

# Survey of India.

## GENERAL REPORT

1918-19.

From 1st October 1918

To 30th September 1919.



PREPARED UNDER THE DIRECTION OF  
LIEUTENANT COLONEL C. H. D. RYDER, C.I.E., D.S.O., R.E.,  
SURVEYOR GENERAL OF INDIA.

S  
Ul. 22  
15 374

PRINTED AT THE PHOTO-LITHO. OFFICE, SURVEY OF INDIA  
CALCUTTA.  
1920.

Price Two Rupees or Four Shillings.

# Survey of India.

## GENERAL REPORT,

### 1918-19.

From 1st October 1918  
To 30th September 1919.

---



PREPARED UNDER THE DIRECTION OF  
COLONEL C. H. D. RYDER, C.I.E., D.S.O., R.E.,  
SURVEYOR GENERAL OF INDIA.

---

PRINTED AT THE PHOTO-LITHO. OFFICE, SURVEY OF INDIA,  
CALCUTTA.

PRINTED AT THE  
PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, SURVEY OF INDIA,  
14, WOOD STREET,  
CALCUTTA.

## NOTICE.

Maps published by the Survey of India can be obtained from the Map Record and Issue Office, 13, Wood Street, Calcutta.

1. TOPOGRAPHICAL MAPS are published on the scales of 4 MILES TO 1 INCH, 2 MILES TO 1 INCH AND 1 MILE TO 1 INCH:—

(a) THOSE SURVEYED AFTER 1905 are printed in colours, in sheets 23 INCHES × 19 INCHES, price ONE RUPEE per copy.

(b) THOSE SURVEYED PRIOR TO 1905 are printed in black only or in black with hills in brown, in sheets 40 INCHES × 27 INCHES, price Re. 1-8-0 per copy.

(c) 4 miles to 1 inch maps are printed in two editions, viz., LAYERED and POLITICAL, as described in para. 4, except those from old surveys, which are printed in black and styled PROVISIONAL, price ONE RUPEE per copy.

2. GEOGRAPHICAL MAPS are also obtainable as follows:—

(a) SOUTHERN ASIA SERIES, scale 1:2,000,000 or nearly 32 miles to 1 inch, in LAYERED and POLITICAL editions, as described in para. 4, size 36 inches × 24 inches, price Rs. 2 per copy.

(b) INDIA AND ADJACENT COUNTRIES, scale 1:1,000,000 or nearly 16 miles to 1 inch, in LAYERED and POLITICAL editions, and from old surveys as PROVISIONAL ISSUES, size 23 INCHES × 19 INCHES, price ONE RUPEE per copy.

(c) INTERNATIONAL MAP OF INDIA, scale 1:1,000,000 or nearly 16 miles to 1 inch, in LAYERED edition (without shading of hills), size 30 inches × 26 inches, price ONE RUPEE per copy.

(d) GENERAL MAPS OF INDIA, scale 32 miles to 1 inch, in sets of 12 sheets, each sheet 25 inches × 32 inches, in LAYERED and POLITICAL (without hills) editions, price Rs. 12 per set. Maps of India on various smaller scales and miscellaneous special maps illustrating Railways, etc., are also available.

3. MISCELLANEOUS maps are also published as below:—

(a) PROVINCIAL MAPS, on scales 16 miles and 32 miles to 1 inch.

(b) DISTRICT MAPS, on scales 4 miles and 8 miles to 1 inch.

(c) CANTONMENT AND TOWN MAPS AND OTHER MISCELLANEOUS MAPS, on various scales and prices.

(d) FOREST MAPS obtainable only from the OFFICER IN CHARGE, FOREST MAP OFFICE, DEHRA DŪN.

4. The styles of printing of 4 miles to one inch and Geographical maps are as follows:—

(a) LAYERED EDITION, printed in colours with contours and graduated layer tints to show altitudes, and shading to emphasize the hills. (Colour ribands along boundaries cannot be added to this edition.)

(b) POLITICAL EDITION, printed in colours with colour ribands along boundaries, contours to show altitudes and shading to emphasize hills.

(c) PROVISIONAL ISSUE, generally printed in black or black with hills in brown. Colour ribands along boundaries are added by hand when required at an extra cost of 2 annas per sheet.

5. MAP CATALOGUES can be obtained at ONE RUPEE per copy.

6. Maps can be mounted on cloth and folded or mounted on rollers for hanging, etc., at a small extra charge.

7. Maps approved for issue to Government Officials on the *PUBLIC SERVICE* are supplied on *BOOK DEBIT*.

Indent forms and rules governing this supply can be obtained on application.

All other issues of printed maps are made on cash payment or by V. P. P. Cash payments may be made by Money Order, or by uncrossed cheques (usual commission charges being added to cheques on Banks outside Calcutta). *Crossed cheques, Hundis and Receipts for payments into Treasuries cannot be accepted.*

Postage, packing and V. P. P. charges are extra.

8. THE MAP RECORD AND ISSUE OFFICE will be glad to give, free of charge, any further information.

**AGENTS FOR THE SALE OF INDIAN OFFICIAL PUBLICATIONS.**

**LONDON.**

A. CONSTABLE & Co., 10, Orange Street,  
Leicester Square, W.C.  
P. S. KING & SON, 2 and 4, Great Smith  
Street, Westminster, S.W.  
KEGAN PAUL, TRENCH, TRÜBNER & Co.,  
68, Carter Lane, E.C.  
B. QUARITCH, 11, Grafton Street, New Bond  
Street, W.  
HENRY S. KING & Co., 65, Cornhill, E.C.  
GRINDLAY & Co., 54, Parliament Street, S.W.  
T. FISHER UNWIN, LTD., 1, Adelphi Terrace,  
W.C.  
W. THACKER & Co., 2, Creed Lane, Ludgate  
Hill, E.C.  
LUZAC & Co., 46, Great Russell Street, W.C.

**EDINBURGH.**

OLIVER AND BOYD, Tweeddale Court.

**DUBLIN.**

E. PONSONBY, LTD., 116, Grafton Street.

**OXFORD.**

B. H. BLACKWELL, 50 and 51, Broad Street.

**CAMBRIDGE.**

DEIGHTON, BELL & Co., LTD., Trinity Street.

**ON THE CONTINENT.**

ERNEST LEROUX, Rue Bonaparte,  
Paris France.  
MARTINUS NIJHOFF, The Hague- Holland.

**FOR MAPS ONLY.**

**LONDON.**

EDWARD STANFORD, LTD., 12-14, Long Acre  
W.C.

**INDIA.**

THACKER, SPINK & Co., No. 3, Esplanade,  
East, Calcutta, and Simla.  
NEWMAN & Co., No. 4, Dalhousie Square  
Calcutta.  
LAL CHAND & SONS, No. 76, Lower Circular  
Road, Calcutta.  
THE MANAGER, THE INDIAN SCHOOL SUPPLY  
DEPOT, No. 309, Bow Bazar Street,  
Calcutta, and Dacca.  
RAI SAHIB M. GULAB SINGH & SONS,  
Lahore.  
THACKER & Co., LTD., Bombay.  
D. B. TARAPOREVALA SONS & Co., Bombay.  
HIGGINBOTHAMS, LTD., Madras.  
PROPRIETOR, MAFASILITE PRINTING WORKS,  
Mussoorie.  
COCKBURNS AGENCY, Srinagar.  
CURATOR, GOVERNMENT BOOK DEPOT,  
BURMA, Rangoon.  
BURMAN & Co., Muzaffarpur.

# CONTENTS

|   |  | PAGE. |
|---|--|-------|
| <b>PART 1.—GENERAL REMARKS—</b>                       | I.—Introduction                        | 1     |
|   | II.—Administration and Personnel       | 3     |
|   | TABLE I.—Disposition of Officers       | 6     |
| <b>PART 2.—WORK OF FIELD PARTIES, &amp;c.—</b>        |  |       |
| I.—TOPOGRAPHICAL SURVEYS                              | TABLE II.—Progress since 1905          | 10    |
|   | TABLE III.—Out-turns and costs         | 11    |
|   | Northern Circle                        | 13    |
|   | Southern Circle                        | 14    |
|   | Eastern Circle                         | 14    |
| II.—FOREST SURVEYS.—                                  | Northern Circle                        | 17    |
|   | Southern Circle                        | 17    |
|   | Eastern Circle                         | 17    |
| III.—CANTONMENT AND LARGE-SCALE SURVEYS.—No. 1 Party  |  | 18    |
|   | No. 2 Party                            | 18    |
|   | Simla Survey Detachment                | 18    |
|   | Punjab Riverain Survey Party           | 18    |
|   | No. 9 Party                            | 19    |
|   | Cantonments                            | 20    |
| IV.—THE TRIGONOMETRICAL SURVEY.—                      | Astronomical Latitudes                 | 21    |
|   | Pendulum Observations                  | 21    |
|   | Triangulation                          | 21    |
|   | Tidal Operations                       | 21    |
|   | Levelling                              | 22    |
|   | Base Lines                             | 23    |
|   | Magnetic Survey                        | 23    |
| <b>PART 3.—OFFICE WORK—</b>                           |  |       |
| I.—HEAD QUARTER OFFICES                               | Map Publication Office                 | 25    |
|   | Map Record and Issue Office            | 27    |
|   | TABLE IV.—Publications during the year | 29    |
|   | No. 1 Drawing Office                   | 30    |
|   | Engraving Office                       | 32    |
|   | Photo.-Litho. Office                   | 33    |
|   | Mathematical Instrument Office         | 35    |
| II.—DEHRA DŪN OFFICES.—                               | Trigonometrical Survey Office          | 36    |
|   | No. 2 Drawing Office                   | 36    |
|   | Forest Map Office                      | 39    |
| III.—CIRCLE AND LOCAL DRAWING OFFICES.—               |  | 41    |
| <b>PART 4.—WORK FOR OTHER GOVERNMENT DEPARTMENTS—</b> |  |       |
|   |  | 45    |

## INDEX MAPS (bound at end of Report).

1. Modern survey and publication.
2. Publication of modern one-inch series.
3. " modern half-inch series for India.
4. " " quarter-inch " "
5. " 'India and Adjacent Countries' series, scale  $\frac{1}{1,000,000}$ .
6. " Indian sheets of "La Carte Internationale du Monde," scale  $\frac{1}{1,000,000}$ .
7. " 'Southern Asia' series, scale  $\frac{1}{2,000,000}$ .
8. Progress of the Great Trigonometrical Survey.

# Survey of India.

## GENERAL REPORT,

1918—19.

From 1st October 1918

To 30th September 1919.

### PART I.—GENERAL REMARKS.

#### I.—INTRODUCTION.

1. The main parts of this report, as shown in the "Contents" on the opposite page, are *Part 2—Work of Field Parties, &c.*, summarising the operations of the field parties, grouped under appropriate headings; and *Part 3—Office Work*, which gives a brief account of the year's progress in the head-quarters and other offices. Fuller details of these operations are being published in Volume XIV of the "Records of the Survey of India."

2. An abstract showing the progress of the topographical programme assigned to the department in 1905, may be found in Table II on page 10. From this it will be seen that the out-turn of topographical survey during the current year was 13,948\* square miles; and that this brings the total progress since 1905 to 510,310 square miles, leaving 1,311,290 square miles still to be done.

3. The first Index map, at the end of the report, shows the progress of this topographical programme both in survey and in publication in the three circles, while the remaining seven indexes show the progress in publication of the various series of maps appertaining to the scheme, and also the main framework of triangulation on which the survey of India is based.

4. Table IV on page 29 gives a list of the new publications of the Calcutta Offices during the year. A complete list of departmental publications, apart from maps, may be found in the annual "Records of the Survey of India"; and lists of new maps are published quarterly by the department, as well as in the monthly "Notes of the Survey of India."

5. Progress in the Trigonometrical Survey can only be ascertained by a study of the "Records of the Survey of India" and the special publications issued at Dehra Dūn. The General Report can attempt little more than a brief abstract of the *locale* and nature of the different operations.

---

\*This however excludes 3,738 square miles of revision survey (provisional) on scale of  $\frac{1}{2}$  inch = 1 mile, and 82 square miles of biennial Delhi revision survey on scale of 4 inches = 1 mile.

**6. The following events are notified:—**

- (a) Nine Imperial Officers and five Provincial Officers have reverted from temporary military duty. The available strength was not, however, increased, owing to the necessity of granting long deferred leave.
- (b) Owing to the shortage of officers the field work of the whole department was again considerably curtailed.
- (c) The Survey party under an Imperial Officer (Deputy Director of Surveys, Mesopotamian Expeditionary Force) which accompanied the field-force in Mesopotamia continued survey operations there.
- (d) The Survey detachment in charge of a Provincial Officer which was employed on service with the Salonika force returned to India on completion of its work, and was disbanded.
- (e) The Survey detachment under a Provincial Officer which was despatched to East Africa for duty with Field Survey units of Royal Engineers, returned to India on completion of work, and was disbanded.
- (f) A Survey party under an Imperial Officer was sent to East Persia in October 1918, to carry out survey operations with the East Persia Cordon Force. The majority of this party returned to India in June 1919, leaving behind a small portion of its personnel from which a separate detachment was formed under a Provincial Officer to complete such extra survey work as might be found to be required by the military authorities.
- (g) A Survey detachment under a Provincial Officer was despatched to carry out survey operations in the neighbourhood of Būshire (Persia).
- (h) A Survey party under an Imperial Officer was sent to Peshāwar for duty with the forces operating against the Afghāns.
- (i) A Survey detachment under a Provincial Officer was sent to Quetta for duty with the forces operating against the Afghāns.
- (j) A Survey detachment under a Provincial Officer was formed for duty with the Kūki Punitive Force.
- (k) Lieut.-General Sir W. R. Marshall, K.C.B., K.C.S.I., Commanding-in-Chief, Mesopotamian Expeditionary Force, in his despatch dated the 1st October 1918 wrote as follows:—  
"Surveys and the Map Compilation Section have always risen to the occasion, and have continued to produce a large output of admirable work".
- (l) A competitive examination for admission to the Provincial Service was held in July 1919. There were 30 candidates for the five vacancies, which were duly filled.
- (m) Recruitment for the Upper Subordinate Service has been reopened, and 7 probationers were nominated by the Surveyor General in September 1919.
- (n) The total number of maps issued continues to show an increase due in part to the operations on the North-West Frontier. The steady increase of issues of maps to private individuals is also noticeable and very satisfactory.
- (o) There has been a marked increase during the last few years in the demand for surveys on large scales other than for ordinary topographical purposes.



## II.—ADMINISTRATION AND PERSONNEL.

7. The actual cost of the department for the financial year ending 31st March 1919 and of the two previous years is shown below:—

|                             | 1916-17.   | 1917-18.   | 1918-19.   | REMARKS.                       |
|-----------------------------|------------|------------|------------|--------------------------------|
|                             | <i>Rs.</i> | <i>Rs.</i> | <i>Rs.</i> |                                |
| Gross actual cost ...       | 32,93,109  | 40,33,295  | 35,93,116* | * These figures are not final. |
| Deduct receipts and credits | 14,79,255  | 17,58,796  | 17,25,606* |                                |
| Net actual cost ...         | 18,13,854  | 22,74,499  | 18,67,510* |                                |

8. Colonel Sir S. G. Burrard, K.C.S.I., R.E., F.R.S., administered the department up to 15th March 1919, except for a month during which he was on leave, Colonel Sir G. P. Lenox-Conyngham, Kt., R.E., F.R.S., officiating for him. Colonel C. H. D. Ryder, C.I.E., D.S.O., R.E., administered the department for the remainder of the year.

9. In the Imperial Service Colonel Sir S. G. Burrard, K.C.S.I., R.E., F.R.S., retired; Lieutenant-Colonel F. P. Nosworthy, D.S.O., M.C., R.E., was transferred permanently to military duty. The number of Imperial Officers remaining temporarily on military duty on account of the war at the end of the Survey year is 12. Colonel R. A. Wauhope, C.B., C.M.G., C.I.E., R.E., (Retired), vacated his temporary appointment in the department.

Commissary and Honorary Major C. J. Arbery, M.B.E., Officer in charge No. 6 Drawing Office (Simla), has been retained in the service after the age of 55 years. Mr. H. G. Salmond, late R.A.F., has been deputed to this department to assist in experiments in producing maps from aeroplane photographs.

In the Provincial Service Mr. P. R. Anderson died; Captain W. P. Hales, I.A.R.O., also died while on active service in Persia. Mr. Syed Aulad Hossein, Khan Bahadur, and Mr. J. A. T. Haddock, the latter of whom was employed under the Government of Burma, retired; Mr. T. W. Babonau was dismissed. Mr. B. M. Berrill has reverted from deputation under the Government of Bombay. The number of officers of the Provincial Service on deputation to military duty at the end of the Survey year is 9.

In the Upper Subordinate Service two officers retired, one of whom, Mr. Lal Singh, Rai Bahadur, was later re-employed; one officer was transferred to foreign service under the Civil Commissioner, Baghdad; one probationer was confirmed and three promotions were made into this service from the Lower Subordinate Service.

The total strength of the department at the close of the Survey year was 44† Imperial Officers, 109‡ Provincial Officers and 52 Upper Subordinates besides specialists, clerks, lower subordinates and menials.

10. A Special Burma Forest Survey Party and a Simla Survey Detachment were formed during the year in addition to the field service parties or detachments already mentioned.

The Punjab Riverain Detachment was raised to the status of a Survey Party.

† Including 12 officers on temporary military duty.

‡ Including 9 officers on temporary military duty, but excluding officers re-employed and on deputation to Local Governments.

11. The following Honours were conferred on members of the department during the year:—

|   |  |
|---|--|
| <i>Knighthood.</i> —  | Colonel G. P. Lenox-Conyngham, R.E., F.R.S.  |
| <i>Companions of the Distinguished Service Order.</i> —         | Major R. H. Thomas, R.E.<br>Major H. J. Couchman, M.C., R.E.*<br>Major J. D. Campbell, R.E.  |
| <i>Commander of the Order of the British Empire.</i> —          | Mr. T. A. Ferrier, Officer in charge, Mathematical Instrument Office.  |
| <i>Officers of the Order of the British Empire.</i> —           | Brevet-Lieut.-Colonel C. P. Gunter, R.E.*<br>Major M. O'C. Tandy, D.S.O., R.E.   |
| <i>Members of the Order of the British Empire.</i> —            | Mr. J. McCracken, Extra Assistant Superintendent.*<br>Mr. W. H. Strong, Extra Assistant Superintendent.*<br>The late Acting Captain W. P. Hales, I.A.R.O., Extra Assistant Superintendent.   |
| <i>Awarded the Order of St. Anne, 2nd Class, with Swords.</i> — | Brevet-Lieut.-Colonel C. M. Browne, C.M.G., D.S.O., R.E.   |
| <i>Awarded the Order of the White Eagle, 4th Class.</i> —       | Brevet-Lieut.-Colonel H. Wood, R.E.*   |
| <i>Promoted to Brevet-Lieutenant-Colonel.</i> —                 | Major R. H. Phillimore, D.S.O., R.E.<br>Major S. W. S. Hamilton, D.S.O., R.E.  |
| <i>Promoted to Brevet-Major.</i> —                              | Captain C. G. Lewis, R.E.  |
| <i>Mentioned in despatches.</i> —                               | Colonel C. H. D. Ryder, C.I.E., D.S.O., R.E.<br>Lieutenant-Colonel G. A. Beazeley, D.S.O., R.E., (third time).<br>Brevet-Lieut.-Colonel H. Wood, R.E., (third time).<br>Major H. McC. Cowie, R.E.<br>Major E. T. Rich, C.I.E., R.E.<br>Major M. O'C. Tandy, D.S.O., R.E., (second time).<br>Major R. H. Thomas, D.S.O., R.E.<br>Brevet-Lieut.-Colonel R. H. Phillimore, D.S.O., R.E., (twice during the year, once in 1916, altogether thrice).<br>Major M. N. MacLeod, D.S.O., M.C., R.E., (second time).<br>Major H. J. Couchman, M.C., R.E., (second time).*<br>Major J. D. Campbell, R.E.*<br>Lieutenant-Colonel F. P. Nosworthy, D.S.O., M.C., R.E., (twice during the year, altogether six times).<br>T. Captain H. B. Simons, Extra Assistant Superintendent.<br>Mr. D. K. Rennie, Extra Assistant Superintendent.<br>Mr. A. J. Booth, Extra Assistant Superintendent. (second time). |

\* Honour conferred during 1917-18.

GENERAL.—ADMINISTRATION AND PERSONNEL.

|  |  |
|--|--|
| <i>Mentioned in despatches (contd.)—</i>                       | Mr. F. R. Vandyke, Manager, Litho. Section, Photo.-Litho. Office, Calcutta.                        |
|  | Mr. Jamna Prasad, R.S., Sub-Assistant Superintendent.  |
|  | Mr. Hamid Gul, K.S., Sub-Assistant Superintendent, (second time).                                  |
|  | Mr. Annada Prasad Ghosh, Sub-Assistant Superintendent.   |
|  | Mr. Lalnan Khan, I.D.S.M., Sub-Assistant Superintendent, (third time).                             |
|  | Mr. Abdul Latif Khan, Sub-Assistant Superintendent.  |
|  | Surveyor Muhammad Nasir Khan.  |
| <i>Title of Khan Bahadur.—</i>                                 | Mr. Asmat-ullah Khan, K.S., Extra Assistant Superintendent.  |
| <i>Title of Rai Bahadur.—</i>                                  | Mr. Girindra Nath Mukherji, R.S., Head Clerk, Mathematical Instrument Office, Calcutta.            |
| <i>Title of Khan Sahib.—</i>                                   | Mr. Hamid Gul, Sub-Assistant Superintendent.   |
| <i>Title of Rai Sahib.—</i>                                    | Mr. Nanak Chand Puri, B.A., Sub-Assistant Superintendent.  |
| <i>Awarded the Indian Distinguished Service Medal.—</i>        | Mr. Lalnan Khan, Sub-Assistant Superintendent.   |
|  | Surveyor Ghulam Rasul Khan.  |
|  | Surveyor Muhammad Abdul Azim.  |
| <i>Silver Medal for long service and good conduct.—</i>        | Sergeant F. J. Weaver, (India Miscellaneous list), Draftsman, No. 6 Drawing Office (Army Section). |
| <i>Services brought to notice of the Government of India.—</i> | Lieut.-Colonel H. H. Turner, R.E., Superintendent, Map Publication, Calcutta.                      |
|  | Mr. T. A. Ferrier, C.B.E., Officer in charge, Mathematical Instrument Office, Calcutta.            |
|  | Mr. S. Woodhouse, Works Manager, Mathematical Instrument Office, Calcutta.                         |
|  | Mr. S. Colquhoun, Assistant Manager, Litho., Photo.-Litho. Office, Calcutta.                       |

12. The following table shows the distribution of officers during the year. The names of officers on deputation to Local Governments or military duty or absent on military duty followed by leave throughout the year are omitted; the names of officers, other than officers in charge, on leave, military duty, or foreign service, during the greater part of the year are also omitted

TABLE I—DISPOSITION OF OFFICERS, 1918-19.

| SURVEYOR GENERAL OF INDIA—  |   | Colonel Sir Sidney G. Burrard, K.C.S.I., R.E., F.R.S., to 5th December 1918 and from 5th January to 15th March 1919.<br>Colonel Sir Gerald P. Lenox-Conyngham, Kt., R.E., F.R.S., Officiating, from 6th December 1918 to 4th January 1919.<br>Colonel C. H. D. Ryder, C.I.E., D.S.O., R.E., from 16th March 1919 (Officiating to 15th September 1919). |  |                                    |   |
|---|---|--|--|------------------------------------|---|
|   | <i>Imperial Officers.</i>   | <i>Provincial Officers.</i>  | <i>Upper Subordinates.</i>   | <i>Lower Subordinates, &amp;c.</i> |   |
| Surveyor General's Office.  | Lieut.-Colonel A. Mears, I.A.<br>Captain W. E. Perry, M.C., R.E.  |  |  |                                    |   |
| No. 6 Drawing Office, Simla.  | Major C. J. Arbery  | Mr. R. E. Sauholle<br>" A. J. A. Drake, D.C.M.   |  |                                    | 26 Draftsmen, &c.                             |
| Mesopotamian Survey Party.  | Colonel C. H. D. Ryder, C.I.E., D.S.O., R.E.<br>Bt.-Colonel F. W. Pirrie, C.M.G., C.I.E., I.A.<br>Bt.-Lieut.-Colonel C. P. Gunter, O.B.E., R.E.<br>Major E. T. Rich, C.I.E., R.E.<br>" L. C. Thuillier, I.A.<br>" L. G. Crosthwait, I.A.<br>Mr. J. deGraaff Hunter, M.A.<br>Major A. H. Gwyn, I.A.<br>Bt.-Major O. G. Lewis, R.E. | Mr. S. S. McA'F. Fielding<br>" C. West<br>" B. C. Newland<br>" E. C. O'Sullivan, D.C.M.<br>" D. K. Rennick<br>" D. H. Luxa<br>" J. McCracken, M.B.E.<br>" F. B. Kitchen<br>" A. J. Booth<br>" J. C. St. C. Pollett<br>" Narendra Nath<br>" Chuckerbutty, I.C.E.<br>" A. F. Murphy  | Mr. Hayat Muhammad, K.S.<br>" Nanak Chand Puri, B.A., R.E.<br>" Hamid Gul, K.S.<br>" Satish Chandra Mukerjee<br>" Annada Prasad Ghosh<br>" Laitan Khan, I.D.S.M.<br>" Abdul Latif Khan |                                    | 68 Surveyors, &c.                             |
| East Africa Survey Detachment.  |   | Mr. A. J. A. Drake, D.C.M.   | Mr. Ram Prasad, R.S.   |                                    | 5 Surveyors.                                  |
| SUPERINTENDENT, MAP PUBLICATION—  |   | Lieut.-Colonel H. H. Turner, R.E.  |  |                                    |   |
|   | <i>Imperial Officers.</i>   | <i>Provincial Officers.</i>  | <i>Upper Subordinates.</i>   | <i>Lower Subordinates, &amp;c.</i> |   |
| Map Publication Office, Calcutta.   |   | Mr. M. Gastaud   |  |                                    |   |
| No. 1 Drawing Office, Map Record and Issue Office and Engraving Office, Calcutta. | Major O. H. B. Trenchard, R.E.  | Mr. P. Williams<br>" Jagdamba Prasad<br>" Abimash Chunder Bose<br>" Asmat-ullah Khan, K.B.<br>" Priya Nath Sur<br>" L. B. Fitz-Gibbon<br>" A. A. Graham<br>" T. F. Kitchen<br>" H. T. Hughes<br>" H. H. P. Butterfield<br>" Jijn Lal Sahgal  |  |                                    |   |
| Photo.-Litho. Office, Calcutta.   | Major F. J. M. King, R.E.<br>" A. H. Gwyn, I.A.   |  |  |                                    |   |
| Mathematical Instrument Office, Calcutta.   | Mr. T. A. Ferrier, C.B.E.   |  |  |                                    |   |
| Bengal & Bihar & Orissa Drawing Office, (Imperial Standard Mapping Section).      |   | Mr. P. Simpson   |  |                                    |   |
| SUPERINTENDENT, NORTHERN CIRCLE   |   | Lieut.-Colonel E. A. Tandy, R.E., up to 29th November 1918.<br>Lieut.-Colonel R. T. Crichton, C.I.E., I.A., from 30th November 1918.   |  |                                    |   |
|   | <i>Imperial Officer</i>   | <i>Provincial Officers.</i>  | <i>Upper Subordinates.</i>   | <i>Lower Subordinates, &amp;c.</i> |   |
| No. 3 Drawing Office, Mussoorie.  |   | Mr. J. A. Freeman<br>" E. B. West<br>" D. K. Rennick<br>" L. Williams<br>" A. A. Graham  | Mr. Imam Din   |                                    | 29 Surveyors, &c.                             |
| No. 1 Party, Punjab and Central India.  | Bt.-Lieut.-Colonel A. A. McHarg, D.S.O., R.E.<br>Captain W. E. Perry, M.C., R.E.  | Mr. H. H. B. Hanby<br>" G. J. S. Rae<br>" A. M. Talati, L.C.E.<br>" R. O. Hanson<br>" G. A. Norman   | Mr. Paras Ram<br>" Jemna Prasad, R.S.<br>" Jagdeesh Prasad Vastav<br>" Muhammad Khan   |                                    | 34 Surveyors, &c.                             |
| No. 2 Party, United Provinces and Delhi Provinces.                                | Major R. Foster, I.A.   | Mr. H. P. D. Morton<br>" J. A. Calvert<br>" Duni Chand Puri  | Mr. Lakshmi Dutt Joshi<br>" Ghulam Hassan<br>" Daulat Ram Vohra.   |                                    | 23 Surveyors, &c.                             |
| No. 3 Party, United Provinces and Punjab.   |   | Mr. H. H. B. Hanby<br>" B. M. Berrill<br>" J. H. Johnson<br>" Moqimuddin   | Mr. Paras Ram<br>" Amir Abdul Salam Matlub Ahmad   |                                    | 31 Surveyors, &c.                             |
| No. 4 Party, United Provinces.  | Lieut.-Colonel E. A. Tandy, R.E.  |  |  |                                    | 2 Clerks.                                     |
| Sind-Sagar Party, Punjab.   |   | Mr. Dhani Ram Verma<br>" J. U. C. Lears<br>" A. M. Talati, L.C.E.<br>" Abdul Karim, B.A.<br>" Moqimuddin   | Mr. Chuni Lal Kapur<br>" Nabadad Khan  |                                    | 27 Surveyors, &c.<br>138 Local Revenue staff. |
| Riverain Survey Party, Punjab.  |   | Mr. Maya Das Puri, R.S.  | Mr. Paras Ram<br>" Ram Narayan Hastir<br>" Lakshmi Dutt Joshi<br>" Vidya Dhar Chopra   |                                    | 73 Surveyors, &c.                             |
| Simla Survey Detachment, Simla.   |   | Mr. W. H. Strong, M.B.E.   |  |                                    | 11 Surveyors, &c.                             |
| Eastern Persia Survey Party.  | Lieut.-Colonel H. L. Crosthwait, R.E.   | Mr. P. A. T. Kenny<br>" E. B. West<br>" L. Williams<br>" G. E. R. Cooper<br>" F. J. Grice  | Mr. Muhammad Husain Khan<br>" Muhammad Husain<br>" Shib Lal<br>" Afras Gul Khan  |                                    | 28 Surveyors, &c.                             |
| North-West Frontier Survey Party.   | Major H. McC. Cowie, R.E.<br>Bt.-Major G. G. Lewis, R.E.  | Mr. R. C. Hanson<br>" B. T. Wyatt<br>" J. A. Calvert   |  |                                    | 9 Surveyors, &c.                              |
| Quetta Survey Detachment.   |   | Mr. F. J. Grice  | Mr. Shib Lal   |                                    | 3 Surveyors.                                  |
| Birjand Survey Detachment.  |   | Mr. L. Williams<br>" G. A. Norman  | Mr. Afras Gul Khan   |                                    | 3 Surveyors.                                  |

TABLE I—(Continued).—DISPOSITION OF OFFICERS, 1918-19.

| SUPERINTENDENT,<br>SOUTHERN CIRCLE   |                             | (Colonel T. F. B. Renny-Tailyour, C.S.I., R.E., up to 5th March 1919.<br>Major L. C. Thuillier, I.A., from 6th to 28th March 1919.<br>Lieut.-Colonel W. M. Coldstream, R.E., from 29th March 1919.) |   |                                    |  |
|--|-----------------------------|---|---|------------------------------------|--|
|  | <i>Imperial Officers.</i>   | <i>Provincial Officers.</i>   | <i>Upper Subordinates.</i>  | <i>Lower Subordinates, &amp;c.</i> |  |
| No. 4 Drawing Office, Bangalore.   |                             | Mr. J. H. Nichol<br>" F. P. Walsh   | Mr. B. V. Narayana Rao  | 37 Draftsmen, &c.                  |  |
| No. 5 Party,<br><i>Central Provinces.</i>  | Major L. C. Thuillier, I.A. | Mr. V. W. Morton<br>" Haji Abdul Rahim, K.B.<br>" F. C. Pilcher   | Mr. P. S. Vengavami<br>" Damodar Khadilkar<br>" Maand Khan                        | 33 Surveyors, &c.                  |  |
| No. 6 Party,<br><i>Bombay and Hyderabad.</i>   |                             | Mr. J. O'B. Donaghey<br>" E. A. Meyer<br>" Munshi Lal, B.A.<br>" N. S. Harihara Iyer  | Mr. Eknath Bhatta<br>" K. Mandanna<br>" E. N. Nutevan, B.A.                       | 23 Surveyors, &c.                  |  |
| No. 7 Party,<br><i>Madras.</i>   |                             | Mr. W. M. Gorman<br>" C. E. C. French<br>" H. B. Simons<br>" F. W. Smith<br>" M. S. Ganesa Aiyar  | Mr. Pulin Behari Roy  | 18 Surveyors, &c.                  |  |
| No. 8 Party,<br><i>Madras.</i>   |                             | Mr. W. M. Gorman<br>" C. E. C. French<br>" M. Mahadeva Mudaliar,<br>M.A.  | Mr. K. Narayanaswami Chetti<br>" H. Narasimhamurti Rao<br>" Shaikh Muhammad Salik | 37 Surveyors, &c.                  |  |
| No. 20 Party,<br><i>Cantonments and Military Stations in the 5th, 6th and 9th Divisions.</i> |                             | Mr. B. R. Hughes<br>" C. E. C. French<br>" O. D. Jackson  | Mr. Dharmu<br>" Jitendra Mohan Mukorji  | 22 Surveyors, &c.                  |  |
| Training Section,<br><i>Mysore.</i>  |                             | Mr. S. F. Norman  | Mr. Hari Ram Chandra<br>Jogalekar.  | 11 Surveyors, &c.<br>and Pupils.   |  |
| Salonika Survey Detachment.  |                             | T. Capt. H. B. Simons<br>Mr. H. T. Wyatt  | Mr. Jamna Prasad, B.S.  | 14 Surveyors, &c.                  |  |
| South-West Persia Survey Detachment.   |                             | Mr. F. H. Grant   |   | 5 Surveyors.                       |  |
| SUPERINTENDENT,<br>EASTERN CIRCLE  |                             | —Lieut.-Colonel C. L. Robertson, C.M.G., R.E.   |   |                                    |  |
|  | <i>Imperial Officers.</i>   | <i>Provincial Officers.</i>   | <i>Upper Subordinates.</i>  | <i>Lower Subordinates, &amp;c.</i> |  |
| No. 5 Drawing Office, Shillong.  |                             | Mr. J. H. S. Wilson<br>" Pramadarajan Ray, B.S.<br>" E. Claudius  |   | 24 Surveyors, &c.                  |  |
| No. 9 Party,<br><i>Bengal.</i>   |                             | Mr. E. J. Biggie<br>" A. B. Hunter<br>" Amar Krishna Mitra<br>" H. T. Hughes  | Mr. Amulya Charan Ghosh<br>" Gopal Lal Mitra                                      | 23 Surveyors, &c.                  |  |
| No. 10 Party,<br><i>Upper Burma.</i>   |                             | Mr. M. C. Petters<br>" W. G. Jarbo<br>" H. H. Creed<br>" Dharendra Nath<br>Banerjee, L.C.E.   | Mr. Dharendra Nath Saha<br>" Ram Prasad, B.S.<br>" Bhamba Ram                     | 27 Surveyors, &c.                  |  |
| No. 11 Party,<br><i>Lower Burma.</i>   |                             | Mr. J. O. Greiff<br>" O. J. H. Hart<br>" E. M. Kenny<br>" C. O. Picard<br>" A. V. Dickson   | Mr. Pratul Chandra Sen Gupta,<br>B.Sc.  | 26 Surveyors, &c.                  |  |
| No. 12 Party,<br><i>Assam.</i>   | Captain F. B. Scott, I.A.   | Mr. H. W. Biggie<br>" E. G. Hardinge<br>" Pramadarajan Ray, B.S.<br>" Prafulla Chandra Mitra,<br>B.A.<br>" K. S. Gopalachari, B.A.  | Mr. Girija Sonker Bagchi  | 25 Surveyors, &c.                  |  |
| Special Burma Forest Survey Party,<br><i>Upper Burma.</i>                                    |                             | Mr. H. W. Biggie<br>" W. G. Jarbo   | Mr. Bhamba Ram  | 9 Surveyors, &c.                   |  |
| Kuki Survey Detachment,<br><i>Assam.</i>   |                             | Mr. H. T. Hughes  |   | 3 Surveyors.                       |  |

TABLE I—(Concluded).—DISPOSITION OF OFFICERS, 1918-19.

| SUPERINTENDENT OF THE<br>TRIGONOMETRICAL SURVEY }—Colonel Sir Gerald P. Lenox-Conyngham, Kt., B.E., F.R.S. |   | Imperial Officers. | Provincial Officers.  | Upper Subordinates.                                      | Lower<br>Subordinates, &c.                      |
|--|---|--------------------|---|--|---|
| Superintendent's<br>Office.  | (Attached)<br>Mr. H. G. Salmond (on deputa-<br>tion from Eastern Bengal<br>Railway).  |                    | Mr. H. A. Charrier.....<br>" C. S. Molnes   |  |   |
| Computing Office   | Major H. McC. Cowie, B.E. ...<br>" C. M. Thompson, I.A.   |                    | Mr. Hanuman Prasad.....   | Mr. Sarat Kumar Mukerji.....<br>" Karuna Kumar Das, B.A. | 42 Computers, &c.                               |
| No. 2 Drawing<br>Office and Forest<br>Map Office, Dehra<br>Dun.  | Colonel R. A. Wanhope, C.B.,<br>C.M.G., C.I.E., B.E.<br>Major F. J. M. King, B.E.   |                    | Mr. C. C. Byrne .....<br>" Rama Prasad Ray, B.A.<br>" O. N. Pushong<br>" J. McCracken, M.B.E.<br>" T. F. Kitchen<br>" Raj Bahadur Mathur,<br>B.A.                                 | Mr. Ram Singh, B.S. ....<br>" Jugal Behari Lal           | 165 Draftsmen, &c.                              |
| No. 13 Party,.....<br>(Astronomical).  | Major H. McC. Cowie, B.E. ....<br>" M. O'C. Tandy, D.S.O.,<br>O.B.E., B.E.<br>Bt.-Major C. G. Lewis, B.E.<br>Major C. M. Thompson, I.A.                                     |                    |   |  | 2 Computers, &c.                                |
| No. 14 Party,.....<br>(Pendulum).  | Major H. McC. Cowie, B.E. ....<br>" C. M. Thompson, I.A.  |                    |   |  | 1 Clerk.  |
| No. 15 Party,.....<br>(Triangulation).   | Major R. H. Thomas, D.S.O.,<br>B.E.<br>" R. Foster, I.A.<br>Bt.-Major C. G. Lewis, B.E.   |                    | Mr. H. G. Shaw .....<br>" C. S. Molnes<br>" Abdul Karim, B.A.   |  | 9 Computers, &c.                                |
| No. 16 Party,.....<br>(Tidal).   |   |                    | Mr. O. C. Ollenbach .....<br>" Syed Zille Hasmain, K.S.   |  | 20 Computers, &c.                               |
| No. 17 Party,.....<br>(levelling).   |   |                    | Mr. H. G. Shaw .....<br>" O. N. Pushong<br>" D. H. Lusa<br>" J. McCracken, M.B.E.<br>" T. F. Kitchen<br>" K. S. Gopalachari,<br>B.A.<br>" Narendra Nath<br>" Chuckerbutty, L.C.M. | Mr. Karuna Kumar Das, B.A.<br>" Satish Chandra Mukerjee  | 12 Computers, &c.                               |
| No. 18 Party, .....<br>(Magnetic).   |   |                    | Mr. E. O. J. Bond, v.D. ...<br>" Nikunjo Ronjon Ma-<br>sundar   | Mr. Bidhu Bhuvan Shome.....                              | 2 Magnetic Ob-<br>servers.<br>12 Computers, &c. |
| No. 19 Party,.....<br>(Base Line).   | Colonel Sir Gerald P. Lenox-<br>Conyngham, Kt., B.E.,<br>F.R.S.<br>Major H. McC. Cowie, B.E.<br>Bt.-Lt.-Colonel A. A. McHarg,<br>D.S.O., B.E.<br>Major C. M. Thompson, I.A. |                    |   |  | 1 Clerk.  |

## CONTENTS OF PART 2.—WORK OF FIELD PARTIES, &c.

|  | <i>Page.</i>  |
|--|---|
| <b>I.—TOPOGRAPHICAL SURVEYS</b> ... ..         | —Table II, Progress since 1905 ... 10<br>Table III, Out-turns and costs ... 11<br>Northern Circle ... .. 18<br>Southern Circle ... .. 14<br>Eastern Circle ... .. 14  |
| <b>II.—FOREST SURVEYS</b> ... ..               | —Northern Circle ... .. 17<br>Southern Circle ... .. 17<br>Eastern Circle ... .. 17   |
| <b>III.—CANTONMENT AND LARGE-SCALE SURVEYS</b> | —No. 1 Party ... .. 18<br>No. 2 Party ... .. 18<br>Simla Survey Detachment ... 18<br>Punjab Riverain Survey Party 18<br>No. 9 Party ... .. 19<br>Cantonments ... .. 20  |
| <b>IV.—THE TRIGONOMETRICAL SURVEY</b> ... ..   | —Astronomical Latitudes ... 21<br>Pendulum Observations ... 21<br>Triangulation ... .. 21<br>Tidal Operations ... .. 21<br>Levelling ... .. 22<br>Base Line Operations ... .. 23<br>Magnetic Survey ... .. 23 |

**PART 2.—WORK OF FIELD PARTIES, &c.****1.—TOPOGRAPHICAL SURVEYS.**

13. The two following tables show respectively the progress of the topographical programme assigned to the department in 1905 and the out-turns and costs of different parties during the year under report. They are followed by brief descriptions of the work of each topographical party.

In 1913, the Secretary of State sanctioned a scheme for the reduction of the scale of survey of certain sparsely populated areas of India. This will greatly reduce the area of survey on the one-inch scale and consequently accelerate the rate of progress of topographical surveys shown in Table II below. In order to give a better idea of what work actually lies before the department, it may be remarked that of the area remaining for survey about 588,000 square miles are likely to be surveyed on the half-inch or smaller scale.

**Table II.—Progress of Topographical Surveys since 1905.**

| Survey year.  | Scales of Survey.                     | Northern Circle.  | Southern Circle.  | Eastern Circle.   | TOTALS.           |
|---|---------------------------------------|-------------------|-------------------|-------------------|-------------------|
|   |                                       | <i>Sq. miles.</i> | <i>Sq. miles.</i> | <i>Sq. miles.</i> | <i>Sq. miles.</i> |
| 1905-06 ...   | Mostly 2-inch and 1-inch              | 6,278             | 1,660             | 10,822            | 18,260            |
| 1906-07 ...   | ditto ...                             | 7,519             | 7,868             | 8,659             | 28,844            |
| 1907-08 ...   | ditto ...                             | 14,590            | 9,256             | 12,481            | 36,217            |
| 1908-09 ...   | ditto ...                             | 18,824            | 12,526            | 11,542            | 42,692            |
| 1909-10 ...   | Mostly 1-inch                         | 28,889            | 12,582            | 9,786             | 46,101            |
| 1910-11 ...   | ditto ...                             | 27,528            | 13,171            | 9,218             | 49,917            |
| 1911-12 ...   | ditto ...                             | 23,852            | 9,115             | 10,654            | 43,621            |
| 1912-13 ...   | Mostly 1-inch and $\frac{1}{2}$ -inch | 28,192            | 13,849            | 11,886            | 53,927            |
| 1913-14 ...   | ditto ...                             | 25,052            | 15,844            | 14,890            | 55,786            |
| 1914-15 ...   | ditto ...                             | 12,884            | 19,286            | 5,056             | 37,226            |
| 1915-16 ...   | ditto ...                             | 8,168             | 17,243            | 6,981             | 32,392            |
| 1916-17 ...   | ditto ...                             | 11,689            | 11,338            | 9,723             | 32,750            |
| 1917-18 ...   | ditto ...                             | 4,202             | 12,181            | 8,396             | 24,779            |
| 1918-19 ...   | ditto ...                             | 509*              | 7,263             | 6,176†            | 13,948            |
| <b>Total areas completed to date ..</b>                         |                                       | <b>212,310</b>    | <b>162,430</b>    | <b>135,570</b>    | <b>510,310</b>    |
| <b>Approximate areas for the whole topographical programme.</b> |                                       | <b>750,000</b>    | <b>542,800</b>    | <b>528,800</b>    | <b>1,821,600</b>  |
| <b>Approximate areas remaining for survey.</b>                  |                                       | <b>537,690</b>    | <b>380,370</b>    | <b>393,230</b>    | <b>1,311,290</b>  |

\* Excluding 82 square miles of biennial Delhi revision survey on scale of 4 inches = 1 mile.

† Excluding 3,738 square miles of revision survey (provisional) on scale of  $\frac{1}{2}$  inch = 1 mile.



**Table III.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1918-19.**

| PARTY and LOCALITY.  |  | OUT-TURNS OF PLANE-TABLING.        |                                | COSTS OF SURVEY INCLUDING MAPPING. |                                | REMARKS.  |
|--|--|------------------------------------|--------------------------------|------------------------------------|--------------------------------|---|
|  |  | Areas on each Scale of each Class. | Totals of areas on all Scales. | Total costs.                       | Cost-rates.                    |   |
| Character of Country.  | Scale and Class of Survey.             |                                    |                                |                                    |                                |   |
|  |  | Sq. miles.                         |                                | Rs.                                | Rs. per sq. mile.              |   |
| <b>NORTHERN CIRCLE.</b>  |  |                                    |                                |                                    |                                |   |
| <b>No. 1 Party—United Provinces, Punjab, Central India.</b>                        |  |                                    |                                |                                    |                                |   |
| Open undulating mostly cultivated country with few hills.                          | 1-inch Original Survey Military        | 92                                 | 320                            | 75,152                             | Indeterminate (a)              | (a) The areas surveyed are so small and so far apart, entailing such costly moves, that it is impossible to arrive at a rational cost-rate for the actual work of survey. |
| Open undulating mostly cultivated country with few hills.                          | 3-inch Original Survey Military        | 188                                |                                |                                    |                                |   |
| Flat valley intersected by usually dry water courses between high ranges of hills. | 3-inch Original Survey Military        | 95                                 |                                |                                    |                                |   |
|  | Large-Scale Surveys                    |                                    |                                |                                    |                                |   |
| <b>No. 2 Party—United Provinces, Delhi Province and Rajputana.</b>                 |  |                                    |                                |                                    |                                |   |
| Low rocky hills and cultivated plains.   | 4-inch Revision Survey                 | 82                                 | 82                             | 74,556 (b)                         | Indeterminate (a)              | (b) Includes Rs. 5,343 debitable to Rajputana and Rs. 268 debitable to Forest Department, U. P.   |
|  | Large-Scale Surveys                    |                                    |                                |                                    |                                |   |
| <b>No. 3 Party—United Provinces.</b>   |  |                                    |                                |                                    |                                |   |
| Wooded hills   | 4-inch Original Special Forest Survey. | 189                                | 189                            | 92,051 (c)                         | Indeterminate (a)              | (c) Includes Rs. 18,420 debitable to Forest Department, U. P.   |
| <b>TOTALS, NORTHERN CIRCLE:—</b>   |  | <b>591</b>                         | <b>sq. m.</b>                  | <b>Rs. 2,41,759</b>                | <b>Cost-Indeterminate rate</b> |   |
| <b>SOUTHERN CIRCLE.</b>  |  |                                    |                                |                                    |                                |   |
| <b>No. 5 Party—Central Provinces.</b>  |  |                                    |                                |                                    |                                |   |
| Well-wooded hills and cultivated plains.   | 1-inch Original Survey                 | 979                                | 1,442                          | 55,112 (d)                         | 38.2                           | (d) Excludes Rs. 13,104, cost of 1-inch mapping, and Rs. 2,500, cost of 3-inch mapping.   |
| Wooded intricate hills   | 1-inch Revision Survey                 | 468                                |                                |                                    |                                |   |
| <b>No. 6 Party—Bombay and Hyderabad.</b>   |  |                                    |                                |                                    |                                |   |
| Undulating and cultivated  | 1/2-inch Original Survey               | 178                                | 2,359                          | 78,282                             | 33.2                           |   |
| Ditto ditto  | 1-inch Original Survey                 | 274                                |                                |                                    |                                |   |
| Ditto ditto  | 1-inch Supplementary Survey            | 1,870                              |                                |                                    |                                |   |
| Wooded hills   | 1 1/2-inch Original Survey             | 287                                |                                |                                    |                                |   |
| <b>No. 7 Party—Madras.</b>   |  |                                    |                                |                                    |                                |   |
| Varied, mostly open plains   | 1-inch Original Survey                 | 2,226                              | 2,238                          | 50,284                             | 25.1                           |   |
| Open, scrub jungle   | 2-inch Original Survey                 | 12                                 |                                |                                    |                                |   |
| <b>No. 8 Party—Madras.</b>   |  |                                    |                                |                                    |                                |   |
| Wooded intricate hills, undulating and cultivated.                                 | 1-inch Supplementary Survey            | 1,182                              | 1,224                          | 53,828 (e)                         | 52.1                           | (e) Excludes Rs. 5,355, cost of 1-inch mapping.   |
| Wooded hills   | 1-inch Revision Survey                 | 42                                 |                                |                                    |                                |   |
| <b>TOTALS, SOUTHERN CIRCLE:—</b>   |  | <b>7,263</b>                       | <b>sq. m.</b>                  | <b>Rs. 2,53,401</b>                | <b>Cost-rate 34.8</b>          |   |

**PART 2.—WORK OF FIELD PARTIES, &c.****1.—TOPOGRAPHICAL SURVEYS.**

13. The two following tables show respectively the progress of the topographical programme assigned to the department in 1905 and the out-turns and costs of different parties during the year under report. They are followed by brief descriptions of the work of each topographical party.

In 1913, the Secretary of State sanctioned a scheme for the reduction of the scale of survey of certain sparsely populated areas of India. This will greatly reduce the area of survey on the one-inch scale and consequently accelerate the rate of progress of topographical surveys shown in Table II below. In order to give a better idea of what work actually lies before the department, it may be remarked that of the area remaining for survey about 588,000 square miles are likely to be surveyed on the half-inch or smaller scale.

**Table II.—Progress of Topographical Surveys since 1905.**

| Survey year.  | Scales of Survey.                     | Northern          | Southern          | Eastern           | TOTALS.           |
|---|---------------------------------------|-------------------|-------------------|-------------------|-------------------|
|   |                                       | Circle.           | Circle.           | Circle.           |                   |
|   |                                       | <i>Sq. miles.</i> | <i>Sq. miles.</i> | <i>Sq. miles.</i> | <i>Sq. miles.</i> |
| 1905-06 ...   | Mostly 2-inch and 1-inch              | 6,278             | 1,660             | 10,322            | 18,260            |
| 1906-07 ...   | ditto                                 | 7,519             | 7,666             | 8,659             | 28,844            |
| 1907-08 ...   | ditto                                 | 14,580            | 9,256             | 12,481            | 86,217            |
| 1908-09 ...   | ditto                                 | 18,624            | 12,526            | 11,542            | 42,692            |
| 1909-10 ...   | Mostly 1-inch                         | 28,889            | 12,582            | 9,736             | 46,101            |
| 1910-11 ...   | ditto                                 | 27,528            | 13,171            | 9,216             | 49,917            |
| 1911-12 ...   | ditto                                 | 28,852            | 9,116             | 10,654            | 48,621            |
| 1912-13 ...   | Mostly 1-inch and $\frac{1}{2}$ -inch | 28,192            | 13,849            | 11,886            | 53,877            |
| 1913-14 ...   | ditto                                 | 25,052            | 15,844            | 14,890            | 55,786            |
| 1914-15 ...   | ditto                                 | 12,884            | 10,286            | 5,056             | 86,876            |
| 1915-16 ...   | ditto                                 | 8,168             | 17,248            | 6,981             | 82,842            |
| 1916-17 ...   | ditto                                 | 11,689            | 11,838            | 9,728             | 82,750            |
| 1917-18 ...   | ditto                                 | 4,202             | 12,181            | 8,396             | 24,779            |
| 1918-19 ...   | ditto                                 | 509*              | 7,263             | 6,176†            | 13,948            |
| <b>Total areas completed to date</b>                            |                                       | <b>212,310</b>    | <b>162,430</b>    | <b>135,570</b>    | <b>510,310</b>    |
| <b>Approximate areas for the whole topographical programme.</b> |                                       | <b>750,000</b>    | <b>542,800</b>    | <b>528,800</b>    | <b>1,821,600</b>  |
| <b>Approximate areas remaining for survey.</b>                  |                                       | <b>537,690</b>    | <b>380,370</b>    | <b>393,230</b>    | <b>1,311,290</b>  |

\* Excluding 88 square miles of biennial Delhi revision survey on scale of 4 inches = 1 mile.

† Excluding 3,738 square miles of revision survey (provisional) on scale of  $\frac{1}{2}$  inch = 1 mile.

**Table III.—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1918-19.**

| PARTY and LOCALITY.  |  | OUT-TURNS OF PLANE-TABLING.        |                                | COSTS OF SURVEY INCLUDING MAPPING. |                   | REMARKS.  |
|--|--|------------------------------------|--------------------------------|------------------------------------|-------------------|---|
|  |  | Arens on each Scale of each Class. | Totals of arens on all Scales. | Total costs.                       | Cost-rate.        |   |
|  |  | Sq. miles.                         |                                | Rs.                                | Rs. per sq. mile. |   |
| <b>No. 1 Party—United Provinces, Punjab, Central India.</b>                        |  |                                    |                                |                                    |                   | <b>NORTHERN CIRCLE.</b>   |
| Open undulating mostly cultivated country with few hills.                          | 1-inch Original Survey Military        | 92                                 | 320                            | 75,152                             | Indeterminate (a) |   |
| Open undulating mostly cultivated country with few hills.                          | 3-inch Original Survey Military        | 188                                |                                |                                    |                   |   |
| Flat valley intersected by usually dry water courses between high ranges of hills. | 3-inch Original Survey Military        | 95                                 |                                |                                    |                   |   |
| Large-Scale Surveys  |  |                                    |                                |                                    |                   |   |
| <b>No. 2 Party—United Provinces, Delhi Province and Rājputāna.</b>                 |  |                                    |                                |                                    |                   | (b) Includes Rs. 5,333 debitabale to Rājputāna and Rs. 268 debitabale to Forest Department, U. P. |
| Low rocky hills and cultivated plains.   | 4-inch Revision Survey                 | 82                                 | 82                             | 74,556 (b)                         | Indeterminate (a) |   |
| Large-Scale Surveys  |  |                                    |                                |                                    |                   |   |
| <b>No. 3 Party—United Provinces.</b>   |  |                                    |                                |                                    |                   | (c) Includes Rs. 18,439 debitabale to Forest Department, U. P.                                    |
| Wooded hills   | 4-inch Original Special Forest Survey. | 189                                | 189                            | 92,051 (c)                         | Indeterminate (a) |   |
| Large-Scale Surveys  |  |                                    |                                |                                    |                   |   |
| <b>TOTALS, NORTHERN CIRCLE:—</b>   |  | <b>591</b>                         | <b>sq. m.</b>                  | <b>Rs. 2,41,759</b>                | <b>Cost-rate</b>  | <b>Indeterminate.</b>   |
|  |  |                                    |                                |                                    |                   | <b>SOUTHERN CIRCLE.</b>   |
| <b>No. 5 Party—Central Provinces.</b>  |  |                                    |                                |                                    |                   |   |
| Well-wooded hills and cultivated plains.   | 1-inch Original Survey                 | 979                                | 1,442                          | 55,112 (d)                         | 38.2              |   |
| Wooded intricate hills   | 1-inch Revision Survey                 | 468                                |                                |                                    |                   |   |
| <b>No. 6 Party—Bombay and Hyderabad.</b>   |  |                                    |                                |                                    |                   | (d) Excludes Rs. 12,104, cost of 4-inch mapping, and Rs. 2,630, cost of 3-inch mapping.           |
| Undulating and cultivated  | 1-inch Original Survey                 | 178                                | 2,359                          | 78,282                             | 33.2              |   |
| Ditto ditto  | 1-inch Original Survey                 | 274                                |                                |                                    |                   |   |
| Ditto ditto  | 1-inch Supplementary Survey            | 1,870                              |                                |                                    |                   |   |
| Wooded hills   | 1½-inch Original Survey                | 287                                |                                |                                    |                   |   |
| <b>No. 7 Party—Madras.</b>   |  |                                    |                                |                                    |                   | (e) Excludes Rs. 4,355, cost of 4-inch mapping.   |
| Varied, mostly open plains   | 1-inch Original Survey                 | 2,226                              | 2,238                          | 56,284                             | 25.1              |   |
| Open, scrub jungle   | 2-inch Original Survey                 | 12                                 |                                |                                    |                   |   |
| <b>No. 8 Party—Madras.</b>   |  |                                    |                                |                                    |                   |   |
| Wooded intricate hills, undulating and cultivated.                                 | 1-inch Supplementary Survey            | 1,182                              | 1,224                          | 68,828 (e)                         | 52.1              |   |
| Wooded hills   | 1-inch Revision Survey                 | 42                                 |                                |                                    |                   |   |
| <b>TOTALS, SOUTHERN CIRCLE:—</b>   |  | <b>7,263</b>                       | <b>sq. m.</b>                  | <b>Rs. 2,53,401</b>                | <b>Cost-rate</b>  | <b>34.8</b>   |

Table III.—(Concluded).—OUT-TURNS of PLANE-TABLING and COSTS of Topographical Surveys, 1918-19.

| PARTY and LOCALITY.   |   | OUT-TURNS OF PLANE-TABLING.        |                                | COSTS OF SURVEY INCLUDING MAPPING. |                                       | REMARKS.   |
|---|---|------------------------------------|--------------------------------|------------------------------------|---------------------------------------|--|
|   |   | Areas on each Scale of each Class. | Totals of areas on all Scales. | Total costs.                       | Cost-rates.                           |  |
|   |   | Sq. miles.                         |                                | Rs.                                | Rs. per sq. mile.                     |  |
|   |   |                                    |                                |                                    |                                       | <b>EASTERN CIRCLE.</b>   |
| <b>No. 9 Party—Bengal.</b>  |   |                                    |                                |                                    |                                       |  |
| Flat and cultivated plains  | ... 1-inch Original Survey                  | 548                                | 548                            | 29,858 <sup>(f)</sup>              | 54·5                                  | (f) Excludes Rs. 9,752, cost of 1-inch mapping, and Rs. 21,400, cost of 12-inch survey.  |
| <b>No. 10 Party—Upper Burma.</b>  |   |                                    |                                |                                    |                                       |  |
| High hills, densely wooded  | ... 1/4-inch Revision Survey (Provisional). | 867 <sup>(g)</sup>                 | 3,516                          | 1,45,658 <sup>(g)</sup>            | 41·4                                  | (g) Includes Rs. 31,696, debitable to the Forest Department on account of special forest surveys, and Rs. 8,426 on account of 1/4-inch survey which, as only provisional, will be redone on the 1/2-inch scale in the near future. |
| High mountains with densely wooded valleys.   | ... 1/4-inch Original Survey                | 2,846                              |                                |                                    |                                       |  |
| Densely wooded hills  | ... 1-inch Original Survey                  | 748                                |                                |                                    |                                       |  |
| Wooded hills, free of undergrowth   | ... 2-inch Original Special Forest Survey.  | 55                                 |                                |                                    |                                       |  |
| <b>No. 11 Party—Lower Burma.</b>  |   |                                    |                                |                                    |                                       |  |
| High hills, densely wooded, from 400 to 9,000 feet.   | ... 1/4-inch Revision Survey (Provisional). | 1,080 <sup>(h)</sup>               | 2,323                          | 1,52,587 <sup>(h)</sup>            | 65·7                                  | (h) Includes cost of Maymyo Drawing Office and Rs. 4,234 on account of 1/4-inch survey which, as only provisional, will be redone on the 1/2-inch scale in the near future.  |
| High hills and low undulating ground containing large areas of swamp and marsh, densely wooded. | ... 1-inch Original Survey                  | 1,217                              |                                |                                    |                                       |  |
| Densely wooded hills  | ... 1-inch Revision Survey                  | 26                                 |                                |                                    |                                       |  |
| <b>No. 12 Party—Assam.</b>  |   |                                    |                                |                                    |                                       |  |
| Plains, mostly densely wooded and partly under cultivation and a portion of a range of hills.   | ... 1-inch Original Survey                  | 1,168                              | 1,216                          | 96,907                             | 79·7                                  |  |
| Plains, mostly densely wooded and partly under cultivation and a portion of a range of hills.   | ... 1-inch Revision Survey                  | 80                                 |                                |                                    |                                       |  |
| Densely wooded plains   | ... 2-inch Original Survey                  | 28                                 |                                |                                    |                                       |  |
| <b>Special Burma Forest Survey Party—Upper Burma.</b>   |   |                                    |                                |                                    |                                       |  |
| Wooded hills  | ... 2-inch Original Survey                  | 20                                 | 20                             | 19,871                             | 993·5                                 |  |
| <b>Kuki Survey Detachment—Assam.</b>  |   |                                    |                                |                                    |                                       |  |
| Hilly and for the most part forest clad.  | ... 1/4-inch Revision Survey (Provisional). | 2,291 <sup>(i)</sup>               | 2,291                          | 10,057 <sup>(j)</sup>              | 4·4                                   | (i) Has not been included in Table II as being only provisional.<br>(j) Refers to plane-tabling only.  |
| <b>TOTALS, EASTERN CIRCLE:—</b>   |   | <b>9,914 sq. m.</b>                |                                | <b>Rs. 4,54,938</b>                | <b>Cost-rate 45·9</b>                 |  |
| <b>GRAND TOTALS:—</b>   |   | <b>17,768 sq. m.</b>               |                                | <b>Rs. 9,50,098</b>                | <b>Cost-rate Indeter-<br/>minate.</b> |  |

**NORTHERN CIRCLE** (*vide* Index map No. 1).

**14. No. 1 Party.**—Three Artillery Practice Camps, comprising an area of 228 square miles, were surveyed on the scale of 3 inches = 1 mile in the vicinities of Jhānsi, Mhow and Quetta. In the case of the first named 16 square miles, and in the case of the second named 76 square miles, were surveyed in addition on the scale of 1 inch = 1 mile, for subsequent enlargement to complete the sheets of the Artillery Practice Camp maps to margin (*vide* also page 45).

The party also carried out large-scale surveys of the cities of Lahore and Ferozepore for the preparation of "Town Guide" maps (*vide* page 18).

**15. No. 2 Party.**—Carried out the biennial revision survey of 64 square miles of Imperial Delhi and New Cantonment, and of 18 square miles outside Imperial limits, on the scale of 4 inches = 1 mile (*vide* page 18).

The activities of this party were mainly confined to large-scale surveys of the cities of Allahābād, Cawnpore, Benares and Agra for the preparation of "Town Guide" maps (*vide* page 18), and to a large-scale survey of the hill station of Mount Abu and vicinity, still in progress (*vide* page 18).

**16. No. 3 Party.**—This party only undertook the survey of 189 square miles in the Dehra Dūn district of the United Provinces, and Dhādi and Raingarh States, Punjab. The survey was executed on the scale of 4 inches = 1 mile in connection with reserved forests (*vide* page 17).

**17. No. 4 Party.**—This party continued in abeyance throughout the year, the Officer in charge being specially employed in connection with the triangulation and traverse records of the Northern Circle, and on other miscellaneous duties.

**18. Training.**—25 pupil surveyors were entertained in June 1919 and drafted into the parties, &c., for preliminary training in drawing during the recess season as follows:—

|                        |     |       |
|------------------------|-----|-------|
| To No. 2 Party         | ... | 6 men |
| " " 3 "                | ... | 6 "   |
| " Sind-Sāgar Party     | ... | 6 "   |
| " No. 3 Drawing Office | ... | 7 "   |

At the close of the recess these men will take the field with No. 2 Party for training in survey.

In addition to the men referred to above, 7 soldier surveyors and 14 pupil surveyors are undergoing their first and second year's training respectively in No. 2 Party making a total of 46 men under training.

**19. Recess Work.**—As in previous year, the programme of fair-mapping has been considerably retarded owing to special work on "Town Guide" maps and transfer of a large number of good surveyors and draftsmen to parties and detachments on active service on the North-West Frontier, in Persia, Mesopotamia and elsewhere.

The fair-mapping of the following sheets of the current and previous season's survey remained for completion on 30th September 1919:—

|                                   |     |     |
|-----------------------------------|-----|-----|
| Sheets on the 1-inch scale        | ... | 17. |
| Sheets on the 2-inch scale        | ... | 12. |
| Royal Artillery Practice Camp Map | ... | 1.  |
| Town Guide Maps                   | ... | 7.  |
| Simla Extension Survey            | ... | 5.  |

20. Particulars of special work done by Nos. 1, 2, 3, the Sind-Sāgar, and Riverain Parties, are given on pages 18, 19, 45 and 46.

#### SOUTHERN CIRCLE (*vide* Index map No. 1).

21. **No. 5 Party.**—This party surveyed an area of 1,442 square miles on the scale of 1 inch = 1 mile in the Jubbulpore, Mandlā and Seoni districts of the Central Provinces, and triangulated an area of 1,652 square miles in the Chhindwāra, Seoni and Bālāghāt districts of the Central Provinces. The country consisted of jungle-clad hills and of well-wooded cultivated plains. The majority, including the head-quarters of the party, remained at Bangalore throughout the year and was principally employed on the fair-mapping of half-inch sheets compiled from published sheets of the one-inch map.

22. **No. 6 Party.**—This party surveyed an area of 2,359 square miles on different scales in the Bijāpur district of Bombay and the Gulbarga, Raichūr and Mahbūbnagar districts of Hyderābād (Daccan), and triangulated an area of 1,699 square miles in the Nalgonda and Warangal districts of Hyderābād. The country surveyed is undulating and highly cultivated, except the forest areas which consist of sparsely wooded hills.

23. **No. 7 Party.**—This party surveyed an area of 2,238 square miles on different scales in the Guntūr, Kurnool and Nellore districts of Madras. The country surveyed comprised open expanses of cultivated land, with isolated barren rocky hills standing out conspicuously from the plains and well distributed over the area.

24. **No. 8 Party.**—This party surveyed an area of 1,224 square miles on the scale of 1 inch = 1 mile in the Tinnevely district and the Travancore State of Madras, and traversed 248 linear miles in the Rāmnād and Tanjore districts of Madras. The country surveyed comprises a portion of the Western Ghāts, mostly forest clad, bold and rugged in its northern reaches, but losing much of its characteristic boldness and steepness as it approaches the sea in its southward trend to Cape Comorin. It divides the country on its flanks into undulating and low lying plains, intensely cultivated, and dotted with numerous scattered huts and village sites and covered with a dense growth of palmyras.

25. **Training Section.**—This section took the field in the Kolār district of Mysore, 9 pupil surveyors received instruction in topographical surveying.

26. **Recess Work.**—The whole of the area surveyed this year will be fair-mapped before the close of this recess season, leaving the parties with no arrears of fair-mapping for next recess season. All the sheets surveyed in the previous year have been fair-mapped, with the exception of one sheet which requires a further reference to the ground but is otherwise completed.

Half-inch mapping from published modern one-inch sheets and quarter-inch mapping are dealt with on page 42.

27. The report on the survey of cantonments and military stations, undertaken by No. 20 Party, is entered on page 20.

#### EASTERN CIRCLE (*vide* Index map No. 1).

28. **No. 9 Party.**—This party executed a topographical survey, on the scale of 1 inch = 1 mile, of 548 square miles in the districts of

Burdwān, Hooghly, Nadiā and Twenty-four Parganas of Bengal, and in the French Settlement of Chandernagore.

The country surveyed lies in the plains of Bengal. It is covered by a number of large and well wooded villages, the intervening spaces being under cultivation.

The river Hooghly flows due south through the eastern portion of the work, and, on its banks are situated several large towns and villages of great commercial importance as centres of jute and paper manufacture and of other industries.

The party also carried out surveys, on the scale of 12 inches = 1 mile, of the towns of Barrackpore and Dum-Dum for the preparation of "Town Guide" maps (see page 19).

**29. No. 10 Party.**—This party surveyed an area of 3,149 square miles, on the scales of 2 inches, 1 inch and  $\frac{1}{2}$  inch = 1 mile, in Meiktila, Myitkyinā, and Putao districts and unadministered territory of Upper Burma. It also traversed an area of 254 square miles in the Meiktila and Kathā districts in advance, for special forest surveys on the scales of 4 inches and 2 inches = 1 mile, and triangulated 1,700 square miles in advance for topographical surveys on the scale of one inch = 1 mile in the Kathā district. The country surveyed in the Meiktila and Kathā districts consisted of well wooded hills at an average elevation of 3,000 feet. In the Myitkyinā and Upper Chindwin districts, the area surveyed consisted of high ridges separated by broad valleys covered with dense forest growth. In the Putao district, the area comprised the high mountainous and hitherto practically unknown region at the source of the Irrawaddy river, and ranged in altitude from 2,000 feet to 19,000 feet above mean sea level. The highest snow peak fixed in this area, which is probably the highest point in the province of Burma, lies at the source of the Nam Tamai, one of the two tributaries of the Irrawaddy in its upper reaches, and has an elevation of 19,315 feet.

A Forest Survey Detachment was constituted on 1st December 1918. The personnel of this detachment was transferred to the Special Burma Forest Survey Party on its formation on 1st May 1919 (*vide* page 17).

A surveyor was deputed during the field season to accompany the Kūki Punitive Measures Force operating in the Somra tract on the Burma-Assam frontier, and surveyed, on the scale of  $\frac{1}{2}$  inch = 1 mile, an area of 367 square miles.

A section of the party consisting of 6 surveyors under a Provincial officer remained in the Putao district during the summer to complete the detail survey of the region, usually under snow in the winter, at the headwaters of the Irrawaddy.

**30. No. 11 Party.**—The party continued operations in Lower Burma, and surveyed, on the scale of 1 inch = 1 mile, in the Tavoy and Mergui districts, 1,243 square miles, and triangulated an area of 1,810 square miles in advance for detail survey. Of the total area surveyed 26 square miles is revision survey on the scale of 1 inch = 1 mile.

A surveyor was deputed to the Kūki Punitive Measures Force operating in the Somra tract on the Burma-Assam frontier, and surveyed, on the scale of  $\frac{1}{2}$  inch = 1 mile, an area of 1,080 square miles.

The country surveyed in the Mergui district comprised the basin of the Little Tenasserim river and its two principal tributaries. Except for a small area lying at the confluence of these tributaries with the main

river, the country is thickly wooded, waterlogged in parts, and rises gradually to the main watershed which separates this district from Siam. The area surveyed is of much historical interest being the *locale* of the once famous overland route, which centuries ago played so important a part in the history and commerce of the ancient kingdom of Siam.

**31. No. 12 Party.**—This party surveyed 1,193 square miles, on the scale of 1 inch = 1 mile, and 23 square miles of reserved forests, on the scale of 2 inches = 1 mile, in the districts of Lakhimpur and Sibsāgar and the Sadiyā frontier tract of Assam. 2,735 square miles of triangulation and 258 linear miles of traversing, covering an area of 410 square miles, was carried out in districts Lakhimpur, Khāsi and Jaintiā Hills, Sylhet and Nowgong, to provide points for detail survey in 1919-20. The area surveyed was flat country partly covered with dense jungle of trees, cane, and tall grass and partly cultivated; and the area triangulated and traversed comprised hills rising to 5,000 feet and plains, both covered with dense jungle, except portions of the plains area which have been cleared for cultivation.

**32. Kūki Survey Detachment.**—This detachment was formed at the end of March 1919 to revise the existing maps of the areas of the Manipur State, in which the Kūki Punitive Measures Force was then operating, in so far as the political and military circumstances would permit. It consisted of 3 plane-tablers under an officer of the Provincial Service and completed the revision, on the  $\frac{1}{4}$ -inch scale, of 2,291 square miles of the existing map, in the southern part of the state and along part of the northern boundaries of the Chin Hills and Lushai Hills, by the middle of June. The work was based on existing triangulation and the whole area dealt with will come under systematic survey in the course of the next few years. It has therefore been considered as merely provisional.

**33. Recess Work.**—Only 2 one-inch sheets, out of 21 one-inch and 2 half-inch sheets surveyed during the year under report, were received in the circle drawing office for publication up to 30th September 1919.

The fair-mapping of 1 one-inch sheet surveyed in 1917-18 was in arrears on 30th September 1919.



## II.—FOREST SURVEYS.

34. Details of the topographical surveys of reserved forests executed by field parties of the Survey of India for the year under report are given below. In the majority of cases the surveys were carried out on the scale of 2 inches = 1 mile, but in special cases the 4 inches and 1 inch = 1 mile scales were used. Boundary surveys on the 4 inches = 1 mile scale were made where required.

## NORTHERN CIRCLE.

35. United Provinces. Western Forest Circle.—In the *Chakrata Forest Division*, 154 square miles of Reserved Forests and 35 square miles of overlap were surveyed on the scale of 4 inches = 1 mile.

## SOUTHERN CIRCLE.

36. Madras. Central Forest Circle.—In the *Nellore district*, 11.7 square miles comprising the *Pedairlapadu*, *Pedacherlopalle*, *Magalicherla* and *Ayyavaripalle* Reserved Forests, were surveyed on the scale of 2 inches = 1 mile.

## EASTERN CIRCLE.

37. Assam. Eastern Forest Circle.—In the *Lakhimpur Forest Division*, 22.6 square miles of the *Kadam* and *Panigaon* Reserved Forests were surveyed on the scale of 2 inches = 1 mile, and 1.7 miles of boundaries were traversed in advance of further detail surveys.

Western Forest Circle.—In the *Khasi and Jaintia Hills Forest Division*, 10.6 miles were traversed in advance for the survey of Blocks I and II of the *Narpuh* Reserved Forest.

38. Burma. Northern Forest Circle.—Preliminary to future detail surveys, boundary traverses were executed in the *Katha Forest Division*, 28.4 miles in the *Mezabya* Reserved Forest, and in the *Mansi Forest Division*, 100.7 miles in the *Mode*, *Hwelit*, *Nansaung* and *Chaunggyibya* Reserved Forests. In addition, 87.3 miles of interior lines were traversed.

Southern Forest Circle.—In the *Meiktila Forest Division*, 74.4 square miles of Reserved Forests were surveyed on the scale of 2 inches = 1 mile, and, for further surveys, 137.9 miles of forest boundaries and 23.6 miles of interior lines were traversed.

Tenasserim Forest Circle.—In the *Tenasserim Forest Division* 27.6 miles of boundaries were traversed in the *Heinze* and *Kaleinaung* Reserved Forests.

Special Burma Forest Survey Party.—This party was formed on the 1st May 1919, from a nucleus which had been constituted as a section of No. 10 Party, and worked in the Northern and Southern Forest Circles; the area surveyed is incorporated above.

### III.—CANTONMENT AND LARGE-SCALE SURVEYS.

**39. No. 1 Party.**—An area of 2·2 square miles was surveyed on the scale of 16 inches = 1 mile for "Town Guide" maps, comprising 1·7 square miles in Lahore city and environs and 0·5 square miles in Ferozepore city, both places being congested city areas.

**40. No. 2 Party.**—This party was employed on the revision surveys of the cities of Allahābād, Cawnpore and Benares on the scale of 16 inches = 1 mile, Agra city on the scale of 13·2 inches = 1 mile, and the cantonments, civil lines and environs of Allahābād, Agra, Lucknow, Cawnpore and Benares on the scale of 6 inches = 1 mile. Total area surveyed was 120·9 square miles.

The city of Lucknow will be mapped on the scale of 16 inches = 1 mile from air photographs taken for the purpose.

The survey of Mount Abu was started during the year in order to comply with a request from the Secretary, Public Works Department, Rājputāna, for the survey of the station itself, and its extension as acquired on lease by the Government from the Sirohi Darbār.

The area concerned comprises some 5,500 acres, averaging 4,000 feet above sea level, the leased portion consists of some cultivated and grass lands, but is mostly rocky ground covered with scrub jungle and trees, and inhabited area with intricate details.

The scale of survey is 24 inches = 1 mile, with a vertical interval of 10 feet for area suitable for building sites, and 50 feet for the rest. The area under survey is 5,000 acres with a few small over-laps making a total of some 5,500 acres. The necessary triangulation and traverse on which the survey is being based is completed and the detail work is now in hand, 584 acres has so far been completed.

In addition a small section of the party carried out the second of the biennial revisions of the four-inch maps of Imperial Delhi and Delhi New Cantonment during the year under report. The area dealt with amounted to 82 square miles, 64 of which comprised Imperial Delhi and the New Cantonment, and 18 square miles being portions outside the Imperial limits. This revision disclosed fairly considerable changes since the execution of the last survey on the same scale. These changes were due partly to demolitions, new lays-out and new construction, and partly to levelling operations, the latter necessitating a good deal of recontouring of the area of the Imperial city.

The cost-rate of revision survey works out at Rs. 36-4-0 per square mile, and that of mapping at Rs. 70-4-0 per square mile.

**41. No. 3 Party.**—(*Simla Survey Detachment*).—The detachment remained at Simla, and carried out the survey of certain areas of the Simla Extension Scheme.

During the year the following work was undertaken:—

Surveys near Potter's Hill, Jutogh Ridge, Prospect Hill and Mushobra.

Out of 19 sheets, 11 have been sent for publication, the mapping of 5 is well advanced and these will be ready in October.

**42. The Punjab Riverain Survey Party.**—The party continued the work of traversing and laying down base lines. 556 linear, and 611 square miles of main circuits; and 3,115 linear, and 611 square miles of minor traverses were executed; 944 theodolite stations of the former, and 13,003 of the latter, in 179 villages, were fixed.

1,026 corners of 342 squares were demarcated in 982 square miles with permanent mark-stones on both banks of the rivers Indus, Sutlej, Chenāb and Rāvi in districts Dera Ghāzi Khān, Muzaffargarh, Multān and the Bahāwalpur State, to serve as bases for the future survey and demarcation of boundaries and fields in the beds of the rivers.

2,034 plotted, and 646 boundary *masāwis* (settlement mapping sheets) on the scale of 1/2,640, and 41 four-inch sheets were traced, and supplied to the settlement officers concerned. Three 4-inch sheets of the Chenāb in districts Multān and Muzaffargarh were recompiled and completed. Besides these, 436 boundary *masāwis* were partly compiled on the scale 220 feet to an inch for the next season's work; and 190 miscellaneous traces were prepared, and all the traverse stations marked during the year were plotted on 38 four-inch sheets. Some of the computation volumes still remain to be completed.

At the request of the Settlement Officer, rectangulation in the Multān district was undertaken during March, and was finished in April 1919 in five riverain villages of the Sutlej in the Mailsi *Tahsil*. The work was based on the Sutlej riverain traverse. 153 corners of 51 rectangles were demarcated with pegs in 22 square miles, forming 46 blocks. 176 stations were fixed with theodolite, and 34 linear miles traversed.

At the request of the Deputy Commissioner, traversing of Jhelum town was commenced in March 1919 and was finished in April 1919. The work was based on the riverain traverse. 209 stations were fixed with theodolite and were permanently marked with stones; and 23 linear miles were traversed in 1,280 acres. Two plotted sheets, on the scale 16 inches = 1 mile, were supplied during May to the Deputy Commissioner, Jhelum.

43. No. 9 Party.—During the year under report, the party carried out a survey of towns of Barrackpore and Dum-Dum, on the scale of 12 inches = 1 mile, for the preparation of up to date "Town Guide" maps.

Field operations in connection with this survey commenced in the beginning of October 1918 and were completed by the end of March 1919.

The survey was partly supplementary and partly original. The former was based on existing traverse data and the latter on a theodolite traverse carried out early in the season in advance of the detail survey.

This latter traversing was connected with 3 stations of the Calcutta Longitudinal Series and the computations were completed in the field. 75.4 linear miles were traversed over an area of 16 square miles.

The supplementary survey comprised the cantonments of Barrackpore, Ishopore and Dum-Dum and extended over an area of 2,481 acres.

The area of original survey in the vicinity of Barrackpore extended westward to include the river Hooghly and a strip, about 200 feet wide, on its right bank. The total area of original survey in both Barrackpore and Dum-Dum is 10,162 acres.

The map of the Barrackpore area has been drawn in 4 sheets, each measuring 34.5 inches by 23.5 inches; that of the Dum-Dum area is in one sheet, measuring 27 inches by 27 inches; all for publication on the scale of survey.

**44. No. 20 Party.**—During the year under report, the party completed the survey of the cantonments and military stations of Bellary, Secunderābād and part of Bolārum on the scale of 16 inches = 1 mile and 5 *bazars* of Secunderābād on the scale of 64 inches = 1 mile. A revision survey of the *bazars* of Secunderābād and Bolārum, on the scale of 50 feet = 1 inch, is in progress.

The traversing and triangulation of Secunderābād and Bolārum, St. Thomas's Mount, Pallāvaram, the zone of Fort St. George, Wellington and of 5 small military areas at Ootacamund and Wellington have been completed, and that of West Hill and the Madras military lands is in hand.

The fair-mapping of the following cantonments and military stations has been completed during the year:—Jatta, Zām, Jandola, Drazinda, Nasirābād, Ghairat, Chaman, Drosh, Chitrāl, Thath, New Delhi, Agar and Erinpura, and that of Jhānsi, Aurangābād, Ahmadnagar, Manora, Hosūr and Bellary is well in hand.

Forty sheets have been fair-mapped and submitted for publication and forty-nine, twenty-two of which are of cantonments the surveys of which have been completed, are at different stages of completion.

The total out-turn of detail survey on the scale of 16 inches = 1 mile was 20,865 acres and, on the scale of 64 inches = 1 mile 92 acres, and the plans of 494 acres, on the scale of 50 feet = 1 inch were corrected. The total areas fair-mapped were 21,212 acres on the scale of 16 inches = 1 mile and 233 acres on the scale of 64 inches = 1 mile.

The total cost of detail survey on the scale of 16 inches = 1 mile was Rs. 20,781 and the cost-rate Re. 1 per acre, the corresponding figures for survey on scale of 64 inches = 1 mile being Rs. 1,698 and Rs. 18·5 per acre.

The total cost of correcting plans on the scale of 50 feet = 1 inch was Rs. 4,804 and the cost-rate Rs. 9·7 per acre.

The total cost of traversing for 16-inch survey was Rs. 18,161 and the cost-rate, Rs. 53·0 per linear mile.

The total cost of fair-mapping on the 16-inch scale was Rs. 7,115 and the cost-rate Re. 0·3 per acre, corresponding figures for the 64-inch scale being Rs. 1,104 and Rs. 4·7 per acre.

**Alphabetical List of Cantonments and Military Stations surveyed and published in modern style, on the scale of 16 inches = 1 mile, up to the end of 1918-19.**

|                                     |                                   |
|-------------------------------------|-----------------------------------|
| (1) Bakloh Cantonment.              | (16) Neemuch Cantonment.          |
| (2) Banna do.                       | (17) Peshāwar do.                 |
| (3) Chaman do.                      | (18) Quetta do.                   |
| (4) Dehra Dūn do.                   | (19) Quetta Civil Station.        |
| (5) Deoli do.                       | (20) Rājkot Cantonment.           |
| (6) Fort Lockhart do.               | (21) Rāwalpindi do.               |
| (7) Guna do.                        | (22) Sahāranpur Remount Depôt.    |
| (8) Hangu do.                       | (23) Sanāwar Cantonment.          |
| (9) Hāpur (Bābāgarh) Remount Depôt. | (24) Saugor do.                   |
| (10) Jhelum Cantonment.             | (25) Siālkot do.                  |
| (11) Jullundur do.                  | (26) Simla Indian Infantry Lines. |
| (12) Kālka do.                      | (27) * Sitābaldī Fort (Nāgpur).   |
| (13) Kamptee do.                    | (28) Thal Cantonment.             |
| (14) Landour do.                    | (29) Topa do.                     |
| (15) Meerut do.                     |                                   |

\* (On scale 24 inches = 1 mile).

IV.—THE TRIGONOMETRICAL SURVEY.

GEODETTIC OPERATIONS.

45. No. 13 Party.—Astronomical.—No latitude operations were carried out during the year under report and the personnel of this party was employed at the Head Quarters Office of the Trigonometrical Survey.

46. No. 14 Party.—Pendulum.—No pendulum operations were carried out during the year under report and the personnel of this party was reduced to a minimum and employed in miscellaneous work.

47. No. 15 Party.—Triangulation.—The party did not take the field during field season 1918-19.

48. No. 16 Party.—Tidal Operations.—During the year under report tidal registrations were carried out by means of self-registering tide-gauges at the stations given in the following list:—

| Stations.                 | Date of commencement of observations. | Date of closing of observations. | Number of years of observations. | REMARKS.                  |
|---------------------------|---------------------------------------|----------------------------------|----------------------------------|---------------------------|
| 1. Aden ...               | 1879 ...                              | Still working                    | 40                               | *With a small tide-gauge. |
| 2. Karachi ...            | 1888 ...                              | 1880                             | *18                              |                           |
|                           | 1891 ...                              | Still working                    | 89                               |                           |
| 3. Bombay (Apollo Bandar) | 1878 ...                              | "                                | 41                               |                           |
| 4. Bombay (Prince's Dock) | 1888 ...                              | "                                | 81                               |                           |
| 5. Madras ...             | 1880 ...                              | 1890                             | 10                               |                           |
|                           | Restarted 1895                        | Still working                    | 24                               |                           |
| 6. Kidderpore ...         | 1881 ...                              | "                                | 88                               |                           |
| 7. Rangoon ...            | 1880 ...                              | "                                | 89                               |                           |
| 8. Moulmein ...           | 1880 ...                              | 1888                             | 8                                |                           |
|                           | Restarted 1909                        | Still working                    | 10                               |                           |
| 9. Port Blair ...         | 1880 ...                              | "                                | 89                               |                           |

In addition to the above, the actual records of high and low water at Bhaunagar, Chittagong and Akyab were obtained from tide-pole readings taken during day-light by the Port Officers concerned.

Tidal observations on an ordinary wooden tide-gauge at Basrah were taken by the military authorities, and a copy of the record was supplied to this department by the Director, Inland Water Transport, Mesopotamia. The observations for the year commencing 1st January 1918 were reduced by the method of harmonic analysis and the constants thus deduced were used in the computation of data for the Basrah tide-tables for 1920. These data were forwarded on 30th April 1919 to the Director, National Physical Laboratory, Teddington, England, for the preparation of the tide-tables with the aid of the tide predicting machine.

The tide-tables have not yet been received.

Tidal registrations at the 9 observatories now working have, on the whole, been carried out satisfactorily and will be continued during the coming year.

All the above observatories with the exception of Aden were inspected during the year under report.

49. In the following table are given the annual and decadal percentages of errors in the predicted times and heights of high and low water at all the stations where observations have been taken by self-registering tide-gauges:—

PERCENTAGE OF ERRORS IN PREDICTED TIMES AND HEIGHTS.

| YEAR.                | AT OPEN COAST STATIONS. |                               |                             |                                      |           | AT RIVERAIN STATIONS.         |                     |                             |                                      |            |           |           |
|----------------------|-------------------------|-------------------------------|-----------------------------|--------------------------------------|-----------|-------------------------------|---------------------|-----------------------------|--------------------------------------|------------|-----------|-----------|
|                      | Number of Stations.     | IN TIME.                      |                             | IN HEIGHT.                           |           |                               | Number of Stations. | IN TIME.                    |                                      | IN HEIGHT. |           |           |
|                      |                         | Within 15 minutes of actuals. | Within 8 inches of actuals. | Within 1/8 of mean range at springs. |           | Within 15 minutes of actuals. |                     | Within 8 inches of actuals. | Within 1/8 of mean range at springs. |            |           |           |
|                      |                         |                               |                             | H.W.—L.W.                            | H.W.—L.W. |                               |                     |                             | H.W.—L.W.                            | H.W.—L.W.  | H.W.—L.W. | H.W.—L.W. |
| 1909                 | 6                       | 86 88                         | 97 97                       | 97 98                                | 3         | 61 59                         | 69 65               | 93 92                       |                                      |            |           |           |
| 1910                 | 6                       | 81 88                         | 98 98                       | 95 98                                | 3         | 57 52                         | 68 71               | 89 94                       |                                      |            |           |           |
| 1911                 | 6                       | 84 84                         | 98 99                       | 97 98                                | 3         | 65 51                         | 68 68               | 90 90                       |                                      |            |           |           |
| 1912                 | 6                       | 82 82                         | 97 98                       | 97 98                                | 4         | 70 58                         | 74 62               | 94 91                       |                                      |            |           |           |
| 1913                 | 6                       | 88 82                         | 97 97                       | 98 99                                | 4         | 68 55                         | 70 58               | 94 88                       |                                      |            |           |           |
| 1914                 | 6                       | 77 79                         | 98 97                       | 98 98                                | 3         | 75 67                         | 71 55               | 92 84                       |                                      |            |           |           |
| 1915                 | 6                       | 82 82                         | 98 98                       | 96 96                                | 3         | 76 66                         | 73 67               | 94 92                       |                                      |            |           |           |
| 1916                 | 6                       | 81 82                         | 96 97                       | 96 99                                | 3         | 81 68                         | 78 62               | 93 87                       |                                      |            |           |           |
| 1917                 | 6                       | 75 72                         | 96 98                       | 96 97                                | 3         | 76 65                         | 69 64               | 92 88                       |                                      |            |           |           |
| 1918                 | 6                       | 88 82                         | 97 97                       | 97 96                                | 3         | 76 63                         | 66 65               | 90 89                       |                                      |            |           |           |
| Average of ten years | ...                     | 81 81                         | 97 98                       | 97 98                                | ...       | 71 60                         | 70 64               | 92 90                       |                                      |            |           |           |

50. No. 17 Party.—Levelling.—Three double detachments were employed during the past season on the levelling operations mentioned below.

(a).—*In the Punjab.*

*Revisionary levelling* by one double detachment from Pathānkot along the Pālampur road to the Chambi bridge and then along the bridle road *viā* Kotwāl Bāzār (Dharmasāla) and McLeodganj Bāzār to Dharmkot hill.

This revision was undertaken in order to ascertain whether the severe earthquake of 1916 had caused any measurable change in the height of Dharmasāla. No change was detected. The difference between the old levelling of 1910 and the new of 1919 was less than 3 inches, a quantity which does not much exceed the probable error of the result.

The out-turn amounted to 56 miles of simultaneous double levelling: 9 primary and 65 secondary bench-marks were reconnected.

(b).—*In Mesopotamia.*

*New levelling* by two double detachments was carried out as follows:—

- (1) From Basrah to Nāsiriya, along the railway, thence northwards *viā* Samāwah to Hillah along the Hillah branch of the Euphrates, and finally, leaving the Euphrates, to Baghdād.
- (2) From Baghdād to Kut-al-'Amarah and thence to Shaikh Sa'ad where a junction was made with a good line run in 1916-17 up the Tigris from Basrah by a party of levellers sent from India by the Public Works Department.
- (3) From Kut-al-'Amarah *viā* Hai along the Shatt-al-Gharrāf to Suwaj and thence by road to Nāsiriya.

- (4) From Baghdād to Ramādi via Feluja.
- (5) From Baghdād to Table Mountain along the railway line.
- (6) From Baghdād to Baiji (Rail head) along the railway line.

The out-turn including branch-lines, amounted to 956 miles of simultaneous double levelling. The heights of 26 primary (Standard), 406 secondary and 467 tertiary bench-marks were determined.

This levelling was undertaken at the request of the Director of Irrigation, Mesopotamia, to serve as a frame-work on which the several schemes of irrigation emanating from the Tigris and the Euphrates could be based, but should geodetic operations be undertaken in Mesopotamia, these lines of levels will be of value.

51. No. 19 Party.—Base Line Operations.—No work was undertaken by this party during the year under report. The officers and establishment from time to time posted to it for administrative purposes were employed on miscellaneous work.

### MAGNETIC SURVEY.

52. No. 18 Party.—Magnetic.—The magnetic observatories at Dehra Dūn and Toungoo were inspected by the Officer in charge during the field season and a complete set of observations was taken at each for the comparison of instruments. The Alibāg and Kodaikānal observatories, under the Meteorological Department, were also visited for the same purpose.

No field observations were taken during the year.

Three detachments will be employed in 1919-20 in taking magnetic observations at the 75 repeat stations in India, Burma and Ceylon in order that reliable values of the annual changes in the magnetic elements may be obtained after 1915 in which year observations were last taken at these stations. The results will be used in revising the present data and maps.

*Special observations.* Observations of the three magnetic elements were taken at the Dehra Dūn observatory on the 28th, 29th and 30th May 1919, in response to an appeal by Dr. L. A. Bauer, Director of Terrestrial Magnetism of the Carnegie Institution of Washington, to magnetic observatories in every country for co-operation in special simultaneous magnetic observations in connection with the Total Solar Eclipse of May 29, 1919. No unusual changes were noticed in the magnetic elements during the three days' observations at Dehra Dūn, but even a result of this nature will no doubt be of use to Dr. Bauer in his investigation of the effects of the eclipse on the Earth's magnetism.

*Publication of the results of the Magnetic Survey.* The publication of the results of the Magnetic Survey from 1901 to 1915, reduced to epoch 1909·0, has been unavoidably delayed. The printing is now, however, almost completed and it is hoped to publish the volume very shortly.

The reduction of the observations of the detail survey and the investigation of the results in disturbed areas are being proceeded with.

*The Magnetic elements at observatories.*—The computation and tabulation of the provisional values of declination, dip, horizontal force and vertical force for the three observatories (Dehra Dūn, Toungoo and

24 WORK OF FIELD PARTIES, &c.—*THE TRIGONOMETRICAL SURVEY.*

Kodaikānal) for 1918 have been completed; the mean values of these elements for the year 1918 derived from all days, excluding those of great disturbance, are given in the table below:—

MEAN VALUES OF THE MAGNETIC ELEMENTS AT OBSERVATORIES IN 1918.

| Observatory. | Latitude<br>&<br>Longitude.      | Dip.      | Declination. | Horizontal<br>Force. | Vertical<br>Force. |
|--------------|----------------------------------|-----------|--------------|----------------------|--------------------|
|              |                                  |           |              | C. G. S.             | C. G. S.           |
| Dehra Dun    | { 30 19 19 N }<br>{ 78 3 19 E }  | N 44 49.6 | E 2 1.4      | 0.32980              | 0.32762            |
| Toungoo      | { 18 65 45 N }<br>{ 96 27 3 E }  | N 23 8.4  | W 0 18.5     | 0.39067              | 0.16696            |
| Kodaikānal   | { 10 13 50 N }<br>{ 77 27 46 E } | N 4 30.3  | W 1 39.2     | 0.37694              | 0.02969            |



## PART 3.—OFFICE WORK.

### I.—HEAD QUARTER OFFICES.

#### MAP PUBLICATION OFFICE (*vide* Index maps at end).

53. Brief reports of the work carried out during the year under review in the five offices administered by the Map Publication Office are given in paras. 55 to 59.

All these offices have continued to work under war conditions throughout the year; the requisitions by the Army for maps, &c., have been even larger than they were in the previous year, and the demand for instruments has remained much above the normal.

No additions have been made to the personnel of any of these offices except the Mathematical Instrument Office, and it is satisfactory therefore to record the fact that the abnormal amount of extra-departmental work has been carried out with little diminution of the ordinary out-turn of departmental mapping, &c.

54. The classes of maps for the publication of which the Head Quarter Offices are responsible are as follows:—

- (a) Topographical maps on the scale of 1 inch = 1 mile.
- (b) Topographical maps on the scale of  $\frac{1}{2}$  inch = 1 mile.
- (c) Topographical maps on the scale of  $\frac{1}{4}$  inch = 1 mile.
- (d) Geographical maps on the 1:1,000,000 scale (about 1 inch = 16 miles).
- (e) Geographical maps on the 1:2,000,000 scale (about 1 inch = 32 miles).
- (f) General maps on smaller scales.
- (g) Special maps.

The progress made in the publication of each of these classes is detailed below:—

(a) **Topographical maps on the scale of 1 inch = 1 mile.**—During the year 57 modern sheets have been published. This is a small increase on the number published during the previous year.

Index map No. 2 at the end of this report shows the progress made in the publication of the modern one-inch public sheets, and the following table gives the annual output of these sheets since the modern topographical surveys were begun:—

| Years of Publication.  | NUMBER OF 1-INCH SHEETS PUBLISHED. |                  |                 |        |
|--|------------------------------------|------------------|-----------------|--------|
|  | Northern Circle.                   | Southern Circle. | Eastern Circle. | Total. |
| 1906-07  | 4                                  | 1                | ...             | 6      |
| 1907-08  | 16                                 | 15               | 22              | 53     |
| 1908-09  | 35                                 | 39               | 68              | 142    |
| 1909-10  | 72                                 | 41               | 69              | 182    |
| 1910-11  | 51                                 | 39               | 25              | 115    |
| 1911-12  | 68                                 | 33               | 58              | 159    |
| 1912-13  | 104                                | 60               | 58              | 222    |
| 1913-14  | 71                                 | 36               | 49              | 156    |
| 1914-15  | 97                                 | 48               | 9               | 154    |
| 1915-16  | 85                                 | 69               | 50              | 204    |
| 1916-17  | 23                                 | 40               | 22              | 85     |
| 1917-18  | 18                                 | 12               | 13              | 43     |
| 1918-19  | 32                                 | 19               | 6               | 57     |
| Total Published  | 676                                | 454              | 449             | 1,579  |
| Probable number of 1-inch sheets which will not be published owing to the area covered by them being included in the programme for survey and publication on the $\frac{1}{2}$ -inch scale | 911                                | 564              | 473             | 1,948  |
| Approximate number remaining for publication   | 565                                | 1,011            | 1,115           | 2,691  |
| Approximate number of public 1-inch sheets in India  | 2,152                              | 2,029            | 2,037           | 6,218  |

5 one-inch sheets of those surveyed during 1915-16, 31 one-inch sheets of those surveyed during 1916-17, and 22 one-inch sheets of those surveyed during 1917-18 remain to be published. Four one-inch sheets of those surveyed during the year under report have also been received for publication before 30th September 1919.

In addition to the above, preliminary editions (in colours) of 24 one-inch sheets, prepared from modern revenue surveys, have been published during the year pending their topographical revision. No new "Village boundary" editions of modern one-inch sheets have been published for Local Governments.

59 modern one-inch, 10 preliminary editions of one-inch, and 45 old style one-inch sheets have been reprinted during the year.

(b) **Topographical Maps on the scale of  $\frac{1}{2}$  inch=1 mile.**—Index map No. 3 at the end of this report shows the progress made in the publication of the modern half-inch public sheets. This series now forms the *tactical* map of India, having taken the place of the quarter-inch maps in this respect. It was commenced in 1914; most of the sheets published up to date are reductions from the one-inch map, but others are from direct half-inch surveys.

The following table gives the annual output of these sheets:—

| Years of Publication.                                  | NUMBER OF $\frac{1}{2}$ -INCH SHEETS PUBLISHED. |                              |        |
|--|---|------------------------------|--------|
|  | Drawn from component one-inch sheets.           | Surveyed on half-inch scale. | Total. |
| 1914-15 ... ..   | ...   | 1                            | 1      |
| 1915-16 ... ..   | 21  | 4                            | 25     |
| 1916-17 ... ..   | 50  | 6                            | 56     |
| 1917-18 ... ..   | 59  | 6                            | 65     |
| 1918-19 ... ..   | 26  | 4                            | 30     |
| <b>Totals</b> ... ..                                   | 156   | 21                           | 177    |
| Approximate number of half-inch sheets in India ... .. | .....   | .....                        | 630    |

20 half-inch sheets of those drawn in 1915-16, 3 half-inch sheets of those drawn in 1916-17, and 1 half-inch sheet of those drawn in 1917-18 remain to be published.

In addition to the above, preliminary editions (in colours) of 13 half-inch sheets, prepared from old half-inch material, have been published during the year.

3 modern public half-inch sheets and 5 old style half-inch sheets have been reprinted during the year.

(c) **Topographical maps on the scale of  $\frac{1}{4}$  inch=1 mile.**—These maps are prepared in "degree" sheets which include 1° of latitude and 1° of longitude, i.e., the area covered by 16 one-inch sheets, or four half-inch sheets.

The production of these maps is still delayed owing to the more urgent work on those of the half-inch scale.

Index map No. 4 at the end of this report shows the progress made in the publication of the modern quarter-inch public sheets.

The following table gives the annual output of these sheets:—

| Years of Publication.                                 | NUMBER OF "DEGREE" SHEETS PUBLISHED. |                  |                 |        |
|---|--------------------------------------|------------------|-----------------|--------|
|   | Northern Circle.                     | Southern Circle. | Eastern Circle. | Total. |
| 1911-12 ... ..  | 2                                    | 1                | 4               | 7      |
| 1912-13 ... ..  | 3                                    | 1                | 1               | 5      |
| 1913-14 ... ..  | 4                                    | 3                | 2               | 9      |
| 1914-15 ... ..  | 1                                    | 3                | 3               | 7      |
| 1915-16 ... ..  | ...                                  | 1                | 4               | 5      |
| 1916-17 ... ..  | 1                                    | ...              | 3               | 4      |
| 1917-18 ... ..  | ...                                  | ...              | 4               | 4      |
| 1918-19 ... ..  | ...                                  | 3                | 8*              | 11     |
| <b>Totals</b> ... ..                                  | 11                                   | 12               | 29              | 52†    |
| Approximate number of "degree" sheets in India ... .. | 170                                  | 140              | 140             | 450    |

\* 2 of these were drawn in No. 1 Drawing Office.

† 13 of these are preliminary editions, having been prepared from surveys (on various scales) prior to 1905.

In addition to the above, 10 modern public quarter-inch sheets have been reprinted during the year.

9 "degree" sheets have been prepared in No. 1 Drawing Office from the old engraved quarter-inch Atlas sheets, brought up to date and published (in black only) as provisional issues; and 5 of such sheets which were published previously have been reprinted during the year. These provisional "degree" sheets, including those in hand, now cover practically the whole area of India for which modern "degree" sheets are not likely to be available for some time.

(d) **Geographical Maps on the 1:1,000,000 scale.**—(i) **The "India and Adjacent Countries" Series** (*Vide* Index map No. 5).—During the year 2 new sheets of this series have been published, 2 sheets have been modernized and republished to supersede old editions, and 11 sheets have been reprinted.

(ii) **La Carte Internationale du Monde.**—(*Vide* Index map No. 6).—A full description of the genesis of this series was given in the General Report for 1913-14. No map of this series has been published during the year; 5 sheets have been published up to date.

(e) **Geographical Maps on the 1:2,000,000 scale.**—(*Vide* Index map No. 7).—No new map of this series was published during the year, but 2 sheets have been reprinted. Experiments to determine the most satisfactory method of engraving and reproducing the new maps of this series (which will eventually supersede the Map of India on the scale 1 inch = 32 miles) have been practically completed.

(f) **General Maps on smaller scales.**—The engraved plates of all these maps have been corrected and brought up to date as far as possible during the year.

(g) **Special maps.**—The annual edition of the Railway Administration map (on the scale 1 inch = 64 miles) and a new provincial map of the Punjab (on the 1:1,000,000 scale) have been published during the year; two provincial maps and the Railway, Canal and Road map of India (on the scale 1 inch = 32 miles) have been reprinted.

Numerous special maps have also been prepared and printed for the Army, for Local Governments and for other departments.

"Town Guide" maps, on the scale 12 inches = 1 mile, of several of the larger Indian cities are under preparation; 2 sheets of the Calcutta-Howrah "Town-guide" map (which will be contained in 16 sheets) have been published during the year.

**55. Map Record and Issue Office.**—No changes of any importance have been made in the organisation of this office during the year.

The amount of work carried out has been growing steadily every year, and more especially since 1914. The increase during the present year is very much greater than ever before; it has been caused partly, as in previous years, by large issues of maps to the Army, and partly by the fact that all extra-departmental publications have been issued throughout the year by this office, instead of direct from the Photo-Litho. Office, as in previous years.

It is satisfactory to note that, despite the untimely death (in April 1919) of one of the Assistant Map Curators and the strain of the past five years' work on the whole staff, to which no additions

have been made during the war, all the urgent demands of the Army during the year have been met without delay.

It has not been possible to complete entirely the new system of recording all issues of maps from the *Print Section* of the office. Ledgers have now been compiled for all modern maps, but stock has yet to be taken of all maps, on various scales, published in old style from surveys prior to 1905.

Fair progress has, however, been made in the *Original Section* of the office during the year in card-indexing the receipts and issues of the records under the new system.

Details of the work of the office in connection with all Survey of India maps, termed "Departmental", and with all other maps, plans, charts and illustrations prepared for and supplied to departments other than the Survey of India and to the public, termed "Extra-departmental", have been sub-divided in this year's report and are shown separately in the subjoined tables of (1) maps issued and of (2) maps received from the Printing Offices.

ISSUES.—FROM MAP RECORD AND ISSUE OFFICE, 1918-19.

| YEAR.   |                              | ON BOOK DEBIT<br>(TO GOVERNMENT<br>OFFICIALS). |              | ON CASH PAY-<br>MENT (TO PRI-<br>VATE INDIVI-<br>DUALS AND MAP<br>AGENTS). |              | FREE ISSUES<br>(DEPARTMENTAL<br>AND TO INDIA<br>OFFICE). |              | TOTAL.                             |              |
|---------|------------------------------|--|--------------|--|--------------|--|--------------|------------------------------------|--------------|
|         |                              | Number<br>of<br>Printed<br>Copies.             | Value<br>Rs. | Number<br>of<br>Printed<br>Copies.   | Value<br>Rs. | Number<br>of<br>Printed<br>Copies.                       | Value<br>Rs. | Number<br>of<br>Printed<br>Copies. | Value<br>Rs. |
| 1918-19 | Depart-<br>mental.           | 386,972  | 2,35,413     | 59,919   | 46,009       | 37,204   | 32,539       | 484,095                            | 3,13,961     |
|         | Extra-<br>depart-<br>mental. | 1,840,038                                      | 1,51,672     | 41,303   | 1,654        | .....  | .....        | 1,881,341                          | 1,53,326     |
|         | Total ...                    | 2,227,010                                      | 3,87,085     | 101,222  | 47,663       | 37,204   | 32,539       | 2,365,436                          | 4,67,287     |
| 1917-18 | Total ...                    | 795,810  | 2,12,861     | 39,183   | 35,795       | 48,550   | 39,382       | 883,543                            | 2,88,038     |
| 1916-17 | Total ...                    | 578,357  | 3,65,568     | 66,149   | 41,670       | 40,700   | 37,160       | 685,206                            | 3,44,398     |

Table IV.—Publications received in Map Record &amp; Issue Office, 1918-19.

A.—From the Calcutta Printing Offices, (including the Engraving Office).

| Class of Maps.   | Scale.      | NUMBER OF DIFFERENT MAPS OF EACH CLASS RECEIVED. |                            | Number of copies printed. | Value.          |
|--|-------------|--|----------------------------|---------------------------|-----------------|
|  |             | New Publications.                                | Reprints and New Editions. |                           |                 |
| <b>DEPARTMENTAL.</b>   |             |  |                            |                           |                 |
| <b>GENERAL MAPS.</b>   |             |  |                            |                           | <i>Rs.</i>      |
| Maps of India ... ..   | Various     | .....  | 3                          | 2,800                     | 3,650           |
| <b>GEOGRAPHICAL MAPS.</b>                                    |             |  |                            |                           |                 |
| Map of India ... ..  | 1"-32 miles | .....  | 1                          | 200                       | 1,800           |
| Southern Asia Series ... ..                                  | 1:2,000,000 | .....  | 2                          | 3,000                     | 9,000           |
| India and Adjacent Countries Series                          | 1:1,000,000 | .....  | 2                          | 13                        | 9,461           |
| La-Carte Internationale du Monde                             | 1:1,000,000 | .....  | .....                      | .....                     | .....           |
| <b>TOPOGRAPHICAL MAPS.</b>                                   |             |  |                            |                           |                 |
| Quarter-inch Modern ... ..                                   | 1"-4 miles  | 6  | 10                         | 34,155                    | 34,155          |
| Do. (Prely.) ... ..  | 1"-4 miles  | 5  | .....                      | 2,960                     | 2,715           |
| Do. (Provl.) ... ..  | 1"-4 miles  | 9  | 5                          | 2,610                     | 2,610           |
| Half-inch Modern ... ..                                      | 1"-2 miles  | 30   | 3                          | 26,345                    | 26,804          |
| Do. (Prely.) ... ..  | 1"-2 miles  | .....  | .....                      | .....                     | .....           |
| One-inch Modern ... ..                                       | 1"-1 mile   | 57   | 59                         | 82,532                    | 82,032          |
| Do. (Prely.) ... ..  | 1"-1 mile   | 24   | 10                         | 17,397                    | 17,397          |
| Old Style sheets ... ..                                      | Various     | .....  | 76                         | 13,085                    | 19,080          |
| <b>SPECIAL MAPS.</b>   |             |  |                            |                           |                 |
| District Maps ... ..   | 1"-4 miles  | .....  | .....                      | .....                     | .....           |
| Administration Report Maps ... ..                            | 1"-8 miles  | .....  | 6                          | 320                       | 122             |
| Provincial Maps ... ..                                       | Various     | 1  | 2                          | 1,300                     | 1,756           |
| Plans of Cities and Cantonments ... ..                       | Various     | 2  | 2                          | 380                       | 440             |
| Index Maps ... ..  | Various     | 3  | 6                          | 14,950                    | 3,224           |
| Miscellaneous Maps ... ..                                    | Various     | 54   | 44                         | 46,995                    | 28,088          |
| <b>Total</b> ... ..  | .....       | <b>193</b>                                       | <b>242</b>                 | <b>258,490</b>            | <b>2,41,284</b> |
| <b>EXTRA-DEPARTMENTAL.</b>                                   |             |  |                            |                           |                 |
| Maps ... ..  | Various     | 153  | 53                         | 316,700                   | 84,024          |
| Plans and diagrams ... ..                                    | Various     | 154  | 29                         | 623,300                   | 40,719          |
| Illustrations ... ..   | .....       | 64   | 6                          | 243,301                   | 11,599          |
| Miscellaneous ... ..   | .....       | 42   | 79                         | 703,815                   | 17,958          |
| <b>Total</b> ... ..  | .....       | <b>413</b>                                       | <b>167</b>                 | <b>1,687,116</b>          | <b>1,54,300</b> |
| <b>Grand Total</b> ... ..                                    | .....       | <b>606</b>                                       | <b>409</b>                 | <b>2,145,606</b>          | <b>3,95,584</b> |
| <b>B.—From the Trigonometrical Survey Office, Dehra Dun.</b> |             |  |                            |                           |                 |
| Various ... ..   | .....       | 5  | 17                         | 1,043                     | 1,683           |

**C.—LETTERPRESS.**

1. Survey of India General Report, 1917-18. Price Rs. 2 or 2s-8d.\*
2. Records of the Survey of India, Volume XII (1919) Notes on Survey of India maps and the modern development of Indian Cartography. Price Rs. 3 or 4s.\*
3. Hand-Book of Topography, Chapter X, Map Reproduction, Second Edition, 1919. Price As. 4 or 4d.\*

\* Sterling prices should be increased by 50 per cent.

**56. No. 1 (Head Quarters) Drawing Office.**—This office is organised in six sections, each section being under its own supervising officer.

(1) *The Compilation Section.*—Deals with “La Carte Internationale du Monde au 1,000,000,” with all “Geographical” maps on scales smaller than the 1:1,000,000, and with miscellaneous work.

- (a) Of the seven sheets of “La Carte Internationale du Monde” which were in hand at the end of the previous year, five sheets have been completed and sent to press; colour proofs (from the engraved plates) of the remaining two sheets are under examination. No new sheets of this series have been taken up during the year.
- (b) Of the new maps of the Southern Asia Series, on the 1:2,000,000 scale, the preparation of patterns for engraving the outline plates of four sheets has been continued throughout the year. A revised table of the lettering to be engraved on this new series has been completed.
- (c) The most important “Miscellaneous” maps dealt with by this section during the year have been “Town Guide” maps. The fair-mapping of four of these maps was in hand at the end of the previous year; of these, two have been completed and sent to press, the third has been transferred to a special party for revision in the field, and the fourth is awaiting return of the corrected proofs.

During the year, print originals of three additional “Town Guide” maps were completed and sent to press, and a preliminary Type table for Town Guide maps was also compiled, drawn and sent to press. Corrected patterns and new colour guides have been prepared for a reprint of the 6-inch (engraved) Map of Calcutta.

(2) *The “One-Millionth” Section.*—Deals with all maps of the “India and Adjacent Countries” Series, on the 1:1,000,000 scale.

- (a) Engraved Editions (original and modernised). Of the 13 sheets which were in hand at the end of the previous year, 7 have been completed and sent to press, working patterns for engraving the plates of 3 sheets, and the preliminary compilation patterns of the remaining 3 sheets, are in hand. The preliminary compilation pattern of one extra sheet has been taken up during the year.
- (b) Helió Editions (Original and Reprint). The fair-mapping of three original sheets was in hand at the end of the previous year. One of these has been sent to press for reproduction and supply of preliminary proofs, work on the remaining two sheets is in progress.

No other original sheets have been taken up during the year. The fair sheets of 5 previously published sheets have been corrected for reprint and sent to press.

(3) *The Quarter-inch Section.*—Deals mainly with the fair-mapping of quarter-inch sheets, compiled from surveys on any scale executed prior to 1905, for publication in modern style either in colours (Preliminary Editions), or in black, or black and brown (Provisional Issues).

- (a) At the end of the previous year, fair-mapping of 9 quarter-inch sheets was in hand (six “Preliminary Editions” and three “Provisional Issues”).

The drawing of seven of these sheets has been completed during the year; considerable progress has been made on the other 2 sheets.

During the year under report, 20 quarter-inch sheets, which were under preparation in the *Mapping and Reprint Section* for publication as "Provisional Issues," were transferred to this section for completion. 4 of these sheets have been fair-mapped for publication as "Preliminary Editions," but have not been sent to press yet; work has been stopped altogether on 2 sheets; and the remaining 14 sheets have had to be put aside for the time being.

In addition to the above, work has been started during the year on two quarter-inch sheets, for publication as 'Provisional Issues,' and fair-mapping of both is in progress.

- (b) The 14 half-inch sheets which were in hand during the previous year, from old Sind Survey sheets, have been completed and sent to press during the year, for reprint in modern style as "Preliminary Editions".

(4) *The Mapping and Reprint Section.*—Deals mainly with the corrections of fair sheets of topographical maps (both from modern surveys and from surveys executed prior to 1905) for reprint, and with the fair-mapping required for special maps (including extra-departmental) on all scales.

- (a) (i) The fair sheets of 148 previously published topographical maps (105 modern and 43 old) have been corrected and brought up to date and sent to press for reprint during the year. Work is in progress at the end of the year under report on 100 sheets (75 modern and 25 old).

(ii) The fair sheets of 33 new topographical maps drawn by field parties or by other drawing offices, have been corrected (on receipt for publication or at proof stage) during the year, before final publication.

(iii) "Press Order Proof" corrections have been inserted on the originals of 101 new topographical maps, after publication.

- (b) 22 "Provisional Issue" degree sheets were prepared from old atlas sheets and sent for publication during the year.

(c) Fair sheets (either original drawings or print originals) of 25 special maps, on various scales, have been drawn for the Army, other Government departments, &c., and sent to press.

There has been little or no diminution during the year of the usual miscellaneous work of all other descriptions (including extra-departmental work) carried out by this section.

(5) *The Office Copy Section.*—Maintains records of all additions and alterations to the details shown on all published maps of all scales, for incorporation in new editions or reprints of such maps.

- (a) These corrections and additions have been made to 2,542 existing "office copies" of maps of all scales during the year. 355 fresh "office copies" of newly published or reprinted maps have been prepared.

- (b) The miscellaneous work of this section includes the checking and recording of the areas contained in all one-inch and half-inch maps received by the Map Publication Office for publication, the supply of certified copies of original records both to official and private applicants, and correspondence relating to Revenue Survey maps.

(6) *The Examining Section.*—Examines the majority of the sheets which are fair-mapped by the other sections of this office, and scrutinizes a large number of sheets which are fair-mapped elsewhere, before publication.

296 "cases", affecting 412 maps on various scales, have been examined and passed during the year.

The amount of miscellaneous work dealt with by this section, in connection with the fair-mapping of the whole department, is exceedingly large and its nature is too diverse to specify in detail.

**57. Engraving Office.**—(1) *Engraving Section.* (a) As in the previous year, most of the engravers have continued to be employed during the year under report on new or modernized editions of maps of the "India and Adjacent Countries" Series and of "La Carte Internationale du Monde", both on the 1:1,000,000 scale.

Of the former series all four plates of all the seven sheets in hand have been completed; of the latter series all four plates of five out of the seven sheets in hand have also been completed, the remaining two sheets having reached proof stage.

(b) No work has been done during the year on the plates of any of the sheets either of the Southern Asia Series, on the 1:2,000,000 scale, or on the new Map of India on the 1:4,000,000 scale.

A good deal of preliminary work, however, has been carried out in connection with the former series, whereby it is hoped considerably to expedite the engraving when the revised patterns of the sheets which are now being compiled are received.

(c) Periodic corrections have been carried out on the plates of all the General (engraved) Maps of India on smaller scales than the 1:2,000,000 and of all Index charts.

The four plates of the 6-inch Map of Calcutta have been corrected and brought up to date for reprint.

The combined outline and contour plates of quarter-inch sheet 38 N which were engraved in 1915 have been corrected and brought up to date, and art paper prints of each have been supplied to the Photo.-Litho. Office for reproduction by heliogravure. This is for experimental purposes.

Miscellaneous work is mostly extra-departmental and includes the engraving of a large War-memorial brass plate, of various kinds of scales required by the Army, and of titles on a considerable number of photogravure plates.

(2) *Printing Section.*—25,544 impressions were pulled during the year compared with 42,158 during the previous year, on the same number of machines. 42 per cent. of the impressions pulled during the year were extra-departmental orders, such as photogravures, commission forms and certificates.

Interesting experiments have been carried out to ascertain whether copies of the "Political Edition" of geographical and general engraved maps could be printed in colours, if necessary, by this section direct from the copper plates. Although it was proved that this could be done successfully, it was decided, for other reasons, to adhere to the present methods of printing such copies from transfers-to-zinc plates in the ordinary litho. machines.



As a result of this experiment however, all multi-plate engraved maps are now proved in colours, which shortens the duration and increases the accuracy of examination.

**58. Photo.-Litho. Office.**—The *Litho.* out-turn for the year under report is slightly smaller than the record out-turn of the previous year, but is considerably greater than that of any other year (*vide* Table B). Very urgent demands by the Army for maps resulted in two new "records" being made for the monthly out-turns of June and July 1919; this was accomplished by the employment of a large amount of overtime.

The two rotary off-set machines presses which were ordered last year having proved unobtainable, other suitable machines are being selected in England. These are required to replace two very old machines which cannot deal efficiently with colour work.

Improvements to plant comprise the laying of floor rails in the studio, to enable No. 1 camera to be swung round for use without a reversing prism, and the building of a large drying-box for use in the *Powder Process Section*. The entire renewal of the wiring of the electric lighting and power circuits and the installation of new switchboards throughout the office is also in hand.

No new processes have been introduced during the year, but the methods of photographing layer and hill-shaded originals have been improved.

Experiments are also being made with a view to supersede the slow and laborious method of "transfer" from engraved copper plates to zinc by the photographic reproduction of art paper prints from the copper plates, and it is hoped that these will prove successful.

The "Powder Process", which was introduced last year for making any number of reversed copies of a negative, has continued to be most successful, not only in reducing the cost and improving the quality of reproduction but also in relieving work in the studio.

The following table summarizes briefly the out-turn of the *Photo. Branch* during the past three years:—

|                            | 1916-17. | 1917-18. | 1918-19. |
|----------------------------|----------|----------|----------|
| Negatives ... ..           | 4,778    | 5,300    | 4,190    |
| Zinc Plates ... ..         | 7,496    | 8,426    | 7,227    |
| Photogravure Plates ... .. | 776      | 380      | 554      |
| Half-tone blocks ... ..    |          |          |          |
| Line blocks ... ..         |          |          |          |

In the *Litho. Branch* the machines and handpresses printed a total of 1,828,240 copies of maps and diagrams during the year under report; the majority of these were printed for the Army.

Details of all the new publications and subsequent new editions or reprints of public maps printed during the year are given in Table IV on page 29.

A comparison of the work done and its cost during the past three years is given in the two tables and diagram below:—

Out-turn of Photo-Litho. Office during 1918-19.

TABLE A.

| 1<br>Year.     | 2<br>*Cost of office.<br><i>Rs.</i> | 3<br>Value of out-turn at cost-rates.<br><i>Rs.</i> | 4<br>NUMBER OF MAPS PRINTED. |                          |              |
|----------------|-------------------------------------|---|------------------------------|--------------------------|--------------|
|                |                                     |   | Departmental.                | Other than Departmental. | Total.       |
|                |                                     |   |                              |                          |              |
| 1916-17        | 1,79,661                            | 3,47,271  | 793                          | 3,391                    | 4,184        |
| 1917-18        | 2,08,784                            | 4,34,124  | 817                          | 3,812                    | 4,629        |
| <b>1918-19</b> | <b>2,21,218</b>                     | <b>4,54,243</b>                                     | <b>637</b>                   | <b>4,203</b>             | <b>4,840</b> |

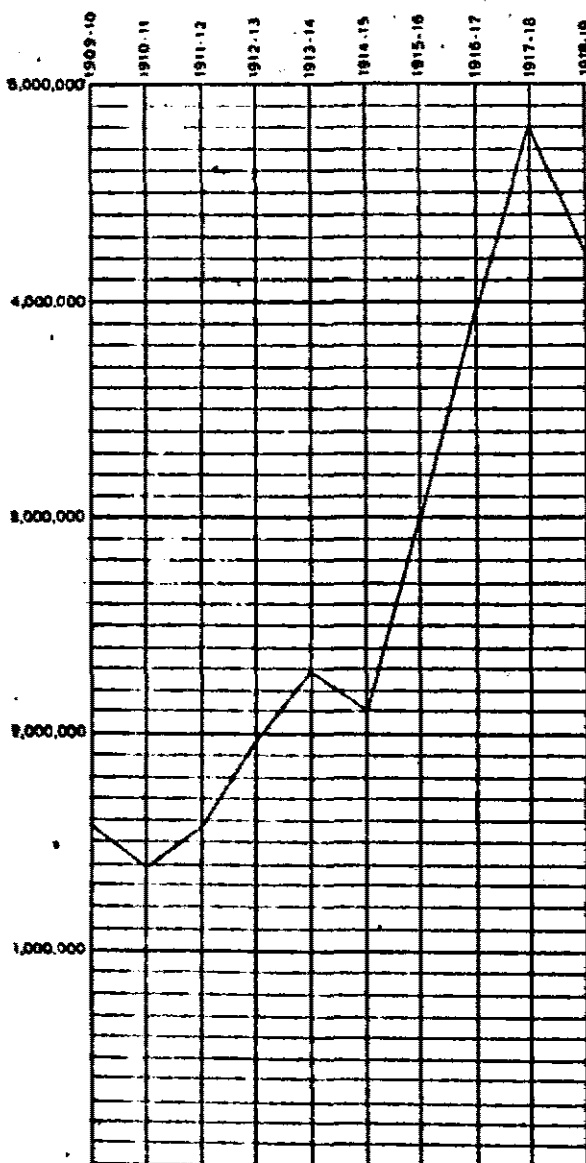
\* Does not include cost of chemicals, paper, &c., obtained from England (Rs. 1,85,633 in the year under report), and excludes the amount recovered directly in cash or book debit for work done (Rs. 20,824 in the year under report).

TABLE B.

| 1<br>Year.     | 2<br>Number of impressions pulled in Litho. Branch. | 3<br>Number of half-tone impressions pulled. | 4<br>Number of line-block impressions pulled. | 5<br>TYPE SECTION OUT-TURN. |                  |                     |
|----------------|---|--|---|-----------------------------|------------------|---------------------|
|                |   |  |   | Pages or items published.   | Copies printed.  | Impressions pulled. |
|                |   |  |   |                             |                  |                     |
| 1916-17        | 3,954,954   | 115,486†                                     | 639,838                                       | 8,216                       | 1,311,014        | 2,051,347           |
| 1917-18        | 4,796,813†  | 224,003                                      | 1,193,418                                     | 7,476                       | 942,811          | 1,677,147           |
| <b>1918-19</b> | <b>4,248,913</b>                                    | <b>183,413</b>                               | <b>1,151,678</b>                              | <b>5,577</b>                | <b>1,233,211</b> | <b>1,829,380</b>    |

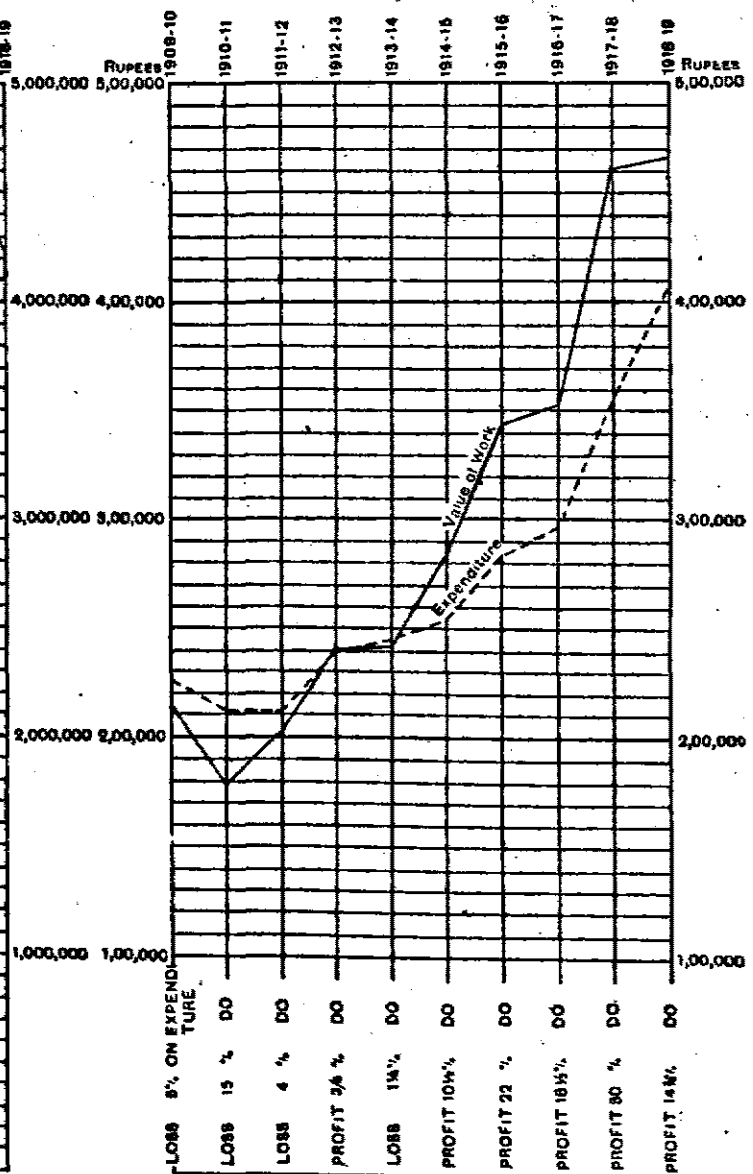
† Incorrectly printed as 5,486 and 4,796,81 in the General Report, 1917-18.

DIAGRAM SHOWING OUTTURN OF THE LITHO. BRANCH during the last ten years.



Number of impressions pulled in Litho. Branch shown thus .....

DIAGRAM SHOWING PROFIT AND LOSS on the working of the whole office during the last ten years.



Total Value of Work Done shown thus .....

Total Expenditure including cost of English stores, &c. shown thus .....

59. **Mathematical Instrument Office.**—During the year from 1st April 1918 to 31st March 1919, there was some decrease in the demands made on this office (*vide* item 1 in para. 2), and an increase in the value of work done (*vide* item 6 in para. 2), and there was respectively a profit of Rs. 1,21,573 and Rs. 39,762 against a profit of Rs. 1,55,859 and Rs. 50,741 in 1917-18.

2. Below are given the usual comparative figures for the last 3 years:—

|   | 1916-17.                | 1917-18.                | 1918-19.                |
|---|-------------------------|-------------------------|-------------------------|
|   | Rs.                     | Rs.                     | Rs.                     |
| 1. Total issues to Public Offices as shown in the Profit and Loss statements of stores.             | 5,52,655                | 8,88,658                | 7,64,795                |
| 2. Value of repairs to instruments received for repairs and returned in serviceable condition.      | 58,423                  | 53,133                  | 50,904                  |
| 3. Value of instruments received from Government Officers when no longer required.                  | 77,147                  | 85,209                  | 1,33,730                |
| 4. Book value of the stock of instruments, &c., in Serviceable Stores.                              | 4,73,155                | 3,92,268                | 4,22,818                |
| 5. Book value of the stock of instruments, &c., in Repairable Stores.                               | 1,15,805                | 1,04,394                | 1,10,554                |
| 6. Total value of work done in the Workshop ...   | 2,99,531                | 3,41,627                | 4,35,023                |
| 7. Value of instruments manufactured in the Workshop for Serviceable Stores.                        | 1,76,119                | 1,85,737                | 2,17,342                |
| 8. Value of instruments purchased locally ...   | 1,09,039                | 4,30,336                | 2,72,462                |
| 9. Value of instruments and materials obtained from England through the Director General of Stores. | 1,01,744                | 66,380                  | 67,174                  |
| 10. Average No. of employees and their pay ...  | No. 417<br>Rs. 1,02,604 | No. 504<br>Rs. 1,33,719 | No. 556<br>Rs. 1,63,759 |

3. During the year the stock of all the three stores (the Serviceable, the Repairable and the Material Stores), was twice taken, and the discrepancies noticed have been adjusted.

## II.—DEHRA DŪN OFFICES.

## TRIGONOMETRICAL SURVEY OFFICE.

**60. Computing Office.**—The notable feature of the year's work is the publication of Professional Paper No. 17—"Investigations of Isostasy in Himalayan and Neighbouring Regions" by Colonel Sir Sidney Burrard, K.C.S.I., R.E., F.R.S. An endeavour has been made in this paper to solve the geodetic problem of the Indo-Gangetic trough.

The adjustment of the pendent portion of the Burma Coast Series which extends to the south of latitude  $18^{\circ}$  and of the Bangkok Series has been carried out. The heights of the principal triangulation in Burma have also been adjusted.

A second edition of Levelling pamphlet 57 and an Addendum to Levelling pamphlet 56 have been published. A reprint of Levelling pamphlet 53 is in hand and well advanced through the press.

Chapter III (1914) of the Hand-Book of Topography is being rewritten and will be ready for publication in the course of the next year. Computation forms are being remodelled and adapted to paper of foolscap size.

158 requisitions for data from departmental and non-departmental officials were complied with.

61 Triangulation pamphlets covering 202 degree sheets were published and issued in the course of the year.

For purposes of investigation a large amount of computation in connection with Isostasy was carried out.

*Type Printing Section.*—The following publications were printed during the year:—

1. Records of the Survey of India, Volume XIII, 1917-18.
2. Professional Paper No. 17.
3. Mesopotamian Levelling pamphlet.
4. Levelling pamphlet 57 (2nd edition, revised) and Addendum to Levelling pamphlet 56.
5. Triangulation pamphlets covering 220 degree sheets.
6. Tables of reduced results of magnetic observations by No. 18 Party.
7. Extracts from Auxiliary Tables for use of explorers, a glossary of Tibetan names and a large amount of miscellaneous work.

*Observatories.*—Meteorological observations were continued as usual, and the Omori Seismograph was in operation throughout the year.

Photographs of the sun were taken on 324 days, the sun being obscured on the remaining days of the year.

*Preservation of Trigonometrical Stations.*—825 stations were repaired by district officers at a cost of Rs. 4,318-9-2. Out of 359 districts from which reports were due, 24 failed to make returns.

**61. No. 2 (Dehra) Drawing Office.**—During the year under report the work in this office was carried out by five sections.

(1) *The Triangulation Chart and Cantonment Plan Section.*—In addition to the ordinary work of this section, 17 miscellaneous maps and charts, 3 Levelling charts and 5 Index charts were prepared and sent to press.

(2) *The Compilation Section.*—The rough compilation on the scale of 1 inch=12 miles of 4 sheets up to East Longitude 108°, and the rough compilation of another sheet on the 1/M scale, were taken in hand during the current year; 4 sheets on the 1/M scale were sent to the Superintendent of Map Publication, for publication, and 9 sheets are still in hand, 4 sheets with hills on the 1/3M scale are now nearly completed and will be sent for publication shortly.

The rough compilation of the northern half of the Brahmaputra sheet of the Southern Asia Series was completed and sent to the Superintendent of Map Publication, for publication. The rough compilation of the North Tibet sheet of the Southern Asia Series was taken in hand during the year.

(3) *The Stein Section.*—The fair-mapping of 31 sheets of Sir Aurel Stein's explorations in 1900-01, 1906-08 and 1913-15 has been continued; of these 19 were completed and sent to press; the remaining 12 sheets are in hand or awaiting scrutiny by Sir Aurel Stein before being sent to press. Of the sheets sent for publication, 27 are still in the "colour proof" stage.

The fair-mapping in this section will be completed shortly, after which the section will be employed on the examination of colour proofs.

(4) *The Half-inch Section.*—The fair-mapping of 4 sheets viz:—63 F/N.W., F/N.E., F/S.W., F/S.E., taken up last year was completed and they will be sent to press when the final corrections are carried out. The personnel of this section has now been absorbed into the other sections and the section done away with.

(5) *The Examination Section.*—This section was organised in March 1919 and has since received 93 cases, of which 79 have been disposed of, leaving a balance of 14 cases in hand.

This section was also employed in preparing numerous diagrams and charts to illustrate reports.

In addition to the above, 22 pupil draftsmen were instructed in drawing, rapid style hand printing, and the use of drawing instruments. Of these 22 pupils, 4 were sent to the Superintendent, Southern Circle, 10 have been given employment in this office and 8 are still undergoing training.

The following is the summary of the work of the office during the year 1918-19:—

| Class of map.   | Balance of sheets on 1st October 1918. | No. of sheets received in 1918-19. | Sheets sent for publication in 1918-19. | Sheets remaining in hand on 30th September 1919. | REMARKS.   |
|---|--|------------------------------------|---|--|--|
| Geographical maps, scale 1/M (Rough compilation).   | .....                                  | 5                                  | .....                                   | 5  | Including one sheet recompiled for engraved edition.<br>For engraved edition.  |
| Geographical maps, scale 1/4 M (Rough compilation).   | .....                                  | 4                                  | .....                                   | 4  |  |
| Geographical maps, scale 1/2 M (Brahmaputra sheet, northern half. Rough compilation).   | 1                                      | .....                              | 1                                       | .....  |  |
| Geographical maps, scale 1/2 M (Southern Asia Series, North Tibet sheet. Rough compilation)                                     | .....                                  | 1                                  | .....                                   | 1  |  |
| Geographical maps, scale 1/M (Fair sheets).   | 19                                     | .....                              | 4                                       | 9  | Includes 3 rough compilations from previous report which are now being fair-drawn.   |
| Geographical maps, scale 1/3 M (Fair sheets).   | 4                                      | .....                              | .....                                   | 4  | Outline and Hill sheets, nearly completed.   |
| Geographical maps, scale 1/M (colour guides).   | .....                                  | 9                                  | 9                                       | .....  |  |
| Sir Aurel Stein's explorations in Chinese Turkistan and Kansu, in 1900-01, 1906-08 and 1913-15, for publication on 1/2 M scale. | 31*                                    | .....                              | 19†                                     | 12   | * 33 sheets remained over from last year, but 2 sheets have been incorporated with other sheets when the sheets were all readjusted.<br>† Of all the sheets sent to press, 27 are still in "Proof in colours" stage. |
| Triangulation Charts, scale 1 inch = 1 mila.  | .....                                  | 3                                  | 3                                       | .....  |  |
| Triangulation Charts, scale 1 inch = 4 miles.   | 14                                     | 35                                 | 34                                      | 15   |  |
| Triangulation Charts, scale 1 inch = 8 miles.   | 5                                      | 10                                 | 13                                      | 2  |  |
| Triangulation Charts, scale 1 inch = 16 miles.  | 3                                      | 6                                  | 6                                       | 1  |  |
| Levelling Charts, scale 1/M   | .....                                  | 4                                  | 4                                       | .....  | Including one of Levelling in Mesopotamia on scale 1/2 M.  |
| Cantonment plans for publication  | .....                                  | 61                                 | 61                                      | .....  | Sheets of 22 cantonments proved and published.   |
| Cantonment plans for corrections  | 64                                     | 58                                 | 70                                      | 52‡  | Corrections of 37 cantonments for 1918 carried out both on originals and office copies.<br>‡ Includes corrections of 18 cantonments for 1919.  |
| Cantonment plans* (colour guides)   | .....                                  | 16                                 | 6                                       | 10   | In hand.   |
| Half-inch sheets  | 4                                      | .....                              | .....                                   | 4  | Will be sent to press shortly.   |
| Miscellaneous Extra-departmental maps and charts and diagrams.  | .....                                  | 27                                 | 27                                      | .....  | Including Mayo Salt Mine map, sketches of chambers and charts.   |
| Maps of Mesopotamia   | .....                                  | 2                                  | 2                                       | .....  | Proofs examined and sent to press.   |
| Index Charts  | .....                                  | 5                                  | 5                                       | .....  |  |

*Photo-Zinco. Section.*—During the year 1918-19, the work undertaken comprised :—

- Cantonment Maps.
- Indexes and Triangulation Charts.
- Forest Maps.
- Sir Aurel Stein's Maps.
- Miscellaneous Maps.
- Extra-departmental Maps.

In the year under review, the small litho. machine was received back from Baghdād, but in the meantime a second-hand machine had been purchased from England and erected in its place. A Reproducing Section (comprising 5 technical hands and khalasis) was formed and placed at the disposal of the Superintendent, Northern Circle, for work with the North-West Frontier Survey Party at Peshāwar.

The following table shows the work done in the last three years :—

| Years.  | No. of Subjects. | No. of Negatives. | No. of Pulls. | No. of Chocolate and Cyanotype prints. |
|---------|------------------|-------------------|---------------|--|
| 1916-17 | 1,302            | 1,600             | 287,514       | 571                                    |
| 1917-18 | 1,130            | 1,719             | 345,776       | 127                                    |
| 1918-19 | 1,193            | 1,475             | 275,276       | 229                                    |

**62. Forest Map Office.**—The classes of work entrusted to the four technical sections of this office were briefly described in last year's report; the distribution of the work has been continued on the same lines, and the progress made during the year under report is described below :—

(1) *The Drawing Section.*—The progress of this section for the year under report is shown in the table below :—

| Class of map. | In hand on 1st October 1918. | Received during the year 1918-19. | Drawn and sent for publication in 1918-19. | In hand on 30th September 1919. | Published during the year 1918-19. | Total number of copies printed. |
|---------------|------------------------------|-----------------------------------|--|---------------------------------|------------------------------------|---------------------------------|
| (a)           | 15                           | 56                                | 71   | .....                           | 74                                 | 18,800                          |
| (b)           | 71                           | 58                                | 66   | 68                              | 62                                 |                                 |
| (c)           | 20                           | 10                                | 18   | 17                              | 4                                  |                                 |
| (d)           | 9                            | 62                                | 57   | 14                              | 17                                 |                                 |
| (e)           | 4                            | 4                                 | 8  | .....                           | 6                                  |                                 |
| (f)           | 44                           | 27                                | 85   | 86                              | 81                                 |                                 |
| (g)           | .....                        | 51                                | 50   | 1                               | 29                                 |                                 |
| <b>TOTALS</b> | <b>168</b>                   | <b>268</b>                        | <b>300</b>                                 | <b>181</b>                      | <b>218</b>                         | <b>18,800</b>                   |

- (a) Reprints of Forest maps on various scales.
- (b) Forest editions, on the scale of 2 inches = 1 mile, of modern one-inch maps.
- (c) Maps of Forest Circles and Divisions.
- (d) Maps to illustrate working plans, &c.
- (e) Maps and diagrams to accompany Administration Reports.
- (f) Forest maps from special surveys, mostly on the scale of 4 inches = 1 mile.
- (g) Index and miscellaneous maps.

(2) *The Portfolio Section.*—Office copies of 1,152 maps and colour specimens of 112 maps were prepared, corrections on 657 sheets were completed, and 3,013 sheets were coloured by hand for issue. New racks for this section were built last year, and the sorting and re-arrangement of all office copies in these racks was completed during the year.

(3) *The Map Record Section.*—The number of maps, diagrams and other records, received for storage was 21,613; and 20,392 maps, &c., valued at Rs. 19,178 were issued. The relative decrease in the value, compared with the figures for last year, is due to the revised rates charged for maps of small sizes. Sales by book-transfer to Government departments amounted to Rs. 7,252 for 7,990 maps, &c., against Rs. 9,449 for 9,086 maps, &c., issued during the previous year. Cash sales to the public amounted to Rs. 3,310 for 5,558 maps, against Rs. 2,025 for 1,375 maps which were sold last year.

(4) *The Book-Binding Section.*—The section dealt with 264 volumes for the Forest Research Institute and 61 volumes for the Library of the Trigonometrical Survey, the value realized being Rs. 701, an increase of 187 volumes and Rs. 336 over the figures for last year; in addition 2,142 maps of various sizes were mounted on cloth for issue.



## III.—CIRCLE AND LOCAL DRAWING OFFICES.

**63. No. 3 Drawing Office (Northern Circle).**—During the year under report 14 one-inch sheets, out of the 29 previously surveyed, were fair-mapped by parties and after final examination have been submitted for publication. In addition to these, 1 one-inch sheet was brought up to date and completed to margin, while 4 other one-inch sheets were brought up to date, redrawn and completed to margin, in the drawing office, for purposes of reprint.

*Half-inch sheets compiled from published sheets of the modern one-inch and old style half-inch maps.*—7 half-inch sheets drawn in the Circle drawing office were submitted for publication during the year.

On the basis of the one-inch maps published to 30th September 1919, there now remain for completion in the Northern Circle 117 half-inch sheets of the kind under consideration. Of this number, the fair-mapping of 23 sheets is in hand or has been started.

In addition to the above, there are 6 half-inch sheets partially incomplete owing to some of the component one-inch sheets, though surveyed, not having been submitted for publication.

*Quarter-inch sheets compiled from the published sheets of the modern one-inch and half-inch maps (and old style maps).*—During the year, 1 quarter-inch sheet was fair-mapped in the Circle drawing office and submitted for publication. The fair-mapping of 3 quarter-inch sheets is in hand while that of 2 others is in abeyance.

The material for 4 quarter-inch sheets is incomplete, owing to component one-inch, though surveyed, not having been submitted for publication; the published material for 23 further quarter-inch sheets is available for fair-mapping.

*Special maps.*—During the year 15 sheets of the Simla Extension Survey, scale 220 feet = 1 inch; 1 sheet of the Jutogh Cantonment, scale 40 feet = 1 inch; 1 sheet of the biennial survey of Delhi and vicinity, scale 4 inches = 1 mile and 3 of the Royal Artillery Practice Camp maps, scale 3 inches = 1 mile, were fair-mapped and submitted for publication.

*Hill-shaded sheets.*—38 hill-shaded sheets, of one-inch, half-inch and quarter-inch sheets and Royal Artillery Practice Camp Maps, were stump shaded and submitted for publication during the year.

*Layer guides.*—Nil.

*Colour patterns and press order proofs.*—During the year 59 press order proofs and colour patterns were prepared and submitted for publication.

*Triangulation charts.*—A special section was formed during the year under report to deal with this work which had fallen much into arrears. Considerable progress has been made in sorting and arranging all volumes and data, but as the major portion of the work has been of a preparatory nature, no out-turn figures can be given at present.

*Miscellaneous.*—The traverse plots of 16 *mauzas* in 33 sheets, scale 16 and 32 inches = 1 mile, of the Gondā district were prepared and the cost of preparation recovered from the Deputy Commissioner, Gondā.

For the purposes of reprint, the office copies of 77 one-inch sheets were corrected, brought up to date and submitted for publication during the year.



hand during the year under report, were under preparation in the Circle drawing office during the year. 11 other sheets were received from the parties of the circle during the year. These, and 3 sheets received prior to 1st October 1918, are being dealt with in the drawing office. 4 of these were received in an incomplete state as regards boundaries and heights and are now being completed in the drawing office.

On the basis of one-inch sheets published up to 30th September 1919, there now remain 62 half-inch sheets for drawing in the circle, of which 39 are under preparation in the drawing office and parties of the circle.

There are 17 half-inch sheet areas completely surveyed on the 1-inch scale, but of these areas, the component one-inch sheets had not been submitted for publication on 30th September 1919.

*Quarter-inch sheets compiled from published sheets of the modern one-inch and half-inch maps (and old style maps).*—2 sheets were received from the parties of the circle during the year, but both were in an incomplete state as regards heights and boundaries and are now being completed in the Circle drawing office.

10 sheets were in hand in the Circle drawing office during the year, work on one of which was held in abeyance, pending completion of further surveys now in progress in its area.

Material for the preparation of two quarter-inch sheets, from either one-inch or half-inch published modern sheets, was ready on 30th September 1919; but draftsmen were not available to draw them. Of 6 other quarter-inch sheets, the component one-inch sheets, but not half-inch sheets, had been published in modern style prior to 1st October 1919; and it is not proposed to take up their preparation till these half-inch components have been published.

There were also, on this date, 4 other quarter-inch sheets the whole areas of which have been surveyed in modern style on the scale of 1 inch = 1 mile, but of which the one-inch sheets have yet to be published; and of these too it is proposed to postpone the preparation pending publication of their half-inch components.

*Hill-shaded sheets.*—Material for 6 sheets (all one-inch) was received during the year and that for 25 sheets (one-inch, half-inch and quarter-inch) was left over from the previous year. Of these 31 sheets, shaded originals for 14 one-inch, half-inch and quarter-inch sheets were submitted during the year and those for 6 others have been completed and are ready for submission. This leaves a balance of 11 sheets in hand for next year.

*The Layer guide* of one quarter-inch sheet was prepared and submitted during the year.

*Colour patterns and press order proofs.*—Proofs for the preparation of colour patterns for 9 sheets were received during the year and those for 34 sheets were in hand on 1st October 1918. 17 of these were completed and finally submitted during the year and one was abandoned pending completion of further surveys and additions to the sheet; 9 others are ready for submission, leaving a balance of 16 sheets in hand in various stages of completion.

*Triangulation charts.*—The preparation of .4 degree triangulation charts was in hand in the circle on 30th September 1919.

**66. No. 6 (Simla) Drawing Office.**—As during the previous year this office was organized in 2 sections.

The *Army Section* has dealt with the preparation of maps and plans for the use of the Army in India while the *Survey Section* has

been employed on the preparation of trans-frontier maps on the one-millionth, quarter-inch and half-inch scales.

Most of the work of the *Survey Section* has consisted in redrawing in modern style, and sometimes to a reduced scale, the maps already existing, with the incorporation of such additional information of recent date as may have been available.

**67. Bengal and Bihār and Orissa Drawing Office.—**  
(*Imperial Standard Mapping Section*). The ordinary work of this office is the compilation (from modern revenue survey material and from "local series" maps) and fair-mapping of one-inch sheets, for publication in colours as preliminary editions pending their topographical revision.

During the year under report the whole strength of this office has not been employed, as in previous years, on this work; and fewer sheets have been completed and submitted for publication in consequence.

Of *Bengal* 12 new sheets have been fair-mapped and submitted for publication during the year.

Of *Bihār & Orissa* 2 new sheets have been fair-mapped and 8 sheets, previously published without hills, have been completed for republication of new editions with hills.

The additional work undertaken by this office during the year, on which a considerable portion of its strength was employed, has been the compilation and fair-mapping of a new "Town Guide" map of Calcutta-Howrah for publication in 16 sheets on the scale of 12 inches = 1 mile.

This new combined map is being compiled from the existing map of Calcutta on the scale of 16 inches = 1 mile, which has been brought up to date as far as possible, and from new drawings prepared from reductions of the recent survey of Howrah on the scale 50 feet = 1 inch.

Work on this map was started in October 1918. All 16 sheets were completed and submitted for publication, and 2 of them were published, before the end of the year under report.

## PART 4.—WORK FOR OTHER GOVERNMENT DEPARTMENTS.

68. Northern Circle. *No. 1 Party*.—Three Royal Artillery Practice Camps were surveyed on the scale of 3 inches = 1 mile, i.e., Baleli (near Quetta) 95 square miles, Pāli-pahāri (near Jhānsi) 61 square miles, and Killod (near Mhow) 72 square miles (*vide* also page 13).

The country round Baleli consisted of an open cultivated valley at an altitude of about 5,000 feet intersected by numerous water courses generally dry and included parts of the foot-hills of the two ranges forming the valley; that round Pāli-pahāri and Killod was mostly open, cultivated and undulating country with a few hills.

The fair-mapping of the Yāru-Bostān Camp left over from last year has been sent in for publication and the fair-mapping of the three new camps mentioned above will be completed shortly.

Details of the survey for "Town Guide" maps executed by this party will be found on page 18.

*No. 2 Party*.—At the instance of the Secretary, Public Works Department, Rājputāna, the survey on the scale of 24 inches to a mile was commenced of the hill station of Mount Abu and its extension as acquired on lease by Government from the Sirohi Darbār, comprising an area of some 5,500 acres in all. The cost of this survey is being borne by the Public Works Department, Rājputāna. The details of the work done up to date are given on page 18.

Details of the survey for "Town Guide" maps executed by this party will be found on page 18.

*Sind-Sāgar Party*.—During the year under report, the party was employed on rectangulation of the Sind-Sāgar Doāb in connection with the Punjab Government's Sind-Sāgar Canal and Colonization Project, in Miānwāli, Shāhpur, Jhang and Muzaffargarh districts.

The whole tract, approximate area 7,863 square miles, comprised in the scheme, was cut up into 1,342 rectangles of 4,000 acres each by locating on the ground 1,920 corners; 1,299 dressed stones were embedded on the main and 2,000-acre corners in the Agricultural or "Included Thal," and 430 iron rails were embedded on main corners in the High or "Excluded Thal".

Sub-division into 100-acre rectangles was carried out over the northern part of the tract, comprising an area of 3644.4 square miles, and embracing parts of Miānwāli, Shāhpur, and Jhang districts; 23,324 rectangles of 100 acres each were laid out and their corners were marked by stones. Nearly 73 per cent. of the work was tested by the superior revenue staff and the survey officers. The party has now to deal with the sub-division into 100-acre rectangles in southern area of the tract already divided into 719 rectangles of 4,000 acres each. This will be done next field season.

Traversing amounting to 279.9 linear miles was also carried out by the party in the strip of thickly wooded country, along the western edge of the "Thal" in Muzaffargarh district, in which triangulation was impracticable. In this tract also, approximate area 405 square miles, the corners of 4,000-acre and 2,000-acre have been located.

The country under rectangulation lies between the Indus river on the west and the Jhelum and Chenāb rivers on the east and is locally known as "Thal" (uplands). The tract is a vast rolling desert of sand studded with

hillocks, sparsely populated and almost waterless. The village wells are generally brackish. The "Thal", with the exception of the north-eastern portion which is more cultivated, is covered by low tree growth. The natural difficulties of the ground make the work arduous and slow.

In recess the party was employed on completion of the computations of triangulation and traverse and other records of the Sind-Sāgar rectangular survey, and also on half-inch fair-mapping, from the middle of July to the end of September 1919.

*Punjab Riverain Survey Party*—As in previous years, this party was employed on local surveys in the Punjab. The details of the work done are given on pages 18 and 19.

**69. Southern Circle.**—The survey of cantonments and military stations was continued by No. 20 Party. The details of the work are given on page 20.

The Royal Artillery Practice Camps of Kāpra, in the Hyderābād State and of Rājankunti in the Mysore State, which were surveyed on the scale of 3 inches = 1 mile by Nos. 6 and 8 Parties respectively the previous year, were fair-mapped by No. 5 Party and submitted for publication.

The special survey on the scale of 1½ inches = 1 mile of reserved forests in the Hyderābād State was continued by No. 6 Party, and an area of 237 square miles was surveyed. The cost of the work is being borne by the Nizām's Government.

**70. Head Quarter Offices.**—Details of all extra-departmental publications during the year for the Army, for Local Governments and for other Government offices are given in Table A of the Photo-Litho. Office report on page 34, in the "Issues" Table and in Table IV of the Map Report and Issue Office report on pages 28 and 29.

In addition to the special maps for other departments which are mentioned in para. 54 (g) on page 27, these extra-departmental publications include Royal Artillery Practice Camp maps and various operation and manœuvre maps for the Army; maps to illustrate the Hydro-Electric Survey Report, the Journals of the United Service Institution, various reports of Government officials, &c.; large numbers of special diagrams for the Railway Board and of forms for Government Promissory Notes; the reprint of a Persian Grammar text book; and the usual large numbers of Weather charts for the Meteorological Department and of photogravure and half-tone illustrations for the Archaeological and other departments.

The work entailed by the preparation of originals for some of these special maps, in addition to their publication, is mentioned in the reports of No. 1 Drawing Office and of the Engraving Office on pages 30 to 33.

**71. Mathematical Instrument Office.**—The manufacture of heliographs, prismatic compasses Mark VIII, scales, protractors, &c., was continued throughout the year. Practically all repair and manufacture work of a civil nature was put aside. Large numbers of metre staves and chains were manufactured to meet Mesopotamia's demands. Several engraving machines were manufactured to facilitate work on scales and protractors, &c.

Instruments were supplied by this office to many Government offices, Imperial and Provincial.

## LIST OF INDEX MAPS.

---

1. Modern survey and publication.
2. Publication of modern one-inch series.
3. " modern half-inch series for India.
4. " " quarter-inch " "
5. " 'India and Adjacent Countries' series, scale  $\frac{1}{1,000,000}$ .
6. " 'Indian sheets of "La Carte Internationale du Monde," scale  $\frac{1}{1,000,000}$ .
7. " 'Southern Asia' series, scale  $\frac{1}{2,000,000}$ .
8. Progress of the Great Trigonometrical Survey.

# Survey of India.

## GENERAL REPORT

### 1918-19.

From 1st October 1918

To 30th September 1919.

---



PREPARED UNDER THE DIRECTION OF  
COLONEL C. H. D. RYDER, C.I.E., D.S.O., R.E.,  
SURVEYOR GENERAL OF INDIA.

---

PRINTED AT THE PHOTO-LITHO. OFFICE, SURVEY OF INDIA -  
CALCUTTA.

1920.

---

Price Two Rupees or Four Shillings.