SURVEY OF INDIA

GENERAL REPORT
1955

From 1st April 1954

To 31st March 1955

PUBLISHED BY ORDER OF
BRIGADIER I. H. R. WILSON, F.R.I.C.S., M.I.S. (IND.)
SURVEYOR GENERAL OF INDIA

PRINTED AT THE OFFICE OF THE NORTHERN CIRCLE,
SURVEY OF INDIA, DEHRA DŪN, 1959.

Price: Thirty Rupees or Forty Five Shillings

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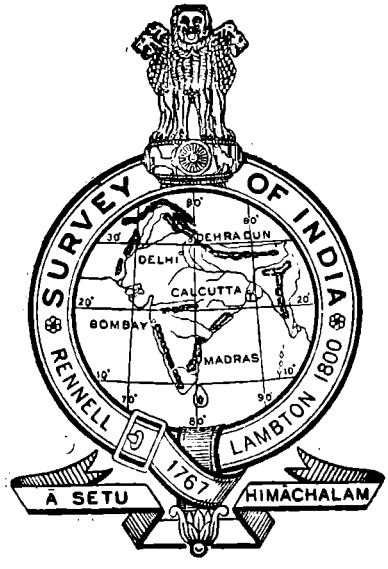

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Scales are referred to as follows :—

(*i*) *for scales which are multiples of 1:1,000,000.*—"1/M scale","1/6 M scale", &c., which mean "1,000,000 scale", "1 : 6,000,000 scale", &c.,

(*ii*) *for scales smaller than 4 miles to one inch*—"50-mile scale", "8-mile scale", &c., which mean "scale of 50 miles to one inch", "scale of 8 miles to one inch", &c.,

(*iii*) *for scales of and larger than 4 miles to one inch*—"$\frac{1}{4}$-inch scale", "$\frac{1}{8}$-inch scale", "4-inch scale", "16-inch scale", &c., which mean scale of "$\frac{1}{4}$ inch to one mile" etc., etc.,

(*iv*) other scales, by their representative fraction, e.g., "1 : 25,000 ".

Serial Numbering of Survey of India maps—

Sheets NE-43, NF-44, &c., are sheets on 1/M scale ; (International Numbering).
Sheets 65, 78, &c., are sheets on the 1/M scale (now superseded by above).
Sheets 65K, 78F, &c., are $\frac{1}{4}$-inch sheets.
Sheets 65K/N.W., 78F/S.E., &c., are $\frac{1}{2}$-inch sheets.
Sheets 65K/1, 78F/16, &c., are 1-inch sheets.
* Sheets 65K/1/1, 78F/16/2, &c., are 1 : 25,000 sheets.

The system of numbering is fully explained in the Indexes at the end of this report.

Explanation of Abbreviations—

G.C.S.	.. General Central Service.
H.L.O.	.. Hāthībarkala Litho Office (Dehra Dūn).
P.L.O.	.. Photo-Litho Office (Calcutta).
P.Z.O.	.. Photo-Zinco Office (Dehra Dūn).
D.O.	.. Drawing Office.
M.R.I.O.	.. Map Record and Issue Office.
I.C.A.O.	.. International Civil Aviation Organization.
G.T.	.. Great Trigonometrical.
C.W. & P.C.	Central Water and Power Commission.
G.S.G.S.	.. Geographical Section, General Staff.
C.I.M.	.. Carte Internationale du Monde.
P.E.P.S.U.	Patiāla and East Punjab States Union.

Definitions of Surveys—

Old Surveys are those carried out prior to 1905.
Modern Surveys are those carried out since 1905.
Original Surveys are Modern Surveys carried out for the first time on a specified scale.
Revision Surveys are those carried out in areas where the existing Original Survey is on the same or on a larger scale.
Verification Surveys are revision surveys directed towards the checking of specified items of detail reported to have undergone changes.
Blue-print Survey is one carried out on light blue prints of the existing survey old or modern.
Colour-print Survey is one carried out on coloured print (usually dark grey outline and brown contours) of an area covered by Modern Survey.

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* 1 : 25,000 SHEETS :—Each one-inch sheet is divided into six 1 : 25,000 sheets, numbered from 1 to 6 as shown in the diagram opposite. The number of a 1 : 25,000 sheet thus takes the form 65 K/1/1.

65 K/1

1	4
2	5
3	6

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PART II. MAP PUBLICATION AND OFFICE WORK

PART III. GEODETIC WORK

ILLUSTRATIONS

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PREFACE

The history and work of the Survey of India Department have been fully described in the *Preface* to the General Report 1953 and its predecessors.

With effect from this year it has been decided to amalgamate the annual Technical Report Parts I and II with the General Report. As a result Table C and other paragraphs of interest which used to appear in the former have now been included in this issue of the General Report. This is a reversion to the practice which was being followed before World War II and besides being economical, has the added advantage of presenting to the readers complete information about the topographical, fair-mapping and reproduction work done and the technical methods followed by the department during the year under report, in a single volume. Part III of the annual Technical Report dealing with geodetic and geophysical work will, however, continue to be published separately under its pre-war title "Geodetic Report".

In this issue the arrangement of the material has been kept the same as in the General Report 1954 with the only difference that Table C—"Areas out-turns and cost-rates of Surveys, Mapping and Computations"—has been added at the end of Section II, and the report of the newly formed Air Survey and Training Directorate has been added as section VI at the end of Part I.

The paragraphs on Technical Methods, etc., appear in the narrative of the units concerned.

As this report relates to the period prior to the 1st November 1956, the names, etc., of States mentioned in its narrative are the same as were current before the enforcement of the States Reorganisation Act, 1956 (No. 37 of 1956).

SURVEY OF INDIA

GENERAL REPORT 1955

From 1st April 1954

To 31st March 1955

I. INTRODUCTION AND SUMMARY

1. **Annual Reports.**—From this year again, as prior to the World War II, the annual reports of the Survey of India Department are being published in two instead of three separate volumes, namely :—

(*a*) *The General Report.*

(*b*) *The Geodetic Report.*

These reports cover the period of the financial year beginning from 1st April and ending on 31st March.

The General Report includes an abstract as well as details of topographical and other surveys together with their areas, out-turns and cost-rates (in *Part I*), of fair-drawing, printing, publications and map issues, both departmental and extra-departmental (in *Part II*) and a brief narrative of geodetic work (in *Part III*). The purpose of this report is to acquaint the various departments of the Central and State Governments of India and others who are interested with the activities of the Survey of India during the year under report.

The Geodetic Report contains fuller technical details of the geodetic and geophysical work such as geodetic triangulation, determination of accurate latitudes, longitudes and azimuths, precise levelling, gravimetric and magnetic observations, etc., etc., done by the department during the year under report and is intended for departmental use as well as for distribution to other survey and scientific departments.

There is also a Technical Supplement to the General Report (formerly called Supplement to the Technical Report), for departmental use, which is merely intended to supply information which is of little general interest, but which is required departmentally as a record of individual out-turns, etc. It does not issue in letterpress.

The General Report described above deals only with surveys which are not of a restricted nature. Particulars of restricted/ secret surveys and those carried out for the Defence Department are published annually in a Supplement to the General Report which is a "restricted" document not for general circulation.

The progress of modern (i.e., post-1905) topographical surveys made by the department and of compilation from our own or other material is illustrated in *Index A* at the end of this report, while *Index B* indicates the obsolescence of modern surveys on 1-inch and ½-inch scales. *Index C* shows project surveys in hand and the remaining *Indexes D, E, F* and *G* show all the standard maps which have been published up to date on various scales. It will be seen from *Index D* that the areas within India which are blank on *Index A* are actually almost entirely covered by topographical maps. These maps are, however, prepared from material based on the old longitude of 1815, which was over 2′ 27″ in error. These maps are mostly uncontoured, drawn in the old style and many years out-of-date, and hence have been excluded from *Index A*.

It may be mentioned here that besides the standard maps shown in *Indexes D, E, F* and *G*, this department also publishes Aeronautical Charts on the 1/M scale, Landing and Approach Charts on scales of 1 : 31,680 and 1 : 250,000 respectively for all civil aerodromes in India, State maps on the 1/M scale, Town Guide maps on scales varying from 3 inches to 16 inches to one mile, general maps of India on scales of 40,70,128 and 192 miles to an inch, special maps such as the Railway Map of India, and the Road Map of India and also Cantonment maps from special surveys.

2. **Surveyor General's Office.**—The post of the Surveyor General of India was held by BRIGADIER I. H. R. WILSON, F.R.I.C.S., M.I.S. (IND.), throughout the period under report.

The posts of the Deputy Surveyor General and the Assistant Surveyor General were held by the Officers as shown below :—

DEPUTY SURVEYOR GENERAL	SHRI K. L. DHAWAN, B.A., M.I.S. (IND.), to 2–1–55.
	SHRI M. M. GANAPATHY, B.A., M.I.S. (IND.), from 3–1–55.
ASSISTANT SURVEYOR GENERAL	MAJOR O. P. ANAND, A.M.I.S. (IND.), ENGRS., to 9–9–54.
	MAJOR J. A. F. DALAL, B.A., A.M.I.S. (IND.), ENGRS., from 10–9–54.

3. **Cost of the Department.**—The total cost of the department for the year ending 31st March, 1955, as compared with those for the previous two years was as follows :—

	1952–53	1953–54	1954–55	REMARKS
	Rs.	*Rs.*	*Rs.*	
Gross actual cost ..	94,67,640	97,70,804	**1,11,26,746**	
Deduct–Recoveries ..	32,58,204	33,80,577	**41,60,693**	
Nett actual charges ..	62,09,436	63,90,227	**69,66,053**	

4. **Sanctioned strength of the Department.**—A statement showing the total number of sanctioned posts in the Survey of India as on 31st March, 1955, is given below :—

Designation of posts	Number	
	Permanent	Temporary
I. FIXED ESTABLISHMENT :		
(*a*) *Class I Service.*—		
Surveyor General	1	..
Directors	7*	1
Deputy Directors (including President, Geodetic and Research Branch) ..	2	5
Superintending Surveyors	33†	8
Deputy Superintending Surveyors ..	22	4
(*b*) *General Central Service Class I.*—		
Mathematical Adviser	1	..
Superintendent Insturment Repair Shop	1‡	..
Chief Manager (Map Reproduction) ..	1§	..
Managers (Map Reproduction Offices) ..	4	..
Senior Scientific Officer	1‖	..
Deputy Stores Officer	..	1
(*c*) *Class II Service.*—		
Officer Surveyors	89	15
(*d*) *General Central Service Class II.*—		
Head Engraver	1	..
Assistant Managers (Map Reproduction)	8¶	..
Officer Supervisor	..	1
Registrar	1**	..
Asst. Head Engraver	1††	..
Electrical Engineer	1	..
Assistant Stores Officers	..	2
Medical Officer	..	1
(*e*) *Class III Service.*—		
(*i*) *Technical.*—		
Surveyors (Division I) ..	85	..
Survey Assistants (Division I) ..	30	..
Draftsmen (Division I) ..	12	..
Assistant Supervisor Printing Office	1	..
Technical Assistants (Division I)	41	..
Engravers (Division I) ..	7	..
Medical Officer	1	..
(*ii*) *Ministerial.*—		
Office Superintendents ..	3	..
Head Assistants	2‡‡	..
Assistants-in-charge	..	2
Assistants	7§§	8
Stenographers	2	..
Clerks Upper Division ..	13	6
Clerks, Lower Division ..	8	15
Record Keepers	1	3

* 1 post held in abeyance.
† 4 posts held in abeyance.
‡ In abeyance.
§ Vacant.
‖ Vacant.
¶ 2 posts held in abeyance.
** Vacant.
†† Non-gazetted.
‡‡ 1 post in N.C.O. now replaced by Office Superintendant.
§§ Includes 1st Division Assistants of Circles.

Designation of posts	Number	
	Permanent	Temporary
(f) Class IV Service.—		
Class IV personnel	23	..
II. UNFIXED ESTABLISHMENT :		
Class III Service.—		
(i) Technical.—		
Surveyors (Division I)		2
Survey Assistants (Division I)		9
Geodetic Computers (Division I) ..		5
Draftsmen (Division I)		10
Scientific Assistants (Division I) ..		3
Topo Trainees Type 'A'		9
Store Assistants (Division I)		8
Head Mechanic	1	..
Plane-tablers, Air Survey Draftsmen, Draftsmen, Computers, Record Keepers, etc., etc.	653	481
Reproduction personnel ..	395	17
Engravers	14	1
Head Artificer	1	..
Assistant Head Artificer ..	1	..
Other Artificers	2	30
Telephone Operators ..	3	1
Librarian	1	..
Motor Drivers	4	39
Compunders	2	1
Head Packer	..	1
Security Supervisor	..	1
Electrician	1	..
Assistant Electrician ..	1	..
Fitter Mechanic	1	..
Motor Mechanics	2	1
(ii) Ministerial.—		
Office Superintendents ..	8	..
Head Clerks, Head Accountants	12	..
Stenographers of Circles ..	5	..
Clerks, Upper Division ..	96	4
Clerks, Lower Division ..	142	73
(iii) Class IV Service.—		
Class IV personnel	297	2718

5. **Raising, Transfer and Disbandment of Units.**—*Computing and Tidal Party.*—The Computing and Tidal Party under the administrative control of the Director, Geodetic and Training Circle, was spilt into two separate units—the Computing Party and the Tidal Party—with effect from 26th April, 1954.

Air Survey and Training Directorate.—A new Directorate designated the Air Survey and Training Directorate was raised, with headquarters at Dehra Dūn, with effect from 1st May, 1954. The

following units/sections were transferred from the administrative control of the Director, Geodetic and Training Circle to that of the Director, Air Survey and Training Directorate from the same date :—

(1) No. 15 (Training) Party.
(2) No. 16 (Training) Party.
(3) No. 20 (Photogrammetric) Party.
(4) Workshop.
(5) Dispensary.
(6) Estate.

Redesignation of the Geodetic and Training Circle.—Consequent on the formation of the Air Survey and Training Directorate, the residual Geodetic and Training Circle was re-designated as the Geodetic and Research Branch with effect from 1st May, 1954.

Flood Survey Wing.—In order to cope with the heavy and emergent task of surveys required by the Central Water and Power Commission in connection with the flood control measures, a Flood Survey Wing was raised at Dehra Dūn, with effect from 1st November, 1954, under the administrative control of the Director, Air Survey and Training Directorate. The wing comprised of the following units under the charge of a Deputy Director :—

1. No. 1 Survey Party (Dehra Dūn), transferred from the Northern Circle with effect from 11th October, 1954.
2. No. 11 Survey Party (Rānchi), transferred from the Eastern Circle with effect from 1st November, 1954.
3. Assam Flood Survey Party, newly raised at Shillong on 7th February, 1955.

No. 21 Party.—A new party designated No. 21 Party (Southern Circle) was raised, with Headquarters at Bangalore, with effect from 1st October, 1954 under the administrative control of the Director, Southern Circle.

Move of the Headquarters of the Eastern Circle.—The Office of the Director, Eastern Circle, closed in Shillong and re-opened in Calcutta with effect from 20th December, 1954.

6. **Deputations.**—SHRI N. C. SEN, Officiating Deputy Superintending Surveyor, went on deputation to the Ministry of Defence as Civilian Hydrographic Officer in the Naval Hydrographic Office, Dehra Dūn, with effect from 8th October, 1954.

The Government of India sanctioned the extension of the period of deputation of SHRI S. VAIKUNTANATHAN, Officer Surveyor, with the Government of Ceylon as Survey Instructor under the Colombo Plan Technical Co-operation Scheme for a further period of six months from 18th September, 1954.

On termination of his deputation period with the G.S.G.S., Army H.Q., Ministry of Defence, SHRI G. C. AGGARWALA reverted to the Survey of India and assumed charge of the duties of the Assistant Director, Map Publication, in the Map Publication Directorate on 22nd November, 1954.

SHRI A. K. SEN GUPTA, Superintending Surveyor remained on deputation with the Government of West Bengal up to 31st August, 1954 and thereafter proceeded on refused leave preparatory to retirement, on the expiry of which he retired from service with effect from 1st March, 1955.

SHRI N. N. DHAWAN, Deputy Superintending Surveyor, and SHRI S. N. ROY, Officer Surveyor, continued to be on deputation with the College of Military Engineering, Kirkee.

7. **Distinguished Visitors.**—DR. H. J. BHABHA, F.R.S., Chairman, Atomic Energy Commission, Government of India, visited the Office of the Director, Southern Circle, Bangalore on the 26th June, 1954 in connection with his requirements of topographical maps.

LIEUT.-COLONEL R. L. YOUNG, Assistant Army Attache, and MR. CONARD J. THOREN, Geographic Attache of the American Embassy, New Delhi, visited the Survey of India Offices at Dehra Dūn on the 8th and 9th September, 1954. MR. THOREN also visited the Office of the Southern Circle, Survey of India, at Bangalore on 30th November, 1954.

SHRI JAIRAMDAS DAULATRAM, Governor of Assam, visited the Headquarter offices of the Eastern Circle at Shillong on 27th October, 1954 to acquaint himself with the terrain of certain parts of the North-East Frontier Agency from the aerial photography available with the Directorate.

SHRI K. N. KAUL, Joint Secretary, Ministry of Natural Resources and Scientific Research, SHRI E. KOLET, Deputy Secretary, Ministry of Finance and SHRI M. R. KALYANARAMAN, Under Secretary, Ministry of Natural Resources and Scientific Research, visited the Surveyor General's Office, Dehra Dūn, on the 4th December, 1954 for discussions to finalize the recommendations of the Special Reorganization Unit regarding the future set-up of the Survey of India Department.

The Delegates of the U.N. Regional Cartographic Conference for Asia and the Far East Region, visited the Geodetic Branch and Map Publication Offices of the Survey of India at Dehra Dūn on 21st February, 1955.

Besides the above, numerous parties of students and trainees from various Government Departments and educational institutions in the country visited the Survey of India Offices in Dehra Dūn, Calcutta and Bangalore and acquainted themselves with the major activities of the department such as surveying, map-drawing, lithographic printing, etc.

8. **Conferences and Meetings.**—*Directors' Conference.*—A conference of the Directors of the Survey of India was held in the Surveyor General's Office at Dehra Dūn from the 10th to 15th May, 1954 to consider the field programme of survey operations during the 5-year period commencing from the field season 1954–55, postings of officers, selection of personnel for filling vacancies in certain Class III Division I and ministerial establishments, etc., and other administrative and technical questions.

The following officers attended the Conference :—

1.	BRIGADIER I. H. R. WILSON	.. Surveyor General.
2.	COLONEL GAMBHIR SINGH	.. Director, Map Publication.
3.	COLONEL R. S. KALHA	.. Director, Eastern Circle.
4.	SHRI B. L. GULATEE	.. Director, Geodetic and Research Branch.
5.	SHRI K. L. DHAWAN	.. Deputy Surveyor General.
6.	SHRI P. A. THOMAS	.. Director, Northern Circle.
7.	COLONEL J. S. PAINTAL	.. Director, Southern Circle.
8.	SHRI E. R. WILSON	.. Director, Air Survey and Training Dte.
9.	COLONEL S. R. NAUTIYAL	.. Deputy Director, Military Survey.
10.	MAJOR O. P. ANAND	.. Assistant Surveyor General.

SHRI M. R. KALYANARAMAN, Under Secretary, Ministry of Natural Resources and Scientific Research also attended the Conference on 15th May.

Institution of Surveyors (India).—Four council meetings of the Institution were held during the year—two in the Surveyor General's Office and two in the "Kashmir House", New Delhi. BRIGADIER I. H. R. WILSON, Surveyor General of India was elected the President of the Institution for the year 1955.

Central Board of Geophysics.—SHRI B. L. GULATEE, Director, Geodetic and Research Branch, attended the 10th Meeting of the Central Board of Geophysics held in New Delhi on 3rd July, 1954.

Pan Indian Ocean Science Association.—SHRI B. L. GULATEE, Director, Geodetic and Research Branch, attended the 2nd Congress of the Pan Indian Ocean Science Association held at Perth (Western Australia) from 17th to 29th August, 1954 as a delegate nominated by the Government of India.

International Union of Geodesy and Geophysics.—SHRI B. L. GULATEE, Director, Geodetic and Research Branch, as one of the delegates from India, attended the Tenth General Assembly of the International Union of Geodesy and Geophysics held in Rome (Italy) from the 15th to 29th September and also the meetings of the International Associations and the International Committee for the Geophysical Year 1957–58 from 30th September to 4th October. While in Europe SHRI B. L. GULATEE visited the Wild Company at Heerbrugg (Switzerland), the German Hydrographic Bureau, and the Hydrographic Office of the Admiralty, London, and had technical discussions with them.

United Nations Regional Cartographic Conference for Asia and the Far East.—At the invitation of the Government of India the first Regional Cartographic Conference for Asia and the Far East was held in the Savoy Hotel in Mussoorie (near Dehra Dūn) from 15th to 26th February, 1955 under the auspices of the United Nations Economic and Social Council.

Delegates from 18 different countries and from five international scientific organizations took part in the deliberations of the conference and adopted twenty-two resolutions dealing with different aspects of Cartography in Asia and the Far East Region. In one of the resolutions it was recommended that the second conference for this region should be held not later than 1958. A list of the delegates and a summary of the resolutions adopted are reproduced in Appendix I, at pages 131–144 of this book.

Although the first of its kind, the conference was a success and keen interest was evinced by all the participating countries.

All-India Printers' Conference.—SHRI B. C. DATTA, Manager (Map Reproduction) attended the conference held in Madras from 6th to 9th February, 1955, as a delegate from the Survey of India.

9. **Indo-Pākistān Boundary Survey**—CAPTAIN K. L. KHOSLA, Engrs., Deputy Superintending Surveyor, representing the Survey of India, attended a conference of the Commissioners Lahore Division (Pākistān) and Ambāla and Jullundur Divisions (India) at Amritsar on 19–5–54 to finalize the Ujh River Sector boundary demarcation. MR. A. AHAD, Deputy Director, represented the Survey of Pākistān.

10. **Miscellaneous.**—*Expansion of the Department.*—(*i*) As a result of the recommendations of the Survey Priorities Committee which met in Dehra Dūn on the 5th of September, 1953, the Government of India, in order to cope with the very heavy demands for new surveys and maps, have approved of the rapid expansion of the department during the coming five years.

The target for expansion is that, by 1959, the department will, excluding geodetic and miscellaneous units, consist of :—

5 Drawing Offices.
4 Photogrammetric Parties.
22 Field Parties.
3 Training Parties.

(*ii*) In addition, Government have approved of, and funds have been allotted for, the photogrammetric mechanization of the department, each photogrammetric party being equipped with 1 Wild A/7 and 2–3 Wild A/8's and each field party with 1 Slotted Template Equipment and 1 Zeiss Stereotop MK IV.

(*iii*) Expansion of the department's geodetic and geophysical activities is also under Government's consideration.

Redetermination of Height of Mount Everest.—The Geodetic and Research Branch which had been engaged on the task of determining a revised and more precise height of the Mount Everest, the

highest peak in the World, have, after careful observation and computations carried out over a period of two years, arrived at the figure of 29,028 feet above mean sea-level. This new height, it is hoped, should be correct within 10 feet either way ; any attempt at a greater degree of accuracy appears pointless as the variation in depth of the Snow Cap on the summit throughout the year, might well be something of this order. The whole operation is described and a detailed analysis of the results of the field observations given in the Survey of India Technical Paper No. 8 "The Height of Mount Everest", by Shri B. L. Gulatee.

Historical Records of the Survey of India, Volume III.—The third volume of the Historical Records of the Survey of India collected and compiled by Col. R. H. Phillimore, C.I.E., D.S.O. has been released. The volume deals with the period 1815–1830 starting from the appointment of Colonel Colin Mackenzie as the first Surveyor General of all India and closing with Sir George Everest's appointment as Surveyor General and Superintendent of the Great Trigonometrical Survey in 1830.

This volume records the passing of William Lambton and tells of the early work of that other great geodesist, Sir George Everest. It also tells of Valentine Blacker, who, in his few years as Surveyor General, ensured that first priority should be given to the Great Trigonometrical Survey.

Retired Officers—Honours and appointments.—Dr. J. de Graaff Hunter, C.I.E., M.A., SC.D., F.R.S., F. INST. P., late Director, Geodetic Branch, Survey of India, was elected President of the International Association of Geodesy for the triennium 1954–57. Brigadier G. Bomford, O.B.E., D.SC., M.A., who had retired from Survey of India Class I Service in 1947, was elected as President of Section V of the Association.

Survey of India Re-Union.—A Society comprising of the retired officers of the Survey of India known as the "Survey of India Re-Union" was formed in London in November, 1954. It is open to all who were members of the Survey of India before the 15th August, 1947. The objects of the Society are to foster the memory of the old Survey of India and to keep members in touch with each other.

The first inaugural meeting of the Union was held on the 19th November, 1954 under the chairmanship of BRIGADIER G. F. HEANEY, C.B.E., F.R.I.C.S., late Surveyor General of India.

The first gathering of the members and their wives was held on the 11th February, 1955 and about 60 people attended.

11. **Personnel.**—Retirements, casualties, promotions appointments, etc.

Class I Servics.—BRIGADIER I. H. R. WILSON—re-employment, as the Surveyor General of India on contract, extended for a further period of 2 years from the 15th August, 1954.

SHRI H. M. CRITCHELL, Director—retired.

SHRI E. R. WILSON and SHRI M. M. GANAPATHY, Deputy Directors—appointed to officiate as Directors.

SARVA SHRI J. C. ROSS, M. R. NAIR and P. S. SHINGHAL, Superintending Surveyors—appointed to officiate as Deputy Directors.

SHRI S. C. CHATTERJEE, Superintending Surveyor—retired.

SHRI A. K. SEN GUPTA, Superintending Surveyor—retired.

CAPTAINS M. L. CHOPRA, K. L. KHOSLA, M. M. DATTA and SARVA SHRI K. SATYANARAYANAN, V. RANGAN, Deputy Superintending Surveyors—appointed to officiate as Deputy Superintending Surveyors-in-Charge.

CAPTAIN J. P. G. KING., Deputy Superintending Surveyor—reverted to the Army for a tour of duty in G.S.G.S.

CAPTAIN G. SHREENIWAS—confirmed as Deputy Superintending Surveyor.

LIEUTS. G. C. AGGARWAL, S. G. KRISHNAMURTY, A. S. IYER, D. N. DARA and T. S. BEDI—appointed as Deputy Superintending Surveyors (on probation) on transfer from the Army.

SARVA SHRI G. S. OBEROI, VASUDEVA KRISHNA PAI and T. K. GURUSWAMY—appointed as Deputy Superintending Surveyors (on probation) against permanent vacancies.

SARVA SHRI V. B. MUDKAVI and J. NARASIMHAN—appointed as Deputy Superintending Surveyors (Temporary).

Class II Service.—SARVA SHRI S. N. MATHUR, T. K. GURUSWAMY, T. K. VISVANATHAN, S. P. GUPTA, D. N. SHARMA, P. K. CHOWDHURY and N. M. BHOPAIAH—confirmed as Officer Surveyors.

SARVA SHRI CHITARANJAN BASU, M. RAMACHANDRA RAO, PIARA SINGH BAINS, A. K. BAGCHI, K. K. RAMPAL and B. R. BOSE—appointed as Officer Surveyors (on probation) against permanent vacancies.

SARVA SHRI S. K. GUHA, JAGAN NATH and B. S. CHOPRA, Surveyors (Selection Grade)—appointed to officiate as Officer Surveyors against temporary vacancies.

SARVA SHRI K. C. BAREJA, S. S. CHHABRA, A. K. BHATIA, K. C. SAXENA and A. K. CHAKRABARTI—appointed as Officer Surveyors (on probation) against temporary vancancies.

SHRI N. S. MUKHARJI, Officiating Officer Supervisor (G.C.S. Class II)—retired.

SHRI M. R. IYENGAR, Superintendent, Surveyor General's Office—appointed to officiate as Officer Supervisor (G.C.S. Class II).

SHRI N. C. NATH—re-employed as Map Curator (G.C.S. Class II, Temporary Post).

Class III Service.—SARVA SHRI J. C. BHATTACHARJEE, N. N. JOSHI, R. K. GUPTA, M. L. GOSWAMI, J. S. MOORTHY, S. A. MUTHUKRISHNAN, DAYA NAND and S. ROY CHOWDHURY, Surveyors (Ordinary Grade)—appointed to officiate as Surveyors (Selection Grade).

SARVA SHRI N. M. DAS, P. N. RAO, P. R. S. NAYYAR, A. K. BANERJI, DASARATHI SEN, P. N. SANYAL, S. N. SETLUR, S. N. BARTHWAL, P. G. MUKERJI, S. D. BHATT, N. K. PAL CHOWDHURY, GURCHARAN SINGH, R. S. SACHDEV, K. L. CHAKRABARTY, S. P. JHAKMOLA, T. K. MAITRA, SACHINMOY ROY, V. R. SAHANE, R. L. SHARMA, A. K. ROY, S. N. NANDI, SUNIRMAL DAS, P. C. MALIK, R. S. CHHABRA, M. L. SAHDEV, S. K. DATTA, KULWANT SINGH, S. K. GHOSH, R. L. TANEJA, J. NARASIMHAN, P. N. PURI, D. D. MEHTA and ISHAR SINGH, Surveyors (Ordinary Grade)—confirmed.

SHRI S. K. SAWHNEY, Geodetic Computer, Ordinary Grade—confirmed.

SARVA SHRI R. K. LAL and JAIKIRTI SINGH, Survey Assistants, Ordinary Grade—appointed to officiate as Survey Assistants, Selection Grade.

SHRI S. K. ROY, Survey Assistant Ordinary Grade—confirmed.

SARVA SHRI MOHAR SINGH, BHAKHTAWAR SINGH, K. B. MADAN, —appointed to officiate as Survey Assistants Ordinary Grade against permanent vacancies.

SARVA SHRI C. GOPALASWAMY, JAGJIT SINGH, JOGINDAR SINGH, LACHMAN DAS, BALDEV SINGH and C. S. OJHA—appointed to officiate as Survey Assistants Ordinary Grade against temporary vacancies.

SARVA SHRI R. SONEE and B. R. SHARMA, Draftsmen Division I—confirmed.

SHRI J. MUKERJEE Draftsman Division I—transferred to Naval Hydrographic Office, Ministry of Defence from 10-8-54.

SHRI S. K. MALLICK—appointed to officiate as Draftsman Division I, Ordinary Grade, against a permanent post.

SARVA SHRI A. M. CHAKRABARTY, G. P. KALE, AMAR SINGH RANA, B. N. BANERJI, K. P. DE, N. D. VERMA, S. K. PAIN, C. L. JAISWAR, M. SADULLAH KHAN and K. SHEIKH IBRAHIM—appointed to officiate as Draftsmen Division I Ordinary Grade against temporary posts.

SARVA SHRI M. L. KOHLI (Surveyor, Selection Grade), LORIND CHAND (Survey Assistant) and DHIRAJ KRISHNA RAM (Engraver, Division I)—retired.

Class III Division II personnel :—343 newly appointed.
18 resigned.
26 retired.

12. **Deaths.**—Deaths of the following officers are noted here with regret :—

SHRI JAGJIT SINGH, late Sub-Assistant Superintendent, U.S.S.
,, BHAN PRAKASH GUPTA, late Draftsman Division I.

SHRI ABDUL GHAFFUR, late Engraver Division I (Selection Grade).

,, SHAM LAL, Draftsman Grade V.

,, N. N. NANDY, Clerk, Upper Division.

,, N. C. BHOWMICK, Clerk, Lower Division.

,, C. K. KRISHNA NANDHAM, Motor Driver.

,, POORAN SINGH, Draftsman Grade IV.

,, LABH SINGH, Traverser Grade V.

,, MOHAN SINGH, Litho Machine Printer, Grade V.

,, SABAR SINGH, Record keeper, Grade V.

,, PROFULLA KUMAR BISWAS, Impression Examiner Class I

Class IV personnel—13.

II. ABSTRACT OF SURVEYS AND TOPOGRAPHICAL WORK

13. The following two tables indicate the progress so far achieved in the topographical survey programme assigned to the department and give details of the work done during the period under report.

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

Survey years	1-inch and large scales	½-inch scale	TOTAL
	sq. miles	sq. miles	sq. miles
1905–54	8,00,219	15,100	8,15,319
1954–55	**15,147**	..	**15,147**
Total to **1955**	**8,15,366**	**15,100**	**8,30,466,**
Balance approximately	* 3,64,255	† 85,291	4,49,546
Total programme			‡ 12,80,012

* 2,21,756 sq. miles of this balance have been surveyed on ½-inch scale or ¼-inch scale but are to be resurveyed on 1-inch scale.

† 9,250 sq. miles of this balance have been surveyed on ¼-inch scale, but are to be resurveyed on ½-inch scale.

‡ Total area of the Indian Union including Sikkim, Bhutān and foreign possessions in India.

Table B.—Revision of above work during the year

Survey year	1-inch and larger scale	½-inch scale	TOTAL
	sq. miles	sq. miles	sq. miles
1954–55	**4,812**		**4,812**

Table C which shows in detail the survey operations carried out during the period under report together with their cost-rates appears at the end of this section (p. 19).

14. Although the primary survey responsibilities of the Survey of India are geodetic, topographical and geographical, the department has to undertake a considerable amount of special surveys in connection with irrigation, hydro-electric, land reclamation, flood control and similar development projects, and to meet demands of large scale surveys of cities, cantonments and important industrial areas. It has also to advise and assist the State Governments in local and settlement surveys as may be required. Since the war, surveys for irrigation and similar projects had largely occupied the resources of the Survey of India, but this year, in accordance with the decisions of the Survey Priorities Committee which met in Dehra Dūn in September 1953, a fair amount of the departmental strength was engaged on departmental work.

The following sub-heads show the various types of work and field operations carried out by the department during the period :—

Boundary Surveys
* Cantonment and other large scale surveys for the Defence Services
Photo-mosaics
Geodetic framework
Geophysical work
Reotangulation
Levelling
Topographical framework
Topographical surveys by air and ground methods
Training
Flood Control Surveys.

An abstract of surveys in each state of the Indian Republic and in the adjoining territory of Nepāl, alphabetically arranged, is given below. Where a state is not mentioned no work has been done in it during the period under report, or the work done is of a 'secret' nature and details of it appear in the Supplement to the General Report which is a 'restricted' document.

15. **Andaman and Nicobar Islands.**

Topographical surveys by ground methods.—Original surveys on 16-inch scale in Mayabundar and Port Blair areas (p. 67).

Topographical framework.—Traversing for the above (p. 67).

16. **Andhra.**

Photo-mosaic of Vizagapatam Oil Refinery site (p. 79).

17. **Assam.**

Topographical surveys by ground methods.—4-inch survey of Nahorkatiya area for the Assam Oil Comapny in Lakhimpur District (p. 68).

4-inch survey of Umtru Umling Reservoir area in United Khāsi and Jaintia Hills District (p. 70).

Topographical surveys by air methods.—1-inch original and revision surveys in Gāro Hills District (p. 63). 4-inch survey of Nahorkatiya area in Lakhimpur District (p. 68) and for Kopili and Pāglādiya Flood Control schemes in Nowgong ; Kāmrūp and Darrang Districts respectively (p. 70).

* Described in the supplement to General Report 1955.

Ground verification and height control in Cāchār, Kāmrūp and United Khāsi and Jaintia Hills Districts for Diyung Reservoir, Bharalu (Gauhāti) Basin, Umtru Umling Reservoir and Palāsbāri Town Protection Projects (p. 70).

Topographical framework.—Theodolite traverse for 4-inch Nahorkatiya survey in Lakhimpur District (p. 68) ; triangulation in Cāchār District for Diyung Reservoir Project and in Silchar and Lushai Hills District for Barāk Reservoir Project theodolite traverse for Bharalu (Gauhāti) Basin and Palāsbāri Town Protection projects in Kāmrūp District (p. 70).

Levelling.—Tertiary levelling for 4-inch Nahorkatiya survey in Lakhimpur District (p. 68).

Double tertiary levelling for Diyung Reservoir, Umtru Umling Reservoir, Bharalu (Gauhāti) Basin, and Palāsbāri Town Protection works in Cāchār, United Khāsi and Jaintia Hills and Kāmrūp Districts respectively (p. 70).

Tertiary and double tertiary levelling for flood control investigations in Lakhimpur and Sibsāgar Districts (p. 98).

Boundary surveys.—16-inch original air survey, triangulation, ground verification and post-pointing for Assam–East Pākistān Boundary in Gāro Hills, Cāchār, and United Khāsi and Jaintia Hills Districts (pp. 67, 68).

18. **Bhopāl.**

Topographical surveys by air methods.—Photo verification and 2-inch air survey in Raisen and Sehore Districts for Barna and Kolār Rivers Projects (p. 48).

Topographical framework.—Triangulation for the above (p. 48).

Levelling.—Double tertiary levelling for the above (p. 48).

19. **Bihār.**

Topographical surveys by air methods.—1-inch original surveys in Purnea District (p. 63) ; 6-inch and 2·5-inch original surveys in Hazāribāgh and Mānbhūm Districts for Dāmodar Valley Project, and 4-inch revision survey for Kosi Project in Purnea and Darbhanga Districts (p. 64).

1 : 25,000 survey of Bihār Mica Belt in Gaya, Monghyr and Santāl Parganas Districts (p. 67).

Levelling.—Tertiary and double tertiary levelling for flood control investigations in Champāran, Darbhanga and Muzaffarpur Districts (p. 92).

20. **Bombay.**

Topographical surveys by ground methods.—4-inch original and revision survey of Reserved Forests in Surat and West Khāndesh Districts ; 12-inch original survey of Atomic Energy Factory site in Bombay Suburban District (p. 80) and 1-inch blue-print survey in North Sātāra, South Sātāra, Sholāpur and Poona Districts (p. 86).

Topographical surveys by air methods.—Compilation ground verification and heighting for 1-inch mapping in Amreli District (p. 77).

4-inch survey of detail only, ground verification and contouring of Reserved Forests areas in West Khāndesh and Surat Districts (p. 79).

Ground verification and heighting on 2-inch scale air photos for 1-inch surveys in Baroda, Broach and Kaira Districts (p. 86).

Topographical framework.—Triangulation for 1-inch surveys in Amreli District (p. 77).

Triangulation and theodolite traverse for 12-inch survey of the Atomic Energy Factory site in Bombay Suburban District ; for the alignment of Koyna Tunnel in North Sātāra District and for forest survey in Dangs, Surat and West Khāndesh Districts (p. 80).

Theodolite traverse for 1-inch surveys in Baroda, Broach and Kaira Districts (p. 87).

Supplementary control in Baroda, Broach and West Khāndesh Districts for 1-inch surveys (p. 88).

Levelling.—Tertiary and double tertiary levelling for 12-inch Atomic Energy Factory, and Pavāi Western Higher Technical Institute sites in Bombay Suburban District and for Koyna Tunnel in North Sātāra District (p. 80).

21. Kutch.

Topographical surveys by ground methods.—Blue-print survey on 1-inch scale (p. 74).

Topographical surveys by air methods.—Ground verification, heighting and contouring on 2-inch and 1 : 25,000 scales and compilation on 2-inch scale for 1-inch mapping (p. 74).

Topographical framework.—Triangulation and theodolite traverse for settlement surveys and for 1-inch surveys (p. 74).

22. Madhya Bhārat.

Topographical surveys by air methods.—2-inch survey (for publication on 4-inch scale) for Chambal Hydel and Irrigation Project in Morena, Bhind and Gird Gwalior Districts (p. 53).

Ground verification heighting air survey compilation for 1-inch departmental maps in Dhār, Jhābua and Nimār Districts (p. 88).

Topographical framework.—Supplementary control for 1-inch surveys in Dhār, Jhābua and Nimār Districts (p. 88).

23. Madhya Pradesh.

Topographical surveys by ground methods.—16-inch and 64-inch survey of Bhilai Steel Plant site in Drug District (p. 48).

Topographical surveys by air methods.—1 : 25,000 survey of detail only, ground verification and height control of Kanhān Valley and Korba Coalfields areas in Bilāspur and Chhindwāra Districts (p. 79).

Topographical framework.—Triangulation and theodolite traverse for survey of Bhilai Steel Plant site in Drug District (p. 48) and for 1 : 25,000 survey of Kanhān Valley and Korba Coalfields in Bilāspur and Chhindwāra Districts (p. 79).

Levelling.—Tertiary and double tertiary levelling for survey of Bhilai Steel Plant site in Drug District (p. 48).

Rectangulation to 1-mile squares for the above (p. 48).

24. **Manipur.**

Topographical surveys by air methods.—Ground verification and height control for 4-inch Barāk Reservoir Survey (p. 70).

Topographical framework.—Triangulation for the above (p. 70).

Levelling.—Double tertiary levelling for the above (p. 70).

25. **Nepāl.**

Levelling.—Tertiary and double tertiary levelling for flood control investigations in Rautāhat District (p. 92).

26. **Orissa.**

Topographical surveys by air methods.—2-inch original survey of outline only of the Mahānadi River Delta area (for publication on 4-inch scale) in Cuttack and Puri Districts (p. 93).

27. **Patiāla and East Punjab States Union.**

Topographical surveys by ground methods.—1-inch verification survey in Patiāla, Bhatinda, Sangrūr and Kohistān Districts (pp. 56, 59, 61).

Topographical framework.—Theodolite traverse for rectangulation in Kapūrthala, Bhatinda and Sangrūr Districts (p. 59).

Levelling.—Double tertiary levelling and tertiary levelling to 25-acre rectangles in Patiāla and Sangrūr Districts (p. 59).

Rectangulation.—3000-acre rectangulation in Kapūrthala, Bhatinda and Sangrūr Districts and 100-acre sub-rectangulation in Sangrūr and Patiāla Districts (p. 59).

28. **Punjab.**

Topographical surveys by ground methods.—1-inch original and verification surveys in Frozepore and Ambāla Districts (p. 56) 2-inch original survey and 1/4-inch verification survey for aerodrome survey in Amritsar District (p. 59).

Topographical framework.—Theodolite traverse for aerodrome survey in Amritsar District and for rectangulation in Ferozepore, Gurgaon, Hoshiārpur, Jullundur and Ludhiāna Districts (p. 59).

Levelling.—Double tertiary levelling for aerodrome survey in Amritsar District (p. 59). Double tertiary levelling and tertiary levelling to 25 acres for rectangulation in Ludhiāna District (p. 58).

Rectangulation.—3,000-acre rectangulation in Ludhiāna, Ferozepore, Gurgaon, Hoshiārpur and Jullundur Districts and 100-acre sub-rectangulation in Ludhiāna District (pp. 58, 59).

29. **Rājasthān.**

Topographical surveys by ground methods.—1-inch departmental survey in Bhīlwāra, Chitorgarh and Udaipur Districts (p. 48) in Jaisalmer District (p. 53) and in Bīkaner and Gangānagar Districts (p. 56).

Topographical surveys by air methods.—2-inch survey (for publication on 4-inch scale) for Chambal Hydel and Irrigation Project in Kota District (p. 47).

Topographical framework.—Triangulation for 1-inch departmental surveys in Bhīlwāra, Chitorgarh, Udaipur (p. 48) and Jaisalmer (p. 53) Districts and for Chambal Hydel and Irrigation Project survey in Būndi, Kota and Sawai Mādhopur Districts (p. 48).

Triangulation and height control for 1 : 25,000 survey of the Lead-Zinc Zone by Multiplex in Udaipur District (p. 97).

30. **Saurāshtra.**

Topographical surveys by air methods.—Ground verification and heighting for 1-inch surveys in Hālār and Sorath Districts (p. 77).

Topographical framework.—Triangulation for the above (p. 77).

31. **Travancore-Cochin.**

Topographical framework.—Triangulation for Pāmbiyār and Kakki Ār Reservoirs' survey in Kottayam District (p. 80).

Levelling.—Double tertiary levelling for the above (p. 80).

32. **Uttar Pradesh.**

Topographical surveys by ground methods.—2-inch original survey in Lucknow District and 1/4-inch verification survey in Unao, Lucknow and Bāra Banki Districts for (I.C.A.O.) survey for Landing and Approach Charts of Lucknow Aerodrome (p. 61).

Topographical framework.—Theodolite traverse in Lucknow District for 2-inch survey for Landing Charts (p. 61).

Levelling.—Tertiary levelling for the above (p. 61).

33. **West Bengal.**

Topographical surveys by air methods.—1-inch original and revision surveys in Bīrbhūm, Burdwān, Murshidābād, Mālda, Nadia and West Dinājpur Districts (p. 63).

Topographical framework.—Theodolite traverse for 1-inch surveys in Burdwān, Hooghly, Murshidābād and Nadia Districts (pp. 63, 67).

Levelling.—Tertiary and double tertiary levelling for flood control investigations in Jalpaiguri, Cooch Behār and Darjeeling Districts (p. 93).

Boundary surveys.—Triangulation and theodolite traverse for demarcation of West Bengal—East Pākistān boundary in Nadia and West Dinājpur Districts (p. 67).

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 2 Party.—		sq. m.	sq. m.	Rs.	Rs.	**NORTHERN CIRCLE**
	Departmental Surveys—1-inch scale, contours at 50 feet V.I.					
Partly undulating plain interspersed with low stony mounds and partly highly intricate and undulating terrain	Checking and supplementing of existing triangulation ..	2830·0	668·5	4·4	6·1	Old triangulation data of 1932–33 was checked with theodolite and plane-table. A few additional points were fixed where considered essential.
	Plane-tabling	1038·5	16·2	62·8	85·4	
	Kolār Reservoir—4-inch scale, contours at 5 and 10 feet V.I.					
Low hills covered with teak forest ..	Triangulation	70·0	77·8	65·9	108·5	
	Photo verification and post-pointing	50·0	45·5	75·1	121·9	
	Air survey compilation and fair drawing (of detail only on 2-inch scale)	115·0	58·5	7·2	10·3	
	Double tertiary levelling in the commanded area and computations	73·0 linear miles	50·0 linear miles	52·3 per linear mile	72·0 per linear mile	
	Barna Project					
Flat and richly cultivated area ..	Double tertiary levelling in the commanded area and computations ..	66·0 linear miles	52·0 linear miles	55·3 per linear mile	86·1 per linear mile	

* Net cost represents the expenditure actually incurred on the work plus party overhead charges.
† Overall cost is the net cost plus the cost incurred on moving the party to and from the field and departmental overhead charges.

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 2 Party.—*Contd.*	**Chambal Hydel and Irrigation Project—4-inch scale, contours at 1 foot V.I.**	sq. m.	sq. m.	Rs.	Rs.	**NORTHERN CIRCLE.—*Contd.***
Flat and cultivated area with broken ground along streams and rivers	Triangulation and computations ..	275·0	294·5	9·1	12·5	For 2nd Extension area.
	Air survey and fair drawing on 2-inch scale	627·5	11·0	54·1	70·4	
	Fair mapping (outline only) ..	709·0	10·6	26·9	35·0	
	Bhilai Steel Plant Site—16-inch and 64-inch scales, contours at 5 feet and 2 feet V.I.					
Open and gradually sloping; about 70% under rice cultivation	Triangulation and computations for 16 and 64-inch scales ..	32·0	36·9	97·1	177·8	
	Theodolite traverse and computations for 16 and 64-inch scales ..	335·0 linear miles	40·9 linear miles	58·1 per linear mile	104·6 per linear mile	
	Theodolite traverse and 1-mile square rectangulation and computations	29·5	11·2	135·4	284·9	
	Double tertiary levelling and computations	160·9 linear miles	24·1 linear miles	22·1 per linear mile	47·2 per linear mile	

* Net cost represents the expenditure actually incurred on the work plus party overhead charges.
† Overall cost is the net cost plus the cost incurred on moving the party to and from the field and departmental overhead charges.

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 2 Party.—*Concld.*		sq. m.	sq. m.	Rs.	Rs.	**NORTHERN CIRCLE.—*Contd.***
	Single tertiary levelling and computations	568·6 linear miles	61·7 linear miles	18·3 per linear mile	38·6 per linear mile	
	Original 16-inch plane-tabling with contours at 5 feet V.I. ..	16,895 acres	1,024 acres	2·1 per acre	3·6 per acre	
	Original 64-inch plane-tabling with contours at 2 feet V.I. ..	2,492 acres	68·5 acres	19·7 per acre	55·8 per acre	
No. 3 Party.—	**Departmental Surveys in Rājasthān—1-inch scale, contours at 50 feet V.I.**					
40% area covered with intricate, dense and high sand dunes; 40% undulating sandy area interspersed with fairly high sand dunes; 20% hard undulating plain with numerous low rocky ridges and knobs	Plane-tabling	2610·0	26·6	66·6	95·9	
	Triangulation	200	193·5	14·3	22·5	
	Chambal Hydel & Irrigation Project—4-inch scale, contours of 1 foot V.I.					
Plain area with ravines along the Southern bank of Chambal River	Air Survey and fair mapping ..	2266	28·3	20·3	27·5	

* Net cost represents the expenditure actually incurred on the work plus party overhead charges.
† Overall cost is the net cost plus the cost incurred on moving the party to and from the field and departmental overhead charges.

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 4 Party.—	**Departmental Surveys in Rājasthān—1-inch scale, contours at 50 feet V.I.**	sq. m.	sq. m.	Rs.	Rs.	**NORTHERN CIRCLE.—*Contd.***
Desert area consisting of dunes varying in height from 20 to 200 feet and covered with low coarse vegetation	Plane-tabling	2,661	29·5	53·8	69·5	
	Fair mapping	1,046	27·0	32·6	42·13	
No. 13 Party.—	**Bhākra-Nāngal Project—4-inch scale, contours at 1 foot V.I.**					
	Field Work.—					
Flat plain, with low sand mounds, largely cultivated and fairly densely inhabited, with extensive patches of dhāk jungle and low thorny bushes in the Patiāla District (P.E.P.S.U.) and stretches of broken and undulating ground in Hoshiārpur District of the Punjab	Traverse and 3,000-acre rectangulation and its computations ..	1,609	80·0	26·8	42·9	
	100-acre rectangulation ..	1,147	12·8	85·0	143·0	
	Tertiary levelling to 25-acre corners and its computations ..	1,032	19·1	64·9	103·9	
	Ground verification of 1-inch sheets	1,210	232·7	10·2	16·5	Carried out as part of survey work for Bhākra Project.
	Mapping.—					
	Compilation and rapid drawing ..	1,007	9·4	23·7	38·0	

* Net cost represents the expenditure actually incurred on the work plus party overhead charges.
† Overall cost is the net cost plus the cost incurred on moving the party to and from the field and departmental overhead charges.

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
		sq. m.	sq. m.	Rs.	Rs.	NORTHERN CIRCLE.—*Contd.*
No. 13 Party.—*Concld.*	**Consolidation of Holdings (Punjab).**					
	Theodolite traverse with its field computations and 3,000-acre rectangulation	973	55·8	32·4	51·7	
	Amritsar Aerodrome Landing Chart—2-inch scale, contours at 50 feet V.I.					
	Plane-tabling	36	11·7	54·7	67·7	
	Theodolite traverse	47 linear miles	50·4 linear miles	23·7 per linear mile	29·3 per linear mile	
	Double tertiary levelling ..	17 linear miles	102·0 linear miles	9·2 per linear mile	11·4 per linear mile	
	Amritsar Aerodrome Approach Chart—$\frac{1}{4}$-inch scale.					
	Ground verification	800	774·2	0·9	1·1	

* **Net cost represents the expenditure actually incurred on the work plus party overhead charges.**
† **Overall cost is the net cost plus the cost incurred on moving the party to and from the field and departmental overhead charges.**

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 2 Drawing Office.—	**Lucknow (Amousi) Aerodrome**	sq. m.	sq. m.	Rs.	Rs.	**NORTHERN CIRCLE.—** *Concld.*
	1. Landing Chart—2-inch scale, contours at 50 feet V.I.					
40% built-up and 60% open cultivated area with orchards	Levelling	12 linear miles	60 linear miles	8·2 per linear mile	24·0 per linear mile	
	Traversing	30 linear miles	69·2 linear miles	14·2 per linear mile	45·8 per linear mile	
	Plane-tabling	14	7·8	44·5	132·8	
	2. Approach Chart—1/4-inch scale, contours at 250 feet V.I.					
Open cultivated area with orchards	Ground verification on 1-inch scale	788	307	1·1	3·3	

* Net cost represents the expenditure actually incurred on the work plus party overhead charges.
† Overall cost is the net cost plus the cost incurred on moving the party to and from the field and departmental overhead charges.

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 5 Party.—		sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE**
	Topographical Surveys in West Bengal & Assam—1-inch scale, contours at 50 feet V.I.					
Flat cultivated plains interspersed with scattered trees and numerous tanks and village sites surrounded by dense vegetation in West Bengal and densely wooded hills with patches of Jhum cultivation in Gāro Hills, Assam	Theodolite traverse (without heights) and computation ..	324 linear miles	65·2 linear miles	47·2 per linear mile	64·2 per linear mile	In Sheet 79 A.
	Air survey and compilation ..	2245·0	20·3	20·0	26·0	
	Fair drawing	1084·9	14·3	29·3	38·1	
No. 9 Party.—						
	Kosi Irrigation—4-inch scale, contours at 1 foot V.I.					
Generally flat ground, interspersed with water channels, patches of jungle and high grass, cultivated areas with scattered trees, mango groves, tanks and groups of small villages	Air survey revision and compilation	162·0	19·6	11·6	15·1	
	Fair mapping	162·0	55·9	33·1	43·1	
	Computations	400·0	3·4	3·1	4·0	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 9 Party.—*Concld.*	**Upper Dāmodar Valley—6-inch scale, contours at 10 and 25 feet V.I.**	sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE.—*Contd.***
Undulating open plains, low mounds and hills, patches of jungle, large cultivated areas, scattered trees and numerous tanks	Air survey compilation ..	154·9	12·4	20·9	27·1	
	Fair mapping	154·9	5·5	58·0	75·4	
	Computations	80·0	1·6	4·1	5·3	
	Pyrites Deposits—16-inch scale, contours at 5 feet V.I.					
Partly open undulating country and partly jungle clad terrain on top of plateau with a little cultivation and almost no perennial water features	Fair mapping	4·81	0·73	376·0	488·8	
	Computations	176·4	2·4	3·4	4·4	
No. 12 Party.—	**Bihār Mica Belt—1 : 25,000 scale, contours at 25 feet V.I.**					
Hilly, undulating ground, with open and fairly dense jungle	Air survey	361·3	4·5	61·7	80·2	
	Fair mapping	135·3	5·0	51·7	67·2	
	Boundary Surveys—West Bengal and East Pākistān Boundary					
70% open flat cultivated plains, 30% covered with villages surrounded by dense growth of trees	Triangulation and its computations	249	91·1	76·6	101·2	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 12 Party.—*Contd.*		sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE.—*Contd.***
	Theodolite traverse	311·3 linear miles	22 linear miles	135·4 per linear mile	181·7 per linear mile	
	Traverse computations ..	311·3 linear miles	27 linear miles	22·9 per linear mile	30·6 per linear mile	
	Boundary Survey—Assam and East Pākistān Boundary (Bagge Dispute III)					
Thickly wooded low undulating hills ..	Triangulation	53	11	345·2	461·1	Low out-turn and high cost due to difficult undulating terrain and heavy jungle clearing.
	Assam—East Pākistān Boundary Surveys—16-inch scale, without contours.					
Cultivated plains and low hills covered with jungle	Ground verification and post-pointing	63·7	6·5	111·9	148·6	Out-turn is low because the personnel had to wait for the Traversers of the Directors of Land Records and Surveys to complete their traverse.

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 12 Party.—*Contd.*		sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE—. *Contd.***
	Revision Surveys—1-inch scale, contours at 50 feet V.I.					
70% open cultivated plains, 30% covered with villages surrounded by dense growth of trees	Theodolite traverse	71 linear miles	44·3 linear miles	54 per linear mile	70·2 per linear mile	
	Ground verificarion	448	116·9	15·4	21·4	
	Nahorkatiya Survey—(Assam Oil Company) 4-inch scale, contours at 5 feet V.I.					
Slightly undulating ground, mostly open with occasional patches of jungle	Theodolite traverse	56·9 linear miles	32·8 linear miles	65·7 per linear mile	92·9 per linear mile	
	Computations	56·9 linear miles	18·6 linear miles	20·7 per linear mile	29·3 per linear mile	
	Levelling	28·6 linear miles	142 linear miles	25·7 per linear mile	36·3 per linear mile	
	Plane-tabling	30·9	1·9	537·9	760	Costs are high because a number of man-days were lost due to rains in March and April, '55.
	Ground verification and height control for contouring ..	13·6	7	159·6	225·5	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 12 Party.—*Concld.*		sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE.—*Contd.***
	Port Blair and Mayabunder Surveys—16-inch scale, contours at 10 feet V.I.					
Undulating country, open near the built-up areas and thickly wooded on the outskirts	Theodolite traverse and its computations	42·3 linear miles	7 linear miles	291·4 per linear mile	410·6 per linear mile	
	Plane-tabling	3,195 acres	240·2 acres	8·5 per acre	11·9 per acre	
No. 18 Party.—						
	Kopili Flood Control Scheme—2nd Extn., 4-inch scale, contours at 1 foot V.I.					
Low-lying plains with swamps ..	Reported in 1954	273·4	12·1	81·7	112·2	Excludes cost of air photography.
	Air survey	268	58·7	18·8	24·4	
	Fair mapping	268	8·9	44·6	58·0	
	Recess computations	268	44·0	8·6	11·2	
	Combined project	268	3·5	153·7	205·8	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 18 Party.—*Contd.*		sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE.—*Contd.***
	Pāgladiya Flood Control Scheme—4-inch scale, contours at 1 foot V.I.					
Low-lying plains with swamps, except a small stretch of undulating and heavily wooded area	Reported in 1954 ..	695·1	8·3	113·0	156·1	
	Air survey	692	64·5	23·2	30·1	
	Fair mapping	692	9·9	32·7	42·5	
	Recess computations	692	44·4	7·0	9·2	
	Combined project	692	3·1	175·9	237·9	
	Dibrugarh Town Protection Survey—					
Densely wooded banks with innumerable channels and islands overgrown with high grass	Reported in 1954	158·8	4·8	185·6	254·4	
	Marking on photo-mosaics ..	483	146·4	1·6	2·0	3 sheets of photo-mosaics on 1 : 5,000 scale, marked with heights and distances at each change of slope along cross-sections at intervals varying from 1 mile to ½ mile.
	Combined project	158·8	5·2	190·4	260·6	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 18 Party.—*Contd.*		sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE.—*Contd.***
	Palāsbāri Town Protection Survey—					
Low-lying cultivated plains	Theodolite traverse	67·7 linear miles	33·3 linear miles	110·9 per linear mile	161·5 per linear mile	Only co-ordinates and heights of points on 1,000 yds. grid lines on both banks of the river required.
	Double tertiary levelling	94·6 linear mile	35·9 linear miles	65·6 per linear mile	93·6 per linear mile	
	Field computations	162·3 linear miles	60·6 linear miles	7·5 per linear mile	10·1 per linear mile	
	Combined project	162·3 linear miles	67·0 linear miles	92·0 per linear mile	132·0 per linear mile	
	Umtru-Umling Reservoir—2-inch scale, contours at 25 feet V.I.					
Densely wooded hills	Double tertiary levelling	39·4 linear miles	12·2 linear miles	266·6 per linear mile	361·5 per linear mile	
	Ground survey	21·0	2·2	601·8	813·3	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 18 Party.—*Contd.*		sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE.—*Contd.***
	Field computations	39·4 linear miles	118·2 linear miles	4·5 per linear mile	5·8 per linear mile	
	Combined project	21·0	1·4	1110·5	1502·4	
	Gauhāti Town (Bharalu Basin) Development Project—2-inch scale, contours at 2 feet V.I.					
Cultivated plains with scattered village sites ..	Theodolite traverse	42·0 linear miles	32·3 linear miles	99·0 per linear mile	130·2 per linear mile	
	Double tertiary levelling ..	47·4 linear miles	32·3 linear miles	44·0 per linear mile	59·0 per linear mile	
	Tertiary levelling	107·7 linear miles	23·4 linear miles	54·5 per linear mile	72·7 per linear mile	
	Ground verification	40·7	8·8	104·2	141·8	
	Field computations	40·7	40·7	11·4	14·8	
	Complete field work	40·7	1·4	413·2	551·5	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 18 Party.—*Concld.*		sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE.—*Contd.***
	Barāk Reservoir—4-inch scale, contours at 25 feet V.I.					
Densely wooded hills	Triangulation	265·0	42·8	81·8	109·2	
	Double tertiary levelling ..	13·0 linear miles	10·5 linear miles	346·0 per linear mile	489·8 per linear mile	
	Height control and ground verification	135·5	7·6	157·2	213·9	
	Complete field work	135·5	4·5	350·3	474·6	
	Diyung Reservoir—4-inch scale, contours at 25 feet V.I.					
Heavily forested low confused hills ..	Triangulation	260·0	45·1	77·6	102·6	
	Double tertiary levelling ..	57·1 linear miles	20·9 linear miles	153·2 per linear mile	203·6 per linear mile	
	Height control and ground verification	143·0	5·5	212·0	284·7	
	Field computations	260·0	94·5	5·6	7·5	
	Complete field work	143·0	3·3	424·4	566·2	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 5 Drawing Office.—		sq. m.	sq. m.	Rs.	Rs.	**EASTERN CIRCLE.—** *Concld.*
	Gandak Barrage Scheme—2-inch scale, contours at 1 foot V.I.					
	Air survey	1158·0	38·2	11·5	14·9	Narrative details appear in Part II, Sec. X (p. 113).
	Fair mapping‡	1069·0	26·5	15·8	20·6	‡Includes P.O.P., corrections.

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 6 Party.—		sq. m.	sq. m.	Rs.	Rs.	**SOUTHERN CIRCLE**
	Framework for future Settlement Surveys.—					
Intricate hills covered with thorny scrubs alternating with open undulating cultivated plains	Theodolite traverse	864·3 linear miles	15·4 linear miles	104·2 per linear mile	162·7 per linear mile	
	Supplementary triangulation ..	230·0	230·0	8·0	11·4	
	Computations	972·0	45·6	11·7	17·9	
	Plotting	1188·0	25·4	14·3	21·9	
	Framework for 1-inch departmental and 8-inch Settlement Surveys—					
Flat open uncultivated plains	Theodolite traverse	211·7 linear miles	51·6 linear miles	44·8 per linear mile	70·3 per linear mile	
Intricate hills with scattered growth of thorny scrub alternating with open undulating ground	Triangulation	710·0	151·1	10·4	16·7	
	Topographical Surveys—1-inch scale, contours at 50 feet V.I.					
Open uncultivated ground interspersed with patches of thorny scrubs and trees	Modern (blue-print) survey ..	272·7	94·0	20·3	31·2	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
		sq. m.	sq. m.	Rs.	Rs.	**SOUTHERN CIRCLE.—*Contd.***
No. 6 Party.—*Concld.*						
Intricate hills covered with thorny scrub alternating with open undulating cultivated plains	Fair mapping	2481·4	24·9	17·2	22·3	
	Topographical Surveys—2-inch scale, contours at 50 feet V.I.					
Varies from flat coastal belt to intricate hills covered with thorny scrub alternating with open undulating and cultivated plains	Ground verification of detail, height control and contouring on photographs	1137·0	49·0	26·4	42·0	For 1-inch mapping.
	Air survey compilation ..	591·7	78·9	8·1	12·5	For 1-inch mapping.
	Topographical Surveys—1:25,000 scale, contours at 50 feet V.I.					
Open uncultivated ground interspersed with patches of thorny scrub with intricate hills at the fringes	Ground verification of detail, height control and contouring on photographs	272·7	104·7	22·6	34·9	For 1-inch mapping.
No. 7 Party.—	**Revision Surveys—1-inch scale, contours at 50 feet V.I.**					
33% moderately high and densely wooded hills sloping into undulating cultivated plains with jungle-covered hillocks. 67% slightly undulating open cultivated plains with scattered trees	Fair mapping	1,746	34·1	23·9	31·1	Correction of black print originals and fair originals.

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 7 Party.—*Concld.*		sq. m.	sq. m.	Rs.	Rs.	**SOUTHERN CIRCLE.—*Contd.***
	Topographical Surveys—2-inch scale, contours at 50 feet V.I.					
Numerous low and rocky mounds with some fairly high hills and open undulating cultivated plains with some salt creeks and a few scattered islands	Supplementary triangulation and post-pointing	4,744	443·4	5·3	7·8	
	Ground verification of detail, heighting and contouring on photographs	2,579	41·9	33·6	51·0	For 1-inch mapping.
	Air survey compilation ..	552	52·2	7·8	10·1	
No. 8 Party.—	**Verification Surveys—1-inch scale**					
Jungle-clad hills and undulating plains ..	Verification of communications ..	79 linear miles	131·7 linear miles	4·5 per linear mile	5·9 per linear mile	
	Bombay Forest Surveys—4-inch scale, contours at 25 feet V.I.					
Low undulating intricate hills, mostly covered with dense teak, rosewood, scattered bamboo and other trees, interlaced with high grass and undergrowth	Supplementary triangulation ..	124	33·2	61·9	85·2	
	Theodolite traverse	35 linear miles	26·9 linear miles	87·9 per linear mile	115·2 per linear mile	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 8 Party.—*Contd.*		sq. m.	sq. m.	Rs.	Rs.	**SOUTHERN CIRCLE.—*Contd.***
	Computations	650	52·3	4·7	6·1	
	Out-line air survey	122	9·1	49·1	63·9	
	Original ground survey ..	34	1·9	557·2	801·1	
	Revision ground survey ..	86	2·4	454·4	652·9	
	Ground verification and contouring on blue-prints of outline detail ..	122	2·5	431·7	620·7	
	Kanhān Valley and Korba Coal-fields—1 : 25,000 scale, contours at 25 feet V.I.					
80% undulating wooded plains with scattered low hills and terraced cultivation and 20% intricate hills, partly wooded and partly open	Supplementary triangulation ..	141	71·6	32·1	41·8	
	Theodolite traverse	72 linear miles	37·3 linear miles	49·1 per linear mile	77·2 per linear mile	
	Height control	330	43·2	45·7	71·4	
	Out-line air survey	315	26·1	11·1	14·4	
	Ground verification of detail and contouring on blue-prints of out-line detail	315	6·3	186·0	296·8	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 8 Party.—*Contd.*		sq. m.	sq. m.	Rs.	Rs.	**SOUTHERN CIRCLE.**—*Contd.*
	Koyna Tunnel Chart—16-inch scale.—					
***High hill range** of the Western Ghāts, partly precipitous and partly densely wooded*	Supplementary triangulation ..	10	3·7	380·2	525·5	
	Theodolite traverse	1 linear mile	5·0 linear miles	557·4 per linear mile	750·8 per linear mile	
	Double tertiary levelling ..	36 linear miles	12·3 linear miles	160·4 per linear mile	222·6 per linear mile	
	Computations	10	6·6	68·9	89·6	
	Preparation of chart	10	10·3	45·7	59·4	
	Complete job	10	..	1138·1	1550·9	
	Vizagapatam Oil Refineries—24·7-inch scale—					
***Isolated hills with** undulating cultivated plains and coastal muddy foreshore*	Photo-mosaic	16·2 sq. feet	40·5 sq. feet	13·4 per sq. foot	17·4 per sq. foot	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 8 Party—*Contd.*		sq. m.	sq. m.	Rs.	Rs.	**SOUTHERN CIRCLE.**—*Contd.*
	Western Higher Technical Institute. Pavāi—16-inch scale Photo-mosaic.					
Undulating plains with isolated low hills ..	Double tertiary levelling ..	15 linear miles	26·5 linear miles	69·5 per linear mile	96·3 per linear mile	
	Single tertiary levelling ..	10 linear miles	30 linear miles	57·8 per linear mile	80·4 per linear mile	
	Atomic Energy Factory Site Bombay—12-inch scale, contours at 2 feet, 5 feet and 20 feet Vertical Intervals for areas below 60-foot contour, between 60-foot and 300-foot contours and above 300-foot contour respectively					
Steep hill slopes with terraced cultivated fields and mangrove swamp	Supplementary triangulation ..	2	3·1	600·5	934·4	
	Theodolite traverse	1 linear miles	30 linear miles	64·0 per linear mile	95·7 per linear mile	
	Double tertiary levelling ..	6 linear miles	16·4 linear miles	107·5 per linear mile	166·4 per linear mile	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 8 Party.—*Concld.*		sq. m.	sq. m.	Rs.	Rs.	**SOUTHERN CIRCLE.—*Contd.***
	Single tertiary levelling ..	6 linear miles	18 linear miles	97·3 per linear mile	152·6 per linear mile	
	Plane-tabling	1·8	0·4	3173·5	4525·4	
	Topographical Surveys—1-inch scale, contours at 50 feet V.I.					
Partly wooded, steep, flat-topped and low undulating hills	Fair mapping	2648·4	14·9	28·6	37·2	Mapping completed between 1951–55 mostly by inexperienced personnel.
No. 17 Party.—						
	Topographical Surveys—1-inch scale, contours at 50 feet V.I.					
30% open hills and 70% open undulating cultivated plains	Plane-tabling	1,983	20·7	48·0	65·3	
	Topographical Surveys—2-inch scale, contours at 50 feet V.I.					
Cultivated plains, 50% somewhat open and 50% covered with thick vegetation	Theodolite traverse	426 linear miles	44·7 linear miles	15·2 per linear mile	20·9 per linear mile	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 17 Party.—*Concld.*		sq. m.	sq. m.	Rs.	Rs.	**SOUTHERN CIRCLE.—*Concld.***
	Ground verification of detail, heighting and contouring on photographs	1,190	51·9	24·2	36·8	For 1-inch mapping.
	Mahi Right Bank Canal Project—4-inch scale, contours at 1 foot V.I.					
Plains covered with thick vegetation ..	Air survey compilation and mapping	410	2·0	93·9	122·0	
	Complete job	410	..	267·8	373·1	Field work done during field seasons 1951–53.
No. 21 Party.—						
	Topographical Surveys—2-inch scale, contours at 50 feet V.I.					
Jungle-clad intricate hills and undulating cultivated plains	Supplementary control and postpointing	1,928	383	6·4	9·1	
	Ground verification of detail, heighting and contouring on photographs	578·7	20·8	72·0	105·0	For 1-inch mapping.
	Air survey compilation ..	275·6	60·0	9·5	12·4	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. I Party.—		sq. m.	sq. m.	Rs.	Rs.	**AIR SURVEY AND TRAINING DIRECTORATE**
	Tractor Going Plans—scale 4 inches to 1 mile					
70% open area, mostly full of Kans and scattered trees, frequently cultivated and occasionally having open forests, 20% undulating and 10% hilly area with open forests	Finalization of plane-table sections for direct publication . . .	1,205	11	24·2	24·2	
	Flood Control Surveys—Levelling, with photo. identification					
Plains, deeply and closely intersected by numerous ravines and interspersed with mango groves	Double tertiary levelling ..	822 linear miles	34·7 linear miles	5·5 per linear mile	16·7 per linear mile	
	Single tertiary levelling ..	8,255 linear miles	45·7 linear miles	6·9 per linear mile	16·5 per linear mile	
No. II Party.—						
	Rānchi District Forest Boundary Survey—1 : 25,000 scale					
Jungle-covered hills and partly jungle-covered plains	Fair-mapping	683·0	57·9	8	10	

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 11 Party.—*Concld.*		sq. m.	sq. m.	Rs.	Rs.	**AIR SURVEY AND TRAINING DIRECTORATE.—*Contd.***
	Mahānadi Delta Survey—scale 4 inches to 1 mile, contours at 1 foot V.I.					
Cultivated plains with numerous water channels, canals and distributaries	2-inch air survey and fair-mapping for publication on scale 4 inches to 1 mile	622·0	9·0	45	59	
	Dāmodar Valley Survey—scale, 6-inches to 1 mile, contours at 10 feet V.I.					
85% jungle-covered hills and undulating plains, 15% open, undulating plains	Fair-mapping	103·2	5·3	156	203	
	Flood Control Surveys—Levelling, with photo. identification					
60% open, cultivated plains with numerous water channels, 40% undulating ground	Double tertiary levelling ..	344·5 linear miles	37·0 linear miles	38 per linear mile	57 per linear mile	
Covered with jungle or tea gardens	Single tertiary levelling ..	1861·9 linear miles	25·8(*a*) linear miles	47 per linear mile	70 per linear mile	(*a*) Low out-turn due to inexperienced Levellers, late arrival of air photos and jungle in a part of the area.
	Partalling or check levelling ..	226·5 linear miles	12·3 linear miles	83 per linear mile	121 per linear mile	

* Net cost represents the expenditure actually incurred on the work plus party overhead charges.
† Overall cost is the net cost plus the cost incurred on moving the party to and from the field and departmental overhead charges.

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

Party and description of country	Class of work (including scale and V.I.)	Area	Out-turn per man per month	Cost Rate per sq. mile (or mile)		Remarks
				*Net	†Overall	
No. 20 (Photogrammetric) Party.—		sq. m.	sq. m.	Rs.	Rs.	**AIR SURVEY AND TRAINING DIRECTORATE.—*Concld.***
	Lead-Zinc Zone Survey—1 : 25,000 scale, contours at 25 feet V.I.					
Low, intricate hills covered with mixed jungle	Triangulation and height control ..	270	45	81	122	
Assam Flood Survey Party.—	**Flood Control Surveys—Levelling, with photo. identification**					
40% marshy and/or jungle-covered; 40% covered by tea gardens; 20% open, dry beds of old streams under rice cultivation	Double tertiary levelling ..	1,000 linear miles	42·8 linear miles	24·2 per linear mile	32·5 per linear mile	
	Single tertiary levelling ..	2,750 linear miles	38·9 linear miles	20·1 per linear mile	26·7 per linear mile	

* Net cost represents the expenditure actually incurred on the work plus party overhead charges.

† Overall cost is the net cost plus the cost incurred on moving the party to and from the field and departmental overhead charges.

III. SURVEY REPORTS, NORTHERN CIRCLE

DIRECTOR :—Shri P. A. Thomas , A.R.I.C.S., M.I.S. (Ind.).

DEPUTY DIRECTOR :—
- Shri M. M. Ganapathy, B.A., M.I.S. (Ind.), to 2–1–55.
- Shri P. A. Thomas, A.R.I.C.S., M.I.S. (Ind.), from 3–1–55 to 19–1–55, (in addition to his duties as Director Northern Circle).
- Shri K. C. Gosain, B.A., M.I.S. (Ind.), from 20–1–55.

34. **Summary.**—The units administered by the Circle were No. 1 Party (up to 10–10–54), No. 2 Party, No. 3 Party, No. 4 Party, No. 13 Party, No. 2 Drawing Office and the Photo-Zinco Office.

35. **Areas Surveyed.**—

2492 acres of 64-inch original ground survey.
16895 acres of 16-inch original ground survey.
50 square miles of 2-inch original ground survey.
3008·5 square miles of 2-inch air survey.
50 square miles of 2-inch ground verification on air photographs.
1210 square miles of 1½-inch verification survey.
6309·5 square miles of 1-inch original ground survey.
1813 square miles of 1-inch verification survey.
800 square miles of ¼-inch verification survey.
577 square miles of triangulation.
2830 square miles of checking and supplementing of existing triangulation.
412 linear miles of traversing.
796·9 linear miles of double tertiary levelling.
580·6 linear miles of tertiary levelling.
1032 square miles of tertiary levelling to 25-acre corners.
2582 square miles of theodolite traverse-cum-rectangulation to 3000-acre corners.
1147 square miles of sub-rectangulation to 100-acre corners.
29·5 square miles of rectangulation to 1-mile squares.

No. 2 PARTY

Officer in charge :—
- Major J. A. F. Dalal, B.A. (Hons.), A.M.I.S. (Ind.), Engineers, to 7–9–54.
- Captain M. M. Datta, B.Sc. (Hons.), B.E. (Civil), Engineers, from 8–9–54 to 19–9–54 and 1–10–54 to 7–11–54.
- Major C. M. Sahni, B.A., Engineers, from 20–9–54 to 30–9–54 and from 8–11–54.

36. **General.**—The party was employed on the following jobs.

(*a*) Departmental surveys on 1-inch scale in Rājasthān.

(*b*) Surveys for the Kolār and Barna Projects in Bhopāl State.

(*c*) Survey and mapping of the Chambal Hydel and Irrigation Project in Rājasthān.

(*d*) Survey of the Bhilai Steel Plant Site in Madhya Pradesh.

(*e*) Triangulation computations for the Jaipur and Kota Aerodromes survey.

Recess H.Q. was at Mussoorie from 14th April, 1954 to 24th October, 1954. Field H.Q. was established at Kota on 1st November 1954 and closed on 10th April, 1955. A drawing section was maintained in Dehra Dūn for the period 28th October, 1954 to 12th March, 1955. A small air survey section was kept at party H.Q. during the field season.

For other work done by this unit see the Supplement to General Report, 1955.

37. **Personnel.**—The average strength of the Party was 1 Class I Officer, 2 Class II Officers, 4 Surveyors, 4 Survey Assistants and 45 other Class III personnel including Clerks.

38. **Areas Surveyed.**—

2492 acres of 64-inch original ground survey.
16895 acres of 16-inch original ground survey.
50 square miles of 2-inch ground verification on air photographs.
742·5 square miles of 2-inch air survey.
1038·5 square miles of 1-inch original survey.
377 square miles of triangulation.
2830 square miles of checking and supplementing of existing triangulation.
335 linear miles of theodolite traverse.
299·9 linear miles of double tertiary levelling.
568·6 linear miles of tertiary levelling.
29·5 square miles of rectangulation to 1-mile squares.

39. **Recess Duties.**—

(*a*) Two sections, one under Shri Sukhwant Rai (Class II) and the other under Shri H. K. Chopra (Class II), were employed on the 2-inch air survey compilation of Chambal Project sheets during recess. A total of 381·5 square miles falling in Kota District of Rājasthān was completed.

(*b*) The computing section completed the following computations during the year.

(*i*) Triangulation for the Kota Aerodrome.

(*ii*) Triangulation for the Jaipur Aerodrome.

(*iii*) Triangulation for departmental 1-inch plane-tabling.

(*iv*) Triangulation and levelling computations of the Kolār and Barna Projects.

(*v*) Triangulation and traverse computations for the Bhilai Steel Plant Site survey.

(*vi*) Triangulation computations of the Chambal Project 2nd Extension area.

(*c*) The drawing section under Shri I. S. Rawat (Survey Assistant) was employed on the fair mapping of 22 sheets of the Chambal Project, at Mussoorie during the recess and at Dehra Dūn during the field season.

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

(*a*) Shri R. S. Chhabra (Surveyor) checked and supplemented 780 square miles of old topo triangulation in sheets 45 K/4 and K/8 (Udaipur and Bhīlwāra Districts). Shri P. N. Puri (Surveyor) checked and supplemented 2,050 square miles of existing triangulation in sheets 45 K/3, 11, 12, 15, 16 and 45 G/16 (Udaipur, Bhīlwāra and Chitorgarh Districts).

(*b*) *Chambal Triangulation.*—Shri P. N. Puri (Surveyor) completed 275 square miles of triangulation for the air survey compilation on 2-inch scale for 2nd Extension area of the Chambal Hydel and Irrigation Project (Būndi, Kota and Sawai Mādhopur Districts).

(*c*) *Original one-inch surveys.*—(*i*) *Camp* (*I*).—Shri H. K. Chopra (Officer Surveyor) with 7 Class III personnel completed 460 square miles in Bhīlwāra and Udaipur Districts.

(*ii*) *Camp* (*II*).—Shri S. B. P. Mathur (Surveyor) with 8 other Class III personnel completed 578·5 square miles in Bhīlwāra, Chitorgarh and Udaipur Districts.

(*d*) *Kolār and Barna Projects.*—Shri Sukhwant Rai (Officer surveyor) with 1 Surveyor, 3 Plane-tablers, 4 Levellers and 1 Computer completed 70 square miles of triangulation, 50 square miles of ground verification on 2-inch air photographs, and 73 linear miles of double tertiary levelling for Kolār Reservoir, and 66 linear miles of double tertiary levelling for Barna Reservoir areas during February and March, 1955, in Raisen and Sehore Districts of Bhopāl State.

(*e*) *Bhilai Steel Plant Site.*—Shri P. A. Thomas, Director, Nothern Circle, personally organized this job. Overall technical and administrative control of the composite detachment in the field was exercised by O.C. No. 2 Party. On transfer to Southern Circle, Major C. M. Sahni (O.C. No. 2 Party) handed over the charge of the detachment to Shri Sukhram Singh (O.C. No. 13 Party) on 26th April, 1955.

Work in the detachment was organized as follows :—

(*i*) Shri Sukhwant Rai (Class II) with 1 Class II Officer, 5 Surveyors, 2 Survey Assistants and 28 other Class III personnel, completed the following from 26th March to 14th May, 1955 :—

Triangulation and its computation for 32 square miles for original plane-tabling on 16-inch and 64-inch scales.

Theodolite traverse (335 linear miles) and its computation.

16895 acres of original plane-tabling on 16-inch scale.

562·5 acres of original plane-tabling on 64-inch scale.

Sarva Shri Lachhman Dass and Bakhtawar Singh (Survey Assistants) were employed as Assistant Camp Officers for 64-inch plane-tabling during May, 1955.

(*ii*) Shri Sukhwant Rai also exercised supervision over other plane-tabling camps as enumerated below, during April, 1955.

(*a*) No. 16 Party camp with 3 Survey Assistants, Sarva Shri Jai Kirti Singh, Puran Chand and B. S. Tomer and 20 Topo Trainees employed on the completion of 1450 acres of plane-tabling on 64-inch scale. This camp was divided into 3 sub-camps one under each Survey Assistant.

(*b*) Shri S. B. P. Mathur (Surveyor) with 12 Plane-tablers employed on the completion of 480 acres of plane-tabling on 64-inch scale.

(*iii*) Shri Arjan Dev (Class II) of No. 13 Party with 3 Traversers, 8 Levellers and 3 Computers completed the following jobs.

160·9 linear miles of double tertiary levelling with its computation.

568·6 linear miles of single tertiary levelling with its computation.

29·5 square miles of theodolite traverse and rectangulation to 1-mile squares with computations.

He also exercised technical control over 6 Plane-tablers of Shri S. B. P. Mathur's camp during May, 1955.

(*iv*) Shri H. K. Chopra (Class II) with 1 Survey Assistant and 20 other Class III personnel completed the following.

(*i*) Fair drawing of 30 original plane-table sections on 16-inch scale.

(*ii*) Interpolation and fair drawing of contours on the above sheets.

(*iii*) Fair drawing of 64 original plane-table sections on 64-inch scale.

Shri I. S. Rawat (Survey Assistant) was employed as Assistant Section Officer.

The above plane-tables were despatched to No. 2 Drawing Office, Dehra Dūn for completion of headings, foot-notes and metric grid. The drawing of field bunds left in pencil on some of the 64-inch plane-tables was also completed.

(*f*) *Air Survey.*—A small air survey section under Shri Bakhtawar Singh (Survey Assistant) was employed at field H.Q. on 2-inch air survey compilation of Chambal Project and Kolār Project sheets and completed 246·0 square miles for the former (in Kota District, Rājasthān) and 115 square miles for the latter project (in Raisen and Sehore Districts, Bhopāl State).

41. **Description of Country.**—(*a*) In general, the area covered by departmental 1-inch plane-tabling is an undulating plain interspersed with low stony mounds. In the north and west the terrain consists of innumerable highly intricate low hillocks of stony waste covered with low scrub. At places, near river banks, fairly dense tree growth is found.

(*b*) The Kolār Reservoir area is bounded by two long and fairly steep ridges at an average height of 500 feet above the Kolār River bed and mostly covered with teak forest. The river is non-perennial and its bed rocky.

(*c*) The Chambal Project area (2nd Extension) is mostly flat cultivated plain interspersed with broken ground near the banks of streams and rivers. It is bounded by a range of hills on the north-west and by the Chambal River on the south-east.

(*d*) The area for the Bhilai Steel Plant Site is open and gently undulating. About 70% is put under rice cultivation and full of low field bunds. Irrigation is by a network of irrigation channels and distributaries from a main canal running through the area. The main line of the Eastern Railway and the Great Eastern Road pass along the northern portion of the area. A few fairly big perennial water tanks exist.

42. **Technical Methods.**—(*i*) *Kolār and Barna Projects.*—Existing triangulation points in the area were post-pointed on 2-inch scale air photographs and the survey of the detail was compiled by normal air survey methods. Supplementary triangulation was carried out to provide data for ground contouring at 20 feet interval on blue prints obtained from the 2-inch air survey compilation. The job was shelved in view of another more urgent priority demand and personnel were withdrawn from the area.

73 linear miles of double tertiary levelling was also completed. Staves were roughly plumbed for their verticality before reading ; two Levellers carried out levelling in opposite directions in sections of five miles.

Barna Project :—Only double tertiary levelling was done and methods employed were the same as for the Kolār Project.

(*ii*) *Chambal Hydel and Irrigation Project* :—Triangulation of the 2nd Extension area was an extension of the triangulation carried out for the rest of the Chambal Project area. Methods employed for air survey compilation and fair drawing are described in the Technical Report, 1954 (p. 33).

(*iii*) *Bhilai Steel Plant Site Survey* :—At the request of the Ministry of Production, Government of India, large scale surveys were required to be carried out urgently in connection with the construction, by a team of Soviet experts, of a steel plant at Bhilai in Madhya Pradesh. Since the time limit imposed was extremely short and the season late (end of March) it was necessary to draw

personnel in large numbers from all units in the Circle spread over North India and also from other Directorates in order to ensure completion in time. It was also necessary that the methods employed should be such as to obtain maximum out-turn. Brief notes on methods employed are given below.

Surveys were required on 16-inch scale with contours at 5 feet interval, and on 64-inch scale with two foot contours, and printed maps were to be supplied to the indentor in three priorities on fixed dates. In order to comply with the dates fixed the following expedients were employed :—

(*a*) Since ground contouring by clinopole would involve extra time, indirect contouring was resorted to. A rectangular mesh of spot levels was laid down and contours interpolated *pari passu* with the plane-tabling. Personnel employed on this were drawn from No. 13 Party, who were experienced in this type of work as a result of employment on the Bhākra Project in the Punjab.

(*b*) Since fair drawing would involve delay it was decided to photograph the plane-table sections direct. This necessitated not only a high standard of drawing on the plane-table sections but a uniformity in standards. In order to ensure this, the Plane-tablers left their work in pencil to be inked up, generally at night, by Draftsmen in a drawing section in the field under the supervision and co-ordination of an officer.

(*c*) A large staff of Computers was employed in the field to provide results of triangulation, traverse and levelling as early as possible after observations were completed and handed in.

(*d*) Permission was obtained from the Ministry for couriers to fly between Nāgpur and Delhi bringing the completed plane-table sections in batches. Motor transport met couriers in Delhi and brought them to Dehra Dūn where the staff of No. 2 Drawing Office would be waiting to receive the material and put on a metric grid and other necessary work before being passed on to the printing office (P.Z.O.).

(*e*) The necessary staff of P.Z.O. worked at night. Material would generally be received about 5 p.m. and proofs would be ready by 9·30 next morning. Corrected proofs were returned by 11·30 a.m. and printed maps would be off the machine by 6 p.m.

(*f*) The completed maps were dispatched by courier in motor transport and delivered to the Ministry of Production in Delhi exactly on the specified dates.

The area involved was nearly 17,000 acres on 16-inch scale comprising 30 sheets and 2,500 acres on 64-inch scale comprising 64 sheets. A job of this magnitude would, using normal methods, take about 1 party year, but by the application of the above expedients and the employment in the field of 109 personnel (Class III and above), the job was completed in 2½ months.

Further details regarding method are given below.

(*a*) Adequate control by triangulation and theodolite traverse was first established.

(*b*) The area for survey on 16-inch scale was divided into 30 plane-table sections, each covering 1 mile × 1 mile area. To mark these limits on the ground, corner and direction stones were embedded by the normal theodolite traverse and rectangulation method.

(*c*) Two lines of precision levelling already existed in the north edge of the area, and these formed the basis for all height control. Double tertiary level lines were run along the north and south edges of each sheet and along the perimeter of the whole area to control tertiary levelling. Tertiary levelling lines were run from north to south to provide a mesh of spot-heights at every 4 chains. This was required for the interpolation of contours at 5 feet interval in 16-inch scale sheets.

(*d*) Additional traverse to a much greater density was carried out for the area for survey on 64-inch scale. Wooden pegs and stones were used for marking these traverse station marks. These marks were later connected by tertiary levelling to provide reliable heights for clinopole contouring at 2 feet interval.

Traverse lines were very close together and to avoid confusion to Plane-tablers, coloured flags tied to wooden sticks were planted near each station. Each traverse line was allocated a different colour of flag to assist in identification.

(*e*) In addition to the normal method of measuring detail by chain and offset the radial line method was commonly adopted. Rays to detail were taken and then plotted on the spot after actual measurement.

(*f*) Only rough field colour traces were kept. No separate height trace or name list was maintained in the field. For names the existing 1-inch map was accepted as sufficient and correct. Plane-table sections were left uninked by Plane-tablers and sent to a drawing section opened in the field for completion of drawing and typing and final scrutiny. The plane-table sections thus completed were used for direct printing and the normal method of fair drawing was dispensed with. Contour originals were prepared on Kodatrace.

(*g*) The lay-out of sheets was in Cassini Projection with Latitude 21° 08′, Longitude 81° 20′ as the origin. This origin was selected outside the south-west corner of the area to keep the values of all co-ordinates positive.

(*h*) Certain new symbols for embankments and geological bore and pit holes were adopted as suggested by the indentor.

Other special demands of the indentor were heights of canal beds, railway line rails, roads, bore holes, trial pits, water in tanks and tank bunds, yard and meter ticks. Special remarks regarding nature of cultivation were also given.

No. 3 PARTY

Officer in charge :— { Shri V. P. Sharma, B.A., to 18-10-54.
Major D. N. Sharma, Engineers, from 19-10-54.

43. **General.**—The party was employed on air survey compilation and fair mapping of sheets of the Chambal Hydel and Irrigation Project in Madhya Bhārat, and also on 1-inch departmental surveys in Rājasthān.

Recess headquarters of the unit was at Mussoorie and field headquarters at Jaisalmer, Rājasthān.

44. **Personnel.**—The average strength of the unit comprised 1 Class I Officer, 2 Class II Officers, 3 Surveyors, 2 Survey Assistants and 30 other Class III personnel.

45. **Areas Surveyed.**—

2266 square miles of 2-inch air survey compilation.
200 square miles of triangulation for current 1-inch surveys.
2610 square miles of 1-inch survey.

46. **Recess Duties.**—During the recess the unit was engaged mainly on air survey compilation and fair mapping of sheets of the Chambal Hydel and Irrigation Project. Three drawing sections in charge of Sarva Shri B. R. Jain (Class II), N. B. Chowdhury (Surveyor) and S. N. Barthwal (Surveyor) completed the work as under :—

2-inch air survey compilation and fair drawing of 2266 square miles, comprising 82 sheets, falling in Morena, Bhind and Gird Gwalior Districts of Madhya Bhārat State.

47. **Field Work.**—The field work was done as under :—

(*a*) Shri C. S. Ojha (Survey Assistant) triangulated 200 square miles for current 1-inch departmental survey in Jaisalmer District of Rājasthān.

(*b*) The 1-inch departmental survey in Jaisalmer District of Rājasthān was carried out by three camps as follows :—

(*i*) One camp of 7 Class III personnel under Shri R. B. Lal (Class II) completed 847 square miles.

(*ii*) One camp of 6 Class III personnel under Shri Jagan Nath (Class II) completed 650 square miles.

(*iii*) One camp of 7 Class III personnel under Shri S. N. Barthwal (Surveyor) from 4-10-54 to 22-1-55 and later under Shri K. L. Puri (Surveyor) completed 1113 square miles.

48. **Description of Country.**—The country surveyed forms part of what is known as the Great Indian Desert. The area falling in Nāchna, Jaisalmer and the eastern part of Rāmgarh *Tahsīls* is an extensive stretch of sand dunes of all shapes and sizes, bleak and inhospitable. The sand dunes which are generally of the transverse type may rise to a height of over 150 feet. Contrary to the widely prevalent belief, most of the sand dunes are consolidated by the roots of vegetation and are stable. Shifting sand dunes are few and far between.

The rest of the area falling in the Rāmgarh *Tahsīl* presents altogether a different and more pleasing appearance. Here, numerous low rocky ridges and knobs rise up from a hard undulating and broken plain. The soil is at places stony and is generally covered with gravel. The country is not so desolate and trees are numerous.

The sand dune areas are covered with tufts of low *bhrunt* and *sīwan* grass, *phog*, *lāna*, and *bui* bushes ; clusters of trees, mainly *khejri*, are frequently found near villages and water tanks ; elsewhere *khejri*, *ber* and *karel* trees are found widely scattered.

Fauna generally met is the Indian gazelle (*chinkāra*), hare, partridge, quail, bustard and sand grouse of various species ; waterfowl may be seen on the water tanks. The wolf and hyena are sometimes seen in Rāmgarh *Tahsīl*. The area abounds in snakes of many varieties ; some do not go into hibernation during winter and are an extra hazard for the surveyor. The people are very scared of a species of snake called *pīvana*, whose existance to the writer, appeared to be product of a fertile imagination. Locust, the scourge of the farmer, breed here.

The climate during winter is healthy and bracing but the hot weather is intense and debilitating. Sand storms are a daily occurrence during summer. Strange though it may seem, the area is malarial.

There is an acute scarcity of water everywhere. Wells are generally over 100 feet deep and contain brackish water which may turn deleterious during the hot months. Rain water is collected and stored in *kunds* which are covered lined tanks up to 20 feet deep. These are jealously guarded and, in many cases, locked.

There are only a few sparsely populated villages which consist of round conical huts of brush wood structures plastered with mud. The staple diet of the people consists of *bājri*, *moth*, milk and milk products. Cultivation is dependent on rainfall which is always scanty and precarious.

The bulk of the people are pastoral and rear sheep, goats, cows and camels. Many villages are occupied only temporarily during the rainy season when water and pasture are available nearby.

Some well planned and attractive stone-built villages, now deserted, stand as monuments of the past prosperity of the *Pāliwal* Brahmans, a community of enterprising and hardy cultivators who fled the country due to the impositions of Metha Sālim Singh, a tyrannical Prime Minister.

Communications are most difficult. The camel is the only reliable means of transport. Light vehicles fitted with four-wheel drive can operate on many of the camel tracks. Post and telegraph facilities do not exist.

49. **Technical Methods.**—(*a*) *Chambal Hydel and Irrigation Project.*—The technical methods used for field work are described in the Technical Report for 1954. The current method employed for fair mapping is described below.

Detail is surveyed by normal air methods and contours are interpolated from spirit levelled heights.

Originally, a combined 2-inch Kodatrace fair original was prepared with contours drawn in black and detail in white for enlargement to 4-inch. An outline original with names typed was prepared on a 4-inch blue-print enlargement and submitted together with guides for yellow tint and correction of contours.

The fair drawing of the outline was considered wasteful and was dropped. A separate name original, however, continued to be prepared on a 4-inch blue-print and submitted together with guides for yellow tint and correction of contours and outline.

This procedure resulted in extra work in the retouching section because of the gaps appearing at places where black and white lines crossed. At the instance of the reproduction office it was given up as unsuitable and the following method was adopted :—

Separate outline and contour originals were drawn in black on Kodatrace for enlargement to 4-inch scale. The name original was prepared on a 4-inch blue print of the outline. Though correct registration of outline and contours is more difficult the method is satisfactory.

(*b*) *1-inch Departmental Surveys* :—Normal departmental technical methods were used. Sand dunes were depicted in the field by contours and dotted form lines but fair mapped by sand shading.

No. 4 PARTY

Officer in charge :— (Shri L. J. Bagnall, B.SC., to 24-5-54.
) Captain M. L. Chopra, B.SC., B.E., Engineers, from 25-5-54.

50. **General.**—The party continued original surveys on 1-inch scale in Rājasthān and also undertook the verification of office copy corrections in Sheet 53 B/11 (Punjab and P.E.P.S.U.).

Recess headquarters was at Mussoorie. Field headquarters opened at Bikaner on 30-10-54 and closed on 23-3-55.

For other work done by this unit see the Supplement to General Report, 1955.

51. **Personnel.**—The average strength of the party was 1 Class I Officer, 2 Class II Officers, 1 Survey Assistant, 2 Surveyors and 36 other Class III personnel including Clerks and M.T. Drivers.

52. **Areas Surveyed** :—

2661 square miles of 1-inch original survey.

215 square miles of 1-inch verification survey of office copy corrections.

53. **Recess Duties.**—The fair drawing was organized into three sections under Sarva Shri R. L. Ghei, B. R. Swarup (both Class II) and Shri Jagan Nath (Officiating Class II) with Shri R. L. Ghei exercising general supervision in addition.

The mapping of 8 sheets on the one-inch scale was taken up; work on 4 of these sheets was completed and work on the other 4 sheets was continued during the field season.

Two main difficulties were encountered in the method of depiction of sand features by sand shading.

(*i*) Considerable time is taken to draw this type of symbol even though double— and even quadruple— banking was adopted.

When double banking was employed, the result presented a patch work of different styles and it became a real problem to get different individuals to produce the same style of work. This difficulty was overcome by getting the sand dots defining main ridges and spurs drawn throughout the sheet by one individual. These dots then automatically controlled the sizes of other dots and also their interspacing, with the result that the work of different sand shaders working on the same sheet conformed to the same style.

(*ii*) The other difficulty was that variation in height between different points on a ridge or spur or between two ridges could not be brought out effectively due to the obvious limitations in this method of depiction. These variations are lost actually at plane-tabling stage as the Plane-tabler only indicates by dots the lines of ridges and spurs. To this extent, sand shading necessarily means far greater generalization of features and fails to portray accurately this type of country.

54. **Filed Work.**—The field work was organized as follows :—

Camp I.—Shri R. L. Ghei (Class II) with 8 Plane-tablers completed 898 square miles of 1-inch original survey in sheets 44 G/6, 7,10 and 11 in Gangānagar District of Rājasthān.

Camp II.—Shri B. R. Swarup (Class II) with Shri K. L. Chakrabarty (Surveyor) and 8 Plane-tablers completed 870 square miles of 1-inch original survey in sheets 44 G/3, 4, 8, 12 and 44 C/16 in Gangānagar and Bīkaner Districts of Rājasthān.

Camp III.—Shri R. P. Kukreti (Survey Assistant) with 8 Plane-tablers completed 893 square miles of 1-inch original survey in sheets 44 G/5, 9, 13 and 14 in Gangānagar District of Rājasthān and Ferozepore District of the Punjab.

Verification.—Shri R. L. Sharma (Surveyor) completed 215 square miles of verification survey of office copy corrections in sheet 53 B/11, covering portions of Patiāla District of P.E.P.S.U. and Ambāla District of the Punjab.

55. **Description of Country.**—The area surveyed during the field season fell into two definite categories :—

(*a*) Canalized area.

(*b*) Desert area.

Canalized area.—The *Tahsīls* of Shri Gangānagar, Padampur, Rai Singhnagar and Karanpur are fully canalized with hardly any patches of barren land. Water is available in plenty from the

canals and this water is filled into village ponds for the consumption of man and beast. Means of communications both by rail and road are good. The area is well populated and there are numerous rich *zamindārs*. The main occupation is agriculture with crops such as wheat, rice, maize, *bājra*, gram, sugarcane and cotton.

Desert area.—The *Tahsīls* of *Anūpgarh* and *Sūratgarh* are mainly covered by sand hills and dunes and barren land, except the area adjacent to the railway line and canal between Sarūpsar and Anūpgarh which is well cultivated. The country is generally undulating with sand hills and dunes varying in height from 20 feet to 200 feet. Villages are few and far between. The only source of drinking water is from *kunds*. Most of the wells are brackish and very deep. The main occupation of the people is the tending of herds of camel, cattle, sheep and goat. People are generally poor. The staple foods are *bājra*, milk and *ghee*. Means of communications are poor and the camel is the main means of transport. The only motorable road runs between Sarūpsar and Anūpgarh.

56. **Miscellaneous.**—

Climate.—The climate is dry and generally healthy though characterized by extremes of temperature.

Sand storms are experienced in the beginning of March when field work becomes very trying and sometimes impossible. These storms gain in frequency and severity as one goes south from the canalized areas.

The average annual rainfall is about 10 inches. This year the rainfall amounted to 8 inches only.

Health.—No case of any type of disease was reported. Paludrine tablets were being regularly used during the whole field season as a preventive against malaria.

57. **Technical Methods.**—Normal plane-tabling methods were used for 1-inch original surveys.

No. 13 PARTY

Officer in charge :— Shri P. S. Shinghal, C.E., A.M.I.E., to 28–4–54.
Captain K. L. Khosla, B.SC., B.E., A.M.I.E., Engineers, from 29–4–54 to 24–6–54.
Shri K. S. Singh, B.A. (Hons.), from 25–6–54.

58. **General.**—The party continued to be employed principally on rectangulation and levelling in the commanded area of the Bhākra-Nāngal Project in Patiāla and East Punjab States Union and the Punjab State. Rectangulation to 3,000 acres was also carried out in three districts of the Punjab for the Directorate of Consolidation of Land Holdings. In addition original topographical survey for Amritsar Aerodrome to I.C.A.O. specifications was carried out.

Recess headquarters of the party remained at Mussoorie ; field headquarters opened at Nābha on 15th October, 1954. Field operations continued well into April, 1955.

59. **Personnel.**—The average effective strength of the party was 1 Class I Officer, 2 Class II Officers, 5 Surveyors, 1 Survey Assistant and 42 other Class III personnel including 5 Clerks and 2 M.T. Drivers.

60. **Areas Surveyed.**

36 square miles of 2-inch original survey.
1210 square miles of $1\frac{1}{2}$-inch verification survey.
800 square miles of $\frac{1}{4}$-inch verification survey.
1032 square miles of tertiary levelling to 25-acre corners.
497 linear miles of double tertiary levelling.
1147 square miles of sub-rectangulation to 100-acre corners.
47 linear miles of theodolite traverse.
2582 square miles of traverse-cum-rectangulation to 3,000-acre corners.

61. **Recess Duties.**—During recess, the party was organized for technical work into 3 sections, supervised by Sarva Shri R. B. Lal (Class II), Arjan Dev (Class II) and Daya Nand (Surveyor) as Section Officers with Sarva Shri R. P. Kukerti (Survey Assistant), S. D. P. Jakhmola (Surveyor) and Isher Singh (Surveyor) as Assistant Section Officers.

In all, 53 sheets, covering about 1007 square miles of area, were completed and submitted for publication in 3 batches.

62. **Field Work.**—During the field season, the work was organized and completed as under :—

No. 1 Camp.—Shri Arjan Dev (Class II) with Shri N. K. Saxena (Computer) and an average of 12 other Class III personnel with camp headquarters first at Dhūri and later at Ahmedgarh, completed 610 square miles of sub-rectangulation to 100 acres. Of this area, 447 square miles was completed for 25-acre levelling. In addition, 59 square miles for which 100-acre rectangulation had been completed during the field season 1953–54 was completed in Sangrūr District of P.E.P.S.U. and Ludhiāna District of the Punjab.

296 linear miles of double tertiary levelling was also done for control of tertiary levelling in Sangrūr District of P.E.P.S.U. and Ludhiāna District of the Punjab.

Computations were done at camp headquarters (Dhūri and Ahmedgarh) by two computers.

No. 2 Camp.—Shri Daya Nand (Surveyor) assisted by Shri S. D. P. Jakhmola (Surveyor) with an average of 11 other Class III personnel, with camp headquarters at Sunam, completed 537 square miles of sub-rectangulation to 100 acres. Of this area 478 square miles was completed for 25-acre levelling plus 48 square miles for which 100-acre rectangulation had been completed during the field season 1953-54, in Patiāla and Sangrūr Districts of P.E.P.S.U.

184 linear miles of double tertiary levelling was also completed for control of tertiary levelling in Patiāla and Sangrūr Districts of P.E.P.S.U.

Two Computers handled all the levelling computations at the camp headquarters (Sunam).

No. 3 Camp.—Shri S.L. Behal (Surveyor) with Shri S. D. Bhatt (Surveyor) and an average of 3 other Class III personnel completed 1620 square miles of traverse cum 3,000-acre rectangulation in Bhatinda and Sangrūr Districts of P.E.P.S.U. and Ludhiāna and Ferozepore Districts of the Punjab.

At camp headquarters, one senior Computer, assisted by a Leveller, handled all traverse computations.

No. 4 Camp.—Shri Dial Singh (Survey Assistant) till 31-1-55 and later Shri S. L. Behal (Surveyor) and 2 Traversers, with headquarters at Hodal and later at Hoshiārpur completed 962 square miles of 3,000-acre rectangulation in Kapūrthala District of P.E.P.S.U. and Gurgaon, Hoshiārpur and Jullundur Districts of the Punjab.

The Camp Officer, assisted by one Computer, handled all traverse computations.

Amritsar Aerodrome Camp.—Shri Isher Singh (Surveyor) completed (*i*) 36 square miles of original topographical survey on 2-inch scale (*ii*) 800 square miles of ground verification of major detail on $\frac{1}{4}$-inch scale (*iii*) 47 linear miles of theodolite traverse and (*iv*) 17 linear miles of double tertiary levelling in Amritsar District of the Punjab in connection with the preparation of the Landing and Approach Charts of Amritsar Aerodrome to I.C.A.O. specifications.

Verification.—Shri Khushal Singh (Plane-tabler), under the direct supervision of the O.C. Party, completed the $1\frac{1}{2}$-inch scale verification of an area of 1210 square miles in sheets 44 N/11, 12,15, 16 and 44 O/13 in Bhatinda, Patiāla and Sangrūr Districts of P.E.P.S.U.

63. **Description of Country.**—The area rectangulated by Nos. 1, 2 and 3 Camps is generally flat plain interspersed with low mounds and is extensively cultivated and well inhabited. This area has poor communications and is quite backward, but new roads are under construction. In Patiāla District of P.E.P.S.U. there exist extensive patches of *dhāk* jungle and low thorny bushes. In Hoshiārpur District of the Punjab, there exist patches of *saroot* jungle along the Beās River.

Permanent hired camel transport was used by the party for the movement of camps and conveyance of rectangulation mark-stones in the entire area of its field operations.

64. **Technical Methods.**—(*i*) *Bhākra-Nāngal Project Survey Work.*—Descriptions of this typical work appear on pages 26 to 28 of Technical Report, 1947, and in the Technical Reports of 1952 and 1953.

Average out-turns achieved during the year against forecast figures anticipated in the preceding year, vide Technical Report 1954, are tabulated below :—

Type of Work	*Out-turn per man per month*			
	Forecast based on reports of the past years		Actually achieved during 1954–55	Party's expected average out-turns for planning programme in future in P.E.P.S.U. & Punjab
	From	To		
	Sq. mile	Sq. mile	Sq. mile	Sq. mile
(*Field Work*)				
3,000-acre rectangulation ..	50·7	62·1	80·0	60
100-acre rectangulation ..	12·0	13·0	12·8	12·5
25-acre levelling ..	18·8	22·0	19·1	19·0
(*Recess Work*)				
Computation and Mapping	7·6	10·9	9·4	9·5

(*ii*) *Consolidation of Holdings.*—This consisted of the fixing and laying of 3,000-acre rectangulation corners conforming precisely to the Bhākra-Nāngal Project style and based on triangulated control. The rate of progress was slower than the average achieved in Bhākra-Nāngal Project on account of undulating terrain.

The breaking down of rectangles to 1 and 5-acre holdings would be done by the district revenue staff of the *patwāri* type.

(*iii*) 1½-*inch Verification Survey* on grey prints of the outline originals of 1-inch topo. sheets followed the same procedure as described in the Technical Report, 1952 (p. 26).

(*iv*) *Original Topographical Survey* for Aerodrome Landing Chart.—

Normal plane-tabling methods were employed for this work. Planimetric and height control was provided by theodolite traverse and levelling.

The accuracy achieved for the main traverse was 1 : 13,000.

No. 2 DRAWING OFFICE

Officer in charge :— Shri N. L. Gupta, C.E., M.I.S. (Ind.), to 3-3-55.
Shri K. C. Gosain, B.A., M.I.S. (Ind.), from 4-3-55 (in addition to his duties as Deputy Director, Northern Circle).

65. **General.**—Landing and Approach Chart Surveys to I.C.A.O. specifications of the Lucknow (Amausi) Aerodrome which were originally allotted to No. 1 Party were carried out

under No. 2 Drawing Office owing to the transfer of No. 1 Party to Air Survey and Training Directorate.

In addition to the completion of the above work, verification survey in the Punjab and P.E.P.S.U. was also carried out for departmental mapping needs.

For other work done by this unit see the supplement to General Report, 1955.

66. **Personnel.**—The following personnel were employed :—

1 Class II Officer and 1 Plane-tabler for I.C.A.O. surveys.
1 Surveyor for verification survey.

67. **Areas Surveyed.**—

14 square miles of 2-inch original survey.
1598 square miles of 1-inch verification survey.
30 linear miles of theodolite traverse.
12 linear miles of tertiary levelling.

68. **Field Work.**—Field work was organized as follows :—

(*i*) *Lucknow Aerodrome Survey.*—Shri Hari Singh (Class II) of No. 1 Party completed 30 linear miles of theodolite traverse and 12 linear miles of tertiary levelling to provide planimetric and height control.

One Plane-tabler completed 14 square miles of 2-inch original survey for the Landing Chart and 788 square miles of 1-inch verification survey for the Approach Chart in Bāra Banki, Lucknow and Unao Districts.

(*ii*) *Verification.*—Shri Gurcharan Singh (Surveyor) completed 810 square miles of verification survey of office copy corrections in sheets 53 B/9,10 and 14 in Ambāla District of the Punjab and Patiāla and Kohistān Districts of P.E.P.S.U.

69. **Description of Country.**—The areas surveyed are well populated and generally cultivated with numerous mango orchards. Communications are good.

70. **Technical Methods.**—Normal methods were used.

IV. SURVEY REPORTS, EASTERN CIRCLE

DIRECTOR :—Colonel R. S. Kalha, M.I.S. (Ind.).

DEPUTY DIRECTOR :—Shri K. C. Gosain, B.A., M.I.S. (Ind.), to 7-1-55.
Shri J. C. Berry, M.I.S. (Ind.), from 8-1-55.

71. **Summary.**—The following units and offices were administered by Eastern Circle :—

Nos. 5, 9, 11 (up to 31-10-54), 12, 18 Parties, No. 5 Drawing Office, Engraving Office and Photo-Litho Office. Reports on the working of the last three offices appear in Part II of this report. Report of No. 11 Party appears under the Air Survey and Training Directorate (page 92).

72. **Areas Surveyed.**—

827·0 square miles of triangulation for topographical surveys on various scales.

915·2 linear miles of theodolite traverse.

251·5 linear miles of double tertiary levelling.

136·3 linear miles of tertiary levelling.

1942·4 square miles of original and revision air surveys on 2-inch and larger scales.

663·9 square miles of compilation on 1-inch scale.

844·5 square miles of ground verification of air photographs.

30·9 square miles of 4-inch ground survey.

3195 acres of 16-inch ground survey.

2434·9 square miles of air survey and mapping of project surveys on 2-inch to 6-inch scales (including air survey and mapping of Gandak Project done in No. 5 D.O.).

21·0 square miles of blue-print survey.

No. 5 PARTY

Officer in charge :—Shri M. D. Nangia, B.A., M.I.S. (Ind.), to 7-7-54.
Shri V. Krishnamurty, M.A., A.R.I.C.S., A.M.I.S. (Ind.), from 8-7-54.

73. **General.**—The party was engaged chiefly on departmental surveys and mapping in areas of Assam, Bihār and West Bengal throughout the period under report. The field programme of the unit included provision of topographical framework in approximately 2,300 square miles of area in West Bengal.

The headquarters of the unit continued to remain at Shillong.

74. **Personnel.**—The average strength of the unit was 1 Class I Officer, 1 Class II Officer, 4 Surveyors and 29 other Class III personnel including Clerks.

75. **Areas Surveyed.**—

1002·5 square miles of 2-inch air survey.

578·6 square miles of 2·5 inch air survey.

663·9 square miles of compilation on 1-inch scale.

324 linear miles of theodolite traverse for future air surveys.

76. **Recess Duties.**—Nearly 90% of the unit's strength remained at the H.Q. engaged on air survey and fair mapping of a large area wherein topographical framework had been established and contouring and ground verification completed during 1948–52. The unit was organized into two main sections, one responsible for air survey and the other for fair mapping.

The air survey section under Shri N. K. Pal Choudhuri (Surveyor) assisted by about 10 other Class III technical personnel completed the air survey on 2-inch and 2·5 inch scales of 1581·1 square miles and 1-inch compilation of 663·9 square miles for fair mapping of 12 one-inch sheets, using the graphical method. The area covered by these sheets falls in Gāro Hills District of Assam, Purnea District of Bihār and Bīrbhūm, Burdwān, Murshidābād, Mālda, Nadia and West Dinājpur District of West Bengal.

The drawing section under Shri S. K. Roy (Survey Assistant) assisted by about 10 other Class III technical personnel completed the fair mapping of 4 one-inch topographical sheets in West Bengal.

Shri N. K. Basu (Class II) supervised the work of both the sections besides being responsible for all the computations and technical records of the unit.

Prior to July 1954, the air survey, drawing and computing sections were under Sarva Shri H. S. Iyer, D. Sen and S. Das (Surveyors) respectively for varying periods.

77. **Field Work.**—A small detachment under Shri A. K. Roy (Surveyor) established by 324 linear miles of theodolite traverse a network of control points for air surveys in approximately 2,300 square miles of area in Burdwān, Hooghly, Nadia and Murshidābād Districts of West Bengal. Detail had already been chalked on the photographs and verified on the ground by personnel of this unit during 1950–51. The intention then was to combine the photographs on to points of detail taken from the existing one-inch maps. This was found to be unsatisfactory and hence the necessity for fixing fresh control by theodolite traverse.

78. **Description of Country.**—The area traversed lies in the flat alluvial plains of West Bengal and is drained by the Bhāgirathi

and Jalangi Rivers. It is divided into two virtually independent blocks by the River Bhāgirathi and has an excellent network of roads and railways on either side of the river. East of the Bhāgirathi the country is better developed and more densely populated than the west.

79. **Technical Methods.**—Normal methods were used.

No. 9 PARTY

Officer in charge :—{ Major J. N. Sinha, M.Sc., A.M.I.E., A.M.I.S. (Ind.), Engineers, to 19-7-54. / Major N. K. Sen, B.Sc., A.M.I.E., Engineers, from 20-7-54.

80. **General.**—The party, during the field season, was employed mainly on surveys of a restricted nature which are described in the Supplement to General Report, 1955. During recess the party carried out air survey and fair mapping for 6-inch Dāmodar Valley surveys, 4-inch Kosi Irrigation surveys and 16-inch Pyrites Deposits surveys.

The party had recess headquarters at Rānchi and field headquarters at Dinapore Cantonment. During the field season a drawing section continued to operate at Rānchi and another operated at the field headquarters at Dinapore.

81. **Personnel.**—The average strength of the party during the recess consisted of 1 Class I Officer, 3 Class II Officers, 4 Surveyors and 42 other Class III personnel including 5 Clerks and 1 Driver (M.T.).

82. **Areas Surveyed.**—154·9 square miles of air survey and fair mapping for 6-inch Dāmodar Valley Project.

162·0 square miles of air survey revision and fair mapping for 4-inch Kosi Irrigation Project.

83. **Recess Duties.**—The party was organized into 6 sections under Sarva Shri D. Biswas, B. S. Rattan, S. P. Banerjee (Class IIs), and S. N. Sanyal, K. R. Basu and S. K. Ghosh (Surveyors) to carry out air survey and/or fair mapping of sheets of the restricted jobs (described in the Supplement to General Report) and of 28 Dāmodar Valley sheets, 17 Kosi Irrigation sheets, and 2 Pyrites Deposits sheets. Most of these sheets were, however, shelved due to high priority restricted work. In all, 4 sheets of Dāmodar Valley Project, 4 of Kosi Irrigation Project and 2 of 16-inch Pyrites Deposits survey were fair mapped during the period under report. The Dāmodar Valley sheets covered areas of Hazāribāgh and Mānbhūm Districts, the Kosi sheets covered areas of Purnea and Darbhanga Districts and the Pyrites Deposits sheets covered areas of Shāhābād District in Bihār.

84. **Technical Methods.**—(*a*) The method followed for *4-inch Kosi Irrigation* sheets is the one described in previous reports except that normal air survey compilation method was resorted to for areas not covered by 1-inch maps.

(*b*) *16-inch Pyrites Deposits.*—Sheets were fair mapped by direct tracing from 16-inch plane-table sections on to seasoned Kodatrace. Two originals were prepared—one for outline and contours (drawn in black and white) and the other for trees. A yellow and blue guide was also prepared as usual. The sheets were finally printed in black, brown, blue and yellow.

(*c*) *6-inch Dāmodar Valley Surveys.*—The method described in the reports of the preceding years was followed for fair mapping except for sheet 60 N the method in respect of which is described below :—

In the case of this sheet air survey was carried out from the 2·5-inch contact prints instead of the 6-inch enlargements. The 2·5-inch combined air survey section was photographically enlarged to 6-inch scale and separate orginals for outline, contours and trees were fair drawn. A yellow guide was prepared as usual. This method had the following advantages over the previous procedure :—

(*i*) Handling of contact prints was easier.

(*ii*) Combination was more accurate, the use of long pieces of Kodatrace for minor control with resultant distortion being avoided.

(*iii*) Handling of fair drawn sheets on Kodatrace over a long period which usually results in damage to the air survey sections, and heavy touching up of the drawing later was avoided.

No. 12 PARTY

Officer in charge :— Shri V. Krishnamurty, M.A., A.R.I.C.S., A.M.I.S. (Ind.), to 29-7-54.
Major J. N. Sinha, M.SC., A.M.I.E., A.M.I.S. (Ind.), Engineers, from 30-7-54.

85. **General.**—During recess the party was employed on air survey and fair mapping of Bihār Mica Belt sheets for future geological investigations.

During the field season the party carried out the following surveys :—

(*a*) Theodolite traverse for West Bengal—East Pākistān boundary.

(*b*) Triangulation for the demarcation of Assam–East Pākistān boundary in the Pāthāria Hills (Bagge Dispute III).

(*c*) Theodolite traverse, ground verification and post-pointing for 1-inch revision surveys in West Bengal.

(*d*) Ground verification and post-pointing for subsequent air survey of Assam–East Pākistān Boundary.

(*e*) Theodolite traverse, levelling, ground survey and ground verification for subsequent air survey of Nahorkatiya area for the Assam Oil Company.

(*f*) Theodolite traverse and ground survey for development purposes in Mayabunder and Port Blair in the Andaman and Nicobar Islands.

In addition a joint air survey section of the Survey of India and the Survey of Pākistān carried out air survey of Assam–East Pākistān Boundary sheets.

The field and recess headquarters of the party remained at Shillong.

86. **Personnel.**—The average recess strength of the party was 1 Class I Officer, 2 Class II Officers, 4 Surveyors and 23 other Class III personnel including Clerks. The average field strength was 1 Class I Officer, 2 Class II Officers, 6 Surveyors and 35 other Class III personnel including Clerks.

87. **Areas Surveyed.**—

3195 acres of original ground survey on the scale of 16 inches to a mile in the Andaman and Nicobar Islands.

42·3 linear miles of theodolite traverse to provide control for the above.

30·9 square miles of original ground survey on the scale of 4 inches to a mile for the Assam Oil Company.

56·9 linear miles of theodolite traverse to provide control for the above.

28·6 linear miles of tertiary levelling to provide height control for the above.

13·6 square miles of ground verification of photographs for subsequent air survey for the Assam Oil Company.

53 square miles of minor triangulation to provide control for demarcation of 20 linear miles of the India–Pākistān Boundary (Bagge Dispute III).

63·7 square miles of ground verification of photographs for subsequent air survey on the scale of 16 inches to a mile for 90·6 linear miles of the Assam–East Pākistān Boundary.

311·3 linear miles of theodolite traverse for demarction of 200 linear miles of the West Bengal–East Pākistān Boundary.

249 square miles of minor triangulation (Bilby tower) to provide control for the above boundary traverse.

71 linear miles of theodolite traverse for planimetric control of 1-inch revision air survey.

448 square miles of rapid ground verification of photographs for 1-inch revision air survey.

361·3 square miles of original air survey of Bihār Mica Belt on 1 : 25,000 scale.

88. **Recess Duties.**—One section under Shri H. S. Iyer (Surveyor) completed fair drawing of three 1 : 25,000 sheets of the

Bihār Mica Belt. One section under Shri N. K. Basu (Class II) and later under Shri N. M. Das (Surveyor) completed air survey of eight 1 : 25,000 sheets covering an area of 361·3 square miles of the Bihār Mica Belt in Gaya, Monghyr and Santāl Parganas Districts of Bihār. The sheets were rigorously air surveyed by the principal-point-radial-line method. The survey was based on geodetic data contained in the triangulation pamphlet of sheet 72 H (G.T. data only), 1917 edition, supplemented by minor triangulation carried out by No. 9 Party in 1927–28. Height control and ground verification of air photographs carried out by No. 11 Party during the field season 1948–49 were found to be inadequate for departmental survey. Supplementary height control and ground verification were, therefore, carried out by this party during the field season 1953–54 to bring the survey to the required standard of accuracy.

One section under Shri N. M. Das (Surveyor) with four Air Survey Draftsmen was engaged throughout the field season on the air survey and mapping of the Assam–East Pākistān Boundary sheets on 16-inch scale in Gāro Hills and United Khāsi and Jaintia Hills Districts (Assam), in conjunction with a detachment of five Pākistāni survey personnel who were deputed to No. 12 Party, Survey of India, Shillong.

89. **Field Work.**—*Camp (1).*—Shri I. C. Deb (Class II) with 4 Surveyors, 2 Plane-tablers and 3 Computers operated jointly with a similar camp of No. 6 Party, Survey of Pākistān and completed the geographical location of boundary pillars on a specified sector of the boundary between West Bengal and East Pākistān in Nadia and West Dināpur Districts which had already been demarcated on the ground by the State authorities. A total of 200 linear miles of this boundary was fixed for which 311·3 linear miles of theodolite traverse and 249 square miles of triangulation were carried out The geographical positions of the boundary pillars were fixed by theodolite traverse emanating from and closing on G.T. Stations or minor triangultion stations fixed by Bilby-tower triangulation. Crinoline chains were used. The average closing error of the traverses was 1 : 10,168.

In addition, Shri I. C. Deb (Class II) with Shri S. K. Datta (Surveyor) carried out 53 square miles of minor triangulation for providing trigonometrical control for demarcation of India–Pākistān Boundary in the Pāthāria Hills (popularly known as Bagge Dispute III) in Cāchār District of Assam.

This camp also provided planimetric control by 71 linear miles of theodolite traverse and carried out 448 square miles of post-pointing and ground verification for subsequent air survey of 1-inch sheets 79 A/9, 11 and 13 in Nadia District of West Bengal. The average closing error of 1 in 11,759 was obtained in this traverse.

Camp (2).—Shri A. Biswas (Class II) with 3 Plane-tablers and 1 Computer carried out 42·3 linear miles of theodolite traverse with heights and completed ground survey on 16-inch scale of an

area of 3195 acres in Mayabunder and Port Blair in the Andaman and Nicobar Islands. The closing error of this traverse was 1 in 4,778.

Camp (*3*).—Shri H. S. Iyer (Surveyor) with 5 Plane-tablers and 1 Computer carried out 56·9 linear miles of traverse with heights and completed ground survey of 30·9 square miles on 4-inch scale of Nahorkatiya area in Lakhimpur District for the Assam Oil Company. The traverse had a closing error of 1 in 7,615. 286 linear miles of tertiary levelling was also completed for this survey.

Survey of an area of 13·6 square miles could not be carried out on the ground. The detail in this area was chalked on the photographs and verified on the ground for subsequent air survey.

Two Air Survey Draftsmen, who were attached to the Assam Survey Detachment, carried out 63·7 square miles of post-pointing and ground verification for subsequent 16-inch air survey of the Assam–East Pākistān Boundary in Gāro Hills and United Khāsi and Jaintia Hills Districts of Assam.

90. **Description of Country.**—The country traversed along the boundary between West Bengal and East Pākistān and the area in sheet Nos. 79 A/9, 11 and 13 consists of flat open cultivated fields. The villages are surrounded by dense growth of bamboos, palms and gardens.

The area of Pāthāria Hills (Bagge Dispute III) consists of undulating hills thickly wooded mostly with bamboo and some hardwood trees.

Port Blair and Mayabunder areas consist of undulating country open near the built-up areas and thickly wooded on the outskirts. Communications between the islands are inadequate, sea routes being the only mode of communication. Acute shortage of drinking water is felt during the summer months.

Nahorkatiya area is slightly undulating. It is mostly open with occasional patches of jungle. The Burhi Dihing River runs through the middle of the area. Communications in the area are adequate. A good gravel road from Nahorkatiya to Digboi is maintained by the Assam Oil Company.

91. **Technical Methods.**—The following technical method was used for demarcating the India–Pākistān boundary in the Pāthāria Hills area :—

(*i*) The red line showing the boundary on the Radcliffe map 'A' was transferred to 1-inch sheets by pantograph. This line was broken up into straight segments care being taken, as far as possible, that the junction points of these straight segments fell on ridges, hill tops or other suitable positions and the losses and gains on either side were balanced. This work was carried out independently by the Survey Departments of India and Pākistān. Co-ordinates of these points were agreed upon and accepted by the Surveyor Generals of India and Pākistān as the basis for the demarcation of the boundary on the ground.

(*ii*) A minor triangulation series based on G.T. Stations was observed astride the boundary in order to locate the preliminary pillar positions on the ground. It was agreed that after locating the preliminary pillar positions losses and gains on either side would be finally balanced by shifting some of the pillar positions.

Only the approximate positions of boundary pillars could be fixed this field season due to persistent bad weather. Final fixation of the pillar positions and the G.T. connection will be taken up during the next field season.

(*iii*) After completion of (*ii*) above, a lane, 20 feet wide, will be cleared along the boundary in the forest area to make consecutive pillar positions intervisible.

For other work carried out by this unit normal departmental methods were used.

No. 18 PARTY

Officer in charge :—{ Major N. K. Sen, B.Sc., A.M.I.E., Engineers, to 7-7-54.
Shri M. D. Nangia, B.A., M.I.S. (Ind.), from 8-7-54.

92. **General.**—The unit was engaged almost exclusively on the following flood control and reservoir surveys to meet the requirements of the state of Assam and the Central Water and Power Commission :—

(*i*) Kopili Flood Control.
(*ii*) Pāglādiya Flood Control.
(*iii*) Dibrugarh Town Protection.
(*iv*) Palāsbāri Town Protection.
(*v*) Barāk Reservoir.
(*vi*) Diyung Reservoir.
(*vii*) Umtru-Umling Reservoir.
(*viii*) Bharalu (Gauhāti Town) Basin.

Most of the areas surveyed fall in the State of Assam. The headquarters of the unit continued to remain at Shillong.

93. **Personnel.**—The average strength of the unit was 1 Class I Officer, 1 Class II Officer, 4 Surveyors and 31 other Class III personnel including Clerks.

94. **Areas Surveyed.**—

960·0 square miles of 4-inch revision air surveys of the Kopili and Pāglādiya Flood Control areas.

21·0 square miles of 2-inch blue-print survey for Umtru-Umling Reservoir area.

251·5 linear miles of double tertiary levelling for Palāsbāri Protection Works, Gauhāti Town Development area and Barāk, Diyung and Umtru-Umling Reservoir areas.

109·7 linear miles of theodolite traverse for Palāsbāri Protection works and Gauhāti Town Development area.

525·0 square miles of triangulation for Barāk and Diyung Reservoir areas.

107·7 linear miles of tertiary levelling for Gauhāti Town Development area.

40·7 square miles of detail verification on photographs for Gauhāti Town Development area.

278·5 square miles of supplementary height control and detail verification on photographs for Barāk and Diyung Reservoir areas.

95. **Recess Duties.**—The unit was organized into three main sections under Shri A. Biswas (Class II), Shri T. K. Maitra and Shri S. Roy (Surveyors). Air survey and fair mapping of 12 Kopili Flood Control 2nd Extension sheets, 27 Pāglādiya Flood Control sheets and 1 sketch map of the Dibrugarh Protection Surveys were completed by these sections. Shri J. C. Sen Gupta (Class II) assisted the Officer-in-charge of the party in the technical supervision and final examination of the fair sheets. The Kopili Flood Control area lies in Nowgong District and Pāglādiya Flood Control area in Kāmrūp and Darrang Districts of Assam.

96. **Field Work.**—Field work was divided into 3 camps as follows :—

Camp I.—Shri J. C. Sen Gupta (Class II) with one Surveyor and 16 other technical personnel was engaged on the surveys of (*i*) the Diyung Reservoir area, comprising 260 square miles of triangulation, 57·1 linear miles of double tertiary levelling and 143 square miles of height control and ground verification in Cāchār District of Assam.

(*ii*) the Bharalu (Gauhāti) Basin, comprising 42 linear miles of theodolite traverse, 107·7 linear miles of tertiary and 47·4 linear miles of double tertiary levelling in Kāmrūp District of Assam ; and (*iii*) the Umtru-Umling Reservoir area, comprising 39·4 linear miles of double tertiary levelling and 21 square miles of ground survey in United Khāsi and Jaintia Hills District, Assam.

Camp II.—Consisting of 2 Surveyors and 5 Class III technical personnel was engaged on the Barāk Reservoir Survey comprising 265 square miles of triangulation (in Silchar and Lushai Hills Districts of Assam and in Manipur State), 13 linear miles of double tertiary levelling and 135·5 square miles of height control and ground verification in Manipur State.

Camp III.—Shri S. Roy (Surveyor) [joined later by Shri Hari Singh (Class II)] with 3 other Class III technical personnel completed surveys for the protection of Palāsbāri Town, comprising theodolite traverse and double tertiary levelling of 67·7 and 94·6 linear miles respectively in Kāmrūp District, Assam.

97. **Description of Country.**—The reservoir areas surveyed were all densely wooded and ranged from low intricate hills in the Diyung to moderately high hills in the Barāk and Umtru areas. Diyung and Barāk areas are sparsely inhabited with very little facilities in respect of communications, transport and foodstuff.

The Bharalu (Gauhāti) Basin is open, well cultivated, with many *bils* and swamps. It is bordered by a few villages to the south and west of Gauhāti Town.

98. **Miscellaneous.**—*Training.*—6 Topo Trainees Type 'B' were trained in the early part of the field season in draftsmanship, single tertiary levelling and theodolite traverse.

Health.—Several Class III and Class IV personnel suffered from malaria even though Paludrine was liberally used. Bites from wild flies were also frequent and caused a few cases of sickness.

99. **Technical Methods.**—All the above surveys were carried out by normal methods which are briefly outlined below :—

Pāglādiya and Kopili Flood Control areas—In the Pāglādiya area detail and contours were surveyed initially on the 2-inch scale and subsequently enlarged to the 4-inch scale. In the Kopili area, however, the detail only was surveyed on 2-inch scale and enlarged to 4-inch scale ; contours were surveyed on the 4-inch scale from enlargements of 2-inch photographs.

Diyung and Barāk Reservoir areas.—The field work consisted of triangulation for planimetric control, ground verification of detail on photographs and of providing clinometric heights for contouring. Post-pointing on the photographs was extremely difficult due to the dense forest in the areas. This is expected to be reflected in occasional discrepancies arising at the time of air survey.

Umtru-Umling area.—Rigorous revision survey was carried out based on existing trig. points which were situated on the higher ridges overlooking the area of survey and hence were not of much assistance to the Plane-tablers.

Palāsbāri Town Protection Surveys—Consisted, solely, of theodolite traversing and levelling to fix the ground positions and heights of certain 1,000-yards grids corners on either side of the Brahmaputra River.

V. SURVEY REPORTS, SOUTHERN CIRCLE

DIRECTOR :—Colonel J. S. Paintal, A.M.I.S. (Ind.).

DEPUTY DIRECTOR :—Shri J. C. Berry, M.I.S. (Ind.), to 30–4–54.
Colonel J. S. Paintal, A.M.I.S. (Ind.), from 1–5–54 to 4–5–54 (in addition to his duties as Director, Southern Circle).
Shri M. R. Nair, B.A., M.I.S. (Ind.), from 5–5–54.

100. **Summary.**—The units administered by the Circle were Nos. 6, 7, 8, 10, 17 and 21 Parties and No. 4 Drawing Office. Of the above No. 21 Party was raised on 1st October 1954.

101. **Areas Surveyed.**—

2255·7 square miles of 1-inch modern (blue-print) ground survey.

5484·7 square miles of 2-inch ground verification and heighting of air photos and contouring.

1419·3 square miles of 2-inch air survey compilation.

315·0 square miles of 1 : 25,000 air survey compilation of details and their ground verification and contouring.

272·7 square miles of 1 : 25,000 ground verification, heighting of air photos and contouring.

34·0 square miles of 4-inch original ground survey.

86·0 square miles of 4-inch revision ground survey.

122·0 square miles of 4-inch air survey compilation of details and their ground verification and contouring.

1·8 square miles of 12-inch original ground survey.

79·0 linear miles of 1-inch verification survey of communications.

6018·0 square miles of triangulation.

330·0 square miles of height control.

1611·0 linear miles of theodolite traverse.

68·0 linear miles of double tertiary levelling.

16·0 linear miles of single tertiary levelling.

102. **Technical Methods.**—For the general types of surveys carried out, normal departmental methods were employed ; in cases of additional types of surveys or modifications in methods, if any, appropriate mention has been made in the party reports. Regarding topographical original surveys in some of the areas where photo cover was available, the following method was generally and profitably adopted.

BHUJIA THE OLD FORT NEAR BHUJ.

6 PARTY FIELD HEADQUARTERS CAMP AT BHUJ.

Air photographs were verified on the ground and field height control charts were maintained on 2-inch and 1 : 25,000 scales (scales of photographs). Details and contours were inked up on the photographs and colour traces for them were also prepared in the field. In flat ground, positions of such points were fixed by plane-table and post-pointed on the photographs. In undulating country, positions of prominent topographical details were transferred to the field height and control chart by means of scaled minor control plots ; these points were checked on the ground by plane-table and accepted for height control. In areas, which were devoid of conspicuous details, post-pointing was carried out by 'air photo resection'. For preparing the air survey sections, planimetric control points as well as reliable height control points were traced from the field charts and with their help details and contours were fitted in directly from the photographs, thus eliminating combination and framework of intersections required for tracing. In doubtful cases, however, principal points of photographs were also resected as a further check.

No. 6 PARTY

Officer in charge :—{ Major S. K. S. Mudaliar, B.A., A.M.I.E., A.M.I.S. (Ind.), Engineers.

103. **General.**—Field work of the party comprised of the following :—

(*a*) Provision of control for settlement work in Kutch State.

(*b*) Ground verification and heighting on vertical air photographs for departmental surveys.

(*c*) Modern (blue-print) survey by ground survey methods for departmental work.

(*d*) Provision of control by triangulation and theodolite traverse for future 1-inch departmental and settlement surveys.

(*e*) Training of 8 Topo Trainees Type 'B' (Traversers) in traversing and 3 Topo Trainees Type 'B' (Computers) in computations.

The field headquarters of the party was at Bhuj in Kutch State throughout the field season. The recess headquarters was at Bangalore in Mysore State. A section was maintained in the field headquarters during the field season for carrying out computations and plotting of settlement surveys in Kutch State.

104. **Personnel.**—The average strength of the party during the period under report was 1 Class I Officer, 3 Class II Officers, 3 Surveyors, 1 Survey Assistant and 30 other Class III personnel including Clerks.

105. **Areas Surveyed.**—

1076·0 linear miles of theodolite traverse for settlement surveys and for 1-inch surveys.

1137·0 square miles of 2-inch ground verification of air photos, height control and contouring.

591·7 square miles of 2-inch air survey compilation.

272·7 square miles of 1-inch modern (blue-print) survey.

272·7 square miles of 1 : 25,000 ground verification of air photos, height control and contouring.

940·0 square miles of triangulation for future 1-inch departmental and settlement surveys.

106. **Recess Duties.**—The party was organized into three drawing sections and one composite computing and plotting section.

One drawing section under Shri M. N. Kutty (Class II) was engaged on fair drawing of three 1-inch sheets.

A second drawing section under Shri S. K. Guha (Class II) was engaged on fair drawing of four 1-inch sheets.

A third drawing section under Shri K. N. S. Pillai (Surveyor) was engaged on fair drawing of two 1-inch sheets.

The composite computing and plotting section under Shri V. Balasubramanyan (Class II) was engaged on computations of framework carried out in Kutch State during the two field seasons 1952–53 and 1953–54. Based on these computations, '*patrak*' forms (giving details of measurements in the field, their computations and calculation of areas) and 'plot sheets' pertaining to 110 villages were prepared and supplied to the Settlement Officer, Kutch State.

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

(*a*) *Camp* (*1*).—Shri T. R. Viswanathan (Class II) with 12 other technical Class III personnel completed 864·3 linear miles of theodolite traverse in Kutch State and carried out training of 8 Topo Trainees Type 'B' in traversing.

(*b*) *Camp* (*2*).—Shri S. K. Guha (Class II) with 12 other technical Class III personnel completed the following :—

(*i*) Ground verification of air photos, heighting and contouring of 1137·0 square miles on 2-inch scale and 272·7 square miles on 1 : 25,000 scale in Kutch State.

(*ii*) 591·7 square miles of air survey compilation from vertical air photographs on 2-inch scale in Kutch State.

(*iii*) 272·7 square miles of modern (blue-print) survey on 1-inch scale in Kutch State.

(*c*) *Camp* (*3*).—Shri K. N. S. Pillai (Surveyor) with another Surveyor completed 940 square miles of triangulation and 211·7 linear miles of theodolite traverse for future 1-inch departmental and settlement surveys in Kutch State.

PART OF THE LAND OF KUTCH WHERE NOTHING GROWS OR LIVES.

(*d*) *Headquarters Section.*—Shri G. S. Tonk (Surveyor) with 1 Class III Division II Computer completed the computations of current field season's theodolite traverse and also carried out training of 3 Topo Trainees Type 'B' in computations.

108. **Description of Country.**—The entire area, covered during the year under report, lies in Kutch State. Bordering the seacoast are numerous sandy ridges, creeks, islands and bits of land jutting into the sea. The mainland is generally undulating with low hills. The *Rann* area is a flat isolated salt waste with practically no habitation or vegetation. There are numerous tracks which are motorable in dry season only. Water and vegetation are scarce. The land is generally barren except for some scattered cactus, *babūl* and other isolated trees.

109. **Miscellaneous.**—The health of the personnel in the field was generally good. Inspite of protective inoculations against small-pox, one case occurred towards the end of the field season. The individual affected was treated and cured in the hospital. There was also a stray case of snake-bite for which necessary first aid, and later further medical help, was rendered successfully.

110. **Technical Methods.**—(*a*) *Framework for 8-inch Settlement Surveys.*—The traversing which was undertaken for the Settlement Officer, Kutch, consisted of the following :—

(*i*) Field measurements for providing framework for future surveys, connecting all the village boundary pillars,

(*ii*) Preparation of '*patrak*' forms (giving details of measurements in the field, their computations and calculation of areas), and

(*iii*) Preparation of 'plot sheets' on 8-inch to 1 mile scale (on which the boundaries are plotted from computed co-ordinates of pillars) village by village.

In the absence of any fairly accurate charts showing village boundaries, the traversers initially had to carry out reconnaissance and line clearing operations in order to be able to plan the most economical method for observations and provision of further points for controlling the traverse lines.

The main control for the framework had been provided by triangulation in field season 1952–53. Traverse lines emanating from and closing on these triangulated stations were run, connecting all the boundary pillars, established by the Settlement Department. In flat ground, linear measurements were obtained by surface taping ; in undulating country cut by deep streams and in 'hilly' areas, tacheometric and subtense-bar methods were used for obtaining distances between traverse stations.

(*b*) *Framework for future Departmental and 8-inch Settlement Surveys.*—In flat and plain areas traversing was carried out using crinoline chain and glass-arc theodolite. Traverse lines were run between triangulation stations.

In hilly areas triangulation was carried out, the series emanating from a G.T. base and closing on another G.T. base. Wherever this was not possible Hunter Short Base Equipment was used for linear control and *Polaris* observations were taken for checking bearings. In areas triangulated in 1949–50, supplementary triangulation was carried out to provide additional control for future settlement surveys.

(*c*) *1-inch Modern* (*blue-print*) *Survey*—This was carried out by normal plane-tabling methods, on blue prints of existing maps which were based on pre-1905 surveys. Main control was provided by theodolite traverse carried out during this season.

No. 7 PARTY

Officer in charge :—
- Captain J. P. G. King, B.Sc., B.T., Engineers, to 4–5–54 and from 14–6–54 to 22–10–54.
- Major S. K. S. Mudaliar, B.A., A.M.I.E., A.M.I.S. (Ind.), Engineers, from 5–5–54 to 13–6–54 (in addition to his duties as Officer in charge No. 6 Party).
- Shri M. R. Nair, B.A., M.I.S. (Ind.), from 23–10–54 to 21–11–54 (in addition to his duties as Deputy Director, Southern Circle).
- Captain M. M. Datta, B.Sc. (Hons.), B.E., Engineers, from 22–11–54.

111. **General.**—During the field season the party was employed on the ground survey work required for departmental 1-inch modern survey, from 2-inch vertical air photographs, in Amreli District of Bombay State and in Hālār, Madhya Saurāshtra and Sorath Districts of Saurāshtra State.

The field headquarters of the party was at Rājkot in Saurāshtra State and its recess headquarters at Bangalore in Mysore State.

112. **Personnel.**—The average strength of the party during the period was 1 Class I Officer, 2 Class II Officers, 2 Surveyors and 27 other Class III personnel including Clerks.

113. **Areas Surveyed.**—

4,744 square miles of supplementary triangulation for 1-inch departmental surveys.

2,579 square miles of 2-inch ground verification, heighting and contouring of vertical air photographs for subsequent 1-inch departmental surveys.

552 square miles of 2-inch air survey compilation for 1-inch departmental mapping.

114. **Recess Duties.**—Recess work consisted of correcting the reproduction originals of six 1-inch sheets and was organized into two drawing sections. One section under Shri C. Sivaraman (Class II) completed four 1-inch sheets covering an area of 1,164 square miles, and the other section under Shri R. Sivaramakrishnan (Class II) completed two 1-inch sheets covering an area of 582 square miles.

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

(*a*) *Camp I.*—Shri C. Sivaraman (Class II) with 8 Plane-tablers completed 1,178 square miles of ground verification and heighting on 2-inch scale and 276 square miles of air survey compilation.

(*b*) *Camp II.*—Shri R. Sivaramakrishnan (Class II) with 7 Plane-tablers and 1 Air Survey Draftsman completed 1,374 square miles of ground verification and heighting on 2-inch scale and 276 square miles of air survey compilation. In addition, Shri A. Ramachandran completed 27 square miles of ground verification and heighting of islands and coastal creeks on 2-inch scale.

(*c*) *Supplementary Framework.*—Shri A. Ramachandran (Surveyor) with Shri P. N. Rao (Surveyor) completed 4,744 square miles of supplementary triangulation to provide control for subsequent 1-inch departmental surveys.

116. **Description of Country.**—Barda Hills (2,091 feet) and part of Alech Hills, heavily wooded with thorny trees, occupy about 150 square miles in the centre of the area. The rest of the area consists of flat and undulating country with salt creeks and scattered islands in the north. Except for creeks, the coast-line consists of steep and scraggy rocks with little or no beach. In the plains, the country is mostly cultivated, and natural vegetation is thin. Isolated rocky hills and stony outcrops abound in the area. Due to the natural hard surface of the ground, most of the cart-tracks are motorable in dry season when a good network of bus services also emanates from the towns of Khambhālia and Porbandar. Communications in Okhāmandal area are, however, in a bad state of maintenance.

117. **Miscellaneous.**—The health of the personnel remained good except for some stray cases of malaria. The use of paludrine, as a preventive measure, however, considerably kept down the incidence of malaria.

Labour and conveyance were readily available in most of the villages. Supplies of rations were also available. The co-operation of the local officials was satisfactory.

The best period for carrying out survey operations in this area is from the beginning of October to the end of March. Thereafter hot winds render field work difficult.

118. **Technical Methods.**—*Framework for Departmental Surveys.*—The old topo triangulation data of 1877–79, 1876–79, 1872–74 and 1874–77 seasons for sheets 41 F and B, G, J and K respectively, was utilized after scrutiny and necessary mean corrections for latitude and longitude to bring them into the terms of modern values of G.T. Stations given in the respective latest G.T. pamphlets. Further supplementary control, as and where necessary, was provided by normal triangulation and traverse methods. All the control was, however, post-pointed on photographs.

No. 8 PARTY

Officer in charge :—Shri M. W. Kalappa, B.A., A.M.I.S. (Ind.).

119. **General.**—The party continued, from the previous year, the 4-inch mapping of 5 sheets of Reserved Forests in Bombay State.

In addition, the following surveys, mapping and photo-mosaic were completed during the year :—

1-inch mapping of 4 sheets in sheet 47 G in Bombay State.

1-inch verification survey of communications in Madhya Pradesh State.

1 : 25,000 air survey compilation of details and their ground verification and contouring of Kanhān Valley and Korba Coalfields in Madhya Pradesh State.

4-inch mapping of 9 sheets of Reserved Forests in Bombay State for the Bombay Government.

4-inch revision survey, ground survey, air survey compilation of details and their ground verification and contouring of Reserved Forests in Bombay State for the Bombay Government.

12-inch ground survey of Atomic Energy Factory Site in Bombay State for the Department of Atomic Energy, Government of India.

24·7-inches to 1 mile scale photo-mosaic of Vizagapatam Oil Refineries in Andhra State for the Caltex Oil Refining (India) Limited.

The field headquarters of the party was established at Surat in Bombay State and its recess headquarters was at Bangalore in Mysore State.

120. **Personnel.**—The average strength of the party was 1 Class I Officer, 4 Class II Officers, 3 Surveyors, 3 Survey Assistants and 41 other Class III personnel including Clerks.

121. **Areas Surveyed.**—

79 linear miles of 1-inch verification survey of communications.

315 square miles of 1 : 25,000 original air survey compilation of details and their ground verification and contouring.

86 square miles of 4-inch revision ground survey.

34 square miles of 4-inch original ground survey.

122 square miles of 4-inch original air survey compilation of details and their ground verification and contouring.

1·8 square miles of 12-inch original ground survey.

334 square miles of supplementary triangulation.
109 linear miles of theodolite traverse.
330 square miles of height control.
68 linear miles of double tertiary levelling.
16 linear miles of single tertiary levelling.

122. **Recess Duties.**—The party was organized for computations, drawing and air survey into 4 sections under Sarva Shri K. Venkataraman (Class II), Y. D. Hegde (Class II), P. G. B. Menon (Class II) and C. M. Azimuddin (Survey Assistant). In addition, a section under Shri C. S. Ananthan Nair (Survey Assistant) with 3 other Class III personnel was formed at the field headquarters to complete part of the arrears of recess mapping and urgent field computations. The following jobs were carried out by these sections :—

1-inch Mapping.—Four 1-inch sheets falling in the area of $\frac{1}{4}$-inch sheet 47 G were completed for fair drawing and submitted for publication.

Bombay Reserved Forests.—The fair drawing of 9 sheets was completed and 5 sheets partly completed on scale 4 inches to 1 mile. The air survey compilation of 10 sheets comprising an area of 121 square miles, on scale 4 inches to 1 mile, was completed for contouring and ground verification of detail in the field. These sheets fall in Broach, Surat and West Khāndesh Districts of Bombay State.

Coalfields.—The air survey compilation of 11 sheets comprising an area of 315 square miles of Kanhān Valley and Korba Coalfields was completed for contouring and ground verification of detail in the field, on scale 1 : 25,000, in Chhindwāra and Bilāspur Districts of Madhya Pradesh State.

Vizagapatam Oil Refineries.—1 photo-mosaic mounted on masonite board, of Vizagapatam area of Andhra State was completed on an approximate scale of 24·7 inches to 1 mile.

Computations.—Computations of 721 square miles of supplementary triangulation, 75 linear miles of theodolite traverse, 148 linear miles of double tertiary levelling and 330 square miles of height control were completed.

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

Camp (1).—Shri Y. D. Hegde (Class II) with an average strength of 2 Surveyors, one Survey Assistant and 11 other technical Class III personnel completed 141 square miles of supplementary triangulation, 72 linear miles of theodolite traverse, 330 square miles of height control, 79 linear miles of verification survey of communications on 1-inch scale and 315 square miles of 1 : 25,000, ground verification and contouring of original air survey of Kanhān Valley and Korba Coalfields in Chhindwāra and Bilāspur Districts of Madhya Pradesh State.

Camp (2).—Shri K. Venkataraman (Class II) with an average strength of 10 technical Class III personnel completed 31

square miles of 4-inch revision ground survey, 34 square miles of 4-inch original ground survey and 58 square miles of 4-inch ground verification and contouring of original air survey of Reserved Forests in Surat and West Khāndesh Districts of Bombay State.

Camp (*3*).—Shri C. M. Azimuddin (Survey Assistant) with an average strength of 9 technical Class III personnel completed 55 square miles of 4-inch revision ground survey and 64 square miles of ground verification and contouring of 4-inch original air survey of Reserved Forests in Surat and West Khāndesh Districts of Bombay State.

Independent Detachments.—Shri M. R. Subramanian (Class II) completed 10 square miles of supplementary triangulation, 1 linear mile of theodolite traverse, 51 linear miles of double tertiary levelling and 10 linear miles of single tertiary levelling for Koyna Tunnel alignment in North Sātāra District and for the photo-mosaic of Pavāi Western Higher Technical Institute in Bombay Suburban District of Bombay State.

Shri P. G. B. Menon (Class II) completed 57 square miles of supplementary triangulation and 11 linear miles of double tertiary levelling for Pāmbiyār and Kakki Ār Reservoirs in Kottayam District of Travancore-Cochin State.

Shri K. B. K. Menon (Surveyor) completed 124 square miles of supplementary triangulation and 35 linear miles of theodolite traverse for Reserved Forest Surveys in the Dāngs, Surat and West Khāndesh Districts and also 2 square miles of supplementary triangulation, 1 linear mile of theodolite traverse, 6 linear miles of double tertiary levelling and 6 linear miles of single tertiary levelling for the survey of the Atomic Energy Factory site in Trombay Island in Bombay Suburban District of Bombay State.

Shri D. J. David (Plane-tabler, Grade III) completed 1·8 square miles of 12-inch original survey for the Atomic Energy Factory in Trombay Island in Bombay Suburban District of Bombay State.

124. **Description of Country.**—The Reserved Forests area of Bombay State consists of low undulating intricate hills mostly covered by dense teak and rosewood with scattered bamboo and other trees interlaced with high grass and undergrowth. Part of the area within about 5 miles of the banks of Tāpti River is covered by thick bamboo clumps with medium mixed jungle. The fuzzy outside of the skin of the beans of a jungle creeper, locally called '*Kujla*' and found in abundance in the area, is an obstruction to free movement in the forests, since even a slight touch of this substance on any exposed part causes very severe irritation of the skin. The thick grass and undergrowth and the '*Kujla*' greatly hampered the progress of surveys till the beginning of February when the vegetation began to dry up and be burnt by forest fires. A fair amount of wild life, such as deer, *sāmbar*, tiger, panther, wild bear, python and black cobra are found in the forests.

The villages in the area are few and far between and the Plane-tablers had often to camp in jungles on the banks of streams and rivulets where water was available. Most of these streams dried up by February and the Plane-tablers had to dig holes in the stream beds, 3 to 6 feet deep in places, to obtain water. Bleaching powder was used to sterilize this water for drinking and cooking purposes.

Communications in the area are scanty. The few existing unmetalled roads and cart-tracks generally follow the forest fire lines and are not motorable till December due to the growth of high grass and weeds and also due to the ruts formed during the monsoon. These are usually cleared and repaired by the Forest Department or timber contractors during the months of November and December.

The area for 1 : 25,000 survey of Korba Coalfields consists of undulating wooded plains with a few isolated low hills and patches of terraced paddy cultivation. The area of Kanhān Valley Coal-fields consists of intricate hills, partly wooded and partly open with narrow cultivated valleys, where scarcity of drinking water prevails in summer months.

The area of Koyna Tunnel lies in a high, partly precipitous and partly densely wooded hill range of the Western Ghāts. The western end of the proposed tunnel, which is about 3 miles long, is approachable from the eastern end only by a circuitous route of about 20 miles.

The area of Pāmbiyār and Kakki Ār Reservoirs consists of high hills and narrow valleys of the Western Ghāts with very dense virgin forest and a few patches of high grass. The area is approachable only by a footpath, about 30 miles long, from the nearest metalled road. Due to the absence of any village within a radius of about 15 miles of the reservoir, all necessities of livelihood had to be transported to the area from Kumili, partly by boat over Periyār Lake for a distance of about 14 miles and partly by headloads for a further distance of about 14 miles. The famous Periyār Lake games' sanctuary lies within about 10 miles of these reservoirs and consequently the area is full of wild life, such as elephant, bison, bear, tiger, deer, *sāmbar*, wild dog and wild fowl. To protect themselves from the roaming wild elephants, the local engineers have dug trenches round some of their temporary camps and built *machāns* to sleep in at nights. The survey personnel also used these temporary camps, whenever convenient, for their field work. The valleys are generally marshy and full of leeches. The area remains wet for a major part of the year and the best time for survey is between December and March. The survey personnel had a very strenuous job to perform in carrying out the ground control in this area. An unmetalled track for jeeps, about 36 miles long, connecting the nearest existing road with the dam sites of these reservoirs, is under construction by the local Government. On its completion movement to and from the area is expected to be greatly eased.

The area of Pavāi Western Higher Technical Institute site lies in the undulating plains, with isolated low hills, between Pavāi and Vehār Lakes.

The area of Atomic Energy Factory site covers part of Trombay Hill and its south-eastern slopes with cultivated terraced fields and mangrove swamp.

125. **Miscellaneous.**—The Bombay Reserved Forests and Kanhān Valley Coalfield area were highly malarious. As a preventive measure, survey personnel were, on the advice of the local doctors, given 1 to 2 quinine tablets of 5 grains each twice a week. In spite of this, the casualties from malaria were about 6% of the field strength. There were also a few cases of guinea-worm and other minor sickness.

126. **Technical Methods.**—Except for the surveys given below, all the other jobs were carried out by normal methods.

(*a*) *1 : 25,000 Kanhān Valley and Korba Coalfields survey with contours at 25 feet Vertical Interval.*—The area involved was covered by 1-inch modern surveys of 1913–14 and 1929–30, and also by 2-inch air photographs, taken in 1952 and 1953. The existing triangulation data was identified on the air photographs with the help of 1-inch maps ; the combination was carried out by slotted-template and the compilation of details by normal radial-line method. Blueprint plane-table sections, on scale 1 : 25,000, of the air surveyed details were then obtained and supplied to the Plane-tablers for verification and contouring on the ground.

As the existing triangulation data was not adequate to obtain heights from interpolated plane-table fixings at suitable intervals for 25-foot contouring, supplementary triangulation and height traverses were carried out in advance of the ground verification and contouring. Triangulation stations and intersected points were fixed about 2 to 5 miles apart. Additional heights were fixed about 1 mile apart by observing vertical angles with a theodolite and scaling off distances by intersections on the 2-inch air survey sections.

Theodolite-Clinopole Traverses.—For flat areas covered with dense jungle, where additional heights could not be fixed at the requisite intervals either by supplementary triangulation or by observing the vertical angles from distant hill-tops, theodolite-clinopole traverses were run between known points, about 1 to 3 miles apart. The clinopole had 3 tin targets fixed at the heights of 5 feet, 13 feet and 15 feet from its foot. Vertical angles to all the 3 targets were read with a theodolite instead of with a clinometer and their natural tangents recorded. The algebraic difference of the values of tangents between the targets at 5 and 15 feet, giving an intercept of 10 feet, was used for computing the distance. The algebraic difference of the values of tangents between the targets at 5 and 13 feet, giving an intercept of 8 feet, was used as a check on the previous value. The height of the theodolite was kept at

about 5 feet throughout and the vertical reading to the target at 5 feet was used for computing heights. A suitable form was devised and used for computing the heights by this method. The positions of these heights were identified on the air photographs on the ground, intersected on the air survey sections and finally transferred on to the plane-table sections. The advantage of using a theodolite is that with it the clinopole targets can be read from a greater distance than with a clinometer and consequently the height traverses could be run faster. The average distance of the theodolite clinopole traverse legs was 500 yards and the maximum distance was 860 yards.

(*b*) *4-inch Bombay Reserved Forests Survey with contours at 25 feet Vertical Interval.*—The Kodatrace outline originals of some of the areas already surveyed for Ukāi and Kākadāpār reservoirs on 4-inch scale with 10-foot contours in 1950–52 were obtained and the sheets were completed for details for the Reserved Forest areas from 4-inch photo enlargements by normal air survey methods. The remaining area, not covered by the above reservoir surveys was compiled on Kodatrace from the 4-inch photo enlargements by air survey based on the supplementary control data of the previous season. Blue-print plane-table sections from these Kodatrace originals and the Kākadāpār reservoir sheets were then obtained and supplied to the Plane-tablers. The area covered by the two reservoirs was revised and the remaining area was verified and contoured on the ground. This was done mainly by plane-table traversing as the country was densely wooded, with thick undergrowth and bamboo clumps in some parts.

(*c*) *12-inch Atomic Energy Factory Site Survey with contours at 2 feet, 5 feet and 20 feet Vertical Intervals for plains, undulating ground and steep hills respectively.*—Additional planimetric control was fixed by supplementary triangulation. Height control was provided by a combination of levelling and tacheometry, based on double tertiary levelling bench-marks of Bombay Oil Refineries survey fixed in 1952–53. A combined colour-print plane-table section of the existing 32-inch (of 1949–50 season) and 12-inch (of 1952–53 season) surveys for some of the area involved was obtained on 12-inch scale, with details in grey and contours in brown, for revision on the ground. The area not covered by the above large scale surveys was, however, surveyed on blank plane-table section by normal ground survey methods. As the grey and brown print gradually began to fade out with the progress of the work, the area of revision survey had to be completely inked up to facilitate proper reproduction for obtaining the drawing blue-prints.

(*d*) *Framework for Koyna Tunnel.*—Horizontal distances, bearings and heights above mean sea-level, accurate *inter se* to 0·1 yard for distances and 0·1 foot for heights, between the different sections of the tunnel, were required. For this purpose, 28 cement concrete pillars about 1 foot by 1 foot by 4 feet with a brass bolt fixed flush with the top surface of the pillar, were constructed and

embedded 3 feet underground at selected sites along the proposed alignment of the tunnel. Iron pins, 6 inches high, 0·75 inch in diameter and pointed at the top, were fixed in the centre of these pillars. The co-ordinates were refered to these pins and the heights were referred to the brass bolts embedded flush with the top surface of the pillars.

As the standard of accuracy required was of a high order, a Class II Officer was put on the job. The terrain involved, being that of partly precipitous and partly densely wooded hills, presented a difficult problem. A Wild T-2 theodolite was used and the co-ordinates of pillars were fixed by a combination of triangulation and theodolite traverse. Triangulation was based on Hunter Short Base for scale, astronomical observations for azimuth and a G.T. Station for origin. Where triangulation was not possible due to the location of some of the pillars in deep valleys and steep hill slopes, theodolite traverse was resorted to. The distances and bearings between pillars were computed from their co-ordinates.

The heights of the pillars were fixed by double tertiary levelling connected to G.T. bench-marks. The level lines had to be run in parts along precipitous ground where the length of the levelling legs had often to be limited to about 20 feet. A distance of 674 yards, along which the double tertiary levelling line could not be run due to the intervening cliff, about 660 feet high, was bridged by observing a series of simultaneous reciprocal vertical angles, every 30 minutes at the time of minimum refraction, between the object glasses of the two Wild T-2 theodolites, one on either end of the gap.

(*e*) *Height control for 16-inch photo-mosaic of Proposed Western Higher Technical Institute Pavāi, with spot heights about 1 furlong apart.*—Dressed stones about 9 inches by 9 inches by 2½ feet were fixed in the area, at about 1 furlong interval, by the Central Public Works Department before the commencement of the height control. A double tertiary levelling line, based on G.T. bench-marks, was run across the centre of the area to fix the heights of 4 main pillars, about 2 feet by 2 feet by 3 feet specially constructed and embedded 2 feet underground. The heights of the other pillars in the area were fixed by connecting them with the main pillars by single tertiary levelling lines. The positions of the pillars were identified on the air photographs on the ground for subsequent entry on the photo-mosaic.

No. 10 PARTY

Officer in charge :—Shri F. M. Hawley, A.R.I.C.S.

127. **General.**—The party continued its function as a training unit for Topographical Trainees, Type 'B', Class III Service.

During recess 1954, there were 61 trainees of whom 18 completed their second year of training and were posted away during recess. The remaining 43 underwent their first year course in fair mapping and air survey.

In October 1954, 12 new trainees were appointed. In November 1954, 25 trainees also reported for duty from the Northern and Eastern Circles, bringing the total number of trainees in the unit to 80. Of these, one resigned on the 14th November 1954.

Eight re-employed senior Class III Officers were engaged throughout the year as instructors.

128. **Personnel.**—The average strength of the party was as follows :—

During recess 1954 : 1 Class I Officer, 1 Class II Officer, 2 Survey Assistants 30 other Class III personnel including Clerks and 61 Topographical Trainees Type 'B'.

During the field season 1954–55 : 1 Class I Officer, 13 Class III personnel including Clerks and 79 trainees.

129. **Recess Duties.**—During Recess 1954, the party was engaged on training as follows :—

(*a*) 18 trainees for the second year course in air surveying. On completion of this course, they were all posted to various units in the Northern, Eastern and Southern Circles.

(*b*) 43 trainees for theodolite traversing, levelling, fair drawing and the first year course in air surveying.

130. **Field Work.**—During the field season 1954–55, the fresh second year batch of 42 trainees underwent a course of plane-tabling on the 1-inch scale under 4 experienced re-employed Class III Officers as instructors.

The new first year batch of 37 trainees underwent a course in plane-tabling first on 1 : 1,000 scale, and later on 1 : 25,000 scale, under 4 experienced re-employed Class III Officers as instructors.

The training area lies approximately 40 miles north of Bangalore, partly in the district of Bangalore and partly in the district of Kolār, of Mysore State.

131. **Description of Country.**— The country selected for training in plane-tabling consists of a flat and open cultivated valley with a moderately high hill range on the eastern side. The area provides almost all types of ground suitable for training on both 1 : 25,000 and 1 inch to 1 mile scales.

132. **Miscellaneous.**—The health of the personnel was good throughout the year.

No. 17 PARTY

Officer in charge :—{ Shri B. N. Murthy, B.Sc., to 3–10–54.
Shri V. Rangan, M.A., from 4–10–54.

133. General.—The field headquarters of the party was shifted first from Bangalore in Mysore State to Sātāra in Bombay State in November 1954, and later from Sātāra to Nadiād in Bombay State in March 1955, for the execution of the field programme. The recess headquarters remained at Bangalore.

During recess, the party completed mapping of the 14 Mahi Project sheets and one departmental sheet surveyed in 1953–54. It also completed the fair drawing of 4 other departmental sheets surveyed in 1953–54.

The field programme consisted of 1-inch scale modern (blue-print) surveys in sheet 47 K, and ground verification and heighting on 2-inch scale vertical air photographs for departmental surveys in sheets 46 B and C, all in Bombay State.

134. **Personnel.**—The average strength of the party was 1 Class I Officer, 2 Class II Officers, 2 Surveyors and 27 other Class III personnel including Clerks.

135. **Areas Surveyed.**—

1983 square miles of 1-inch scale modern (blue-print) survey.

1190 square miles of 2-inch ground verification, heighting and contouring on air photos.

426 linear miles of theodolite traverse.

136. **Recess Duties.**—The party was organized into 3 sections as follows :—

Section (1).—Shri J. E. David (Class II) with 10 Plane-tablers took up the mapping of four 1-inch sheets. By the close of the recess, one sheet was completed, two were completed as far as fair drawing was concerned and one was held in abeyance due to lack of man-power.

Section (2).—Shri S. R. M. Louis (Class II) with 10 Plane-tablers completed fair drawing of two 1-inch sheets.

Section (3).—Shri V. Raghavan (Surveyor) assisted by Sarva Shri R. S. Ramamoorthy (Surveyor) and R. H. S. Vasu (Survey Assistant) and 6 Plane-tablers completed the air survey compilation and mapping of 410 square miles of the 14 Mahi Project sheets.

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

Camp (1).—Shri J. E. David (Class II) with 12 Class III personnel up to March 1955 and 10 thereafter carried out 1313 square miles of 1-inch modern (blue-print) survey in North Sātāra, South Sātāra, Sholāpur and Poona Districts of Bombay State.

Camp (2).—Shri S. R. M. Louis (Class II), with 10 Class III personnel, working up to March 1955, completed 670 square miles of 1-inch modern (blue-print) survey in North Sātāra and South Sātāra Districts of Bombay State. Later with 5 Class III personnel, he carried out 675 square miles of 2-inch ground verification and heighting on photos in Baroda and Broach Districts of Bombay State.

Camp (3).—Shri V. Raghavan (Surveyor), with 7 Class III personnel, starting in March 1955, completed 515 square miles of 2-inch ground verification and heighting on photos in Baroda and Kaira Districts of Bombay State.

Detachments (1) and (2).—Sarva Shri V. Raghavan and P. G. Mukherji (Surveyors) completed 426 linear miles of theodolite traverse in Baroda, Broach and Kaira Districts of Bombay State to provide control for subsequent departmental surveys.

138. **Description of Country.**—The country for modern (blue-print) survey consists of undulating plains with occasional bare hills. The area is well provided for communications and thanks to the Community Projects and the First Five-Year Plan, further roads are also under construction. The staple crop is *jawār*, though a good amount of sugar-cane is also grown in the Mīra River Valley. The climate is generally moderate.

The area for ground verification on photos consists of plains, generally covered with thick vegetation, and has high cactus hedges along field bunds. The communications though satisfactory in Baroda and Kaira Districts, are not so well provided in Broach District. The main crops are cotton, tobacco and *bajri*. Considerable amount of lift irrigation, from wells, by power pumps is employed in Kaira District. The climate is that of extremes, temperature rising to over 110°F. in summer months and falling to about 40°F. in winter.

139. **Miscellaneous.**—The health of the personnel in the field was generally good.

140. **Technical Methods.**—(*a*) *1-inch Modern (blue-print) Survey.*—This was carried out by normal plane-tabling methods on zinc-mounted blue prints obtained after mosaicing, as far as possible, the existing old maps (based on pre-1905 surveys) on the control data of topo triangulation done during 1880–82, as available for the area.

(*b*) *Framework for subsequent departmental surveys.*—The areas involved being generally plain and flat, in addition to the points recognizable on the ground, of the existing topo triangulation done during 1869–73, supplementary control as and where necessary was provided by theodolite traverse.

No. 21 PARTY

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

141. **General.**—The party was raised on 1st October 1954. The field headquarters of the party was at Baroda in Bombay State throughout the field season. The recess headquarters was at Bangalore in Mysore State.

142. **Personnel.**—The average strength of the party during the period under report was 1 Class I Officer, 3 Class II Officers, 1 Surveyor, 1 Survey Assistant and 30 other Class III personnel including Clerks.

143. Areas Surveyed.—

1928 square miles of supplementary control work for 1-inch departmental surveys.

578·7 square miles of 2-inch ground verification, heighting and countouring of vertical air photographs for subsequent 1-inch departmental surveys.

144. Field Work.—

Camp (1).—Shri M. N. Kutty (Class II) with one Survey Assistant and five Plane-tablers completed 578·7 square miles of ground verification and heighting on 2-inch scale, in Dhār, Jhābua and Nimār Districts of Madhya Bhārat State for 1-inch departmental Surveys. Air survey compilation for 275·6 square miles was also completed.

Supplementary framework.—Shri V. Balasubramanyan (Class II) carried out supplementary control work for subsequent 1-inch departmental survey covering an area of 1928 square miles in Baroda and West Khāndesh Districts of Bombay State and Dhār, Jhābua, and Nimār Districts of Madhya Bhārat State.

145. Description of Country.—The entire area covered during the year under report, lies in the Narbada Valley, and consists mostly of steep jungle-covered hills of Sātpura Range, cut by deep ravines. Some patches of cultivation could be seen in the area north of the river, whereas there is practically no cultivation to the south of it.

146. Miscellaneous.—The health of the personnel remained good inspite of the area being known to be malarious. The use of paludrine, as a preventive measure, however, considerably kept down the incidence of malaria. In some areas police protection had to be sought due to reported danger of dacoits.

147. Technical Methods.—*Framework for departmental surveys.*—As far as recoverable on the ground, the existing topo triangulation data of triangulation done during 1871–76 was utilized, and based on it, further supplementary control was provided as and where necessary.

VI. SURVEY REPORTS, AIR SURVEY AND TRAINING DIRECTORATE

DIRECTOR :—Shri E. R. Wilson, B.A., M.I.S. (Ind.).

DEPUTY DIRECTOR :—Shri J. C. Ross, A.R.I.C.S., M.I.S. (Ind.).

DEPUTY DIRECTOR, FLOOD SURVEY WING { Shri P. S. Shinghal, C.E., A.M.I.E.

148. Summary.—This Directorate was raised with effect from 1–5–54, and initially consisted of Nos. 15 (Training), 16 (Training) and 20 (Photogrammetric) Parties, Workshop and Estate Sections and Dispensary. Shortly after its formation, however, the Government of India took up the very pressing question of flood control investigations and the Survey of India were called upon to carry out special surveys in this connection, on a war priority basis. A Flood Survey Wing was, therefore, formed and consisted of No. 1 Party (transferred from the control of the Director, Northern Circle, on 11–10–54), No. 11 Party (transferred from the control of the Director, Eastern Circle, on 1–11–54) and the Assam Flood Survey Party (raised with effect from 7–2–55). This wing was placed under the charge of a Deputy Director.

This Directorate was unable to obtain substantial help from elsewhere in the way of clerical staff and equipment, owing to the fact that the department was already in the process of rapid expansion, with the result that the former comprises mainly raw recruits, while the procurement of the latter has consumed (and is still consuming) a considerable amount of time and energy. Fresh recruitment had also to be done for a large proportion of the Class III technical staff required for the Flood Survey Wing.

149. Areas Surveyed.—

270	square miles of triangulation and height control for survey on the 1 : 25,000 scale by Multiplex.
12,866·9	linear miles of tertiary levelling for flood control investigations.
2,166·5	linear miles of double tertiary levelling for flood control investigations.
226·5	linear miles of check-levelling.
622	square miles of air survey of outline on 2-inch scale (for publication on 4-inch scale).

150. Technical Methods.—Copies of photo-mosaics, marked with a mesh of levelled heights, were required for flood control investigations by the Central Water and Power Commission ; they

were required for those parts of the plains areas of the Brahmaputra and Ganga Rivers basins which were liable to inundation during the peak monsoon period. This mesh was to afford an indication of the general slope of the ground.

The field work done for this purpose consisted, first, of running lines of double tertiary levelling, emanating from and closing on bench-marks of secondary levelling lines run in the area by No. 14 Party and later of running lines of tertiary levelling at intervals of 30 to 50 chains, connected either to the secondary or double tertiary levelling.

The double tertiary levelling net was so arranged that the length of any of the single tertiary lines tied on to it and run in the direction of the general slope of the ground would not exceed 8 miles in length. For running a double tertiary line only one observer was employed (instead of two, which is the usual practice), and he took a second set of readings at each station by changing the height of the instrument after observing the first set. If, however, the two values of the difference in height did not agree within 0·010 of a foot, additional sets were observed until the desired agreement was obtained. The mean value of the mutually-agreeing sets was accepted for the computation of heights.

Semi-permanent bench-marks at intervals of about half-a-mile along (or within the close vicinity of) the lines of double and single tertiary levelling were established at the bases of trees, on culverts, mile and furlong stones, *pucca* wells and other similar objects. The photo positions of all these bench-marks, as also of spots on the ground (at an average interval of about 10 chains) at which the levelling staves were erected, were marked on vertical air photographs on the scale of 2 inches to a mile. The relative heights (above or below general ground level) of all these bench-marks were also recorded. For the purpose of marking the photo positions of the bench-marks and spot heights, the air photographs were treated as maps and plane-table fixings interpolated in open areas, while plane-table compass traverses were run in jungle areas.

During the course of tertiary levelling, names of large villages and rivers were picked up on the ground. The usual "village list" was maintained, the reference circles being marked on the back of photographs.

Check-levelling lines were run across the lines of tertiary levelling, connecting the tertiary bench-marks. This work was done by *partallers*, who checked also the accuracy of a good precentage of the pricked photo positions and spot heights. Tolerable discrepancy between the heights of any bench-mark, as obtained by a tertiary leveller and a *partaller*, was 3 inches.

Permissible closing errors in double and single tertiary levelling lines were $0 \cdot 05\sqrt{M}$ and $0 \cdot 15\sqrt{M}$ feet, respectively, where M denotes the length of a line in miles. Lines that did not pass within these limits of accuracy were revised.

The single tertiary Levellers engaged on work during the field season under report were fresh recruits, who had to be trained before being put on to productive work. The field season, consequently, commenced late. These trainees required constant supervision and guidance, throughout. In open areas they gave an out-turn of only 1 mile per working day, initially. Later, the average out-turn increased to $3\frac{1}{2}$ miles. The out-turn was less in tea-garden areas and still less in jungle areas, where line clearing and plane-table traverse had to be resorted to. The out-turn in jungle areas was also affected by the absence of suitable camp sites, difficulty in obtaining *mazdoors* for jungle clearing and want of transport. Thus, the out-turn in jungle areas fell to about one-quarter of that in open areas.

No. 1 PARTY

Officer in charge :—
- Captain K. L. Khosla, B.SC., B.E. (Civil), A.M.I.E , Engineers, to 6–4–54.
- Major D. N. Sharma, Engineers, from 7–4–54 to 12–10–54.
- Shri J. C. Ross, A.R.I.C.S., M.I.S. (Ind.), Deputy Director, Air Survey and Training Directorate, from 13–10–54 to 19–10–54 (in addition to his own duties).
- Shri V. P. Sharma, B.A., from 20–10–54 to 7–2–55.
- Shri P. S. Shinghal, C.E., A.M.I.E., Deputy Director (Flood Survey Wing), from 8–2–55 (in addition to his own duties).

151. General.—The party was employed entirely on Flood Control Investigation Surveys in North Bihār and Nepāl, except for carrying out the fair-mapping of survey done in the previous field season (already reported in the General Report for 1954, page 23).

Surveys during the period under report mainly involved the provision of a network of heights throughout the area affected by floods and the pricking of spot heights on aerial photographs of the area.

For administrative convenience and technical co-ordination the party was transferred from the administrative control of the Director, Northern Circle, to that of the Director, Air Survey and Training Directorate, and incorporated in the newly-constituted Flood Survey Wing under a Deputy Director.

152. Personnel.—The average strength of the unit during the period under report was 1 Class I Officer, 2 Class II Officers and 68 Class III personnel (including 4 Clerks and 3 Drivers).

153. Areas Surveyed.—

822 linear miles of double tertiary levelling.

8255 linear miles of single tertiary levelling.

154. Recess Duties.—The recess strength of the party was divided into 3 technical sections. Sarva Shri T. C. Jyoti and Hari Singh (Class II), carried out finalization of 61 Tractor Going Plans.

Shri Sohan Singh (Survey Assistant), held charge of the third section and carried out preparation of sections for the survey of the Delhi Guide Map on the scale of 7·5″ to 1 mile by air survey methods, for subsequent ground verification.

In addition to the above, 44 Topo. Trainees Type ' B ' recruited for Flood Control Investigation Surveys were given preliminary training at Dehra Dūn in tertiary levelling and photo identification for about five weeks.

155. **Field Work.**—The party was organized for Flood Control Investigation Surveys as follows :—

Camp. I.—Shri G. N. Dubey (Class II) was in charge, and with 17 Class III personnel completed 150 linear miles of double tertiary levelling and over 2,080 linear miles of single tertiary levelling with photo pricking of spot-heights to be marked on 4-inch photo-mosaics for engineering purposes.

Camp II.—Shri T. C. Jyoti (Class II) was in charge, and with 18 Class III personnel completed 379 linear miles of double tertiary levelling and 3,238 linear miles of single tertiary levelling with photo pricking for the same purpose as stated above.

Camp III.—Shri N. B. Chowdhury (Surveyor) was in charge, and with 19 Class III personnel completed 293 linear miles of double tertiary levelling and 2,937 linear miles of single tertiary levelling with photo pricking for the same purpose as stated above.

The area of work of all the three camps lay in Darbhanga, Champāran and Muzaffarpur Districts of Bihār and in Rautāhat District of Nepāl.

156. **Description of Country.**—The country consists of plains deeply and closely intersected by numerous ravines and interspersed with mango groves. The area is very thickly populated and has very poor communications. The transport generally used is the bullock-cart and there is not much difficulty in obtaining this except during the harvest season. The procurement of wheat is rather difficult. Dispensaries are few and not well equipped.

157. **Miscellaneous.**—Except in the months of March and April, when some cases of diarrhoea and malaria were reported, all field hands, in general, enjoyed good health.

No. 11 PARTY

Officer in charge :—Shri J. Chatterjee, B.Sc., A.M.I.S. (Ind.).

158. **General.**—The recess activities of the party consisted of air survey and mapping for irrigation and other development projects in Bihār and Orissa.

Field work consisted of providing a network of heights in connection with flood control investigations in Jalpaiguri, Cooch Behār and Darjeeling Districts of West Bengal.

The field headquarters of the party was at Jalpaiguri and the recess headquarters remained at Rānchi.

The party was transferred from the administrative control of the Director, Eastern Circle, to that of the Director, Air Survey and Training Directorate, with effect from 1-11-54.

159. Personnel.—The average recess strength of the party was 1 Class I Officer, 2 Class II Officers and 45 Class III personnel (including Clerks and Drivers). During the field season the average strength was 1 Class I Officer, 1 Class II Officer and 49 Class III personnel (including 30 Topographical Trainees Type 'B', 3 Clerks and 2 Drivers).

160. Areas Surveyed.—

344·5 linear miles of double tertiary levelling for flood control investigations.

1,861·9 linear miles (covering 757·5 square miles area) of tertiary levelling for flood control investigations.

226·5 linear miles of check-levelling.

622·0 square miles of 2-inch outline air survey of a part of the Mahānadi Delta Survey area, for publication on the 4-inch scale after mapping.

161. Recess Duties.—Four drawing sections under Sarva Shri B. K. Satpathi and Satnam Singh (Class II), and Sarva Shri D. P. Chatterjee and P. B. Ghildyal (Surveyors), completed the air survey and fair-mapping of 18 Mahānadi Delta sheets covering an area of 622 square miles in Cuttack and Puri Districts of Orissa, mapping (only) of 4 Dāmodar Valley Survey sheets and 5 Forest (Rānchi District) sheets. Air survey combination (only) of 14 Dāmodar Valley Survey sheets was also completed. Shri J. K. Chatterjee (Surveyor) replaced Shri Satnam Singh in the middle of recess, when the latter was transferred away from the party. A computing section under Shri K. B. Madan (Survey Assistant) completed all computations of field work of the previous season.

Towards the end of recess, training in tertiary levelling and photo identification was given to 50 freshly recruited Topographical Trainees Type 'B'. The training was continued during the first month of the field season and subsequently, 21 trainees were transferred to the Assam Flood Survey Party.

162. Field Work.—Field work was organized as follows :—

Camp I.—Shri B. K. Satpathi (Class II) with 3 Plane-tablers, 1 Leveller, 2 Computers and 15 Topographical Trainees Type 'B' completed 93·2 linear miles of double tertiary and 941·5 linear miles of tertiary levelling, including identification of heighted points on 2-inch air photographs, in an area of 396 square miles in Jalpaiguri and Cooch Behār Districts of West Bengal. 108·9 linear miles of cross levelling for checking the work of tertiary levellers was also done in this camp.

Camp II.—Shri J. K. Chatterjee (Surveyor) with 1 Plane-tabler, 2 Levellers, 2 Computers and 14 Topographical Trainees Type 'B' completed 251·3 linear miles of double tertiary and 920·4 linear miles of tertiary levelling, including identification of heighted points on 2-inch air photographs in an area of 361·5 square miles in Jalpaiguri, Cooch Behār and Darjeeling Districts of West Bengal. 117·6 linear miles of cross levelling for checking the work of tertiary Levellers was also done in this camp.

Field work was started late because of the time taken at the beginning of the field season in training the freshly recruited trainees. The out-turn of field work was also low because air photographs for the area of survey were not available in time due to adverse weather conditions.

163. **Description of Country.**—About half the area for survey consisted of open, cultivated plains with numerous small and big water channels. The River Tista flows through the middle of the area from north to south. The northern side of the area is undulating and is covered either with jungle or tea-gardens. The jungle consists mainly of *sāl* trees with occasional patches of cane-brake; wild animals such as tiger, panther, elephant and buffalo are frequently seen in these forests. The islands in the Tista River are covered with high grass. The area is well served with roads and railways, though the heavy floods of 1954 damaged many of the bridges and culverts. Bullock-cart transport is difficult to obtain in tea-garden areas and the rate is comparatively high all over. Normal foodstuffs are usually obtainable, though the cost is higher than in other parts of the country; milk and *ghee* are scarce. Due to the incidence of tea-gardens in the area, local *mazdoors* are not easily available even at high rates of wages.

164. **Miscellaneous.**—General health of the personnel of the party was good, but towards the later part of the field season a few persons suffered from stomach troubles due to the non-availability of good drinking water.

No. 15 (TRAINING) PARTY

Officer in charge :—{ Major C. M. Sahni, B.A., Engineers, to 10-9-54.
{ Major O. P. Anand, A.M.I.S. (Ind.), Engineers, from 11-9-54.

165. **General.**—The headquarters of the unit remained at Dehra Dūn throughout the year.

166. **Personnel.**—The average strength of the instructional staff was 1 Class I, 3 Class II and 4 Class III Officers (excluding Clerks and Drivers).

167. **Training.**—The following courses of training were undertaken during the period under reports :—

(*a*) *Departmental Officers.*—Duration of course 2 years :—

(*i*) *1952–54.*

2 Corps of Engineer Officers and
5 Class II Officers.

(*ii*) *1953–55.*
1 Class I Officer and
7 Class II Officers.

(*iii*) *1954–56.*
5 Corps of Engineer Officers,
3 Class I Officers,
11 Class II Officers and
8 Class III Officers.

(*b*) *State Trainees.*—Cadastral and revenue survey course, 1953–54, duration 8 months.

6 trainees as mentioned in the General Report for 1954.

168. Recess Duties.—The 7 Officers of the 1952–54 course and 4 Class III Officers from different circles joined a Refresher Course which commenced on 18–5–54. On completion of the course at the end of September 1954, these officers took the Intermediate Examination of the Institution of Surveyors (India). 6 candidates were declared successful, while 4 had to pass in one subject in order to be declared successful in this examination.

At the beginning of October 1954, 5 Class II Officers of the 1952–54 course (who had also joined the above-mentioned Refresher Course), took the Union Public Service Commission Examination for confirmation after their two years' probationary period.

In October 1954 all officers of the 1952–54 course were posted away to other units.

The 8 officers of the 1953–55 course were trained in air survey and field astronomy.

The officers of the 1954–56 course – who joined in October 1954 – practised drawing and were instructed in the use and adjustment of simple surveying instruments.

On completion of their training, the 6 officers of the State Trainees Course left the party at the end of May 1954.

169. Field Work.—Field training of officers of the 1953–55 course commenced on 8–10–54 and consisted of triangulation, 1-inch plane-table survey, barometric heights and Hunter Short Base traverse.

Training in field work of officers of the 1954–56 course started on 6–11–55 and consisted of chain survey, tertiary spirit-levelling, theodolite levelling, theodolite resection, tacheometry, 16-inch plane-table survey (contouring with clinopole) and 1 : 25,000 plane-table survey.

The field work was organized as follows :—

Bhatta Camp (1953–55 course).—Shri A. C. Chawla (Class II), assisted by Shri Sohan Singh (Survey Assistant), trained the officers of the course in triangulation, while Shri Sohan Singh trained them in plane-table survey. The camp headquarters moved from Bhatta to Clement Town in March 1955. Shri Mastan Singh (Class II), and Shri Sohan Singh trained them in barometric heights and Hunter Short Base traverse.

Rājpur Camp (1954–56 course).—Shri Mastan Singh assisted by Shri Satnam Singh and Shri J. C. Sahgal (Class II) and 4 Class III Instructors, trained 27 officers.

170. **Description of Country.**—The training area around Bhatta is hilly ; it is covered by light vegetation and scrub, with patches of cultivation. The metalled road from Dehra Dūn to Mussoorie runs through the area. The area around Rājpur consists of hills and undulating plains interspersed with roads, villages, and light vegetation The hilly area is scrub-covered.

171. **Miscellaneous.**—Health of all personnel remained satisfactory.

No. 16 (TRAINING) PARTY

Officer in charge :—Shri U. D. Mamgain, B.Sc., A.M.I.S. (Ind.).

172. **General.**—This party continued to function as a training party for Topographical Trainees Type 'B'. The headquarters of the party remained at Dehra Dūn throughout the year.

A new syllabus of training for Topo. Trainees Type 'B' was drawn up, replacing the old syllabus given in the appendix to the Technical Report (Parts I and II), 1948–49. Training in accordance with this syllabus was started in June 1954. The new syllabus is reproduced as Appendix II to this report (p. 145).

Due to the late raising of this unit, the period of training for the present batch has had to be reduced from 24 months to 19, resulting in a proportionate reduction in the period for each item in the course.

173. **Personnel.**—The average strength of the party was 1 Class I Officer, 1 Class II Officer, 2 Surveyors, 6 Survey Assistants and 62 other Class III personnel including Trainees, Clerks and a Driver.

174. **Recess Duties.**—Training in fair drawing was completed from July to September 1954.

175. **Field work.**—Training in plane-tabling on scale of 1 : 1,000 and 1 : 25,000 continued in the Rajpur-Nāgal area up to the end of June 1954, when camps closed for recess.

Training in 1-inch plane-tabling in the high hills of the Chakrāta-Sahiya area was started early in October 1954. Camps for this were organized as follows :—

Camp I.—35 trainees under Shri R. D. Verma (Class II), assisted by 5 instructors, with camp headquarters at Thāna, from 29–9–54.

Camp II.—21 trainees under Shri Hari Singh (Surveyor), assisted by 3 instructors, with camp headquarters at Thāna, from 29–9–54.

Each trainee was given an area of approximately 28 square miles to survey on the 1-inch scale in the course of about $4\frac{1}{2}$ months. Average out-turn per trainee during this period was 20 square miles.

On completion of this plane-tabling, training in post-pointing was carried out for 5 weeks (from the 18th February to the 23rd March 1955).

176. Description of Country.—The country covered by the 1-inch survey consisted of high, bare hills ranging from 3,000 to 7,000 feet in height above sea-level. The country for post-pointing consisted of open plains with low wooded hills along the eastern border.

177. Miscellaneous.—Health of personnel was generally satisfactory.

No. 20 (PHOTOGRAMMETRIC) PARTY

Officer in charge :—{ Shri J. C. Ross, A.R.I.C.S., M.I.S. (Ind.), to 6-5-54.
Shri J. C. Sikka, B.A., A.M I.S. (Ind.), from 7-5-54.

178. General.—The headquarters of the unit remained at Dehra Dūn throughout the period under report. The party was transferred from the Geodetic and Research Branch Directorate to the Air Survey and Training Directorate from 1-5-54.

179. Personnel.—The average strength of the party was 2 Class I Officers, 2 Class II Officers and 16 Class III personnel (including 3 Clerks and 1 Record-keeper). Mr. K. Hollan Hagen, United Nations' Technical Expert on Photogrammetry, remained attached to this unit as Chief Instructor.

180. Areas Surveyed.—

270 square miles of triangulation and height control for 1 : 25,000 surveys on the Multiplex Machine.

181. Recess Duties.—Short courses of training for a month in the general principles of photogrammetry, including operation of the Multiplex and Wild Autograph A7 in particular, were conducted by Mr. Hollan Hagen for 20 Class I and 2 Class II Officers in two batches. Another batch of 12 Surveyors was given an intensive course of training on these machines, with a view to training them as operators. Practical lessons were also given in aerial triangulation and in the drawing of detail and contours with this automatic plotting equipment. Mr. K. Hollan Hagen was assisted in these courses by Sarva Shri A. N. Gosain and G. B. Das, Class II Officers.

182. Field Work.—Capt. P. Rout (Class I) and Shri Ratna Singh (Surveyor, Selection Grade) completed the planimetric and height control of about 270 square miles, covering Sheet 45 H/11, for the 1 : 25,000 Rājasthān Lead-Zinc Zone Survey, in Udaipur District.

This was required for the purpose of providing sufficient control for combination by the slotted-template method and of providing

about four points per overlap for setting models in the Multiplex. In some strips it was not possible to fix suitable control without wasting considerable time, and the distribution of control points for these strips was, therefore, arranged so that aerial triangulation could be done in the Wild Autograph A7.

The mapping is to be carried out with the help of the Multiplex equipment installed in the unit.

183. Description of Country.—The area triangulated for the 1 : 25,000 Rājasthān Lead-Zinc Zone Survey consisted of low but intricate hills covered with mixed jungle and having cultivated fields mostly in the narrow valleys.

184. Miscellaneous.—Professor P. B. Shahani of the Roorkee Engineering University was given a short course of training on the Multiplex Machine.

Shri G. B. Das was sent to Roorkee to set up a Multiplex Machine purchased by the Engineering University.

Shri Ratna Singh went to Darjeeling on duty, in connection with the mountaineering exhibition held there.

ASSAM FLOOD SURVEY PARTY

Officer in charge :—Shri V. P. Sharma, B.A.

185. General.—The party was raised with effect from 7-2-55 and was employed exclusively on levelling and photo pricking for flood control investigations in Lakhimpur and Sibsāgar Districts of Assam. The headquarters was at Shillong.

186. Personnel.—The average strength of the unit was 1 Class I Officer, 3 Class II Officers and 63 Class III personnel (including Clerks).

187. Areas Surveyed.—

1,000 linear miles of double tertiary levelling.

2,750 linear miles of tertiary levelling.

188. Recess Duties.—The unit was raised during the field season and, therefore, had no recess.

189. Field Work.—The work was divided between 3 camps, under Sarva Shri A. C. Chawla and Hari Singh (Class II) and Shri B. P. Ghildyal (Surveyor). It consisted of simultaneous double tertiary levelling and tertiary levelling, with photo pricking, and was carried out by normal departmental methods.

190. Description of Country.—The country was generally flat, with patches of dense jungle and water-logged areas. Levelling was restricted to open country and identifiable tracks in jungle areas, with the approval of the indentor.

191. Miscellaneous.—The health of all personnel was satisfactory.

PART II.—MAP PUBLICATION AND OFFICE WORK

VII. INTRODUCTION

192. Progress of Map Publication.—Index maps *D*, *E*, *F* and *G* at the end of this report, show the progress of publication to-date for all standard series of modern maps, the maintenance of which is a departmental commitment of the Survey of India.

193. Work of Map Drawing and Printing Offices :—The work of drawing and printing offices of the department for the period under report is described in three sections as follows :—

Section IX (page 106) gives statistics of map publication, extra-departmental printing and map issues.

Section X (page 111) describes the work of the drawing offices and includes two tables which quantitatively summarize this work.

Section XI (page 114) describes the work of the printing offices.

194. Map Publication Policy.—In pursuance of the policy of decentralization of topo mapping adopted during 1950, the Map Publication Directorate continued to be responsible for geographical mapping and for those maps which formed the international mapping commitment of this department such as World Aeronautical Charts (ICAO) and the 1 : M Carte internationale Du Monde series. The work on these jobs progressed steadily.

In accordance with the decisions taken by the Government of India, the maps on scale 1 : 2 Million, comprising the Southern Asia Series, were revived during the period under report. This series had formed the departmental responsibility up to the year 1949 and was abandoned thereafter. Steps to bring the 21 maps of this series uptodate have been taken by putting four sheets in hand for mapping. See Index Map G.

Among the geographical maps, the 70-mile Political Map of India, English edition, was published in February 1950. Its second edition is now under publication. The publication of the 70-mile Tourist and Physical Maps in English last year was held up owing to certain considerations which have not yet been concluded. The 67-mile Railway Map, 1954 edition, and the 192-mile Map of India and Adjacent Countries, English edition, were also published. Several State Maps in English on scale 1 : Million, are in various stages of mapping or proving. The new editions of the 40-mile Wall Map and the 40-mile Road Map are nearing completion.

A revised edition of the Map Catalogue incorporating changes since its last issue was taken up and work is progressing.

The department had adopted the policy of producing Hindi editions in Devanagri script of the various general and geographical maps of India to meet popular demand. As a first step towards implementing this policy the 70-mile Political Map of India was published in 1952 and its second edition was published during the period under report. The Hindi editions of the 128-mile and 192-mile Maps of India and Adjacent Countries were also published. The work on the 70-mile Physical Map in Hindi is well advanced. Hindi editions of other general maps of India and 1 : Million State Maps are in the process of mapping and printing. The paucity of suitable typo founts in Hindi, however, persists and, therefore, it has not yet been possible to take up the publication of any topographical maps in Hindi.

The policy of reverting to full colour specifications for new maps was steadily followed. During the period under report new editions of 109 topo maps, including 13 new publications, were published, of which 36 were in full colours.

According to the reprint policy adopted in 1950, reprints of 110 topo maps showing the latest political set-up were published in basic colours.

Printing of the School Atlas which was taken up at the instance of the Government of India is in an advanced stage of completion and the Atlas is likely to be put on sale during the next year.

In addition to the normal work of the department, a large number of miscellaneous mapping and printing jobs were undertaken on behalf of various departments of the Central and the State Governments and for certain commercial firms.

VIII. PERSONNEL OF THE MAP PUBLICATION DIRECTORATE AND OF HEADQUARTERS OFFICES EMPLOYED ON MAP DRAWING AND PRINTING

Dehra Dūn. — Director, Map Publication

Colonel Gambhir Singh, M.I.S. (Ind.), to 2–1–55 and from 8–3–55.

Shri K. L. Dhawan, B.A., M.I.S. (Ind.), from 3–1–55 to 7–3–55.

Deputy Director, Map Publication

Shri C. T. Hurley, M.I.S. (Ind.).

Assistant Director, Map Publication

Shri J C. Sikka, B.A., A.M.I.S. (Ind.), to 7–5–54.

Shri P. S. Shinghal, C.E., A.I.M.E., from 8–5–54 to 26–5–54.

Shri L. J. Bagnall, B.Sc., from 27–5–54 to 11–11–54.

Shri G. C. Aggarwala, B.A., A.M.I.S. (Ind.), from 12–11–54.

Attached to Headquarters Office

Class II	..	Officer Surveyor ..	... 1

No. 1 Drawing Office

Officer in charge—

Shri M. R. Nair, B.A., M.I.S. (Ind.), to 30–4–54.

Shri P. S. Shinghal, C.E., A.M.I.E., from 1–5–54 to 31–5–55 and 1–7–54 to 1–11–54.

Shri L. J. Bagnall, B.Sc., from 1–6–54 to 30–6–54 and from 2–11–54.

Class II	..	Officer Surveyors ..	.. 2
,, III	Division I	Survey Assistant ..	.. 1
,, III	,,	Draftsmen ..	.. 10
,, III	,,	II Plane-tablers ..	.. 3
,, III	,,	II Draftsmen (including trainees) ..	88

Photo-Litho Office (Hāthībarkala)

Managers—

Shri C. V. M. Hayman, to 16–1–55 and from 13–2–55.

Shri B. C. Dutta, B.A., DIP. (Tech.), (Leeds), A.R.P.S. (London).

Class	II	..	Assistant Managers ..	.. 2
,,	III	Division I	Technical Assistants ..	.. 14
,,	III	,, II	Reproduction personnel	.. 157

Map Record and Issue Office

Officer in charge—

Shri T. M. C. Alexander, to 31–8–54 and from 1–10–54.

Shri L. J. Bagnall, B.SC., from 1–9–54 to 30–9–54.

Works Office (Hāthībarkala)

Electrical Engineer—

Shri A. L. Sood.

Class	III	Division II	Artificers	.. 16
,,	III	,, II	Drivers	.. 6

Calcutta. **Director, Eastern Circle**

Colonel R. S. Kalha, M.I.S. (Ind.).

Deputy Director, Eastern Circle

Shri K. C. Gosain, B.A., M.I.S. (Ind.), to 7–1–55.

Shri J. C. Berry, from 8–1–55.

Attached to Headquarters Office (Calcutta)

Class	I	..	Deputy Superintending Surveyor—Capt. P. Rout, Engrs., B.SC. (Eng.), up to 21–11–54.		
,,	II	..	Officer Surveyor	1	
,,	III	Division I	..	1	
,,	III	,, I	..	1	to 1–10–54.
,,	III	,, I	..	1	to 18–12–54
,,	III	,, II	..	10	to 18–12–54.

No. 5 Drawing Office

Officer in charge—

Shri H. H. Phillips, B.SC. (HONS.), M.I.S. (Ind.).

Class	I	..	Deputy Superintending Surveyor—Shri N. C. Sen, B.COM., to 30–9–54.
,,	II	..	Officer Surveyors .. .. 5 (one from 30–9–54).
,,	III Division	I	.. .. .. 7 (3 from 15–5–54 and one from 30–9–54).
,,	III ,,	II	.. .. .. 78 (Average)

Photo-Litho Office

Managers—

Shri K. L. Dev, to 11–4–54 and again from 23–5–54.

Capt. P. Rout, Engrs., B.SC. (Eng.), from 12–4–54 to 22–5–54.

Class	II	..	Assistant Managers 2
,,	III Division	I	 11
,,	III ,,	II	.. 126 (average).

Engraving Office

Class	II	..	Assistant Head Engraver .. 1
,,	III Division	I	.. .. .. 1 to 12–12–54.
,,	III ,,	II	 21

Dehra Dūn. **Director, Northern Circle**

Shri P. A. Thomas, A.R.I.C.S., M.I.S. (Ind.).

Deputy Director, Northern Circle

Shri M. M. Ganapathy, B.A., M.I.S. (Ind.), to 2–1–55.

Shri P. A. Thomas, A.R.I.C.S., M.I.S. (Ind.), from 3–1–55 to 19–1–55 (in addition to his duties as Director, Northern Circle).

Shri K. C. Gosain, B.A., M.I.S. (Ind.), from 20–1–55.

No. 2 Drawing Office

Officer in charge—

Shri N. L. Gupta, C.E., M.I.S. (Ind.).

Class	II	..	Officer Surveyors 2

No. 2 Drawing Office.—concld.

Class	III	Division I	Surveyors 7	(One up to 8–10–54) (One up to 4–10–54).
,,	III	,, I	Survey Assistants 2	(One up to 2–6–54 and one up to 10–2–55).
,,	III	,, I	Draftsmen	2
,,	III	,, II	Plane-tablers	2
,,	III	,, II	Air Survey Draftsman ..	1
,,	III	,, II	Draftsmen (including trainees) ..	59

Photo-Zinco Office

Manager—

Shri P. N. Kirpal, B.A., Dip. in Printing (London).

Class	II	..	Assistant Managers	2
,,	III	Division I	Technical Assistants	4
,,	III	,, II	Reproduction Personnel ..	68

Letterpress Printing Section

(Under Director, Geodetic and Research Branch)

Assistant Manager—

Shri S. N. Sen, from 12–8–54 to 17–12–54.

Assistant Supervisors—

Shri H. H. Williams, to 12–6–54 and from 13–10–54.

Shri K. P. Bhattacharya, from 13–6–54 to 12–10–54.

Class	III	Division I	Technical Assistants	2
,,	III	,, II	Proof Readers	3
,,	III	,, II	Compositors	21
,,	III	,, II	Letterpress Printers	5
,,	III	,, II	Machine Feeders	7
,,	III	,, II	Monotype Operators—Keyboard ..	3
,,	III	,, II	Monotype Operators—Casters ..	4
,,	III	,, II	Stereo Typers	3

Bangalore. **Director, Southern Circle**

Colonel J. S. Paintal, A.M.I.S. (Ind.).

Deputy Director, Southern Circle

Shri J. C. Berry, M.I.S. (Ind.), to 30–4–54.

Colonel J. S. Paintal, A.M.I.S. (Ind.), from 1–5–54 to 4–5–54.

Shri M. R. Nair, B.A., M.I.S. (Ind.), from 5–5–54.

No. 4 Drawing Office

Officer in charge—

Shri B. B. Kuttappa, A.M.I.S. (Ind.).

Class	II	..	Officer Surveyors	..	3
,,	III	Division I	Surveyor ..	..	1
,,	III	,, I	Survey Assistants	..	3
,,	III	,, I	Draftsmen	..	3
,,	III	,, II	Draftsmen (including trainees)	..	67
,,	III	,, II	Plane-tablers	..	3

IX. PUBLICATIONS, EXTRA-DEPARTMENTAL PRINTING AND MAP ISSUES

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

Table I(*a*) Departmental maps.

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

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

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

Table I(*a*)—Departmental Maps published

Class of Maps	Scale	New Publications				New Editions and Reprints					Number of copies printed				Value in Rupees			
		Dehra Dūn		Calcutta	Total	Dehra Dūn		Calcutta	Total		Dehra Dūn		Calcutta		Dehra Dūn		Calcutta	
		Map Publication Office	Northern Circle	Eastern Circle		Map Publication Office	Northern Circle	Eastern Circle	New Editions	Reprints	Map Publication Office	Northern Circle	Eastern Circle	Total	Map Publication Office	Northern Circle	Eastern Circle	Total
GENERAL MAPS																		
Maps of India	Various	3	..	..	3	3	..	..	2	1	40,612	..	..	40,612	55,343	..	..	55,343
GEOGRAPHICAL MAPS																		
Carte Internationale du Monde ..	1 : 1 Million	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
World Aeronautical Charts (I.C.A.O.)	1 : 1 „	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
TOPOGRAPHICAL MAPS																		
1:25,000 ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Quarter-inch (Modern) ..	1″ = 4 miles	..	1	..	1	8	8	4	15	5	26,980	29,810	14,530	71,320	40,470	44,715	21,795	1,06,980
„ (Preliminary) ..	„	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
„ (Provisional) ..	„	..	..	..	..	..	1	..	1	..	..	3,120	..	3,120	..	4,680	..	4,680
Half-inch (Modern—Primary) ..	1″ = 2 miles	..	..	..	..	1	..	..	..	1	300	..	..	300	300	..	..	300
One-inch (Modern) ..	1″ = 1 mile	10	2	..	12	112	12	11	39	96	3,42,549	37,630	30,620	4,10,799	3,83,209	49,110	30,620	4,62,939
Old Style maps (1″ & ½″ Primary)	Various	..	..	..	..	22	25	2	42	7	73,011	86,640	7,290	1,66,941	73,011	86,640	7,290	1,66,941
SPECIAL MAPS																		
Maps of States	1 : 1 Million	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
City and Town Guide Maps ..	Various	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Index Maps	„	2	..	..	2	3	..	..	3	..	2,188	..	..	2,188	1,407	..	..	1,407
Miscellaneous maps, charts, Diagrams and Panoramas ..	„	19	10	..	29	26	10	1	9	28	11,396	13,660	300	25,356	14,136	3,185	600	17,921
Total ..		34	13	..	47	175	56	18	111	138	4,97,036	1,70,860	52,740	7,20,636	5,67,876	1,88,330	60,305	8,16,511

Note.—In addition to the printing summarized above the following miscellaneous departmental printing was also done during the year :—

Office		Number of originals for litho reproduction	Number of prints	Number of originals for half-tone reproduction, etc.	Number of prints
Dehra Dūn	Map Publication Office	476	3,875	86	142
	Northern Circle	152	1,056	37	422
Calcutta	Eastern Circle	190	1,258	8	14

The above includes prints prepared or use in surveying and mapping, e.g., black-prints for mosaics, blueprints for fair mapping, etc.

List of First and New Edition sheets printed

Scale	Sheet No.	Edition Number and Date
1″ = 1 mile	40 P/7	1st (Provl.) 1953
	41 A/2	1st („) 1953
	41 A/6	1st („) 1953
	41 A/12	1st („) 1954
	41 I/9	1st („) 1953
	41 I/13	1st („) 1953
	41 K/3	1st („) 1954
	41 K/7	1st („) 1954
	41 M/4	1st („) 1953
	41 M/5	1st („) 1954
	41 O/7	1st („) 1954
	44 J/3	3rd 1953
	44 J/4	2nd 1953
	44 P/1	2nd (Provl.) 1953
	44 P/4	2nd („) 1953
	44 P/5	2nd („) 1953
	44 P/8	2nd („) 1953
	44 P/12	2nd („) 1953
	44 P/16	2nd („) 1954
	45 H/9	2nd („) 1954
	45 H/11	2nd („) 1953
	45 H/12	2nd („) 1953
	45 H/13	2nd („) 1954
	45 H/14	2nd („) 1954
	45 H/16	2nd („) 1953
	45 J/8	2nd 1953
	45 K/3	2nd (Provl.) 1954
	45 K/4	2nd („) 1953
	45 K/7	2nd („) 1954
	45 K/8	2nd („) 1953
	46 A/4	2nd („) 1953
	46 E/10	2nd („) 1953
	46 E/13	2nd („) 1953
	46 E/14	2nd („) 1954
	46 G/6	2nd 1952
	46 H/5	2nd 1952
	46 H/6	2nd 1953
	47 H/6	2nd 1951
	47 H/10	2nd 1952
	47 H/11	2nd 1952
	47 N/7	2nd 1954
	48 I/14	2nd 1953
	48 I/16	2nd 1952
	52 D/2	2nd 1953
	53 F/15	6th 1953
	53 J/3	6th 1953
	53 O/1	1st 1952
	53 O/2	1st 1953
	54 O/5	2nd 1954
	54 O/6	2nd 1954
	54 O/9	2nd 1954
	54 O/10	2nd 1953
	54 O/14	2nd 1954
	54 P/6	2nd 1954
	54 P/7	2nd 1954
	55 F/6	2nd 1953
	55 H/12	2nd 1954
	55 I/16	2nd 1954
	56 C/8	2nd 1954
	57 O/12	2nd 1954
	58 B/13	2nd 1954
	58 C/9	2nd 1953
	58 C/12	2nd 1954
1″ = 1 mile	58 H/3	2nd 1954
	62 B/4	1st 1952
	62 B/12	2nd 1953
	62 C/2	1st 1952
	63 B/2	4th 1954
	63 L/10	2nd (Provl.) 1954
	63 L//14	2nd („) 1954
	63 P/1	2nd („) 1953
	63 P/2	2nd („) 1953
	63 P/6	2nd („) 1953
	63 P/7	3rd 1954
	64 A/7	2nd 1954
	64 A/11	2nd 1953
	64 A/13	2nd 1954
	64 A/15	2nd 1953
	64 D/5	2nd 1954
	64 D/12	2nd 1954
	64 D/13	2nd 1954
	64 D/15	2nd 1954
	64 D/16	2nd 1954
	64 E/1	2nd (Provl.) 1953
	64 E/5	2nd („) 1953
	64 E/9	2nd („) 1953
	64 E/13	2nd („) 1953
	64 J/13	2nd 1953
	64 N/12 & 16	1st (Provl.) 1953
	73 D/7	2nd 1954
	78 B/14	2nd 1954
	78 C/8	1st (Provl.) 1953
1″ = 4 miles	44 K	4th 1952
	44 L	2nd(Provl.) 1952
	45 E	5th 1953
	48 L	3rd 1951
	53 F	5th 1953
	53 P	3rd 1951
	54 C	3rd 1952
	54 J	3rd 1953
	54 O	6th 1953
	55 E	3rd 1951
	63 G	3rd 1951
	63 J	3rd 1951
	64 H	2nd 1951
	73 B	2nd 1951
	73 E	5th 1951
	79 G	2nd 1952
	84 F	2nd 1953
1″ = 192 miles	India and Adjacent Countries (English)	1st 1954
1″ = 192 miles	do. (Hindi)	1st 1954
1″ = 128 miles	do. (do.)	1st 1954
1″ = 70 miles	Political map of India (Hindi)	2nd 1954
1″ = 67·08 miles	Railway Map of India (corrected up to 31st March 1954)	1954

Table I(*b*)—Extra-departmental Maps printed

Class of Maps	Scale	New publications				New Editions and Reprints				Number of copies printed				Value in Rupees			
		Dehra Dūn		Calcutta	Total	Dehra Dūn		Calcutta	Total	Dehra Dūn		Calcutta	Total	Dehra Dūn		Calcutta	Total
		Map Publication Office	Northern Circle	Eastern Circle		Map Publication Office	Northern Circle	Eastern Circle		Map Publication Office	Northern Circle	Eastern Circle		Map Publication Office	Northern Circle	Eastern Circle	
PRINTED FOR THE DEFENCE FORCES																	
Geographical Maps																	
Asia Hind 5000 Series ..	1:1 Million	1	..	..	1	..	..	..	..	4,100	..	..	4,100	3,829	..	..	3,829
Hind 5005 Series ..	,,	1	..	..	1	..	..	..	..	3,000	..	..	3,000	852	..	..	852
Hind 1091 Series ..	1:2 Million	..	..	..	..	2	..	..	2	4,010	..	..	4,010	3,047	..	..	3,047
Special Maps																	
Cantonment maps	64″ = 1 mile	..	10	..	10	..	..	..	..	..	1,740	..	1,740	..	1,573	..	1,573
Do.	16″ = 1 mile	..	8	..	8	10	..	..	10	2,188	1,232	..	3,420	3,251	2,285	..	5,536
Miscellaneous maps and charts ..	Various	..	2	..	2	..	..	..	..	..	260	..	260	..	487	..	487
Total ..		2	20	..	22	12	..	..	12	13,298	3,232	..	16,530	10,979	4,345	..	15,324
PRINTED FOR OTHER DEPARTMENTS OF THE CENTRAL AND STATE GOVERNMENTS																	
Maps for Irrigation, Hydro-electric and other Projects ..	4″ = 1 mile	26	105	84	215	..	10	..	10	6,567	24,810	23,451	54,828	22,550	43,482	55,291	1,21,323
Do. ..	6″ = 1 mile	..	..	17	17	..	..	..	..	..	..	3,860	3,860	..	..	17,677	17,677
Do. ..	8″ = 1 mile	..	..	42	42	..	..	..	..	..	..	6,552	6,552	..	..	6,031	6,031
Forest maps	Various	2	..	30	32	..	..	..	..	314	..	4,500	4,814	2,251	..	10,461	12,712
Miscellaneous Maps, Plans, Charts and diagrams ..	,,	280	15	5,071	5,366	..	21	..	21	4,01,489	2,410	17,34,326	21,38,225	1,03,665	4,193	1,29,599	2,37,457
Total ..		308	120	5,244	5,672	..	31	..	31	4,08,370	27,220	17,72,689	22,08,279	1,28,466	47,675	2,19,059	3,95,200
PRINTED FOR COMMERCIAL FIRMS AND THE PUBLIC																	
Miscellaneous Maps, Plans, Charts and diagrams ..	Various	3	8	212	223	..	..	..	..	4,262	16,000	86,352	1,06,614	662	300	19,231	20,193
Total ..		3	8	212	223	..	..	..	..	4,262	16,000	86,352	1,06,614	662	300	19,231	20,193
Grand Total ..		313	148	5,456	5,917	12	31	..	43	4,25,930	46,452	18,59,041	23,31,423	1,40,107	52,320	2,38,290	4,30,717

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

	Number of items printed				Number of colours printed			Number of copies printed				Value in Rupees			
	Dehra Dūn		Calcutta		Dehra Dūn		Calcutta	Dehra Dūn		Calcutta		Dehra Dūn		Calcutta	
	Map Publication Office	Northern Circle	Eastern Circle	Total	Map Publication Office	Northern Circle	Eastern Circle	Map Publication Office	Northern Circle	Eastern Circle	Total	Map Publication Office	Northern Circle	Eastern Circle	Total
DEPARTMENTAL WORK															
Posters	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Booklets	20	1	..	21	5	3	..	9,493	110	..	9,603	14,289	5,030	..	19,319
Miscellaneous	19	15	14	48	4	4	4	69,581	13,085	3,676	86,342	6,869	2,013	2,931	11,813
Total ..	39	16	14	69	..	..	..	79,074	13,195	3,676	95,945	21,158	7,043	2,931	31,132
EXTRA-DEPARTMENTAL WORK FOR OTHER CENTRAL AND STATE GOVERNMENT DEPARTMENTS															
Posters	1	..	..	1	4	..	..	1,509	..	..	1,509	458	..	..	458
Booklets	..	1	..	1	..	1	..	..	2,000	..	2,000	..	35,331	..	35,331
Miscellaneous	40	10	5,053	5,103	5	2	3	1,83,277	580	13,73,862	15,57,719	8,300	1,055	86,087	95,442
Total ..	41	11	5,053	5,105	..	..	..	1,84,786	2,580	13,73,862	15,61,228	8,758	36,386	86,087	1,31,231
EXTRA-DEPARTMENTAL WORK FOR COMMERCIAL FIRMS AND THE PUBLIC															
Posters	1	..	..	1	3	..	..	4,000	..	..	4,000	435	..	..	435
Booklets	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Miscellaneous	3	4	187	194	3	1	1	4,262	6,134	59,552	69,948	662	519	11,280	12,461
Total ..	4	4	187	195	..	..	..	8,262	6,134	59,552	73,948	1,097	519	11,280	12,896
Grand Total ..	84	31	5,254	5,369	..	..	..	2,72,122	21,909	14,37,090	17,31,121	31,013	43,948	1,00,298	1,75,259

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

	India			India and Adjacent Territories			
					1 : M		1 : 2M
	1″ = 1 mile	1″ = 2 miles	1″ = 4 miles	Carte Internationale du Monde	World Aeronautical Charts (I.C.A.O.)	State maps	Southern Asia Series
Maps Published							
Primary ..	2917‡	15*	8	..	..	..	..
Compiled ..	..	..	241†	29	..	15	21
Remaining							
Primary ..	1722	125	..	..	..	..	..
Compiled ..	..	..	140	..	23	1	..
Total (Approx.)	4639	140	389	29	23	16	21

Note :—In the Carte Internationale du Monde Series are also included those sheets of the modified international style on 1 : M scale which have been published for the Defence Services and Aviation but which have not as yet been issued on regular international style.

* 233 half-inch sheets in addition are also current which previously formed the departmental responsibility. They will remain such until replaced by one-inch sheets in due course.

† In addition, 103 quarter-inch sheets have been published in modern style, but wholly or partly based on old surveys.

‡ In addition, 63 sheets have been published in modern style but wholly or partly based on old surveys.

Table III—Letterpress Publications

(*a*) Published at Dehra Dūn

1. Supplement to General Report 1947–50.
2. Secondary Levelling Pamphlets (3 Pamphlets).
3. Technical Papers Nos. 5 and 8.
4. Tide-Tables for the Port of Bombay, 1955 including 3 Reprints.
5. Tide-Tables for the Port of Rangoon, 1955 including Reprint.
6. Tide-Tables for the Port of Kandla, 1955.
7. Tide-Tables, Indian Ocean, 1955.
8. Tide-Tables for the Hooghly River, 1955.

Table III—(*contd.*)

9. Handbook of Topography, Chapter VI.
10. Levelling of Precision in India, Sheet No. 53.
11. General Report 1951.
12. Grid Data Tringulation Pamphlets (2 Pamphlets).
13. Auxiliary Tables Parts I and II.
14. Historical Records of the Survey of India, Volume III.
15. Journal of the Institution of Surveyors (India).
16. Diagrams and Descriptions of Bench-Marks.
17. Indian Forester (12 Journals).
18. Indian Forest Records (2 Records).
19. Indian Forest Bulletins (10 Bulletins).
20. Indian Forest Leaflet No. 138.
21. Index of Indian Forester Volumes 78 and 79 for 1952 and 1953 respectively.
22. Brochure of the Forest Research Institute and Colleges.
23. IV World Forestry Congress Pamphlet.

(*b*) In Hand at Dehra Dūn

1. Annotated Index and Glossary of Survey of India, War Records 1939–46.
2. Historical Records of the Survey of India Volume IV.
3. Secondary Levelling Pamphlets (6 Pamphlets).
4. Technical Reports Parts I and II, 1952.
5. Supplement to General Report, 1951.
6. General Report 1952.
7. Handbook of Topography, Chapter X.
8. Accounts Pamphlet, Chapter III.
9. Instructions to Plane-tablers.
10. Auxiliary Tables, Part V.
11. Tide-Tables, Indian Ocean 1956.
12. Tide-Tables, Rangoon River, 1956.
13. Tide-Tables, for the Port of Bombay, 1956.
14. Addendum to Secondary Levelling Pamphlet 75.
15. Technical Papers Nos. 9 and 10 (2 Papers).
16. Journal of the Institution of Surveyors (India).
17. Instructions for use with the Surveying Officer's Medicine Chest.
18. List of Officers in Survey of India, 1955.
19. Indian Forester, May 1955.
20. Lecture notes on Wood Technology.
21. Indian Forest Bulletins (3 Bulletins).
22. Indian Forest Records (6 Records).
23. Monograph of Indian Trees (5 monographs).
24. 8th Silviculture Conference 1951 (Parts I and II).

(*c*) Published at Calcutta

1. Agmark Labels.
2. Photo for General Report – 1951 – Brig. Heaney.
3. Photos for General Report 1952 :—
   (*a*) Bhadra Dam Site.
   (*b*) Mr. Cowen of Burmah Shell & Co., watches plane-tablers.
4. Photo for General Report 1954 – Photo of Wild A-7 Machine.
5. Identity Cards for East-West Bengal Boundary Survey personnel.
6. Illustrations to technical paper No. 8 – Photo of Mount Everest.
7. Work for Govt. Epigraphist in India. – Photo of Rao Bahadur K. N. Dikshit.
8. Miscellaneous Work for departmental use – Letterheads, Index Cards, etc.

(*d*) In Hand at Calcutta

1. Certificate of Thermometer, Form NIF-83 – for National Instrument Factory.
2. Agmark Labels.
3. Miscellaneous – Departmental Forms, Letterheads, etc.

Out-turn of Letterpress Sections

Sections	Items or pages published	Copies Printed	Impressions Pulled
Dehra Dūn ..	1,369	13,81,276	15,50,782
Calcutta ..	200	13,09,992	6,99,775
TOTAL ..	1,569	26,91,268	22,50,557

196. **Map Issues.**—The issues of both departmental and extra-departmental maps during the period under report by the various Survey of India Offices are shown in Table IV below. Table V, which follows, gives the stocks of maps held on the 31st March, 1955 of both departmental and extra-departmental series that are normally stocked for sale.

Table IV—Maps issued by Survey of India Offices

	Central and State Government Departments		Defence Forces		Public		Total		Free Issues	
	Number of copies	Sale value Rupees	Number of copies	Sale value Rupees	Number of copies	Sale value Rupees	Number of copies	Sale value Rupees	Number of copies	Sale value Rupees
DEPARTMENTAL										
Dehra Dūn	44,581	52,332	3,77,447	2,83,073	20,588	29,802	4,42,616	3,65,207	7,986	8,331
Calcutta	*15,064	*16,207	34,100	25,575	*9,206	*10,792	58,370	52,574	5,243	8,191
Shillong	..	..	..	..	..	..	..	..	..	..
Bangalore	4,630	4,895	..	..	3,060	3,384	7,690	8,279	4,059	3,666
Delhi	11,971	15,052	..	..	2,351	4,654	14,322	19,706	14,937	23,006
Total (Departmental) ..	76,246	88,486	4,11,547	3,08,648	35,205	48,632	5,22,998	4,45,766	32,225	43,194
EXTRA-DEPARTMENTAL										
Dehra Dūn	4,67,620	1,85,937	11,050	7,728	10,131	33,813	4,88,801	2,27,478	50	110
Calcutta	16,28,311	2,04,181	8,317	6,239	32,339	30,960	16,68,967	2,41,380	8,012	12,518
Shillong	..	..	..	..	..	..	..	..	..	..
Bangalore	..	..	..	..	2	4	2	4	..	..
Delhi	..	..	..	..	15	22	15	22	16	39
Total (Extra-departmental)	20,95,931	3,90,118	19,367	13,967	42,487	64,799	21,57,785	4,68,884	8,078	12,667
Grand Total ..	21,72,177	4,78,604	4,30,914	3,22,615	77,692	1,13,431	26,80,783	9,14,650	40,303	55,861

* This includes Shillong Office figures.

Table V—Stock of Maps

(This table gives the stock as on 31st March 1955 of Departmental maps and of those Extra-departmental maps of which stocks are held for sale)

	CALCUTTA		DEHRA DŪN		BANGALORE		DELHI		TOTAL	
	Eastern Circle Office		Map Record and Issue Office		Southern Circle Office		Map Sales Office			
	Number of copies in stock	Present face value Rs.	Number of copies in stock	Present face value Rs.	Number of copies in stock	Present face value Rs.	Number of copies in stock	Present face value Rs.	Number of copies in stock	Present face value Rs.
DEPARTMENTAL MAPS										
1 : 2 M Southern Asia Series	4,517	9,034	2,532	5,064	35	70	243	486	7,327	14,654
1 : M Carte Internationale du Monde ..	7,848	23,544	12,630	25,260	220	330	3,007	7,021	23,705	56,155
1 : M World Aeronautical Charts (I.C.A.O.)	..	..	..	..	..	..	..	..	..	..
1 : M India and Adjacent Countries Series *	7,496	11,244	..	..	..	..	..	..	7,496	11,244
Quarter-inch topographical maps ..	58,293	62,440	3,76,521	4,52,822	6,300	6,500	4,844	5,250	4,45,958	5,27,012
Half-inch topographical maps (Primary and compiled)	1,20,992	1,31,448	2,09,065	235,192	8,475	8,775	14,025	14,119	3,52,557	3,89,534
One-inch topographical maps	6,68,825	7,53,238	17,24,712	17,54,935	47,849	48,249	57,156	58,159	24,98,542	26,14,581
General maps of India	3,036	3,782	43,286	77,184	1,734	1,934	7,326	11,004	55,382	93,904
Maps of States	1,943	5,303	1,362	3,581	234	434	991	2,400	4,530	11,718
City and Town Guide maps	9,803	21,044	26,120	59,656	194	294	870	1,709	36,987	82,703
Miscellaneous maps, charts and diagrams ..	9,989	18,818	28,807	29,246	140	140	118	179	39,054	48,383
EXTRA-DEPARTMENTAL MAPS STOCKED FOR SALE										
1 : 2 M Extension of Southern Asia Series— (HIND 1080 Series)	3,875	7,750	3,450	6,714	175	350	310	620	7,810	15,434
1 : M Modified Carte Internationale du Monde (Army/Air style) HIND 5000 series ..	16,573	49,719	15,856	39,640	667	2,001	117	300	33,213	91,660
Cantonment plans	1,209	2,418	55,662	1,11,324	46	92	19	16	56,936	1,13,850
Forest maps	..	..	1,69,275	4,11,040	..	..	..	..	1,69,275	4,11,040
Manoeuvre and Radius maps	2,013	4,567	20,255	37,284	216	250	48	77	22,532	42,178
Miscellaneous maps, charts and diagrams ..	..	..	..	..	..	..	494	213	494	213
Total ..	9,16,412	11,04,349	26,89,533	32,48,942	66,285	69,419	89,568	1,01,553	37,61,798	45,24,263

* This series has been abandoned.

X. WORK OF DRAWING OFFICES

197. **No. 1 Drawing Office, Dehra Dūn.**—This Drawing Office was employed on new and revised compilations and mapping of the undermentioned categories of maps.—

(*a*) World Aeronautical Charts and Landing and Approach Charts (I.C.A.O.) of India, as these form part of the international commitment of the department.

(*b*) Geographical and general maps of India, English and Hindi Editions.

(*c*) Forest maps as required by the Forest Departments of various States.

(*d*) Paid-for extra-departmental jobs sponsored by the Central and State Governments and Commercial firms.

The main activities of this office were organized as follows :—

(*a*) *Aeronautical Chart Section.*—A section of average strength of 7 Draftsmen was employed on preparation of World Aeronautical Charts (I.C.A.O.) covering India on scale 1 : 1,000,000. Out of the 23 charts allotted to India, compilation and drawing of two charts remained uncompleted for various reasons.

Preparation of Instrument Approach and Landing Charts of 31 aerodromes of India was in hand. No progress was made in the mapping of three Obstruction Charts which remained under reference with the Director-General of Civil Aviation.

(*b*) *Geographical Section.*—Two sections consisting of about 15 Draftsmen, completed the mapping of Hindi and English Editions of the 70-mile Political and 192-mile Maps of India, and reissue of 67-mile Railway and 40-mile Road Maps of India. Fair mapping of 128-mile Map of India and 70-mile Physical Map of India in Hindi was also completed. Fair mapping of 1 : 1 M C.I.M. Series maps, 40-mile Wall Map of India and 70-mile Tourist Map of India continued.

Fair mapping of 1 : 2 M Southern Asia Series maps was started during the year under report.

(*c*) *Miscellaneous Section.*—Two sections consisting of 22 Draftsmen produced three 40-mile Regional Tourist Maps, 150-mile Map of India surprinted over Europe, 32-mile Hydrological Map of Rājasthān, 16-mile Post and Telegraph Map of Rājasthān, and 4-mile map showing area irrigated by Hīrākud Reservoir. In addition the section was engaged on completing (*i*) scrutiny of fair originals of maps prepared by different departments of State and Central Governments, for direct printing ; (*ii*) preparation of

correction prints for reprint of one-inch sheets of Southern Circle area, and (*iii*) proof examination of the School Atlas, 32-mile Map of India showing Power Stations and Transmission Lines and 32-mile Irrigation Map of India.

Work was started on reissue of the departmental Map Catalogue and its Supplement.

(*d*) *Forest Map Section.*—About 8 Draftsmen were employed on maintenance of office copies in respect of forest maps and preparation of new editions of forest maps for the contributing States. Paid-for work was also undertaken for some of the non-contributing States.

(*e*) *Shading Section.*—3 Draftsmen were employed on preparation of shade originals for geographical and topographical maps. They also carried out scrutiny and correction of a few shade originals submitted by the Regional Directors for publication.

(*f*) *Examination and Reference Section.*—This section of about 7 Draftsmen carried out the final examination of all departmental maps submitted by the drawing sections for publication. This section also carried out the preparation of boundary reports on the external boundary of India in respect of all departmental and extra-departmental maps. Besides, it maintained up-to-date portfolios of maps, boundary sets and departmental charts and tables used for reference purposes by the department.

(*g*) *Maintenance Section.*—This section of about 6 Draftsmen was employed on collection of map information and corrections from various Government Agencies through "Traveller" sets on $\frac{1}{4}$-inch scale maps covering the whole of India and posting them on the office copies of the maps concerned.

198. **No. 2 Drawing Office, Dehra Dūn.**—The main work of this Drawing Office was organized as follows :—

(*a*) *Drawing Sections.*—Compilation of new maps, reissue of current maps and necessary drawing work for reprints of 116 topographical maps, on 1-inch, $\frac{1}{2}$-inch and $\frac{1}{4}$-inch scales were completed. In addition, work on 1 : 1 M State Map of Rājasthān, Hindi Edition, was finalized.

(*b*) *Maintenance Section.*—The section's main function was the maintenance of office copies of maps covering the area of the Northern Circle and correspondence with the State Governments for obtaining information regarding changes in administrative boundaries owing to political integration and merger of States.

199. **No. 4 Drawing Office, Bangalore.**—The Drawing Office was engaged on compilation of new maps, reissues of new editions of current maps and accessory drawing work for the reprints of topographical maps on 1-inch, $\frac{1}{2}$-inch and $\frac{1}{4}$-inch scales pertaining to the area of Southern Circle.

It also organized map sales and maintained all technical records for the Circle as heretofore.

WORK OF DRAWING OFFICES

Table VI—New Maps

(*a*) denotes work completed and (*b*) denotes work in hand

DEPARTMENTAL

	Topographical Maps: 1:25,000 (a)	1:25,000 (b)	1-inch (a)	1-inch (b)	½-inch (a)	½-inch (b)	¼-inch (a)	¼-inch (b)	Geographical Maps 1:M Carte Internationale: Helio (a)	Helio (b)	Engraved (a)	Engraved (b)	World Aeronautical Charts (I.C.A.O.) (a)	World Aeronautical Charts (b)	General and Special Maps: City and Town, etc., Guide Maps (a)	City (b)	District (a)	District (b)	State (a)	State (b)	India and Adjacent Countries (a)	India (b)	Accessory: Hill Shading Sheets (a)	Hill Shading (b)	Miscellaneous: Indexes (a)	Indexes (b)	Charts (a)	Charts (b)	Various (a)	Various (b)	Total man-days' work in year under report
MAP PUBLICATION OFFICE																															
No. 1 Drawing Office	..	..	..	..	..	..	..	..	..	..	..	..	1	2	..	..	..	..	..	..	5	4	26	4	2	1	..	1	3	..	3,209
NORTHERN CIRCLE																															
No. 2 Drawing Office	..	..	1	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	1	5	..	..	..	..	..	..	..	..	..	..	2,889
Field Parties	..	..	4	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2,017
EASTERN CIRCLE																															
No. 5 Drawing Office	..	..	..	9	..	..	..	2	..	..	..	..	..	..	..	..	..	..	3	3	..	..	5	4	..	..	..	..	8	..	1,220
Engraving Office	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	32	6	1,792
Field Parties	..	12	13	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	7,675
SOUTHERN CIRCLE																															
No. 4 Drawing Office	..	..	..	3	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	456
Field Parties	..	3	7	35	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3,099
Total	..	15	25	57	..	..	..	6	..	..	..	..	1	2	..	..	..	..	4	9	5	4	31	8	2	1	..	1	43	6	22,357

EXTRA-DEPARTMENTAL (FOR THE DEFENCE FORCES)

	Topographical maps (a)	Topographical (b)	Geographical maps (a)	Geographical (b)	General maps (a)	General (b)	Cantonment maps (a)	Cantonment (b)	Miscellaneous maps (a)	Miscellaneous (b)	Plans and diagrams (a)	Plans (b)	Grid Originals (a)	Grid Originals (b)	Total man-days' work in year under report
MAP PUBLICATION OFFICE															
No. 1 Drawing Office	..	..	11	2	..	..	..	..	..	..	..	..	4	..	104
NORTHERN CIRCLE															
No. 2 Drawing Office	..	..	..	..	..	..	..	..	..	..	..	..	45	6	260
Field Parties	..	..	..	..	..	..	13	..	..	..	..	..	..	..	590
EASTERN CIRCLE															
No. 5 Drawing Office	..	..	23	12	..	..	9	..	..	52	1	..	24	1	3,899
Engraving Office	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Field Parties	..	..	..	..	..	..	5	..	..	..	..	..	..	..	82
SOUTHERN CIRCLE															
No. 4 Drawing Office	..	..	..	..	..	..	..	..	..	..	..	..	30	8	327
Field Parties	..	..	..	..	..	..	10	..	..	..	..	..	..	..	900
Total	..	..	34	14	..	..	37	..	..	52	1	..	103	15	6,162

EXTRA-DEPARTMENTAL (FOR OTHER DEPARTMENTS OF THE CENTRAL AND STATE GOVERNMENTS)

	Maps of surveys for irrigation and other engineering projects (a)	Maps of surveys (b)	Large scale town maps (a)	Large scale (b)	Forest maps (a)	Forest (b)	Miscellaneous maps, plans and diagrams, etc. (a)	Miscellaneous (b)	Engraved commission forms and certificates, etc. (a)	Engraved (b)	Total man-days' work in year under report
MAP PUBLICATION OFFICE											
No. 1 Drawing Office	..	..	..	..	29	26	19	64	..	..	2,855
NORTHERN CIRCLE											
No. 2 Drawing Office	..	..	..	..	..	..	..	..	..	..	..
Field Parties	117	..	..	..	..	..	..	..	..	..	7,190
EASTERN CIRCLE											
No. 5 Drawing Office	89	41	..	..	..	..	17	3	..	..	2,608
Engraving Office	..	..	..	..	..	..	..	..	..	..	..
Field Parties	54	13	..	..	..	..	..	20	..	..	4,404
SOUTHERN CIRCLE											
No. 4 Drawing Office	..	..	..	..	..	..	..	..	..	..	..
Field Parties	..	14	..	..	2	12	..	..	..	..	2,278
Total	260	68	..	..	31	38	36	87	..	..	19,335

EXTRA-DEPARTMENTAL (FOR COMMERCIAL FIRMS AND THE PUBLIC)

	Miscellaneous maps, plans, charts and diagrams (a)	Miscellaneous (b)	Total man-days' work in year under report
MAP PUBLICATION OFFICE			
No. 1 Drawing Office	3	..	10
NORTHERN CIRCLE			
No. 2 Drawing Office	..	..	..
Field Parties	..	..	..
EASTERN CIRCLE			
No. 5 Drawing Office	2	..	46
Engraving Office	12	..	148
Field Parties	..	..	..
SOUTHERN CIRCLE			
No. 4 Drawing Office	..	..	..
Field Parties	..	..	..
Total	17	..	204

WORK OF DRAWING OFFICES

Table VII—Re-issues of departmental maps and of extra-departmental maps of which stocks are held for sale

(*a*) denotes work completed and (*b*) denotes work in hand

	TOPOGRAPHICAL														GEOGRAPHICAL						1 : 2 M Southern Asia Series and Hind 1080				GENERAL AND SPECIAL														OFFICE COPIES		Total man-days
	Modern style including preliminary editions								Old style including provisional issues						1 : M																								Under maintenance by end of year under report	Newly started during year under report	
	1:25,000		1-inch		½-inch		¼-inch		1-inch		½-inch		¼-inch		Carte Internationale Helio		Carte Internationale En-graved		World Aeronautical Charts (I.C.A.O.)		Helio		En-graved		City and Town, etc., Guide maps		District		State		India and Adjacent Countries on scales smaller than 1 : 2 M		Forest maps		Cantonment maps 16-inch		Cantonment maps 64-inch		Miscel-laneous				
	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)			
MAP PUBLICATION OFFICE																																									
No. 1 Drawing Office—																																									
New editions	..	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	12	..	..	..	..	..	..	..	..	..	..	..	..	1	6	18	3	..	..	..	..	..	..	473	..	7,637
Reprints	..	..	21	29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	22	..	..	..	..	..	..	..	..	..	772
NORTHERN CIRCLE																																									
No. 2 Drawing Office—																																									
New editions	..	..	17	7	1	4	2	2	2	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1875	126	5,233
Reprints	..	..	87	38	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,264
EASTERN CIRCLE																																									
No. 5 Drawing Office— (including Engraving Office)—																																									
New editions	..	..	21	6	..	2	1	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	11	14	..	1	..	..	..	..	..	2	..	..	..	..	..	..	1,013	21	4,961
Reprints	..	..	25	34	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	103	29	..	..	1,624
SOUTHERN CIRCLE																																									
No. 4 Drawing Office—																																									
New editions	..	..	3	5	..	..	5	18	1	..	..	..	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1,060	76	3,985
Reprints	..	..	49	16	..	3	..	2	..	19	..	2	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,080
TOTAL	..	..	223	135	1	9	8	33	8	21	..	2	1	3	..	..	..	12	..	..	..	..	11	14	1	2	..	..	..	..	1	6	42	3	..	..	..	..	104	29	4,421	223	26,556

200. **No. 5 Drawing Office, Calcutta**—Besides the normal work of reissue, reprint and revised editions of departmental $\frac{1}{4}$-inch, $\frac{1}{2}$-inch, 1-inch maps and map maintenance work, this office completed a large number of extra-departmental jobs for other government departments and private indentors. Air survey compilation and fair drawing on 2-inch scale of seventeen sheets covering Gandak Barrage Scheme area were completed for publication on 4-inch scale.

A fairly large number of items of stationery such as, water colour cakes, water-proof inks, pencils and tracing linen were tested for the Central Stationery Office, Calcutta. Correct spellings (in English and Hindi) of names were supplied to different Railways and the Post and Telegraph Department.

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

Table VII shows the present state of progress on work involving new editions and reprints of departmental and extra-departmental maps.

XI. WORK OF PRINTING OFFICES

202. **Photo-Litho Office, Hāthībarkala, Dehra Dūn.**—Besides normal departmental maps, a large number of extra-departmental jobs were printed during the period under report. Different kinds of lithographic printing were carried out for Central and State Governments. Some of the important jobs printed are listed below :—

(*i*) Maps, drawings, plans, were printed for irrigation schemes, road and canal construction and technical development schemes.

(*ii*) Posters and brochures were printed for Central Water and Power Commission and Defence Department.

(*iii*) Diagrams and charts for the annual reports of various Government departments.

(*iv*) A number of working plans and forest maps were printed for the various forest departments.

203. **Photo-Zinco Office, Dehra Dūn.**—In addition to the printing of departmental maps, charts and other publications, a fairly large number of extra-departmental maps, charts, diagrams were printed for other Central and State Government departments. A dictionary, " Mahan Kosh ", in Gurmukhi was also printed for the Director, Punjabi Department, P.E.P.S.U.

A total of 18 Indian Other Ranks (Corps of Engineers) were given training in different trades of map reproduction.

204. **Photo-Litho Office, Calcutta.**—Besides printing the standard departmental maps, a large number of extra-departmental and commercial jobs were printed off during the period under report. Various kinds of lithographic printing, listed below, were executed for other Government departments.

(*i*) A large number of drawings and sketches for the Engineer-in-Chief, Calcutta Urban Electrification Project, Eastern Railway.

(*ii*) All-India Railways and Central Railway Map for Central Railway Time-Table.

(*iii*) All-India Railways and Eastern Railway Map for Eastern Railway Time-Table.

(*iv*) A large number of Part Drawings of Railways, for Central Standard Offices, Kanchrapara, Ministry of Railways.

(*v*) Section Paper, etc., for Controller of Printing and Stationery, Calcutta.

(*vi*) Agmark Labels for Agricultural Marketing Adviser to the Government of India.

(*vii*) A large number of drawing specifications for Controller of Patents and Designs, Calcutta.

(*viii*) Englargement of topo maps for Government of Travancore and Cochin.

(*ix*) Forest maps of Ranchi District for Chief Conservator of Forests, Government of Bihār.

205. **Engraving Office, Calcutta.**—This office continued to be mainly employed in bringing uptodate the engraved plates of the 1 : M Carte Internationale Du Monde Series.

A fairly large number of standing plates of the above series were strengthened by Electro-deposition process, in order to keep the plates suitable for receiving further corrections.

In addition to the above, miscellaneous departmental jobs, symbol tables, scales, etc., extra-departmental jobs like charts, graphs, invitation cards, dies, etc., as well as repair work of the old standing engraved plates and training of the junior Engravers in skilled artistic work, were also undertaken.

206. **Equipment.**—There has been no addition to the equipment held in the various reproduction offices during the year under report.

207. **Printing Statistics.**—Statistics relating to the various map printing offices of the department will be found in Section IX of this part of the Report (page 106 *et seq*) and in Table VIII below. Tables IX and X which follow, give information regarding the out-turn of the Process Engraving and Copper Plate Printing Sections respectively.

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

Name of office	Maps printed (departmental and extra-departmental)	Work other than maps (number of items)	Number of negatives prepared	Number of zinc plates prepared	Number of impressions pulled	Value of out-turn at office rates	Total expenditure of the printing offices during year under report
1. *Dehra Dūn*						Rupees	Rupees
(*a*) Map Publication Office	303	207	4,122	5,390	52,02,623	6,57,703	4,66,251
(*b*) Northern Circle	182	59	1,528	1,980	9,31,788	2,16,801	2,38,138
2. *Calcutta*							
Eastern Circle	224	5,254	4,117	4,721	23,56,209	4,42,913	4,22,408
Total ..	709	5,520	9,767	12,091	84,90,620	13,17,417	11,26,797

Table IX—Out-turn of Process Engraving

Name of the Printing Office	Process Engraving Section			
	Half-tone work		Line work	
	Blocks prepared	Impressions pulled	Blocks prepared	Impressions pulled
Dehra Dūn				
Map Publication Office ..	Nil	Nil	Nil	Nil
Calcutta				
Eastern Circle ..	38	2,038	Nil	Nil

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

Impressions pulled			
Chromo paper	Transfer	Miscellaneous	Total
6,874	Nil	2,242	9,116

PART III—GEODETIC WORK

XII. ABSTRACT OF GEODETIC OPERATIONS

208. **General.**—Purely geodetic operations include miscellaneous computations and research, preparation and publication of records, observatory work (astronomical, magnetic, seismological and meteorological observations), measurement of geodetic bases, principal triangulation, geodetic levelling, determination of precise latitudes, longitudes, azimuths, gravity observations and prediction of tides at 38 ports between Suez and Singapore. A complete account of all geodetic work is published regularly in Part III of the Technical Report, now redesignated as Geodetic Report.

The following is a brief *résumé* of the geodetic operations carried out from 1st April 1954 to 31st March 1955, further details of which will be published in the Geodetic Report 1955.

209. **Triangulation.**—The geodetic triangulation carried out to provide control points at Bhākra Dam site in Punjab was completed. 13 stations and 7 intersected points were fixed by triangulation and observations for deviation of the vertical at 2 stations and for azimuth at 1 station were also taken.

A programme of geodetic triangulation was undertaken in South India (Travancore-Cochin) to link the Malabār Coast Series to the Great Arc Meridional Series. Only one-third of the programme could be completed during the period under report.

210. **Levelling.**—1188 linear miles of levelling of secondary precision and 62 linear miles of double tertiary levelling was carried out in Bihār, West Bengal, Assam and Nepāl for providing height control in connection with the flood control surveys. 203 linear miles of secondary levelling was run along the seacoast in Kutch, Saurāshtra and Bombay to connect the tidal stations to the Indian Mean Sea-level Net.

211. **Gravity.**—Observations were taken at 469 stations with the Worden Gravimeter in Nepāl, East Punjab, Madhya Bhārat, Madhya Pradesh, Bombay, Hyderabād and Uttar Pradesh.

212. **Deviation of the Vertical.**—Observations for determination of both the components of the deviation of the vertical were taken at 24 stations. Laplace observations were taken at one station only in Bhākra Dam Site area.

213. **Magnetic.**—The magnetic observatory at Dehra Dūn has not been re-commissioned yet. Observations for horizontal and vertical force and declinations were taken at 46 new stations in Bihār, West Bengal and Orissa.

214. **Computations and Publications.**—Computation of geodetic and topographical triangulation, height of Mt. Everest and other Himālayan Peaks, reduction of gravity and astronomical observations, geoidal rise computations, adjustment of Nepāl triangulation of (1946–53) and other topographical triangulations in sheets 41 A, E and 47 A and E were carried out.

Besides the above a number of Secondary Levelling Pamphlets, Technical Papers, Tide-tables, Historical Record Volume III, General Report for 1951, Supplement to General Report (1947–50), Auxiliary Tables Parts I, II and V and Chapter VI of Handbook of Topography were also printed.

215. **Tidal Work.**—Tidal predictions for a number of ports in the Indian Ocean have been carried out as usual at Dehra Dūn and Tide-tables published. A touring tidal detachment carried out 31-day tidal observations at 5 secondary ports for obtaining the necessary latest tidal data. Harmonic analyses and investigations and automatic registration of tides at 11 ports were also carried out.

216. **Observatory Work.**—Seismological and meteorological observations, calibration, testing and repair of survey instruments and maintenance of clocks have been carried out as usual.

217. An abstract of Geodetic and geophysical surveys carried out in each State of the Indian Republic and in the adjoining territory of Nepal is alphabetically arranged and given below.

Assam.

Levelling.—Secondary levelling in connection with flood control survey work (p. 129).

Bihār.

Geophysical work.—Magnetic observations at 29 stations (p. 122).

Levelling.—Secondary levelling in connection with flood control survey work (p. 129).

Bombay.

Geophysical work.—Tidal observations at the secondary ports (p. 127). Gravity observations (p. 122).

Levelling.—Secondary levelling for connecting tidal reference benchmarks to Indian Mean Sea-Level Net (p. 127).

Hyderābād.

Geophysical work.—Gravity observations (p. 122).

Kutch.

Levelling.—Secondary levelling for connecting tidal reference benchmarks to Indian Mean Sea-Level Net (p. 127).

Madhya Bhārat.

Geophysical work.—Gravity observations (p. 122).

Madhya Pradesh.

Geophysical work.—Gravity observations (p. 122).

Madras.

Geodetic triangulation.—Primary triangulation (p. 129).

Geophysical work.—Tidal observations at the secondary ports (p. 127)

Nepāl.

Geophysical work.—Determination of both the components of the deviation of the vertical at 8 stations. Gravity observations at 46 stations (p. 122).

Levelling.—Double tertiary levelling in connection with flood control survey work (p. 129).

Orissa.

Geophysical work.—Magnetic observations at 7 stations (p. 122).

Punjab.

Geodetic triangulation.—Observations at 13 stations in connection with Bhākra Dam Project work (p. 127).

Geophysical work.—Determination of both the components of the deviation of the vertical at 8 stations in Punjab and 2 stations in the Bhākra Dam area. Laplace observations at 1 station. Gravity observations at 178 stations (p. 122).

Saurāshtra.

Levelling.—Secondary levelling for connecting tidal reference bench-marks to Indian Mean Sea-Level Net (p. 127).

Travancore-Cochin.

Geodetic triangulation (p. 129).

Uttar Pradesh.

Geophysical work.—Determination of both the components of the deviation of the vertical at 2 stations. Gravity observations (p. 122).

West Bengal.

Geophysical work.—Determination of both the components of the deviation of the vertical at 4 stations in West Bengal area (p. 122). Magnetic observations at 10 stations (p. 122).

Levelling.—Secondary levelling in connection with flood control survey work (p. 129).

XIII. SURVEY REPORTS, GEODETIC AND RESEARCH BRANCH

DIRECTOR:—Shri B. L. Gulatee, M.A. (Cantab.), F.R.I.C.S., M.I.S. (Ind.).

DEPUTY DIRECTOR:—Shri E. R. Wilson, B.A., M.I.S. (Ind.), to 30-4-54 (thereafter the post was abolished).

PRESIDENT, GEODETIC AND RESEARCH BRANCH—Shri B. L. Gulatee, M.A. (Cantab.), F.R.I.C.S., M.I.S. (Ind.).

218. Summary.—The Geodetic and Research Branch consists of the Geodetic and Geophysical units, the Statistical Branch and the Instrument Repair Shop.

219. Duties carried out.—(*i*) *Geodetic and Geophysical units.*—These units deal with the geodetic and geophysical activities of the department and research in these fields. These comprise levelling of high precision, secondary levelling, gravimetric and magnetic surveys, tidal observations at ports, geodetic triangulation, high precision traverses and the observation of astronomical latitudes, longitudes and azimuths to a high degree of precision. The reduction and evaluation of the results of field observations are carried out during recess.

This branch is also responsible for the work of the Tidal Party which prepares and publishes annual Tide-Tables of the Indian Ocean containing prediction of times and heights of high and low waters at 38 ports between Suez and Singapore.

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

(*ii*) *Statistical Branch.*—The maintenance of the geodetic records of the department and the issue of all types of data and miscellaneous information is the responsibility of the Statistical Branch. The Geodetic Branch Library and the Letterpress Printing Section are also attached to this branch.

(*iii*) *Instrument Repair Shop.*—At present only the nucleus of an Instrument Repair Shop exists under the Observatory Section, in which the testing and repair of various kinds of survey instruments are being carried out.

The units forming the Geodetic and Research Branch consist of Headquarters Sections, Computing Party, Tidal Party and No. 14 Party. The Headquarters Sections were directly administered by the Director Geodetic and Research Branch.

A detailed narrative of the work carried out during the period under report is given in the following pages.

HEADQUARTERS SECTIONS

220. **Observatory Section.**—This section carried out the usual seismological and meteorological observations, the comparison and maintenance of standards of length, the care and maintenance of delicate scientific and geodetic instruments, observatory clocks and other equipment, the issue of instrumental stores and equipment to the various field detachments of the circle.

The new seismological observatory in the compound of Geodetic and Research Branch, fitted with the modified pattern of ' Milne-Shaw and Wood Anderson Seismographs', is in operation and is functioning satisfactorily.

Preliminary work regarding construction of the new magnetic observatory is in progress. The variometer (La-Cour type manufactured by Anderson and Sorensen) for observing declination, horizontal and vertical forces, complete with photographic accessories has been received for the new observatory.

The Geodetic Wild T4 theodolite was tested and its accessories were adjusted for automatic recording of wireless time singnals. Practice observations were taken on a number of clear nights.

221. **Instrument Repair Shop.**—During the period under report 254 instruments of various kinds were tested and calibrated. The main calibration has been of Hunter Short Base 20-meter steel tapes calibrated in catenary against bays 1–6 of the 24-meter comparator. The other items calibrated were invar staves, 10-foot tapes, steel bands, crinoline chains, barometers (Aneroid and Paulin) Besides these a number of other instruments such as theodolites, chronometers, compasses, levels and clocks were tested and adjusted.

Repairs to 525 surveying instruments were carried out. These include glass-arc, micrometer and vernier theodolites, high precision, secondary and tertiary levels, calculating machines, prismatic and ordinary compasses, tide-gauges, wall-clocks, time pieces and pocket watches, chronometers, barometers, binoculars and sextants.

Besides these the new 42-component tide-predicting machine, the seismograph, Wild A7 autograph and multiplex were attended to and kept in working order.

222. **Gravity Detachment.**—The programme of gravity observations was carried out by Sarva Shri A. N. Ramanathan and

C. M. Sapru with Worden Gravimeter. Observations at 46 stations in Nepāl, 178 stations in Punjab(I) and 245 stations in Madhya Bhārat, Madhya Pradesh, Bombay, Hyderābād, and Uttar Pradesh were carried out for supplementing the existing gravity data.

223. **Magnetic Detachment.**—Detailed magnetic observations for the determination of horizontal force, vertical force and declinations were carried out with the help of Q.H.M. 204 and a Watt type variometer which were tested and adjusted before proceeding to field.

7 stations in Orissa, 29 in Bihār and 10 in West Bengal were observed.

224. **Deflection Detachment.**—Both components of the deviation of the vertical were measured with the large 60-degree prismatic astrolabe at 2 stations in Uttar Pradesh, 8 stations in Punjab, 4 stations in West Bengal and 2 stations in Bhākra Dam Project area. Further astrolabe observations were taken at 8 stations in Nepāl for studying the geoidal section between Harinagar T.S. and Manāslu Peak. Laplace observations were taken at one station only in the Bhākra Dam area.

225. **Statistical Branch.**—This branch is responsible for the supply of all forms of information and data (triangulation, traverse, levelling, tidal, gravity, magnetic, astronomical, etc.) to departmental and extra-departmental indentors, maintenance of geodetic records and the sale and issue of departmental forms and publications.

The Library and the Letterpress Printing Sections are also attached to this branch.

(*a*) *Technical Publications.*—A number of triangulation and levelling pamphlets, Supplement to General Report (1947–50), General Report 1951, Technical Paper No. 8, Auxiliary Tables Parts I, II and V, Historical Records Volume III, Handbook of Topography Chapter VI and Tide-Tables for various ports were prepared and published during the period under report.

(*b*) *Preservation and Maintenance of G.T. Stations and Primary Protected Bench-marks.*—Annual reports on the condition of about 3,100 G.T. stations and 2,000 Primary Protected bench-marks were received and considered. Repairs were scheduled to be carried out to 277 G.T. stations and 22 P.P. bench-marks at a cost of Rs. 6,034·56 nP.

COMPUTING PARTY

Officer in charge :— Shri R. S. Chugh, M.A., A.M.I.S. (Ind.), to 27–4–54.
Shri V. Rangan, M.A., from 28–4–54 to 27–6–54.
Shri K. Satyanarayanan, M.A., from 28–6–54.

226. **General.**—The parent unit of Computing and Tidal Party was split into two parties, Computing Party and Tidal Party on 28th April, 1954. The headquarters of the Computing Party

remained at Dehra Dūn throughout the year. The main task of the party during the period under report has been computation of geodetic and topographical triangulations, computation of astrolabe observations for astronomical co-ordinates, deflection and geoidal rise, adjustment of co-ordinates and heights, compilation of trilangulation pamphlets, the printing of professional forms, auxiliary tables and technical papers and the training of Computers.

227. **Personnel.**—The average strength of the party during the period under report was 1 Class I Officer, 1 Class II Officer, 1 Surveyor, 1 Survey Assistant, 1 Scientific Assistant and 51 other Class III personnel including Trainees, Draftsmen and Clerks.

228. **Work at Headquarters.**—(*a*) *Computations.*—The personnel were employed mainly on the following tasks :—

(*i*) Computation and adjustment of the geodetic triangulation for Bhākra Dam Project.

(*ii*) Computation and adjustment of topographical triangulations in Barāhakshetra, Dudh Kosi and Sun Kosi areas carried out by Eastern Circle and in sheets 41A and E by the Southern Circle.

(*iii*) Computation of astromical latitudes, longitudes and azimuths observed in 1954–55 in various states.

(*iv*) Adjustment of triangulation data in sheets 47A and E and heights of stations and intersected points in sheets 44D, G, H, K and L carried out by No. 4 Party.

(*v*) Gravity reduction of 51 stations in Nepāl, 70 stations in Rājasthān, 110 stations in Bombay and 151 stations in Madhya Bhārat and Hayford Deflections for 56 stations and isostatic geoidal height for 43 stations.

(*vi*) Compilation of two grid data triangulation pamphlets [redacted]

(*vii*) Compilation of an up-to-date list of gravity data in India.

(*viii*) Supply of trigonometrical, traverse, levelling and other geophysical data to departmental and extra-departmental indentors.

(*ix*) Drawing of originals of charts for triangulation pamphlets and diagrams, charts and indexes for technical papers, topographical handbooks, auxiliary tables and other publications.

(*b*) *Training.*—A batch of 3 Computers from Eastern Circle have completed a portion of their training in computations and another batch of 10 Computers from Southern Circle have recently joined and are undergoing training.

Besides the above a number of publications, auxiliary tables, technical papers and professional forms were examined and seen through the press.

229. **Field Work.**—In main this is a static party but the following two detachments were formed and sent on field duty :—

(*a*) Shri K. Satyanarayanan with Shri J. B. Mathur and a Computer carried out observations for astronomical latitudes and longitudes of two stations, Amsot H.S. and Chilmeri h.s. in Uttar Pradesh.

(*b*) A second detachment under Shri J. B. Mathur and one Computer carried out observations for studying the geoidal section between Harinagar T.S. and Manāslu Peak with a view to refixing the position and height of the peak. 8 stations were observed.

230. **Miscellaneous.**—Much progress could not be made with regard to the compilation and publication of a new series of complete data pamphlet for India, due to shortage of trained personnel.

TIDAL PARTY

Officer in charge :—Shri R. S. Chugh, M.A., A.M.I.S. (Ind.).

231. **General.**—The parent Computing and Tidal Party was split up into two parties, Computing Party and Tidal Party, on 28–4–54. The headquarters of the Tidal Party remained at Dehra Dūn throughout the year. The party was engaged on the following tasks :—

(*a*) Prediction of tides at 38 ports between Suez and Singapore.

(*b*) Automatic registration of tides at 11 ports.

(*c*) 31-day tidal observations at 5 secondary ports.

(*d*) Harmonic analyses and investigations.

(*e*) Calculation of Chart Datums for extra-departmental indentors.

(*f*) Geodetic triangulation for Bhākra Dam Site.

(*g*) Secondary levelling for connection to tidal stations.

232. **Personnel.**—The average strength of the party during the period under report was 1 Class I Officer, 1 Class II Officer (on deputation to Government of Ceylon), 2 Surveyors, 2 Survey Assistants, 1 Scientific Assistant and 30 other Class III personnel including Clerks.

233. **Areas Surveyed.**—

3 square miles of geodetic triangulation for Bhākra Dam Site.

203 linear miles of secondary levelling for connection to tidal stations.

Short period tidal observations were taken at 5 ports.

234. **Work at Headquarters.**—

(*a*) *Tide Tables.*—

(*i*) Tide-Tables of the Indian Ocean and four separate pamphlets for the port of Kandla, the port of Bombay, the Hooghly River, and the Rangoon River for the year 1955, were published.

(*ii*) Advance predictions for 16 ports for the year 1956 were despatched to the Hydrographic Departments of the U.S.A., U.K., Portugal and Japan and also to the Liverpool Tidal Institute and to the Indian Navy in accordance with standing arrangements. Advance predictions for 7 ports for the year 1956 were also sent to the German Hydrographic Institute in accordance with freshly negotiated arrangements in exchange of advance predictions of 4 German ports.

Predictions for the remaining ports for 1956, as well as, advance predictions for certain ports for 1957 are in hand.

(*b*) *Analyses and Investigations.*—

(*i*) Intensive analyses by the method of Liverpool Tidal Institute of one full year's observations, for the years indicated in brackets, of the following ports were completed :—

Moulmein (1923), Vizagapatam (1952–53), Saugor (1949), Aden (1952), Port Blair (1952–53 and 1953–54), Bombay (1953) ;

and those of the following ports are in hand :—

Kandla (1953–54), Mangalore (1953–54).

(*ii*) Harmonic shallow water analyses for the new 42-component Doodson-Légé Tide-Predicting Machine, based on primary predictions also obtained on that machine, were carried out for the following ports and years :—

Diamond Harbour (1948, 1951, 1952, 1953), Garden Reach (1948, 1951, 1952 1953), Saugor (1948, 1951, 1952, 1953), Hooghly Point (1952), Bombay (1952), Moulmein (1922, 1923), Amherst (1883), Rangoon (1941) and Elephant Point (1930).

(*iii*) Harmonic analyses of 29-day tidal observations carried out by the touring tidal detachment at Kārwār, Mālvan, Kumta and Ganguli (Coondapore), by the Hydrographic Department of the Navy at Ross Island, Long Island, and Nancowry Harbour and by the Port Officer Kandla at Tokra, Khori and Jāfarwāli were completed.

(*iv*) Calculations of Chart Datums from dry period hourly heights of tides at Chāndbāli, North Point, Dhāmra

and Talchua on Dhāmra River were made for the Director, Central Water and Power Commission (Water Wing).

(*v*) Investigations were made of the coastal stability at Port Blair and Cochin from tidal and levelling evidence.

(*vi*) Computations were done of percentage accuracies of predictions as compared against actuals of the Hooghly River ports, for many years, by different methods, namely, Riverain, Harmonic Shallow Water Corrections from Kelvin and Doodson-Légé Tide-Predicting machines, with and/or without tabular corrections, with a view to assess their relative suitability.

(*vii*) Investigations of relations between Head Water discharges, as measured at Swarupganj, into Hooghly, on account of variable freshets from year to year, and tides at the lower riverain ports of Garden Reach and Diamond Harbour are in hand for improvement of the predictions.

(*viii*) Investigations regarding comparative accuracies of predictions of Saugor and Bombay as open sea ports with and without empirical corrections and with Harmonic Shallow Water Corrections were made to decide which would be the best method for their predictions.

(*ix*) Connections of coastal high precision levelling with tidal observatories in Kutch, Saurāshtra, Bombay, Madras and Orissa were studied for adjustment of lines.

Investigations were completed of the secondary levelling connections to secondary ports on West Coast of India, where short period tidal observations have been taken from 1947 onwards.

(*c*) *Miscellaneous.*—

(*i*) Hourly heights of tide levels were read off the tide-gauge diagrams for the following ports and years :—

Aden (1952, 1953, 1954), Kandla (1953, 1954), Bombay (1951, 1953, 1954), Mangalore (1952, 1953, 1954), Madras (1953, 1954), Vizagapatam (1953, 1954), Port Blair (1953, 1954), Rangoon (1953, 1954), Saugor (1950, 1951, 1952).

(*ii*) Forms and some tables for tidal computations were designed and printed.

(*iii*) Thorough revision was made of bench-marks of reference and levels of zeros of predictions and non-harmonic levels of all ports published as Tables III(*a*) and III(*b*) in Tide-Tables of the Indian Ocean.

(*iv*) Non-harmonic tide-levels, time differences and range ratios of some of the secondary ports in the gulfs of Kutch and Cambay on primary ports in their near vicinities were computed and supplied to the Botanical Survey of India.

(*v*) Monthly and annual Mean Tide Levels and/or Mean Sea-Levels were computed of 11 ports, where tide-gauges are functioning, from 1949 to 1953 for completion of Chapter VIII Research and Technical Notes, Technical Report 1948-49, and for supplying to the International Hydrographic Bureau who publish them in their Bulletins Scientifique.

235. **Field Work.**—

(*a*) Shri R. S. Chugh, Officer-in-charge Tidal Party carried out observations for geodetic triangulation in an area of 3 square miles for providing control points at Bhākra Dam Site in the Punjab. 13 stations and 7 intersected points were fixed. He also took observations for the deviation of the vertical at 2 stations and for azimuth at 1 station in the area. Two short base lines were also measured with invar wires.

(*b*) Shri S. K. Bose (Surveyor), with one Leveller ran 203 linear miles of secondary levelling near the seacoast in Kutch, Saurāshtra and Bombay to connect tidal stations with Indian Mean Sea-Level Net.

(*c*) Shri A. K. Banerji (Surveyor) with 4 Recorders took 31-day tidal observations at each of the secondary ports of Mālvan, Kārwār, Kumta in Bombay and Ganguli (Coondapore) and Cannanore in Madras.

(*d*) Automatic tide-gauge registrations were continued at Aden, Kandla, Bombay (Apollo Bandar), Mangalore, Madras, Vizagapatam, Saugor, Diamond Harbour, Garden Reach (Calcutta), Rangoon and Port Blair.

Tide-pole observations of high and low waters, during day-light, were continued at Bhavnagar.

No. 14 PARTY

Officer in charge :— Shri K. S. Singh, B.A. (Hons.), to 20-6-54.
Shri R. S. Chugh, M.A., from 21-6-54 to 27-6-54.
Captain K. L. Khosla, Engineers, B.Sc., B.E. (Civil), A.M.I.E., from 28-6-54.

236. **General.**—The recess activities of the party consisted of computations of high precision and secondary levelling, preparation of press copies of levelling pamphlets, examination of proofs of levelling pamphlets, supply of levelling data to departmental and extra-departmental indentors, and training of extra-departmental officers in levelling.

The field work consisted of secondary levelling in Bihār, West Bengal and Assam to provide height control for Flood Control Surveys required by the Central Water and Power Commission, and primary triangulation in Madras and Travancore-Cochin States to link the Malabār Coast Series and the Great Arc Meridional Section 8°–18°.

The field and recess headquarters of the party remained at Dehra Dūn.

237. **Personnel.**—The average strength of the party was I Class I Officer, 2 Class II Officers, 6 Surveyors, 1 Survey Assistant, 1 Geodetic Computer, and 15 other Class III personnel including 3 Clerks.

238. **Areas Surveyed.**—

(*a*) Secondary Levelling.—

(*i*) Bihār	...	467 linear miles
(*ii*) West Bengal	...	313 linear miles
(*iii*) Assam	...	470 linear miles

(*b*) Geodetic Triangulation in Madras and Travancore-Cochin States.—

Reconnaissance	...	955 square miles.
Observations	...	695 square miles.

239. **Recess Duties.**—Two sections under Sarva Shri A. K. Bhattacharjee and J. K. Donald (both Class II) completed all the computations of high precision and secondary levelling executed during the field season 1953–54, and also supplied levelling data to departmental and extra-departmental indentors.

In addition, press copies for five secondary levelling lines and examination of five levelling pamphlets were completed.

Two training courses in levelling, of one month duration each, were run during the recess and 6 officers deputed from the following states were given training :—

(*a*) 3 officers from Madras and 1 officer from P.E.P.S.U. Government joined the 1st course from 1-5-54 to 31-5-54.

(*b*) 2 officers from Madras Government joined the 2nd course from 1-6-54 to 28-6-54.

240. **Field Work.**—(*a*) *Secondary Levelling.* – A national emergency having arisen due to floods in Bihār, Bengal and Assam, the entire levelling potential of the unit was mobilised for carrying out secondary levelling for providing height control for Flood Control Surveys.

Nine levelling detachments were formed and the work was organized as follows :—

(*i*) Four detachments under Sarva Shri A. K. Bhattacharjee, J. K. Donald (both Class II), S. A. Muthukrishnan (Surveyor) and I. M. Saklani (Survey Assistant) were detailed for the Bihār area.

After completing their share of secondary levelling in the area, Shri A. K. Bhattarcharjee with his men moved to the West Bengal area, and Sarva Shri J. K. Donald and S. A. Muthukrishnan shifted to the Assam area, while Shri I. M. Saklani continued in Bihār throughout the field season, except for some time in Nepāl.

467 linear miles of secondary levelling were carried out in the Bihār area, including 62 miles of double tertiary levelling in Nepāl.

(*ii*) Two detachments under Sarva Shri J. Narasimhan(Class I on loan from Air Survey and Training Directorate) and P. N. Sanyal (Surveyor) were detailed for the West Bengal area.

Shri J. Narasimhan was replaced by Shri K. K. Sawhney (Geodetic Computer) in January 1955.

313 linear miles of secondary levelling were carried out in the West Bengal area.

(*iii*) Three detachments under Sarva Shri N. N. Joshi, Avinash Chandra and S. N. Nandi (Surveyors) were detailed for the Assam area.

470 linear miles of secondary levelling were carried out in the area, including two river crossings, one at Murkong Salek and the other at Pasighāt.

(*b*) *Geodetic triangulation.*—One detachment under Captain K. L. Khosla, Engineers, with one recorder, Shri K. S. Srivastava, Trig. Computer, was detailed to carry out primary triangulation in Madras and Travancore-Cochin States to link the Malabār Coast Series and the Great Meridional Arc Section 8°–18°.

Reconnaissance of 955 square miles was completed and about 64 miles of the new triangulation series, named as the South-West Coast Series, was observed covering an area of 695 square miles with 8 stations of observations.

241. **Description of Country.**—(*a*) The area of secondary levelling varied from the cultivated plains of Bihār to the forests of North-East Assam.

The Bihār area is well served with roads and railways. There are, however, numerous small and big water channels on the route of levelling and most of the area is inundated during the rainy season.

The West Bengal area consists of undulating lands in the North, covered either with forests or tea gardens, and cultivated plains in the south, with numerous small and big water channels. The rivers Tista, Jaldhāka and Torsa flow through the area from north to south. This area in not well served with roads and railways.

The Brahmaputra River flows through the northern portion of the Assam area. The area south of the river consists of cultivated

lands and tea gardens, and is served by roads. There is, however, only one railway line.

The major portion of the area north of the river is covered with dense forests and undergrowth of cane-brake and is infested with wild animals such as tiger, elephant and wild buffalo. The detachments working here experienced difficulty in procuring local labour and transport. The usual means of transport in this area was either by elephant or by boat along water courses, both of which were very expensive.

(*b*) The area of geodetic triangulation in Madras and Travancore-Cochin States varied from the densely forested hills of the Western Ghāts in the east, infested with wild animals, to the flat coastal belt in the west, studded with cocoanut plantations and numerous backwaters and lakes. The portion in between consists of open cultivated areas alternating with undulating plains, and is well served with roads. There is at present no rail connection between North and South Travancore-Cochin. A rail link, however, between Ernākulam and Quilon is under construction. The area in the plains is very thickly populated and under intensive cultivation even the low hill-tops either have cultivated fields or are covered with rubber, cashew-nut and other useful trees. Travancore-Cochin and the neighbouring districts of Madras State have an additional monsoon, called the N.E. monsoon, in the winter months.

242. Miscellaneous.—The health of the party was, in general, fair. One contingent Class IV employed in the geodetic triangulation detachment was killed by a wild elephant in the forest near Kaliyar in Travancore-Cochin.

APPENDIX I

UNITED NATIONS REGIONAL CARTOGRAPHIC CONFERENCE FOR ASIA AND THE FAR EAST, 15-25 FEBRUARY 1955, MUSSOORIE - INDIA

LIST OF DELEGATES TO THE CONFERENCE

(A) GOVERNMENTS

Afghanistan

Major Amir Ahmed Khan,
Royal Afghan Army.

Belgium

Mr. Raoul Clement Degroodt,
Chief, Cartographic Service,
Ministry of Colonies.

Burma

U Hla Khin Maung,
Director of Survey.

U Ko Gyi,
Superintendent of Survey.

U Lun Pe,
Superintendent of Survey.

Canada

Mr. W. H. Miller,
Director, Surveys and Mapping Branch, Department of Mines and Technical Surveys.

China

Mr. Tsao, Mo,
Adviser, Ministry of Interior.

Mr. Sun Tang-Hueh,
Director, Department of Higher Education, Ministry of Education.

Dr. Tchen Hiong-Fei,
Counsellor, Chinese Embassy, Paris.

Mr. Tcheng Tse-Koei,
First Secretary, Chinese Embassy, Baghdad.

Mr. Yu Mou-Chiang,
Ministry of Interior.

Finland.

Dr. T. J. Kukkamaki,
Finnish Geodetic Institute.

France.

M. Georges Laclavere,
Ingenieur en chef-geographe, Institut geographique national.

Germany (Federal Republic of)

Dr. Ing. Erwin H. Gigas,
Director, Institut fur angewandte Geodæsie.

India.

Brigadier I. H. R. Wilson,
Surveyor General of India—(*President*).

Dr. S. Gopal,
Director, Historical Division, Ministry of External Affairs.

Shri T. S. N. Murty,
Research Officer, Historical Division, Ministry of External Affairs.

Colonel Gambhir Singh,
Director, Survey of India—(*Organizing Secretary*).

Shri P. A. Thomas,
Director, Northern Circle, Survey of India.

Shri M. M. Ganapathy,
Deputy Surveyor General, Survey of India.

Shri B. L. Gulatee,
Director, Geodetic and Research Branch, Survey of India.

Shri R. S. Chugh,
Officer-in-Charge, Tidal Party, Survey of India.

Shri A. N. Ramanathan,
Mathematical Adviser, Survey of India.

Shri K. L. Dhawan,
Director, Map Publication, Survey of India.

Shri C. T. Hurley,
Deputy Director, Map Publication, Survey of India.

Shri E. R. Wilson,
Director, Air Survey and Training Directorate, Survey of India.

Shri J. C. Sikka,
Officer-in-Charge, No. 20 (Photo) Party, Survey of India.

Shri S. S. Sundram,
I. N. Commissioned Instructor Officer, Naval Hydrographic Office.

Shri M. M. Srinivasan,
Central Silviculturist, Forest Research Institute and Colleges.

Shri J. P. Mehrotra,
Deputy Director (Engineering), Indian Standards Institution.

Shri S. R. Singh,
Head of the Civil Engineering Department, Roorkee University.

Dr. Amarjit Singh,
National Physical Laboratory.

Shri Prem Prakash,
National Physical Laboratory.

Shri M. D. Mittal,
Central Water and Power Commission.

Shri Prem Prakash,
Deputy Collector, Allahabad, Uttar Pradesh.

Shri A. K. Sen Gupta,
Deputy Director of Surveys, West Bengal.

Shri M. L. Sethi,
Director of Mines and Applied Geology, Rājasthān.

Shri S. L. Malurkar,
Director, Colaba and Alibag Observatory, India Meteorological Department.

Shri P. R. Purohit.
Director of Land Records, Tripura.

Shri S. M. Karayalar,
Professor of Geography, Travancore University.

Shri R. Giri,
Statistician, Survey and Settlements Department, Madhya Pradesh.

Indonesia

Lt. Col. Sutarjo Surjosumarno,
Director, Topographical Survey, Ministry of Defence.

Mr. Mas Muntaha,
Director, Cadastre Service, Ministry of Justice.

Lt. Rudy Emond Beaupain,
First Assistant, Photogrammetrical Office, Topographical Survey, Ministry of Defence.

Israel.

Mr. Joseph Elster,
Director, Survey Division, Ministry of Labour.

Japan

Dr. Naomi Miyabe,
Chief Inspector, Geographical Survey Institute, Ministry of Construction—(*Vice-President*).

Dr. Kanji Suda,
Chief Hydrographer, Hydrographic Office, Maritime Safety Agency, Ministry of Transportation.

Mr. Hideho Tanaka,
First Secretary, Embassy of Japan, India.

Netherlands

Dr. W. Schermerhorn,
Dean, International Training Centre for Aerial Survey.

Philippines

Lt.-Comdr. Sergio M. Maulawin,
Chief, Operation Branch, Coast and Geodetic Survey.

Mr. Mario Manansala,
Chief, Cartographic Division, Coast and Geodetic Survey.

Portugal

Dr. Alvaro Brilhan te Laborinho, Counsellor, Protuguese Embassy, New Delhi.

Thailand

Mr. Chootragoon Suwankate,
Division of Cadastral Survey, Department of Lands, Ministry of Interior.

Capt. Chumphon Kulkasem,
Division of Ground Control Survey Department of the Army, Ministry of Defence—(*Rapporteur*).

Turkey

Major-General Ihsan Saref Dura,
Director, Geodetic Survey—(*Vice-President*).

Lt. Col. Sevat Goktuna,
Geodetic Survey.

Maj. Eng. Tevfit Ates,
Geodetic Survey.

United States of America

Colonel Frank A. Pettit,
Photographic and Survey Section, The Joint Staff, U.S. Army, Department of Defence.

Colonel Robert C. Miller,
Office Chief of Engineers, Department of the Army.

Captain Philip C. Doran,
Assistant Chief, Division of Geodesy, U.S. Coast and Geodetic Survey, Department of Commerce.

Mr. Charles B. Ferguson,
Geographic Attache, American Embassy, Tokyo.

Mr. Conrad J. Thoren,
Geographic Attache, American Embassy, New Delhi.

(B) INTERNATIONAL GOVERNMENT ORGANIZATIONS

Food and Agriculture Organization

Mr. F. George,
Agriculture Officer, Land and Water Use Branch.

International Civil Aviation Organization

Mr. J. Park,
Chief, Aeronautical Information Services and Aeronautical Charts.

International Hydrographic Bureau

Rear Admiral C. L. Nichols,
President, Directing Committee.

(C) INTERNATIONAL NON-GOVERNMENTAL ORGANIZATIONS

International Organization for Standardization

Shri J. P. Mehrotra,
Deputy Director (Engineering), Indian Standards Institution.

International Union of Geodesy and Geophysics

Mr. G. Laclavere,
Secretary-General.

(D) UNITED NATIONS SECRETARIAT

Dr. P. S. Lokanathan,
Executive Secretary of the Economic Commission for Asia and Far East (ECAFE), representing the Secretary-General.

Dr. Te-Lou Tchang,
Chief, Cartographic Section, Bureau of Economic Affairs, Economic and Social Affairs Department—(*Executive Secretary*).

Mr. James B. Orrick,
Director of United Nations Information Centre for India, Burma and Ceylon.

Dr. C. Y. Li,
Chief, Mineral Resources Section, ECAFE, Assistant Secretary.

Mr. J. R. Dean,
Cartographic Section, Bureau of Economic Affairs, Economic and Social Affairs Department, Assistant Secretary.

RESOLUTIONS ADOPTED BY THE CONFERENCE

I

The Conference

HAVING TAKEN NOTE OF

(*i*) the present state of progress of the various nations of this region in the cartographic field, both as regards the methods in use in each country, and in respect of the great leeway required to be made up in the various cartographic fields before cartographic self-sufficiency can be achieved, and

(*ii*) the notable recent technical developments being initiated and pursued by the countries experienced in cartography which attended the Conference,

TRUSTS that this mutual interchange of information will prove a solid foundation leading to improved procedure and practice in the field of technical assistance, in that the advanced countries will be aware of the position and problems facing the various nations of this Region, and the latter, in their turn, will know where to apply for advice and assistance in the various fields of cartography.

II

The Conference

RECOGNIZES the desirability of connecting the Andaman and Nicobar Islands to the mainland of India, and that the most expeditious method of such connexion is by electronic measuring devices,

OBSERVES that the limitations of existing electronic devices necessitate a direct connexion of these islands to the triangulation extending along the coast of Burma,

NOTES that Canada and the United States of America have highly developed electronic measuring devices and methods of operation,

CONSIDERS that the connexion with India-Burma of the outlying islands would be a first step towards the realization of the far bigger task of linking the India-Burma triangulation to that of Indonesia and ultimately to that of Australia,

RECOMMENDS that the countries having the necessary equipment and experienced personnel for this type of work, such as Canada and the United States of America, should be approached by the interested governments with a view to dermining how this project might be executed.

III

The Conference

CONSIDERS that in view of the remarkably accurate results that are obtainable with the Vaisala Comparator of the Finnish Geodetic Institute, which has been calibrated against the international prototype of the International Bureau of Weights and Measures, and in view of the difficulties and uncertainties associated with the physical standards of length for calibration purposes,

RECOMMENDS to the Governments of the Asian countries that a few standard base-lines in this region should be established by the Vaisala method for assuring a uniform scale in all net-works and for calibrating invar tapes and other equipment.

IV

The Conference

OBSERVES that the construction of a non-magnetic ship for magnetic observations on the oceans cannot be carried out as planned because of lack of funds,

NOTES that instruments for magnetic measurements at sea now being developed in various countries will probably be available for the International Geophysical Year 1957–1958,

RECOMMENDS to the Special Committee for the International Geophysical Year that it consider in its programme the inclusion of magnetic observations in the Indian Ocean, particularly in the Bay of Bengal and in the Arabian Sea.

V

The Conference

RECOGNIZES the importance of gravity measurements at sea and the necessity of carrying out programmes in this field by the countries of the region which have not the adequate equipment,

REQUESTS the International Union of Geodesy and Geophysics to provide a list of organizations which possess the necessary equipment including the information as to whether this equipment could be made available to other countries on a loan basis,

REQUESTS the United Nations authorities to facilitate the carrying out of any such programme, including information regarding the possibilities of obtaining personnel and equipment, such as technicians and submarines, that countries might make available for undertaking such a programme.

VI

The Conference

TAKES NOTE of the existence within the International Union of Geodesy and Geophysics of a permanent service for the International comparison of geomagnetic standards,

RECOMMENDS countries which desire to compare their national standards with a calibrated instrument to apply to the International Union of Geodesy and Geophysics for the loan of such an instrument.

VII

The Conference

RECOGNIZES the importance of the junction of the triangulations of Irān, Irāq, Syria and Turkey, both for homogeneous mapping and for scientific purposes such as a better definition of the shape of the earth,

RECOGNIZES the importance of the junction of the levelling nets for the study of the fluctuations of the sea-levels in various parts of the seas surrounding the countries concerned,

NOTES that the International Union of Geodesy and Geophysics has several times recommended such international connexions,

RECOMMENDS that the four interested countries meet together to study the arrangements that might be made in this respect,

REQUESTS that the United Nations facilitate such a meeting.

VIII

The Conference

CONSIDERING :

(*a*) that topographic maps are made in the most economic way by means of photogrammetry,

(*b*) that good topographic maps up to the scale of 1 : 25,000 can be made from air photographs at scales between 1 : 40,000 and 1 : 70,000 using modern wide angle lenses,

(*c*) that a collection of such photographs constitutes a valuable and economical means which can be used in many development programmes,

RECOMMENDS to governments to take adequate measures, adapted to the local conditions, to obtain a regular coverage of high quality small scale photographs of those regions, where such coverage is non-existent or insufficient, taking into account that :

(1) this kind of small scale photography in most cases does not need repetition within the period of one generation ;

(2) for large areas without primary triangulation, the necessary control can be obtained either by astronomical measurement or by the use of electronic means. (In the latter case, the choice is between radar controlled photography and the use of radar for the determination of ground control. The radar altimeter can be considered as a promising means for improving vertical control. The choice between the various methods depends largely on local conditions of topography, available means, etc.) ;

(3) the use of private enterprise can enable a government to use electronic and other highly specialized techniques without the necessity of large investments and expensive training of personnel ;

(4) the best results are obtained with modern cameras with high quality lenses of the latest design, used by organizations, either military, civil or private enterprise, which have permanent personnel engaged in aerial photography ;

DRAWS the attention of this Region to the vital necessity of completing the photographic coverage prior to undertaking any field operations.

IX

The Conference

NOTES the report of Committee II dealing with item 6(*b*)(*ii*) of the Agenda of the Conference and approves the views expressed therein.

X

The Conference

NOTES the following points which are essential with regard to the improvement of cadastral systems in various countries :

(1) The precision of a cadastral survey should not be higher than necersary for the fulfilment of practical requirements. The system, the method of production and the legal basis should be adapted to local circumstances both social and physical.

(2) In the choice between a numerical and a graphical cadastre, the latter must not, *a priori*, be considered as inferior and must be recommended in all cases in which it can give the required precision.

(3) Cadastral surveys should in all cases be based on a sound trigonometrical control and connected with the existing national trigonometrical data.

(4) It is inadvisable to represent on cadastral maps any more than the necessary topographic details for identification of the boundaries. If large scale topographic maps are needed for the whole area or for a part of it, they should be made separately on the same or on a smaller scale than the cadastral map. Those maps can be derived either from the cadastral map as far as planimetry is concerned or from the same basic material used for the preparation of the cadastral map, such as airphotographs.

(5) Except in the case of densely built-up area high degree of precision is necessary ; photogrammetric methods, in which high precision equipment is used properly, have proved to be at least as accurate as normal ground survey methods for the determination of well identifiable boundaries.

Therefore, the possibility of the application of this modern method should be studied in the light of local conditions. A further advantage of photogrammetry must be taken into account, namely, the availability of the same photographs for agricultural interpretation (soil survey, land use, crop estimates, forest inventory, etc.) and for the production of large scale topographic maps.

XI

The Conference

COMMENDS to the notice of the countries attending the Conference the suggestion of the Government of the U.S.A., in paragraph 6 of page 16 of document E/CONF. 18/A/L. 3, dated 1 February 1955, viz :

"...The United States Government would be willing to co-operate in drafting a general framework for a programme looking toward maximum international uniformity in the writing of geographical names, for consideration by the United Nations Economic and Social Council, or by an International Conference called by the Council for that purpose, or in drafting an agenda for such a Conference", and

RECOMMENDS that a Committee be set up under the United Nations, on the lines proposed by the Government of the United States of America and that the Governments of this Region should appoint experts to participate in the deliberations.

XII

The Conference

NOTES the report of Committee III on items 6(*c*) and 6(*d*) of the Agenda of the Conference, and

DECIDES to adopt the views expressed therein.

XIII

The Conference

CONSIDERS that the dangers of maritime navigation often occur in waters were adequate hydrographic surveys have not been made and where an effective system of notifying navigators of navigational changes or dangers to navigation is not in operation, and that such conditions exist usually in navigable waters of countries without a hydrographic service,

RECOMMENDS that such countries establish hydrographic services.

TAKES NOTE of the statute (11) of the International Hydrographic Bureau which states :

"The Bureau will on request tender its advice and assistance to those states which have not yet established hydrographic services or whose hydrographic services are not fully developed".

BELIEVES that it is to the advantage of countries having hydrographic services or which are establishing such services, to become members of the International Hydrographic Bureau.

XIV

The Conference

AGREED that as the I.M.W. and the 1:1,000,000 W.A.C. series (ICAO) are designed for very different needs, it is essential to maintain both series ;

REALIZED that although these two series have very different specifications, projections and limits of sheets, one basic compilation can be used in the preparation of both these series ; and

CONSIDERING the usefulness of both these series for national development and aviation,

RECOMMENDS (*a*) that the countries of this region should stimulate their progress in completing for their own territories the I.M.W. series, so as to attain as soon as possible world coverage in this series ; and

(*b*) that they should take steps to expedite completion of the verious aeronautical maps and charts to meet the requirements of civil aviation.

XV

The Conference

RECOMMENDS (*a*) that the specifications which govern the publication of I.M.W. series should be such as to allow a certain amount of flexibility so that no change in existing sheets would

be required and no country would be prevented from producing this series of maps due to specifications they could not meet. While the major items, such as projection, sheets lines, etc., would be made mandatory, minor deviations from the specifications laid down should be permissible to meet local requirements, and

(*b*) that it would be desirable for the Secretary-General of the United Nations to appoint an advisory Committee of Experts to examine proposals on the specifications for the I.M.W. series received from countries. The findings of the Committee should be transmitted to Governments for consideration before final adoption by an international conference to be convened by the United Nations.

XVI

The Conference

RECOMMENDS that the following procedure be followed regarding the responsibility for the publication of a sheet covering two or more countries :

(*a*) Where the territories of several countries, each possessing cartographic establishments, fall on one sheet, duplication of sheets be avoided by the countries concerned coming to an agreement as to which country shall produce the sheet, the others supplying the producing country with the necessary materials as far as their own territories are concerned. The principle generally observed in arriving at these agreements is that the country which has the largest portion of land territory falling on a sheet shall be responsible for the publication of that sheet.

(*b*) In the event of difficulties arising in reaching agreement as to which country shall produce a sheet covering two or more countries, the good offices of the United Nations Cartographic Office should be sought.

XVII

The Conference

RECOMMENDS the setting-up of :

(1) Regional Inter-Governmental Cartographic Organizations where these do not exist at present : these would form an authoritative source for advising Nations

of the Region on their cartographic problems and on the vital need of giving primary importance to cartographic self-sufficiency as a prerequisite to orderly and economic development, and

(2) A small Central Advisory Board: this would consist of one representative of each Regional Organization and of the International Technical Institutions concerned. The Board may also co-opt such experts as they deem necessary. The Board would act as an authoritative source for advising the United Nations on matters of cartographic policy and related technical matters.

The Terms of Reference of the Central Advisory Board should be primarily limited to the production of maps.

XVIII

The Conference

While appreciating the need for a Central Regional Office from which advice on all cartographic matters could be obtained,

REALIZES the many difficulties involved in the formation of such an office, and

SUGGESTS that, as a first step, the countries of this Region should set up a Committee or Committees each covering a certain field or fields of cartography, and, where these Committees need more expert guidance, that they should refer their problems to those countries or institutions properly qualified in the cartographic field concerned.

XIX

The Conference

Dealt with items 8(*i*), 8(*ii*) and 8(*iii*) of the Agenda simultaneously, and

PLACES ON RECORD the following :

The Conference

(*i*) in view of the fact that basic self-sufficiency in the field of cartography is an essential prerequisite to methodical and economical national development in every field, and

(*ii*) in view of the great amount to be done in the various fields of cartography by the countries of this Region,

TRUSTS that

(*a*) the clarification given of the methods of procedure for obtaining technical assistance,

(*b*) the practical difficulties expounded in providing such effective technical assistance, and

(*c*) the suggestion by the Canadian delegation that the extreme difficulty in obtaining the services of experts in certain fields of cartography could best be overcome by the countries of this region sending their specialist officers to countries where facilities exist for further study and examination of their country's problems,

will help the countries of this Region both in formulating their future requests for technical assistance and in obtaining this effectively ; and also

EXPRESSES a hope that it may in time be possible for the Technical Assistance Programme for the United Nations Organization, to have a fixed and continued budget for the furtherance of a long-term programme.

XX

The Conference

CONSIDERING the value gained by the countries of this Region from the deliberations of the Conference,

RECOMMENDS that a second cartographic conference for the Region be held not later than 1958.

APPENDIX II

BLOCK SYLLABUS FOR CLASS III SERVICE, TOPOGRAPHICAL TRAINEES TYPE 'B'

Serial No.	Duration in weeks (approx.)	Period (Actual dates shown are approxi-mate – depend on the date of commence-ment of course)	Subject
1	2	3	4
1	4	..	(*a*) Preliminary lectures – including scope of training duties of Air Survey Draftsmen, Plane-tablers and Draftsmen, Organization of the Survey of India, Elementary Mathematics required for computing clino heights, reference to log tables, simple problems on heights and distances.
			(*b*) Drawing practice.
			First Field Season
2(*a*)	8	..	1 : 1000 scale plane-tabling in open and undulating country– by plane-table fixings, intersections, radiation and distance ; and by using clinopole for detail survey and contouring.
(*b*)	..	..	Large scale town surveys (64″ scale) – in built-up areas using methods of chain survey and optical square ; preparation of field books. [The practical work should bring out the relative merits of all methods employed for large scale ground survey work including those in Sl. 2 (*a*) above].
			NOTE.—(*a*) and (*b*) above may be combined, if possible, on the one plane-table at the discretion of the O.C. concerned.
3	15	..	1 : 25,000 scale plane-tabling including all preparatory work. Study and knowledge of symbols in "Instructions to Plane-tablers".
			Mounting plane-table section, projection of graticule, projection of grid, plotting trig. points, completion of border items, preparation of colour and height traces.
			1 week's break for revision or leave.

(Contd.)

BLOCK SYLLABUS FOR CLASS III SERVICE, TOPOGRAPHICAL TRAINEES TYPE 'B'—(*Concld.*)

Serial No.	Duration in weeks (approx.)	Period (Actual dates shown are approxi-mate – depend on the date of commence-ment of course)	Subject
1	2	3	4
		First Recess	
4	12	..	Air Survey – indexing listing and sorting of air photo-graphs ; stereoscopic examination of air photographs ; air photo interpretation ; construction of minor control plots ; preparation of combination chart ; survey of detail only, on Kodatrace (air survey section).
5	12	..	Fair drawing – completion of all originals of 1″ = 1 mile sheet making use of old 1″ = 1 mile plane-tables (every one should be trained in typing). Use of Planimeter and Pantograph. NOTE.—During this period 2 hours per week will be devoted for lectures and practice of routine administration, e.g., maintenance of cash book, preparation of bills, reports and returns ; stores maintenance and repair ; knowledge of circular orders applicable. Special stress on what records – administrative and technical – are maintained by field hands in the field. *Weed out All Unsuitable Trainees*
		Second Field Season	
6	21	..	(*a*) 1″ = 1 mile plane-tabling including preparatory work.
	4	..	(*b*) 1″ = 1 mile post pointing, heighting and ground verifi-cation on air photos for compilation. *Break 1 week.*
		Second Recess	
7	26	..	Air Survey compilation 6(*b*) including contouring of air photos. Use of slotted template machine. (*For Air Survey Draftsmen*). NOTE.—*For Plane-tablers* – Extra plane-tabling and practice in Pantograph, etc., as the season allows. Thereafter trainees revert to home circle.

GENERAL NOTE.—Trainees suitable to become Draftsmen should be posted to Drawing Offices *as soon as* a firm assessment has been made as to their un-suitability for Air Survey Draftsman or Plane-tabler and of their promise of becoming good Draftsmen.

INDEX MAPS

A. Modern Topographical Surveys and Compilation.

B. Modern Topographical Survey and Revision (1-inch and ½-inch scales) by 10-year periods from 1905.

C. Index showing Project Surveys in hand.

D. Maps published on scales of one-inch and half-inch to one mile.

E. Maps published on scale of quarter-inch to one mile.

F. Index to the maps of the I : M Carte Internationale du Monde Series.

G. Index to the maps of the 1 : 2M Southern Asia Series.

N.C.—P.Z.O.—J.S. 162—28-3-56—300

Survey & Compilation
from 4" to 1 mile to $\frac{1}{8}$" to 1 mile scales

SURVEY OF INDIA

MODERN TOPOGRAPHICAL SURVEYS AND COMPILATION

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

Survey & Compilation
from 4" to 1 mile to $\frac{1}{8}$" to 1 mile scales

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

SYSTEM OF NUMBERING SHEETS.

THE $\frac{1}{M}$ SERIES forms the basis of numbering for sheets on all scales. It consists of sheets 4° × 4° on the scale of 1:1,000,000, whose numbers are shown on the Index thus:— 55

QUARTER-INCH SHEETS—Each $\frac{1}{M}$ sheet is divided into 16 sheets of scale quarter-inch to one mile, lettered A—P as shown on the Index. The number of each quarter-inch sheet is therefore written thus:— ..... 55 K

HALF-INCH SHEETS. Each $\frac{1}{4}$ inch sheet is divided into four half-inch sheets, named respectively N.W., N.E., S.W., S.E. The number of a half-inch sheet thus takes the form:— ..... $55\frac{K}{N.E.}$

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

MODERN TOPOGRAPHY
up to 31st March 1955.

REFERENCES.

MODERN SURVEYS (since 1905).
Scale 1 inch to 1 mile, and over
" about $\frac{1}{2}$ inch to 1 mile
" $\frac{1}{4}$ inch to 1 mile, and less

MODERN COMPILATION (since 1905)
Scale 1 inch to 1 mile, and over
" about $\frac{1}{2}$ inch to 1 mile
" $\frac{1}{4}$ inch to 1 mile, and less

CURRENT SURVEYS are further distinguished by marks as follows — Scale $\frac{1}{2}$ $\frac{1}{4}$ 1" larger
Surveyed last season 1954-55. ○ + • ::
Proposed for survey in 1955-56. (with red initials or numbers to indicate the unit concerned)

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

Published under the direction of Brigadier Gambhir Singh, M.I.S.(Ind.), Surveyor General of India,
1959.

Sikkim and Bhutan States are attached to India by special treaties.

Reg. No. 6846 HD'59-320'60.

PRINTED AT THE SURVEY OF INDIA OFFICES (H. L. O.).

MODERN TOPOGRAPHICAL SURVEY AND REVISION

(1-inch & 1/2-inch Scales)

By 10-year periods from 1905.

INDEX B

SURVEY OF INDIA

REFERENCES.

Unsurveyed or surveyed prior to 1905

Surveyed or revised 1905-06 to 1914-15

" " 1915-16 to 1924-25

" " 1925-26 to 1934-35

" " 1935-36 to 1944-45

" " 1945-46 to 1954-55

64° E. of Greenwich.

Scale of Index 1:12 Million.

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

Published under the direction of Brigadier Gambhir Singh M.I.S.(Ind.), *Surveyor General of India,*

1959.

Sikkim and Bhutān States are attached to India by special treaties.

REG. No. 6847 HD'59~320.

PRINTED AT THE SURVEY OF INDIA OFFICES (H.L.O.)

SURVEY OF INDIA

MAPS PUBLISHED

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

MAPS PUBLISHED
1 inch and ½ inch scales

MODERN MAPS, shown in bright colours, are based on the true longitude adopted in 1905.
OLD MAPS, shown in purple and green were about 2 miles out of position, being based on the longitude of 1815.

SYSTEM OF NUMBERING SHEETS.

THE $\frac{1}{M}$ SERIES forms the basis of numbering for sheets on all scales. It consists of sheets 4° × 4° on the scale of 1:1,000,000, whose numbers are shown on the Index thus:— 55

QUARTER-INCH SHEETS—Each $\frac{1}{M}$ sheet is divided into 16 sheets of scale quarter-inch to one mile, lettered A—P as shown on the Index. The number of each quarter-inch sheet is therefore written thus:— ..... 55 K

HALF-INCH SHEETS. Each $\frac{1}{4}$ inch sheet is divided into four half-inch sheets, named respectively N.W., N.E., S.W., S.E. The number of a half-inch sheet thus takes the form:— ..... $55\frac{K}{N.E.}$

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

PUBLICATIONS up to 31st March 1955
on ONE-INCH and HALF-INCH scales.

REFERENCES.

MODERN MAPS (since 1905).
Scale 1 inch to 1 mile only.....
„ ½ inch „ „ only.....
Published on both scales.....

OLD MAPS (previous to 1905).
Scale 1 inch to 1 mile.....
„ ½ inch „ „.....

NEW MAPS (including new editions).
Published during the year 1954-55 one-inch • half-inch +
In hand, to be published by the end of 1955. do • do +

MAPS OUTSIDE THE RED LINE, AND WHICH INCLUDE ANY PORTION OF ANDAMAN & NICOBAR ISLANDS ARE RESTRICTED.

Scale of Index 1:12 Million.

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

Published under the direction of Brigadier Gambhir Singh M.I.S.(Ind.), Surveyor General of India, 1958.

Sikkim and Bhutān are attached to India by special treaties.

64° E. of Greenwich.

Reg. No. 6622 HD'58-320'59.

PRINTED AT THE SURVEY OF INDIA OFFICES (H. L. O).

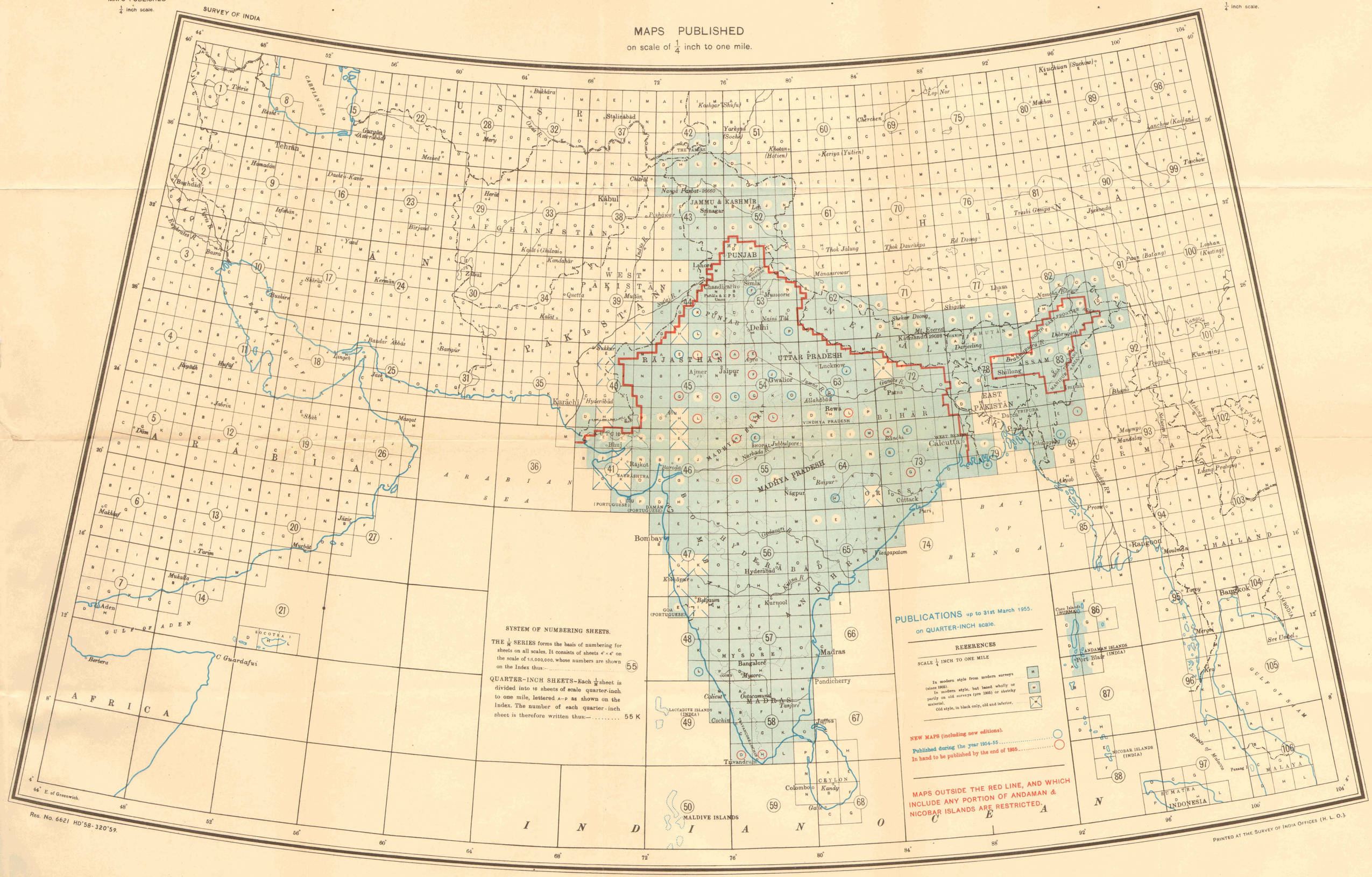
MAPS PUBLISHED
$\frac{1}{4}$ inch scale.

MAPS PUBLISHED
$\frac{1}{4}$ inch scale.

SURVEY OF INDIA

MAPS PUBLISHED

on scale of $\frac{1}{4}$ inch to one mile.



SYSTEM OF NUMBERING SHEETS.

THE $\frac{1}{M}$ SERIES forms the basis of numbering for sheets on all scales. It consists of sheets 4° × 4° on the scale of 1:1,000,000, whose numbers are shown on the Index thus:— ..... (55)

QUARTER-INCH SHEETS—Each $\frac{1}{M}$ sheet is divided into 16 sheets of scale quarter-inch to one mile, lettered A–P as shown on the Index. The number of each quarter-inch sheet is therefore written thus:— ..... 55 K

PUBLICATIONS up to 31st March 1955.

on QUARTER-INCH scale.

REFERENCES

SCALE $\frac{1}{4}$ INCH TO ONE MILE

In modern style from modern surveys (since 1905). M

In modern style, but based wholly or partly on old surveys (pre 1905) or sketchy material. M

Old style, in black only, old and inferior. M

NEW MAPS (including new editions).

Published during the year 1954-55 .....

In hand to be published by the end of 1955.....

MAPS OUTSIDE THE RED LINE, AND WHICH INCLUDE ANY PORTION OF ANDAMAN & NICOBAR ISLANDS ARE RESTRICTED.

Scale of Index 1:12 Million.

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

Published under the direction of Brigadier Gambhir Singh M.I.S.(Ind), *Surveyor General of India*, 1958.

Sikkim and Bhutan States are attached to India by special treaties.

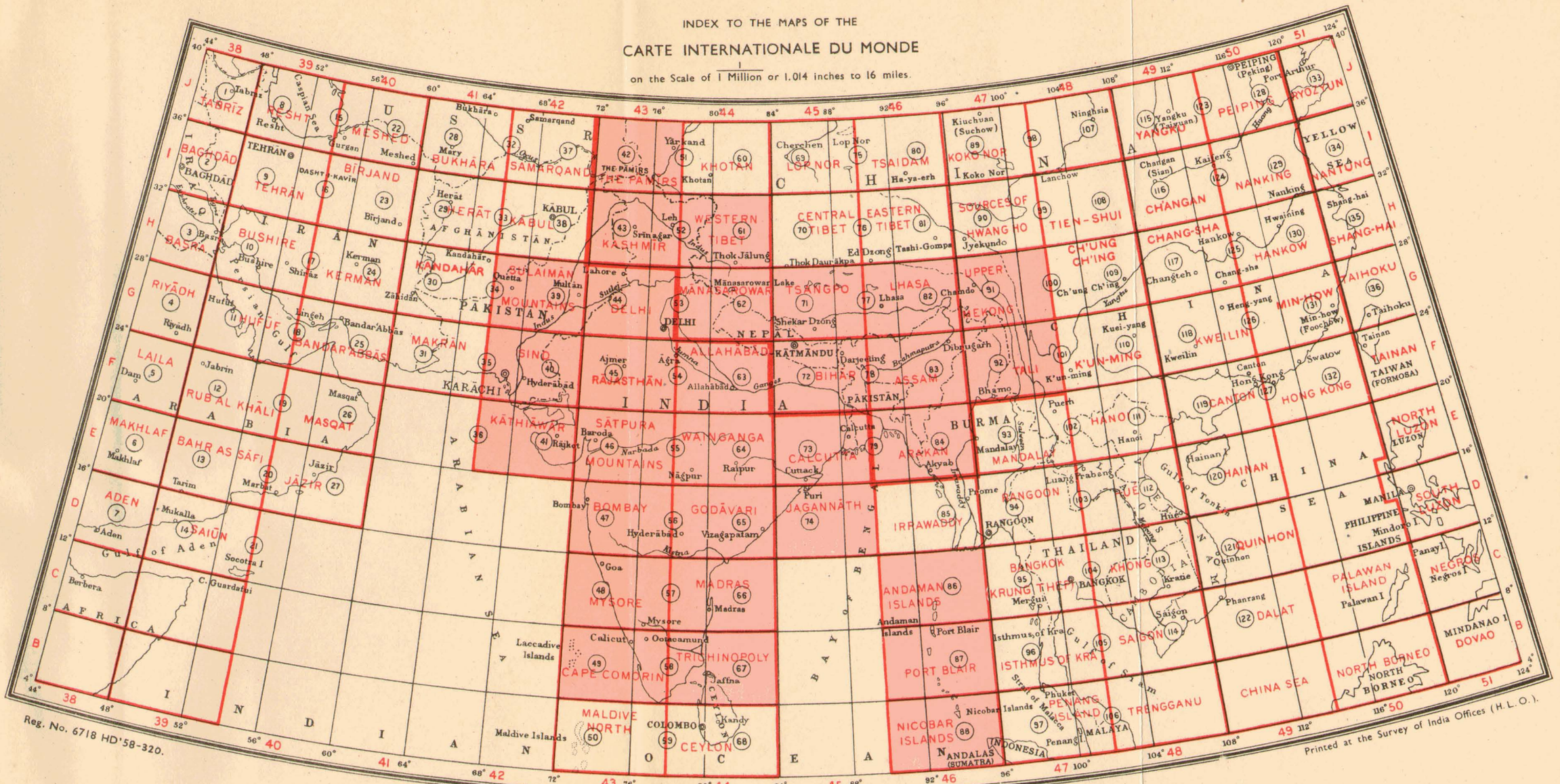
Reg. No. 6621 HD'58-320'59.

PRINTED AT THE SURVEY OF INDIA OFFICES (H. L. O.).

INDEX TO THE MAPS OF THE

CARTE INTERNATIONALE DU MONDE

on the Scale of 1 Million or 1.014 inches to 16 miles.



Reg. No. 6718 HD'58-320.

Printed at the Survey of India Offices (H. L. O.).

Published under the direction of Brigadier Gambhir Singh, M.I.S.(Ind), *Surveyor General of India,*

1958.

Scale of Index $\frac{1}{30 \text{ Million}}$

Miles 200 0 200 400 600 800 Miles

MAPS OUTSIDE THE THICK RED LINE ARE RESTRICTED.

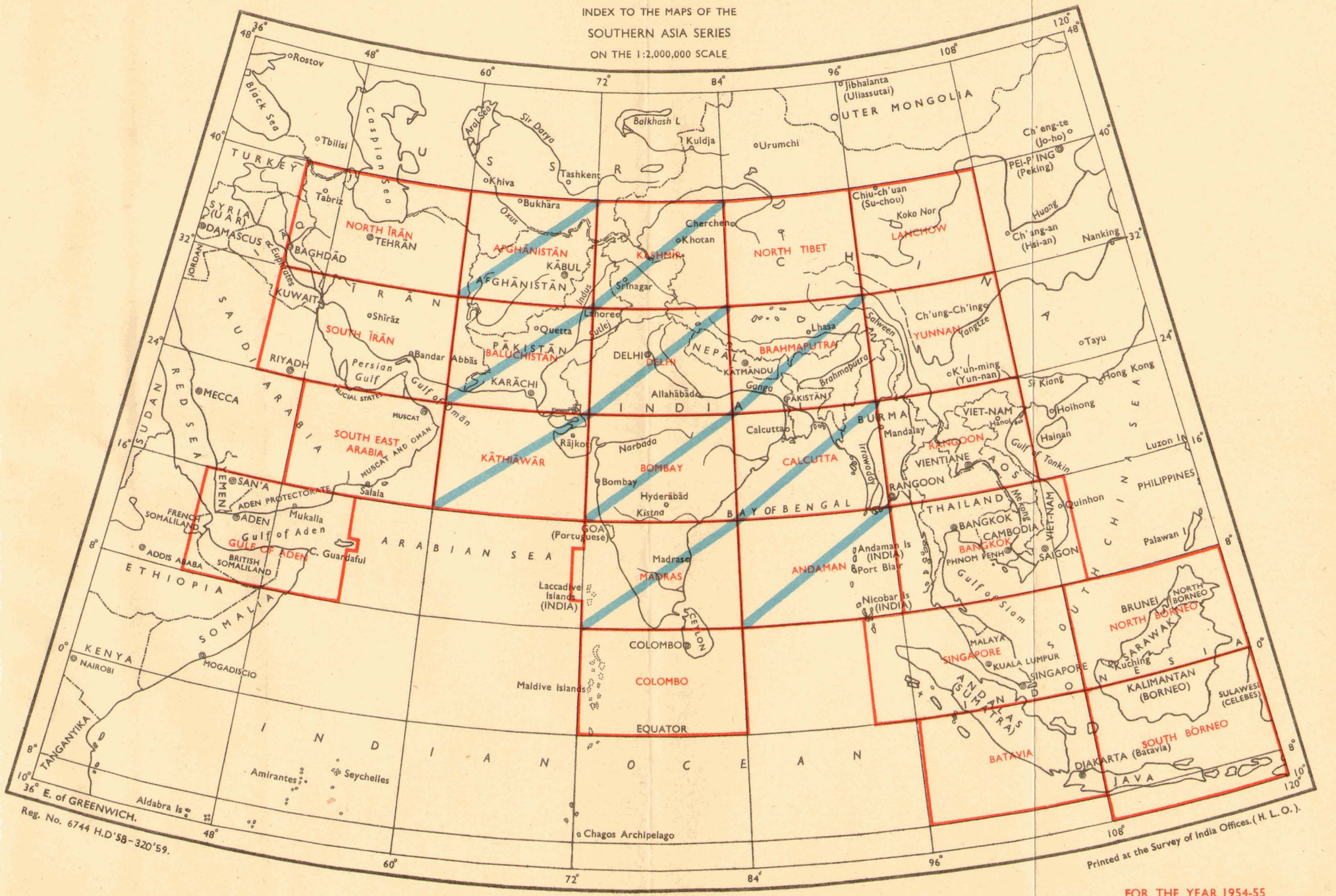
FOR THE YEAR 1954-55.

REFERENCE

Maps published.....

Most of the sheets shown were issued during the war as the Hind 5000 series. They are now in the process of being re-converted to the Carte Internationale du Monde style.

INDEX TO THE MAPS OF THE
SOUTHERN ASIA SERIES
ON THE 1:2,000,000 SCALE



Reg. No. 6744 H.D'58–320'59.

Printed at the Survey of India Offices. (H. L. O.).

Published under the direction of Brigadier Gambhir Singh, M.I.S. (Ind.), *Surveyor General of India*, 1959.

Most of the sheets shown were issued during the war as the Hind 1080 and 1091 series. They are now in the process of being re-converted to the Southern Asia Series style.

Scale of Index 1:40,000,000

Miles 200 0 200 400 600 800 Miles

Kilometres 500 0 500 1000 Kilometres

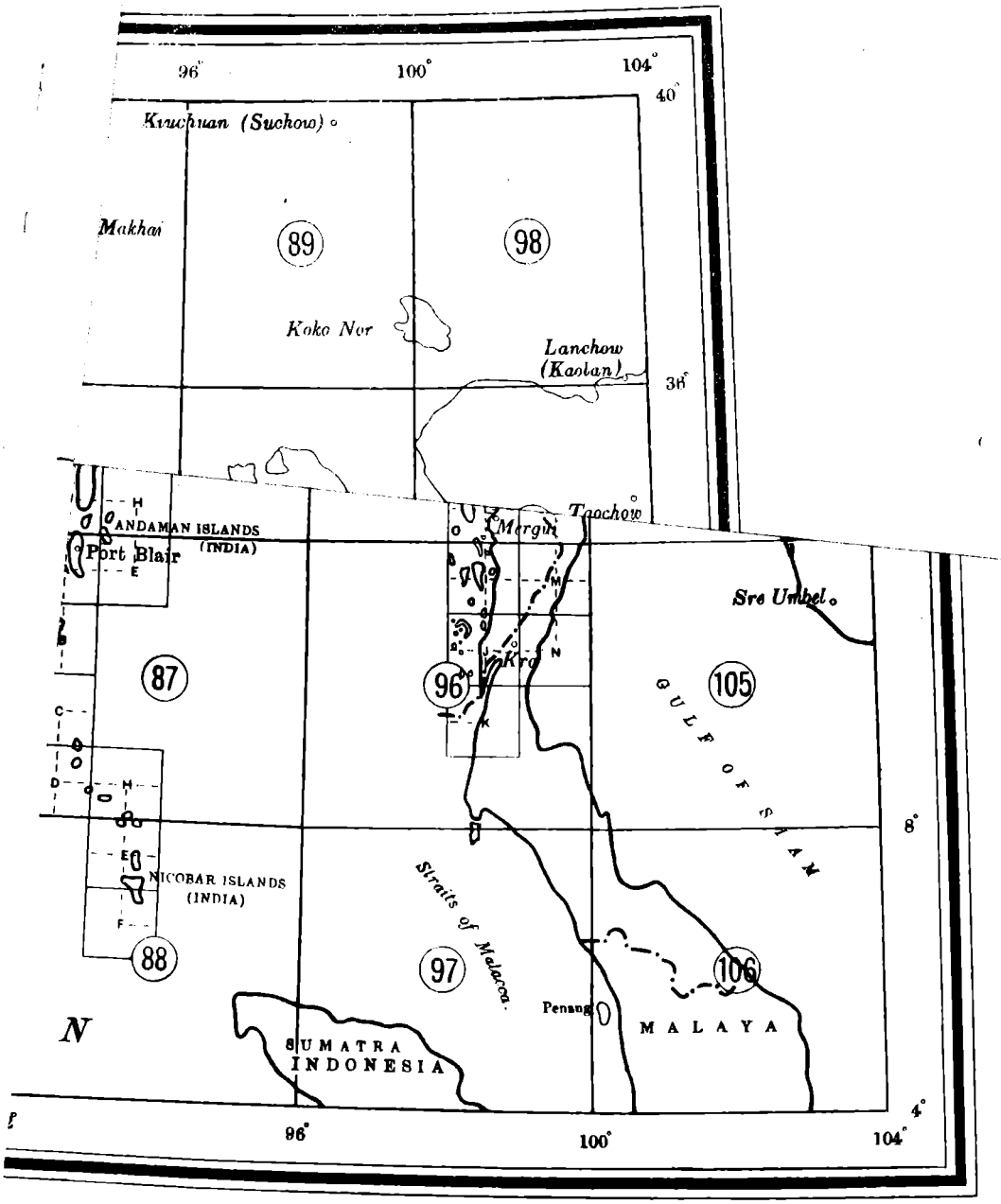
FOR THE YEAR 1954-55

REFERENCES

Maps published . . . . . .

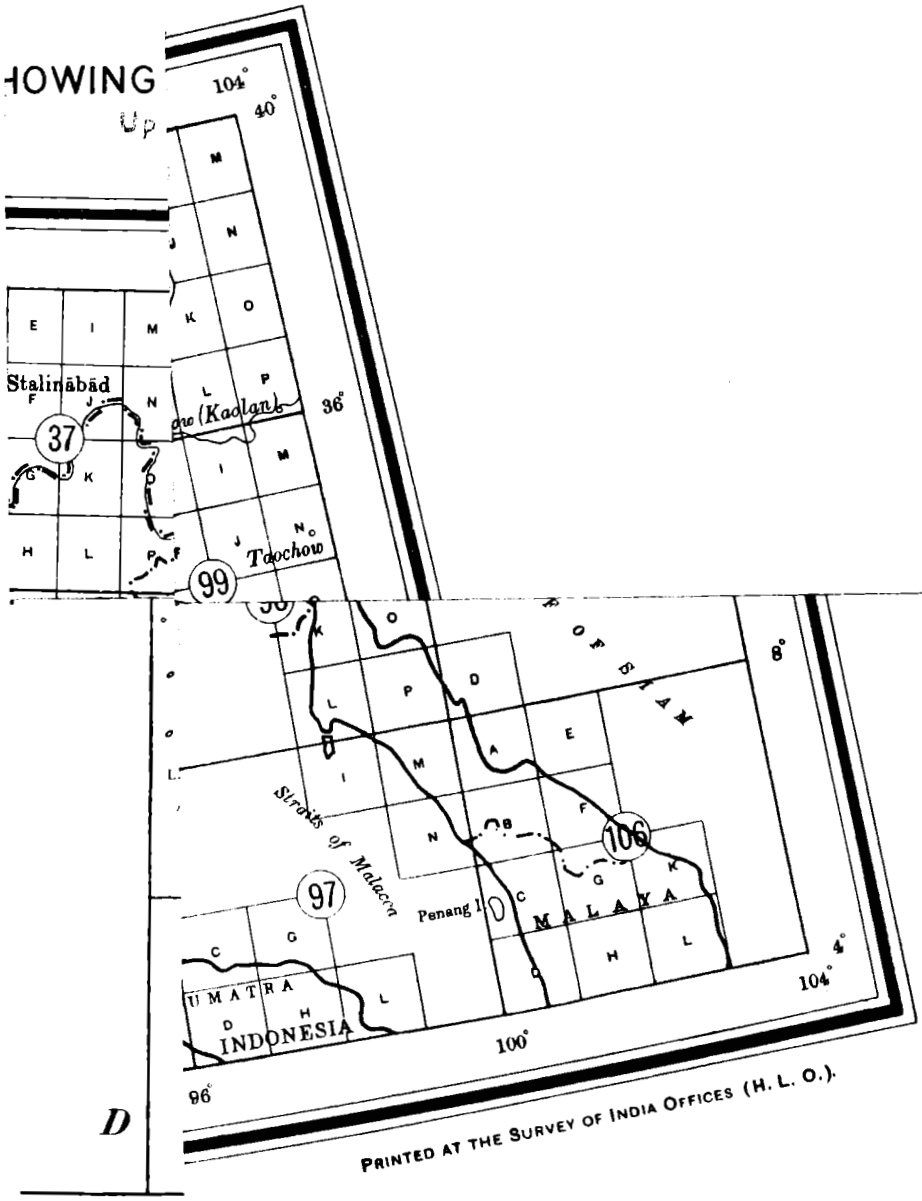
„ in hand . . . . . .

INDEX B



PRINTED AT THE SURVEY OF INDIA OFFICES (H.L.O.)

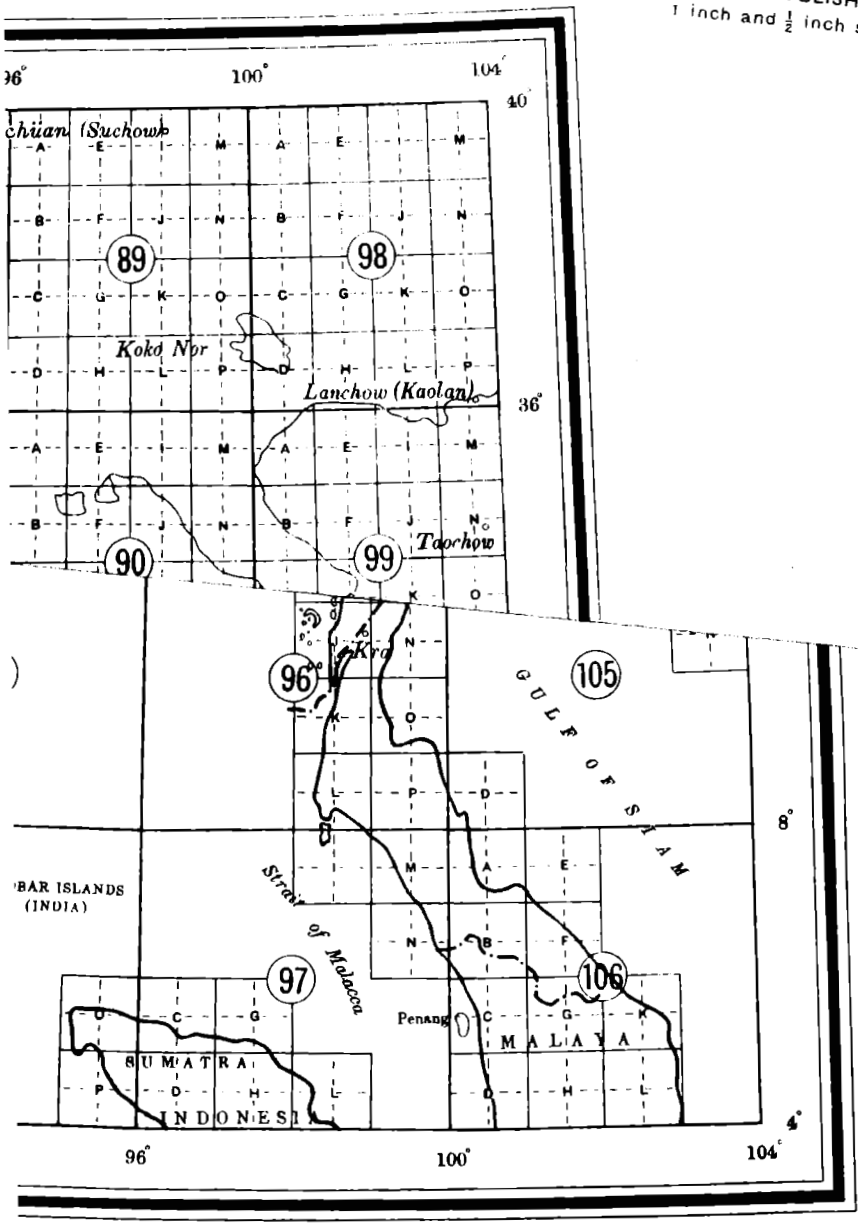
INDEX C



PRINTED AT THE SURVEY OF INDIA OFFICES (H. L. O.).

INDEX D

MAPS PUBLISHED
1 inch and $\frac{1}{2}$ inch scales

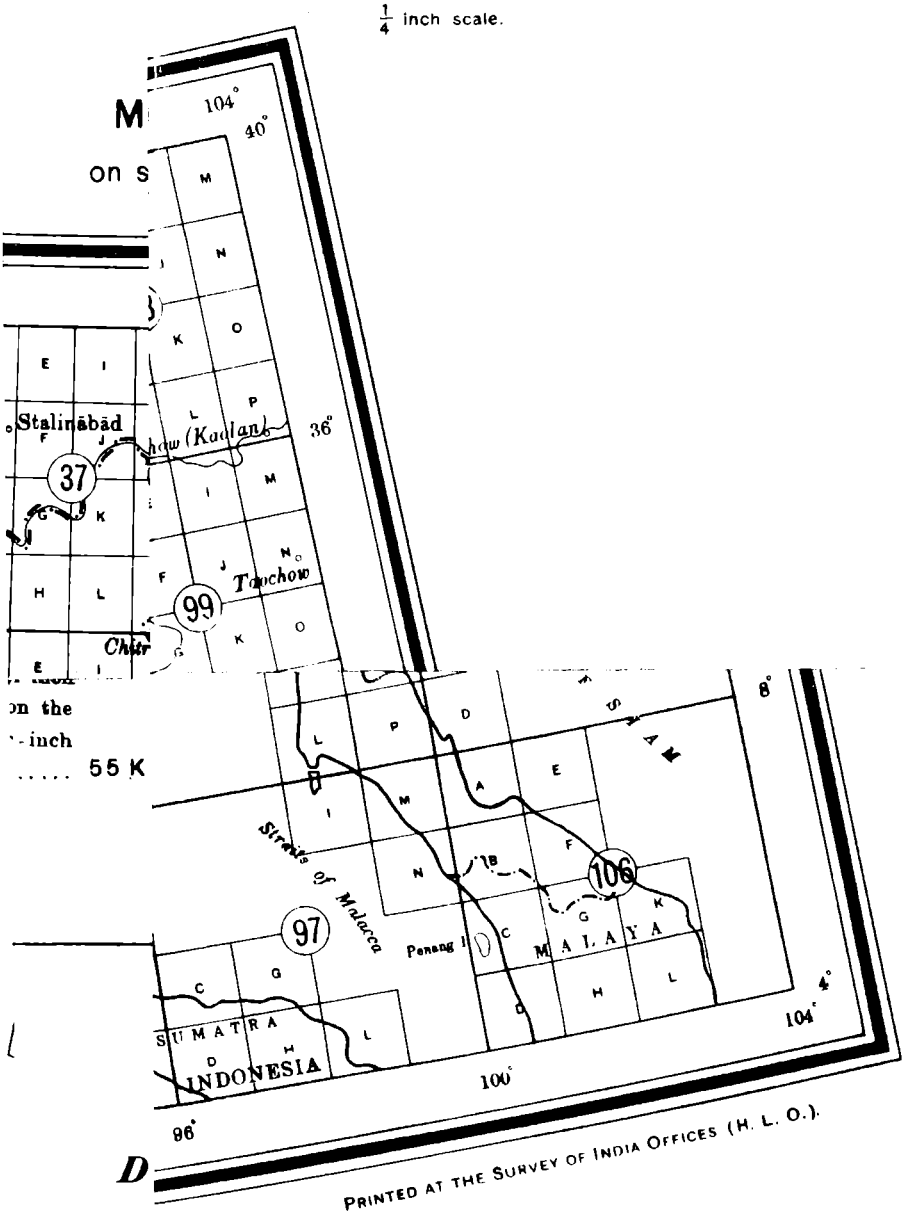


PRINTED AT THE SURVEY OF INDIA OFFICES (H. L. O.)

INDEX E

MAPS PUBLISHED

$\frac{1}{4}$ inch scale.



PRINTED AT THE SURVEY OF INDIA OFFICES (H. L. O.).

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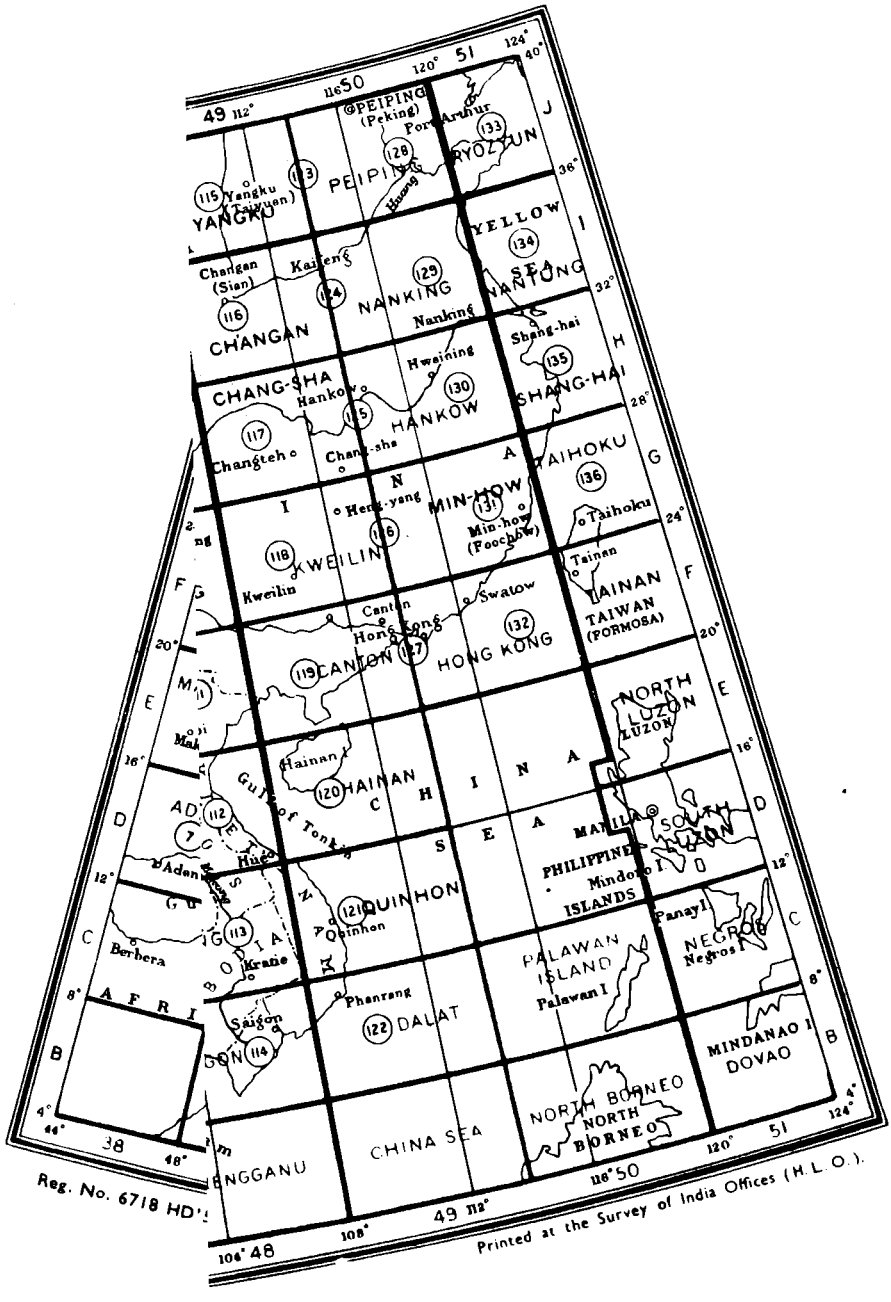
INDEX F



FOR THE YEAR 1954-55.

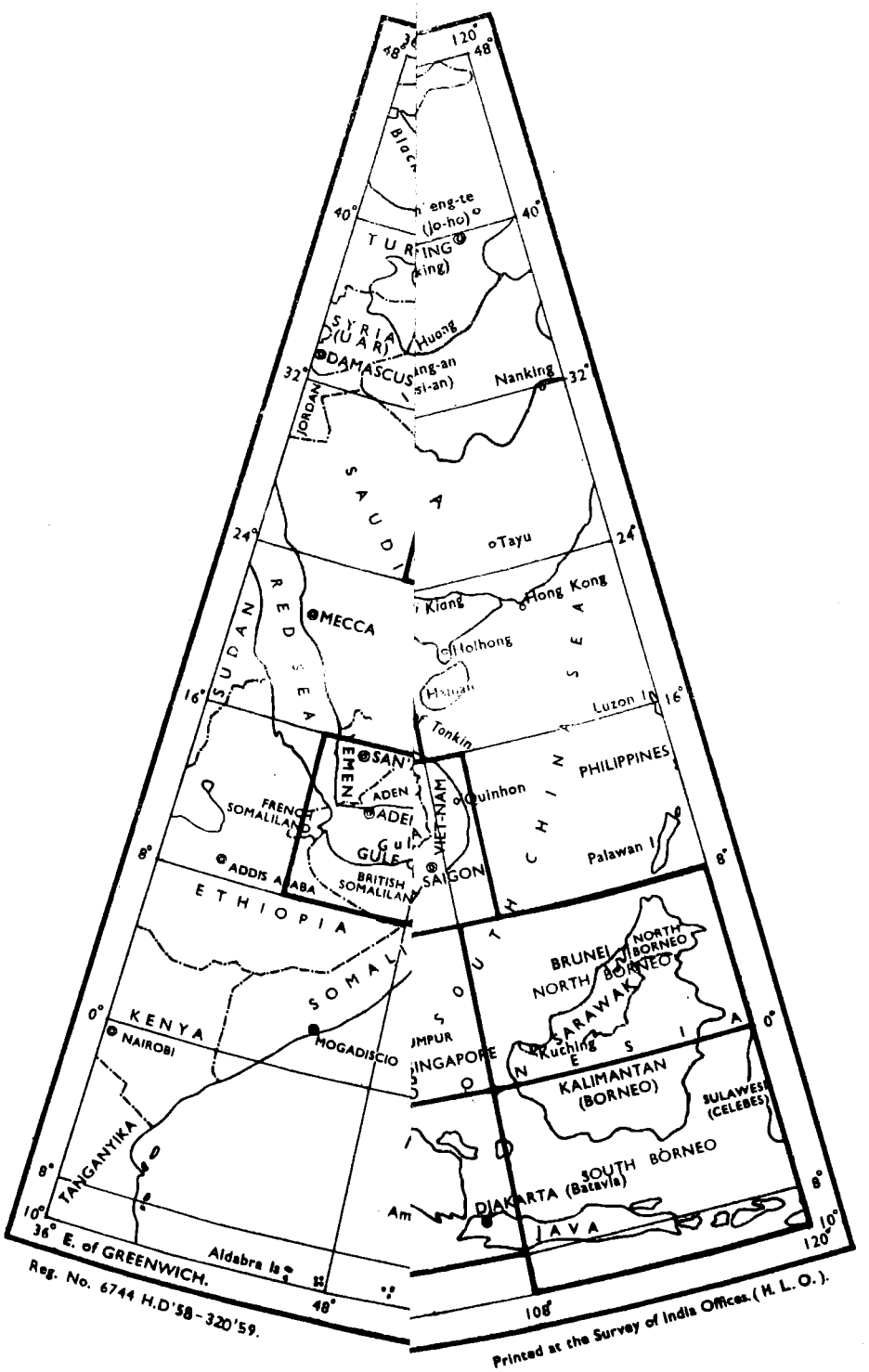
REFERENCE

MAPS OUTSIDE

Maps published..... ☐

Most of the sheets shown were issued during the war as the Hind 5000 series. They are now in the process of being re-converted to the Carte Internationale du Monde style.

INDEX G



Reg. No. 6744 H.D'58-320'59.

Printed at the Survey of India Offices. (H. L. O.).

FOR THE YEAR 1954-55

REFERENCES

Maps published . . . . . ■

" in hand . . . . . ▨

Most of the sheets shown were issued
Hind 1080 and 1091 series. They are now
being re-converted to the Southern Asia