

SURVEY OF INDIA  
GENERAL REPORT  
1940



From 1st October 1939  
To 30th September 1940

PUBLISHED BY ORDER OF  
THE SURVEYOR GENERAL OF INDIA.

Printed at the Photo.-Litho. Office,  
Survey of India,  
CALCUTTA,  
1940.

Copyright reserved.



One Rupee Eight Annas or Two Shillings and Six Pence.

Hc.

63.

Hc 63

3239



17

# SURVEY OF INDIA

## GENERAL REPORT

### 1940



From 1st October 1939  
To 30th September 1940

PUBLISHED BY ORDER OF  
THE SURVEYOR GENERAL OF INDIA

---

Printed at the Photo.-Litho. Office,  
Survey of India,  
CALCUTTA,  
1940.

Copyright reserved





13

## P R E F A C E

In order to save labour and paper some index maps, tabular statements and other material usually included in the General Report have been omitted from this Report for 1940.

The index map which is included at the end of the volume shows areas covered by modern topographical surveys and compilation. The index maps which have been omitted normally illustrate the position as regards the publication of maps on different scales. In so far as the progress made in any one year represents only a small fraction of the mapping of the whole of India, the present position is approximately shown by the index maps included in the Report for 1939, to which reference may be made.

Recent General Reports have also contained a brief History of the Department (in the Preface) and Notices regarding its work and publications. Reference may be made to the 1939 Report for these also.

---



# IC

## CONTENTS.

	PAGE.
<b>PART 1. GENERAL.</b>	
I. INTRODUCTION and SUMMARY ... ..	1
<b>PART 2. GEODETIC WORK.</b>	
II. ABSTRACT OF GEODETIC OPERATIONS ... ..	5
<b>PART 3. TOPOGRAPHICAL WORK.</b>	
III. ABSTRACT OF TOPOGRAPHICAL WORK (with Tables A and B)	8
IV. SURVEY REPORTS, FRONTIER CIRCLE—	
‘A’ Survey Company ... ..	10
‘E’ Survey Company ... ..	12
No. 18 (Air Survey) Party ... ..	14
Lahore Survey Detachment ... ..	15
V. SURVEY REPORTS, GEODETIC BRANCH—	
No. 1 Party ... ..	17
No. 20 (Cantonments) Detachment ... ..	19
VI. SURVEY REPORTS, EASTERN CIRCLE—	
Summary ... ..	21
No. 4 Party ... ..	21
No. 5 Party ... ..	23
No. 12 Party ... ..	23
VII. SURVEY REPORTS, INDEPENDENT PARTIES—	
No. 6 (South India) Party ... ..	26
Burma Survey Party ... ..	27
VIII SURVEY REPORTS, MISCELLANEOUS ... ..	31
<b>PART 4. MAP PUBLICATION AND MATHEMATICAL INSTRUMENT OFFICE.</b>	
IX. MAP PUBLICATIONS (with Tables I, II and III) ... ..	32
X. MATHEMATICAL INSTRUMENT OFFICE ... ..	41
INDEX MAP.—Modern topographical surveys and compilation	At end

11

## GLOSSARY.

**Scales** are referred to as follows:—

- (i) for scales which are multiples of  $1/1,000,000$ —“1/M scale”, “1/6M scale” &c., which mean “1/1,000,000 scale”, “1/6,000,000 scale” &c.,
- (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 65, 78 &c. are sheets on the 1/M scale;
- 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 Index at the end of this report.

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

L. S. S. denotes Lower Subordinate Service.

U. S. Officer denotes Upper Subordinate Officer.

L. S. Officer denotes Lower Subordinate Officer.

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

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

D. O. denotes Drawing Office.

F. O. U. O. denotes “For Official Use Only”.



12

# SURVEY OF INDIA

110  
63

## GENERAL REPORT

1940

From 1st October 1939

To 30th September 1940

### INTRODUCTION AND SUMMARY.

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

*The Geodetic Report.*

*The General Report.*

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

The *Geodetic Reports* contain full details of all scientific work, but are being held in abeyance during the war.

The *General Report* includes an abstract of the *Geodetic Report* (in *Part 2*), and full details of the survey operations of the ordinary field units (*Part 3*) as well as map publication, and instrument manufacture (*Part 4*).

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

The post of Assistant Surveyor General was held by MAJOR G. F. HEANEY, R.E., up to 6th March 1940, and thereafter by MAJOR G. BOMFORD, R.E.

**3. The total cost of the Department** for the year ending 31st March 1940, as compared with that of previous years, was as follows:—

	1937-38	1938-39	1939-40
	Rs.	Rs.	Rs.
Gross actual cost ... ..	37,91,805(a)	38,17,091(b)	33,92,841†
Deduct recoveries ... ..	12,90,079	14,32,043	14,70,004
Nett actual charges ... ..	25,01,726	23,85,048	19,22,837†
<i>Total area of survey of all kinds completed during the year.</i>	Square miles.	Square miles.	Square miles.
	38,559	23,558	18,513*

(a) Including (1) Rs. 71,001 for English Charges (High Commissioner) on Stores, and loss or gain by exchange, and (2) Rs. 1,88,646 for sterling overseas pay and leave salary &c., paid in England.

(b) Including Rs. 96,173 for (1) and Rs. 2,15,944 for (2) above.

\* *Vide* page 9.

† These figures exclude payments made in England, as in (1) and (2) above.

#### 4. Noteworthy events.—

During the field season 1939-40 financial stringency, which had developed some time before the outbreak of war, severely restricted the activities of field parties so far as work on the primary programme was concerned. Instead, many surveyors remained at headquarters to overtake arrears of fair drawing and to bring old sheets on the quarter-inch scale up-to-date from information already available. A start was also made with verification surveys, designed to incorporate major changes in new editions without complete resurvey.

*Military Training.*—A test mobilization of a Field Survey Company and training in military survey under active service conditions were carried out in November and December 1939 in the vicinity of Nowshera, culminating in a Tactical exercise, from 6th to 9th December, in which an Indian Field Survey Company worked in conjunction with the Survey Section R. A. Further training was carried out during the period February to June 1940.

*Temporary posts.*—The following temporary posts have been sanctioned in connection with the war:—

- (a) Two Assistant Directors, Frontier Circle.
- (b) A Survey Training Officer in the Frontier Circle.
- (c) An Additional Chief Draftsman in the Map Publication Office.
- (d) A temporary Assistant Superintendent in the Mathematical Instrument Office.
- (e) An Assistant Officer in Charge, Photo.-Litho. Office. (Mr. S. Colquhoun, re-employed).

*Organisation.*—The Government of India have sanctioned the grant of special pay of Rs. 50 per mensem to the Class II officer in charge of the Drawing Section of No. 6 (S. I.) Party, Survey of India, with effect from the 1st October 1939.

The Government of India have sanctioned the formation under the Survey Training Officer of a separate office called the Survey Training Centre with headquarters at Risālpur with effect from the 15th July 1940.

*Conference.*—A conference consisting of the Surveyor General, all Directors and other available officers met at Lahore in March 1940 to discuss methods of map maintenance in the field and in office.

*Survey Operations in Sikkim State.*—The survey of Sikkim State, which started in August 1939 under MR. A. AHAD (Class II) of No. 12 Party as camp officer assisted by MR. J. N. KOHLI (U. S. S.) was completed by the end of May 1940.

**5. Awards.**—His Excellency the Viceroy and Governor General has been pleased to confer the title of Rai Sahib, as a personal distinction, upon MR. DIWAN CHAND VERMA, Registrar.

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

*Class I Officers.*—COLONEL F. B. SCOTT, I.A., and MESSRS. O. N. PUSHONG, M. M. MUDALIAR, M.A., A. J. A. DRAKE, D.C.M., and F. W. SMITH retired.

LT.-COLONEL E. A. GLENNIE, D.S.O. confirmed as Director and promoted to Colonel.

LT.-COLONEL W. J. NORMAN, M.C., R.E., promoted to Acting Colonel, CAPTAIN R. C. N. JENNEY, R.E. to Acting Major and LIEUT. L. H. WILLIAMS, R.E., to Acting Captain.

CAPTAIN I. H. R. WILSON, R.E., promoted to Major.

CAPTAIN J. S. O. JELLY, R.E., promoted to Superintendent.

CAPTAINS GAMBHIR SINGH, I.A., and R. S. KALHA, I.A., confirmed as Assistant Superintendent.

LIEUTS. A. D. VERMA, I.E., and ANANT SINGH, I.E., and 2ND LIEUT. P. G. MOTT, R.E., joined the Department as Assistant Superintendent (on probation).

2ND LIEUT. E. E. SHIPTON, I.A., joined the Department temporarily in July as Assistant Superintendent, but was transferred to the External Affairs Department in August.

MESSRS. F. W. SMITH, B. T. WYATT, V.D., C. S. McINNES and W. H. STRONG, M.B.E., promoted to Superintendent.

MR. A. J. A. DRAKE, D.C.M., re-employed.

MR. F. H. GRANT granted extension of service for one year.

The following officers temporarily reverted to military duty:—

A/COLONEL W. J. NORMAN, M.C., R.E., MAJOR J. B. P. ANGWIN, M.B.E., R.E., A/MAJOR R. C. N. JENNEY, R.E., CAPTAINS J. S. O. JELLY, R.E., D. M. CLEMENTI, R.E., and R. T. L. ROGERS, R.E., and L. H. WILLIAMS, R.E. and 2ND LIEUT. P. G. MOTT, R.E.

*Class II Officers.*—The following officers were confirmed in their appointments:—

MR. J. C. ST. C. POLLETT, V.D., Chief Draftsman, Map Publication Office.

MR. D. N. BANERJEE, L.C.E., Head Draftsman, No. 1 Drawing Office.

**MR. MOQUIMUDDIN ANSARI**, Officer-in-charge, No. 20 (Cantonments) Detachment.

**MR. N. N. CHUCKERBUTTY**, L.C.E., Survey Instructor.

**MESSRS. SURESH PRASAD** and **R. L. GHEI** confirmed as Extra-Assistant Superintendent.

**MR. D. N. BANERJEE** appointed to the post of Additional Chief Draftsman, Map Publication Office.

The following officers have been granted Emergency Commissions:—

As 2ND LIEUT. (A/LIEUT.):—**MESSRS. J. C. BERRY**, **A. R. QURAIISHI** and **K. L. DHAWAN**.

*General Central Service (Class II)*.—**MR. S. COLQUHOUN** retired and was re-employed to the temporary post of Assistant Officer-in-charge, Photo.-Litho. Office.

**MR. L. H. MORDUE** confirmed as Manager, Photo.-Litho. Office and **MR. G. J. SHAHA** as Assistant Head Engraver.

**MR. C. V. M. HAYMAN** appointed as Assistant Manager, Photo.-Litho. Office, on probation.

**MR. I. L. E. HEINZELMANN** appointed to the temporary post of Assistant Superintendent, Mathematical Instrument Office.

The following officer has been granted an Emergency Commission:—

As 2ND LIEUT.:—**MR. C. V. M. HAYMAN**.

*Upper Subordinate Officers*.—**MR. M. N. CHATARJI** retired.

**MR. A. N. RAMANATHAN** confirmed as Sub-Assistant Superintendent.

**MESSRS. J. A. CABRAL** and **A. G. QURESHI** reverted from foreign service with Messrs. Andrew Yule & Coy., Ltd.

**MESSRS. B. S. CHOPRA**, **P. RAMAN KUTTY KURUP**, **E. J. A. FRANCIS** and **RUSTAM KHAN**, appointed on probation.

The following officers of the U. S. S. and L. S. S. etc. have been granted Viceroy's Commissions:—

As *Subedar*:—**MESSRS. I. K. PONNAPPA**, **K. B. MUTHANNA**, **J. N. KOHLI**, **L. R. HOWARD**, **S. S. HASAN**, **MANAWAR KHAN** and **SULTAN MAHMUD**.

As *Jemadar*:—**SURVEYORS**—**SAT NARAIN SHARMA**, **PANIRUDDIN AHMAD**, **C. MUHAMMAD AZIMUDDIN**, **GURDIT SINGH**, **MAUJI RAM**, **BHAJAN SINGH**, **NAZIR HASAN**, **BALDEO NARAYAN SINGH**, **HARWANT SINGH**, **BISHAMBAR DUTT**, **WILKINS EPHRAIM**, **KEDAR NARAIN**, **AMAR SINGH RANA**, **LIAQATULLA KHAN**, **RAI SINGH**, **TEJA SINGH** and **HIKMATULLAH KHAN**.

**Computers**—**PARESH CHANDRA DATTA**, **DAULAT RAM**, **KRISHNA KUMAR** and **JALESWAR CHANDRA DAS**.

**Clerks**—**D. AROKIASVAMI**, **SHAMSHER SINGH**, **JAGDISH LAL UBEROI**, **K. ALAUL HASAN**, **JUBBAL SINGH BIST**, **SHAFIQ HUSAIN KHAN**, **MIRZA LAIK BAIG**, **PITAMBAR DUTT PANTH** and **HITENDRA LAL BOSE**.

**Litho. Machine Printers**—**ABUL KHAIR ABDULLAH** and **AMAR SINGH**. **Photographer**—**ATTAR SINGH II**, **Vandyke** and **Helio Operator**—**SYED ZAHID ALI** and **Hand Press Printer**—**ALLAH BACHAYA**.

## PART 2.—GEODETIC WORK.

### II.—ABSTRACT OF GEODETIC OPERATIONS.

**DIRECTOR** :—Colonel E. A. Glennie, D.S.O.

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

*Topographical Survey* carried out by No. 1 Party (paras. 45—49).

*Cantonment Surveys* (paras. 50—54).

*Training School* (paras. 84-85).

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

These operations are normally fully described in the annual Geodetic Reports of the Survey of India which contain complete index maps and detailed results, but during the war no Geodetic Reports will be published. The following is a brief abstract of the geodetic operations whose detailed description is thus unavoidably deferred.

**9. Observatory Section.**—The usual magnetic, seismographic and meteorological observations have been carried on. The latitude variation programme at Agra was brought to a close at the end of its third year. The variation continues large, and its analysis should prove of interest.

**10. Computing Section.**—The compilation of the new series of “complete data” triangulation pamphlets has not progressed as fast as was anticipated when work was started on them last year. Much of the old triangulation was found to require recomputation, and more urgent work has now made progress very intermittent.

It has been decided that for all small scale maps of the Survey of India ( $\frac{1}{2}$ M and smaller) the Lambert Orthomorphic Projection with two standard parallels should be adopted. This will replace the Modified Secant Conical Projection, which has been generally used hitherto. Tables for the new projection are under preparation, and will in due course be published as a new edition of the Survey of India Auxiliary Tables, Part I (Graticules of maps).

Computation was completed of the 98 stations observed by the Latitude and Longitude Detachment of No. 14 Party.

Arrears in the computation of Hayford anomalies are being made up; 70 stations were computed during the year, and only 160 now remain.

Assistance has again been given to the Burma Oil Company in the computation of gravity anomalies.

Triangulation and traverse computation carried out has included some field work of No. 1 Party required for immediate plane-tabling, and assistance in the Karakoram work of Messrs Shipton and Mott.

The following publications were seen through the press:—

- (1) Geodetic Report 1939.
- (2) Handbook of Topography Chapters VIII & XII.
- (3) Professional Paper No. 30.
- (4) Levelling Pamphlets 34 and 39.

**11. Tidal Section.**—The tide-tables of the Indian Ocean for 67 ports and the three pamphlets for Bombay, Hooghly River and Rangoon River, for 1941, were prepared and published in September 1940.

Automatic tidal registrations were continued at Aden, Karāchi, Bombay, Vizagapatam, Dublat, Calcutta and Rangoon. The gauge at Aden was dismantled on the 12th December 1939 for reconstruction of the pier on which the observatory is situated, and it resumed working on the 2nd January 1940.

In addition, tide-pole readings of high and low water, during day-light only, were continued at Bhāvnagar, Chittagong and Akyab.

**12. Latitude and Longitude.**—(No. 14 Party).—A programme of observations with the astrolabe for deflection had been prepared which entailed about four months work in the north-west of India, and two months in Assam and Bengal. Mr. P. S. Shinghal (Class II) was the observer, travelling with two hired motor lorries. He began work in N. W. F. P. and Waziristān, where delays were occasioned by the unsettled tribal situation, so that doubt was felt as to whether the programme would be completed before April, when wireless conditions in Bengal become difficult. It was accordingly decided to postpone the work in Assam and Bengal until 1940-41, and to substitute a more complete programme in the Punjab and Punjab States. This was successfully carried out, and Mr. Shinghal was able to observe at 98 stations before the end of March. His observations close several complete circuits, round which the integration of geoidal height will give a measure of the accuracy both of his and of previous seasons' work.

**13. Gravity Observations.**—(No. 14 Party).—Observations with the pendulums to determine the force of gravity were made by Mr. M. N. A. Hashmie (Class II) at 15 new stations in south Burma, and at one station in the Andaman Islands. Transport was by rail and motor lorry in the northern part of the work; a Government launch was hired from Mergui for the journey down the coast to Victoria Point and to Court Island, where a landing was made.

The results of the observations made in 1939 with the apparatus on loan from Cambridge University were computed. The results were unexpected, and indicate that at present there is insufficient justification for the revision of the value hitherto assumed for the force of gravity at Dehra Dūn.

**14. Geodetic Traverse.**—(No. 15 Party).—On account of financial stringency the geodetic traverse could not be taken up in 1939-40.

**15. High Precision Levelling.**—(No. 15 Party).—Out of the total length of 15,800 miles of levelling of high precision required for the new Geodetic level net of India, 594 miles were completed during 1939-40, by levelling in the back direction from (i) Balasore to Bhadrakh, (ii) Bhadrakh to Sambalpur (iii) Vizianagaram to Cuttack with a branch line from False Point to Cuttack. This makes a total of 10,678 miles completed up to date.

---

## PART 3.—TOPOGRAPHICAL WORK.

### III.—ABSTRACT OF TOPOGRAPHICAL WORK.

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

*Table A* shows the area of survey completed on various scales since 1905, as well as the approximate balance which remains to complete the contoured topographical survey of India.

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

**17.** The terms Original Survey, Resurvey, Revision and Supplementary Survey have been in use hitherto to describe surveys with reference to the state of surveys already existing in the area and also to indicate the technical method employed. This combination of classifications has been found unsatisfactory and dual sets of terms have now been introduced as follows:—

- (i) Broad classification of surveys in relation to existing surveys and to the reorganisation of 1905.
  - (a) Surveys executed prior to 1905-06 are termed *Old Surveys*.
  - (b) Surveys in areas which have not been surveyed since 1905 are termed *New Surveys*.
  - (c) Surveys in areas which have been surveyed since 1905 are termed *Revision Surveys*.
  - (d) The survey of particular items of detail or relief which have changed or come into existence since the previous survey, is termed *Verification*. This is distinct from Revision Survey in that it does not purport to bring up to date the whole area of a map.
- (ii) Nomenclature for describing technical methods of survey irrespective of the classification detailed in sub-para. (i) above.
  - (a) *Original Survey*. Survey carried out on blank paper without making use of any previous work (which may or may not exist).
  - (b) *Blue-print Survey*. Survey carried out with the assistance of previous work which is printed, or hand-transferred, in blue on the plane-table section.
  - (c) *Colour-print Survey*. Survey carried out by the correction of previous work which is printed in colour on the plane-table section.

NOTE.—These terms are used in the technical parts of this report, *viz.* in Table C (not published this year) and in "Survey Reports" Sec. IV *et seq.*



Table A.—Progress of Topographical Surveys in India since 1905.

Survey years.	1-inch and larger scales.	$\frac{3}{4}$ and $\frac{1}{2}$ -inch scales.	$\frac{3}{8}$ and $\frac{1}{4}$ -inch scales.	TOTALS.
	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>
1905—35 ... ..	848,629	189,084	25,929	1,063,642
1935—39 ... ..	49,512	58,846	19,868	128,226
1939-40 ... ..	8,467	5	.....	8,472
<b>Totals to 1940</b> ...	<b>906,608</b>	<b>247,935</b>	<b>45,797</b>	<b>1,200,340</b>
<i>Balance</i> ... ..	<i>approximately.</i> 160,000	<i>approximately.</i> 160,000	<i>approximately.</i> 100,000	422,675
<b>Total programme</b> ...	.....	.....	.....	<b>1,623,015</b>

Progress of Topographical Surveys in Burma since 1905.

1905—35 ... ..	146,208	41,634	.....	187,842
1935—39 ... ..	15,546	2,379	.....	17,925
1939-40 ... ..	1,247	.....	.....	1,247
<b>Totals to 1940</b> ...	<b>163,001</b>	<b>44,013</b>	.....	<b>207,014</b>
<i>Balance</i> ... ..	.....	.....	.....	54,706
<b>Total programme</b> ...	.....	.....	.....	<b>261,720</b>

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

India 1939-40 ...	3,793	2,392	.....	6,185
Burma 1939-40 ...	2,609	.....	.....	2,609

#### IV.—SURVEY REPORTS, FRONTIER CIRCLE.

**DIRECTOR:**— { Colonel E. O. Wheeler, M.C. to 8-9-40.  
Lt.-Colonel T. M. M. Penney from 9-9-40 in addition to his own  
duties as Assistant Director (Civil).

*Assistant Director (Civil).*— { Major G. W. Gemmell, I.A. from 1-3-40 to 14-4-40.  
Lt.-Colonel T. M. M. Penney from 15-4-40.

*Assistant Director (Military).*— { Lt.-Colonel W. J. Norman, M.C., R.E. from 9-5-40 to 14-7-40.  
Major J. B. P. Angwin, M.B.E., R.E. from 15-7-40 to 8-8-40.  
Lt.-Colonel T. M. M. Penney for 9-8-40 in addition to his  
own duties as Assistant Director (Civil).  
Major G. F. Heaney, R.E. from 10-8-40.

The units administered by the Frontier Circle were 'A' and 'E' Companies, No. 18 Party, Lahore Survey Detachment, No. 6 Drawing Office and Survey Training Centre.

#### 'A' Survey Company.

*Officer Commanding.*— { Major J. B. P. Angwin, M.B.E., R.E., to 29-4-40.  
Captain R. C. N. Jenney, R.E., from 30-4-40 to 6-8-40.  
Captain R. A. Gardiner, R.E., from 7-8-40 to 10-9-40.  
Captain D. E. O. Thackwell, R.E., from 11-9-40.

**18. General.**—The Company carried out topographical survey training of Class I officers in Hazāra district of N. W. F. P.; verification surveys in Gurdāspur, Hoshiārpur, Jullundur, Lahore, Ludhiāna, Rāwalpindi and Shekhupura districts of the Punjab, Kapūrthala State of the Punjab States, and in Kashmir and Jammu state, and framework in Gwalior and in Udaipur (Mewār) state of Rājputāna on behalf of the Imperial Airways.

Field headquarters were at Lahore Cantonment from 28th October 1939 to 7th April 1940.

The Company was amalgamated with "E" Company in September, the combined unit being designated "A & E" Company.

**19. Personnel.**—The average strength of the Company during the year was 4 Class I, 2 Class II, 3 Upper Subordinate officers and 21 Lower Subordinates (excluding 3 clerks, 1 storekeeper clerk and 2 computers).

Captains D. M. Clementi, R.E., and Lt. L. H. Williams, R.E., were posted to the Company during the field season for training in plane tabling. Mr. D. C. Puri (Class II) was transferred to the Lahore Survey Detachment in November; Messrs. C. L. Kapur, R.S. and R. N. Hastir, (both Class II) were transferred to the Company in August and September 1939 respectively; 3 Probationers (Class II) were posted to the Company for training during the field season. Among the U. S. S. officers, the following were transferred to No. 18 Party:—Messrs. N. N. Dhawan and S. S. Hasan in December, Mr. Chiragh Shah in January, and Mr. U. D. Mangain in June.

Messrs. I. K. Ponnappa and S. Alauddin were transferred to the Lahore Survey Detachment in January and August respectively, and Mr. Muhammad Akbar was posted to the Company in May.

**20. Areas surveyed.—**

16 square miles of triangulation.

10 square miles of 1-inch original survey (training).

15 square miles of 1½-inch original survey (training).

50 one-inch sheets, on which verification survey on one-inch scale was carried out.

1 three-inch sheet, on which verification survey on 3-inch scale was carried out for the Lahore Guide Map.

*Areas for inclusion in Tables A and B.*

*Nil.*

**21. Field work** was organized as follows:—

(1) *Verification Surveys* on 1-inch printed sheets for the verification of detail received from extra-departmental sources:—

One surveyor was employed from October to June in Kashmir and Jammu state in sheets 43 F, J, K, N, O, P.

One surveyor was employed from January to April in Gurdāspur, Hoshiārpur, Jullundur, and Ludhiāna districts of the Punjab and Kapūrthala state of the Punjab States in sheets 43 P, 44 M, N and 53 A.

One surveyor was employed in October and again in March and April in Hazāra district of N. W. F. P. and in Rāwalpindi and Shekhupura districts of the Punjab in Sheets 43 F, G and 44 E.

One surveyor was employed in March in Lahore district of the Punjab to verify the detail affected by the Karol tube well project in sheet 44 I.

(2) *Verification surveys* on scale 3 inches to one mile:—

Two surveyors were employed for a short time in April on blue print verification survey of the Lahore Guide Map in sheet 44 I.

(3) *Officers' training camp.*—On conclusion of the military training period in December, Mr. Chiragh Shah proceeded to Abbottābād, Hazāra district, and formed a camp for 3 Class I officers under training. Shortly after commencement of the camp Mr. Chiragh Shah was transferred to No. 18 Party and was relieved by surveyor Mir Abdullah. At the end of January the camp was temporarily closed and all personnel proceeded to a Control Training Camp under Major G. Bomford, R.E. At the end of February the camp was reopened with two Class I officers under the administrative arrangements of Captain Gambhir Singh, I.A., training being continued under the direct orders of the O. C. Company.

(4) *Triangulation.*—In response to an urgent request by the Engineer in Charge, Captain R. A. Gardiner, R.E., was lent for a period of four weeks during January and February to the Imperial Airways, together with two computers from the Geodetic Branch. Captain Gardiner's work consisted of the provision of the triangulation control for the hydrographic survey of proposed flying boat bases at Jai Samand (Udaipur) and Tighāra Lake (Gwalior), and the provision of spot heights in the surrounding country wherever they would be of value to aircraft approaching or departing. Computation was carried out by the computers, who also assisted with the hydrographic survey.

Captain R. S. Kalha, I.A., carried out triangulation in "E" Company from December till April, *vide* para. 26.

## 22. Office work.—

(1) *Fair drawing*.—During the field season a drawing section of 8 surveyors and draftsmen under Mr. D. C. Puri (Class II) up to November, and then Mr. R. N. Hastir (Class II), were employed on the fair drawing of quarter-inch, half-inch and one-inch sheets. During recess the fair drawing was continued, and personnel were also employed on drawing work for the Map Maintenance Section, including the correction of originals of sheets from verification surveys and office copy corrections.

The strength of the section was considerably reduced in recess and it was chiefly employed on miscellaneous work in connection with preparations for war.

(2) *Map Maintenance Section*.—This section consisting of one section officer R. S. C. L. Kapur (Class II), 1 record keeper clerk, and 2 draftsmen transferred corrections on 219 office copies for one-inch and quarter-inch sheets, and prepared and supplied 3 traces of 4-inch Revenue sheets to the Director of Land Records, Punjab.

Preparation of a detailed index register of the whole maintenance area of the Company was taken in hand. The kalamazoo filing system was employed in order to record the information concerning each one-inch sheet necessary for the maintenance of the sheet and for the preparation of a revision programme.

The Section Officer carried out in addition the duties of camp officer for the surveyors employed on verification surveys, the collection and systematic record of office copy corrections, and all work in connection with maps sales.

(3) *Murree Large Scale Survey*.—One draftsman under the supervision of Mr. U. D. Mangain (U. S. S.) was employed during the field season on the plotting of an experimental sheet of the Murree survey. An area of 8 acres was plotted on one sheet on a scale of 40 feet to an inch, and its uncorrected proof was supplied to the Secretary, Murree Municipality, early in March for his criticism and suggestions. This work was subsequently abandoned due to lack of funds.

## 'E' Survey Company.

*Officer Commanding*.—Captain D. E. O. Thackwell, R.E.

**23. General.**—The Company carried out surveys in Dādu, Hyderābād, Karāchi, Lārkāna, Nawābshāh, Sukkur, Thar Pārkar and Upper Sind Frontier districts of Sind, Khairpur State of the Punjab States Agency and Cutch State of Western India States. The field season opened on 23rd October 1939 and closed on 22nd April 1940.

The headquarters of the Company remained at Karāchi until September, when the unit was combined with 'A' Company, the combined unit being designated 'A & E' Company with headquarters at Murree.

**24. Personnel.**—The average strength during the year was 1 Class I officer, 2 Class II officers, 3 Upper Subordinate officers and 20 Lower Subordinates (excluding 3 clerks, 1 storekeeper clerk and

1 computer). Captain R. S. Kalha, I.A., temporarily joined the Company on 18th December 1939 and carried out triangulation in sheet 35 N/SE, on completion of which on 16th April 1940 he was transferred to No. 18 Party. Mr. N. D. Joshi (Class II) proceeded on 2 months and 4 days' leave from 3rd June 1940 on the expiry of which he joined Lahore Survey Detachment. Mr. Muhammad Akbar (U. S. S.) was transferred to 'A' Company on 21st May 1940.

### 25. Areas surveyed.—

- 926 square miles of triangulation.
- 13 linear miles of traversing.
- 2 square miles of rectangulation.
- 15 square miles of 1½-inch original survey.
- 621 square miles of 1-inch original survey.
- 20,756 square miles over which verification survey on ¼-inch scale was carried out.

*Area for inclusion in Table A.*

*New Survey.*—1-inch (and larger) scales:—636 square miles.

### 26. Field work was organized as follows:—

*Camp (1)* under Mr. C. M. Aslam (Class II) assisted by Mr. Sardar Khan (U. S. S.) completed 636 square miles of 1-inch and 1½-inch original survey in Dādu district in sheet 35 O. At the beginning of the season the camp consisted of 11 soldier surveyors under training, but during January 6 soldier surveyors were transferred to No. 18 Party for air survey training, and a modified programme was completed with the assistance of 3 surveyors from headquarters.

The country was varied and very suitable for training, as it comprised high and low barren hills, open and wooded plains, and a few intricate and broken areas. The climate was healthy, although water was scarce over most of the area.

*Camp (2)* under Mr. N. D. Joshi (Class II) with 3 surveyors completed 20,756 square miles of verification survey on the ¼-inch scale in Upper Sind Frontier, Sukkur, Lārkāna, Dādu, Nawābshāh, Hyderābād, Thar Pārkar, and Karāchi districts, Khairpur State of the Punjab States and Cutch State of Western India States in sheets 40 A, B, C, D and G. This programme was undertaken with the object of producing modern ¼-inch maps to replace the existing old style editions, and to incorporate the new canal system and its consequent developments. The survey was necessarily rapid and was not of the same standard as normal rigorous survey, but it is hoped that it will satisfy the demand for up to date maps until such time as the rigorous survey planned for this area can be completed.

*Triangulation.*—Captain R. S. Kalha, I.A., completed the triangulation of 926 square miles in Dādu district in sheet 35 N.

**27. Office work.**—During the field season, an average of 8 surveyors were employed in headquarters on fair drawing, maintenance, and miscellaneous work. The maintenance section under Mr. V. D. Chopra (U. S. S.) with two surveyors was chiefly engaged in the completion of the office copies and other maintenance records for Sind and Khairpur State, and later started on similar work for Baluchistān.

The fair drawing section during the field season was under the charge of Mr. N. D. Joshi (Class II) with the assistance of Mr. Muhammad Akbar (U. S. S.), and during recess was under Mr. C. M. Aslam (Class II) with the assistance of Mr. Sardar Khan (U. S. S.). During recess, the average strength was 10 surveyors.

During the year 6 sheets were completed and submitted for publication.

### No. 18 (Air Survey) Party.

*Officer in charge.*—Major D. R. Crone, R.E.

**28. General.**—Recess and field headquarters remained at Murree and Risālpur respectively, the latter opening on 21st October 1939 and closing on 15th April 1940.

**29. Personnel.**—The average strength of the party was 5 Class I, 6 Class II, 8 Upper Subordinate officers and 35 Lower Subordinates (excluding clerks and reproduction section personnel).

#### 30. Areas surveyed.—

1,500 square miles compiled (1-inch and 1/25,000 original survey).

236 square miles compiled (1-inch provisional survey).

*Areas for inclusion in Tables A and B.*

*New Survey.*—1-inch scale:—413 square miles.

*Revision survey.*—1-inch (and larger) scale:—1,087 square miles.

#### 31. Field work.—

2,269 square miles of vertical photography.

32 linear miles of oblique photography.

Nos. 5, 11, 20 and 27 Squadrons and No. 1 Wing, R. A. F. supplied vertical photography of 590 square miles in Kohāt, Dera Ismail Khān and Bannu districts, and 1,432 square miles in N. and S. Waziristān Agency and tribal territory

Vertical air photographs of 169 square miles in Dir, Swāt and Chitrāl Agency, 62 square miles in Khyber Agency, and 16 square miles in Peshāwar district were supplied by 27 Squadron, R. A. F., Risālpur.

Oblique photographs of 23 linear miles in Dir, Swāt and Chitrāl Agency and 9 linear miles in Waziristān were supplied by 27 Squadron R. A. F., Risālpur.

Captain R. C. A. Edge, R.E., calibrated one F/8 camera during the year.

**32. Compilation.**—Compilation was carried out in tribal territory under Capt. R. C. A. Edge, R.E., assisted by Messrs. K. L. Dhawan (Class II), J. C. Ross (Class II), N. C. Sen (U. S. S.) and O. P. Anand (U. S. S.).

Compilation in tribal territory and in sheets 35 P, 38 L and 43 A and B was carried out in the course of training under K. S. Muhammad Hasan (Class II) and Mr. E. R. Wilson (Class II) assisted by Messrs. N. C. Sen and Govind Prasad (both U. S. S.).

**33. Office work.**—An average of 5 draftsmen under Captain R. T. L. Rogers, R.E., assisted by Messrs. Bashirullah Khan and G. C.

Aggarwala (both U. S. S.) was employed on fair mapping and miscellaneous work during the year. 5 fair sheets and 10 name originals were prepared and submitted for publication.

A nucleus maintenance section was started under Captain R. T. L. Rogers, R.E., assisted by Mr. J. C. Berry (Class II).

**34. Training.**—During the year 6 Class I, 4 Class II and 7 Upper Subordinate officers and an average of 30 Lower Subordinates were under air survey training. 5 Class I officers received refresher courses in air survey.

**35. Reproduction Section.**—For details of the work of the reproduction section, see page 35.

### Lahore Survey Detachment.

*Officer in charge.*— { Mr. F. J. Grice, to 24-11-39.  
                                  { ,, D. C. Puri, from 25-11-39.

**36. General.**—The whole programme of the unit so far as the field work is concerned is expected to be completed by about the end of February 1941. The plotting and its check on the ground and completion of sections for publication will probably take from 6 to 8 months after field work is completed.

**37. Personnel and distribution of duties.**—The strength excluding the officer in charge, was 1 Class II, 5 Upper Subordinate officers and 41 Lower Subordinates including 3 clerks.

Mr. I. K. Ponnappa joined on 25th January 1940 to replace Mr. B. B. Kuttappa transferred to No. 18 Party.

Mr. M. R. Nair joined on 1st April 1940. Mr. G. S. Sidhu was transferred to No. 18 Party on 13th May 1940 on return from control training camp.

Messrs. M. R. Nair (Class II), I. K. Ponnappa (U. S. S.) and K. B. Muthanna (U. S. S.) were in charge of the field camps consisting of 16 Lower Subordinates.

Mr. Manawar Khan (U. S. S.) with 13 draftsmen and plotters dealt with the plotting, while Mr. Irshad Ahmad (U. S. S.) with 9 computers looked after the computations.

### **38. Field work.**—

*Control.*—80 stations of subsidiary triangulation were laid down, making a total of 69 main triangulation stations, 151 subsidiary stations (including *Downs*).

The *Down* stations were linked up by 260 linear miles of main traverse, making a total of 4,939 marks of main traverse and 418 linear miles and 9,879 stations of detail traversing.

Traverse work has been completed over an area of 12,900 acres during the year, making a total of 21,300 acres leaving a balance of 3,500 acres to be completed during the next year.

**39. Detail Survey (Offsetting).**—3,703 acres on the 40-foot scale and 6,648 acres on the 100-foot scale have been completed for survey during the year, leaving a balance of 400 acres and 5,400 acres on 40-foot and 100-foot scales respectively.

**40. Check measurements.**—After a sheet is completely plotted, a trace on tracing paper in pencil is sent out to the camp officer for a thorough check on the ground, by direct and cross measurements, which are recorded in ink on the trace. The drawing section with the help of all measurements recorded on the trace recheck all the plotting and ink up all detail that is considered to be completely checked. A final trace on tracing cloth in ink is then prepared with any detail that is still considered doubtful left in pencil, and passed on to the camp officer for a final scrutiny and correction where necessary.

**41. Boundaries and limits of holdings.**—The final traces on tracing cloth are then submitted to the Settlement Department, who enter on them the boundaries of individual holdings in red, from measurements that have been recorded on these traces. 263 traces have been supplied up to date out of which 11 have been received back. These boundaries are being transferred on to the original plot charts and on completion will be examined by a responsible officer of the Settlement Department and certified as having been correctly transferred.

**42. Plotting and inking up detail.**—Every effort has been made to complete the plotting *pari-passu* with detail survey, but due to increased speed and out-turn of offsetting in some of the open areas, plotting has not kept pace with offsetting and is therefore slightly in arrears.

**43. Area for square laying.**—3,000 acres of area was completely traversed and plot charts (*musavis*) on scale 1-inch to 40 *karams* supplied to the Settlement Department, who are making their own arrangements to carry out the square laying.

**44. Training.**—6 Class II probationers were posted to this detachment in the beginning of the year for training in city surveys. They completed their training by the end of March 1940 and were transferred to the orders of the Director, Geodetic Branch from 1st April.

Besides this all surveyors and traversers attached to the unit have been trained by turns in the method of survey by 'offsets'.



## V.—SURVEY REPORTS, GEODETIC BRANCH.

### No. 1 Party.

*Officer in charge.*—Major G. H. Osmaston, M.C., R.E.

**45. General.**—Owing to financial stringency the field programme was very much reduced, some topographical surveys were carried out however at the special request of H. Q. Eastern Command in the United Provinces and Central India in sheet 63 L.

The remainder of the field programme consisted in verification and vegetation survey in the United Provinces, Delhi and the Punjab in sheets 53 D, G, H, K, P and 63 K and L.

Revision of the 3-inch Delhi Guide Map was also taken up and the survey nearly completed.

The following special surveys were done on payment:—

- (a) Riverain Survey in Gurgaon district, at the request of the Punjab Government.
- (b) Demarcation of a small boundary dispute between Garrauli and Alipura Jagirs of Bundelkhand Agency, C. I.

Contributions were received during the year towards the cost of the topographical surveys in their territories from the States of Jodhpur (Mārwar), Gwalior, Jaora, Ratlām and Partābgarh.

A Maintenance section was opened in the party to deal with the upkeep of maps in the Geodetic Branch area, work which was formerly carried out in Calcutta.

A Drawing section remained at headquarters during the winter and was fully occupied on the drawing of the previous season's work and the modernisation of  $\frac{1}{4}$ -inch maps.

The party headquarters remained at Dehra Dūn throughout the year.

**46. Personnel.**—The strength of the party during the field season was 1 Class I, 2 Class II, 3 Upper Subordinate officers, 45 Lower Subordinates, including 4 pupils and 4 clerks.

#### **47. Areas surveyed.**—

- 540 square miles of 1-inch blue print survey.
- 5 square miles of  $\frac{3}{4}$ -inch original survey.
- 6,725 square miles of 1-inch verification and vegetation survey.
- 67 square miles of 3-inch blue print survey.
- 460 square miles of supplementary triangulation.
- 20 linear miles of supplementary traverse.

*Areas for inclusion in Tables A and B.*

*New survey.*—1-inch scale:—540 square miles,  
 $\frac{3}{4}$ -inch scale:—5 square miles.

*Revision survey.*—1-inch (and larger) scale:—67 square miles.

#### **48. Field work.**—

*Himālayas.*—During October a single surveyor carried out 5 square miles of  $\frac{3}{4}$ -inch original plane-table survey in Almora, to complete 62 B/SW.

*Camp (1)* under Mr. K. A. Sheikh (Class II) with H. Q. at Ballabgarh, 20 miles south of Delhi, was divided into two detachments, one carrying out verification and the other riverain surveys.

*Verification Detachment.*—3 surveyors completed vegetation survey and verification of changes in 11 one-inch sheets in 53 D, G, H and K in Pataudi State, Delhi Province and Gurgaon, Rohtak and Karnāl districts of the Punjab, and Meerut, Muzaffarnagar, Bijnor and Morādābād districts of the United Provinces. The surveyors worked on foot and picked up and corrected all obvious changes while surveying the vegetation; in this way the survey approximated closely to what was previously termed 'Correction' survey and covered the whole area.

This detachment completed work by 15th April.

*Delhi Revision Survey.*—It was decided during the field season that it was necessary, owing to extensive changes, to revise the 3-inch Guide Map of Delhi before the 1-inch map could be brought up to date by verification. The surveyors were withdrawn from this survey at the end of April leaving a small part to be completed next autumn.

*Riverain Detachment.*—This work was taken up at the request of the Punjab Government and consisted of providing a framework for the preparation of 16-inch settlement maps of 40 villages of Ballabgarh tahsil, of Gurgaon district, whose boundaries had been affected by changes in the course of the Jumna river. Three traversers, one computer and two draftsmen completed the work in about four months, by February 1940, in time for the local settlement personnel to continue with the large scale field maps.

*Camp (2)* under Mr. B. P. Rundev (U. S. S.) had its H. Q. at Izatnagar near Bareilly. Three surveyors completed vegetation survey and verification of changes in 12 one-inch sheets in 53 P in Rāmpur State and Bareilly, Budaun, Naini Tāl, Pilibhit and Shāhjahānpur districts of the United Provinces. The work was exactly similar to the verification survey done in *Camp (1)* except that in this *Camp* each surveyor and one of his khalasis were given bicycles, and the maps were more out of date. It was evident that in some types of country bicycles cannot be used, but that where communications are good they enable the surveyor to cover much more ground than on foot. The *Camp* completed its programme by the end of March.

*Camp (3)* under Mr. L. R. Howard (U. S. S.) with 2 surveyors at first, and later 3 more, completed 540 square miles of blue-print survey in Rewa State, Central India, and Mirzāpur district, United Provinces, in sheets 63 L/1 and 5. The sheets formed part of a military training area.

Framework was barely sufficient in 63 L/1, and supplementary triangulation was carried out by the camp officer in 63 L/5 before surveyors started work in that sheet. Additional triangulation and traverse work was also started in 63 L/9 for next season's work.

Verification and vegetation surveys were also completed for sheets 63 K/8, L/9 & 13, in Benares State, Allāhābād and Mirzāpur districts.

*Boundary demarcation.*—At the request of the Political Officer, Mr. M. A. Faruque (U. S. S.) carried out the demarcation of a disputed boundary between Garrauli and Alipura Jagirs of Bundelkhand Agency, Central India, during April.

**49. Recess duties.**—About half the personnel of the party did not take the field but remained at Dehra Dūn at party headquarters throughout the year, employed on drawing.

Besides the drawing of current surveys, the modernisation of certain ¼-inch sheets was taken up.

A Maintenance section was formed under Mr. M. A. Faruque to deal with the upkeep of all primary maps falling in the Geodetic Branch area.

### No. 20 (Cantonments) Detachment.

*Officer in Charge.*—Mr. Moquimuddin Ansari.

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

The field season commenced in the first week of September 1939 and closed on the 31st March 1940, field headquarters remaining at Dehra Dūn.

*Personnel.*—The field strength, excluding the officer in charge, was 2 U. S. officers and 33 Lower Subordinates, including 4 draftsmen, 4 computers and 3 clerks employed at field headquarters.

#### 51. Areas Surveyed.—

##### *64-inch survey.*

Dalhousie Cantonment New Bāzār	...	21·8 acres.
Jullundur Cantonment Bāzārs	...	25·0 „

##### *16-inch revision survey.*

Cherāt Cantonment	...	2,289 acres.
Dalhousie Cantonment	...	1,125 „
Bannu Cantonment	...	1,425 „
Fort Akālgarh (Dera Ismāil Khān)	...	834 „
Dera Ismāil Khān Cantonment	...	1,563 „
Jhelum Cantonment	...	4,011 „
Jullundur Cantonment	...	3,987 „
Kohāt Cantonment (Extension survey)	...	124 „

##### *64-inch revision survey.*

Cherāt Cantonment Sadr Bāzār	...	11·3 acres.
Dalhousie Cantonment Bāzār	...	23·0 „
Jhelum Cantonment Bāzārs	...	4·7 „
Jullundur Cantonment Bāzārs	...	109·2 „

The above areas include “overlap”.

#### 52. Field work was organized as follows:—

*Camp (1)* with headquarters at Jhelum Cantonment under Mr. Bakhshi Harnam Singh (U. S. S.) with 10 surveyors and 2 traversers completed the detail survey of Cherāt, Bannu, Fort Akālgarh, Dera Ismāil Khān and Jhelum Cantonments, and an extension of Kohāt Cantonment, and the advance traversing and levelling of Lahore Cantonment, and boundary traverse of Lorālāi Cantonment.

Boundary pillars Nos. 8, 9, 10 and 11 of Fort Akālgarh were re-sited according to the survey map of 1904-05 at the request of the local authorities.

*Camp (2)* with headquarters at Jullundur Cantonment under Mr. A. Francis (U. S. S.) with 8 surveyors and 2 traversers completed the detail survey of Dalhousie and Jullundur Cantonments, and the advance traversing and levelling of Kasauli, Subāthu, Dagshai Cantonments and Jhānsi Sadr Bāzār.

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

**53. Traversing and Levelling.**—4·8 linear miles of traversing were carried out for an extension of Kohāt Cantonment and 253·4 linear miles of traversing and 91·1 linear miles of levelling were completed for next season's survey in Lahore, Kasauli, Dagshai and Subāthu Cantonments and Jhānsi Sadr Bāzār. 7·6 linear miles of traversing were also carried out for Lorālāi Cantonment boundary.

**54. Recess duties.**—Fair mapping was carried out by two sections during the recess under Messrs. Bakhshi Harnam Singh (U. S. S.) and A. Francis (U. S. S.) respectively, the former also supervised the computation section.

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

28 sheets on the 16-inch scale and 11 sheets on the 64-inch scale of \*Kohāt, Cherāt, Fort Akālgarh, Jullundur, Jhelum, Dalhousie, \*Siālkot and \*Drigh Road Cantonments and Bāzārs were completed and sent for publication while 28 sheets on the 16-inch scale and 2 sheets on the 64-inch scale of Bannu, Cherāt, Dalhousie, Dera Ismāil Khān, Jhelum and Jullundur Cantonments comprising the current season's mapping were partially completed.

The computation of traversing and levelling carried out during the field season was also completed during recess.

---

\* Arrears mapping.

## VI.—SURVEY REPORTS, EASTERN CIRCLE.

**DIRECTOR.**— { Lieut.-Colonel T. M. M. Penney, to 12-10-39.  
Colonel L. H. Jackson, I.A., from 13-10-39.

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

Owing to financial restrictions, the field programme of No. 5 Party was postponed and that of Nos. 4 and 12 parties much curtailed.

### No. 4 Party.

*Officer in charge.*— { Mr. A. J. A. Drake, D.C.M., to 13-10-39 and from 4-5-40.  
,, F. W. Smith, from 14-10-39 to 6-4-40.  
,, W. H. Strong, M.B.E., from 7-4-40 to 3-5-40.

**56. General.**—Due to financial restrictions the party did not take the field for normal topographical surveys.

It however carried out triangulation, traversing and original survey on the 5-inch scale for the new edition of the Shillong Guide Map, original survey on the 1-inch scale in the Shāhābād district of Bihār at the request of the Geological Survey Department, colour-print survey on the  $\frac{1}{4}$ -inch scale in the Bālipāra Frontier Tract of Assam, verification on the 1-inch scale of the Inner line in sheet 83 E/16 & E/12 and in addition the following special surveys on payment:—

- (a) Original survey on the 5-inch scale of a danger zone at the Happy Valley Cantonment, Shillong, for the Defence Department.
- (b) Triangulation, traversing and original survey on the 16-inch scale of the Happy Valley Cantonment, Shillong, in the Khāsi and Jaintia Hills of Assam for the Defence Department.

The party headquarters remained at Shillong throughout the year.

**57. Personnel.**—The average strength of the party was 1 Class I, 3 Class II, 4 U. S. S. officers and 24 Lower Subordinates.

### 58. Areas surveyed.—

- 2 square miles of 16-inch original survey.
- 24 square miles of 5-inch original survey.
- 45 square miles of 1-inch original survey.
- 782 square miles of  $\frac{1}{4}$ -inch colour-print survey (Exploratory).
- Verification of a portion of the Inner line, Bālipāra Frontier Tract.
- 74 square miles of triangulation.
- 56 linear miles of traverse.
- 44 linear miles of tertiary levelling.

*Areas for inclusion in Tables A and B.*

*New Survey.*—1-inch scale:—45 square miles.

*Revision Survey.*—1-inch (and larger) scales:—26 square miles.

**59. Field work** was organised as follows:—

*Rohtāgarh Survey.*—Mr. Hari Singh (U. S. S.) and surveyor K. S. Loverwell completed 45 square miles of 1-inch original survey of Rohtāgarh and environments in the Shāhābād district, Bihār, in sheet 63 P, at the request of the Geological Survey Department.

*Dafla and Mīri Hills.*—Surveyor K. S. Loverwell accompanied the Political Officer, Bālipāra Frontier Tract, on his tour of the area and carried out exploratory survey of 782 square miles on  $\frac{1}{4}$ -inch scale in sheets 83 A, B, E and F. Copies of the published sheets were utilised for planetabing and he also verified the changes of the Inner line on 1-inch sheets 83 E/16 & E/12 in the Bālipāra Frontier Tract, Assam.

*Shillong Guide Map.*—Mr. P. K. Chowdhury (U. S. S.) with 2 Class II, 2 U. S. S. officers and one surveyor completed 23 square miles of original survey on the 5-inch scale in sheet 78 O for the new edition of the Shillong Guide Map.

*Happy Valley Cantonment Danger Zone.*—Mr. P. K. Chowdhury (U. S. S.) and one surveyor completed 1 square mile of 5-inch original survey in sheet 78 O for the danger zone area at Happy Valley Cantonment, Shillong.

*Happy Valley Cantonment Survey.*—Mr. P. K. Chowdhury with 2 U. S. S. officers and 2 surveyors completed 1,534 acres of original survey on the 16-inch scale required by the Defence Department. The built up area was contoured at 5 feet vertical intervals and the remainder at 10 feet intervals.

*Triangulation, Traversing and Levelling.*—The following frame work was executed for the detail surveys:—

- (a) 45 square miles of triangulation for 1-inch original survey at Rohtāgarh.
- (b) 27 square miles of triangulation for the 5-inch Shillong Guide Map.
- (c) 2 square miles of triangulation for the 16-inch original survey of Happy Valley Cantonment.
- (d) 16 linear miles of traverse for the 5-inch Shillong Guide Map.
- (e) 40 linear miles of traverse for the 16-inch original survey of Happy Valley Cantonment.
- (f) 44 linear miles of tertiary levelling for the 16-inch original survey of Happy Valley Cantonment.

**60. Description of country.**—

*Rohtāgarh Survey.*—The country consists of low flat hills covered with fairly dense mixed forest.

*Dafla and Mīri Hills.*—The area consists of high hills covered with dense mixed forest. It is sparsely populated and communications are not good.

*Shillong Guide Map and Happy Valley Cantonment Survey.*—Pine clad hills ranging from 4,000 to 6,000 feet in height with built up areas on flat topped knolls and spurs.

**61. Recess duties.**—Mr. J. C. Berry (Class II) up to 1-3-40 and Mr. Mohammad Alauddin (Class II) from 2-3-40 assisted by Mr. A. G. Qureshi (U. S. S.) supervised the fair drawing of 1 compiled  $\frac{1}{4}$ -inch

sheet, 1 compiled  $\frac{1}{4}$ -inch sheet and redrawing of 9 quarter-inch sheets by the method of insertion originals and deletion guides.

### No. 5 Party.

*Officer in charge.*—  
 { Mr. F. W. Smith, to 13-10-39.  
 Lt.-Colonel T. M. M. Penney, from 14-10-39 to 31-3-40.  
 Colonel L. H. Jackson, I.A., from 1-4-40 to 15-4-40.  
 Mr. W. H. Strong, M.B.E., from 16-4-40 to 3-5-40.  
 ,, A. J. A. Drake, D.C.M., from 4-5-40.

**62. General.**—Due to financial restrictions the party did not take the field.

**63. Recess duties.**—The fair mapping of the Air Survey of Jamshedpur on the scale of 4-inches to 1 mile was carried out under Mr. B. N. Saha (Class II).

The redrawing of six  $\frac{1}{4}$ -inch sheets was carried out in two drawing sections under Messrs. N. L. Gupta and L. J. Bagnall (both Class II) and the general supervision of Mr. B. N. Saha (Class II).

### No. 12 Party.

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

**64. General.**—The survey on the  $\frac{3}{4}$ -inch scale of part of Sikkim State in sheets 77 D and 78 A begun in August 1939, was completed in May 1940.

Verification surveys on the 1-inch scale in connection with survey maintenance work and reissue of sheets were carried out in sheet 83 B.

Except for the few officers and surveyors who were engaged on survey in Sikkim State, the party had no field season. This was due to financial stringency.

**65. Personnel.**—The strength of the party was 1 Class I, 2 Class II, 4 Upper Subordinate officers and an average of 24 Lower Subordinates.

**66. Areas surveyed.**—

2,142 square miles of  $\frac{3}{4}$ -inch original survey.

91 items of detail of verification survey.

*Areas for inclusion in Table B.*

*Revision survey.*— $\frac{3}{4}$ -inch scale:—2,392 square miles.

**67. Field work.**—

*Sikkim survey.*—Mr. A. Abad (Class II), Mr. J. N. Kohli (U. S. S.) and Mr. Hari Singh (U. S. S.), the last for 3 months only, and 8 surveyors carried out the survey of 2,142 square miles of original survey in Sikkim State on the  $\frac{3}{4}$ -inch scale in sheets 77 D and 78 A. This completes the 2,392 square miles of survey of this state started in August 1939.

Considerable difficulties and delays usually attendant on all high mountain surveys were experienced, the principal cause of delay being the extremely poor and uncertain weather and severe cold of the eastern Himalayas.

The survey was started in August 1939 in the extreme north of Sikkim, out of range of the worst of the monsoon weather. During

the next four months as the weather improved the survey was carried southwards, until by December most of the high peaks and glacier areas in north Sikkim had been surveyed.

By the end of December the cold and snow were too severe to allow further progress in high altitudes, and the camp therefore moved to the lower areas in order to complete the survey southwards to the limit of previous 1-inch survey along Latitude  $27^{\circ} 15'$ .

With the return of the warmer weather in the Spring of 1940, the few small areas remaining in north Sikkim were completed. The camp finally returned to recess at the end of May.

The officer in charge did a tour of inspection in north Sikkim in November, and the Director accompanied by the officer in charge did a second inspection in February in the lower areas of south Sikkim.

The camp closed on 6th June 1940.

*Transport.*—Permanent coolie transport was employed and was arranged locally as required through the Political Officer by the Sikkim Darbar. The terms of employment for this transport had been settled during the triangulation last year at a conference kindly arranged at Gangtok by the Political Officer.

The transport on the whole proved satisfactory, especially in the Bhutia areas of high altitude of north Sikkim. When the survey work moved to the lower areas, it was necessary to change over from Bhutia to Lepcha coolies, and here considerable transport difficulties and delays arose due to the poor physique and unreliability of the Lepchas.

**68. Description of country.**—Sikkim State is bounded on the east and west by high prominent ranges, forming distinct natural boundaries, and on the north by a line of hills rising above the 17,000 foot Tibetan plateau. The whole area is drained southwards by the Tista River and its confluent.

The areas of high altitude in Sikkim lie mostly to the north of a line drawn from the mountain Kabru on the western boundary, to Black Rock on the eastern boundary. North of this line the average altitude is about 16,000 feet, and contains some of the highest and best known peaks of the Himālayas, such as, Kānchenjunga 28,168, Pauhunri 23,385, Jongsong Peak 24,472, Kabru 24,078 and Siniolchu 22,595. Dense juniper and rhododendron forests cover the lower valleys, while above 14,000 feet nothing but low grass and rock exists, with permanent ice and snow above 18,000 feet.

To the south of this line the mountains average about 10,000 feet in height, while the valleys drop as low as 1,600 feet. Much of this area lying below 7,000 feet is under cultivation, while the rest is covered in dense tropical forest infested with leeches.

**69. Miscellaneous.**—Considering the abnormal length of the field season, the severe conditions of cold weather and height and the strenuous nature of the work, the health of the camp remained surprisingly good. There were, however, a few cases of minor frost-bite and debility, but a short rest and treatment at lower altitudes usually cured these illnesses.



Two surveyors suffering from severe debility and fever were invalidated from the area.

**70. Recess duties.**—The four  $\frac{1}{2}$ -inch sheets surveyed during the field season were fair-mapped under the supervision of Mr. A. Ahad, assisted by Mr. H. H. Phillips (both Class II).

Messrs. J. R. Chibbar and S. B. P. Mathur (both U. S. S.) had charge of drawing sections during the year, while Mr. Hari Singh (U. S. S.) had charge of the maintenance section.

In addition to the Sikkim sheets, two  $\frac{1}{4}$ -inch, one  $\frac{1}{2}$ -inch and one 1-inch sheets were fair drawn during the year, while the process of getting  $\frac{1}{4}$ -inch sheets on to separate originals was completed for 10 sheets.

---

## VII.—SURVEY REPORTS, INDEPENDENT PARTIES.

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

### No. 6 (South India) Party.

*Officer in charge.*—Major I. H. R. Wilson, R.E.

**72. General.**—The party completed its programme of 1-inch topographical surveys in Bombay, Kolhāpur State and the Deccan States, and triangulation in Bombay and the Deccan States for the control of next season's 1-inch survey. Field work commenced in the beginning of October 1939. All field personnel engaged on these surveys had returned to recess in Bangalore by the end of March 1940. In addition to the above, revision survey was carried out by 5 surveyors in the Coimbatore and Nilgiri districts of Madras Presidency and in Mysore State, and verification survey was carried out round Bhatgar Lake area in Bhor State, Deccan States. Work commenced towards the end of October 1939 and continued till the end of July 1940. Two more surveyors had to be sent in May to complete the work in Coimbatore and Nilgiri districts. Owing to the excessive amount of corrections found on the sheets in the Mysore State area, it was found impossible to complete the original programme and 3 sheets had to be cut out. The party was administered throughout the season from Bangalore. The officer in charge made tours of inspection in December 1939, January, February, March, and April 1940.

**73. Personnel.**—1 Class I, 4 Class II and 6 U. S. S. officers, 49 surveyors, 5 draftsmen and 5 clerks. 1 Class II officer was transferred to Frontier Circle on 18th January 1940, and on 1st April one U. S. S. officer joined. 2 Class II and 3 U. S. S. officers and 42 surveyors were employed in the field, and on mapping on their return to recess. The remainder were employed on mapping and miscellaneous drawing throughout the year.

### **74. Areas surveyed.**—

- 291 square miles of 2-inch blue-print survey (revision).
- 2,322 square miles of 1-inch blue-print survey (revision).
- 34 square miles of 1-inch verification survey.
- 6,833 square miles of 1-inch blue-print survey (new).
- 4,533 square miles of triangulation.

*Areas for inclusion in Tables A and B.*

*New Survey.*—1-inch scale:—6,833 square miles.

*Revision Survey.*—1-inch (and larger) scales:—2,613 square miles.

### **75. Field work** was organized as follows:—

*Camp (1).*—Mr. B. N. Murthy (Class II) and 12 surveyors carried out the 1-inch blue-print survey (new) of 2,278 square miles of Belgaum and Sātāra districts of Bombay, of Kolhāpur State and of the Deccan States in sheet 47 L.

*Camp (2).*—Mr. M. A. Azim (U. S. S.) and 12 surveyors carried out the 1-inch blue-print survey (new) of 2,283 square miles of Belgaum district of Bombay, of Kolhāpur State and of the Deccan States in sheet 47 L.

*Camp (3).*—Mr. P. A. Thomas (Class II) and 12 surveyors carried out the 1-inch blue-print survey (new) of 2,272 square miles of Bijāpur and Sholāpur districts of Bombay, and of the Deccan States in sheet 47 O.

*Blue-print (revision) survey* was started by 5 surveyors under the orders of the officer in charge, Drawing Section, later 2 more surveyors were sent out to reinforce the men employed.

*Verification survey* of Bhatgar Lake falling in sheets 47 F/12 and 16 was carried out by one surveyor under the orders of the officer in charge, Camp (1).

*Triangulation.* Mr. M. L. Kohli (U. S. S.) triangulated an area of 1,133 square miles of Poona and Sholāpur districts of Bombay and of the Deccan States in sheet 47 O.

Mr. A. Shamanna (U. S. S.) triangulated an area of 3,400 square miles of Poona, Sātāra and Sholāpur districts of Bombay and of the Deccan States in sheet 47 K.

**76. Description of country.**—The country covered by 1-inch new survey is open undulating plains, partly black cotton soil under cultivation, and partly barren and sterile country with a lot of stone and rock outcrops. The western part of sheet 47 L is hilly with a certain amount of jungle. The area presented no serious difficulties, technical or otherwise. The Bhīma, Ghātprabha, Kistna, Mān and Vārna Rivers pass through the area. The roads from (i) Bangalore to Bombay, (ii) Bijāpur to Sholāpur, (iii) Bijāpur to Ratnāgiri *via* Kolhāpur and (iv) Miraj to Pandharpur pass through the area. A dam constructed across the Ghātprabha River about 5½ miles N. W. of Gokāk offers facilities for canal irrigation over a small area in 47 L/16, otherwise irrigation is mostly from wells. The hills and ridges tend to be flat topped with terraced scarps.

**77. Recess duties.**—Three primary mapping sections under Messrs. B. N. Murthy (Class II), P. A. Thomas (Class II) and M. A. Azim (U. S. S.) carried out the fair mapping of the 24 one-inch sheets they had been responsible for surveying in the field season. Mr. N. S. Harihara Iyer (Class II) remained in charge of the Drawing Section.

## Burma Survey Party.

*Officer in charge.*—Major H. W. Wright, R.E.

**78. General.**—The party continued its topographical survey programme and drawing office map maintenance duties: for the first time in Burma extensive maintenance operations were carried out in the field as an inception of the policy of providing up to date maps at more frequent intervals.

The Burmanisation of the party continued and one Class II Burman probationer and one Upper Subordinate Burman probationer were sent to Dehra Dūn, India, under the Director, Geodetic Branch: the training of 6 Burman pupils for the Lower Subordinate establishment was begun in Maymyo.

The Government of Burma did not modify the peace time programme on the outbreak of war, but by August 1940 the organisation and scope of the party work was radically modified.

### 79. Personnel.—

#### At headquarters, Maymyo.—

*Office of the Officer in charge*:—1 Class I officer and 5 clerks.

*Drawing Section*:—2 Class II officers, 2 U. S. S. officers, 5 surveyors (including 1 pupil), 18 draftsmen, 2 computers and 1 clerk.

#### In the Field.

*Primary programme*:—Framework and Detail surveys: 1 Class II Officer, 1 U. S. S. officer, 15 surveyors and 2 computers.

*Maintenance programme*:—Framework and Detail surveys: 1 Class II officer, 1 U. S. S. officer, 17 surveyors and 1 U. S. S. officer under training.

Verification surveys: 3 surveyors.

Triangulation connection series: 1 U. S. S. officer.

### 80. Field outturn.—

120 linear miles of triangulation for connection series.

#### *Primary programme.*—

##### *Framework.*

651 square miles of triangulation.

369 linear miles of theodolite traverse.

##### *Detail surveys.*

151 square miles of 1-inch original survey.

164 square miles of 1½-inch original survey for publication on 1-inch scale, including 3.0 square miles for publication also as reserved forest map.

132 square miles of 1-inch blue-print survey.

967 square miles of 1½-inch colour-print survey for publication on 1-inch scale.

#### *Maintenance programme.*—

##### *Framework.*

166 linear miles of theodolite traverse.

##### *Detail survey.*

1,296 square miles of 1-inch blue-print survey.

1,146 square miles of 1½-inch blue-print survey for publication on 1-inch scale, including 16 square miles for publication also on 2-inch scale as reserved forest maps.

2,157 linear miles of verification surveys of motor roads not previously departmentally surveyed.

28 linear miles of verification survey of the Irrawaddy and Sittang Rivers where the channels have changed.

*Areas for inclusion in Tables A and B.*

*New survey.*—1-inch (and larger) scales:—1,247 square miles.

*Revision survey.*—1-inch (and larger) scales:—2,609 square miles.

**81. Field work.**—

Mr. C. T. Hurley (Class II) and Mr. A. K. Talapatra (U. S. S.) were in charge of detail survey and framework camps totalling 15 surveyors and 2 computers. Five 1-inch sheet areas of the primary programme were completed comprising 151 square miles of 1-inch original surveys, 164 square miles of 1½-inch original surveys, 132 square miles of 1-inch blue-print surveys and 967 square miles of 1½-inch colour-print surveys in sheets 85 O, 94 B and 94 C in Henzada, Pegu, Tharrawaddy and Toungoo districts.

The framework completed consisted of 369·4 linear miles of theodolite traverse and 651 square miles of triangulation in sheets 85 M, N and 93 B in Prome, Tharrawaddy and Thayetmyo districts and Northern Shan States.

Mr. C. T. Hurley's camp also completed two 1-inch sheet areas of maintenance surveys comprising 566 square miles of 1-inch blue-print surveys in sheet 94 C in Pegu district.

Mr. H. M. Critchell (Class II) and U. On Ba, A.T.M. (U. S. S.) were in charge of maintenance detail survey camps totalling 17 surveyors and one U. S. S. officer under training. Surveys were carried out within nine 1-inch sheet areas comprising 1,146 square miles of 1½-inch blue-print surveys, 730 square miles of 1-inch blue-print surveys in sheets 94 B and 94 C in Pegu, Thaton and Toungoo districts.

2 surveyors, both from Mr. A. K. Talapatra's camp, observed 165·9 linear miles of theodolite traverse for these blue-print surveys.

4 surveyors verified 2,157 linear miles of motor roads and 28 linear miles of changes in the courses of the Irrawaddy and Sittang Rivers in sheets 84 K, L, O, P, 85 O, 92 G, H, L, 93 B, C, E, F, I, K, O, P, 94 A, B, C, E, F, H, L, 95 E, I, J, K, L, 102 C, D, in Amherst, Bhamo, Henzada, Insein, Magwe, Mandalay, Ma-ubin, Mergui, Minbu, Myingyan, Myitkyina, Pegu, Sagaing, Tavoy, Tharrawaddy, Thaton districts, Northern and Southern Shan States and Karenni.

The personnel conducting the primary and maintenance field programmes entered, on the ground, on the scale of the existing Reserved Forest maps much new information for the Forest Department: they carried out 1½-inch scale special surveys, in 18·5 square miles of their programmes as described, to provide Reserved Forest maps of parts of Chaungmange, Mekwa, Metindein and Wunpein in Pegu and Toungoo districts.

Surveyors used reductions, prepared at Maymyo, of large scale Reserved Forest maps to assist out-turn of topographical surveys.

Incomplete surveys by late No. 11 Party, Survey of India, of the period of the 1930-31 Burma Rebellion were accepted as mapping material after revision and completion on the ground.

In four 1-inch sheet areas in 94 C in Pegu, Thaton and Toungoo districts information, surveyed on the ground and supplemented by the Deputy Commissioner's office records, was collected for the co-ordination

of *kwin* and village boundary information with the topographical detail of the maps concerned.

In Mr. C. T. Hurley's camp a large proportion of the heights in the low forested hills area were obtained from aneroid barometer readings connected to a control of theodolite and clinometer heights assisted by concurrent barometer observations at a local base.

Mr. A. K. Talapatra supervised the fixing on the ground by theodolite traverse of 11 points identified on vertical air photographs on the 1½-inch scale approximately over an area of 90 square miles of heavily timbered low hills for compilation and assistance in forthcoming surveys of reserved and unclassed forest in sheet 85 N.

Mr. S. K. Guha, (U. S. S.) observed a triangulation connection series from the Manipur meridional series for 120 miles across to the Mandalay meridional series in sheets 84 K, L, O and P in Magwe, Meiktila, Minbu, Myingyan, Pakokku and Yamethin districts.

Mr. V. W. H. Raphael (U. S. S.) triangulated 370 square miles in sheet 93 B in the Northern Shan States.

**82. Description of country.**—The country of the topographical primary programme consisted of low forested hills, flat rice fields and small towns: the maintenance programme fell into two main categories, that of the Irrawaddy and Sittang riverain and the routes of motor roads not previously surveyed departmentally, lying mostly along the Tenasserim coast, in the Shan Plateau and trans-Salween hills.

**83. Work at headquarters.**—The field section completed the fair mapping of 11 sheets for publication on scale 1 inch to 1 mile.

The Drawing Section under Mr. A. F. Murphy (Class II) assisted by Mr. F. M. Hawley (Class II) and Messrs. H. K. Kar and Muhammad Mustafa (both U. S. S.) carried out compiled geographical and degree sheet mapping, re-issues of geographical, topographical and Forest Department sheets and the preparation of colour patterns and grid originals.

32 sets of maps covering Burma were reviewed and issued to the local authorities for the entry by them of topographical changes and return for record in the Burma Survey Party.

Map Records and business: the stock and sale of Burma maps continued to be the divided responsibility of the Curator, Government Book Depot, Rangoon, and the Officer in charge, Burma Survey Party, Maymyo.

## VIII.—MISCELLANEOUS SURVEY REPORTS.

### Training School, Dehra Dūn.

*Officer in charge.*— { Mr. B. T. Wyatt, v.D. to 4-10-39.  
 ,, N. N. Chuckerbutty from 5-10-39.

**84.** Two officers of the Corps of Indian Engineers, Lieuts. Anant Singh, and A. D. Verma joined the Class I Service and spent 7 and 8 months respectively in the Training School.

**85.** Four Upper Subordinate Service probationers were appointed in November 1939, of whom three completed the usual course of instruction; the fourth had to proceed on leave on medical certificate from March 1940.

Two Burman officers, U. Ba Han, Probationary Asstt. Supdt. of Land Records and Mr. Edgar Thwin, Probationary Inspector of Land Records, who joined the Training School during December 1939 underwent the same course of instruction as the U. S. S. probationers. They were transferred to the Burma Survey Party in November 1940 for further training.

A Bhutanese pupil surveyor joined in December 1939, and will be under further training during the field season 1940-41.

---

## PART 4.—MAP PUBLICATION AND MATHEMATICAL INSTRUMENT OFFICE.

From 1st April 1939 to 31st March 1940.

### IX.—MAP PUBLICATIONS.

**86. Map Policy.**—A fair amount of progress has been made in technical research in connection with the new reissue policy and it appears at present that the best non-distorting material for drawing is a treated aluminium surface.

In addition, various procedures have been devised for systematising the collection of ground information and speeding up the reproduction of it in the form of map corrections.

Both of these have been considerably interfered with by the outbreak of the war which has necessitated the diversion of many departmental activities to war purposes, and for practical purposes all research and changes of procedure are now in abeyance.

**87. The Photo.-Litho. Office, Calcutta.**—Normal average out-turn has been maintained.

*The 1:1,000,000 International Map.*—A new technique has been developed for the reproduction of the three different editions of this series. The final printing plate of any one colour for one of the editions may have to be made by combining portions from several of the fair drawings. This is done by printing photographically in turn the required portions of the fair drawings on to a white enamelled metal plate thus forming a subsidiary original. From these subsidiary originals the final printing plates are made in the normal manner.

*Photographic combination.*—A photographic process has been adapted to the rapid production of composite maps from the separate colour negatives of component sheets. Hitherto the difficulty has been to produce colour negatives and subsequently colour plates for such composite maps in exact register, without recourse to the preparation of a composite print original of the whole matter, rephotography of the whole, and the production of colour plates by the normal photo.-lithographic processes. When the separate colour negatives of the component sheets are available, the new process shortens the time taken to produce the composite map and gives better printed results than previously it has been possible to obtain. In the new method, a translucent blue negative image of the whole map is first built up photographically on glass, using the complete outline (and contour) negatives of component sheets. By the same contact process used in making this negative, several blue copies are made. Each of these is re-sensitised and on each, again by the same process, a black negative is built up of the detail to be printed in one particular colour. This detail is printed down from the component colour negatives, one at a time, each negative being registered with the appropriate colour detail on its composite blue negative. From the completed composite negative, printing plates are made in the usual way.



*Photo.-lettering.*—Experiments continue with the latest Mark IV camera reported in the 1939 Report as under construction in the Mathematical Instrument Office. A complete series of suitable alphabets has now been completed by the Engraving Office. Present experiments are being directed towards the production of a positive photographic image on photographic film strips of the name composed in the camera and positioned in its correct relative position by means of a swivelling lid on a light-tight box. On one side of the lid is the positioning guide and on the other the film. To avoid having mains voltage on the light switch which is incorporated in the swivelling lid, a relay operating on small dry cells has been designed for the operation of the light switch. Satisfactory vandyke name printing plates have been built up by successive contact exposures with the positive film strips.

The following presses were in use in the Photo.-Litho. Office:—

*Lithographic Printing Machines.*

Two Mann "Standard" Single Colour Double Demy Rotary Offset machines with "chain delivery".

Two Mann "Standard" Single Colour Double Demy Rotary Offset machines with "shooting delivery".

One Ratcliffe Quad Demy Flatbed machine.

Two Mann Quad Crown Flatbed machines.

Two Furnival Double Demy Flatbed machines.

Two Mann Double Demy Flatbed machines.

One Ratcliffe Double Demy Flatbed machine.

*Lithographic Proving Presses.*

One Mann Quad Crown Offset Proving and Duplicating Press (Power driven).

Two Mann Double Demy Offset Proving and Duplicating Presses (Power driven).

One Hoe Quad Demy Proving Press.

One Greig & Sons Quad Demy Proving Press.

Two Hoe Double Imperial Proving Presses.

One Furnival Double Imperial Proving Press (Power driven).

Four Hoe Double Elephant Proving Presses.

Three Furnival Double Elephant Proving Presses (Power driven).

Two Greig & Sons Imperial Proving Presses.

Three Furnival Imperial Proving Presses (one Power driven).

One Ratcliffe Imperial Proving Press.

*Letterpress Printing Machines.*

One Payne and Dawson Double Royal Wharfedale machine.

One Linotype & Machinery Double Crown "Centurette" machine.

One Dawson & Sons Double Demy Wharfedale machine.

One Payne & Otley Demy Wharfedale machine.

One Rockstorch & Scheinder Foolscap "Victoria" Platen.

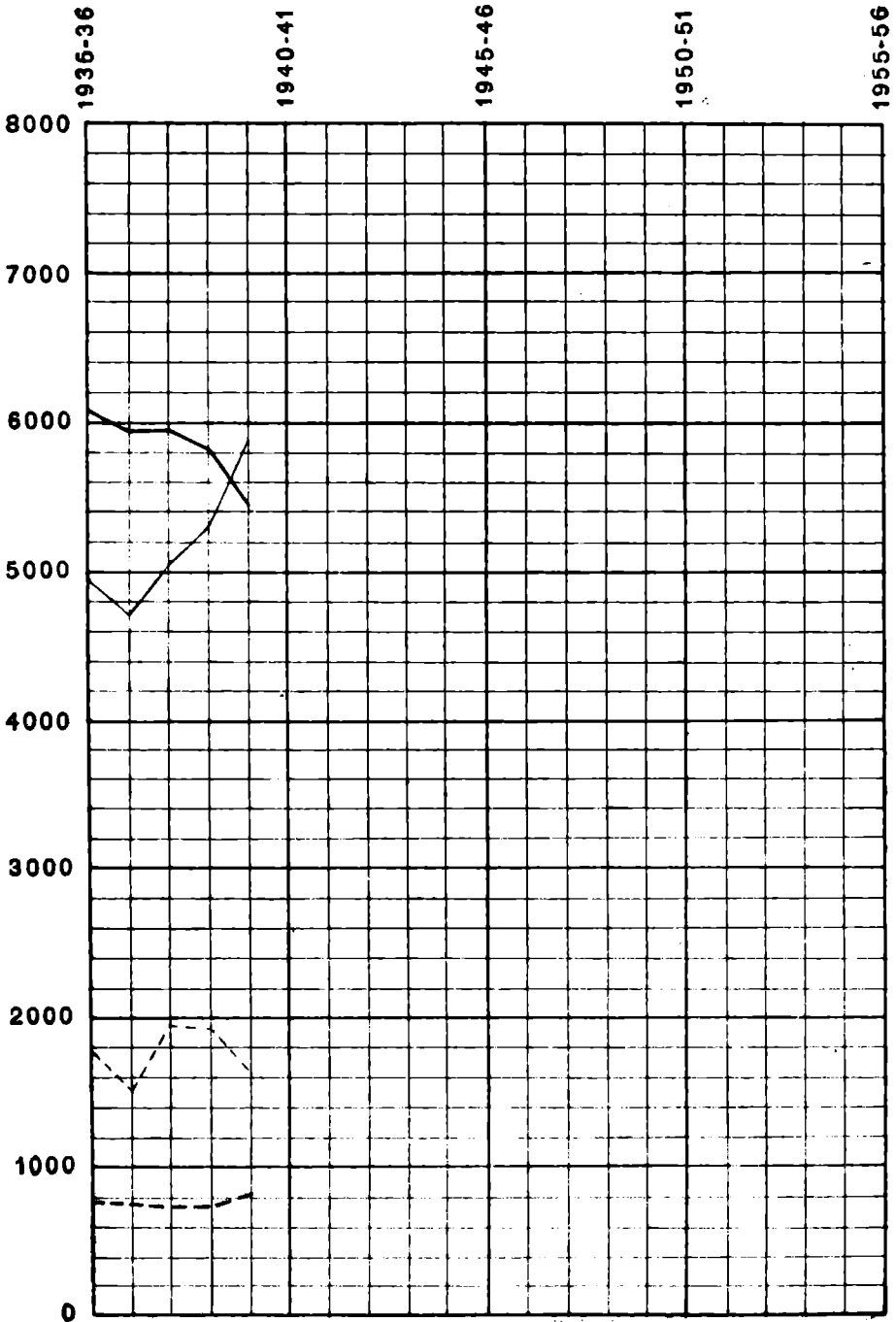
One Walter Bros. Foolscap "Lauerte" Platen.

One Chandler & Price Foolscap Platen.

One Furnival & Co. Crown Folio Platen.

One Ruling machine.

# OUT-TURN OF THE PHOTO-LITHO OFFICE



Negatives prepared. . . . .  
Zinc plates prepared. . . . .  
Departmental maps printed (including Burma) - - - - -  
Extra-departmental maps printed. . . . .

**88. Photo.-Zinco. Section, Dehra Dūn.**—There have been no alterations to or changes in main plant and equipment during the year.

The "Ditto" duplicating machine (mentioned in last year's report) has not proved an unqualified success in its application to the work of this Section, and has been transferred to the Frontier Circle for further trial.

The following presses were in use in the Photo.-Zinco. Office:—

- One Double Demy Rotary Offset Machine Press.
- One Quad Demy Flatbed Machine Press.
- One Imperial Flatbed Machine Press.
- One Double Demy Duplicating and Proving Press.
- Three Double Imperial Hand Presses.
- One Double Royal Hand Press.
- One Double Elephant Hand Press.

**89. No. 18 (Air Survey) Party, Murree and Risālpur.**—During the year the Reproduction Section was re-equipped to enable it to carry out wet plate photography and rotary offset machine press printing.

The Double Demy Rotary Offset machine, its Duplicating and Proving Press and the Paper Cutting machine previously installed in "E" Company, Quetta were received and installed in the Risālpur offices.

The room camera, referred to in this report for the year 1937-38, was completed by the installation of 52-inch and 25-inch focal length lenses and the plate carrier and plan board received from "E" Company.

The plan board was later replaced by a vacuum copy holder on the same carriage.

The following presses were in use in No. 18 Party:—

- One Double Demy Rotary Offset Machine Press.
- One Double Demy Offset Duplicating and Proving Press with hand and electric drive (the latter not yet fitted).
- Two D. E. Hand Presses.
- Three D. E. Hand Presses (used in exercise only).
- One Flatbed Furnival Press for motor drive 41 inches × 29 inches (Motor not yet fitted).
- One Furnival Portable handpress 23 inches × 21 inches.
- Two Furnival portable hand presses 23 inches × 21 inches (used in exercise only).

Reproduction of originals received:—

In one colour	...	...	...	485
In two colours	...	...	...	57
In three "	...	...	...	10
In four "	...	...	...	7
Vandyke and helio plates prepared	...	...	...	314
Prints pulled	...	...	...	24,441

**90. "E" Survey Company, Karachi.**—The remaining plant with this Company was transferred to No. 18 (Air Survey) Party, early in the year and no reproduction was carried out by the Company.

Table I(a)—Maps published at Calcutta, during the year 1939-40.

Class of maps.	Scale.	New publica- tions.	Revised editions, new edi- tions and reprints.	Number of copies printed.	Value. Rs.
<i>Departmental.</i>					
<b>GENERAL MAPS.</b>					
Maps of India ... ..	Various	1	6	16,631	20,612
<b>GEOGRAPHICAL MAPS.</b>					
Southern Asia Series ... ..	1:2 million	...	1	210	420
India and Adjacent Countries Series ... ..	1:1 million	...	38	11,760	17,638
Carte Internationale du Monde ... ..	"	1	6	1,531	3,092
<b>TOPOGRAPHICAL MAPS.</b>					
Quarter-inch, Modern ... ..	1" = 4 miles	15	53	33,103	43,524
" (Prely.) ... ..	"	...	1	106	159
" (Provl.) ... ..	"	...	12	3,644	3,471
Half-inch, Modern ... ..	1" = 2 miles	21	6	13,346	18,247
One-inch, Modern ... ..	1" = 1 mile	37	125	101,480	1,45,160
" (Prely.) ... ..	"	1	1	1,170	1,858
" (Provl.) ... ..	"	...	2	2,576	2,588
Old style maps ... ..	Various	...	8	1,488	2,232
<b>SPECIAL MAPS.</b>					
Provincial maps ... ..	Various	2	11	4,705	12,107
City & Town Guide maps ... ..	"	...	1	330	660
Index maps ... ..	"	2	100	48,647	5,320
Miscellaneous maps ... ..	"	30	57	33,211	7,926
<b>Total</b> ... ..	.....	<b>110</b>	<b>428</b>	<b>273,938</b>	<b>2,85,014</b>
<i>Extra-departmental.</i>					
Manœuvre and Radius maps ... ..	Various	1	6	5,005	11,778
Other maps ... ..	"	133	37	133,294	19,323
Plans and diagrams ... ..	"	146	17	28,957	3,867
Illustrations ... ..	"	94	...	9,160	2,884
Miscellaneous ... ..	"	24	10	232,538	4,575
<b>Total</b> ... ..	.....	<b>398</b>	<b>70</b>	<b>408,954</b>	<b>42,427</b>
<i>Maps published for the Govt. of Burma.</i>					
General & Geographical maps ... ..	Various	...	3	1,484	1,044
Topographical maps ... ..	"	1	24	9,406	20,914
Special maps ... ..	"	1	...	511	2,128
<b>Total for Burma</b> ... ..	.....	<b>2</b>	<b>27</b>	<b>11,351</b>	<b>24,086</b>
<b>Total Extra-departmental</b>	.....	<b>400</b>	<b>97</b>	<b>420,306</b>	<b>66,513</b>
<b>Grand Total</b> ... ..	.....	<b>510</b>	<b>525</b>	<b>694,243</b>	<b>3,51,527</b>

**NOTES.**—*Calcutta.*—In addition to the work shown in Table I(a), 18,979 copies of 137 maps were gridded during the year.

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

Class of maps.	Scale.	New publica- tions.	Reprints and new editions.	Number of copies printed.	Value. Rs.
<i>Departmental.</i>					
Cantonment maps ...	Various	13	45	7,408	3,910
Forest maps ...	"	...	15	1,287	1,163
Miscellaneous ...	"	44	49	51,110	8,627
<b>Total</b> ...	...	<b>57</b>	<b>109</b>	<b>59,805</b>	<b>13,700</b>
<i>Extra-departmental.</i>					
Maps ...	Various	47	34	7,166	6,722
Plans and diagrams ...	"	20	26	22,929	2,481
Charts ...	"	212	2	13,017	8,998
Forest maps ...	"	10	3	1,737	3,062
<b>Total</b> ...	...	<b>289</b>	<b>65</b>	<b>44,849</b>	<b>21,263</b>
Burma maps (Canton- ment & Forest) ...	4"=1 mile	...	2	102	120
<b>Total Extra- departmental</b> ...	...	<b>289</b>	<b>67</b>	<b>44,951</b>	<b>21,383</b>
<b>Grand Total</b> ...	...	<b>346</b>	<b>176</b>	<b>104,756</b>	<b>35,083</b>

**NOTES.**—*Dehra Dūn.*—In addition to the work shown in Table I(b) above, 1,649 prints of 314 originals, consisting of plane-table sections, triangulation charts and forest maps, &c. were printed. 291 bromide prints, 36 ferro prints, 12 chocolate prints and 2 line blocks were also prepared.

Table I (c)—Maps published at Murree and Risālpur.

Class of maps.	Scale.	New publica- tions.	Reprints and new editions.	Number of copies printed.	Value. Rs.
<i>Departmental.</i>					
Maps ...	Various	...	...	3,525	6,065
Plans and diagrams ...	"	...	...	135	107
Charts } Forms } including pano- ramas	"	...	...	5,480	313
<b>Total</b> ...	...	...	...	<b>9,140</b>	<b>6,485</b>
<i>Extra-departmental</i>					
Maps ...	Various	...	...	12,426	3,828
Plans and diagrams ...	"	...	...	1,575	25
Charts } Forms } including pano- ramas	"	...	...	1,300	88
<b>Total</b> ...	...	...	...	<b>15,301</b>	<b>3,941</b>
<b>Grand Total</b> ...	...	...	...	<b>24,441</b>	<b>10,426</b>

Table II.—Abstract of Modern Topographical and Geographical Maps.

	INDIA.						BURMA.					
	1'	½'	¼'	1/M		1 2 M	1'	½'	¼'	1/M		1 2 M
				I. & A. C.	Carte Inter- nationale.					I. & A. C.	Carte Inter- nationale.	
<b>Published maps.</b>												
Primary ...	3,280	235	23	.....	.....	.....	612	25	.....	.....	.....	.....
Compiled ...	.....	755	285	*75	21	14	.....	161	54	*8	1	.....
<b>Remaining (Approx.)</b>												
Primary ...	830	130	7	.....	.....	.....	.....	.....	.....	.....	.....	.....
Compiled ...	.....	300	116	.....	20	6	260	70	19	.....	5	.....
Totals (Approx.) ...	4,100	1,420	430	.....	41	20	870	260	73	.....	6	.....
Transfrontier ...	.....	.....	151	.....	.....	.....	.....	.....	4	.....	.....	.....
<b>Grand total (Approx.) ...</b>	<b>4,100</b>	<b>1,420</b>	<b>584</b>	.....	<b>41</b>	<b>20</b>	<b>870</b>	<b>260</b>	<b>77</b>	.....	<b>6</b>	.....

\* This series has been abandoned and no new sheets will be taken up.

**91. Map Issues.**—It will be seen from Table III below that the total sales by the entire department during the year 1939-40 were 594,211 copies, value Rs. 2,40,238 as against 519,939 copies, value Rs. 2,63,680, sold during the previous year.

The Map Record and Issue Office's total sales of departmental maps were 148,542 copies, value Rs. 1,54,333 as against 140,457 copies, value Rs. 1,56,324, sold during the previous year. The slight increase in number of copies is due to the increased demands of the Government and the Army who purchased roughly 2,400 and 5,500 maps more this year; and the slight decrease in value is due to the concessions extended to all Educational Institutions and Boy Scouts Associations in India.

The total number of extra-departmental maps issued by the Map Record and Issue Office was 405,547 copies, value Rs. 62,115.

The number of copies transferred to the High Commissioner for India, London and the Circle Offices for stock and issue was 34,595 copies, value Rs. 50,907.

Table III.—Maps issued by Survey units.

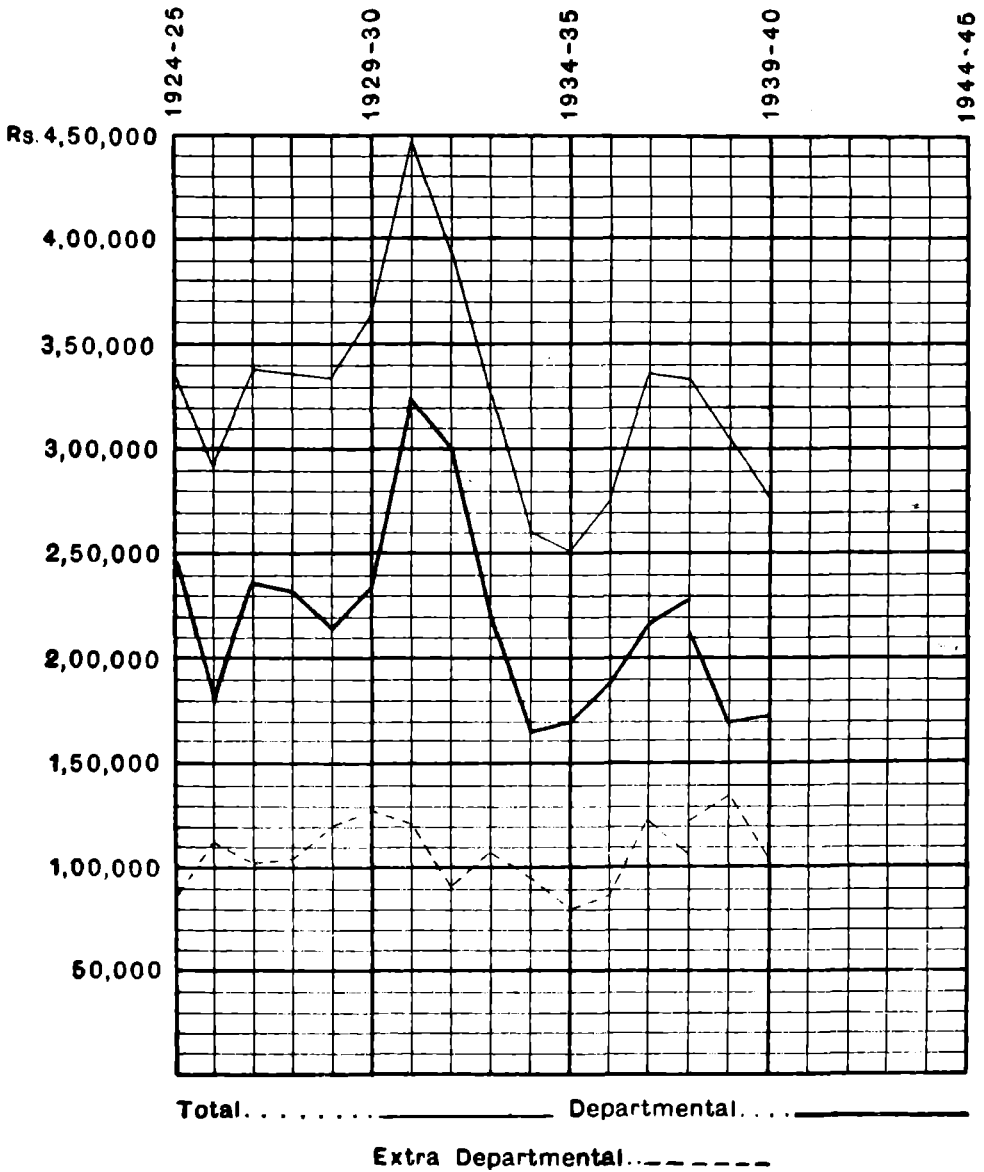
D=Departmental. X=Extra-departmental.		SALES.								FREE ISSUES.
		GOVERNMENT OFFICIALS.		ARMY AND ROYAL AIR FORCE.		PUBLIC.		TOTAL.		
		Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.	Sale Value. Rs.	Number of copies.
Calcutta	D	26,596	29,138	75,529	67,033	46,417	58,162	148,542*	1,54,333*	18,490
	X	300,129	18,429	23,618	6,246	70,449	13,354	394,196	38,029	2,983
Dehra Dūn	D	1,235	3,509	15,743	6,603	828	1,288	17,806	11,400	5,466
	X	1,002	59	986	906	29	59	2,017	1,024	3
Simla	D	94	185	105	160	250	402	449	747	4,794
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Murree and Lahore ("A" Company)	D	2	14	17	31	46	90	65	135	1,262
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Karāchi ("E" Company)	D	118	173	49	77	802	1,172	969	1,422	286
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Murree and Risālpur (No. 18 Party)	D	.....	.....	.....	.....	.....	.....	.....	.....	9,140
	X	107	131	15,194	3,810	.....	.....	15,301	3,941	.....
Bangalore	D	15	30	192	220	2,112	2,961	2,919	3,211	445
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Shillong	D	569	936	154	166	473	808	1,196	1,910	1,049
	X	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals (excluding Burma maps).		329,867	52,604	131,587	85,252	121,406	78,296	582,860	2,16,152	43,918
Calcutta, (Burma maps)	X	11,351	24,086	.....	.....	.....	.....	11,351	24,086	.....
Grand Total	...	341,218	76,690	131,587	85,252	121,406	78,296	594,211	2,40,238	43,918

\* Excludes 34,595 copies of maps, value Rs. 50,907 issued by the Map Office, Calcutta to the High Commissioner for India and the Survey Circles and Parties, for stock and sale.

Note.—In this table the figures in the sale-value column exclude the cost of mounting in various linen-backed styles.

PROGRESS OF MAP SALES

1924-40.



NOTE:—The break in Departmental and Extra Departmental graphs after the year 1937-38 indicates the change over of Burma maps from Departmental to Extra Departmental.

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



## X.—MATHEMATICAL INSTRUMENT OFFICE.

### 92. Manufactures, Repairs and Issues.

The year under report is the hundred and tenth year of the Mathematical Instrument Office. The work done during the year presents a considerable increase in the sale of instruments, the out-turn of the Workshops being slightly less than that of the previous year. This was due to diminished supervising staff arising from leave, deaths and retirement. Preparations for considerable expansion, as the result of war work, were beginning to be made at the end of the period under report.

**93. Distribution of transactions.**—The value of invoices covering transactions with various Government Departments etc. during the year is as follows:—

	Rs.
1. P. W. Department ... ..	1,36,950
2. Survey of India ... ..	79,556
3. Military Engineering Department etc. ...	91,642
4. Railways ... ..	32,664
5. Forest Departments ... ..	19,420
6. Education Departments ... ..	9,380
7. Medical Departments ... ..	5,538
8. Other Civil Departments, which include Excise, Jails, Meteorological, Judicial, R. I. Marine, Posts & Telegraphs, Geological, Botanical and Archæological Survey Depts. etc. ... ..	59,853
9. Government Officers, Municipalities, District Boards, Indian States, etc. on cash payment ... ..	42,489
<b>TOTAL</b> ...	<b>4,77,492</b>

The above were spread over Departments of the Central and Provincial Governments in various provinces etc. as shown below:—

	Rs.
Punjab ... ..	80,965
Bengal ... ..	77,008
Orissa ... ..	8,484
Bombay ... ..	32,509
Central Provinces & Berār ... ..	15,375
United Provinces ... ..	21,664
Bihār ... ..	20,602
Assam ... ..	9,117
Madras ... ..	13,273
Burma ... ..	12,101
North West Frontier Province ... ..	9,367
Sind ... ..	3,053
Baghdad ... ..	1,006
Andamans ... ..	1,517
Survey of India ... ..	79,556
Military Engineering Department etc. ... ..	91,642
Aden, Uganda, Bahrein, Malay States ... ..	253
	<hr/>
TOTAL ... ..	4,77,492

Issues by the Serviceable Store amounted to 45,643 instruments. The Stores Section dealt with 17,942 requisitions from workshops. The Clerical Section received and dealt with 20,909 letters. The Accounts Section dealt with 5,623 invoices, 1,421 bills and vouchers for the local purchase of instruments and materials. The number of contingent bills drawn on the Accountant General, Bengal during the year amounted to 334.

During the year 3,406 instruments have been deposited by various Government Departments as no longer required. Credit afforded by this office for above instruments returned on deposit was Rs. 23,450. The deposited instruments will be reconditioned for reissue at reduced prices.

A sum of Rs. 2,315 was realised by the disposal of surplus and obsolescent stores and scrap materials.

**94. Summary.** The following table shows the value of work done during the last three years.

Sale.	1937-38.	1938-39.	1939-40.
	Rs.	Rs.	Rs.
1. Total value of stores issued ...	2,85,149	3,29,428	3,97,907
<i>Out-turn in Works:—</i>			
2. Total value, manufacture of new instruments and components—	1,69,952	1,86,684	1,66,967
3. „ value of repairs to orders— ...	84,080	76,934	79,586
4. „ value of instruments reconditioned for issue— ...	48,356	54,440	60,835
5. „ value of adjustment and cleaning charges ...	5,582	4,366	3,441
6. „ value of work done in the workshop as per items 2 to 5 above— ...	3,07,970	3,22,424	3,10,829
7. <i>Book value of stock in—</i>			
(a) Serviceable store ...	2,79,009	3,06,493	2,69,018
(b) Repairable „ ...	1,41,308	1,32,754	1,30,953
(c) Material „ ...	1,07,089	1,13,815	1,10,637
8. <i>Value of new instruments—</i>			
(a) Purchased locally ...	69,913	78,857	95,514
(b) Imported through the Store Department, London— ...	25,722	49,058	36,978
9. Value obtained by sale of obsolescent and condemned stores— ...	2,438	2,392	2,315
10. <i>Employees—</i>			
(a) Total number of employees on register on 31st March ...	376	365	399
(b) Cost of employees in workshop ...	1,42,061	1,41,858	1,42,295

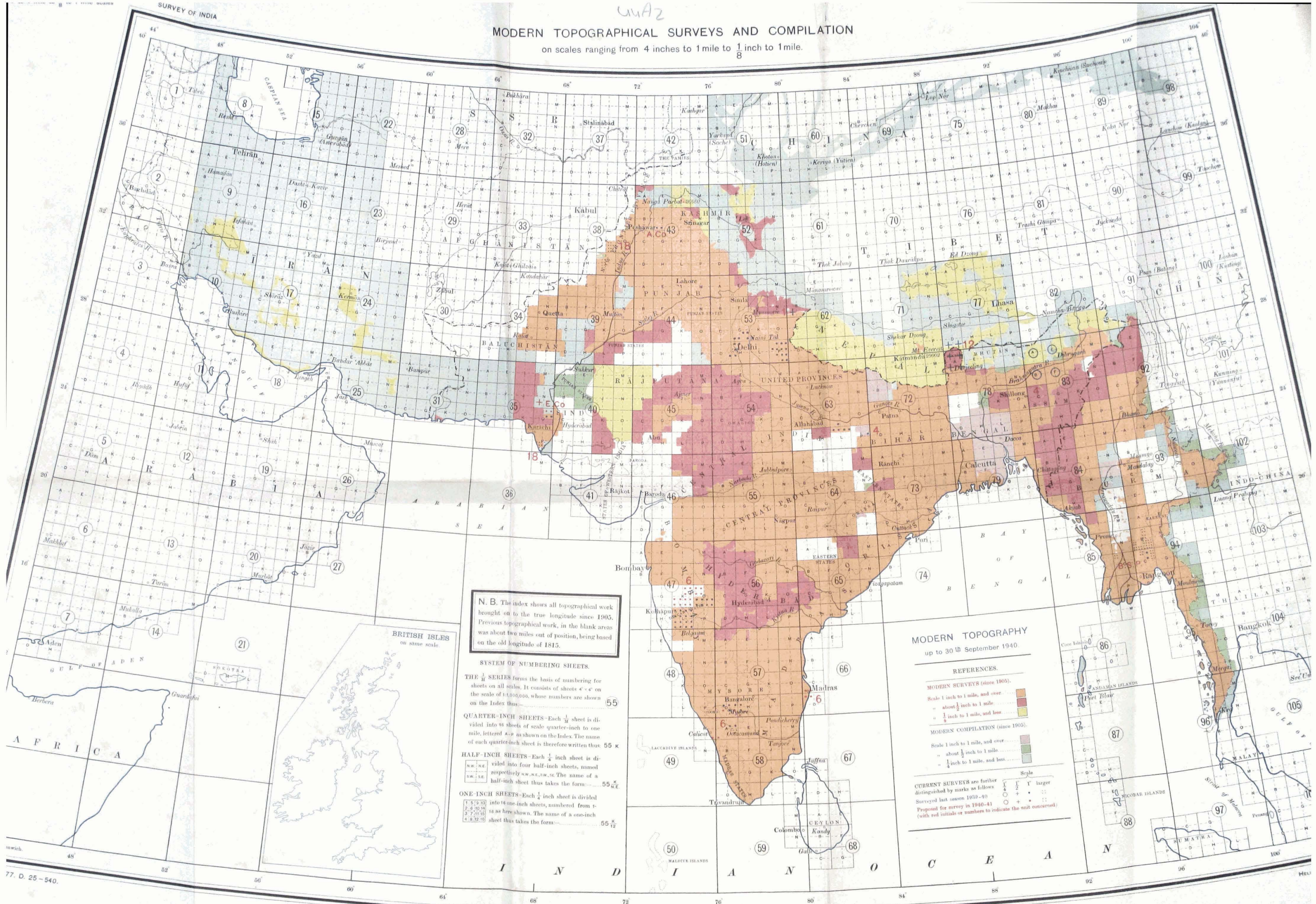




442

# MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION

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



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

### SYSTEM OF NUMBERING SHEETS.

THE  $\frac{1}{4}$  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  $\frac{1}{4}$  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  $\frac{K}{N.E.}$

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

### MODERN TOPOGRAPHY up to 30<sup>th</sup> September 1940.

- REFERENCES.
- MODERN SURVEYS (since 1905).
    - Scale 1 inch to 1 mile, and over: [Red]
    - about  $\frac{1}{2}$  inch to 1 mile: [Orange]
    - $\frac{1}{4}$  inch to 1 mile, and less: [Yellow]
  - MODERN COMPILATION (since 1905).
    - Scale 1 inch to 1 mile, and over: [Light Green]
    - about  $\frac{1}{2}$  inch to 1 mile: [Light Blue]
    - $\frac{1}{4}$  inch to 1 mile, and less: [Light Purple]
- CURRENT SURVEYS are further distinguished by marks as follows:  
 Surveyed last season 1939-40: [Red circle]  
 Proposed for survey in 1940-41: [Blue circle]  
 (with red initials or numbers to indicate the unit concerned)

Scale of Index 1:12 Million.  
 Miles 100 0 100 200 300 400 500 600 700 800 900 Miles

442