale.

Table IV—Maps issued by Survey of India Offices

	CENTRAL AND PROVINCIAL GOVERNMENT DEPARTMENTS		DEFENCE FORCES		PUBLIC		TOTAL		FREE ISSUES	
	Number of copies	Sale Value Rupees	Number of copies	Sale Value Rupees	Number of copies	Sale Value Rupees	Number of copies	Sale Value Rupees	Number of copies	Sale Value Rupees
DEPARTMENTAL										
Dehra Dün ..	49,905	54,327	2,643,092	9,90,534	37,716	54,622	27,30,713	10,99,483*	4,354	5,009
Calcutta ..	37,834	46,762	692	371	48,209	38,663	86,735	85,796	18,971	19,260
Murree ..	..	..	Data	not	Available	..	..	..	..	..
Bangalore ..	1,344	2,549	..	..	1,916	3,179	3,260	5,728	1,100	1,500
Total (Departmental) ..	89,083	1,03,638	26,43,784	9,90,905	87,841	96,464	28,20,708†	11,91,007	24,425	25,769
EXTRA-DEPARTMENTAL										
Dehra Dün ..	23,97,963	2,10,451	10,36,883	3,87,432	61,36,056	1,67,262	95,70,902	7,85,145	3,228	2,627
Calcutta ..	..	81,667	10,92,947	4,08,516	20,109	15,346	13,20,888	5,05,529	16,881	17,040
Murree ..	..	..	Data	Data	not	Available	..	..	..	..
Bangalore ..	..	..	..	..	not	Available	..	..	..	..
Total (Extra-departmental)	26,05,795	2,92,118	21,29,830	7,95,948	61,56,165	1,82,608	1,08,91,790	12,70,674	20,109	19,667
GRAND TOTAL ..	26,94,878	3,95,756	47,73,614	17,86,853	62,44,006	2,79,072	1,37,12,498	24,61,681	44,534	45,436

* Including Rs. 24,526 for mounting charges.

† Excludes 10,56,220 copies issued on stock transfer.

PUBLICATIONS AND ISSUES

Table V—Stock of Maps

(This table gives the stock as on 14th August 1947 of Departmental maps and those Extra-Departmental maps of which stocks are held for sale)

	CALCUTTA		BANGALORE		DEHRA DUN				MURREE		TOTAL	
	MAP RECORD AND ISSUE OFFICE		SOUTHERN CIRCLE		HATHIBARKALA MAP RECORD & ISSUE OFFICE		GEODETIC BRANCH MAP RECORD OFFICE		FRONTIER CIRCLE		Number of copies in stock	Present Face Value Rs.
	Number of copies in stock	Present Face Value Rs.	Number of copies in stock	Present Face Value Rs.	Number of copies in stock	Present Face Value Rs.	Number of copies in stock	Present Face Value Rs.	Number of copies in stock	Present Face Value Rs.		
DEPARTMENTAL MAPS												
1/2 M Southern Asia Series	11,344	22,688	..	..	841	1,682	278	493			12,463	24,863
1/M Carte Internationale du Monde .. ..	..	..	..	..	..	..	951	1,928			951	1,928
1/M International Civil Aviation Organization Series .. ..	..	..	..	..	..	..	..	..			..	..
1/M India and Adjacent Countries Series* ..	7,165	10,720	..	..	..	..	..	..			7,165	10,720
Quarter-inch topographical maps	73,544	73,744	1,269	1,539	1,34,753	1,34,883	14,110	14,242			2,23,076	2,24,408
Half-inch topographical maps (Primary and Compiled)	1,67,060	1,70,590	2,097	2,856	2,43,532	2,43,682	16,519	19,294			4,29,208	4,36,422
One-inch topographical maps	0,86,178	6,89,267	6,574	9,186	10,39,973	10,40,198	66,449	75,570			17,99,174	18,14,221
General maps of India	2,454	3,848	153	161	5,955	11,209	279	372			8,841	15,590
Maps of Indian Provinces and States	1,798	1,623	34	50	2,210	5,617	124	310			4,166	7,600
City and Town Guide Maps	5,528	13,446	103	184	17,627	50,762	1,171	2,162			24,429	66,554
Miscellaneous maps, charts and diagrams ..	3,966	4,791	59	59	15,811	17,734	829	431			20,665	23,015
EXTRA-DEPARTMENTAL MAPS STOCKED FOR SALE												
1/2 M HIND 1080 Series .. ..	..	..	..	..	5,273	10,546	..	..			5,273	10,546
1/M HIND 5000 Series (Army/Air Style) ..	27,200	81,600	..	..	47,539	1,42,617	1,109	3,327			75,848	2,27,544
Cantonment plans .. ..	..	..	..	..	..	..	55,069	1,10,138			55,069	1,10,138
Forest maps .. ..	..	..	..	..	..	..	1,69,477	3,03,851			1,69,477	3,03,851
Manœuvre and Radius maps	1,246	2,344	129	224	..	..	297	697			1,672	3,265
Miscellaneous maps, charts and diagrams ..	..	..	..	..	12,387	23,679	..	..			12,387	23,679

* This series has been abandoned.

XI.—WORK OF DRAWING OFFICES

154. **No. 1 Drawing Office, Dehra Dūn.**—The headquarters of this office were transferred from Calcutta to Dehra Dūn with effect from 14th May 1947. There is a continuous demand from the army for Geographical and Special maps and about one-third of the staff is employed on the preparation of Hind Series maps asked for by the Geographical Section, General Staff Branch, Army Headquarters.

To meet urgent post-war demands from civil and army authorities, a new rapid method of compiling $\frac{1}{4}$ inch maps was introduced. This method which is still under trial has cut down the time previously spent on compiling and drawing a $\frac{1}{4}$ -inch sheet by more than a half.

A new style of type and lettering is under trial with a view to improve legibility of maps. This has been temporarily suspended due to the non-availability of some of the type founts required.

A series of maps on 1/M scale showing the major and minor catchment limits of waterways for the whole of India was prepared for the Central Waterways, Irrigation and Navigation Commission.

155. **No. 2 Drawing Office, Dehra Dūn.**—One Section was employed on Geographical and Special maps for the army. These extra-departmental maps were drawn in accordance with specifications issued by the Geographical Section, General Staff Branch, Army Headquarters, from time to time.

The main departmental work in the unit during the period was the new compilation and reissue of $\frac{1}{2}$ -inch (primary) and $\frac{1}{4}$ -inch sheets. About one-fourth of the strength of the drawing office was employed on accessory work in connection with the reprinting of 1-inch sheets.

156. **No. 4 Drawing Office, Bangalore.**—The formation of No. 4 Drawing Office was sanctioned by the Govt. of India, with effect from the 19th April 1946, as part of the post-war re-organisation of the Department. It assumed its responsibilities by taking over from No. 6 (S. I.) Party, all the $\frac{1}{4}$ -inch and the greater part of the 1-inch mapping programme as well as the whole of the Map Maintenance, Records and Map Sales sections.

The work of the Map Sales Section which is responsible for the stock and issue of all maps of Southern Circle area increased considerably during the period under report, with the removal of war-time restrictions on the sale of Survey of India maps.

A headquarters section was organized to deal with surveys required in connection with Development Projects in Southern Circle area. This section is directly under the technical control of the Director, Southern Circle. A report of its activities appears on page 44.

157. **No. 5 Drawing Office (Shillong Calcutta).**—The headquarters of this office were transferred from Shillong to Calcutta with effect from 5th May 1947.

Normal drawing work on departmental maps, as reported in Tables VI and VII was carried out by the Shillong Office. In addition, the records of No. 5 Drawing Office (Shillong) were sorted, packed and despatched to Calcutta.

The Calcutta drawing office was mostly engaged in re-issues and reprints of topo sheets and compilation of Hind Series sheets. Besides this, new style Province maps were prepared from 1/M engraved prints, and some extra-departmental maps were also prepared.

158. **No. 6 Drawing Office (Murree).**—This office was under the control of the Director, Map Publication, Dehra Dūn, up to 13th May 1947. With effect from 14th May 1947 the headquarters of this office were transferred to the Frontier Circle, Murree. A report on its activities appears on page 14.

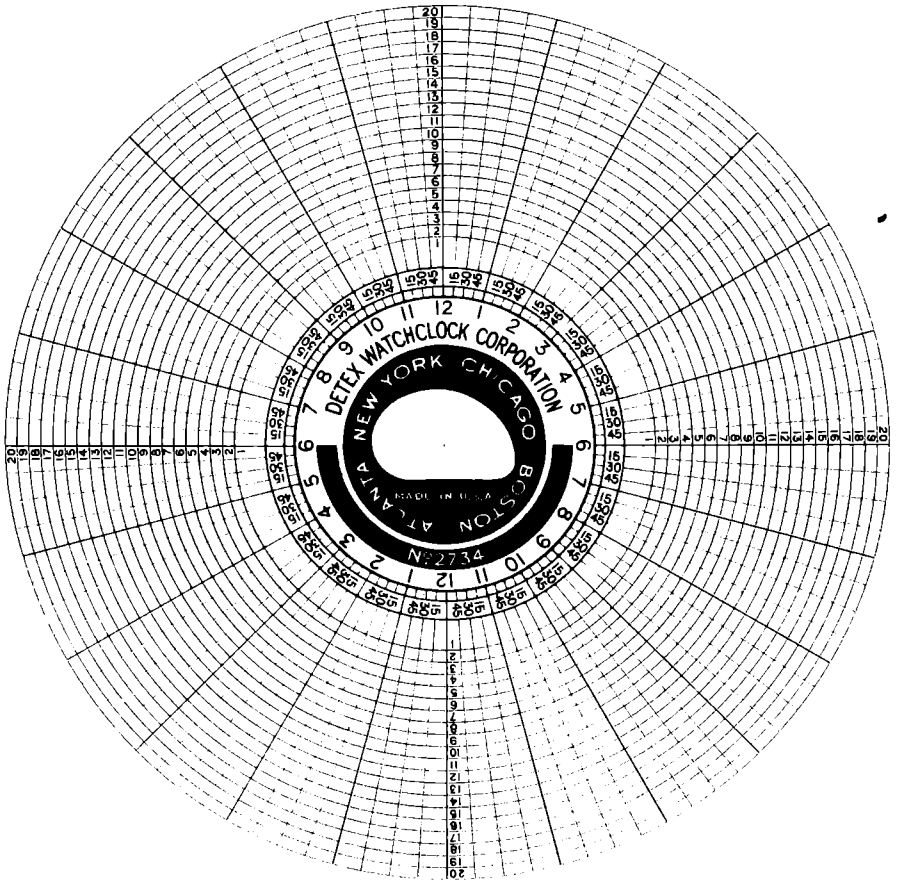
159. **Engraving Office (Calcutta).**—The main task consisted of the engraving of the Carte Internationale du Monde sheets and also correction of those sheets from Maintenance Unit's corrections. Two plaques and two copper plates for the Kohima Memorial were completed. Two Appointment plates for Rear Admiral the Earl Mountbatten of Burma, Governor General of India were also completed in addition to the engraving of various offset scales. Many old copper plates were cleaned off and holes filled in by electrolysis. Experiments were completed in connection with the new method of printing on zinc mounted chromo paper with most satisfactory results. This method ensures perfect measurements for combination of all colour originals in reproduction offices and abolishes uneven expansion and contraction of chromo prints.

Specimens of engraving work done by the Survey of India are reproduced at Plates A and B.

160. **Forest Map Office (Geodetic Branch), 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 Agra and Oudh, continued to meet all demands from these Governments for forest maps. Its main task is the fair drawing of forest working plans and new editions of forest maps and the maintenance of the office copies for these maps. In addition it undertakes paid-for work for non-contributing Provinces and States in India and for Burma.

161. **Summary of Drawing Work.**—Table VI which follows gives the numbers of new maps completed in the various drawing offices and field parties during the period under report and also the number in hand at the end of the period.

Table VII gives statistics for the work of map revision and re-issue involving the collection of and incorporation of new material into existing fair drawn originals of maps.



*Plate B—Specimen of engraving work
done in the Survey of India.*

XII.—WORK OF PRINTING OFFICES

162. **Photo-Litho Office, Hathibarkala, Dehra Dūn.**—In addition to the normal map publication which was itself quite considerable, other extra-departmental and commercial jobs as given below were also printed during the period :—

- (i) Various posters in several colours were printed for the the Information and Broadcasting Department.
- (ii) Covers for “AJKAL” Magazine in Urdu were printed.
- (iii) Various jobs for Messrs J. Walter Thompson & Co., such as Tata’s Calendar, Tata’s Atlas, Tata’s Popular Booklets, Tiscor, Tiscrom, Steel Town, etc., were printed.
- (iv) Telegraphic Forms and Labels in two colours with a Press Order of 1 million copies each were printed for the Post & Telegraph Department.
- (v) Considerable work for the Central Waterways, Irrigation, and Navigation Commission and the Government of India Press was undertaken.
- (vi) A large number of milk labels for Studio Nash were printed.

The following Printing Machines & Proving Presses were in use :—

Lithographic Printing Machines :—

- One Crabtree Fully Automatic Quad Demy Single Colour Offset with H.T.B. Feeder.
- One Crabtree Fully Automatic Quad Demy Double Colour Offset with H.T.B. Feeder.
- Three Crabtree Fully Automatic Double Demy Double Colour Offset with H.T.B. Feeder.
- One Crabtree Fully Automatic Double Demy Single Colour Offset with H.T.B. Feeder.
- Two Mann Fast Fully Automatic Quad Demy Single Colour Offset with M.S. Feeder.
- One Mann Fast Five Fully Automatic Quad Demy Double Colour Offset with M.S. Feeder.
- One Mann Standard Double Demy Single Colour Offset (Hand-fed).
- Two “Baby” Mann Fully Automatic Single Colour Offset with H.T.B. Feeder.
- One Harris Fully Automatic, Demy Single Colour Offset with Harris Feeder.

Lithographic Proving Presses :—

- Six Furnival Quad Demy Offset Proving and Duplicating Presses.
- One Furnival Quad Crown Offset Proving and Duplicating Press.

One Furnival Double Demy Offset Proving and Duplicating Press (Hand Driven).

One Mann Quad Demy Deffa.

One Mann Quad Demy Offset Proving and Duplicating Press.

One Hoe Quad Demy Flat-bed Proving Press (Hand-driven).

One Hoe Double Imperial Flat-bed Proving Press (Hand-driven).

163. Photo-Zinco Office (Geodetic Branch), Dehra Dūn.—Apart from printing our standard departmental maps, P.Z.O. remained busy with printing a large number of maps for G.S. G.S. Branch, A.H.Q. It also printed several Cantonment and Forest maps and charts for the Survey Research Institute. As regards extra-departmental work, a large number of Project maps and Burma Forest maps were printed during the period.

The following Printing Machines and Presses were in use :—

Lithographic Printing Machines :—

Two Crabtree, fully automatic, Double Demy, Single Colour Offset with H.T.B. Feeder.

Three Crabtree fully automatic Double Demy double colour Offset with H.T.B. Feeder.

One Mann Double Demy, Single Colour Offset Hand-fed.

Lithographic Proving Presses :—

One Mann Quad Demy Deffa Press.

Two 'Furnival' Quad Demy Offset Proving and Duplicating Presses.

One 'Furnival' Double Demy Offset Proving and Duplicating Press.

Two Mann Double Demy Offset Proving and Duplicating Presses.

164. Printing Office (Geodetic Branch), Dehra Dūn.—The Photo-Litho Office Letterpress Section was amalgamated with that of the Printing Office (G.B.). The strength of the section has now increased to 3 times and the output to 6 times that of the pre-war period.

During the war the machinery in the Printing Office which was already very old was subjected to considerable strain. Orders were therefore placed for new plant and equipment most of which was not received within the estimated period and is still awaited. One of the important acquisitions during the war was a " Monotype Keyboard and Casting machine ". This machine was used to print lists of names for a number of publications. One more machine of this kind has recently been acquired from surplus military stores.

The following printing machines, etc., are in use in the Printing Office :—

1. Two Payne and Dawson, Double Crown, Warfedale.
2. One Payne and Otley, Demy, Warfedale.
3. One Furnival Platen, $13\frac{1}{2}'' \times 8\frac{1}{2}''$.

4. One Walker Bros. 'Laurette' Platen— $\frac{1}{2}$ Super Royal.
5. Two Hand Press, 21" \times 29".
6. One Hand Press, 21" \times 16".
7. One Harrild Galley Press, 28" \times 14".
8. One Harrild Compositors Proof Press, 32" \times 16".
9. One Harrild Speedy Proving Press, Double Crown.
10. One Stereo Mangle Press.
11. Two Monotype Keyboard.
12. Two Monotype Casting Machine.
13. Two Cross-land Guillotine Machine.
14. Two Wire Stitching Machine.
15. One Punching Machine.
16. One Perforating Machine.
17. One Board Cutting Machine.
18. One Blocking Press.

165. Photo-Litho Office, Calcutta.—Besides printing the standard maps for the department and special maps for the Army, this office also carried out extra-departmental printing work as detailed below :—

- (a) Kwin maps of Burma (637 sheets).
- (b) Jobs for the Central Technical Power Board.
- (c) Various Project and Irrigation maps.
- (d) Agmark labels.
- (e) Forest Division maps (113 maps).
- (f) 70-mile Power map of India.
- (g) Patent specifications.
- (h) Railway maps for (a) G.I.P. Railway, (b) N.W. Railway.
- (i) Diagram showing capital outlay gross earning for Railway Board.
- (j) Bromide prints of air-photo mosaics for Indian Air Survey and Transport Company Ltd.
- (k) Overprinting of special information on Burma maps.

The following Printing Machines and Proving Presses were in use :—

Lithographic Printing Machines :—

- One Crabtree Fully Automatic Quad Demy Single Colour Offset with H.T.B. Feeder.
- One Crabtree Fully Automatic Double Demy Single Colour Offset with H.T.B. Feeder.
- One Crabtree Fully Automatic Double Demy Double Colour Offset with H.T.B. Feeder.
- Two Mann Standard Double Demy Single Colour Offset Hand-fed.
- Two Mann Double Demy Single Colour Offset Hand-fed.
- One 'Ratcliffe' Quad Demy Flat-bed.
- One Mann Double Elephant Flat-bed.

Lithographic Proving Presses :—

- One Mann Quad Crown Offset Proving and Duplicating Press.

One Mann Quad Demy Offset Proving and Duplicating Press.

One Mann Double Demy Offset Proving and Duplicating Press.

Two Furnival Double Elephant Flat-bed Proving Presses.

Two Furnival Double Imperial Flat-bed Proving Presses.

One Grieg Special Double Imperial Flat-bed Proving Press (Hand Driven).

One Hoe Double Imperial Flat-bed Proving Press (Hand Driven).

Two Hoe Double Elephant Flat-bed Proving Presses (Hand Driven).

Letterpress Printing Machines :—

One Dawson & Sons Double Demy Warfedale.

One Linotype & Machinery Double Crown Centurette.

One Rockstorch & Schneider Foolscap Victoria Platen.

One Furnival Crown Folio Platen.

One Ruling Machine.

166. Map Reproduction Section. Frontier Circle, Murree.—

The Map Reproduction Section was kept fully occupied, the greater part of its work being the printing of standard sheets allotted to the Frontier Circle by the Director, Map Publication.

During the summer the Section was located at Murree and used Mann. D. Demy Rotary Offset machines (hand-fed). In October 1946 the Section moved to Risalpur and took over the equipment belonging to No. 72 Base Map Printing Section R.E. which included one single colour and one double colour D. Demy Autofeed Crabtree Machine. Personnel of the Section had previously been trained in the use of these machines by the personnel of No. 72 Base Map Reproduction Section, R.E. and one British Sergeant of that unit remained attached to the Frontier Circle and continued training Survey of India personnel till they were capable of running these machines.

The following machines and presses were in use at Murree and Risalpur :—

Lithographic Printing Machines :—

Three Mann Standard Double Demy Single Colour Offset (hand-fed).

One Crabtree Fully Automatic Double Demy Single Colour Offset with H.T.B. Feeder.

One Crabtree Fully Automatic Double Demy Double Colour Offset with H.T.B. Feeder.

One Double Crown Flat-bed.

Lithographic Proving Presses :—

One Mann Quad Demy Deffa.

One Mann Double Demy Offset Proving and Duplicating Press.

Two Double Demy Offset Proving Presses.

Three Double Elephant Proving Press (hand driven).

167. **Printing Statistics.**—Statistics relating to the various map printing offices of the Department will be found in Section X of Part II of this report (page 56 et seq) and in Table VIII below. Tables IX and X, which follow, give information regarding the outturn of the process engraving and copper plate printing sections respectively.

Table VIII—Out-turn and Cost of the Photo-Litho Offices

Name of Office	Maps printed (departmental and extra-departmental)	Work other than maps—Number of items	Number of Negatives prepared	Number of Zinc printing plates prepared	Number of impressions pulled	Value of out-turn at office rates	Total expenditure of the printing offices during year under report
						Rupees	Rupees
1. <i>Dehra Dūn</i>							
(a) Map Publication Office	823	219	5398	8428	13,841,200	7,42,564	5,97,810
(b) Geodetic Branch	1040	278	5008	7049	9,788,262	9,81,107	3,49,594
2. <i>Calcutta</i>							
Eastern Circle	1985	2329	4734	7089	7,389,679	5,84,830	4,69,125
3. <i>Murree</i>							
Frontier Circle				Data not available			
Total	3848	2826	15140	22,566	31,019,141	23,08,501	14,16,529

Table IX—Out-turn of Process Engraving

Name of the Printing Office	Process Engraving Section			
	Half-tone Work		Line Work	
	Blocks prepared	Impressions pulled	Blocks prepared	Impressions pulled
<i>Dehra Dūn</i>				
Geodetic Branch	Nil	Nil	Nil	Nil
<i>Calcutta</i>				
Eastern Circle	60	8,480	4	460

For impressions pulled see Table X.

Table X—Out-turn of Copper Plate Printing (Calcutta)

Impressions pulled			
Chromo Paper	Transfer	Miscellaneous	Total
14,565	Nil	22,152	36,717

PART III.—GEODETIC WORK

XIII.—ABSTRACT OF GEODETIC OPERATIONS

168. **General.**—Purely geodetic operations include miscellaneous computations and research, preparation and publication of records, observatory work (astronomical, magnetic, seismological and meteorological), measurement of geodetic bases, principal triangulation, geodetic levelling, precise latitudes, longitudes, azimuths, gravity determinations, and prediction of tides at 39 ports between Suez and Singapore.

These operations were previously fully described in the annual Geodetic Reports of the Survey of India, but during the war no Geodetic Reports were published except for a short one for 1940, which placed on record only the most important items of geodetic work to safeguard against the risk of their being forgotten altogether. A complete account of all the geodetic work carried out during the period 1st October 1939 to 30th September 1947, and which is not reported in Geodetic Report 1940, is therefore included in the Technical Report of the Survey of India 1947, Part III, Geodetic Work. The following is a brief abstract of these geodetic operations. It is followed by a short narrative of the activities of the various sections and detachments engaged on the work.

169. **Triangulation in the Countries adjacent to India.**—The triangulation in the countries neighbouring India is of great interest in the study of many geodetic problems. Important gaps have been filled during World War II. A continuous chain of triangulation now exists from Syria to Malaya and the prospects of its extension in the east to Australia and on the west to European triangulation are now bright. The discrepancies at the triangulation junctions of the various countries are described in the report of the Computing Office.

170. **Levelling of High Precision.**—A programme of observations of 15,800 miles of levelling of high precision for a new level net has been in progress from 1913 to 1941. From 1941 to 1945 this work remained in abeyance due to the war. In 1946–47 one detachment worked from Bombay to Ratnagiri and added 338 miles of single levelling. The total mileage remaining to complete the programme is about 5,000 miles (10,000 miles of single levelling).

Levelling in India and Burma is now connected to the Siamese levelling. This important connection was effected in 1946 by No. 2 Indian Field Survey Company, R.I.E.

171. **Gravity.**—An epoch of gravity observations in India with pendulums, which started in the beginning of this century, came to a close in 1939 after the observation of 564 stations more or less uniformly distributed over the whole of India and Burma

forming a 70-mile network. It had been felt for some time that this broad framework was insufficient to provide adequate control and issue points for intensive detailed work for local geophysical prospecting to detect buried deposits and for the study of several other problems.

The Geophysical Planning Committee set up by the Government of India to go into this problem in 1946 came to the conclusion that a 10-mile grid of gravity stations was very desirable. This would involve observations at about 30,000 stations and it was realized that if the objective was to be gained in any reasonable time, the cumbersome technique of observations with the pendulums would have to be replaced by work with faster instruments such as the Gravimeters. A Frost Gravimeter has consequently been acquired and is now in use.

172. Deviation of the Vertical.—The surface of a plastic, homogeneous earth, as the result of its rotation, assumes the form of a spheroid. Land masses, ocean depths and lack of homogeneity of the crust, however, cause deviations of the vertical from the true normal to the spheroid. Astronomical observations for latitude, longitude, and azimuth provide data for the calculation of these deviations of the vertical, from which a surface is obtained, which would represent the mean surface of the sea, were it extended inland by means of hypothetical canals. This surface is known as the geoid. A study of the geoid is important for the problems connected with the figure and shape of the earth. Observations were made at 1,160 stations up to 1940, and it has not been possible to carry out any work from 1941–47. It is hoped that these activities will be resumed shortly.

173. Magnetic Observations.—With the disbanding of the Magnetic Party in 1923, the scheme of visiting the repeat stations at intervals of five years to determine the secular change of magnetic elements could not be given effect to and the work of magnetic observations was confined to observations at the Dehra Dūn Observatory only. On the outbreak of World War II in order to meet the demand for magnetic declination for maps for military purpose, the reobservation at magnetic repeat stations became inevitable. All the repeat stations were visited from 1943 to 1945. The sites of several stations were found to have been rendered unsuitable due to the construction of new buildings around them containing magnetic materials, and for various other reasons. Alternative sites were prepared and observations were made at them during 1946 and 1947.

174. Computations and Publications.—A programme was drawn up for the adjustment and publication of triangulation and traverse data all over India in a new series of complete data pamphlets, but much progress could not be made for want of adequate personnel. A few grid data triangulation pamphlets for Persia and for the military training areas in India were compiled

and published. Some levelling pamphlets have also been revised and printed.

A new series of research publications entitled "Memoirs of the Survey Research Institute" has been introduced. Vol. I, No. 1, published in 1947, describes the evidence secured in 1940-41 by observations with a Gradiometer (a modified form of Torsion Balance) of the existence of a manganese reef in the Parsoda area (Nagpur, C.P.), which has now been confirmed through observations with magnetic variometers.

The distance apart of our precise (Geodetic) triangulation chains and precise spirit level lines is too great and often leads to delay in the provision of accurate control data on which to base large scale survey work. To enable accurately fixed and heightened points to be provided where required with a minimum of delay, new methods and apparatus were tried (See report of No. 15 Party, page 28). These methods are known as "All India Development (A.I.D.) Survey Framework". The computations of results involving laborious reductions were carried out in the Computing Office.

The triangulation carried out by the Kulu Survey Detachment for the control of settlement surveys in 1946 was recomputed.

A detailed account of the geodetic work carried out by the Survey of India from 1939 to 1947 has been compiled and published in the Technical Report of the Survey of India for 1947, Part III, Geodetic Work.

175. Headquarters Routine.—The tidal prediction, and the magnetic, seismographical, and meteorological observations at Dehra Dūn have been carried out as usual.

The underground magnetic observatory was seriously flooded in August 1943 and has not been functioning since then. The present site has been rendered unsuitable due to the construction of new buildings all around it to meet war needs. The construction of a new surface observatory about 15 miles away from Dehra Dūn is contemplated.

XIV.—SURVEY REPORTS, SURVEY RESEARCH INSTITUTE

DIRECTOR OF WAR RESEARCH INSTITUTE	{ Colonel J. B. P. Angwin, M.B.E., to 11-10-45. Colonel G. F. Heaney, C.B.E., 12-10-46 to 21-10-46. Colonel J. B. P. Angwin, M.B.E., from 22-10-46 to 1-12-46.
PRESIDENT, SURVEY RESEARCH INSTITUTE	{ Mr. B. L. Gulatee, M.A. (Cantab.), from 2-12-46 to 26-5-47. Major R. H. Sams, B.E., from 27-5-47 to 15-8-47.

176. **Summary.**—The Survey Research Institute deals with the purely geodetic and geophysical activities of the Survey of India. These comprise levelling of high precision, gravimetric and magnetic surveys, tidal observations at ports, geodetic triangulation, high precision traverses and the observation of astronomical latitudes, longitudes and azimuths of a high degree of accuracy. The reduction and interpretation of the results of field observations are carried out during recess.

The institute is also responsible for the work of the Tidal Office, which prepares and publishes annual tide-tables of the Indian Ocean containing predictions of times and heights of high and low water at 39 ports between Suez and Singapore. The maintenance of all geodetic records for the department is also the responsibility of this Institute.

Other important functions are the preparation of auxiliary tables for projection of maps and grids and other purposes and computation forms, the adjustment of both geodetic and topographical triangulation, and other survey data, the preparation of pamphlets giving triangulation and levelling data and the editing and proof-reading of technical publications of the Department.

The field and headquarters work is carried out by the three sections of the Computing and Tidal Party, viz., Computing Office, Tidal Section, and Observatory Section. A detailed narrative of the work carried out during the period under report is given in the following pages.

COMPUTING AND TIDAL PARTY

Officer in charge:—{ Mr. B. L. Gulatee to 26-5-47.
Major R. H. Sams from 26-5-47 to 14-8-47.

COMPUTING OFFICE

177. **General.**—The normal activities of the Computing Office consist of the following:—

- (i) Compilation, scrutiny, adjustment and publication of geodetic and topographical triangulation, traverse and levelling data all over India.

- (ii) Preparation and publication of tables for the computation and reduction of the results of geodetic operations and of the field survey parties.
- (iii) The provision of map projection tables.
- (iv) Drafting of professional forms to facilitate computation and reduction of results.
- (ii) Editing and proof reading of departmental technical publications such as Professional papers, Departmental papers, Geodetic Handbook, some chapters of the Topographical Handbooks, Survey Research pamphlets, triangulation and levelling pamphlets, etc.
- (vi) Preparation and publication of the annual Geodetic Report, which now forms Part III of the Technical Report.

On the outbreak of World War II, these activities were seriously interrupted and in some cases entirely suspended, and the entire strength of the Computing Office was employed on the production of data, tables and charts required by the army. Efforts are in progress to resume the pre-war activities, although there are difficulties due to shortage of suitably trained personnel, and to general unsettlement.

The following is a brief resumé of some of the more important items of work carried out apart from routine work such as the supply of triangulation, traverse and levelling data to various departmental and non-departmental units, the upkeep and maintenance of geodetic and topographical records, the preservation and maintenance of G.T. Stations and protected Primary bench-marks with the help of local officials, and the training in computations of Topographical Assistants and Temporary Computers.

178. Triangulation in the Countries Neighbouring India.—A resolution was passed at the triennial conference of the International Union of Geodesy and Geophysics at Stockholm in 1930, that Siam and neighbouring countries should collaborate with each other in effecting junctions between their systems of triangulation, with the object of continuing if possible, the chain of triangulation to the Australian continent and the Philippines.

During World War II and immediately after it, Survey Companies of the Allied forces effected several important additions, notably Malaya-Siam, and India-Persia-Iraq-Syria connections, which have brought the much desired objective of Indo-European and Indo-Australian triangulation connections appreciably nearer to fulfilment.

Due to the diversity of independent data and different spheroids in use in different countries, the problem of rectifying the discrepancies at the various junctions is rather involved. A detailed study has been made in the Computing Office of the continuous chain of triangulation that extends from Syria to Malaya from which it is possible to assess how much work remains to be done to continue the triangulation chain from India to Australia and the Philippines and

to complete the block Irāq-Persia-India-Burma-Siam-French Indo-China-Malaya.

The details and discussion of the discrepancies at the various triangulation junctions is given in the Technical Report 1947, Part III—Geodetic Work, Chapter I.

The triangulation series of the countries discussed in this chapter having all been connected, it should be possible to reduce all these triangulations to the Indian datum at Kaliānpur. The question of the spheroid to be chosen however demands further consideration. The triangulation of India and Burma is computed on the Everest spheroid which does not fit the geoid at all well and its axes are about 3,000 feet smaller than those of the more modern spheroids adopted to represent the figure of the earth. If this spheroid were consistently used in all neighbouring countries such as Persia, Burma, Siam, Indo-China, etc., (which is by no means the case at present), the map sheets at the junctions would no doubt fit, and topographers would not be worried, but still certain complications would be introduced.

In the first place, all these countries would occupy on the map more than their proper share of the earth's surface and secondly in the outlying areas there would be large systematic difference between triangulated and astronomical positions. Thus in Siam the use of the Everest spheroid extended so far east from Kaliānpur datum produces a systematic tendency for astronomical longitudes to be about 17" too small. There is also a systematic tendency for astronomical latitudes to be about 8" too large in Siam south of latitude 16° N. These large differences are not due to anomalous masses in the earth's crust but only to an unsuitable spheroid. On a good spheroid, the astronomical values are only liable to random departures from the triangulated values.

The availability of accurate triangulation in the countries bordering India has brought to the fore the question of adoption of a suitable spheroid, like the International, in India and the determination of its orientation at the datum. But this would involve, besides republishing of all our trig. data, a shift of the details of all maps with respect to their graticules—a colossal undertaking. In the long interim period the country would be saddled with two sets of maps and the scheme requires such ample resources and finance that in spite of its indubitable advantages, there is no hope of embarking upon it at an early stage; and it can only be regarded as a long range objective.

There is thus no alternative but to accept the present state of affairs in which each country's maps are gridded with respect to its own sphericals on its own independent origin and at the boundaries when one crosses from one datum to another, the spherical graticules of one series may be out of sympathy with those on an adjacent map series of another country; and the graticules may be out of sympathy with the grid.

As an example, at the meridian of 60° E. which is the junction line of the Indian and Persian grids, the discrepancy (India-Persia

terms) is $+14''\cdot6$ in latitude and $-2''\cdot6$ in longitude. The two sets of maps on either side of 60° E. will obviously differ by these amounts and there may appear a no man's land in between, not covered by any map, which will confuse the topographers, especially when working on large scales. The remedy might be to have a certain area of overlap (say one sheet depth) on either side of the junction line and have maps on both systems in this area. The two sets of maps would also indicate the discrepancies by suitable marginal notes.

179. New Series of Triangulation Pamphlets.—In 1914 a start was made with the publication of all triangulation, geodetic and topographical, in the form of a series of triangulation pamphlets each covering one degree square. It was soon realized that it was premature to include all topographical triangulation, partly because so much was then being observed and partly because its very great bulk would indefinitely delay the publication of geodetic data. For all except frontier and trans-frontier areas the pamphlets have therefore been published as "G.T. data only" editions, containing only such data as were available in the Dehra Dūn Office.

The situation was reviewed in 1938 and it was found that the topographical triangulation of much of India was complete and that the time was ripe for making a fresh start on the publication of complete-data pamphlets. It was decided to take up the compilation of the topographical triangulation by blocks surrounded by geodetic series and to reconsider its adjustment where necessary. Old triangulation which has been superseded, and points which were unlikely to be recognizable were to be excluded. Traverse data were to be included where it has been the basis of modern survey.

A start was made with this work in 1939. Two blocks were selected, which it was hoped were typical and would enable an estimate to be made of the labour involved in the whole work. Progress was slow since it was found necessary to recompute much of the old triangulation completely, discrepancies being too serious to be dealt with by graphical methods. The work was in progress when World War II broke out but it had to be suspended and the entire personnel of the Computing Office was employed to meet the demands of the army.

The systematic adjustment of topographical triangulation all over India and its publication in pamphlets has now become an urgent necessity on account of frequent demands of data for the various irrigation and other projects and it is hoped to make a serious start with it in the very near future.

180. New Geodetic Framework.—In areas for which large scale maps are required to meet the needs of development schemes and projects, topographical triangulation is usually not sufficiently accurate unless it is well controlled by geodetic triangulation. At present the geodetic triangulation framework is not dense and the distance apart of our geodetic chains and precise spirit-levelling lines is too great.

To supplement points fixed by geodetic triangulation and heightened by spirit levelling, a proposal has been made to lay down special marks fixed and heightened with geodetic accuracy in areas earmarked for development. These marks are to be known as the "All-India Development" (A.I.D.) Survey marks.

The experimental work carried out to test methods for the fixing of the positions of these marks rapidly is described in the report of No. 15 Party (*see pages 28-29*). The reduction of the field observations involved laborious computations, which were carried out in the Computing Office.

The results indicated that the apparatus and the methods had not attained finality and were not as yet ready for employment on productive work. The work has been suspended for the present to give priority to more urgent work, but it is hoped to resume the experiments at a later date.

181. Geophysical Prospecting.—The manganese deposits in India especially in the Central Provinces have long been important sources of supply to foreign steel producing countries. The ore-beds are blanketed over by alluvium in many places, and during World War II an investigation was carried out to study the applicability of geophysical methods of prospecting to the systematic location of these hidden bodies.

A site was selected in the alluvial area of Parsoda in Nagpur district, in which the ore occurs in reef as well as in boulder form. The boulders are embedded in shallow alluvium and are scattered over the area; the reef is more compact but from having been subjected to considerable folding, its thickness and width vary. From the point of view of testing geophysical methods, the site selected was not ideal as the area contained rich boulders which contaminated the measured values. The main consideration was that a company was opening up the area and it would be possible to verify the geophysical indications.

A gravity method was utilized in the first instance as manganese has a distinctly higher density than its surrounding rocks. The instrument actually used was the Gradiometer which is a modification of the Torsion balance and measures only the horizontal gradient of gravity. Six traverses were run perpendicular to the conjectured direction of the reef with stations about 40 feet apart and the reef was clearly located. It was not realized till the party returned to headquarters and some samples were tested that the ore body in this area contained minerals which were magnetic.

The area was therefore covered by observations with two Watts Vertical Force Variometers, and very clear indications of the reef were obtained. It was thus established that both magnetic and gravimetric methods were suited to the problem and that the reef could be fairly accurately delineated by either. Full details of the work are discussed by Mr. B. L. Gulatee, President, Survey Research Institute in *Memoirs of the Survey Research Institute, Vol. I, No. 1, 1947.*

182. Gravity Survey.—The programme of pendulum observations for gravity in India, which was started in the beginning of this century, was concluded in 1939 after observing 564 stations distributed more or less uniformly over India and Burma (an area of over $1\frac{1}{2}$ million square miles). The conclusion of this work coincided with the outbreak of World War II, when all geodetic activities had to be suspended. It had, however, been felt for sometime that pendulums had served their purpose by providing a broad framework and that the next stage was to put in further stations for detailed studies for which the pendulum apparatus was unsuited on account of the laborious observations and computations involved.

It had been known for sometime that the premier oil companies in the world especially in America had in their possession precise and quick instruments called gravimeters for differential measurements of gravity, but the secrets of these were jealously guarded. At the end of the war, enquiries revealed that the Frost Gravimeter Co., of Tulsa, Oklahoma were putting on the market a precise gravimeter. This was immediately indented for and an instrument was received early in 1947.

Soon after the instrument's arrival and assemblage in Dehra Dūn towards the end of March, certain trial observations were taken to test its working. It was received with a very incomplete set of instructions and was found to be very much out of adjustment. This necessitated its dismantling several times before it could be made to work satisfactorily.

To test the working of the Frost Gravimeter under field conditions, a trial circuit of about 100 linear miles was first run near Dehra Dūn during the third week of April by Mr. A. N. Ramanathan, M.A. The traverse started from Dehra Dūn and proceeded along the motorable road to Roorkee via Fatehpur I, thence to Hardwar and thence back to Dehra Dūn via Raiwāla, Kansrao and Lachiwāla. A 15-cwt. truck was used for transport, the instrument being kept fastened in its cushioned box, designed to protect it from jolts and jerks during transport. The last 20 miles of the circuit were along a very bad road and the instrument was subjected to very severe shaking. The circuit took 3 days to complete and included five old pendulum stations. The results were very satisfactory.

It is now proposed as a matter of long term policy for the Survey of India to establish a network of gravimeter stations at roughly a 10-mile interval throughout the extent of India; and it is hoped that this will provide a much better basis for discussions of the gravity distribution of India than we have at present. These stations would also serve as reference bench-marks for detailed exploration of limited areas. The Mineral Adviser to the Government of India in consultation with the Geological Survey of India has suggested some priority areas, which are believed to be economically productive. It is hoped to start work with the Gravimeter in these areas shortly.

183. Levelling of High Precision in India.—No levelling of high precision was carried out during the war years 1941 to 1945 due to the non-availability of trained personnel. One detachment under Mr. B. P. Rundev (U.S.S.) was, however, formed in 1946 to run a new levelling line from Bombay to Ratnagiri, which is not covered by the old precision level net. The Bombay Government had been pressing for it for a long time and the bench-marks along this line had already been built by Bombay Public Works Department in 1938.

Before leaving for Bombay, the detachment also connected the west end of the Dehra Dūn Base-line to the spirit-levelled net. This base is seven miles, long and was measured in 1835. Its east end was connected in 1862 but the west end had not so far been connected. Of late some need had been felt for a reliable geodetic base, with the height of both its ends fixed by spirit-levelling in order to test new methods of precision traverses and also to provide reliable control data for training purposes. The height of the west end base determined by vertical angles from three stations was 1,770 feet ; the spirit-levelled height as now determined is 1,774 feet.

The levelling under report has added 338 miles to the total mileage of the new level net in one direction only. When this net was planned in 1913-14, it was estimated that it would be completed in 1938 but the financial stringency which prevailed after 1931 necessitated a curtailment of the detachments. Urgent demands for secondary and precision levelling to test the change of levels after earthquakes and to meet needs of priority railway and irrigation projects also impeded the progress of high precision levelling. Work on this class of levelling was almost entirely suspended during the two World Wars, with the result that even today about 5,000 miles of high precision levelling remain to be executed to complete the new level net which would be an estimated total length of 15,800 miles.

184. Indo-Siamese Levelling Connection.—Results are now available of the important connection of the levelling lines in Burma to Siamese levelling effected by a detachment of No. 2 Indian Field Survey Company with Capt. I. K. Ponnappa as first leveller and Subedar Z. A. Qureshi as second leveller, carried out from December 1945 to January 1946. The work started from Siamese bench-mark CCXCIX at Phayao Police Station and closed on the Standard bench-mark No. 29/93 P at Hawang-Luk. The difference between the first and second levellers was 0.046 feet in a distance of 100.9 miles. The height of bench-mark No. 29/93 P as published in the levelling pamphlets for Burma was found to be 1.567 feet higher than that now obtained in terms of Siamese levelling. This discrepancy is discussed in Chapter II of Technical Report 1947, Part III.

OBSERVATORY SECTION

185. Routine work.—The usual seismological and meteorological observations have been carried on. The underground magnetic observatory has been out of commission since 1943 and

no magnetic observations have been taken. The site is now surrounded by buildings and electric installations which render it unsuitable for a magnetic observatory. Proposals are afoot to build a surface observatory at a new site.

About 454 instruments of all types—theodolites, levels barometers, prismatic and oil compasses, All-India Development and Hunter Short Base, and other steel tapes, chronometers and watches, calculating machines, binoculars, staves, subtense bars, and pedometers—were handled either for tests, calibration or repairs.

Six pilot model targets were prepared for precise traverse work and supplied to the Director, Eastern Circle for trials in the field.

The 24-metre invar base tape was compared against the 4-metre standard invar bar.

Planetary tables for Survey of India Star Almanac were prepared and published for 1947 and the preparation of a complete Star Almanac for 1948 is in hand.

186. Magnetic Detachment.—On the outbreak of World War II the demand for accurate magnetic data and especially for magnetic declinations for maps for military purposes greatly increased; and to meet this demand re-observation of Magnetic Repeat Stations became inevitable for a proper determination of the secular variation. There are 80 repeat stations in India and it had originally been intended to observe at them every five years, but the scheme could not be given effect to after the disbandment of the Magnetic Party in 1923.

In 1943, a hurried programme was drawn up to visit repeat stations spread all over India; and this programme was continued till all the stations had been reobserved in 1945. The sites of several stations were found to be unsuitable due to the erecting of buildings around them and for other reasons. Alternative sites were prepared, and observations were made at some of them during the period under report.

The results of the above observations were also utilized to prepare a chart of Magnetic Declinations for 1946. This chart, which is labelled as Hind/Misc. 7553, covers the area bounded by latitudes 60° N. to 60° S. and longitudes 40° E. to 168° E. The following other material was used in the compilation:—

- (i) British Admiralty Chart of Curves of Equal Magnetic Variation 1942, Sheet 2, Indian and Western Pacific Oceans.
- (ii) Australian aeronautical Series, Magnetic Sheets Nos. 1, 2, and 3, Nov. 1944.
- & (iii) Observations at Cocos Island in 1946 by Messrs. Chamberlain & McCarthy of the Department of Mineral Resources, Survey of Australia.

187. Deflection Detachment.—Observations for the deviation of the vertical required for the determination of the form of the geoid have been in abeyance since 1940 due to the war.

In January 1947 observations were made with the large astrolabe by Mr. J. B. Mathur (U.S.S.) at two different sites in Lahore. The first determination was made at the Punjab University Observatory to obtain its astronomical co-ordinates. Geodetic co-ordinates of this location are not known and the University authorities were only interested in the astronomical values. The second site was at the triangulation station on the SE. tower of Lahore railway station. The objective here was to determine the deflections of the plumb-line. The details of observations and the results are given in the Technical Report 1947, Part III, Chapter IV.

TIDAL SECTION

188. Tide-Tables.—The preparation of the tide-tables of the Indian Ocean (67 Ports) for the year 1948 was completed and that for the year 1949 continued. Preliminary computations for the Tidal Predictions for 1950 have also been started.

Advance Tidal Predictions of 23 ports for the year 1948 were sent (in print) to the British Admiralty, the U.S. Coast and Geodetic Survey and the Royal Indian Navy, and those of 18 ports for the year 1949 required by the British Admiralty, the Hydrographer, U.S.A. and the Royal Indian Navy are under preparation.

The publication "Tide Tables of the Indian Ocean 1948" has practically been seen through the press and is expected to be published soon.

The Tide-Table pamphlets for Bombay (1 port), Rangoon River (2 ports), and the Hooghly (3 ports) for the year 1947 were published and those for 1948 are in the press and in proof stage.

189. Tidal Observations.—Automatic tidal registrations were continued at Aden, Karachi, Bombay, Vizagapatam and Calcutta. Owing to a strike of the Port staff at Calcutta during February–April, there was, however, a break in the registrations at that port from 5th February to 2nd May 1947. Tide Pole reading of the High and Low water, during day light only, was continued at Bhavnagar and Chittagong.

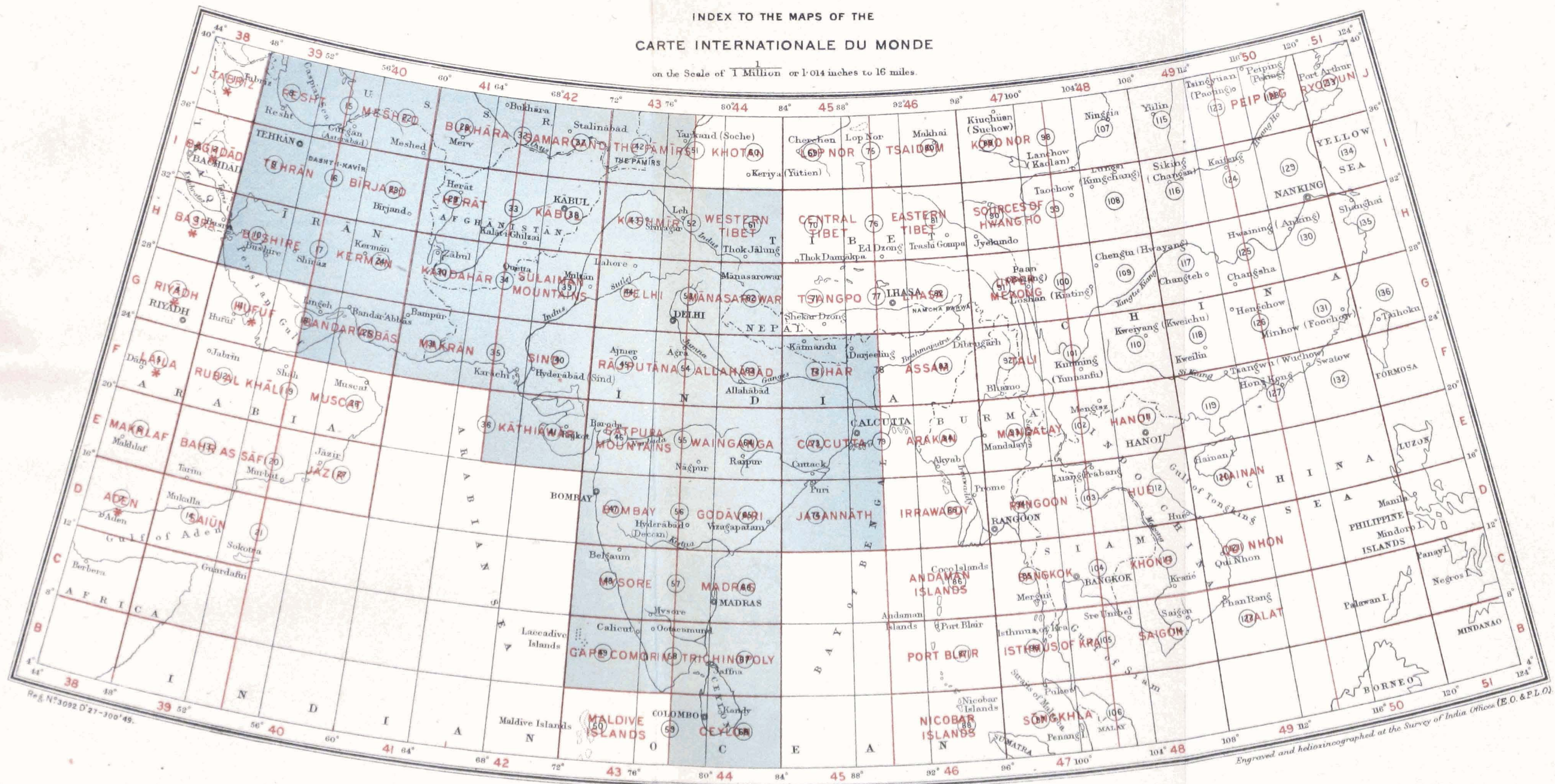
Provision has not yet been made to replace the Rangoon Tidal Observatory which was destroyed during the last war. A start has, however, been made since January 1947 with observations to a Tide Pole, during day light only, at a place about $1\frac{1}{2}$ miles lower down the Rangoon river.

INDEX MAPS

- A. Modern Topographical Surveys and Compilation.
 - B. Modern Topographical Survey and Revision.
 - C. Index showing Project surveys in hand.
 - D. Maps published on scales of one-inch and half-inch to one mile.
 - E. Maps published on scale of quarter-inch to one mile.
 - F. Index to the maps of the 1/M Carte Internationale du Monde Series.
 - G. Index to the maps of the 1/2 M Southern Asia Series.
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INDEX TO THE MAPS OF THE
CARTE INTERNATIONALE DU MONDE

on the Scale of 1 Million or 1:014 inches to 16 miles.



Published under the direction of Brigadier G.F. Heaney, C.B.E., Surveyor General of India, 1947.

Scale of Index 30 Million
Miles 200 400 600 800 Miles.

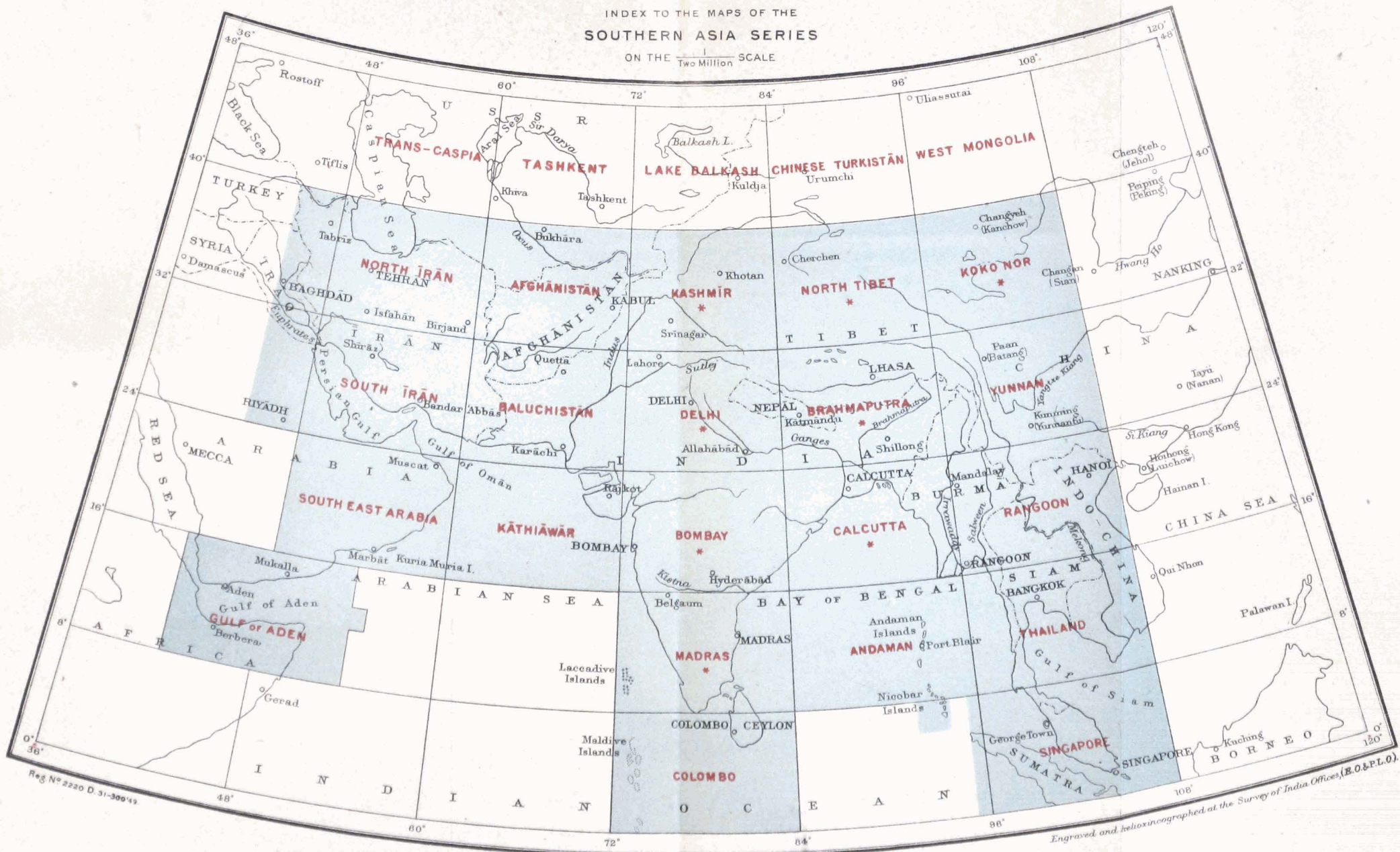
FOR THE YEAR 1946-47.
REFERENCE
Maps published.....
" in hand.....
" published by other countries.....



Engraved and heliogravured at the Survey of India Office (E.O. & P.L.O.)

INDEX TO THE MAPS OF THE
SOUTHERN ASIA SERIES

ON THE $\frac{1}{2,000,000}$ SCALE



Published under the direction of Brigadier G.F. Heaney, C.B.E., Surveyor General of India,
1947.

Scale of Index $\frac{1}{40,000,000}$

Miles 0 200 400 600 800 1000 Miles

FOR THE YEAR 1946-47.

REFERENCE

Helio Engd

Maps published (Ordinary & Layered Edn)

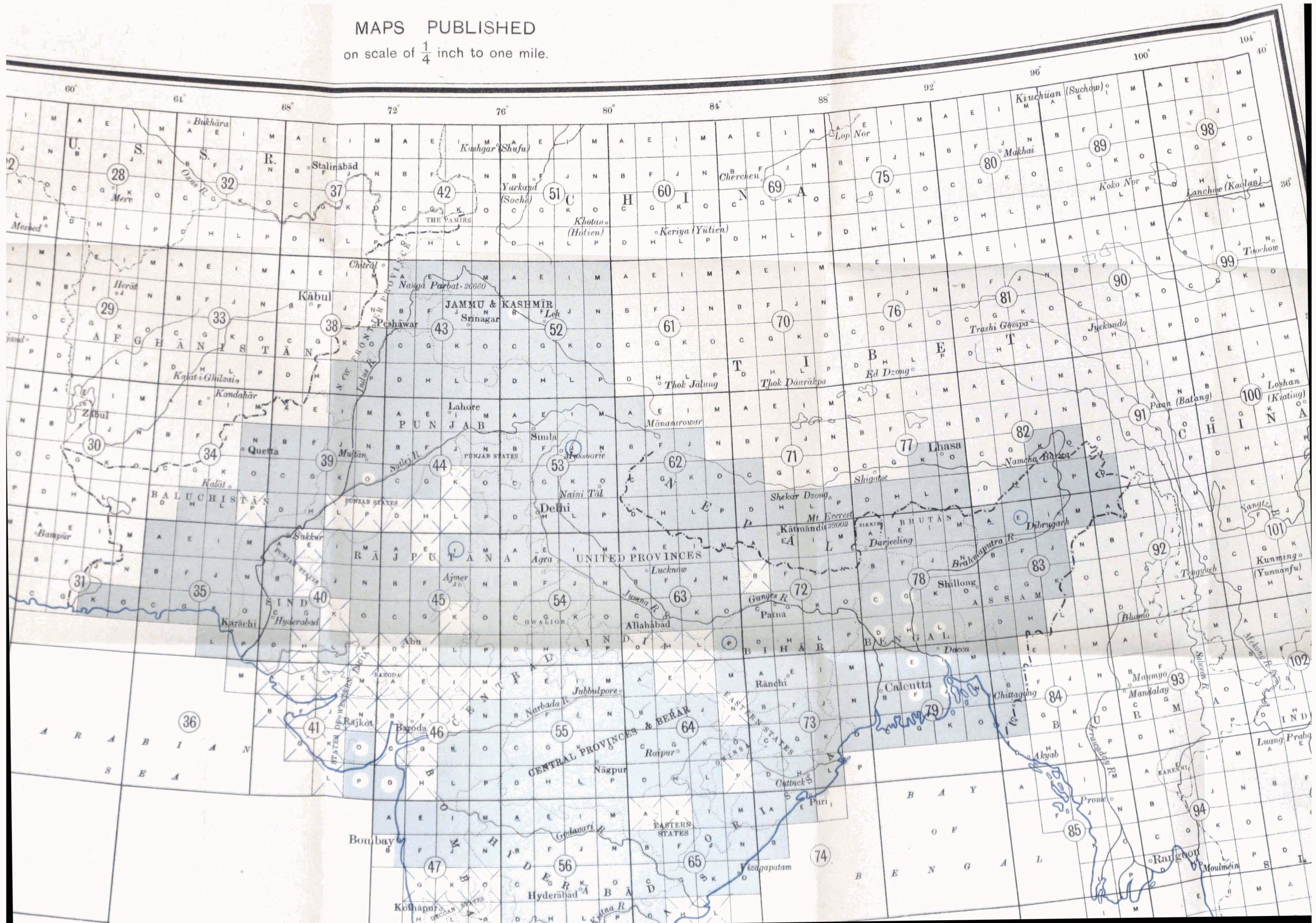
in hand



Engraved and heliographic at the Survey of India Offices (E.O.&P.L.O.)

MAPS PUBLISHED

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

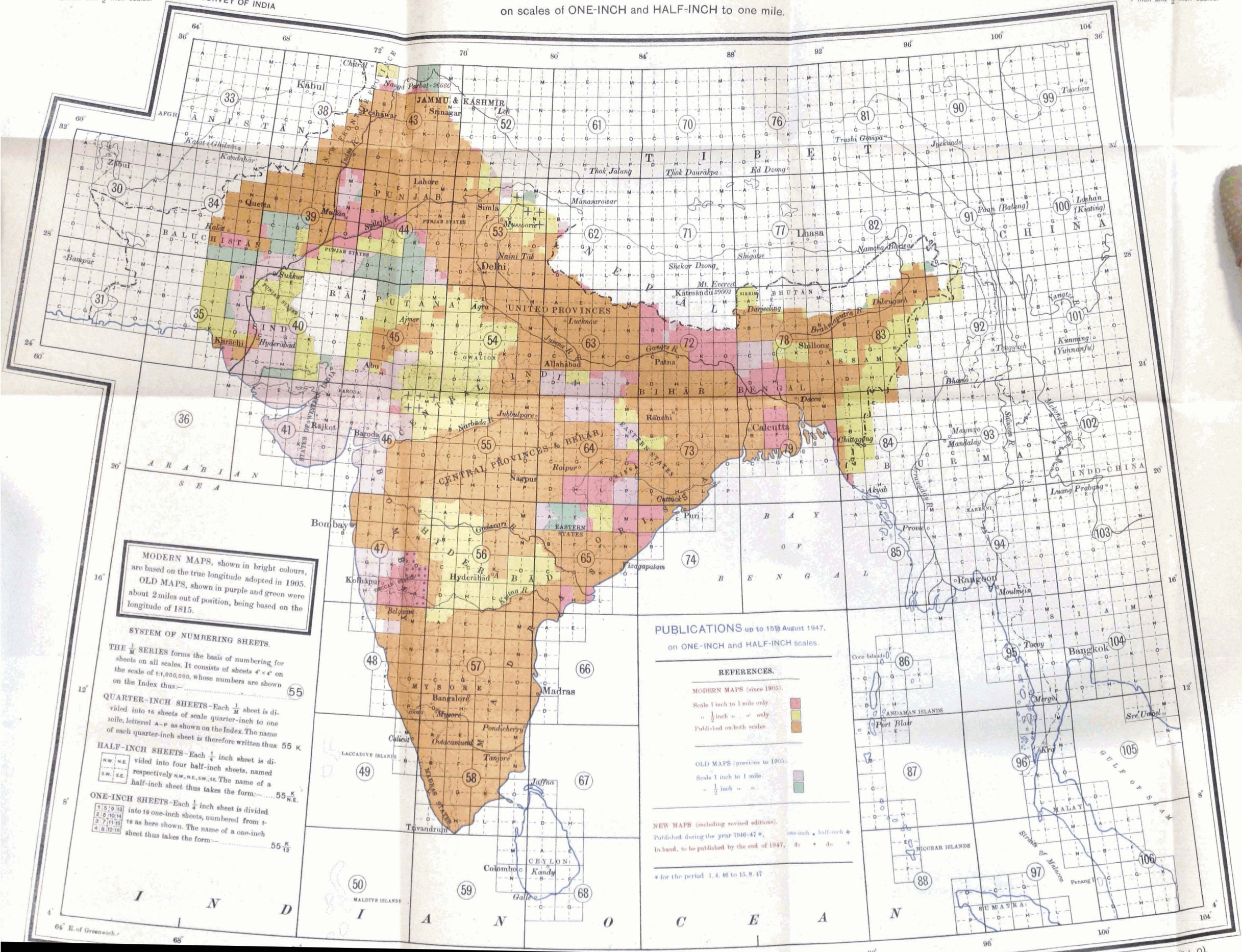


MAPS PUBLISHED
1 inch and 1/2 inch scales.

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

MAPS PUBLISHED
1 inch and 1/2 inch scales.

SURVEY OF INDIA



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

SYSTEM OF NUMBERING SHEETS.

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

QUARTER-INCH SHEETS—Each 1/4° sheet is divided into 16 sheets of scale quarter-inch to one mile, lettered A-P as shown on the Index. The name of each quarter-inch sheet is therefore written thus: 55 K

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

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

Diagram showing a grid of 16 one-inch sheets within a 1/4-degree area, numbered 1 through 16 in a 4x4 arrangement.

PUBLICATIONS up to 15th August 1947. on ONE-INCH and HALF-INCH scales.

REFERENCES.

MODERN MAPS (since 1905).
Scale 1 inch to 1 mile only
" 1/2 inch " " only
Published on both scales

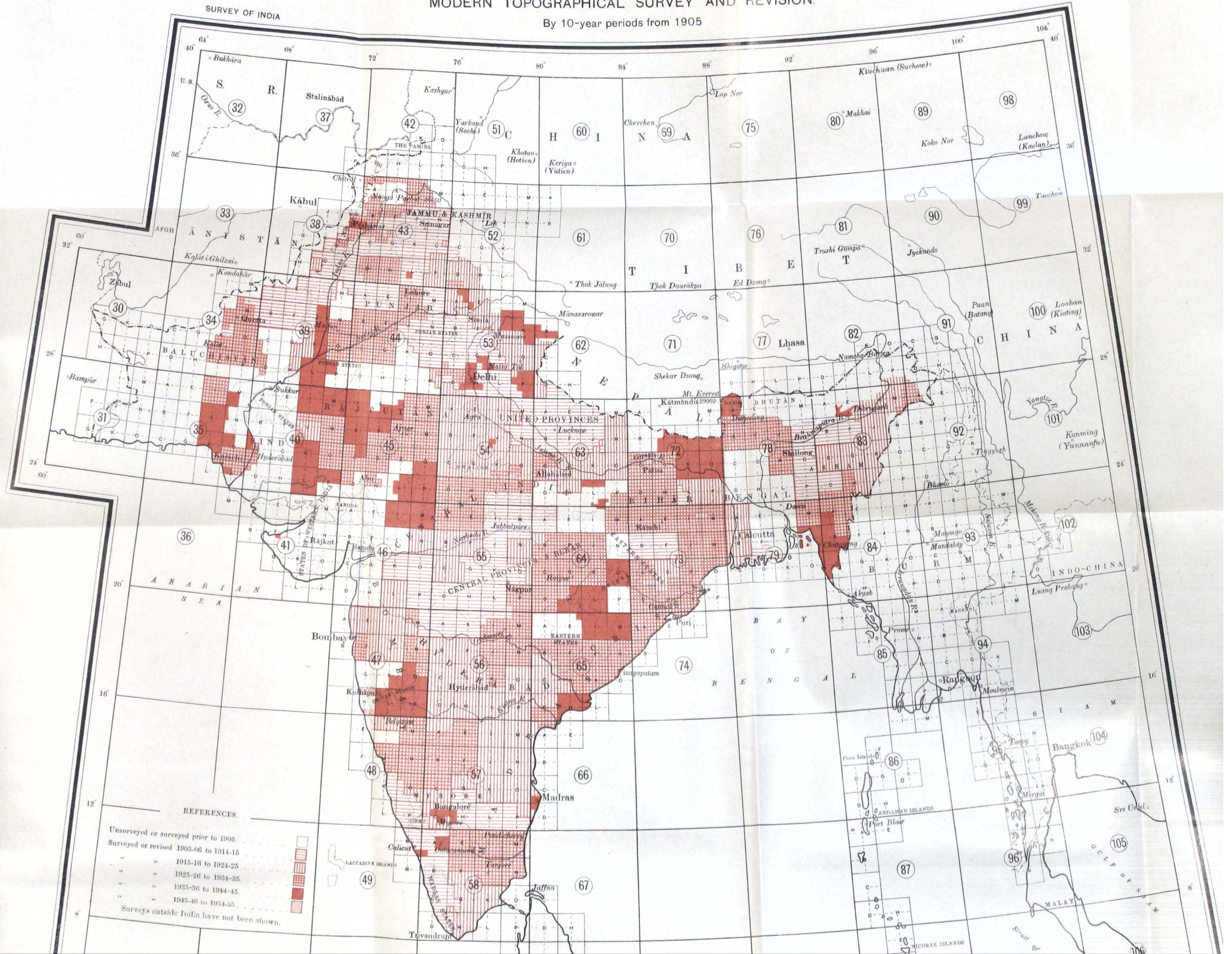
OLD MAPS (previous to 1905).
Scale 1 inch to 1 mile.
" 1/2 inch " " "

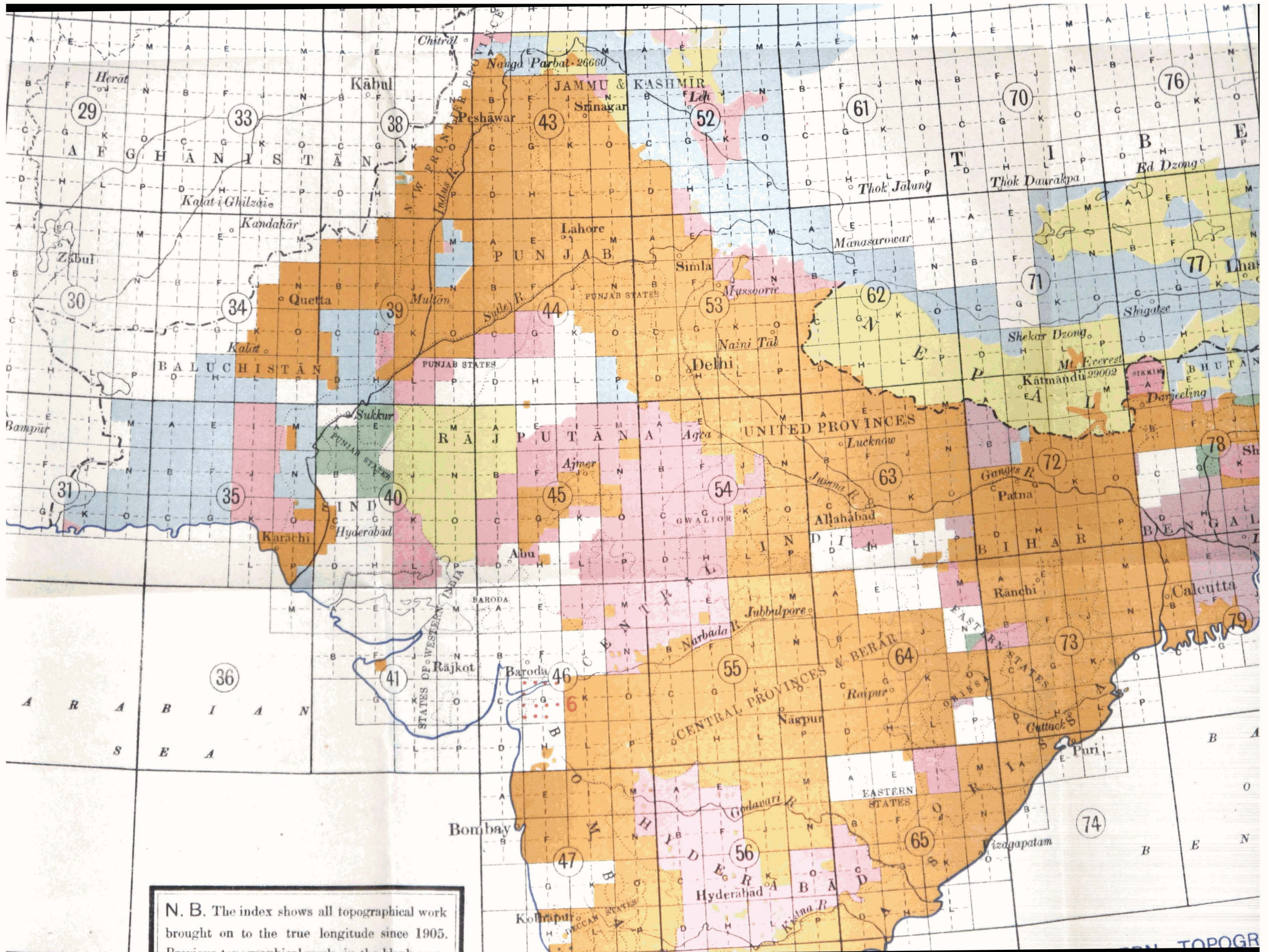
NEW MAPS (including revised editions).
Published during the year 1946-47 *
In hand, to be published by the end of 1947, do * do *
* for the period 1.4.46 to 15.8.47

MODERN TOPOGRAPHICAL SURVEY AND REVISION.

By 10-year periods from 1905

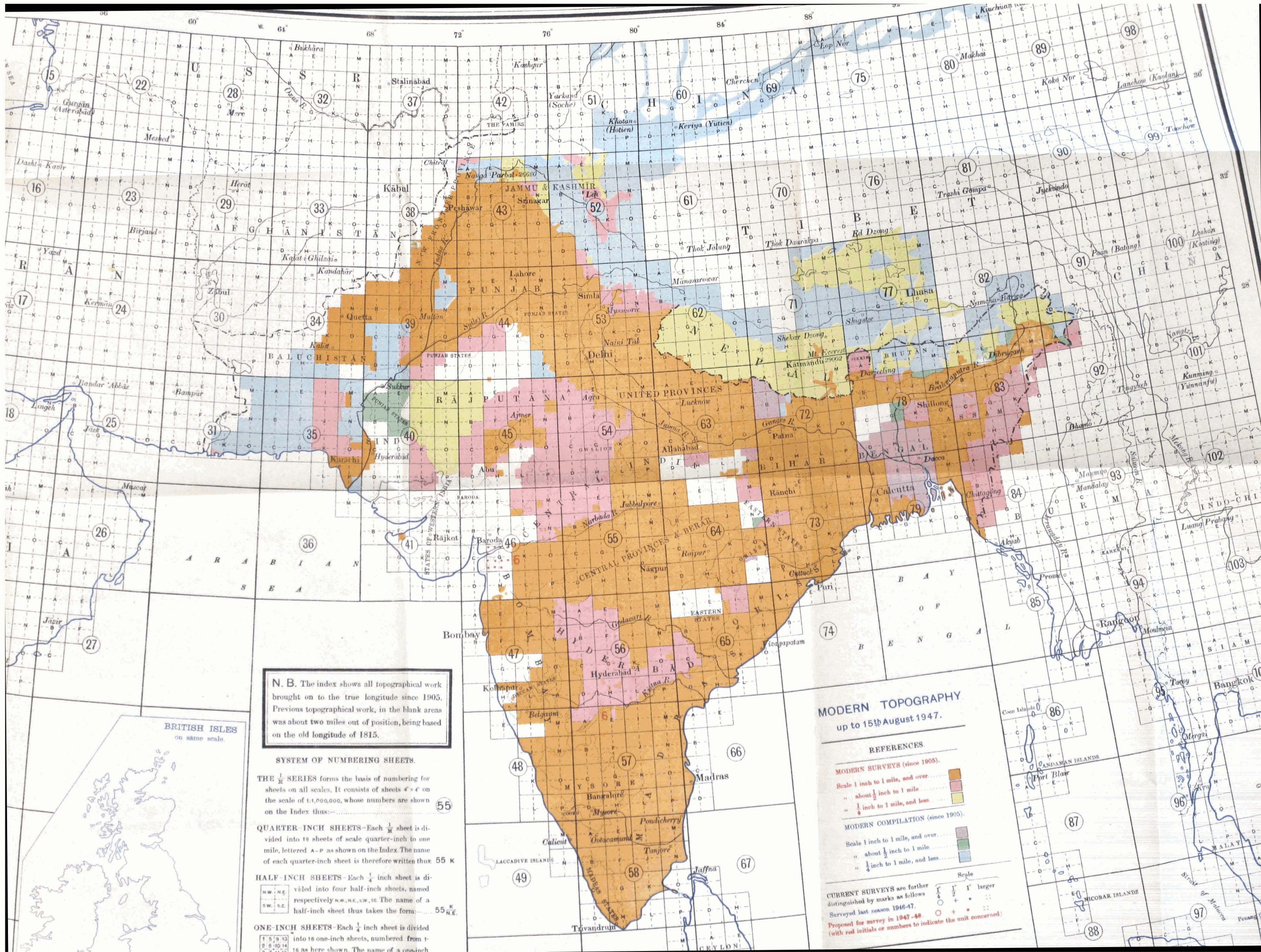
SURVEY OF INDIA





N. B. The index shows all topographical work brought on to the true longitude since 1905.

TOPOGR



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

SYSTEM OF NUMBERING SHEETS.

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

QUARTER-INCH SHEETS—Each $\frac{1}{4}$ sheet is divided into 16 sheets of scale quarter-inch to one mile, lettered A-P as shown on the Index. The name of each quarter-inch sheet is therefore written thus: 55 K

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

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

MODERN TOPOGRAPHY
up to 15th August 1947.

REFERENCES

MODERN SURVEYS (since 1905).

- Scale 1 inch to 1 mile, and over. [Orange box]
- " about $\frac{1}{2}$ inch to 1 mile. [Red box]
- " $\frac{1}{4}$ inch to 1 mile, and less. [Yellow box]

MODERN COMPILATION (since 1905).

- Scale 1 inch to 1 mile, and over. [Purple box]
- " about $\frac{1}{2}$ inch to 1 mile. [Green box]
- " $\frac{1}{4}$ inch to 1 mile, and less. [Blue box]

CURRENT SURVEYS are further distinguished by marks as follows:

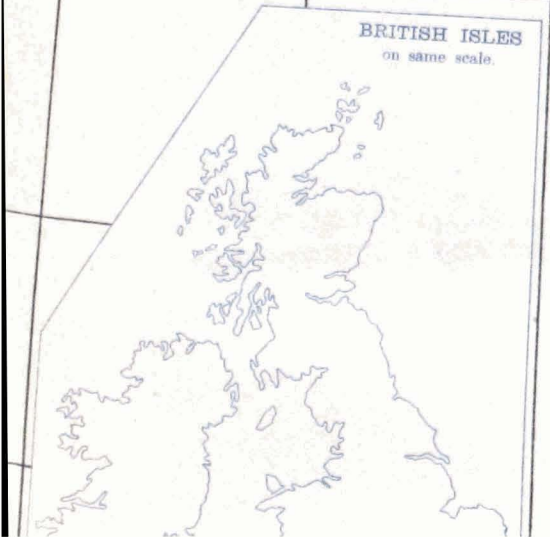
Surveyed last season 1946-47. [Circle with dot]

Proposed for survey in 1947-48. [Circle with cross]

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

Scale

1" = 1 mile
 1" = 2 miles
 1" = 4 miles



Survey & Compilation
from 4" to 1 mile to 1/8" to 1 mile scales

MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION

on scales ranging from 4 inches to 1 mile to 1/8 inch to 1 mile.



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

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

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

MODERN TOPOGRAPHY up to 15th August 1947.

- REFERENCES
- MODERN SURVEYS (since 1905).
 - Scale 1 inch to 1 mile, and over
 - " about 1/2 inch to 1 mile
 - " 1/4 inch to 1 mile, and less
 - MODERN COMPILATION (since 1905).
 - Scale 1 inch to 1 mile, and over
 - " about 1/2 inch to 1 mile
 - " 1/4 inch to 1 mile, and less

CURRENT SURVEYS are further distinguished by marks as follows:
Surveyed last season 1946-47.
Proposed for survey in 1947-48.
(with red initials or numbers to indicate the unit concerned)

